PHYS 251 - Homework 7

7 Homework 7

Please upload your answers to Bitbucket.

The documentation provided in the Python web page should be the first stop to get help. **Python documentation**.

7.1 Problem 1: Calculate df/dx of $f(x) = \cos x + \sin x$

Please write a script that will evaluate the approximate derivative of the function $f(x) = \cos x + \sin x$, in x from 0 to 2π using 100 points, with the following approximations:

- the *Forward Difference* approximation, df/dx_{FD},
- the *Backward Difference* approximation, df/dx_{BD}, and
- the *Central Difference* approximation, df/dx_{CD}.

Plot in the same figure the function $f(x)$, the analytical derivative df/dx, the approximated derivatives df/dx_{FD}, df/dx_{BD} and df/dx_{CD} versus x. Your plot must have an appropriate legend, axis labels and a grid.

You must write your script using **for** or **while** loops.

Please place comments in your code.

Save your script as **hw7_1.py**. Place your figure in a document using Word or PDF, add a caption to your figure. Save the document with the figure as **hw7_1_figs**. Upload the files to your Bitbucket account.

7.2 Problem 2: Calculate df/dx of $f(x) = \frac{\sin x}{x}$

Please write a script that will evaluate the approximate derivative of the function $f(x) = \frac{\sin x}{x}$, in x from 5 to 30 using 200 points, with the following approximations:

- the *Forward Difference* approximation, df/dx_{FD},
- the *Backward Difference* approximation, df/dx_{BD}, and
- the *Central Difference* approximation, df/dx_{CD}.

Plot in the same figure the function $f(x)$, the analytical derivative df/dx, the approximated derivatives df/dx_{FD}, df/dx_{BD} and df/dx_{CD} versus x. Your plot must have an appropriate legend, axis labels and a grid.

You must write your script using **for** or **while** loops.

Please place comments in your code.

Save your script as **hw7_2.py**. Place your figure in a document using Word or PDF, add a caption to your figure. Save the document with the figure as **hw7_2_figs**. Upload the files to your Bitbucket account.

7.3 Problem 3: Calculate df/dx and d^2/dx^2 of $f(x) = \mathrm{e}^{-x^2}$

Please write a script that will evaluate the approximate first and second derivatives of the function $f(x) = \mathrm{e}^{-x^2}$, in x from -5 to 5 using 200 points, with the following approximations:

- the *Forward Difference* approximation of the derivative of first order, df/dx_{FD},
- the *Backward Difference* approximation of the derivative of first order, df/dx_{BD},
- the *Central Difference* approximation of the derivative of first order, df/dx_{CD}, and
- the *Central Difference* approximation of the derivative of second order, d^2f/dx^2_{CD}.

Plot in the same figure the function $f(x)$, the analytical derivatives df/dx and d^2f/dx^2, the approximated derivatives df/dx_{FD}, df/dx_{BD}, df/dx_{CD} and d^2f/dx^2_{CD} versus x. Your plot must have an appropriate legend, axis labels and a grid.

You must write your script using **for** or **while** loops.

Please place comments in your code.

Save your script as **hw7_3.py**. Place your figure in a document using Word or PDF, add a caption to your figure. Save the document with the figure as **hw7_3_figs**. Upload the files to your Bitbucket account.

7.4 Problem 4: Plot $\delta(\Delta x)$ vs Δx - (Optional: 10 points extra credit)

Write a python script that will reproduce Figure 6 from the Lecture on *Derivatives* using the function $f(x) = \mathrm{e}^{-x^2}$. Please evaluate your approximate derivatives and function at $x = 1$.

You must write your script using **for** or **while** loops.

Please place comments in your code.

Save your script as **hw7_4.py**. Place your figure in a document using Word or PDF, add a caption to your figure. Save the document with the figure as **hw7_4_figs**. Upload the file to your Bitbucket account.