Java CountDownLatch: Example Application

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Learning Objectives in this Part of the Lesson

- Understand the structure & functionality of Java CountDownLatch
- Recognize the key methods in Java CountDownLatch
- Know how to program with Java CountDownLatch in practice

```
class GCDCountDownLatchWorker implements Runnable {
  private final CountDownLatch mEntryBarrier;
  private final CountDownLatch mExitBarrier;
  ...

  GCDCountDownLatchWorker(CountDownLatch entryBarrier,
                          CountDownLatch exitBarrier, ...) {
    mEntryBarrier = entryBarrier; mExitBarrier = exitBarrier;
    ...
  }

  public void run() {
    ...
    mEntryBarrier.await();
    runTest();
    mExitBarrier.countDown(); ...
```

Overview of the GCD App

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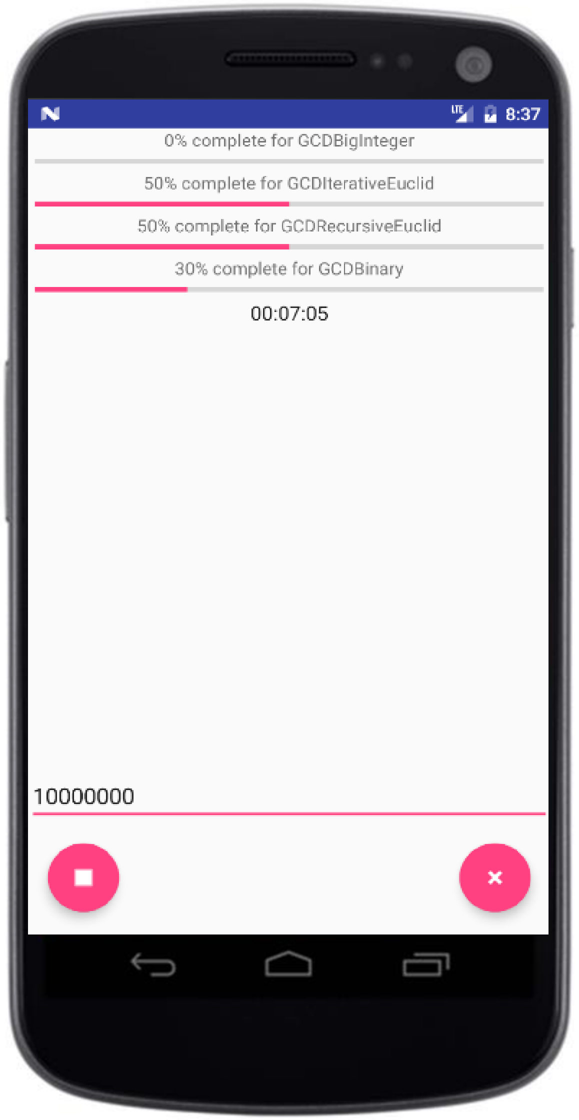
- This Android app uses two CountDownLatch objects to coordinate the concurrent benchmarking of four Greatest Common Divisor (GCD) algorithms



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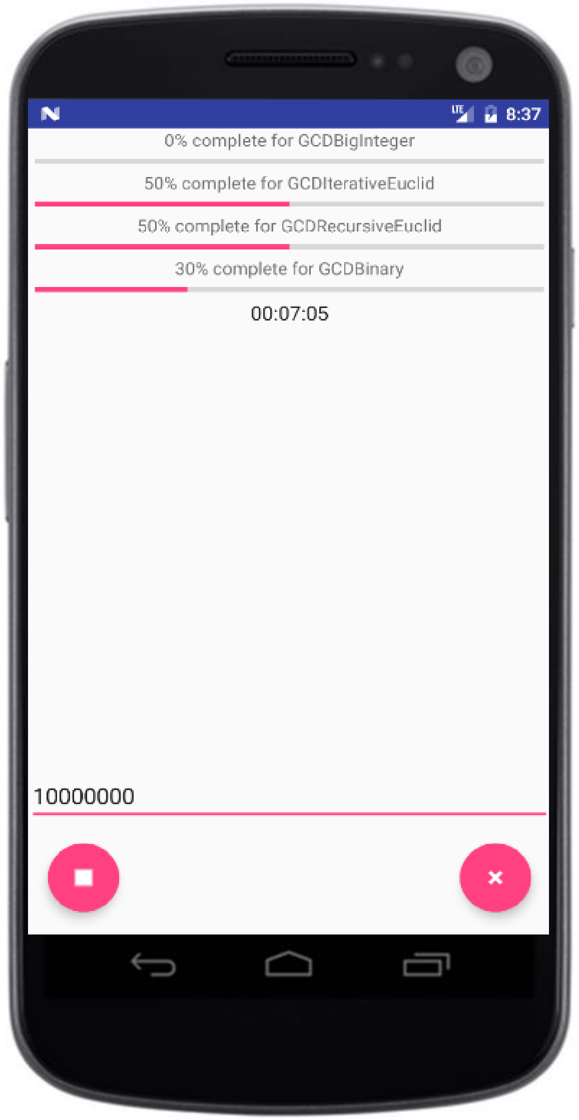
See github.com/douglascraigschmidt/POSA/tree/master/ex/M3/GCD/CountDownLatch

Overview of the GCD App

- This Android app uses two CountDownLatch objects to coordinate the concurrent benchmarking of four Greatest Common Divisor (GCD) algorithms
  - GCD computes the largest positive integer that is a divisor of two numbers
    - e.g., the GCD of 8 & 12 = 4



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See en.wikipedia.org/wiki/Greatest_common_divisor

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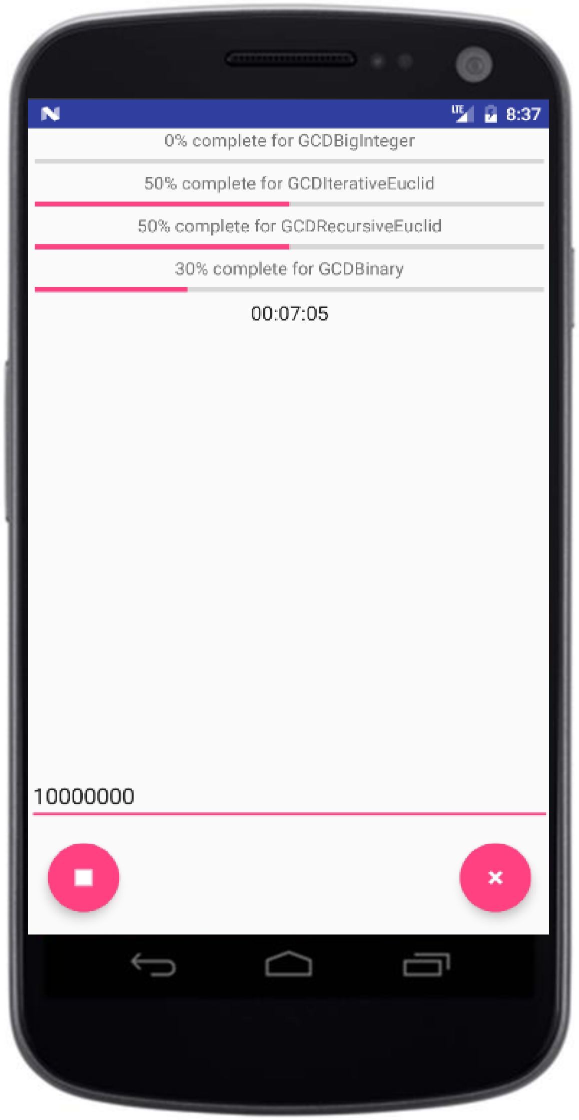
  - Four GCD algorithms are tested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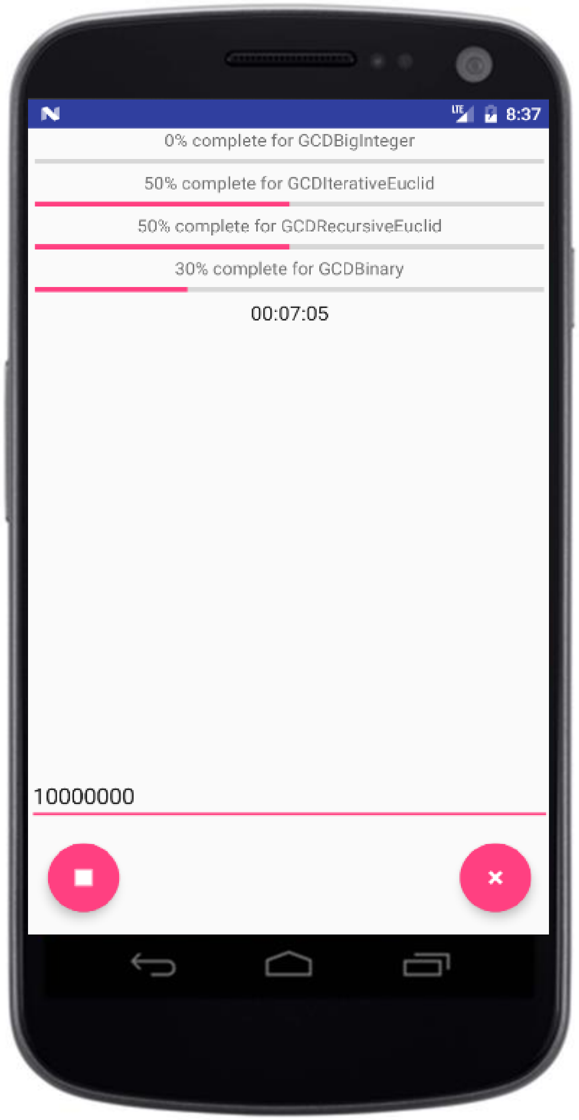
    - The gcd() method defined by BigInteger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See docs.oracle.com/javase/8/docs/api/java/math/BigInteger.html#gcd

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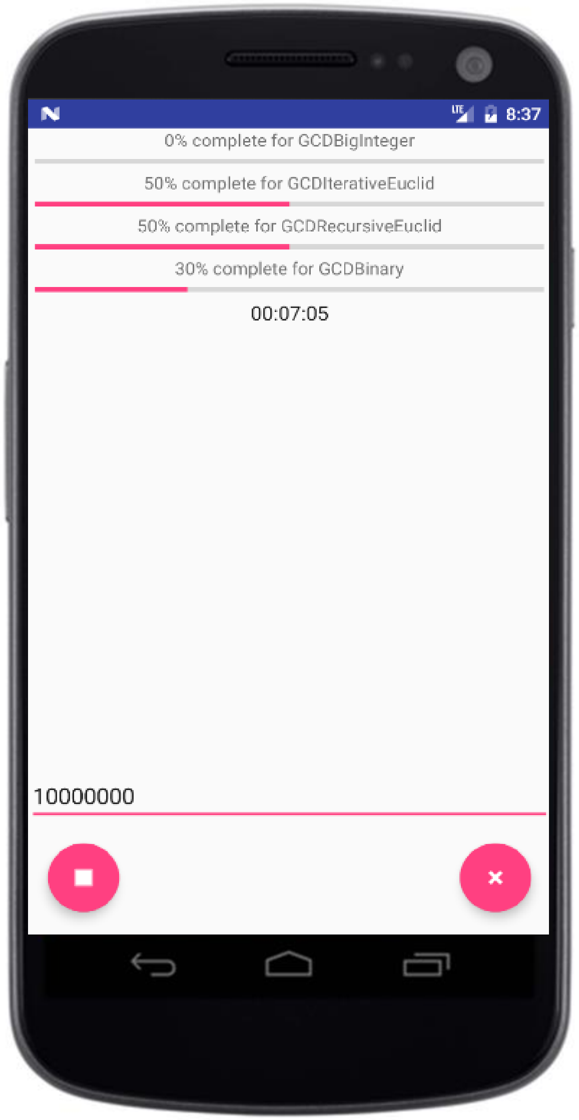
    - An iterative Euclid algorithm



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See en.wikipedia.org/wiki/Euclidean_algorithm

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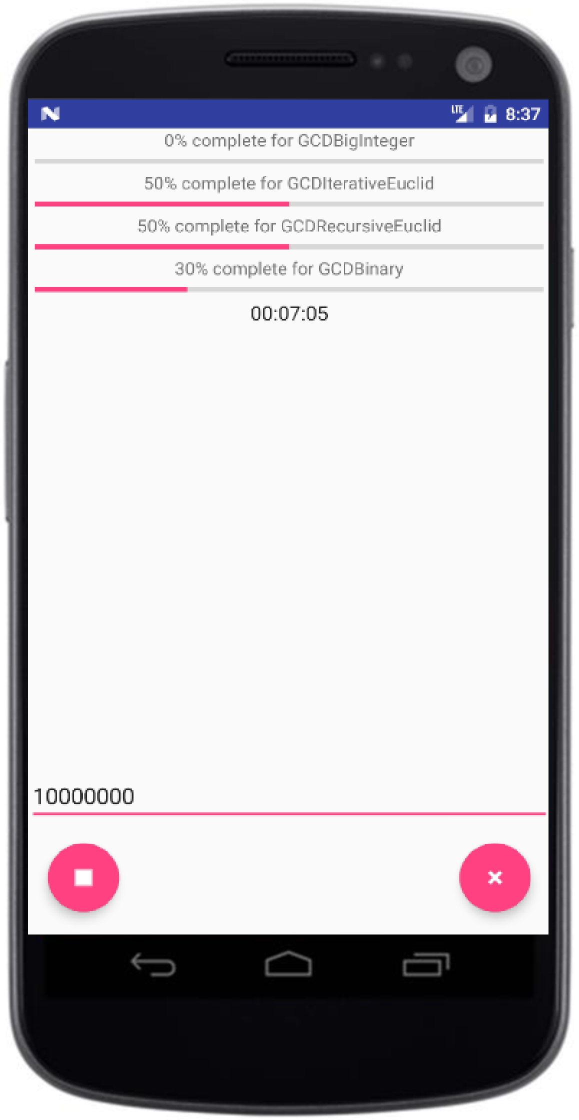
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See codedost.com/java/methods-and-recursion-in-java/java-program-to-find-gcd-hcf-using-euclidean-algorithm-using-recursion

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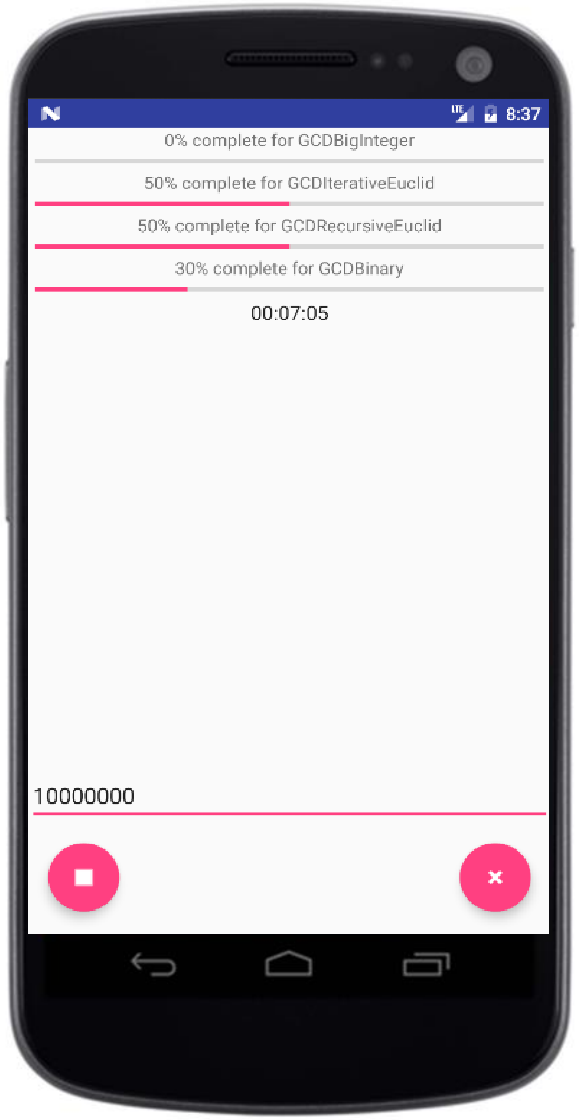
    - The gcd() method defined by BigInteger
    - An iterative Euclid algorithm
    - A recursive Euclid algorithm
    - A complex GCD algorithm that uses binary arithmetic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See en.wikipedia.org/wiki/Binary_GCD_algorithm

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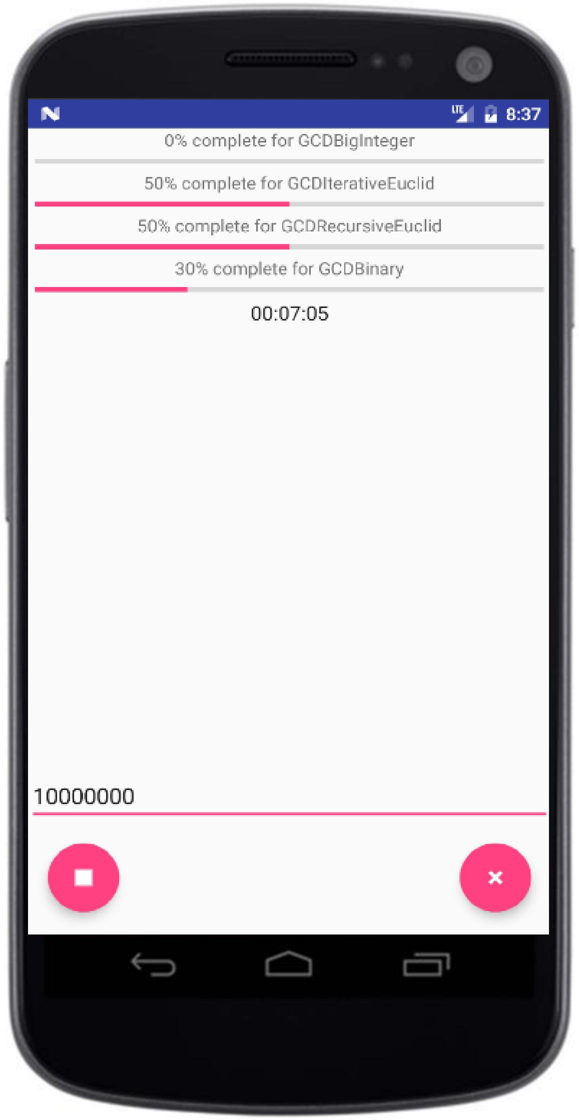
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However, the details of these algorithms are not important for our discussion

GCDCountDownLatchTest Class Walkthrough

GCDCountDownLatchTest Class Walkthrough

- Create worker threads that use entry & exit barrier CountDownLatch objects

```
class GCDCountDownLatchTest {
  @Test public void testGCDCountDownLatchTester() {
    ...
    List<GCDTuple> gcdTests = makeGCDTuples();

    CountDownLatch entryBarrier = new CountDownLatch(1);
    CountDownLatch exitBarrier =
      new CountDownLatch(gcdTests.size());

    gcdTests.forEach(gcdTest -> new Thread
      (new GCDCountDownLatchWorker
        (entryBarrier, exitBarrier, gcdTuple, this)).start());

    System.out.println("Starting tests");
    entryBarrier.countDown();
    System.out.println("Waiting for results");
    exitBarrier.await();
    System.out.println("All tests done"); ...
```

See [GCD/CountDownLatch/app/src/test/java/edu/vandy/gcdtesttask/GCDCyclicBarrierTest.java]()

GCDCountDownLatchTest Class Walkthrough

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Entry point into test

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```

Initialize all the GCD algorithms

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Create the entry barrier

GCDCountDownLatchTest Class Walkthrough

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Create the exit barrier

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Iterate through all the GCD algorithms

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Create/start worker threads w/barriers

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    exitBarrier.await();
    System.out.println("All tests done"); ...
```

The worker threads don't start just yet

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```

Let all worker threads proceed

The countDown() method is a "latch" that let's all the worker threads start running, but it doesn't ensure all the worker threads start at the same time..

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    System.out.println("Starting tests");
    entryBarrier.countDown();
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    exitBarrier.await();
    System.out.println("All tests done"); ...
```

Wait for all to finish (exit barrier)

After await() returns for a CountDownLatch it can't be reused/ reset without creating a new CountDownLatch instance

GCDCountDownLatchWorker Class Walkthrough

GCDCountDownLatchWorker Class Walkthrough

- This class applies two entry & exit barrier CountDownLatch objects to coordinate the benchmarking of a given GCD algorithm implementation

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  GCDCountDownLatchWorker(CountDownLatch entryBarrier,
                          CountDownLatch exitBarrier, ...) {
    mEntryBarrier = entryBarrier; mExitBarrier = exitBarrier;
    ...
  }

  public void run() {
    ...
    mEntryBarrier.await();
    runTest();
    mExitBarrier.countDown();
    ...
```

Define a worker that runs in a thread

See GCD/CountDownLatch/app/src/main/java/edu/vandy/gcdtesttask/presenter/GCDCountDownLatchWorker.java

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    ...
  }

  public void run() {
    ...
    mEntryBarrier.await();
    runTest();
    mExitBarrier.countDown();
    ...
```

Initialize barrier fields et al.

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```

This hook method executes after the thread is started

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  }

  public void run() {
    ...
    mEntryBarrier.await();
    runTest();
    mExitBarrier.countDown();
    ...
```

This entry barrier causes the worker thread to wait until main thread is ready, though worker threads may not start simultaneously

See the upcoming lesson on "*Java CyclicBarrier*" for a solution to this problem

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    mEntryBarrier.await();
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    mExitBarrier.countDown();
    ...
```

Run the GCD algorithm associated with this object

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  }

  public void run() {
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    runTest();
    mExitBarrier.countDown();
    ...
```

Decrement the count, which lets the main thread proceed when the count reaches 0

End of CountDownLatch: Example Application