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Multithreading

Thread Pools and Work Queues

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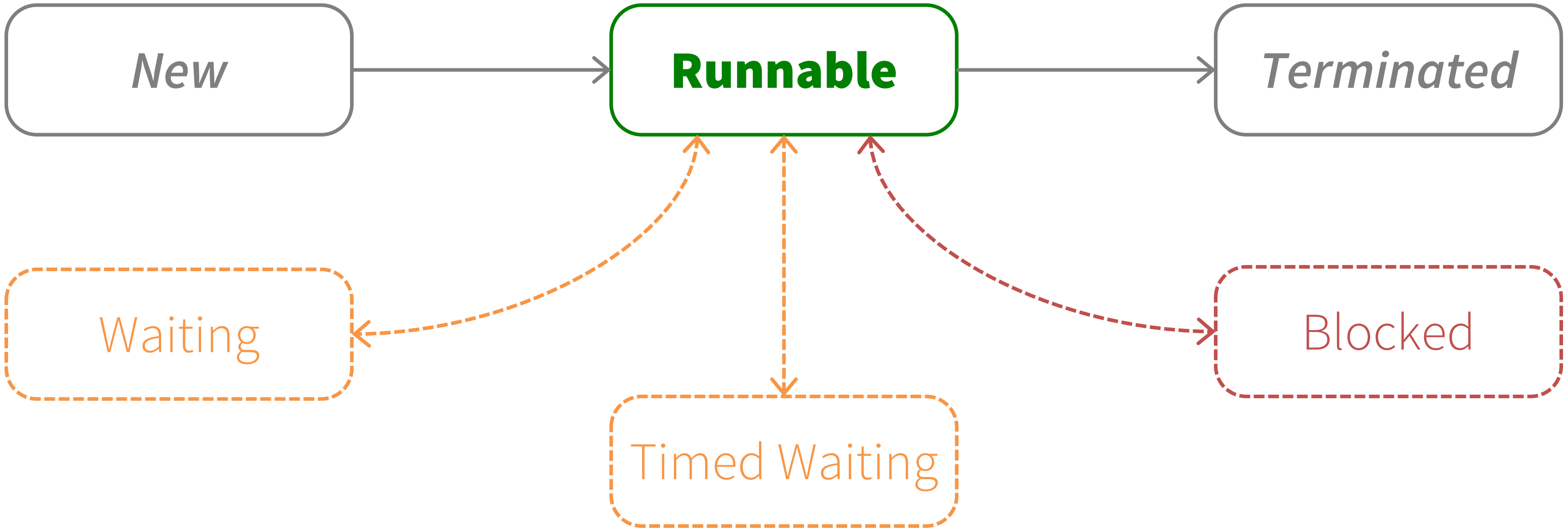
Thread States



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

Motivation

- **Goal: Web Server**
  - Must handle multiple simultaneous requests
  - Must be **responsive** AND **efficient** (e.g. respond quickly, finish quickly)
- **Implementation: Multithreading**
  - One thread per request?

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Problems

- Overhead cost to **creating objects**
  - Initialization in constructor (and `super()` calls)
- Overhead cost to **destroying objects**
  - Garbage collection
- Overhead cost to **excessive memory usage**
  - Causes thrashing

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Solutions

- Keep Threads Around
  - Initialize a "wise" number of threads once
  - Reuse threads for other tasks instead of destroying
- Two Approaches
  - Thread pool
  - Work queue

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Thread Pools

- Create a fixed number of worker threads
- When have work to do…
  - Get available thread from pool and assign task
  - Thread runs assigned task
  - Thread returns to pool of available threads
- What if there are no available threads?

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Work Queue

- Add a work queue to thread pool
- Threads check for available work in queue
  - Usually remove work in FIFO fashion
  - If no work, thread waits until queue is not empty
- When have work to do…
  - Add work to queue and return

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Keeping Threads Around

- **Thread Pools**
  - Basically an array of threads that sticks around
  - Simple, but causes blocking
- **Work Queues**
  - Adds a queue of "work" (runnable objects)
  - More complicated, but responsive

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IBM Work Queue

Java Theory and Practice:
Thread Pools and Work Queues
IBM developerWorks
http://www.ibm.com/developerworks/library/j-jtp0730/index.html

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