

Core Java

Day 05 Agenda

- Array
 - Object arrays
 - 2-D arrays
 - Ragged arrays
 - Variable arity method
- Method overloading
- Method arguments - Call by value/reference
- Command line arguments
- Arrays class -- Helper methods
- Object/Field initializers
- final variables
- static keyword
 - Static fields
 - Static methods
 - ~~Static block~~
 - ~~Static import~~

Arrays

2-D/Multi-dimensional array

```
double[][] arr = new double[2][3];

double[][] arr = new double[][]{ { 1.1, 2.2, 3.3 }, { 4.4, 5.5, 6.6 } };

double[][] arr = { { 1.1, 2.2, 3.3 }, { 4.4, 5.5, 6.6 } };
```

- Internally 2-D arrays are array of 1-D arrays. "arr" is array of 2 elements, in which each element is 1-D array of 3 doubles.
- Individual element is accesses as `arr[i][j]`.

Ragged array

- Ragged array is array of 1-D arrays. Each 1-D array in the ragged array may have different length.

```
int[][] arr = new int[4][];
arr[0] = new int[] { 11 };
arr[1] = new int[] { 22, 33 };
arr[2] = new int[] { 44, 55, 66 };
arr[3] = new int[] { 77, 88, 99, 110 };
for(int i=0; i<arr.length; i++) {
```

```

        for(int j=0; j<arr[i].length; j++) {
            System.out.print(arr[i][j] + ", ");
        }
    }
}

```

Variable Arity Method

- Methods with variable number of arguments. These arguments are represented by ... and internally collected into an array.

```

public static int sum(int... arr) {
    int total = 0;
    for(int num: arr)
        total = total + num;
    return total;
}

public static void main(String[] args) {
    int result1 = sum(10, 20);
    System.out.println("Result: " + result1);
    int result2 = sum(11, 22, 33);
    System.out.println("Result: " + result2);
}

```

- If method argument is `Object... args`, it can take variable arguments of any type.
- Pre-defined methods with variable number of arguments.
 - `PrintStream` class: `PrintStream printf(String format, Object... args);`
 - `String` class: `static String format(String format, Object... args);`

Method overloading

- Methods with same name and different arguments in same scope - Method overloading.
- Arguments must differ in one of the follows
 - Count

```

static int multiply(int a, int b) {
    return a * b;
}

static int multiply(int a, int b, int c) {
    return a * b * c;
}

```

- Type

```

static int square(int x) {
    return x * x;
}

```

```
static double square(double x) {
    return x * x;
}
```

◦ Order

```
static double divide(int a, double b) {
    return a / b;
}
static double divide(double a, int b) {
    return a / b;
}
```

- Constructors have same name (as of class name) and different arguments. This is referred as "Constructor overloading".
- Note that return type is NOT considered in method overloading. Following code cause error.

```
static int divide(int a, int b) {
    return a / b;
}
static double divide(int a, int b) {
    return (double)a / b;
}
```

```
int result1 = divide(22, 7);
double result2 = divide(22, 7);
// collecting return value is not mandatory
divide(22, 7);
```

Method arguments

- In Java, primitive values are passed by value and objects are passed by reference.
- Pass by reference -- Stores address of the object. Changes done in called method are available in calling method.

```
public static void testMethod(Human h) {
    h.setHeight(5.7);
}
public static void main(String[] args) {
    Human obj = new Human(40, 76.5, 5.5);
    obj.display(); // age=40, weight=76.5, height=5.5
    testMethod(obj);
    obj.display(); // age=40, weight=76.5, height=5.7
}
```

- Pass by value -- Creates copy of the variable. Changes done in called method are not available in calling method.

```
public static void swap(int x, int y) {  
    int t = x;  
    x = y;  
    y = t;  
}  
public static void main(String[] args) {  
    int num1 = 11, num2 = 22;  
    System.out.printf("num1=%d, num2=%d\n", num1, num2);  
    swap(num1, num2);  
    System.out.printf("num1=%d, num2=%d\n", num1, num2);  
}
```

- Pass by reference for value/primitive types can be simulated using array.

Command line arguments

- Additional data/information passed to the program while executing it from command line -- Command line arguments.

```
terminal> java pkg.Program Arg1 Arg2 Arg3
```

- These arguments are accessible in Java application as arguments to main().

```
package pkg;  
class Program {  
    public static void main(String[] args) {  
        // ... args[0] = Arg1, args[1] = Arg2, args[2] = Arg3  
    }  
}
```

Object/Field initializer

- In C++/Java, constructor is used to initialize the fields.
- In Java, field initialization can be done using
 - Field initializer
 - Object initializer
 - Constructor
- Example:

```
class InitializerDemo {
    int num1 = 10;
    int num2;
    int num3;

    InitializerDemo() {
        num3 = 30;
    }
    // ...

    public static void main(String[] args) {
        InitializerDemo obj = new InitializerDemo();
        System.out.printf("num1=%d, num2=%d, num3=%d\n", num1, num2, num3);
    }
}
```

final variables

- In Java, const is reserved word - but not used.
- Java has final keyword instead. It can be used for
 - final variables
 - final fields
 - final methods
 - final class
- The final local variables and fields cannot be modified after initialization.
- The final fields must be initialized any of the following.
 - Field initializer
 - Object initializer
 - Constructor
- Example:

```
class FinalDemo {
    final int num1 = 10;
    final int num2;
    final int num3;

    {
        num2 = 20;
    }

    FinalDemo() {
        num3 = 30;
    }
    public void display() {
        System.out.printf("num1=%d, num2=%d, num3=%d\n", num1, num2, num3);
    }

    public static void main(String[] args) {
        final int num4 = 40;
    }
}
```

```
        final FinalDemo obj = new FinalDemo();
        obj.display();
    }
}
```

static keyword

- In OOP, static means "shared" i.e. static members belong to the class (not object) and shared by all objects of the class.
- Static members are called as "class members"; whereas non-static members are called as "instance members".
- In Java, static keyword is used for
 - static fields
 - static methods
 - static block
 - static import
- Note that, static local variables cannot be created in Java.

Static fields

- Copies of non-static/instance fields are created one for each object.
- Single copy of the static/class field is created (in method area) and is shared by all objects of the class.
- Can be initialized by static field initializer or static block.
- Accessible in static as well as non-static methods of the class.
- Can be accessed by class name or object name outside the class (if not private). However, accessing via object name is misleading (avoid it).

Static methods

- Methods can be called from outside the class (if not private) using class name or object name. However, accessing via object name is misleading (avoid it).
- When needs to call a method without object, then make it static.
- Since static methods are designed to be called on class name, they do not have "this" reference. Hence, cannot access non-static members in the static method (directly). However, we can access them on an object reference.
- Applications
 - To initialize/access static fields.
 - Helper/utility methods

```
import java.util.Arrays;
// in main()
int[] arr = { 33, 88, 44, 22, 66 };
Arrays.sort(arr);
System.out.println(Arrays.toString(arr));
```

- Factory method - to create object of the class

```
import java.util.Calendar;
// in main()
//Calendar obj = new Calendar(); // compiler error
Calendar obj = Calendar.getInstance();
System.out.println(obj);
```

Static field initializer

- Similar to field initializer, static fields can be initialized at declaration.

```
// static field
static double price = 5000.0;
// static final field -- constant
static final double PI = 3.142;
```

Assignments

1. Create a class Triangle that has three sides. Implement constructors, getter/setters, accept(), display(), calcPeri(), isValid() method. The method isValid() returns true if triangle is valid. A triangle is valid if sum of any two sides is greater than the third side. Create array of 4 Triangles, accept from user and calculate perimeters of the valid triangles. Hint:

```
Triangle[] arr = new Triangle[4];
for(int i=0; i<arr.length; i++) {
    arr[i] = new Triangle();
    arr[i].accept();
}
// ...
```

2. Create a 2-D array of 5x5. Initialize with fixed values 1 to 25. For given input, produce given outputs.

- Input

```
1,  2,  3,  4,  5,
6,  7,  8,  9,  10,
11, 12, 13, 14, 15,
16, 17, 18, 19, 20,
21, 22, 23, 24, 25
```

- Output-1:
 - 1, 6, 11, 16, 21, 2, 7, 12, 17, 22, 3, 8, 13, 18, 23, 4, 9, 14, 19, 24, 5, 10, 15, 20, 25
- Output-2:
 - 1, 2, 3, 4, 5, 10, 9, 8, 7, 6, 11, 12, 13, 14, 15, 20, 19, 18, 17, 16, 21, 22, 23, 24, 25

- Output-3:
 - 1, 7, 13, 19, 25, 5, 9, 13, 17, 21

3. Create Sphere class with field radius. Add methods calcVolume() and calcSurfaceArea(). Declare static final field PI.

- Volume = $(4/3) \cdot \pi r^3$
- Surface Area = $4\pi r^2$

```
private static final double PI = 3.14;
```

4. Create Employee class with fields id, name, basicSalary. Add constructors, getter/setters, accept() and display() methods. DA is calculated as 50% of basic salary, HRA is 20%, TA is 10% and tax deduction is 5% for all employees. Write a method to calculate gross salary. Store DA, HRA, TA and Tax percentage as static fields and also provide static getter/setters. Hint:

```
class Employee {  
    // ...  
    private static double taxPercent = 0.05;  
    // ...  
}
```

5. Pune corporation have a set of buses for tourism. Each bus have different capacity but same adult and child ticket rate. Each bus should have methods reserveAdultTicket(), reserveChildTicket(), cancelAdultTicket(), cancelChildTicket(). Create a Bus class to model this scenario. In main() create array of 5 buses. Write a menu driven program to reserve and cancel tickets from given bus. Provide additional menus to change ticket rates and display total business.