Java ExecutorService: Evaluating Pros & Cons

Douglas C. Schmidt

d.schmidt@vanderbilt.edu

www.dre.vanderbilt.edu/~schmidt

Professor of Computer Science

Institute for Software Integrated Systems

Vanderbilt University

Nashville, Tennessee, USA

Learning Objectives in this Part of the Lesson

- Recognize the powerful features defined in the Java ExecutorService interface
- Understand other interfaces related to ExecutorService
- Know the key methods provided by ExecutorService
- Be aware of how ThreadPoolExecutor implements ExecutorService
- Learn how to program the PrimeChecker app using ExecutorService

- Evaluate the pros & cons of this version of the PrimeChecker app

Evaluating this Version of the PrimeChecker App

Evaluating this Version of the PrimeChecker App

- ExecutorService version of PrimeChecker app fixes problems with earlier Executor PrimeChecker

Evaluating this Version of the PrimeChecker App

- ExecutorService version of PrimeChecker app fixes problems with earlier Executor PrimeChecker, e.g.
  - Two-way semantics of Java callables decouple PrimeCallable & MainActivity


```
public class PrimeCallable
       implements Callable<PrimeResult> {
   ...

   public PrimeCallable(long PrimeCandidate) { ... }

   public PrimeResult call() {
     return new PrimeResult(mPrimeCandidate,
                            isPrime(mPrimeCandidate));
   } ...
```

MainActivity appears nowhere in PrimeCallable class..

This decoupling simplifies runtime configuration changes

Evaluating this Version of the PrimeChecker App

- ExecutorService version of PrimeChecker app fixes problems with earlier Executor PrimeChecker, e.g.
  - Two-way semantics of Java callables decouple PrimeCallable & MainActivity
  - Lifecycle operations enable task interruptions

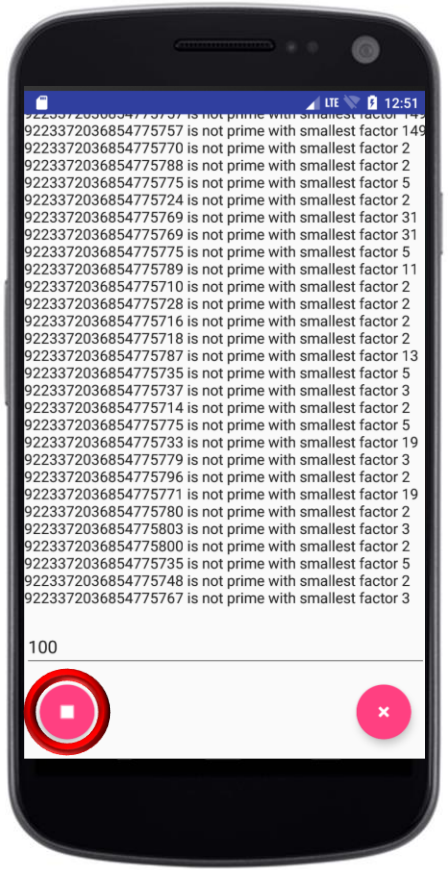
```
void interruptComputations() {
  mRetainedState.mExecutorService
                .shutdownNow();

  mRetainedState.mThread.interrupt();
  ...
  mRetainedState
    .mExecutorService.awaitTermination
      (500, TimeUnit.MILLISECONDS);
```

Shutting down an executor service interrupts *all* threads running tasks

Evaluating this Version of the PrimeChecker App

- ExecutorService version of PrimeChecker app fixes problems with earlier Executor PrimeChecker, e.g.
  - Two-way semantics of Java callables decouple PrimeCallable & MainActivity
  - Lifecycle operations enable task interruptions

```
long isPrime(long n) {
  if (n > 3)
    for (long factor = 2;
         factor <= n / 2; ++factor)
      if (Thread.interrupted()) break;
      else if (n / factor * factor == n)
         return factor;
  return 0L;
}
```



The isPrime() method repeatedly checks to see if it's been interrupted

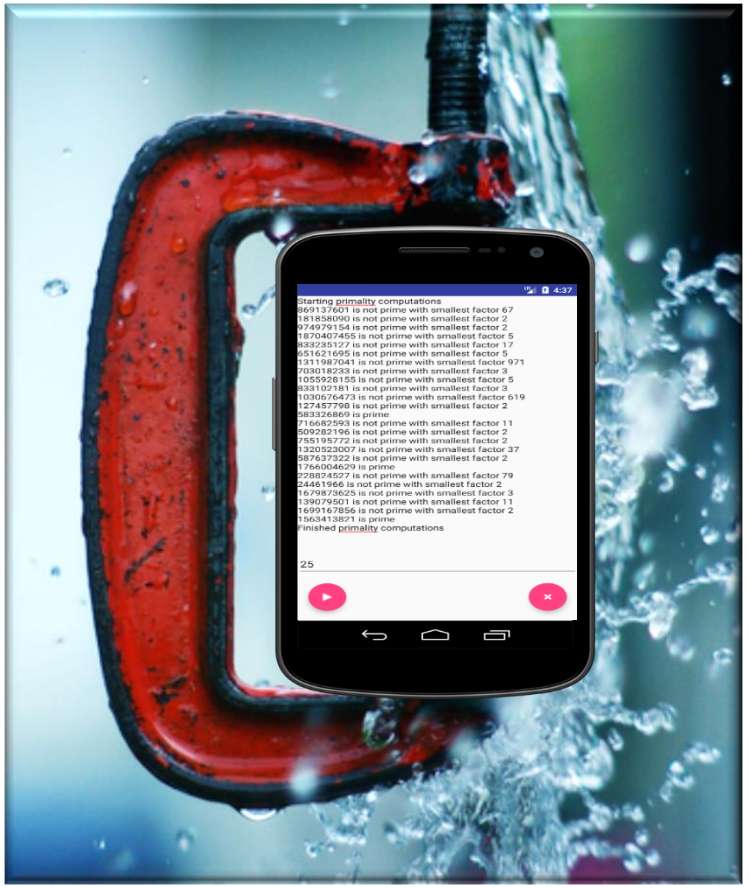
Evaluating this Version of the PrimeChecker App

- ExecutorService version of PrimeChecker app fixes problems with earlier Executor PrimeChecker, e.g.
  - Two-way semantics of Java callables decouple PrimeCallable & MainActivity
  - Lifecycle operations enable task interruptions
  - Runtime configuration changes handled gracefully

Running tasks execute & update the GUI until they finish or are interrupted

Evaluating this Version of the PrimeChecker App

- However, there are still some limitations



Evaluating this Version of the PrimeChecker App

- However, there are still some limitations, e.g.
  - future::get blocks the thread, even if other futures may have completed

```
private class FutureRunnable
  implements Runnable {
  MainActivity mActivity; ...

 public void run() {
   mFutures.forEach(future -> {
     PrimeCallable.PrimeResult pr =
       rethrowSupplier(future::get).get();

   if (pr.mSmallestFactor != 0) ...
   else ...
   mActivity.done(); ...
```

This problem is inherent with the "synchronous future" processing model

We fix this problem in an upcoming lesson on "*Java ExecutorCompletionService*"!

Evaluating this Version of the PrimeChecker App

- However, there are still some limitations, e.g.
  - future::get blocks the thread, even if other futures may have completed
  - isPrime() tightly coupled with PrimeCallable

```
public class PrimeCallable ... {
  long isPrime(long n) {
    if (n > 3)
      for (long factor = 2; factor <= n / 2; ++factor)
        if (Thread.interrupted())
          break;
        else if (n / factor * factor == n)
          return factor;

    return 0L;
  } ...
```

The "brute force" primality checker always runs, even if results were computed earlier

Fixed by Memoizer in an upcoming lesson on "*Java ExecutorCompletionService*"!

End of Java ExecutorService: Evaluating the Pros & Cons