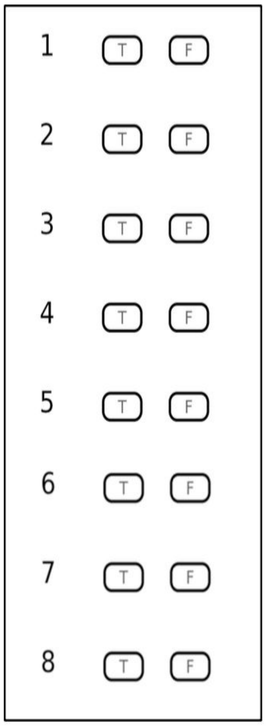
1. [8%] General AI Knowledge and Application.



T, 1). [1%]

F, 2). [1%]

F, 3). [1%]

F, 4). [1%]

T, 5). [1%]

T, 6). [1%]

F, 7). [1%]

T, 8). [1%]

2.[16%] Multiple Choice

1. (abce)
2. (abd)
3. (ad)
4. (b)
5. (c)
6. (a)
7. (bde)
8. (b)

3.[23%] MDPs and RL: Mini-Grids

3A. [1%]

10

(No partial credits)

3B. [1%]

2

(No partial credits)

3C. [1%]

1

(No partial credits)

3D. [1%]

4

(No partial credits)

3E. [1%]

10/8

Or

1.25

(No partial credits)

3F. [2%]

$1/\sqrt{10} \leq \gamma \leq 1$

Or

$1/\sqrt{10} < \gamma \leq 1$

Or

$1/\sqrt{10} < \gamma$

Or

γ ^2 > 0.1

Or

γ ^2 >= 0.1

(No partial credits)

3G. [1%]

10

(No partial credits)

3H. [1%]

4

(No partial credits)

3I. [1%]

10/8

Or

1.25

(No partial credits)

3J. [1%]

Never.(1pt, no partial credits)

There is always only a 1/2 probability of success on any movement action, so while Vk will asymptotically approach V*, it won't ever equal it. Consider the square right next to the exit, which we'll call C: Vk+1(C) =10/2 + (1/2)*Vk(C).

3K. [1%]

1/8

Or

0.125

(No partial credits)

3L. [1%]

1/8

Or

0.125

(No partial credits)

3M. [1%]

4

(No partial credits)

3N. [2%]

16/2 + 4/2 = 10

(No partial credits)

3O. [2%]

4

(No partial credits)

3P. [2%]

16

(No partial credits)

4.[18%] Bayes Net

4A.[3%]

P(+g)P(+a | + g)P(+b)P(+s | + b, +a) = (0.1)(1.0)(0.4)(1.0) = 0.04

Full credit if expression is correct. -0.5 if the final answer is incorrect.

4B.[3%]

P(+a) = P(+a | + g)P(+g) + P(+a | − g)P(−g) = (1.0)(0.1) + (0.1)(0.9) = 0.19

Full credit if expression is correct. -0.5 if the final answer is incorrect.

4C.[3%]

P(+a | + b) = P(+a) = 0.19 The first equality holds true as we have A ⊥ ⊥ B, which can be inferred from the graph of the Bayes' net.

Full credit if expression is correct. -0.5 if the final answer is incorrect.

4D.[3%]

$$P(+a \vee +b \mid +s) = 1 - P(-a, -b \mid +s) = 1 - \frac{P(-a,-b,+s)}{P(+s)} = 1 - \frac{P(+s|-a,-b)P(-a)P(-b)}{P(+s)}$$

$$= 1 - \frac{P(+s|-a,-b)P(-a)P(-b)}{P(+s|+a+b)P(+a)P(+b) + P(+s|+a-b)P(+a)P(-b) + P(+s|-a+b)P(-a)P(+b) + P(+s|-a-b)P(-a)P(-b)}$$

$$= 1 - \frac{0.1*0.81*0.6}{1.0*0.19*0.4 + 0.9*0.19*0.6 + 0.8*0.81*0.4 + 0.1*0.81*0.6} \approx 0.9001$$

Full credit if expression is correct. -0.5 if the final answer is incorrect. Expansion of all the terms carry 1 point each.

4E.[3%]

$$P(+g|+a) = \frac{P(+g)P(+a\mid +g)}{P(+g)P(+a|+g) + P(-g)P(+a|-g)} = 0.5263$$

$P(+g|+a)$ (1%), $\frac{P(+g)P(+a\mid +g)}{P(+g)P(+a|+g) + P(-g)P(+a|-g)}$ (2%), 0.5263 is optional.

You can still get 1%, if you write part of the $\frac{P(+g)P(+a\mid +g)}{P(+g)P(+a|+g) + P(-g)P(+a|-g)}$.

You get 3% if you calculate 0.5263 correctly.

4F.[3%]

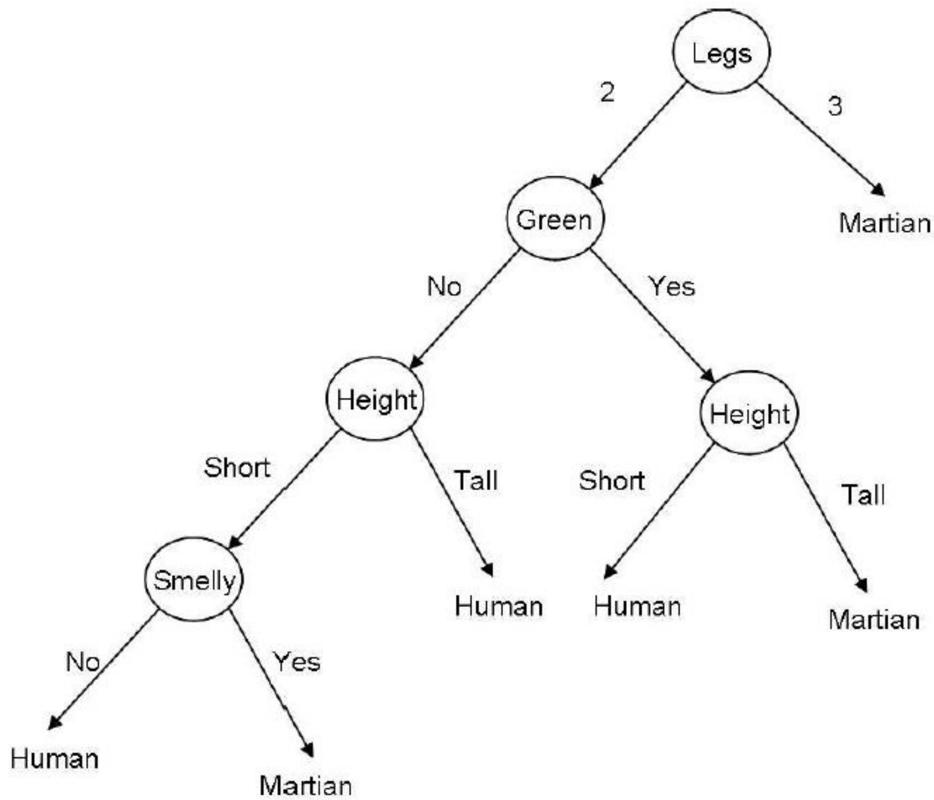
P(+g| + b) = P(+g) = 0.1 The first equality holds true as we have G ⊥⊥ B, which can be inferred from the graph of the Bayes' net.

P(+g| + b) (1%), P(+g)(2%), 0.1 is optional.

You get 3% if you calculate 0.1 correctly.

5.[20%] Decision Tree

5A.[8%]



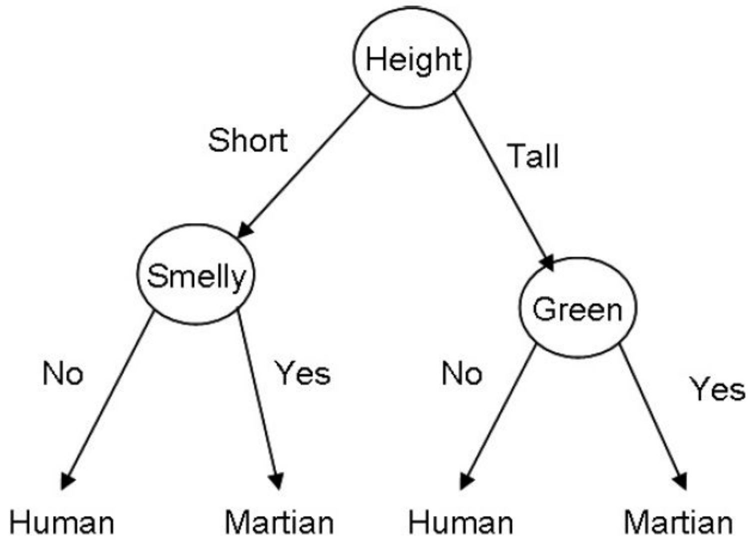
0.5 point off for every incorrect leaf.
2 points for getting Legs as the root node, because that a grasp of information gain, and then back to 1 point for the other branches.
All deductions up to 8 points total.

<u>5B. [6%]</u>

Only the disjunction of conjunctions for Martians was required.
(Legs=3) V
(Legs=2 ^ Green=Yes ^ Height=Tall) V
(Legs=2 ^ Green=No ^ Height=Short ^ Smelly=Yes)
partial credit: 2 points each line.

<u>5C. [6%]</u>

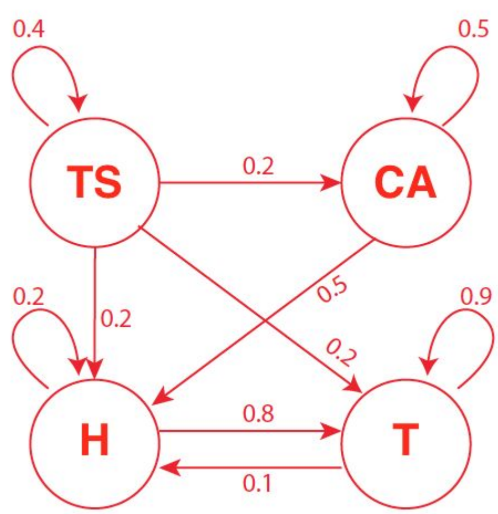
(Green=Yes ^ Height=Tall) V (Smelly=Yes ^ Height=Short) These conjunctive rules share the height term, so a depth-2 tree is possible. See the figure below. If only give the “yes” answer without correct explanation, no partial credits.



<u>6.[18%] HMM</u>

<u>6A. [8%]</u>

(Green=Yes ^ Height=Tall) V (Smelly=



	TS_{t+1}	CA_{t+1}	H_{t+1}	T_{t+1}
TS_t	**0.4**	**0.2**	**0.2**	**0.2**
CA_t	**0**	**0.5**	**0.5**	**0**
H_t	**0**	**0**	**0.2**	**0.8**
T_t	**0**	**0**	**0.1**	**0.9**

Partial Credits:

- **Total 4 Points for the markov chain graph with 1 point for each entry(node).**
- **4 points for the transition probability table - 1 point for each entry in the table.**

6B. [4%]

	$P(X_0)$	$P(X_{Mon})$	$P(X_{Tue})$
TS	**0**	**0**	**0*0.4+0.5*0+0.5*0+0*0 = 0**
CA	**1**	**0.5**	**0*0.2+0.5*0.5+0.5*0+0*0 = 0.25**
H	**0**	**0.5**	**0*0.2+0.5*0.5+0.5*0.2+0*0.1 = 0.35**
T	**0**	**0**	**0*0.2+0.5*0+0.5*0.8+0*0.9 = 0.4**

Partial Credits - 0.5 points for each correct probability(total 8) computed in the table. 0.5 * 8 = 4

6C. [6%]

The goal is to compute the stationary distribution. From the Markov chain it is obvious that $P_\infty(TS) = 0$ and $P_\infty(CA) = 0$. Let $x = P_\infty(H)$ and $y = P_\infty(T)$. Then the definition of stationarity implies

x = 0.2x + 0.1y

y = 0.8x + 0.9y

Since we must have x >= 0 and y >= 0, we can choose any x > 0 and solve for y. For example, x = 1 yields y = 8, which normalized results in $x = P_\infty(H) = 1/9$ and $x = P_\infty(T) = 8/9$.

Partial Credits:

2 Points for pointing out the equations.

2 Points for computing the probability.

2 Points for the logic.