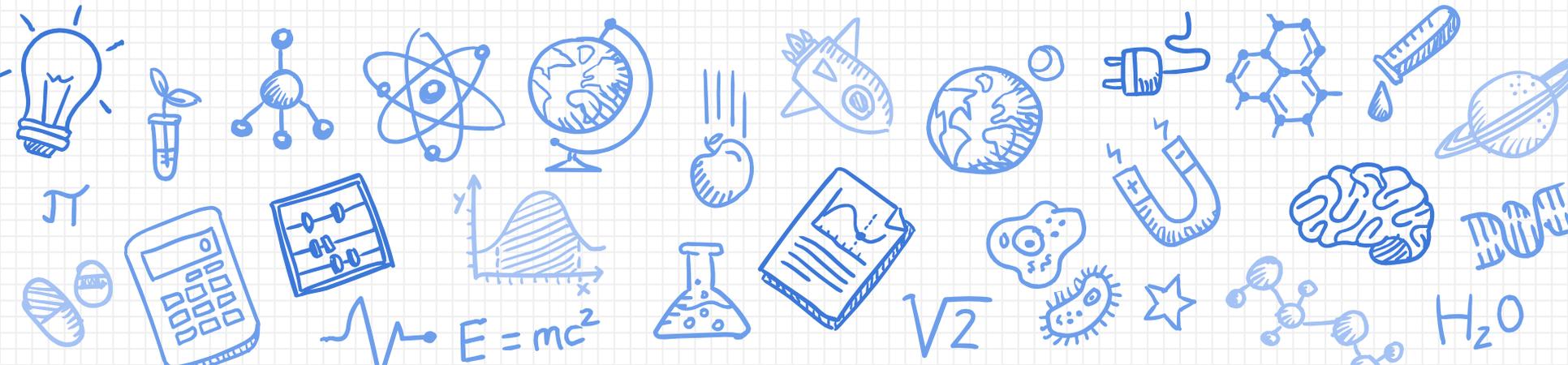


# EE16A Lab: APS 2

GSI: Angela Ko

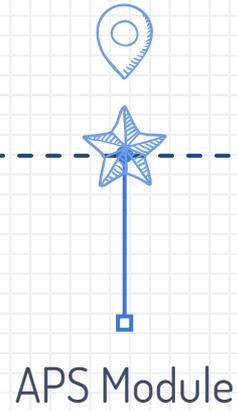
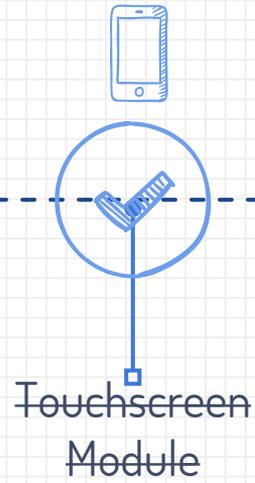
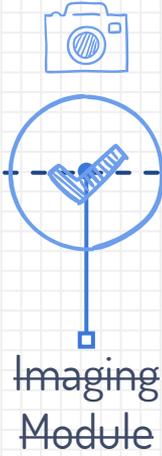
Lab Assistants: Nick, Hersh, Gary





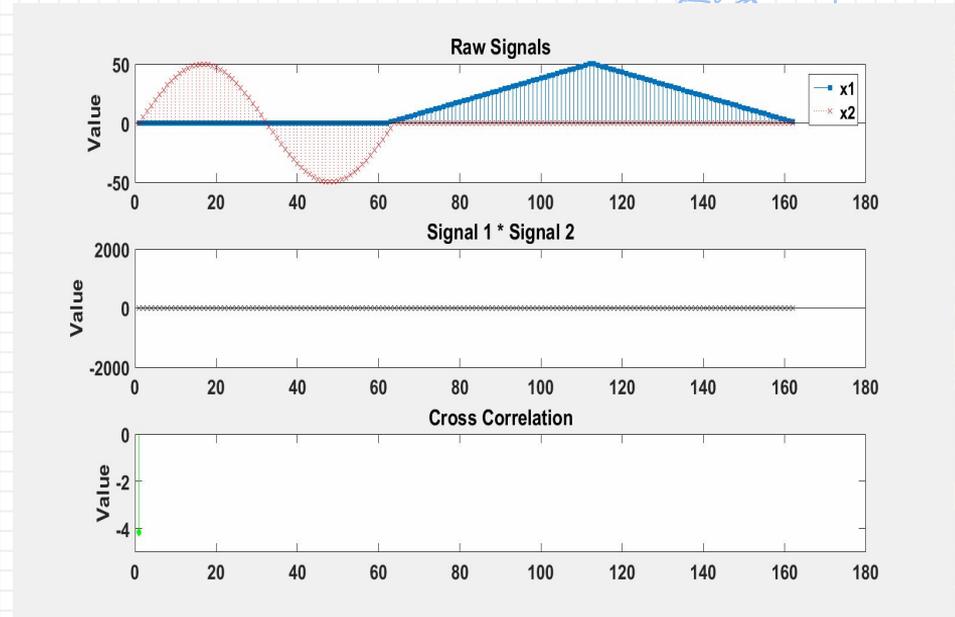


# Semester Outline



# Last lab

- ✗ Cross Correlation
  - ✗ Similarity between signals
  - ✗ Separate signals
  - ✗ Find index where signal arrived
- ✗ Signal arrival time → distance
  - ✗ How can we do this?





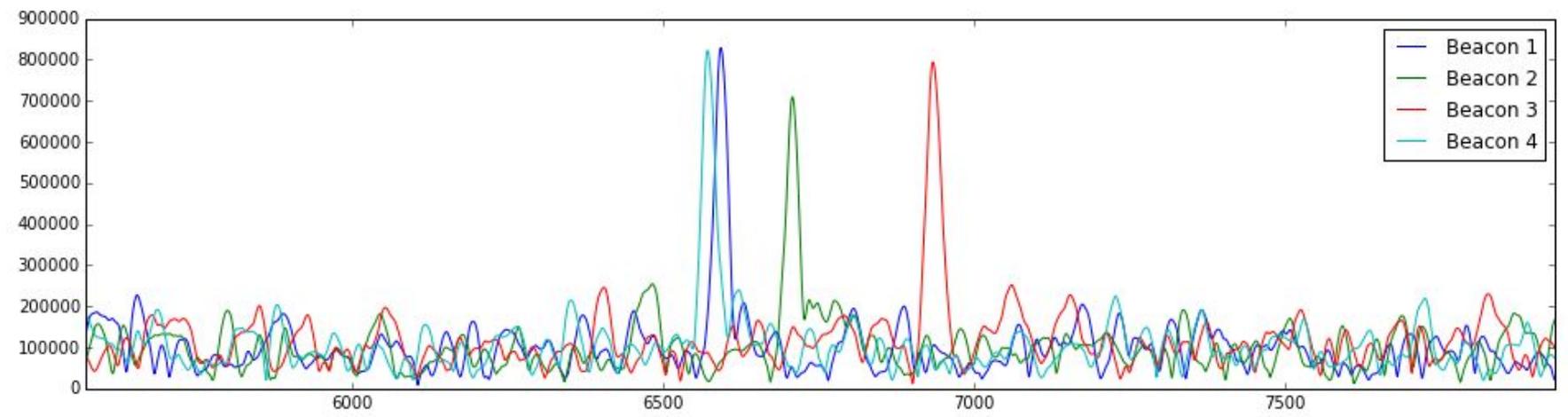
# Task 1: Separating Beacons

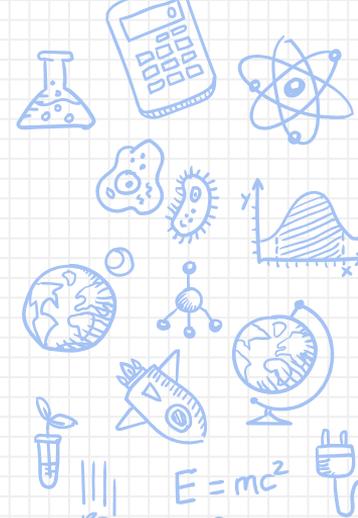
---

def separate\_signal(raw\_signal):

Input: raw signal from microphone

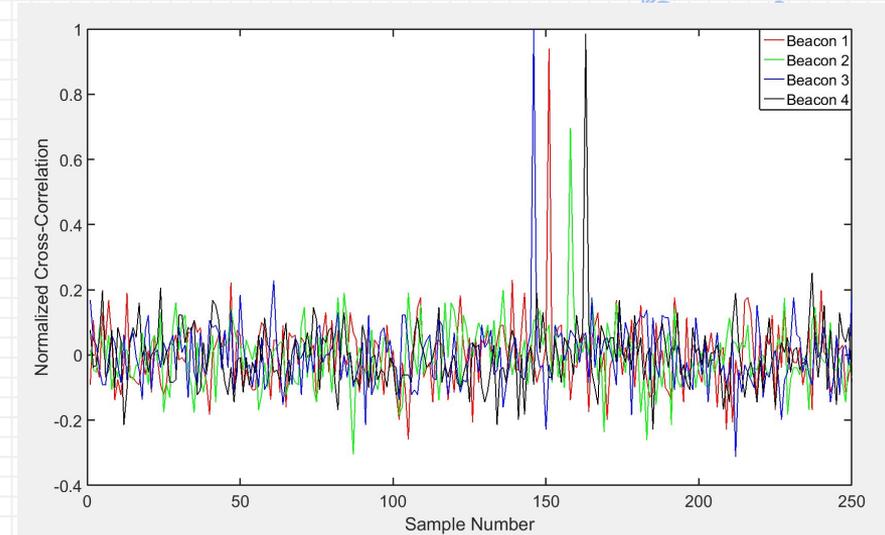
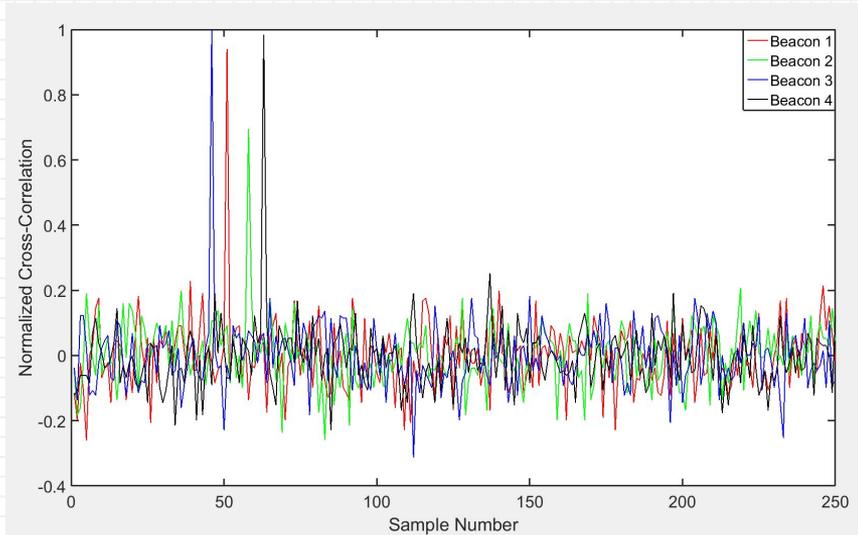
Output: list of cross-correlations of raw signal with each beacon signal

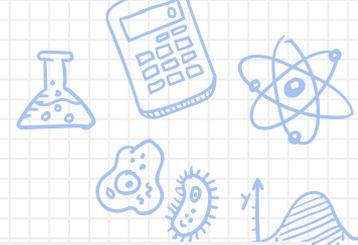




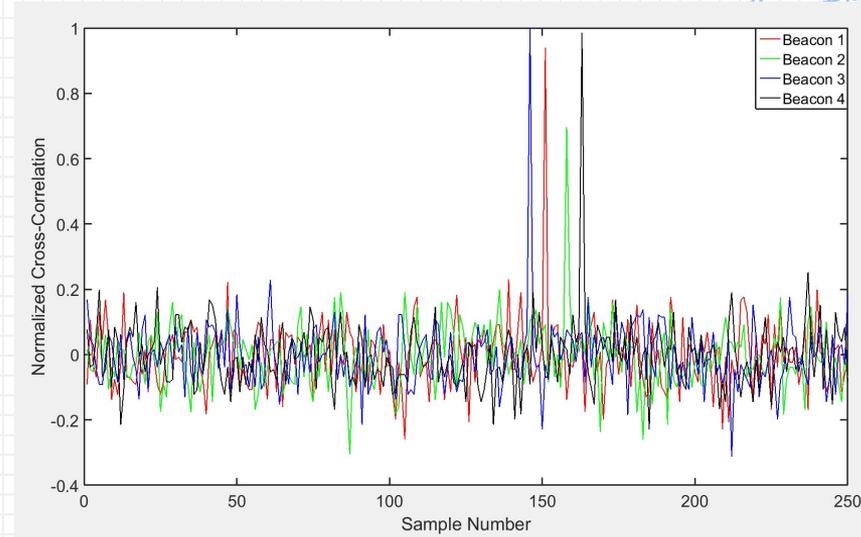
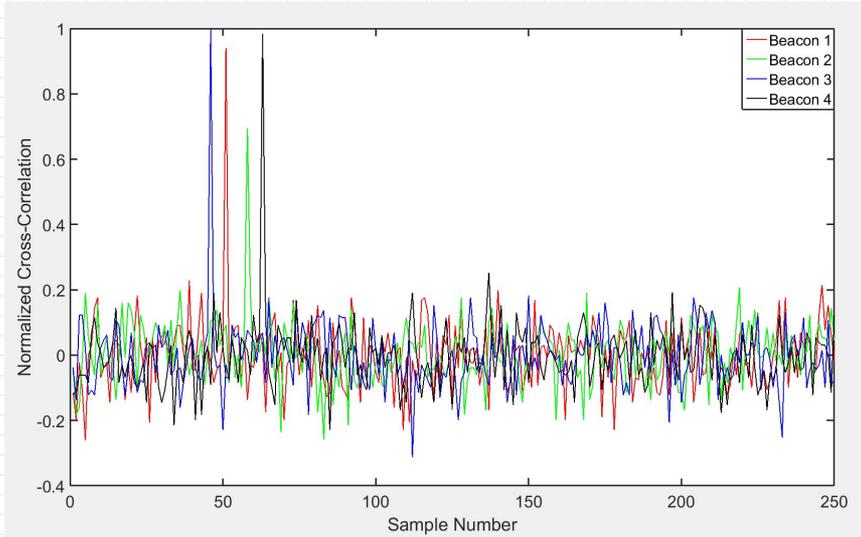
## Issue With APS System

- ✘ Beacons signal every 230ms
- ✘ Don't know when the signals were actually sent
- ✘ Cannot use beginning of recording as a reference



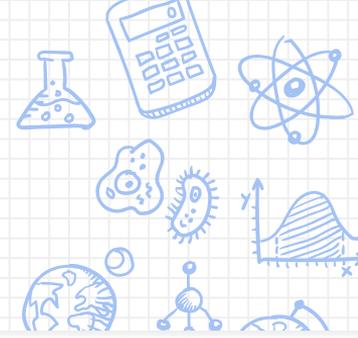


## Task 2a: Computing Distances



- ✘ Use a particular beacon as a reference
- ✘ Find offsets of other beacons with respect to reference beacon
- ✘ Turn these offsets into time difference of arrival (TDOA) then distances

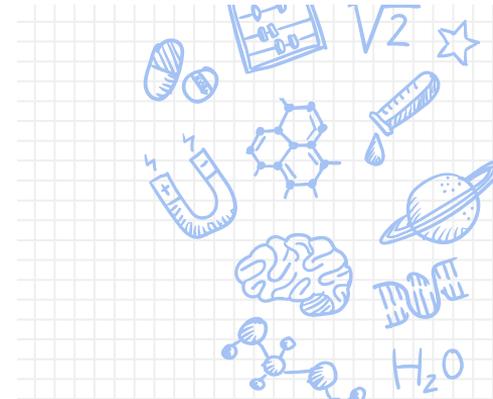
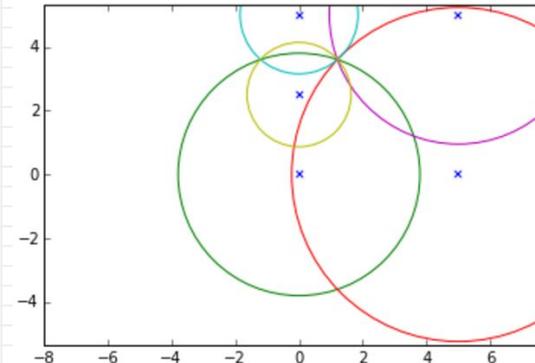
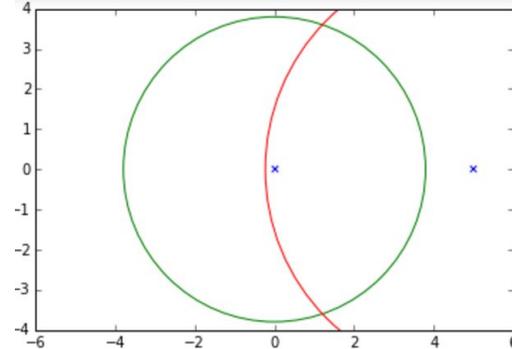
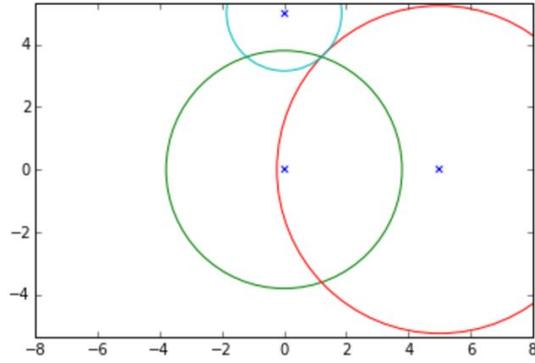




# Number of Beacons

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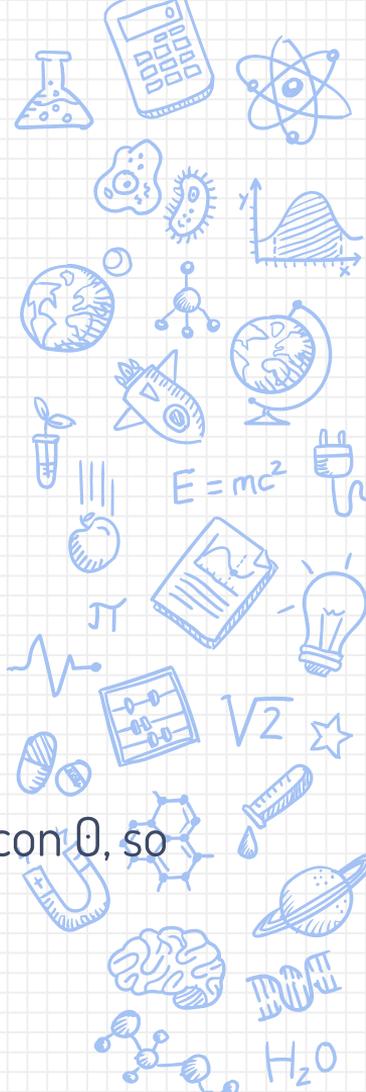
- ✘ What is the difference among using 2, 3 and 5 beacons?
- ✘ Any benefit to using more?
- ✘ What do the circles represent?
- ✘ What do their intersections represent?



## Today:

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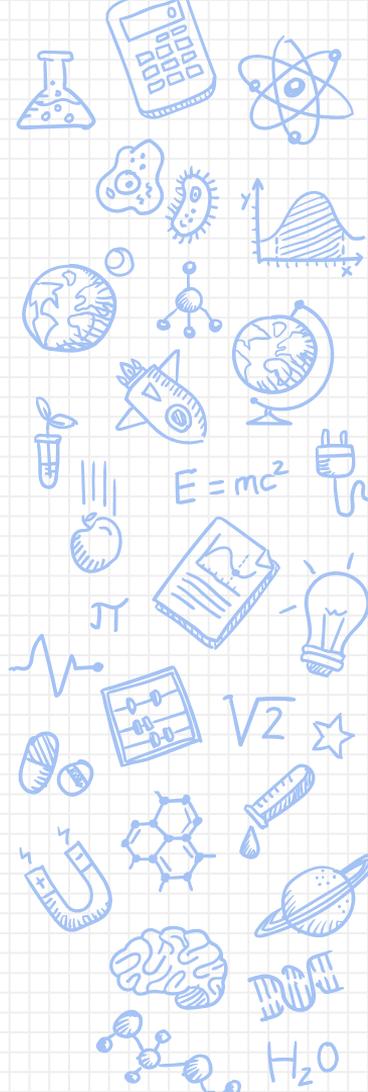
- ✘ Relative difference in arrival times is preserved
- ✘ Pick a beacon to be the reference
  - ✘ WLOG, beacon 0
- ✘ Compute difference in times of flight / distance to speakers:
  - ✘ Signal from beacon  $i > 0$  arrived  $x$  seconds after that of beacon 0, so beacon  $i$  is  $y$  metres farther away than beacon 0.



## Notes:

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- ✘ If we knew distance / time of flight for beacon 0, finding location is easy
- ✘ Today this value will be given to you for testing purposes
- ✘ In the real system, we still won't know this
  - ✘ Turns out we don't need to -- next week!



## Notes

- ✘ Plug the microphone in before starting your iPython notebook to avoid having to restart the kernel later on.
- ✘ Don't forget to copy over APS 1.py from Lab 1!
  - ✘ If you saved the file locally, you will need to go to the station you were at last week and move the file into the U: drive :
  - ✘ Type **U:** into command prompt

**Check off:** [tinyurl.com/sp17-lab-checkoff](https://tinyurl.com/sp17-lab-checkoff)

**Form:** [tinyurl.com/lab16-sp17-form](https://tinyurl.com/lab16-sp17-form)

**Queue:** [tinyurl.com/lab16-sp17-queue](https://tinyurl.com/lab16-sp17-queue)

**Spotify:** [tinyurl.com/116-spotify](https://tinyurl.com/116-spotify)

