# Problem Set 1

Fall 19

November 16, 2019

## Problem Definition

**Peter:** Dr. Kaw, I am taking a course in manufacturing. We are solving the following problem.

A robot arm with a rapid laser scanner is doing a quick quality check on holes drilled in a 15"$x$10" rectangular plate. The centers of the holes in the plate describe the path the arm needs to take, and the hole centers are located on a Cartesian coordinate system (with the origin at the bottom left corner of the plate) given by the specifications in Table 1. Your job is to plan a *smooth* trajectory for the robot so that it can visit the holes for quality check.

Table 1: Coordinates of the holes in the plate

| X(inches) | Y(inches) |
|---|---|
| 2.00 | 7.2 |
| 4.25 | 7.1 |
| 5.25 | 6.0 |
| 7.81 | 5.0 |
| 9.20 | 3.5 |
| 10.60 | 5.0 |

**Dr. kaw:** Why do you not just join the consecutive points in a straight line; just like the kids do at Pizza Hut with those Connect the dots' activities?

**Peter:** You are making me hungry and I wish it were that easy. *The path of the robot going from one point to another needs to be smooth so as to avoid sharp jerks in the arm that can otherwise create premature wear and tear of the robot arm.*

**Dr. kaw:** As I recall, you took my course in Numerical Methods. What was that-one year ago?

**Peter:** Yes your memory is sharp but my retention from that course-can we not talk about that?

**Dr. kaw:** C'mon it was not that bad! Meet me at the office and maybe we can then have a discussion over a cup of tea.

While they are going at it, why don't you give it a try and estimate the best possible trajectory for the robot to navigate?

## Tasks

1. Estimate the best possible trajectory for the robot by using different interpolating polynomials.
2. Plot the trajectory of the robot in graphs using any Python library(e.g. Matplotlib) you feel comfortable with.
3. Prepare a report justifying the decision which interpolating polynomial you are going to use and why.

## Mark Distribution

Algorithm implementation(Code): 8
Plotting graphs: 1
Reasoning: 1

## Rules

- At the time of evaluation, a group has to bring a printed copy of the report and a laptop for showing the code. All members of a group should be able to explain the code.
- Any type of plagiarism is strongly forbidden. **NO/NEGATIVE** marks will be given to the students who will be found to be involved in plagiarism (from internet/senior/class- mates code etc.).

  **It does not matter who is the server and who is the client.**
- It is expected that all the members of a group will have equal participation in completing the project. If any certain member is not found to be involved in the project, **NO** marks will be provided for that particular member regardless of the group's performance.

## Deadline

Deadline is set at **5 December**, 2019