DAILY ASSESSMENT

Date:	10-6-2020	Name:	Kavyashreem
Course:	VLSI	USN:	4al15ec036
Topic:	MOS transistor basics-I	Semester & Section:	8th A
Github Repository:	kavya		

FORENOON SESSION DETAILS

Image of session

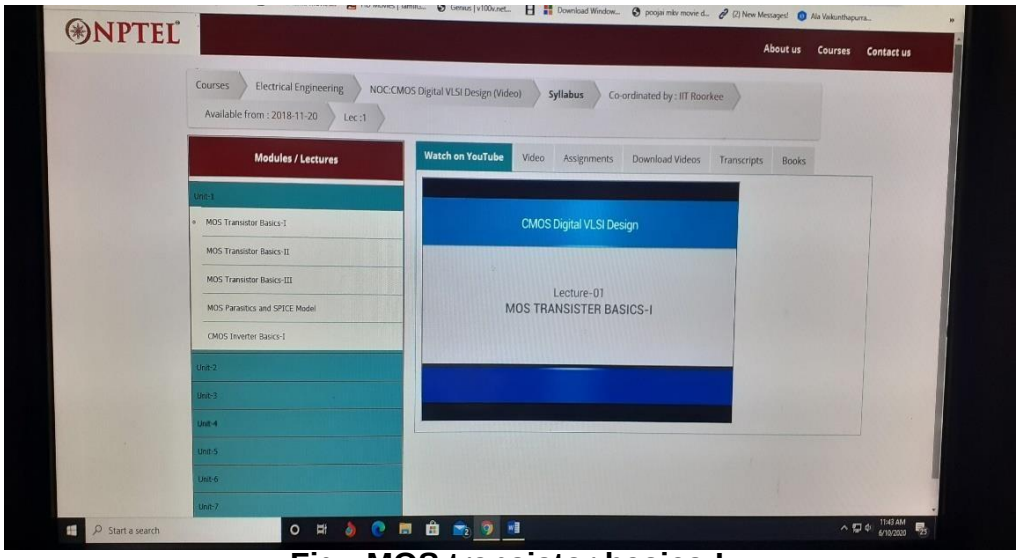
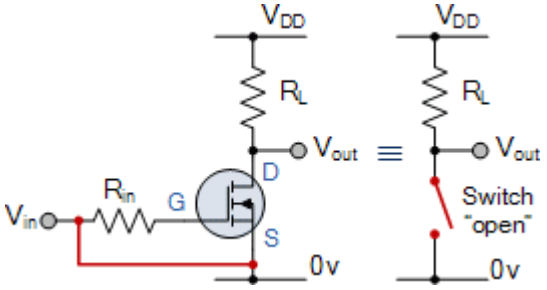


Fig : MOS transistor basics-I

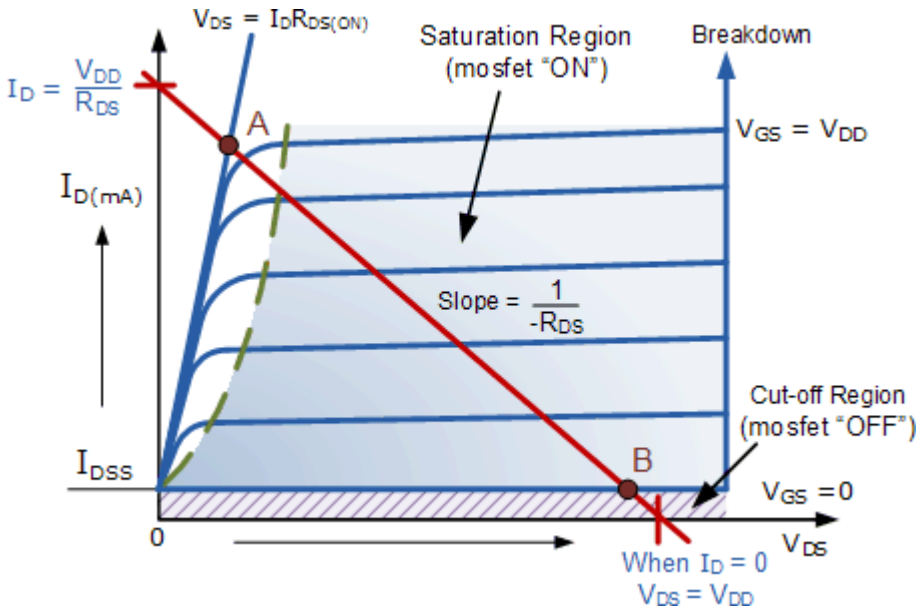
MOS transistor basics-I

MOSFET as a switch

MOSFET's make very good electronic switches for controlling loads and in CMOS digital circuits as they operate between their cut-off and saturation regions.



MOSFET Characteristics Curves



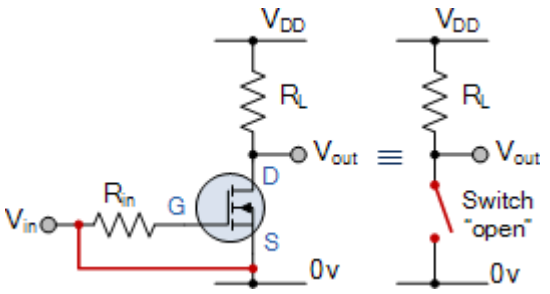
The minimum ON-state gate voltage required to ensure that the MOSFET remains "ON" when carrying the selected drain current can be determined from the V-I transfer curves above. When V_{IN} is HIGH or equal to V_{DD}, the MOSFET Q-point moves to point A along the load line.

The drain current I_D increases to its maximum value due to a reduction in the channel resistance. I_D becomes a constant value independent of V_{DD}, and is dependent only on V_{GS}. Therefore, the transistor behaves like a closed switch but the channel ON-resistance does not reduce fully to zero due to its $R_{DS(on)}$ value, but gets very small

1. **Cut-off Region**

Here the operating conditions of the transistor are zero input gate voltage (V_{IN}), zero drain current I_D and output voltage V_{DS} = V_{DD}. Therefore for an enhancement type MOSFET the conductive channel is closed and the device is switched "OFF".

Cut-off Characteristics

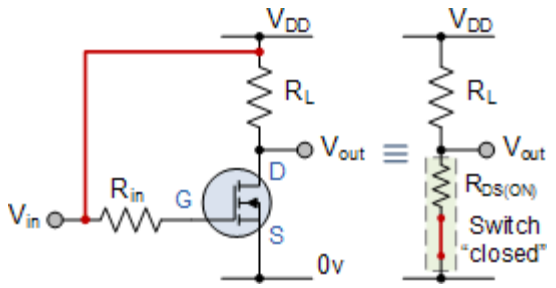


- The input and Gate are grounded (0V)
- Gate-source voltage less than threshold voltage $V_{GS} < V_{TH}$
- MOSFET is “OFF” (Cut-off region)
- No Drain current flows ($I_D = 0$ Amps)
- $V_{OUT} = V_{DS} = V_{DD} = ”1″$
- MOSFET operates as an “open switch”

2. Saturation Region

In the saturation or linear region, the transistor will be biased so that the maximum amount of gate voltage is applied to the device which results in the channel resistance $R_{DS(on}$ being as small as possible with maximum drain current flowing through the MOSFET switch. Therefore for the enhancement type MOSFET the conductive channel is open and the device is switched “ON”.

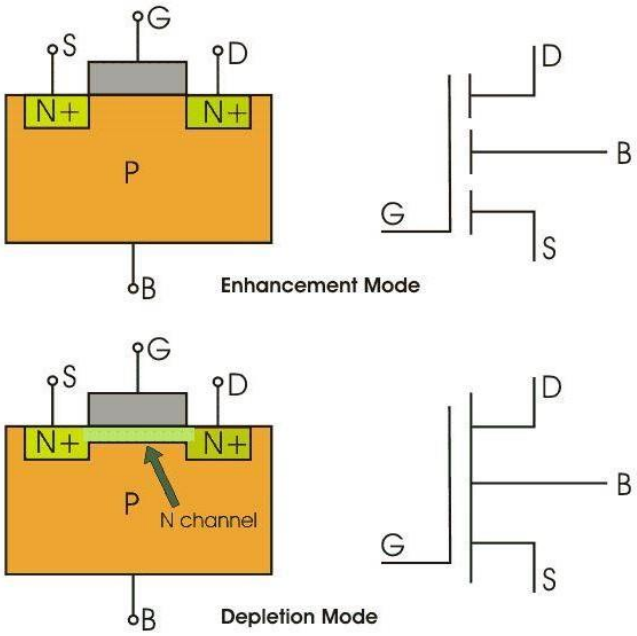
Saturation Characteristics



- The input and Gate are connected to V_{DD}
- Gate-source voltage is much greater than threshold voltage $V_{GS} > V_{TH}$
- MOSFET is “ON” (saturation region)

	• Max Drain current flows ($I_D = V_{DD} / R_L$) • V_{DS} = 0V (ideal saturation) • Min channel resistance $R_{DS(on)} < 0.1\Omega$ • $V_{OUT} = V_{DS} \cong 0.2V$ due to $R_{DS(on)}$ • MOSFET operates as a low resistance "closed switch"

MOSFET Structure

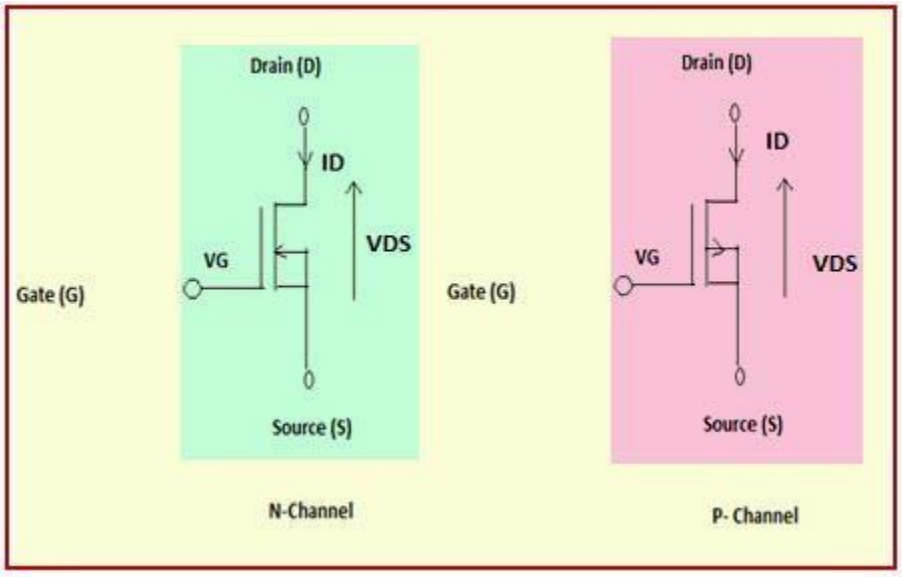


Types of MOSFET

The MOSFET is classified into two types such as;

- Depletion mode MOSFET
- Enhancement mode MOSFET

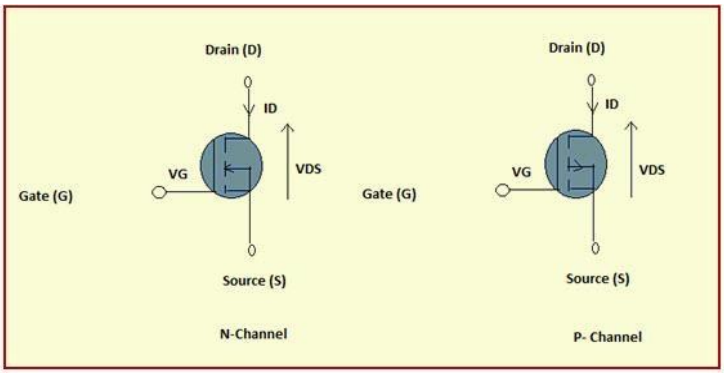
Depletion Mode: When there is zero voltage on the gate terminal, the channel shows its maximum conductance. As the voltage on the gate is negative or positive, then decreases the channel conductivity.



Depletion Mode MOSFET

Enhancement Mode

When there is no voltage on the gate terminal the device does not conduct. More voltage applied on the gate terminal, the device has good conductivity



Enhance Mode MOSFET

Threshold voltge of MOSFET

VTH is the value of VG that will cause the interface potential to be equal in magnitude and opposite in sign to the substrate potential ϕp . Physically this mean that

there would now be a mobile electron concentration at the surface that is equal in magnitude to the mobile hole concentration is the p-substrate. When this happens we say that the surface is INVERTED, and the electron channel at the surface is called the inversion layer. So define threshold voltage as V V G TH = when $\phi s = -\phi p$ (21) Substituting in VTH and ϕs , we obtain the following expression for the threshold voltage in nchannel MOSFETs. 1 1 2 = 4 | | + 2 - C TH Si A p p bi ox V qN ⌈ ⌉ ε ϕ ϕϕ

Current-voltage characteristics

n-channel Enhancement-type MOSFET

Figure 1a shows the transfer characteristics of n-channel Enhancement-type MOSFETs. From this, it is evident that the current through the device will be zero until the V_{GS} exceeds the value of threshold voltage V_T. This is because under this state, the device will be void of channel which will be connecting the drain and the source terminals. Under this condition, even an increase in V_{DS} will result in no current flow as indicated by the corresponding output characteristics shown by Figure 1b. As a result this state represents nothing but the cut-off region of MOSFET's operation.

Next, once V_{GS} crosses V_T, the current through the device increases with an increase in I_{DS} initially and then saturates to a value as determined by the V_{GS} i.e. as V_{GS} increases**,** even the saturation current flowing through the device also increases. This is evident by Figure 1b where I_{DSS2} is greater than I_{DSS1} as $V_{GS2} > V_{GS1}$, I_{DSS3} is greater than I_{DSS2} as $V_{GS3} > V_{GS2}$, so on and so forth. Further, Figure 1b also shows the locus of pinch-off voltage , from which V_P is seen to increase with an increase in V_{GS}

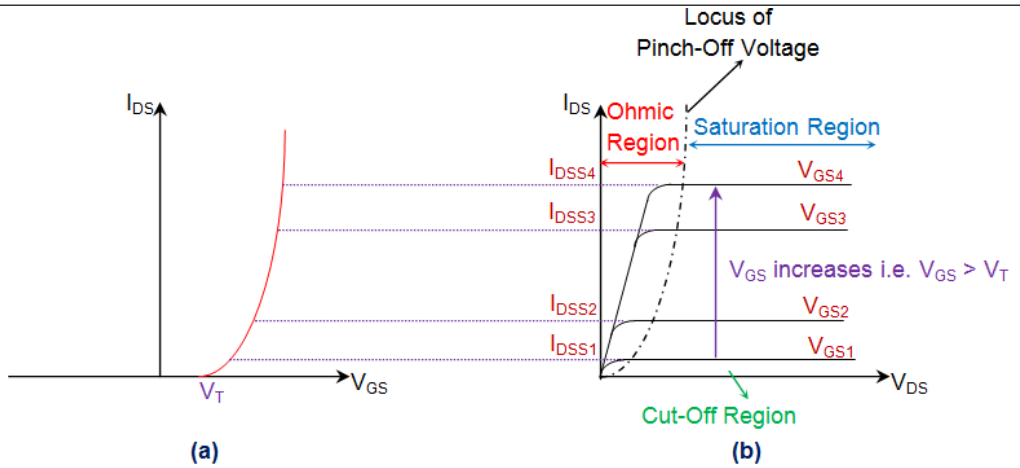


Figure 1 *n*-Channel Enhancement type MOSFET (a) Transfer Characteristics (b) Output Characteristics

p-channel Enhancement-type MOSFET

Figure 2a shows the transfer characteristics of p-type enhancement MOSFETs from which it is evident that I_{DS} remains zero (cutoff state) untill V_{GS} becomes equal to $-V_T$. This is because, only then the channel will be formed to connect the drain terminal of the device with its source terminal. After this, the I_{DS} is seen to increase in reverse direction (meaning an increase in I_{SD}, signifying an increase in the device current which will flow from source to drain) with the decrease in the value of V_{DS}. This means that the device is functioning in its ohmic region wherein the current through the device increases with an increase in the applied voltage (which will be V_{SD}).

However as V_{DS} becomes equal to $-V_P$, the device enters into saturation during which a saturated amount of current (I_{DSS}) flows through the device, as decided by the value of V_{GS}. Further it is to be noted that the value of saturation current flowing through the device is seen to increase as the V_{GS} becomes more and more negative i.e. saturation current for V_{GS3} is greater than that for V_{GS2} and that in the case of V_{GS4} is much greater than both of them as V_{GS3} is more negative than V_{GS2} while V_{GS4} is much more negative when compared to either of them (Figure 2b). In addition, from the locus of the pinch-off voltage it is also clear that as V_{GS} becomes more and more negative, even the negativity of V_P also increases.

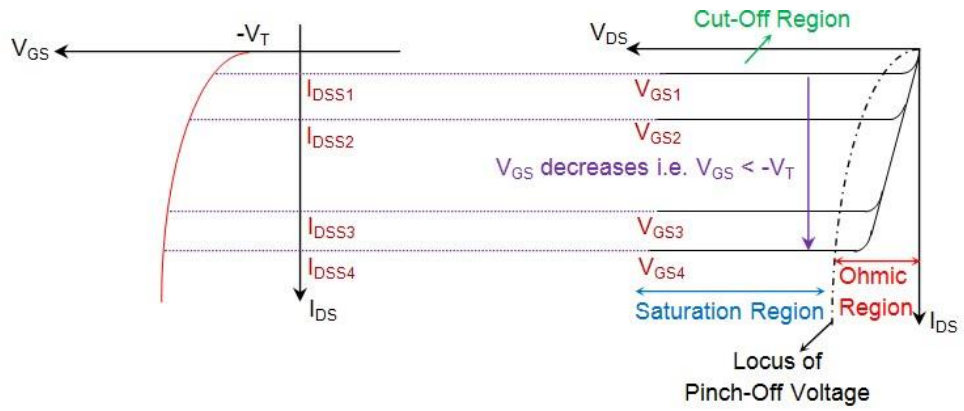
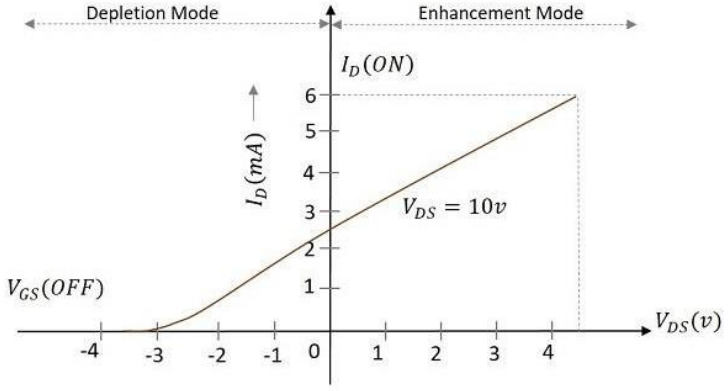


Figure 2 ***p*-Channel Enhancement type MOSFET (a) Transfer Characteristics (b) Output Characteristics**

Transfer charactersitcs and sub-threshold slope

Transfer Characteristics

Transfer characteristics define the change in the value of V_{DS} with the change in I_D and V_{GS} in both depletion and enhancement modes. The below transfer characteristic curve is drawn for drain current versus gate to source voltage.



Transfer Characteristics of a MOSFET

The subthreshold slope is a feature of a MOSFET's current–voltage characteristic.

In the subthreshold region, the drain current behaviour – though being controlled by the gate terminal – is similar to the exponentially decreasing current of a forward biased diode. Therefore a plot of drain current versus gate voltage with drain, source,

and bulk voltages fixed will exhibit approximately log linear behaviour in this MOSFET operating regime. Its slope is the subthreshold slope.

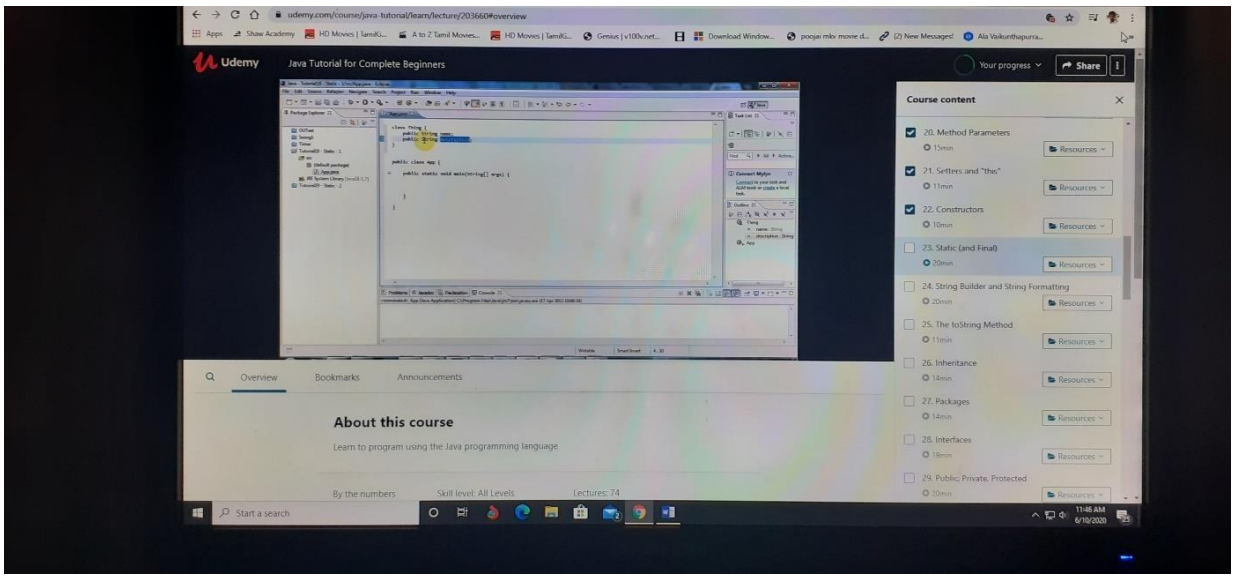
The subthreshold slope is also the reciprocal value of the subthreshold swing $S_{s\text{-}th}$ which is usually given as:

- Depletion layer capacitance
- Gate-oxide capacitance
- Thermal Voltage

AFTERNOON SESSION DETAILS

Date:	**10-6-2020**	**Name:**	**Kavyashreem**
Course:	**Java**	**USN:**	**4al15ec036**
Topic:	**Array of strings,multi-dimensional arrays,classes and object,methods,getters and return values,method parameter,setters and "this",constructors,static,string builder and string formatting**	**Semester & Section:**	**8th A**
Github Repository:	**kavya**		

Image of session



Array of strings

Java String array is used to hold fixed number of Strings. String array is very common in simple java programs, specially among beginners to java and to test some specific scenarios. Even java main method argument is string array – public static void

main(String[] args). So today we will look into different aspects of java string array with example programs.

- Java String array is basically an array of objects.
- There are two ways to declare string array – declaration without size and declare with size.
- There are two ways to initialize string array – at the time of declaration, populating values after declaration.
- We can do different kind of processing on string array such as iteration, sorting, searching etc.

Multidimensional Arrays

Multidimensional Arrays can be defined in simple words as array of arrays. Data in multidimensional arrays are stored in tabular form (in row major order).

Syntax:

data_type[1st dimension][2nd dimension][]..[Nth dimension] array_name = new data_type[size1][size2]….[sizeN];

where:

- data_type: Type of data to be stored in the array. For example: int, char, etc.
- dimension: The dimension of the array created.For example: 1D, 2D, etc.
- array_name: Name of the array
- size1, size2, …, sizeN: Sizes of the dimensions respectively.

Classes and Object

A Class is like an object constructor, or a "blueprint" for creating objects.

Create a Class

To create a class, use the keyword class:

MyClass.java

Create a class named "MyClass" with a variable x:

```
public class MyClass {
  int x = 5;
}
```

Create an Object

In Java, an object is created from a class. We have already created the class named MyClass, so now we can use this to create objects.

To create an object of MyClass, specify the class name, followed by the object name, and use the keyword new:

Example

Create an object called "myObj" and print the value of x:

```
public class MyClass {
  int x = 5;

  public static void main(String[] args) {
    MyClass myObj = new MyClass();
    System.out.println(myObj.x);
  }
}
```

Getters and return values

The get method returns the variable value, and the set method sets the value. Syntax for both is that they start with either get or set, followed by the name of the variable, with the first letter in upper case:

Example

```
public class Person {
  private String name; // private = restricted access
```

```
  // Getter
  public String getName() {
    return name;
  }

  // Setter
  public void setName(String newName) {
    this.name = newName;
  }
}
```

Method parameter

In Java, parameters sent to methods are passed-by-value: What is passed "to" a method is referred to as an "argument". The "type" of data that a method can receive is referred to as a "parameter".

Pass-by-value means that when a method is called, a copy of the value of each argument is passed to the method. This copy can be changed inside the method, but such a change will have NO effect on the argument.

Constructors

A Java constructor is special method that is called when an object is instantiated. In other words, when you use the new keyword. The purpose of a Java constructor is to initializes the newly created object before it is used. This Java constructors tutorial will explore Java constructors in more detail.Here is a simple example that creates an object, which results in the class constructor being called:

```
MyClass myClassObj = new MyClass();
```

Here is a simple Java constructor declaration example.

```
public class MyClass {
```

```
    public MyClass() {
    }
}
```

Static

In Java, static keyword is mainly used for memory management. It can be used with variables, methods, blocks and nested classes. It is a keyword which is used to share the same variable or method of a given class. Basically, static is used for a constant variable or a method that is same for every instance of a class.

String builder and string formatting

StringBuilder: private static final String PROFILE_PICTURE_URL_BASE = "https://cdn.myapp.com/user/";

private static final String PROFILE_PICTURE_URL_EXTENSION = ".png";

Long userId = ...;

StringBuilder sb = new StringBuilder(PROFILE_PICTURE_URL_BASE);

sb.append(userId);

sb.append(PROFILE_PICTURE_URL_EXTENSION);

String profilePictureUrl = sb.toString();

String.format: private static final String PROFILE_PICTURE_URL = "https://cdn.myapp.com/user/%d.png";

Long userId = ...;

String profilePictureUrl = String.format(PROFILE_PICTURE_URL, userId);