

## ME 701 – Development of Computer Applications In Mechanical Engineering

### Homework 4 – Due 10/6/2017

Instructions: Your solutions to the following should be contained in one file named `lastname_firstname_hw3.py` and uploaded to Canvas.

#### Problem 1 – Basic Regular Expressions

Define a regular expression that matches all of the items in the left column but none in the right column:

pit	pt
spot	Pot
spate	peat
slap two	part
respite	

#### Problem 2 – More Complex Regex

Consider the file `regex_sample_mcnp.txt` (in the examples folder). There are two blocks of text in that file that look like

```
1tally      18      nps =      10000
+
GOOD COUNTS
tally type 8      pulse height distribution.      units      number
particle(s): heavyions

cell 10
energy
0.0000E+00      0.00000E+00      0.0000
3.0000E-01      0.00000E+00      0.0000
2.0000E+02      3.3520E-01      0.0141
total      3.3520E-01      0.0141
```

Use regex to process the file and produce a dictionary of the form

```
1  d{18: {'energy': [0, 3e-1, 2e2], 'value': [0, 0, 3.352e-1], 'sigma'=[0.0, 0.0,
2    0.0141]}},
   28: {... so on and so forth
```

Here, 18 and 28 are integer identifiers for particular results of interest (called a “tally”). The energy, value, and uncertainty arrays are the corresponding numerical data.

#### Problem 3 – Regression

Go out and find some interesting data for which a suitable model has been (or could be) defined. Use that data and the tools presented in class to determine the coefficients to that model that produce the (1) least-squares and (2) minimax fit.

Note, you are all smart engineers, so I assume you can find interesting data. If you can't, some possible options are

- Getting atomic mass data and generating the coefficients to the semi-empirical mass formula.
- Acquiring (maybe even from an MNE faculty member) some measured thermal-hydraulic measurements used to define a correlation (like Dittus-Boelter, etc.)

These models can be linear or nonlinear, but they should not be trivial.

#### **Problem 4 – ODEs**

Use SciPy to solve the following:

1.  $y' = y + 1$  for  $y(0) = 1$  and  $t \in [0, 10]$ .
2.  $y''' = y - y'$  for  $y(0) = y'(0) = y''(0) = 1$  and  $t \in [0, 10]$ .
3.  $y' = 1000y + 1$  and  $z' = 0.0001z + 1000y$  for  $y(0) = z(0) = 1$  and  $t \in [0, 10]$ .
4.  $y' = y^2 + 1$  for  $y(0) = 1$  and  $t \in [0, 10]$ . How would you apply good-old Euler's method to this problem? Do it!
5.  $-y'' + y = 1$  for  $y(0) = y(10) = 1$ . This is a BVP! Look up the “shooting method” or `bvp_solver`.