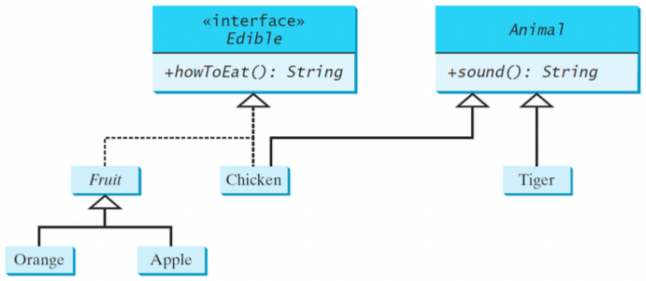
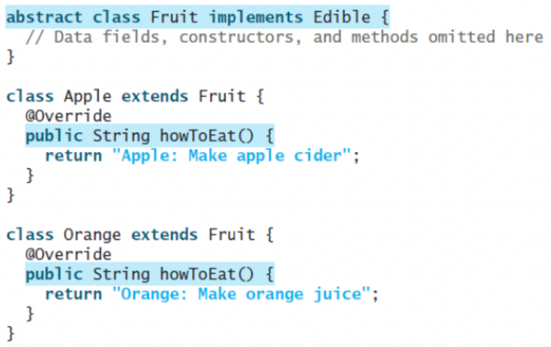
Lecture 4 - Object Oriented Programming (2)

- Abstract Classes
  - Cannot be instantiated using the **new** operator
  - Usually contain abstract methods that are implemented in concrete subclasses
    - e.g. computeArea() in GeometricObject
  - Abstract classes and abstract methods are denoted using the **abstract** modifier in the header
  - A class that contains abstract methods must be defined as abstract
  - If a subclass of an abstract superclass does not implement all the abstract methods, the subclass must be defined as abstract
- Interfaces
  - An interface can be used to define common behaviour for classes (including unrelated classes)
  - Contains only constants and abstract methods
  - Interfaces are denoted using the **interface** modifier in the header
  - Example





```
abstract class Fruit implements Edible {
  // Data fields, constructors, and methods omitted here
}

class Apple extends Fruit {
  @Override
  public String howToEat() {
    return "Apple: Make apple cider";
  }
}

class Orange extends Fruit {
  @Override
  public String howToEat() {
    return "Orange: Make orange juice";
  }
}
```

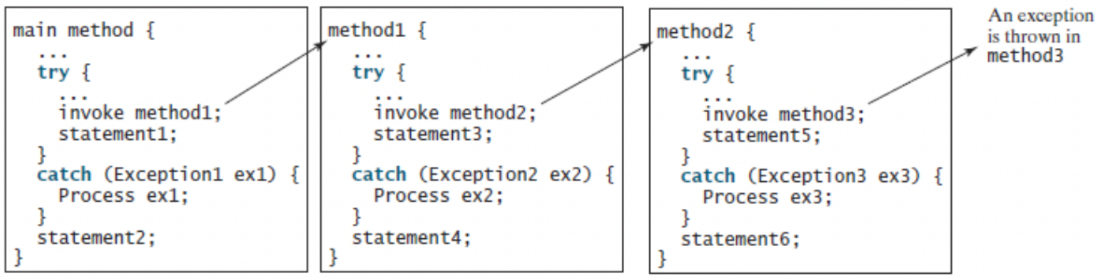
- Generics
  - Enable type parameterization
    - Generic interfaces
    - Generic classes
    - Generic methods
  - Example: **ArrayList** class
    - ArrayList⟨Integer⟩ A = new ArrayList⟨Integer⟩();
    - ArrayList⟨String⟩ B = new ArrayList⟨String⟩();
  - Generic types must be reference types
  - Enable error detection at compile time
  - The **Comparable** interface
    - Defines the **compareTo** method for comparing objects
    - Defined as follows:

```
public interface Comparable<T> {
        public int compareTo(T t);
}
```

    - The **compareTo** method determines the order of the calling object with **t** and returns a negative integer, zero, or a positive integer if the calling object is less than, equal to, or greater than **t**
    - Many classes implement Comparable (e.g. **String**, **Integer**)

  - The **ArrayList** class
    - Arrays can be used to store lists of objects. However, once an array is created, its size is fixed
    - Java provides the generic class **ArrayList** whose size is variable
    - Imported using: **import java.util.ArrayList;**
    - Commonly used methods (**ArrayList<E>**)
      - **boolean add(E e)**
      - **E get(int index)**
      - **int size()**
      - **boolean contains(Object o)**
      - **int indexOf(Object o)**
    - An **ArrayList** could be traversed using a for-each loop
  - The **HashSet** class
    - Generic class that can be used to store elements without duplicates
      - No two elements e1 and e2 can be in the set such that e1.equals(e2) is true
    - Imported using: **import java.util.HashSet;**
    - Objects added to the hash set should override **equals** and **hashCode** properly
    - Commonly used methods (**HashSet⟨E⟩**)
      - **boolean add(E e)**
      - **int size()**
      - **boolean contains(Object o)**
    - A **HashSet** could be traversed using a for-each loop
  - The **LinkedHashSet** class
    - Elements of a **HashSet** are not necessarily stored in the same order they were added
    - **LinkedHashSet** is a subclass of **HashSet** with a linked-list implementation that supports an ordering of the elements in the set
    - Imported using: **import java.util.LinkedHashSet;**

- Exceptions
  - Example



```
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;
}
```

  - Java has a **finally** clause that can be used to execute some code regardless of whether an exception occurs or is caught. For example:

```
try {
        //statements;
}
catch Exception ex) {
        //handling ex; }
finally {
        //final statements;
}
```