Java 22+,
Toward Java 25

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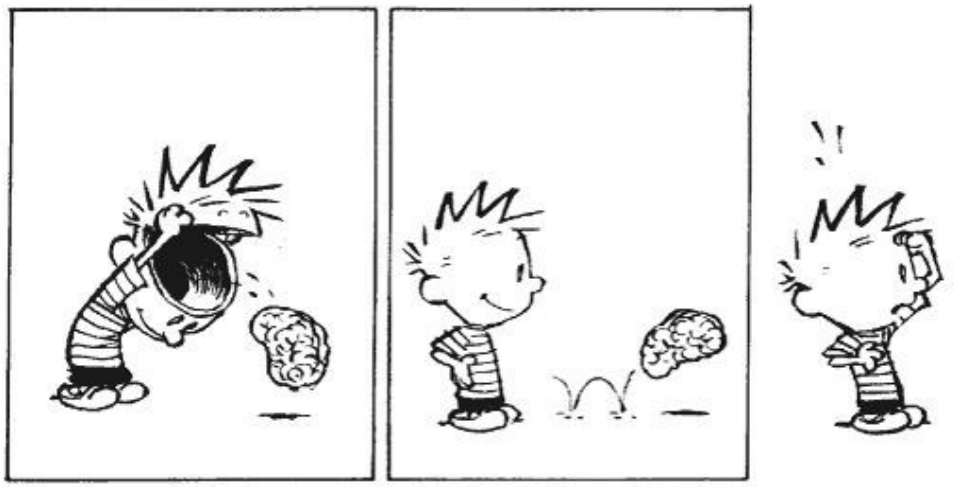
Université Gustave Eiffel – June 2024



Don’t believe what I’m saying !

Me, myself and I

Rémi Forax

- Assistant Prof at University Gustave Eiffel
- Expert for lambda, module, record, etc

Feel free to google me if you want to know more ...

Java 22/23 → Java 25

Language

- Implicit classes et java.lang.IO (preview)
- String templates ??? (in limbo)
- Unnamed variable (‘_’) and the *any* pattern (released 22)
- Flexible constructors (preview)

APIs

- Scoped Values (preview)
- Structured Concurrency (preview)
- Foreign Functions / Memory API (released 22)
  - Deprecate for removal sun.misc.Unsafe (java 23, warning in 24, off by default in 26+)
- Stream Gatherer (preview)

DEMO !

https://github.com/forax/java-25-demo

Great for teaching !

Great for scripting !

Implicit class

Class can be implicit

- No explicit constructor, no package

  static void main(String[] args) { … }

main / launcher protocol simplification

- The parameter is optional, static is optional
  - If not static, the default constructor is called

    void main() { … }

Import module

Great for scripting !

Can import all exported packages of a module

- Equivalent to import *

  import module java.base;

  <=> import java.lang.*, java.util.*, java.io.*, etc

Implicit classes import the module java.base by default

Great for teaching !

java.io.IO

New class with 3 methods

- void **print/println**(Object)
- void **readln**(Object prompt)

Implicit classes import all static methods of java.io.IO

```
import static java.io.IO.*;
```

String template

String interpolation

- **var** name = ...
  STR."foo \{name}"

Generalized

- Can return any types
- SQL."select foo where id = \{name}”

String template (remaster)

The proposed API

- String template arguments are typed java.lang.Object
- String template processor are not efficient
- Using a method is more powerful

```
sql("select foo where id = \{name}”)
    => sql("select foo where id = \{}”, name)
```

Need to go back to the backboard

- No preview for Java 23

Unnamed variable

Can be used anywhere a variable is not part of the API

```
for(var _ = …)
try(var _ = …)
catch(Throwable _)
(int x, int _) -> …

class A {
  void m(String _) {  }  // error, public API !
}
```

Any pattern

A pattern that recognizes any value

```
record Point(int x, int y) { }

switch(point) {
  case Point(int _, int _) - > …  // unnamed variable
  case Point(_, _) - > … // any pattern
}
```

Flexible constructor

Align the Java semantics to the JVM semantics

- JVM: do not use “this” as a value before the call to the super constructor
- Java : do not use any statements before the call to the super constructor
  - But inner class outer instance is an exception

Statements before super()

Preconditions can be validated before the call to super()

```
class Dog {
  final String name;

  Dog(String name) {
    Objects.requireNonNull(name);  // ok !
    super();
    this.name = name;
  }
}
```

Field inits before super()

Fields can be initialized before the call to super()

```
class Dog {
  final String name;

  Dog(String name) {
    Objects.requireNonNull(name);
    this.name = name;   // ok !
    super();
  }
}
```

This is required for fields of value classes (Valhalla)

Foreign Memory API

Safe/Fast Access to off-heap memory

- Off-heap memory == not managed by the GC
- Like ByteBuffer
  - But explicit deallocation, and index > 2G (long)

MemorySegment == a region of memory

Arena

- allocate() one or more MemorySegment
- close() deallocate all segments

Example

Uses Arena.global() == no deallocation

- Arena arena = Arena.global();

Allocate 16 bytes of memory

- MemorySegment segment = arena.allocate(16);

Set a byte

- segment.set(ValueLayout.JAVA_BYTE, 7, (byte) 12);

Get a byte

- segment.get(ValueLayout.JAVA_BYTE, 7)

Arenas

Apart global(), there are ~~three~~ two other arenas

- Arena.ofConfined()
  - Only the current thread can allocate()
- Arena.ofShared()
  - All threads can allocate()
  - Close() quite slow => thread handshakes
- Arena.~~ofAuto~~()
  - Deallocation by the GC, do not use explicitly !
    - ByteBuffer has been retrofitted to use MemorySegment

Struct (1/2)

A MemoryLayout defines an offset for each fields

```
static final MemoryLayout POINT = MemoryLayout.structLayout(
    JAVA_INT.withName("x"),
    JAVA_INT.withName("y")
);
```

A VarHandle can access to a specific field

```
static final VarHandle X = POINT.varHandle(groupElement("x"));
```

Warning: you need both **static** and **final** to get performance

Struct (2/2)

A MemoryLayout defines an offset for each fields

- Allocate using a MemoryLayout

```
var segment = arena.allocate(POINT);
```

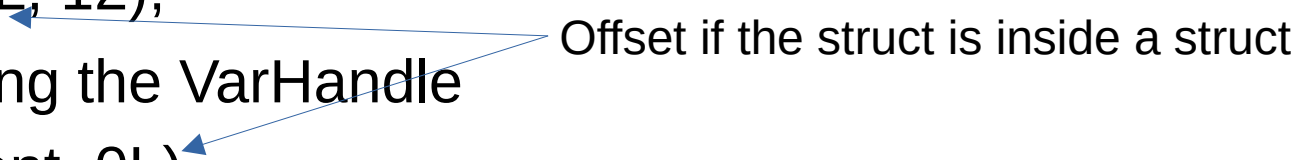
- Set a field value using the VarHandle

```
X.set(segment, 0L, 12);
```

- Get a field value using the VarHandle

```
(int) X.get(segment, 0L)
```

the cast is necessary otherwise the value is boxed !



Array of Struct

Accessing a memory segment as an array

- Need an array element VarHandle

```
static final VarHandle ARRAY_X =
    POINT.arrayElementVarHandle(groupElement("x"));
```

- Allocate Using a MemorySegment and a size

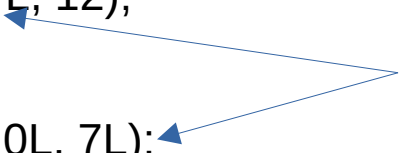
```
var segment = arena.allocate(POINT, 16);
```

- Set a value at an index

```
ARRAY_X.set(segment, 0L, 7L, 12);
```

- Get a value at an index

```
(int) ARRAY_X.get(segment, 0L, 7L);
```



Memory Mapped File

The off-heap memory can be mapped to a file

- Create a FileChannel
  - **try**(**var** channel = FileChannel.open(path, READ, WRITE, CREATE)) {
- Declare an arena
  - **try**(**var** arena = Arena.ofConfined()) {
- Create the segment by mapping the file
  - **var** segment = channel.map(READ_WRITE,
    0L, 16L * POINT.byteSize(), arena);

MemorySegment based Stream

See a segment + MemoryLayout as a Stream

```
try(var arena = Arena.ofConfined()) {
  var segment = channel.map(READ_WRITE,
     0L, 16L * POINT.byteSize(), arena);
```

Using MemorySegment.elements(MemoryLayout)

```
  var sum = segment.elements(POINT)
      .mapToInt(s - > (int) X.get(s, 0L))
      .sum();
```

The stream slices the big segments in small segments

And with a parallel stream

Use Arena.ofShared() instead of ofConfined()

```
try(var arena = Arena.ofShared()) {
  var segment = channel.map(READ_WRITE,
      0L, 16L * POINT.byteSize(), arena);
```

Using MemorySegment.elements(MemoryLayout)

```
  var sum = segment.elements(POINT)
      .parallel()
      .mapToInt(s - > (int) X.get(s, 0L))
      .sum();
```

Executive Summary

Executive Summary

- Scripting / Teaching is easier
- Valhalla integration with flexible constructors
- Stream gatherer (not specialized, no characteristics)
- Foreign API
  - Nice API to call C Methods (but unsafe)
  - Can access off heap memory in a safe/structured way
    - sun.misc.Unsafe will require a command line flag