MM 225: AI and Data Science

Tutorial 1: Introduction to python

Week 1: Tutorial Group 1

You may use the slides of the lecture for reference. You may use the library *numpy* and the commands `linspace` and other function calls of `numpy` such as `np.sin` and `np.tanh` for generating the required variables and data.

1. Write a python script to plot the self-diffusivity of copper as a function of temperature in the temperature range 100 K to 1350 K given that the temperature dependence is given by the expression $D(T) = D_0 \exp\left(-\frac{Q}{RT}\right)$, where, T is the temperature in Kelvin scale, $D_0 = 3.1 \times 10^{-5}$ m^2/s, $Q = 200300$ J/mol and $R = 8.314$ J/mol/K.

2. Write a python script to do the following: create a list called vegetables which consists of the following entries: *potato, beetroot, beans, capsicum, carrot*. Use the function call `permutations` from the module *itertools* to create all possible permutations of the vegetables and print them. You may use the command `help("itertools.permutations")` for more information.

3. Find the roots of the polynomial $f(x) = x^5 + 3x^2 - x$ using the *numpy* function call `roots`. Plot the funnction and check that the roots are indeed the same.

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Week 1: Tutorial Group 2

You may use the slides of the lecture for reference. You may use the library *numpy* and the commands `linspace` and other function calls of `numpy` such as `np.sin` and `np.tanh` for generating the required variables and data.

1. Write a python script to plot the function $\sin(x)/x$ for $x = (-10\pi, 10\pi)$.

2. Consider the following two vectors:

   $$\mathbf{a} = \begin{pmatrix} 1 \\ 1 \\ -2 \end{pmatrix} \text{ and } \mathbf{b} = \begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix}.$$

   Calculate the inner and outer product of these two vectors. The `numpy` module contains the commands `inner` and `outer`. You may use `help` to learn the syntax.

3. Consider the data $\{1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89\}$. Write a script to calculate the mean, mode and median of this data using the function calls from the module `statistics`.

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Week 1: Tutorial Group 3

You may use the slides of the lecture for reference. You may use the library *numpy* and the commands `linspace` and other function calls of `numpy` such as `np.sin` and `np.tanh` for generating the required variables and data.

1. Write a python script to plot $\sinh(x)$ in the range (-100,100). Upload your script and the figure.

2. Write a python script to do the following: create a list called fruit which consists of the following entries: *apple, orange, mango, banana, guava, kiwi, papaya, watermelon, musk melon, sitaphal, sapota, jack fruit, lichi*. Use the function call `combinations` from the module *itertools* to create all possible combinations of three fruits and print them. You may use the command `help("itertools.combinations")` for more information.

3. Find the roots of the polynomial $f(x) = x^4 - 2x^3 + 3x^2 - 4x$ using the *numpy* function call `roots`. Plot the funnction and check that the roots are indeed the same.

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Week 1: Tutorial Group 4

You may use the slides of the lecture for reference. You may use the library *numpy* and the commands `linspace` and other function calls of `numpy` such as `np.sin` and `np.tanh` for generating the required variables and data.

1. Write a python script to plot the function $\left(\frac{1}{r}\right)^{12} - \left(\frac{1}{r}\right)^{6}$ for r in the range 0.95 to 3.

2. Consider the following two vectors:

   $$\mathbf{a} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \text{ and } \mathbf{b} = \begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix}.$$

   Calculate the dot and cross product of these two vectors. The `numpy` module contains the commands `dot` and `cross`. You may use `help` to learn the syntax.

3. Write a script to calculate the value of $\mathrm{erf}(x)$ for $x = -\infty$ and $x = +\infty$. Note that the module contains both error function and a means to input infinity using `math.erf` and `math.inf` respectively.