Exceptions
(part 2)

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ComS 207: Programming I (in Java)
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Quick Review of Last Lecture

Exceptions

- An *exception* is an object that describes an unusual or erroneous situation.

Exceptions

- Exceptions are *thrown* by a program, and may be *caught* and *handled* by another part of the program
- A program can be separated into a normal execution flow and an *exception execution flow*
- An *error* is also represented as an object in Java, but usually represents a unrecoverable situation and should not be caught

Exception Handling

- Java has a predefined set of exceptions and errors that can occur during execution
- A program can deal with an exception in one of three ways:
  - ignore it
  - handle it where it occurs
  - handle it an another place in the program
- The manner in which an exception is processed is an important design consideration

Exception Handling

- If an exception is ignored by the program, the program will terminate abnormally and produce an appropriate message
- The message includes a *call stack trace* that:
  - indicates the line on which the exception occurred
  - shows the method call trail that lead to the attempted execution of the offending line
- See `Zero.java` (page 533)

Examples:

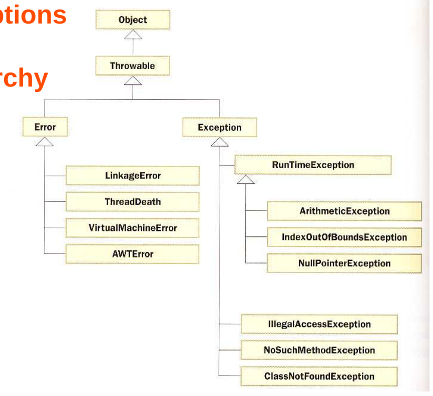
`Zero.java`

`Zero_Caught.java`

The Exception Class Hierarchy

- Classes that define exceptions are related by inheritance, forming an exception class hierarchy
- All error and exception classes are descendents of the `Throwable` class
- A programmer can define an exception by extending the `Exception` class or one of its descendants
- The parent class used depends on how the new exception will be used

Exceptions Class Hierarchy



Exception Hierarchy

- java.lang.Object
- java.lang.Throwable
- java.lang.Exception
- java.lang.RuntimeException
- java.lang.ArithmeticException

On-line Java Documentation

- http://java.sun.com/j2se/1.5.0/docs/api/index.html

The try Statement

- To handle an exception in a program, the line that throws the exception is executed within a *try block*
- A try block is followed by one or more *catch* clauses
- Each catch clause has an associated exception type and is called an *exception handler*
- When an exception occurs, processing continues at the first catch clause that matches the exception type

The finally Clause

- A try statement can have an optional clause following the catch clauses, designated by the reserved word `finally`
- The statements in the finally clause always are executed
- If no exception is generated, the statements in the finally clause are executed after the statements in the try block complete
- If an exception is generated, the statements in the finally clause are executed after the statements in the appropriate catch clause complete

Examples:

`OutOfBounds.java`

`OutOfBounds_Caught.java`

Exception Hierarchy

- java.lang.Object
  ↑
- java.lang.Throwable
  ↑
- java.lang.Exception
  ↑
- java.lang.RuntimeException
  ↑
- java.lang.IndexOutOfBoundsException
  ↑
- java.lang.ArrayIndexOutOfBoundsException

Examples:

`NullReference.java`

`NullReference_Caught.java`

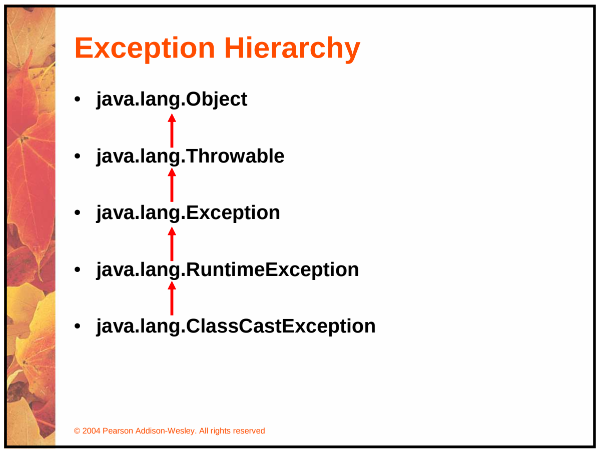
Exception Hierarchy

- java.lang.Object
  ↑
- java.lang.Throwable
  ↑
- java.lang.Exception
  ↑
- java.lang.RuntimeException
  ↑
- java.lang.NullPointerException

Examples:

`ClassCast.java`

`ClassCast_Caught.java`



Exception Hierarchy

- java.lang.Object

$\uparrow$

- java.lang.Throwable

$\uparrow$

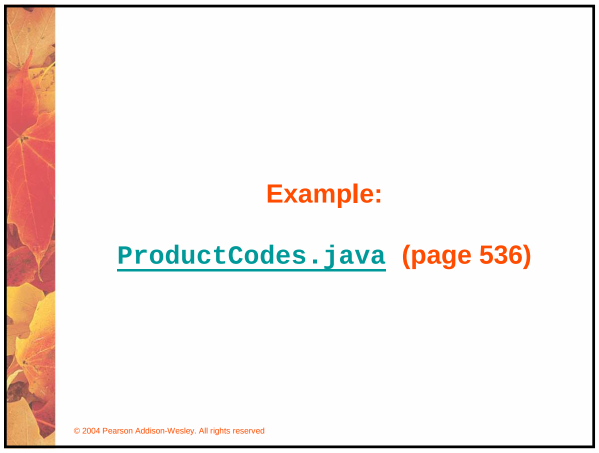
- java.lang.Exception

$\uparrow$

- java.lang.RuntimeException

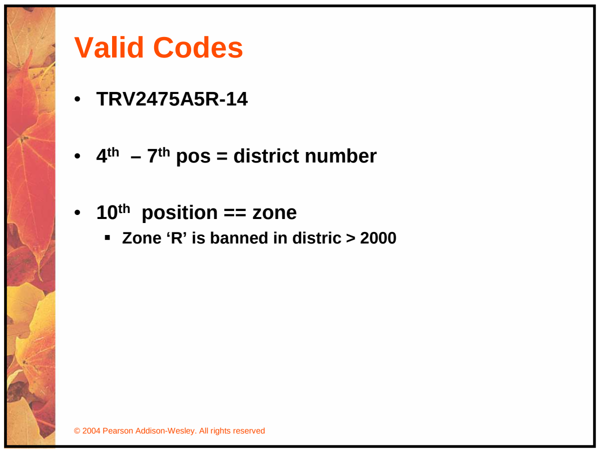
$\uparrow$

- java.lang.ClassCastException



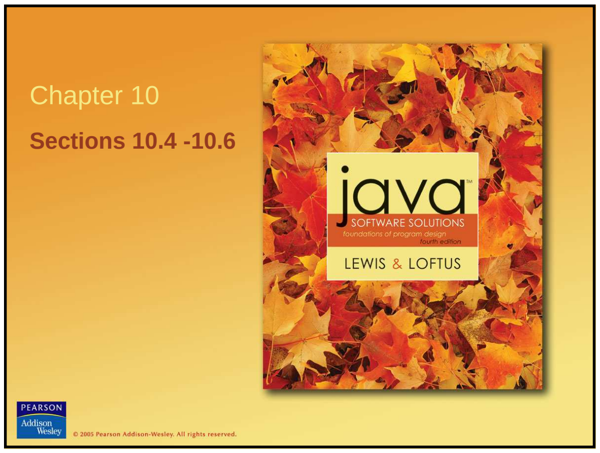
Example:

`ProductCodes.java` (page 536)



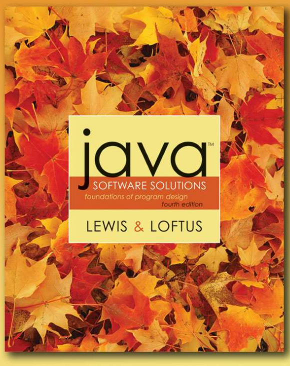
Valid Codes

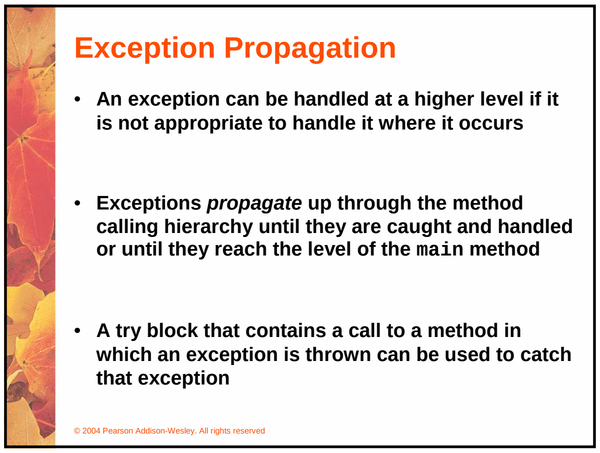
- TRV2475A5R-14
- 4th – 7th pos = district number
- 10th position == zone
  - Zone ‘R’ is banned in distric > 2000



Chapter 10

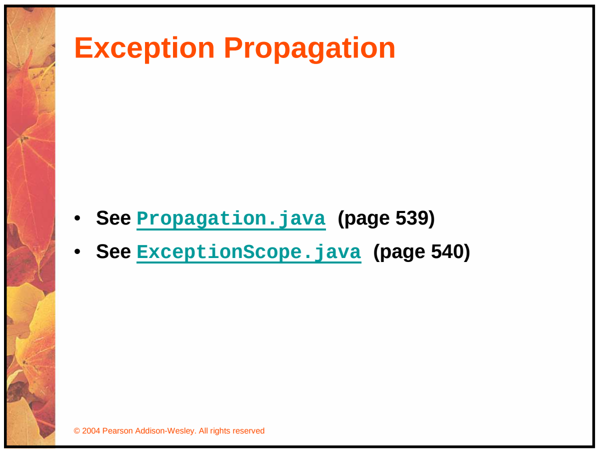
Sections 10.4 -10.6





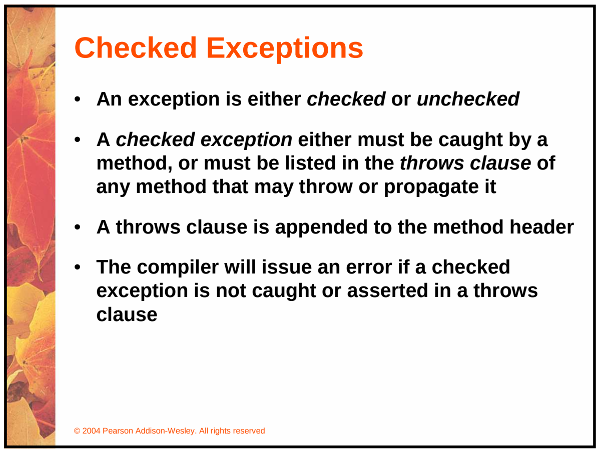
Exception Propagation

- An exception can be handled at a higher level if it is not appropriate to handle it where it occurs
- Exceptions *propagate* up through the method calling hierarchy until they are caught and handled or until they reach the level of the `main` method
- A try block that contains a call to a method in which an exception is thrown can be used to catch that exception



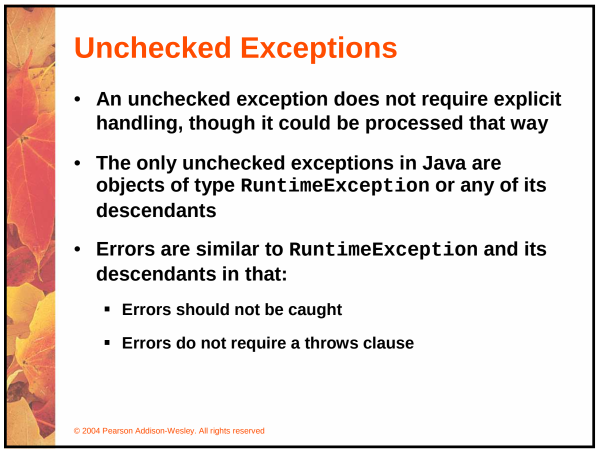
Exception Propagation

- See `Propagation.java` (page 539)
- See `ExceptionScope.java` (page 540)



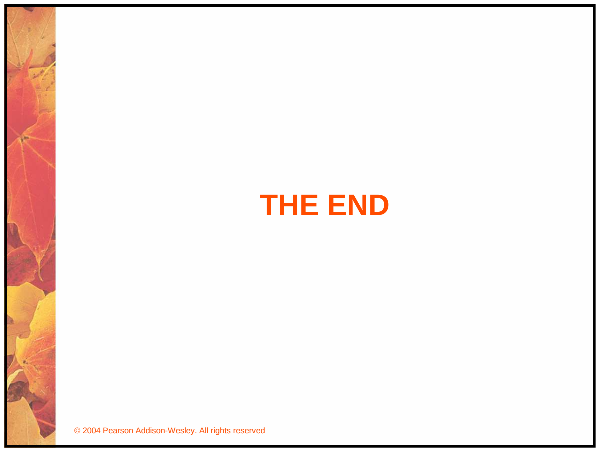
Checked Exceptions

- An exception is either *checked* or *unchecked*
- A *checked exception* either must be caught by a method, or must be listed in the *throws clause* of any method that may throw or propagate it
- A throws clause is appended to the method header
- The compiler will issue an error if a checked exception is not caught or asserted in a throws clause



Unchecked Exceptions

- An unchecked exception does not require explicit handling, though it could be processed that way
- The only unchecked exceptions in Java are objects of type `RuntimeException` or any of its descendants
- Errors are similar to `RuntimeException` and its descendants in that:
  - Errors should not be caught
  - Errors do not require a throws clause



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