Overview of the Java Memory Model

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Learning Objectives in this Part of the Lesson

• Be aware of the Java memory model
Overview of the Java Memory Model
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- Java’s memory model defines semantics of memory shared by multiple threads within a process

See gee.cs.oswego.edu/dl/cpj/jmm.html
Overview of the Java Memory Model

- Java's memory model defines semantics of memory shared by multiple threads within a process, e.g.
- Which instruction reorderings are allowed in memory

There are various potential sources of reordering, e.g., the Java compiler, the Just-In-Time (JIT) compiler, processor instruction pipelines, caches, etc.
Overview of the Java Memory Model

- Java’s memory model defines semantics of memory shared by multiple threads within a process, e.g.
  - Which instruction reorderings are allowed in memory
  - Should not be overly restrictive, to enable hardware optimizations

```
start threads
```

```
x = y = 0
x = 1
j = y
Thread₁
```

```
y = 1
i = x
Thread₂
```

It can end up that \( i = 0 \) & \( j = 0 \) due to local caching effects in Thread₁ & Thread₂

See [en.wikipedia.org/wiki/Memory_ordering](en.wikipedia.org/wiki/Memory_ordering)
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  - Which instruction reorderings are allowed in memory
  - Which program outputs may occur in a correct Java implementation

```
x = y = 0
```

```
Thread1
r1 = x
y = r1
```

```
Thread2
r2 = y
x = r2
```

See [docs.oracle.com/javase/specs/jls/se7/html/jls-17.html#jls-17.4.3](docs.oracle.com/javase/specs/jls/se7/html/jls-17.html#jls-17.4.3)
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- Java’s memory model defines semantics of memory shared by multiple threads within a process, e.g.
  - Which instruction reorderings are allowed in memory
  - Which program outputs may occur in a correct Java implementation
  - Reordering should not be so generous such that values appear randomly!

![Diagram showing Java Memory Model example]

- See [simple.wikipedia.org/wiki/42_(answer)](simple.wikipedia.org/wiki/42_(answer))
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- Reading about Java’s memory model is as much fun as watching paint dry.

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Fortunately, you needn’t understand all these memory model details – you just need to know how to use Java synchronizers properly!!
End of Overview of the Java Memory Model