

Synchronized

Synchronized

Java

Synchronized

Synchronized JVM

Synchronized

Synchronized

monitorenter monitorexit

monitorenter

+1 monitorexit -1

0

Java Synchronize

$\frac{1}{2}$ $\frac{1}{2}$

$\frac{1}{2}$ $\frac{1}{2}$ monitorenter monitorexit

Reference

Synchronized

```
1. Synchronized Synchronized
   Synchronized(this)
```

2. Synchronized

Synchronized

Synchronized

Synchronized

Synchronized

Synchronized method2

method2 method1

 $\frac{1}{2}$ \mathbb{C}^2

Synchronized

monitorenter

+ 1

JVM Java

Java 6 Monitor

/

Java

JDK

JDK

Monitor

Biased Locking

JDK

Synchronized

JVM

JVM

CAS

Mark Word

ID

JVM

CAS

Mark Word

Synchronized

Synchronized

CAS

Synchronized

CAS Compareand Swap

CAS

CPU

JNI

Native

C++

JDK

Unsafe

1.

2.

CPU

CAS

3. ABA

CAS

A

B

A

CAS

ReentrantLock

Synchronized

ReentrantLock

Synchronized

JVM

ReentrantLock

Lock

volatile

int

int

AQS

AQS

AQS AbstractQueuedSynchronizer

Lock

ReentrantLock

ReadWriteLock

Semaphore

CountDownLatch

FutureTask

AQS

1. AQS

volatile int state

lock

state=0

state=1

state=1

2. AQS

Node

o Node

waitStatus

Node

prev

next

FIFO

o Node

SHARED

EXCLUSIVE

Semaphore

AQS

ReentrantLock

3. AQS

ConditionObject

Condition

wait()

Condition signal()

4. AQS Condition Lock

Condition

Synchronized

ReentrantLock

ReentrantLock Lock

ReentrantLock Synchronized

Synchronized

Synchronized

Synchronized JVM

Synchronized

JVM

Lock

Lock

unLock()

finally{}

Synchronized

ReentrantLock

Java 6

Synchronized

ReentrantLock

Synchronized

ReentrantLock

ReentrantLock

ReentrantLock

Sync Sync

AQS

AOS

AOS

CAS

ID

ID

ReentrantLock

JUC

JUC

java.util.concurrent

Java

CountDownLatch

CyclicBarrier

Semaphore

Synchronized

ConcurrentHashMap

ConcurrentSkipListMap

CopyOnWriteArrayList

ArrayBlockingQueue SynchronorousQueue

PriorityBlockingQueue

Executor

ReadWriteLock StampedLock

ReentrantLock Synchronized

Java

ReadWriteLock

½

Synchronized

JDK

StampedLock

validate

½

Java

JUC

CountDownLatch CyclicBarrier

Semaphore

CountDownLatch

½

½

100

CountDownLatch

countDown

1

await

CyclicBarrier

CyclicBarrier

CyclicBarrier

CyclicBarrier

await()

await()

1

0

CyclicBarrier

await()

N-1

Cyclic

CyclicBarrier.await()

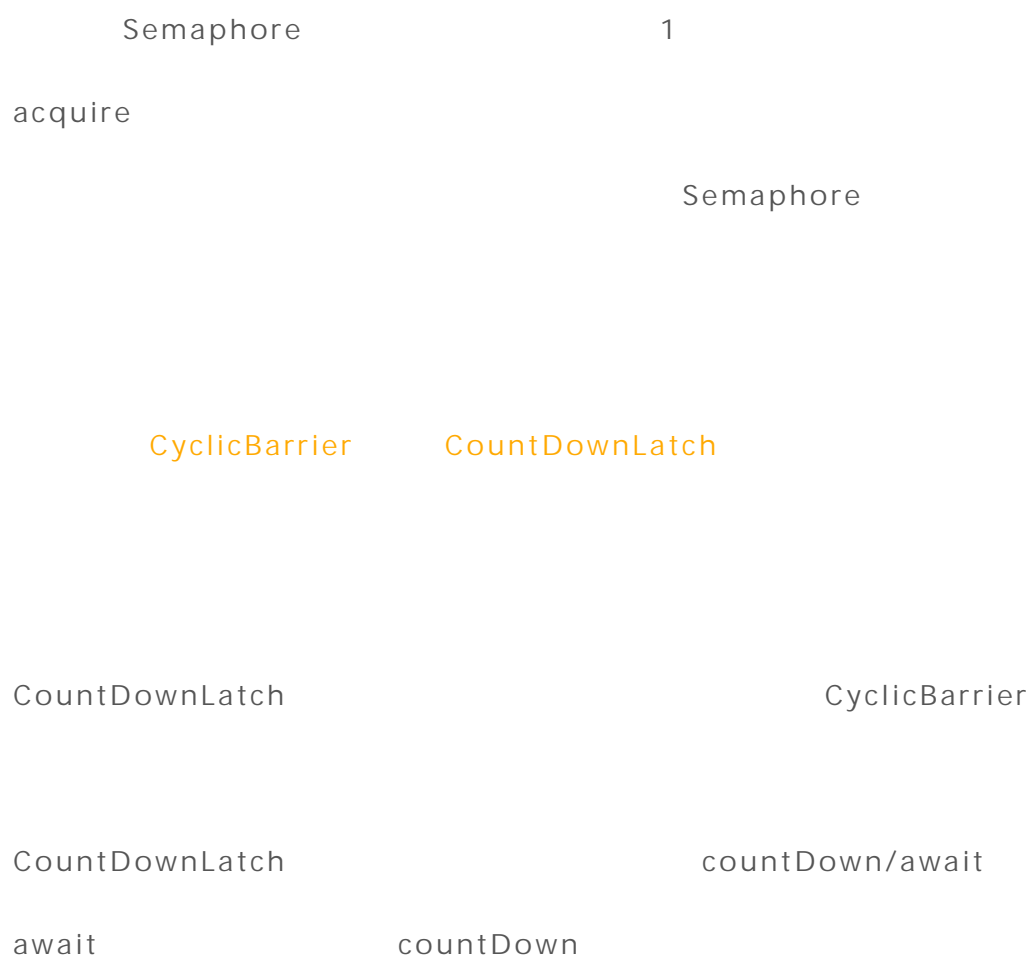
Barrier

1/2

Semaphore Java

acquire()

release()



countDown

CyclicBarrier

await

await

CountDownLatch

N

CyclicBarrier

```
public CyclicBarrier(int parties, Runnable barrierAction)
```

CyclicBarrier

N

N

CountDownLatch

Java

Java

Java

 $\mathbb{C}^{1/2} \quad \mathbb{C}^{1/2}$

Worker

AQS

```
HashSet<Worker> workers
```

workQueue

```
BlockingQueue<Runnable> workQueue
```

workQueue

Workers

Java

corePoolSize

maximumPoolSize

keepAliveTime

workQueue

execute

Runnable

Worker

execute()

corePoolSize

corePoolSize

maximumPoolSize

maximumPoolSize

RejectExecutionException

keepAliveTime

corePoolSize

corePoolSize

Java

1. SingleThreadExecutor

corePoolSize 1

maximumPoolSize 1

keepAliveTime 0L

workQueue new LinkedBlockingQueue<Runnable>()

2. FixedThreadPool

FixedThreadPool

FixedThreadPool

corePoolSize nThreads

maximumPoolSize nThreads

keepAliveTime 0L

workQueue new LinkedBlockingQueue<Runnable>()

3. CachedThreadPool

CachedThreadPool

60

JVM

SynchronousQueue

1

daemon SERVER

Executor

corePoolSize 0

maximumPoolSize Integer.MAX_VALUE

keepAliveTime 60L

workQueue new SynchronousQueue<Runnable>()

1

4. ScheduledThreadPool

ScheduledThreadPool

DEFAULT_KEEPAIVEMILLIS

corePoolSize corePoolSize

maximumPoolSize Integer.MAX_VALUE

keepAliveTime DEFAULT_KEEPAIVE_MILLIS

workQueue new DelayedWorkQueue()

Java

1. execute() ExecutorService.execute

Runnable

1/2

2. submit() ExecutorService.submit()

Future

isDone()

Future

get()

isDone()

get()

get()

Java

Java

Java

Java

Java

Java

volatile

volatile Java

volatile

1.

2.

Java 8

lock unlock

read write

load

store

load store

read

write

use assign

volatile 8

volatile

volatile

volatile

volatile

volatile

volatile

Java

volatile

volatile

Synchronized

Synchronized

volatile

ThreadLocal

Synchronized

ThreadLocal

Synchronized

Synchronized

1/2

1/2

ThreadLocal

1/2

1/2

ThreadLocal

ThreadLocal

Java

ID Cookie

ThreadLocal

ThreadLocal

Map

ThreadLocal

ThreadLocal

ThreadLocal

remove

ThreadLocal

ThreadLocalMap

ThreadLocalMap

key

ThreadLocal

ThreadLocalMap

OOM

remove

worker