





Figure 1: A plot of `ptsXY` and `ptsXYSorted` for  $n = 30$ .

P3-D Assume  $n \in \mathbb{N}$ . Generate a list of  $n$  2D-points (a matrix with 2 columns and  $n$  rows). Denote the list as `ptsRhoPhi`, it is a list of the form  $\{\{\rho_1, \varphi_1\}, \{\rho_2, \varphi_2\}, \dots, \{\rho_n, \varphi_n\}\}$ . Generate  $\rho_i$ s as a random variable from the **normal distribution**  $\mathcal{N}(10, 1)$  – `RandomVariate[NormalDistribution[10, 1]]` and  $\varphi_i$ s as a random variable from the **continuous uniform distribution**  $\mathcal{U}(0, 2\pi)$  – `RandomVariate[UniformDistribution[0, 2 Pi]]`.

Create matrices/lists `ptsXY` and `ptsXYSorted` such that:

- the list `ptsXY` contains pairs  $\{x_i, y_i\}$ , where  $x_i = \rho_i \cos(\varphi_i)$  and  $y_i = \rho_i \sin(\varphi_i)$ .
- the list `ptsXYSorted` is sorted `ptsXY` by the angle of the point in plain.

Task: For a given  $n$ , create list `ptsRhoPhi`. Then create lists `ptsXY` and `ptsXYSorted`. Write the procedure to your notebook.

A hint: You can use *e.g.* `ArcTan` to get the angle from  $x, y$  coordinates.

You can plot the resulted vectors using:

```
ListPlot[{ptsXY, ptsXYSorted}, Joined -> True, AspectRatio -> 1, AxesLabel -> {"x", "y"}, PlotLegends -> {"ptsXY", "ptsXYSorted"}]
```

An example of such a plot can be seen in Figure 1.

**(2 points)**

P3-E Assume a list of pairs,  $\{\{1, 2\}, \{5, 3\}, \{3, 3\}\}$ , and the following procedure:

- 1) take last two elements from the original list: `last` and the one before last, `bLast`. In our case it would be, `last` --  $\{3, 3\}$  and `bLast` --  $\{5, 3\}$ .
- 2) revert vector `bLast`, *i.e.* get  $\{3, 5\}$ ,
- 3) ... and add it to the `last`. *i.e.*  $\{3, 3\} + \{3, 5\}$  produces  $\{6, 8\}$ .
- 4) Append the resulting element ( $\{6, 8\}$ ) at the end of the original list. *i.e.* the new list will be  $\{\{1, 2\}, \{5, 3\}, \{3, 3\}, \{6, 8\}\}$ .

Do the following iteration for the starting list  $\{\{1, 2\}, \{-2, 5\}\}$ . What will be the 15-th element in the list?

Task: Define a function `ff[list_List]` that takes the original list and produces the new list – original with the one new element at the end. And use `Nest` with `ff` to get 15-th element in such a sequence.

**(3 points)**

## 2 Instructions

Complete all the assignments till

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Write your solutions into a notebook called `Problem3_yourusername.nb` and send it to [lukacjo1@fel.cvut.cz](mailto:lukacjo1@fel.cvut.cz) with subject "CAS:HW3". All the problems shall be solved by the students individually. Do not use functions from MATHEMATICA Packages.

Contact us at [lukacjo1@fel.cvut.cz](mailto:lukacjo1@fel.cvut.cz) with any questions. The team of teachers wishes you good luck in solving.