CS112

Exception Handling (Part 1)

Chapter 12

Lecture 07

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College of Computer Science and Engineering

Why do we need exception handling?

- When a program runs into a runtime error, the program terminates abnormally
- How can you handle the runtime error so that the program can continue to run or terminate gracefully?
  - This is the subject we will introduce in this chapter (Chapter 12)

Overview - Examples

- Show runtime error:
  - Quotient.java
- Fix it using an if statement:
  - QuotientwithIf.java
- Fix it using a method:
  - QuotientWithMethod

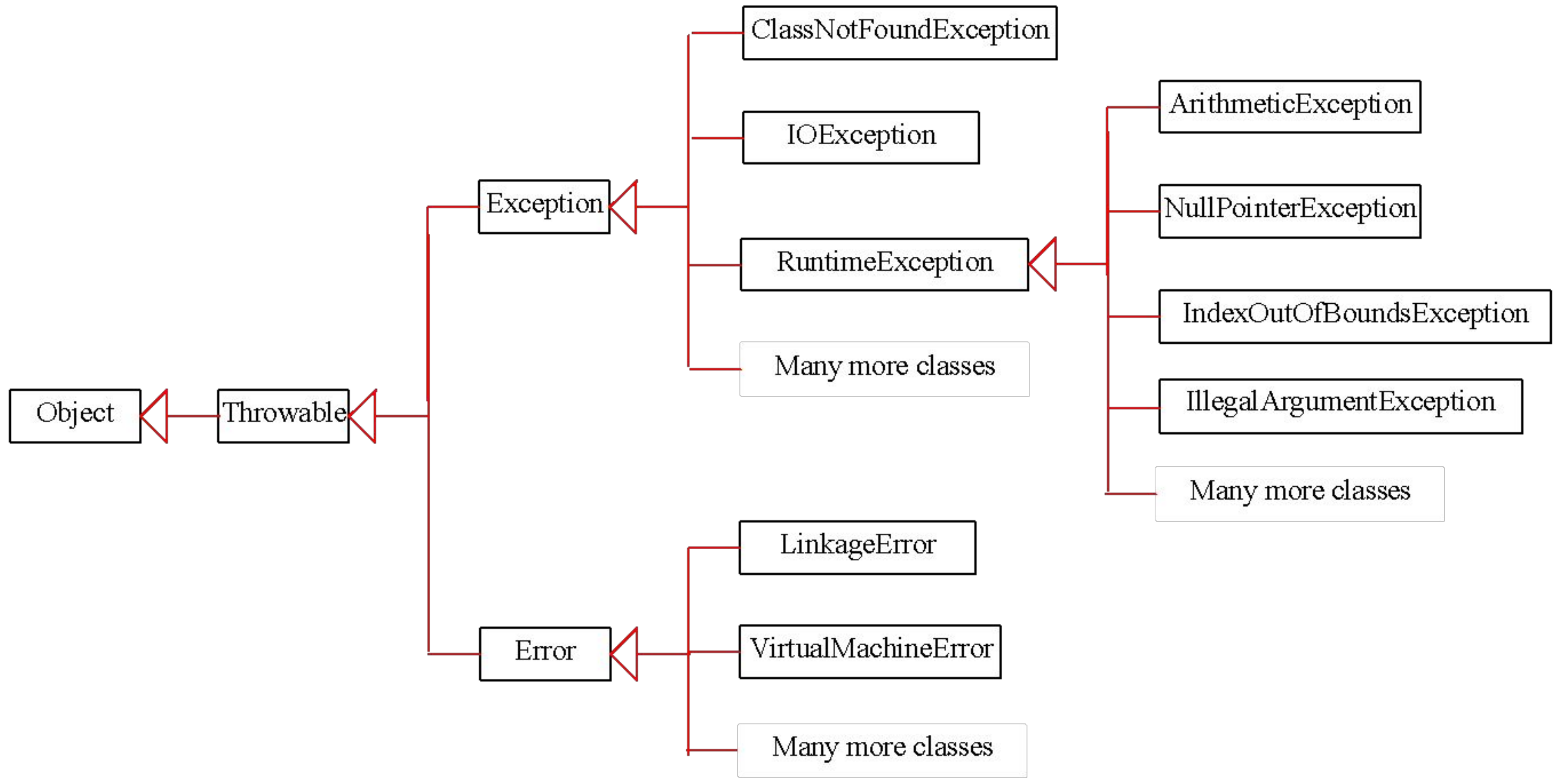
Exception Advantages

- Now you see the *advantages* of using exception handling:
  - It enables a method to throw an exception to its caller
  - Without this capability, a method must handle the exception or terminate the program
  - Example: QuoteintWithException.java

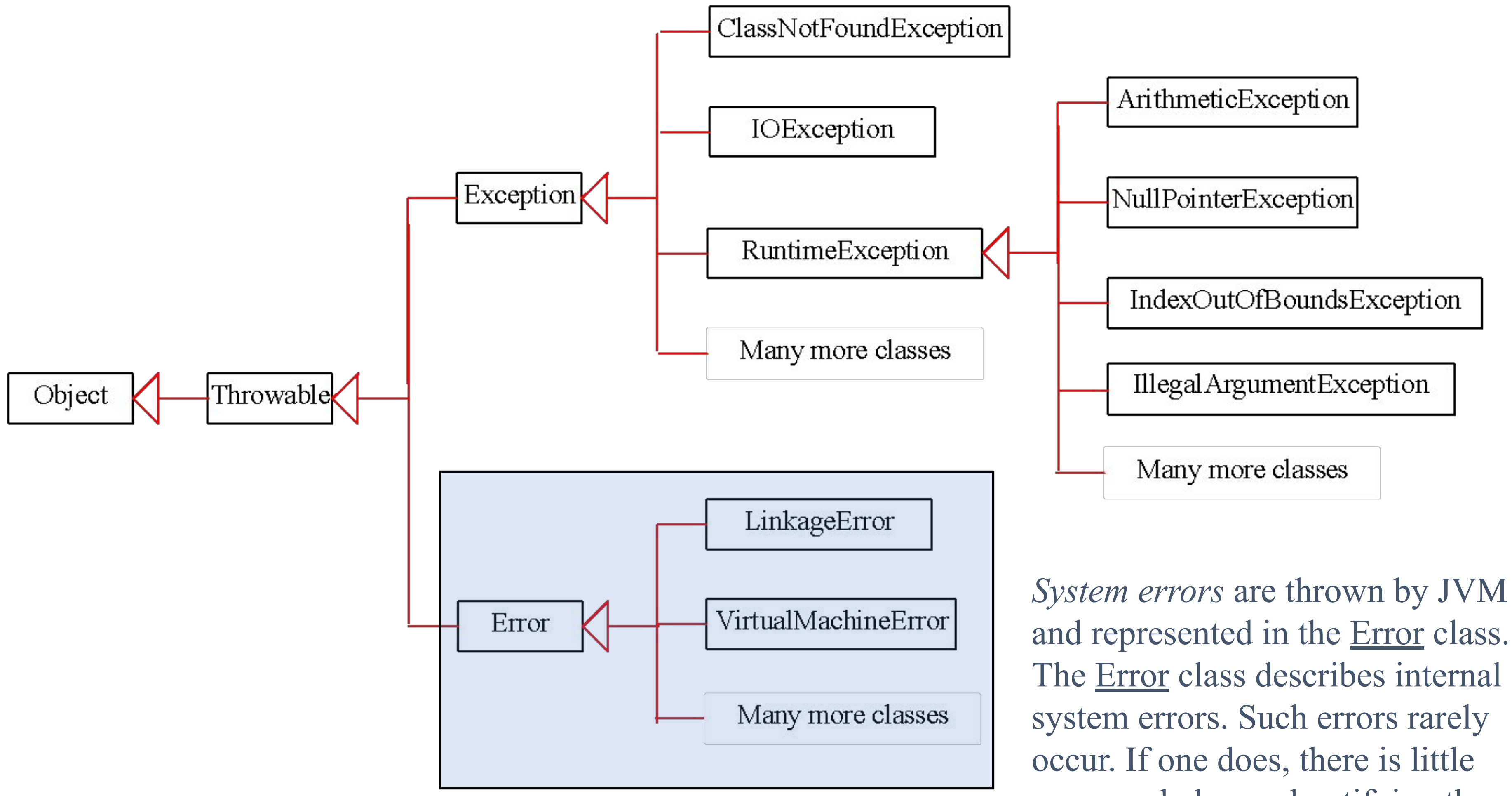
Handling InputMismatchException

- By handling InputMismatchException, your program will continuously read an input until it is correct
  - Example: InputMismatchException.java

Exception Types



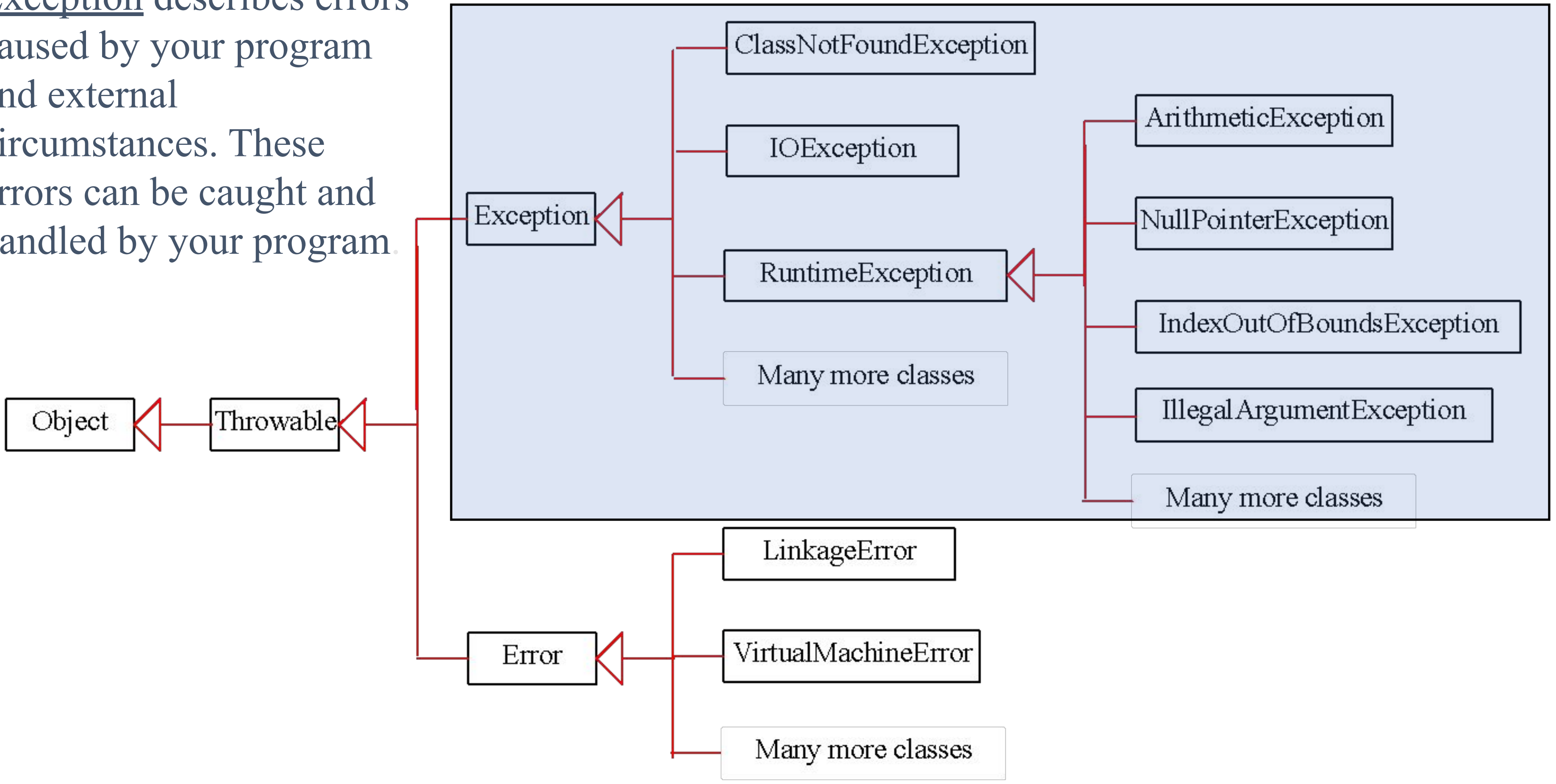
System Errors



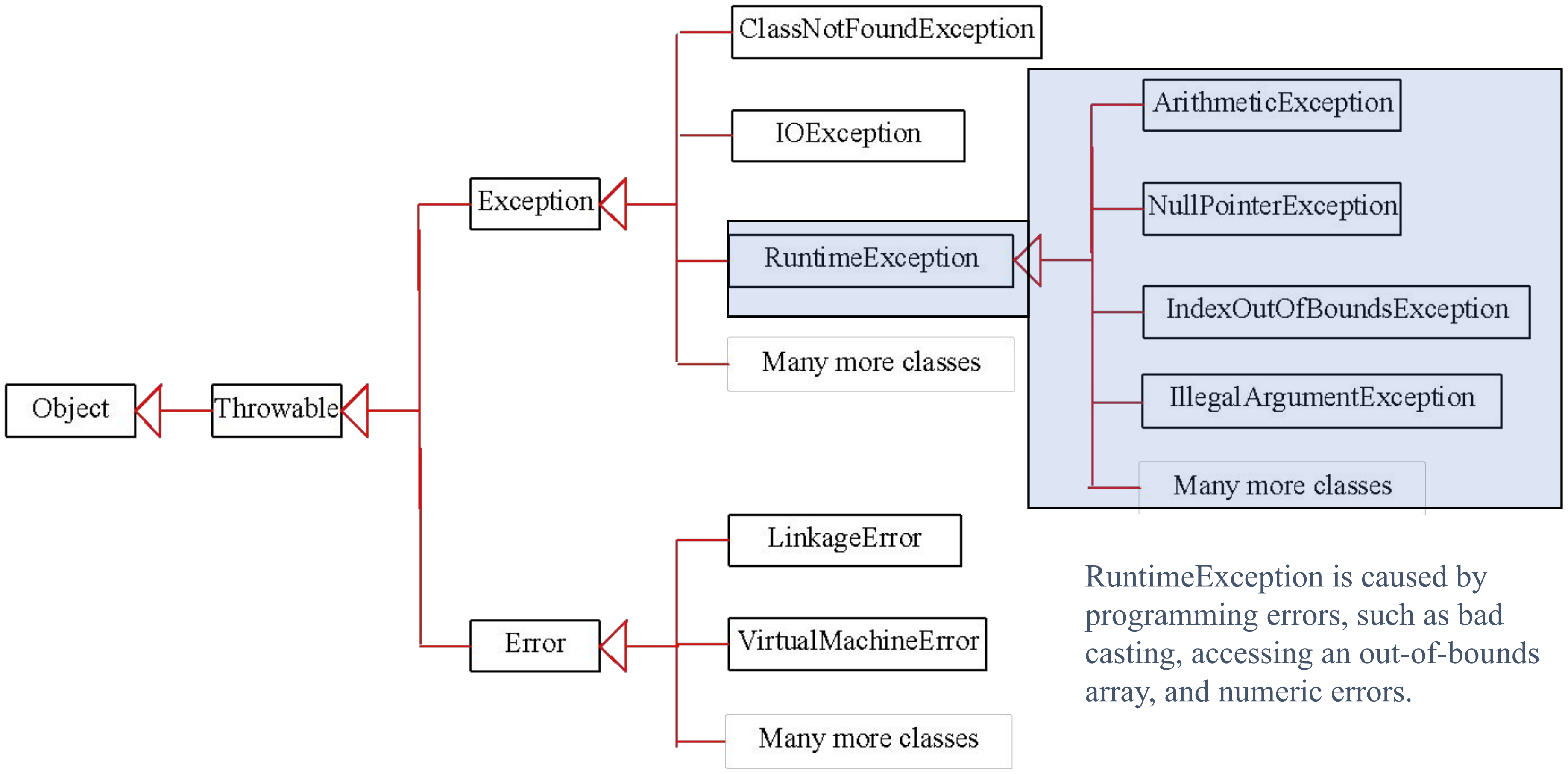
System errors are thrown by JVM and represented in the Error class. The Error class describes internal system errors. Such errors rarely occur. If one does, there is little you can do beyond notifying the user and trying to terminate the program gracefully.

Exceptions

Exception describes errors caused by your program and external circumstances. These errors can be caught and handled by your program.



Runtime Exceptions



RuntimeException is caused by programming errors, such as bad casting, accessing an out-of-bounds array, and numeric errors.

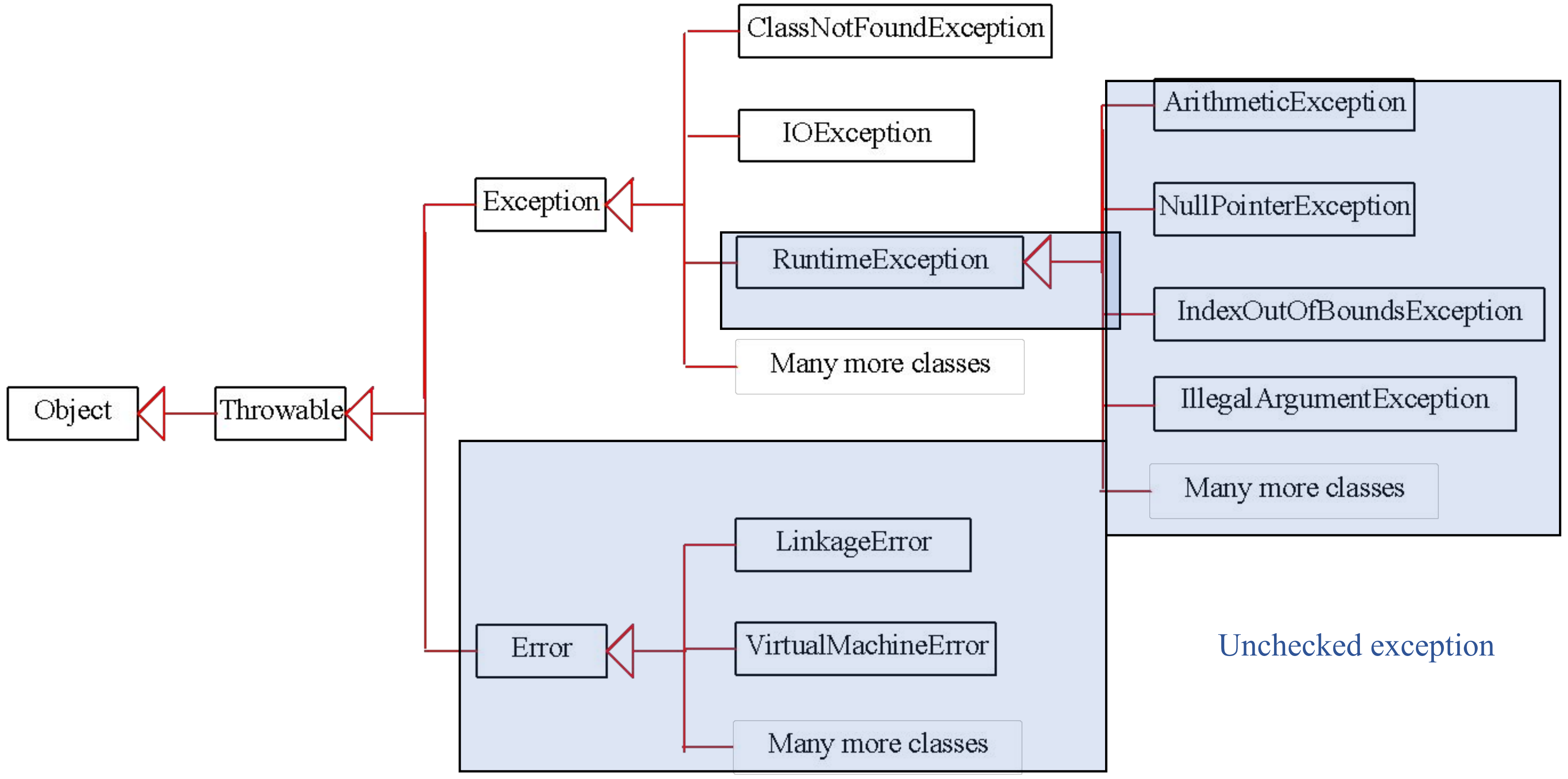
Checked Exceptions vs. Unchecked Exceptions

- RuntimeException, Error and their subclasses are known as *unchecked exceptions*
- All other exceptions are known as *checked exceptions* □ meaning that the compiler forces the programmer to check and deal with the exceptions

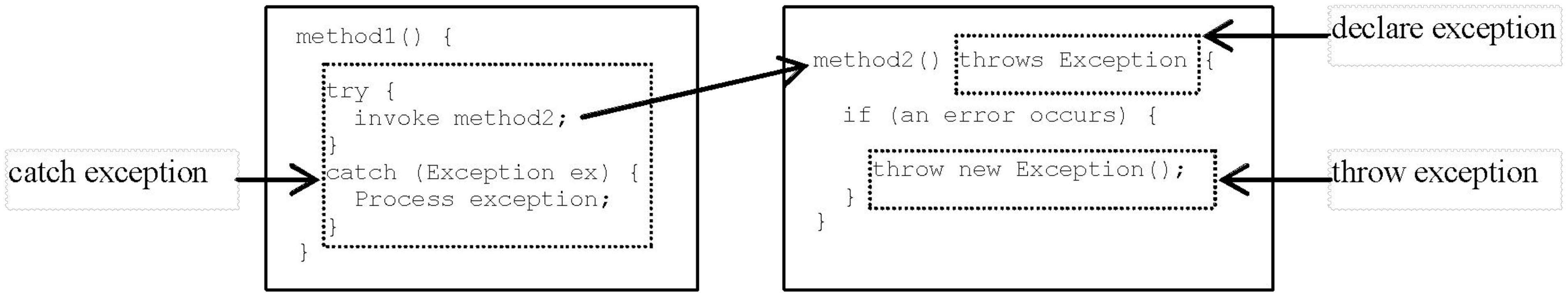
Unchecked Exceptions

- In most cases, unchecked exceptions reflect **programming logic errors** that are not recoverable
- Examples:
  - NullPointerException is thrown if you access an object through a reference variable before an object is assigned to it
  - IndexOutOfBoundsException is thrown if you access an element in an array outside the bounds of the array.
- These are the logic errors that should be corrected in the program.
- Unchecked exceptions can occur anywhere in the program.
- To avoid cumbersome overuse of try-catch blocks, Java does not mandate you to write code to catch unchecked exceptions.

Unchecked Exceptions



Declaring, Throwing, and Catching Exceptions



```
method1() {

  try {
    invoke method2;
  }
  catch (Exception ex) {
    Process exception;
  }
}
```

```
method2() throws Exception {

  if (an error occurs) {

    throw new Exception();
  }
}
```

Declaring Exceptions

- Every method must state the types of checked exceptions it might throw. This is known as *declaring exceptions*.

```
public void myMethod()
  throws IOException

public void myMethod()
  throws IOException, OtherException
```

Throwing Exceptions

- When the program detects an error, the program can create an instance of an appropriate exception type and throw it. This is known as *throwing an exception*. Here is an example,

```
throw new TheException();

TheException ex = new TheException();
throw ex;
```

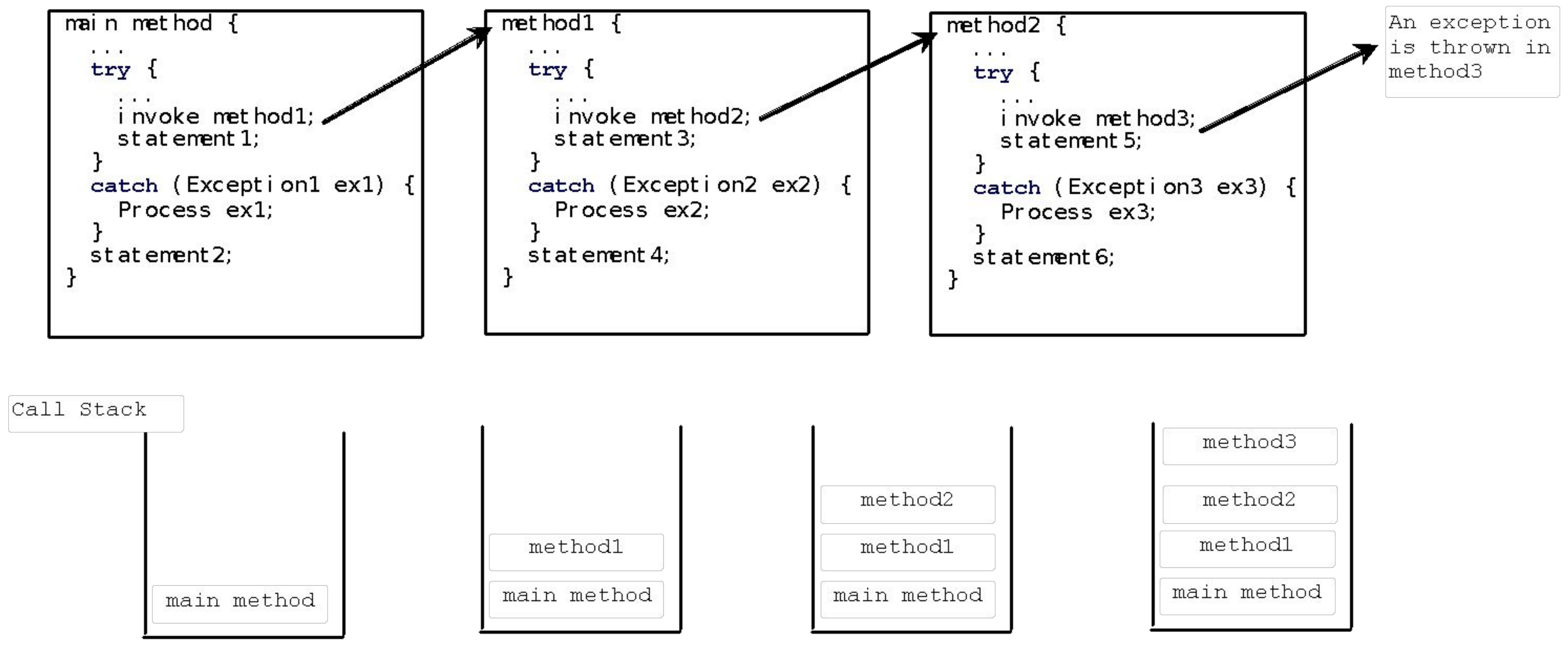
Throwing Exceptions Example

```
  /** Set a new radius */
public void setRadius(double newRadius)
    throws IllegalArgumentException {
  if (newRadius >= 0)
    radius =  newRadius;
  else
    throw new IllegalArgumentException(
      "Radius cannot be negative");
}
```

Catching Exceptions

```
try {
  statements;  // Statements that may throw exceptions
}
catch (Exception1 exVar1) {
  handler for exception1;
}
catch (Exception2 exVar2) {
  handler for exception2;
}
...
catch (ExceptionN exVar3) {
  handler for exceptionN;
}
```

Catching Exceptions



```
main method {
  ...
  try {
    ...
    invoke method1;
    statement1;
  }
  catch (Exception1 ex1) {
    Process ex1;
  }
  statement2;
}
```

```
method1 {
  ...
  try {
    ...
    invoke method2;
    statement3;
  }
  catch (Exception2 ex2) {
    Process ex2;
  }
  statement4;
}
```

```
method2 {
  ...
  try {
    ...
    invoke method3;
    statement5;
  }
  catch (Exception3 ex3) {
    Process ex3;
  }
  statement6;
}
```

Catch or Declare Checked Exceptions

- Suppose p2 is defined as follows:

```
void p2() throws IOException {
  if (a file does not exist) {
     throw new IOException("File does not exist");
  }

  ...
}
```

Catch or Declare Checked Exceptions

Java forces you to deal with checked exceptions. If a method declares a checked exception (i.e., an exception other than Error or RuntimeException), you must invoke it in a try-catch block or declare to throw the exception in the calling method. For example, suppose that method p1 invokes method p2 and p2 may throw a checked exception (e.g., IOException), you have to write the code as shown in (a) or (b).

```
void p1() {
  try {
    p2();
  }
  catch (IOException ex) {
    ...
  }
}
```

(a)

```
void p1() throws IOException {

  p2();

}
```

(b)

Example

- TestCircleWithException.java
- CircleWithException.java