CECS 451
Assignment 6
Total: 54 Points

General Instruction

- Submit your work in the Dropbox folder via BeachBoard (Not email or in class).

- Submit the separate files as they are. (no zip file)

1. (10 points) Implement a program to compute π value using Monte Carlo simulation method. Use Python 3 and the name pi.py

   (a) The program should generate n points to compute π for $n \in \{10^3, 10^4, 10^5, 10^6\}$.

   (b) You can use math.pi to compute error rates.

   (c) Please follow the output format. (Fix precisions using "0:.nf".format)

   ```
   n = 10 ^ 3  pi =  3.096000  error =  1.4513 %
   n = 10 ^ 4  pi =  3.136800  error =  0.1526 %
   n = 10 ^ 5  pi =  3.145280  error =  0.1174 %
   n = 10 ^ 6  pi =  3.140568  error =  0.0326 %
   ```

2. Consider Figure 1, and implement a program to answer the query $\vec{P}(C|\neg s, w)$ by using Gibbs sampling. The program should generate $1,000,000$ samples to compute the probability. Use Python 3 and the name gibbs.py

   (a) (8 points) Show $\vec{P}(C|\neg s, r), \vec{P}(C|\neg s, \neg r), \vec{P}(R|c, \neg s, w), \vec{P}(R|\neg c, \neg s, w)$.

   (b) (16 points) Show the transition probability matrix $Q \in \mathbb{R}^{4 \times 4}$ where
   q_{ij} = transition probability from S_i to S_j in Figure 2.

   (c) (20 points) Show the probability of the query $\vec{P}(C|\neg s, w)$

   (d) Please follow the output format. (Fix precisions using "0:.nf".format)

   ```
   Part A. The sampling probabilities
   P(C|-s,r) = ...
   P(C|-s,-r) = ...
   P(R|c,-s,w) = ...
   P(R|-c,-s,w) = ...

   Part B. The transition probability matrix
           S1      S2      S3      S4
   S1      .       .       .       .
   S2      .       .       .       .
   S3      .       .       .       .
   S4      .       .       .       .

   Part C. The probability for the query
   P(C|-s,w) = <..., ...>
   ```

C	P(S)
t	.10
f	.50

C	P(R)
t	.80
f	.20

P(C)=.5

Cloudy

Sprinkler

Rain

Wet Grass

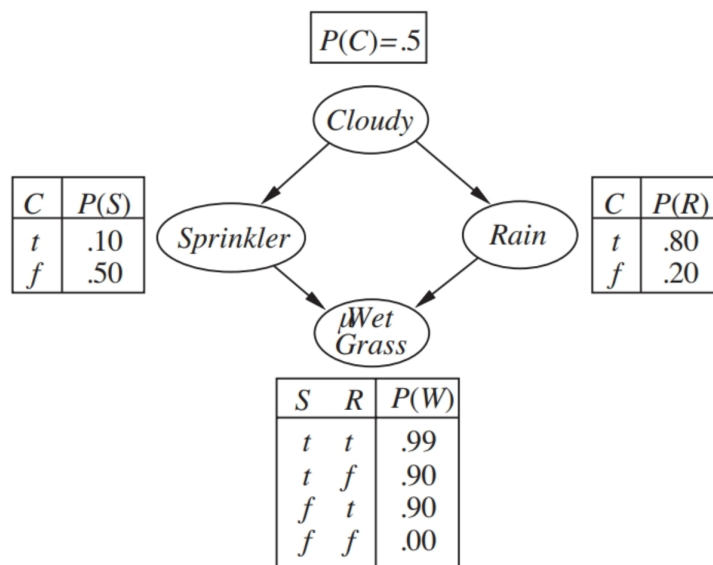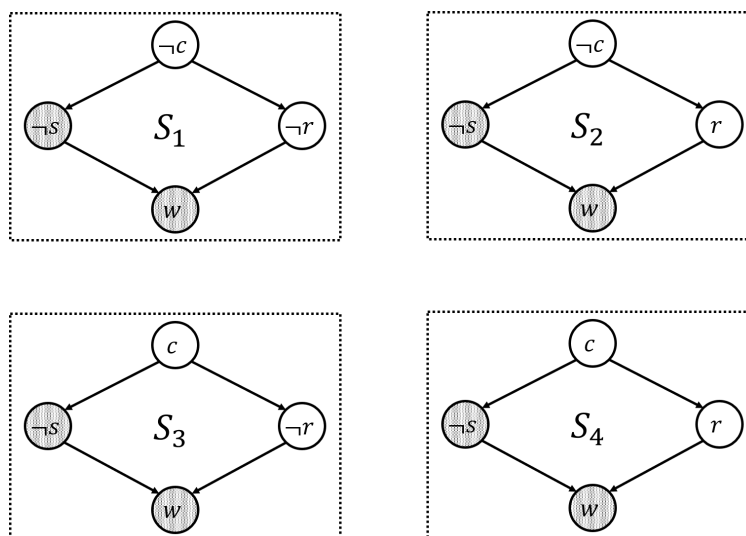| S	R	P(W)
t	t	.99
t	f	.90
f	t	.90
f	f	.00

Figure 1: A multiply connected network with conditional probability tables

Figure 2: Possible states diagram