EECS 16B Designing Information Devices and Systems II
Fall 2017 Miki Lustig and Michel Maharbiz **Homework 10**

This homework is due November 16, 2017, at noon.

1. **Interpolation**

Samples from the sinusoid $f(x) = \sin(0.2\pi x)$ are shown in Figure 1. Draw the results of interpolation using each of the following three methods:

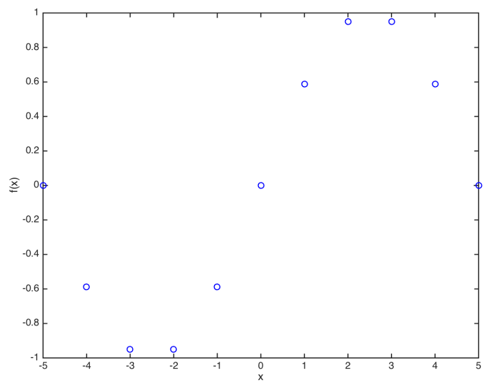

Figure 1: Samples of $f(x)$.

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(a) Zero order hold interpolation.

(b) Linear interpolation.

(c) Sinc interpolation assuming the Nyquist limit has been satisfied.

2. **Polynomial interpolation and regression**

Variometers indicate the rate of climb or descent (vertical velocity) in an aerial vehicle. I have a small variometer sensor that I would like to use on a quadrotor for altitude control. In order to evaluate the sensor's performance, I launch it on a small model rocket and record its measurements. The recorded values are:

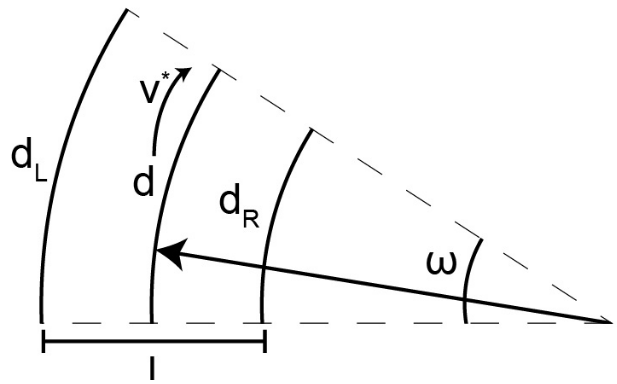
Time (s)	Velocity (m/s)
0	3.75
0.5	-1.5
1.5	-8.5

(a) Perform polynomial inerpolation on these points. Show your work (you can use a computer to do a matrix inverse).

(b) (Optional) The rocket is in freefall, so I expect that it will approximately follow a parabolic trajectory (its flight will not be exactly parabolic due to wind resistance). The velocity profile of a parabolic trajectory is linear. Perform polynomial regression using a first-order polynomial.

3. **Turning via reference tracking**

We would like the car to turn with a specified radius r and speed v^*. The controller's unit for distance is encoder ticks, but each tick is approximately 1 cm of wheel circumference. To turn, we want δ to change at a particular rate. Without loss of generality, we'll analyze a right turn, corresponding to increasing δ. For a left turn, we simply negate δ. Our goal is to generate a reference from the desired r and v^* for the controller to follow. This reference will be a function of the controller's time-step. Inspect the following diagram:



- r - turn radius in cm where 1 cm   1 encoder tick
- ω - angular velocity
- θ - angle traveled
- d - distance traveled by the center of the car in ticks
- l - distance between the centers of the wheels in cm

From this geometry, can you write $\delta[k]$ in the following form?

$$\delta[k] = f(r, v^*, l, k)$$

4. **Redo problem 1 on the midterm**

5. **Redo problem 2 on the midterm**

6. **Redo problem 3 on the midterm**

7. **Redo problem 4 on the midterm**

8. **Redo problem 5 on the midterm**

Contributors:

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