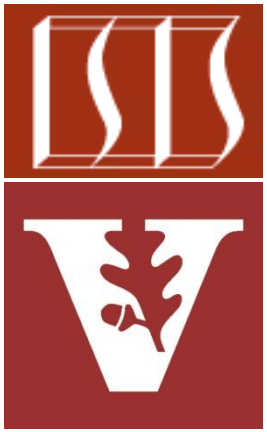
Managing the Java Thread Lifecycle: State Machine for Java Threads



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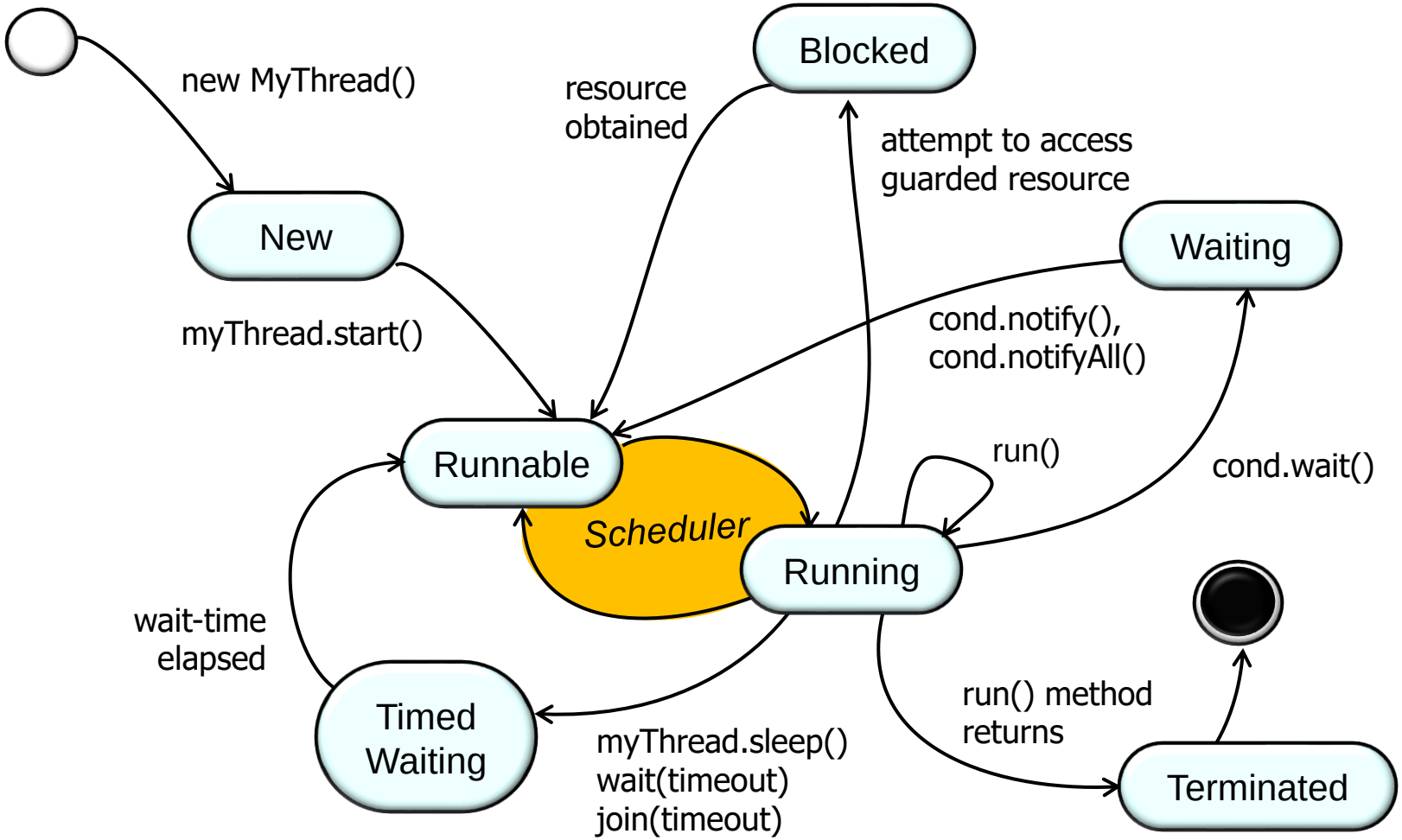
Learning Objectives in this Part of the Lesson

- Be aware of the Java thread lifecycle
- Understand the various states in the Java thread lifecycle



The State Machine for Java Threads

The State Machine for the Java Thread Lifecycle

- A Java thread can be in various states (one at a time) during its lifecycle

Enum Thread.State

java.lang.Object
    java.lang.Enum<Thread.State>
        java.lang.Thread.State

All Implemented Interfaces:

`Serializable, Comparable<Thread.State>`

Enclosing class:

`Thread`

```
public static enum Thread.State
extends Enum<Thread.State>
```

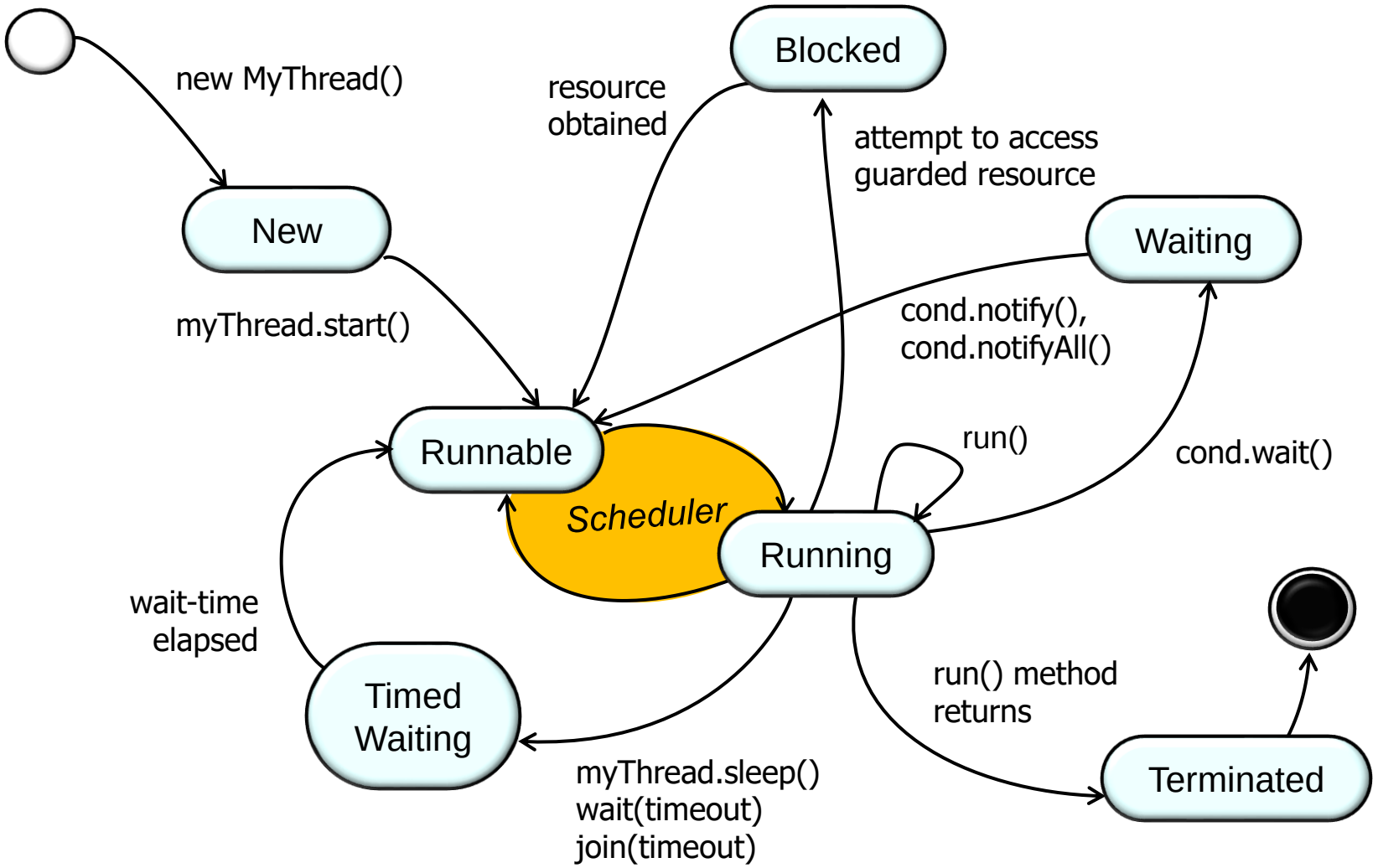
A thread state. A thread can be in one of the following states:

- `NEW`
  A thread that has not yet started is in this state.
- `RUNNABLE`
  A thread executing in the Java virtual machine is in this state.
- `BLOCKED`
  A thread that is blocked waiting for a monitor lock is in this state.
- `WAITING`
  A thread that is waiting indefinitely for another thread to perform a particular action is in this state.
- `TIMED_WAITING`
  A thread that is waiting for another thread to perform an action for up to a specified waiting time is in this state.
- `TERMINATED`
  A thread that has exited is in this state.

A thread can be in only one state at a given point in time. These states are virtual machine states which do not reflect any operating system thread states.

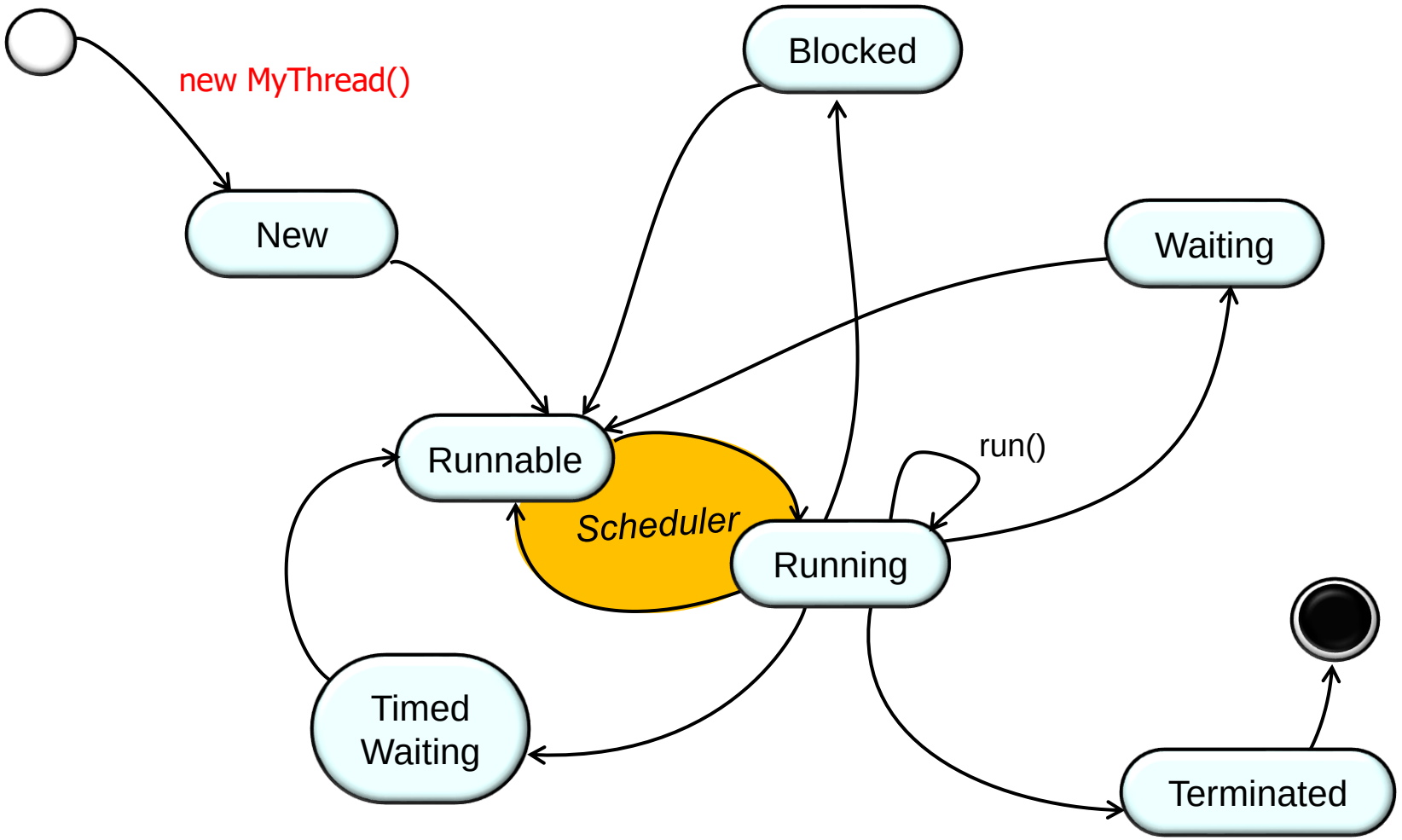
See docs.oracle.com/javase/8/docs/api/java/lang/Thread.State.html

The State Machine for the Java Thread Lifecycle



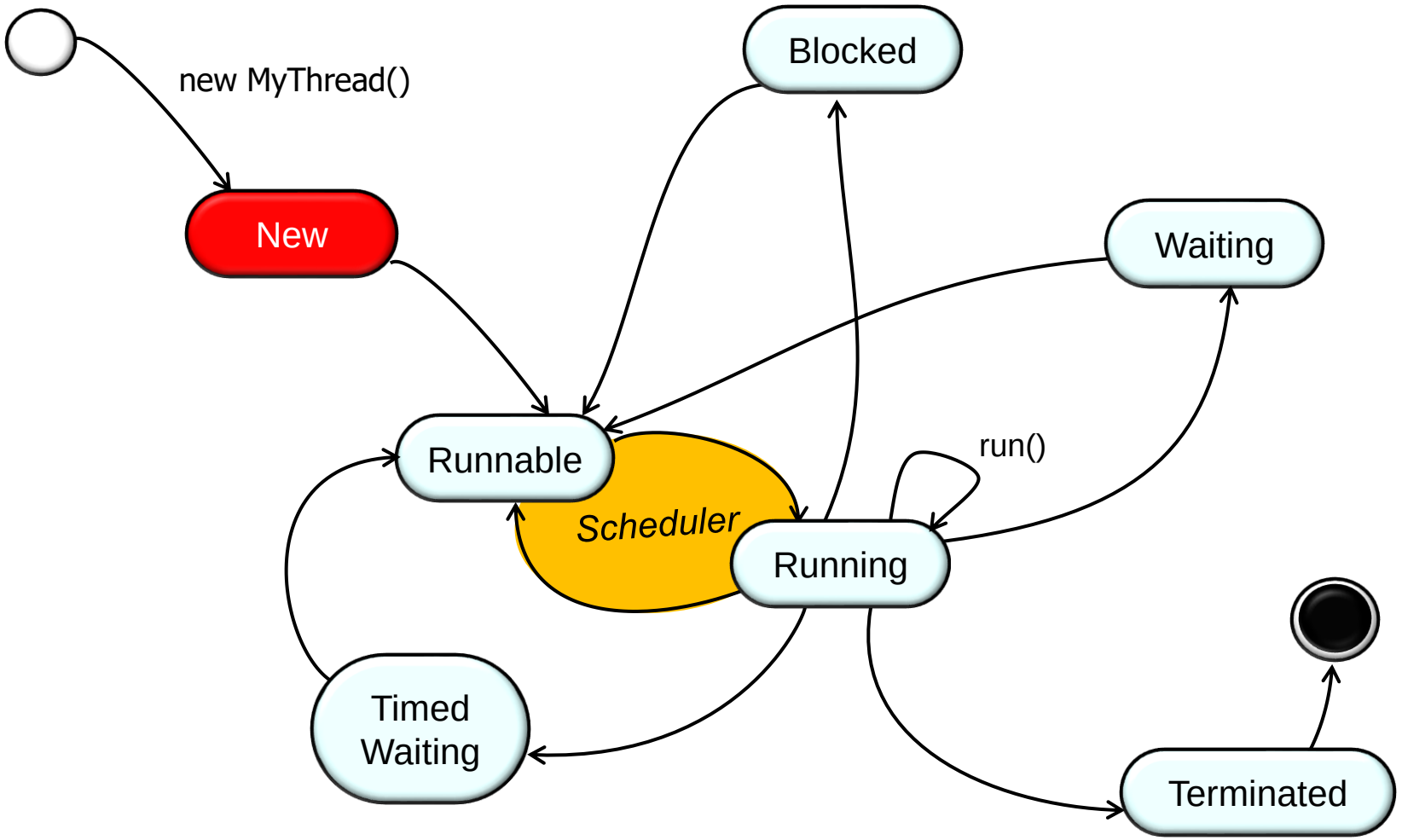
See www.uml-diagrams.org/examples/java-6-thread-state-machine-diagram-example.html

The State Machine for the Java Thread Lifecycle



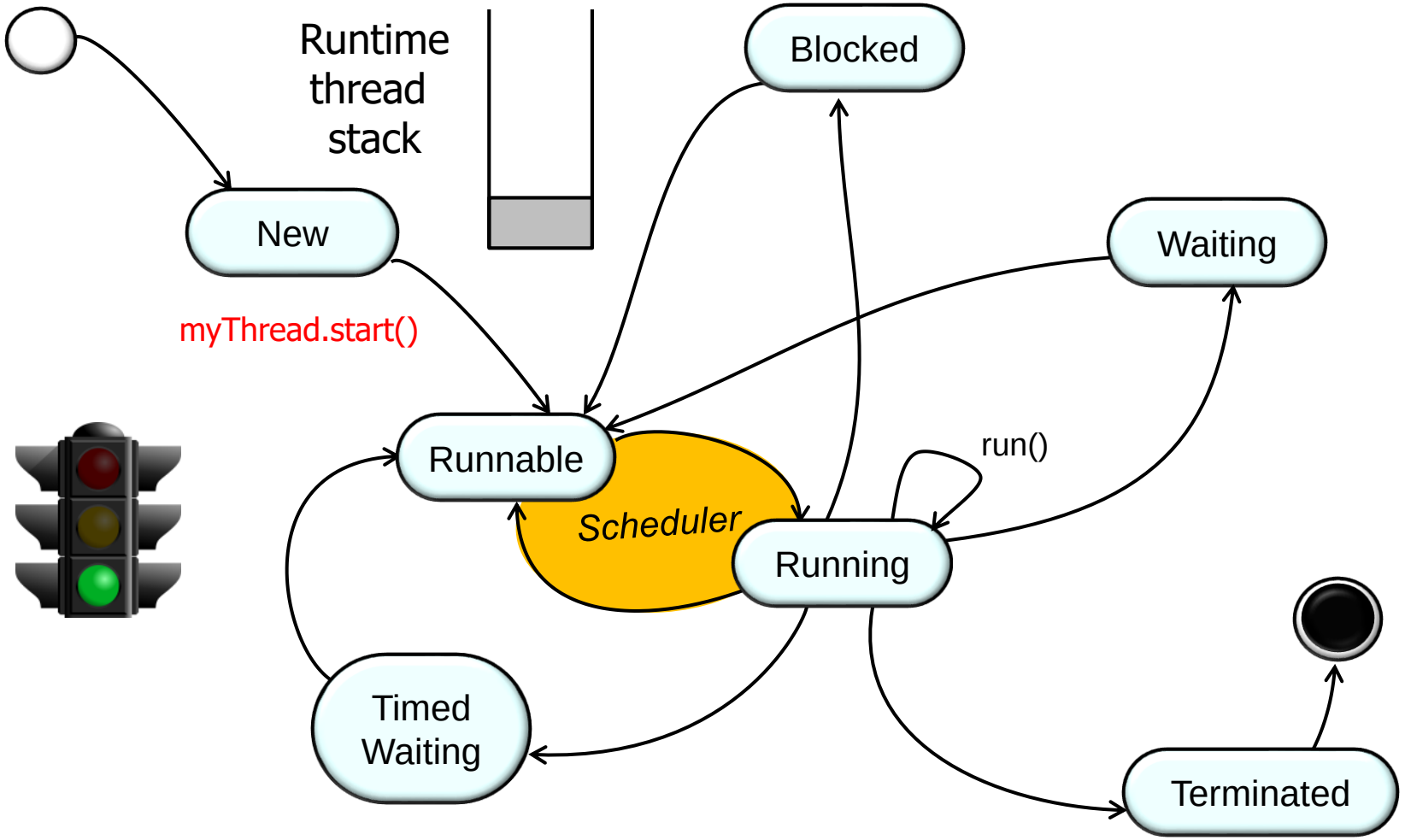
Begin by creating a new thread object

The State Machine for the Java Thread Lifecycle



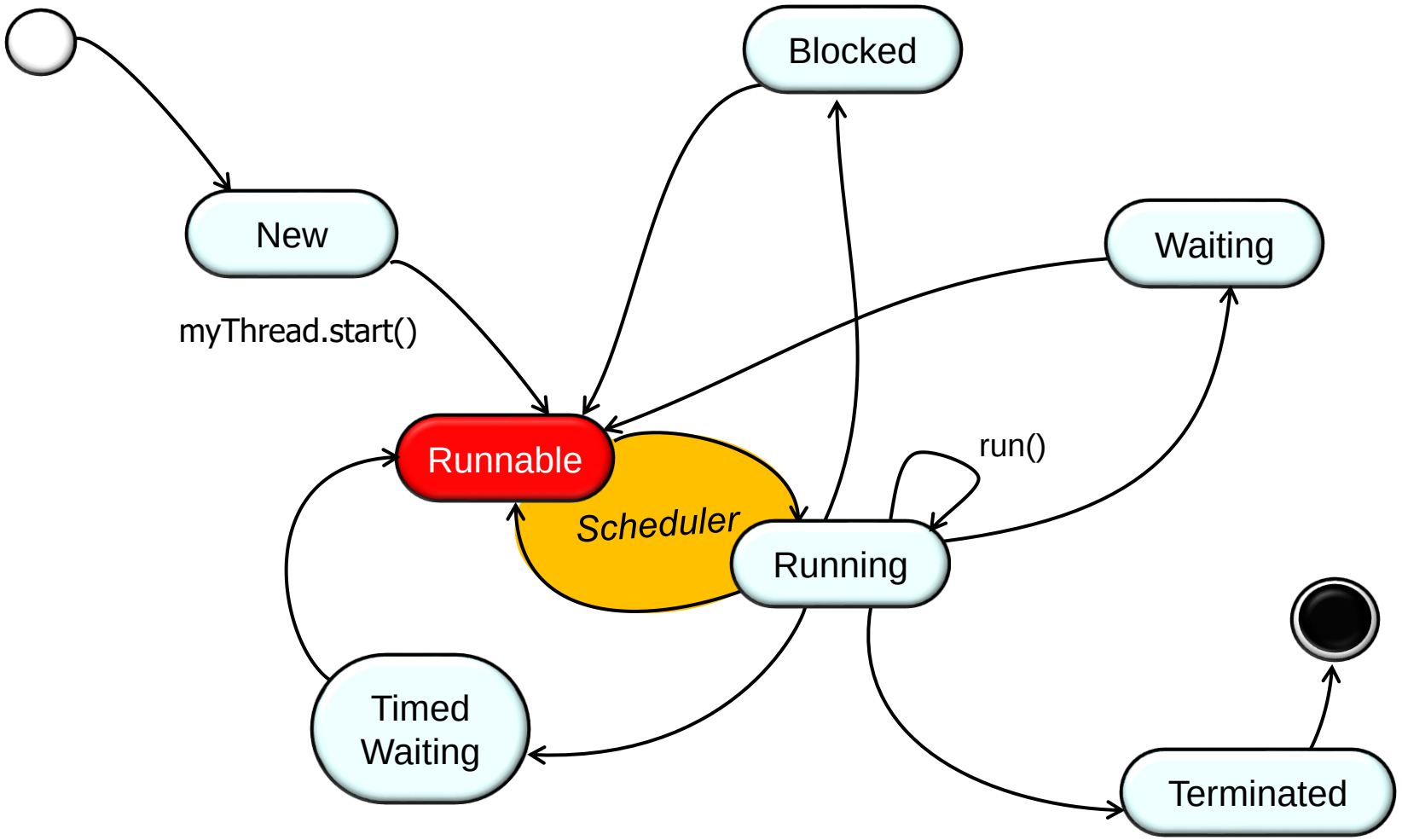
Transitions to the "New" state

The State Machine for the Java Thread Lifecycle



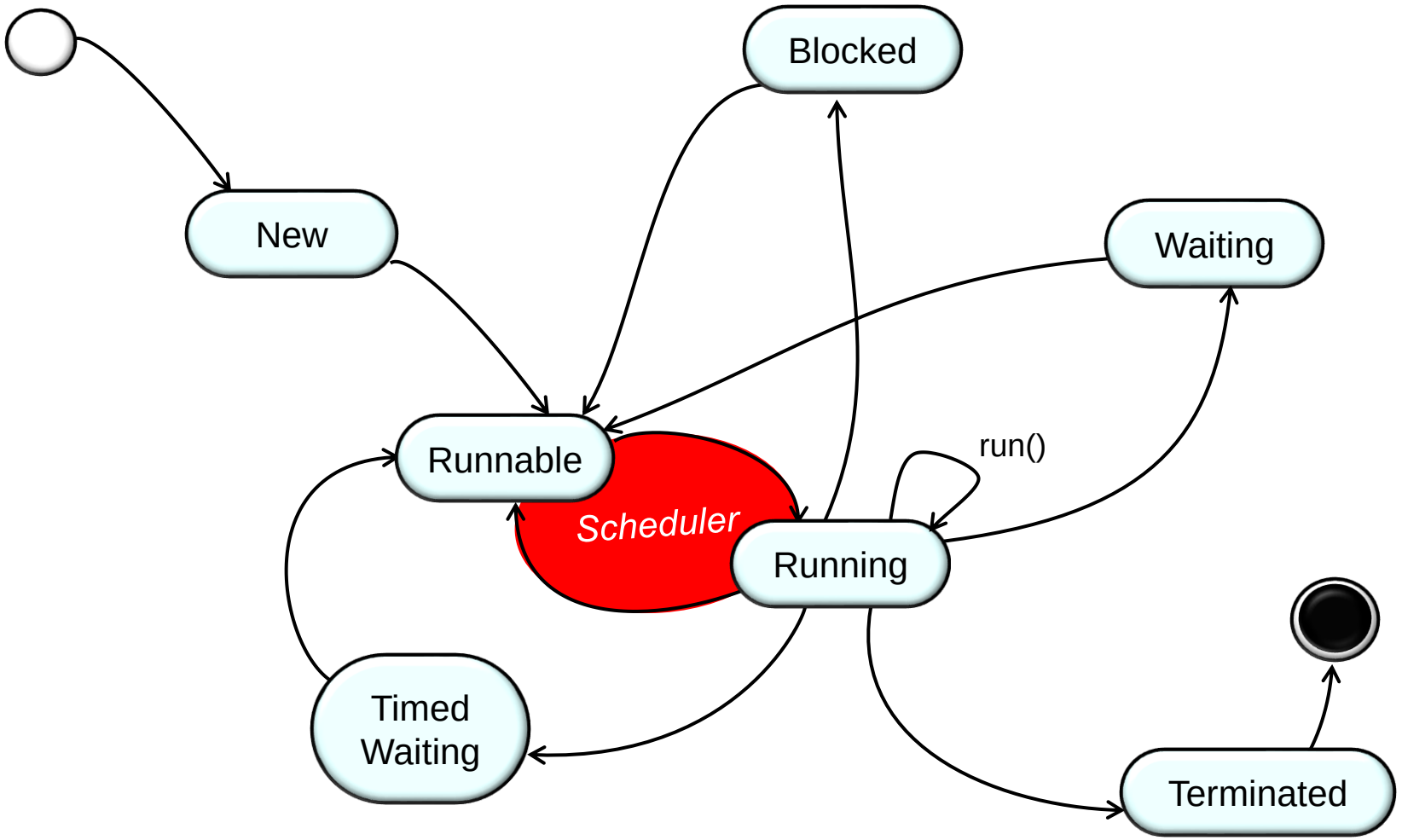
Call start() to launch the thread

The State Machine for the Java Thread Lifecycle



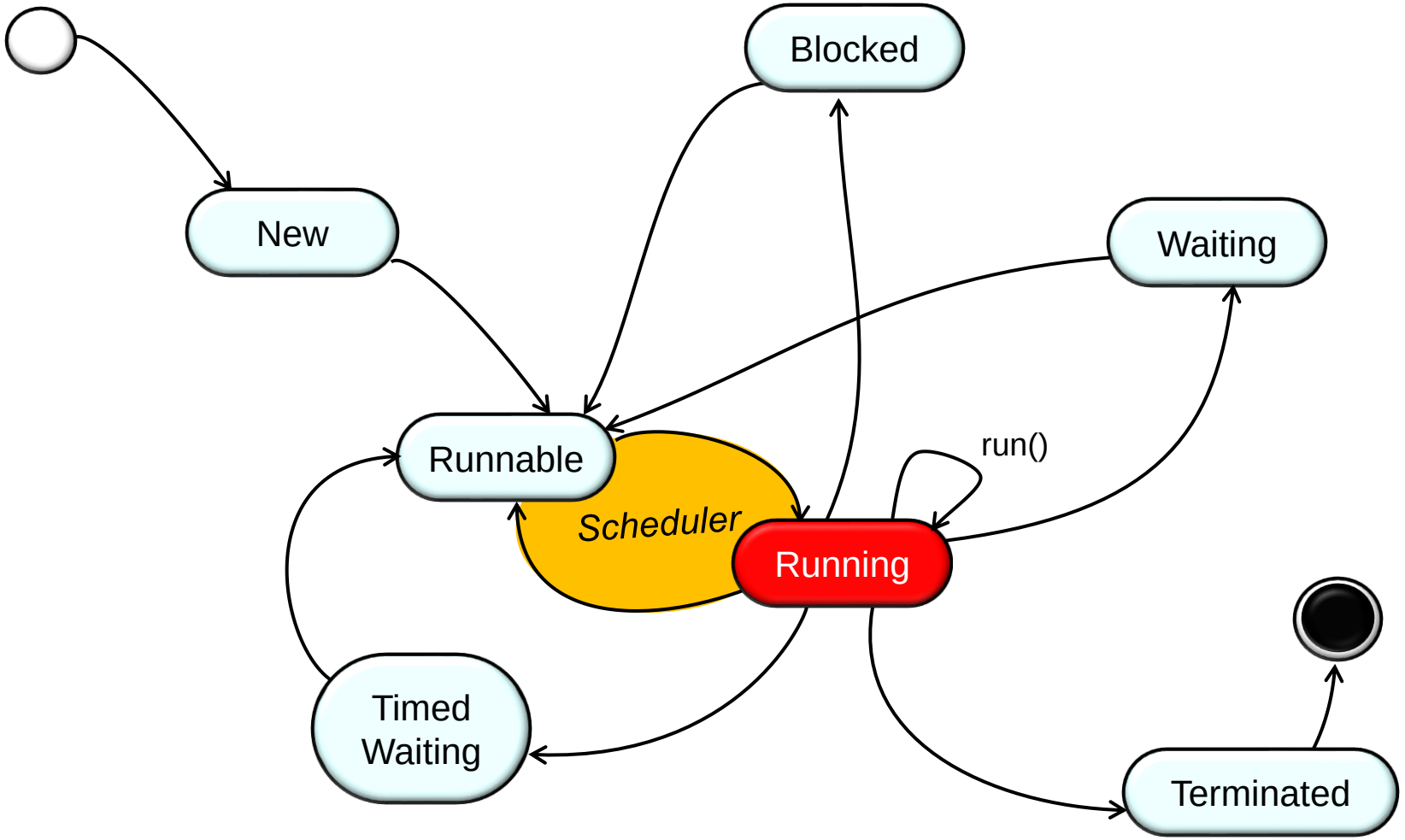
Transitions to the "Runnable" state

The State Machine for the Java Thread Lifecycle



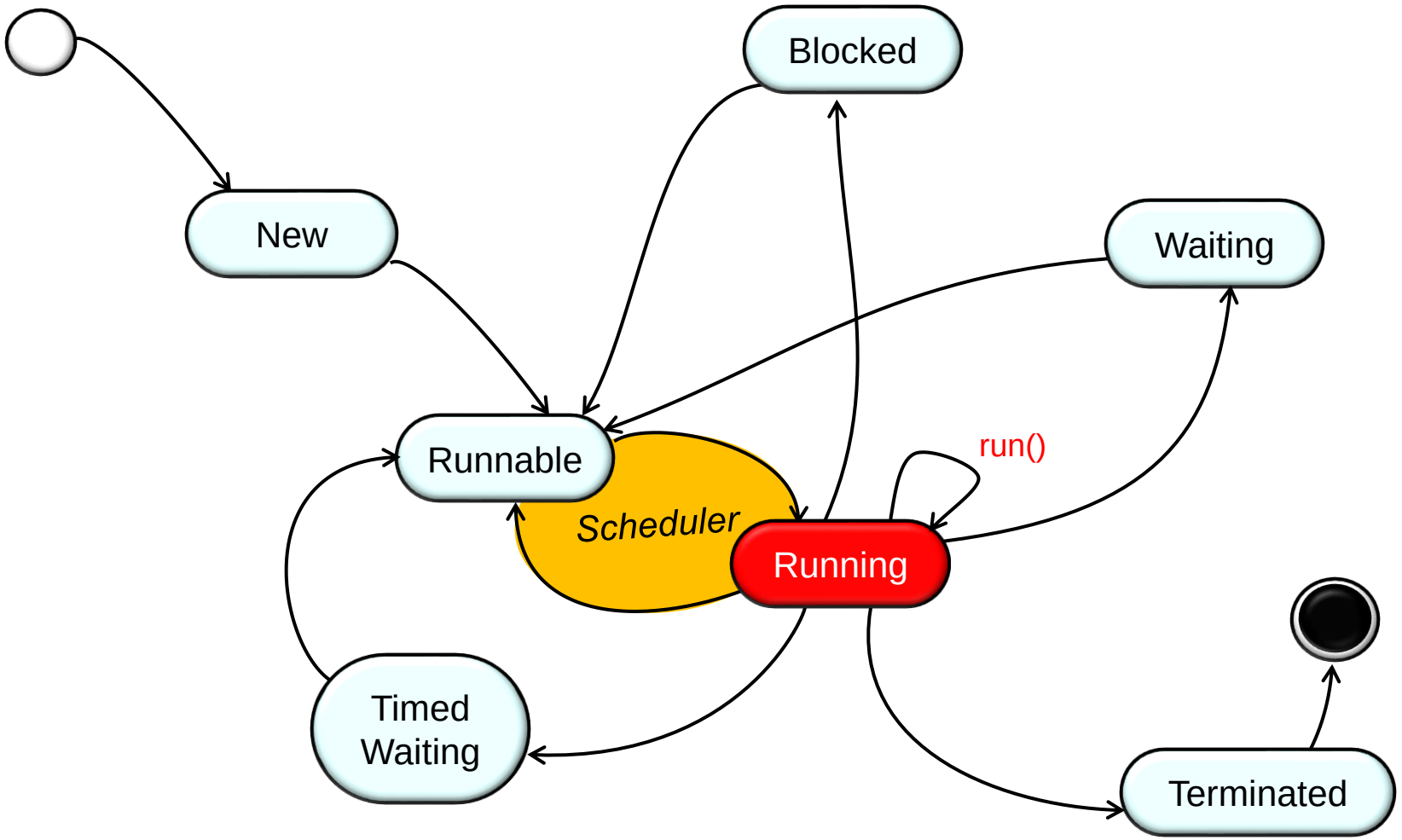
The Java & Android Linux thread scheduler controls what happens next since there may be multiple threads waiting for their chance to run

The State Machine for the Java Thread Lifecycle



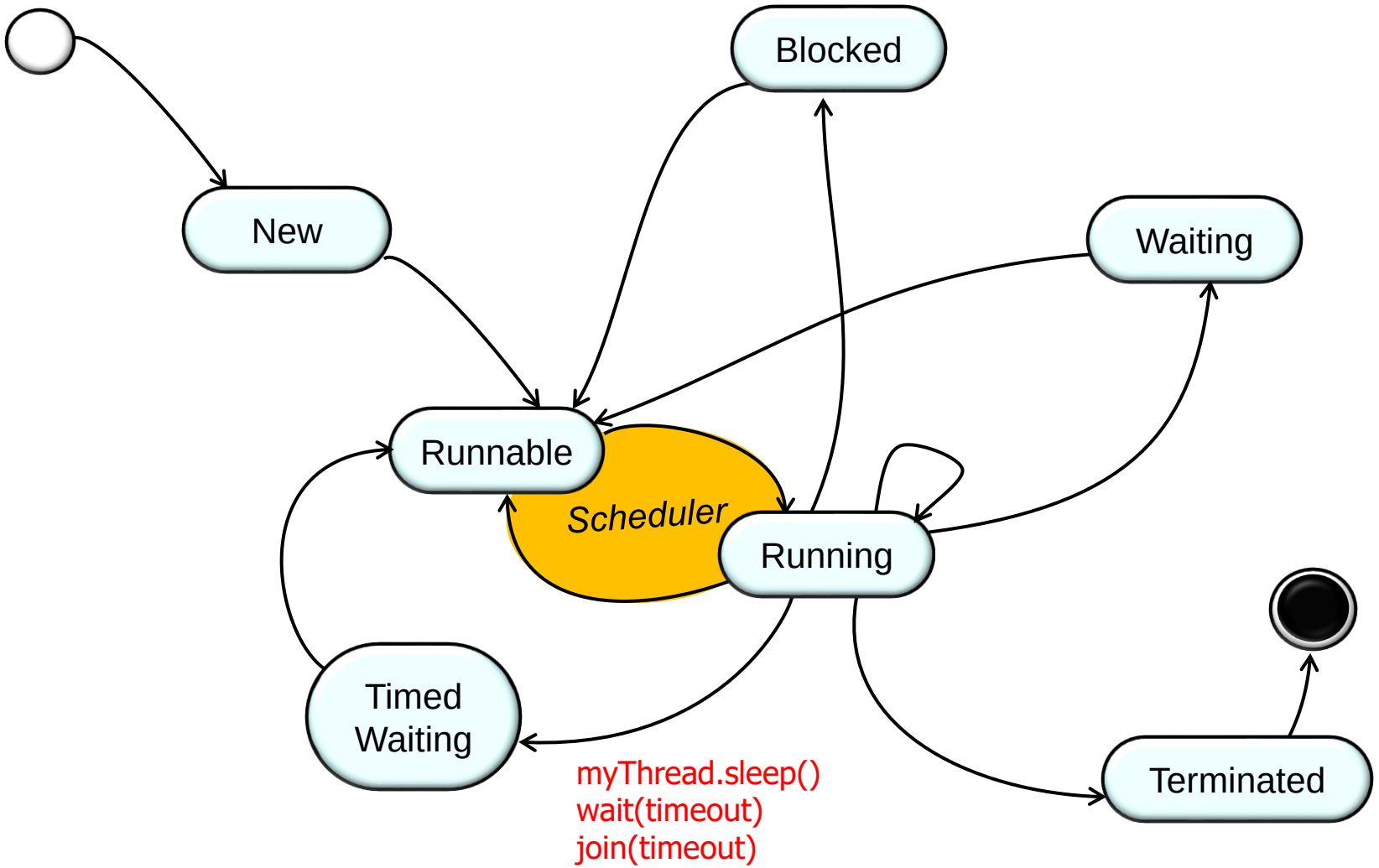
When the scheduler selects a thread to execute it transitions to the "Running" state

The State Machine for the Java Thread Lifecycle



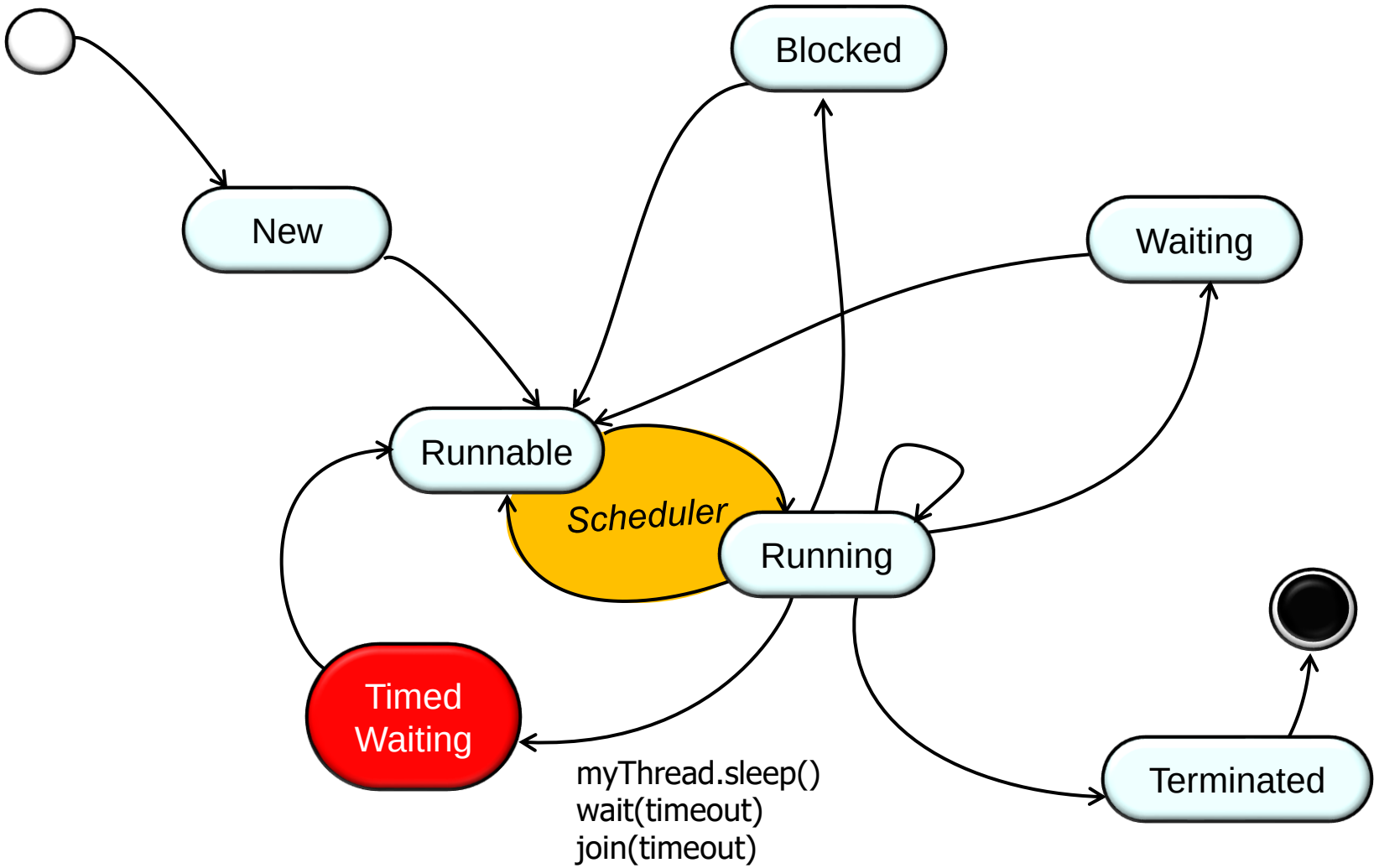
The Java execution environment (e.g., JVM, Dalvik, ART, etc.) then invokes the thread's run() hook method

The State Machine for the Java Thread Lifecycle



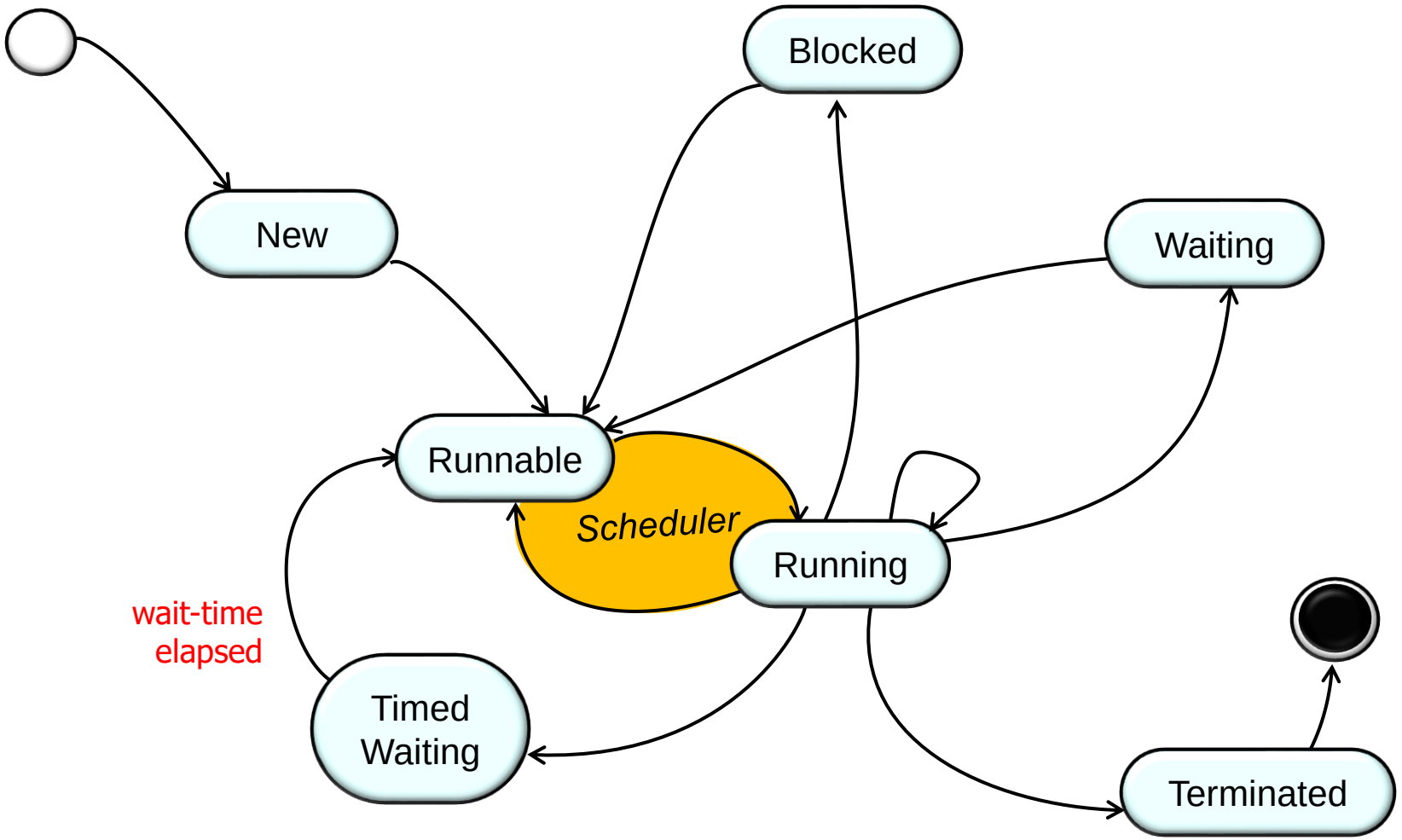
A thread can call various methods that cause it to wait for a period of time, which suspends the thread

The State Machine for the Java Thread Lifecycle



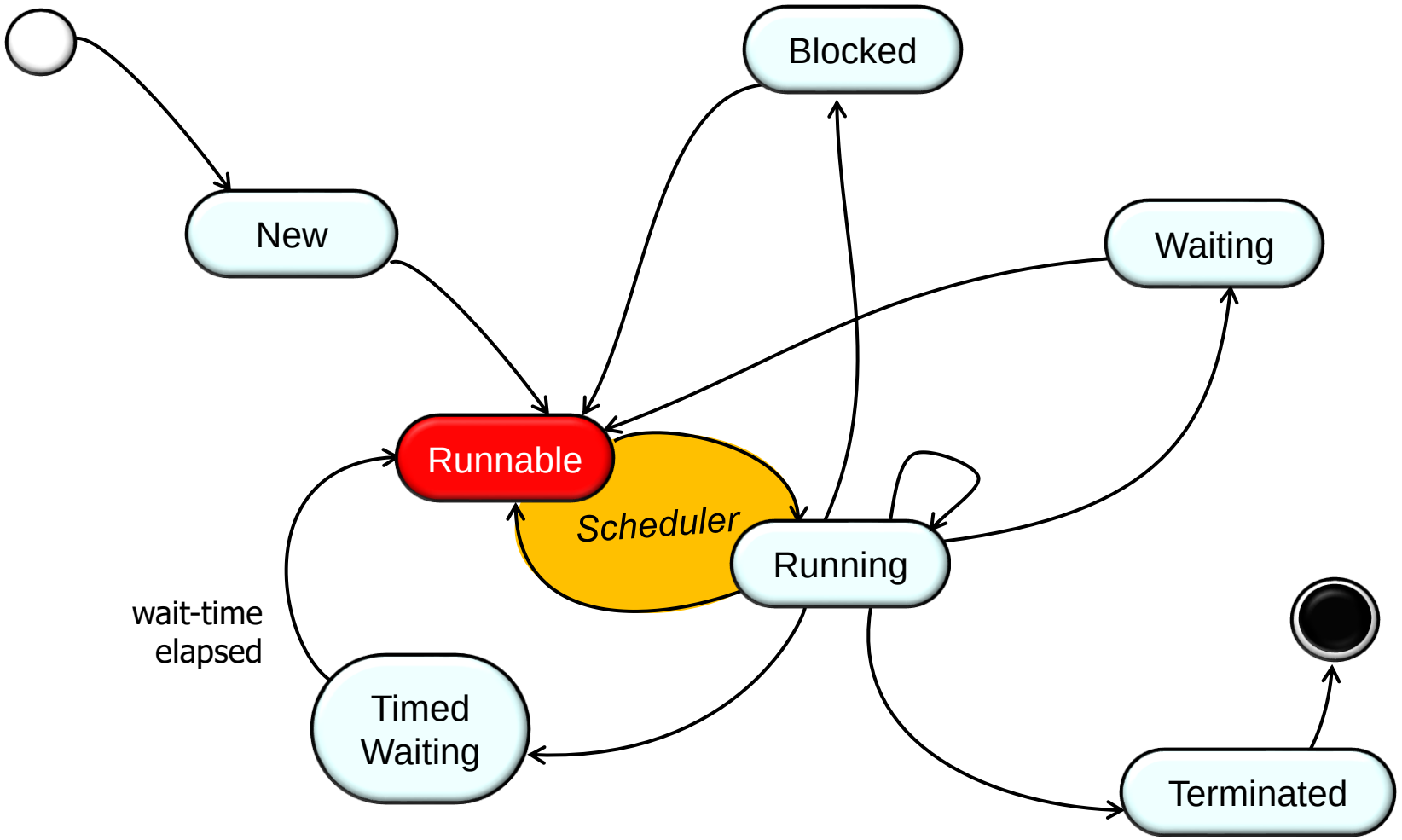
Transitions to the "Timed Waiting" state

The State Machine for the Java Thread Lifecycle



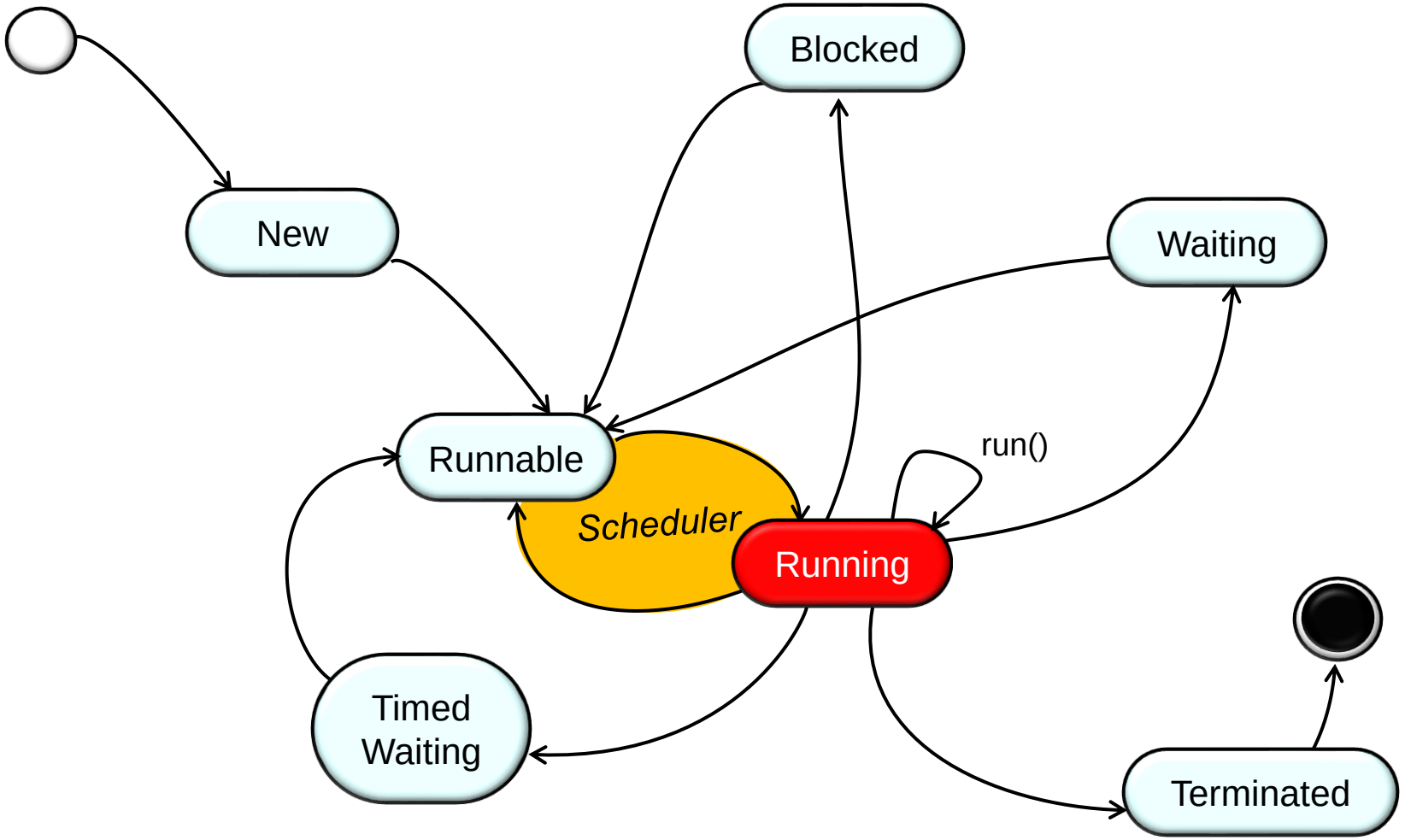
The wait time elapses or the operation completes

The State Machine for the Java Thread Lifecycle



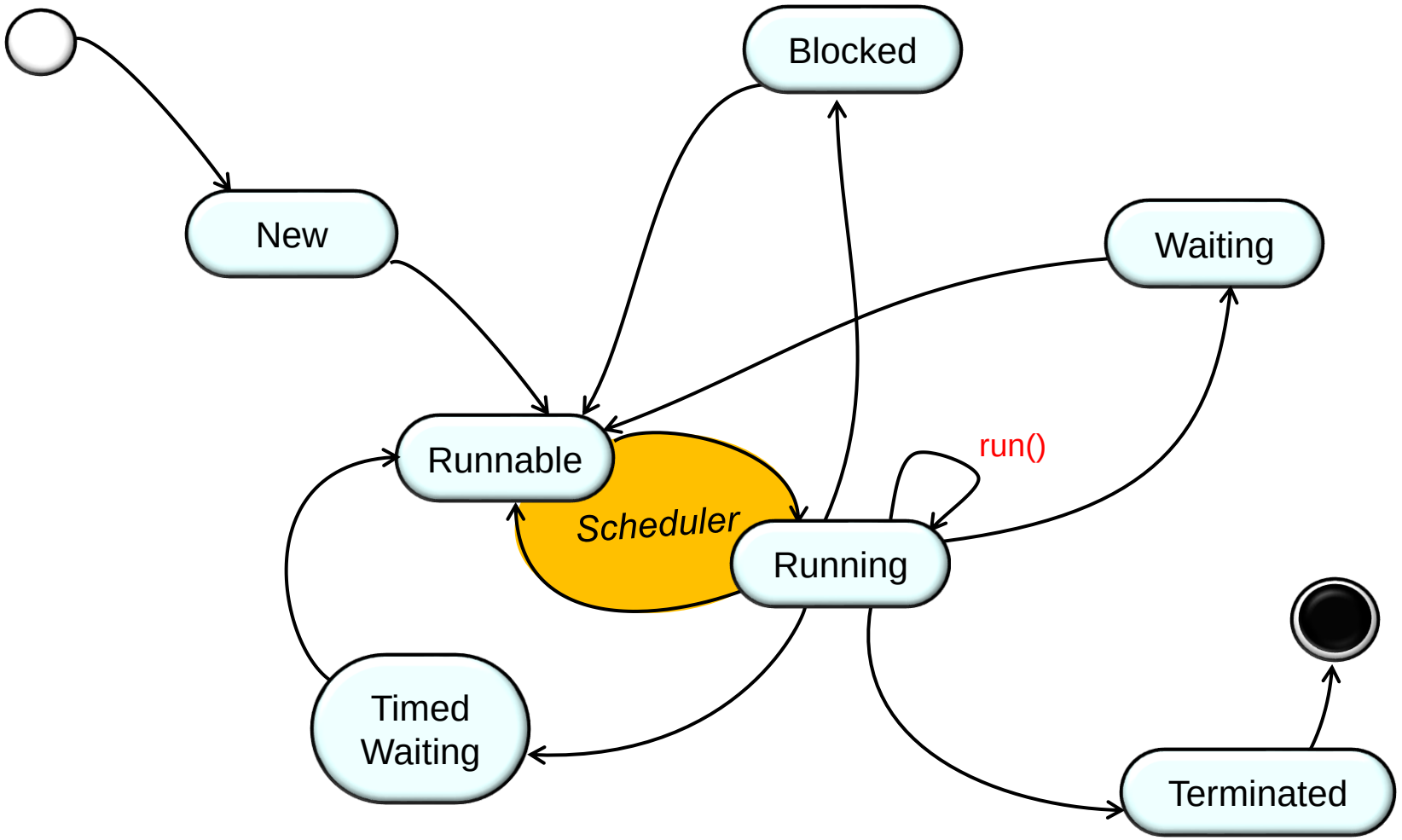
Transitions to the "Runnable" state (i.e., it doesn't start to run immediately)

The State Machine for the Java Thread Lifecycle



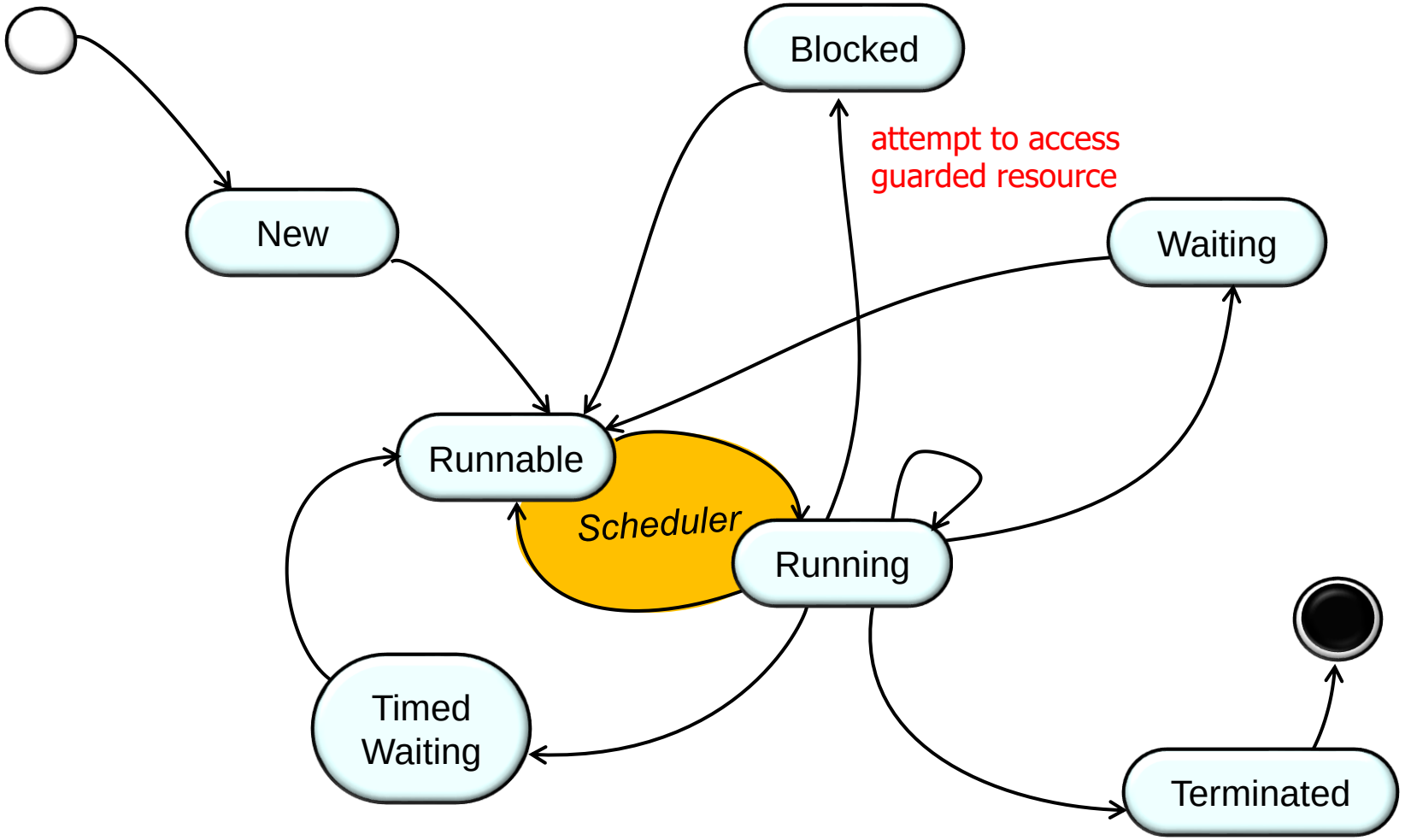
When the scheduler selects a thread to execute it transitions to the "Running" state

The State Machine for the Java Thread Lifecycle



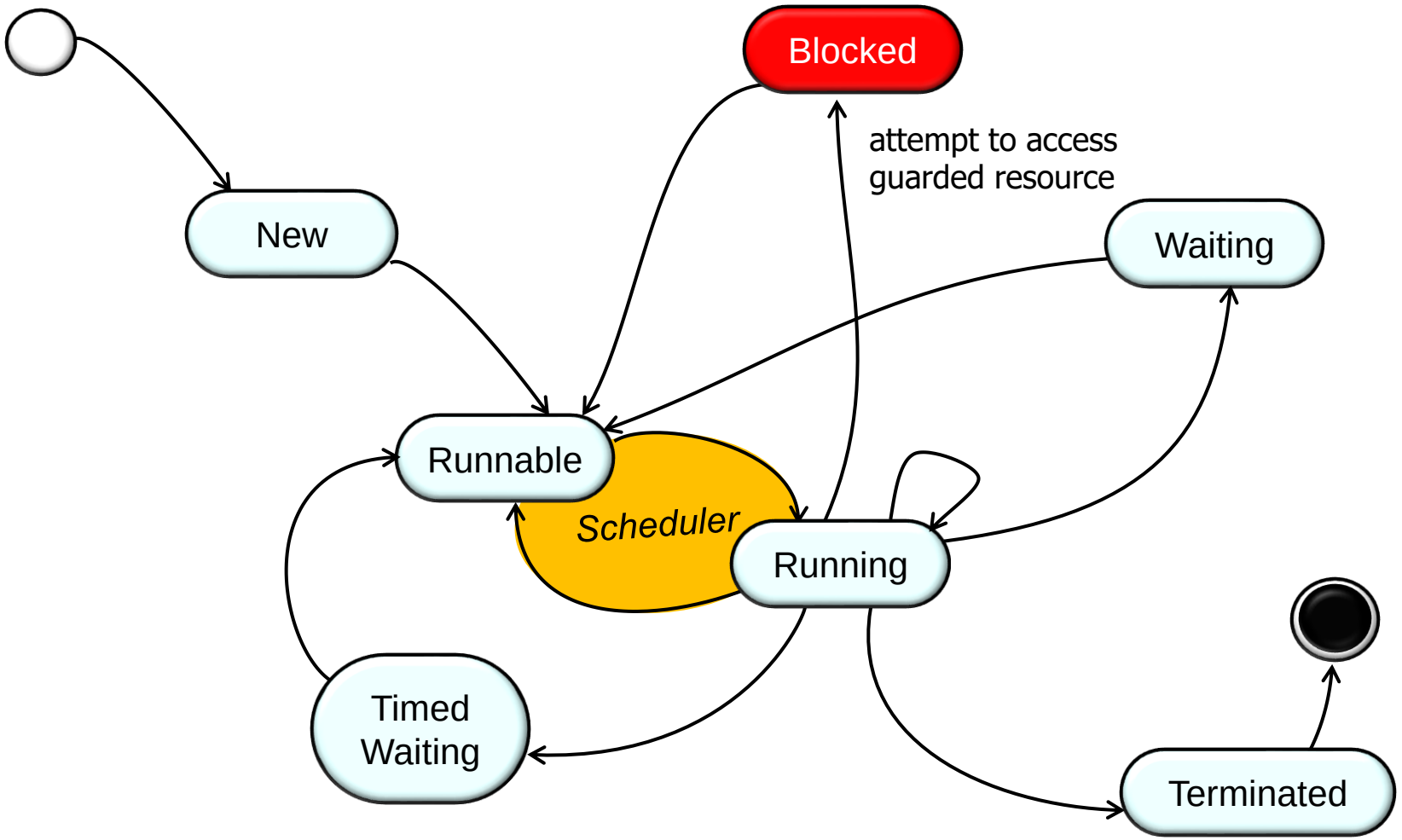
The Java execution environment then resumes executing the method the thread was running when it was suspended

The State Machine for the Java Thread Lifecycle



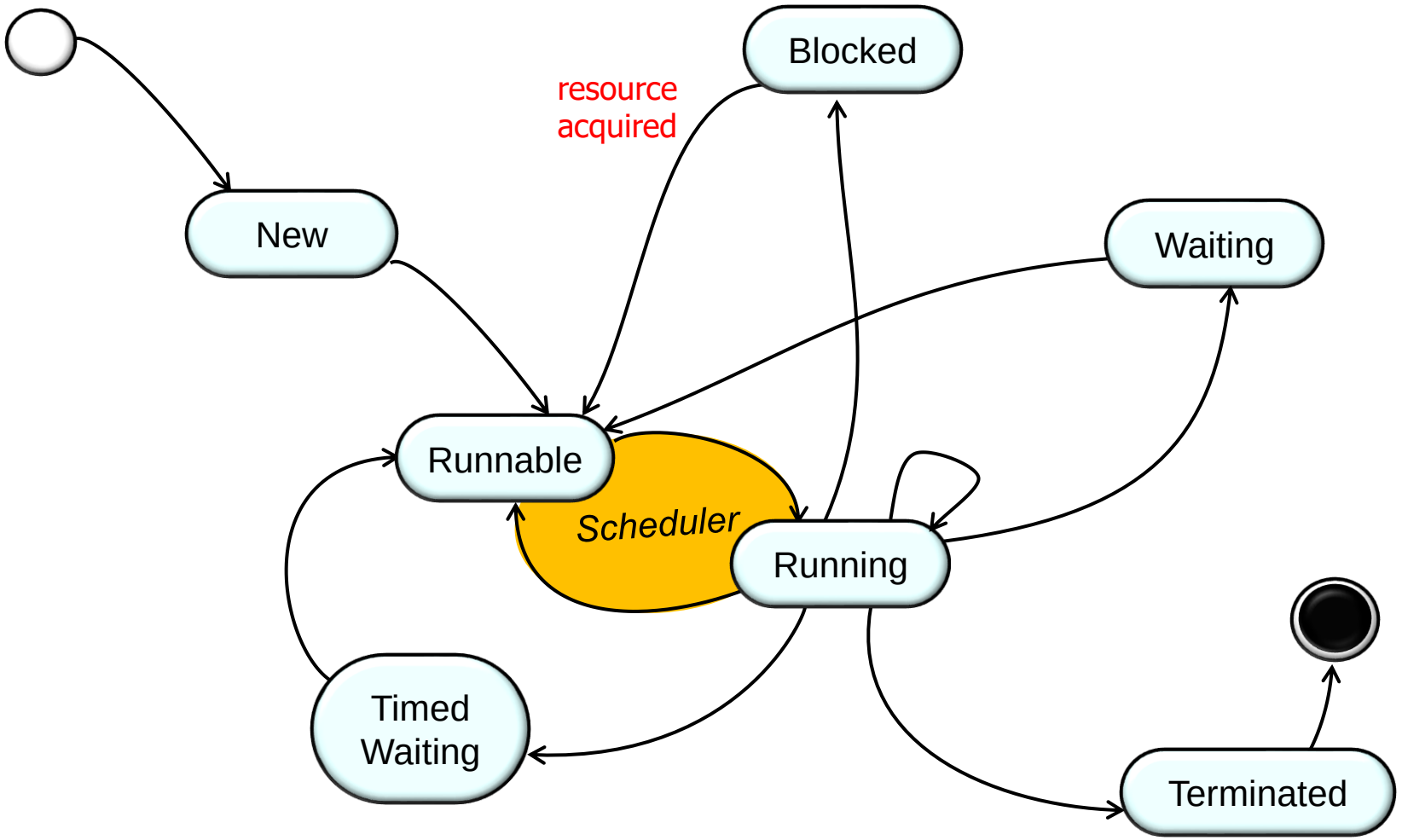
A thread will block (which suspends the thread) when it tries to access a "guarded resource" (e.g., a monitor lock) in use by another thread

The State Machine for the Java Thread Lifecycle



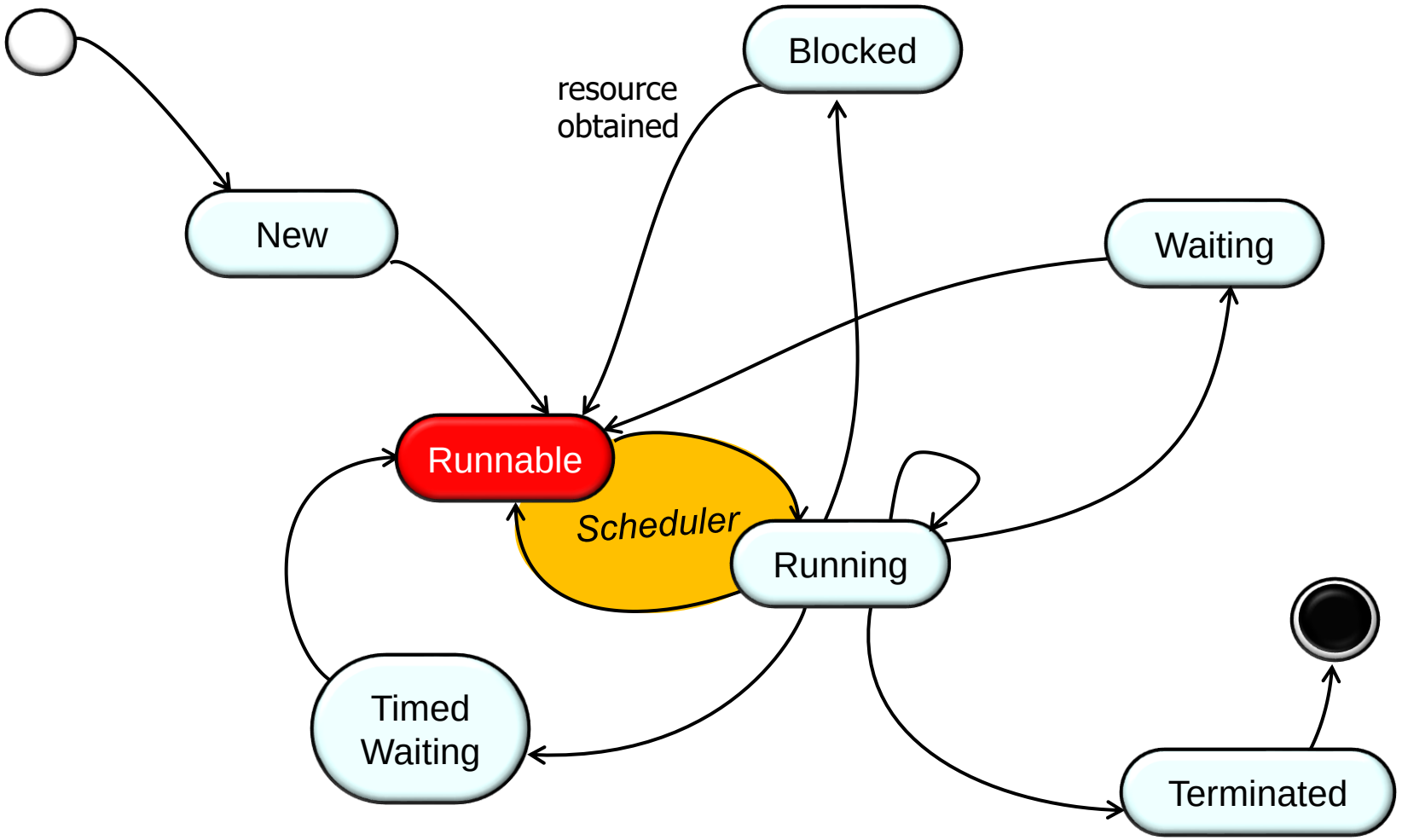
Transitions to the "Blocked" state

The State Machine for the Java Thread Lifecycle



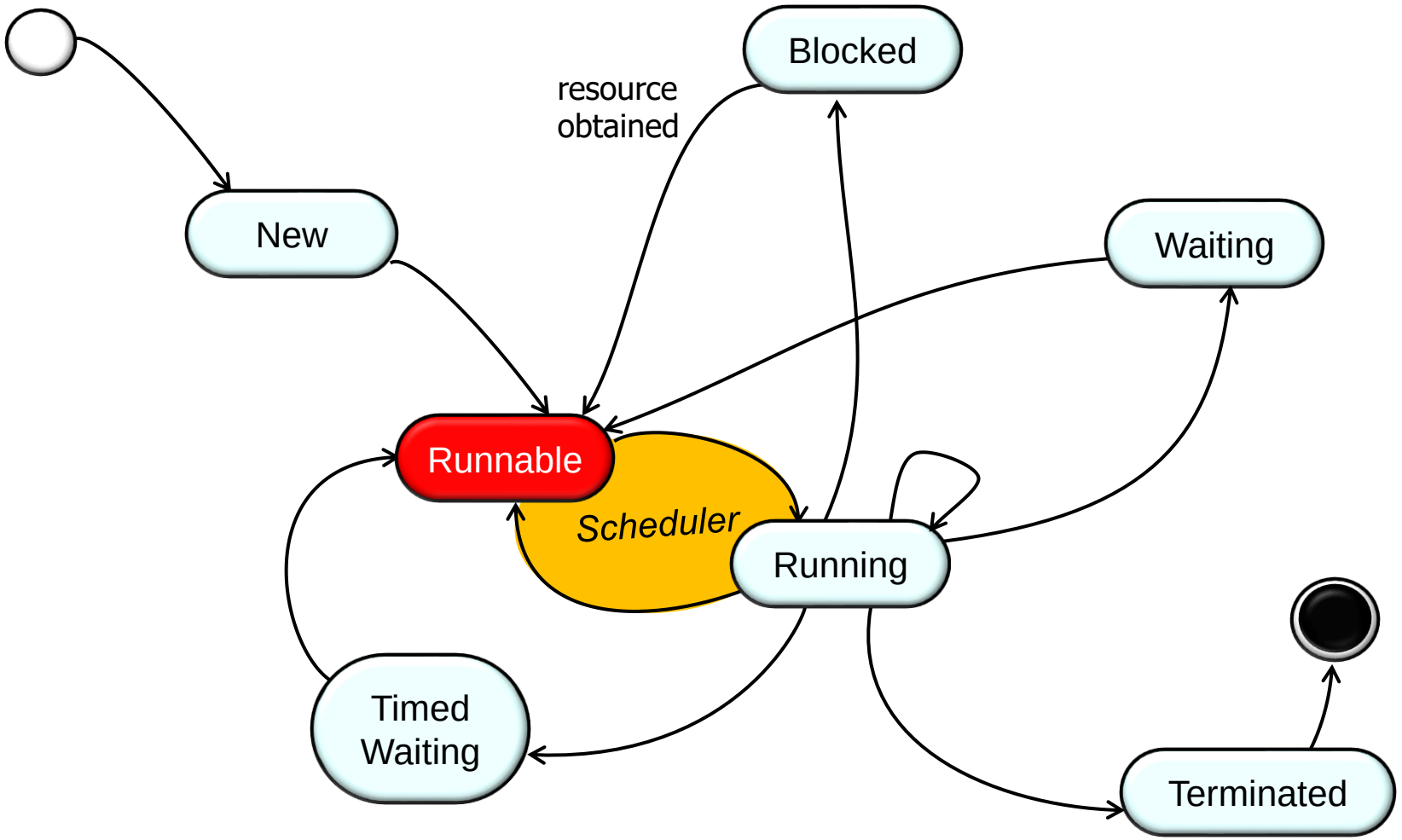
When the resource is released by the other thread the blocked thread will acquire it & become unblocked

The State Machine for the Java Thread Lifecycle



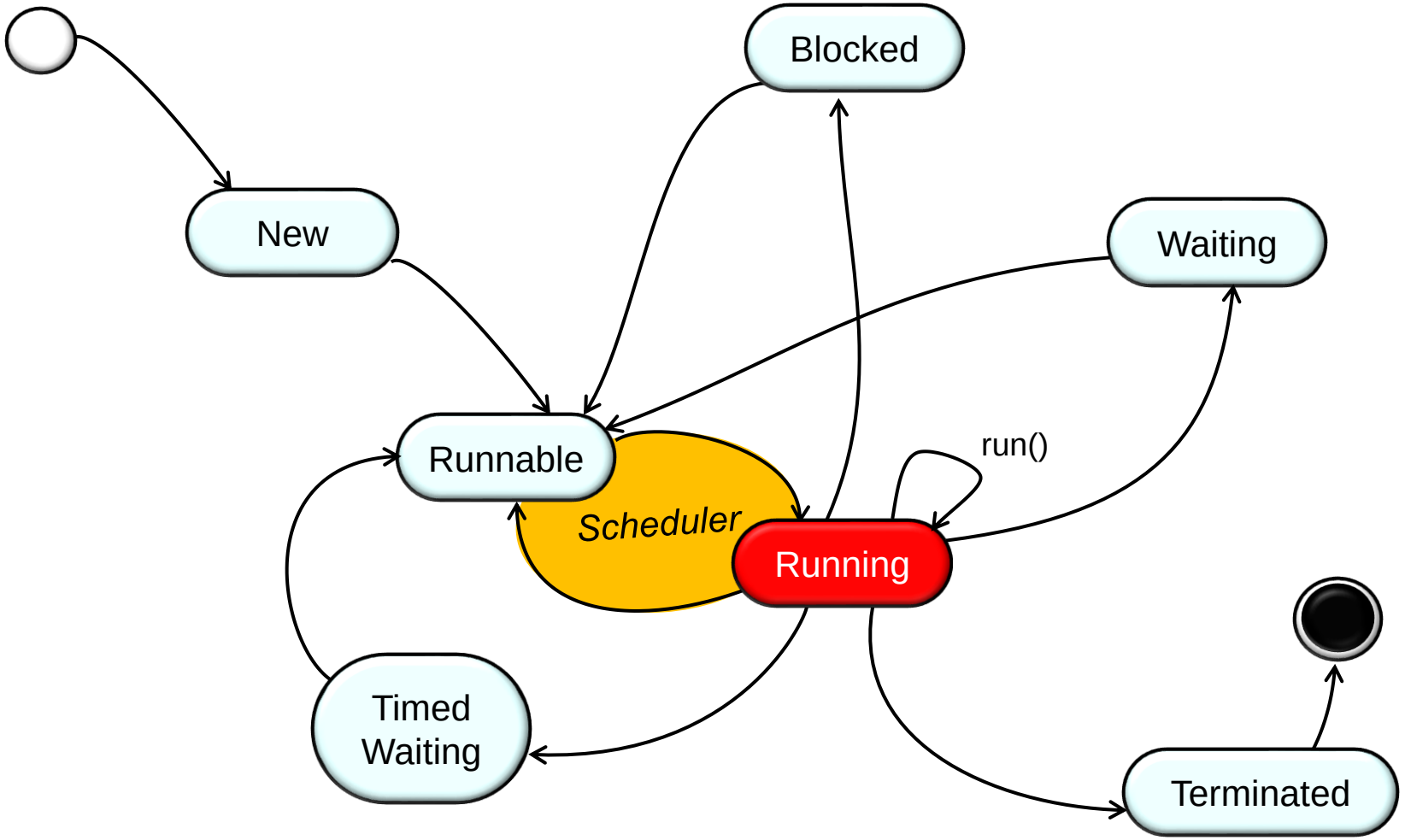
Transitions to the "Runnable" state (i.e., it doesn't start to run immediately)

The State Machine for the Java Thread Lifecycle



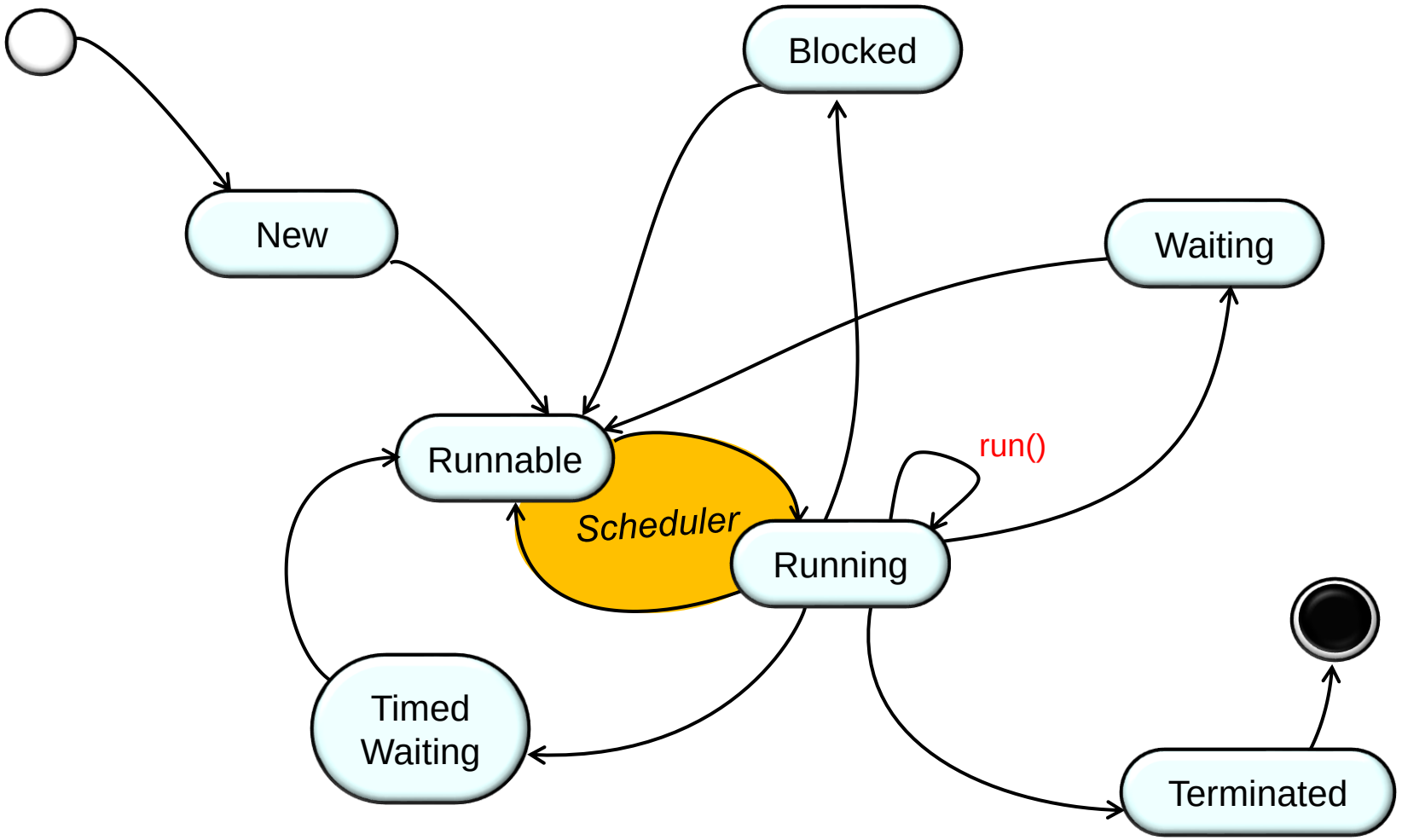
Ironically, the thread state for blocking I/O is "Runnable," as discussed in stackoverflow.com/questions/19981726/java-thread-blocked-status

The State Machine for the Java Thread Lifecycle



When the scheduler selects a thread to execute it transitions to the "Running" state

The State Machine for the Java Thread Lifecycle



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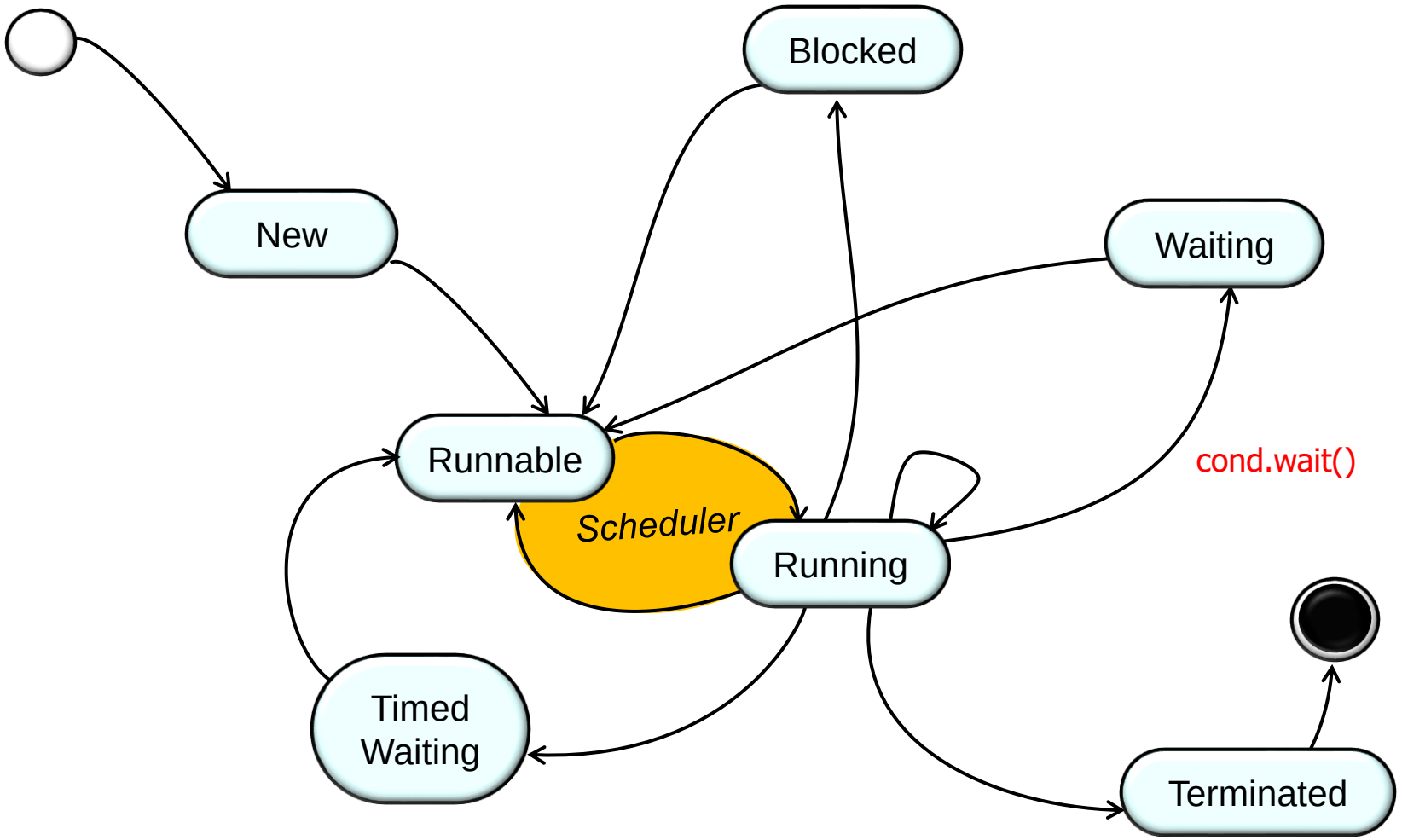
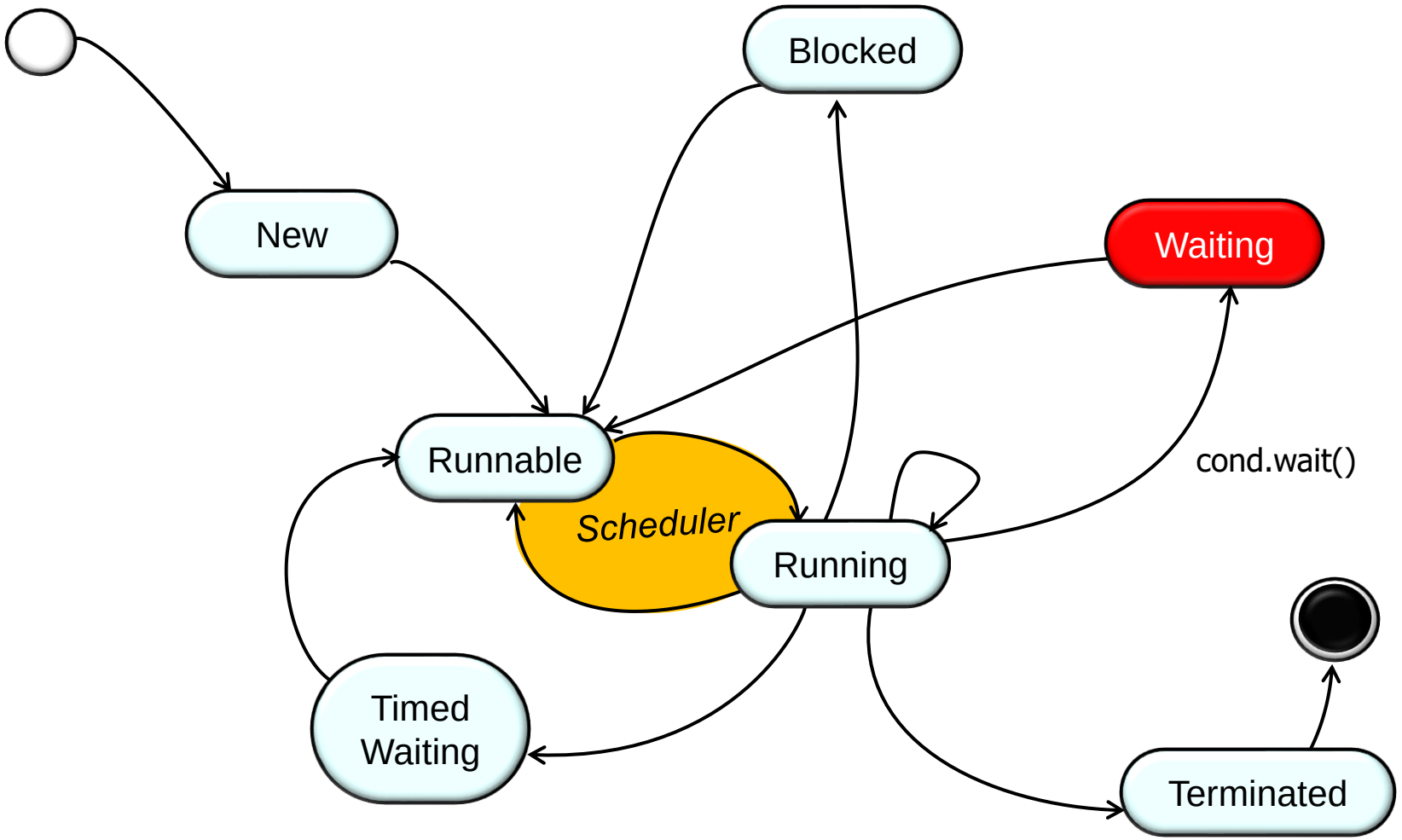
The State Machine for the Java Thread Lifecycle



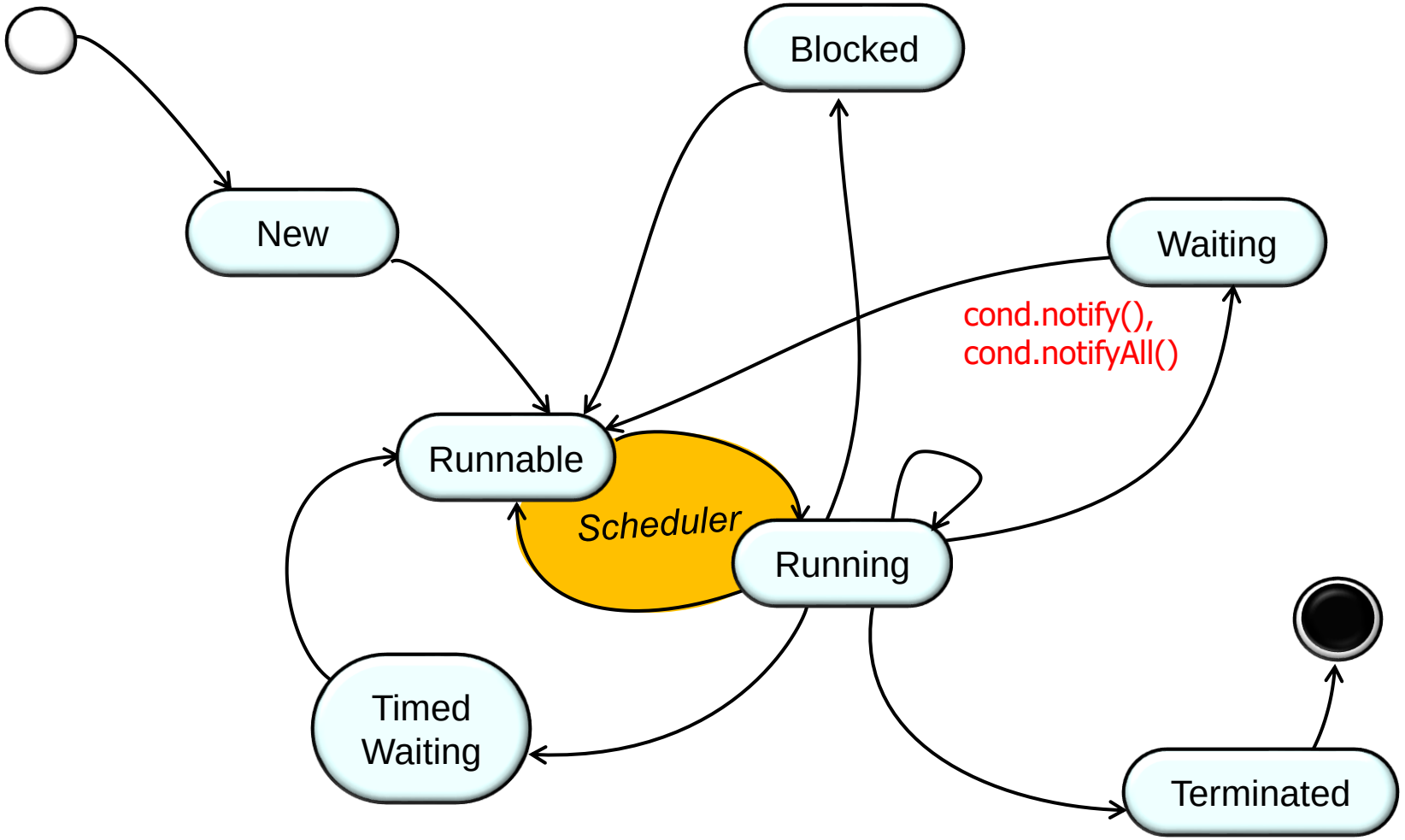
A thread may call wait() on its monitor condition (the monitor lock must have already been acquired), which suspends the thread

The State Machine for the Java Thread Lifecycle



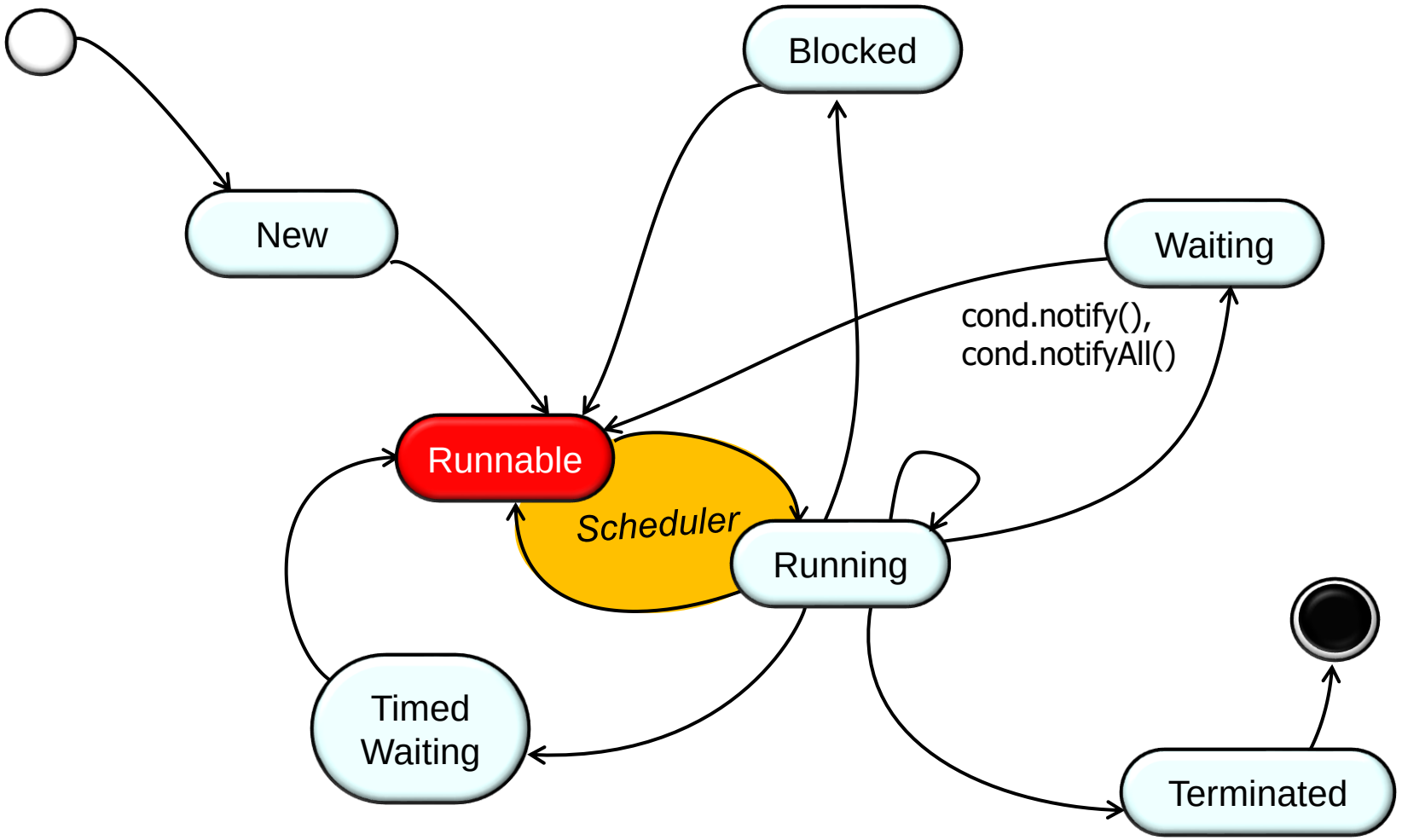
Transitions to the "Waiting" state

The State Machine for the Java Thread Lifecycle



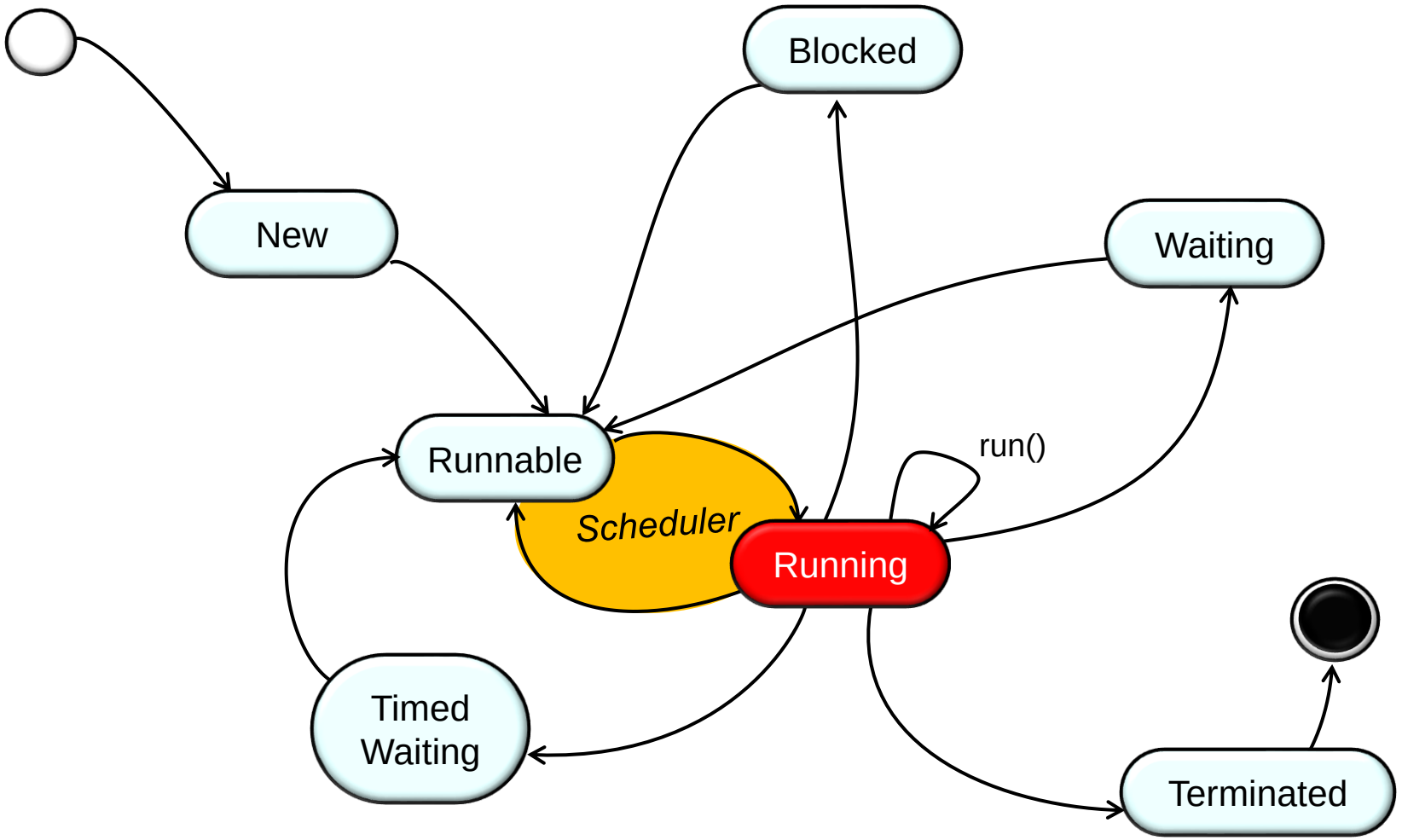
When another thread calls notify() or notifyAll() waiting thread will be released (though it may need to transition to the "Blocked" state to reacquire the lock)

The State Machine for the Java Thread Lifecycle



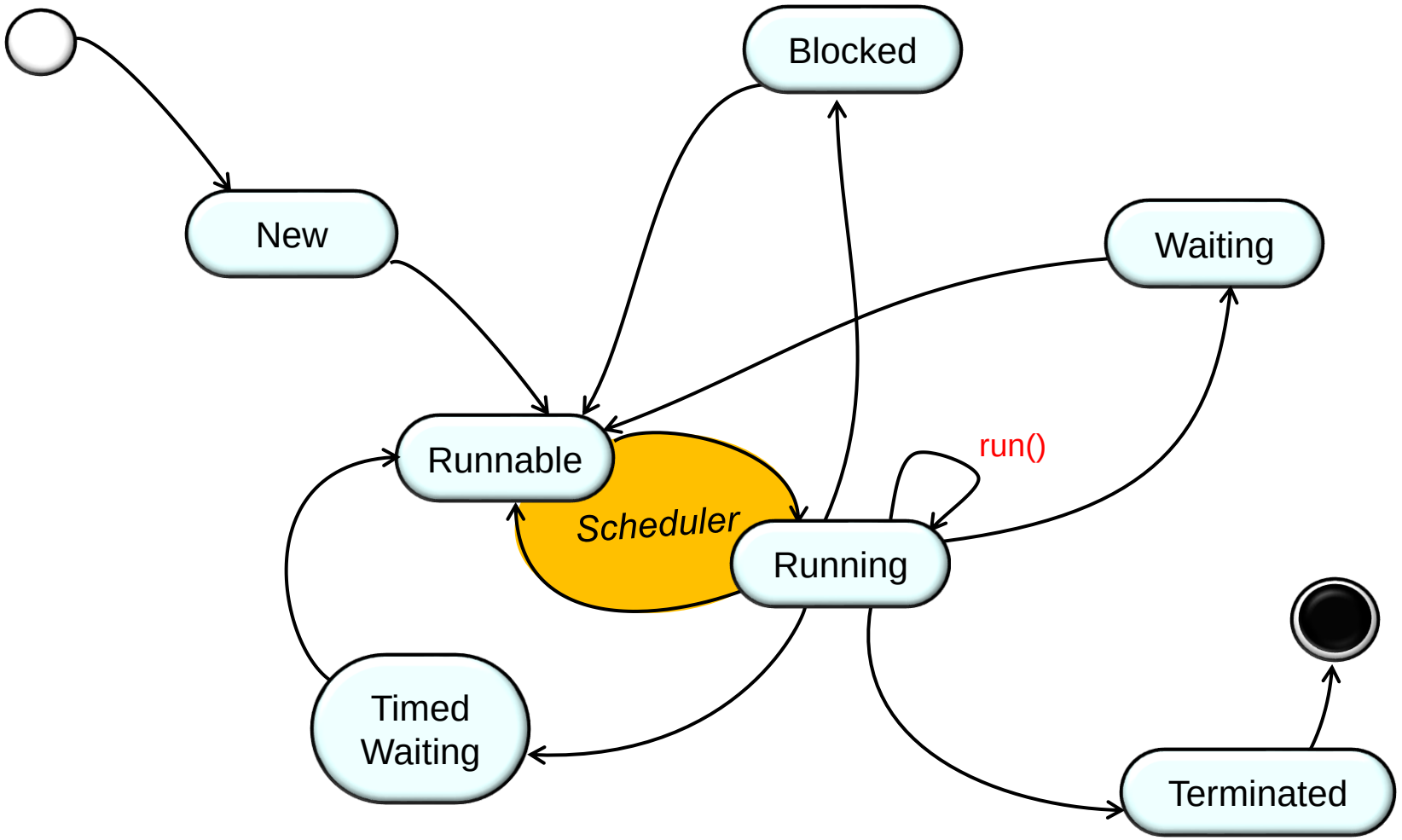
Transitions to the "Runnable" state (i.e., it doesn't start to run immediately)

The State Machine for the Java Thread Lifecycle



Transitions to the "Running" state

The State Machine for the Java Thread Lifecycle



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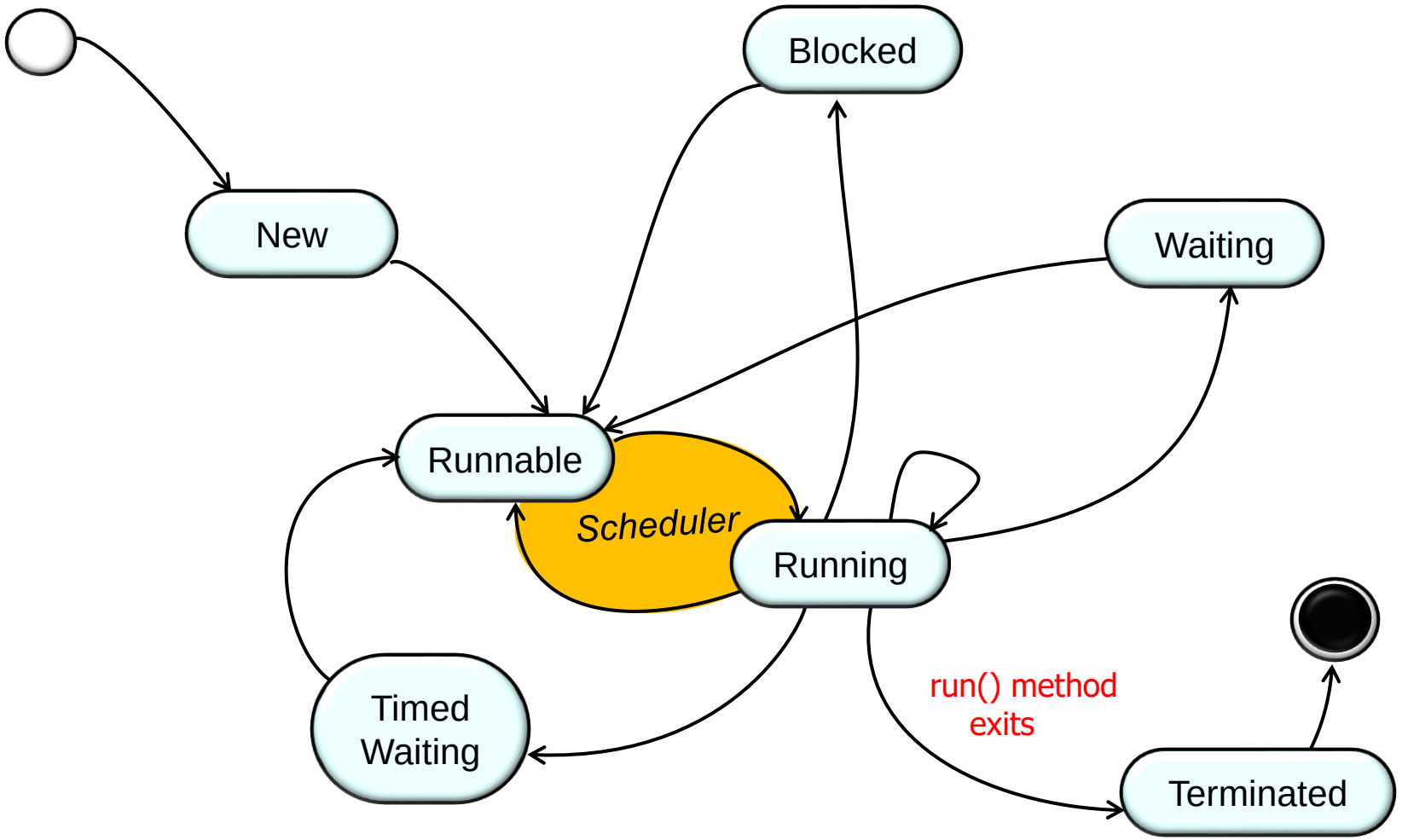
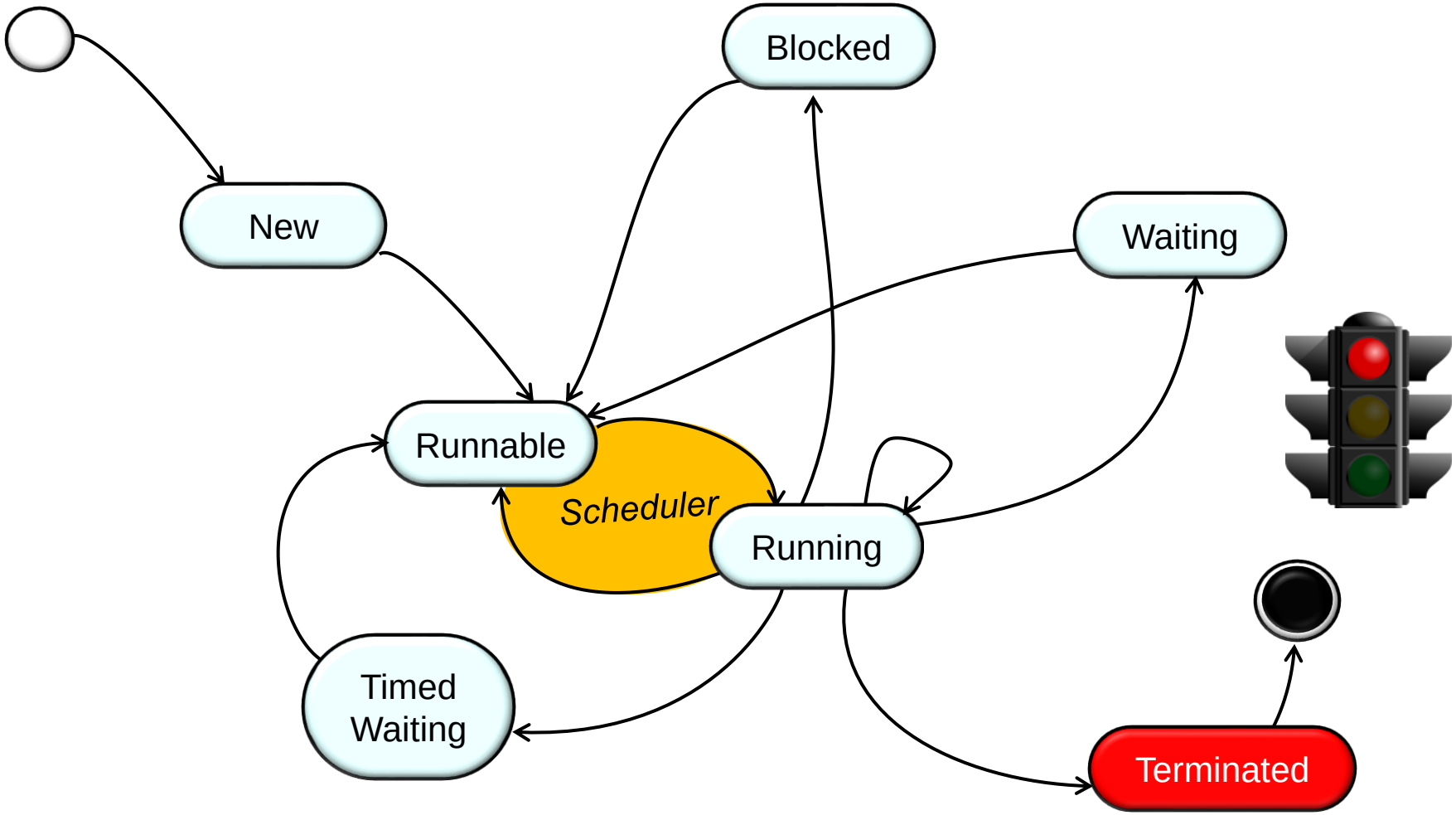
The State Machine for the Java Thread Lifecycle



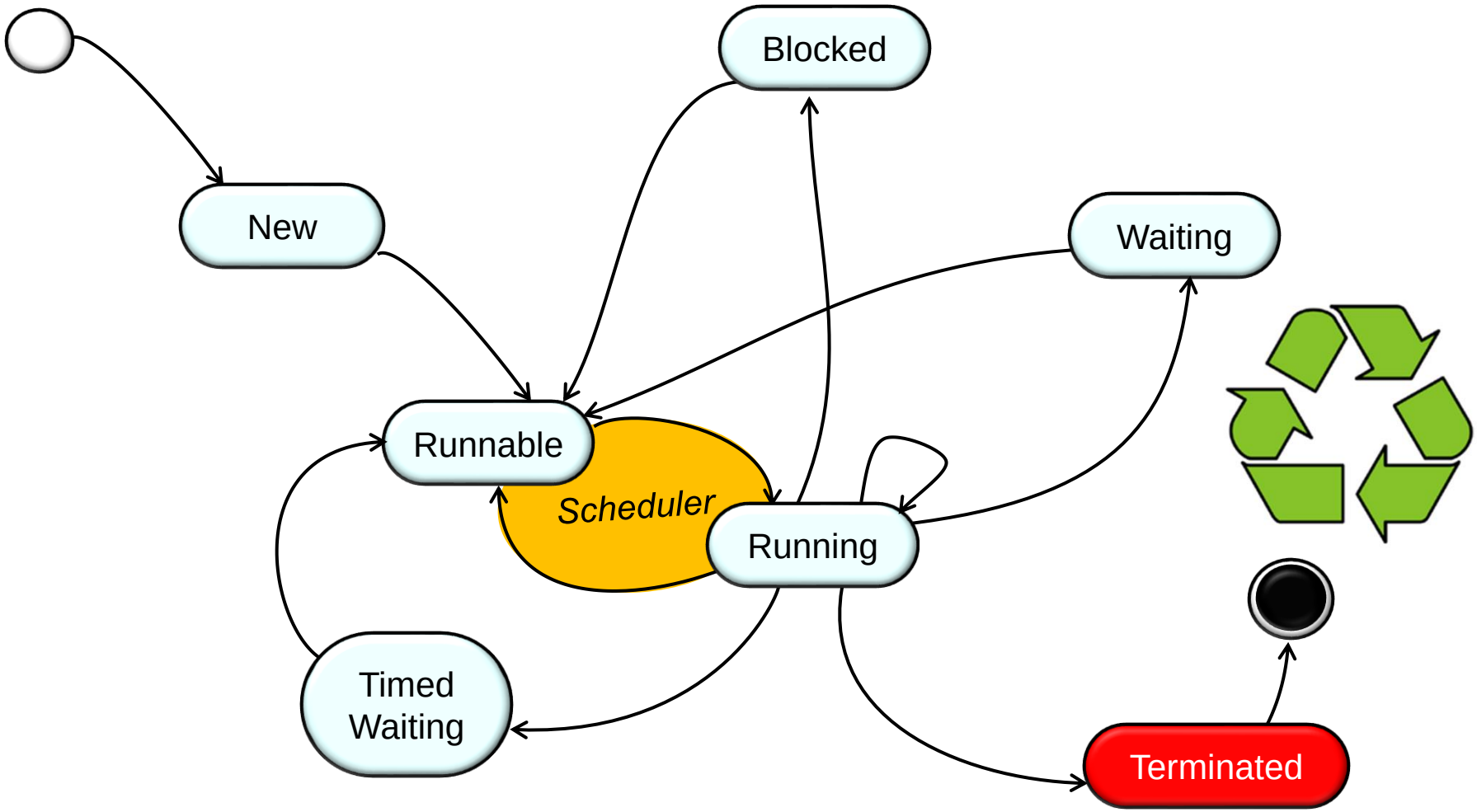
The run() method can exit either normally (by "falling off the end" of run()) or via an unhandled exception

The State Machine for the Java Thread Lifecycle



Transitions to the "Terminated" state

The State Machine for the Java Thread Lifecycle



The Java execution environment can then reclaim the thread's resources

End of Managing the Java Thread Lifecycle: State Machine for Java Threads