State Estimation

The Big Ideas:	- State Estimation is the process of: - Taking the three defining elements of a Stochastic State Machine model - Observing and noting the actions taken relevant to that Stochastic State Machine, and - Using that information along with the three defining elements of the model of the Stochastic State Machine to - Make an estimate of the current state - State Estimation can be performed with a reduced number of computations

Introduction

Last week, we introduced probability and the basic tools to interact with probability distributions. We use probability to model degrees of belief, so that we can build systems that are robust in the face of uncertainty.

This week, we focus on state estimation. We'll use state estimation to make estimates of the internal state of a stochastic state machine. We'll also optimize that relationship. Instead of marginalizing out a behavior after solving for an entire probability table, we will normalize the conditional distribution at during each step of state estimation.

We'll use state estimation to estimate the location of a robot in a hallway, and use it to localize a robot. Later we'll be able to localize and map at the same time.

Vocabulary

In order to engage the material, be able to communicate about the topic with others, and in particular ask questions, we encourage familiarity with the following terms:

Theory

- Stochastic State Machine model
    - Initial distribution
    - State transition model
    - Observation model
- Belief state
- State estimation
- Normalization
- Marginalization

Practice

- State Estimator
- bayesEvidence

- Bayes evidence update
- Law of total probability
- normalizing
- localization
- discretization
- totalProbability
- dictCopy
- function call
- optimization
- naiveBayes

Check Yourself

Theory: you should understand:

- State Estimation
- Algorithm optimization

Practice: you should be able to:

- Identify the necessary parts of a piece of code, given a spec that is not already pseudocode
- Identify when probabilities can be normalized
- Identify the number of function calls used as a consequence of running a piece of code

Resources

Theory:

Chapter 7 of the 6.01 Course Notes is the official assigned reading for this week. In particular, the latter half concerning State Estimation is relevant to this week's assignments.

Practice:

The 6.01 Software Documentation will come in handy, in particular modules `dist`, `ssm` and `dist.DDist`.

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