

thinknode™ Examples

These examples provide a starting point for issuing http connections and requests to the dosimetry app on the thinknode™ framework. They are provided as is, and are written in python. Any further dependencies are listed along with the provided scripts.

Python: decimal Libraries

rt_types

The *rt_types* module is a reconstruction of all astroid types in python class format. This includes interdependencies between types (e.g. the class “polyset” requires the class “polygon2”).

Each data type detailed in the [astroid Manifest Guide](#) has a corresponding class in this python module.

Below you will see a snippet from the *rt_types* module that shows the class for the *polyset* rt_type along with its default initialization, *expand_data* and *from_json* functions.

```
class polygon2(object):

    #Initialize
    def __init__(self):
        blob = blob_type()
        self.vertices = blob.toStr()

    def expand_data(self):
        data = {}
        data['vertices'] =
parse_bytes_2d(base64.b64decode(self.vertices['blob']))
        return data

    def from_json(self, jdict):
        for k, v in jdict.items():
            if hasattr(self,k):
                setattr(self, k, v)

class polyset(object):

    #Initialize
    def __init__(self):
        self.polygons = []
        self.holes = []
```

```

def expand_data(self):
    data = {}
    polygon = []
    for x in self.polygons:
        s = polygon2()
        s.from_json(x)
        polygon.append(s.expand_data())
    data['polygons'] = polygon
    hole = []
    for x in self.holes:
        s = polygon2()
        s.from_json(x)
        hole.append(s.expand_data())
    data['holes'] = hole
    return data

def from_json(self, jdict):
    for k, v in jdict.items():
        if hasattr(self, k):
            setattr(self, k, v)

```

- **Interdependence:** When `rt_types` are constructed of other or multiple named types, they will be constructed as such in each class as seen in the `polygons` parameter of the `polyset` in the above example.
- **expand_data function:** Each class's `expand_data` function returns a python dictionary containing each of the values in the class, with all data values expanded out to remove compression or other encodings (i.e. providing results in a format more useful for send to other applications or for human-readability).
- **from json function:** Each class's `from_json` function provides a method to turn a raw json string (e.g. a result from a thinknode calculation or ISS object) into an `rt_type` data type. Proper use is to first construct an empty class instance, then to call the `from_json` method on that instance, passing in the desired json data string.

Below is an example usage of getting a thinknode dose image (`image_3d` data type in the `astroid` manifest) and turning it into a `rt_types` `image_3d` data type, so that it can be expanded and then used to output the image into a VTK graphics file:

```

def dose_to_vtk(dose_id):
    img_data = json.loads(thinknode.get_immutable(iam, 'dicom', dose_id))

    img = rt_types.image_3d()
    img.from_json(img_data)
    img2 = img.expand_data()

    vtk.write_vtk_image3('E:/dicom/dose.vtk', img2)

```

thinknode_worker

The `thinknode_worker` module is the main work horse for communication with the astroid app and thinknode. The module will handle authentication, posting objects to ISS, creating most of the common calculation request structures, and posting the calculation request.

Refer to the [.decimal GitHub repository](#) for the complete module. Below are a few of the more common `thinknode_worker` functions and their intended usages:

```
# Authenticate with thinknode and store necessary ids.
# Gets the context id for each app detailed in the thinknode config
# Gets the app version (if non defined) for each app in the realm
# param config: connection settings (url and unique basic user
authentication)
def authenticate(config):

# Send calculation request to thinknode and wait for the calculation to
perform. Caches locally calculation results so if the same
# calculation is performed again, the calculation
# does not have to be repeatedly pulled from thinknode. Saves one calculation
time and bandwidth.
# note: see post_calculation if you just want the calculation ID and don't
need to wait for the calculation to finish or get results
# param config: connection settings (url, user token, and ids for context
and realm)
# param json_data: calculation request in json format
# param return_data: When True the data object will be returned, when false
the thinknode id for the object will be returned
# param return_error: When False the script will exit when error is found,
when True the script will return the error
def do_calculation(config, json_data, return_data=True, return_error=False):

# Post immutable named_type object to ISS
# param config: connection settings (url, user token, and ids for context
and realm)
# param app_name: name of the app to use to get the context id from the iam
config
# param json_data: immutable object in json format
# param obj_name: object name of app to post to
def post_immutable_named(config, app_name, json_data, obj_name):
    scope = '/iss/named/' + config["account_name"] + '/rt_types' + '/' +
obj_name
    return post_immutable(config, app_name, json_data, scope)

# Post immutable object to ISS
# param config: connection settings (url, user token, and ids for context
and realm)
```

```
# param app_name: name of the app to use to get the context id from the iam
config
# param obj_id: thinknode iss reference id for object to get
def get_immutable(config, app_name, obj_id):
```

dosimetry_worker

The dosimetry_worker module provides high-level functions for building data types and calculation requests for common dosimetry tasks. This library is constantly growing as more routine tasks are programmed in python.

Refer to the [.decimal GitHub repository](#) for the complete module. Some basic examples of provided functionality are:

1. Aperture creation (using structures/beams or basic geometric)
2. Dose comparison
3. Grid creation
4. Image creation
5. PBS Spot functions

vtk_worker

The VTK worker provides a means to write out common rt_types to a vtk file format ([The Visualization Toolkit](#)) that can be visualized in [Paraview](#). It's most useful for displaying and post-processing image, mesh, and other primitive object data types.

Below is an example of turning a dose image_3d into a vtk file for visualization in Paraview:

```
def dose_to_vtk(dose_id):
    img_data = json.loads(thinknode.get_immutable(iam, 'dicom', dose_id))

    img = rt_types.image_3d()
    img.from_json(img_data)
    img2 = img.expand_data()

    vtk.write_vtk_image3('E:/dicom/dose.vtk', img2)
```

decimal_logging

The *decimal_logging* module provides formatted and detailed output window messages and file logging.

The following settings are available in the decimal_logging.py file: **display_timestamps:** display timestamps in the output window/logfile **display_types:** display message types (e.g. debug, data, alert) in the output window/logfile **log_file:** sets the logfile name and location

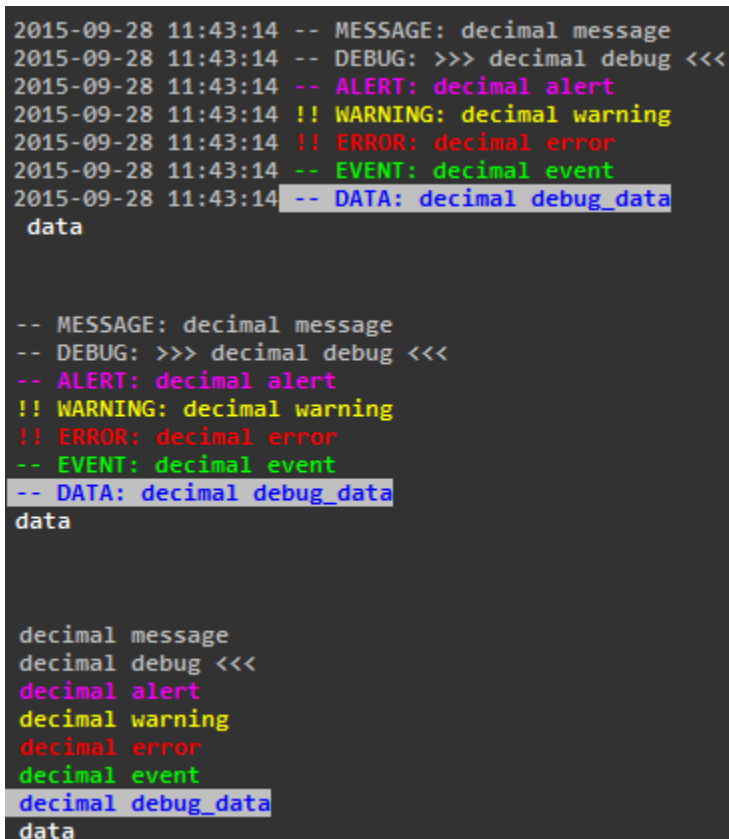
Debugging

When debugging, use the `dl.debug()` function and set the `isDebug` flag in the `decimal_logging` library to `True`. This toggles on the output for each of the `dl.debug` calls. By default we keep debugging off, but it can be turned on as needed.

Other Flags

The following image shows the logging settings for each message type as:

1. Timestamps = `True`; Types = `True`
2. Timestamps = `False`; Types = `True`
3. Timestamps = `False`; Types = `False`



```
2015-09-28 11:43:14 -- MESSAGE: decimal message
2015-09-28 11:43:14 -- DEBUG: >>> decimal debug <<<
2015-09-28 11:43:14 -- ALERT: decimal alert
2015-09-28 11:43:14 !! WARNING: decimal warning
2015-09-28 11:43:14 !! ERROR: decimal error
2015-09-28 11:43:14 -- EVENT: decimal event
2015-09-28 11:43:14 -- DATA: decimal debug_data
data

-- MESSAGE: decimal message
-- DEBUG: >>> decimal debug <<<
-- ALERT: decimal alert
!! WARNING: decimal warning
!! ERROR: decimal error
-- EVENT: decimal event
-- DATA: decimal debug_data
data

decimal message
decimal debug <<<
decimal alert
decimal warning
decimal error
decimal event
decimal debug_data
data
```

File Logging

The `decimal_logging` library also provides simple file logging. The `log_file` variable at the top of the library sets the log file. By using any of the following functions, you can easily log data to the specified file:

- `log(message)`
- `log_debug_data(message,data)`

- `log_data(data)`

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