

Problem 1 Script + Output:

```
import numpy as np

# imported bisection method from class example
# with added print statements at each iteration
# and tolerance checking for relative error
# instead of absolute error

def driver():
    # function declaration
    f = lambda x: 2 * x - 1 - np.sin(x)

    # endpoints for parts a,b,c
    a = 0
    b = np.pi / 2

    # tolerance for 8 correct digits
    tol = 0.5 * 10**-8

    print("(1):\n")
    [astar, ier] = bisection(f, a, b, tol)
    print("the approximate root is", astar)
    # print("the error message reads:", ier)
    print("f(root) =", f(astar))
    print("\n")

    return
```

(1):

iteration: 1		curr_root = 1.1780972450961724
iteration: 2		curr_root = 0.9817477042468103
iteration: 3		curr_root = 0.8835729338221293
iteration: 4		curr_root = 0.9326603190344698
iteration: 5		curr_root = 0.9081166264282996
iteration: 6		curr_root = 0.8958447801252145
iteration: 7		curr_root = 0.889708856973672
iteration: 8		curr_root = 0.8866408953979006
iteration: 9		curr_root = 0.8881748761857863
iteration: 10		curr_root = 0.8874078857918435
iteration: 11		curr_root = 0.8877913809888149
iteration: 12		curr_root = 0.8879831285873006
iteration: 13		curr_root = 0.8878872547880577
iteration: 14		curr_root = 0.8878393178884363
iteration: 15		curr_root = 0.887863286338247
iteration: 16		curr_root = 0.8878513021133416
iteration: 17		curr_root = 0.8878572942257943
iteration: 18		curr_root = 0.8878602902820206
iteration: 19		curr_root = 0.8878617883101338
iteration: 20		curr_root = 0.8878625373241904
iteration: 21		curr_root = 0.8878621628171621
iteration: 22		curr_root = 0.8878623500706763
iteration: 23		curr_root = 0.8878622564439191
iteration: 24		curr_root = 0.8878622096305406
iteration: 25		curr_root = 0.8878622330372299
iteration: 26		curr_root = 0.8878622213338853
iteration: 27		curr_root = 0.8878622154822129
iteration: 28		curr_root = 0.8878622125563768

Number of iterations: 28

the approximate root is 0.8878622125563768
f(root) = 1.3490933925552895e-09

Problem 2 Output:

(2):

normal version (part a):

iteration:	1		curr_root =	4.915
iteration:	2		curr_root =	4.9625
iteration:	3		curr_root =	4.98625
iteration:	4		curr_root =	4.998125
iteration:	5		curr_root =	5.0040625
iteration:	6		curr_root =	5.00109375
iteration:	7		curr_root =	4.999609375
iteration:	8		curr_root =	5.000351562500001
iteration:	9		curr_root =	4.9999804687500005
iteration:	10		curr_root =	5.000166015625
iteration:	11		curr_root =	5.000073242187501

Number of iterations: 11

the approximate root is 5.000073242187501

$f(\text{root}) = 6.065292655789404e-38$

expanded version (part b):

iteration:	1		curr_root =	5.105
iteration:	2		curr_root =	5.1525
iteration:	3		curr_root =	5.12875

Number of iterations: 3

the approximate root is 5.12875

$f(\text{root}) = 9.721317766824793e-09$

Problem 3 Output:

(3):

approximation:

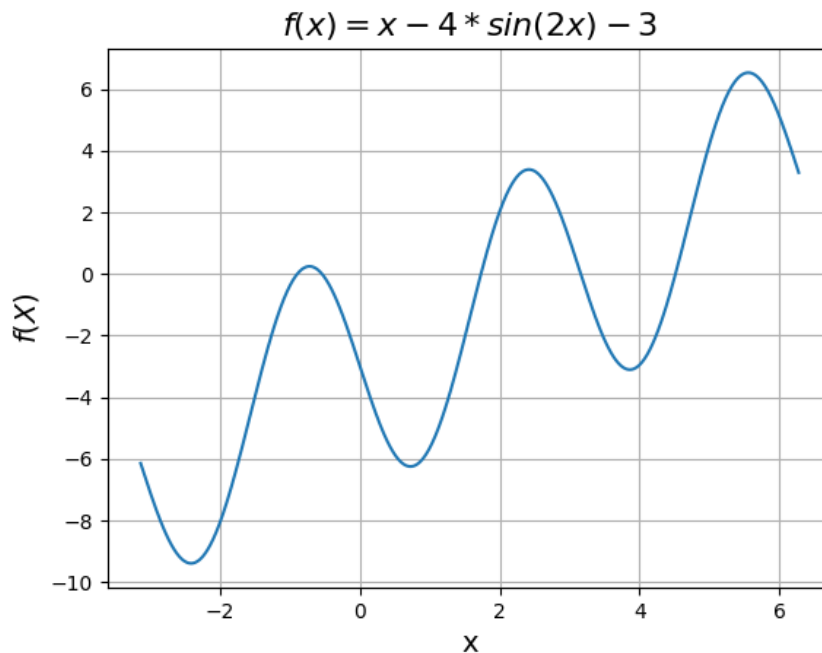
iteration:	1		curr_root =	1.75
iteration:	2		curr_root =	1.375
iteration:	3		curr_root =	1.5625
iteration:	4		curr_root =	1.46875
iteration:	5		curr_root =	1.421875
iteration:	6		curr_root =	1.3984375
iteration:	7		curr_root =	1.38671875
iteration:	8		curr_root =	1.380859375
iteration:	9		curr_root =	1.3779296875
iteration:	10		curr_root =	1.37939453125
iteration:	11		curr_root =	1.378662109375

Number of iterations: 11

the approximate root is 1.378662109375
 $f(\text{root}) = -0.0009021193400258198$

Problem 5 Output:

(a):



(b):

(5):

```
looking for root at x=-0.898 with x0 = -0.9
the approximate fixed point is: -2761829351.191013
f(fixed_point): -3452286689.3512335
Error message reads: 1
```

```
looking for root at x=-0.544 with x0 = -0.4
the approximate fixed point is: -0.5444424006756098
f(fixed_point): -0.5444424006790539
Error message reads: 0
```

```
looking for root at x=1.732 with x0 = 1.7
the approximate fixed point is: -0.5444424006869433
f(fixed_point): -0.5444424006827152
Error message reads: 0
```

```
looking for root at x=3.162 with x0 = 3
the approximate fixed point is: 3.161826486605397
f(fixed_point): 3.1618264865119454
Error message reads: 0
```

```
looking for root at x=4.518 with x0 = 4.5
the approximate fixed point is: 3.161826486613379
f(fixed_point): 3.161826486505972
Error message reads: 0
```