Washington State University
School of Electrical Engineering and Computer Science
Fall 2019

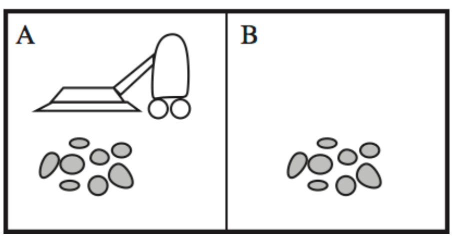
CptS 440/540 Artificial Intelligence

Homework 7

Due: October 17, 2019 (11:59pm)

General Instructions: Put your answers to the following problems into a PDF document and submit as an attachment under Content → Homework 7 for the course CptS 440 Pullman (all sections of CptS 440 and 540 are merged under the CptS 440 Pullman section) on the Blackboard Learn system by the above deadline. Note that you may submit multiple times, but we will only grade the most recent entry submitted before the above deadline.

1. Recall the vacuum cleaner world depicted below from the Agents lecture (slide 4). We want to define the three actions (Left, Right, Suction) for a planner in the PDDL format. Below is the domain PDDL specification (missing the Suction action) and the problem PDDL specification.




```
(define (problem prob)
  (:domain VACUUM)
  (:objects A B)
  (:init (room A) (dirty A) (dirty B))
  (:goal (and (clean A) (clean B)))
)
```

```
(define (domain VACUUM)
  (:predicates
    (room ?r)
    (dirty ?r)
    (clean ?r)
  )

  (:action left
    :precondition (room B)
    :effect (and (not (room B)) (room A))
  )

  (:action right
    :precondition (room A)
    :effect (and (not (room A)) (room B))
  )
)
```

   a. Show the definition of the Suction action in PDDL format consistent with the domain and problem specifications above.
   b. *CptS 540 students only*: Put the above domain PDDL specification, including your Suction action, in a file called "domain.pddl". Put the above problem PDDL specification in a file called "prob.pddl". Run the Fast-Downward planner on your domain and problem using the following command:
      `./fast-downward.py domain.pddl prob.pddl --search "astar(blind())"`
      Include the output in your homework submission. The Fast-Downward planner is available at http://www.fast-downward.org. Download and installation instructions are available at http://www.fast-downward.org/ObtainingAndRunningFastDownward.

2. Suppose we are given the following full joint probability distribution for Halloween World, where random variable *Weather* has domain {clear, cloudy, rain}, random variable *Costume* has domain {yes, no}, and random variable *Party* has domain {yes, no}. Compute the following probabilities. Show your work.

	Weather:	clear		cloudy		rain	
	Costume:	yes	no	yes	no	yes	no
Party:	yes	0.084	0.032	0.18	0.06	0.09	0.024
	no	0.036	0.048	0.12	0.14	0.09	0.096

a. P(Weather=clear, Costume=yes, Party=yes).
b. P(Weather=cloudy, Party=no).
c. P((Costume=yes) $\wedge$ (Party=no)).
d. P((Costume=yes) $\vee$ (Party=no)).
e. P(Party=yes | Weather=rain, Costume=no).
f. P(Party=yes | Costume=yes).

3. Suppose we are given the following information about the Boolean random variables LikeCoding and LearnAI.
   - P(LikeCoding=true | LearnAI=true) = 0.8
   - P(LikeCoding=true | LearnAI=false) = 0.6
   - P(LearnAI=true) = 0.5

   Using Bayes rule and normalization, compute **P**(LearnAI | LikeCoding=true). Note the boldfaced **P** means we want the probability *distribution* of LearnAI given LikeCoding=true. Show your work, including the value of the normalization constant α.