CS 188 Robotics Week 1

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Robots

What is a robot

- "A robot is defined as intelligence embodied in an engineered construct, with the ability to process information, sense, plan, and move within or substantially alter its working environment.

FILL

- Therefore, the following count as robots:
  - Roombas
  - Automatic sliding doors (which may use facial recognition, or just a simple proximity sensor)

Robotics

- Robots must be able to move (physically), or interact with its environment in some way. There are three sectors of robotics:
  - **Kinematics**: the study of motion *without* considering forces or torques
  - **Dynamics**: the study of motion considering the forces and torques that caused it.
  - **Control**: how to execute the desired motion
  - **Perception**: how to understand the world using sensors
  - **Planning**: how to reach a goal

Course Objectives

[FILL format]

- Develop a foundational understanding of kinematics, dynamics, and control for modeling and managing robotic motion
- Become familiar with sensors and pereption algorithms to interpret environmental data for robotic decision-making
- Understand principles of state estimation, as well as task and motion planning, to enable reliable and efficient robot behaviors.

- Explore basic ideas of AI in robotics, including imitation learning and human-robot interactions, for advanced autonomous capabilities.
- Gain hands-on experience in simulation tools to design, test, and refine robitic systems in a virtual environment
- Reflect on the ethical implications of robotics, fostering responsible development and deployment [FILL]

Designing a Robot

Considerations:

1. Tasks and Operating Environments
    - Define specific tasks the robot will perform.
    - Analyze working environments: indoor/outdoor, structured/unstructured, temperature, terrain, obstacles, etc.
2. Hardware Design
    - Mechanical Structure: Chassis, joints, degrees of freedom
    - Actuators: Motors, servos, pneumatic or hydraulic systems
    - Power System: Battery type, power efficiency, backup options
3. Firmware and Embedded Systems
    - Computing Units: Microcontrollers, onboard processors
    - Sensor integration: Cameras, IMUs, LiDAR, GPS, force sensors
    - Communication Interfaces: Wired/wireless protocols (e.g., I2C, SPI, UART, CAN, Wi-Fi, Bluetooth)
4. Software Architecture
    - Control Algorithms: Motion planning, PID control, pathfinding
    - Autonomy and Intelligence: SLAM, AI/ML models, obstacle avoidance
    - User Interface: Remote control, dashboards, or autonomous modes.