

MUHAMMAD UMAR KHAN 10619
NUMERICAL COMPUTING LAB#03

Question 01:

```
def f(x):  
    return x**2-2
```

```
def bisection(a,b,tol):  
    itera = 0  
    print('Iterations a b mid f(a) f(b) f(mid) PRE')  
    while(abs(a-b)>=tol):  
        mid = (a+b)/2  
        prod = f(a)*f(mid)  
        if prod > tol:  
            a = mid  
        else:  
            if prod < tol:  
                b = mid  
        itera += 1  
        print(itera, a, b, mid, f(a), f(b), f(mid), ((abs(a-b)/a)*100))  
    return mid
```

```
res = bisection(1,2,0.001)
```

OUTPUT:

```
Iterations a b mid f(a) f(b) f(mid) PRE  
1 1 1.5 1.5 -1 0.25 0.25 50.0  
2 1.25 1.5 1.25 -0.4375 0.25 -0.4375 20.0  
3 1.375 1.5 1.375 -0.109375 0.25 -0.109375 9.090909090909092  
4 1.375 1.4375 1.4375 -0.109375 0.06640625 0.06640625 4.545454545454546  
5 1.40625 1.4375 1.40625 -0.0224609375 0.06640625 -0.0224609375 2.222222222222223  
6 1.40625 1.421875 1.421875 -0.0224609375 0.021728515625 0.021728515625 1.1111111111111112  
7 1.40625 1.4140625 1.4140625 -0.0224609375 -0.00042724609375 -0.00042724609375 0.5555555555555556  
8 1.40625 1.41015625 1.41015625 -0.0224609375 -0.0114593505859375 -0.0114593505859375 0.2777777777777778  
9 1.40625 1.408203125 1.408203125 -0.0224609375 -0.016963958740234375 -0.016963958740234375 0.1388888888888889  
10 1.40625 1.4072265625 1.4072265625 -0.0224609375 -0.019713401794433594 -0.019713401794433594 0.06944444444444445
```

QUESTION 02 & 03:

CODE FOR ONE QUESTION

```
def f1(x):
    return x**3-x-1
```

```
print('LOWER LIMIT IS: {0} & UPPER LIMIT IS: {1} '.format(f1(0), f1(2)))
```

LOWER LIMIT IS: -1 & UPPER LIMIT IS: 5

```
def bisection(a,b,tol):
    itera = 0
    while(abs(a-b)>=tol):
        mid = (a+b)/2
        prod = f1(a)*f1(mid)
        if prod > tol:
            a = mid
        else:
            if prod < tol:
                b = mid
            itera += 1
    return mid,itera
```

Lower Limit Is 0 and Upper Limit Is 2

```
res, itera=bisection(0,2,0.01)
```

```
print("Bisection method gives root at {0} in {1} iterations".format(res, itera))
```

Bisection method gives root at 1.3203125 in 8 iterations

TABLE

Serial No	Function	Intervals	Tolerance	Number of Iterations	Root
1	$x^3 - x - 1 = 0$	0 -- 2	0.01	8	1.3203125
			0.001	11	1.3173828125
			0.00001	18	1.3242263793945312
2	$x^3 + 1 = 0$	-2 -- 2	0.01	9	-1.0234375
			0.001	12	-1.0068359375
			0.00001	19	-1.0009689331054688
3	$x^2 - 3 = 0$	1 -- 2	0.01	7	1.7109375
			0.001	10	1.7236328125
			0.00001	17	1.7314529418945312
4	$x^3 + 4x^2 - 10 = 0$	0 -- 2	0.01	8	1.3671875
			0.001	11	1.3642578125
			0.00001	18	1.3650588989257812