Mobile Application Develpment

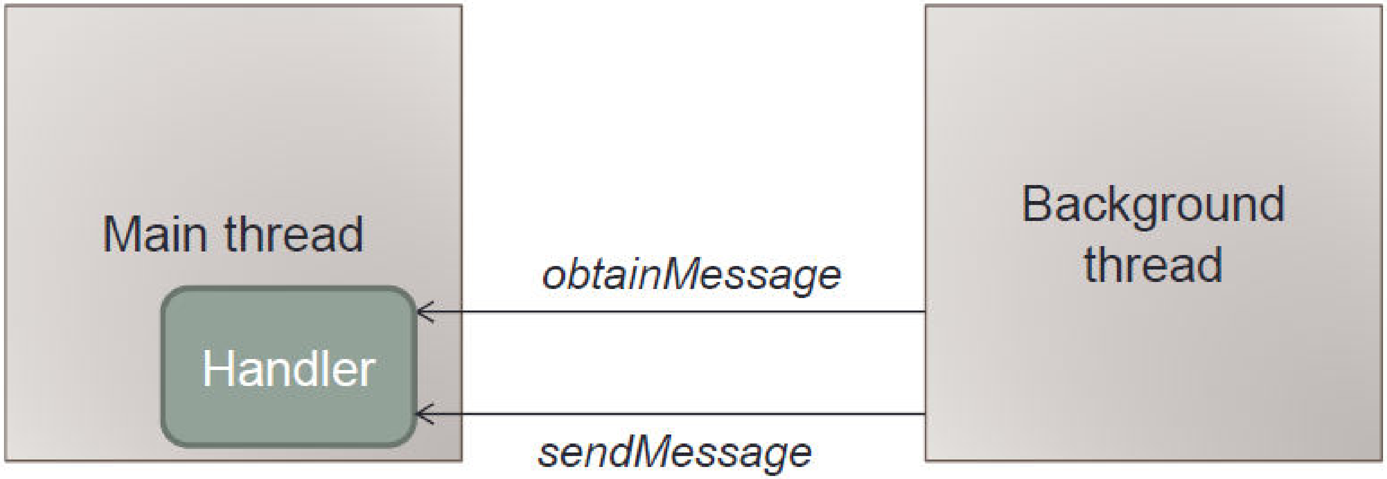
Background Tasks in Android

Handler

Android‘s Approach to Slow Activities

- **By default**, **app** runs in the **main thread**.
  - Every statement is executed in sequence.
  - If an **app** perform a long lasting operation, the **app blocks** until the corresponding operation has finished.
- **To provide a good user experience**
  - All slow running operations should run asynchronously.
  - This can be archived via **concurrency processing**.
- **Example**:
  - **Potentially slow operations are** network, file and database access and complex calculations.
- **Android enforces a worst case reaction time of applications.**
  - If an ***activity*** does not react within 5 seconds to user input, the Android system displays an ***Application not responding* (ANR) dialog**. From this dialog the user can choose to stop the application.

Interacting with the UI

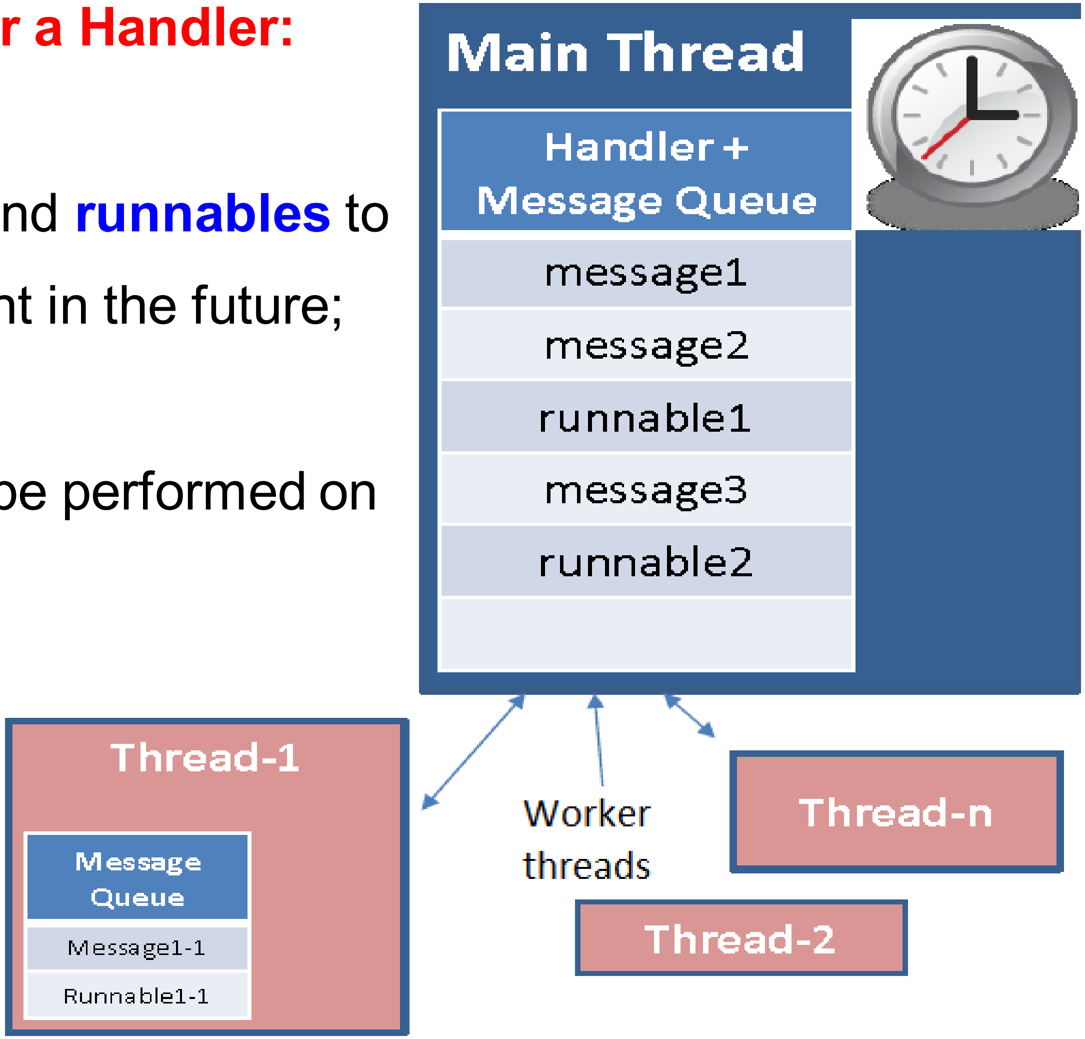


- The **UI thread** creates a **Handler object** internal to itself

- The **working thread** uses this object to **obtain** an **empty message** and **send** a **message** to the **UI thread**

Message based mechanism using Handler class

- **There are two main uses for a Handler:**
  - **to schedule** **messages** and **runnables** to be executed as some point in the future;
  - to **enqueue an action** to be performed on another thread



Main Thread

Handler + Message Queue

message1

message2

runnable1

message3

runnable2

Thread-1

Message Queue

Message1-1

Runnable1-1

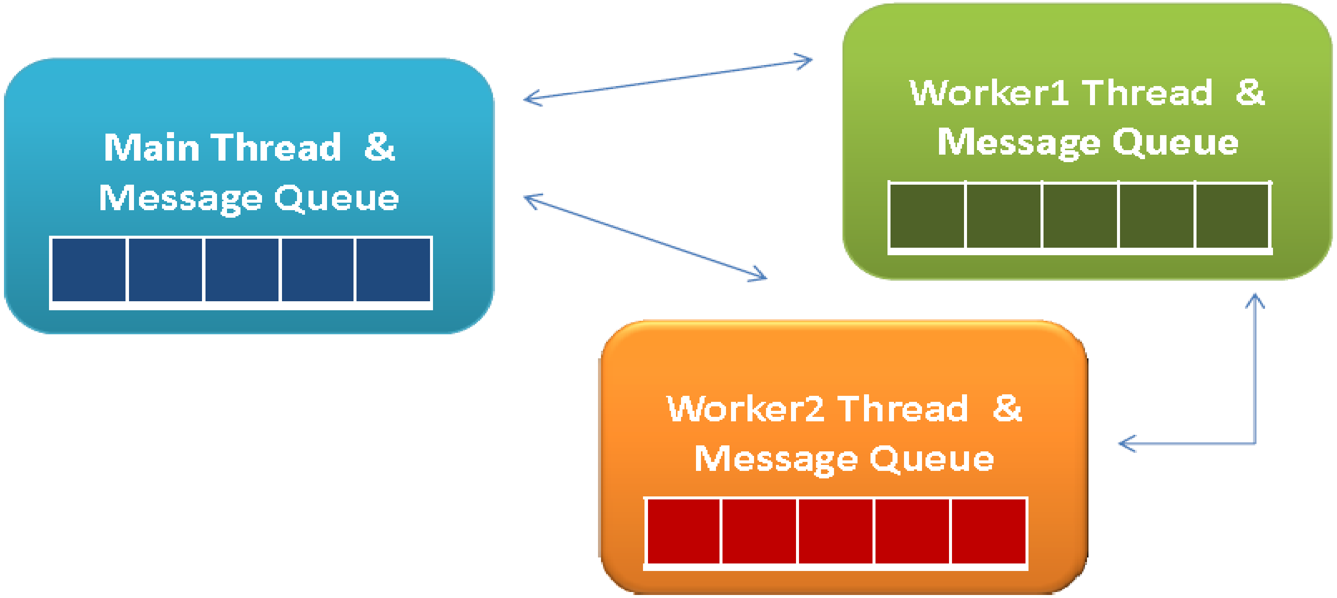
Worker threads

Thread-n

Thread-2

Inter-Thread Communications.

- **Typically** the **main UI thread** sets a handler to get **messages** from its worker threads; however *each worker thread could also define its own handler*.
- A handler in the worker thread creates a **local message-queue** which could be used to receive messages from other threads **(including main)**.



Handler. Using Messages

Main Thread

```
...
Handler myHandler= new Handler() {

  @Override
  public void handleMessage(Message msg) {
     // do something with the message...
     // update GUI if needed!
     ...
  }//handleMessage


};//myHandler
...
```

Background Thread

```
...
Thread backgJob = new Thread (new Runnable (){
   @Override
   public void run() {

      // do some busy work here
      // ...
      // get a token to be added to
      // the main's message queue
      Message msg= myHandler.obtainMessage();
       ...
      // deliver message to the
      // main's message-queue
      myHandler.sendMessage(msg);
   }//run

 });//Thread
// this call executes the parallel thread
backgroundJob.start();
. . .
```

Handler. Using Runnables

Main Thread

```
...
Handler     myHandler = new Handler();
@Override
public void onCreate(Bundle
                    savedInstanceState){
 ...
 Thread myThread1 = new Thread(
                         backgroundTask,
                         "backAlias1");
   myThread1.start();

}//onCreate

...
// this is the foreground runnable
private Runnable foregroundTask
   = new Runnable() {
  @Override
  public void run() {
   // work on the UI if needed
           }
...
```

Background Thread

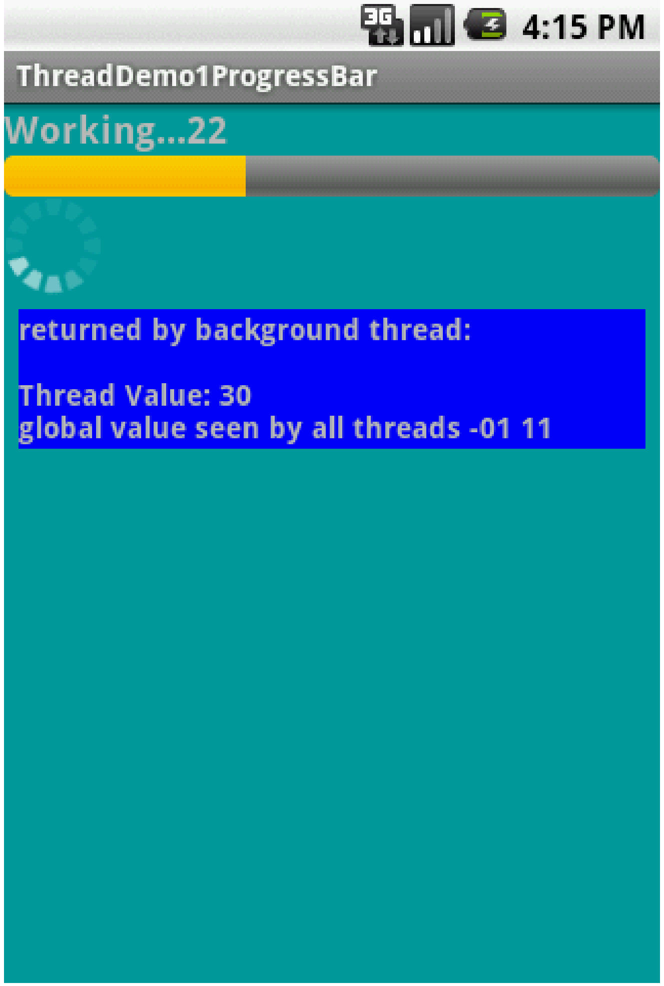
```
// this is the "Runnable" object
// representing the background thread

private Runnable backgroundTask
                 = new Runnable () {
    @Override
    public void run() {
        // Do some background work here
        myHandler.post(foregroundTask);

    }//run
};//backgroundTask
```

Example 1.
Using Message Passing

- The **main thread** displays a **horizontal** and a **circular** **progress bar** widget showing the progress of a slow background operation.
- Some random data is periodically sent from the background thread and the messages are displayed in the **main view**.



```
Working...22
```

```
returned by background thread:

Thread Value: 30
global value seen by all threads -01 11
```

```
public class MainActivity extends Activity {
    ProgressBar         bar1;
    ProgressBar         bar2;
    TextView            msgWorking;
    TextView            msgReturned;
    boolean             isRunning= false;
    final int           MAX_SEC= 60; // (seconds) lifetime for background thread
    String              strTest= "global value seen by all threads ";
    int                 intTest= 0;
    Handler handler = new Handler() {
    @Override
    public void handleMessage(Message msg) {
            String returnedValue= (String)msg.obj;
            //do something with the value sent by the background thread here ...
            msgReturned.setText("returned by background thread: \n\n"  + returnedValue);
            bar1.incrementProgressBy(2);
            if(bar1.getProgress() == MAX_SEC){      //testing thread's termination
                    msgReturned.setText("Done \n back thread has been stopped");
                    isRunning= false;
            }
```

```
        if(bar1.getProgress() == bar1.getMax()){
                msgWorking.setText("Done");
                bar1.setVisibility(View.INVISIBLE);
                bar2.setVisibility(View.INVISIBLE);
        }
        else{
                msgWorking.setText("Working..."+ bar1.getProgress() );
        }
    } // handleMessage method
}; //handler
```

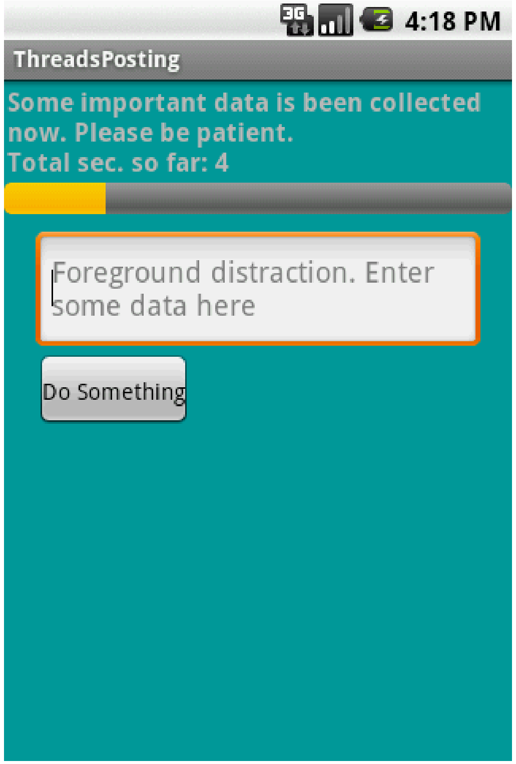
```
@Override
 public void onCreate(Bundle icicle) {
     super.onCreate(icicle);
    setContentView(R.layout.activity_main);
    bar1= (ProgressBar) findViewById(R.id.progress);
    bar2= (ProgressBar) findViewById(R.id.progress2);
    bar1.setMax(MAX_SEC);
    bar1.setProgress(0);
    msgWorking= (TextView) findViewById(R.id.TextView01);
    msgReturned= (TextView) findViewById(R.id.TextView02);
    strTest+= "-01"; // slightly change the global string
    intTest= 1;
 } //onCreate

public void onStop() {
     super.onStop();
    isRunning= false;
 }
```

```
public void onStart() {
    super.onStart();
    Thread background = new Thread (new Runnable() {
      public void run() {
        try{
          for(int i = 0; i < MAX_SEC && isRunning; i++) { // Toast method will not work!
                Thread.sleep(1000);          //one second at a time
                Random rnd= new Random();
                String data = "Thread Value: "+ (int) rnd.nextInt(101);
                data += "\n"+ strTest+ " "+ intTest; //we can see and change (global) class vars
                intTest++; //request a message token and put some data in it
                Message msg= handler.obtainMessage(1, (String)data);
                if(isRunning)
                 {   handler.sendMessage(msg); // if thread is still alive send msg   }
          }
        } catch(Throwable t) { }
      } //run
    }); //background
    isRunning= true;
    background.start();
  } //onStart
}
```

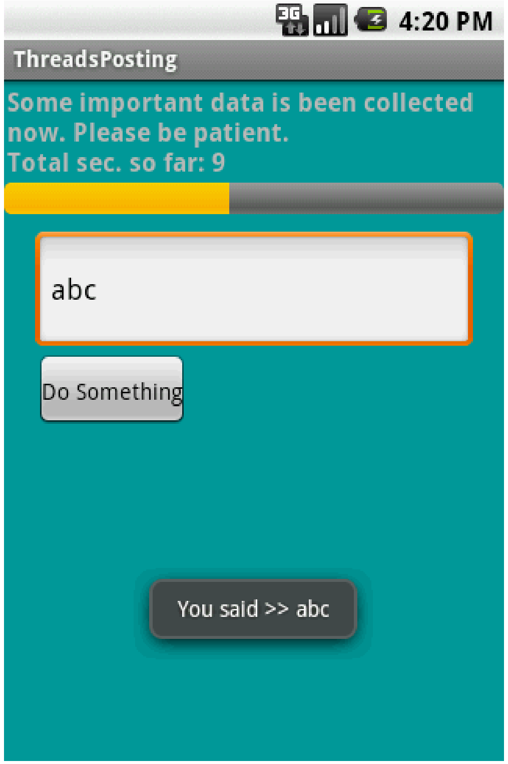
Example 2. Using Runnable

- We will try the same problem presented earlier (a slow background task and a responsive foreground UI) this time using the **posting mechanism** to execute foreground ***runnables***.



Some important data is been collected now. Please be patient.
Total sec. so far: 4

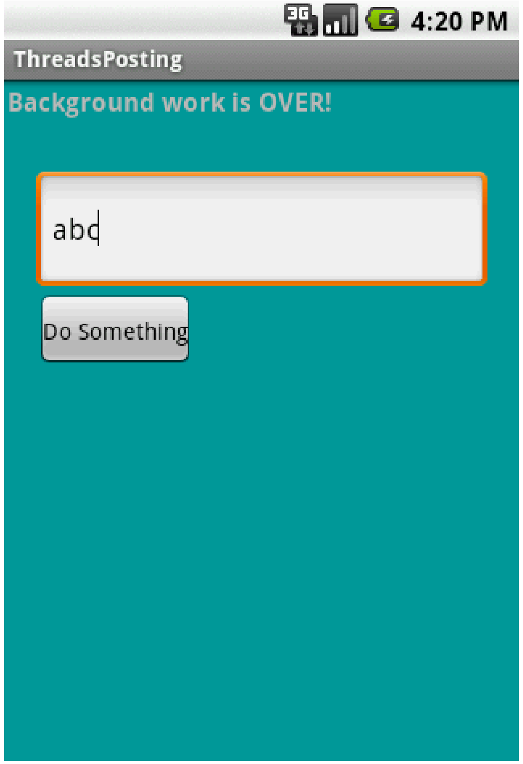
Foreground distraction. Enter some data here



Some important data is been collected now. Please be patient.
Total sec. so far: 9

abc

You said >> abc



Background work is OVER!

abc

```
public class MainActivity extends Activity {

    ProgressBar        myBar;
    TextView           lblTopCaption;
    EditText           txtBox1;
    Button             btnDoSomething;
    int                accum= 0;
    long               startingMills= System.currentTimeMillis();
    String             PATIENCE= "Some important data is been collected now. "+ "\nPlease be
      patient.";


    Handler myHandler= new Handler();
```

```
@Override
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_main);
    lblTopCaption= (TextView) findViewById(R.id.lblTopCaption);
    myBar= (ProgressBar) findViewById(R.id.myBar);
    myBar.setMax(100);
    txtBox1= (EditText) findViewById(R.id.txtBox1);
    txtBox1.setHint("Foreground distraction. Enter some data here");
    btnDoSomething= (Button) findViewById(R.id.btnDoSomething);

  btnDoSomething.setOnClickListener(new OnClickListener() {
        @Override
            public void onClick(View v) {
            Editable txt = txtBox1.getText();
            Toast.makeText(getBaseContext(), "You said >> "+ txt, LENGTH_LONG).show();
        } //onClick
    }); //setOnClickListener
} //onCreate
```

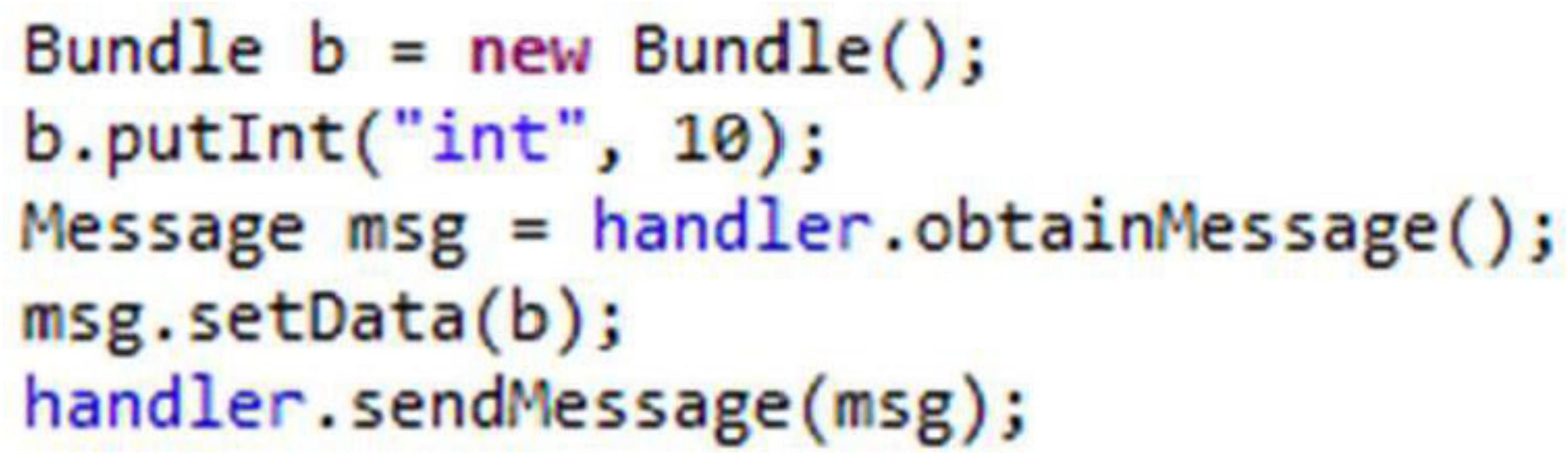
```
   @Override
   protected void onStart() {
           super.onStart(); // create background thread were the busy work will be done
           Thread myThread1 = new Thread (backgroundTask, "backAlias1");
           myThread1.start();
            myBar.incrementProgressBy(0);
   }
private Runnable foregroundTask= new Runnable() {
     @Override // foreground "Runnable" object responsible for GUI updates
           public void run() {
                   try{
                           int progressStep= 5;
                           lblTopCaption.setText (PATIENCE+ "\nTotalsec. so far: "+
                           (System.currentTimeMillis() -startingMills) / 1000 );
                           myBar.incrementProgressBy(progressStep);
                           accum+= progressStep;
                           if(accum>= myBar.getMax()){
                                   lblTopCaption.setText("Background work is OVER!");
                                   myBar.setVisibility(View.INVISIBLE);
                           }
                   } catch(Exception e) {    }
           } //run
   }; //foregroundTask
```

```
//this is the "Runnable" object that executes the background thread
  private Runnable backgroundTask= new Runnable() {
     @Override
           public void run() {
                       //busy work goes here...
                        try{
                                   for(int n=0; n<20; n++) {
                                               Thread.sleep(1000);
                                               myHandler.post (foregroundTask);
                                   }
                       } catch(InterruptedException e) { }
            } //run
    }; //backgroundTask
} //MainActivity
```

Passing data through the message

Three steps to send data in (**Background thread**)

- **Create** a **bundle**
- **Put** data in
- **Set** the data field of the **message**

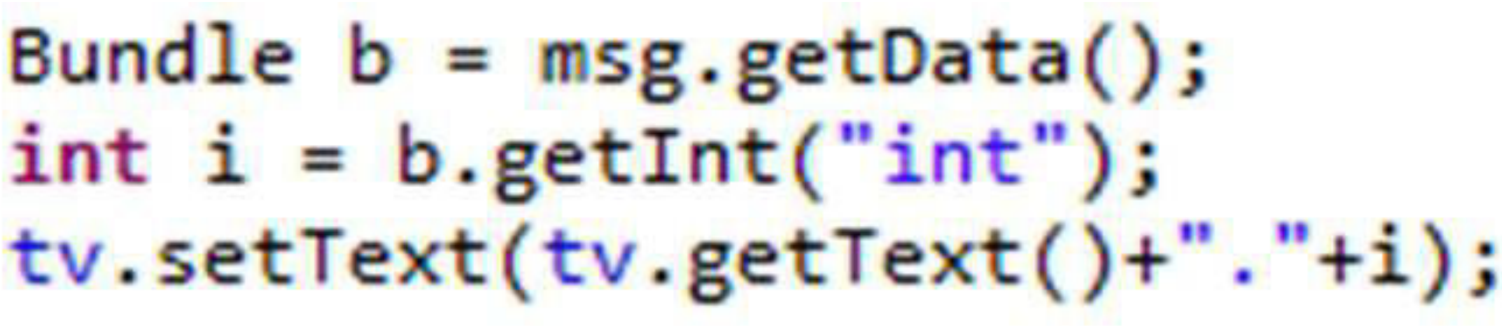


```
Bundle b = new Bundle();
b.putInt("int", 10);
Message msg = handler.obtainMessage();
msg.setData(b);
handler.sendMessage(msg);
```

Passing data through the message (Cont.)

Two steps to receive data in (UI thread)

- **Get bundle** from the **message**
- **Get** the **data**



```
Bundle b = msg.getData();
int i = b.getInt("int");
tv.setText(tv.getText()+"."+i);
```

References

- Background tasks in Android
- Threads in Java
- Android – Threads