Homework 1
CPE381

Canvas: `hw01`

Due: 01 September 2024, 11:59 PM

You are allowed to use a generative model-based AI tool for your assignment. However, you must submit an accompanying reflection report on how you use the AI tool, what the query was to the tool, and how it improved your understanding of the subject. You must also add your thoughts on how you would tackle the assignment if there was no such tool available. Failure to provide a reflection report for every single assignment where an AI tool was used may result in a penalty and subsequent actions will be taken in line with plagiarism policy.

Submission instruction:

Upload a PDF on Canvas with the format {firstname.lastname}_cpe381_hw01.pdf. I recommend using Latex to typeset your submissions.

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1 Let's face the truth. (10 points)

Prove:

1. $1 + e^{j\pi} = 0$.
2. $\sin(-\theta) = -\sin\theta$ using Euler's identity.

2 Tigonometry Fun (20 points)

1. Verify the following identities: $1 - \dfrac{\cos^2\theta}{1+\sin\theta} = \sin\theta$
2. Solve $\cos 2x - 3\sin x + 1 = 0$ for x.

3 It's Complicated (20 points)

1. Using Euler's formula evaluate the following complex numbers: (a) $z = e^{j2\pi}$ (b) $z = e^{j\pi}$
2. Using Euler's formula derive the following: $\cos^2\theta = \frac{1}{2}(1 + \cos(2\theta))$

4 It's all Derivatives (10 points)

1. Taylor's Formula is written as

$$f(x) \approx g_n(x) = f(c) + f'(c)(x-c) + \frac{f''(c)}{2!}(x-c)^2 + \cdots + \frac{f^{(n)}(c)}{n!}(x-c)^n$$

   If $f(x) = e^{\sin x}$, the Taylor's second degree $(n = 2)$ polynomial of initial point $c = 0$ is

$$g_2(x) = \cdots$$

2. Differentiate: (a) $f(x) = x(\ln x - 1)$, (b) $f(x) = \ln(\tan x)$.

5 Area under curve. (20 points)

1. Find the value $\int_0^{\pi} |\cos x| dx$.
2. Additionally, write a MATLAB script to create a plot of the function $|\cos x|$ and shade the region between $x = 0$ to $x = \pi$ with the green color. You may choose a curve color as a contrasting color. Use `trapz` function in MATLAB to calculate the area of $|\cos x|$ between $x = 0$ to $x = \pi$. Comment on the result with what you obtained from the absolute integration above.

6 Initial value problem. (20 points)

Solve the differential equation $ty' + 3y = 0, \quad y(1) = 2$, assuming $t > 0$. In addition to doing to mathematically, write a MATLAB script to solve it programmatically.