Instructions: Please fill in your name and matric. no. For each question, write your choice(s) in the box (2pts), explain your choice (3pts), and answer the additional question (5pts). Each T/F question is worth 2pts.

1. Suppose we have a dataset of MRI scans from patients with and without cancer. The dataset has 800 cancer-free images and 200 images from cancer patients. If we train a classifier which achieves 85% accuracy on this dataset, is it a good classifier?

   A) Yes
   B) No
   C) Not enough info

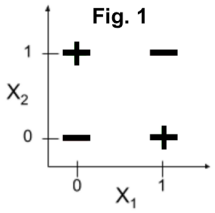
   Choice:

   (a) Explain your choice below. (b) Is a classifier that attains 100%/70% accuracy on the training/test sets better than a classifier that attains 80%/75% training/test accuracy? Explain your answer.

2. Which of the following classifiers can perfectly classify the data shown below in Fig. 1?

   A) Decision Tree
   B) Perceptron
   C) Neural Network
   D) Linear SVM

   Choice:



   (a) Explain your choice below. (b) Draw the decision tree classifier for the dataset shown in Fig. 1.

3. True/False Questions. Each question is worth 2 points. Write True or False in the box.

   a. In machine learning algorithms, generalization error is a measure of how accurately the classifier works on training data.
   b. When the hypothesis space is richer, over fitting is more likely.
   c. When the feature space is too small, over fitting is more likely.
   d. As the number of training examples goes to infinity, your model trained on that data will have lower variance.
   e. As the number of training examples goes to infinity, your model trained on that data will have lower bias.
   f. If a decision tree is grown to full depth, it is more likely to fit the noise in the data.
   g. Neural networks are simply function approximation machines in disguise.
   h. In SVM with hard margin, the classifier is allowed to make errors.
   i. In SVM with soft margin, the classifier is not allowed to make errors.
   j. Random forest uses an ensemble of decision trees to reduce overfitting and increase accuracy.

4. For the boolean function shown in Fig. 1, which of the following changes will permit linear SVM to accurately classify the resulting dataset?

   A) 01 ⇒ −
   B) 10 ⇒ −
   C) 11 ⇒ −
   D) Not possible

   Choice:

   (a) Explain your choice below. (b) Can you represent the boolean function in Fig. 2 using the perceptron (single unit from a neural network)? If yes, give the weights. If not, briefly explain why.