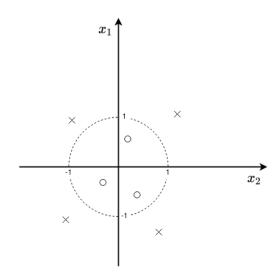
CS3244 Exam 1: Part 2 28 Sep 2020

Please do not turn to the next page until you are told to do so by your proctor.

- This exam part is worth 25 marks out of a 75 mark total for all three parts.
- This exam part is estimated to take you about 25 minutes to complete.
- This exam part has a total of 7 questions.
- This exam part contains only multiple choice questions (MCQs) and multiple response questions (MRQ). Please key these into the assessment system.
- You can visit http://www.comp.nus.edu.sg/~cs3244/2010/e1.part2.html to reach the entry form for this survey if you lose your browser window.
- Do remember that you will need to key in and submit your answers to the according assessment system as designated by your proctor or by exam central.

- 1. (MRQ with 4 options; 3 marks) Bias-Variance. Mark all statements that are true.
 - (a) A model with high variance will tend to have low test error over different samples of training data.
 - (b) An ${\cal H}$ with high complexity will tend to exhibit high variance.
 - (c) High variance models tend to have low bias.
 - (d) An \mathcal{H} with low bias will generally improve over one with high bias, given sufficient training data.
- 2. (MCQ; 2 marks) Which of the following statements is true of Logistic Regression?
 - (a) The sigmoid function is differentiable everywhere except at x = 0.
 - (b) The output interval of logistic regression will be [-1,1].
 - (c) When using gradient descent for the training of logistic regression at Step t to update θ , we update in same direction as $\nabla J_{train}(\theta(t))$.
 - (d) It is used as a linear classifier by setting a cutoff value to the output of the sigmoid function.
- 3. (MCQ; 2 marks) In lecture, we have seen the Bias–Variance decomposition for squared loss; i.e., $J(f(x),h(x))=(f(x)-h(x))^2$. Let us now define the error as $J(f(x)-h(x))=(|f(x)-h(x)|^p)$. Given this, choose the correct Bias–Variance decomposition.
 - (a) $Bias^p + Variance^{p/2}$.
 - (b) $Bias^{p/2} + Variance^p$.
 - (c) $Bias^p + Variance^p$.
 - (d) $Bias^{p/2} + Variance^{p/2}$.
 - (e) None of the above.
- 4. (MRQ with 5 options; 3 marks) Which set of features can result in zero training loss on the following training examples when using a linear model?



- (a) $x_1^2, x_2^2, -1$
- (b) $x_1^2, x_2^2, 1$
- (c) $x_1, x_2, 1$.
- (d) $x_1, x_2, x_1^2, x_2^2, 1$.
- (e) $x_1, x_2, x_1^2, x_2^2, -1$.

[Questions 5–7] Consider the instance space consisting of integer points in the range $\{0,1,...,10\}$ in the x,y plane and the set of hypotheses \mathcal{H} consisting of rectangles with sides parallel to the x-axis and y-axis; i.e., $h \in \mathcal{H}$ is of the form $a \le x \le b$, $c \le y \le d$, where a,b,c, and d is also restricted to the range $\{0,1,...,10\}$, and an h(x,y)=1 if lies within or touches the rectangle defined by h, and 0 otherwise.

5. (MCQ; 7 marks) Given the input below, what does **Candidate-Elimination algorithm** output for *G*?

Example	Input Instance	Target Concept
1	(6,4)	1
2	(8,7)	0
3	(4,7)	1
4	(2,2)	0

- (a) $\{(3,10,0,6), (0,10,3,6), (0,7,3,10), (3,7,0,10)\}$
- (b) $\{(2,10,0,6),(0,10,2,6),(0,7,2,10),(2,7,0,10)\}$
- (c) $\{(0,7,3,10),(3,7,0,10)\}$
- (d) $\{(0,7,2,10),(2,7,0,10)\}$
- 6. (MCQ; 4 marks) Given an arbitrary target concept f of the same form as h (e.g., $3 \le x \le 5, 2 \le y \le 9$), what is the fewest number of training examples you must provide so that Candidate-Elimination learns it perfectly?
 - (a) 6
 - (b) 2
 - (c) 4
 - (d) 5
 - (e) 8
- 7. (MCQ; 4 marks) Suppose we are given several input instances and obtain the *S* and *G* boundary sets after running Candidate-Elimination:

$$S: \{(6 \le x \le 8, 3 \le y \le 5)\}$$

$$G: \{(2 \le x \le 9, 2 \le y \le 7), (3 \le x \le 9, 2 \le y \le 9)\}$$

Which new instance below will reduce the number of hypotheses remaining in the version space?

- (a) (6,5)
- (b) (4, 6)
- (c) (2,9)
- (d) (7,4)
- (e) None of the above. It will also depend on the instance's label.

This marks the end of this part of the exam. These is no additional material beyond this point.