Run in the mse213 environment, Jupyter notebook Backup: use noto.epfl.ch

Python practice week 2:

Task 1)

- Create three numpy arrays of random integers from 0 to 9 (inclusive), containing 100, 1000 and 10000 entries.
- Plot the histogram of the relative frequencies of each array, together with a dashed line showing the expected value
- Compute mean, median, IQD, standard deviation (SD) and box plots for this distribution
- Compare the results (esp. for the array with100 numbers) to your neighbour
- Assume these numbers are temperatures in °C – convert them to °F, then compute the mean & SD of the resulting array. How does this compare to converting the old mean & SD directly?
- Now assume these numbers are currents in amperes. Compute the corresponding power consumed by a kettle with a resistance of 20Ohm (use Ohm's law and P=V*I). How does the mean & SD of the resulting array of powers compare to converting the mean & SD directly?
- Now assume these numbers are wind speeds in km/h. Use the equation

  $$P_T = ½ * \rho * A * v^3 * Cp$$

  (where ρ is the density of air, Cp is the Bentz coefficient – you can use 0.5, and A is the area of the circle covered by the blades – assume a rotor diameter of 100m). Again how does the mean & SD of the resulting array of powers compare to converting the mean & SD directly?

Task 2)

- Write a script that implements a random walk. That is, starting from 0, at every step decide randomly, with a 50:50 probabiliy to either increase the number by one (move right) or reduce it by one (move left), and find the value after n-steps.

This process is of great importance for understanding phenomena such as thermal transport, charge diffusion and many others.

- Make a line-plot showing the position of one trajectory after 100 steps.
- Optional: can you think of a more efficient way to compute this, using just numpy array functions and no loop?
- Either way, create 1000 of those trajectories, and plot a histogram of their final positions after (a) 10 steps, (b) 100 steps. (c)1000 steps
- Compute the mean and SD of those distributions of final positions after 10 / 100 / 1000 steps.
- Plot the mean as a function of step number (optional: show +-SD as shaded areas)
- Now change the probability to 60:40 and 70:30, again plot the mean as a function of step size (optional: with SD). What type of function do you recognize, and how does the slope depend on probability?
- Optional: Plot the mean position after 1000 steps as a function of probability for moving left.