Swing Implementation Issues

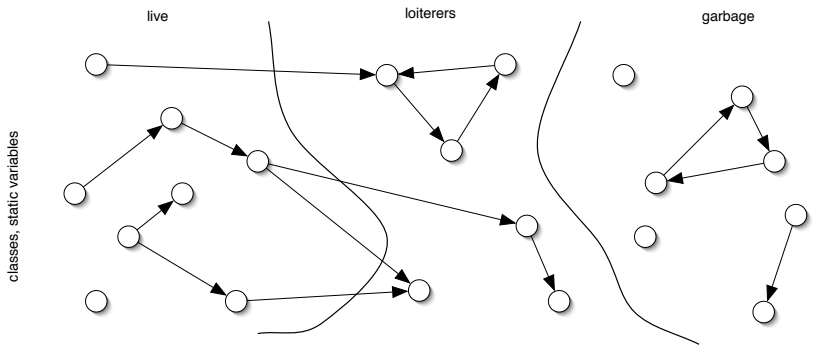
- Strange as it may seem, Swing has implementation issues that sound a lot like operating system concepts:
  - Memory management — specifically, memory leaks (what??? in Java???)
  - Process management — a.k.a. some implications of Swing's single-threaded nature
- Fortunately, there are ways to address these issues, though they may change the way you have written code so far

Implementation Testing Aids

Good	Operating system tools: memory or process monitors can show coarse-grained memory or threading issues
Better (sort of)	In-software instrumentation: code can explicitly detect or report the status of threads, object existence
Best	Java profilers — they allow instrumentation without needing explicit code, and have pretty good user interfaces, too: JProfiler, OptimizeIt

Caveat Listener

- Yes, improperly written Swing programs *can* and *do* leak memory
- The main cause comes from orphaned listeners ("loiterers") for the Java/Swing event model:



Don't Lose Track of Your Listeners

- Listeners are primarily for "non-deterministic" and "asynchronous" notification:
  - User activity
  - Network notifications
  - Updates from unknown sources
- Treat listeners like pointers in other languages — when you don't need them anymore, disconnect them
  - Use addNotify() / removeNotify()
  - Hold onto listeners as instance variables

Swing is Single-Threaded

- While you won't find this in the tutorials, you *will* find a good write-up (3, in fact) on threads and Swing in the Swing Connection Web site. Consider these articles as your primary reference for this subject:

  http://java.sun.com/products/jfc/tsc/articles/threads/threads[1|2|3].html

- The main points, in a nutshell:

  1. Swing is single-threaded: the "event dispatch thread"
  2. Swing components must be touched only from within this thread — *and absolutely nowhere else*

Threading Ground Rules

- If you're going to change a Swing component (set, add, remove, anything), *do it on the Swing thread* — the article's official wording is "*all code that might affect or depend on the state of that component*"
- There are a few exceptions: *repaint()*, *revalidate()*, *invalidate()*; add/remove listener methods
- Put any lengthy, unpredictable, or otherwise non-UI activity on a different thread
- …but how about user interface feedback?

SwingUtilities to the Rescue

- SwingUtilities provides a number of static methods that assist in threading:
  - *public static boolean isEventDispatchThread()* tells you if you are on the Swing thread
  - *public static void invokeLater(Runnable)* posts some code (as a Runnable) for execution in the Swing thread at the next possible opportunity
- For threaded operations that follow certain operational flows, some wrapper classes are available…

Common Threading Models

- *SwingWorker* (available through Swing Connection threading articles) — for long, non-UI tasks followed by Swing feedback
- *ProgressMonitor*, *ProgressMonitorInputStream* — for long tasks that require on-going progress feedback
  - My personal opinion — not recommended; not enough control of user interface
  - But adequate for quickie threading/feedback