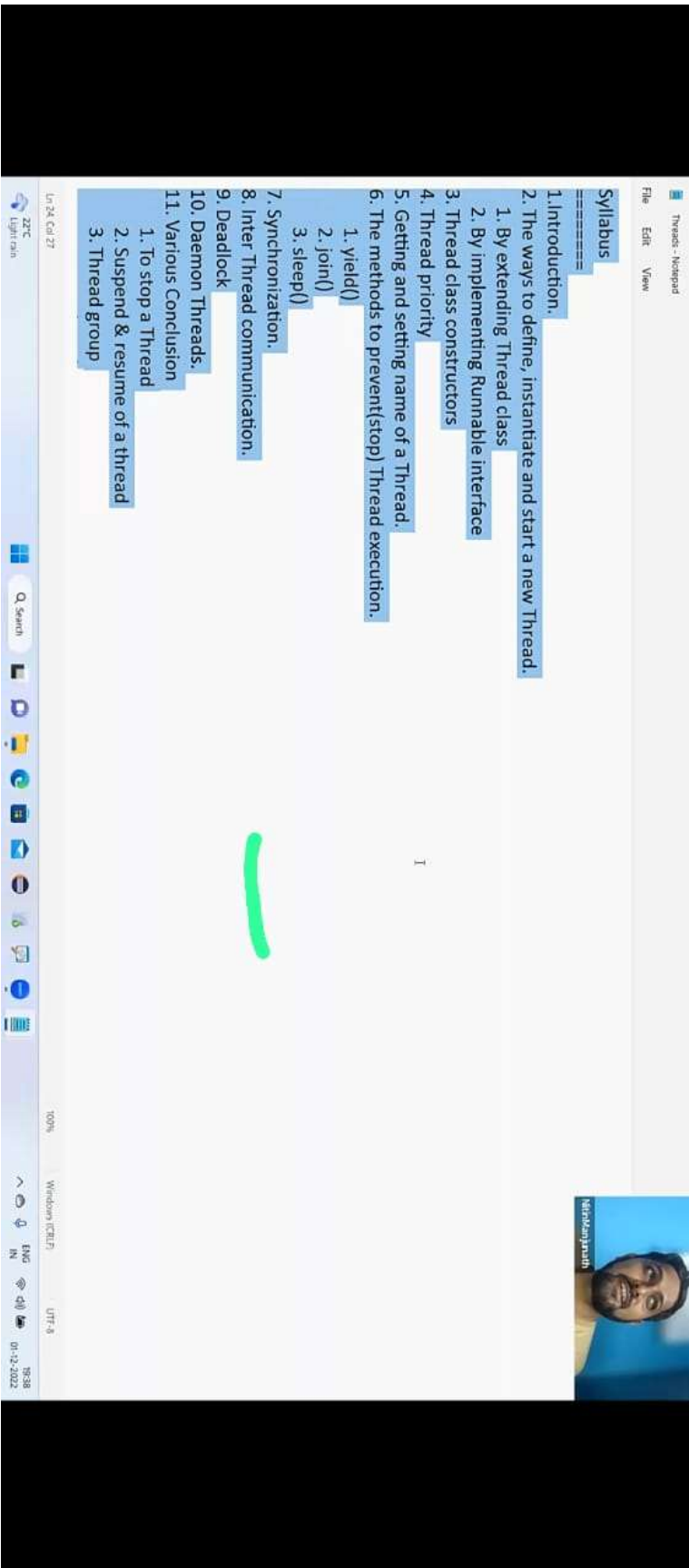


# Java Multithreading Part1



Threads - Notepad

File Edit View

Syllabus

====

1. Introduction.
2. The ways to define, instantiate and start a new Thread.
  1. By extending Thread class
  2. By implementing Runnable interface
3. Thread class constructors
4. Thread priority
5. Getting and setting name of a Thread.
6. The methods to prevent(stop) Thread execution.
  1. yield()
  2. join()
  3. sleep()
7. Synchronization.
8. Inter Thread communication.
9. Deadlock
10. Daemon Threads.
11. Various Conclusion
  1. To stop a Thread
  2. Suspend & resume of a thread
  3. Thread group

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- 1,12,2022\_threads\_classroom - Notepad
- File Edit View
3. Thread class constructors
  4. Thread priority
  5. Getting and setting name of a Thread.
  6. The methods to prevent(stop) Thread execution.
    1. yield()
    2. join()
    3. sleep()
  7. Synchronization.
  8. Inter Thread communication.
  9. Deadlock
  10. Daemon Threads.
  11. Various Conclusion
    1. To stop a Thread
    2. Suspend & resume of a thread
    3. Thread group
    4. Green Thread
    5. Thread Local
  12. Life cycle of a Thread



## Multitasking

=====

Executing several task simultaneously is the concept of multitasking.

There are 2 types of Multitasking.

- Process based multitasking
- Thread based multitasking.

### Process based multitasking

=====

Executing several tasks simultaneously where each task is a separate independent process such type of multitasking is called

"process based multitasking".

eg:: typing a java pgm

listening to a song

downloading the file from internet

Process based multitasking is best suited at "os level".



## Process based multithreading

=====

Executing several tasks simultaneously where each task is a separate independent process such type of multithreading is called "process based multithreading".

eg:: typing a java pgm  
listening to a song  
downloading the file from internet

Process based multithreading is best suited at "os level".



## Thread based multithreading

=====

=>Executing several tasks simultaneously where each task is a separate independent part of the same Program, is called "Thread based Multithreading".



listening to a song  
downloading the file from internet

Process based multitasking is best suited at "os level".

Thread based multitasking

=====

=>Executing several tasks simultaneously where each task is a separate independent part of the same Program, is called "Thread based MultiTasking".

Each independent part is called "Thread".!

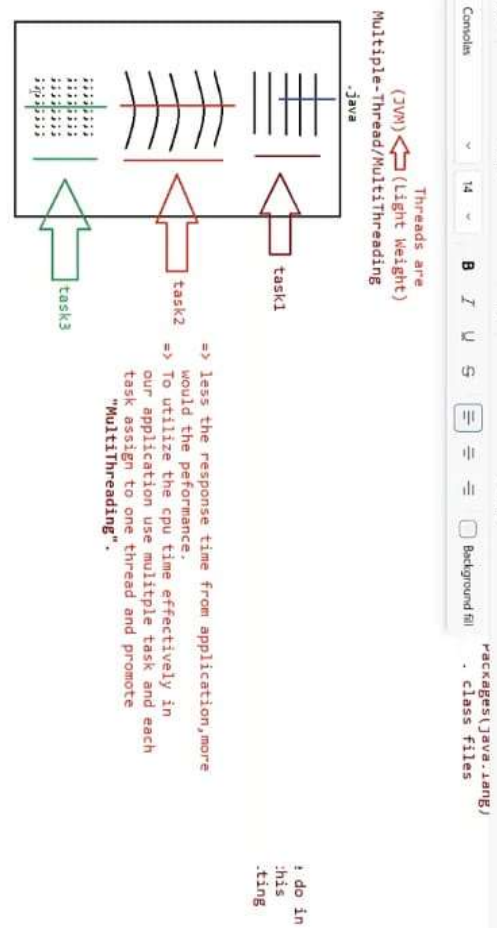
1. This type of multitasking is best suited at "Programatic level".

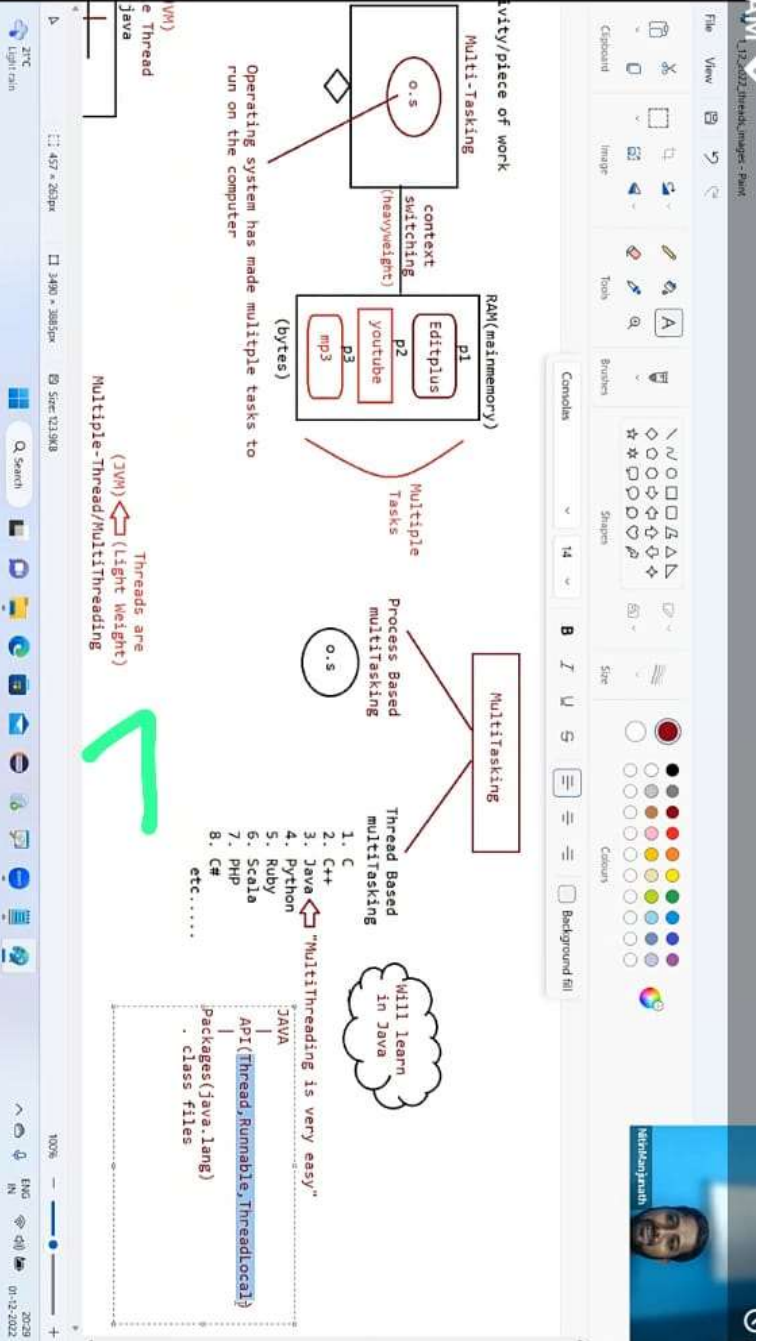
The main advantages of multitasking is to reduce the response time of the system and to improve the performance.

2. The main important application areas of multithreading are

- a. To implement multimedia graphics
- b. To develop web application servers
- c. To develop video games







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Multiple Tasks

Process Based multithreading

o.s

Thread Based multithreading

1. C  
2. C++  
3. Java  
4. python  
5. Ruby  
6. Scala  
7. PHP  
8. C#  
etc.....

Will learn in Java

JAVA  
API(Thread,Runnable,ThreadLocal)  
Packages(java.lang)  
class files

90% work done by API  
+  
10% work will be done by developer(writing a task)

Threads are (light Weight) and Multithreading

task1

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Q Search

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Neelkanth

## Thread based multitasking

[illegible]

=>Executing several tasks simultaneously where each task is a separate independent part of the same Program, is called

## "Thread based MultiTasking".

Each independent part is called "Thread".

1. This type of multitasking is best suited at "Programmatic level".

The main advantages of multitasking is to reduce the response time of the system and to improve the performance.

2. The main important application areas of multithreading are

- a. To implement multimedia graphics
- b. To develop web application servers(will learn in JEE)
- c. To develop video games
- d. To develop animations

3. Java provides inbuilt support to work with threads through API called Thread, Runnable, ThreadGroup, ThreadLocal, ...

4. To work with multithreading, java developers will code only for 10% remaining 90% java API will take care...

FileView

1,12,2022,threads,images - Paint

Clipboard

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Tools

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Shapes

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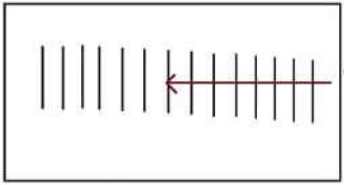
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Single Thread

(JVM)

.java

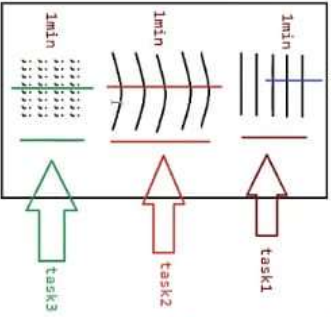


Multiple-Thread/Multithreading

(JVM)

(Light Weight)

.java



Threads are

(T.S)

3min

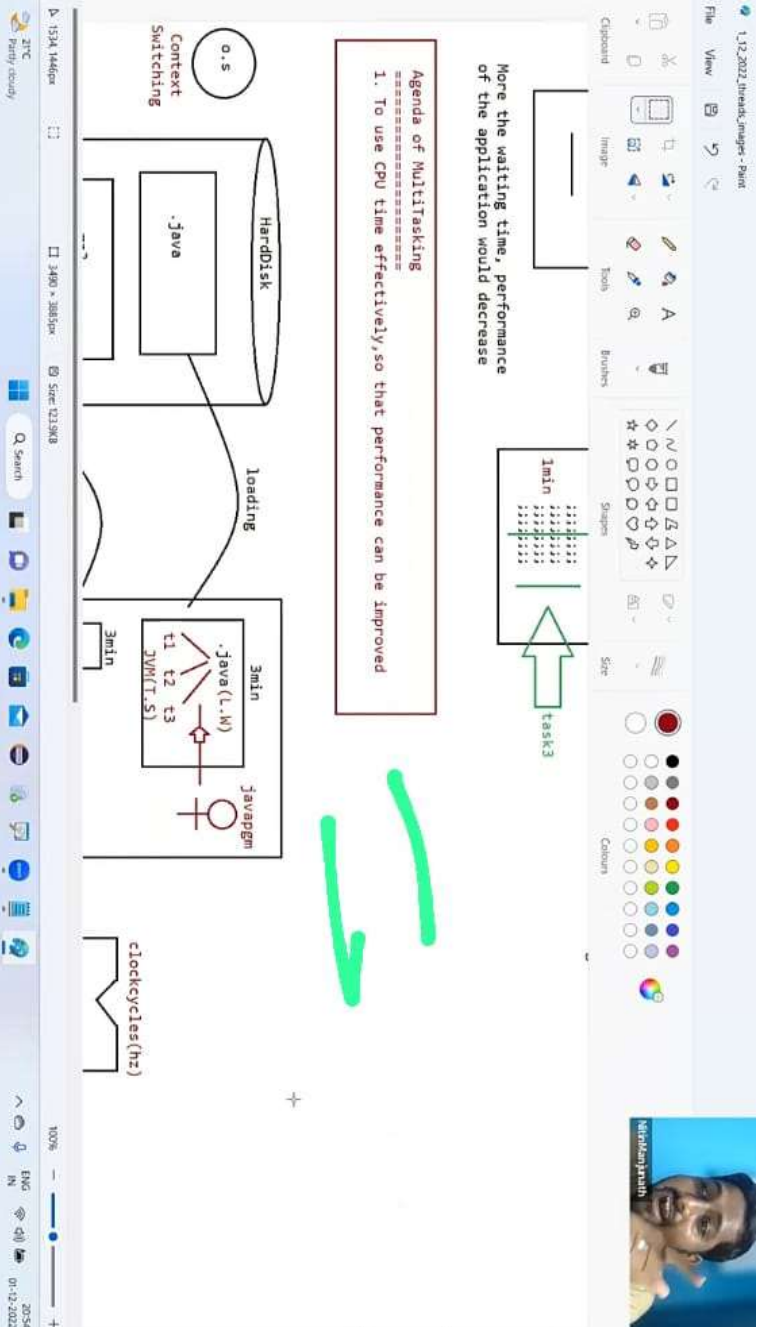
ThreadScheduler

More the waiting time, performance of the application would decrease

=> less the response time from application, more would the performance.

=> To utilize the cpu time effectively in our application use multiple task and each task assign to one thread and promote "Multithreading".

10



### What is thread?

A. Separate flow of execution is called "Thread".

if there is only one flow then it is called "SingleThread" programming.  
For every thread there would be a separate job.

B. In java we can define a thread in 2 ways

- a. implementing Runnable interface
- b. extending Thread class;

12



Editor - (D:\Wrapper classes\TestJava 1

File Edit View Search Document Project Tools Browser Export Window Help

Directory Object Functions

D:\ New Volume

Wrapper classes

TestJava

```
10  
11  
12  
13  
14  
15 public class Test {  
16     public static void main(String[] args){  
17  
18         MyThread t = new MyThread();  
19         t.start();  
20  
21         // 2 threads started and eagerly waiting for CPU time,scheduling is done by T.S  
22  
23         //task for main thread  
24         for (int i = 1;i<=10;i++)  
25         {  
26             System.out.println("Main thread");  
27         }  
28  
29     }  
30  
31 }
```

TestJava

System.out.println("Child thread");

System.out.println("Main thread");

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File View

Clipboard Image Tools Brushes Shapes Size Colours

```
class MyThread extends Thread
{
    @Override
    public void run() // override run() to define a job for a thread
    {
        for (int i=1; i<=10; i++)
        {
            System.out.println("Child thread");
        }
    }
} // Task of a Thread
```

Defining a Thread

```
public class Test {
    public static void main(String[] args){
        MyThread t = new MyThread();
        t.start();
    }
} // main thread and user defined thread
```

#1.

MethodArea stackArea HeapArea

Test.class

MyThread

Thread

t1

t2

T.S

```
public class Thread{
    public void run(){
    }
    public void start(){
        //logic internally available
    }
}
```

51

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ENG IN 01-12-2022 21:45

Nepanjanani

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Task of a Thread

Defining a Thread

```
public class Test {  
    public static void main(String[] args){  
        MyThread t = new MyThread();  
        t.start();  
        for (int i = 1; i<=10; i++)  
            System.out.println("Main thread");  
        }  
    }  
}  
  
javac Test.java => Test.class, MyThread.class  
java Test  
=> contain main() so load and start  
the execution
```

#1.

MethodArea

Test.class

MyThread

Thread

Object

stackArea

T.S

t1 (main)

t2 (user thread)

#3. main

HeapArea

MyThread

#2. main()

JRE

16



Narayanarath

1,12,2022\_thread\_classmate - Notepad

File Edit View

- a. Implementing Runnable interface
- b. extending Thread class

### 1. Extending Thread class

=> we can create a Thread by extending a Thread.

```
class MyThread extends Thread{  
    @Override  
    public void run(){  
        for(int i=0;i<10;i++)  
            System.out.println("child thread");  
    }  
}
```

defining a thread(writing a class and extending a Thread)  
job a thread(code written inside run())

```
class ThreadDemo{  
    public static void main(String... args){  
        MyThread t=new MyThread();//Thread instantiation  
        t.start();//starting a thread
```



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1\_12\_2022\_threads\_classmate - Notepad

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```
}  
} defining a thread(writing a class and extending a Thread)  
job a thread(code written inside run())
```

```
class ThreadDemo{
```

```
public static void main(String... args){
```

```
    MyThread t=new MyThread();//Thread instantiation  
    t.start();//starting a thread
```

```
    .... // At this line 2 threads are there
```

```
    for(int i=1;i<=5;i++)
```

```
        System.out.println("Main Thread");
```

```
    }
```

```
}
```

Behind the scenes

1. Main thread is created automatically by JVM.
2. Main thread creates child thread and starts the child thread.

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```
System.out.println("Main Thread");
```

```
}  
}
```

### Behind the scenes

1. Main thread is created automatically by JVM.
2. Main thread creates child thread and starts the child thread.

### ThreadScheduler

=====

If multiple threads are waiting to execute, then which thread will execute 1st is decided by ThreadScheduler which is part of JVM.

In case of MultiThreading we can't predict the exact output only possible output we can expect.

Since jobs of threads are important, we are not interested in the order of execution it should just execute such that performance should be improved.



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Directory Object Functions

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On

Whisper classes

Test.java

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```
1  
2  
3 //  
4 class Thread  
5 {  
6     //Heart of Multithreading  
7     public void start(){  
8         1. Register the thread with ThreadScheduler  
9         2. All other mandatory low level activities(memory level)  
10        3. invoke or call run() method  
11    }  
12    public void run()  
13    {  
14        //no implementation  
15    }  
16 }  
17 */  
18 class MyThread extends Thread  
19 {  
20     @Override  
21     public void run()  
22 }
```

Test.java

Java (.java)

Test.java

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Whisper classes

Test.java

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```
28 }
29 }
30
31 public class Test {
32     public static void main(String[] args){
33
34         MyThread t = new MyThread();
35
36         //This line will create a new Thread which is responsible to execute run().
37         t.start();
38
39
40 // 2 threads started and eagerly waiting for CPU time,scheduling is done by T.S
41
42 //task for main thread
43 for (int i = 1;i<=10;i++)
44 {
45     System.out.println("Main thread");
46 }
47 }
48 }
```



case2: diff b/w t.start() and t.run()

if we call t.start() and separate thread will be created which is responsible to execute run() method.

if we call t.run(), no separate thread will be created rather the method will be called just like normal method by main thread

if we replace t.start() with t.run() then the output of the program would be

1

```
child thread  
child thread  
child thread  
child thread  
child thread  
child thread  
child thread  
child thread  
child thread  
main thread  
main thread  
main thread  
main thread
```

22



### case3:: Importance of Thread class start() method

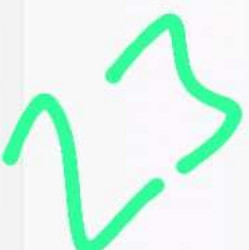
For every thread, required mandatory activities like registering the thread with ThreadScheduler will be taken care of by the Thread class start() method and programmer is responsible of just doing the job of the Thread inside run() method.

start() acts like an assistance to programmer.

```
{  
    register thread with ThreadScheduler  
    All other mandatory low level activities  
    invoke or calling run() method.  
}
```

I

We can conclude that without executing Thread class start() method there is no chance of starting a new Thread in java.  
Due to this start() is considered as heart of Multithreading.



We can conclude that without executing Thread class start() method there is no chance of starting a new Thread. Due to this start() is considered as heart of Multithreading.

case4:: If we are not overriding run() method

If we are not Overriding run() method then Thread class run() method will be executed which has empty implementation and hence we won't get any output.

eg::  
1

```
class MyThread extends Thread{}  
class ThreadDemo{  
    public static void main(String... args){  
        MyThread t=new MyThread();  
        t.start();  
    }  
}
```

It is highly recommended to override run() method, otherwise don't go for Multithreading concept.

24



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```
class Payload {  
    private int weight;  
    public Payload (int w) { weight = w; }  
    public void setWeight(int w) { weight = w; }  
    public String toString() { return Integer.toString(weight); }  
}  
  
public class TestPayload {  
    static void changePayload(Payload p) {  
        /* insert code */ //Line 12  
    }  
  
    public static void main(String[] args) {  
        Payload p = new Payload(200); // weight = 200  
        p.setWeight(1024); // weight = 1024  
        changePayload(p);  
        System.out.println("p is " + p);  
    }  
}
```

Which code fragment, inserted at the end of line 12, produces the output p is 420?

- A. p.setWeight(420);
- B. p.changePayload(420);
- C. p = new Payload(420);
- D. Payload.setWeight(420);



```
public class TestPayload {  
    static void changePayload(Payload p) {  
        p.setWeight(420);  
        /* insert code */ //line 12  
    }  
    public static void main(String[] args) {  
        Payload p = new Payload(200); // weight = 200  
        p.setWeight(1024); // weight = 1024  
        changePayload(p);  
        System.out.println("p is " + p);  
    }  
}
```

Which code fragment, inserted at the end of line 12, produces the output p is 420?

- A. p.setWeight(420);
- B. p.changePayload(420);
- C. p = new Payload(420);
- D. Payload.setWeight(420);
- E. p = Payload.setWeight(420);

Answer: A

26



```
int check = 4;  
if (check = str.length()) {  
    System.out.print(str.charAt(check -= 1) + ", ");  
} else {  
    System.out.print(str.charAt(0) + ", ");  
}  
}
```

and the invocation:

```
test("four");  
test("tee");  
test("to");
```

What is the result?

- A. f, t, t,
- B. f, e, o,
- C. Compilation fails.
- D. An exception is thrown at runtime.

Answer: C

1

3



Question

```
abstract class C1 {  
    public C1() { System.out.print(1); }  
}  
  
class C2 extends C1 {  
    public C2() { System.out.print(2); }  
}  
  
class C3 extends C2 {  
    public C3() { System.out.println(3); }  
}  
  
public class Ctest {  
    public static void main(String[] a) { new C3(); }  
}
```

What is the result?

- A. 3
- B. 23
- C. 32
- D. 123
- E. 321
- F. Compilation fails.
- G. An exception is thrown at runtime.

23



```
}  
class C2 extends C1 {  
    public C2() { System.out.print(2); }  
}  
class C3 extends C2 {  
    public C3() { System.out.println(3); }  
}  
public class Ctest {  
    public static void main(String[] a) { new C3(); }  
}
```

What is the result?

- A. 3
- B. 23
- C. 32
- D. 123
- E. 321
- F. Compilation fails.
- G. An exception is thrown at runtime.

Answer: D

1



Given:

```
class One {  
    public One foo() {  
        return this;  
    }  
}  
  
class Two extends One {  
    public One foo() {  
        return this;  
    }  
}  
  
class Three extends Two {  
    // insert method here  
}
```

1

OK

Which two methods, inserted individually, correctly complete the Three class? (Choose two.)

- A. public void foo() {}
- B. public int foo() { return 3; }
- C. public Two foo() { return this; }
- D. public One foo() { return this; }
- E. public Object foo() { return this; }



```
        return this;
    }

    class Two extends One {
        public One foo() {
            return this;
        }
    }

    class Three extends Two {
        // insert method here
    }
}
```

Which two methods, inserted individually, correctly complete the Three class? (Choose two.)

- A. public void foo() {} 1
- B. public int foo() { return 3; }
- C. public Two foo() { return this; }
- D. public One foo() { return this; }
- E. public Object foo() { return this; }

Answer : D



5

```
class Two extends One {  
    public One foo() {  
        return this;  
    }  
}
```

```
class Three extends Two {  
    // insert method here  
}
```

Which two methods, inserted individually, correctly complete the Three class? (Choose two.)

- A. public void foo() {}
- B. public int foo() { return 3; }
- C. public Two foo() { return this; }
- D. public One foo() { return this; }
- E. public Object foo() { return this; }

Answer : C,D

Parent

| => IS-A relationship

Child

Covariant return types

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Q Search

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Q>

Given:

```
public interface A { public void m1(); }
```

```
class B implements A { } //CE
```

```
class C implements A { public void m1() { } }
```

```
class D implements A { public void m1(int x) { } } //CE
```

```
abstract class E implements A { }
```

```
abstract class F implements A { public void m1() { } }
```

```
abstract class G implements A { public void m1(int x) { } }
```

What is the result?

- A. Compilation succeeds.
- B. Exactly one class does NOT compile.
- C. Exactly two classes do NOT compile.
- D. Exactly four classes do NOT compile.

3



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```
class D implements A { public void m1(int x) {} } //CE
```

```
abstract class E implements A {}
```

```
abstract class F implements A { public void m1() {} }
```

```
abstract class G implements A { public void m1(int x) {} }
```

What is the result?

- A. Compilation succeeds.
- B. Exactly one class does NOT compile.
- C. Exactly two classes do NOT compile.
- D. Exactly four classes do NOT compile.
- E. Exactly three classes do NOT compile.

Answer: C

34



Answer: C

Q>

Given:

1. class TestA {
2.   public void start() { System.out.println("TestA"); }
3. }
4. public class TestB extends TestA {
5.   public void start() { System.out.println("TestB"); } //overriden method
6.   public static void main(String[] args) {
7.     ((TestA)new TestB()).start();
8.   }
9. }

What is the result?

- A. TestA
- B. TestB
- C. Compilation fails.
- D. An exception is thrown at runtime.

Answer: B

I

55



Given:

```
class Line {  
    public class Point {  
        public int x, y;  
    }  
    public Point getPoint() {  
        return new Point();  
    }  
}  
class Triangle {  
    public Triangle() {  
        // insert code here line 16  
        Line.Point p = new Line().getPoint();  
    }  
}
```

36

Which code, inserted at line 16, correctly retrieves a local instance of a Point object?

- A. Point p = Line.getPoint();
- B. Line.Point p = Line.getPoint();
- C. Point p = (new Line()).getPoint();
- D. Line.Point p = (new Line()).getPoint();



```
public int x, y;  
}  
public Point getPoint() {  
    return new Point();  
}  
}  
class Triangle {  
    public Triangle() {  
        // insert code here line 16  
    }  
}
```

5

Which code, inserted at line 16, correctly retrieves a local instance of a Point object?

- A. Point p = Line.getPoint();
- B. Line.Point p = Line.getPoint();
- C. Point p = (new Line()).getPoint();
- D. Line.Point p = (new Line()).getPoint()

Answer: D

