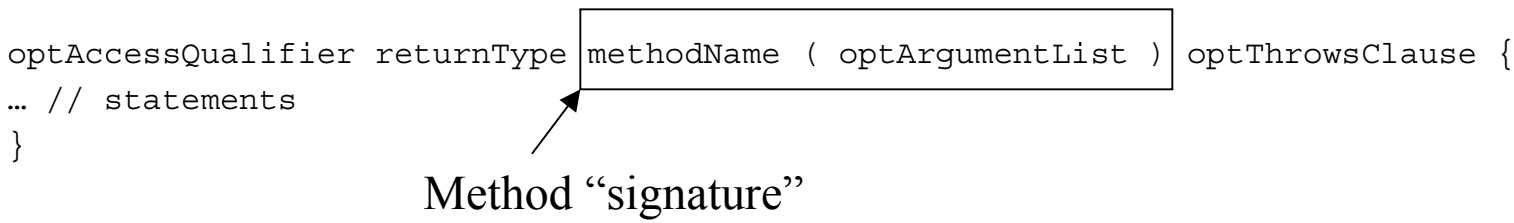
Introduction to Java

Handout-1d

Methods (i)

- *Method* is the OOP name for function
  - Must be declared always within a class



- You can several methods with the same name in the class
  - Same-name methods are said to *overload* the name
  - Methods with same name should do the same thing

Methods (ii)

- Primitive variables declared inside a method have undefined initial values

```
Class Fruit {
  int grams; // instance variable, will be initialized to 0 (zero)

  void someMethod() {
    int calories;  // method variable, need to initialize before using
}
```

Methods (iii)

- Calling a method in the same class

```
class Fruit {
  int grams;

  int totalCalories() {
    … // Statements
  }

  void someMethod() {
    int i = totalCalories();  //same as i = this.totalCalories()
}
```

Methods (v)

- Calling a method in a different class

```
class Cooking {
  int grams;

  Fruit apple = …

  void otherMethod() {
    int i = apple.totalCalories(); // tell what object to use
}
```

Methods (vi)

- Passing parameters to methods
  - Variables of primitive types are passed *by value*
    - The argument's value is copied and passed to the method. The method can change this copy, however this will not change the original argument
  - Objects are passed *by reference*
    - The method is directly accessing the object. After returning from the method the object retains all changes made in the method

Methods (vii)

- Dynamic data structures

Ex:

```
class BinaryTree {
  private Object nodeData;
  private Tree left;  // left sub-tree
  private Tree right; // right sub-tree
  …
}
```

Methods (viii)

- Per-instance and per-class members
  - `static` keyword makes something exist per-class, not per instance of that class
- There are four varieties of static
  - Data; the data belongs to the class, not individual instances of the class
  - Methods; these are methods that belong to the class
  - Blocks; these are blocks that are executed only once
  - Classes; these are classes that are nested in another class

Methods (ix)

- Static data

Ex:

```
class Employee {
  String name;     //per object field
  int salary;      // per-object field
  int employee_id; // per-object field

  static int total_employees; // per-class field (one only)
  …
}
```

Methods – static data

- Inside the class static data is accessed by its name.
- Outside the class, static data can be accessed by:
  - Prefix it with the name of an object of that class OR
  - Prefix it with the name of the class

Ex:

```
Employee newhire = new Employee();

newhire.total_employees=1;  // reference through the instance

Employee.total_employees=1; // reference through the class
```

Methods – static methods

- Static methods, aka *class methods* do class wide operations and do not apply to individual objects

Ex:

```
class Employee {
  String name;
  int salary;
  int employee_id;
  static int total_employees;
  static void clear() {
    total_employees = 0;
  }
}
```

Methods – static methods

- Access static method: better to call using the name of the class to avoid confusion with per-instance methods

Ex:

```
newhire.clear();  // reference through an instance

Employee.clear(); // better, reference through class
```

Methods – static method pitfalls

- Common error: reference per-object data from a static method

Ex:

```
public static void main(String[] args) {
  salary = 50000;  // Compiler error

  Employee e = new Employee();
  e.salary = 50000; // This is ok
}
```

Methods – static blocks

- Block of code: statements within a pair of curly braces
- Static block is prefixed by `static`
  - Inside a class
  - Outside all methods
  - Most commonly used for initialization
  - Each static block is executed once only, when class if first loaded into the JVM
  - Can only access static data

Methods – static blocks

Ex:

```
public class Employee {
  String name;
  int salary;
  int employee_id;
  static int total_employees;

  static {
    if ( IncludingTempsAnd Contractors)
      total_employees = 100;
      else total_employees = 75;
  }
}
```

Methods – static classes

- Nested static class: the declaration of an entire class (methods, data fields, constructors) as a static member of another class
  - Nested purely for convenience

Modifiers - `final`

- Makes something constant. Can be applied to code and data
  - When reference variable is declared final you can't make that variable point at some other object
  - The reference is final not the referenced object

Modifiers - `final`

Ex:

```
final static int myTotal = 100; // constant data
final Fruit banana = new Fruit(100, 30); // constant reference
Fruit lemon = new Fruit();
banana = lemon; // compilation error
             // cannot assign a value to final variable banana
```

Modifiers – `final`

- Method arguments can be marked as final

Ex:

```
void someMethod(final MyClass c) {
  c.field = 7; // Ok
  c = new MyClass(); //compilation error
}
```

Modifiers - `final`

- *Blank final variable*: a final variable of any kind that does not have an initializer
  - Must be assigned a value; that value can be assigned only once
  - If you give a value to a blank final in a constructor, then you must assign it a value in each constructor

Modifiers - `final`

Ex:

```
Class Fruit {
  final String consumer; // blank final variable

  Fruit (String s) {    // constructor
    consumer = s;  // the blank final is now initialized
  }
  …  // more stuff
}
```

Access modifiers

- `private`: members are not accessible outside the class
- None (aka “package access”): members are accessible from classes in the same package
- `protected`: members are accessible from the package AND in subclasses of this class
  - This is *less* protected than the default of package access
- `public`: members are accessible anywhere the class is accessible

Access modifiers - `private`

- Making a constructor private prevents the class from being instantiated by other classes
- Making a method private means it can only be called by another method in the same class

Ex:

```
class Fruit {
  private int grams;
  private int caloriesPerGram;

  private Fruit() {    // constructor
    grams = 0;
    caloriesPerGram = 0;
}
```

Access modifiers - package

```
Ex:
class Employee {  // package access
  String name;
  int salary;
  static int total_employees;

  static void clear() {
    total_employees = 0;
  }
}
```

Access modifiers - `protected`

```
Ex:
class Employee {  // package access
  protected String name;
  protected int salary;
  static int total_employees;

  protected void giveRaise(int amount) {
    salary = salary + amount;
  }
}
```

Access modifiers - `public`

```
Ex:

public class Employee {  // public access

  public static void main() {
    …
  }
  …
}
```