In groups (please register)

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thu, Apr 25</td>
<td>Project Discussion</td>
</tr>
<tr>
<td>Tue, Apr 30</td>
<td>Lab Lecture: Introduction to Robots</td>
</tr>
<tr>
<td>Thu, May 2</td>
<td>Lab Lecture: Introduction to Robots</td>
</tr>
<tr>
<td>Mon-Thurs, May 6-9</td>
<td>Office Hours: Individual Group Meetings</td>
</tr>
<tr>
<td>Tue, May 7</td>
<td>Lab Lecture: Experiments with Robots</td>
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<tr>
<td>Thu, May 9</td>
<td>Lab Lecture: Experiments with Robots</td>
</tr>
<tr>
<td>Mon-Wed, May 13-15</td>
<td>Office Hours: Individual Group Meetings</td>
</tr>
<tr>
<td>Tue, May 14</td>
<td>Project Updates</td>
</tr>
<tr>
<td>Thu, May 16</td>
<td>Project Updates</td>
</tr>
<tr>
<td>Tue, May 21</td>
<td>In-class Individual Group Meetings</td>
</tr>
<tr>
<td>Thu, May 23</td>
<td>In-class Individual Group Meetings</td>
</tr>
<tr>
<td>Tue, May 28</td>
<td>In-class Individual Group Meetings</td>
</tr>
<tr>
<td>Thu, May 30</td>
<td>In-class Individual Group Meetings</td>
</tr>
<tr>
<td>Tue, June 4</td>
<td>Final Project Updates</td>
</tr>
</tbody>
</table>

HW3 due

Whole class attendance (register for presentation time slot)

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>Thu, June 6</td>
<td>Project Demonstrations (start at 2:30pm)</td>
</tr>
</tbody>
</table>
Cameras and Vision system

Cs225a - 2019
Mikael Jorda
Hardware

- RGB camera
  - Logitech webcam
- RGBD camera
  - Kinect
- Motion tracking system
  - (cameras + reflexive markers)
  - Optitrack
Software

OpenCV
Motive Body

1. Place Markers on your objects to track
2. Regroup markers into rigid bodies
3. Track the position and orientation of rigid bodies
4. Broadcast to the network and write to redis
5. Read in your controller from redis
OpenCV

1. Place your camera (fixed in environment or robot)
2. Calibrate your camera (camera intrinsic and extrinsic parameters)
3. Write a program to process the images and extract the useful information (position of an object …)
4. Write this useful information to Redis
5. Read in your controller from Redis
OpenCV Tutorials

- [https://opencv.org/](https://opencv.org/)

- In Python or C++
  - C++: [https://docs.opencv.org/master/d9/df8/tutorial_root.html](https://docs.opencv.org/master/d9/df8/tutorial_root.html)
Modules you need to look at

- Core module: Basic images operations, manipulate images as computer objects.
- Claib3d module: Camera calibration.

- **C++**:
  - [https://docs.opencv.org/master/de/d7a/tutorial_table_of_content_core.html](https://docs.opencv.org/master/de/d7a/tutorial_table_of_content_core.html)

- **Python**:
Useful functions

- Image Processing Module:
  - Tresholding
  - Hough Line transform
  - Hough Circle transform
Useful Functions

- **Image Processing Module**:
  - Canny Edge detector

- **2d Features Module**:
  - Corner detection
    - Harris
    - Shi-Tomasi
More Advanced Functions

- Contour segmentation
  - https://github.com/AdityaPai2398/Colour-Segmentation-in-OpenCV
- Image segmentation
- Object detection Module
- Machine learning Module
- Deep Neural Networks Module

There are a lot of resources you can find on openCV webpage and also on github