SchokoVM

JVM Interpreter in C++

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Aktueller Stand

- ✓ Class File Parsing
- ✓ alle Instruktionen bis auf invokedynamic
- ✓ Objekte/Arrays
- ✓ Exceptions
- ✓ Native Methoden aufrufe

- ~ OpenJDK Class Library
- ~ Primitive Garbage Collection

- □ invokedynamic (String concatenation)
- □ multi-threading / synchronized
- □ eigene Class Loader

String concatenation

```
$ ./SchokoVM KarelTheRobot
BEGINNING-OF-PROGRAM
   DEFINE-NEW-INSTRUCTION turnright AS
     BEGIN
          turnleft
          turnleft
          turnleft
     END
   BEGINNING-OF-EXECUTION
terminate called after throwing an instance of 'std::runtime_error'
  what():  Unimplemented/unknown opcode 186 at 9
```

Workaround:

```
javac -XDstringConcat=inline KarelTheRobot.java
```

Interpreter

```
while (!should_exit) {
  if (exception) { … }
  switch (code[pc]) {
    case OpCode::imul: ...
  }
}
```

Nicht rekursiv

Speicherlayout: `struct Object { Clazz *clazz, …, E data[n]}`

Stack

ein einziges Array pro Thread

Frame: operands view, locals view, program counter, method

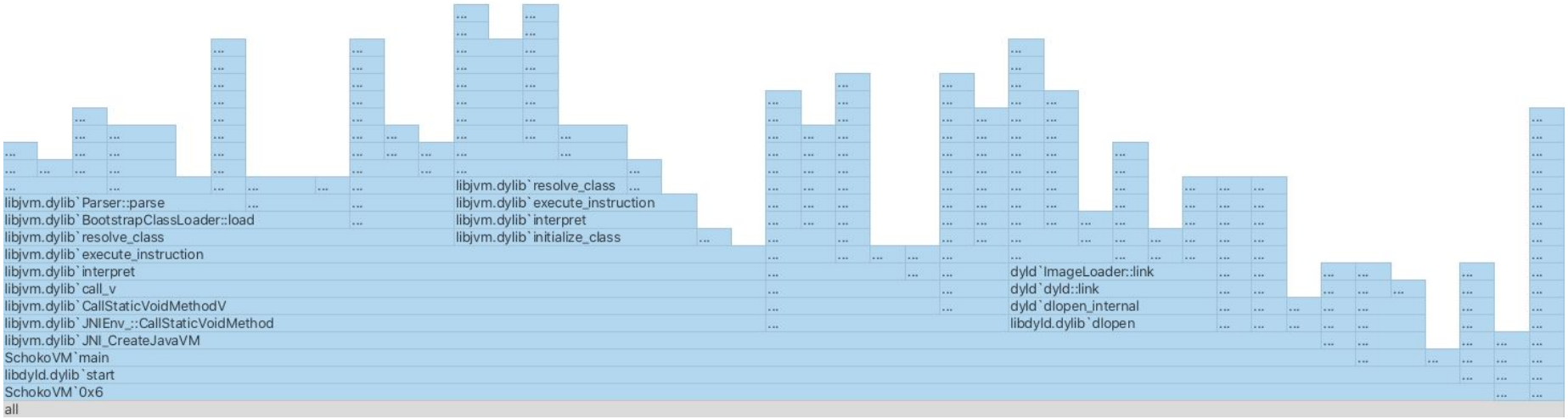
```
//
//   |caller local variables| caller operand stack |
//   |  n     n+1     n+2   | n+3 | n+4  n+5   n+6 |  n+7  n+8  |  n+9    n+10  | n+11
//                            |   callee local variables    |callee operands|
//
```

OpenJDK 11 Class Library

VM-spezifische Funktionalität in nativen Methoden:

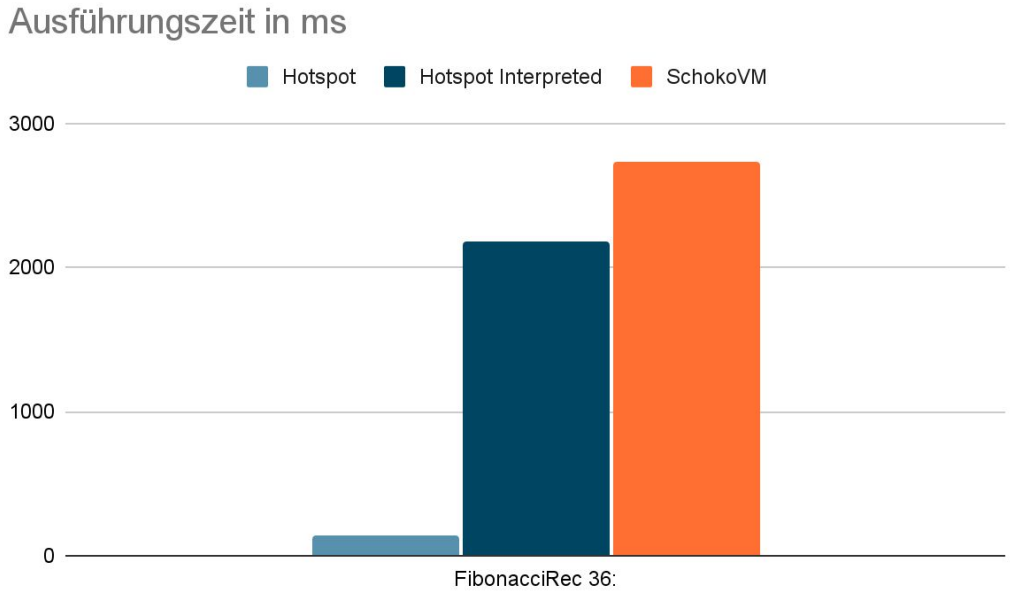
- JVM_*
  - `jobject JVM_Clone(JNIEnv *env, jobject obj) {`
- JNI_*
  - `jint JNI_CreateJavaVM(JavaVM **pvm, void **penv, void *args);`
  - `jsize CreateArrayLength(JNIEnv *env, jarray array);`
- Unsafe
  - `public native void putInt(Object o, long offset, int x);`

Benchmark: Hello World (50ms)



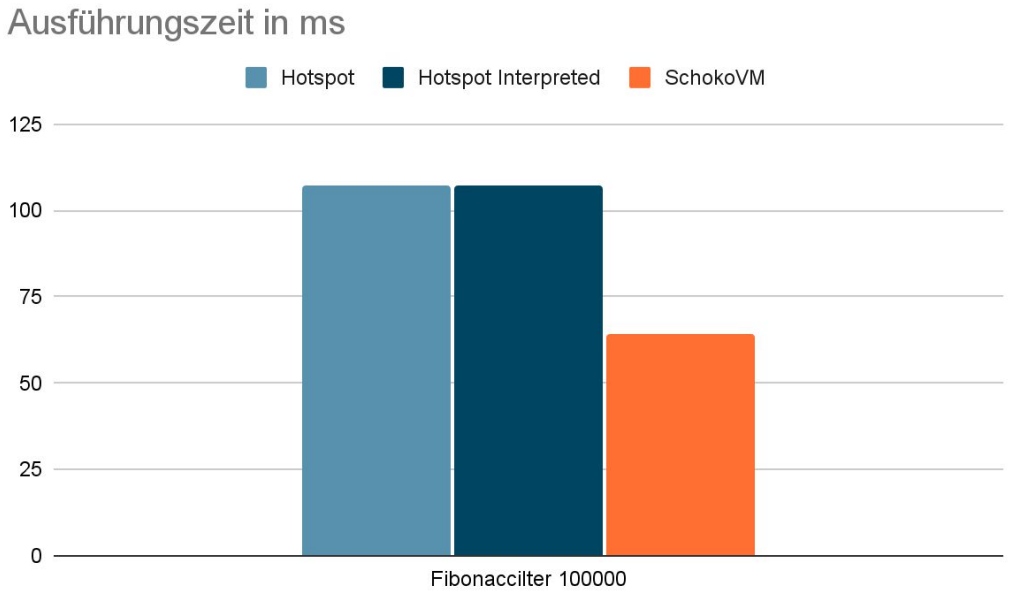
Benchmark: Fibonacci rekursiv, n=36

HotSpot	0.145s
HotSpot Interpreted	2.178s
SchokoVM	2.733s



Benchmark: Fibonacci iterativ long, n=100000

HotSpot	0.107s
HotSpot Interpreted	0.107s
SchokoVM	0.064s



Benchmark: Fibonacci iterativ BigInteger, n=100000

HotSpot	0.560s
HotSpot Interpreted	3.904s
SchokoVM	17.347s