Difference between ConcurrentHashMap, Hashtable and Synchronized Map in Java

ConcurrentHashMap vs Hashtable vs Synchronized Map

Though all three collection classes are thread-safe and can be used in multi-threaded, concurrent Java application, there is significant difference between them, which arise from the fact that how they achieve their thread-safety. Hashtable is a legacy class from JDK 1.1 itself, which uses synchronized methods to achieve thread-safety. All methods of Hashtable are synchronized which makes them quite slow due to contention ifnumber of thread increases. Synchronized Map is also not very different than Hashtable and provides similar performance in concurrent Java programs. Only difference between Hashtable and Synchronized Map is that later is not a legacy and you can wrap any Map to create it's synchronized version by using `Collections.synchronizedMap()` method. On the other hand, ConcurrentHashMap is especially designed for concurrent use i.e. more than one thread. By default it simultaneously allows 16 threads to read and write from Map without any external synchronization. It is also very scalable because of stripped locking technique used in internal implementation of ConcurrentHashMap class. Unlike Hashtable and Synchronized Map, it never locks whole Map, instead it divides the map in segments and locking is done on those. Though it perform better if number of reader threads is greater than number of writer threads.

To be frank, Collections classes are heart of Java API though I feel using them judiciously is an art. Its my personal experience where I have improved performance of Java application by using ArrayList where legacy codes were unnecessarily using `Vector` etc. Prior Java 5, One of the major drawback of Java Collection framework was lack of scalability. In multi-threaded Java application synchronized collection classes like Hashtable and Vector quickly becomes bottleneck; to address scalability JDK 1.5 introduces some good concurrent collections which is highly efficient for high volume, low latency system electronic trading systems In general those are backbone for Concurrent fast access of stored data. In this tutorial we will look on `ConcurrentHashMap`, `Hashtable`, `HashMap` and synchronized Map and see difference between ConcurrentHashMap and Hashtable and synchronized Map in Java. We have already discussed some key difference between HashMap and Hashtable in Java in this blog and those will also help you to answer this question during interviews.

Why need ConcurrentHashMap and CopyOnWriteArrayList

The synchronized collections classes, Hashtable and Vector, and the synchronized wrapper classes, `Collections.synchronizedMap()` and`Collections.synchronizedList()`, provide a basic conditionally thread-safe implementation of Map and List. However, several factors make them unsuitable for use in highly concurrent applications for example their single collection-wide lock is an impediment to scalability and it often becomes necessary to lock a collection for a considerable time during iteration to prevent ConcurrentModificationException.

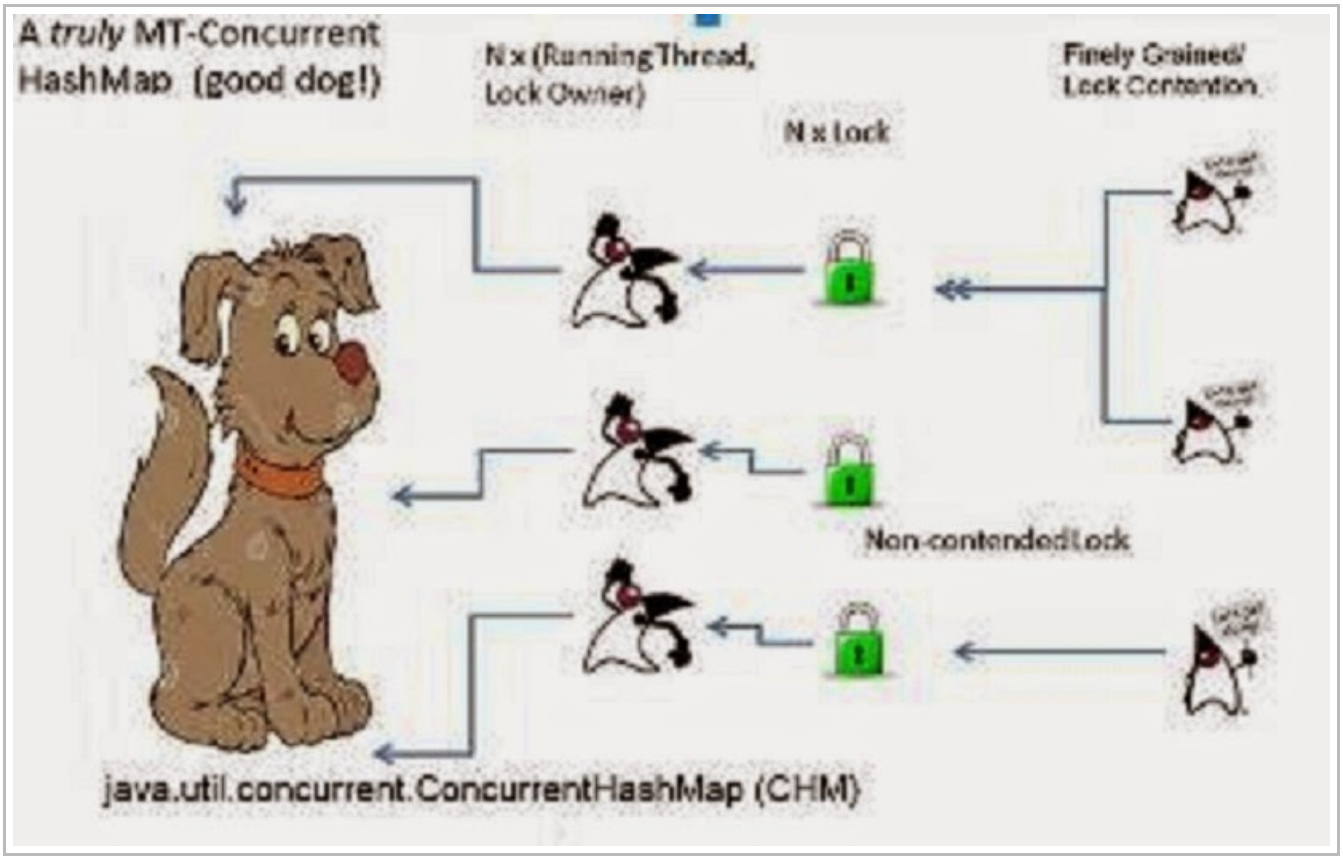
`ConcurrentHashMap` and `CopyOnWriteArrayList` implementations provide much higher concurrency while preserving thread safety, with some minor compromises in their promises to callers. ConcurrentHashMap and CopyOnWriteArrayList are not necessarily useful everywhere you might use HashMap or ArrayList, but are designed to optimize specific common situations. Many concurrent applications will benefit from their use.

Difference between ConcurrentHashMap and Hashtable

So what is the difference between Hashtable and ConcurrentHashMap , both can be used in multithreaded environment but once the size of Hashtable becomes considerable large performance degrade because for iteration it has to be locked for longer duration.

Since ConcurrentHashMap introduced concept of segmentation , how large it becomes only certain part of it get locked to provide thread safety so many other readers can still access map without waiting for iteration to complete.

In Summary ConcurrentHashMap only locked certain portion of Map while Hashtable lock full map while doing iteration. This will be more clear by looking at this diagram which explains internal working of ConcurrentHashMap in Java.



Difference between ConcurrentHashMap and Collections.synchronizedMap

ConcurrentHashMap is designed for concurrency and improve performance while HashMap which is non synchronized by nature can be synchronized by applying a wrapper using synchronized Map. Here are some of common differences between ConcurrentHashMap and synchronized map in Java

ConcurrentHashMap do not allow null keys or null values while synchronized HashMapallows one null keys.