Case study -I

Determine wether X is a prime number or not.

Solution-1:

Algorithm:

```
if (X==1) || (X==2)
        print → "X is a prime number";

for(int i =2; i<X; i++)
{   if (X%i==0)
        { print → "X is not a prime
                        number";
            return; }}}
        print → "X is a prime number"; }
```

Let X = 31

prime (x) = search space

= 2 to 30

Time complexity:

Best case : a) X is an even number

b) $\Omega(\cdot) = 1$

Worst case: a) X is a prime number

b) $O(\cdot) = X$

Solution - 2:

Algorithm:

```
if (X==1)||(X==2)
    { print -> "X is a prime number";
      return ; }

    for (i=2; i<=(X/2); i++)
        { if (X%i==0)
            {print -> "X is not a prime
                            number"
              return; }}

            print -> "X is a prime
                            number"; }
```

let   X=31

prime (X) = Search space

= 2 to 15

Search space is reduced to half
in solution 2 as compared to solution
1.

Time complexity:

Best case : a) X is an even number

b) $\Omega(\cdot) = 1$

Worst case : a) X is a prime number

b) $O(\cdot) = (X/2)$

Solution -3:

Algorithm:

```
if ((X==1) || (X==2))
        print → "X is a prime number"
        return;

if (X%2 == 0)
        print → "X is not a prime
                number. In fact, X is
                an even number";

        return;

for (i=3; i<=(X/2); i=i+2)
        if (X%i==0)
        print → "X is not a prime
                number";
        return;
```

Print ⟶ " X is a prime number";
   return;

X = 31

prime (X) = search space

prime (X) = 3, 5, 7, 9, 11, 13, 15

In solution 3, the half remaining solution search space of
2 is further reduced by removing
the even numbers from it.

Time complexity:

Best case: a) X is an even number
              or equal to 1 or 2

          b) $\Omega(\cdot) = 1$

worst case: a) X is a prime number

          b) $O(\cdot) = (X/4)$

Conclusion:
     Solution 2 is twice faster
     then solution 1.
          $Sol_2 = 2 \times Sol_1$
     Solution 3 is two times faster

than solution 2, and four times faster than solution 1

$$Sol_3 = 2 \times Sol_2$$

$$Sol_3 = 4 \times Sol_1$$