CS1571  
Assignment 3

# [Important] Requirements for code submission

* All the functions for answering the questions should be put into a file named **“a3.py”**.
* When submitting your code, include all the dependencies and put all of them into a **single zip file.**
* For each question, your function should be a **global** function that can be called by **importing** your file **a3.py**.
  + For example, if your function for question 2 in Part A is defined as
    - **def q2(): …**
  + We will (conceptually) call it like
    - **import a3**
    - **answer = a3.q2()**
  + In your **writing** submission (.doc file) below the corresponding question (e.g., Q2)
    - You need to write the **exact** function call **q2()** to use with the **exact** parameters to use if needed.
    - You also need to write the **exact** output we are supposed to get when we call your function as above.
    - Explain the answer if necessary.
* We highly recommend you to **name** your functions **systematically** corresponding to the question numbers, such as q2(), q3(), etc.

# Part A – Decision Trees (60 points)

1. (10 pts)
   1. 0.5 pts for each cell in the table
   2. 4.5 pts for the best course of action
2. (30 pts)
   1. Check the beginning for requirements for code submission. You will be graded on getting a correct answer using a correct computation. Your solution can be specific to the scenario outlined in the question.
3. (10 pts)
   1. If you use reasoning, write clearly how you reason **step by step** and **explain**. Use graphs and equations to help you explain.
   2. Check the beginning for requirements for code submission
4. (5 pts)
   1. Write clearly the mathematical definition of the utility function.
   2. Clearly define the symbols in your equation.
   3. Explain why your utility function achieves the requirements.
5. (5 pts)
   1. Name and describe two different changes, including a subsection of the tree if necessary.
   2. Justify your changes.

# Part B – Conditional Probabilities & Bayes Nets (60 points)

1. (10 pts)
   1. For each case, write clearly the **nodes** that are **independent** and the **nodes** that are **conditioned on**.
2. (10 pts)
   1. Write in mathematical equations **step by step** your computations.
   2. Write down the final answer (after doing the computations).
   3. *Note: There are multiple ways to arrive at a correct answer for this problem. Any method that you clearly explain is acceptable.*
3. (15 pts)
   1. Check the beginning for requirements for code submission. Your function can be specific to this particular Bayes Net, but should be able to respond to similar queries on conditional probabilities for the Bayes Net. We will be grading you on achieving the correct answer through a correct and generalizable method.
4. (15 points)
   1. Check the beginning for requirements for code submission. We will be grading you on outputting the joint distribution through a correct computation.
5. (10 points)
   1. If you use reasoning, write clearly the reasoning and computations **step by step** and **explain** each step.
   2. Check the beginning for requirements for code submission. Remember to include a brief explanation of why your code yields the correct answer.

# Part C –Markov Decision Processes (30 pts)

1. (20 pts)
   1. Clearly outlining each component (states, actions, transitions, rewards, etc.) of your MDP.
   2. Your MDP must be a **valid** MDP. That is, it must satisfy the necessary properties of a valid MDP.
   3. Your MDP must preserve the relative utilities of the different actions as described in **Part A** and leverage the different probabilities as described in Question 10 of **Part B**. The states in the MDP must mirror the different possibilities specified by the decision tree and Bayes Net.
2. (5 pts)
   1. Clearly identify and explain the differences between your MDP and Part A. You are not expected to actually calculate the policy for the MDP, so simply make inferences based on the structure of your MDP and the rewards you’ve assigned.
3. (5 pts)
   1. Critically argue which way is more suitable for this type of problem, based on at least one relevant property that differs between MDPs and decision trees.

# Part D – Bonus (up to 30 points)

Check the beginning for requirements for code submission