Homework 1 of CS 165A (Winter 2019)

University of California, Santa Barbara

Assigned on January 17, 2019 (Thursday)
Due at 12:30 pm on January 29, 2019 (Tuesday)

Notes:

- Be sure to read "Policy on Academic Integrity" on the course syllabus.
- Any updates or correction will be posted on the course Announcements page and piazza, so check there occasionally.
- You must do your own work independently.
- Please typeset your answers and you must turn in a hard copy to the CS 165A homework box in the copy room of Harold Frank Hall before the due time.
- We also encourage you to submit a digital copy on the GauchoSpace for record purpose, we won't grade this.
- Keep your answers concise. In many cases, a few sentences are enough for each part of your answer.

Problem 1(12')

Let us see the vacuum-cleaner example again from the textbook. Under the assumption listed on textbook page 38:

(a) Explain that why this vacuum-cleaner agent function described in Figure 2.3 is rational. (5')

(b) If each movement of the cleaner generate a unit cost, explain that now a rational agent needs to maintain an internal state.(4')

(c) Back to the original problem, now there is a naughty pet dog in the environment. At each time step, each clean square has a 50% chance of becoming dirty. Briefly explain how can you modified the rational agent in this case.(3')

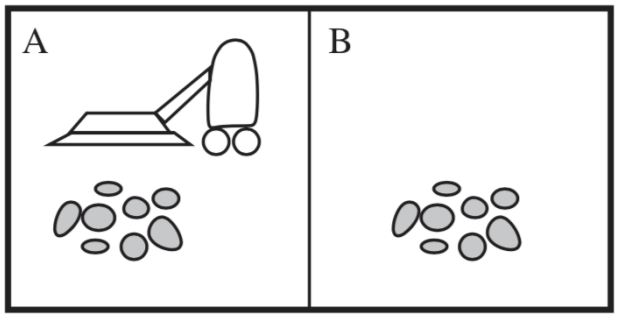

Figure 2.2 A vacuum-cleaner world with just two locations.

Percept sequence	Action
$[A, Clean]$	*Right*
$[A, Dirty]$	*Suck*
$[B, Clean]$	*Left*
$[B, Dirty]$	*Suck*
$[A, Clean], [A, Clean]$	*Right*
$[A, Clean], [A, Dirty]$	*Suck*
⋮	⋮
$[A, Clean], [A, Clean], [A, Clean]$	*Right*
$[A, Clean], [A, Clean], [A, Dirty]$	*Suck*
⋮	⋮

Figure 2.3 Partial tabulation of a simple agent function for the vacuum-cleaner world shown in Figure 2.2.

Problem 2 (21')

(a) What is the principal difference of strong AI and weak AI? Describe one example of each in a few sentences. (5')

(b) For each of the following activities, give a **PEAS** description of the task environment and characterize it in terms of the properties listed in textbook Section 2.3.2.

- Playing soccer as a robot (6')

- Internet laptop-shopping agent (6')

(c) Look at the six problems regarding the ethics of AI in textbook section 26.3. In your own words, which one do you think poses the biggest risk? Elaborate how that risk can be managed in a few sentences. (4')

Problem 3 (20')

If $2n$ boys are divided into two equal subgroups, find the probability that the two tallest boys will be: (a) in the same subgroup. (10') (b) in different subgroups. (10')

Problem 4 (15')

In answering a question on a multiple choice test, a candidate either knows the answer with probability p ($0 \leq p < 1$) or does not know the answer with probability $1 - p$. If he knows the answer, he puts down the correct answer with probability 0.99, whereas if he guesses, the probability of his putting down the correct result is $1/k$ (k choices to the answer). Find the conditional probability that the candidate knew the answer to a question, given that he has made the correct answer. Show that this probability tends to 1 as $k \to \infty$.

Problem 5 (15')

A doctor gives a patient a drug dependent on their age and gender. The patient has a probability to recover depending on whether s/he receives the drug, how old s/he is and which gender the patient has. Additionally it is known that age and gender are conditional independent if nothing else is known from the patient.

(a) Draw the Bayesian network which describes this situation. (5')

(b) How does the factorized probability distribution look like? (5')

(c) Write down the formula to compute the probability that a patient recovers given that you know if s/he gets the drug. Write down the formula using only probabilities which are part of the factorized probability distribution. (5')

Problem 6 (17')

Drawing a Bayes net for the following scenario. Showing all relevant nodes and arcs, providing a conditional probability table (CPT) for each node. (Fill in the values that seems reasonable and realistic to you). This requires you to decide what variables are needed, how many discrete value each variable has, and your choice of reasonable values. Scenario: Assuming that you are applying to UCSB graduate school this year, whether or not your are accepted depends on your GPA(high, medium, low), your GRE scores(high, medium, low) and your letters of recommendation(strong, weak). Being accepted to UCSB determines whether your friends think you are smart. Their thinking whether your are smart determines whether or not you are happy. (5')

Now that you have the network, figure out the representation of following probabilities, no need to do the calculation.

(a) The probability that friends think you are smart, given you have high GRE scores and High GPA. (3')

(b) The probability that friends think you are smart, given that you have strong letter of recommendation. (3')

(c) The probability that you are happy. (3')

(d) The probability that you are happy, given you are accepted to UCSB. (3')