Problem 1

a. For an agent to be rational it must act rationally, the agent must have 4 things. First the agent must have a performance measure that defines the agent's success. Second, the agent must have prior knowledge of the environment. Third, it must have actions that the agent can perform. Lastly, the agent has a percept sequence to date. The vacuum cleaner criterion defines all four things and therefore is therefore rational.

b. If each movement of the vacuum cleaner generates a unit cost, then the vacuum cleaner needs to maintain an internal state that will help it determine how often the agent should move from square to square to minimize the unit cost and maximize the number of clean squares.

c. If we add a naughty pet dog in the environment, then we must now adapt the actions of the cleaner. For example, the vacuum cleaner might STAY in the same square even if it's clean since there is a 50% chance it might become dirty in the next time step. Or it can move LEFT or RIGHT to the opposing square since there is a 50% chance the square will not become dirty in the next time step.

Problem 2

a. The principle difference between strong AI and weak AI is how close an agent's intelligence compares to a human's intelligence. If the agent can physically walk around and communicate with the world, can come up with unique ideas, and can have some consciousness, then the AI is strong. If the agent only does some "thinking like" features such as image recognition or language recognition can be considered weak AI.

b. PEAS
   1. Robot soccer player
      P – Shooting accuracy, passing accuracy, speed, defense, ball control
      E – Other soccer players, ball, referees, rocks, dirt, grass, holes
      A – Legs, torso, head
      S – Camera, accelerometer
   2. Internet shopping agent
      P – Minimize expenses, maximize saving
      E – Internet, shopping websites
      A – buying requests, confirmation emails
      S – Website scraper

c. The ethical question that I believe poses the greatest risk is that the success of AI can lead to the end of the human race. This is because if anyone ever builds an agent to solve all problems, the agent can learn that humans are inferior to machines and therefore kill all humans. The risk can be managed by making it illegal to build an agent that is more intelligent than a human used to solve all problems.

Problem 3

a. (# ways tallest two are in same group) / (# ways to divide 2n -> n and n)
(2n choose n) * (1/2)= unique ways to divide 2n -> n and n
(2n-2 choose n - 2) = ways to combine the rest of the group when the two tallest individuals are in the same group

(2n choose n) * (1/2) = (2n)! / (n! * (2n - n)! * 2)
(2n-2 choose n - 2) = (2n-2)! / ((n-2)! * n!)

(2n)! / (n! * (2n - n)! * 2) / [(2n-2)! / ((n-2)! * n!)] = **(n-1)/(2n -1)**

b. Probability that they are in different subgroups = (1 – the probability they are in the same subgroup) = **1- [(n-1)/(2n -1)]**

Problem 4

a. K = candidate knows the answer
C = candidate puts down the correct answer

P(K|C) = [P(C|K) * P(K)] / P(C)

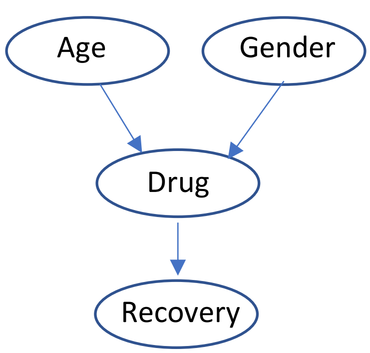
P(C|K) = 0.99
P(K) = p
P(C) = 0.99*p + (1/k)*(1-p)

P(C|K) = **(0.99*p)/ [(0.99*p) + (1/k)*(1-p)]**

If k –> infinity, then (1/k) goes to 0 and the equation becomes 0.99*p / 0.99*p = 1

Problem 5

a.



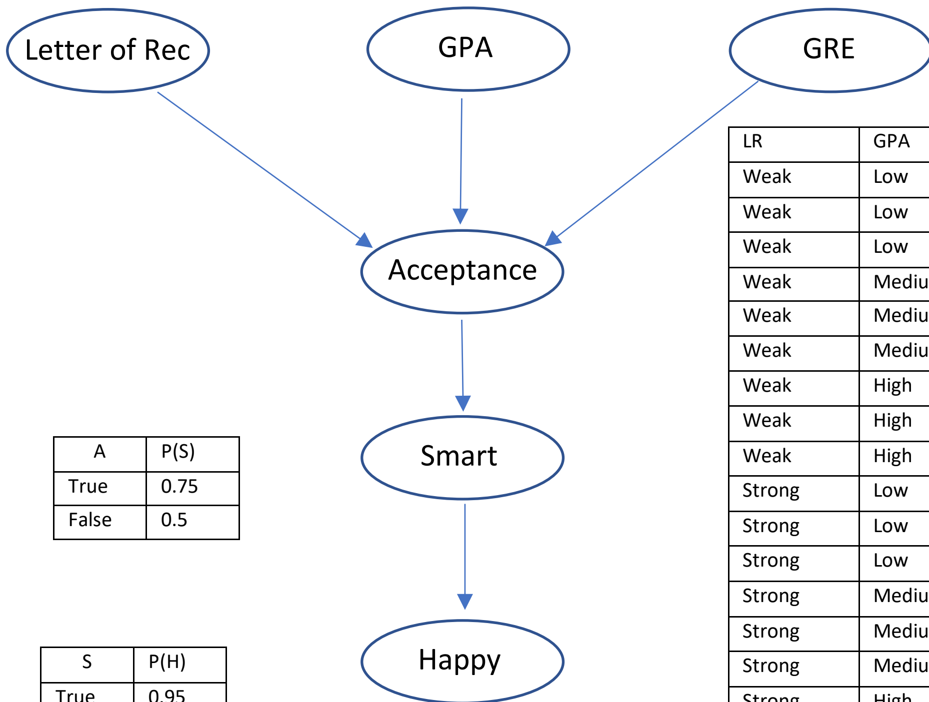
b. P(A,G,D,R) = P(A) * P(G) * P(D|A,G) * P(R|D)
c. P(R|D) = P(R,D)/P(D)
= $[\sum_i \sum_j P(R,D,G_i,A_j)] / [\sum_i \sum_j \sum_k P(D,R_i,G_j,A_k)]$
= $\mathbf{[\sum_i \sum_j P(A_j) * P(G_i) * P(D|A_j,G_i) * P(R|D)] / [\sum_i \sum_j \sum_k P(A_k) * P(G_j) * P(D|A_k,G_j) * P(R_i|D)]}$

Problem 6

	P(LR)
Weak	0.25
Strong	0.75

	P(GPA)
Low	0.2
Medium	0.5
High	0.3

	P(GRE)
Low	0.25
Medium	0.7
High	0.05



LR	GPA	GRE	P(A)
Weak	Low	Low	0.0
Weak	Low	Medium	0.1
Weak	Low	High	0.15
Weak	Medium	Low	0.1
Weak	Medium	Medium	0.2
Weak	Medium	High	0.3
Weak	High	Low	0.2
Weak	High	Medium	0.3
Weak	High	High	0.5
Strong	Low	Low	0.4
Strong	Low	Medium	0.5
Strong	Low	High	0.6
Strong	Medium	Low	0.5
Strong	Medium	Medium	0.6
Strong	Medium	High	0.7
Strong	High	Low	0.6
Strong	High	Medium	0.8
Strong	High	High	0.95

A	P(S)
True	0.75
False	0.5

S	P(H)
True	0.95
False	0.15

$P(LR,GPA,GRE,A,S,H) = P(LR) * P(GPA) * P(GRE) * P(A|GRE,GPA,LR) * P(S|A) * P(H|S)$

a. $P(S|GRE=high, GPA=high) = P(S,GRE=high, GPA=high) / P(GRE=high ,GPA=high)$

$=\sum_i \sum_j P(LR_i,GPA = high,GRE = high,A_j,S)/ \sum_i \sum_j \sum_k P(LR_i,GPA=high,GRE=high,A_j,S_k)$

$\mathbf{=[\sum_i \sum_j P(LR_i) * P(GPA=high) * P(GRE=high) * P(A_j|GRE=high,GPA=high,LR_i) * P(S|A_j)] / [\sum_i \sum_j \sum_k P(LR_i) * P(GPA=high) * P(GRE=high) * P(A_j|GRE=high,GPA=high,LR_i) * P(S_k|A_j)]}$

b. $P(S|LR=strong) = P(LR = strong, S) / P(LR= strong)$

$=\sum_i \sum_j \sum_k P(LR=strong,GPA_i ,GRE_j,A_k,S)/ \sum_i \sum_j \sum_k \sum_l P(LR=strong,GPA_i,GRE_j,A_k,S_l)$

$=[\sum_i \sum_j \sum_k P(LR) * P(GPA_i) * P(GRE_j) * P(A_k|GRE_j,GPA_i,LR) * P(S|A_k)] / [\sum_i \sum_j \sum_k \sum_l P(LR) * P(GPA_i) * P(GRE_j) * P(A_k|GRE_j,GPA_i,LR) * P(S_l|A_k)]$

c. $P(H) = \sum_i \sum_j \sum_k \sum_l \sum_m P(LR_i,GPA_j,GRE_k,A_l,S_m,H) / \sum_i \sum_j \sum_k \sum_l \sum_m \sum_n P(LR_i,GPA_j,GRE_k,A_l ,S_n,H_m)$

$= [\sum_i \sum_j \sum_k \sum_l P(LR_i) * P(GPA_j) * P(GRE_k) * P(A_l|GRE_k,GPA_j,LR_i) * P(S_m|A_l) * P(H|S_m)] / [\sum_i \sum_j \sum_k \sum_l \sum_m P(LR_i) * P(GPA_j) * P(GRE_k) * P(A_l|GRE_k,GPA_j,LR_i) * P(S|A_l) * P(H_m|S_n)]$

d. $P (H|A) = P(H,A) / P(A)$

$= \sum_i \sum_j \sum_k \sum_l P(LR_i,GPA_j,GRE_k,A,S_l,H) / \sum_i \sum_j \sum_k \sum_l \sum_m P(LR_i,GPA_j,GRE_k,A_l,S_m,H)$

$= [\sum_i \sum_j \sum_k \sum_l P(LR_i) * P(GPA_j) * P(GRE_k) * P(A|GRE_k,GPA_j,LR_i) * P(S_l|A) * P(H|S_l)] / [\sum_i \sum_j \sum_k \sum_l \sum_m P(LR_i) * P(GPA_j) * P(GRE_k) * P(A_l|GRE_k,GPA_j,LR_i) * P(S_m|A_l) * P(H|S_m)]$