Advanced Programming

Lecture 2: Errors, exceptions and streams

Tommi Tervonen

Econometric Institute, Erasmus School of Economics

Arrays in Java

- Special objects with publicly visible (immutable) field `length`
- Fixed length
- Example: `int[] myNumbers = new int[10];`
- Object arrays do **not** construct the objects to be stored (example: `String[] myNames = new String[3];`)
- `String[] myNames = new String[] {"tommi", "alex", "fred"};`
- Multidimensional arrays do not exist within computers (c.f. LN-TT-22012-3)

ArrayList<T>

- A collections framework class that implements a dynamically allocated list (array that can grow/shrink) to store objects of a certain type `T`

```
ArrayList<String> myStrs = new ArrayList<String>();
myStrs.add(``s1'');
myStrs.add(``s2'');

for (String s : myStrs) {
  System.out.println(s);
}
```

On typing

- Type system forms the core of all programming languages
- Strong typing reduces bugs by detecting errors at compile-time
- Primitive values have a single type (int, double)
- Objects can be of multiple types (Student is also an Object)

Expected and unexpected failures

- Method calls can fail due to
  - external factors uncontrollable for the programmer
  - violation of a pre-condition
- How to signal failure?

Return value outside the valid set

```
public int lengthOfString(String str) { ... }

public int parseInt(String str) { ... }
```

Abstraction of failure: Exception

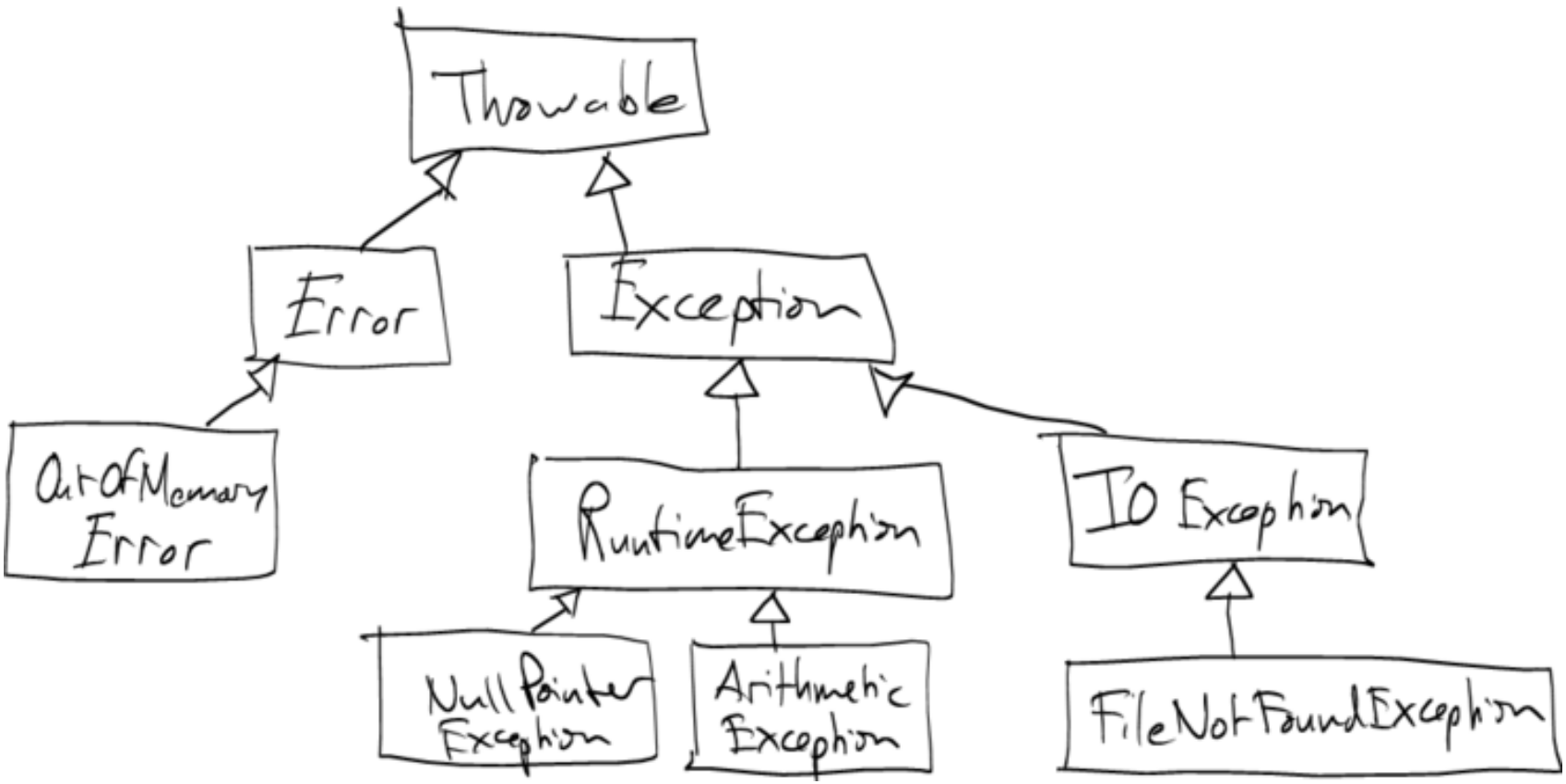
```
public int parseInt(String str)
  throws NumberFormatException { ... }
...
try {
  int myint = parseInt("1");
  myint = parseInt("5.5");
} catch (NumberFormatException e) {
  System.out.println("Cannot parse: "
  + e.getMessage());
}
```

- Can have multiple catch-blocks (example later on)

Checked exceptions

- **Checked** exceptions are ones that the program has to be able to recover from (caught)
- **Unchecked** exceptions are serious errors (out of memory) or logic errors (method call with invalid input values) that the program should not recover from (note: rule not always adhered to)
- Unchecked exceptions in Java are in the type hierarchy below RuntimeException or Error

Exception hierarchy (part)



Errors

```
public int add(int a, int b) {
  int c = a;
  c += b;
  if (c != (a + b)) {
    throw new VirtualMachineError();
  }
  return c;
}
```

If you can't handle it, delegate

```
/**
 * Loads in the file for doing something.
 *
 * @param filename The file to read contents from
 * @throws IOException If the file could not be
 *         read succesfully
 */
public void loadFromFile(String filename)
  throws IOException {

  FileInputStream f =
    new FileInputStream(filename);
  ... // read file in and do something
}
```

Constructor failures

```
public class MyDatabase {
   ...

   public MyDatabase(String filename)
     throws FileNotFoundException, IOException {

        FileInputStream f =
          new FileInputStream(filename);

        ... // read file in and do something

   }
   ...
}
```

Making your own exceptions

```
package fi.smaa.libror;

@SuppressWarnings("serial")
public class SamplingException extends Exception {

  public SamplingException(String reason) {
    super(reason);
  }
}
```

Using your own exceptions

```
package fi.smaa.libror;

public class RejectionValueFunctionSampler ... {
   ...
   private FullValueFunction sampleValueFunction()
     throws SamplingException {
        ...

        throw new SamplingException("Cannot sample a"
       + "VF within " + maxTries + " iterations");
        }
}
```

Too many exceptions

```
public QResult execQuery(Connection c, String q)
  throws ServerbusyException,
  QueryIncorrectException,
  QuerySyntaxException
{ ... }

public QResult dbQuery(String serv, String query)
  throws ServerbusyException,
  QueryIncorrectException,
  QuerySyntaxException,
  IncorrectServerAddressException,
  NetworkException
{
  Connection c = openConnection(serv);
  QResult r = c.execQuery(c, "SELECT * FROM db");
  ...
}
```

Exception wrapping

```
public class QueryException extends Exception {
  public QueryException(Exception e) {
    super(e);
  }
}

public QResult execQuery(Connection c, String q)
  throws QueryException { ... }

public QResult dbQuery(String serv, String query)
  throws QueryException { ... }
```

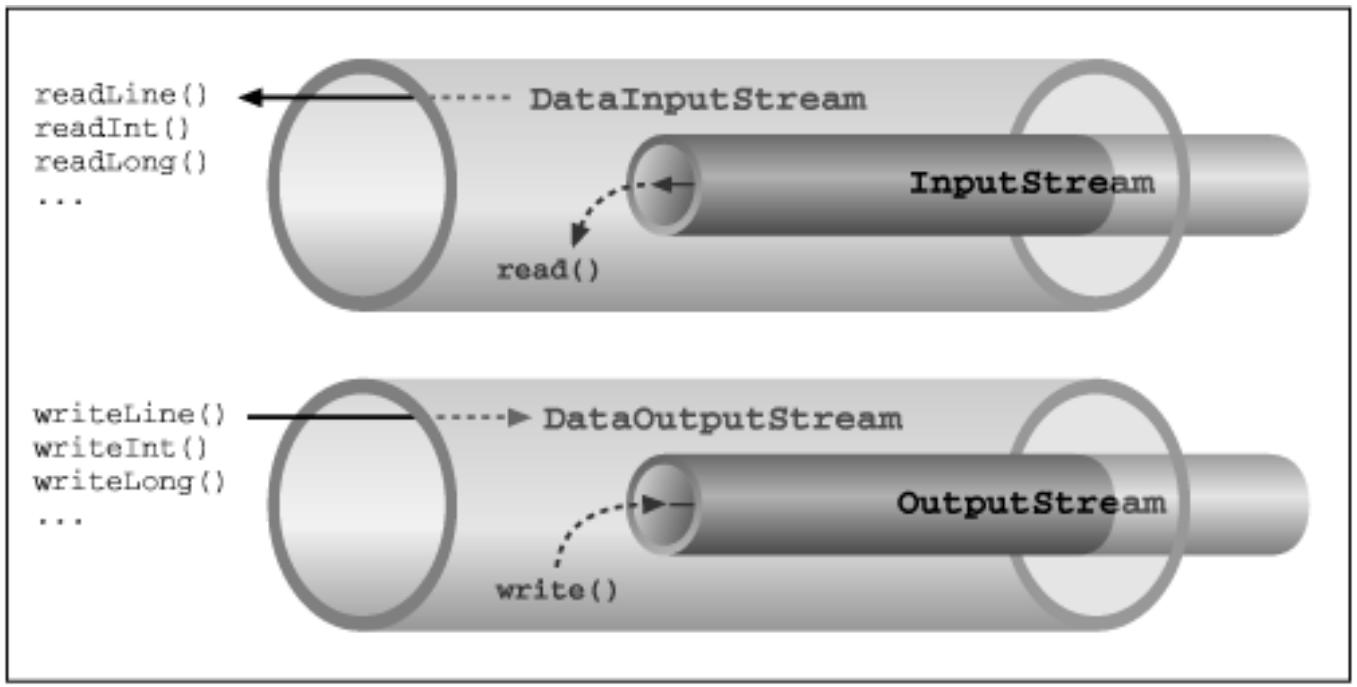
Aren't exceptions like GOTO?

I/O: streams

- Streams are abstraction of input/output in OOP
- Allow transparently to change transmission/storage media
- `System.out` is a `PrintStream`
- Character sources/sinks can be read/written with Readers/Writers

Stream combination

- Lower level streams can be used by higher level streams to provide additional functionality
- Streams can perform input conversion transparently on the fly



```
BufferedReader rdr = null;
try {
  rdr = new BufferedReader(
  new FileReader("file.txt"));
  String s = null;
  do {
    s = rdr.readLine();
    if (s!=null){System.out.println("Read:" + s);}
  } while (s != null);
} catch (FileNotFoundException e) {
  System.out.println("file.txt not found");
} catch (IOException e) {
  System.out.println("Error reading file: "
    + e.getMessage());
} finally {
  try {
    if (rdr != null) {
      rdr.close();
    } } catch (IOException e) { }
}
```

Do not ever use `Scanner`

Separation of concerns (@ exercise 1)