Weekly Homework 5

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Problem 1.
For problem 1-4, the code is displayed in the appendix section.

Problem 2.
Q: Why dont we want to try it for exp(x)?
A: Cause the image of exp(x) doesn't cross the x-axle, it doesn't have root. There is no x for exp(x) to equal 0.

Result of Problem 2:
For funtion funsin: The zero of x occurs at x= 0.000000 Loop 6 times
For funtion funcos: The zero of x occurs at x= 1.570796 Loop 5 times
For funtion funtan: The zero of x occurs at x= 0.000000 Loop 6 times
For funtion funlog: The zero of x occurs at x= 1.000000 Loop 1 times
For funtion funpow2: The zero of x occurs at x= 0.000000 Loop 213 times
For funtion funpow3: The zero of x occurs at x= 0.000000 Loop 362 times

Problem 3.
In this problem, I use 3 stop criterion:
SC1. number of iterations > MAX-ITERATION-TIMES SC2.

$$|x_{k+1} - x_k| < \varepsilon$$

SC3.

$$|f(x_{k+1}) - 0| < \varepsilon$$

Result of Problem 3:
SC1:
For Funtion funsin and Stop Criterion 1: The zero of x occurs at x= 0.000000 Loop 100001 times
For Funtion funcos and Stop Criterion 1: The zero of x occurs at x= 1.570796 Loop 100001 times
For Funtion funtan and Stop Criterion 1: The zero of x occurs at x= 0.000000 Loop 100001 times

For Funtion funlog and Stop Criterion 1: The zero of x occurs at x= 1.000000 Loop 100001 times
For Funtion funpow2 and Stop Criterion 1: The zero of x occurs at x= 0.000000 Loop 100001 times
For Funtion funpow3 and Stop Criterion 1: The zero of x occurs at x= 0.000000 Loop 100001 times

SC2:
For Funtion funsin and Stop Criterion 2: The zero of x occurs at x= 0.000000 Loop 6 times
For Funtion funcos and Stop Criterion 2: The zero of x occurs at x= 1.570796 Loop 5 times
For Funtion funtan and Stop Criterion 2: The zero of x occurs at x= 0.000000 Loop 6 times
For Funtion funlog and Stop Criterion 2: The zero of x occurs at x= 1.000000 Loop 1 times
For Funtion funpow2 and Stop Criterion 2: The zero of x occurs at x= 0.000000 Loop 67 times
For Funtion funpow3 and Stop Criterion 2: The zero of x occurs at x= 0.000000 Loop 112 times

SC3:
For Funtion funsin and Stop Criterion 3: The zero of x occurs at x= 0.000000 Loop 5 times
For Funtion funcos and Stop Criterion 3: Exceed limit time
For Funtion funtan and Stop Criterion 3: The zero of x occurs at x= 0.000000 Loop 5 times
For Funtion funlog and Stop Criterion 3: The zero of x occurs at x= 1.000000 Loop 1 times
For Funtion funpow2 and Stop Criterion 3: The zero of x occurs at x= 0.000000 Loop 34 times
For Funtion funpow3 and Stop Criterion 3: The zero of x occurs at x= 0.000000 Loop 38 times

Problem 4.
In this problem, I use the SC2 described above.

Result for problem 4:
For Funtion funcosp1 and Stop Criterion 2: The zero of x occurs at x= 3.141593 Loop 27 times
It takes more times to converge when compared to cos(x). Increase the base make the function's root away from 1, so it's harder to converge.

Problem 5.
In this problem, I use the combination of 3 stop criterion list above.

Result for problem 5:
For Funtion funpow2: The zero of x occurs at x= 0.000000 Loop 1 times m= 2.000000
For Funtion funpow3: The zero of x occurs at x= 0.000000 Loop 1 times m= 3.000000
For Funtion funcosp1: The zero of x occurs at x= 3.141593 Loop 5 times m= 2.014195
From the result, we can conclude that the number of loop is much smaller then in problem 1 to 4.

A Code for P1-P2

```
import math
E = 1e-64
TIME_MAX = 1000

def genfun():
    def funsin(x):
        return math.sin(x)
    def funcos(x):
        return math.cos(x)
    def funtan(x):
        return math.tan(x)
    def funlog(x):
        return math.log(x)
    def funpow2(x):
        return math.pow(x,2)
    def funpow3(x):
        return math.pow(x,3)
    return (funsin, funcos, funtan,
    funlog, funpow2, funpow3)

def gendfun():
    def funsin(x):
        return math.cos(x)
    def funcos(x):
        return -1.0 * math.sin(x)
    def funtan(x):
        return 1/math.pow(math.cos(x),2)
    def funlog(x):
        return 1/x
    def funpow2(x):
        return 2*x
    def funpow3(x):
        return 3*math.pow(x,2)
    return (funsin, funcos, funtan,
    funlog, funpow2, funpow3)

def my_zero(x0,f,fp):
    x0= float(x0)
    time=0
    while True: #time<=TIME_MAX:
        time += 1
```

```
        x1 = x0 - f(x0)/fp(x0)
        if abs(x1-x0)<E:
            return x1, time
        else:
            x0 = x1
    return x0, time

if __name__ == "__main__":

    for i in range(6):
        zero, time = my_zero(1.0, genfun()[i], gendfun()[i])
        print "For funtion %s:\t The zero of x occurs at x= %f \tLoop %d time
```

B Code for P3-P4

```
import math
E = 1e-20
TIME_MAX = 100000

def genfun():
    def funsin(x):
        return math.sin(x)
    def funcos(x):
        return math.cos(x)
    def funtan(x):
        return math.tan(x)
    def funlog(x):
        return math.log(x)
    def funpow2(x):
        return math.pow(x,2)
    def funpow3(x):
        return math.pow(x,3)
    def funcosp1(x):
        return math.cos(x)+1
    return (funsin, funcos, funtan,
    funlog, funpow2, funpow3, funcosp1)

def gendfun():
    def funsin(x):
        return math.cos(x)
    def funcos(x):
        return -1.0 * math.sin(x)
    def funtan(x):
        return 1/math.pow(math.cos(x),2)
```

```
    def funlog(x):
        return 1/x
    def funpow2(x):
        return 2*x
    def funpow3(x):
        return 3*math.pow(x,2)
    def funcosp1(x):
        return -1*math.sin(x)
    return (funsin, funcos, funtan,
    funlog, funpow2, funpow3, funcosp1)

def my_zero(x0,f,fp,sc=2):
    x0= float(x0)
    time=0

    issc1 = False if sc==1 else True
    while issc1 or time<=TIME_MAX:
        time += 1
        x1 = x0 - f(x0)/fp(x0)
        if sc==2 and abs(x1-x0)<E:
            return x1, time
        if sc==3 and abs(f(x1))<E:
            return x1, time
        if time>TIME_MAX:
            return x1, time
        x0 = x1

    return x0, time

if __name__ == "__main__":
    # Q3
    # for i in range(6):
    #     for sc in range(1,4):
    #         zero, time = my_zero(1.0, genfun()[i], gendfun()[i],sc)
    #         print "For Funtion %s and Stop Criterion %d:\t The zero of x oc


    zero, time = my_zero(1.0, genfun()[6], gendfun()[6], 2)
    print "For Funtion %s and Stop Criterion %d:\t The zero of x occurs at x=
```

C Code for P5

```
import math
E = 1e-20
```

```
TIME_MAX = 100000

def genfun():
    def funpow2(x):
        return math.pow(x,2)
    def funpow3(x):
        return math.pow(x,3)
    def funcosp1(x):
        return math.cos(x)+1
    return (funpow2, funpow3, funcosp1)

def gendfun():
    def funpow2(x):
        return 2*x
    def funpow3(x):
        return 3*math.pow(x,2)
    def funcosp1(x):
        return -1*math.sin(x)
    return (funpow2, funpow3, funcosp1)

def genddfun():
    def funpow2(x):
        return 2

    def funpow3(x):
        return 6 * x

    def funcosp1(x):
        return -1 * math.cos(x)

    return (funpow2, funpow3, funcosp1)

def calM(x0,f,fp,ffp):
    a= pow(fp(x0),2)
    b=f(x0) * ffp(x0)
    m=a/(a-b)
    return m

def my_zero(x0,f,fp,ffp,calM):
    x0= float(x0)
    time=0
    m = calM(x0, f, fp, ffp)

    while time<=TIME_MAX:
        #print m
```

```
        time += 1
        x1 = x0 - ((m * f(x0))/fp(x0))
        if abs(x1-x0)<E or abs(f(x1))<E:
            return x1, time, m

        x0 = x1
        m = calM(x0, f, fp, ffp)

    return x0, time, m


if __name__ == "__main__":
    for i in range(3):
        zero, time, m = my_zero(1.0, genfun()[i], gendfun()[i], genddfun()[i]
        print "For Funtion %s:\t The zero of x occurs at x= %f \tLoop %d time
```