CS 251
Intermediate Programming
Exceptions

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Expecting the Unexpected

Most of the time our programs behave well, however sometimes unexpected things happen. Java’s way of handling these types of problems is called *exception handling*
When do exceptions occur?

- When you least expect them to...
- When there’s something wrong with the hardware, or other things that you can’t control from your program.
  - Input from files (or other streams)
  - Communication of various kinds (internet, users)
- Or... When you create them yourself
What is an exception?

- Like everything else in java, they are Objects
- Objects can be created and customized, extended and inherited
- Many exceptions are already predefined in java
  - ArrayIndexOutOfBoundsException is one of them
  - Belongs to the class RuntimeException
  - For more refer to the Exception class in the Java API.
public class DivideByZeroException extends RuntimeException {

    public DivideByZeroException () {
        super("Zero division detected");
    }

    public DivideByZeroException ( String msg ) {
        super(msg);
    }
}

Just an example! Java already has an ArithmeticException for this.
Creating an exception

- Create a new exception object:
  ```csharp
  Exception myEx = new DivideByZeroException();
  ```

- Creating an exception, doesn’t mean you caused an exceptional event.
- Nothing happens until you “throw” it...
Exception keywords

- **try** – clause for testing potential exception code.
- **catch** – catching the exceptions, if they happen
- **throws** – used in method headers to indicate method might cause exception
- **throw** – used by a method to “throw” (cause) an exception
- **finally** – code executed after the try-catch clauses, regardless of whether exception happened or not.
Catching an Exception

• Try to compile the following:

```java
public class Sleeper {
    public void sleep10Secs () {
        Thread.sleep(10000);
    }
}
```

• Will not work... Why?
**Methods throwing Exceptions**

- Methods can define that they wish to be able to throw one or more exceptions
  
  ```java
  int myMethod() throws SomeException
  ```
  
  ```java
  int myMethod() throws SomeException, SomeOtherException
  ```

- Note that these exception classes must exist and be defined as the prior `DivideByZeroException` for the program to compile

- `Thread.sleep()` is defined like this, it throws an `InterruptedException` in case its sleep is disturbed.
Catching exceptions

- Calls to methods that potentially throw exceptions must be “padded” to allow compilation, to allow for the exception to happen
- There are two basic approaches:
  - Ignoring the exceptions, and passing them on to the caller of your method.
  - Catching the exception and dealing with it yourself
Ignoring (passing on) exceptions

- To avoid dealing with the exceptions yourself, while still calling methods that might throw exceptions - your method must also be declared to throw those same exceptions.

```java
public class Sleeper {
    public void sleep10Secs ()
        throws InterruptedException {
            Thread.sleep(10000);
        }
}
```

- Only viable if caller is prepared to handle exceptions
Catching exceptions

Other solution: catch the exception and handle it yourself

```java
public class Sleeper {
    public void sleep10Secs () {
        try {
            Thread.sleep(10000);
        } catch (InterruptedException ie) {
            System.out.println ( "Woke up early!" );
        }
    }
}
```

When you do this, make sure you really handle the exception.
Don’t eat exceptions!

```java
try {
    bigRedButton.pushIt();
} catch (EndOfTheWorldException ex) {
    // Silently ignoring Armageddon...
}
```

At the very least, add some debugging output in case the “impossible” exception happens.
Which one to use?

- Both above methods are allowed
- Only use “passing on” when you are sure that caller can handle exception, or if ok to ignore exceptions
- If you can handle exception within – then do!
- Makes your program more robust
Throwing an exception

- If necessary, you can create and throw an exception:
  
  ```java
  throw new SomeException("Explanation");
  ```

- Assumes the SomeException class exists, and has a constructor taking a String argument

- Aborts the execution of the current method, no return value is provided

- Exception must be handled by the caller of your method

- Your method must be declared as:
  
  ```java
  public int myMethod() throws SomeException
  ```
Throwing while catching

- Can throw an exception in a catch clause, if you want to create your own Exception messages, or provide an abstraction for the “real” exception:

```java
try {
    Thread.sleep(10000);
} catch (InterruptedException ie) {
    throw new SomeException("Awakened");
}
```

- The class SomeException must exist
try ...catch ...finally

- Similar to an if statement
- Can have only one try clause, but...
- Any number of catch clauses
- Catch clauses should be ordered in decreasing order of specialization, i.e., if catch (Exception e) is the first, it will catch all exceptions.
- finally clause to be used if something must happen, even if exception will be thrown (and method exit)
try {
    driver.getInCar();
    driver.driveToWork();
} catch (DeadBatteryException ex) {
    driver.callAAA();
} catch (NoKeysException ex) {
    driver.takeBus();
} finally {
    if(driver.isInCar()) {
        driver.getOutOfCar();
    }
}
A note on usage...

- Many types of problems can be detected and prevented inside your code. When possible this is preferred since exceptions run slower than “normal” code.
- Exception code is executed in special mode, and exiting by normal means is faster in high-performance requirements.
- Good article: http://www.javaworld.com/javaworld/jw-08-2000/jw-0818-exceptions.html