Phy 206 - Physics Through Computational Thinking: Assignment 1

January 17, 2025

Instructions

Answer the following questions using Mathematica. Provide your code and outputs.

Questions

Question 1: Common Errors
Identify and correct the errors in the following Mathematica code snippets:

1.
```
f[x_] = e^x  (*Code to Plot exponential function*)
Plot[f[x], {x, 0, 10}]
```

2.
```
g[x] = sin {x} (*Code to Plot a sine function*)
plot[g[x], (x, -2 Pi, 2 Pi)]
```

3.
```
FindRoot[Sin[t] = t^2, {x, 1}] (*Finding the root of f(t)=Sin(t)-t^2*)
Plot[Sin[t] - t^2, {x, -10, 10}]]
```

4.
```
Manipulate[Plot[{x^n, x + n, Sqrt[x*n/7], {x, 10, 0}], {n, 0, 10, 15}]
(*Varying Parameter n in the functions*)
```

5.
```
Piecewise[{{x^2, x < 0}, {x, x >= 0}}]
Plot[k[x], {x, -2, 2}] (*Plotting a Piecewise Function*)
```

Question 2: Order of Growth
Rank the following functions by order of growth.

- $\log(\log x)$
- $4^{\log X}$
- $x^{1+\log(x)}$
- $2^{\log x}$
- $\exp x$
- $x!$
- $\sqrt{\log(x)}$
- 1
- $x^{\log(\log(x))}$
- 2^x

.

Question 3: Taylor Expansion Perform a Taylor expansion of the function $f(x) = e^x \sin(x)$ around $x = 0$ up to the quadratic term. Plot the original function and the Taylor approximation on the same graph for $x \in [-\pi, \pi]$.

Question 4: Explore numerical function N[x]: N calculates numerical value of any expression.

(a) Find out Pi and E (the Euler number e) to 10 digits by evaluating the commands: N[Pi], N[Pi, 10], N[E, 10]

(b) Find Pi to 100 digits.

(c) Find $2^{1/2}$ and $2^{1/3}$ up to 16 digits.

Question 5: For the function $e^{-x/4}cos(x)$, find the distance between two consecutive minima, using Mathematica. Then analyze your results.

Question 6: Plot the curves $y = x^4$ and $y = e^{x/4}$. Find the point of intersection of the curves, first by visualization and then by solving it in Mathematica.

Question 7: Plot the following periodic functions with ω equal to the last non-zero digit of your role number. Please show at least 4 periods in the plot. Label the plots.

- $sin^2(\omega t)$
- $cos(\omega^2 t)$
- $sin(\omega t)cos(\omega t)$