ClassLoaders

Rikhard Goldenberg
SberTech JavaSchool, Feb.2018

СБЕРБАНК ТЕХНОЛОГИИ

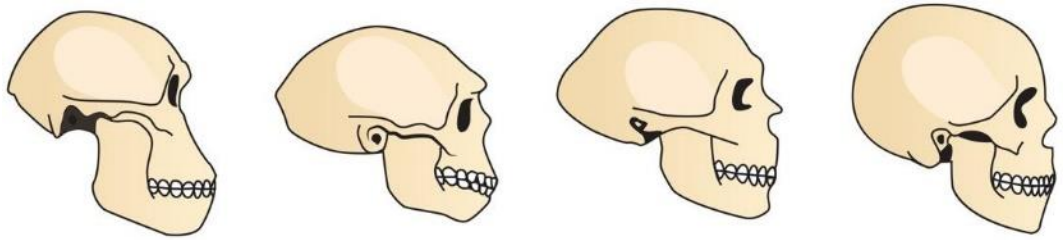
JAVA CLASS LOADING MECHANISM

or a short story on how a lonely

.class file

becomes a

java.lang.Class instance

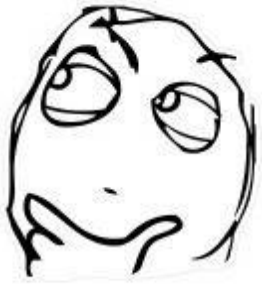


.class →→→ java.lang.Class

СБЕРБАНК ТЕХНОЛОГИИ

Q: When does the JVM load classes?

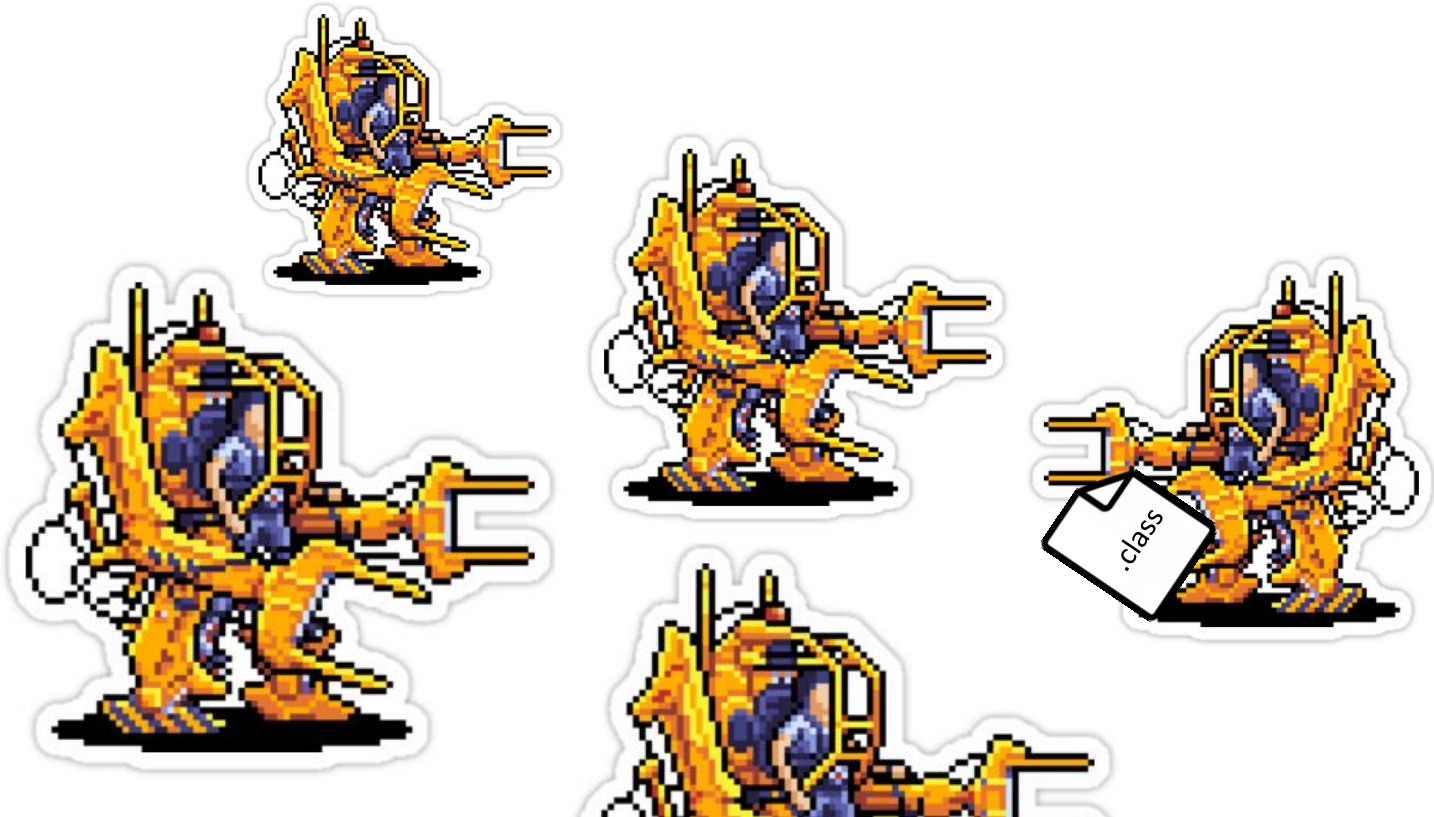
Q: When does the JVM load classes?

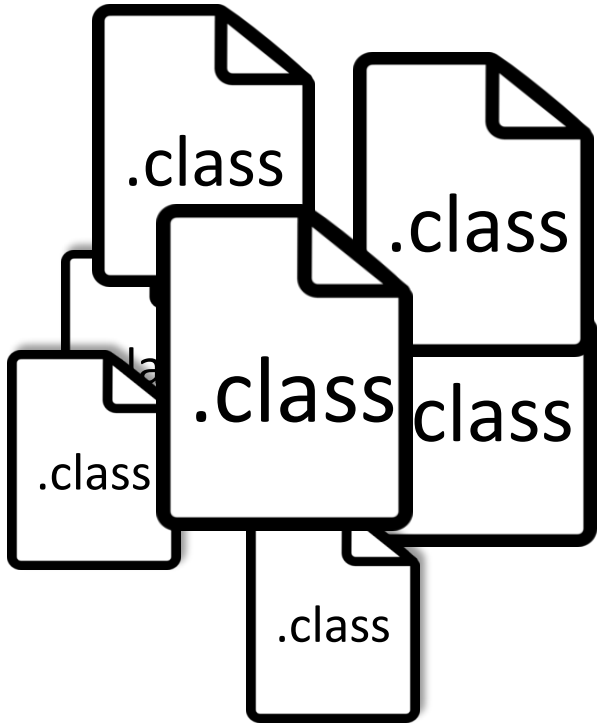


A: When they are needed to execute the program.

СБЕРБАНК ТЕХНОЛОГИИ

Class loaders are classes that load other classes



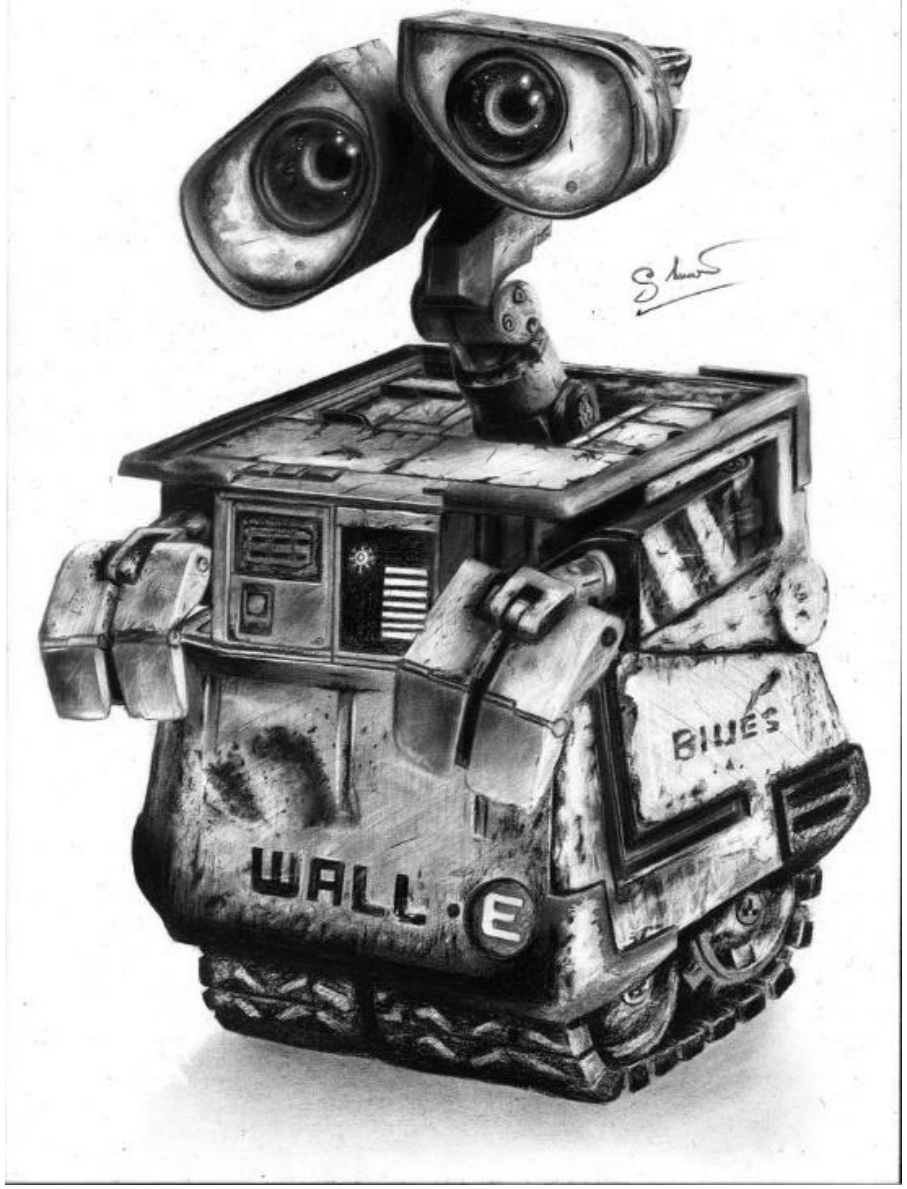


- **Bootstrap** classloader
- **Extension** classloader
- **Application/System** classloader

СБЕРБАНК ТЕХНОЛОГИИ

- Root of the loading process
- Lives outside the runtime - native code
- Loads rt.jar (among other things)
- -Xbootclasspath

sun.misc.Launcher$ExtClassLoader



- **Loads extensions from jre/lib/ext**
- **-Djava.ext.dirs**
- ***Does not use the class path***

СБЕРБАНК ТЕХНОЛОГИИ

sun.misc.Launcher$AppClassLoader

- **Works with the class path**
- **-cp/-classpath**
- **-Djava.class.path**

СБЕРБАНК ТЕХНОЛОГИИ

java.net.URLClassloader

- Works with URLs
- Scans directories and .jar files

СБЕРБАНК ТЕХНОЛОГИИ

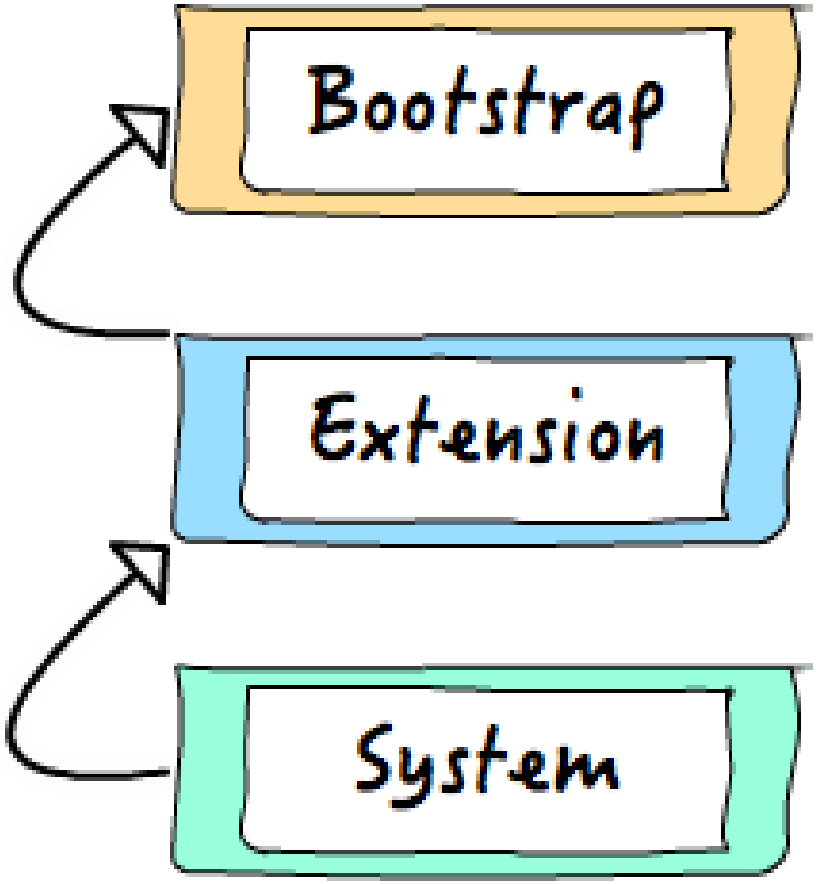
```
package java.lang;

public abstract class ClassLoader {

        public Class loadClass(String name);

        protected Class defineClass(byte[] b);

        protected Class findClass(String name);

        public ClassLoader getParent();
}
```

СБЕРБАНК ТЕХНОЛОГИИ

Class loaders and the assert keyword

- void setDefaultAssertionStatus(boolean b)
- void setClassAssertionStatus(String className, boolean b)
- void setPackageAssertionStatus(String packageName, boolean b)
- void clearAssertionStatus() //'assert' disabled by default

Classloader hierarchy



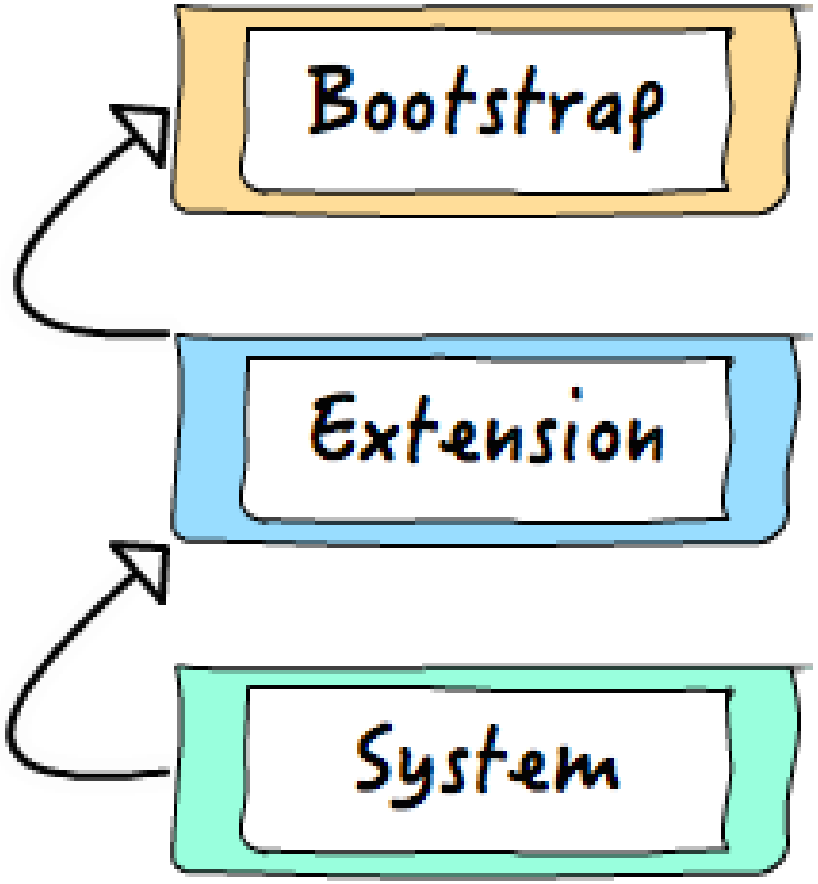
СБЕРБАНК ТЕХНОЛОГИИ

Classloader hierarchy

Delegation

Child → Parent

Child → Parent



Which classloader loads other classes?

```
public class Main {
        public static void main(String[] args) {
                A a = new A();
                //equivalent to
                //Main.class.getClassLoader().loadClass("A");
        }
}
```

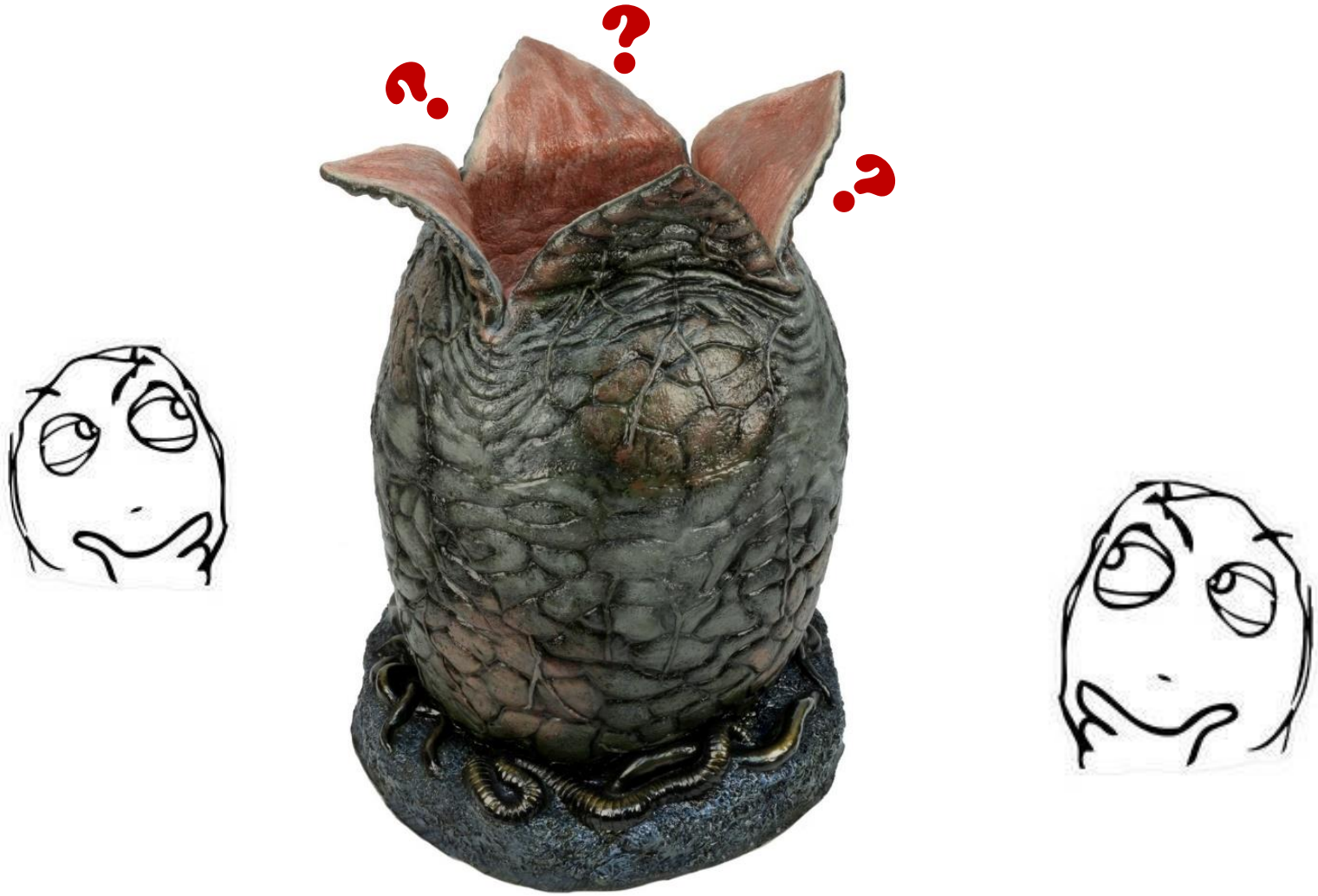
Class loading happens at runtime.

And that leads to...


BUGS

СБЕРБАНК ТЕХНОЛОГИИ

java.lang.ClassNotFoundException
java.lang.NoClassDefFoundError



СБЕРБАНК ТЕХНОЛОГИИ

java.lang.ClassNotFoundException
java.lang.NoClassDefFoundError

- **ClassNotFoundException**
  - ***no definition of the class could be found***
- **NoClassDefFoundError**
  - ***definition existed at compile-time, missing at runtime***

HOW TO SOLVE?

```
System.out.println(
        Arrays.toString(
                ((URLClassLoader) SomeClass.class.getClassLoader()).getURLs()
        ));
```

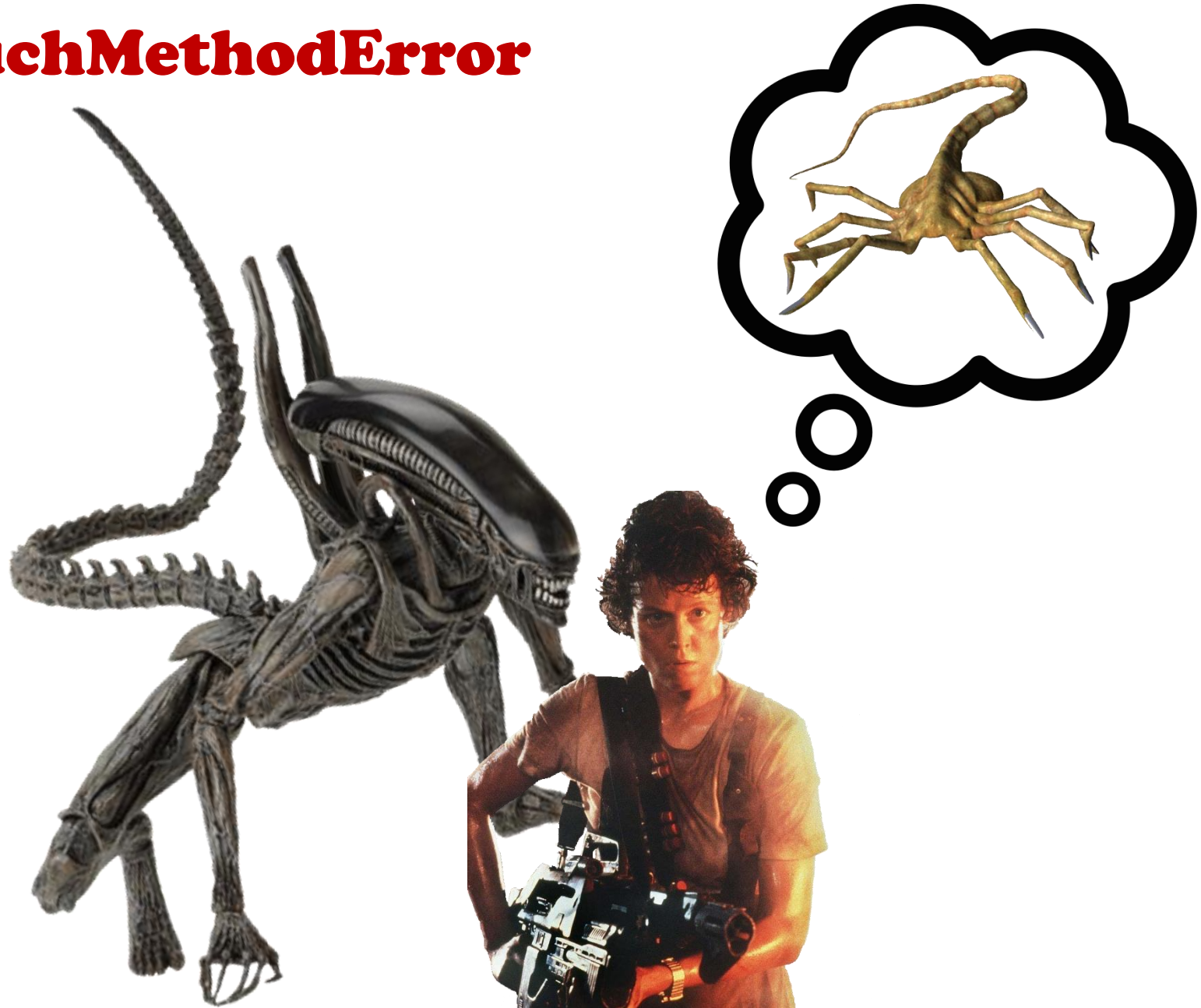
also, read logs.

СБЕРБАНК ТЕХНОЛОГИИ

NoSuchMethodError

Other ususal suspects:

- **IllegalAccessError**
- **AbstractMethodError**



СБЕРБАНК ТЕХНОЛОГИИ

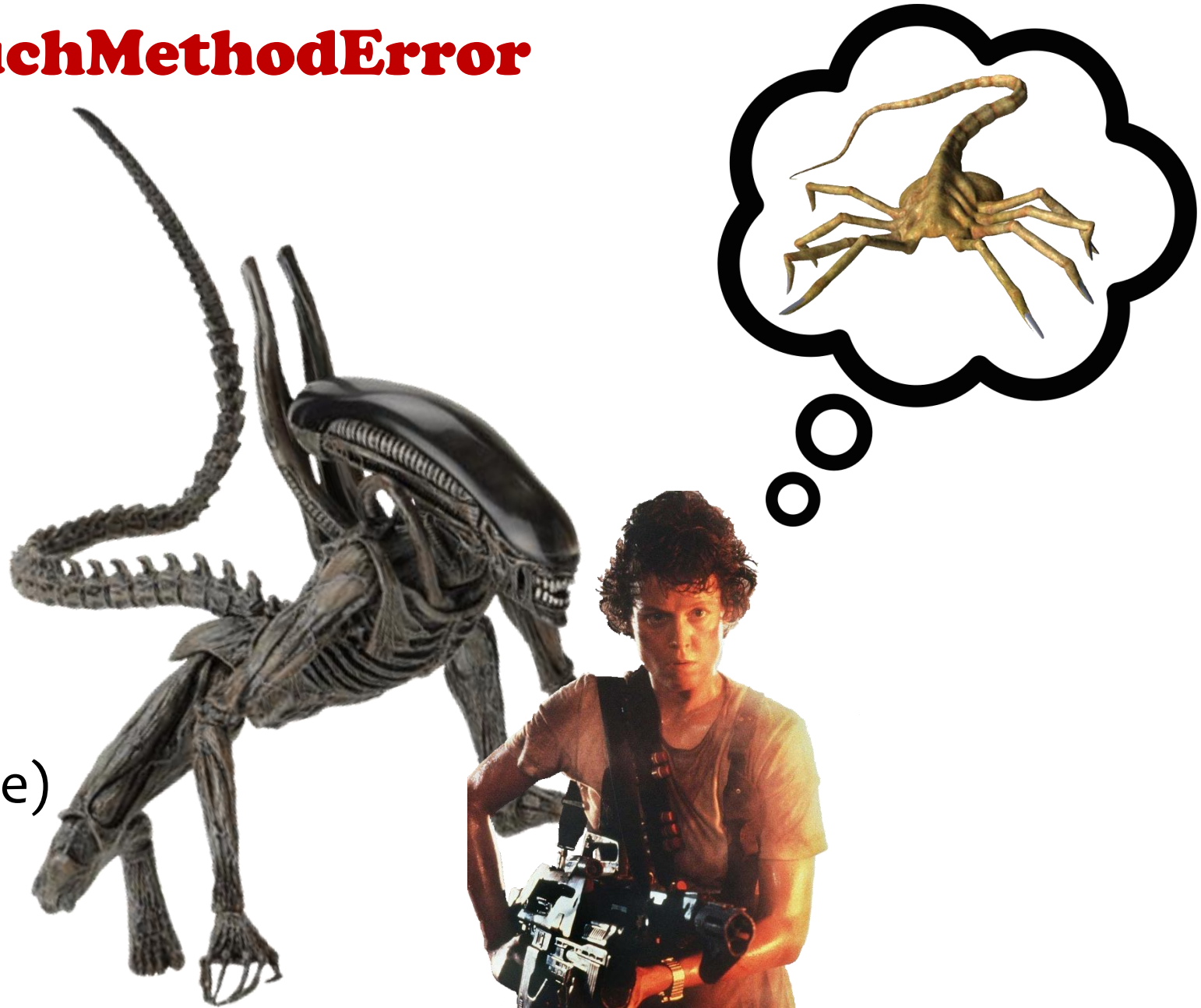
NoSuchMethodError

Other ususal suspects:

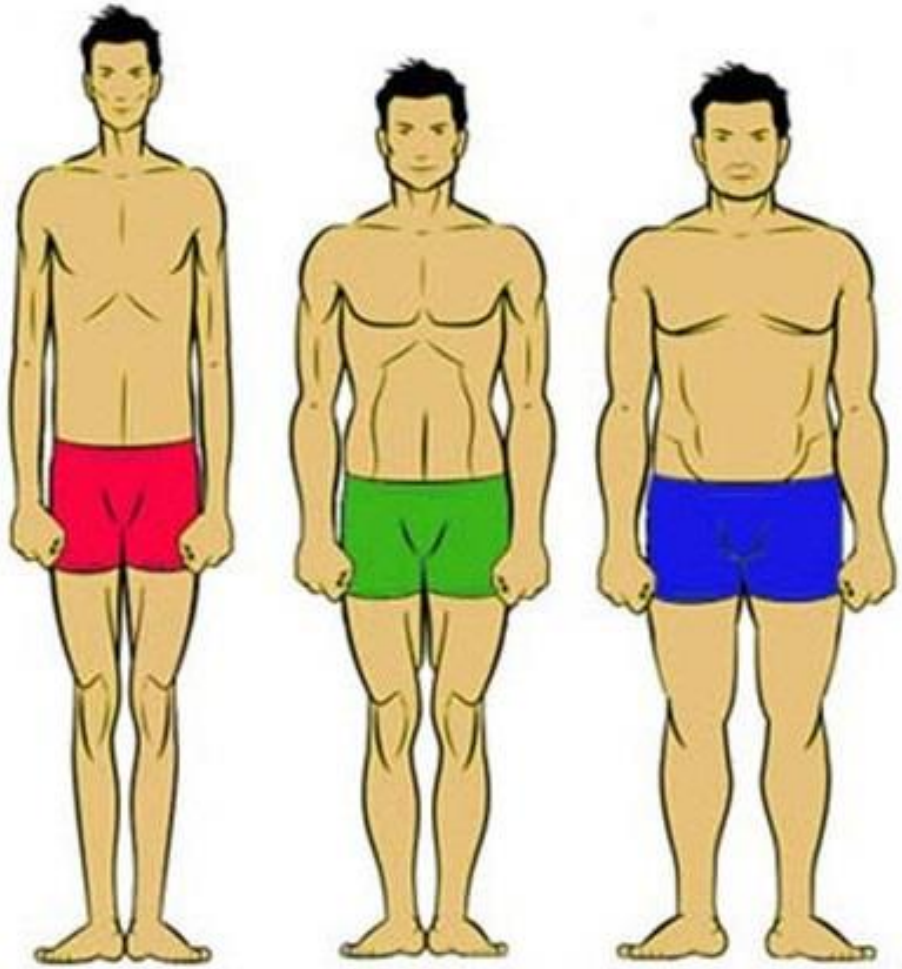
- **IllegalAccessError**
- **AbstractMethodError**

HOW TO SOLVE?

- -verbose:class
- javap
- Class.class
  .getClassLoader()
  .getResource(classname)



ClassCastException



СБЕРБАНК ТЕХНОЛОГИИ

ClassCastException

and LinkageError

Java is not type-safe

Vijay Saraswat

1997

HOW TO SOLVE?

- -verbose:class
- Class.class
  .getClassLoader()
  .getResource(classname)