

Homework #7: Chapters 18 - 20

1. [10 pts.] Tennis: The primary sensors are the eye, although ears and touch can also play a role. The actuators are muscles, particularly in order to move to different positions on the court and to swing at the ball. The performance element must decide where to move, when to swing, and what kind of swing to use based on the percepts. We can think of three things that must be learned: movement, playing strokes, and strategy. The learning process involves both supervised and reinforcement learning. **Supervised learning** occurs as the agent develops predictive models of the environments: e.g. where will the ball land when someone hits it a certain way. When a point is won or lost, then **reinforcement learning** comes into play. Note, the reinforcement is not immediate with respect to each action, but only comes after a series of actions. Therefore, the learning must assess which actions deserve the most credit/blame when updating the performance element.

2. [25 pts.]

a. [8 pts, 1pt. each]

$\text{Type}(X_1, \text{TownHouse}) \wedge \text{Garage}(X_1, \text{Yes}) \wedge \text{Beds}(X_1, 2) \wedge \text{Baths}(X_1, 1.5),$	$Q(X_1)$
$\text{Type}(X_2, \text{Condo}) \wedge \text{Garage}(X_2, \text{No}) \wedge \text{Beds}(X_2, 2) \wedge \text{Baths}(X_2, 2),$	$\neg Q(X_2)$
$\text{Type}(X_3, \text{Apartment}) \wedge \text{Garage}(X_3, \text{Yes}) \wedge \text{Beds}(X_3, 2) \wedge \text{Baths}(X_3, 1),$	$\neg Q(X_3)$
$\text{Type}(X_4, \text{TownHouse}) \wedge \text{Garage}(X_4, \text{Yes}) \wedge \text{Beds}(X_4, 4) \wedge \text{Baths}(X_4, 1),$	$\neg Q(X_4)$
$\text{Type}(X_5, \text{TownHouse}) \wedge \text{Garage}(X_5, \text{Yes}) \wedge \text{Beds}(X_5, 3) \wedge \text{Baths}(X_5, 1.5),$	$Q(X_5)$
$\text{Type}(X_6, \text{Condo}) \wedge \text{Garage}(X_6, \text{Yes}) \wedge \text{Beds}(X_6, 1) \wedge \text{Baths}(X_6, 1),$	$\neg Q(X_6)$
$\text{Type}(X_7, \text{TownHouse}) \wedge \text{Garage}(X_7, \text{No}) \wedge \text{Beds}(X_7, 3) \wedge \text{Baths}(X_7, 1.5),$	$\neg Q(X_7)$
$\text{Type}(X_8, \text{Apartment}) \wedge \text{Garage}(X_8, \text{Yes}) \wedge \text{Beds}(X_8, 2) \wedge \text{Baths}(X_8, 1.5),$	$\neg Q(X_8)$

b. [8 pts, 1pt. for each example]

$\text{Beds}(x, 2) \wedge \text{Baths}(x, 1.5)$ is consistent with examples $X_1, X_2, X_3, X_4, X_6,$ and X_7 .
 X_8 is a false positive example. X_5 is a false negative example.

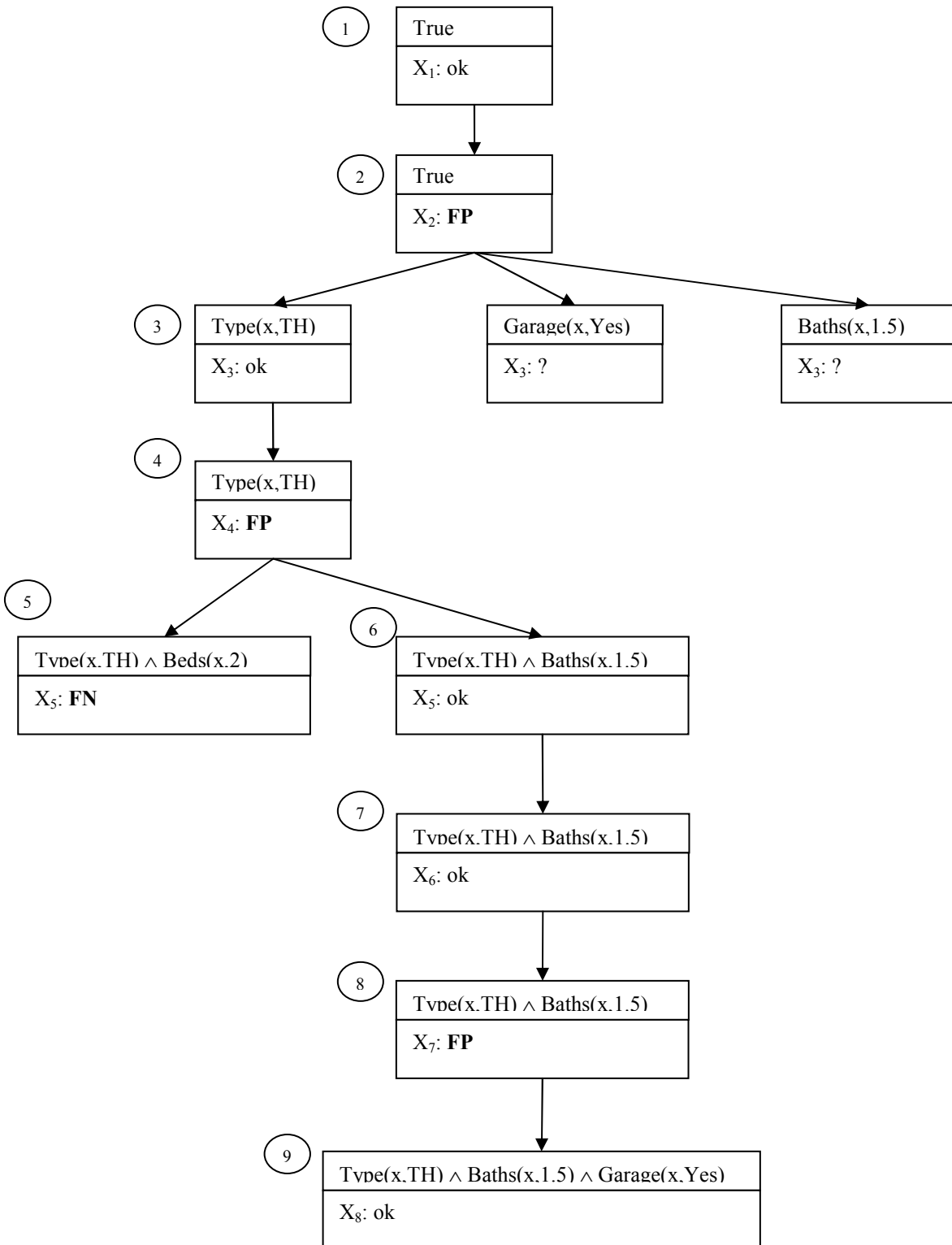
c. [3 pts.]

$\text{Type}(x, \text{TownHouse}) \wedge \text{Garage}(x, \text{Yes}) \wedge \text{Beds}(x, 3)$
 $\text{Type}(x, \text{TownHouse}) \wedge \text{Garage}(x, \text{Yes}) \wedge \text{Baths}(x, 1.5)$

d. [4 pts.]

$\text{Garage}(x, \text{No}) \wedge \text{Beds}(x, 3)$
 $\text{Type}(x, \text{Condo}) \wedge \text{Beds}(x, 3)$

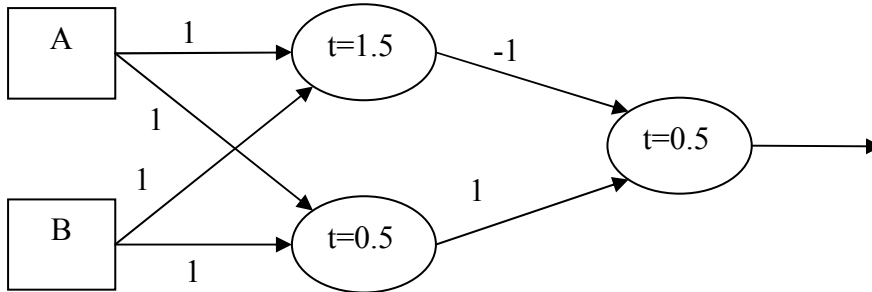
3. [30 pts.] Below, we abbreviate “Townhouse” as “TH”.



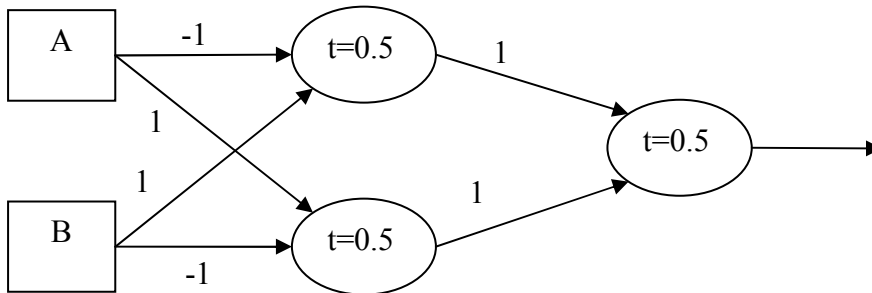
4. [15 pts.]

A XOR B, using threshold function. There are many possible solutions:

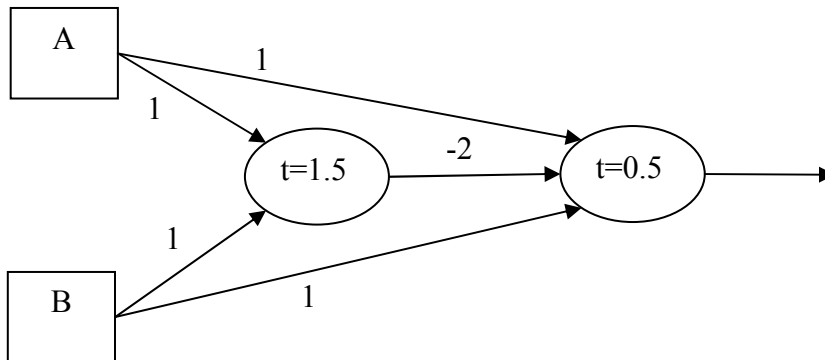
Solution 1: $A \text{ XOR } B = \neg(A \wedge B) \wedge (A \vee B)$



Solution 2: $A \text{ XOR } B = (\neg A \wedge B) \vee (A \wedge \neg B)$



Solution 3: *This one is feed-forward, but not layered!*



Note: -3 if didn't explicitly say what activation function was being used (i.e., threshold)

5. [20 pts: 3pts. each, 2 “free” pts. for basic understanding of the problem]

$$a_4 = g(5*0 + 2*1 - 1) = g(1) \quad \therefore \quad a_4 = 1$$

$$a_5 = g(3*0 + 2*1 - 3*1 - 4) = g(-5) \quad \therefore \quad a_5 = 0$$

$$a_6 = g(2*1 + 3*1 - 2) = g(3). \quad \therefore \quad a_6 = 1$$

$$a_7 = g(3*1 - 3*0 + 2*1 - 4) = g(1) \quad \therefore \quad a_7 = 1$$

$$a_8 = g(4*1 + 1*0 - 5*1 - 2) = g(-3) \quad \therefore \quad a_7 = 0$$

$$a_9 = g(-4*1 + 4*0) = g(-4) \quad \therefore \quad a_7 = 0$$