# Applying the Java ScheduledExecutor Service to TimedMemoizer

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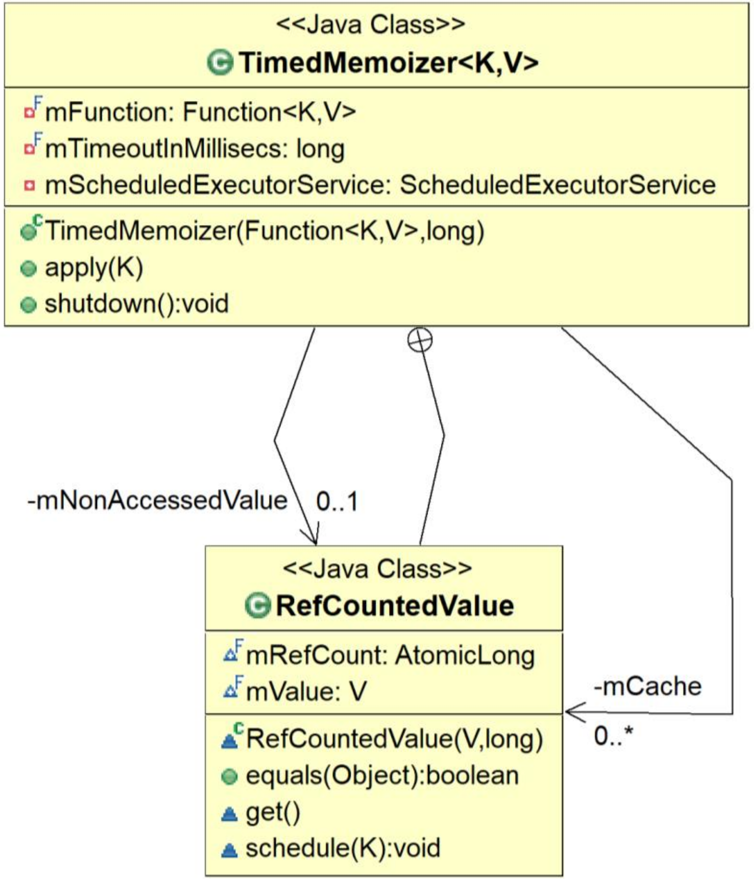
# Learning Objectives in this Part of the Lesson

- Learn how to create a TimedMemoizer that applies ScheduledExecutorService to remove stale entries



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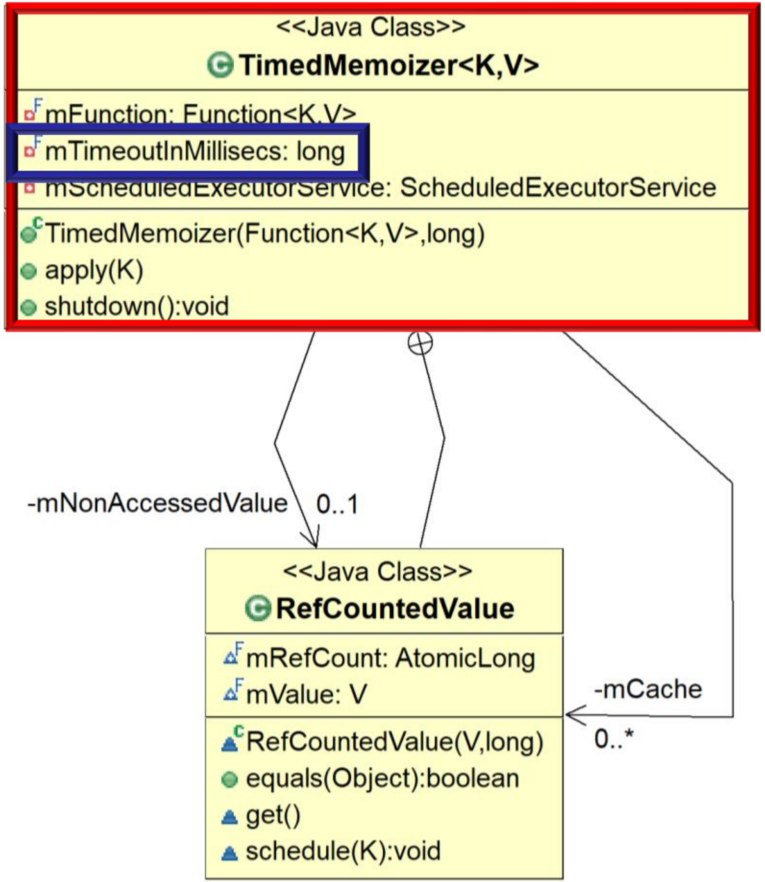
- TimedMemoizer maps a key to the value produced by a function, but limits the time a key/value pair remains cached



<<Java Class>>
**TimedMemoizer<K,V>**

mFunction: Function<K,V>
mTimeoutInMillisecs: long
mScheduledExecutorService: ScheduledExecutorService

TimedMemoizer(Function<K,V>,long)
apply(K)
shutdown():void

-mNonAccessedValue 0..1

-mCache 0..*

<<Java Class>>
**RefCountedValue**

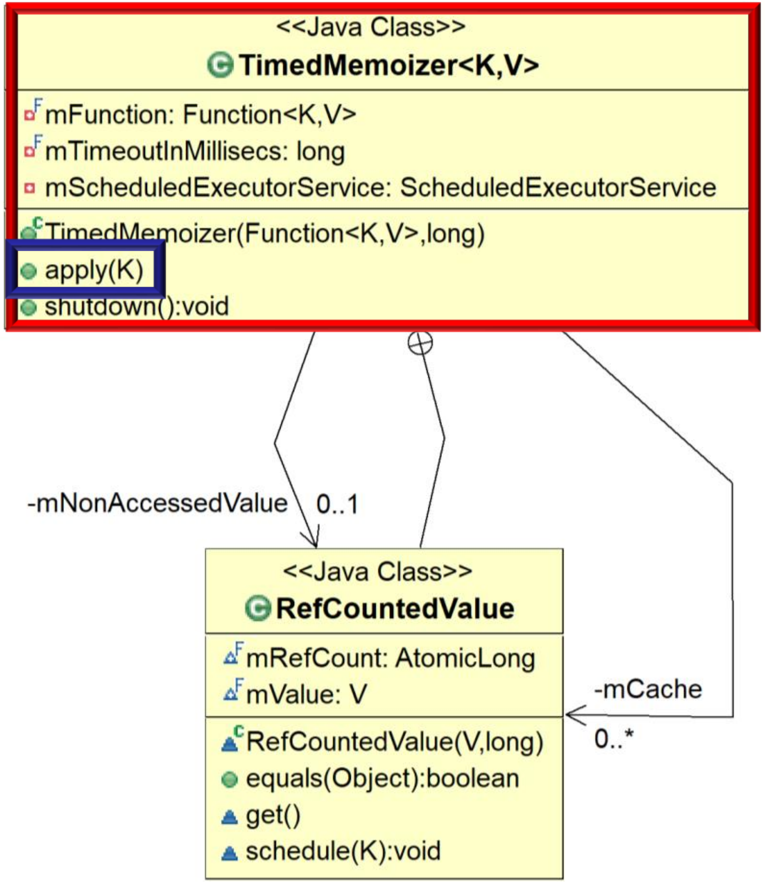
mRefCount: AtomicLong
mValue: V

RefCountedValue(V,long)
equals(Object):boolean
get()
schedule(K):void

See PrimeScheduledExecutorService/app/src/main/java/vandy/mooc/prime/utils/TimedMemoizer.java

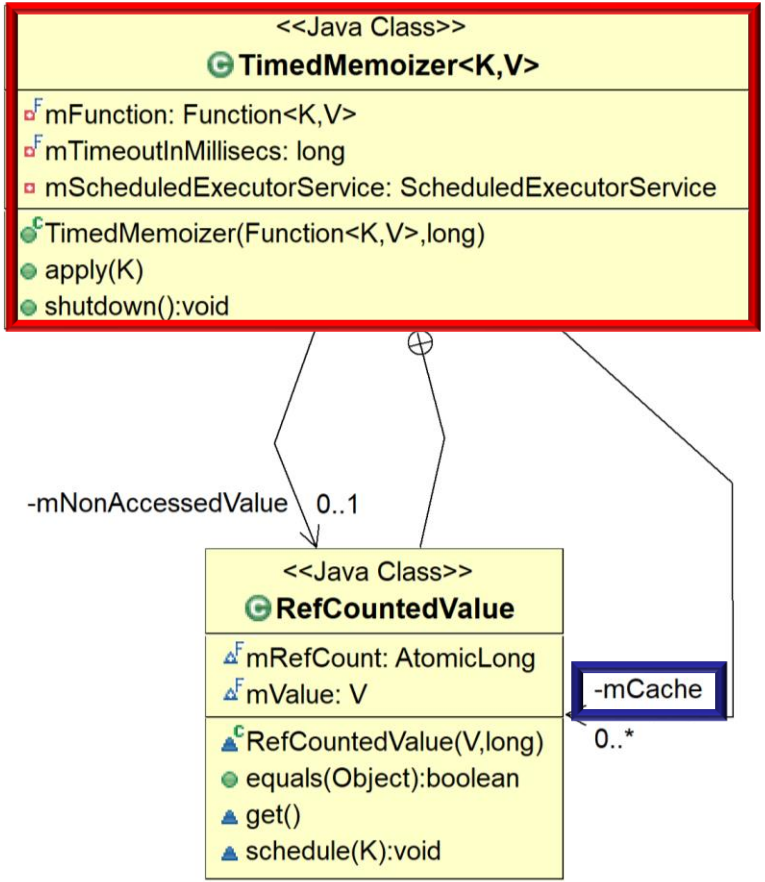
# Applying ScheduledExecutorService to TimedMemoizer

- TimedMemoizer maps a key to the value produced by a function, but limits the time a key/value pair remains cached
  - If a value has been computed for a key it is returned rather than calling the function to compute it again



# Applying ScheduledExecutorService to TimedMemoizer

- TimedMemoizer uses ConcurrentHashMap to minimize synchronization overhead

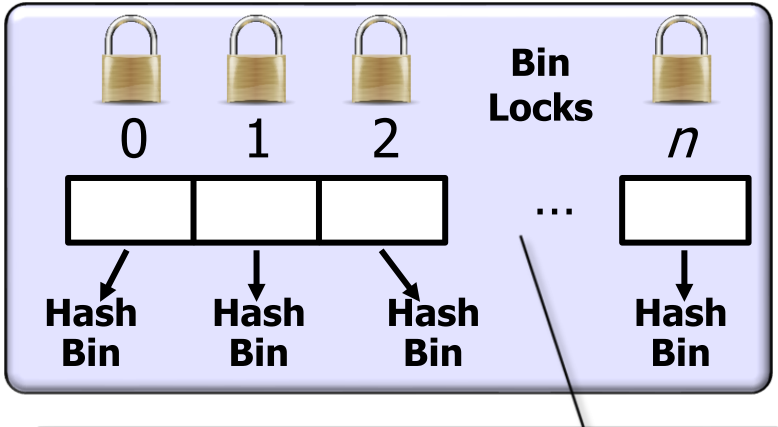


See docs.oracle.com/javase/8/docs/api/java/util/concurrent/ConcurrentHashMap.html

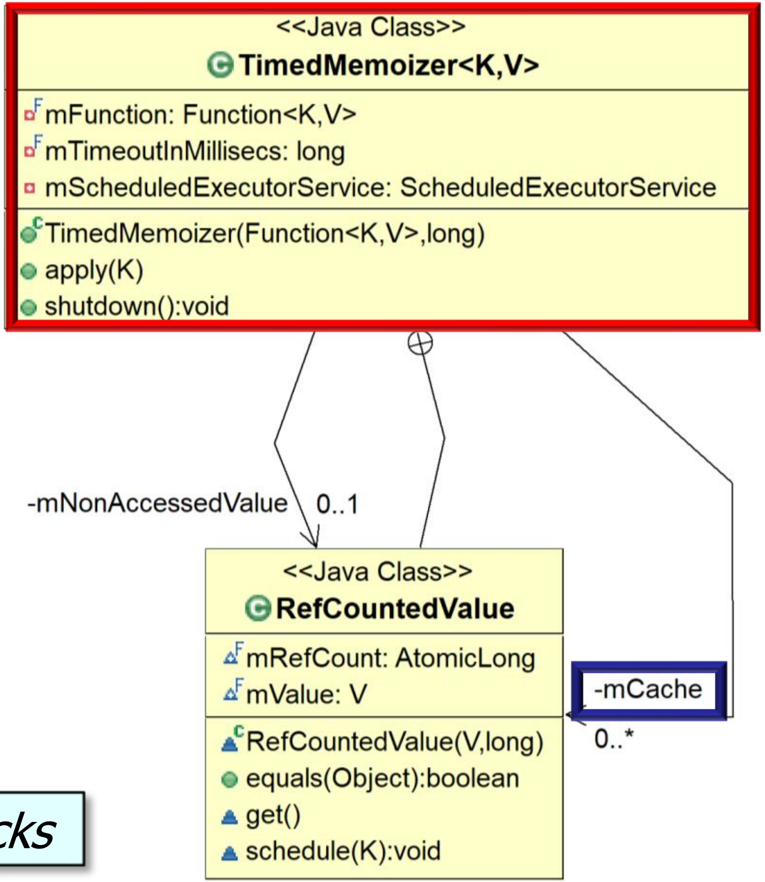
# Applying ScheduledExecutorService to TimedMemoizer

- TimedMemoizer uses ConcurrentHashMap to minimize synchronization overhead
  - A different lock guards each hash bin

**ConcurrentHashMap**



*Contention is low due to use of multiple locks*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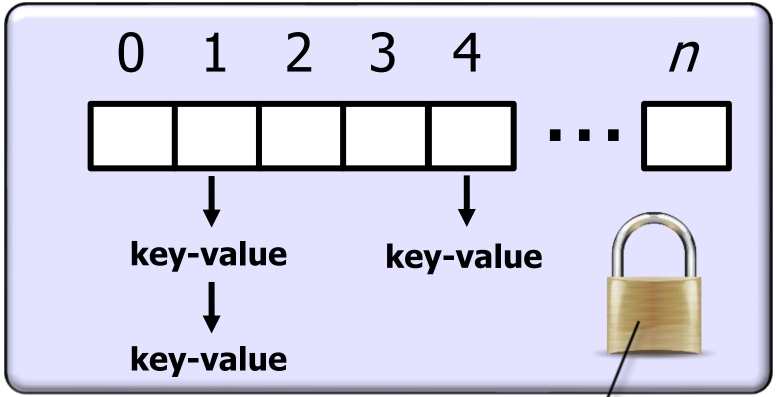
See www.ibm.com/developerworks/java/library/j-jtp08223

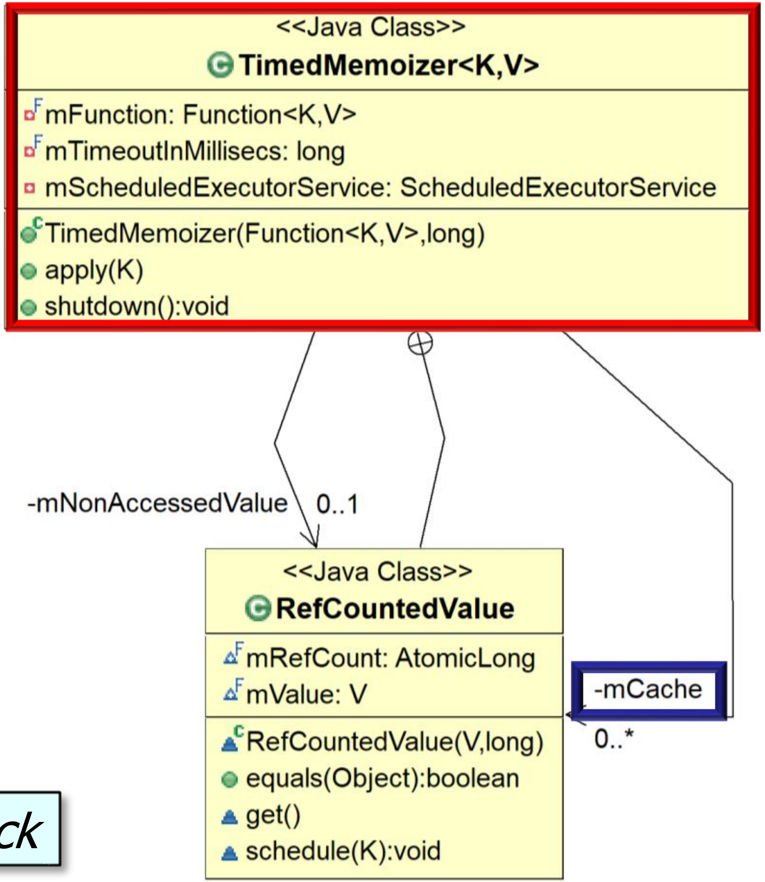
# Applying ScheduledExecutorService to TimedMemoizer

- TimedMemoizer uses ConcurrentHashMap to minimize synchronization overhead
  - A different lock guards each hash bin
  - A SynchronizedMap just uses one lock

**SynchronizedMap**



*Contention is higher due to use of one lock*



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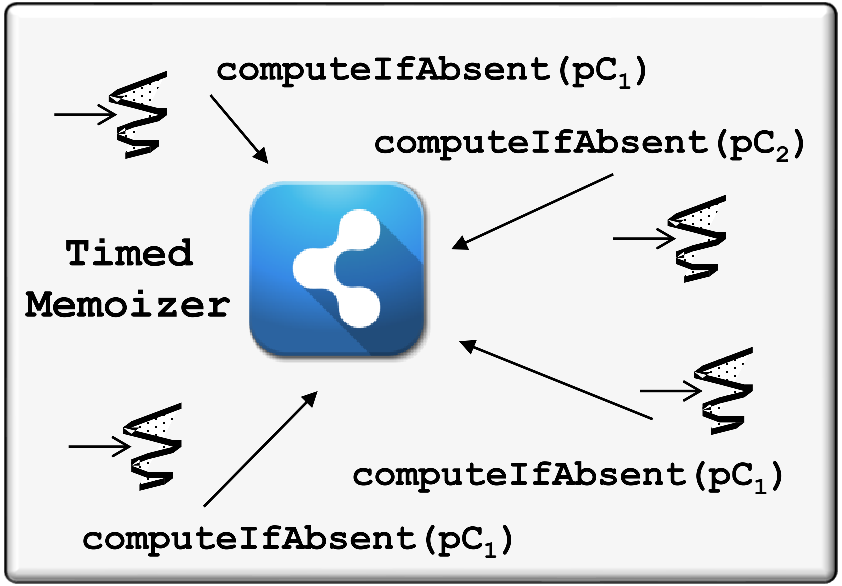
See codepumpkin.com/hashtable-vs-synchronizedmap-vs-concurrenthashmap

# Applying ScheduledExecutorService to TimedMemoizer

- TimedMemoizer uses ConcurrentHashMap to minimize synchronization overhead
  - A different lock guards each hash bin
  - computeIfAbsent() ensures only one call to function runs when a key & value are first added to the cache



See docs.oracle.com/javase/8/docs/api/java/util/concurrent/ConcurrentHashMap.html#computeIfAbsent

# Applying ScheduledExecutorService to TimedMemoizer

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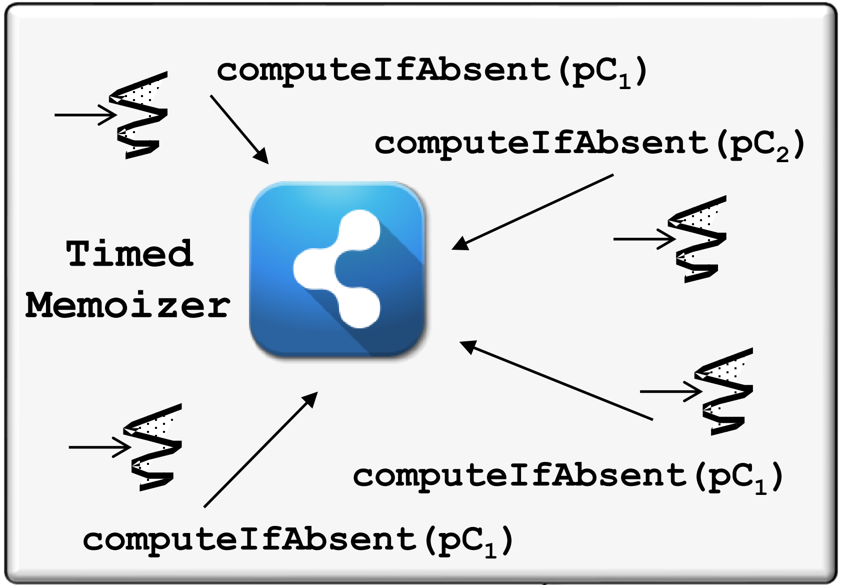
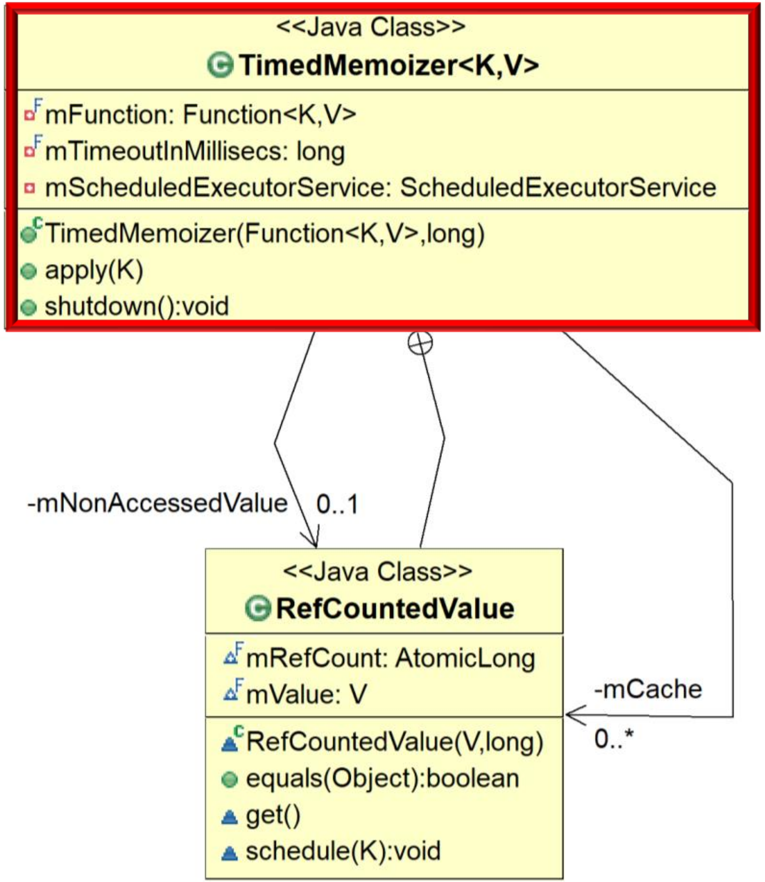


*Only one computation per key is performed even if multiple threads call computeIfAbsent() using the same key*

Eliminates FutureTask (ashkrit.blogspot.com/2014/12/what-is-new-in-java8-concurrenthashmap.html)

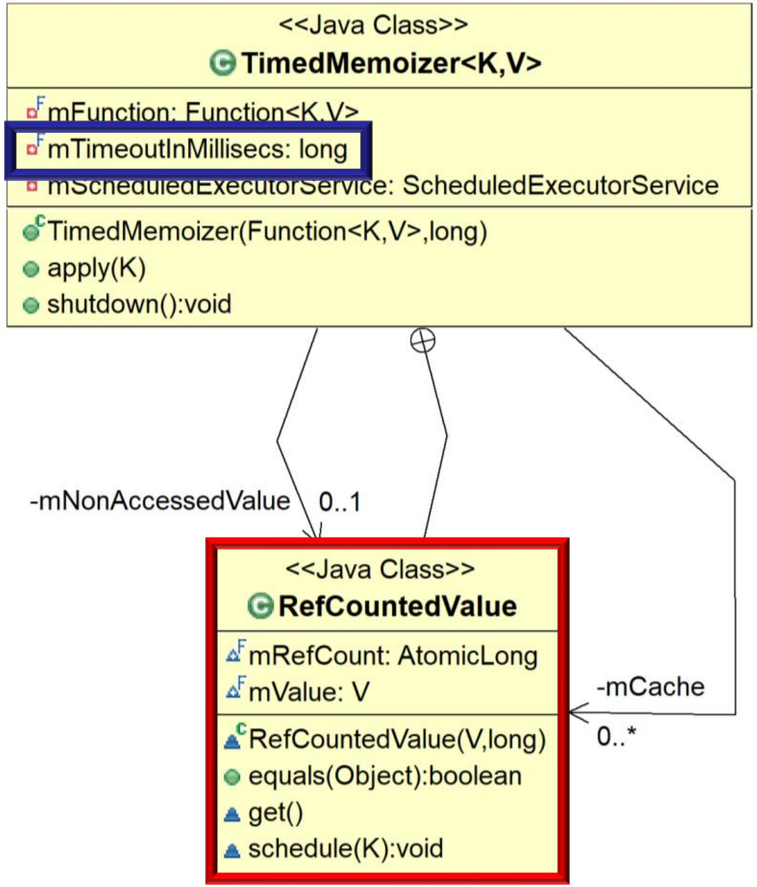
# Applying ScheduledExecutorService to TimedMemoizer

- If a key isn't accessed within a given period TimedMemoizer purges it from the map



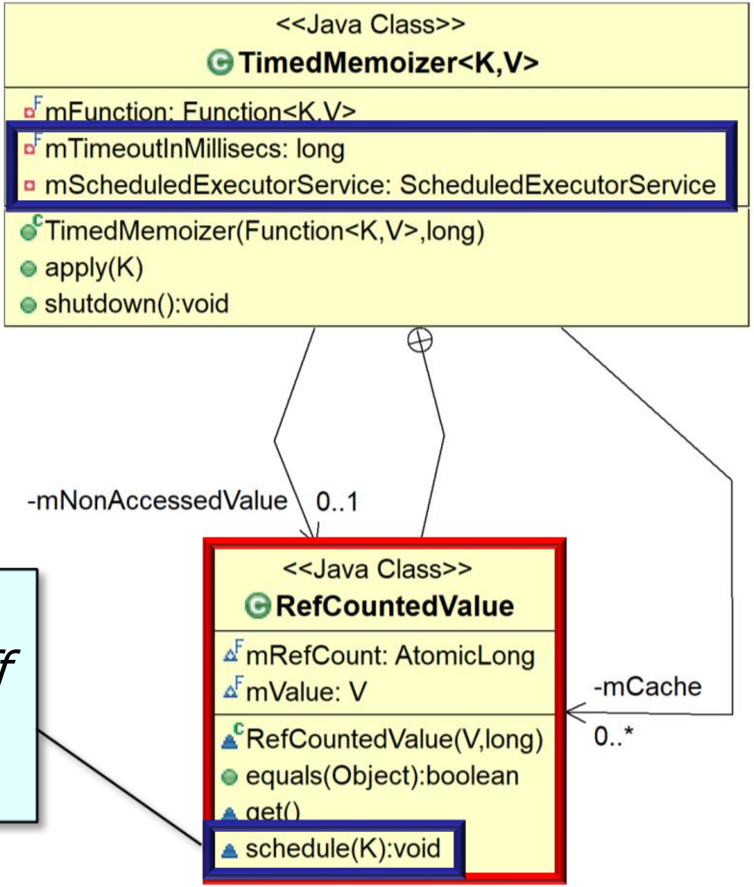
# Applying ScheduledExecutorService to TimedMemoizer

- If a key isn't accessed within a given period TimedMemoizer purges it from the map
  - RefCountedValue tracks # of times a key is referenced within a given # of millisecs



# Applying ScheduledExecutorService to TimedMemoizer

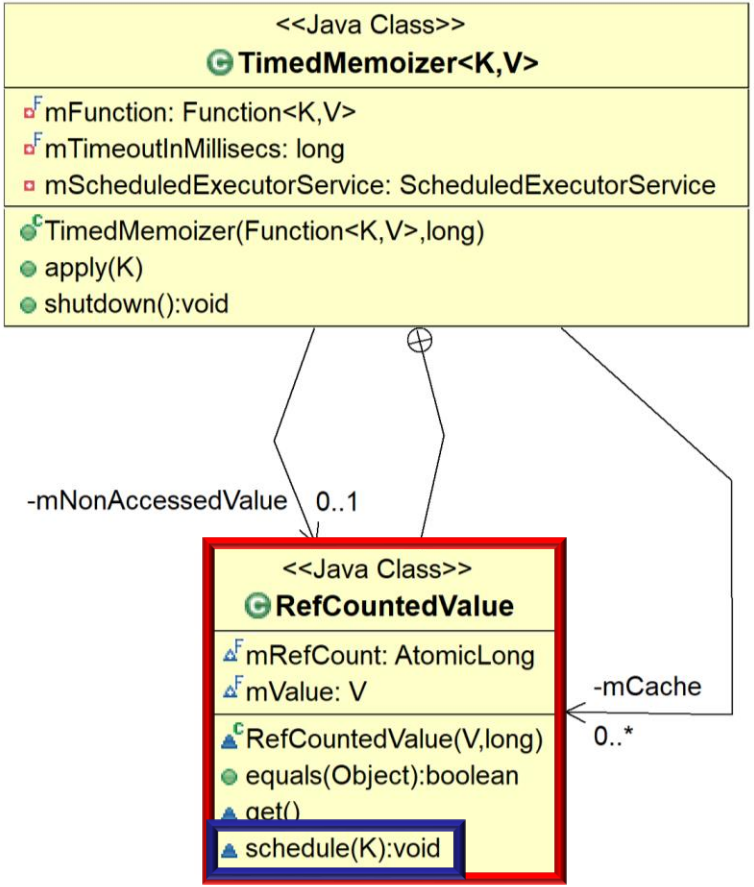
- If a key isn't accessed within a given period TimedMemoizer purges it from the map
    - RefCountedValue tracks # of times a key is referenced within a given # of millisecs
    - Timeout logic is performed by scheduling a new "removeIfStale" runnable via the Java ScheduledExecutorService



*Each runnable is scheduled as a "one-shot" task that's rescheduled iff the value has been accessed during the mTimeoutInMillisecs period*

# Applying ScheduledExecutorService to TimedMemoizer

- Lots of memory can be consumed w/a large # of map entries since each key will create a new "removeIfStale" runnable



See upcoming lesson on *"Java ScheduledExecutorService: Application to TimedMemoizerEx"*

# End of Applying the Java ScheduledExecutorService to TimedMemoizer