EEE 419/591
Spring 2026
Homework 2

[Same instructions as HW 1. Changes highlighted in bold font]

Solve the following problems. Put them into a single code named **hw2.py** and submit it to the designated link on Canvas. If you upload a second attempt to Canvas and it renames your file, ignore the renaming.

In this HW, only limited AI is allowed. Examples of allowed prompts on this HW:

- What is a greatest common divisor of two numbers?
- How do I write an if statement in python? Give me an example
- How do I check if a number is integer in python?
- I got this error message. How do I interpret it?

Examples of prohibited prompts on this HW:

- Write me a code that calculates the greatest common divisor of a list of numbers in python
- I ran this code. [PASTE CODE HERE]. I got this error message. [PASTE THE ERROR MESSAGE HERE]. How do I fix my code?

Do not forget to cite your AI chat if you used any. Check the last page of this HW assignment.

Problem 1: Estimating the accuracy of quad Package for Finite Integrals

Compute the value of the integral:

$$I_1(r) = \int_3^{10} (ax^3 + bx^2 + cx)dx$$

where a, b, and c are some numbers fed by the user and ranging between -10 and 10. Pay attention to the powers of x in the integrand. The integrand is not a quadratic function but a cubic function. Use the following two methods to compute the above integral

Method 1: Use scipy.integrate.quad package.

Method 2: Numerical integration with a suitable step size. Recall: Numerical integration calculates the area under the curve manually.

Your code should expect a set of 3 numbers separated by a space as an input and print the value of the integration for each method as well as the percentage error between the two methods as the following example

```
Input a set of 3 numbers between -10 and 10: -2 6 0

Method 1: I1 = -8.3333

Method 2: I1 = -8.3333

Percentage error: 0.0005%
```

Hint: Choose a small step size in Method 2 to be considered more accurate. It is up to you to decide how small is "small". You need to balance the accuracy with running time. This is an important skill you learn. Choosing a very small step size for ultra-high accuracy might not be right/wise. Note: it is acceptable to get 0 error in this problem since quad is already accurate.

$$Percentage\ error\ = \left|\frac{Accurate\ Method\ -\ Inaccurate\ Method}{Accurate\ Method}\right| \times 100\%$$

Problem 2: Estimating the Accuracy of the Substitution Method and Numerical Method for Infinite Integrals

Compute the value of the integral:

$$I_2(r) = \int_1^{\infty} \frac{dx}{x\sqrt{x-1}} = \pi$$

using the following two methods:

Method 1: Substitution method taught in video lecture 2.6 at min ~3:45. You can do this by coding or on a piece of paper. You might be able to find a package that will integrate this integral without substitution, do not use it.

Method 2: Numerical Integration: use a suitable step size and value to replace ∞. Recall: Numerical integration calculates the area under the curve manually. Instead of Numerical Integration, you are allowed to use a package that calculates infinite integrals without substitution.

Be sure to use np.sqrt() to compute any square roots required. Note that this is a known integral whose answer is, in fact, π. For each method,

- Print out the integration value to a precision of 8 digits past the decimal point.
- Print out the absolute difference from π. Recall, you already have an accurate value of π in the numpy package. Subtract π from the integration value from each method. Print as many decimal digits as what illustrates the difference (not more than 16 decimal digits).

Your code should not expect anything as an input and prints something like the following example (on each line, print the number first then the name of the method for easy comparisons):

```
3.14159265              # I2 Method 1
3.14159245              # I2 Method 2
0.000000000000099   # Difference Method 1
0.000000000000043   # Difference Method 2
```

Note that these numbers might be inaccurate. Your numbers will be different.

MANDATORY – Citing AI chat in each assignment, if used:

- Using AI: If you use AI in an assignment, you MUST cite the chat that you used to help you finish that assignment. Keep in mind the following:
    - Cite your chat by pasting its link in your code as a commented line. If you use multiple chats on the same or different AI platforms, cite them all.
    - Make sure you use an AI platform that allows sharing a link to the chat and that allows the chat to be viewed publicly by anyone who has the link.
    - Each assignment needs to have a separate dedicated chat. Parts of a single assignment can share the same AI chat or each can have its own chat.
    - Each chat needs to have the following identifying info: Your name, Assignment name, today's date. The following prompt to the chat is sufficient for the identifying info to be saved in the chat:
      Name: First Last Name
      Assignment: HW 1 – Prime Numbers
      Date: Sunday Jan 24, 20xx.
    - A chat without identifying information means it is not yours. The identifying information could go at the beginning or at the end of the chat.
- Not using AI: If you do not use AI at all in a particular assignment, you must write the following commented line in the code you submit "*I did not use AI at all to complete this (part of the) assignment*".