CSCI 1108

Localization

Where am I

- Localization is one of the fundamental problems in robotics
- This includes the terrestrial coordinates of a mobile robot as well as the pose of a robot
- Modern solution: Bayes Localization
- Principle method for SLAM (simultaneous mapping and localization)

- We can use two ways to “measure” where we are:

Sensor Model

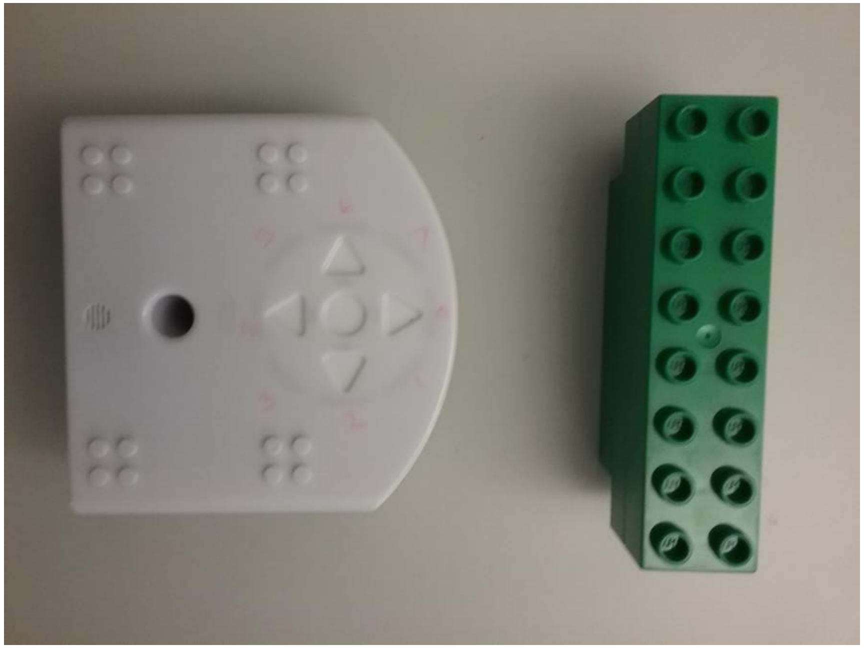
We can use a sensor to tell us where we are such as the distance from a known object

For example sensor model: $x(t) = x_0 + 3 * s(t)$

X(t)= estimated position at time t

X_0 = bias parameter

S(t) = sensor value at time t



Motion model

- If we know our initial position and move the robot by a specific motor command, then we can keep track (calculate) the new position

Example motion model: $x(t) = x(t-1) + v*t$

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motor.left.target = speed
motor.right.target = speed
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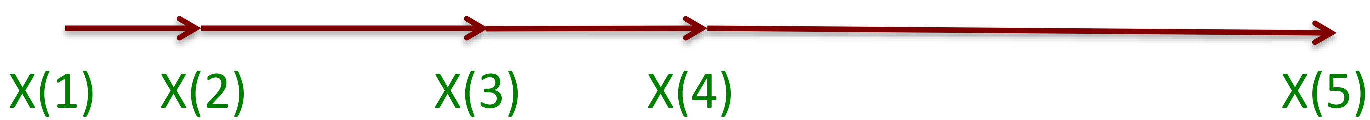
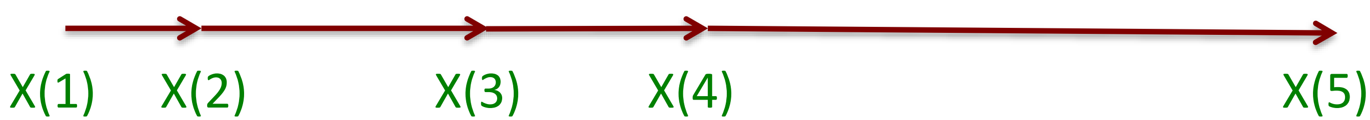


Motion model with Sensor reading

- There are usually even more option, such as using an odometer to measure the velocity instead of assuming it from the motor command

Example motion model: $x(t) = x(t-1) + v*t$

velocity measure



This is also called dead reckoning in robotics or path-integration

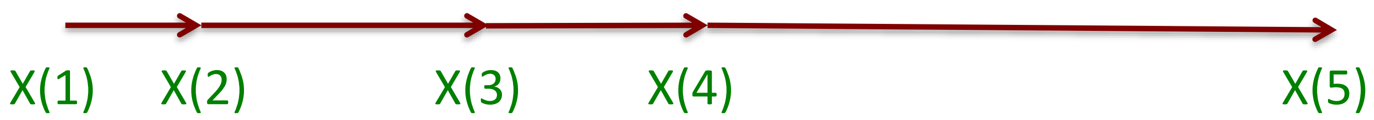
Model (Sensor) Fusion

- What do we do when the different methods of estimating the position localization disagree?

→ Principle Idea: Combine the information proportionally to how much you trust them (uncertainty, probability)

Point Estimate vs Probability Map

- In previous example we estimate the most likely position, which then is the starting point for the next step
  Observation: error will add up over time



- Better method: Keep track of all possible positions and their probability

Probability Distributions

- Discrete versus continuous events

  For example states versus location

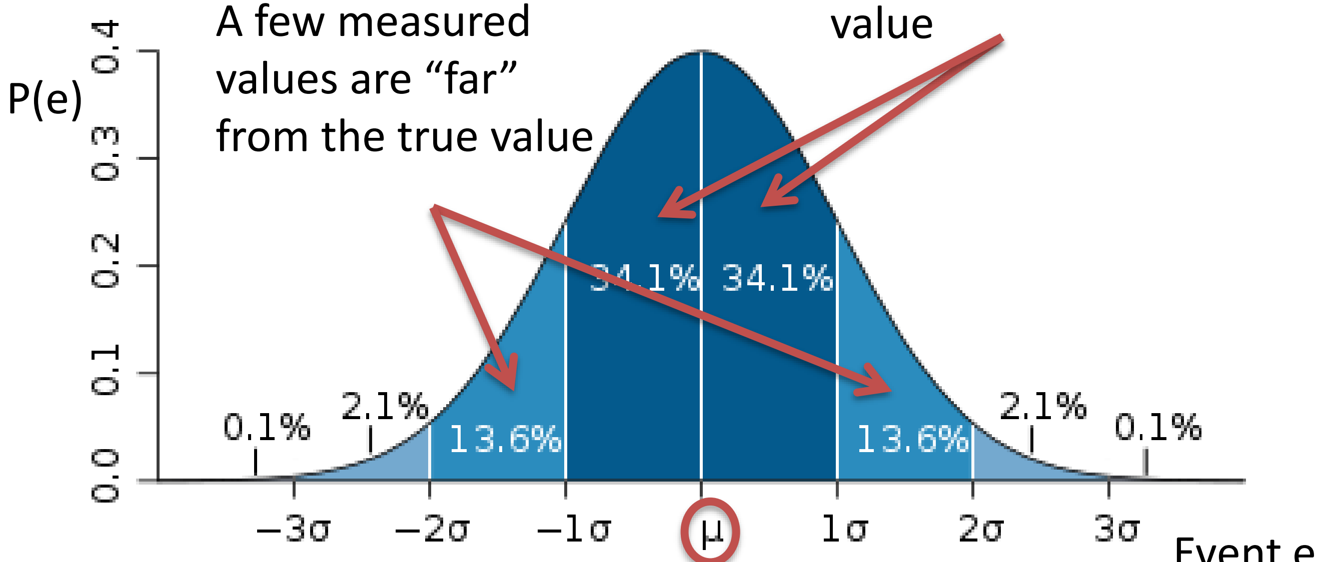
- Uniform

  Example: Rolling a dice

- Normal

Most measured values are “close” to the true value

A few measured values are “far” from the true value



http://en.wikipedia.org/wiki/File:Standard_deviation_diagram.svg

Probability

- Probability P(e) is a specification how likely the event e is

- Measured by fraction between P(e)=0 (event does not happen) and P(e)=1 (certainty)

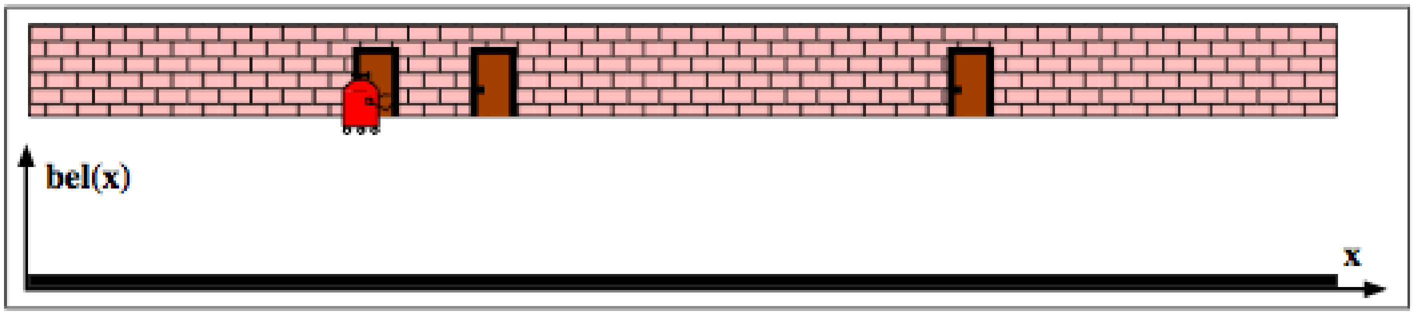
- Aseba allows only integer number

  Solution: multiply by 100 and hence measure in percentage: P(e)= (P in percent) / 100

- Can you multiply with another number?

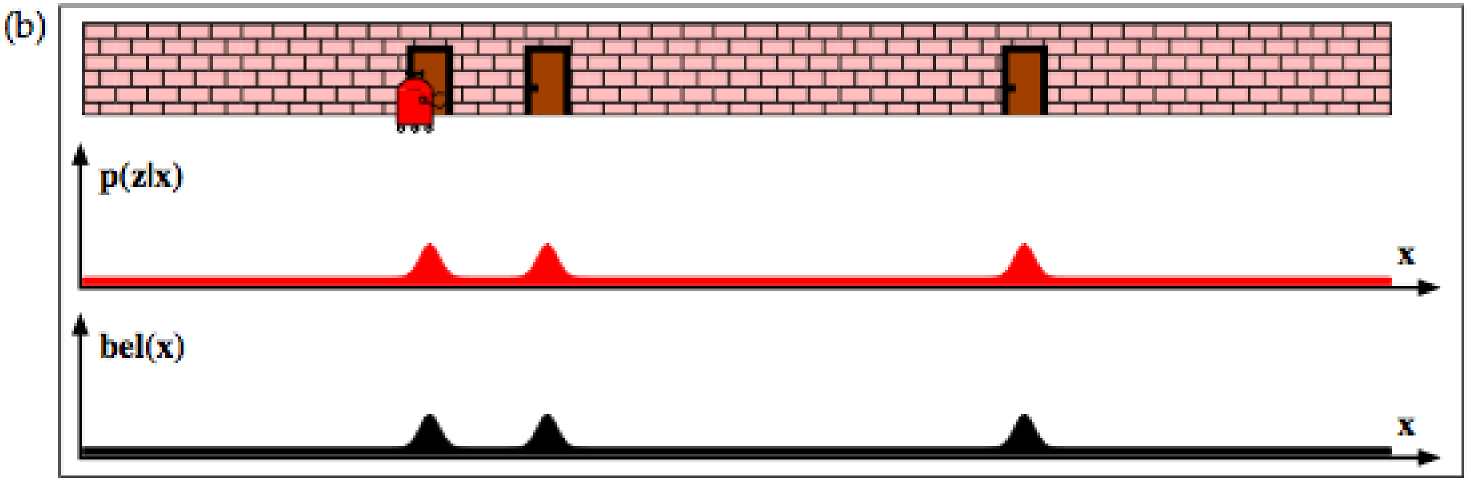
Markov Localization

(a)



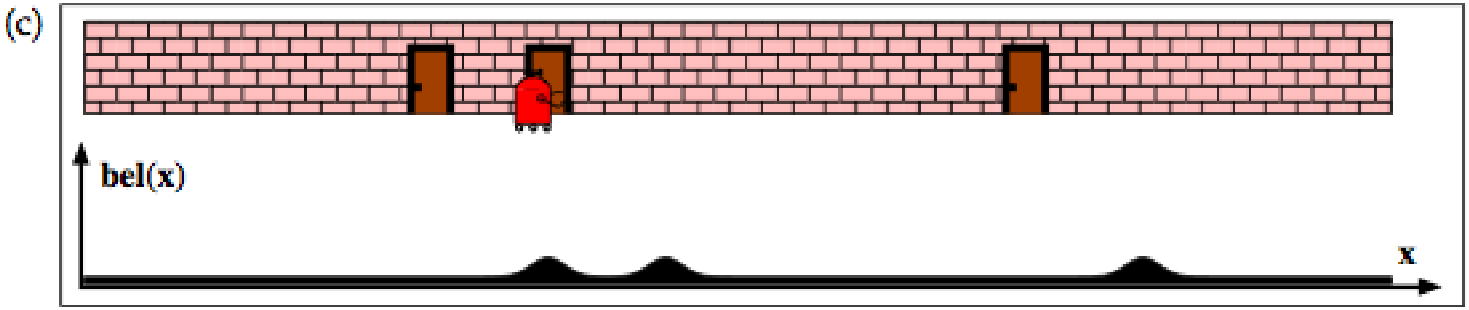
The robot doesn't know where it is. Thus, a reasonable initial believe of it's position is a uniform distribution.

Markov Localization



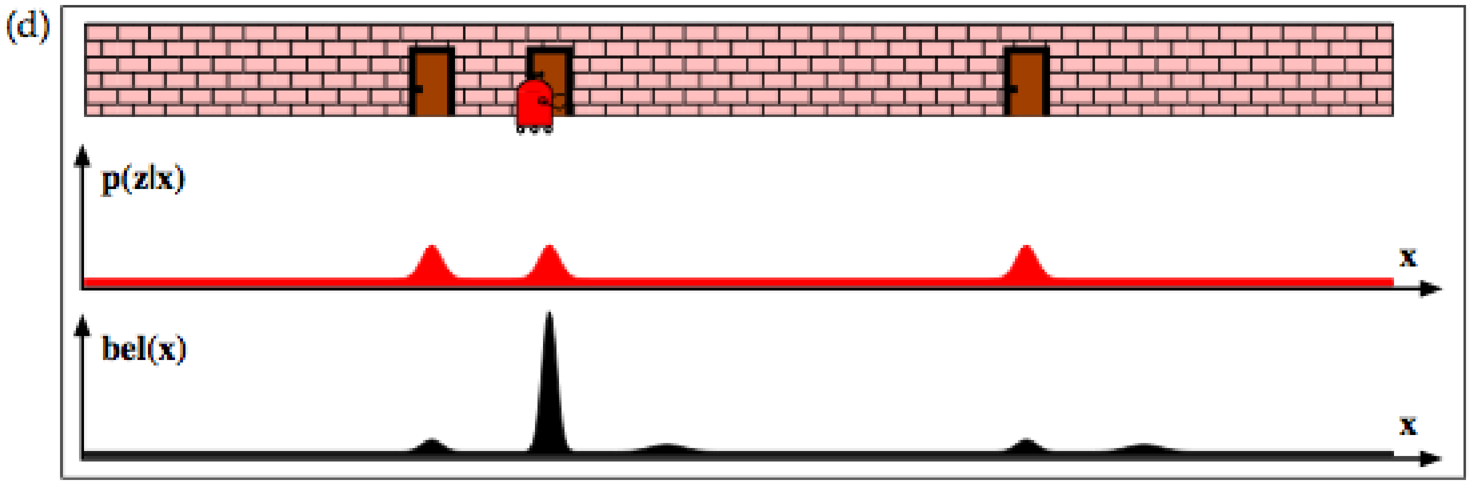
A sensor reading is made (USE SENSOR MODEL) indicating a door at certain locations (USE MAP). This sensor reading should be integrated with prior believe to update our believe (USE BAYES).

Markov Localization



The robot is moving (USE MOTION MODEL) which adds noise.

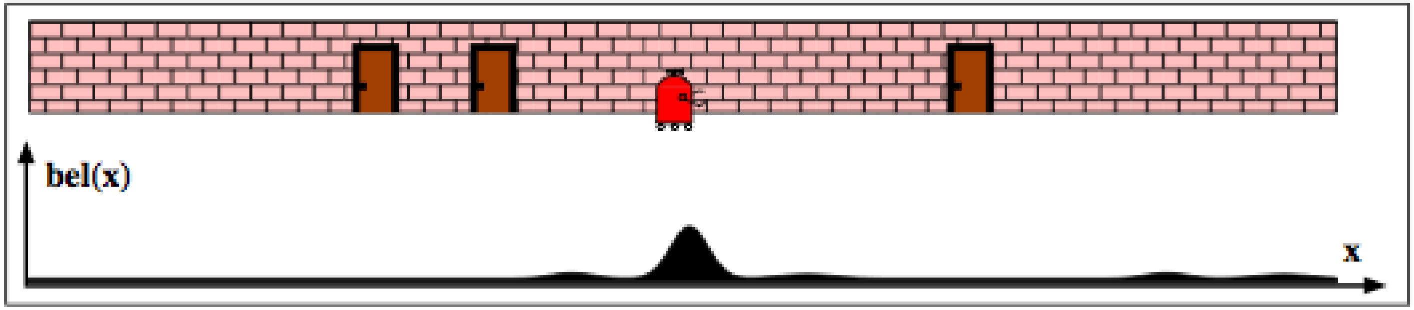
Markov Localization



A new sensor reading (USE SENSOR MODEL) indicates a door at certain locations (USE MAP). This sensor reading should be integrated with prior believe to update our believe (USE BAYES).

Markov Localization

(e)



The robot is moving (USE MOTION MODEL) which adds noise. …

Localization Tutorial