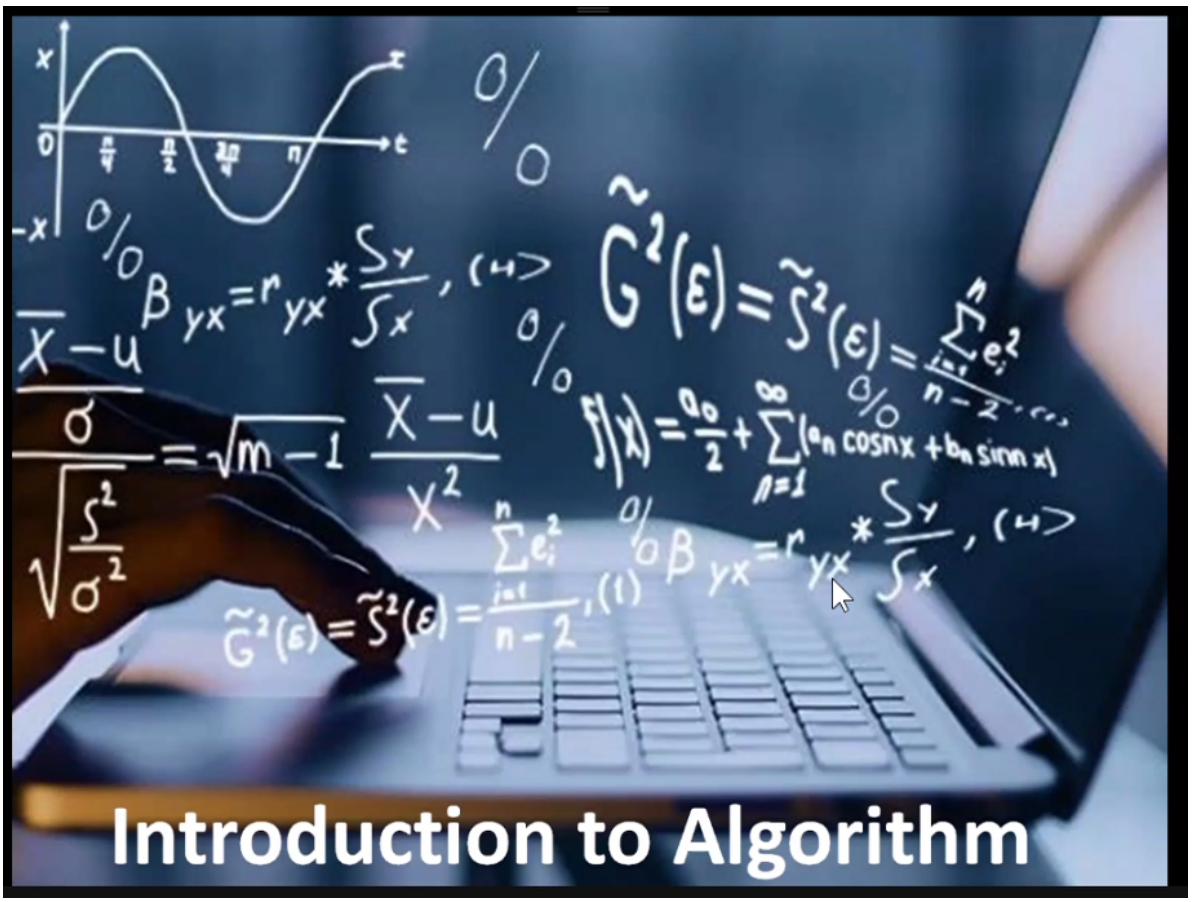
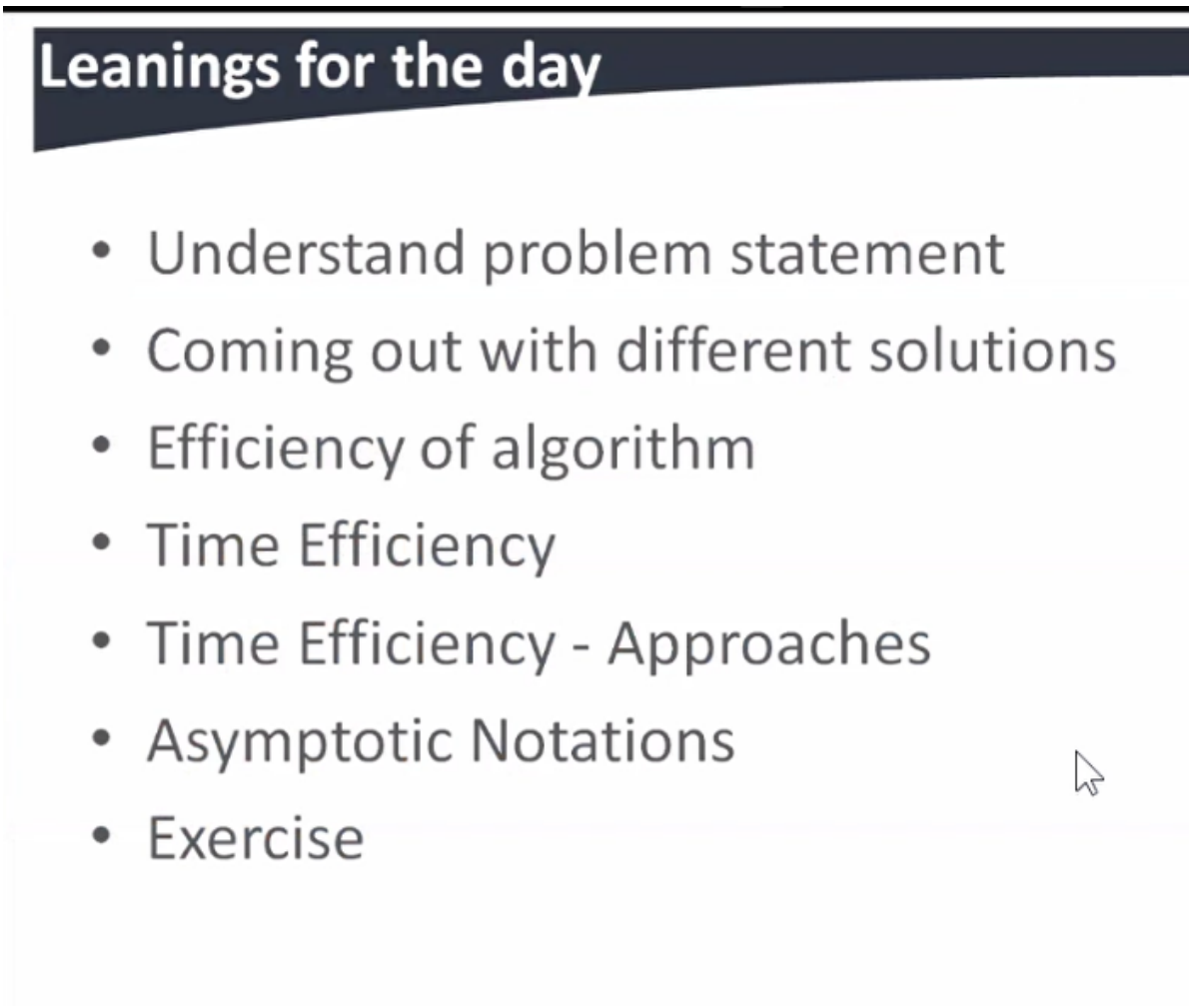
Introduction to algorithm

Date =19 -10-21 day7

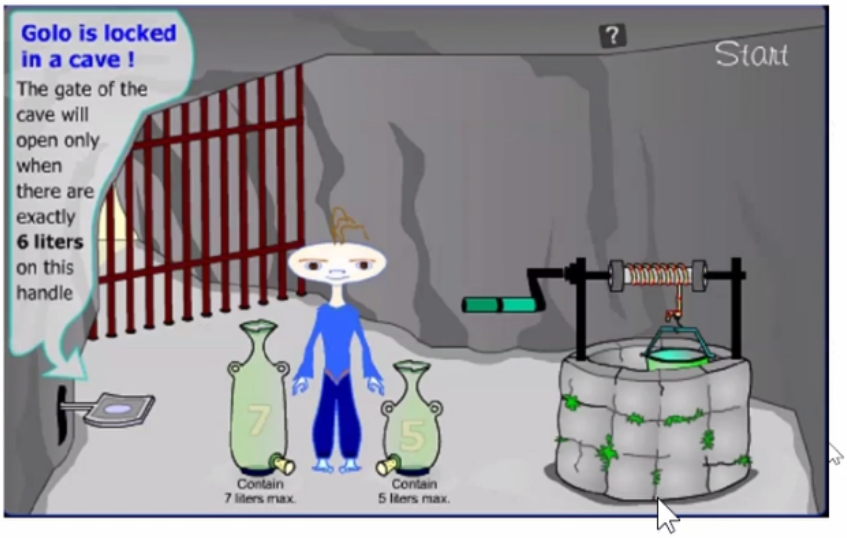




What is Optimization ?

Reducing Time and Space Complexity

Problem Statement



Our friend is struck in a cave and need our help to come out. He needs 6 liters of water in 7 liters of container.

NOTE:

> We can fetch water from well and transfer water to any container.

> We can transfer water from any container and we can empty the container at any time.

Solution 1

1. Transfer water from well to 5 liter container
2. Transfer water from 5 liter container to 7 liter container
3. Transfer water from well to 5 liter container
4. Transfer water from 5 liter container to 7 liter container
5. Empty 7 liter container
6. Transfer water from 5 liter container to 7 liter container
7. Transfer water from well to 5 liter container
8. Transfer water from 5 liter container to 7 liter container
9. Empty 7 liter container
10. Transfer water from well to 5 liter container
11. Transfer water from well to 5 liter container
12. Transfer water from 5 liter container to 7 liter container

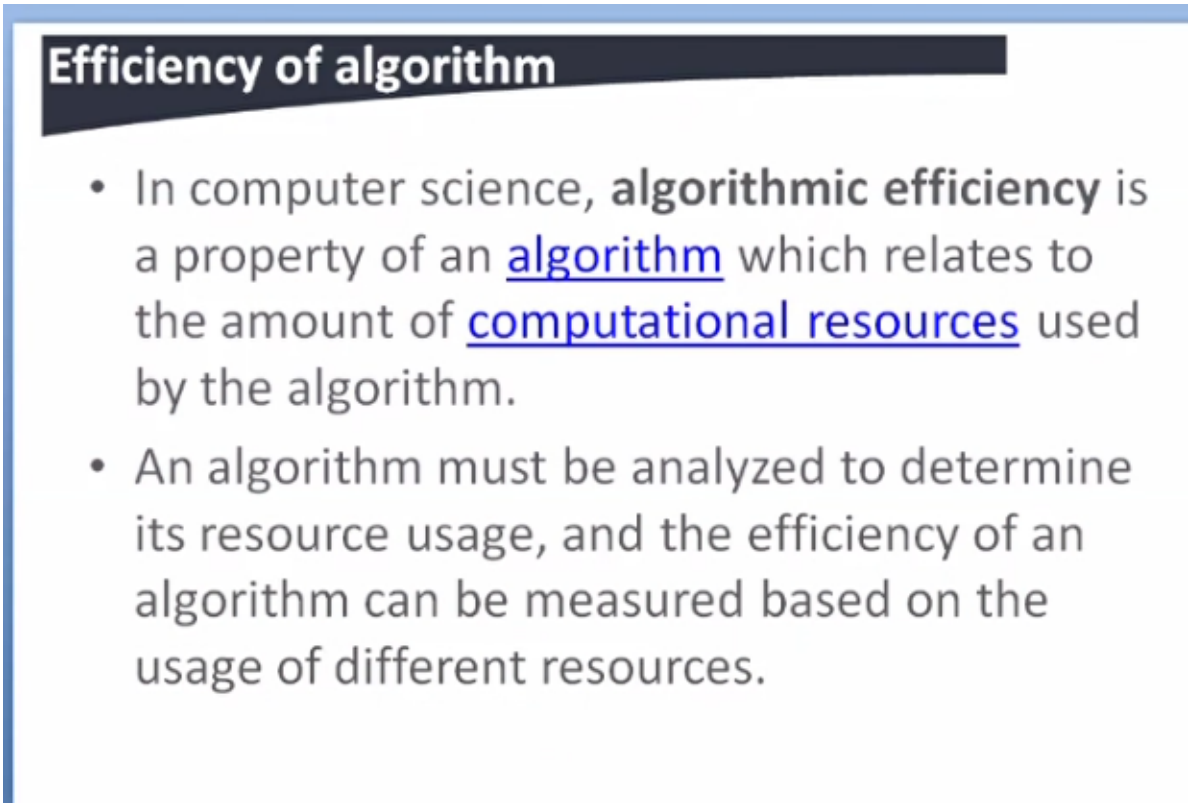
7 liter container	5 liter container
0	5
5	0
5	5
7	3
0	3
3	0
3	5
7	1
0	1
1	0
1	5
6	0

Solution 2

1. Transfer water from well to 7 liter container
2. Transfer water from 7 liter container to 5 liter container
3. Empty 5 liter container
4. Transfer water from 7 liter container to 5 liter container
5. Transfer water from well to 7 liter container
6. Transfer water from 7 liter container to 5 liter container
7. Empty 5 liter container
8. Transfer water from 7 liter container to 5 liter container
9. Transfer water from well to 7 liter container
10. Transfer water from 7 liter container to 5 liter container

7 liter container	5 liter container
7	0
2	5
2	0
0	2
7	2
4	5
4	0
0	4
7	4
6	5

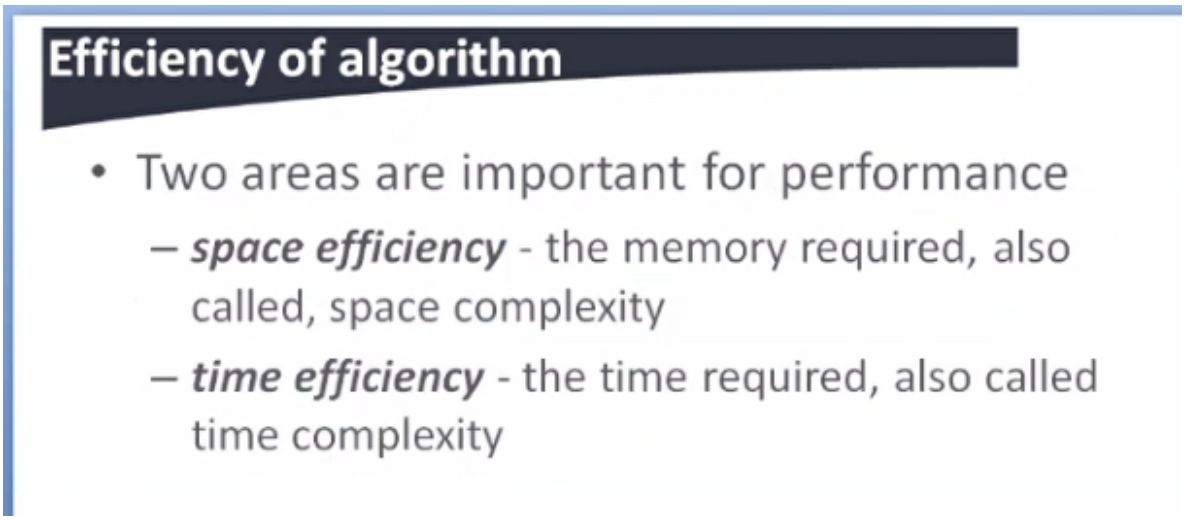
Here this problem has 2 solutions but the 2nd one is optimized it take less steps
So,always focus on optimized code

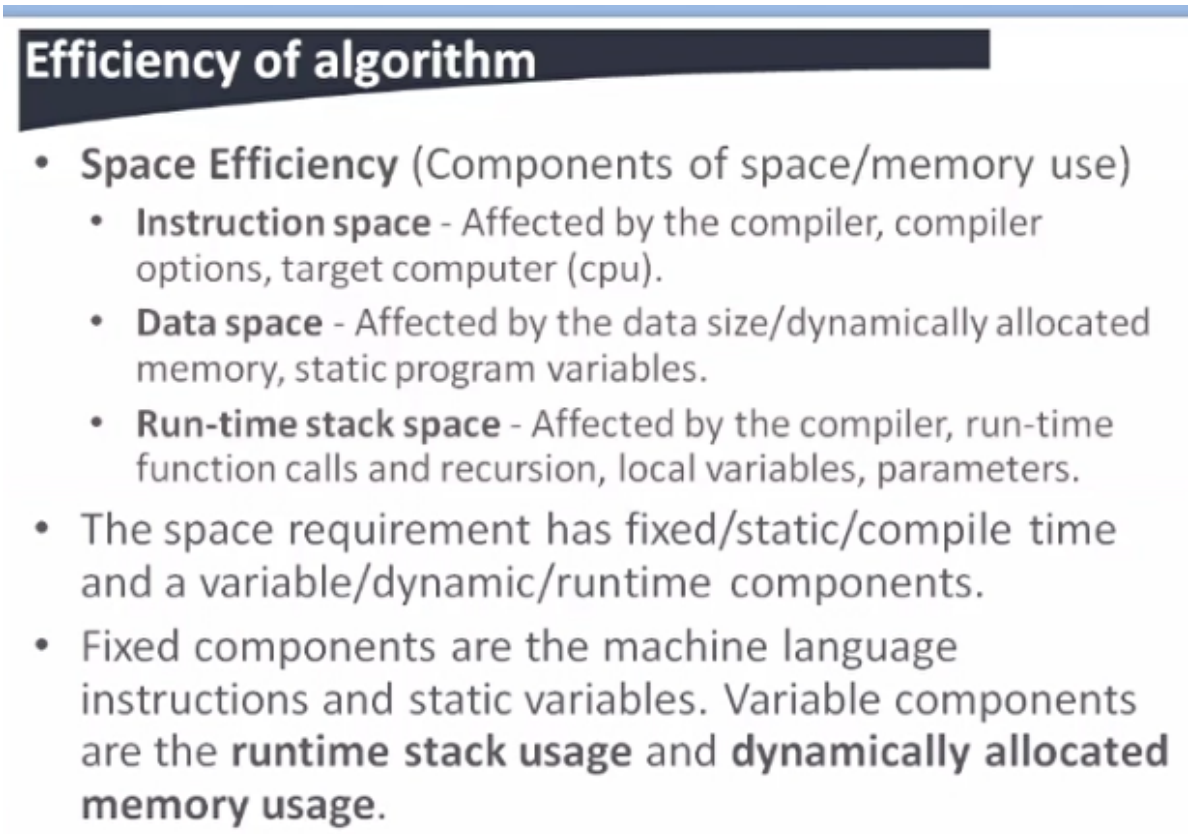


Algorithm is used to solve a particular problem ,so that particular problem can be any thing
So i have to go indore so 1st i analyse that how far it is acc to this
which vehicle should it take if bike is not starting so i take ola
(So i think how to go with particular step to find the solution) thats called my algorithm **Algorithm is step by step procedure to find the solution**

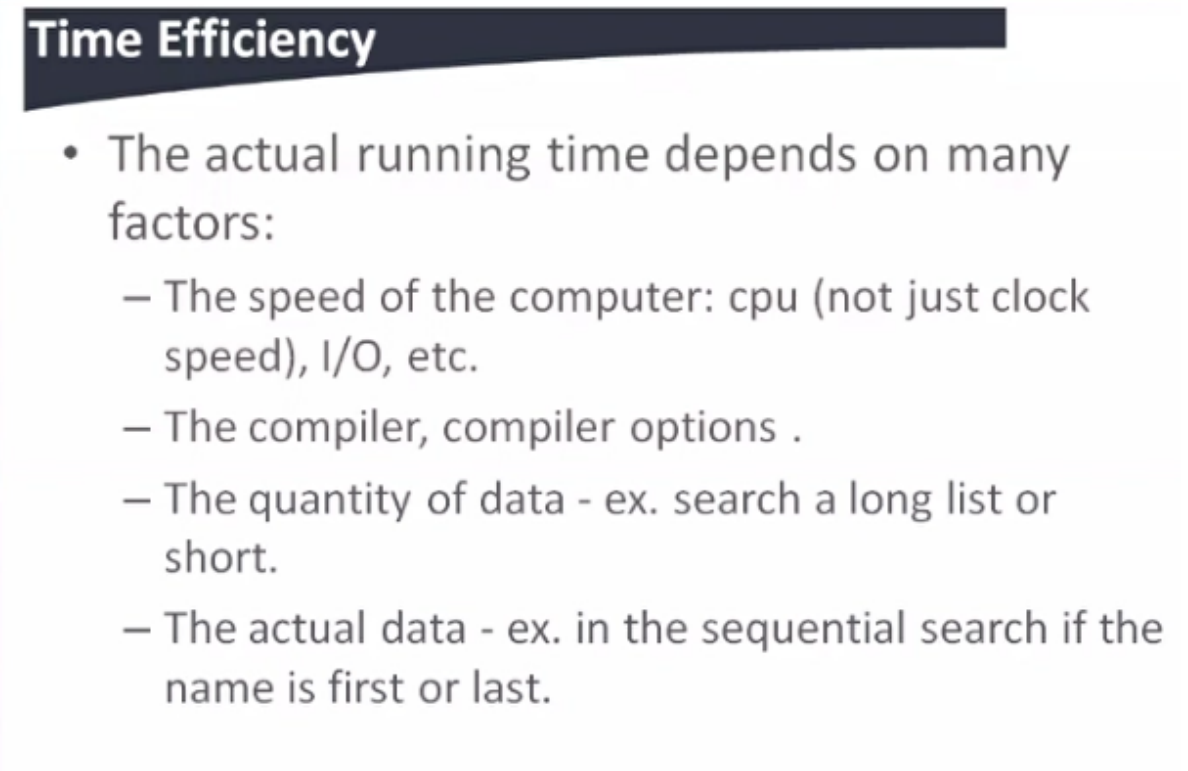
so when ever you write a particular algorithm so make sure that you always think

for 2 most important things --------**time and space complexity**--------

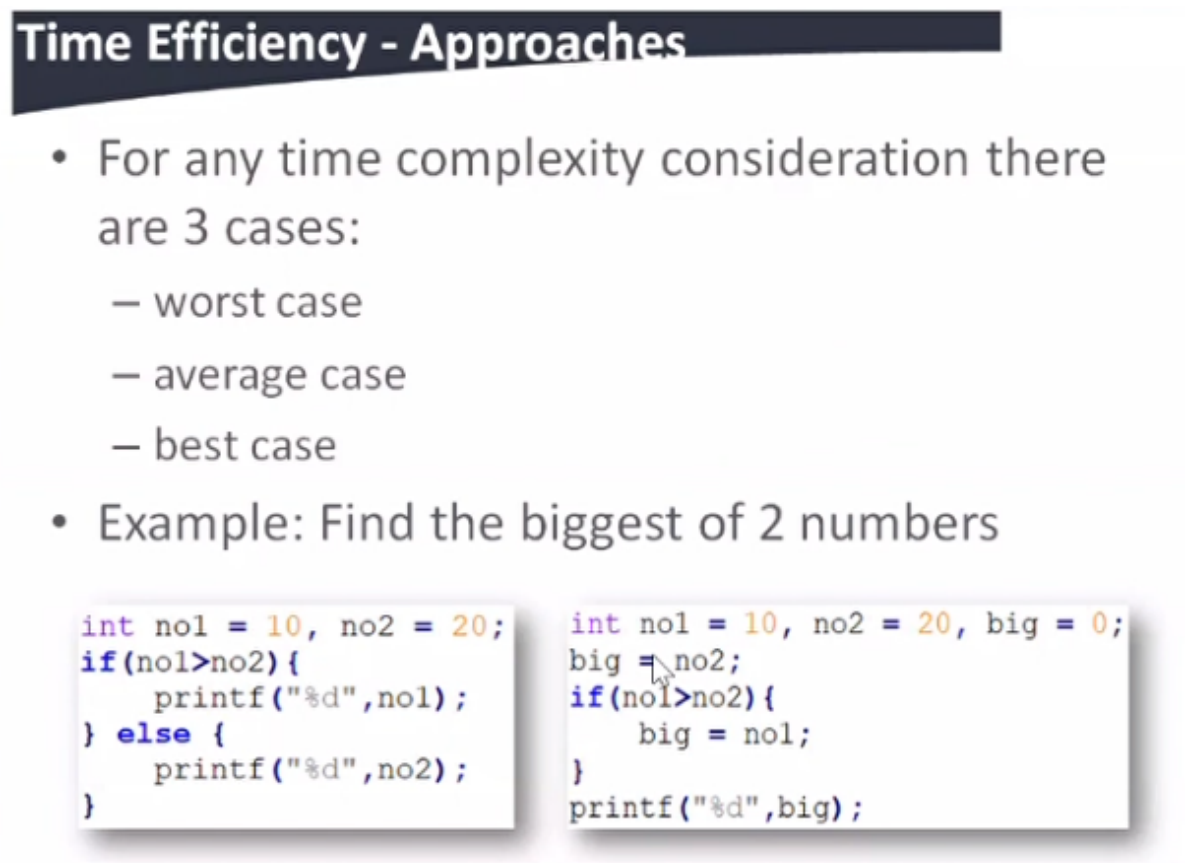




In space complexity we talk about how to reduce the space



Always search that can you still write a efficient code for this solution



For Example that this is the code to find the biggest of 2 number

Solution 1 we have written without using the third variable but we have a else statement here

this is process overhead you have one more additional statement to execute

but where as you come down in

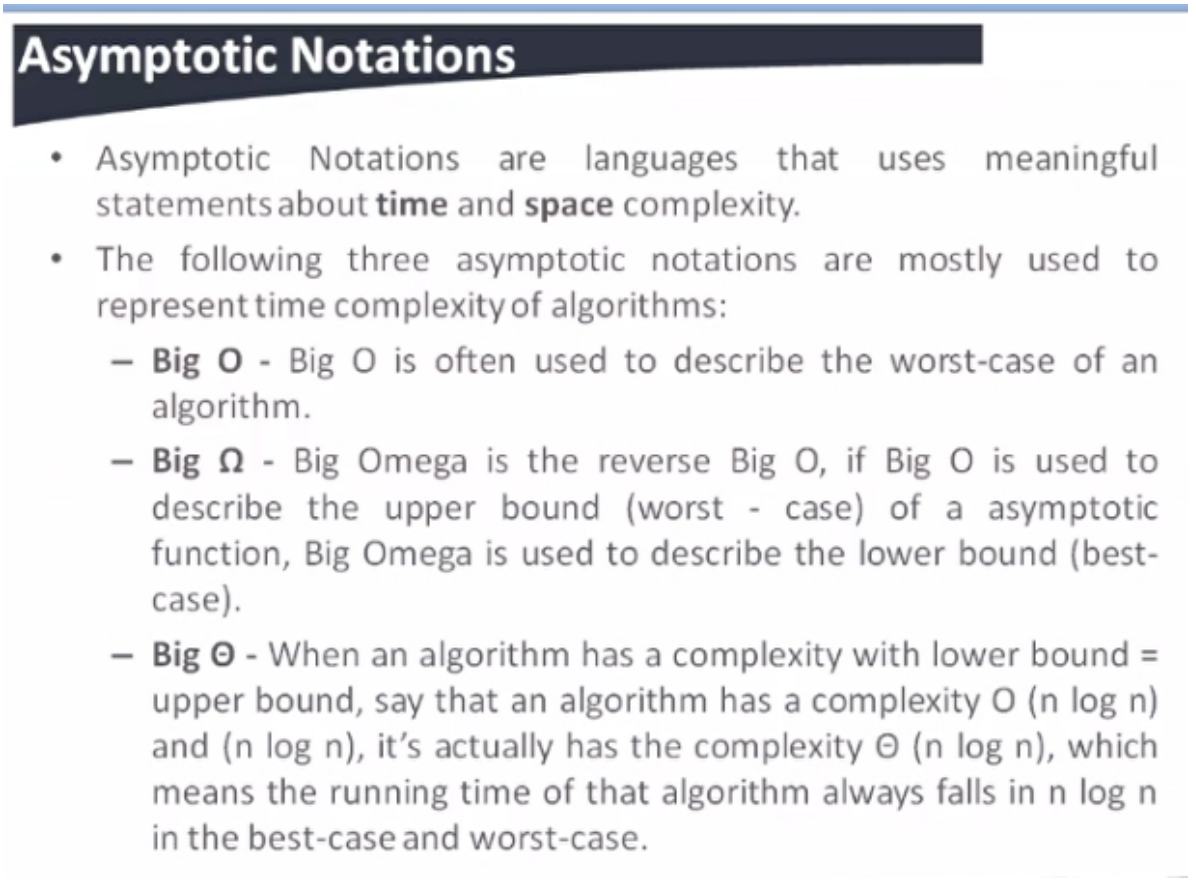
Solution 2 so we have a additional one more variable but here i don't have any else statement

and this particular variable will be a local variable and it will loose its value as soon as program control comes to this particular block

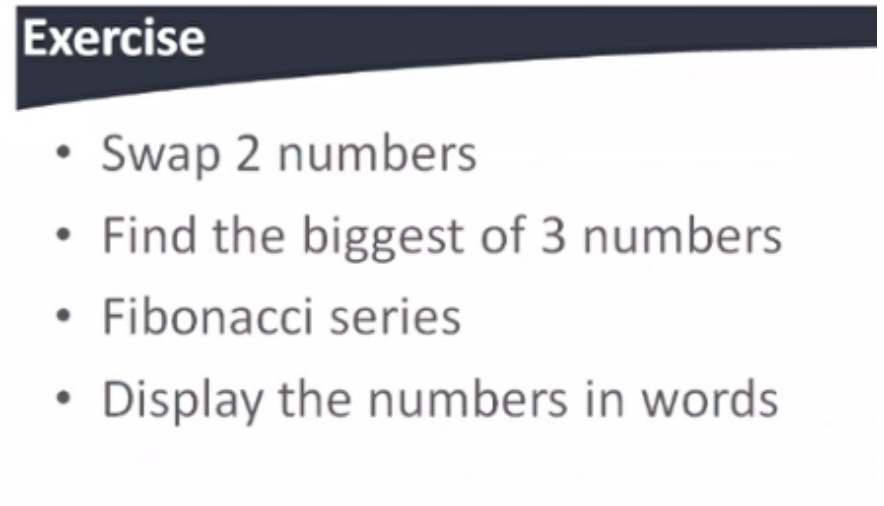
so no doubt i am taking a additional variable here but still i am playing safe

so this is how you need to think that what is the worst senario what is the best senario

and what is better to use so keep thinking about all this things **thats very imp**

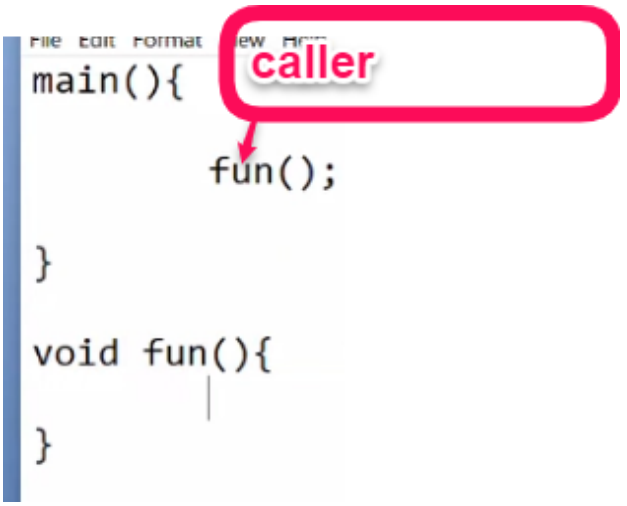


Assignment 1 :- write the below programs in C#



swap 2 no

```
using System;

public class HelloWorld
{
    public static void Main(string[] args)
    {
        int no1 = 10, no2 = 20, big = 0;
        big= no2;
        if(no1>no2)
        {
            big = no1;
        }
        Console.WriteLine(big);
    }
}
```

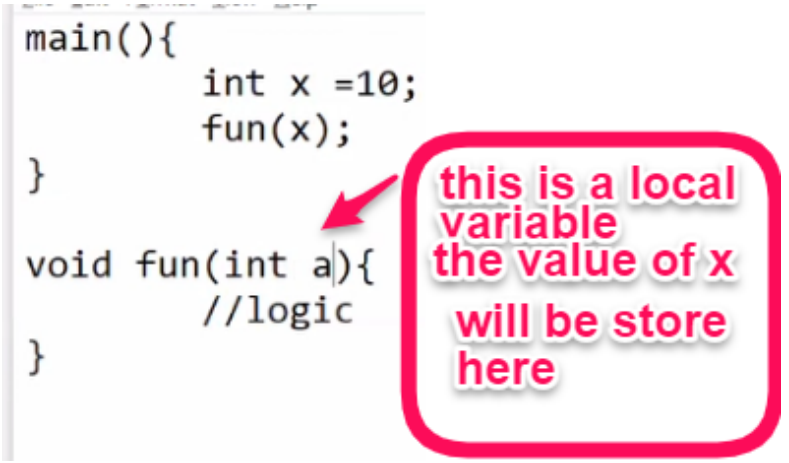


When ever you have a caller and he is not passing any parameter

in this case my function defination would be **void**

void is a return type ,it says that this function is not passing any value

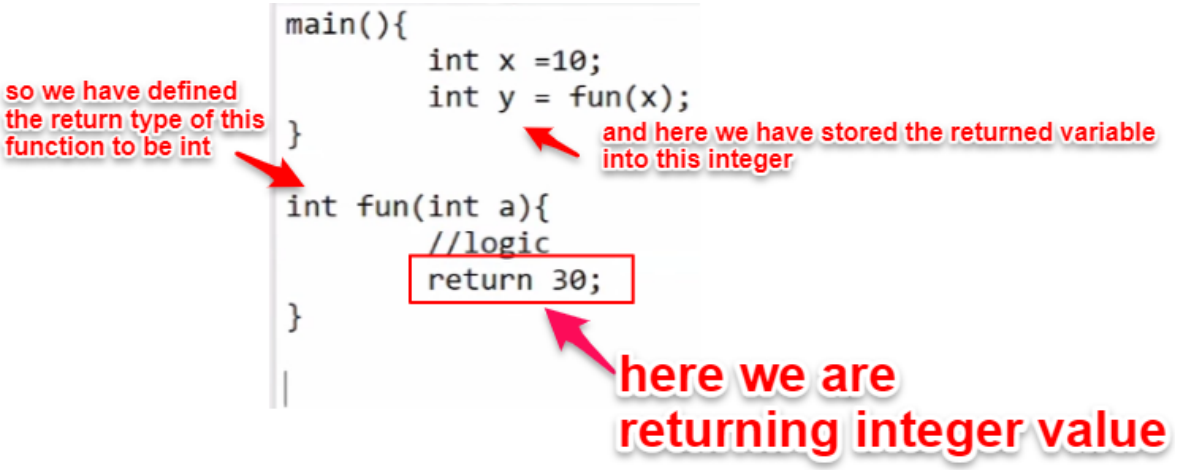
it is not returning anything to the caller ,Who is the caller----Main.



this is local variable so it can be accessed inside this fun() only outside this

function we cant access this variable int a

and inside main we are calling this variable passing this value x which can be stored inside a you are passing integer value so here it should have a integer variable




```
main(){
        int x =10;
        int y = fun(x);
}

int fun(int a){
        //logic
        return 30;
}
```

```
main(){
        fun();
}

void fun(){
        int x = 10;
        int res = fun2(x);
        print("In fun %d", res);
}

int fun2(int x){
        print("In fun2 %d",x);
        return x++;
}
```

What is the output of this function?

In fun2 10

In fun 30

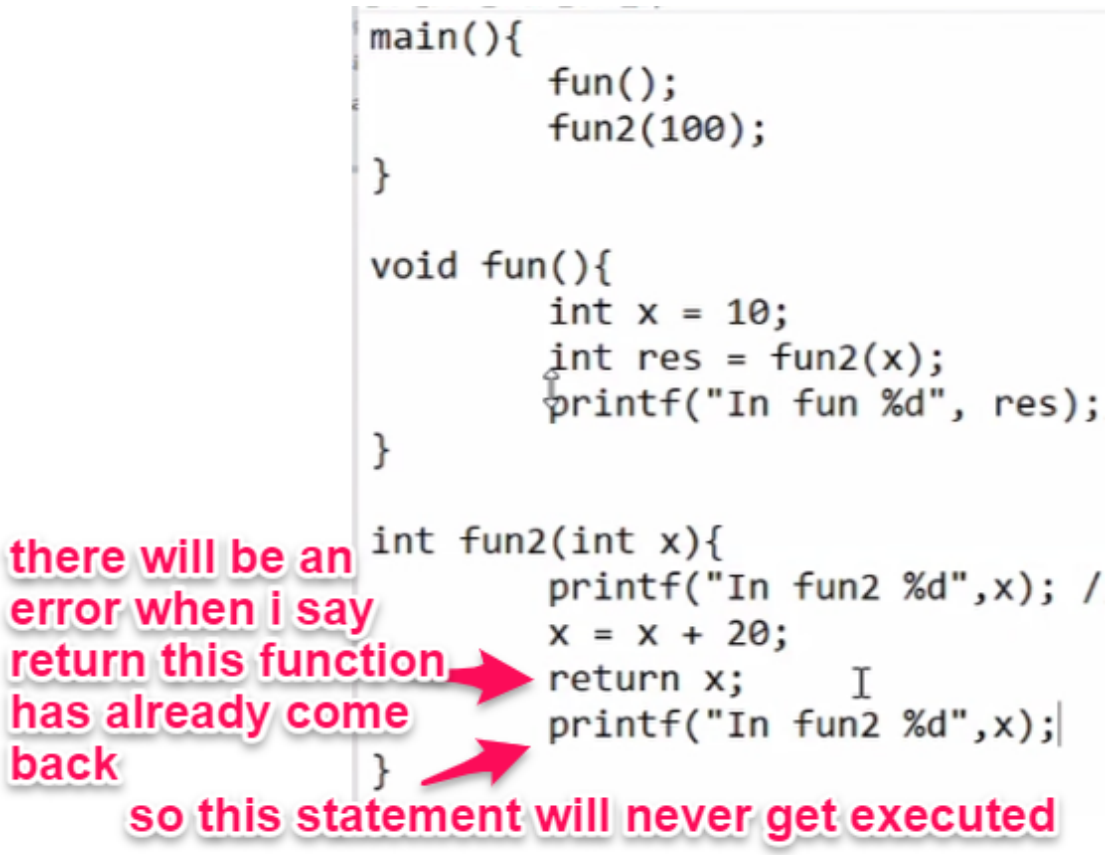
```
main(){
        fun();
        fun2(100);
}

void fun(){
        int x = 10;
        int res = fun2(x);
        print("In fun %d", res);//In fun 30
}

int fun2(int x){
        print("In fun2 %d",x); //In fun2 10
        x = x + 20;
        return x;
}
```

What is the output of this code

In fun2 10

In fun 30

In fun2 100



The statement after the return statement will never gets executed

so you should not write any program or statement after the return statement

```
main(){
        fun();
        fun2(100);
}

void fun(){
        int x = 10;
        int res = fun2(x);
        printf("In fun %d", res);
}

int fun2(int x){
        printf("In fun2 %d",x); /
        x = x + 20;
        if(x > 30)
                return x;
        printf("In fun2 %d",x);
        return x;
}
```

if this condition has a return so it will give an error because of the else part

output is

In fun2 10

In fun2 30

In fun 30

In fun 2 100

```
main(){
        fun();
        fun2(100);
}

void fun(){
        int x = 10;
        int res = fun2(x);
        printf("In fun %d", res);
}

int fun2(int x){
        printf("In fun2 %d",x); /
        x = x + 20;
        if(x > 30)
                break;
        printf("In fun2 %d",x);
        return x;
}
```

this is a compilation error

we cannot use break directly until and unless break can be use only with loops or switch

Break can be used only with loops and switch

So, Any program you write you should always put a function ,

Whats a difference between in a function and a method

if you define a particular class and inside the class

if you write a function so those are called as **methods**

we called them as a member method they are the part of member

In C , java script we usually called it as a **function** but in C# or in C++ or in java we called them as a method

Java Script is object based programming it is not object oriented

So if java script if you write a particular object and inside that if you write a

particular method then we call it as a method we'll not call it as a function
both works in a same way

```
main(){
        int x = 10, y = 20;
        swap(x,y);
}
```

Here in c we call it as a function

```
class MyClass{

        void Swap(int x, int y)
        {

        }
}
```

In C++ or in java or C# we put everything inside the class
and inside this we write a particular function so in the class they are not called as a function they are called as a member methods

```
main(){
        int x = 10, y = 20;
        swap(x,y);
}


void swap(int x, int y)
{
        int temp = x;
        x = y;
        y = temp;
        printf("X = %d Y = %d",x,y);
}
```

When you write a code so you should there are 2 most important things what you should always follow

When ever we could push any piece of code to the production it will be thorolly tested ,so you should always do this

once you are on floor You will go with a **peer review** (your peer can be your friend how gone to review your piece of code

so if your peer is your senior may be Team Lead so if you go to your TL with this piece of code)

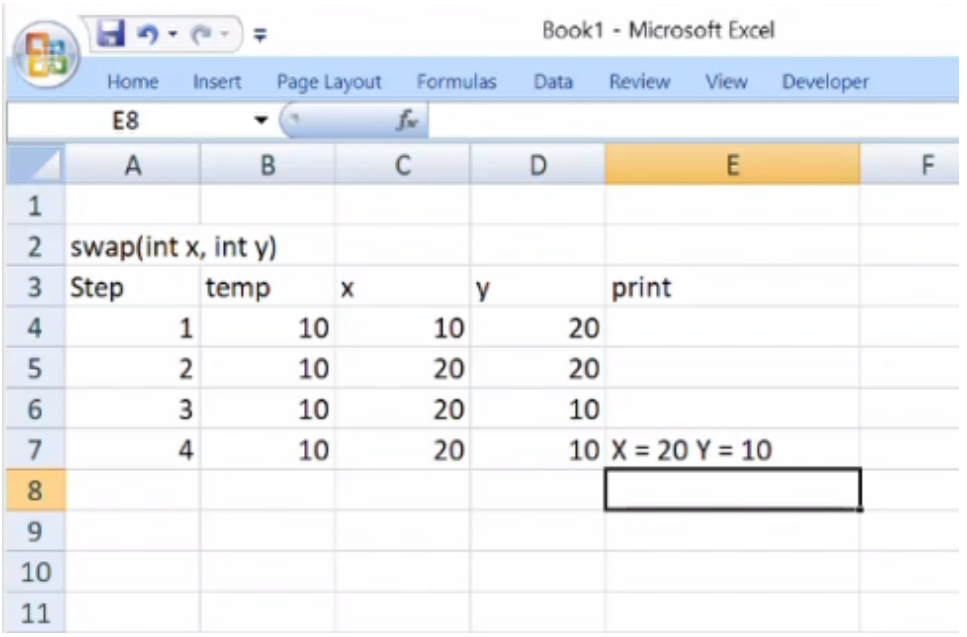
So 1st thing what they do is they gone to just keep seeing this

if somebody comes to me and they have written this piece of code so in my brain i draw a small x and y boxes

and i put 3 variable temp ,x and y and i'll calculate this
so for you to practice this what you have to do is
you have 3 variables na so put them in excel sheet

1st DRY Run :-When ever you write any program so you should understand

------How it Works -----



	A	B	C	D	E	F
1						
2	swap(int x, int y)					
3	Step	temp	x	y	print	
4	1	10	10	20		
5	2	10	20	20		
6	3	10	20	10		
7	4	10	20	10	X = 20 Y = 10	
8						
9						
10						
11						

this is called dry run
run function put steps make changes in variable and see output

Apart from this solution for swapping 2 numbers do you have any other solution

```
Soln 2
     x = x + y;
     y = x - y;
     x = x - y;
```

Dry run for this is :

Step	x	y	print
1	30	20	
2	30	10	
3	20	10	
4			X = 20 Y = 10

So, Which is better solution 1 or 2

1st is better because it is straight away assigning it but here we are taking an
extra variable so if you go with the solution 2 we can save this space
so performance wise 1st is better
But when talk about space complexity 2nd solution would be better

2nd Testing

We gone to write test cases here

Test Case	X	Y	TR
TC1	30	20	P
TC2	10	30	P
TC3	-10	30	
TC4	-10	-30	
TC5	0	-10	
TC6			

here we are giving different possible values what our end user can give to our program
and perform the dry run with each test case like in tc1 value of x is 30 and y is 20 to ye leke hum
dry run karenge next me x=10 and y=30 and .....soon
tester will put all this nonsense data and they will test it

```
x = x * y;
y = x / y;
x = x / y;
```

perform dry run on this solution with this testcases and check weather it works or not

Test Case	X	Y	TR
TC1	30	20	P
TC2	10	30	P
TC3	-10	30	
TC4	-10	-30	
TC5	0	-10	
TC6			

So the test case 5 fails here in this solution when we put x=0 and y=-10 and run this solution
we are not getting the desired output
So ,any code you write you should 1st think ok what are the test cases i can write and please test

against them

that weather this piece of code will work or not

so this will help you in TDD(Test Driven Development)

in TDD we first write all the test cases and against those test cases we will write the logic