University of Zurich[UZH]

S3IT

Application control and post-processing

Riccardo Murri <riccardo.murri@uzh.ch>

S3IT: Services and Support for Science IT

University of Zurich

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Application run states

Application lifecycle

```
$ ./grayscale.py lena.jpg
[...]
          NEW  1/1   (100.0%)
      RUNNING  0/1    (0.0%)
      STOPPED  0/1    (0.0%)
    SUBMITTED  0/1    (0.0%)
   TERMINATED  0/1    (0.0%)
  TERMINATING  0/1    (0.0%)
      UNKNOWN  0/1    (0.0%)
        total  1/1   (100.0%)
```

`Application` objects can be in one of several states.

(A session-based script prints a table of all managed applications and their states.)

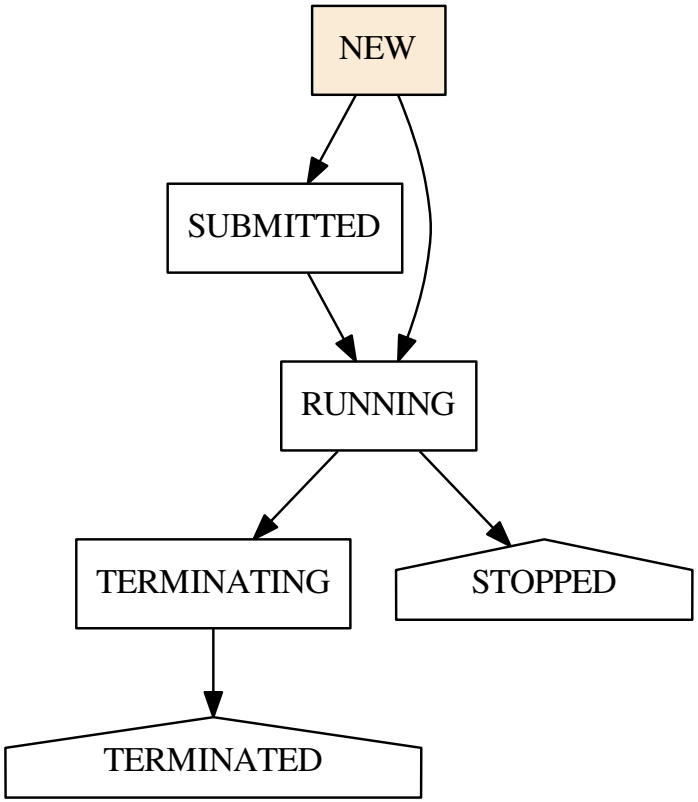
```
>>> print(app.execution.state)
'TERMINATED'
```

The current state is stored in the `.execution.state` instance attribute.

Reference:

http://gc3pie.readthedocs.io/en/master/programmers/api/gc3libs.html#gc3libs.Run.state

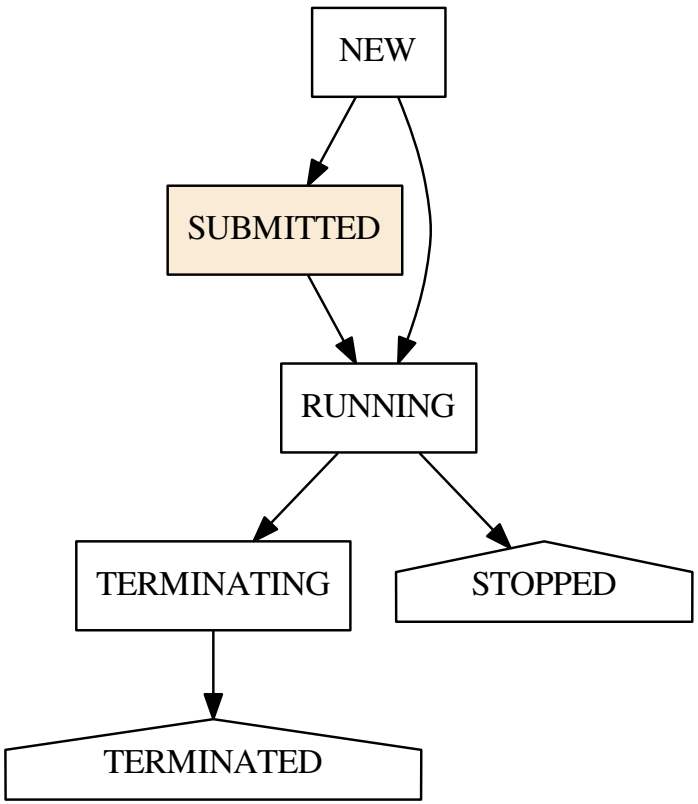
Application lifecycle: state NEW



NEW is the state of "just created" Application objects.

The Application has not yet been sent off to a compute resource: it only exists locally.

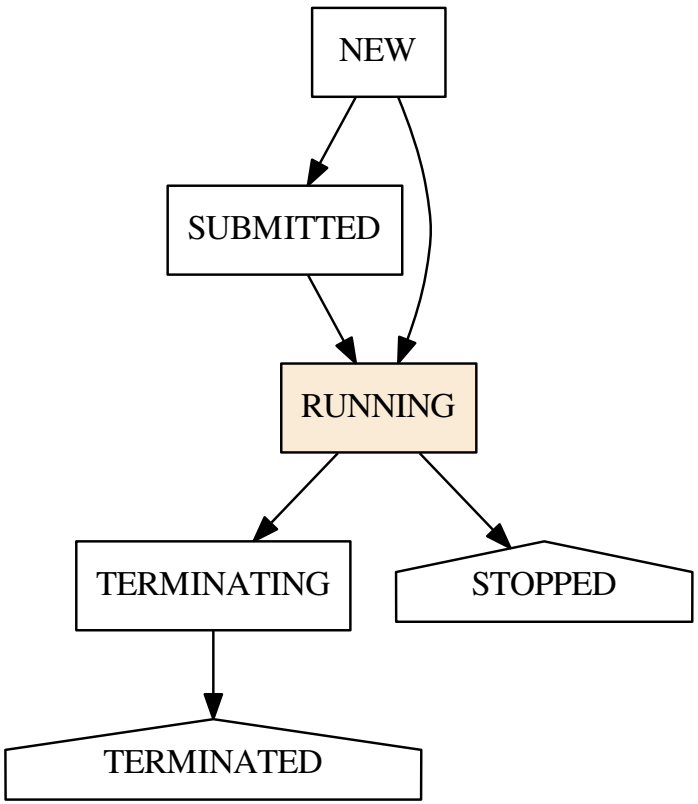
Application lifecycle: state SUBMITTED



SUBMITTED applications have been successfully sent to a computational resource.

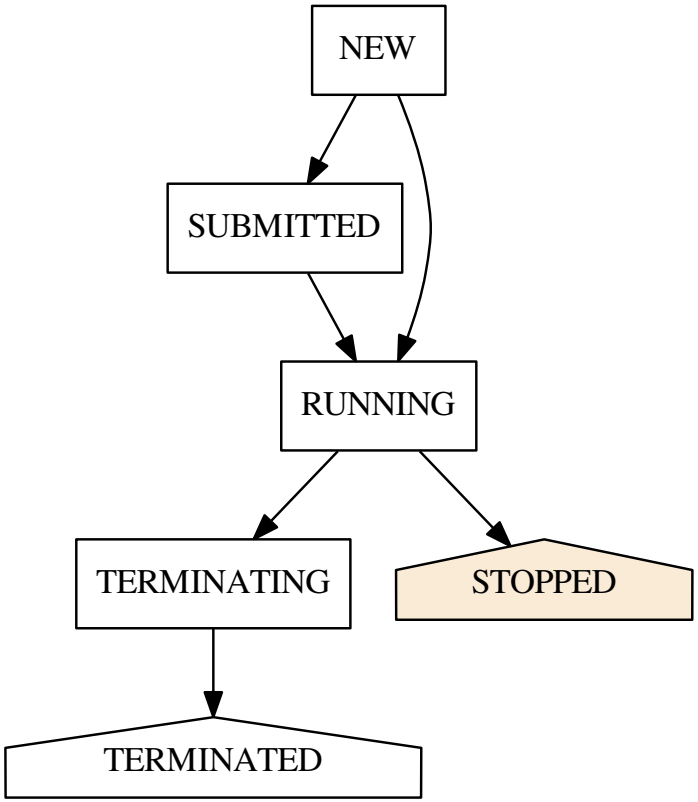
(The transition to *RUNNING* happens automatically, as we do not control the remote execution.)

Application lifecycle: state RUNNING



RUNNING state happens when the computational job associated to an application starts executing on the computational resource.

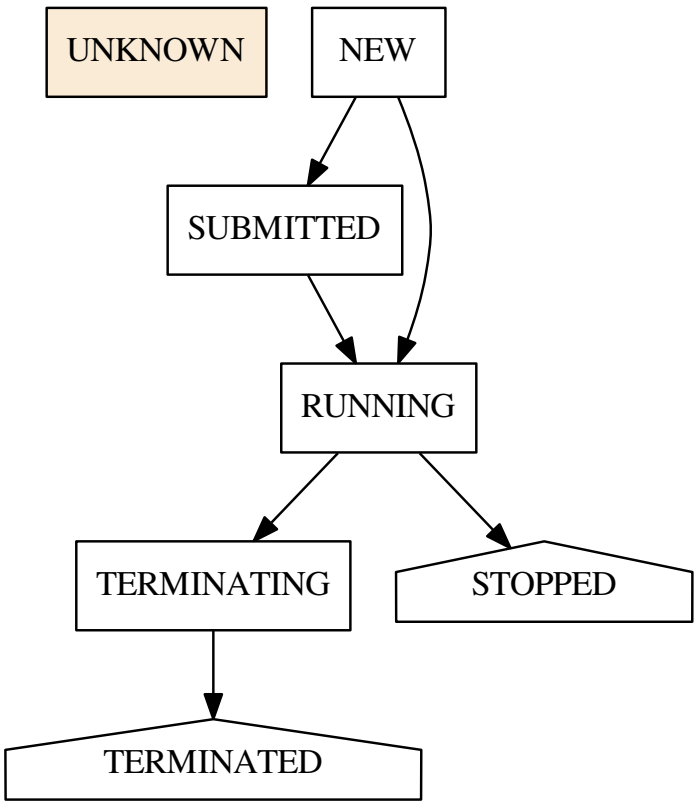
Application lifecycle: state STOPPED



A task is in *STOPPED* state when its execution has been blocked at the remote site and GC3Pie cannot recover automatically.

User or sysadmin intervention is required for a task to get out of *STOPPED* state.

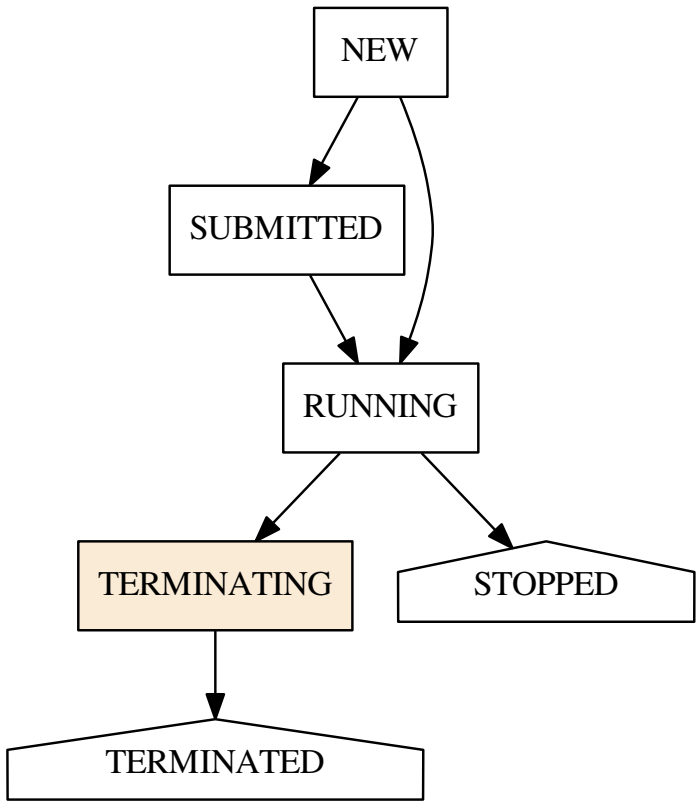
Application lifecycle: state UNKNOWN



A task is in *UNKNOWN* state when GC3Pie can no longer monitor it at the remote site.

(As this might be due to network failures, jobs *can* get out of *UNKNOWN* automatically.)

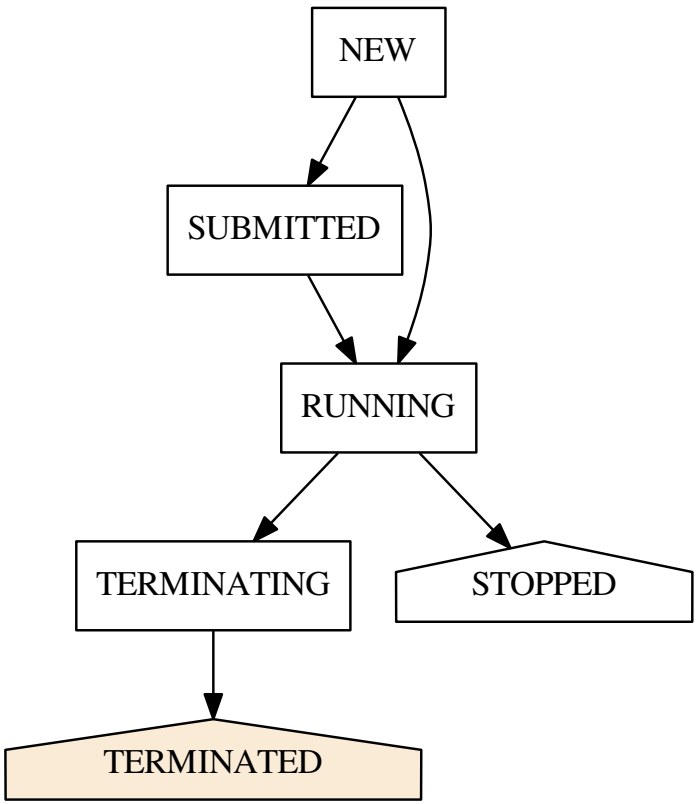
Application lifecycle: state TERMINATING



TERMINATING state when a computational job has finished running, for whatever reason.

(Transition to *TERMINATED* only happens when `fetch_output` is called.)

Application lifecycle: state TERMINATED



A job is *TERMINATED* when its final output has been retrieved and is available locally.

The exit code of *TERMINATED* jobs can be inspected to find out whether the termination was successful or unsuccessful, or if the program was forcibly ended.

Post-processing

Post-processing features, I

When the remote computation is done, the `terminated` method of the application instance is called.

The path to the output directory is available as `self.output_dir`; if `stdout` and `stderr` have been captured, the **relative** paths to the capture files are available as `self.stdout` and `self.stderr`.

Post-processing features, II

For example, the following code logs a warning message if the standard error output is non-empty:

```
class MyApp(Application):
  # ...
  def terminated(self):
    stderr_file = self.output_dir+"/"+self.stderr
    stderr_size = os.stat(stderr_file).st_size
    if stderr_size > 0:
      gc3libs.log.warn(
        "Application %s reported errors!", self)
```

Exercise 4.A:

Modify the `GrayscaleApp` application to print a message "`Conversion of '`*`filename`*`' done.`" whenever running the `convert` program terminates.

Termination status

A successful run or not?

There's a *single TERMINATED state*, whatever the task outcome. You have to inspect the "return code" to determine the cause of "task death".

Attribute '.execution.returncode' provides a numeric termination status (with the same format and meaning as the POSIX termination status).

The termination status combines two fields: the "termination signal" and the "exit code".

Termination signal, I

The `.execution.signal` instance attribute is non-zero if the program was killed by a signal (e.g., memory error / segmentation fault).

The `.execution.signal` instance attribute is zero only if the program run until termination. (**Beware!** This does not mean that it run *correctly*: just that it halted by itself.)

Termination signal, II

Read `man 7 signal` for a list of OS signals and their numeric values.

Note that GC3Pie overloads some signal codes (unused by the OS) to represent its own specific errors.

For instance, if program `app` was cancelled by the user, `.execution.signal` will take the value 121:

```
>>> print(app.execution.signal)
121
```

Reference: https://github.com/uzh/gc3pie/blob/master/gc3libs/__init__.py#L1579

Exit code

The `.execution.exitcode` instance attribute holds the numeric exitcode of the executed command, or `None` if the command has not finished running yet.

Note that the `.execution.exitcode` is guaranteed to have a valid value only if the `.execution.signal` attribute has the value 0.

The `.execution.exitcode` is the same exitcode that you would see when running a command directly in the terminal shell. (By convention, code 0 is successful termination, every other value indicates an error.)

Exercise 4.B:

Write a `TermStatusApp` application, which is like a generic `Application` class with the addition that upon termination it prints:

- whether the program has been killed by a signal, and the signal number;
- whether the program has terminated by exiting, and the exit code.

Verify that it works by plugging the class into the "grayscale" session-based script.

Exercise 4.B+: *(Bonus points)* Abstract the verbose `terminated` method from exercise 3.B into an application class `TermStatusApp`.

Use Python class inheritance to add the `TermStatusApp` functionality into `GrayscaleApp`.

Application-specific configuration

Application classes may be tagged so that parts of the configuration file can be overridden just for them.

Suppose you tag the `GrayscaleApp` class by giving it this name:

```
class GrayscaleApp(Application):
  application_name = 'grayscale'
  #  [...]
```

then you can provide a specific VM image just for "`grayscale`" applications:

```
# in the GC3Pie config file:
[resource/sciencecloud]
#  [...]
image_id=2b227d15-8f6a-42b0-b744-ede52ebe59f7
grayscale_image_id=0cca5346-ca12-4cb4-8007-8875c10cce02
```

Other configuration items that can be specialized are: `instance_type`, `user_data` (cloud), and `prolog_file`, `epilog_file` (batch-systems).

Exercise 4.C: *(Difficult)*

MATLAB has the annoying habit of exiting with code 0 even when some error occurred.

Write a `MatlabApp` application, which:

- is constructed by giving the path to a MATLAB '`.m`' script file, like this: `app = MatlabApp("ra.m");`
- Runs the following command:

  `matlab -nodesktop -nojvm` *`file.m`*

  where *file.m* is the file given to the `MatlabApp()` constructor.
- captures the standard error output (`stderr`) of the MATLAB script and, if the string "`Out of memory.`" occurs in it, sets the application exitcode to 11.

Verify that it works by running MATLAB script `ra.m` many times over. The script initializes a array of random size: for some values, the size exceeds the amount of available memory.