WRITTEN ASSIGNMENT 2

Q1. [15 points] Bayesian Networks. Do Problem 14.6 from AIMA 3rd Edition.

Q2. [20 points] Probabilistic Reasoning. You are given results from a set of experiments. In each experiment, one of the two dice were rolled 20 times and observations taken. Unfortunately, the experimenter forgot to annotate which die he rolled in each experiment.

Each die is biased with different unknown probabilities of getting 1-6. The goal is to output the best estimate of probabilities of 1-6 for both the dice. Also, we need to annotate the experiments with the most likely die used to generate them. How can we achieve our goal?

You do NOT have to write the code and output final answers. Instead, write the pseudo-code and all relevant equations so that your method can be implemented.

The observations are:

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51124513353231115451
55215666134526666626
15124666435461666263
42416454331556332252
11215135454446361114
22142633516334223116
66643666566156412646
43612443113354266262
53532642445163432412
31312666216431144511
46616616616231566666
52612646232644253311
15153611342143525326
22333361145115464221
14345244352633242333
52664436514666255154
24315122534251143452
52436561466251355556
65131361615432213621
44166445456333551414
13532156653365261424
56131565132532626412
64564634133641125445
21461423355564661123
```

Q3. [10 points] Neural Networks. Consider training a single perceptron with the threshold activation rule to recognize features of images. For this exercise, assume that an image is a three by three array of pixels, p_{ij} denoting the pixel in i^{th} row and j^{th} column (i,j =1,2,3). Each pixel is either on or off. For each of the following features, either present a perceptron that recognizes the feature, or prove that no such perceptron exists.

1. bright: At least 75% of the pixels are on.

2. top-bright: A larger fraction of pixels is on in the top row than in the bottom two rows.

3. connected: The set of pixels that are on is connected. (In technical terms, this means that if we define a graph in which the vertices are the pixels that are on, and there is an edge between two pixels if they are adjacent vertically or horizontally, then there is a path between every pair of vertices in the graph.)

Q4. [15 points] Information Retrieval. Do Problem 22.8 from AIMA 3rd Edition.