Theory: Hierarchy of exceptions

22 minutes

Verify to skip Start practicing

9203 users solved this topic. Latest completion was **about 8 hours ago**.

Java is primarily an object-oriented language. In such a paradigm, all exceptions are considered objects of special classes organized into a class hierarchy. Understanding this hierarchy is essential both for job interviews and daily programming practice.

3 required topics

✓ Inheritance In project 1
✓ The keyword super In project
✓ What is an exception 4

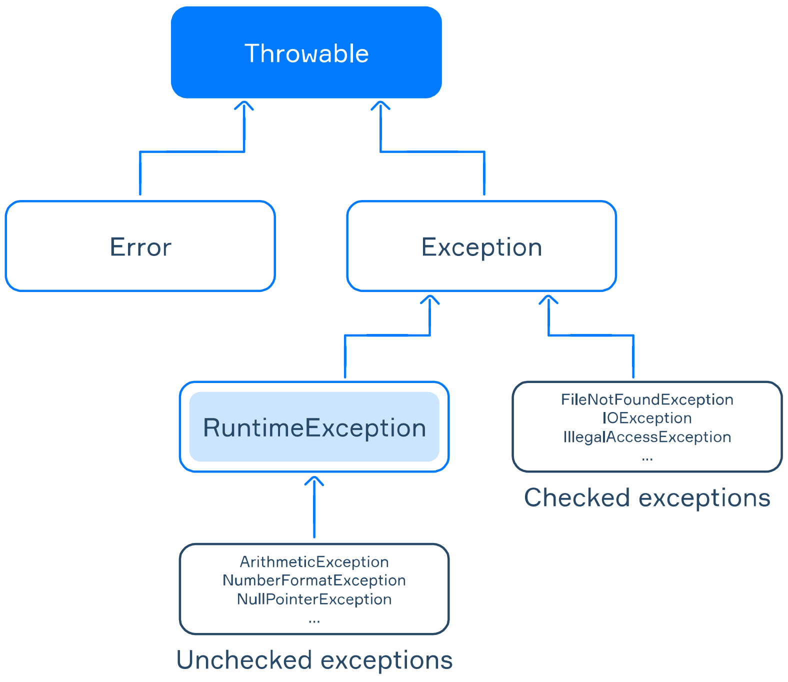
3 dependent topics

Exception handling
Throwing exceptions
Debugging techniques

Table of contents:

§1. Hierarchy of exceptions

The following picture illustrates the simplified hierarchy of exceptions:



The base class for all exceptions is `java.lang.Throwable`. This class provides a set of common methods for all exceptions:

- `String getMessage()` returns the detailed string message of this exception object;
- `Throwable getCause()` returns the cause of this exception or `null` if the cause is nonexistent or unknown;
- `printStackTrace()` prints the stack trace on the standard error stream.

We will return to the methods and constructors of this class in the following topics.

The `Throwable` class has two direct subclasses: `java.lang.Error` and `java.lang.Exception`.

- subclasses of the `Error` class represents low-level exceptions in the JVM, for example: `OutOfMemoryError`, `StackOverflowError`;
- subclasses of the `Exception` class deal with exceptional events inside applications, such as: `RuntimeException`, `IOException`;
- the `RuntimeException` class is a rather special subclass of `Exception`. It represents so-called **unchecked** exceptions, including: `ArithmeticException`, `NumberFormatException`, `NullPointerException`.

While developing an application, you normally will process objects of the `Exception` class and its subclasses. We won't discuss `Error` and its subclasses here.

The four basic classes of exceptions (`Throwable`, `Exception`, `RuntimeException` and `Error`) are located in the `java.lang` package. They do not need to be imported. Yet their subclasses might be placed in different packages.

§2. Checked and unchecked exceptions

All exceptions can be divided into two groups: checked and unchecked. They are functionally equivalent but there is a difference from the compiler's point of view.

1. Checked exceptions are represented by the `Exception` class, excluding the `RuntimeException` subclass. The compiler checks whether the programmer expects the occurrence of such exceptions in a program or not.

If a method throws a checked exception, this must be marked in the declaration using the special `throws` keyword. Otherwise, the program will not compile.

Let's take a look at the example. We use the `Scanner` class, which you are already familiar with, as a means to read from standard input, to read from a file:

```
public static String readLineFromFile() throws FileNotFoundException {
    Scanner scanner = new Scanner(new File("file.txt")); // java.io.FileNotFo
    return scanner.nextLine();
}
```

Here, `FileNotFoundException` is a standard checked exception. This constructor of `Scanner` declares a `FileNotFoundException` exception, because we assume that the specified file may not exist. Most importantly, there is a single line in the method that may throw an exception, so we put the `throws` keyword in the method declaration.

2. Unchecked exceptions are represented by the `RuntimeException` class and all its subclasses. The compiler does not check whether the programmer expects the occurrence of such exceptions in a program.

Here is a method that throws `NumberFormatException` when the input string has an invalid format (e.g., `"abc"`).

```
public static Long convertStringToLong(String str) {
    return Long.parseLong(str); // It may throw a NumberFormatException
}
```

This code always successfully compiles without the `throws` keyword in the declaration.

Runtime exceptions may occur anywhere in a program. The compiler doesn't require that you specify runtime exceptions in declarations. Adding them to each method's declaration would reduce the clarity of a program.

The `Error` class and its subclasses are also considered as unchecked exceptions. However, they form a separate class.

§3. Conclusion

All exceptions are represented by the `Throwable` class, which has two subclasses: `Exception` and `Error`. There are also two types of exceptions: checked and unchecked.

Unchecked exceptions are expected by the compiler, so you don't have to handle them. They are represented by the `RuntimeException` subclass of the `Exception` class. Errors from the `Error` class are also considered unchecked.

Checked exceptions have to be handled and indicated explicitly. They are located in all the other subclasses of `Exception`.