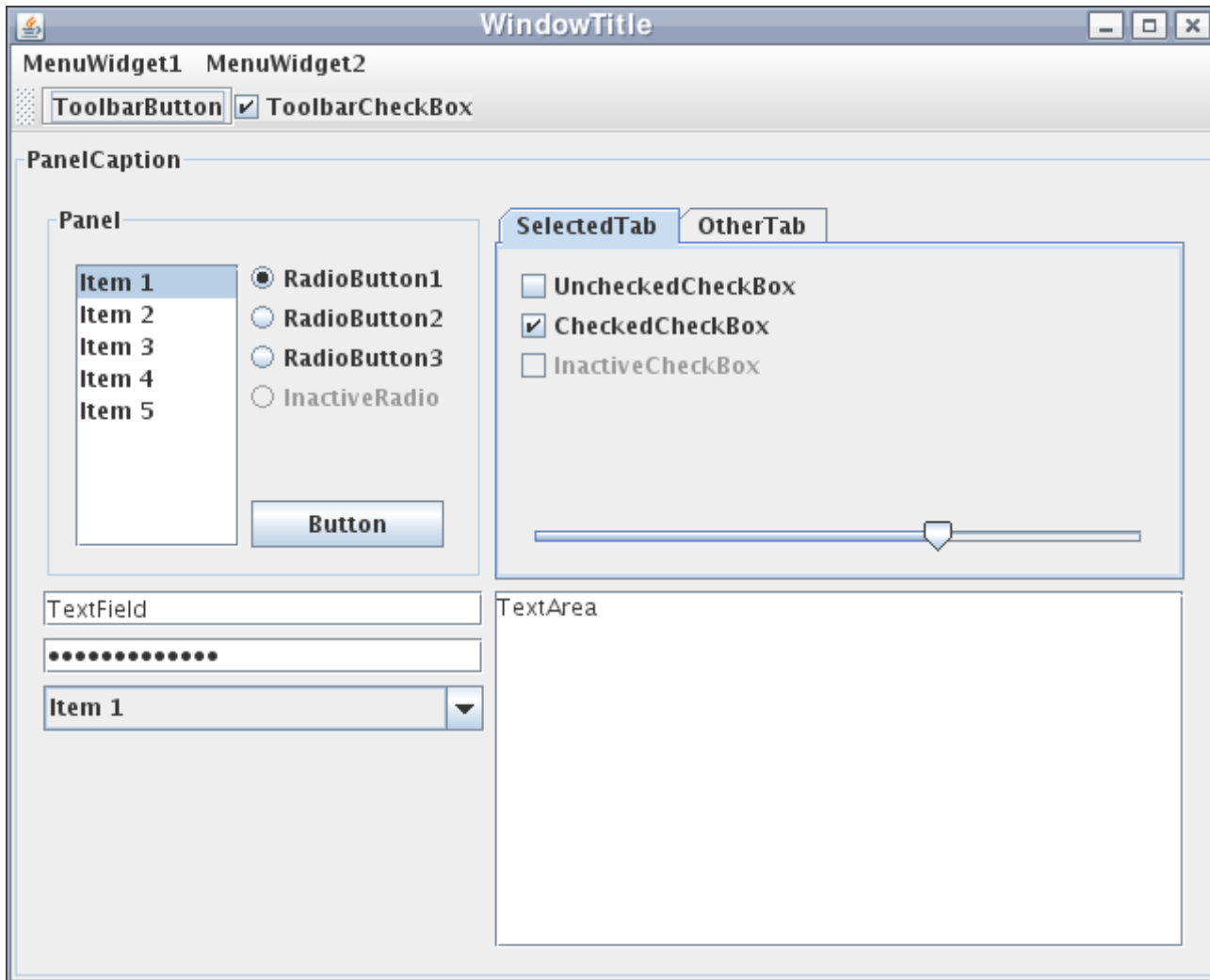# GUI Applications
Concurrent Swing

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Swing – A GUI framework in Java

Swing

- Swing is **single-threaded**
  - Android UI, SWT, QT, MacOS Cocoa, X Windows
  - (However, there are some methods that are thread-safe…)
- GUIs are **event-driven** (mouse click, …,)
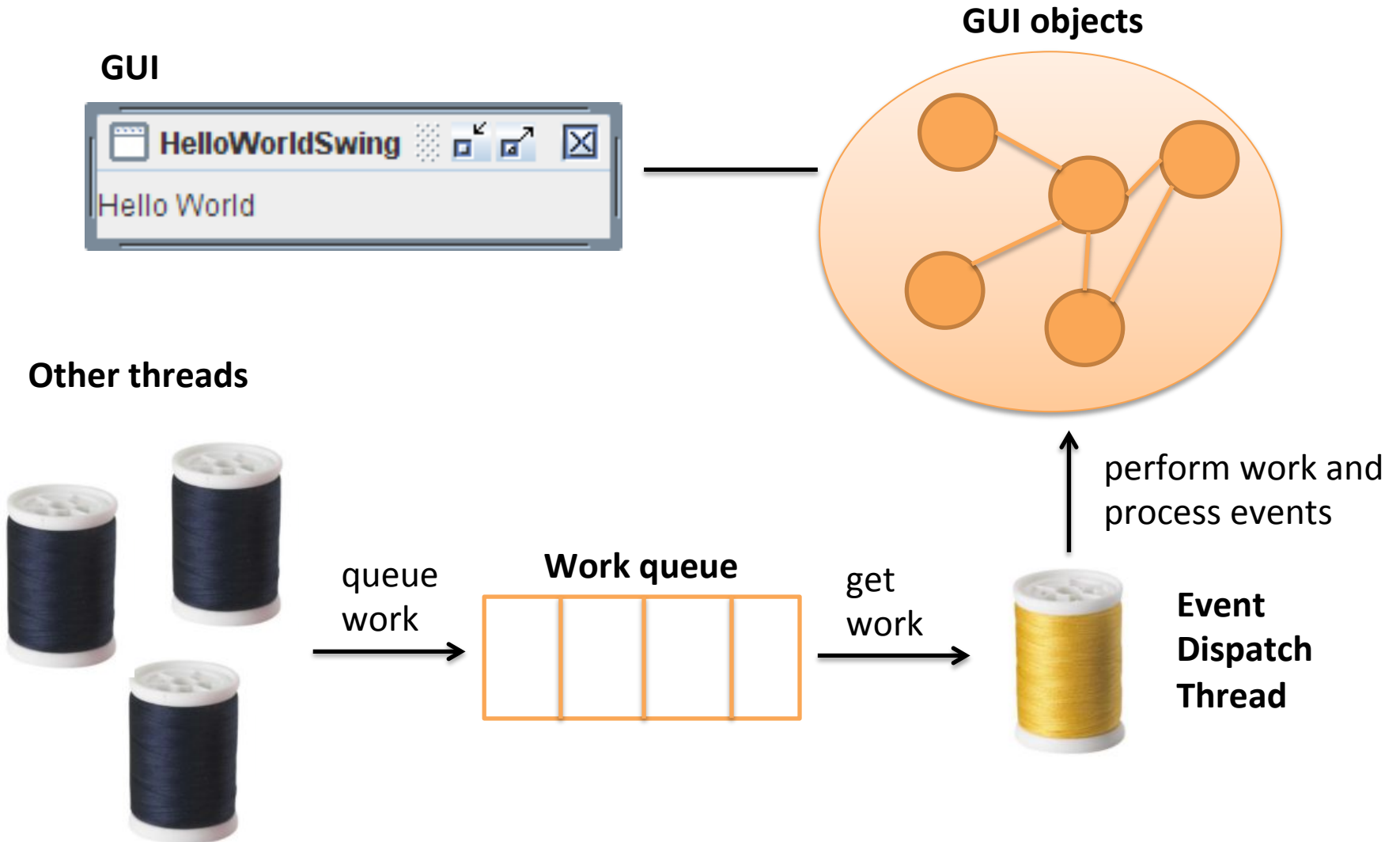 - Register event listeners

Register event listener

```java
JButton button = ...;
button.addActionListener(new ActionListener() {
  public void actionPerformed(ActionEvent e) {
    // Do something useful here
  }
});
```

Event Dispatch Thread

- Manipulations of the GUI state should be done in the **Event Dispatch Thread (EDT)** (or the Swing thread)

- EDT ~ `Executors.newSingleThreadExecutor()`

Overview

GUI

GUI objects

Other threads

queue work

Work queue

get work

Event Dispatch Thread

perform work and process events

Other thread -> Swing

```java
// synchronous
SwingUtilities.invokeAndWait(Runnable r);

// asynchronous
SwingUtilities.invokeLater(Runnable r);

interface Runnable {
  public void run();
}
```

Other thread -> Swing

```java
class MyThread extends Thread {
  private final JLabel label;
  public MyThread(JLabel label) {
    this.label = label;
  }

  public void run() {
    final int x = veryComplicatedComputation();

    SwingUtilities.invokeLater(new Runnable() {
      public void run() {
        label.setText(String.valueOf(x));
      }
    });
  }
}
```

Long-running tasks

- Do not run long-running tasks in the EDT!!!
  - The GUI will freeze!
- Run long-running tasks in other threads
  - SwingWorker
  - Executor framework (ask Alma!)
  - ...

Long-running tasks

- Use **SwingWorker** (or the **Executor** framework)

```
abstract class SwingWorker<T,V> extends ... {
  // run code in a worker thread
  protected abstract T doInBackground();

  // run code in the EDT
  protected void done();

  // schedule this work in a work thread
  public void execute();
  ...
}
```

Initial thread

```java
public class Test {
  public static void main(String args[]) {
    // This code is running in the initial thread
  }
}
```

Conclusion

- Swing is a **single-threaded** framework
- Run short-running tasks that modify the GUI in the EDT
- Do **not** run long-running tasks in the EDT
  - The GUI will freeze
  - Use SwingWorker (or something else)

Exercise – IsItFika?

- All GUI changes should be done by the EDT
  - (Even the creation of the GUI)
- Implement the Refresh button
  - Use SwingWorker (RTFM)
  - Add loading text that is displayed during loading
  - Disable Refresh button during loading
  - Add delay (e.g., 500 ms) to simulate network delay

http://fileadmin.cs.lth.se/cs/Education/EDA015F/2013/Ch9-IsItFika.java