Artificial Intelligence Lab 1 : Python Introduction

import numpy as np

Q1) [20 Marks] **Random Number Generation**

Using commands `np.random.randint` and `np.random.rand`, generate:

(i) 100 random integers in the interval -10 to 10.

(ii) uniform random numbers in the interval $[0, 1]$.

Q2) [40 Marks] **Operations with Vectors**

a) [20 Marks]: Write a function which accepts integer n as input and outputs a data set of n points of form $(x_i, y_i)_{i=1}^{n}$ in the 2-dimensional plane (chosen at random) in the interval $[-1, 1) \times [-1, 1)$. Here (x, y) means points are in 2-dimensions, and the subscript i in (x_i, y_i) means it is the i^{th} data point.

b) [10 Marks]: Given a point (x_{new}, y_{new}) find $k = 5, 10, 15$ nearest point in the data set generated in part a). Distance between point in data set and the new point is given by $\sqrt{(x_i - x_{new})^2 + (y_i - y_{new})^2}$. Can you find a better command in numpy to do this? (Hint: Search in `np.linalg`).

c) [10 Marks]: Given a point (x_{new}, y_{new}) find $k = 5, 10, 15$ points in the data set generated in part a) that make a positive angle with the new point. Implement this as a separate function.

Q3) **Plotting** [30 Marks]

a) [10 Marks] Plot the data set in blue and the k points obtained in Q2 a) and Q2 b) in red.

b) [10 Marks] Generate $n = 100$ random integers and plot their histogram.

Q4)[10 Marks] Generate $n = 100$ random points in the interval $[-0.5, 0.5]$. Plot the sample mean given by

$$y_k = \frac{x_1 + \ldots + x_k}{k} \tag{1}$$

as a function of k.

Also plot the functions $f_1 = \sqrt{\frac{1}{k}}, f_2 = -\sqrt{\frac{1}{k}}$

AI Lab 1

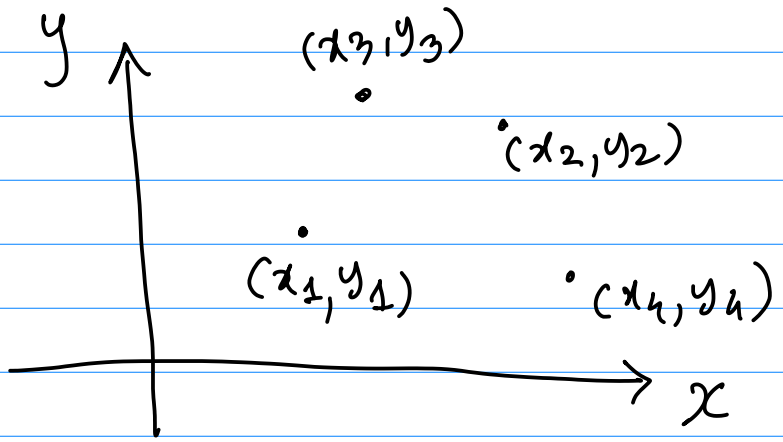
Q1) Generating random numbers (Basic Question)

a) integer

b) Real

Q2) Notation:

'n' - points ; each point is in 2-dim



$n = 4$

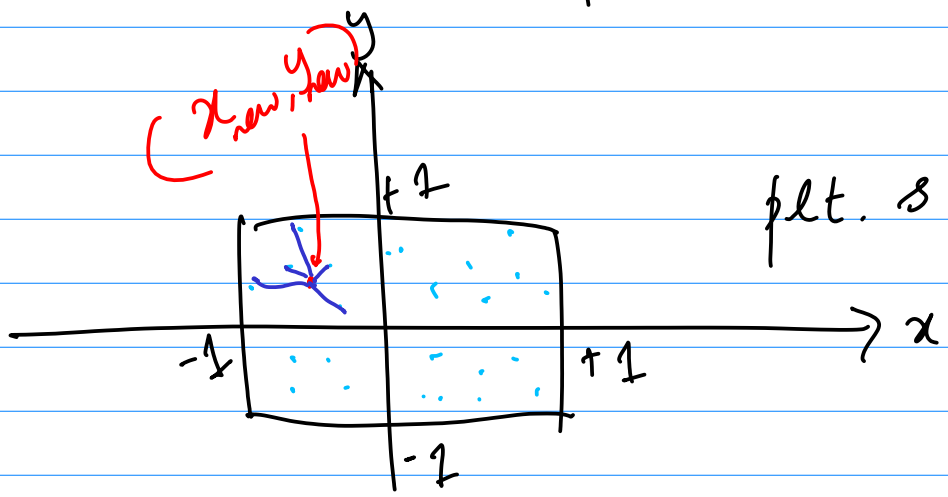
data set : $(x_1, y_1), (x_2, y_2), (x_3, y_3), (x_4, y_4)$

↳ Collection n points

$$(x_i, y_i)_{i=1}^{n}$$

Q 2

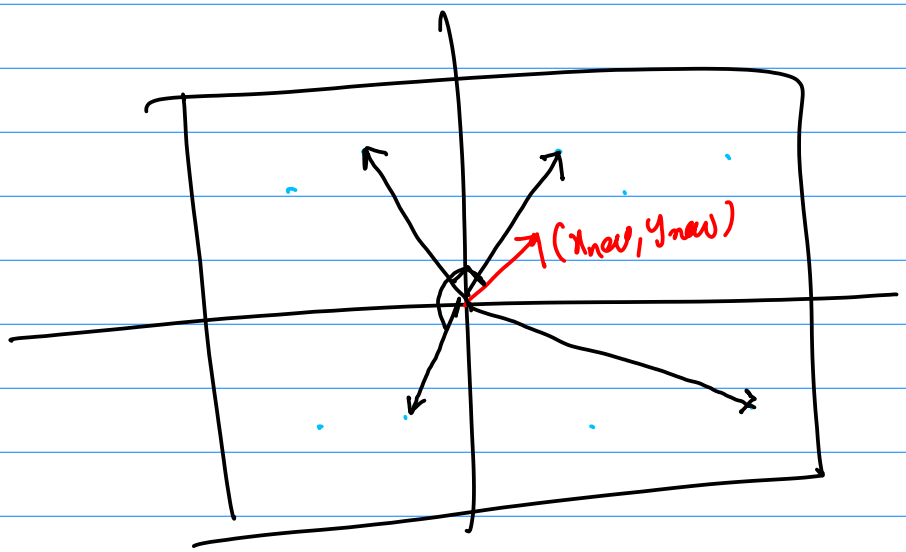
(a) $n = 100$ random points in 2-dimensions



plt.scatter(x, y)

(b) use Euclidean distance to find 'k' nearest points in the dataset; nearest to (x_{new}, y_{new})

(c)



Q3)

(a) using function in Q2 to plot

(b) Histogram plot

Q4

$x_1, \ldots, x_n$ all real numbers in $(-0.5, 0.5)$

$$y_k = \frac{x_1 + x_2 + \cdots x_k}{k}$$

$\to 0$ at rate $\frac{1}{\sqrt{k}}$

$$y_1 = \frac{x_1}{1}, \quad y_2 = \frac{x_1 + x_2}{2}, \quad y_3 = \frac{x_1 + x_2 + x_3}{3}$$

Running average