Midterm

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1. a) True

b) ~~True~~ False. You train on testing data and use validation set to tune hyperparameters

c) True

d) False. Its more likely an overly complex model results in overfitting.

2. $A = (10, 0)$ $B = (5\sqrt{2}, 5\sqrt{2})$

a) L_1: $\|A\|_1 = 10$

$\|B\|_1 = |5\sqrt{2}| + |5\sqrt{2}| = 10\sqrt{2}$ ← larger

L_∞: $\|A\|_\infty = 10$ ← larger

$\|B\|_\infty = 5\sqrt{2}$

3. $TPR = \frac{TP}{P} = 0.6$

$TP = \frac{6(40)}{10} = 24$

$\Rightarrow FN = 40 - 24 = 16$ for 40 P ($\Rightarrow$ 60 N)

Since 30 were misclassified

$FP = 30 - 16 = 14$ | $\Rightarrow TN = 60 - 14 = 46$

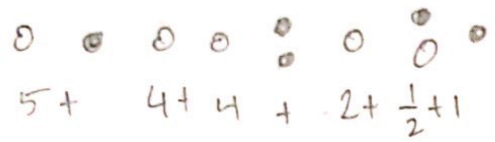
So the false positive rate

a) $\boxed{FPR = \frac{14}{60}}$

b) $\boxed{FNR = 1 - TPR = 0.4}$

c) precision $= \frac{TP}{\hat{P}} = \frac{TP}{TP+FP} = \frac{24}{24+14} = \boxed{\frac{24}{38}}$

d) accuracy $= \frac{TP+TN}{P+N} = \frac{24+46}{40+60} = \frac{70}{100} = \boxed{0.7}$

4. 

$5+ \quad 4+4+ \quad 2+\frac{1}{2}+1$

ranking errors

$16+\frac{1}{2}=\frac{33}{2}$

ranking error rate

$$\frac{33/2}{5(5)}$$

ranking accuracy

$$1-\frac{33/2}{25}$$

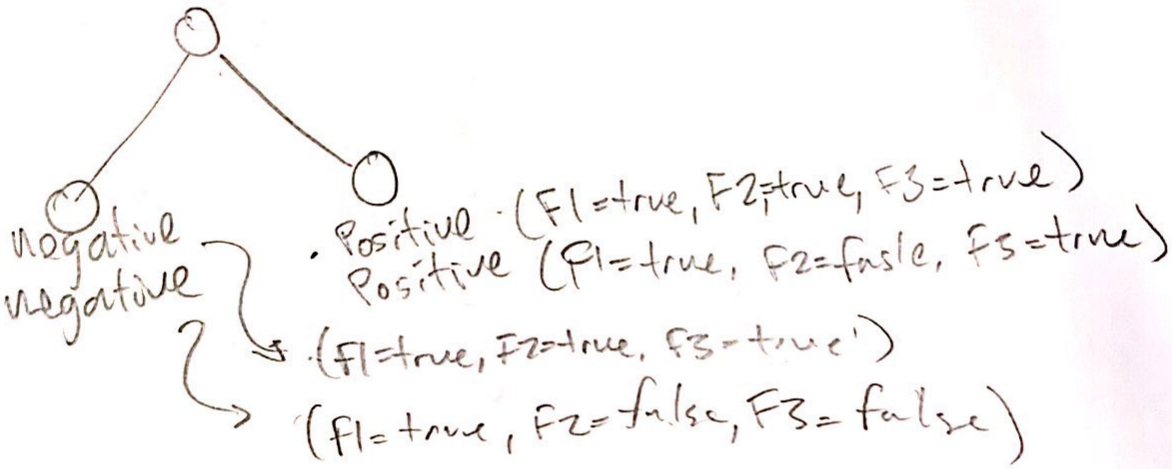
5. a) winter ∧ morning

b) morning

c) winter ∧ [True ∨ Sat] ∧ morning

morning

6.



7. a) $\begin{pmatrix} 3 & 1 & 4 & 1 \\ 0 & 2 & 2 & 1 \\ -1 & 6 & 5 & 1 \\ -1 & -3 & 2 & 1 \\ 0 & 1 & 0 & 1 \end{pmatrix} = X$

b) $X\hat{w} = \begin{pmatrix} 7 \\ 5 \\ 0 \\ -2 \\ 3 \end{pmatrix} = y$

$X^T X \hat{w} = X^T y$

$\hat{w} = (X^T X)^{-1} X^T y$

$\hat{w} = \begin{pmatrix} w_0 \\ w_1 \\ w_2 \\ -t \end{pmatrix}$

c) $\hat{w}^T \vec{x} \geq t$ positive

$\hat{w}^T \vec{x} < t$ negative

decision rule

8. a basic binary classifier. a perceptron will not converge for overlapping data

9. ~~$(2dN)t$~~

$d^2 + N^2 \cdot t$

$x^T x$ for loop