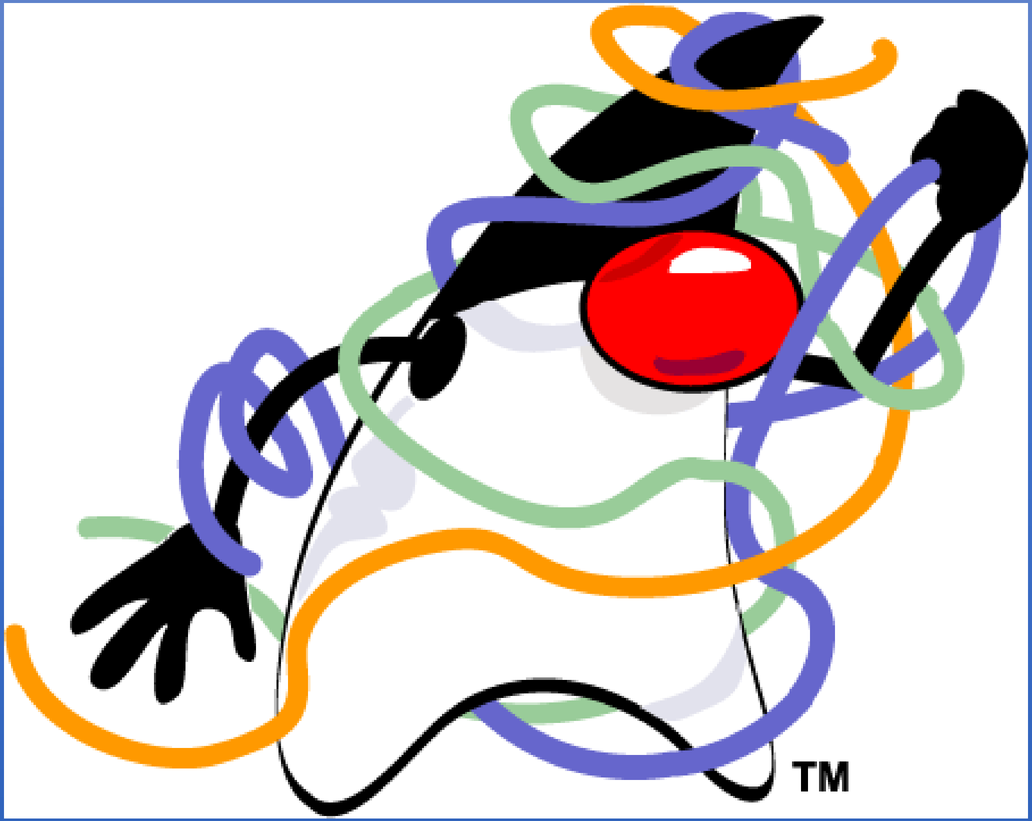


# Lab 9
# Java Concurrency (Multithreads)

## Goals

- Learn how to:
  - Create and start Java Threads
  - Work with SwingWorker

## KEYNOTE

# 1. Creating and Starting Threads

## 1.1. Subclass Thread

- Create a **subclass of Thread** and **override the run() method**. The run() method is what is executed by the thread after you call start().

Local -> Field at Preference in eclipse

access by any function

```
public class MyThread extends Thread {
    public void run(){
        System.out.println("MyThread running");
    }
}
```

- To create and start the above thread you can do like this:

```
MyThread myThread = new MyThread ("ThreadOne");
myThread.start();
```

# 1. Creating and Starting Threads

## 1.1. Subclass Thread

- Following is the list of important methods available in the Thread class.

| Method | Description |
|---|---|
| void start() | Starts the thread in a separate path of execution |
| void run() | Run the process |
| final void setName(String name) | Changes the name of the Thread object. |
| void interrupt() | Interrupts this thread |
| final boolean isAlive() | Returns true if the thread is alive |

# 1. Creating and Starting Threads

## 1.2. Runnable Interface

- Create a class that **implements java.lang.Runnable**. The Runnable object can be executed by a Thread.

```
public class MyRunnable implements Runnable {
    public void run(){
    System.out.println("MyRunnable running");
    }
 }
```

- To create and start the above object you can do like this:

```
Thread myThread = new Thread (new MyRunnable());
myThread.start();
```

If you call "myThread.run()" no thread will be created

# 1. Creating and Starting Threads

## 1.3. Pausing Execution

- **Thread.sleep** causes the current thread to suspend execution for a specified period.

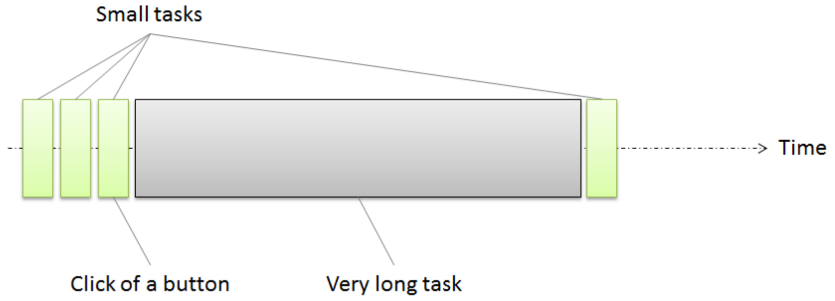
```java
// Pause for 4 seconds
try {
    Thread.sleep(4000);
} catch (InterruptedException e) {
    // We've been interrupted: no more messages.
    return;
}
```

## 2. Thread in Java Swing

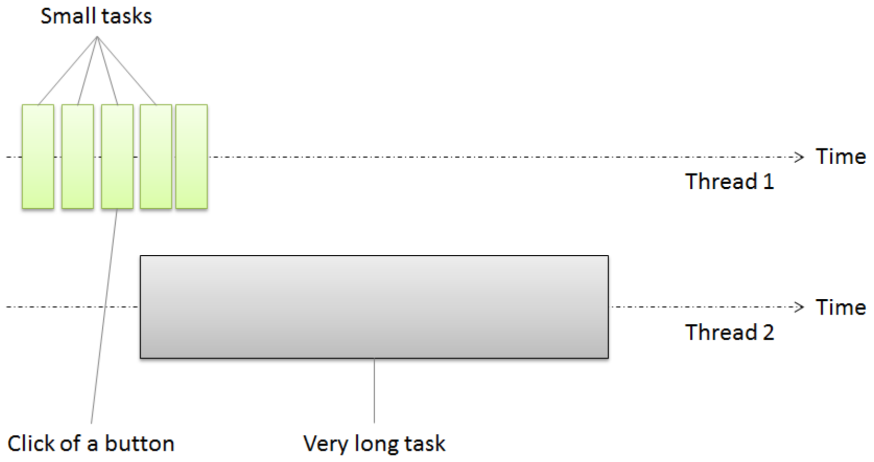
- A Swing programmer deals with the following kinds of threads:
  - Initial threads, the threads that execute initial application code.
  - The event dispatch thread, where all event-handling code is executed. Most code that interacts with the Swing framework must also execute on this thread.
  - Worker threads, also known as background threads, where time-consuming background tasks are executed.

# 3. Worker Threads (Background thread)

- With single threaded applications, the user clicks the button that starts the process and then has to wait for the task to finish before the user can do something else with the application.



- Multithreading address this problem. The application handles small tasks, such as button clicks, by one thread and the long taking tasks by another thread.



## 3. SwingWorker
## Common methods

| Method | Description |
|---|---|
| **doInBackground** | Defines a long computation and is called in a worker thread. |
| **done** | Executes on the event dispatch thread when **doInBackground** returns. |
| **execute** | Schedules the SwingWorker object to be executed in a worker thread. |
| **get** | Waits for the computation to complete, then returns the result of the computation (i.e., the return value of **doInBackground**). |
| **publish** | Sends intermediate results from the **doInBackground** method to the process method for processing on the EDT. |
| **process** | Receives intermediate results from the **publish** method and processes these results on the EDT. |
| **setProgress** | Sets the progress property to notify any property change listeners on the EDT of progress bar updates. |

# 3. Implements SwingWorker SwingWorker class template

```
public class WorkerClass extends
SwingWorker<Integer, String> {

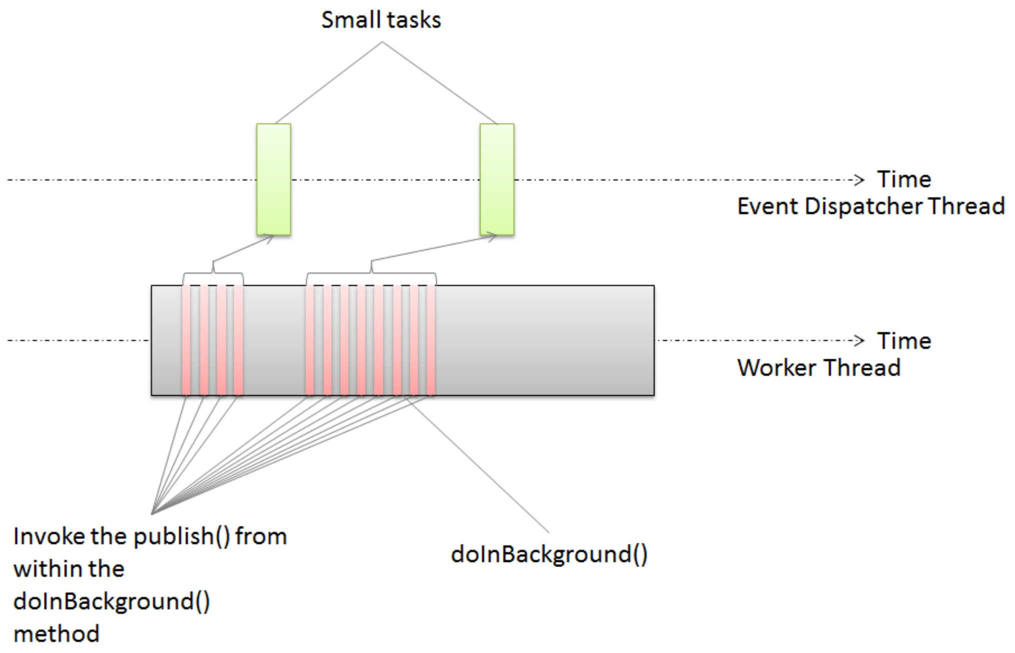
// constructor
public WorkerClass() {
}

// main process
protected Integer doInBackground()
throws Exception {
   //...
   setProgress(0..100);
   publish("Update content here");
   // ...
}

// displays published values
protected void process(List<String>
publishedVals) {}

// code to execute when
doInBackground completes
protected void done() {
   //...
   int retNum = (int)get();
   //...
}
}
```

(1) Type of return value in background process
(2) Type of observation value

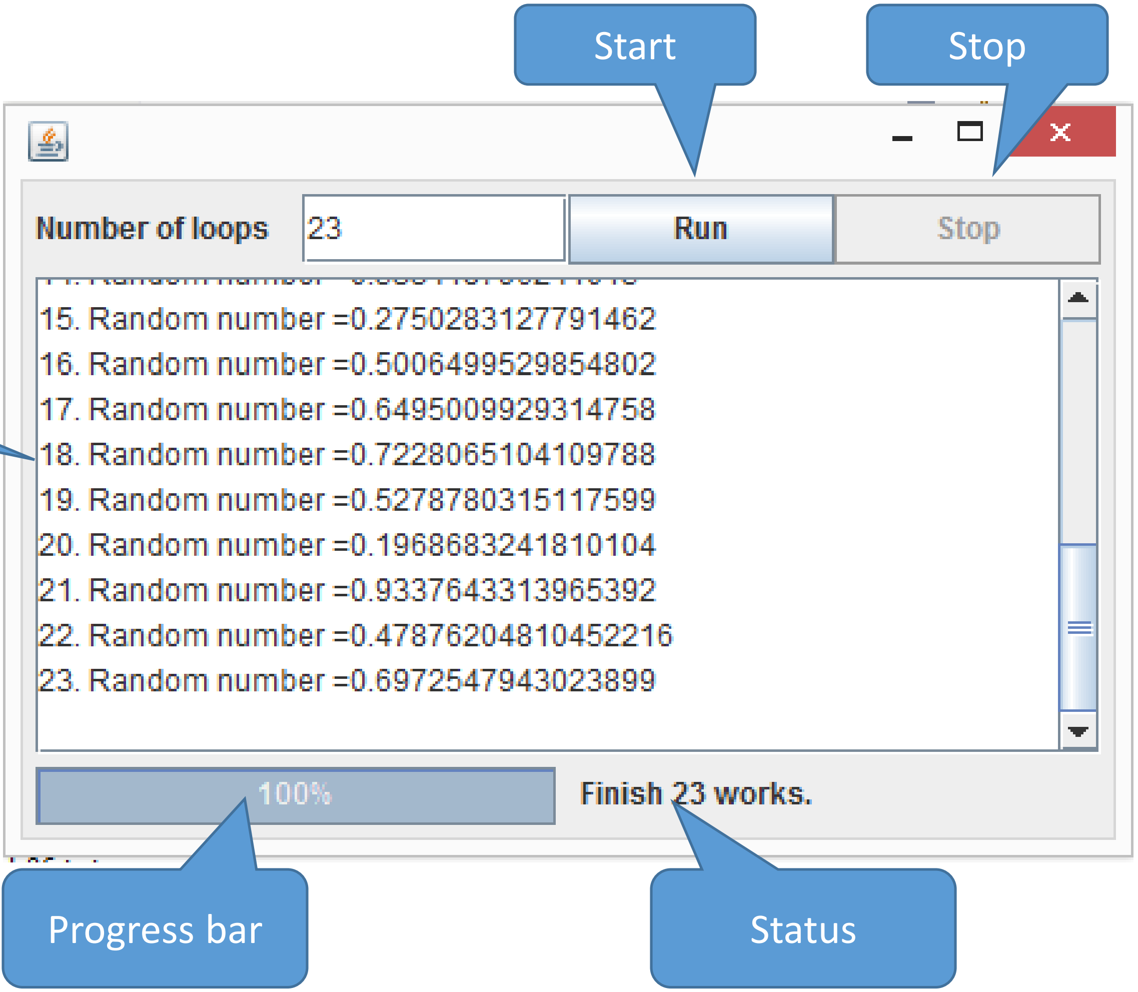


PRACTICE

# 1. Problem

The work is the loops of:
+Thread.sleep(300);
+ Print out random double number

We'll code using both:
+ Normal thread
+ Worker thread

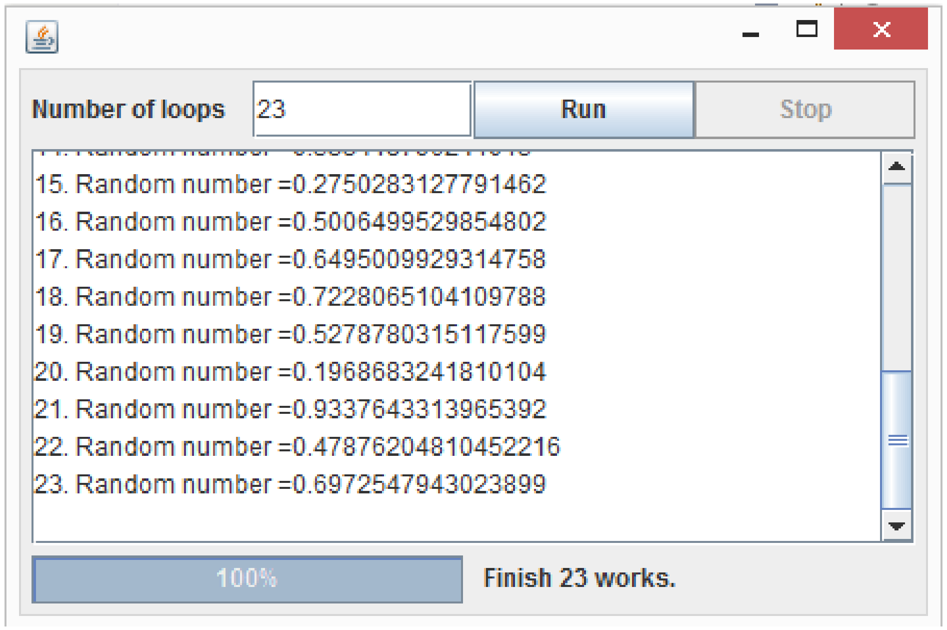


```
15. Random number =0.2750283127791462
16. Random number =0.5006499529854802
17. Random number =0.6495009929314758
18. Random number =0.7228065104109788
19. Random number =0.5278780315117599
20. Random number =0.1968683241810104
21. Random number =0.9337643313965392
22. Random number =0.47876204810452216
23. Random number =0.6972547943023899
```

Finish 23 works.

# 2. Design - MVC pattern

- Model:
  - Thread/SwingWorker
- View:
  - JTextArea txtArea.
  - JProgressBar progressBar
  - JLabel lblStatus
- Controller:
  - private JTextField textField;
  - JButton btnRun
  - JButton btnStop



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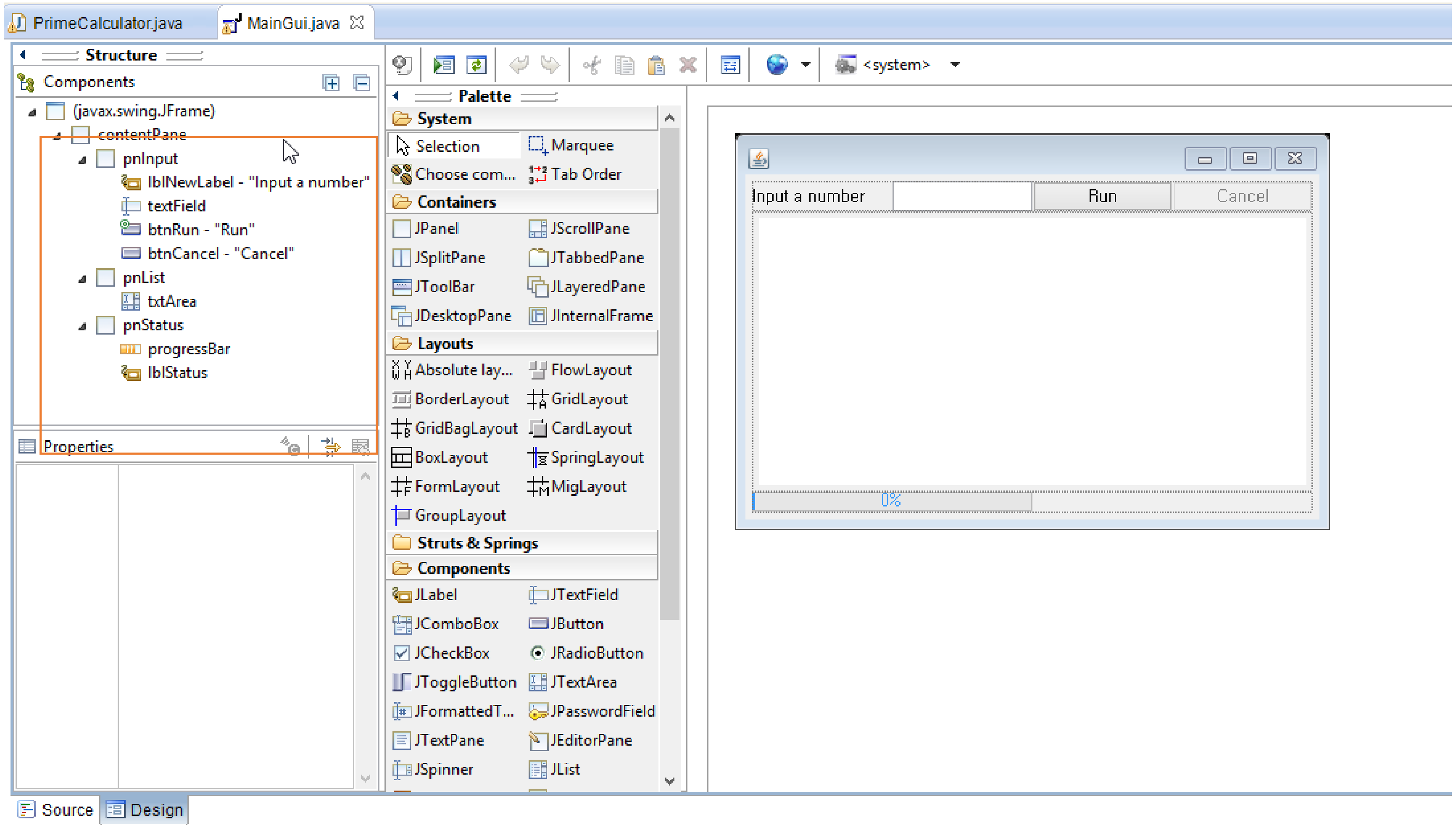
22. Random number =0.47876204810452216
23. Random number =0.6972547943023899
```

Finish 23 works.

File -> New other -> WindowBuilder -> Swing Designer -> Application Window
Design -> cilck&add로 component 생성
container에서 layout, naming 가능

# 3. Implements - GUI
## Create the components



## QUIZ

## We have a bank account

```
class BankAccount {
   int amount;
   public BankAccount(int initMoney){
       amount = initMoney;
   }
   public void Deposit(int add) {
           try {
               int temp = amount;

               // do some works here
               Thread.sleep(300);

               amount = temp + add;
           } catch (InterruptedException e) {
               e.printStackTrace();
           }
   }
   public void Print(){
       System.out.println("Current money is: "+ amount);
   }
}
```

## Three people (threads) deposit at the same time. Results? Why? Solution?

```java
class AddThread extends Thread {
   BankAccount account;
   int deposit;
   AddThread(String name, BankAccount acc, int depo) {
      super(name);
      account = acc;
      deposit = depo;
   }
   public void run() {
      System.out.println("Thread " + this.getName() + " run.");
      account.Deposit(deposit);
      account.Print();
      System.out.println("Thread " + this.getName() + " exiting.");
   }
}

public class ThreadTut2 {
   public static void main(String args[]) {
      BankAccount account = new BankAccount(100);
      account.Print();

      Thread t1 = new Thread(new AddThread("First", account, 10));
      Thread t2 = new Thread(new AddThread("Second", account, 20));
      Thread t3 = new Thread(new AddThread("Third", account, 30));
      t1.start();
      t2.start();
      t3.start();
   }
}
```