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Core Java

Exception Handling

Objectives

- Exception Handling in Java overview
- Identify the need for Exception Handling
- try/catch block
- Exception hierarchy
- RuntimeExceptions
- Flow control in try/catch blocks
- finally block
- Throwing multiple exceptions

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Objectives

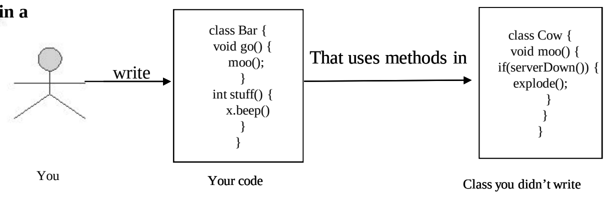
- Catching multiple exceptions
- Exceptions are polymorphic
- Throwing Exception
- Exception rules
- Describe the cascading of exceptions
- Distinguish between throw & throws keyword
- Create User defined Exceptions
- Assertion

Exception Handling in Java overview

- Exception : an OO way of handling errors.
- Keeps problem solving & error handling code different.
- Thus, program is less complex.
- Exceptions in Java are actual objects, instances of classes that inherit from class Throwable.
- These objects encapsulate the error information.
- Created when a abnormal situation arises in your java program.

Need for Exception Handling

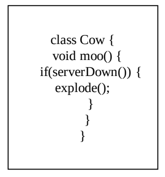
You want to call a method in a Class that you didn't write



```
class Bar {
  void go() {
    moo();
  }
  int stuff() {
    x.beep()
  }
}
```

```
class Cow {
  void moo() {
  if(serverDown()) {
    explode();
    }
  }
}
```

That method does something risky, something that might not work at runtime

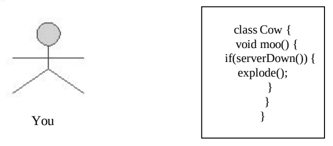


```
class Cow {
  void moo() {
  if(serverDown()) {
    explode();
    }
  }
}
```

Class you didn't write

Need for Exception Handling

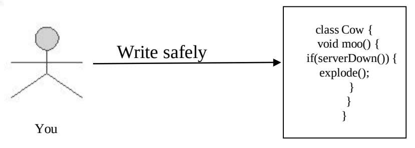
You need to know that the method You are calling is risky



```
class Cow {
  void moo() {
  if(serverDown()) {
    explode();
    }
  }
}
```

Class you didn't write

You then write code that can handle the failure if it does happen. You need to be prepared, just in case



```
class Cow {
  void moo() {
  if(serverDown()) {
    explode();
    }
  }
}
```

Class you didn't write

try/catch block

- Compiler needs to know that you know you are calling a risky method

```
import javax.sound.midi.*;

public class Musictest {   // this is the first one

   public void play() {

              Sequencer player = MidiSystem.getSequencer();

   }
}
```

- Example:- IOStreamDemoWithError.java

try/catch block

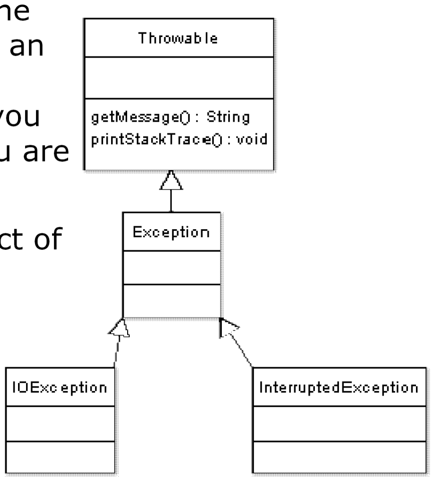
```
import javax.sound.midi.*;

public class Musictest {   // this is the first one

   public void play() {

     try {

              Sequencer player = MidiSystem.getSequencer();

          } catch (MidiUnavailableException ex) {
               ex.printStackTrace();
          }
   }
}
```

- Put the risky thing in a **try** block
- Make a **catch** block for what to do if the exceptional situation happens.
- Example:- IOStreamDemo.java

Exception

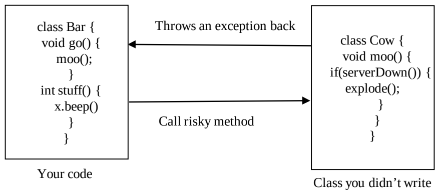
- A try/catch block tells the compiler that you know an exceptional thing could happen in the method you are calling, and that you are prepared to handle it
- An exception is an object of type **Exception**

```
try {
        //something risky
} catch (Exception ex) {
        try to recover
}
```



Exception

- If it is your code that catches the exception, then whose code throw it???



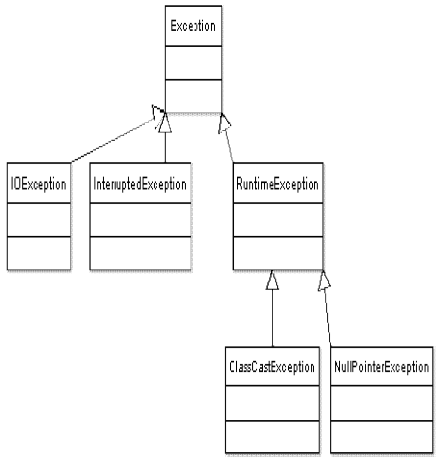
```
class Bar {
  void go() {
    moo();
  }
  int stuff() {
    x.beep()
  }
}
```

```
class Cow {
  void moo() {
    if(serverDown()) {
      explode();
    }
  }
}
```

- One method will catch what another method throws. An exception is always thrown back to the caller
- The method that throws has to declare that it might throw the exception

RuntimeExceptions

- The compiler checks for everything except **RuntimeExceptions**.
- Exceptions that are not subclasses of **RuntimeException** are checked for by the compiler. They are called "checked" exceptions
- **RuntimeException** occurs because user made a programming error i.e. code was not very robust.
- Includes problems as:
  - A bad cast
  - A out-of-bounds array access
  - A null pointer access



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Flow control in try/catch blocks

```
try {
            Foo a = x.doRiskyThing();
            int b = f.getNum();
     } catch (Exception ex) {
            System.out.println("failed");
   }
   System.out.println("success");
```

- If the **try** succeeds – doRiskyThing() does not throw an exception
  - The code in the **catch** block never runs
  - The code below the **catch** block runs
- If the **try** fails – doRiskyThing() does throw an exception
  - Rest of the **try** block doesn't run
  - The **catch** block runs, then the method continues on.

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finally block

- A finally block is where you put code that must run regardless of an exception

```
try {
      turnWaterHeaterOn()
      x.boil();
    } catch (BoilingException ex) {
      ex.printStackTrace();
   } finally {
         turnWaterHeaterOff();
   }
   System.out.println(“success”);
```

- A finally block lets you put all your important cleanup code in one place instead of duplicating it.

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Throwing multiple exceptions

```
public class Account {
    public void withdrawMoney(int m) throws InsufficientBalanceException,
    TransactionFailureException {
          //Code that does withdrawing
    }
}
```

- A method can **throw** multiple exceptions if it needs. But a method’s declaration must declare all the checked exceptions it can throw
- How to catch multiple exceptions???

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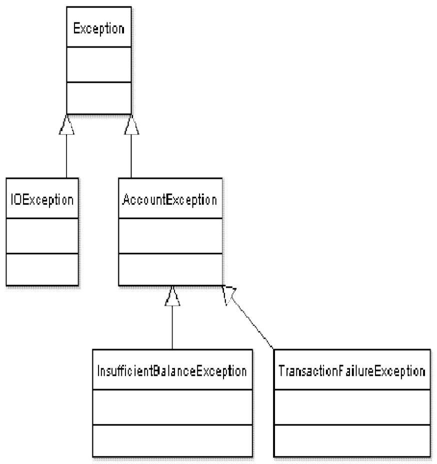
Catching multiple exceptions

- *public class AccountTest {*
```
        public void withdraw() {
      Account act = new Account(1234);
      try {
            act.withdrawMoney(1000);
      } catch(InsufficientBalanceException ex) {
                //recovery code here
      } catch(TransactionFailureException tex) {
                //recovery code here
       }
    }
}
```
- Stack the **catch** blocks under the **try**, one after the other

Exceptions are polymorphic

- You can **DECLARE** exceptions using supertype of the exceptions you throw
  public void withdrawMoney(int m) throws AccountException

- You can **CATCH** exceptions using a supertype of the exception thrown
```
try {
     act.withdrawMoney(1000);
   } catch(AccountException ex) {
     //recovery code here
   }
```

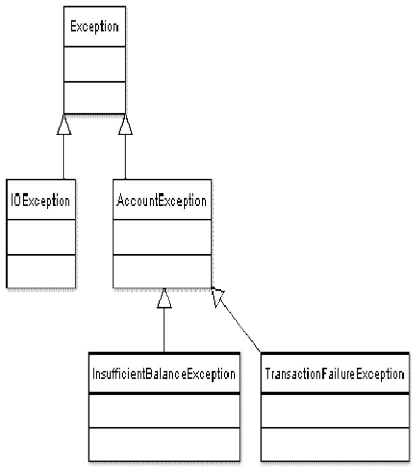


Exceptions are polymorphic

- Just because you **CAN** catch everything with one big super polymorphic catch, doesn't always mean you **should**.

```
try {
      act.withdrawMoney(1000);
    } catch(Exception ex) {
      //recovery code here
    }
```

  - You won't automatically know what went wrong



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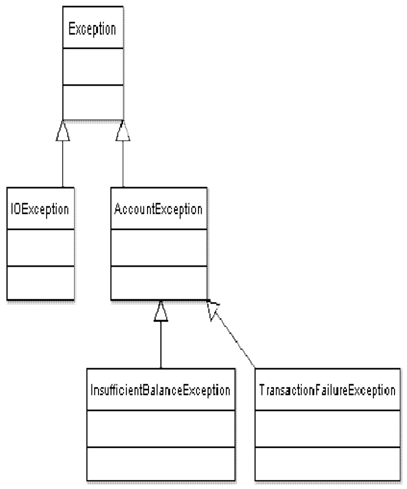
Exceptions are polymorphic

- Write a different catch block for each exception that you need to handle uniquely

```
try {
        act.withdrawMoney(1000);
    } catch(InsufficientBalanceException ex) {
        //recovery from insufficient bal
    } catch(TransactionFailureException tex) {
       //recovery from transaction failure
    } catch(AccountException aex) {
       //recovery from all others
    }
```

- Multiple catch blocks **must** be ordered from smallest to biggest



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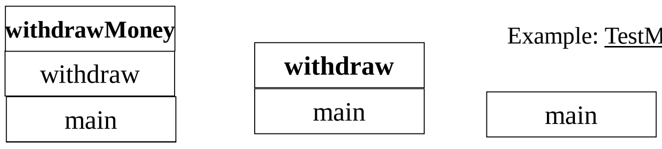
Throwing Exception

- If you don’t want to handle an exception, you can declare it by **throws**

```
public void withdraw() throws AccountException{
        Account act = new Account(1234);
         act.withdrawMoney(1000);
}
```



Example: TestMyException.java

The JVM shuts down

- main() calls withdraw()
- withdraw() calls withdrawMoney()
- withdrawMoney() runs and throws an AccountException

- withdrawMoney() pops off the stack immediately and the exception is thrown back to withdraw()
- withdraw() does not have a try/catch so…

- withdraw() pops off the stack immediately and the exception is thrown back to main(), which in turn throws it to JVM

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Exception rules

- You can’t have a catch or finally without a try
- You can’t put code between the try and the catch
- A try must be followed by either a catch or finally
- A try with only a finally (no catch) must still declare the exception
- If you override a method from a superclass, the checked exceptions that the subclass method declares cannot be more general than those of the superclass method

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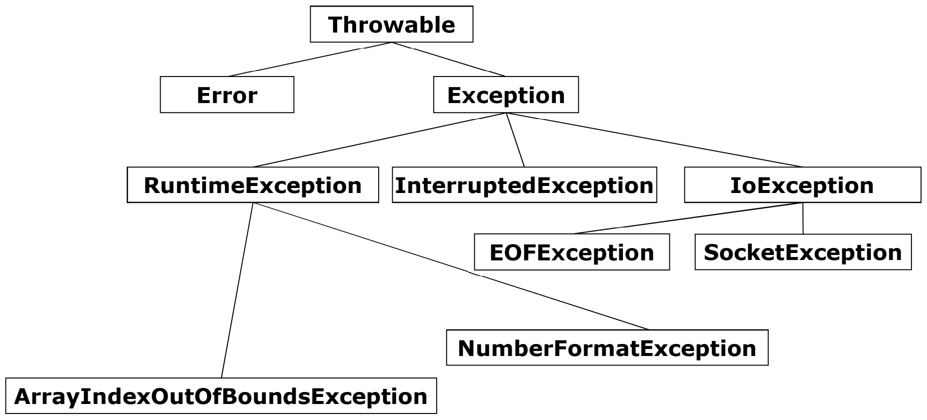
Exception Hierarchy



The class "Throwable" and some of its Subclasses.

Errors

- Are internal errors in the java Runtime environment
- Describe internal errors & resource exhaustion in JVM.
- Rare & usually fatal.
- Used by Java run-time system to indicate errors having to do with run-time environment itself.
  - OutOfMemoryError
  - StackOverflowError

User Defined Exceptions

```
class MyException extends Exception {
   MyException() { }
   MyException(String s)
   {
        super(s);
   }
}
```

User Defined Exceptions

```
class ExceptionDemo {
public void myMethod() throws MyException
{
   ….
   if(<some condition>){
        throw new MyException();
   }
……
}
```

User Defined Exceptions

```
    public static void main(String args[ ]) {
          try{
                    ExceptionDemo e=new
          ExceptionDemo();
                    e.myMethod();
          }
          catch(MyException e) {
                    // handle  the exception
          }
}
```

Assertion

- When ***implementing*** and ***debugging*** a class, it is sometimes useful to state conditions that should be true at a particular point in a method. These conditions called assertions, help ensure a program’s validity by catching potential bugs and identifying possible logic errors during development.
- Java includes two versions of the **assert** statement for validating assertions programmatically. The assert statement evaluates a boolean expression and determines whether it is true or false

Assertion

- The first form of assert statement is
  - **assert *expressrion;*** this statement evaluates expression and throws an **AssertionError** if expression is false
- The second form is
  - ***assert expression1:expression2;*** this statement evaluates ***expression1*** and throws an **AssertionError** with ***expression2*** as the error message if ***expression1*** is false
- Example:-

  AssertTest.java

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Assertion

- Note:-
  - By default assertions are disabled when executing a program because they reduce performance and are unnecessary for the program's user.
  - To enable assertion at runtime use the following version of java command
    - ***java –ea AssertTest***

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