nunavut Documentation

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Contents

While this python package is normally used as a command-line program we provide documentation here for developers of the command-line and anyone that wants to integrate nunavut directly into their own Python package.

CHAPTER 1

nunavut

Code generator built on top of pydsdl.

Nunavut uses pydsdl to generate text files using templates. While these text files are often source code this module could also be used to generate documentation or data interchange formats like JSON or XML.

The input to the nunavut library is a list of templates and a list of `pydsdl.pydsdl.CompositeType` objects. The latter is typically obtained by calling pydsdl:

```
from pydsdl import read_namespace

compound_types = read_namespace(root_namespace, include_paths)
```

Next a `nunavut.LanguageContext` is needed which is used to configure all Nunavut objects for a specific target language

```
from nunavut.lang import LanguageContext

# Here we are going to generate C headers.
language_context = LanguageContext('c')
```

nunavut.generators.AbstractGenerator objects require a *nunavut.Namespace* tree which can be built from the pydsdl type map using *nunavut.build_namespace_tree()*:

```
from nunavut import build_namespace_tree

root_namespace = build_namespace_tree(compound_types,
                                      root_ns_folder,
                                      out_dir,
                                      language_context)
```

Putting this all together, the typical use of this library looks something like this:

```
from pydsdl import read_namespace
from nunavut import build_namespace_tree
```

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```
from nunavut.lang import LanguageContext
from nunavut.jinja import DSDLCodeGenerator

# parse the dsdl
compound_types = read_namespace(root_namespace, include_paths)

# select a target language
language_context = LanguageContext('c')

# build the namespace tree
root_namespace = build_namespace_tree(compound_types,
                                      root_ns_folder,
                                      out_dir,
                                      language_context)


# give the root namespace to the generator and...
generator = DSDLCodeGenerator(root_namespace)

# generate all the code!
generator.generate_all()
```

class nunavut.**Namespace**(*full_namespace: str*, *root_namespace_dir: pathlib.Path*, *base_output_path: pathlib.PurePath*, *language_context: nunavut.lang.LanguageContext*)

Bases: pydsdl._expression._any.Any

K-ary tree (where K is the largest set of data types in a single dsdl namespace) where the nodes represent dsdl namespaces and the children are the datatypes and other nested namespaces (with datatypes always being leaf nodes). This structure extends pydsdl.Any and is a pydsdl.pydsdl.CompositeType via duck typing.

Parameters

- **full_namespace** (*str*) – The full, dot-separated name of the namepace. This is expected to be a unique identifier.
- **root_namespace_dir** (*pathlib.Path*) – The directory representing the dsdl namespace and containing the namespaces's datatypes and nested namespaces.
- **base_output_path** (*pathlib.PurePath*) – The base path under which all namespaces and datatypes should be generated.
- **language_context** (LanguageContext) – The generated software language context the namespace is within.

DefaultOutputStem = '_'

output_folder
The folder where this namespace's output file and datatypes are generated.

get_support_output_folder() → pathlib.PurePath
The folder under which support artifacts are generated.

get_language_context() → nunavut.lang.LanguageContext
The generated software language context the namespace is within.

get_root_namespace() → nunavut.Namespace
Traverses the namespace tree up to the root and returns the root node.

Returns The root namespace object.

get_nested_namespaces() → Iterator[nunavut.Namespace]
Get an iterator over all the nested namespaces within this namespace. This is a shallow iterator that only

provides directly nested namespaces.

get_nested_types() → ItemsView[pydsdl._serializable._composite.CompositeType, pathlib.Path]
Get a view of a tuple relating datatypes in this namespace to the path for the type's generated output. This is a shallow view including only the types directly within this namespace.

get_all_datatypes() → Generator[Tuple[pydsdl._serializable._composite.CompositeType, pathlib.Path], None, None]
Generates tuples relating datatypes at and below this namespace to the path for each type's generated output.

get_all_namespaces() → Generator[Tuple[nunavut.Namespace, pathlib.Path], None, None]
Generates tuples relating nested namespaces at and below this namespace to the path for each namespace's generated output.

get_all_types() → Generator[Tuple[pydsdl._expression._any.Any, pathlib.Path], None, None]
Generates tuples relating datatypes and nested namespaces at and below this namespace to the path for each type's generated output.

find_output_path_for_type(*any_type: pydsdl._expression._any.Any*) → pathlib.Path
Searches the entire namespace tree to find a mapping of the type to an output file path.

Parameters **any_type** (*Any*) – Either a Namespace or pydsdl.CompositeType to find the output path for.

Returns The path where a file will be generated for a given type.

Raises **KeyError** – If the type was not found in this namespace tree.

full_name

full_namespace

source_file_path

data_types

attributes

nunavut.**build_namespace_tree**(*types: List[pydsdl._serializable._composite.CompositeType], root_namespace_dir: str, output_dir: str, language_context: nunavut.lang.LanguageContext*) → nunavut.Namespace
Generates a *nunavut.Namespace* tree.

Given a list of pydsdl types, this method returns a root *nunavut.Namespace*. The root *nunavut.Namespace* is the top of a tree where each node contains references to nested *nunavut.Namespace* and to any pydsdl.CompositeType instances contained within the namespace.

Parameters

- **types** (*list*) – A list of pydsdl types.
- **root_namespace_dir** (*str*) – A path to the folder which is the root namespace.
- **output_dir** (*str*) – The base directory under which all generated files will be created.
- **language_context** (nunavut.lang.LanguageContext) – The language context to use when building *nunavut.Namespace* objects.

Returns The root *nunavut.Namespace*.

nunavut.**generate_types**(*language_key: str*, *root_namespace_dir: pathlib.Path*, *out_dir: pathlib.Path*, *omit_serialization_support: bool = True*, *is_dryrun: bool = False*, *allow_overwrite: bool = True*, *lookup_directories: Optional[Iterable[str]] = None*, *allow_unregulated_fixed_port_id: bool = False*, *language_options: Optional[Mapping[str, Any]] = None*) → None

Helper method that uses default settings and built-in templates to generate types for a given language. This method is the most direct way to generate code using Nunavut.

Parameters

- **language_key** (*str*) – The name of the language to generate source for. See the *Template Language Guide* for details on available language support.
- **root_namespace_dir** (*pathlib.Path*) – The path to the root of the DSDL types to generate code for.
- **out_dir** (*pathlib.Path*) – The path to generate code at and under.
- **omit_serialization_support** (*bool*) – If True then logic used to serialize and deserialize data is omitted.
- **is_dryrun** (*bool*) – If True then nothing is generated but all other activity is performed and any errors that would have occurred are reported.
- **allow_overwrite** (*bool*) – If True then generated files are allowed to overwrite existing files under the *out_dir* path.
- **lookup_directories** (*typing.Optional[typing.Iterable[str]]*) – Additional directories to search for dependent types referenced by the types provided under the *root_namespace_dir*. Types will not be generated for these unless they are used by a type in the root namespace.
- **allow_unregulated_fixed_port_id** (*bool*) – If True then errors will become warning when using fixed port identifiers for unregulated datatypes.
- **typing.Any]] language_options** (*typing.Optional[typing.Mapping[str,*) – Opaque arguments passed through to the language objects. The supported arguments and valid values are different depending on the language specified by the *language_key* parameter.

class nunavut.**YesNoDefault**

Bases: enum.Enum

Trinary type for decisions that allow a default behavior to be requested that can be different based on other contexts. For example:

```
def should_we_order_pizza(answer: YesNoDefault) -> bool:
    if answer == YesNoDefault.YES or (
        answer == YesNoDefault.DEFAULT and
        datetime.today().isoweekday() == 5 ):
        # if yes or if we are taking the default action which is to
        # order pizza on Friday, and today is Friday, then we order pizza
        return True
    else:
        return False
```

test_truth = <bound method YesNoDefault.test_truth of <enum 'YesNoDefault'>>

NO = 0

YES = 1

DEFAULT = 2

1.1 Subpackages

1.1.1 nunavut.cli

Command-line for using nunavut and jinja to generate code from dsdl definitions.

nunavut.cli.**main**() → int
Main entry point for this program.

Submodules

nunavut.cli.runners

Objects that utilize command-line inputs to run a program using Nunavut.

class nunavut.cli.runners.**ArgparseRunner**(*args: argparse.Namespace, extra_includes: Union[str, List[str], None]*)
Bases: object

Runner that uses Python argparse arguments to define a run.

Parameters

- **args** (*argparse.Namespace*) – The commandline arguments.
- **typing.List[str]]] extra_includes** (*typing.Optional[typing.Union[str,*) – A list of paths to additional DSDL root folders.

extra_includes

generator

support_generator

root_namespace

setup() → None
Required to prepare this object to run (run method will raise exceptions if called before this method). While this may seem a bit clunky it helps isolate errors to two distinct stages; setup and run.

Setup never generates anything. It only parses the inputs and creates the generator arguments.

run() → None
Perform actions defined by the arguments this object was created with. This may generate outputs where the arguments have requested this action.

> **Warning:** *setup()* must be called before calling this method.

1.1.2 nunavut.jinja

jinja-based *AbstractGenerator* implementation.

class nunavut.jinja.**CodeGenerator**(*namespace: nunavut.Namespace, generate_namespace_types: nunavut._utilities.YesNoDefault = <YesNoDefault.DEFAULT: 2>, templates_dir: Union[pathlib.Path, List[pathlib.Path], None] = None, followlinks: bool = False, trim_blocks: bool = False, lstrip_blocks: bool = False, additional_filters: Optional[Dict[str, Callable]] = None, additional_tests: Optional[Dict[str, Callable]] = None, additional_globals: Optional[Dict[str, Any]] = None, post_processors: Optional[List[nunavut.postprocessors.PostProcessor]] = None, builtin_template_path: str = 'templates'*)

Bases: *nunavut.generators.AbstractGenerator*

Abstract base class for all Generators that build source code using Jinja templates.

Parameters

- **namespace** (nunavut.Namespace) – The top-level namespace to generates code at and from.
- **generate_namespace_types** (YesNoDefault) – Set to YES to emit files for namespaces. NO will suppress namespace file generation and DEFAULT will use the language's preference.
- **templates_dir** (*typing.Optional[typing.Union[pathlib.Path, typing.List[pathlib.Path]]]*) – Directories containing jinja templates. These will be available along with any built-in templates provided by the target language. The templates at these paths will take precedence masking any built-in templates where the names are the same. See jinja2.ChoiceLoader for rules on the lookup hierarchy.
- **followlinks** (*bool*) – If True then symbolic links will be followed when searching for templates.
- **trim_blocks** (*bool*) – If this is set to True the first newline after a block is removed (block, not variable tag!).
- **lstrip_blocks** (*bool*) – If this is set to True leading spaces and tabs are stripped from the start of a line to a block. Defaults to False.
- **typing.Callable] additional_filters** (*typing.Dict[str,*) – typing.Optional jinja filters to add to the global environment using the key as the filter name and the callable as the filter.
- **typing.Callable] additional_tests** (*typing.Dict[str,*) – typing.Optional jinja tests to add to the global environment using the key as the test name and the callable as the test.
- **typing.Any] additional_globals** (*typing.Dict[str,*) – typing.Optional objects to add to the template environment globals collection.
- **post_processors** (*typing.Optional[typing.List[*nunavut.postprocessors.PostProcessor*]]*) – A list of *nunavut.postprocessors.PostProcessor*
- **builtin_template_path** – If provided overrides the folder name under which built-in templates are loaded from within a target language's package (i.e. ignored if no target language is specified). For example, if the target language is `c` and this parameter was set to `foo` then built-in templates would be loaded from `nunavut.lang.c.foo`.

Raises **RuntimeError** – If any additional filter or test attempts to replace a built-in or otherwise already defined filter or test.

dsdl_loader

language_context

get_templates() → Iterable[pathlib.Path]
Enumerate all templates found in the templates path. `TEMPLATE_SUFFIX` as the suffix for the filename.

Returns A list of paths to all templates found by this Generator object.

class nunavut.jinja.**DSDLCodeGenerator**(*namespace: nunavut.Namespace*, ***kwargs*)
Bases: *nunavut.jinja.CodeGenerator*

CodeGenerator implementation that generates code for a given set of DSDL types.

static filter_yamlfy(*value: Any*) → str
Filter to, optionally, emit a dump of the dsdl input as a yaml document. Available as `yamlfy` in all template environments.

Example:

```
/*
{{ T | yamlfy }}
*/
```

Result Example (truncated for brevity):

```
/*
!!python/object:pydsdl.StructureType
_attributes:
- !!python/object:pydsdl.Field
_serializable: !!python/object:pydsdl.UnsignedIntegerType
    _bit_length: 16
    _cast_mode: &id001 !!python/object/apply:pydsdl.CastMode
    - 0
_name: value
*/
```

Parameters **value** – The input value to parse as yaml.

Returns If a yaml parser is available, a pretty dump of the given value as yaml. If a yaml parser is not available then an empty string is returned.

filter_type_to_template(*value: Any*) → str
Template for type resolution as a filter. Available as `type_to_template` in all template environments.

Example:

```
{%- for attribute in T.attributes %}
    {%* include attribute.data_type | type_to_template %}
    {%- if not loop.last %},{% endif %}
{%- endfor %}
```

Parameters **value** – The input value to change into a template include path.

Returns A path to a template named for the type with *TEMPLATE_SUFFIX*

filter_type_to_include_path(*value: Any*, *resolve: bool = False*) → str
Emits an include path to the output target for a given type.

Example:

```
# include "{{ T.my_type | type_to_include_path }}"
```

Result Example:

include “foo/bar/my_type.h”

Parameters

- **value** (*typing.Any*) – The type to emit an include for.
- **resolve** (*bool*) – If True the path returned will be absolute else the path will be relative to the folder of the root namespace.

Returns A string path to output file for the type.

static filter_typename(*value: Any*) → str

Filters a given token as its type name. Available as `typename` in all template environments.

This example supposes that `T.some_value == "some string"`

Example:

```
{{ T.some_value | typename }}
```

Result Example:

```
str
```

Parameters **value** – The input value to filter into a type name.

Returns The `__name__` of the python type.

static filter_alignment_prefix(*offset: pydsdl._bit_length_set._bit_length_set.BitLengthSet*) → str

Provides a string prefix based on a given `pydsdl.BitLengthSet`.

```
# Given
B = pydsdl.BitLengthSet(32)

# and
template = '{{ B | alignment_prefix }}'

# then ('str' is stropped to 'str_' before the version is suffixed)
rendered = 'aligned'
```

```
# Given
B = pydsdl.BitLengthSet(32)
B += 1

# and
template = '{{ B | alignment_prefix }}'

# then ('str' is stropped to 'str_' before the version is suffixed)
rendered = 'unaligned'
```

Parameters **offset** (*pydsdl.BitLengthSet*) – A bit length set to test for alignment.

Returns ‘aligned’ or ‘unaligned’ based on the state of the `offset` argument.

static filter_bit_length_set(*values: Union[Iterable[int], int, None]*) → pydsdl._bit_length_set._bit_length_set.BitLengthSet
Convert an integer or a list of integers into a `pydsdl.BitLengthSet`.

static filter_remove_blank_lines(*text: str*) → str

Remove blank lines from the supplied string. Lines that contain only whitespace characters are also considered blank.

456

789') == '123 456 789'

static filter_bits2bytes_ceil(*n_bits: int*) → int
Implements `int(ceil(x/8)) | x >= 0`.

static is_None(*value: Any*) → bool
Tests if a value is `None`

static is_saturated(*t: pydsdl._serializable._primitive.PrimitiveType*) → bool
Tests if a type is a saturated type or not.

static is_service_request(*instance: pydsdl._expression._any.Any*) → bool
Tests if a type is request type of a service type.

static is_service_response(*instance: pydsdl._expression._any.Any*) → bool
Tests if a type is response type of a service type.

static is_deprecated(*instance: pydsdl._expression._any.Any*) → bool
Tests if a type is marked as deprecated

generate_all(*is_dryrun: bool = False*, *allow_overwrite: bool = True*) → Iterable[pathlib.Path]
Generates all output for a given *nunavut.Namespace* and using the templates found by this object.

Parameters

- **is_dryrun** (*bool*) – If True then no output files will actually be written but all other operations will be performed.
- **allow_overwrite** (*bool*) – If True then the generator will attempt to overwrite any existing files it encounters. If False then the generator will raise an error if the output file exists and the generation is not a dry-run.

Returns 0 for success. Non-zero for errors.

Raises PermissionError if `allow_overwrite` is False and the file exists.

class nunavut.jinja.**SupportGenerator**(*namespace: nunavut.Namespace*, ***kwargs*)
Bases: *nunavut.jinja.CodeGenerator*

Generates output files by copying them from within the Nunavut package itself for non templates but uses jinja to generate headers from templates with the language environment provided but no `T` (DSDL type) global set. This generator always copies files from those returned by the `file_iterator` to locations under *nunavut.Namespace.get_support_output_folder()*

get_templates() → Iterable[pathlib.Path]
Enumerate all templates found in the templates path. `TEMPLATE_SUFFIX` as the suffix for the filename.

Returns A list of paths to all templates found by this Generator object.

generate_all(*is_dryrun: bool = False*, *allow_overwrite: bool = True*) → Iterable[pathlib.Path]
Generates all output for a given *nunavut.Namespace* and using the templates found by this object.

Parameters

- **is_dryrun** (*bool*) – If True then no output files will actually be written but all other operations will be performed.
- **allow_overwrite** (*bool*) – If True then the generator will attempt to overwrite any existing files it encounters. If False then the generator will raise an error if the output file exists and the generation is not a dry-run.

Returns 0 for success. Non-zero for errors.

Raises PermissionError if `allow_overwrite` is False and the file exists.

Submodules

nunavut.jinja.environment

class nunavut.jinja.environment.**LanguageTemplateNamespace**(***kwargs*)

Bases: object

Generic namespace object used to create reserved namespaces in the global environment.

```
ns = LanguageTemplateNamespace()

# any property can be set at any time.
ns.foo = 'foo'
assert ns.foo == 'foo'

# repr of the ns enables cloning using exec
exec('ns2={}'.format(repr(ns)))
assert ns2.foo == 'foo'

# clones will be equal
assert ns2 == ns

# but not the same object
assert ns2 is not ns
```

In addition to the namespace behavior this object exposed some dictionary-like methods:

```
ns = LanguageTemplateNamespace()
ns.update({'foo':'bar'})

assert ns.foo == 'bar'
```

update(*update_from: Mapping[str, Any]*) → None

items() → ItemsView[str, Any]

values() → ValuesView[Any]

class nunavut.jinja.environment.**CodeGenEnvironment**(*loader: nunavut.jinja.jinja2.loaders.BaseLoader, lctx: Optional[nunavut.lang.LanguageContext] = None, trim_blocks: bool = False, lstrip_blocks: bool = False, additional_filters: Optional[Dict[str, Callable]] = None, additional_tests: Optional[Dict[str, Callable]] = None, additional_globals: Optional[Dict[str, Any]] = None, extensions: List[nunavut.jinja.jinja2.ext.Extension] = [<class 'nunavut.jinja.jinja2.ext.ExprStmtExtension'>, <class 'nunavut.jinja.jinja2.ext.LoopControlExtension'>, <class 'nunavut.jinja.extensions.JinjaAssert'>, <class 'nunavut.jinja.extensions.UseQuery'>], allow_filter_test_or_use_query_overwrite: bool = False*)

Bases: nunavut.jinja.jinja2.environment.Environment

Jinja Environment optimized for compile-time generation of source code (i.e. as opposed to dynamically generating webpages).

```
template = 'Hello World'

e = CodeGenEnvironment(loader=DictLoader({'test': template}))
assert 'Hello World' == e.get_template('test').render()
```

Warning: The *RESERVED_GLOBAL_NAMESPACES* and *RESERVED_GLOBAL_NAMES* collections contain names in the global namespace reserved by this environment. Attempting to override one of these reserved names will cause the constructor to raise an error.

```
try:
    CodeGenEnvironment(loader=DictLoader({'test': template}), additional_globals={
↪'ln': 'bad_ln'})
    assert False
except RuntimeError:
    pass
```

Other safe-guards include checks that Jinja built-ins aren't accidentally overridden...

```
try:
    CodeGenEnvironment(loader=DictLoader({'test': template}),
                       additional_filters={'indent': lambda x: x
↪})
    assert False
except RuntimeError:
```

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```
    pass

# You can allow overwrite of built-ins using the ``allow_filter_test_or_use_query_
↪overwrite``
# argument.
e = CodeGenEnvironment(loader=DictLoader({'test': template}),
                       additional_filters={'indent': lambda x: x},
                       allow_filter_test_or_use_query_
↪overwrite=True)
assert 'foo' == e.filters['indent']('foo')
```

. . . or that user-defined filters or redefined.

```
class MyFilters:

    @staticmethod
    def filter_misnamed(name: str) -> str:
        return name

e = CodeGenEnvironment(loader=DictLoader({'test': template}),
                       additional_filters={'filter_misnamed': lambda x: x})

try:
    e.add_conventional_methods_to_environment(MyFilters())
    assert False
except RuntimeError:
    pass
```

Note: Maintainer's Note This class should remain DSDL agnostic. It is, theoretically, applicable using Jinja with any compiler front-end input although, in practice, it will only ever be used with pydsdl AST. Pydsdl-specific logic should live in the CodeGenerator (*nunavut.jinja.DSDLCodeGenerator*).

RESERVED_GLOBAL_NAMESPACES = {'ln', 'nunavut', 'options', 'uses_queries'}

RESERVED_GLOBAL_NAMES = {'now_utc'}

NUNAVUT_NAMESPACE_PREFIX = 'nunavut.lang.'

add_conventional_methods_to_environment(*obj: Any*) → None

supported_languages

nunavut_global

target_language_uses_queries

language_options

language_support

target_language

now_utc

add_test(*test_name: str*, *test_callable: Callable*) → None

nunavut.jinja.extensions

class nunavut.jinja.extensions.**JinjaAssert**(*environment: nunavut.jinja.jinja2.environment.Environment*)
Bases: nunavut.jinja.jinja2.ext.Extension

Jinja2 extension that allows `{% assert T.attribute %}` statements. Templates should use these statements where False values would result in malformed source code :

```
template = '''{% assert False %}'''
```

This extension also support provding an assertion message:

```
template = '''{% assert (1 + 1 == 4) and (2 + 2 == 5), "this was truly␣
↪false" %}'''
```

tags = {'assert'}

parse(*parser: nunavut.jinja.jinja2.parser.Parser*) → nunavut.jinja.jinja2.nodes.Node
See http://jinja.pocoo.org/docs/2.10/extensions/ for help writing extensions.

identifier = 'nunavut.jinja.extensions.JinjaAssert'

class nunavut.jinja.extensions.**UseQuery**(*environment: nunavut.jinja.jinja2.environment.Environment*)
Bases: nunavut.jinja.jinja2.ext.Extension

Jinja2 extension that allows conditional blocks like `{% ifuses "std_variant" %}` or `{% ifnuses "std_variant" %}`. These are defined by the *nunavut.lang.Language* object based on the values returned from nunavut.lang.Language.get_uses_queries().

```
template = ''' {%- ifuses "some_language_key" -%}
                   #include "header 0"
               {%- elifuses "some_other_language_key" -%}
                   #include "header 1"
               {%- else -%}
                   #include "header 2"
               {%- endifuses -%}
           '''
```

For “not uses” replace all “uses” tokens with “nuses”:

```
template = ''' {%- ifnuses "some_language_key" -%}
                   #include "header 1"
               {%- elifnuses "some_other_language_key" -%}
                   #include "header 0"
               {%- elifuses "yet_another_language_key" -%}
                   #include "header 2"
               {%- else -%}
                   #include "header 3"
               {%- endifnuses -%}
           '''
```

tags = {'ifnuses', 'ifuses'}

parse(*parser: nunavut.jinja.jinja2.parser.Parser*) → nunavut.jinja.jinja2.nodes.Node
See http://jinja.pocoo.org/docs/2.10/extensions/ for help writing extensions.

identifier = 'nunavut.jinja.extensions.UseQuery'

nunavut.jinja.loaders

nunavut.jinja.loaders.**TEMPLATE_SUFFIX = '.j2'**
The suffix expected for Jinja templates.

class nunavut.jinja.loaders.**DSDLTemplateLoader**(*templates_dirs: Optional[List[pathlib.Path]] = None*, *followlinks: bool = False*, *package_name_for_templates: Optional[str] = None*, *builtin_template_path: str = 'templates'*, ***kwargs*)
Bases: nunavut.jinja.jinja2.loaders.BaseLoader

Nunavut's DSDL template loader is similar to a choice loader with a file-system loader first and a package loader as a fallback. The major difference is a DFS is performed on the type hierarchy of the type a template is being loaded for. So, for example, if no `StructureType.j2` template is found then this loader will look for a `CompositeType.j2` and so on.

Parameters

- **templates_dirs** (*Optional[List[Path]]*) – A list of directories to load templates from using a `nunavut.jinja.jinja2.FileSystemLoader`. If `None` no filesystem loader is created.
- **followlinks** (*bool*) – Argument passed on to the `nunavut.jinja.jinja2.FileSystemLoader` instance.
- **package_name_for_templates** (*Optional[str]*) – The name of the package to load templates from. If `None` then no `nunavut.jinja.jinja2.PackageLoader` is created.
- **builtin_template_path** (*str*) – The name of the package under the `package_name_for_templates` package to load templates from. This is ignored if `package_name_for_templates` is None.
- **kwargs** (*Any*) – Arguments forwarded to the `jinja.jinja2.BaseLoader`.

get_source(*environment: nunavut.jinja.jinja2.environment.Environment*, *template: str*) → Tuple[Any, str, Callable[[...], bool]]
Get the template source, filename and reload helper for a template. It's passed the environment and template name and has to return a tuple in the form `(source, filename, uptodate)` or raise a *TemplateNotFound* error if it can't locate the template.

The source part of the returned tuple must be the source of the template as unicode string or a ASCII bytestring. The filename should be the name of the file on the filesystem if it was loaded from there, otherwise *None*. The filename is used by python for the tracebacks if no loader extension is used.

The last item in the tuple is the *uptodate* function. If auto reloading is enabled it's always called to check if the template changed. No arguments are passed so the function must store the old state somewhere (for example in a closure). If it returns *False* the template will be reloaded.

list_templates() → Iterable[str]
Override of `BaseLoader.list_templates()` that returns an aggregate of the filesystem loader and package loader templates.

Returns A list of templates names (i.e. file stems) found by this Generator object.

get_template_sets() → List[Tuple[str, str, Tuple[int, int, int]]]

get_templates() → Iterable[pathlib.Path]
Enumerate all templates found in the templates path. *TEMPLATE_SUFFIX* as the suffix for the filename.

This method differs from the `BaseLoader` override of `BaseLoader.list_templates()` in that it returns paths instead of just file name stems.

Returns A list of paths to all templates found by this Generator object.

type_to_template(*value_type: Type[CT_co]*) → Optional[pathlib.Path]
Given a type object, return a template used to generate code for the type.

Returns a template or None if no template could be found for the given type.

1.1.3 nunavut.lang

Language-specific support in nunavut.

This package contains modules that provide specific support for generating source for various languages using templates.

class nunavut.lang.**LanguageLoader**(**additional_config_files*)
Bases: object

Factory class that loads language meta-data and concrete *nunavut.lang.Language* objects.

Parameters **additional_config_files** – A list of paths to additional configuration files to load as configuration. These will override any values found in the `nunavut.lang.properties.yaml` file and files appearing later in this list will override value found in earlier entries.

classmethod load_language_module(*language_name: str*) → module

config
Meta-data about all languages merged from the Nunavut internal defaults and any additional configuration files provided to this class's constructor.

load_language(*language_name: str*, *omit_serialization_support: bool*, *language_options: Optional[Mapping[str, Any]] = None*) → nunavut.lang.Language

Parameters

- **language_name** (*str*) – The name of the language used by the *nunavut.lang* module.
- **config** (*LanguageConfig*) – The parser to load language properties into.
- **omit_serialization_support** (*bool*) – The value to set for the `omit_serialization_support()` property for this language.
- **typing.Any]] language_options** (*typing.Optional[typing.Mapping[str,*) – Opaque arguments passed through to the target *nunavut.lang.Language* object.

Returns A new object that extends *nunavut.lang.Language*.

Return type *nunavut.lang.Language*

```
lang_c = LanguageLoader().load_language('c', True)
assert lang_c.name == 'c'
```

class nunavut.lang.**Language**(*language_module: module*, *config: nunavut.lang._config.LanguageConfig*, *omit_serialization_support: bool*, *language_options: Optional[Mapping[str, Any]] = None*)
Bases: object

Facilities for generating source code for a specific language. Concrete Language classes must be implemented by the language support package below lang and should be instantiated using *nunavut.lang.LanguageLoader*.

Parameters

- **language_name** (*str*) – The name of the language used by the *nunavut.lang* module.
- **config** (*LanguageConfig*) – The parser to load language properties into.
- **omit_serialization_support** (*bool*) – The value to set for the *omit_serialization_support()* property for this language.
- **typing.Any]] language_options** (*typing.Optional[typing.Mapping[str,*) –

  Opaque arguments passed through to the target *nunavut.lang.Language* object.

classmethod default_filter_id_for_target(*instance: Any*) → str

The default transformation of any object into a string.

Parameters **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.

Returns Either `str(instance.name)` if the instance has a name property or just `str(instance)`

get_support_module() → Tuple[str, Tuple[int, int, int], Optional[module]]

Returns the module object for the language support files. :return: A tuple of module name, x.y.z module version, and the module object itself.

get_dependency_builder

get_includes(*dep_types: nunavut.dependencies.Dependencies*) → List[str]

Get a list of include paths that are specific to this language and the options set for it. :param Dependencies dep_types: A description of the dependencies includes are needed for. :return: A list of include file paths. The list may be empty if no includes were needed.

filter_id(*instance: Any*, *id_type: str = 'any'*) → str

Produces a valid identifier in the language for a given object. The encoding may not be reversible.

Parameters

- **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.
- **id_type** (*str*) – A type of identifier. This is different for each language. For example, for C this value can be 'typedef', 'macro', 'function', or 'enum'. Use 'any' to apply stropping rules for all identifier types to the instance.

Returns A token that is a valid identifier in the language, is not a reserved keyword, and is transformed in a deterministic manner based on the provided instance.

filter_short_reference_name(*t: pydsdl._serializable._composite.CompositeType*, *stropping: nunavut._utilities.YesNoDefault = <YesNoDefault.DEFAULT: 2>*, *id_type: str = 'any'*) → str

Provides a string that is a shorted version of the full reference name omitting any namespace parts of the type.

Parameters

- **t** (*pydsdl.CompositeType*) – The DSDL type to get the reference name for.

- **stropping** (YesNoDefault) – If DEFAULT then the stropping value configured for the target language is used else this overrides that value.
- **id_type** (*str*) – A type of identifier. This is different for each language. For example, for C this value can be 'typedef', 'macro', 'function', or 'enum'. Use 'any' to apply stropping rules for all identifier types to the instance.

get_config_value(*key: str*, *default_value: Optional[str] = None*) → str
Get an optional language property from the language configuration.

Parameters

- **key** (*str*) – The config value to retrieve.
- **default_value** (*typing.Optional[str]*) – The value to return if the key was not in the configuration. If provided this method will not raise.

Returns Either the value from the config or the default_value if provided.

Return type str

Raises KeyError if the section or the key in the section does not exist and a default_value was not provided.

get_config_value_as_bool(*key: str*, *default_value: bool = False*) → bool
Get an optional language property from the language configuration returning a boolean.

Parameters

- **key** (*str*) – The config value to retrieve.
- **default_value** (*bool*) – The value to use if no value existed.

Returns The config value as either True or False.

Return type bool

get_config_value_as_dict(*key: str*, *default_value: Optional[Dict[KT, VT]] = None*) → Dict[str, Any]
Get a language property parsing it as a map with string keys.

Parameters

- **key** (*str*) – The config value to retrieve.
- **default_value** (*typing.Optional[typing.Mapping[str, typing.Any]]*) – The value to return if the key was not in the configuration. If provided this method will not raise a KeyError nor a TypeError.

Returns Either the value from the config or the default_value if provided.

Return type typing.Mapping[str, typing.Any]

Raises KeyError if the key does not exist and a default_value was not provided.

Raises TypeError if the value exists but is not a dict and a default_value was not provided.

get_config_value_as_list(*key: str*, *default_value: Optional[List[T]] = None*) → List[Any]
Get a language property parsing it as a map with string keys.

Parameters

- **key** (*str*) – The config value to retrieve.
- **default_value** (*typing.Optional[typing.List[typing.Any]]*) – The value to return if the key was not in the configuration. If provided this method will not raise a KeyError nor a TypeError.

Returns Either the value from the config or the default_value if provided.

Return type typing.List[typing.Any]

Raises KeyError if the key does not exist and a default_value was not provided.

Raises TypeError if the value exists but is not a dict and a default_value was not provided.

extension
The extension to use for files generated in this language.

namespace_output_stem
The name of a namespace file for this language.

name
The name of the language used by the *nunavut.lang* module.

support_namespace
The hierarchical namespace used by the support software. The property is a dot separated string when specified in configuration. This property returns that value split into namespace components with the first identifier being the first index in the array, etc.

enable_stropping
Whether or not to strop identifiers for this language.

has_standard_namespace_files
Whether or not the language defines special namespace files as part of its core standard (e.g. python's __init__).

stable_support
Whether support for this language is designated 'stable', and not experimental.

omit_serialization_support
If True then generators should not include serialization routines, types, or support libraries for this language.

support_files
Iterates over non-templated supporting files embedded within the Nunavut distribution.

get_option(*option_key: str, default_value: Union[Mapping[str, Any], str, None] = None*) → Union[Mapping[str, Any], str, None]
Get a language option for this language.

```
# Values can come from defaults...
assert lang_cpp.get_option('target_endianness') == 'little'

# ... or can come from a sane default.
assert lang_cpp.get_option('foobar', 'sane_default') == 'sane_default'
```

Returns Either the value provided to the *Language* instance, the value from properties.yaml, or the `default_value`.

get_templates_package_name() → str
The name of the nunavut python package containing filters, types, and configuration for this language.

get_named_types() → Mapping[str, str]
Get a map of named types to the type name to emit for this language.

get_named_values() → Mapping[str, str]
Get a map of named values to the token to emit for this language.

get_globals() → Mapping[str, Any]
Get all values for this language that should be available in a global context.

Returns A mapping of global names to global values.

get_options() → Mapping[str, Any]
Get all language options for this Language.

Returns A mapping of option names to option values.

class nunavut.lang.**LanguageContext**(*target_language: Optional[str] = None*, *extension: Optional[str] = None*, *namespace_output_stem: Optional[str] = None*, *additional_config_files: List[pathlib.Path] = []*, *omit_serialization_support_for_target: bool = True*, *language_options: Optional[Mapping[str, Any]] = None*, *include_experimental_languages: bool = True*)
Bases: object

Context object containing the current target language (if any) and used to access *Language* objects.

Parameters

- **target_language** (*str*) – If provided a *Language* object will be created to hold the target language set for this context. If None then there is no target language.
- **extension** (*str*) – The extension to use for generated file types or None to use a default based on the target_language.
- **namespace_output_stem** (*str*) – The filename stem to give to Namespace output files if emitted or None to use a default based on a target_language.
- **additional_config_files** (*typing.List[pathlib.Path]*) – A list of paths to additional files to load as configuration. These will override any values found in the nunavut.lang.properties.yaml file and files appearing later in this list will override value found in earlier entries.
- **omit_serialization_support_for_target** (*bool*) – If True then generators should not include serialization routines, types, or support libraries for the target language.
- **typing.Any]] language_options** (*typing.Optional[typing.Mapping[str,*) – Opaque arguments passed through to the target *nunavut.lang.Language* object.
- **include_experimental_languages** (*bool*) – If True, expose languages with experimental (non-stable) support.

Raises

- **ValueError** – If extension is None and no target language was provided.
- **KeyError** – If the target language is not known.

get_language(*key_or_module_name: str*) → nunavut.lang.Language
Get a *Language* object for a given language identifier.

Parameters **key_or_module_name** (*str*) – Either one of the Nunavut mnemonics for a supported language or the __name__ of one of the nunavut.lang.[language] python modules.

Returns A *Language* object cached by this context.

Return type *Language*

get_supported_language_names() → Iterable[str]
Get a list of target languages supported by Nunavut.

Returns An iterable of strings which are languages with special support within Nunavut templates.

get_output_extension() → str
Gets the output extension to use regardless of a target language being available or not.

Returns A file extension name with a leading dot.

get_default_namespace_output_stem() → Optional[str]
The filename stem to give to Namespace output files if emitted or None if there was none specified and there is no target language.

Returns A file name stem or None

get_target_language() → Optional[nunavut.lang.Language]
Returns the target language configured on this object or None if no target language was specified.

filter_id_for_target(*instance: Any*, *id_type: str = 'any'*) → str
A filter that will transform a given string or pydsdl identifier into a valid identifier in the target language. A default transformation is applied if no target language is set.

Parameters

- **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.
- **id_type** (*str*) – A type of identifier. This is different for each language. Use 'any' to apply stropping rules for all identifier types to the instance.

Returns A token that is a valid identifier in the target language, is not a reserved keyword, and is transformed in a deterministic manner based on the provided instance.

get_supported_languages() → Dict[str, nunavut.lang.Language]
Returns a collection of available language support objects.

config

Subpackages

nunavut.lang.c

Filters for generating C. All filters in this module will be available in the template's global namespace as `c`.

class nunavut.lang.c.**Language**(*language_module: module*, *config: nunavut.lang._config.LanguageConfig*, *omit_serialization_support: bool*, *language_options: Optional[Mapping[str, Any]] = None*)
Bases: *nunavut.lang.Language*

Concrete, C-specific *nunavut.lang.Language* object.

get_includes(*dep_types: nunavut.dependencies.Dependencies*) → List[str]
Get a list of include paths that are specific to this language and the options set for it. :param Dependencies dep_types: A description of the dependencies includes are needed for. :return: A list of include file paths. The list may be empty if no includes were needed.

filter_id(*instance: Any*, *id_type: str = 'any'*) → str
Produces a valid identifier in the language for a given object. The encoding may not be reversible.

Parameters

- **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.
- **id_type** (*str*) – A type of identifier. This is different for each language. For example, for C this value can be 'typedef', 'macro', 'function', or 'enum'. Use 'any' to apply stropping rules for all identifier types to the instance.

Returns A token that is a valid identifier in the language, is not a reserved keyword, and is transformed in a deterministic manner based on the provided instance.

nunavut.lang.c.**filter_id**(*language: nunavut.lang.c.Language*, *instance: Any*, *id_type: str = 'any'*) → str

Filter that produces a valid C identifier for a given object. The encoding may not be reversible.

```
# Given
I = 'I  c'

# and
template = '{{ I | id }}'

# then
rendered = 'I_zX2764_c'
```

```
# Given
I = 'if'

# and
template = '{{ I | id }}'

# then
rendered = '_if'
```

```
# Given
I = '_Reserved'

# and
template = '{{ I | id }}'

# then
rendered = '_reserved'
```

```
# Given
I = 'EMACRO_TOKEN'

# and
template = '{{ I | id("macro") }}'

# then
rendered = '_eMACRO_TOKEN'
```

Parameters

- **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.
- **id_type** (*str*) – A type of identifier. For C this value can be 'typedef', 'macro', 'function', or 'enum'. use 'any' to apply stropping rules for all identifier types to the instance.

Returns A token that is a valid identifier for C, is not a reserved keyword, and is transformed in a deterministic manner based on the provided instance.

nunavut.lang.c.**filter_macrofy**(*language: nunavut.lang.c.Language*, *value: str*) → str

Filter to transform an input into a valid C preprocessor identifier token.

```
# Given
template = '#ifndef {{ "my full name" | macrofy }}'

# then
rendered = '#ifndef MY_FULL_NAME'
```

Note that individual tokens are not stropped so the appearance of an identifier in the `SCREAMING_SNAKE_CASE` output my be different then the token as it appears on its own. For example:

```
# "register" is reserved so it will be stropped if it appears as an
# identifier...
template = '''#ifndef {{ "namespaced.Type.register" | macrofy }}
{{ "register" | id }}
'''

# ...but it will not be stropped within the macro.
rendered = '''#ifndef NAMESPACED_TYPE_REGISTER
_register
'''
```

If stropping is enabled, however, the entire token generated by this filter will be stropped:

```
# Given
template = '#ifndef {{ "_starts_with_underscore" | macrofy }}'

# then
rendered = '#ifndef _sTARTS_WITH_UNDERSCORE'
```

And again with stropping disabled:

```
# Given
template = '#ifndef {{ "_starts_with_underscore" | macrofy }}'

# then with stropping disabled
rendered = '#ifndef _STARTS_WITH_UNDERSCORE'
```

Parameters **value** (*str*) – The value to transform.

Returns A valid C preprocessor identifier token.

nunavut.lang.c.**filter_type_from_primitive**(*language: nunavut.lang.c.Language*, *value: pydsdl._serializable._primitive.PrimitiveType*) → str

Filter to transform a pydsdl `PrimitiveType` into a valid C type.

```
# Given
template = '{{ unsigned_int_32_type | type_from_primitive }}'

# then
rendered = 'uint32_t'
```

```
# Given
template = '{{ int_64_type | type_from_primitive }}'

# then
rendered = 'int64_t'
```

Parameters **value** (*str*) – The dsdl primitive to transform.

Returns A valid C99 type name.

Raises **RuntimeError** – If the primitive cannot be represented as a standard C type.

nunavut.lang.c.**filter_to_snake_case**(*value: str*) → str

Filter to transform a string into a snake-case token.

```
# Given
template = '{{ "scotec.mcu.Timer" | to_snake_case }} a();'

# then
rendered = 'scotec_mcu_timer a();'
```

```
# Given
template = '{{ "scotec.mcu.TimerHelper" | to_snake_case }} b();'

# then
rendered = 'scotec_mcu_timer_helper b();'
```

```
# and Given
template = '{{ "SCOTEC_MCU_TimerHelper" | to_snake_case }} b();'

# then
rendered = 'scotec_mcu_timer_helper b();'
```

Parameters **value** (*str*) – The string to transform into C snake-case.

Returns A valid C99 token using the snake-case convention.

nunavut.lang.c.**filter_to_screaming_snake_case**(*value: str*) → str

Filter to transform a string into a SCREAMING_SNAKE_CASE token.

```
# Given
template = '{{ "scotec.mcu.Timer" | to_screaming_snake_case }} a();'

# then
rendered = 'SCOTEC_MCU_TIMER a();'
```

nunavut.lang.c.**filter_to_template_unique_name**(*_: Any*, *base_token: str*) → str

Filter that takes a base token and forms a name that is very likely to be unique within the template the filter is invoked. This name is also very likely to be a valid C identifier.

Important: The exact tokens generated may change between major or minor versions of this library. The only guarantee provided is that the tokens will be stable for the same version of this library given the same input.

Also note that name uniqueness is only likely within a given template. Between templates there is no guarantee of uniqueness and, since this library does not lex generated source, there is no guarantee that the generated name

does not conflict with a name generated by another means.

```
# Given
template  = '{{ "foo" | to_template_unique_name }},{{ "Foo" | to_template_unique_
↪name }},'
template += '{{ "fOO" | to_template_unique_name }}'

# then
rendered = '_foo0_,_foo1_,_fOO0_'
```

```
# Given
template = '{{ "i like coffee" | to_template_unique_name }}'

# then
rendered = '_i like coffee0_'
```

Parameters **base_token** (*str*) – A token to include in the base name.

Returns A name that is likely to be valid C identifier and is likely to be unique within the file generated by the current template.

nunavut.lang.c.**filter_short_reference_name**(*language: nunavut.lang.c.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is a shorted version of the full reference name.

```
# Given a type with illegal C characters
my_type.short_name = '_Foo'
my_type.version.major = 1
my_type.version.minor = 2

# and
template = '{{ my_type | short_reference_name }}'

# then, with stropping enabled
rendered = '_foo_1_2'
```

With stropping disabled:

```
rendered = '_Foo_1_2'
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the reference name for.

nunavut.lang.c.**filter_includes**(*language: nunavut.lang.c.Language*, *t: pydsdl._serializable._composite.CompositeType*, *sort: bool = True*) → List[str]

Returns a list of all include paths for a given type.

```
# Listing the includes for a union with only integer types:
template = '''{% for include in my_type | includes -%}
{{include}}
{% endfor %}'''

# stdint.h will normally be generated
rendered = '''<stdint.h>
```

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```
<stdlib.h>
'''
```

```
# You can suppress std includes by setting use_standard_types to False under
# nunavut.lang.c
rendered = ''
```

Parameters

- **t** (*pydsdl.CompositeType*) – The type to scan for dependencies.
- **sort** (*bool*) – If true the returned list will be sorted.

Returns a list of include headers needed for a given type.

nunavut.lang.c.**filter_to_static_assertion_value**(*obj: Any*) → int

Tries to convert a Python object into a value compatible with static comparisons in C. This allows stable comparison of static values in headers to promote consistency and version compatibility in generated code.

Will raise a ValueError if the object provided does not (yet) have an available conversion in this function.

Currently supported types are string:

```
 # given
template = '{{ "Any" | to_static_assertion_value }}'

# then
rendered = '1556001108'
```

int:

```
 # given
template = '{{ 123 | to_static_assertion_value }}'

# then
rendered = '123'
```

and bool:

```
 # given
template = '{{ True | to_static_assertion_value }}'

# then
rendered = '1'
```

nunavut.lang.c.**filter_constant_value**(*language: nunavut.lang.c.Language*, *constant: pydsdl._serializable._attribute.Constant*) → str

Renders the specified constant as a literal. This is a shorthand for *filter_literal()*.

```
 # given
template = '{{ my_true_constant | constant_value }}'

# then
rendered = 'true'
```

Language configuration can control the output of some constant tokens. For example, to use non-standard true and false values in c:

```
 # given
template = '{{ my_true_constant | constant_value }}'

# then, if true = 'NUNAVUT_TRUE' in the named_values for nunavut.lang.c
rendered = 'NUNAVUT_TRUE'
```

Floating point values are converted as fractions to ensure no python-specific transformations are applied:

```
 # given a float value using a fraction of 355/113
template = '{{ almost_pi | constant_value }}'

# ...the rendered value with include that fraction as a division statement.
rendered = '((float) (355.0 / 113.0))'
```

nunavut.lang.c.**filter_literal**(*language: nunavut.lang.c.Language, value: Union[fractions.Fraction, bool, int], ty: pydsdl._expression._any.Any, cast_format: Optional[str] = None*) → str

Renders the specified value of the specified type as a literal.

nunavut.lang.c.**filter_full_reference_name**(*language: nunavut.lang.c.Language, t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is the full namespace, typename, major, and minor version for a given composite type.

```
# Given a type with illegal characters for C++
my_obj.full_name = 'any.int.2Foo'
my_obj.full_namespace = 'any.int'
my_obj.version.major = 1
my_obj.version.minor = 2

# and
template = '{{ my_obj | full_reference_name }}'

# then, with stropping enabled
rendered = 'any_int_2Foo_1_2'
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the fully-resolved reference name for.

nunavut.lang.c.**filter_to_standard_bit_length**(*t: pydsdl._serializable._primitive.PrimitiveType*) → int

Returns the nearest standard bit length of a type as an int.

```
# Given
I = pydsdl.UnsignedIntegerType(7, pydsdl.PrimitiveType.CastMode.TRUNCATED)

# and
template = '{{ I | to_standard_bit_length }}'

# then
rendered = '8'
```

nunavut.lang.c.**is_zero_cost_primitive**(*language: nunavut.lang.c.Language, t: pydsdl._serializable._primitive.PrimitiveType*) → bool

Assuming that the target platform is IEEE754-conformant detects whether the native in-memory representation

of a value of the supplied primitive type is the same as its on-the-wire representation defined by the DSDL Specification.

For instance; all little-endian, IEEE754-conformant platforms have compatible in-memory representations of int8, int16, int32, int64, uint8, uint16, uint32, uint64, float32, float64. Values of other primitive types typically require some transformations (e.g., float16).

It follows that arrays, certain composite types, and some other entities composed of zero-cost composites are also zero-cost types, but such non-trivial conjectures are not recognized by this function.

Raises a `TypeError` if the argument is not a value of type `pydsdl.PrimitiveType`.

```
# Given
i7  = pydsdl.SignedIntegerType(7, pydsdl.PrimitiveType.CastMode.SATURATED)
u32 = pydsdl.UnsignedIntegerType(32, pydsdl.PrimitiveType.CastMode.TRUNCATED)
f16 = pydsdl.FloatType(16, pydsdl.PrimitiveType.CastMode.TRUNCATED)
f32 = pydsdl.FloatType(32, pydsdl.PrimitiveType.CastMode.SATURATED)
bl = pydsdl.BooleanType(pydsdl.PrimitiveType.CastMode.SATURATED)

# and
template = (
    '{{ i7  is zero_cost_primitive }} '
    '{{ u32 is zero_cost_primitive }} '
    '{{ f16 is zero_cost_primitive }} '
    '{{ f32 is zero_cost_primitive }} '
    '{{ bl is zero_cost_primitive }}'
)

# then
rendered = 'False True False True False'
```

`nunavut.lang.c.`**`filter_is_zero_cost_primitive`**(*language: nunavut.lang.c.Language*, *t: pydsdl._serializable._primitive.PrimitiveType*) → str

Deprecated as a filter. Please use test version.

Subpackages

nunavut.lang.c.support

Contains supporting C headers to distribute with generated types.

`nunavut.lang.c.support.`**`list_support_files`**() → Generator[pathlib.Path, None, None]

Get a list of C support headers embedded in this package.

```
for path in list_support_files():
    support_file_count += 1
    assert path.parent.stem == 'support'
    assert (path.suffix == '.h' or path.suffix == '.j2')
```

Returns A list of C support header resources.

nunavut.lang.c.templates

Contains the Jinja templates to generate C headers.

nunavut.lang.cpp

Filters for generating C++. All filters in this module will be available in the template's global namespace as `cpp`.

class nunavut.lang.cpp.**Language**(*language_module: module*, *config: nunavut.lang._config.LanguageConfig*, *omit_serialization_support: bool*, *language_options: Optional[Mapping[str, Any]] = None*)

Bases: *nunavut.lang.Language*

Concrete, C++-specific *nunavut.lang.Language* object.

CPP_STD_EXTRACT_NUMBER_PATTERN = re.compile('(?:gnu|c)\\+\\+(\\d(?:\\w))')

get_includes(*dep_types: nunavut.dependencies.Dependencies*) → List[str]

Get a list of include paths that are specific to this language and the options set for it. :param Dependencies dep_types: A description of the dependencies includes are needed for. :return: A list of include file paths. The list may be empty if no includes were needed.

filter_id(*instance: Any*, *id_type: str = 'any'*) → str

Produces a valid identifier in the language for a given object. The encoding may not be reversible.

Parameters

- **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.
- **id_type** (*str*) – A type of identifier. This is different for each language. For example, for C this value can be 'typedef', 'macro', 'function', or 'enum'. Use 'any' to apply stropping rules for all identifier types to the instance.

Returns A token that is a valid identifier in the language, is not a reserved keyword, and is transformed in a deterministic manner based on the provided instance.

nunavut.lang.cpp.**uses_std_variant**(*language: nunavut.lang.cpp.Language*) → bool

Uses query for std variant.

If the language options contain an `std` entry for C++ and the specified standard includes the `std::variant` type added to the language at C++17 then this value is true. The logic included in this filter can be stated as "options has key std and the value for options.std evaluates to C++ version 17 or greater" but the implementation is able to parse out actual compiler flags like `gnu++20` and is aware of any overrides to suppress use of the standard variant type even if available.

Example:

```
template = '''
    {%- ifuses "std_variant" -%}
        #include <variant>
    {%- else -%}
        #include "user_variant.h"
    {%- endifuses -%}
'''
```

nunavut.lang.cpp.**filter_constant_value**(*language: nunavut.lang.cpp.Language*, *constant: pydsdl._serializable._attribute.Constant*) → str

Renders the specified value of the specified type as a literal.

nunavut.lang.cpp.**filter_literal**(*language: nunavut.lang.cpp.Language*, *value: Union[fractions.Fraction, bool, int]*, *ty: pydsdl._expression._any.Any*, *cast_format: Optional[str] = None*) → str

Renders the specified value of the specified type as a literal.

nunavut.lang.cpp.**filter_to_standard_bit_length**(*t: pydsdl._serializable._primitive.PrimitiveType*) → int

Returns the nearest standard bit length of a type as an int.

nunavut.lang.cpp.**filter_id**(*language: nunavut.lang.cpp.Language*, *instance: Any*, *id_type: str = 'any'*) → str

Filter that produces a valid C and/or C++ identifier for a given object. The encoding may not be reversible.

```
# Given
I = 'I like c++'

# and
template = '{{ I | id }}'

# then
rendered = 'I_like_czX002BzX002B'
```

```
# Given
I = 'if'

# and
template = '{{ I | id }}'

# then
rendered = '_if'
```

```
# Given
I = 'I   really like     coffee'

# and
template = '{{ I | id }}'

# then
rendered = 'I_really_like_coffee'
```

Parameters **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.

Returns A token that is a valid identifier for C and C++, is not a reserved keyword, and is transformed in a deterministic manner based on the provided instance.

nunavut.lang.cpp.**filter_type**(*language: nunavut.lang.cpp.Language*, *obj: Any*) → str

Tries to convert a Python object into a c++ typename.

Will raise a ValueError if the object provided does not (yet) have an available conversion in this function.

Currently supported types are string:

```
 # given
template = '{{ "Any" | type }}'

# then
rendered = "const char* const"
```

int:

```
 # given
template = '{{ 123 | type }}'
```

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```
# then
rendered = 'long long'
```

and bool:

```
 # given
template = '{{ True | type }}'

# then
rendered = 'bool'
```

nunavut.lang.cpp.**filter_open_namespace**(*language: nunavut.lang.cpp.Language*, *full_namespace: str*, *bracket_on_next_line: bool = True*, *linesep: str = '\n'*) → str

Emits c++ opening namespace syntax parsed from a pydsdl "full_namespace", dot-separated value.

```
# Given
T.full_namespace = 'uavcan.foo'

# and
template = '{{ T.full_namespace | open_namespace }}'

# then
rendered = '''namespace uavcan
{
namespace foo
{'''
```

Parameters

- **full_namespace** (*str*) – A dot-separated namespace string.
- **bracket_on_next_line** (*bool*) – If True (the default) then the opening brackets are placed on a newline after the namespace keyword.
- **linesep** (*str*) – The line-separator to use when emitting new lines. By default this is `\n`.

Returns C++ namespace declarations with opening brackets.

nunavut.lang.cpp.**filter_close_namespace**(*language: nunavut.lang.cpp.Language*, *full_namespace: str*, *omit_comments: bool = False*, *linesep: str = '\n'*) → str

Emits c++ closing namespace syntax parsed from a pydsdl "full_namespace", dot-separated value.

```
# Given
T.full_namespace = 'uavcan.foo'

# and
template = '{{ T.full_namespace | close_namespace }}'

# then
rendered = '''} // namespace foo
} // namespace uavcan'''
```

Parameters

- **full_namespace** (*str*) – A dot-separated namespace string.

- **omit_comments** (*bool*) – If True then the comments following the closing bracket are omitted.
- **linesep** (*str*) – The line-separator to use when emitting new lines. By default this is `\n`

Returns C++ namespace declarations with opening brackets.

nunavut.lang.cpp.**filter_full_reference_name**(*language: nunavut.lang.cpp.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is the full namespace, typename, major, and minor version for a given composite type.

```
# Given a type with illegal characters for C++
my_obj.full_name = 'any.int.2Foo'
my_obj.version.major = 1
my_obj.version.minor = 2

# and
template = '{{ my_obj | full_reference_name }}'

# then, with stropping enabled
rendered = 'any::_int::_2Foo_1_2'
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the fully-resolved reference name for.

nunavut.lang.cpp.**filter_full_macro_name**(*language: nunavut.lang.cpp.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string usable as part of a macro name that is the full namespace, typename, major, and minor version for a given composite type.

```
# Given a type with illegal characters for C++
my_obj.full_name = 'any.int.2Foo'
my_obj.version.major = 1
my_obj.version.minor = 2

# and
template = '{{ my_obj | full_macro_name }}'

# then, with stropping enabled
rendered = 'any__int__2Foo_1_2'
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the fully-resolved reference name for.

nunavut.lang.cpp.**filter_short_reference_name**(*language: nunavut.lang.cpp.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is a shorted version of the full reference name. This type is unique only within its namespace.

```
# Given a type with illegal C++ characters
my_type.short_name = '2Foo'
my_type.version.major = 1
my_type.version.minor = 2
```

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```
# and
template = '{{ my_type | short_reference_name }}'

# then, with stropping enabled
rendered = '_2Foo_1_2'
```

```
# Given a type with legal C++ characters
my_type.short_name = 'Struct_'
my_type.version.major = 0
my_type.version.minor = 1

# and
template = '{{ my_type | short_reference_name }}'

# then, with stropping enabled
rendered = 'Struct__0_1'
```

```
# Given a service type
my_service_type.short_name = 'Struct_'
my_service_type.version.major = 0
my_service_type.version.minor = 1

# and
template = '''
{{ my_service_type | short_reference_name }}
{{ my_service_type.request_type | short_reference_name }}
{{ my_service_type.response_type | short_reference_name }}
'''

# then, with stropping enabled
rendered = '''
Struct_
Request_0_1
Response_0_1
'''
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the reference name for.

nunavut.lang.cpp.**filter_includes**(*language: nunavut.lang.cpp.Language*, *t: pydsdl._serializable._composite.CompositeType*, *sort: bool = True*) → List[str]

Returns a list of all include paths for a given type.

Parameters

- **t** (*pydsdl.CompositeType*) – The type to scan for dependencies.
- **sort** (*bool*) – If true the returned list will be sorted.

Returns a list of include headers needed for a given type.

nunavut.lang.cpp.**filter_destructor_name**(*language: nunavut.lang.cpp.Language*, *instance: pydsdl._expression._any.Any*) → str

Returns a token that is the local destructor name. For example:

```
# Given a pydsdl.FixedLengthArrayType "my_type":
my_type.short_name = 'Foo'
```

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```
my_type.capacity = 2

# and
template = 'ptr->{{ my_type | destructor_name }}'

# then
rendered = 'ptr->~array<std::uint8_t,2>'
```

Parameters **t** (*pydsdl.CompositeType*) – The type to generate a destructor template for.

Returns A destructor name token.

nunavut.lang.cpp.**filter_declaration**(*language: nunavut.lang.cpp.Language*, *instance: pydsdl._expression._any.Any*) → str

Emit a declaration statement for the given instance.

nunavut.lang.cpp.**filter_definition_begin**(*language: nunavut.lang.cpp.Language*, *instance: pydsdl._serializable._composite.CompositeType*) → str

Emit the start of a definition statement for a composite type.

```
# Given a pydsdl.CompositeType "my_type":
my_type.short_name = 'Foo'
my_type.version.major = 1
my_type.version.minor = 0

# and
template = '{{ my_type | definition_begin }}'

# then
rendered = 'struct Foo_1_0'
```

```
# Also, given a pydsdl.UnionType "my_union_type":
my_union_type.short_name = 'Foo'
my_union_type.version.major = 1
my_union_type.version.minor = 0

# and
union_template = '{{ my_union_type | definition_begin }}'

# then
rendered = 'struct Foo_1_0'
```

```
# Finally, given a pydsdl.ServiceType "my_service_type":
my_service_type.short_name = 'Foo'
my_service_type.version.major = 1
my_service_type.version.minor = 0

# and
template = '''
{{ my_service_type | definition_begin }};
{{ my_service_type.request_type | definition_begin }};
{{ my_service_type.response_type | definition_begin }};
'''
```

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```
# then
rendered = '''
namespace Foo;
struct Request_1_0;
struct Response_1_0;
'''
```

nunavut.lang.cpp.**filter_definition_end**(*language: nunavut.lang.cpp.Language*, *instance: pydsdl._serializable._composite.CompositeType*) → str

Emit the end of a definition statement for a composite type.

nunavut.lang.cpp.**filter_type_from_primitive**(*language: nunavut.lang.cpp.Language*, *value: pydsdl._serializable._primitive.PrimitiveType*) → str

Filter to transform a pydsdl `PrimitiveType` into a valid C++ type.

```
# Given
template = '{{ unsigned_int_32_type | type_from_primitive }}'

# then
rendered = 'std::uint32_t'
```

Also note that this is sensitive to the `use_standard_types` configuration in the language properties:

```
# rendered will be different if use_standard_types is False
rendered = 'unsigned long'
```

Parameters **value** (*str*) – The dsdl primitive to transform.

Returns A valid C++ type name.

Raises **TemplateRuntimeError** – If the primitive cannot be represented as a standard C++ type.

nunavut.lang.cpp.**filter_to_namespace_qualifier**(*namespace_list: List[str]*) → str

Converts a list of namespace names into a qualifier string. For example:

```
my_namespace = ['foo', 'bar']
template = '{{ my_namespace | to_namespace_qualifier }}myType()'
expected = 'foo::bar::myType()'
```

This filter gracefully handles empty namespace lists:

```
my_namespace = []
template = '{{ my_namespace | to_namespace_qualifier }}myType()'
expected = 'myType()'
```

nunavut.lang.cpp.**filter_to_template_unique_name**(*base_token: str*) → str

Filter that takes a base token and forms a name that is very likely to be unique within the template the filter is invoked. This name is also very likely to be a valid C++ identifier.

Important: The exact tokens generated may change between major or minor versions of this library. The only guarantee provided is that the tokens will be stable for the same version of this library given the same input.

Also note that name uniqueness is only likely within a given template. Between templates there is no guarantee of uniqueness and, since this library does not lex generated source, there is no guarantee that the generated name does not conflict with a name generated by another means.

```
# Given
template  = '{{ "foo" | to_template_unique_name }},{{ "Foo" | to_template_unique_
↪name }},'
template += '{{ "fOO" | to_template_unique_name }}'

# then
rendered = '_foo0_,_foo1_,_fOO0_'
```

```
# Given
template = '{{ "i like coffee" | to_template_unique_name }}'

# then
rendered = '_i like coffee0_'
```

Parameters **base_token** (*str*) – A token to include in the base name.

Returns A name that is likely to be valid C++ identifier and is likely to be unique within the file generated by the current template.

nunavut.lang.cpp.**filter_as_boolean_value**(*value: bool*) → str

Filter a boolean expression to produce a valid C++ “true” or “false” token.

```
assert "true" == filter_as_boolean_value(True)
assert "false" == filter_as_boolean_value(False)
```

nunavut.lang.cpp.**filter_indent_if_not**(*language: nunavut.lang.cpp.Language*, *text: str*, *depth: int = 1*) → str

Emit indent characters as configured for the language but only as needed. This is different from the built-in indent filter in that it may add or remove spaces based on the existing indent.

```
# Given a string with an existing indent of 4 spaces...
template  = '{{ "    int a = 1;" | indent_if_not }}'

# then if cpp.indent == 4 we expect no change.
rendered = '    int a = 1;'
```

```
# If the indent is only 3 spaces...
template  = '{{ "   int a = 1;" | indent_if_not }}'

# then if cpp.indent == 4 we expect 4 spaces (i.e. not 7 spaces)
rendered = '    int a = 1;'
```

```
# We can also specify multiple indents...
template  = '{{ "int a = 1;" | indent_if_not(2) }}'

rendered = '        int a = 1;'
```

```
# ...or no indent
template  = '{{ "    int a = 1;" | indent_if_not(0) }}'

rendered = 'int a = 1;'
```

```
# Finally, note that blank lines are not indented.
template  = '''
    {%- set block_text -%}
        int a = 1;
        {# empty line #}
        int b = 2;
    {%- endset -%}{{ block_text | indent_if_not(1) }}'''

rendered  = '    int a = 1;'
rendered += '\n'
rendered += '\n'  # Nothing but spaces so this is stripped
rendered += '    int b = 2;'
```

Parameters

- **text** – The text to indent.
- **depth** – The number of indents. For example, if depth is 2 and the indent for this language is 4 spaces then the text will be indented by 8 spaces.

nunavut.lang.cpp.**filter_minimum_required_capacity_bits**(*t: pydsdl._serializable._serializable.SerializableType*) → int

Returns the minimum number of bits required to store the deserialized value of a pydsdl `SerializableType`. This capacity may be too small for some instances of the value (e.g. variable length arrays).

```
# Given
template = '{{ unsigned_int_32_type | minimum_required_capacity_bits }}'

# then
rendered = '32'
```

Parameters **t** (*pydsdl.SerializableType*) – The dsdl type.

Returns The minimum, required bits needed to store some values of the given type.

nunavut.lang.cpp.**filter_block_comment**(*language: nunavut.lang.cpp.Language*, *text: str*, *style: str*, *indent: int = 0*, *line_length: int = 100*) → str

Reformats text as a block comment using Python's `textwrap.TextWrapper.wrap()` function.

Parameters

- **text** – The text to emit as a block comment.
- **style** – Dictates the style of comments (see return documentation for valid style names).
- **indent** – The number of spaces to indent the comments by (tab indent is not supported. Sorry).
- **line_length** – The soft maximum width to wrap text at. Some violations may occur where long words are used.

Returns str A comment block. Comment styles supported are:

javadoc

```
# Given a type with the following docstring
text = 'This is a bunch of documentation.'
```

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```
# and
template = '''
    {{ text | block_comment('javadoc', 4, 24) }}
    void some_method();
'''

# the output will be
rendered = '''
    /**
     * This is a bunch
     * of documentation.
     */
    void some_method();
'''
```

cpp-doxygen

```
# that same template using the cpp style of doxygen...
template = '''
    {{ text | block_comment('cpp-doxygen', 4, 24) }}
    void some_method();
'''

# ...will be
rendered = '''
    ///
    /// This is a bunch
    /// of
    /// documentation.
    ///
    void some_method();
'''
```

cpp

```
# also supported is cpp style...
template = '''
    {{ text | block_comment('cpp', 4, 24) }}
    void some_method();
'''

rendered = '''
    // This is a bunch of
    // documentation.
    void some_method();
'''
```

c

```
# c style...
template = '''
    {{ text | block_comment('c', 4, 24) }}
    void some_method();
'''

rendered = '''
    /*
```

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```
     * This is a bunch
     * of documentation.
     */
    void some_method();
'''
```

qt

```
# and Qt style...
template = '''
    {{ text | block_comment('qt', 4, 24) }}
    void some_method();
'''

rendered = '''
    /*!
     * This is a bunch
     * of documentation.
     */
    void some_method();
'''
```

Subpackages

nunavut.lang.cpp.support

Contains supporting C++ headers to distribute with generated types.

nunavut.lang.cpp.support.**list_support_files**() → Generator[pathlib.Path, None, None]

Get a list of C++ support headers embedded in this package.

```
for path in list_support_files():
    support_file_count += 1
    assert path.parent.stem == 'support'
    assert (path.suffix == '.hpp' or path.suffix == '.j2')
```

Returns A list of C++ support header resources.

nunavut.lang.cpp.templates

Contains the Jinja templates to generate C++ headers.

nunavut.lang.html

Filters for generating docs. All filters in this module will be available in the template's global namespace as `ln.html`.

nunavut.lang.html.**filter_extent**(*instance: pydsdl._expression._any.Any*) → int

nunavut.lang.html.**filter_max_bit_length**(*instance: pydsdl._expression._any.Any*) → int

nunavut.lang.html.**filter_tag_id**(*instance: pydsdl._expression._any.Any*) → str

nunavut.lang.html.**filter_url_from_type**(*instance: pydsdl._expression._any.Any*) → str

nunavut.lang.html.**filter_make_unique**(*_: Any*, *base_token: str*) → str

Filter that takes a base token and forms a name that is very likely to be unique within the template the filter is invoked.

Important: The exact tokens generated may change between major or minor versions of this library. The only guarantee provided is that the tokens will be stable for the same version of this library given the same input.

Also note that name uniqueness is only likely within a given template. Between templates there is no guarantee of uniqueness and, since this library does not lex generated source, there is no guarantee that the generated name does not conflict with a name generated by another means.

```
# Given
template  = '{{ "foo" | make_unique }},{{ "Foo" | make_unique }},'
template += '{{ "fOO" | make_unique }}'

# then
rendered = 'foo0,foo1,fOO0'
```

```
# Given
template = '{{ "coffee > tea" | make_unique }}'

# then
rendered = 'coffee &gt; tea0'
```

Parameters **base_token** (*str*) – A token to include in the base name.

Returns A name that is likely to be unique within the file generated by the current template.

nunavut.lang.html.**filter_namespace_doc**(*ns: nunavut.Namespace*) → str

nunavut.lang.html.**filter_display_type**(*instance: pydsdl._expression._any.Any*) → str

nunavut.lang.html.**filter_natural_sort_namespace**(*instance: List[pydsdl._expression._any.Any]*) → List[pydsdl._expression._any.Any]

Namespaces come in plain lists; sort by name only.

nunavut.lang.html.**filter_natural_sort_type**(*instance: pydsdl._expression._any.Any*) → List[pydsdl._expression._any.Any]

Types come in tuples (type, path). Sort by type name.

Subpackages

nunavut.lang.html.templates

Contains the Jinja templates to generate HTML documentation.

nunavut.lang.js

Filters for generating javascript. All filters in this module will be available in the template's global namespace as `ln.js`.

nunavut.lang.js.**filter_to_true_or_false**(*value: str*) → str

Jinja filter that takes in a value, casts it to a bool and emits `true` or `false`.

The following example assumes `deprecated` as an integer `1`.

Example:

```
"deprecated": {{ T.deprecated | ln.js.to_true_or_false }},
```

Results Example:

```
"deprecated": false,
```

Parameters **value** (*str*) – The template value to evaluate.

Returns `true` or `false`

nunavut.lang.py

Filters for generating python. All filters in this module will be available in the template's global namespace as `py`.

class nunavut.lang.py.**Language**(*language_module: module*, *config: nunavut.lang._config.LanguageConfig*, *omit_serialization_support: bool*, *language_options: Optional[Mapping[str, Any]] = None*)

Bases: *nunavut.lang.Language*

Concrete, Python-specific *nunavut.lang.Language* object.

PYTHON_RESERVED_IDENTIFIERS = ['ArithmeticError', 'AssertionError', 'AttributeError',

get_includes(*dep_types: nunavut.dependencies.Dependencies*) → List[str]

Get a list of include paths that are specific to this language and the options set for it. :param Dependencies dep_types: A description of the dependencies includes are needed for. :return: A list of include file paths. The list may be empty if no includes were needed.

filter_id(*instance: Any*, *id_type: str = 'any'*) → str

Produces a valid identifier in the language for a given object. The encoding may not be reversible.

Parameters

- **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.
- **id_type** (*str*) – A type of identifier. This is different for each language. For example, for C this value can be 'typedef', 'macro', 'function', or 'enum'. Use 'any' to apply stropping rules for all identifier types to the instance.

Returns A token that is a valid identifier in the language, is not a reserved keyword, and is transformed in a deterministic manner based on the provided instance.

nunavut.lang.py.**filter_to_template_unique_name**(*context: nunavut.templates.SupportsTemplateContext*, *base_token: str*) → str

Filter that takes a base token and forms a name that is very likely to be unique within the template the filter is invoked. This name is also very likely to be a valid Python identifier.

Important: The exact tokens generated may change between major or minor versions of this library. The only guarantee provided is that the tokens will be stable for the same version of this library given the same input.

Also note that name uniqueness is only likely within a given template. Between templates there is no guarantee of uniqueness and, since this library does not lex generated source, there is no guarantee that the generated name does not conflict with a name generated by another means.

```
# Given
template  = '{{ "f" | to_template_unique_name }},{{ "f" | to_template_unique_name␣
↪}},'
template += '{{ "f" | to_template_unique_name }},{{ "bar" | to_template_unique_
↪name }}'

# then
rendered = '_f0_,_f1_,_f2_,_bar0_'
```

```
# Given
template = '{{ "i like coffee" | to_template_unique_name }}'

# then
rendered = '_i like coffee0_'
```

Parameters **base_token** (*str*) – A token to include in the base name.

Returns A name that is likely to be valid python identifier and is likely to be unique within the file generated by the current template.

nunavut.lang.py.**filter_id**(*language: nunavut.lang.py.Language*, *instance: Any*, *id_type: str = 'any'*) → str

Filter that produces a valid Python identifier for a given object. The encoding may not be reversible.

```
# Given
I = 'I like python'

# and
template = '{{ I | id }}'

# then
rendered = 'I_like_python'
```

```
# Given
I = '&because'

# and
template = '{{ I | id }}'

# then
rendered = 'zX0026because'
```

```
# Given
I = 'if'

# and
template = '{{ I | id }}'

# then
rendered = 'if_'
```

Parameters **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.

Returns A token that is a valid Python identifier, is not a reserved keyword, and is transformed in a deterministic manner based on the provided instance.

nunavut.lang.py.**filter_full_reference_name**(*language: nunavut.lang.py.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is the full namespace, typename, major, and minor version for a given composite type.

```
# Given
full_name = 'any.str.2Foo'
major = 1
minor = 2

# and
template = '{{ my_obj | full_reference_name }}'

# then
rendered = 'any_.str_.zX0032Foo_1_2'
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the fully-resolved reference name for.

nunavut.lang.py.**filter_short_reference_name**(*language: nunavut.lang.py.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is a shorted version of the full reference name. This type is unique only within its namespace.

```
# Given
short_name = '2Foo'
major = 1
minor = 2

# and
template = '{{ my_obj | short_reference_name }}'

# then
rendered = 'zX0032Foo_1_2'
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the reference name for.

nunavut.lang.py.**filter_imports**(*language: nunavut.lang.py.Language*, *t: pydsdl._serializable._composite.CompositeType*, *sort: bool = True*) → List[str]

Returns a list of all modules that must be imported to use a given type.

Parameters

- **t** (*pydsdl.CompositeType*) – The type to scan for dependencies.
- **sort** (*bool*) – If true the returned list will be sorted.

Returns a list of python module names the provided type depends on.

nunavut.lang.py.**filter_longest_id_length**(*language: nunavut.lang.py.Language, attributes: List[pydsdl._serializable._attribute.Attribute]*) → int

Return the length of the longest identifier in a list of `pydsdl.Attribute` objects.

```
# Given
I = ['one.str.int.any', 'three.str.int.any']

# and
template = '{{ I | longest_id_length }}'

# then
rendered = '32'
```

Subpackages

nunavut.lang.py.templates

Contains the Jinja templates to generate Py headers.

1.2 Submodules

1.2.1 nunavut.dependencies

Objects and utilities for handling DSDL dependencies when generating code for a given type.

class nunavut.dependencies.**Dependencies**

Bases: `object`

Data structure that contains a set of composite types and annotations (bool flags) which constitute a set of dependencies for a set of DSDL objects.

class nunavut.dependencies.**DependencyBuilder**(**dependant_types*)

Bases: `object`

Given a list of DSDL types this object builds a set of types that the given types use.

Parameters **dependant_types** (*typing.Iterable[pydsdl.Any]*) – A list of types to build dependencies for.

transitive() → nunavut.dependencies.Dependencies

Build a set of all transitive dependencies for the dependent types set for this builder.

direct() → nunavut.dependencies.Dependencies

Build a set of all first-order dependencies for the dependent types set for this builder.

1.2.2 nunavut.generators

Module containing types and utilities for building generator objects. Generators abstract the code generation technology used to transform pydsdl AST into source code.

class nunavut.generators.**AbstractGenerator**(*namespace: nunavut.Namespace*, *generate_namespace_types: nunavut._utilities.YesNoDefault = <YesNoDefault.DEFAULT: 2>*)

Bases: object

Abstract base class for classes that generate source file output from a given pydsdl parser result.

Parameters

- **namespace** (nunavut.Namespace) – The top-level namespace to generates types at and from.
- **generate_namespace_types** (YesNoDefault) – Set to YES to force generation files for namespaces and NO to suppress. DEFAULT will generate namespace files based on the language preference.

namespace
The root *nunavut.Namespace* for this generator.

generate_namespace_types
If true then the generator is set to emit files for *nunavut.Namespace* in addition to the pydsdl datatypes. If false then only files for pydsdl datatypes will be generated.

get_templates() → Iterable[pathlib.Path]
Enumerate all templates found in the templates path. :return: A list of paths to all templates found by this Generator object.

generate_all(*is_dryrun: bool = False*, *allow_overwrite: bool = True*) → Iterable[pathlib.Path]
Generates all output for a given *nunavut.Namespace* and using the templates found by this object.

Parameters

- **is_dryrun** (*bool*) – If True then no output files will actually be written but all other operations will be performed.
- **allow_overwrite** (*bool*) – If True then the generator will attempt to overwrite any existing files it encounters. If False then the generator will raise an error if the output file exists and the generation is not a dry-run.

Returns 0 for success. Non-zero for errors.

Raises PermissionError if allow_overwrite is False and the file exists.

nunavut.generators.**create_generators**(*namespace: nunavut.Namespace*, ***kwargs*) → Tuple[nunavut.generators.AbstractGenerator, nunavut.generators.AbstractGenerator]
Create the two generators used by Nunavut; a code-generator and a support-library generator.

Parameters

- **namespace** (nunavut.Namespace) – The namespace to generate code within.
- **kwargs** – A list of arguments that are forwarded to the generator constructors.

Returns Tuple with the first item being the code-generator and the second the support-library generator.

1.2.3 nunavut.postprocessors

Module containing post processing logic to run on generated files.

class nunavut.postprocessors.**PostProcessor**
Bases: object

Abstract base class for all post processor functors.

class nunavut.postprocessors.**FilePostProcessor**
Bases: *nunavut.postprocessors.PostProcessor*

Abstract base class for all post processor functors that are invoked after a file is written.

All file post processors are callable with the generated file `pathlib.Path` as the sole argument.

Example Usage:

```
class ClangFormat(FilePostProcessor):
    """
    Invoke clang-format on each file after it is generated.
    """
    def __init__(self, clang_format_path: str):
        self._clang_format_args = [clang_format_path, '-i']

    def __call__(self, generated: pathlib.Path) -> pathlib.Path:
        subprocess.run(self._clang_format_args + [str(generated)])
        return generated

...
```

class nunavut.postprocessors.**LinePostProcessor**
Bases: *nunavut.postprocessors.PostProcessor*

Abstract base class for all post processor functors that are invoked after a line is generated from a template but before it is written to the output file.

All line post processors are callable with a 2-tuple containing the contents of the line as the first item and any newline characters as the second item. Note that if there are no newlines generated or if the last line generated does not end with a newline then this post-processor will be invoked at least once with the second item in the tuple as an empty string.

Important: Providing even a single LinePostProcessor to a generator may have a significant impact on generation performance. Some underlying generators (e.g. Jinja) are optimized to stream output based on internal buffer sizes and are not line oriented. For such implementations nunavut will have to create an intermediate line buffer which may impact performance.

Example Usage:

```
class CommentItAllOut(nunavut.postprocessors.LinePostProcessor):

    def __init__(self, open_line_comment: str, close_line_comment: str):
        self._line_comment_pattern = open_line_comment + ' {} ' + close_line_
↪comment

    def __call__(self, line_and_lineend: typing.Tuple[str, str]) -> typing.
↪Tuple[str, str]:
        if len(line_and_lineend[0]) > 0:
            return (self._line_comment_pattern.format(line_and_lineend[0]), line_
↪and_lineend[1])
        else:
            return ('', '')
```

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```
...

c_style = CommentItAllOut('/*', '*/')
my_generator.generate_all(False, True, [c_style])
```

class nunavut.postprocessors.**SetFileMode**(*file_mode: int*)
Bases: *nunavut.postprocessors.FilePostProcessor*

Set the file mode after a file is generated using the `pathlib.Path.chmod(mode)` API.

Parameters **file_mode** (*int*) – The file permissions to set for the file.

class nunavut.postprocessors.**ExternalProgramEditInPlace**(*command_line: List[str], check: bool = True*)
Bases: *nunavut.postprocessors.FilePostProcessor*

Run an external program after generating a file. This version expects the program to either not modify the file or to modify it in-place (e.g. the functor always returns the same path it was provided).

Parameters

- **command_line** (*typing.List[str]*) – The command and arguments to pass to the external program using `subprocess.run`. The file to be processed will be appended as the last positional argument in the command before it is invoked.
- **check** (*bool*) – By default, if the external program returns a non-zero exit status a `subprocess.CalledProcessError` is raised. Set this argument to `False` to ignore external program errors.

class nunavut.postprocessors.**TrimTrailingWhitespace**
Bases: *nunavut.postprocessors.LinePostProcessor*

Remove all trailing whitespace from each line.

Important: See performance note in *LinePostProcessor* documentation. Consider invoking a code formatter from a *FilePostProcessor* instead.

---

class nunavut.postprocessors.**LimitEmptyLines**(*max_empty_lines: int*)
Bases: *nunavut.postprocessors.LinePostProcessor*

Set a limit to the number of consecutive empty lines to allow.

Important: See performance note in *LinePostProcessor* documentation. Consider invoking a code formatter from a *FilePostProcessor* instead.

1.2.4 nunavut.templates

Abstractions around template engine internals.

nunavut.templates.**ENVIRONMENT_FILTER_ATTRIBUTE_NAME = 'environmentfilter'**
For now this is set to a value that is internally compatible with the embedded version of jinja2 we use in Nunavut. If you use this variable instead of its current value you will be insulated from this.

nunavut.templates.**CONTEXT_FILTER_ATTRIBUTE_NAME = 'contextfilter'**
For now this is set to a value that is internally compatible with the embedded version of jinja2 we use in Nunavut. If you use this variable instead of its current value you will be insulated from this.

nunavut.templates.**LANGUAGE_FILTER_ATTRIBUTE_NAME = 'nv_languagefilter'**
Nunavut-specific attribute for filters or tests that take their *nunavut.lang.Language* as the first argument.

class nunavut.templates.**SupportsTemplateContext**
Bases: object

Provided as a pseudo protocol. (in anticipation of that becoming part of the core Python typing someday).

nunavut.templates.**template_environment_filter**(*filter_func: Callable*) → Callable[[...], str]
Decorator for marking environment dependent filters. An object supporting the SupportsTemplateEnv protocol will be passed to the filter as the first argument.

nunavut.templates.**template_context_filter**(*filter_func: Callable*) → Callable[[...], str]
Decorator for marking context dependent filters. An object supporting the *SupportsTemplateContext* protocol will be passed to the filter as the first argument.

Note that any template that uses such a filter will make the jinja "frame" the filter appears within volatile and therefore unable to be optimized.

nunavut.templates.**template_volatile_filter**(*filter_func: Callable*) → Callable[[...], str]
Decorator for marking a filter as volatile therefore disabling optimizations for the frame it appears within. An opaque object will be passed to the filter as the first argument.

class nunavut.templates.**GenericTemplateLanguageFilter**(*language_name_or_module: str*)
Bases: typing.Generic

Decorator for marking template filters that take a *nunavut.lang.Language* object as the first argument with a generic return type.

class nunavut.templates.**template_language_filter**(*language_name_or_module: str*)
Bases: *nunavut.templates.GenericTemplateLanguageFilter*

Decorator for marking template filters that take a *nunavut.lang.Language* object as the first argument.

class nunavut.templates.**template_language_list_filter**(*language_name_or_module: str*)
Bases: *nunavut.templates.GenericTemplateLanguageFilter*

Decorator for marking template filters that take a *nunavut.lang.Language* object as the first argument and return a list of strings.

class nunavut.templates.**template_language_int_filter**(*language_name_or_module: str*)
Bases: *nunavut.templates.GenericTemplateLanguageFilter*

Decorator for marking template filters that take a *nunavut.lang.Language* object as the first argument and return an integer.

class nunavut.templates.**template_language_test**(*language_name_or_module: str*)
Bases: *nunavut.templates.GenericTemplateLanguageFilter*

Decorator for marking template tests that take a *nunavut.lang.Language* object as the first argument.

class nunavut.templates.**LanguageEnvironment**(*language_name: str*)
Bases: object

Data structure defining stuff contributed to a template environment for a given Language.

TEST_NAME_PREFIX = 'is_'

FILTER_NAME_PREFIX = 'filter_'

USES_QUERY_PREFIX = 'uses_'

classmethod is_test_name(*callable_name: Optional[str]*) → bool

classmethod is_filter_name(*callable_name: Optional[str]*) → bool

classmethod is_uses_query_name(*callable_name: Optional[str]*) → bool

LanguageListT = ~LanguageListT

language_name

tests

filters

uses_queries

classmethod handle_conventional_methods(*callable: Callable*, *callable_name: Optional[str] = None*, *supported_languages: Optional[LanguageListT] = None*) → Tuple[Optional[str], str, Callable]

Processes method objects that utilize the nunavut convention of `is_`, `filter_`, or `uses_` prefixes. Also wraps the method in a partial if it requested the language as the first argument.

Parameters **callable_name** (*str*) – If provided this is the name used to process the callable otherwise the `__name__` property is used from the callable itself.

Returns A 3-tuple with the prefix, method name without prefix, and the method or partial. If the first element is `None` then the callable was not a conventional method.

classmethod find_all_conventional_methods_in_language_module(*language: nunavut.lang.Language*, *all_languages: LanguageListT*, *language_module: module*) → nunavut.templates.LanguageEnvironn

1.2.5 nunavut.version

nunavut.version.**__version__ = '1.8.1'**

The version number used in the release of nunavut to pypi.

CHAPTER 2

Template Language Guide

For now we have only a jinja generator for code generation. As such this guide will only discuss using nunavut with jinja templates. There are no immediate plans to support any other template syntax.

2.1 Environment

Note: See *nunavut.jinja* and the language support modules within this one for detailed documentation on available filters and tests provided by nunavut.

The Jinja templates documentation is indispensible as nunavut embeds a full-featured version of jinja 2.

Each template has in its global environment the following:

2.1.1 nunavut

A global `nunavut` is available in the global namespace with the following properties:

version

A pep 440 compatible version number for the version of Nunavut that the template is running within.

support

Meta-data about built-in support for serialization.

omit

`bool` that is True if serialization support was switched off for this template.

namespace

An array of identifiers under which Nunavut support files and types are namespaced. The use of this value by built-in templates and generators is language dependant.

2.1.2 T

The T global contains the type for the given template. For example:

```
{{T.full_name}}
{%- for attr in T.attributes %}
    {{ attr.data_type }}
{%- endfor %}
```

2.1.3 now_utc

The time UTC as a Python `datetime.datetime` object. This is the system time right before the file generation step for the current template began. This will be the same time for included templates and parent templates.

2.1.4 ln

Options and other language-specific facilities for all supported languages. This namespace provides access to other languages that are *not* the target language for the current template. This allows the development of mixed language templates.

2.1.5 Filters and Tests

In addition to the built-in Jinja filters and tests (again, see the Jinja templates documentation for details) pydsdl adds several global tests and filters to the template environment. See *nunavut.jinja* for full documentation on these. For example:

```
# typename filter returns the name of the value's type.
{{ field | typename }}
```

Also, for every pydsdl type there is a test automatically appended to the global environment. This means you can do:

```
% if field is IntegerType %
    // stuff for integer fields
% endif %
```

Finally, for every pydsdl object that ends in "Type" or "Field" a lower-case name ommitting these suffixes is made available. For example:

```
template = '{% if some_type is integer %}This is a pydsdl.IntegerType{% endif %}'
```

2.1.6 Named Types

Some language provide named types to allow templates to use a type without making concrete decisions about the headers and conventions in use. For example, when using C it is common to use size_t as an unsigned, integer length type. To avoid hard-coding this type a C template can use the named type:

```
{{ typename_unsigned_length }} array_len;
```

Named Types by Language

Type name	Language(s)	Use
typename_unsigned_length	C, C++	An unsigned integer type suitable for expressing the length of any valid type on the local system.
typename_byte	C	An unsigned integer type used to represent a single byte (8-bits).

2.1.7 Named Values

Some languages can use different values to represent certain data like null references or boolean values. Named values allow templates to insert a token appropriate for the language and configurable by the generator in use. For example:

```
MyType* p = {{ valuetoken_null }};
```

Named Values by Language

Value name	Language(s)
valuetoken_true	C
valuetoken_false	C
valuetoken_null	C

2.1.8 Language Options

The target language for a template contributes options to the template globals. These options can be invented by users of the Nunavut library but a built-in set of defaults exists.

All language options are made available as globals within the *options* namespace. For example, a language option "target_arch" would be available as the "options.target_arch" global in templates.

For options that do not come with built-in defaults you'll need to test if the option is available before you use it. For example:

```
# This will throw an exception
template = '{% if options.foo %}bar{% endif %}'
```

Use the built-in test `defined` to avoid these exceptions:

```
# Avoid the exception
template = '{% if options.foo is defined and options.foo %}bar{% endif %}'
```

Language Options with Built-in Defaults

The following options have built-in defaults for certain languages. These options will always be defined in templates targeting their languages.

options.target_endianness

This option is currently defined for C and C++; the possible values are as follows:

- `any` — generate endianness-agnostic code that is compatible with big-endian and little-endian machines alike.
- `big` — generate code optimized for big-endian platforms only. Implementations may treat this option like `any` when no such optimizations are possible.
- `little` — generate code optimized for little-endian platforms only. Little-endian optimizations are made possible by the fact that DSDL is a little-endian format.

```
template = '{{ options.target_endianness }}'

# then
rendered = 'any'
```

2.1.9 Filters

Common Filters

nunavut.jinja.DSDLCodeGenerator.**filter_yamlfy**(*value: Any*) → str

Filter to, optionally, emit a dump of the dsdl input as a yaml document. Available as `yamlfy` in all template environments.

Example:

```
/*
{{ T | yamlfy }}
*/
```

Result Example (truncated for brevity):

```
/*
!!python/object:pydsdl.StructureType
_attributes:
- !!python/object:pydsdl.Field
_serializable: !!python/object:pydsdl.UnsignedIntegerType
    _bit_length: 16
    _cast_mode: &id001 !!python/object/apply:pydsdl.CastMode
    - 0
_name: value
*/
```

Parameters **value** – The input value to parse as yaml.

Returns If a yaml parser is available, a pretty dump of the given value as yaml. If a yaml parser is not available then an empty string is returned.

nunavut.jinja.DSDLCodeGenerator.**filter_type_to_template**(*self*, *value: Any*) → str

Template for type resolution as a filter. Available as `type_to_template` in all template environments.

Example:

```
{%- for attribute in T.attributes %}
    {%* include attribute.data_type | type_to_template %}
```

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```
    {%- if not loop.last %},{% endif %}
{%- endfor %}
```

Parameters **value** – The input value to change into a template include path.

Returns A path to a template named for the type with *TEMPLATE_SUFFIX*

nunavut.jinja.DSDLCodeGenerator.**filter_type_to_include_path**(*self*, *value: Any*, *resolve: bool = False*) → str

Emits an include path to the output target for a given type.

Example:

```
# include "{{ T.my_type | type_to_include_path }}"
```

Result Example:

include “foo/bar/my_type.h”

Parameters

- **value** (*typing.Any*) – The type to emit an include for.
- **resolve** (*bool*) – If True the path returned will be absolute else the path will be relative to the folder of the root namespace.

Returns A string path to output file for the type.

nunavut.jinja.DSDLCodeGenerator.**filter_typename**(*value: Any*) → str

Filters a given token as its type name. Available as `typename` in all template environments.

This example supposes that `T.some_value == "some string"`

Example:

```
{{ T.some_value | typename }}
```

Result Example:

```
str
```

Parameters **value** – The input value to filter into a type name.

Returns The `__name__` of the python type.

nunavut.jinja.DSDLCodeGenerator.**filter_alignment_prefix**(*offset: pydsdl._bit_length_set._bit_length_set.BitLengthSe*) → str

Provides a string prefix based on a given `pydsdl.BitLengthSet`.

```
# Given
B = pydsdl.BitLengthSet(32)

# and
template = '{{ B | alignment_prefix }}'

# then ('str' is stropped to 'str_' before the version is suffixed)
rendered = 'aligned'
```

```
# Given
B = pydsdl.BitLengthSet(32)
B += 1

# and
template = '{{ B | alignment_prefix }}'

# then ('str' is stropped to 'str_' before the version is suffixed)
rendered = 'unaligned'
```

Parameters **offset** (*pydsdl.BitLengthSet*) – A bit length set to test for alignment.

Returns 'aligned' or 'unaligned' based on the state of the `offset` argument.

`nunavut.jinja.DSDLCodeGenerator.`**filter_bit_length_set**(*values: Union[Iterable[int], int, None]*) → pydsdl._bit_length_set._bit_length_set.BitLengthSet

Convert an integer or a list of integers into a `pydsdl.BitLengthSet`.

`nunavut.jinja.DSDLCodeGenerator.`**filter_remove_blank_lines**(*text: str*) → str

Remove blank lines from the supplied string. Lines that contain only whitespace characters are also considered blank.

456

789') == '123 456 789'

`nunavut.jinja.DSDLCodeGenerator.`**filter_bits2bytes_ceil**(*n_bits: int*) → int

Implements `int(ceil(x/8)) | x >= 0`.

Common Tests

`nunavut.jinja.DSDLCodeGenerator.`**is_None**(*value: Any*) → bool

Tests if a value is `None`

`nunavut.jinja.DSDLCodeGenerator.`**is_saturated**(*t: pydsdl._serializable._primitive.PrimitiveType*) → bool

Tests if a type is a saturated type or not.

`nunavut.jinja.DSDLCodeGenerator.`**is_service_request**(*instance: pydsdl._expression._any.Any*) → bool

Tests if a type is request type of a service type.

`nunavut.jinja.DSDLCodeGenerator.`**is_service_response**(*instance: pydsdl._expression._any.Any*) → bool

Tests if a type is response type of a service type.

`nunavut.jinja.DSDLCodeGenerator.`**is_deprecated**(*instance: pydsdl._expression._any.Any*) → bool

Tests if a type is marked as deprecated

C Filters

`nunavut.lang.c.`**filter_id**(*language: nunavut.lang.c.Language*, *instance: Any*, *id_type: str = 'any'*) → str

Filter that produces a valid C identifier for a given object. The encoding may not be reversible.

```
# Given
I = 'I  c'

# and
template = '{{ I | id }}'

# then
rendered = 'I_zX2764_c'
```

```
# Given
I = 'if'

# and
template = '{{ I | id }}'

# then
rendered = '_if'
```

```
# Given
I = '_Reserved'

# and
template = '{{ I | id }}'

# then
rendered = '_reserved'
```

```
# Given
I = 'EMACRO_TOKEN'

# and
template = '{{ I | id("macro") }}'

# then
rendered = '_eMACRO_TOKEN'
```

Parameters

- **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.
- **id_type** (*str*) – A type of identifier. For C this value can be 'typedef', 'macro', 'function', or 'enum'. use 'any' to apply stropping rules for all identifier types to the instance.

Returns A token that is a valid identifier for C, is not a reserved keyword, and is transformed in a deterministic manner based on the provided instance.

nunavut.lang.c.**filter_macrofy**(*language: nunavut.lang.c.Language*, *value: str*) → str

Filter to transform an input into a valid C preprocessor identifier token.

```
# Given
template = '#ifndef {{ "my full name" | macrofy }}'

# then
rendered = '#ifndef MY_FULL_NAME'
```

Note that individual tokens are not stropped so the appearance of an identifier in the

`SCREAMING_SNAKE_CASE` output my be different then the token as it appears on its own. For example:

```
# "register" is reserved so it will be stropped if it appears as an
# identifier...
template = '''#ifndef {{ "namespaced.Type.register" | macrofy }}
{{ "register" | id }}
'''

# ...but it will not be stropped within the macro.
rendered = '''#ifndef NAMESPACED_TYPE_REGISTER
_register
'''
```

If stropping is enabled, however, the entire token generated by this filter will be stropped:

```
# Given
template = '#ifndef {{ "_starts_with_underscore" | macrofy }}'

# then
rendered = '#ifndef _sTARTS_WITH_UNDERSCORE'
```

And again with stropping disabled:

```
# Given
template = '#ifndef {{ "_starts_with_underscore" | macrofy }}'

# then with stropping disabled
rendered = '#ifndef _STARTS_WITH_UNDERSCORE'
```

Parameters **value** (*str*) – The value to transform.

Returns A valid C preprocessor identifier token.

nunavut.lang.c.**filter_type_from_primitive**(*language: nunavut.lang.c.Language*, *value: pydsdl._serializable._primitive.PrimitiveType*) → str

Filter to transform a pydsdl `PrimitiveType` into a valid C type.

```
# Given
template = '{{ unsigned_int_32_type | type_from_primitive }}'

# then
rendered = 'uint32_t'
```

```
# Given
template = '{{ int_64_type | type_from_primitive }}'

# then
rendered = 'int64_t'
```

Parameters **value** (*str*) – The dsdl primitive to transform.

Returns A valid C99 type name.

Raises **RuntimeError** – If the primitive cannot be represented as a standard C type.

nunavut.lang.c.**filter_to_snake_case**(*value: str*) → str

Filter to transform a string into a snake-case token.

```
# Given
template = '{{ "scotec.mcu.Timer" | to_snake_case }} a();'

# then
rendered = 'scotec_mcu_timer a();'
```

```
# Given
template = '{{ "scotec.mcu.TimerHelper" | to_snake_case }} b();'

# then
rendered = 'scotec_mcu_timer_helper b();'
```

```
# and Given
template = '{{ "SCOTEC_MCU_TimerHelper" | to_snake_case }} b();'

# then
rendered = 'scotec_mcu_timer_helper b();'
```

Parameters **value** (*str*) – The string to transform into C snake-case.

Returns A valid C99 token using the snake-case convention.

nunavut.lang.c.**filter_to_screaming_snake_case**(*value: str*) → str

Filter to transform a string into a SCREAMING_SNAKE_CASE token.

```
# Given
template = '{{ "scotec.mcu.Timer" | to_screaming_snake_case }} a();'

# then
rendered = 'SCOTEC_MCU_TIMER a();'
```

nunavut.lang.c.**filter_to_template_unique_name**(*_: Any*, *base_token: str*) → str

Filter that takes a base token and forms a name that is very likely to be unique within the template the filter is invoked. This name is also very likely to be a valid C identifier.

Important: The exact tokens generated may change between major or minor versions of this library. The only guarantee provided is that the tokens will be stable for the same version of this library given the same input.

Also note that name uniqueness is only likely within a given template. Between templates there is no guarantee of uniqueness and, since this library does not lex generated source, there is no guarantee that the generated name does not conflict with a name generated by another means.

```
# Given
template  = '{{ "foo" | to_template_unique_name }},{{ "Foo" | to_template_unique_
↪name }},'
template += '{{ "fOO" | to_template_unique_name }}'

# then
rendered = '_foo0_,_foo1_,_fOO0_'
```

```
# Given
template = '{{ "i like coffee" | to_template_unique_name }}'

# then
rendered = '_i like coffee0_'
```

Parameters **base_token** (*str*) – A token to include in the base name.

Returns A name that is likely to be valid C identifier and is likely to be unique within the file generated by the current template.

nunavut.lang.c.**filter_short_reference_name**(*language: nunavut.lang.c.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is a shorted version of the full reference name.

```
# Given a type with illegal C characters
my_type.short_name = '_Foo'
my_type.version.major = 1
my_type.version.minor = 2

# and
template = '{{ my_type | short_reference_name }}'

# then, with stropping enabled
rendered = '_foo_1_2'
```

With stropping disabled:

```
rendered = '_Foo_1_2'
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the reference name for.

nunavut.lang.c.**filter_includes**(*language: nunavut.lang.c.Language*, *t: pydsdl._serializable._composite.CompositeType*, *sort: bool = True*) → List[str]

Returns a list of all include paths for a given type.

```
# Listing the includes for a union with only integer types:
template = '''{% for include in my_type | includes -%}
{{include}}
{% endfor %}'''

# stdint.h will normally be generated
rendered = '''<stdint.h>
<stdlib.h>
'''
```

```
# You can suppress std includes by setting use_standard_types to False under
# nunavut.lang.c
rendered = ''
```

Parameters

- **t** (*pydsdl.CompositeType*) – The type to scan for dependencies.
- **sort** (*bool*) – If true the returned list will be sorted.

Returns a list of include headers needed for a given type.

nunavut.lang.c.**filter_to_static_assertion_value**(*obj: Any*) → int

Tries to convert a Python object into a value compatible with static comparisons in C. This allows stable comparison of static values in headers to promote consistency and version compatibility in generated code.

Will raise a ValueError if the object provided does not (yet) have an available conversion in this function.

Currently supported types are string:

```
# given
template = '{{ "Any" | to_static_assertion_value }}'

# then
rendered = '1556001108'
```

int:

```
# given
template = '{{ 123 | to_static_assertion_value }}'

# then
rendered = '123'
```

and bool:

```
# given
template = '{{ True | to_static_assertion_value }}'

# then
rendered = '1'
```

nunavut.lang.c.**filter_constant_value**(*language: nunavut.lang.c.Language*, *constant: pydsdl._serializable._attribute.Constant*) → str

Renders the specified constant as a literal. This is a shorthand for *filter_literal()*.

```
# given
template = '{{ my_true_constant | constant_value }}'

# then
rendered = 'true'
```

Language configuration can control the output of some constant tokens. For example, to use non-standard true and false values in c:

```
# given
template = '{{ my_true_constant | constant_value }}'

# then, if true = 'NUNAVUT_TRUE' in the named_values for nunavut.lang.c
rendered = 'NUNAVUT_TRUE'
```

Floating point values are converted as fractions to ensure no python-specific transformations are applied:

```
# given a float value using a fraction of 355/113
template = '{{ almost_pi | constant_value }}'

# ...the rendered value with include that fraction as a division statement.
rendered = '((float) (355.0 / 113.0))'
```

nunavut.lang.c.**filter_literal**(*language: nunavut.lang.c.Language*, *value: Union[fractions.Fraction, bool, int]*, *ty: pydsdl._expression._any.Any*, *cast_format: Optional[str] = None*) → str

Renders the specified value of the specified type as a literal.

nunavut.lang.c.**filter_full_reference_name**(*language: nunavut.lang.c.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is the full namespace, typename, major, and minor version for a given composite type.

```
# Given a type with illegal characters for C++
my_obj.full_name = 'any.int.2Foo'
my_obj.full_namespace = 'any.int'
my_obj.version.major = 1
my_obj.version.minor = 2

# and
template = '{{ my_obj | full_reference_name }}'

# then, with stropping enabled
rendered = 'any_int_2Foo_1_2'
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the fully-resolved reference name for.

nunavut.lang.c.**filter_to_standard_bit_length**(*t: pydsdl._serializable._primitive.PrimitiveType*) → int

Returns the nearest standard bit length of a type as an int.

```
# Given
I = pydsdl.UnsignedIntegerType(7, pydsdl.PrimitiveType.CastMode.TRUNCATED)

# and
template = '{{ I | to_standard_bit_length }}'

# then
rendered = '8'
```

C Tests

nunavut.lang.c.**is_zero_cost_primitive**(*language: nunavut.lang.c.Language*, *t: pydsdl._serializable._primitive.PrimitiveType*) → bool

Assuming that the target platform is IEEE754-conformant detects whether the native in-memory representation of a value of the supplied primitive type is the same as its on-the-wire representation defined by the DSDL Specification.

For instance; all little-endian, IEEE754-conformant platforms have compatible in-memory representations of int8, int16, int32, int64, uint8, uint16, uint32, uint64, float32, float64. Values of other primitive types typically require some transformations (e.g., float16).

It follows that arrays, certain composite types, and some other entities composed of zero-cost composites are also zero-cost types, but such non-trivial conjectures are not recognized by this function.

Raises a `TypeError` if the argument is not a value of type `pydsdl.PrimitiveType`.

```
# Given
i7  = pydsdl.SignedIntegerType(7, pydsdl.PrimitiveType.CastMode.SATURATED)
u32 = pydsdl.UnsignedIntegerType(32, pydsdl.PrimitiveType.CastMode.TRUNCATED)
f16 = pydsdl.FloatType(16, pydsdl.PrimitiveType.CastMode.TRUNCATED)
f32 = pydsdl.FloatType(32, pydsdl.PrimitiveType.CastMode.SATURATED)
b1  = pydsdl.BooleanType(pydsdl.PrimitiveType.CastMode.SATURATED)
```

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```
# and
template = (
    '{{ i7  is zero_cost_primitive }} '
    '{{ u32 is zero_cost_primitive }} '
    '{{ f16 is zero_cost_primitive }} '
    '{{ f32 is zero_cost_primitive }} '
    '{{ bl is zero_cost_primitive }}'
)

# then
rendered = 'False True False True False'
```

C++ Filters

nunavut.lang.cpp.**filter_id**(*language: nunavut.lang.cpp.Language*, *instance: Any*, *id_type: str = 'any'*) → str

Filter that produces a valid C and/or C++ identifier for a given object. The encoding may not be reversible.

```
# Given
I = 'I like c++'

# and
template = '{{ I | id }}'

# then
rendered = 'I_like_czX002BzX002B'
```

```
# Given
I = 'if'

# and
template = '{{ I | id }}'

# then
rendered = '_if'
```

```
# Given
I = 'I   really like     coffee'

# and
template = '{{ I | id }}'

# then
rendered = 'I_really_like_coffee'
```

Parameters **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.

Returns A token that is a valid identifier for C and C++, is not a reserved keyword, and is transformed in a deterministic manner based on the provided instance.

nunavut.lang.cpp.**filter_open_namespace**(*language: nunavut.lang.cpp.Language*, *full_namespace: str*, *bracket_on_next_line: bool = True*, *linesep: str = '\n'*) → str

Emits c++ opening namespace syntax parsed from a pydsdl "full_namespace", dot-separated value.

```
# Given
T.full_namespace = 'uavcan.foo'

# and
template = '{{ T.full_namespace | open_namespace }}'

# then
rendered = '''namespace uavcan
{
namespace foo
{'''
```

Parameters

- **full_namespace** (*str*) – A dot-separated namespace string.
- **bracket_on_next_line** (*bool*) – If True (the default) then the opening brackets are placed on a newline after the namespace keyword.
- **linesep** (*str*) – The line-separator to use when emitting new lines. By default this is `\n`.

Returns C++ namespace declarations with opening brackets.

nunavut.lang.cpp.**filter_close_namespace**(*language: nunavut.lang.cpp.Language*, *full_namespace: str*, *omit_comments: bool = False*, *linesep: str = '\n'*) → str

Emits c++ closing namespace syntax parsed from a pydsdl "full_namespace", dot-separated value.

```
# Given
T.full_namespace = 'uavcan.foo'

# and
template = '{{ T.full_namespace | close_namespace }}'

# then
rendered = '''} // namespace foo
} // namespace uavcan'''
```

Parameters

- **full_namespace** (*str*) – A dot-separated namespace string.
- **omit_comments** (*bool*) – If True then the comments following the closing bracket are omitted.
- **linesep** (*str*) – The line-separator to use when emitting new lines. By default this is `\n`

Returns C++ namespace declarations with opening brackets.

nunavut.lang.cpp.**filter_full_reference_name**(*language: nunavut.lang.cpp.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is the full namespace, typename, major, and minor version for a given composite type.

```
# Given a type with illegal characters for C++
my_obj.full_name = 'any.int.2Foo'
my_obj.version.major = 1
my_obj.version.minor = 2
```

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```
# and
template = '{{ my_obj | full_reference_name }}'

# then, with stropping enabled
rendered = 'any::_int::_2Foo_1_2'
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the fully-resolved reference name for.

nunavut.lang.cpp.**filter_short_reference_name**(*language: nunavut.lang.cpp.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is a shorted version of the full reference name. This type is unique only within its namespace.

```
# Given a type with illegal C++ characters
my_type.short_name = '2Foo'
my_type.version.major = 1
my_type.version.minor = 2

# and
template = '{{ my_type | short_reference_name }}'

# then, with stropping enabled
rendered = '_2Foo_1_2'
```

```
# Given a type with legal C++ characters
my_type.short_name = 'Struct_'
my_type.version.major = 0
my_type.version.minor = 1

# and
template = '{{ my_type | short_reference_name }}'

# then, with stropping enabled
rendered = 'Struct__0_1'
```

```
# Given a service type
my_service_type.short_name = 'Struct_'
my_service_type.version.major = 0
my_service_type.version.minor = 1

# and
template = '''
{{ my_service_type | short_reference_name }}
{{ my_service_type.request_type | short_reference_name }}
{{ my_service_type.response_type | short_reference_name }}
'''

# then, with stropping enabled
rendered = '''
Struct_
Request_0_1
Response_0_1
'''
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the reference name for.

nunavut.lang.cpp.**filter_includes**(*language: nunavut.lang.cpp.Language*, *t: pydsdl._serializable._composite.CompositeType*, *sort: bool = True*) → List[str]

Returns a list of all include paths for a given type.

Parameters

- **t** (*pydsdl.CompositeType*) – The type to scan for dependencies.
- **sort** (*bool*) – If true the returned list will be sorted.

Returns a list of include headers needed for a given type.

nunavut.lang.cpp.**filter_destructor_name**(*language: nunavut.lang.cpp.Language*, *instance: pydsdl._expression._any.Any*) → str

Returns a token that is the local destructor name. For example:

```
# Given a pydsdl.FixedLengthArrayType "my_type":
my_type.short_name = 'Foo'
my_type.capacity = 2

# and
template = 'ptr->{{ my_type | destructor_name }}'

# then
rendered = 'ptr->~array<std::uint8_t,2>'
```

Parameters **t** (*pydsdl.CompositeType*) – The type to generate a destructor template for.

Returns A destructor name token.

nunavut.lang.cpp.**filter_declaration**(*language: nunavut.lang.cpp.Language*, *instance: pydsdl._expression._any.Any*) → str

Emit a declaration statement for the given instance.

nunavut.lang.cpp.**filter_definition_begin**(*language: nunavut.lang.cpp.Language*, *instance: pydsdl._serializable._composite.CompositeType*) → str

Emit the start of a definition statement for a composite type.

```
# Given a pydsdl.CompositeType "my_type":
my_type.short_name = 'Foo'
my_type.version.major = 1
my_type.version.minor = 0

# and
template = '{{ my_type | definition_begin }}'

# then
rendered = 'struct Foo_1_0'
```

```
# Also, given a pydsdl.UnionType "my_union_type":
my_union_type.short_name = 'Foo'
my_union_type.version.major = 1
my_union_type.version.minor = 0

# and
```

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```
union_template = '{{ my_union_type | definition_begin }}'

# then
rendered = 'struct Foo_1_0'
```

```
# Finally, given a pydsdl.ServiceType "my_service_type":
my_service_type.short_name = 'Foo'
my_service_type.version.major = 1
my_service_type.version.minor = 0

# and
template = '''
{{ my_service_type | definition_begin }};
{{ my_service_type.request_type | definition_begin }};
{{ my_service_type.response_type | definition_begin }};
'''

# then
rendered = '''
namespace Foo;
struct Request_1_0;
struct Response_1_0;
'''
```

nunavut.lang.cpp.**filter_definition_end**(*language: nunavut.lang.cpp.Language*, *instance: pydsdl._serializable._composite.CompositeType*) → str

Emit the end of a definition statement for a composite type.

nunavut.lang.cpp.**filter_to_namespace_qualifier**(*namespace_list: List[str]*) → str

Converts a list of namespace names into a qualifier string. For example:

```
my_namespace = ['foo', 'bar']
template = '{{ my_namespace | to_namespace_qualifier }}myType()'
expected = 'foo::bar::myType()'
```

This filter gracefully handles empty namespace lists:

```
my_namespace = []
template = '{{ my_namespace | to_namespace_qualifier }}myType()'
expected = 'myType()'
```

nunavut.lang.cpp.**filter_type_from_primitive**(*language: nunavut.lang.cpp.Language*, *value: pydsdl._serializable._primitive.PrimitiveType*) → str

Filter to transform a pydsdl `PrimitiveType` into a valid C++ type.

```
# Given
template = '{{ unsigned_int_32_type | type_from_primitive }}'

# then
rendered = 'std::uint32_t'
```

Also note that this is sensitive to the `use_standard_types` configuration in the language properties:

```
# rendered will be different if use_standard_types is False
rendered = 'unsigned long'
```

Parameters **value** (*str*) – The dsdl primitive to transform.

Returns A valid C++ type name.

Raises **TemplateRuntimeError** – If the primitive cannot be represented as a standard C++ type.

nunavut.lang.cpp.**filter_to_template_unique_name**(*base_token: str*) → str

Filter that takes a base token and forms a name that is very likely to be unique within the template the filter is invoked. This name is also very likely to be a valid C++ identifier.

Important: The exact tokens generated may change between major or minor versions of this library. The only guarantee provided is that the tokens will be stable for the same version of this library given the same input.

Also note that name uniqueness is only likely within a given template. Between templates there is no guarantee of uniqueness and, since this library does not lex generated source, there is no guarantee that the generated name does not conflict with a name generated by another means.

```
# Given
template  = '{{ "foo" | to_template_unique_name }},{{ "Foo" | to_template_unique_
↪name }},'
template += '{{ "fOO" | to_template_unique_name }}'

# then
rendered = '_foo0_,_foo1_,_fOO0_'
```

```
# Given
template = '{{ "i like coffee" | to_template_unique_name }}'

# then
rendered = '_i like coffee0_'
```

Parameters **base_token** (*str*) – A token to include in the base name.

Returns A name that is likely to be valid C++ identifier and is likely to be unique within the file generated by the current template.

nunavut.lang.cpp.**filter_as_boolean_value**(*value: bool*) → str

Filter a boolean expression to produce a valid C++ “true” or “false” token.

```
assert "true" == filter_as_boolean_value(True)
assert "false" == filter_as_boolean_value(False)
```

nunavut.lang.cpp.**filter_indent_if_not**(*language: nunavut.lang.cpp.Language*, *text: str*, *depth: int = 1*) → str

Emit indent characters as configured for the language but only as needed. This is different from the built-in indent filter in that it may add or remove spaces based on the existing indent.

```
# Given a string with an existing indent of 4 spaces...
template  = '{{ "    int a = 1;" | indent_if_not }}'

# then if cpp.indent == 4 we expect no change.
rendered = '    int a = 1;'
```

```
# If the indent is only 3 spaces...
template  = '{{ "   int a = 1;" | indent_if_not }}'

# then if cpp.indent == 4 we expect 4 spaces (i.e. not 7 spaces)
rendered = '    int a = 1;'
```

```
# We can also specify multiple indents...
template  = '{{ "int a = 1;" | indent_if_not(2) }}'

rendered = '        int a = 1;'
```

```
# ...or no indent
template  = '{{ "    int a = 1;" | indent_if_not(0) }}'

rendered = 'int a = 1;'
```

```
# Finally, note that blank lines are not indented.
template  = '''
    {%- set block_text -%}
        int a = 1;
        {# empty line #}
        int b = 2;
    {%- endset -%}{{ block_text | indent_if_not(1) }}'''

rendered  = '    int a = 1;'
rendered += '\n'
rendered += '\n'  # Nothing but spaces so this is stripped
rendered += '    int b = 2;'
```

Parameters

- **text** – The text to indent.
- **depth** – The number of indents. For example, if depth is 2 and the indent for this language is 4 spaces then the text will be indented by 8 spaces.

nunavut.lang.cpp.**filter_minimum_required_capacity_bits**(*t: pydsdl._serializable._serializable.SerializableType*) → int

Returns the minimum number of bits required to store the deserialized value of a pydsdl `SerializableType`. This capacity may be too small for some instances of the value (e.g. variable length arrays).

```
# Given
template = '{{ unsigned_int_32_type | minimum_required_capacity_bits }}'

# then
rendered = '32'
```

Parameters **t** (*pydsdl.SerializableType*) – The dsdl type.

Returns The minimum, required bits needed to store some values of the given type.

nunavut.lang.cpp.**filter_block_comment**(*language: nunavut.lang.cpp.Language*, *text: str*, *style: str*, *indent: int = 0*, *line_length: int = 100*) → str

Reformats text as a block comment using Python's `textwrap.TextWrapper.wrap()` function.

Parameters

- **text** – The text to emit as a block comment.
- **style** – Dictates the style of comments (see return documentation for valid style names).
- **indent** – The number of spaces to indent the comments by (tab indent is not supported. Sorry).
- **line_length** – The soft maximum width to wrap text at. Some violations may occur where long words are used.

Returns str A comment block. Comment styles supported are:

javadoc

```
# Given a type with the following docstring
text = 'This is a bunch of documentation.'

# and
template = '''
    {{ text | block_comment('javadoc', 4, 24) }}
    void some_method();
'''

# the output will be
rendered = '''
    /**
     * This is a bunch
     * of documentation.
     */
    void some_method();
'''
```

cpp-doxygen

```
# that same template using the cpp style of doxygen...
template = '''
    {{ text | block_comment('cpp-doxygen', 4, 24) }}
    void some_method();
'''

# ...will be
rendered = '''
    ///
    /// This is a bunch
    /// of
    /// documentation.
    ///
    void some_method();
'''
```

cpp

```
# also supported is cpp style...
template = '''
    {{ text | block_comment('cpp', 4, 24) }}
    void some_method();
'''

rendered = '''
    // This is a bunch of
```

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```
    // documentation.
    void some_method();
'''
```

c

```
# c style...
template = '''
    {{ text | block_comment('c', 4, 24) }}
    void some_method();
'''

rendered = '''
    /*
     * This is a bunch
     * of documentation.
     */
    void some_method();
'''
```

qt

```
# and Qt style...
template = '''
    {{ text | block_comment('qt', 4, 24) }}
    void some_method();
'''

rendered = '''
    /*!
     * This is a bunch
     * of documentation.
     */
    void some_method();
'''
```

C++ Use Queries

nunavut.lang.cpp.**uses_std_variant**(*language: nunavut.lang.cpp.Language*) → bool

Uses query for std variant.

If the language options contain an `std` entry for C++ and the specified standard includes the `std::variant` type added to the language at C++17 then this value is true. The logic included in this filter can be stated as "options has key std and the value for options.std evaluates to C++ version 17 or greater" but the implementation is able to parse out actual compiler flags like `gnu++20` and is aware of any overrides to suppress use of the standard variant type even if available.

Example:

```
template = '''
    {%- ifuses "std_variant" -%}
        #include <variant>
    {%- else -%}
        #include "user_variant.h"
    {%- endifuses -%}
'''
```

Python Filters

nunavut.lang.py.**filter_id**(*language: nunavut.lang.py.Language*, *instance: Any*, *id_type: str = 'any'*) → str

Filter that produces a valid Python identifier for a given object. The encoding may not be reversible.

```
# Given
I = 'I like python'

# and
template = '{{ I | id }}'

# then
rendered = 'I_like_python'
```

```
# Given
I = '&because'

# and
template = '{{ I | id }}'

# then
rendered = 'zX0026because'
```

```
# Given
I = 'if'

# and
template = '{{ I | id }}'

# then
rendered = 'if_'
```

Parameters **instance** (*any*) – Any object or data that either has a name property or can be converted to a string.

Returns A token that is a valid Python identifier, is not a reserved keyword, and is transformed in a deterministic manner based on the provided instance.

nunavut.lang.py.**filter_to_template_unique_name**(*context: nunavut.templates.SupportsTemplateContext*, *base_token: str*) → str

Filter that takes a base token and forms a name that is very likely to be unique within the template the filter is invoked. This name is also very likely to be a valid Python identifier.

Important: The exact tokens generated may change between major or minor versions of this library. The only guarantee provided is that the tokens will be stable for the same version of this library given the same input.

Also note that name uniqueness is only likely within a given template. Between templates there is no guarantee of uniqueness and, since this library does not lex generated source, there is no guarantee that the generated name does not conflict with a name generated by another means.

```
# Given
template  = '{{ "f" | to_template_unique_name }},{{ "f" | to_template_unique_name␣
↪}},'
template += '{{ "f" | to_template_unique_name }},{{ "bar" | to_template_unique_
↪name }}'
```

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```
# then
rendered = '_f0_,_f1_,_f2_,_bar0_'
```

```
# Given
template = '{{ "i like coffee" | to_template_unique_name }}'

# then
rendered = '_i like coffee0_'
```

Parameters **base_token** (*str*) – A token to include in the base name.

Returns A name that is likely to be valid python identifier and is likely to be unique within the file generated by the current template.

nunavut.lang.py.**filter_full_reference_name**(*language: nunavut.lang.py.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is the full namespace, typename, major, and minor version for a given composite type.

```
# Given
full_name = 'any.str.2Foo'
major = 1
minor = 2

# and
template = '{{ my_obj | full_reference_name }}'

# then
rendered = 'any_.str_.zX0032Foo_1_2'
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the fully-resolved reference name for.

nunavut.lang.py.**filter_short_reference_name**(*language: nunavut.lang.py.Language*, *t: pydsdl._serializable._composite.CompositeType*) → str

Provides a string that is a shorted version of the full reference name. This type is unique only within its namespace.

```
# Given
short_name = '2Foo'
major = 1
minor = 2

# and
template = '{{ my_obj | short_reference_name }}'

# then
rendered = 'zX0032Foo_1_2'
```

Parameters **t** (*pydsdl.CompositeType*) – The DSDL type to get the reference name for.

nunavut.lang.py.**filter_imports**(*language: nunavut.lang.py.Language*, *t: pydsdl._serializable._composite.CompositeType*, *sort: bool = True*) → List[str]

Returns a list of all modules that must be imported to use a given type.

Parameters

- **t** (*pydsdl.CompositeType*) – The type to scan for dependencies.
- **sort** (*bool*) – If true the returned list will be sorted.

Returns a list of python module names the provided type depends on.

nunavut.lang.py.**filter_longest_id_length**(*language: nunavut.lang.py.Language, attributes: List[pydsdl._serializable._attribute.Attribute]*) → int

Return the length of the longest identifier in a list of `pydsdl.Attribute` objects.

```
# Given
I = ['one.str.int.any', 'three.str.int.any']

# and
template = '{{ I | longest_id_length }}'

# then
rendered = '32'
```

HTML Filters

nunavut.lang.html.**filter_extent**(*instance: pydsdl._expression._any.Any*) → int

nunavut.lang.html.**filter_max_bit_length**(*instance: pydsdl._expression._any.Any*) → int

nunavut.lang.html.**filter_tag_id**(*instance: pydsdl._expression._any.Any*) → str

nunavut.lang.html.**filter_url_from_type**(*instance: pydsdl._expression._any.Any*) → str

nunavut.lang.html.**filter_make_unique**(*_: Any*, *base_token: str*) → str

Filter that takes a base token and forms a name that is very likely to be unique within the template the filter is invoked.

Important: The exact tokens generated may change between major or minor versions of this library. The only guarantee provided is that the tokens will be stable for the same version of this library given the same input.

Also note that name uniqueness is only likely within a given template. Between templates there is no guarantee of uniqueness and, since this library does not lex generated source, there is no guarantee that the generated name does not conflict with a name generated by another means.

```
# Given
template  = '{{ "foo" | make_unique }},{{ "Foo" | make_unique }},'
template += '{{ "fOO" | make_unique }}'

# then
rendered = 'foo0,foo1,fOO0'
```

```
# Given
template = '{{ "coffee > tea" | make_unique }}'
```

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(continued from previous page)

```
# then
rendered = 'coffee &gt; tea0'
```

Parameters **base_token** (*str*) – A token to include in the base name.

Returns A name that is likely to be unique within the file generated by the current template.

nunavut.lang.html.**filter_namespace_doc**(*ns: nunavut.Namespace*) → str

nunavut.lang.html.**filter_display_type**(*instance: pydsdl._expression._any.Any*) → str

nunavut.lang.html.**filter_natural_sort_namespace**(*instance: List[pydsdl._expression._any.Any]*) → List[pydsdl._expression._any.Any]

Namespaces come in plain lists; sort by name only.

nunavut.lang.html.**filter_natural_sort_type**(*instance: pydsdl._expression._any.Any*) → List[pydsdl._expression._any.Any]

Types come in tuples (type, path). Sort by type name.

2.2 Template Mapping and Use

Templates are resolved as `templates/path/[dsdl_typename].j2` This means you must, typically, start with four templates under the templates directory given to the `Generator` instance

```
ServiceType.j2
StructureType.j2
DelimitedType.j2
UnionType.j2
```

Note: You can chose to use a single template `Any.j2` but this may lead to more complex templates with many more control statements. By providing discreet templates named for top-level data types and using jinja template inheritance and includes your templates will be smaller and easier to maintain.

To share common formatting for these templates use Jinja template inheritance. For example, given a template `common_header.j2`:

```
/*
 * UAVCAN data structure definition for nunavut.
 *
 * Auto-generated, do not edit.
 *
 * Source file: {{T.source_file_path.as_posix()}}
 * Generated at: {{now_utc}}
 * Template: {{ self._TemplateReference__context.name }}
 * deprecated: {{T.deprecated}}
 * fixed_port_id: {{T.fixed_port_id}}
 * full_name: {{T.full_name}}
 * full_namespace: {{T.full_namespace}}
 */

 #ifndef {{T.full_name | ln.c.macrofy}}
```

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```
#define {{T.full_name | ln.c.macrofy}}

{%- block contents %}{% endblock -%}

#endif // {{T.full_name | ln.c.macrofy}}

/*
{{ T | yamlfy }}
*/
```

. . . your three top-level templates would each start out with something like this:

```
{% extends "common_header.j2" %}
{% block contents %}
// generate stuff here
{% endblock %}
```

2.2.1 Resolving Types to Templates

You can apply the same logic used by the top level generator to recursively include templates by type if this seems useful for your project. Simply use the `nunavut.jinja.Generator.filter_type_to_template()` filter:

```
{%- for attribute in T.attributes %}
    {%* include attribute.data_type | type_to_template %}
{%- endfor %}
```

2.2.2 Namespace Templates

If the `generate_namespace_types` parameter of `Generator` is `YES` then the generator will always invoke a template for the root namespace and all nested namespaces regardless of language. `NO` suppresses this behavior and `DEFAULT` will choose the behavior based on the target language. For example:

```
root_namespace = build_namespace_tree(compound_types,
                                      root_ns_folder,
                                      out_dir,
                                      language_context)

generator = Generator(root_namespace, YesNoDefault.DEFAULT)
```

Would generate python `__init__.py` files to define each namespace as a python module but would not generate any additional headers for C++.

The `Generator` will use the same template name resolution logic as used for pydsdl data types. For namespaces this will resolve first to a template named `Namespace.j2` and then, if not found, `Any.j2`.

2.2.3 Internals

Nunavut reserves all global identifiers that start with *_nv_* as private internal globals.

2.3 Built-in Template Guide

This section will contain more information as the project matures about the build-in language support for generating code. Nunavut is both a framework that allows users to write their own dsdl transformation templates but also works, out-of-the-box, as a transplier for C, and C++. More languages may be added in the future.

2.3.1 C++

Note: C++ support is currently experimental. You can only use this by setting the `--experimental-languages` flag when invoking nnvg.

2.3.2 C

Note: Documentation is provided in the generated source.

Manual Override of Array Capacity

By default, the C structures generated will utilize C arrays sized by the maximum size of a variable-length array. To override this behavior you can pre-define the `_ARRAY_CAPACITY_` for individual fields. For example:

```
#include <stdio.h>

#define reg_drone_service_battery_Status_0_2_cell_voltages_ARRAY_CAPACITY_ 6
#include "inc/UAVCAN/reg/drone/service/battery/Status_0_2.h"

int main(int argc, char *argv[])
{
    reg_drone_service_battery_Status_0_2 msg;
    printf("Size of reg_drone_service_battery_Status_0_2 %li\n", sizeof(msg));
}
```

CHAPTER 3

nnvg

3.1 Usage

Generate code from UAVCAN DSDL using pydsdl and jinja2

```
usage: nnvg [-h] [--lookup-dir LOOKUP_DIR] [--verbose] [--version]
            [--outdir OUTDIR] [--templates TEMPLATES]
            [--target-language TARGET_LANGUAGE] [--experimental-languages]
            --output-extension OUTPUT_EXTENSION [--dry-run] [--list-outputs]
            [--generate-support {always,never,as-needed,only}] [--list-inputs]
            [--generate-namespace-types] [--omit-serialization-support]
            [--namespace-output-stem NAMESPACE_OUTPUT_STEM] [--no-overwrite]
            [--file-mode FILE_MODE] [--trim-blocks] [--lstrip-blocks]
            [--allow-unregulated-fixed-port-id]
            [--pp-max-emptylines PP_MAX_EMPTYLINES]
            [--pp-trim-trailing-whitespace] [-pp-rp PP_RUN_PROGRAM]
            [-pp-rpa PP_RUN_PROGRAM_ARG]
            [--target-endianness {any,big,little}]
            [--omit-float-serialization-support]
            [--enable-serialization-asserts]
            [--enable-override-variable-array-capacity]
            [--language-standard LANGUAGE_STANDARD]
            [root_namespace]
```

3.1.1 Positional Arguments

root_namespace A source directory with DSDL definitions.

Default: “.”

3.1.2 Named Arguments

--lookup-dir, -I List of other namespace directories containing data type definitions that are referred to from the target root namespace. For example, if you are reading a vendor-specific namespace, the list of lookup directories should always include a path to the standard root namespace "uavcan", otherwise the types defined in the vendor-specific namespace won't be able to use data types from the standard namespace.

Additional directories can also be specified through the environment variable DSDL_INCLUDE_PATH, where the path entries are separated by colons ":" on posix systems and ";" on Windows.

Default: []

--verbose, -v verbosity level (-v, -vv)

--version show program's version number and exit

--outdir, -O output directory

Default: "nunavut_out"

--templates Paths to a directory containing templates to use when generating code.

Templates found under these paths will override the built-in templates for a given language. If no target language was provided and no template paths were provided then no source will be generated.

--target-language, -l Language support to install into the templates.

If provided then the output extension (–e) can be inferred otherwise the output extension must be provided.

--experimental-languages, -Xlang Activate languages with unstable, experimental support.

By default, target languages where support is not finalized are not enabled when running nunavut, to make it clear that the code output may change in a non-backwards-compatible way in future versions, or that it might not even work yet.

Default: False

--output-extension, -e The extension to use for generated files.

--dry-run, -d If True then no files will be generated.

Default: False

--list-outputs Emit a semicolon-separated list of files. (implies –dry-run) Emits files that would be generated if invoked without –dry-run. This command is useful for integrating with CMake and other build systems that need a list of targets to determine if a rebuild is necessary.

Default: False

--generate-support Possible choices: always, never, as-needed, only

Change the criteria used to enable or disable support code generation.

as-needed (default) - generate support code if serialization is enabled. always - always generate support code. never - never generate support code. only - only generate support code.

Default: "as-needed"

--list-inputs Emit a semicolon-separated list of files. (implies –dry-run) A list of files that are resolved given input arguments like templates. This command is useful for integrating with CMake and other build systems that need a list of inputs to determine if a rebuild is necessary.

Default: False

--generate-namespace-types If enabled this script will generate source for namespaces. All namespaces including and under the root namespace will be treated as a pseudo-type and the appropriate template will be used. The generator will first look for a template with the stem "Namespace" and will then use the "Any" template if that is available. The name of the output file will be the default value for the –namespace-output-stem argument and can be changed using that argument.

Default: False

--omit-serialization-support, -pod If provided then the types generated will be POD datatypes with no additional logic. By default types generated include serialization routines and additional support libraries, headers, or methods.

Default: False

--namespace-output-stem The name of the file generated when –generate-namespace-types is provided.

--no-overwrite By default, generated files will be silently overwritten by subsequent invocations of the generator. If this argument is specified an error will be raised instead preventing overwrites.

Default: False

--file-mode The file-mode each generated file is set to after it is created. Note that this value is interpreted using python auto base detection. Because of this, to provide an octal value, you'll need to prefix your literal with '0o' (e.g. –file-mode 0o664).

Default: 292

--trim-blocks If this is set to True the first newline after a block in a template is removed (block, not variable tag!).

Default: False

--lstrip-blocks If this is set to True leading spaces and tabs are stripped from the start of a line to a block in templates.

Default: False

--allow-unregulated-fixed-port-id Do not reject unregulated fixed port identifiers. This is a dangerous feature that must not be used unless you understand the risks. The background information is provided in the UAVCAN specification.

Default: False

--pp-max-emptylines If provided this will suppress generation of additional consecutive empty lines beyond the limit set by this argument.

Note that this will insert a line post-processor which may reduce performance. Consider using a code formatter on the generated output to enforce whitespace rules instead.

--pp-trim-trailing-whitespace Enables a line post-processor that will elide all whitespace at the end of each line.

Note that this will insert a line post-processor which may reduce performance. Consider using a code formatter on the generated output to enforce whitespace rules instead.

Default: False

-pp-rp, --pp-run-program Runs a program after each file is generated but before the file is set to read-only.

example

```
# invokes clang-format with the "in-place" argument on␣
↪each file after it is
# generated.

nnvg --outdir include --templates c_jinja -e .h --pp-rp␣
↪clang-format --pp-rpa=-i dsdl
```

-pp-rpa, --pp-run-program-arg Additional arguments to provide to the program specified by –pp-run-program. The last argument will always be the path to the generated file.

3.1.3 language options

Options passed through to templates as *language_options* on the target language.

Note that these arguments are passed though without validation, have no effect on the Nunavut library, and may or may not be appropriate based on the target language and generator templates in use.

--target-endianness Possible choices: any, big, little

Specify the endianness of the target hardware. This allows serialization logic to be optimized for different CPU architectures.

--omit-float-serialization-support Instruct support header generators to omit support for floating point operations in serialization routines. This will result in errors if floating point types are used, however; if you are working on a platform without IEEE754 support and do not use floating point types in your message definitions this option will avoid dead code or compiler errors in generated serialization logic.

Default: False

--enable-serialization-asserts Instruct support header generators to generate language-specific assert statements as part of serialization routines. By default the serialization logic generated may make assumptions based on documented requirements for calling logic that could expose a system to undefined behavior. The alternative, for languages that do not support exception handling, is to use assertions designed to halt a program rather than execute undefined logic.

Default: False

--enable-override-variable-array-capacity Instruct support header generators to add the possibility to override max capacity of a variable length array in serialization routines. This option will disable serialization buffer checks and add conditional compilation statements which violates MISRA.

Default: False

--language-standard, -std For language generators that support different standards of their core language this option can be used to optimize the output. For example, C templates may generate slightly different code for the the c99 standard then for c11. For

available support in Nunavut see the documentation for built-in templates (https://nunavut.readthedocs.io/en/latest/docs/templates.html#built-in-template-guide).

Example Usage:

```
# This would include j2 templates for a folder named 'c_jinja'
# and generate .h files into a directory named 'include' using
# dsdl root namespaces found under a folder named 'dsdl'.

nnvg --outdir include --templates c_jinja -e .h dsdl
```

CHAPTER 4

Contributor Notes

Hi! Thanks for contributing. This page contains all the details about getting your dev environment setup.

Note: This is documentation for contributors developing nunavut. If you are a user of this software you can ignore everything here.

- To ask questions about nunavut or Cyphal in general please see the OpenCyphal forum.
- See nunavut on read the docs for the full set of nunavut documentation.
- See the OpenCyphal website for documentation on the Cyphal protocol.

Warning: When committing to main you **must** bump at least the patch number in `src/nunavut/version.py` or the build will fail on the upload step.

4.1 Tools

4.1.1 tox -e local

I highly recommend using the local tox environment when doing python development. It'll save you hours of lost productivity the first time it keeps you from pulling in an unexpected dependency from your global python environment. You can install tox from brew on osx or apt-get on GNU/Linux. I'd recommend the following environment for vscode:

```
git submodule update --init --recursive
tox -e local
source .tox/local/bin/activate
```

4.1.2 cmake

Our language generation verification suite uses CMake to build and run unit tests. If you are working with a native language see *Nunavut Verification Suite* for details on manually running these builds and tests.

4.1.3 Visual Studio Code

To use vscode you'll need:

1. vscode
2. install vscode command line (*Shell Command: Install*)
3. tox
4. cmake (and an available GCC or Clang toolchain, or Docker to use our toolchain-as-container)

Do:

```
cd path/to/nunavut
git submodule update --init --recursive
tox -e local
source .tox/local/bin/activate
code .
```

Then install recommended extensions.

4.2 Running The Tests

To run the full suite of tox tests locally you'll need docker. Once you have docker installed and running do:

```
git submodule update --init --recursive
docker pull uavcan/toxic:py35-py39-sq
docker run --rm -v $PWD:/repo uavcan/toxic:py35-py39-sq tox
```

To run a limited suite using only locally available interpreters directly on your host machine, skip the docker invocations and use `tox -s`.

To run the language verification build you'll need to use a different docker container:

```
docker pull uavcan/c_cpp:ubuntu-20.04
docker run --rm -it -v $PWD:/repo uavcan/c_cpp:ubuntu-20.04
./.github/verify.py -l c
./.github/verify.py -l cpp
```

The verify.py script is a simple commandline generator for our cmake scripts. Use help for details:

```
./.github/verify.py --help
```

4.2.1 Files Generated by the Tests

Given that Nunavut is a file generator our tests do have to write files. Normally these files are temporary and therefore automatically deleted after the test completes. If you want to keep the files so you can debug an issue provide a "keep-generated" argument.

example

```
pytest -k test_namespace_stropping --keep-generated
```

You will see each test's output under "build/(test name}".

Warning: Don't use this option when running tests in parallel. You will get errors.

4.2.2 Sybil Doctest

This project makes extensive use of Sybil doctests. These take the form of docstrings with a structure like thus:

```
.. invisible-code-block: python

    from nunavut.lang.c import filter_to_snake_case

.. code-block:: python

    # an input like this:
    input = "scotec.mcu.Timer"

    # should yield:
    filter_to_snake_case(input)
    >>> scotec_mcu_timer
```

The invisible code block is executed but not displayed in the generated documentation and, conversely, `code-block` is both rendered using proper syntax formatting in the documentation and executed. REPL works the same as it does for `doctest` but `assert` is also a valid way to ensure the example is correct especially if used in a trailing `invisible-code-block`:

```
.. invisible-code-block: python

    assert 'scotec_mcu_timer' == filter_to_snake_case(input)
```

These tests are run as part of the regular pytest build. You can see the Sybil setup in the `conftest.py` found under the `src` directory but otherwise shouldn't need to worry about it. The simple rule is; if the docstring ends up in the rendered documentation then your `code-block` tests will be executed as unit tests.

4.2.3 import file mismatch

If you get an error like the following:

```
_____ ERROR collecting test/gentest_dsdl/test_dsdl.py _____
↪_____
import file mismatch:
imported module 'test_dsdl' has this __file__ attribute:
/my/workspace/nunavut/test/gentest_dsdl/test_dsdl.py
which is not the same as the test file we want to collect:
/repo/test/gentest_dsdl/test_dsdl.py
HINT: remove __pycache__ / .pyc files and/or use a unique basename for your test file␣
↪modules
```

Then you are probably a wonderful developer that is running the unit-tests locally. Pytest's cache is interfering with your docker test run. To work around this simply delete the pycache files. For example:

```
#! /usr/bin/env bash
clean_dirs="src test"

for clean_dir in $clean_dirs
do
    find $clean_dir -name __pycache__ | xargs rm -rf
    find $clean_dir -name \.coverage\* | xargs rm -f
done
```

Note that we also delete the .coverage intermediates since they may contain different paths between the container and the host build.

Alternatively just nuke everything temporary using git clean:

```
git clean -X -d -f
```

4.3 Building The Docs

We rely on read the docs to build our documentation from github but we also verify this build as part of our tox build. This means you can view a local copy after completing a full, successful test run (See *Running The Tests*) or do `docker run --rm -t -v $PWD:/repo uavcan/toxic:py35-py39-sq /bin/sh -c "tox -e docs"` to build the docs target. You can open the index.html under .tox/docs/tmp/index.html or run a local web-server:

```
python3 -m http.server --directory .tox/docs/tmp &
open http://localhost:8000/docs/index.html
```

Of course, you can just use *Visual Studio Code* to build and preview the docs using `> reStructuredText: Open Preview`.

4.3.1 apidoc

We manually generate the api doc using `sphinx-apidoc`. To regenerate use `tox -e gen-apidoc`.

Warning: `tox -e gen-apidoc` will start by deleting the docs/api directory.

4.4 Coverage and Linting Reports

We publish the results of our coverage data to sonarcloud and the tox build will fail for any mypy or black errors but you can view additional reports locally under the `.tox` dir.

4.4.1 Coverage

We generate a local html coverage report. You can open the index.html under .tox/report/tmp or run a local web-server:

```
python -m http.server --directory .tox/report/tmp &
open http://localhost:8000/index.html
```

4.4.2 Mypy

At the end of the mypy run we generate the following summaries:

- .tox/mypy/tmp/mypy-report-lib/index.txt
- .tox/mypy/tmp/mypy-report-script/index.txt

4.5 Nunavut Verification Suite

Nunavut has built-in support for several languages. Included with this is a suite of tests using typical test frameworks and language compilers, interpreters, and/or virtual machines. While each release of Nunavut is gated on automatic and successful completion of these tests this guide is provided to give system integrators information on how to customize these verifications to use other compilers, interpreters, and/or virtual machines.

4.5.1 CMake scripts

Our language generation verification suite uses CMake to build and run unit tests. Instructions for reproducing the CI automation execution steps are below. This section will tell you how to manually build and run individual unit tests as you develop them.

TLDR:

```
git submodule update --init --recursive
export NUNAVUT_VERIFICATION_LANG=c
cd verification
mkdir "build_$NUNAVUT_VERIFICATION_LANG"
cd "build_$NUNAVUT_VERIFICATION_LANG"
cmake ..
cmake --build . --target help
```

Try running a test which will first compile the test. For example, in the C language build

```
cmake --build . --target run_test_serialization
```

To run the C++ test use the same steps shown in the TLDR above but set `NUNAVUT_VERIFICATION_LANG` to "cpp" first.

In the list of targets that the `cmake --build . --target help` command lists the targets that build tests will be prefixed with `test_` and the psedo-target that also executes the test will be prefixed with `run_test_`. You should avoid the `_with_lcov` when you are manually building tests.

cmake build options

The following options are supported when configuring your build. These can be specified by using `-D` arguments to cmake. For example

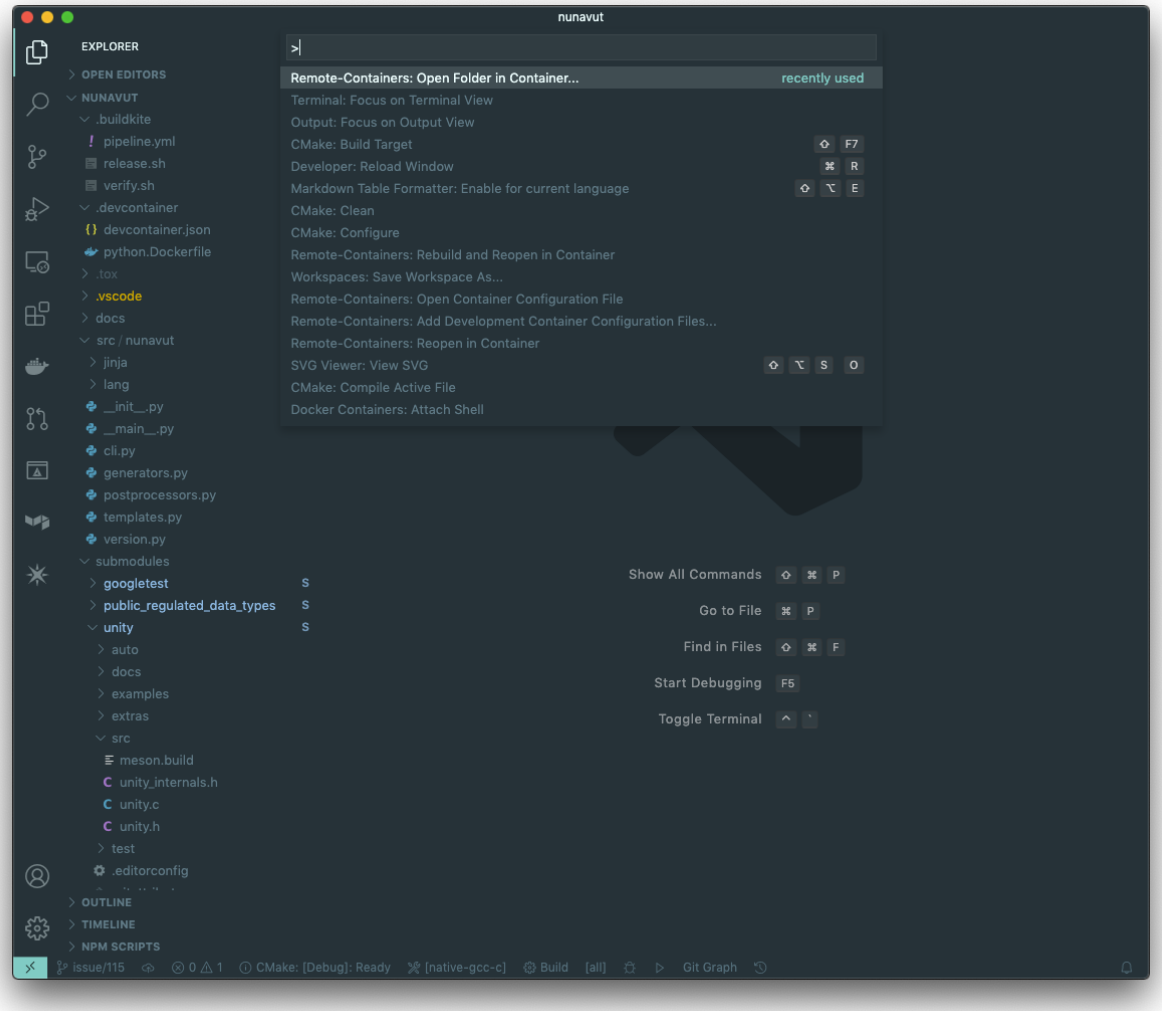
```
cmake -DNUNAVUT_VERIFICATION_LANG=c -DNUNAVUT_VERIFICATION_TARGET_ENDIANNESS=any ..
```

Option	Type	Default	Values	Description
CMAKE_BUILD_TYPE	string	release	Debug, Release, MinSizeRel	Compiler optimizations are set based on the CMake build type.
NUNAVUT_VERIFICATION_LANG	string	c, cpp	Specifies the language for source	code generated by nnvg.
NUNAVUT_VERIFICATION_TARGET_ENDIANNESS	string	any	little, big, any	Modifies generated serialization code and support code to support various CPU architectures. Other than endianess, Nunavut serialization and support code should be generic.
NUNAVUT_VERIFICATION_TARGET_PLATFORM	string	(unset)	native32, native64	The target platform to compile for. In future releases we hope to support ppc (Big), AVR8, RISCV, ARM.
NUNAVUT_VERIFICATION_SER_ASSERT	bool	ON	ON, OFF	Enable or disable asserts in generated serialization and support code.
NUNAVUT_VERIFICATION_SER_FP_DISABLE	bool	OFF	ON, OFF	Enable to omit floating-point serialization routines.
NUNAVUT_VERIFICATION_LANG_STANDARD	string	(empty)	c++17, c99 (etc)	override value for the -std compiler flag of the target language

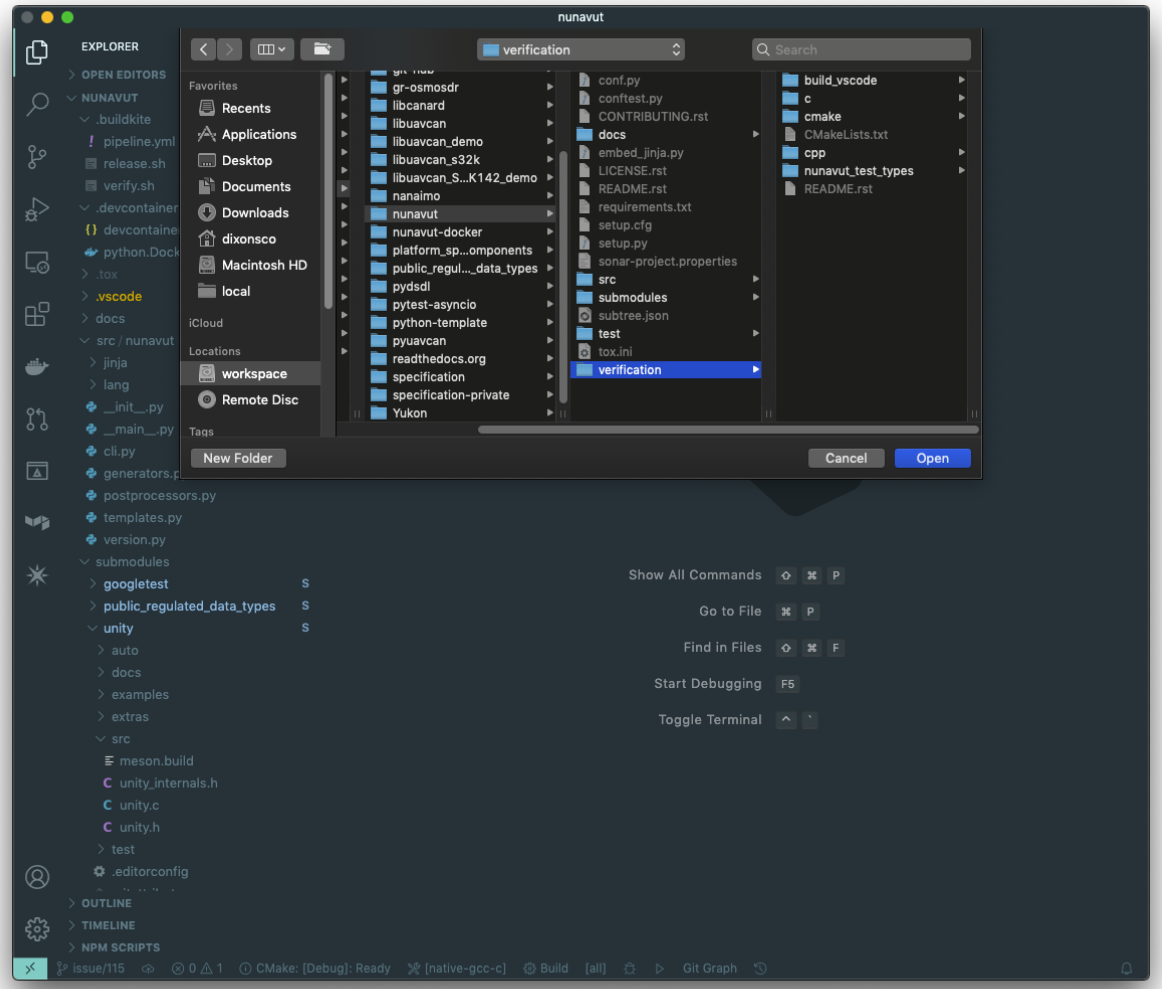
** Because this option has no default, a value must be provided by the user.*

4.5.2 VSCode Remote Container Development of Verification Tests

To write and debug verification tests using VSCode Remote Containers you'll need to use the "Open Folder in Container..." option:



Open the "verification" folder:



We play a little trick here where we dump you back into the Nunvut repo root when you reopen in the container. This lets you also work with the Python source. If you "reopen locally" while in this state, however, you'll find yourself back in the verification folder which can be a little disorienting. Write to Microsoft asking them to allow multiple images in the .devcontainer json and we can get rid of this ugly hack. Sorry.

CHAPTER 5

Licenses

5.1 Licence

5.1.1 nunavut (MIT)

The MIT License (MIT)

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5.1.2 Jinja2 and Markupsafe (BSD 3 clause)

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CHAPTER 6

Nunavut: DSDL transpiler

tox build (main)	
static analysis	
unit test code coverage	
Python versions supported	
latest released version	
documentation	
license	
community/support	

Nunavut is a source-to-source compiler (transpiler) that automatically converts OpenCyphal DSDL definitions into source code in a specified target programming language. It is constructed as a template engine that exposes a PyDSDL abstract syntax tree to Jinja2 templates allowing authors to generate code, schemas, metadata, documentation, etc.

Fig. 1: Nunavut DSDL transcompilation pipeline.

Nunavut ships with built-in support for some programming languages, and it can be used to generate code for other languages if custom templates (and some glue logic) are provided. Currently, the following languages are supported out of the box:

- **C11** (generates header-only libraries)
- **HTML** (generates documentation pages) (experimental support)

The following languages are currently on the roadmap:

- **Python** (already supported in Pycyphal, pending transplantation into Nunavut)
- **C++ 14 and newer** (generates header-only libraries; work-in-progress)

Nunavut is named after the Canadian territory. We chose the name because it is a beautiful word to say and read.

6.1 Installation

Nunavut depends on PyDSDL.

Install from PIP:

```
pip install -U nunavut
```

6.2 Examples

The examples do not replace the documentation, please do endeavor to read it.

6.2.1 Generate C headers using the command-line tool

This example assumes that the public regulated namespace directories `reg` and `uavcan` reside under `public_regulated_data_types/`. Nunavut is invoked to generate code for the former.

```
nnvg --target-language c --target-endianness=little --enable-serialization-asserts␣
↪public_regulated_data_types/reg --lookup-dir public_regulated_data_types/uavcan
```

6.2.2 Generate HTML documentation pages using the command-line tool

See above assumptions. The below commands generate documentation for the `reg` namespace. Note that we have to generate documentation for the `uavcan` namespace as well, because there are types in `reg` that will link to `uavcan` documentation sections.

```
nnvg --experimental-languages --target-language html public_regulated_data_types/reg -
↪-lookup-dir public_regulated_data_types/uavcan
nnvg --experimental-languages --target-language html public_regulated_data_types/
↪uavcan
```

6.2.3 Use custom templates

Partial example: generating a C struct

```
    /*
     * UAVCAN data structure definition
     *
     * Auto-generated, do not edit.
     *
     * Source file: {{T.source_file_path.as_posix()}}
     */

    #ifndef {{T.full_name | ln.c.macrofy}}
    #define {{T.full_name | ln.c.macrofy}}

    {%- for constant in T.constants %}
    #define {{ T | ln.c.macrofy }}_{{ constant.name | ln.c.macrofy }} {{ constant |␣
↪constant_value }}
    {%- endfor %}
```

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```
    typedef struct
    {
        /*
            Note that we're not handling union types properly in this simplified␣
↪example.
            Unions take a bit more logic to generate correctly.
        */
        {%- for field in T.fields_except_padding %}
            {{ field.data_type | declaration }} {{ field | id }}
            {%- if field.data_type is ArrayType -%}
                [{{ field.data_type.capacity }}]
            {%- endif -%};
        {%- if field is VariableLengthArrayType %}
            {{ typename_unsigned_length }} {{ field | id }}_length;
        {%- endif -%}
        {%- endfor %}
...

    } {{ T | full_reference_name }};

    #endif // {{T.full_name | lnc.macrofy}}
```

6.2.4 More examples

Where to find more examples to get started:

1. See built-in templates under `nunavut.lang.LANGUAGE.templates`.
2. API usage examples can be found in the Pycyphal library.

6.3 Bundled third-party software

Nunavut embeds the following third-party software libraries into its source (i.e. these are not dependencies and do not need to be installed):

- Jinja2 by Armin Ronacher and contributors, BSD 3-clause license.
- markupsafe by Armin Ronacher and contributors, BSD 3-clause license (needed for Jinja).

6.4 Documentation

The documentation for Nunavut is hosted on readthedocs.io:

- nunavut - The python library provided by this project.
- nnvg – Command-line script for using nunavut directly or as part of a build system.
- nunavut template guide – Documentation for authors of nunavut templates.
- nunavut contributors guide – Documentation for contributors to the Nunavut project.
- nunavut licenses – Licenses and copyrights

Nunavut is part of the UAVCAN project:

- OpenCyphal website
- OpenCyphal forum

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