Practice Exam 1 – Numerical Computing

Ch En 263 – Numerical Tools

Instructions

- You have 50 minutes to complete the exam.
- You **may** use one page (front and back) of notes.
- You **may not** look at another persons exam or ask them for help, but you may of course ask clarifying questions to Dr. Tree or the TAs.
- You need a computer to complete this exam. You may not use a calculator.
- You may use scratch paper, but it will not be accepted for credit.
- Certain questions require that you submit an Excel workbook (*.xlsx) and/or a Python (*.py) file.
- **Save often!**
- **Make sure that you turn in the correct files!**

Exam Contents

This exam contains:

- 8 Qualitative Questions (32 pts)
- 4 Quantitative Questions (64 pts)
- Turn in your files (4 pts)

I. Qualitative Questions (36 pts)

1. The equations

$$5x^3 + y^2 + 3 = 0$$
$$x^4 + 3y^2 - 2 = 0$$

can be best classified as a system of

(a) coupled linear algebraic equations
(b) coupled linear differential equations
(c) uncoupled linear algebraic equations
(d) uncoupled linear differential equations
(e) coupled nonlinear algebraic equations
(f) coupled nonlinear differential equations
(g) uncoupled nonlinear algebraic equations
(h) uncoupled nonlinear differential equations

2. Which of the following is *not* one of the primary capabilities of a CPU?

(a) Storing information
(b) Logic
(c) Communicating with memory
(d) Arithmetic

3. Generally we prefer a numerical solution to an analytical solution, because the former is usually easier to get and use.

(a) True
(b) False

4. Which of the following describes how floating point data types are stored on a computer?

(a) Single bits (a one for true and a zero for false).
(b) One or more bytes for a "mantissa" and an "exponent", i.e. like scientific notation.
(c) One or more bytes representing a binary number that is converted to decimal.
(d) One or more bytes in a table with specific sequences of zeros and ones to represent a character.

5. If I want to use the number 4.8384, what data type should it be stored as in Python?

(a) Bool
(b) Integer
(c) String
(d) Float

6. Which of the following best describes the scope of the variables in the Python code snippet?

```
a = 5
def my_function():
    b = 2
    return (a + b)
```

(a) `a` is a local variable and `b` is a local variable
(b) `a` is a local variable and `b` is a global variable
(c) `a` is a global variable and `b` is a local variable
(d) `a` is a global variable and `b` is a global variable

7. Which is the correct output from the code snippet?

```
a = 3
b = 5
if (a < 0 and b == 5):
    print('A')
elif (a < 0 or b == 5):
    print('B')
else:
    print('C')
```

(a) 'A' (b) 'B'

(c) 'C' (d) 'ABC'

8. What will print if the Python code below is executed?

```
def f(x):
    return x**2

x=5
print(x)
```

(a) x (b) x**2

(c) 5 (d) 25

II. Quantitative Questions (64 pts)

9. Use functions with conditionals in Excel to find the average yearly salary of the people in the table below who make more than $20,000. Enter the number you obtain in the cell in the "Multiple_Choice" worksheet.

Person	**Salary**
Margaret	95000
Michael	109000
Toby	69000
Josh	134000
CJ	17000
Gus	1000
Andrew	26000
Joe	50000
Donna	17000
Spencer	6000

10. In Fluid Mechanics, you will learn about the drag coefficient, which is a dimensionless quantity that can be used to calculate the drag force exerted by a fluid on a moving object. The drag coefficient for a sphere at moderate Reynolds number is given by

$$C_D = \frac{24}{\mathrm{Re}} + \frac{2.6\frac{\mathrm{Re}}{5.0}}{1 + (\frac{\mathrm{Re}}{5.0})^{1.52}}$$

where Re is dimensionless number called the Reynolds number that characterizes how fast the object is moving. Use Excel to calculate the drag coefficient at Re = 2000.

11. In Python write a function for computing the Reynolds number

$$\mathrm{Re} = \frac{\rho U D}{\mu}$$

given a flow rate

$$Q = UA$$

where ρ is the fluid density, U is the fluid velocity, D is the pipe diameter, μ is the fluid viscosity, and A is the pipe cross-sectional area (determined from $A = \pi D^2/4$). Your function should take a value of Q in L/min and return (a dimensionless) Re. Test your function using $\rho = 1000$ kg/m^3, $D = 1$ in, $\mu = 10^{-3}$ kg/(m s) and $Q = 1$ L/min. *Note that* $1m^3 = 1000L$.

12. In Python, write the piecewise function g given below, and use it to evaluate g(1.4, 1.5)

$$g(x,y) = \begin{cases} \sqrt{x}, & x^2 + y^2 \leq 4 \\ y^3, & x^2 + y^2 > 4 \end{cases}$$