

Concurrent Programming in Java

Thread Pools

- Use a collection of worker threads, not just one
 - ◆ Can limit maximum number and priorities of threads
 - ◆ Dynamic worker thread management
 - Sophisticated policy controls
 - ◆ Often faster than thread-per-message for I/O bound actions

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Concurrent Programming in Java

Web Server Using Thread Pool

- `PooledExecutor` from the `dl.util.concurrent` package

```

import EDU.oswego.cs.dl.util.concurrent.PooledExecutor;

private PooledExecutor pool; // WebServer16
public synchronized void startServer() throws ... {
    // ... as before
    pool = new PooledExecutor();
    serverThread = new Thread(new ConnectionHandler());
    serverThread.start();
}

private class ConnectionHandler implements Runnable {
    public void run() {
        RequestHandler r = null;
        try {
            while (!Thread.interrupted()) {
                r = new RequestHandler(server.accept());
                pool.execute(r);
            }
        }
        // ... as before
    }
}

public void shutdownServer() throws ... {
    // ... as before
    serverThread.interrupt();
    serverThread.join();
    pool.interruptAll();
    server.close();
}

```

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Policies and Parameters for Thread Pools

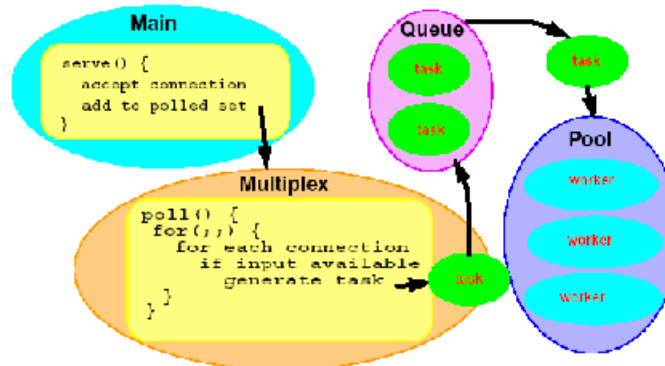
- The kind of channel used as task queue
 - ◆ Unbounded queue, bounded queue, synchronous hand-off, priority queue, ordering by task dependencies, stream, socket
- Bounding resources
 - ◆ Maximum number of threads
 - ◆ Minimum number of threads
 - ◆ “Warm” versus on-demand threads
 - ◆ Keepalive interval until idle threads die
 - Later replaced by new threads if necessary
- Saturation policy
 - ◆ Block, drop, producer-runs, etc
- These policies and parameters can interact in subtle ways!

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Pools in Connection-Based Designs

- For systems with many open connections (sockets), but relatively few active at any given time
- Multiplex the delegations to worker threads via polling
 - ◆ Requires underlying support for select/poll and nonblocking I/O
 - ◆ Supported in JDK1.4 `java.nio`



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