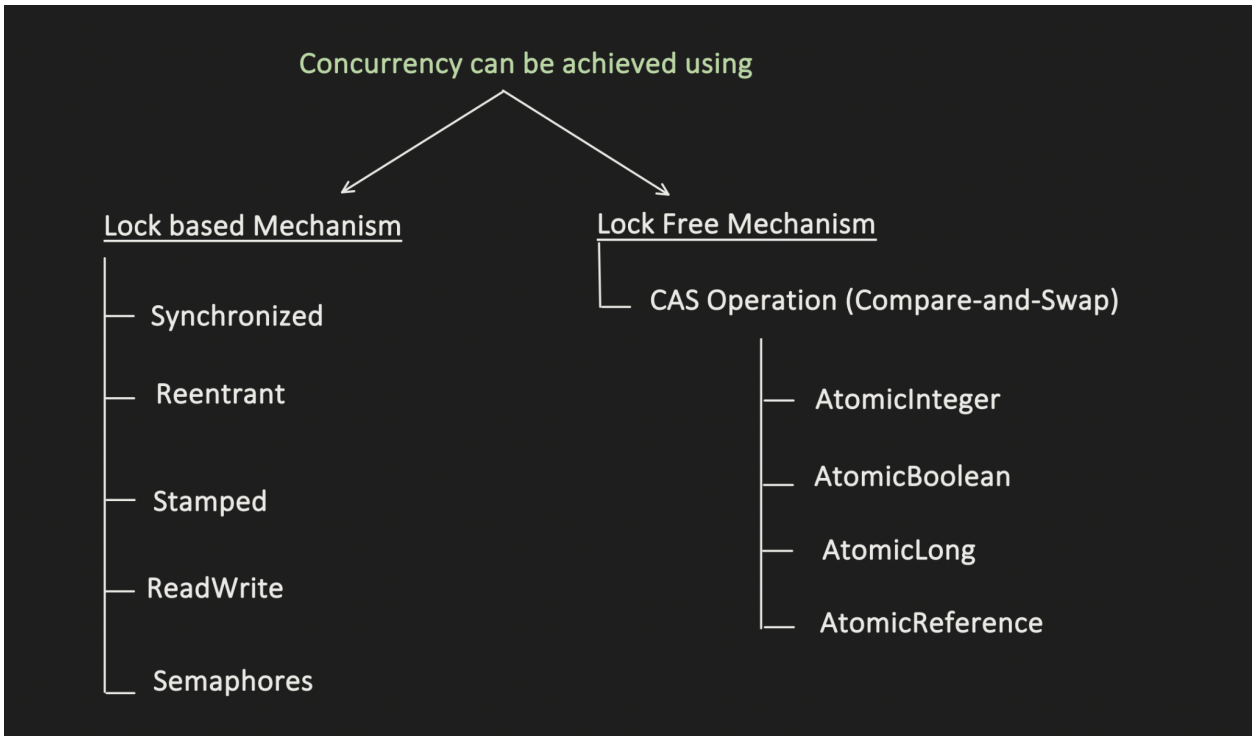
Lock Free Concurrency (CAS)



Lock Free Mechanism

It uses CAS (compare and Swap) technique:

- It's a Low level operation.
- Its Atomic.
- And all modern Processor supports it.

It involves 3 main parameters:

- Memory location: location where variable is stored.
- Expected Value: value which should be present at the memory.
  - *ABA* problem is solved using version or timestamp.
- New Value: value to be written to memory, if the current value matches the expected value.

Atomic Variables:

What ATOMIC means:

- It means Single or "all or nothing"

```java
public class Main {

    public static void main(String[] args) {

        SharedResource resource = new SharedResource();
        for(int i=0; i<400; i++) {
            resource.increment();
        }
        System.out.println(resource.get());
    }
}
```

```java
public class SharedResource {

    2 usages
    int counter;

    no usages
    public void increment() {
        counter++;
    }

    no usages
    public int get() {
        return counter;
    }
}
```

Output:

```
400

Process finished with exit code 0
```

```java
public class Main {

    public static void main(String[] args) {

        SharedResource resource = new SharedResource();

        Thread t1 = new Thread(() -> {

            for(int i=0; i< 200; i++) {
                resource.increment();
            }
        });

        Thread t2 = new Thread(() -> {

            for(int i=0; i< 200; i++) {
                resource.increment();
            }
        });

        t1.start();
        t2.start();

        try {
            t1.join();
            t2.join();
        }catch (Exception e) {

        }

        System.out.println(resource.get());
    }
}
```

```java
public class SharedResource {

    2 usages
    int counter;

    no usages
    public void increment() {
        counter++;
    }

    no usages
    public int get() {
        return counter;
    }
}
```

Output:

```
371

Process finished with exit code 0
```

2 solutions:

1. Using lock like synchronized
2. Using lock free operation like AtomicInteger

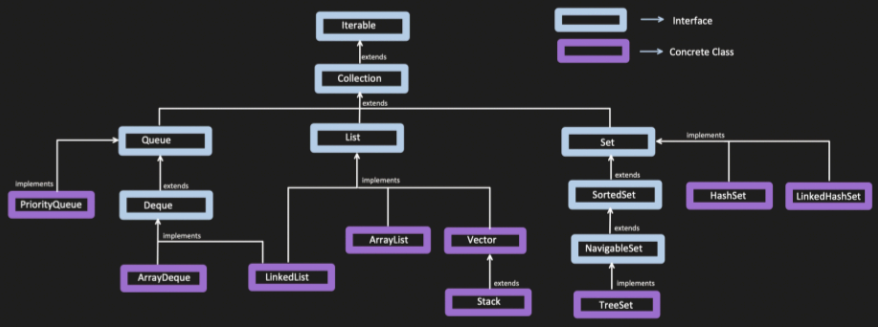
1. Using lock like synchronized

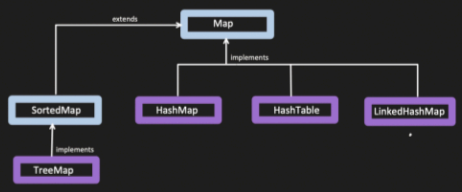
```
public class SharedResource {

    2 usages
    int counter;

    2 usages
    public synchronized void increment() {
        counter++;
    }

    1 usage
    public int get() {
        return counter;
    }
}
```

2. Using lock free operation like AtomicInteger

```
public class SharedResource {

    2 usages
    AtomicInteger counter = new AtomicInteger( initialValue: 0);

    2 usages
    public void increment() {
        counter.incrementAndGet();
    }

    1 usage
    public int get() {
        return counter.get();
    }
}
```

Concurrent Collection





Collection	Concurrent Collection	Lock
PriorityQueue	PriorityBlockingQueue	ReentrantLock
LinkedList	ConcurrentLinkedDeque	Compare-and-swap operation
ArrayDeque	ConcurrentLinkedDeque	Compare-and-swap operation
ArrayList	CopyOnWriteArrayList	ReentrantLock
HashSet	newKeySet method inside ConcurrentHashMap	Synchronized
TreeSet	Collections.synchronizedSortedSet	Synchronized
LinkedHashSet	Collections.synchronizedSet	Synchronized
Queue Interface	ConcurrentLinkedQueue	Compare-and-swap operation