CS 165A Discussion 1
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General Contact Info

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- Post questions on Piazza to get the most help.

About the section

Section will be a combination of:

- Lecture slides review
- Extra examples
- Homework help
- Exam & exam review
- Q&A
- What else…?

About the section

- Bring your questions
- Stop me anytime for question, clarification …
- Help your peers

Outline

- Rational agent
- Task environment
- Probability review
- Q&A

Agents

- Definition from textbook:

An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators.

Rational agent

- Definition from wiki:

A rational agent is an agent that has clear preference, models uncertainty via expected values of variables or functions of variables, and always chooses to perform the action with the optimal expected outcome for itself from among all feasible actions.

Rationality

- Maximize performance measure, given the evidence/knowledge
- What is rational at any given time depends on four things:
  - The performance measure that defines the criterion of success.
  - The agent’s prior knowledge of the environment.
  - The actions that the agent can perform.
  - The agent’s percept sequence to date.

Agent Questions (T/F?)

- An agent that senses only partial information about the state cannot be perfectly rational.
- There exist task environments in which no pure reflex agent can behave rationally.
- There exists a task environment in which every agent is rational.
- It is possible for a given agent to be perfectly rational in two distinct task environments.
- Every agent is rational in an unobservable environment.
- A perfectly rational poker-playing agent never loses.

- An agent that senses only partial information about the state cannot be perfectly rational.

False. Perfect rationality refers to the ability to make good decisions given the sensor information received.

- There exist task environments in which no pure reflex agent can behave rationally.

  True. A pure reflex agent ignores previous percepts, so cannot obtain an optimal state estimate in a partially observable environment.

- There exists a task environment in which every agent is rational.

  True. Eg, in an environment with a single state, such that all actions have the same reward, it doesn’t matter which action is taken.

- It is possible for a given agent to be perfectly rational in two distinct task environments.

  True. For example, we can arbitrarily modify the parts of the environment that are unreachable by any optimal policy as long as they stay unreachable.

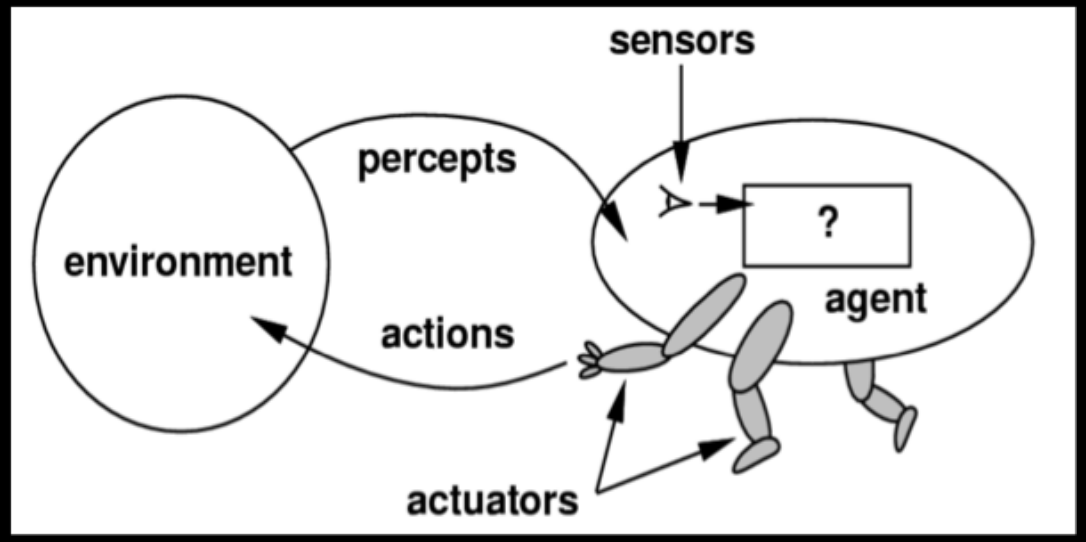
- Every agent is rational in an unobservable environment.

  False. Some actions are stupid—and the agent may know this if it has a model of the environment—even if one cannot perceive the environment state.

- A perfectly rational poker-playing agent never loses.

  False. Unless it draws the perfect hand, the agent can always lose if an opponent has better cards. This can happen for game after game. The correct statement is that the agent's expected winnings are nonnegative.

Task Environment -specifying



- Performance measure
- Environment
- Actuator
- Sensor

Taxi driver example

- P: fast, legal, comfortable trip, maximize profit
- E: Road, other traffic, pedestrian, customer
- A: Steering, Accelerator, brake, signal, horn, display
- S: Camera, sonar, speedometer, GPS, odometer, engine sensor, keyboard

Task environment-properties

- **Fully Observable vs Partially observable**: can the agent sense the entire environment or just a part of it
- **Deterministic vs stochastic**: is the next state of the environment determined by the current state and action of agent or is it random
- **Episodic vs sequential**: does the current decision effect all future decisions?
- **Static vs. dynamic**: environment change while agent is thinking ?
- **Discrete vs continuous**: are there a finite number of distinct state
- **Single agent vs multi agent**: is something or someone else interfering with your environment?

What about the taxi driver task environment?

- Partially,
- Stochastic
- Sequential
- Dynamic
- Continuous
- Multi agent

Probability

- Marginal, or Prior Probability:

  Probabilities associated with a proposition or variable, prior to any evidence.

Conditional, or Posterior Probability:

Probability after evidence is gathered.

The Bayes' Rule

Conditional Probability: $\mathrm{P}(X|Y) = \frac{P(X,Y)}{P(Y)}$

$$\mathrm{P}(Y|X) = \frac{P(Y,X)}{P(X)}$$

Bayes Rule: $\mathrm{P}(X|Y) = \frac{P(Y|X)P(X)}{P(Y)}$

Exercise from instructor's slide

P(X,Y)

	x_1	x_2	x_3
y_1	0.2	0.1	0.1
y_2	0.1	0.2	0.3

P(X)

x_1	x_2	x_3
0.3	0.3	0.4

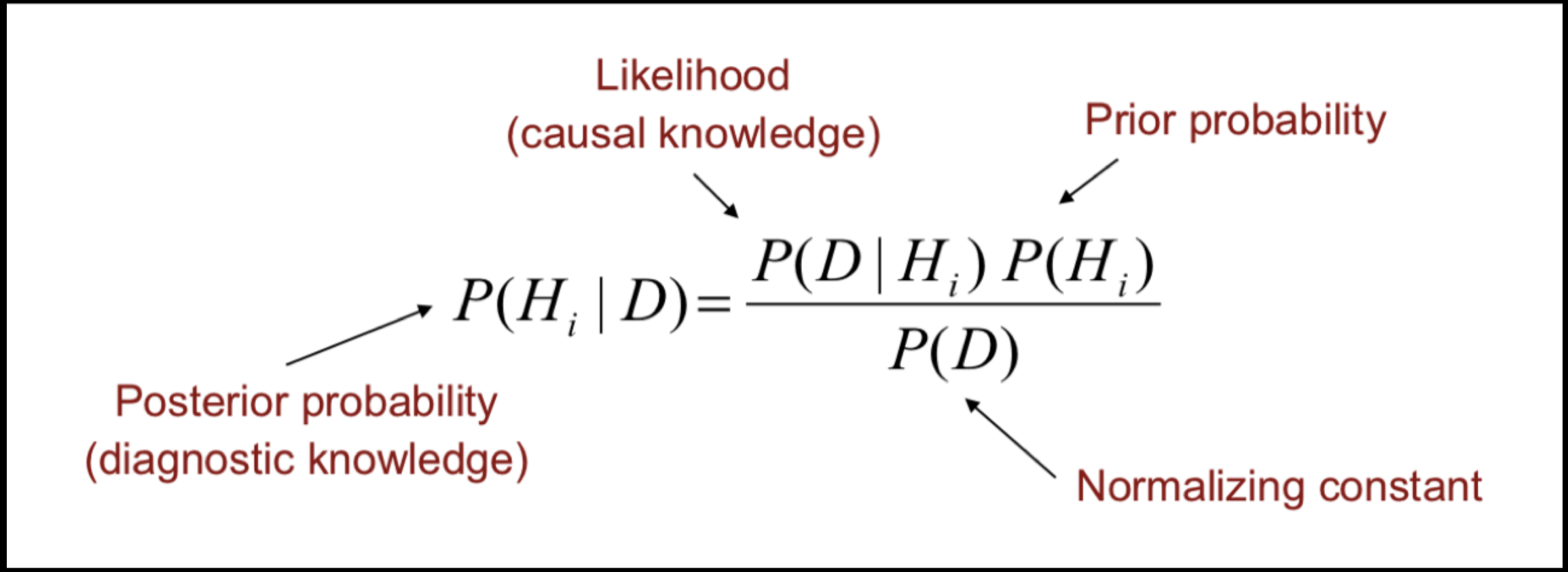
P(Y)

y_1	0.4
y_2	0.6

Conditional Probability Table
P(X|Y)

	X1	X2	X3
y1	0.5	0.25	0.25
y2	0.167	0.333	0.5

Bayes' Rule for Bayesian Inference



Ex.

We have two boxes: one with $100 and 5 balls (2 red, 3 black) and the other that is empty with 5 balls (3 red, 2 black). You choose one of the boxes at random, choose one of the ball in it, and find that the color is red.

Suppose hypothesis h1 says that the chosen box has the money and h2 says that the box is empty.

Compute the probability P(h1| chosen ball is red).

Sol.

- P(h1|chosen ball is red) = $\frac{P(chosen\ ball\ is\ red|h1)P(h1)}{p(red)}$

$$= \frac{P(chosen\ ball\ is\ red|h1)P(h1)}{P(red|h1)P(h1)+P(red|h2)P(h2)}$$

$$= \frac{0.4*0.5}{0.4*0.5+0.6*0.5} = 0.4$$

Q&A ?

- Good luck with HW1!
- Have a good weekend !