

Distributed Resource Management Application API 1.0 – Python Language Binding

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Abstract

This document describes the representation of the DRMAA 1.0 API in the Python programming language. It is based on the DRMAA 1.0 IDL recommendation (GFD-R-P.130), and maps the DRMAA IDL interface definition to specific Python language constructs.

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1. Introduction

This document describes the representation of the DRMAA 1.0 API in the Python programming language. It is based on the DRMAA 1.0 IDL specification, which contains the detailed functionality description for each method of the API. The rules for language bindings are described in Section 2.2 of the DRMAA 1.0 IDL specification [GFD130].

2. Python Language Mapping for DRMAA

A Python module implementation can declare “DRMAA 1.0-compliance” if it realizes the API signature described in the following sections, and the functional behavior as described in [GFD130]. Additional module functionality beside the specified API is allowed, but must be clearly identifiable (e.g. by a function name convention).

The following table provides the basic mapping overview for the DRMAA IDL constructs to the Python programming language:

<i>DRMAA 1.0 IDL specification</i>	<i>DRMAA 1.0 Python binding</i>
module definition	Python module file named “drmaa.py”
interface definition	class definition
enum definition with enumeration members	Pre-defined attributes in module scope, with values as stated below
string type	str
long type	int
long long type	long
const definition	Pre-defined class attributes
boolean type	bool
[readonly] attribute definition	class attributes
exception definition	Class definition derived from Exception, or mapping to in-build Python exception; message parameter maps to args attribute
raises clause	Not mapped
valuetype definition	class definition with <code>__cmp__(self, other)</code> method
StringList	Python list of str objects
OrderedStringList	Python list of str objects
TimeAmount	long
Dictionary	dict
PartialTimestamp	str

The resulting Python module signature MUST be realized by all implementations. The `pass` statements should be replaced by an according implementation. It is RECOMMENDED to add the IDL specification description text as documentation to the DRMAA Python module functions.

```
"""This is drmaa.py, implementing the DRMAA Python language binding
   Visit www.drmaa.org for details"""
```

```
# Job control action
```

```
SUSPEND, RESUME, HOLD, RELEASE, TERMINATE=\
'suspend', 'resume', 'hold', 'release', 'terminate'
```

```
# Job state
```

```
UNDETERMINED, QUEUED_ACTIVE, SYSTEM_ON_HOLD, USER_ON_HOLD,\
USER_SYSTEM_ON_HOLD, RUNNING, SYSTEM_SUSPENDED,\
USER_SUSPENDED, USER_SYSTEM_SUSPENDED, DONE, FAILED=\
'undetermined', 'queued_active', 'system_on_hold', 'user_on_hold',\
'user_system_on_hold', 'running', 'system_suspended',\
'user_suspended', 'user_system_suspended', 'done', 'failed'
```

```
# Job submission state
```

```
HOLD_STATE, ACTIVE_STATE='hold', 'active'
```

```
class FileTransferMode:
```

```
    transferInputStream=False
    transferOutputStream=False
    transferErrorStream=False
    def __cmp__(self, other):
        pass
```

```
class Version:
```

```
    major='1'
    minor='0'
    def __cmp__(self, other):
        pass
```

```
class AlreadyActiveSessionException(Exception):
    pass
```

```
class AuthorizationException(Exception):
    pass
```

```
class ConflictingAttributeValuesException(Exception):
    pass
```

```
class DefaultContactStringException(Exception):
    pass
```

```
class DeniedByDrmException(Exception):
    pass
```

```
class DrmCommunicationException(Exception):
    pass
```

```
class DrmsExitException(Exception):
    pass
```

```
class DrmsInitException(Exception):
    pass
```

```
class ExitTimeoutException(Exception):
    pass
```

```
class HoldInconsistentStateException(Exception):
    pass
```

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```
class IllegalStateException(Exception):
    pass
class InternalException(Exception):
    pass
class InvalidAttributeFormatException(Exception):
    pass
class InvalidContactStringException(Exception):
    pass
class InvalidJobException(Exception):
    pass
class InvalidJobTemplateException(Exception):
    pass
class NoActiveSessionException(Exception):
    pass
class NoDefaultContactStringSelectedException(Exception):
    pass
class ReleaseInconsistentStateException(Exception):
    pass
class ResumeInconsistentStateException(Exception):
    pass
class SuspendInconsistentStateException(Exception):
    pass
class TryLaterException(Exception):
    pass
class UnsupportedAttributeException(Exception):
    pass
InvalidArgumentException=TypeError
InvalidAttributeValueException=ValueError
OutOfMemoryException=MemoryError

class JobInfo:
    def __init__(self):
        self.resourceUsage={}
        self.jobId=""
        self.hasExited=False
        self.exitStatus=0
        self.hasSignaled=False
        self.terminatingSignal=""
        self.hasCoreDump=False
        self.wasAborted=False

class JobTemplate:
    HOME_DIRECTORY='$drmaa_hd_ph$'
    WORKING_DIRECTORY='$drmaa_wd_ph$'
    PARAMETRIC_INDEX='$drmaa_incr_ph$'
    # contains list of strings
    attributeNames=[]
    def __init__(self):
        self.remoteCommand=""
        self.jobEnvironment={}
        self.workingDirectory=""
        self.jobCategory=""
        self.nativeSpecification=""
        self.blockEmail=False
        self.jobName=""
```

```

self.inputPath=""
self.outputPath=""
self.errorPath=""
self.joinFiles=False
# contains list of strings
self.args=[]
# contains one of the job submission state values, or None
self.jobSubmissionState=None
# contains list of strings
self.email=[]
# [[[CC]YY/]MM/]DD]hh:mm[:ss] [{-|+}UU:uu]
self.startTime=""
self.deadlineTime=""
# contains FileTransferMode instance, or None
self.transferFiles=None
# in seconds
self.hardWallclockTimeLimit=0
self.softWallClockTimeLimit=0
self.hardRunDurationLimit=0
self.softRunDurationLimit=0

class Session:
    TIMEOUT_WAIT_FOREVER=-1
    TIMEOUT_NO_WAIT=0
    JOB_IDS_SESSION_ANY='DRMAA_JOB_IDS_SESSION_ANY'
    JOB_IDS_SESSION_ALL='DRMAA_JOB_IDS_SESSION_ALL'
    def __init__(self):
        self.contact=""
        self.drmsInfo=""
        self.drmaaImplementation=""
        version=Version()
    # no return value
    def init(self, contactString=""):
        pass
    # no return value
    def exit(self):
        pass
    # returns JobTemplate instance
    def createJobTemplate(self):
        pass
    # takes JobTemplate instance, no return value
    def deleteJobTemplate(self, jobTemplate):
        pass
    # takes JobTemplate instance, returns string
    def runJob(self, jobTemplate):
        pass
    # takes JobTemplate instance and num values, returns string list
    def runBulkJobs(self, jobTemplate, beginIndex, endIndex, step):
        pass
    # takes string and JobControlAction value, no return value
    def control(self, jobName, operation):
        pass
    # takes string list, num value and boolean, no return value
    def synchronize(self, jobList, timeout, dispose):
        pass

```

```

# takes string and long, returns JobInfo instance
def wait(self, jobName, timeout):
    pass
# takes string, returns JobState instance
def jobStatus(jobName):
    pass

```

3. Rationale

A Python module is a single file encapsulating Python definitions and statements [PyTut]. The file name acts as parameter for the `import` statement, and therefore realizes the concept of a module name in the IDL sense. A DRMAA Python module SHOULD NOT be declared as part of a custom Python package, since this would lead to non-portable import statements in the application.

Interfaces in the sense of Java or C# are not a dedicated language construct in Python [PEP245]. Instead a class encapsulates all DRMAA functions and attributes. The mapping does not imply an implementation strategy for the class. Implementations could use ‘old-style’ and ‘new-style’ classes as well as inheritance, as long as the instantiation procedure is not changed for the DRMAA-based application.

Enumerations are explicitly no part of the Python language [PEP354]. Since they are used as a structuring concept for constants in the DRMAA IDL specification, they are mapped accordingly.

The IDL `long` type represents a 32-bit signed value and therefore maps to the Python `int` type, which is promised to have at least 32-bit of precision [PyLib]. The Python `long` type is promised to have unlimited precision, and therefore represents the 64-bit IDL `long long` and `TimeAmount` type.

Python has no support for declaring constant attributes. The IDL `const` type is therefore mapped to a pre-defined attribute in the according scope. Default values for the constant / enumeration / value type attributes are partially adopted from the DRMAA 1.0 C language binding specification [DRMAAC10].

Some of the DRMAA IDL exceptions are mapped to built-in Python exceptions, as suggested by Section 5 of [GFD130]. Even though Python exception names usually end in “`...Error`” and not in “`...Exception`”, the original names are kept. This makes the resulting source code more familiar to experienced DRMAA developers, and eases the re-use of existing documentation. The binding does not rely on a common exception base class (“`DrmaaException`”), since the module scoping already ensures encapsulation.

Partial timestamp objects are mapped to native Python strings, without a separate type definition in module scope. The in-built Python types for date and time representation are not usable here, due to the partial time stamp feature of DRMAA 1.0 (see Section 6 of [GFD130]).

According to the discussion in Section 8.2 of [GFD130], this language binding maps implementation-specific job template attributes to additional class data attributes [PyTut].

The `runBulkJobs` method in the IDL specification has three numerical parameters to express a range of `int` values. In Python, this is usually expressed by a numerical list created by the `range()` function. Since the increment value for a list generated by `range()` cannot be determined in a reliable way, the language binding sticks with the original syntax.

`Session.init()` is intentionally NOT mapped to the Python `__init__()` function. The DRMAA `init()` function explicitly attaches the application to the DRM system, which is not necessary in all cases (e.g. reading the library version number).

The IDL `valuetype` is mapped to a Python class, even though a Python `dict` might look appropriate, especially with the demand for comparability (see Section 2.2 of [GFD130]). The main reason is the restriction to the defined set of attributes, while a dictionary type would allow the DRMAA library implementation to support more keys.

4. Python 3.0 compatibility

Python 3 removes the in-built `int` type in favor of `long`, which changes the mapping described in Section 2 accordingly. However, the DRMAA Python module API does not change for a Python 3 implementation.

5. Security Considerations

The language binding specification does not imply security demands upon an implementation. According to the functional behavior, GFD.130 rules and best practices apply also here.

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