What is a robot?

- Mechanicality
- Sensitivity
- potency
- intelligence
- artificiality
- autonomy

Are the following robots

- ✓ Roomba
- ✗ Desktop Computer
- HVAC System
- ✗ Toilet Tank
- ✗ Car
- ✗ Robot Simulation
- 3D printer

Why Robots

- Autonomy
- Repetitive work
- Dangerous
- Dull
- Dirty
- Speed
- Precision
- Economics

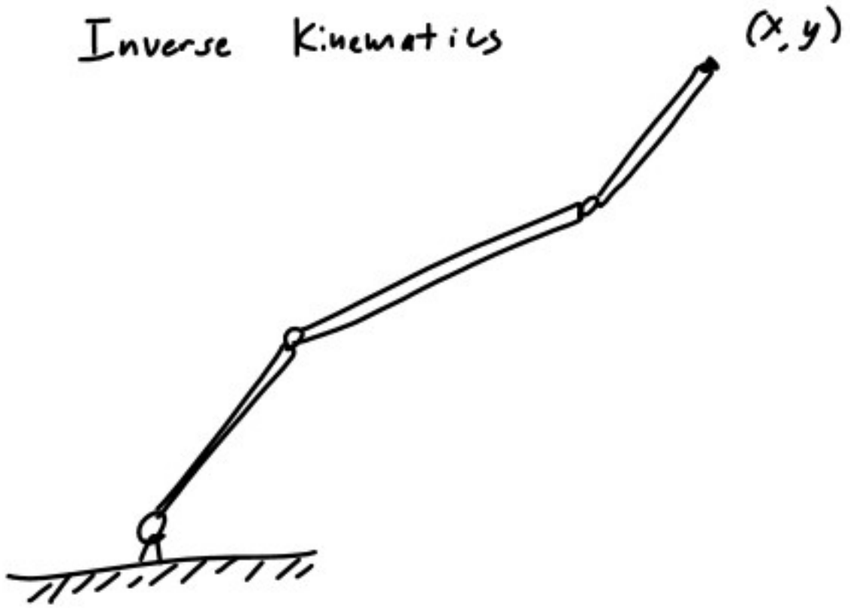
Mechanicality

Mobile Robots

- Locomotion
  - Rolling
    - wheels
    - tracks
  - walking
  - Flying
  - Swimming
  - Jumping
  - Slithering

Serial Kinematic Manipulators

- Kinematics
- Inverse Kinematics



Sensitivity

Sensors

Transducer

proprioceptive vs exteroceptive

passive vs active

examples

temperature sensor

force/pressure senson

switch

Gyroscope/Accelerometer

Fish finder

GPS

Ultra-sonic

Camera

Laser

Rador

Encoders

Sensor Fusion

Probability

Discrete Random Variables

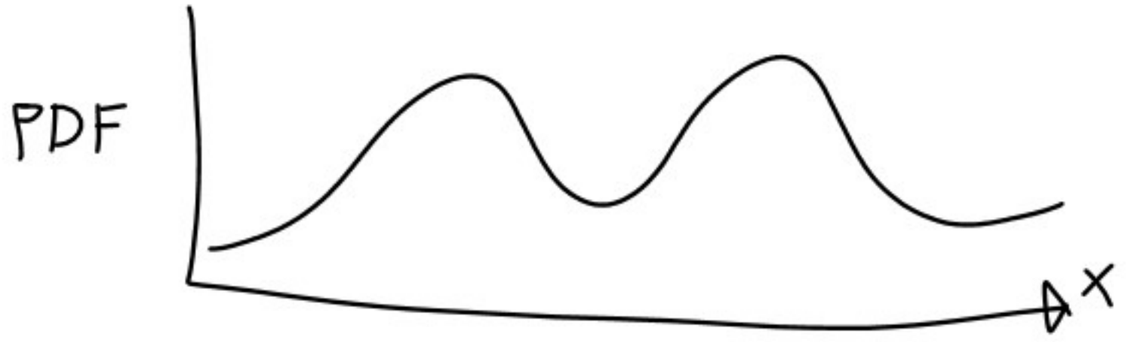
$p(X = \text{heads}) = 0.5$

$\sum_x p(X = x) = 1$

$p(X = \text{tails}) = 0.5$

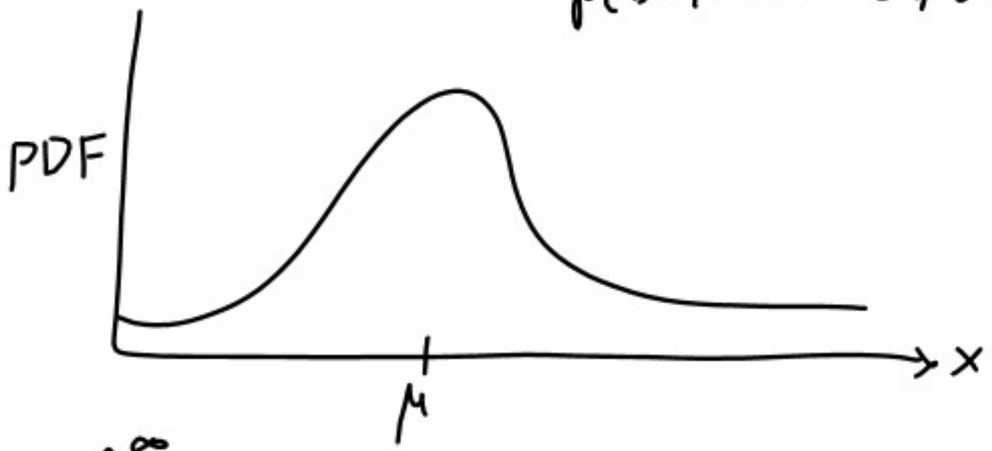
Robot Localization

Continuous Random Variable



Gaussian

$$p(x) = (2\pi\sigma)^{-1/2} \exp\left(-\frac{1}{2}\frac{(x-\mu)^2}{\sigma^2}\right)$$



$$\int_{-\infty}^{\infty} p(x)\,dx = 1$$

$$p(x) = dt + (2\pi\Sigma)^{-1/2} \exp\left(\frac{-1}{2}(x-\mu)^T \Sigma^{-1}(x-\mu)\right)$$

$$\mathbb{X} \in N(\mu, \Sigma)$$

Conditional Probability

$$p(x \mid y) = p(X = x \mid Y = y)$$

Bayes Rule

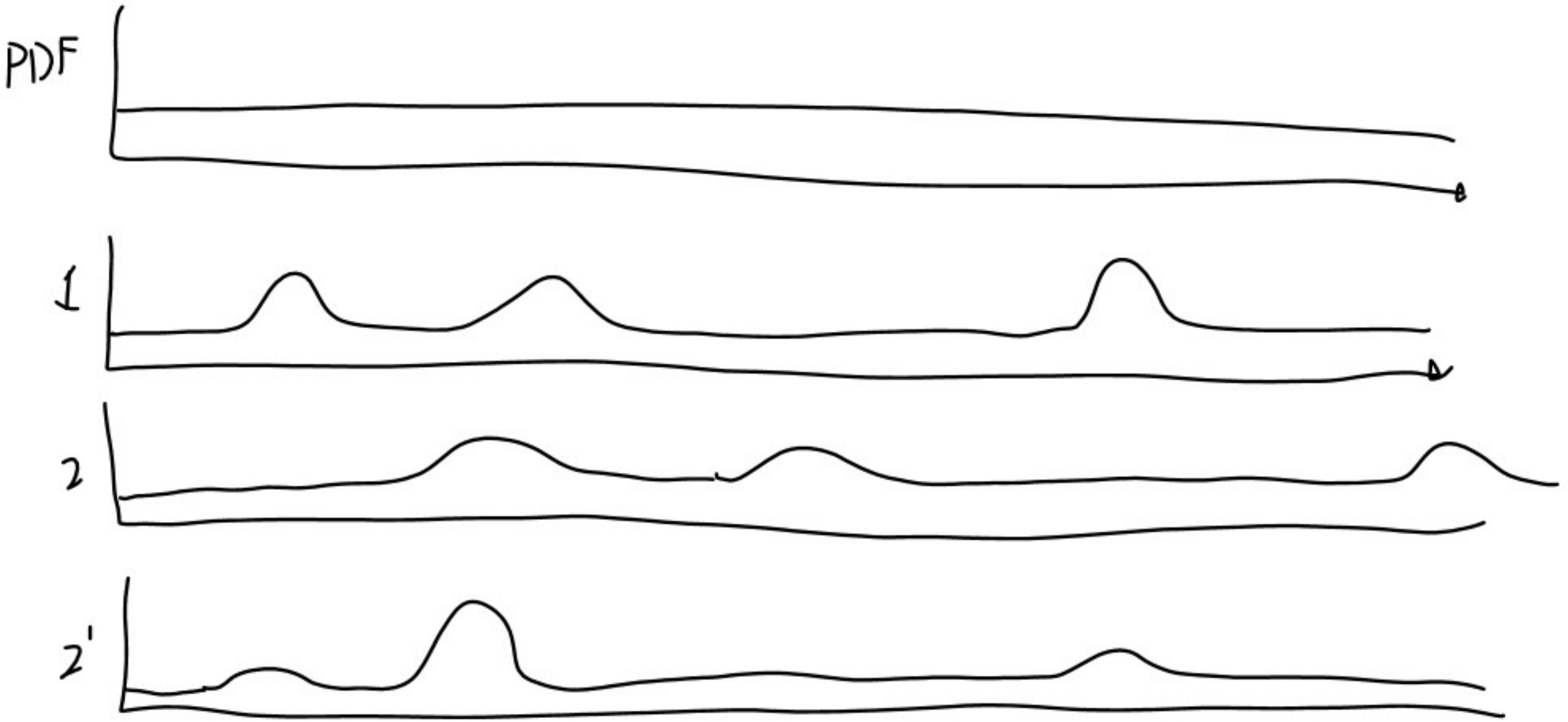
$$p(x \mid y) = \frac{p(y \mid x)\, p(x)}{p(y)}$$

Expectation

$$E[X] = \sum_x x\, p(x)$$

$$= \int x\, p(x)\, dx$$

Markov Localization



$$p(\text{at door} \mid \text{sensed door}, \text{location}) = \frac{p(\text{sensed door} \mid \text{at door}, \text{location})\ p(\text{at door} \mid \text{location})}{p(\text{sensed door} \mid \text{location})}$$