Problem 1 - Decision trees

Suppose we want to predict if there is traffic downtown using 4 different boolean predicates: H (true if its rush hour), W (true if its the weekend), F (true if fuel price is high), R (true if its raining). Draw a small decision tree that agrees with the following examples:

- H W F R traffic
  - t f f f t
  - f f f t t
  - t f t f f
  - f t f t t
  - f t f f f

Problem 2 - Bayesian networks

Let $B_x$ be a random variable that is true if person $x$ has blue eyes. Let $G_x$ be a random variable that is true if person $x$ has a particular gene $G$. Suppose that the probability that a person has blue eyes depends only on the presence of gene $G$. Furthermore, suppose that the probability that a person $x$ has gene $G$ depends only whether or not the parents $y, z$ of $x$ have gene $G$ themselves.

Draw a simple bayesian network capturing the relationships among $B_x, G_x, B_y, G_y, B_z, G_z$.

Problem 3 - Search

Suppose we have a map with $n$ cities and roads between some pairs of them. The amount of time it takes to go from city $i$ to city $j$ equals the length of the road between them, $d(i, j)$. Two people start in different cities and want to move along the map to meet as quickly as possible at a common city. However, whenever one person arrives at a new city they wait until the other person arrives at their destination so they can talk on the phone before moving again. In each turn either one or both people move. The next move occurs as soon as both people arrive at their destination.

Let us formulate this as a search problem.

(a) What is the state space?

(b) What are the successors of a given state?
(c) What is the cost of moving from one state to one of its successors?
(c) What is the goal?
(d) Let $s(i, j)$ denote the straight line distance between cities $i$ and $j$. Give a heuristic function in terms of $s(i, j)$ and prove that it is admissible.