Core Java

Agenda

- Multi-Threading
- Nested/Inner classes

Multi-Threading

Inter-thread communication

- wait()
  - Causes the current thread to wait until another thread invokes the notify() method or the notifyAll() method for this object.
  - The current thread must own this object's monitor i.e. wait() must be called within synchronized block/method.
  - The thread releases ownership of this monitor and waits until another thread notifies.
  - The thread then waits until it can re-obtain ownership of the monitor and resumes execution.
- notify()
  - Wakes up a single thread that is waiting on this object's monitor.
  - If multiple threads are waiting on this object, one of them is chosen to be awakened arbitrarily.
  - The awakened thread will not be able to proceed until the current thread relinquishes the lock on this object.
  - This method should only be called by a thread that is the owner of this object's monitor.
- notifyAll()
  - Wakes up all threads that are waiting on this object's monitor.
  - The awakened threads will not be able to proceed until the current thread relinquishes the lock on this object.
  - This method should only be called by a thread that is the owner of this object's monitor.

Member/Nested classes

- By default all Java classes are top-level.
- In Java, classes can be written inside another class/method. They are Member classes.
- Four types of member/nested classes
  - Static member classes -- demo11_01
  - Non-static member class -- demo11_02
  - Local class -- demo11_03
  - Annoymous Inner class -- demo11_04
- When .java file is compiled, separate .class file created for outer class as well as inner class.

Static member classes

- Like other static members of the class (belong to the class, not the object).
- Accessed using outer class (Doesn't need the object of outer class).
- Can access static (private/public) members of the outer class directly.

- Static member class cannot access non-static members of outer class directly.
- The outer class can access all members (including private) of inner class directly (no need of getter/setter).
- The static member classes can be private, public, protected, or default.

```
class Outer {
    private int nonStaticField = 10;
    private static int staticField = 20;

    public static class Inner {
        public void display() {
            System.out.println("Outer.nonStaticField = " + nonStaticField);
// error
            System.out.println("Outer.staticField = " + staticField); // ok
- 20
        }
    }
}
public class Main {
    public static void main(String[] args) {
        Outer.Inner obj = new Outer.Inner();
        obj.display();
    }
}
```

Non-static member classes/Inner classes

- Like other non-static members of the class (belong to the object/instance of Outer class).
- Accessed using outer class object (Object of outer class is MUST).
- Can access static & non-static (private) members of the outer class directly.
- The outer class can access all members (including private) of inner class directly (no need of getter/setter).
- The non-static member classes can be private, public, protected, or default.

```
class Outer {
    private int nonStaticField = 10;
    private static int staticField = 20;
    public class Inner {
        public void display() {
            System.out.println("Outer.nonStaticField = " + nonStaticField);
// ok-10
            System.out.println("Outer.staticField = " + staticField); // ok-
20
        }
    }
}
```

```
public class Main {
    public static void main(String[] args) {
        //Outer.Inner obj = new Outer.Inner(); // compiler error
        // create object of inner class
            //Outer outObj = new Outer();
            //Outer.Inner obj = outObj.new Inner();
        Outer.Inner obj = new Outer().new Inner();
        obj.display();
    }
}
```

- If Inner class member has same name as of outer class member, it shadows (hides) the outer class member. Such Outer class members can be accessed explicitly using `Outer.this`.

Static member class and Non-static member class -- Application

```
// top-level class
class LinkedList {
    // static member class
    static class Node {
        private int data;
        private Node next;
        // ...
    }
    private Node head;
    // non-static member class
    class Iterator {
        private Node trav;
        // ...
    }
    // ...
    public void display() {
        Node trav = head;
        while(trav != null) {
            System.out.println(trav.data);
            trav = trav.next;
        }
    }
}
```

Local class

- Like local variables of a method.
- The class scope is limited to the enclosing method.
- If enclosed in static method, behaves like static member class. If enclosed in non-static method, behaves like non-static member class.
- Along with Outer class members, it can also access (effectively) final local variables of the enclosing method.
- We can create any number of objects of local classes within the enclosing method.

```
public class Main {
    private int nonStaticField = 10;
    private static int staticField = 20;
    public static void main(String[] args) {
        final int localVar1 = 1;
        int localVar2 = 2;
        int localVar3 = 3;
        localVar3++;
        // local class (in static method) -- behave like static member class
        class Inner {
            public void display() {
                System.out.println("Outer.nonStaticField = " +
nonStaticField); // error
                System.out.println("Outer.staticField = " + staticField); //
ok 20
                System.out.println("Main.localVar1 = " + localVar1); // ok 1
                System.out.println("Main.localVar2 = " + localVar2); // ok 2
                System.out.println("Main.localVar3 = " + localVar3); //
error
            }
        }
        Inner obj = new Inner();
        obj.display();
        //new Inner().display();
    }
}
```

Annoymous Inner class

- Creates a new class inherited from the given class/interface and its object is created.
- If in static context, behaves like static member class. If in non-static context, behaves like non-static member class.
- Along with Outer class members, it can also access (effectively) final local variables of the enclosing method.

```
// (named) local class
class EmpnoComparator implements Comparator<Employee> {
    public int compare(Employee e1, Employee e2) {
        return e1.getEmpno() - e2.getEmpno();
    }
}
Arrays.sort(arr, new EmpnoComparator());    // anonymous obj of local class
```

```
// Anonymous inner class
Comparator<Employee> cmp = new Comparator<Employee>() {
    public int compare(Employee e1, Employee e2) {
        return e1.getEmpno() - e2.getEmpno();
    }
};
Arrays.sort(arr, cmp);
```

Date and Time API

- Legacy Java classes
    - Date
    - Calendar
- Java 8 Date Time
    - https://www.baeldung.com/java-8-date-time-intro