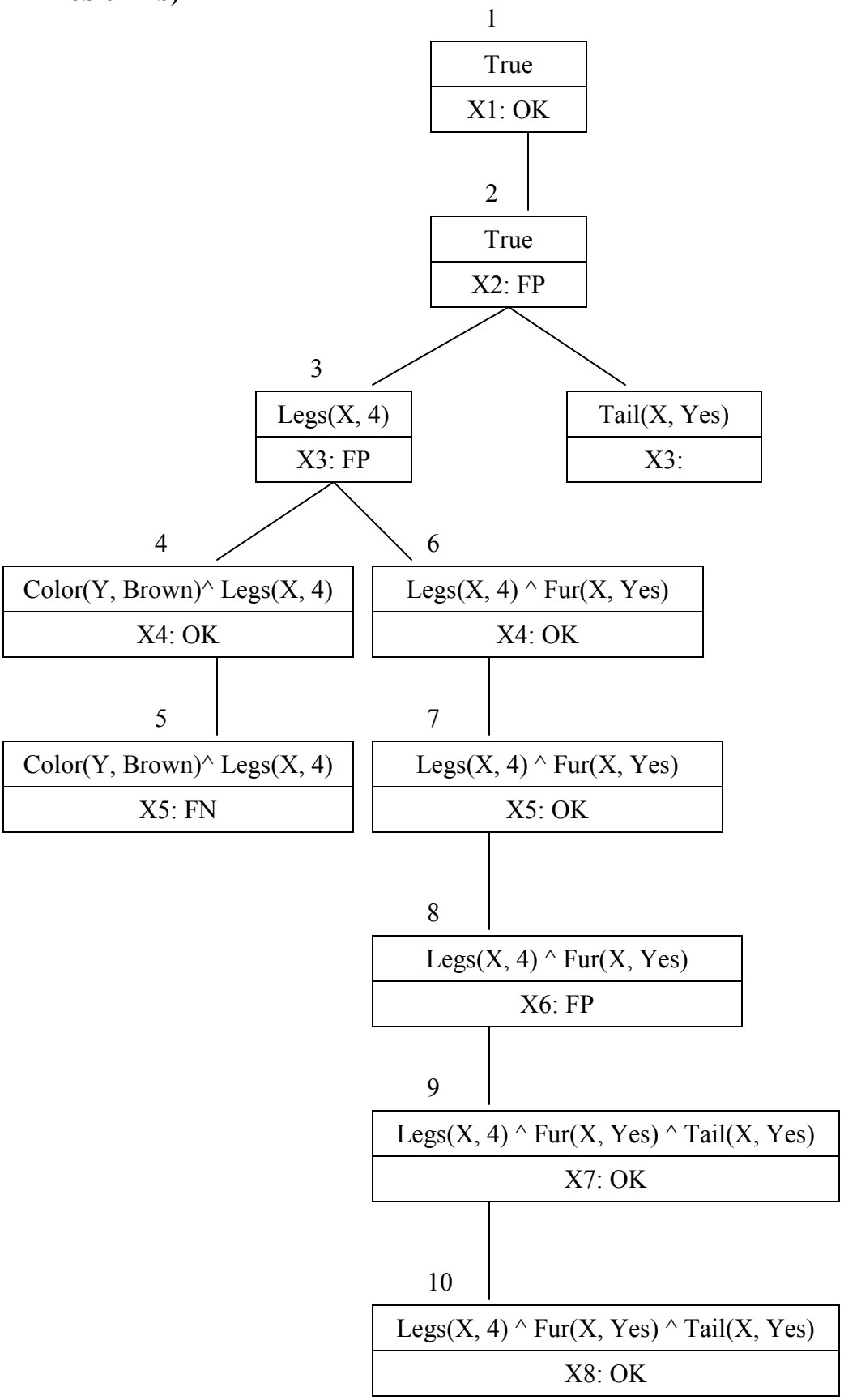
Homework #7: Chapters 18 - 20

Problem 1a)
Q(X1), Color(X1, Brown) ^ Legs(X1, 4) ^ Tail(X1, Yes) ^ Fur(X1, Yes)
¬Q(X2), Color(X2, Brown) ^ Legs(X2, 2) ^ Tail(X2, No) ^ Fur(X2, Yes)
¬Q(X3), Color(X3, Green) ^ Legs(X3, 4) ^ Tail(X3, Yes) ^ Fur(X3, No)
¬Q(X4), Color(X4, Brown) ^ Legs(X4, 0) ^ Tail(X4, Yes) ^ Fur(X4, No)
Q(X5), Color(X5, Black) ^ Legs(X5, 4) ^ Tail(X5, Yes) ^ Fur(X5, Yes)
¬Q(X6), Color(X6, Black) ^ Legs(X6, 4) ^ Tail(X6, No) ^ Fur(X6, Yes)
¬Q(X7), Color(X7, Gold) ^ Legs(X7, 2) ^ Tail(X7, Yes) ^ Fur(X7, No)
Q(X8), Color(X8, Gold) ^ Legs(X8, 4) ^ Tail(X8, Yes) ^ Fur(X8, Yes)

Problem 1b)


1
True
X1: OK
2
True
X2: FP
3
Legs(X, 4)
X3: FP
Tail(X, Yes)
X3:
4
Color(Y, Brown)^ Legs(X, 4)
X4: OK
6
Legs(X, 4) ^ Fur(X, Yes)
X4: OK
5
Color(Y, Brown)^ Legs(X, 4)
X5: FN
7
Legs(X, 4) ^ Fur(X, Yes)
X5: OK
8
Legs(X, 4) ^ Fur(X, Yes)
X6: FP
9
Legs(X, 4) ^ Fur(X, Yes) ^ Tail(X, Yes)
X7: OK
10
Legs(X, 4) ^ Fur(X, Yes) ^ Tail(X, Yes)
X8: OK

Problem 2)

There are many possible solutions to this problem. The important point is to find a data set that no matter what the hypothesis is, it will classify one of the examples as wrong. The easiest way to do this is to give two examples with the same descriptive properties, but different classifications. For example:

Description Sentence	**Classification Sentence**
$P(X_1)$	$Q(X_1)$
$P(X_2)$	$\neg Q(X_2)$

If the hypothesis is $\forall x\ Q(x) \Leftrightarrow P(x)$, then X_2 will be a false positive. If the hypothesis is $\forall x\ Q(x) \Leftrightarrow \neg P(x)$, then X_1 will be a false negative.

Problem 3:

step	W0	W1	W2	X0	X1	X2	Y		in	out	Err	change in W0	change in W1	change in W2	changed?
initial												0.2	-0.5	0.1	
1	0.2	-0.5	0.1	-1	0	1	1		-0.1	0	1	-0.1	0	+0.1	Y
2	0.1	-0.5	0.2	-1	1	0	0		-0.6	0	0	0	0	0	N
3	0.1	-0.5	0.2	-1	0	0	1		-0.1	0	1	-0.1	0	0	Y
4	0	-0.5	0.2	-1	1	1	1		-0.3	0	1	-0.1	+0.1	+0.1	Y
5	-0.1	-0.4	0.3	-1	0	1	1		0.4	1	0	0	0	0	N
6	-0.1	-0.4	0.3	-1	1	0	0		-0.3	0	0	0	0	0	N
7	-0.1	-0.4	0.3	-1	0	0	1		0.1	1	0	0	0	0	N
8	-0.1	-0.4	0.3	-1	1	1	1		0	0	1	-0.1	+0.1	+0.1	Y
9	-0.2	-0.3	0.4	-1	0	1	1		0.6	1	0	0	0	0	N
10	-0.2	-0.3	0.4	-1	1	0	0		-0.1	0	0	0	0	0	N
11	-0.2	-0.3	0.4	-1	0	0	1		0.2	1	0	0	0	0	N
12	-0.2	-0.3	0.4	-1	1	1	1		0.3	1	0	0	0	0	N

*Note, the problem states that the threshold function used returns 0 when the input is 0, and only returns 1 when it is greater than 0. If you use threshold(0)=1, then in step 8, your g(in)=1 and you have no Error, resulting in termination after that step. We took off **3 points** in this case.*

Problem 4:

To more clearly show the calculations, we generalize the threshold function to specify a threshold parameter:

Threshold function: $g(x, t) = 0$, if $x \leq t$
1, if $x > t$

$a_4 = g(in_4, t_4) = g(a_1 * w_{1,4} + a_2 * w_{2,4}, t_4)$
$= g(1 * 5 + 1 * 2, 1) = g(7, 1)$
$= \mathbf{1}$

$a_5 = g(in_5, t_5) = g(a_1 * w_{1,5} + a_2 * w_{2,5} + a_3 * w_{3,5}, t_5)$
$= g(1 * 3 + 1 * 2 + 0 * -3, 4) = g(5, 4)$
$= \mathbf{1}$

$a_6 = g(in_6, t_6) = g(a_2 * w_{2,6} + a_3 * w_{3,6}, t_6)$
$= g(1 * 2 + 0 * 3, 2) = g(2, 2)$
$= \mathbf{0}$

$a_7 = g(in_7, t_7) = g(a_4 * w_{4,7} + a_5 * w_{5,7} + a_6 * w_{6,7}, t_7)$
$= g(1 * 3 + 1 * -3 + 0 * 2, 4) = g(0, 4)$
$= \mathbf{0}$

$a_8 = g(in_8, t_8) = g(a_4 * w_{4,8} + a_5 * w_{5,8} + a_6 * w_{6,8}, t_8)$
$= g(1 * 4 + 1 * 1 + 0 * -5, 2) = g(6, 2)$
$= \mathbf{1}$

$a_9 = g(in_9, t_9) = g(a_7 * w_{7,9} + a_8 * w_{8,9}, t_9)$
$= g(0 * -4 + 1 * 4, -1) = g(4, -1)$
$= \mathbf{1}$