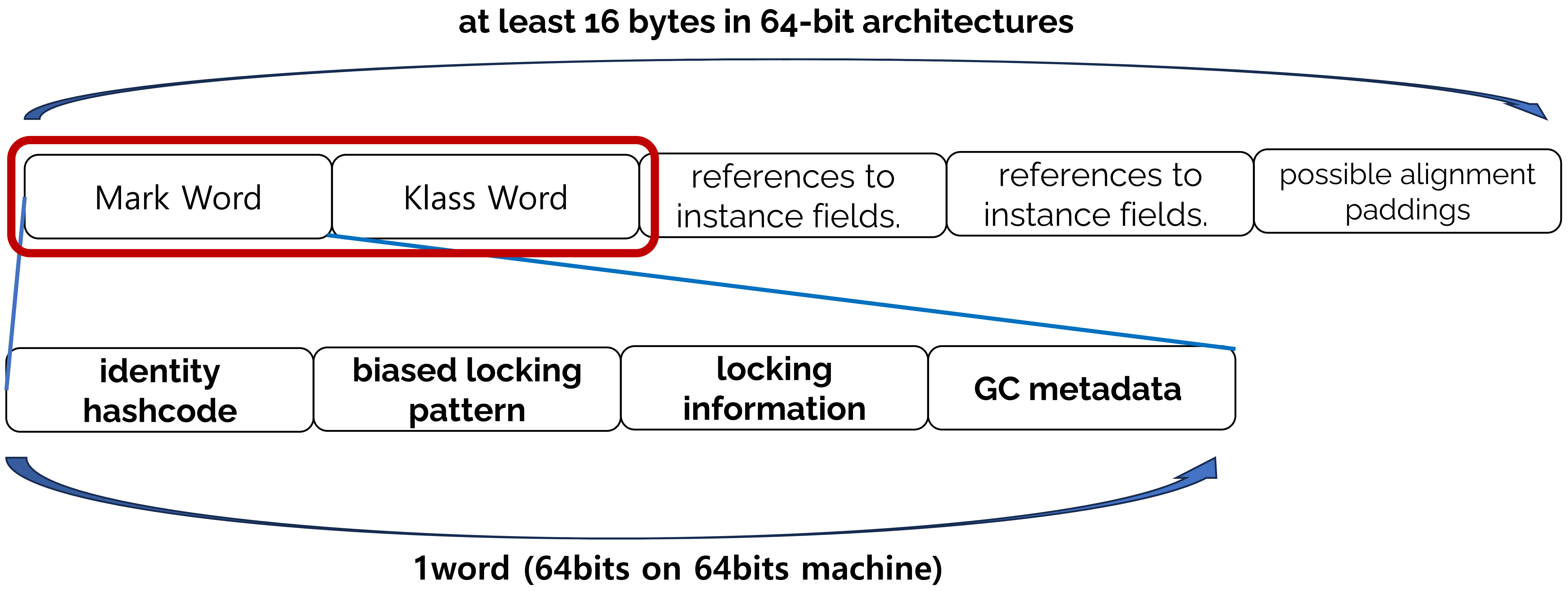
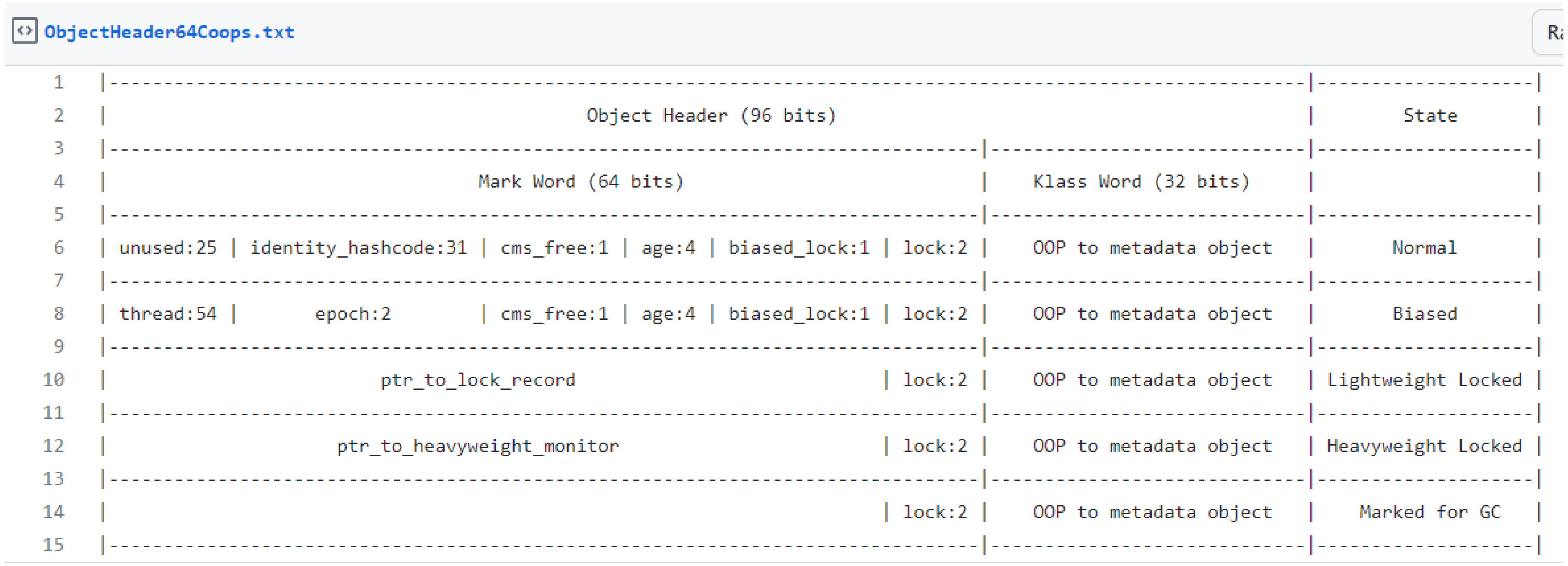
Ordinary Object Pointers (OOPs)

data structure to represent pointers to objects.


at least 16 bytes in 64-bit architectures
Mark Word
Klass Word
references to instance fields.
references to instance fields.
possible alignment paddings
identity hashcode
biased locking pattern
locking information
GC metadata
1word (64bits on 64bits machine)

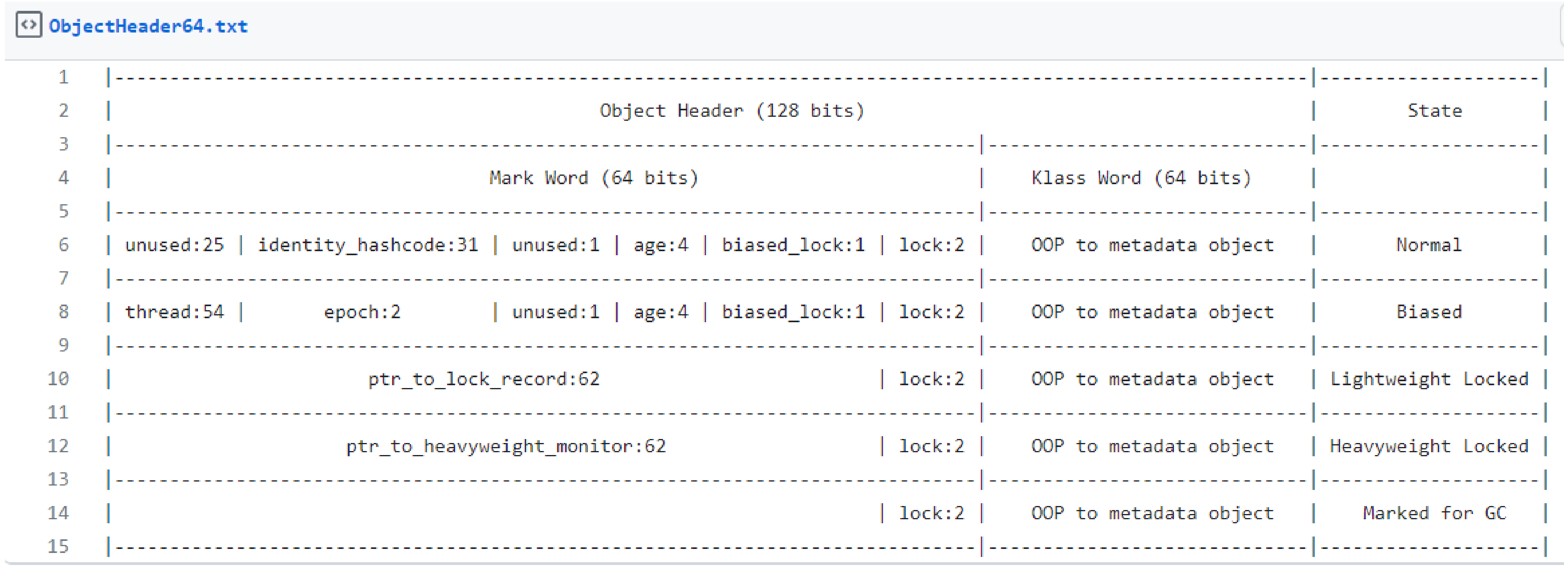
Compressed OOPs



ObjectHeader64Coops.txt

```
|--------------------------------------------------------------------------------------------------------------|--------------------|
|                                           Object Header (96 bits)                                            |        State       |
|--------------------------------------------------------------------------------|-----------------------------|--------------------|
|                              Mark Word (64 bits)                               |    Klass Word (32 bits)     |                    |
|--------------------------------------------------------------------------------|-----------------------------|--------------------|
| unused:25 | identity_hashcode:31 | cms_free:1 | age:4 | biased_lock:1 | lock:2 |    OOP to metadata object   |       Normal       |
|--------------------------------------------------------------------------------|-----------------------------|--------------------|
| thread:54 |       epoch:2        | cms_free:1 | age:4 | biased_lock:1 | lock:2 |    OOP to metadata object   |       Biased       |
|--------------------------------------------------------------------------------|-----------------------------|--------------------|
|                         ptr_to_lock_record                            | lock:2 |    OOP to metadata object   | Lightweight Locked |
|--------------------------------------------------------------------------------|-----------------------------|--------------------|
|                     ptr_to_heavyweight_monitor                        | lock:2 |    OOP to metadata object   | Heavyweight Locked |
|--------------------------------------------------------------------------------|-----------------------------|--------------------|
|                                                                       | lock:2 |    OOP to metadata object   |    Marked for GC   |
|--------------------------------------------------------------------------------|-----------------------------|--------------------|
```

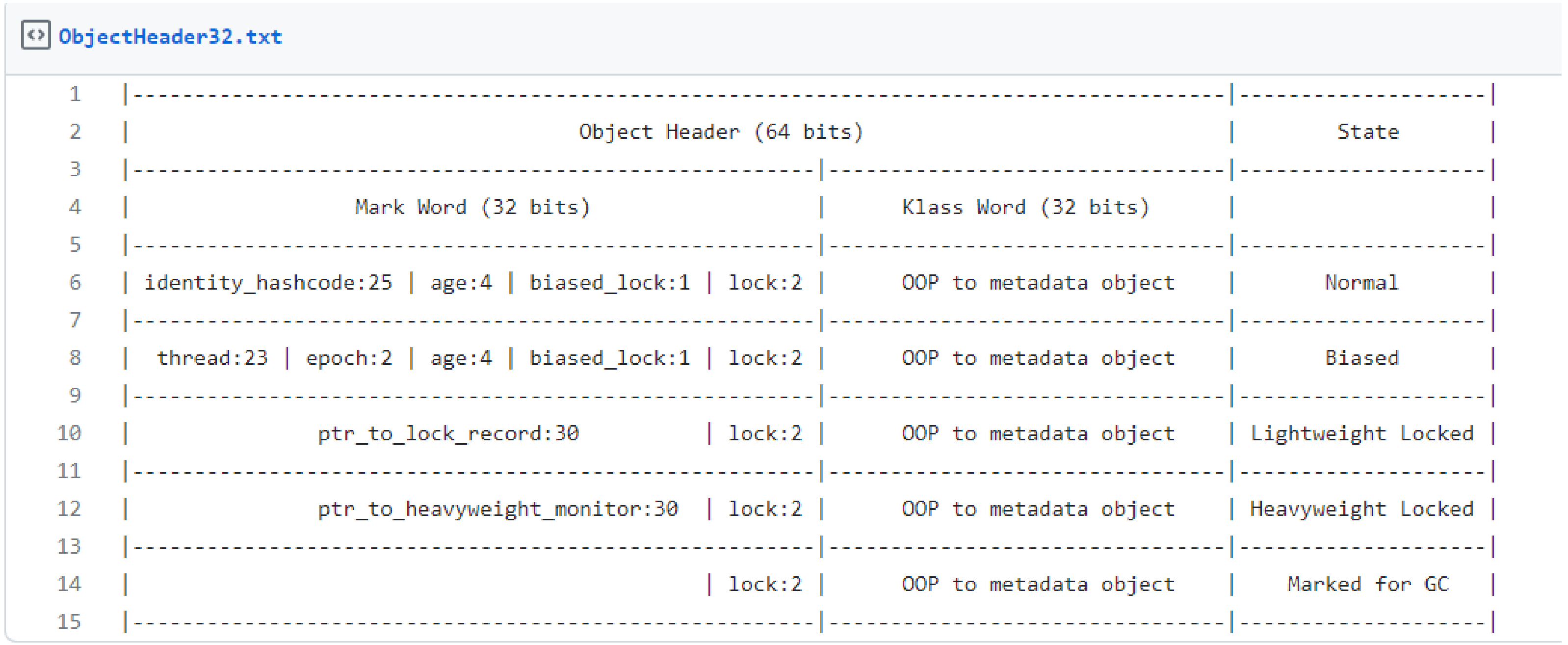
OOPs



ObjectHeader64.txt

```
|------------------------------------------------------------------------------------------------------------|--------------------|
|                                          Object Header (128 bits)                                          |        State       |
|------------------------------------------------------------------------------|-----------------------------|--------------------|
|                                  Mark Word (64 bits)                         |    Klass Word (64 bits)     |                    |
|------------------------------------------------------------------------------|-----------------------------|--------------------|
| unused:25 | identity_hashcode:31 | unused:1 | age:4 | biased_lock:1 | lock:2 |    OOP to metadata object   |       Normal       |
|------------------------------------------------------------------------------|-----------------------------|--------------------|
| thread:54 |       epoch:2        | unused:1 | age:4 | biased_lock:1 | lock:2 |    OOP to metadata object   |       Biased       |
|------------------------------------------------------------------------------|-----------------------------|--------------------|
|                      ptr_to_lock_record:62                          | lock:2 |    OOP to metadata object   | Lightweight Locked |
|------------------------------------------------------------------------------|-----------------------------|--------------------|
|                    ptr_to_heavyweight_monitor:62                    | lock:2 |    OOP to metadata object   | Heavyweight Locked |
|------------------------------------------------------------------------------|-----------------------------|--------------------|
|                                                                     | lock:2 |    OOP to metadata object   |    Marked for GC   |
|------------------------------------------------------------------------------|-----------------------------|--------------------|
```

Ordinary Object Pointers (OOPs) – 32bits computer


ObjectHeader32.txt

```
|----------------------------------------------------------------------------------------|--------------------|
|                                  Object Header (64 bits)                                |        State       |
|-------------------------------------------------------|----------------------------------|--------------------|
|                   Mark Word (32 bits)                  |       Klass Word (32 bits)      |                    |
|-------------------------------------------------------|----------------------------------|--------------------|
| identity_hashcode:25 | age:4 | biased_lock:1 | lock:2 |       OOP to metadata object     |       Normal       |
|-------------------------------------------------------|----------------------------------|--------------------|
|  thread:23 | epoch:2 | age:4 | biased_lock:1 | lock:2 |       OOP to metadata object     |       Biased       |
|-------------------------------------------------------|----------------------------------|--------------------|
|               ptr_to_lock_record:30          | lock:2 |       OOP to metadata object     | Lightweight Locked |
|-------------------------------------------------------|----------------------------------|--------------------|
|               ptr_to_heavyweight_monitor:30  | lock:2 |       OOP to metadata object     | Heavyweight Locked |
|-------------------------------------------------------|----------------------------------|--------------------|
|                                              | lock:2 |       OOP to metadata object     |    Marked for GC   |
|-------------------------------------------------------|----------------------------------|--------------------|
```

My understanding of **Mark word** in OOPs Header

1. mark word는 결국 instance에 대한 meta data를 위한 공간이다.

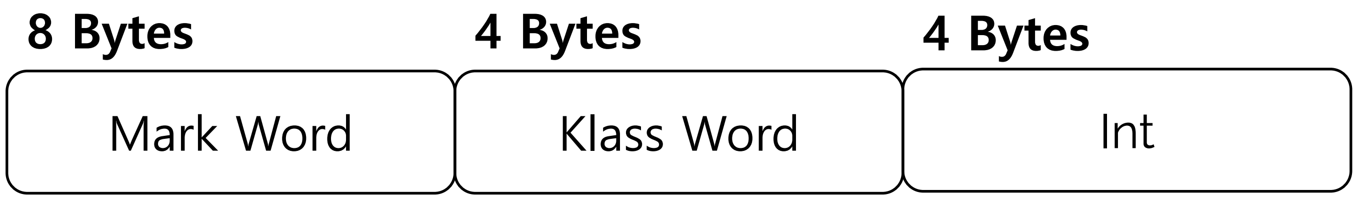
2. 다만, 세부적으로 각 항목이 어떻게 사용되는지 이해하지는 못했지만 Mark word라는 공간이 다양하게 사용될 수 있다는 것을 이해하면 될 것 같다.

3. 즉, **객체 또한 다양한 상태에 존재할 수 있고 그 상태에서 필요한 meta 정보가 기록된다고 이해하면 될 것 같다**.

Basic Example

```java
public class SimpleInt {
    private int state;
}
```

```
SimpleInt object internals:
 OFFSET  SIZE   TYPE DESCRIPTION                               VALUE
      0    12        (object header)                           N/A
     12     4    int SimpleInt.state                           N/A
Instance size: 16 bytes
Space losses: 0 bytes internal + 0 bytes external = 0 bytes total
```



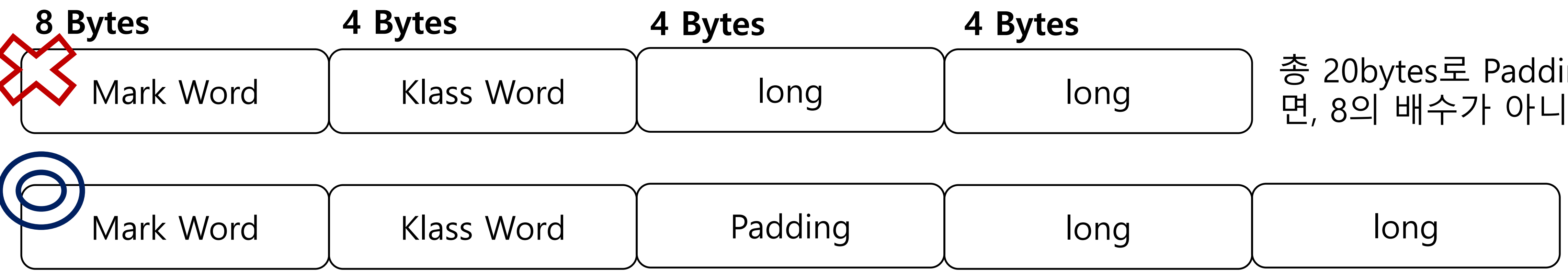
Alignment

By default, the JVM adds enough padding to the object **to make its size a multiple of 8.**

Example

```java
public class SimpleLong {
    private long state;
}
```

```
SimpleLong object internals:
 OFFSET  SIZE   TYPE DESCRIPTION                               VALUE
      0    12        (object header)                           N/A
     12     4        (alignment/padding gap)
     16     8   long SimpleLong.state                          N/A
Instance size: 24 bytes
Space losses: 4 bytes internal + 0 bytes external = 4 bytes total
```



총 20bytes로 Padding이 없으면, 8의 배수가 아니다.