

Practice Exam 1 – Numerical Computing

Ch En 263 – Numerical Tools

Instructions

- You have 70 minutes to complete the exam.
- You **may** use your notes, the internet, help menus, etc. (i.e. the exam is “open book”). 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 use either the lab computer or your own computer, but **you may not use a calculator**. You may also use scratch paper or write on your test, but neither will be accepted for credit.
- A **required** Excel template and necessary data files are provided on Learning Suite. Do not move the colored cells in the Excel workbook.
- Submit your exam to Learning Suite **at the end of class**. You will submit two files.
 - Lastname_Firstname_Exam1.xlsx
 - Lastname_Firstname_Exam1.py

Save often and make sure you submit the correct file!

Exam Contents

This exam contains:

- 13 Qualitative Questions (39 pts)
- 6 Quantitative Questions (60 pts)

I. Qualitative Questions (39 pts)

Enter your answer into the “Multiple_Choice” worksheet in the Excel workbook named “Last-name_Firstname_Exam1.xlsx.”

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. When copying formulas in Excel an ampersand (e.g. &A&4) is used to “lock” the cell so it refers to the same location in the new cell.
- (a) True (b) False
3. Which of the following is not one of the capabilities of a CPU
- (a) Storing information (b) Logic
 - (c) Communicating with memory (d) Arithmetic
 - (e) All of the above are capabilities of a CPU
4. Generally we prefer a numerical solution to an analytical solution, because the former is usually easier to get and use.
- (a) True (b) False
5. 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.
6. The number 4.8384 will be stored as a Boolean data type in Python.
- (a) True (b) False
7. Which of the following is true about the snippet of python code:

```
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

8. This operator `=` is used to assign, but not to compare variables in Python.

- (a) True
- (b) False

9. Which of the following could *not* be written as a function in Python?

- (a) Evaluation of the formula $x^2 + 3x + 5$.
- (b) Evaluation of the formula $\sum_{i=1}^{100} \frac{\sqrt{i}}{3}$
- (c) A process to sort the string 'The rain in Spain stays mainly in the plain' in alphabetical order.
- (d) Code to draw a plot of x versus $f(x) = x^3 + ax^2 - 4x + 2$ where a is a parameter.
- (e) All of the above *can* be written as a function in Python.

10. 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'

11. The following code snippet defines what type of object?

```
unknown_variable = (4, 5, 8, 10)
```

- (a) A list
- (b) A tuple
- (c) A Numpy array
- (d) A range

12. 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

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

```
i=0
while (i<5):
    i=1
    print(i)
```

- (a) 0 1 2 3 4
(b) 1 2 3 4 5
(c) 0 1 2 3 4 5
(d) 1 1 1 1 ... (forever)

II. Quantitative Questions (60 pts)

Enter your answers into the “Multiple_Choice” worksheet in the Excel workbook named “Lastname_Firstname_Exam1.xlsx.” *Additionally, you must show your work for these problems in order to get full credit.* For problems 14, 15, and 16 use an Excel Workbook named “Lastname_Firstname_Exam1.xlsx”. For problems 17, 18, and 19 use a Python file named “Lastname_Firstname_Exam1.py”.

14. 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

15. 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

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

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 $\text{Re} = 2000$. Enter the number you obtain in the appropriate cell in the “Multiple_Choice” worksheet.

16. Use Excel to find the quantity

$$\frac{1}{50} \sum_{n=1}^{50} \cos\left(\frac{3\pi}{4n}\right)$$

Enter the number you obtain in the appropriate cell in the “Multiple_Choice” worksheet.

17. Use Python to find the sum of all of the odd numbers between 0 and 100. Enter the number you obtain in the appropriate cell in the “Multiple_Choice” worksheet.

18. Use Python to evaluate $g(1.4, 1.5)$

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

Enter the number you obtain in the appropriate cell in the “Multiple_Choice” worksheet.

19. The file `Birthdays.csv` contains a list of the birth month (1st column), day (2nd column) and year (3rd column) for several different people. Note also that the first line of the file is a header. In Python read this file and use a loop to determine how many birthdays in the list occur in the Spring (i.e., in March, April, or May). Enter the number you obtain in the appropriate cell in the “Multiple_Choice” worksheet.