COMP541 Self Assessment Quiz

Name:

0. Computer Access

Do you have a laptop or other portable device you can bring to lecture for in-class exercises? What kind? (Please bring it starting next lecture, and talk to the professor if you do not have access to one).

1. Course Prerequisites

Please indicate what semester you have completed the following courses and your letter grade:

Course	Semester	Grade
Engr 200 Probability and Statistics: Reasoning from incomplete information forms the core of machine learning.		
Math 107 Linear Algebra: Needed for data processing as well as dimensionality reduction techniques like PCA.		
Math 203 Multivariable Calculus: Required for optimization (SGD, Backprop) and Bayesian integration.		
Comp 302 Software Engineering: Advanced software development skills are necessary for the class project.		

2. The Gaussian (Normal) Distribution

Which of the following is the PDF of the Gaussian (or normal) distribution?

(A) $\mathcal{N}(x \mid \mu, \sigma^2) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left\{-\frac{(x-\mu)^2}{2\sigma^2}\right\}$

(B) $\mathcal{N}(x \mid \mu, \sigma^2) = \frac{\mu^\sigma}{\Gamma(\sigma)} x^{\sigma-1} \exp\{-x\mu\}$

(C) $\mathcal{N}(x \mid \mu, \sigma^2) = \frac{x}{\sigma\sqrt{2\pi}} \exp\left\{-\frac{(\ln x-\mu)^2}{2\sigma^2}\right\}$

(D) $\mathcal{N}(x \mid \mu, \sigma^2) = \binom{\mu+\sigma}{\mu} x^\mu (1-x)^{1-\sigma^2}$

3. Eigenvectors and Eigenvalues

If v is an eigenvector of square matrix $\boldsymbol{A}$ with eigenvalue λ, which of the following is true? Boldface lowercase letters like v are column vectors.

(A) $\boldsymbol{A}v = v^{\lambda}$

(B) $\boldsymbol{A}v = \lambda v$

(C) $\lambda \boldsymbol{A} = \boldsymbol{A}v$

(D) $\lambda \boldsymbol{A}v = v$

4. Computing Gradients

Which of the following is the gradient of the scalar function $f(\boldsymbol{x}) = (\boldsymbol{a} - \boldsymbol{x})^{\mathsf{T}} \boldsymbol{B} (\boldsymbol{a} - \boldsymbol{x})$, where $\boldsymbol{B}$ is symmetric? The notation $\boldsymbol{x}^{\mathsf{T}}$ indicates transpose.

(A) $\nabla_{\boldsymbol{x}} f = -2\boldsymbol{B}^{-1}(\boldsymbol{a} - \boldsymbol{x})$

(B) $\nabla_{\boldsymbol{x}} f = -2\boldsymbol{B}(\boldsymbol{a} - \boldsymbol{x})$

(C) $\nabla_{\boldsymbol{x}} f = 2\boldsymbol{B}^{-1}(\boldsymbol{a} - \boldsymbol{x})$

(D) $\nabla_{\boldsymbol{x}} f = \boldsymbol{B}^{-1}(\boldsymbol{a} - \boldsymbol{x})$

5. Properties of Expectations

Let X and Y be independent random variables with finite expectations. Which of the following statements is false?

(A) $\mathbb{E}[X + Y] = \mathbb{E}[X] + \mathbb{E}[Y]$

(B) $\mathbb{E}[X \cdot Y] = \mathbb{E}[X] \cdot \mathbb{E}[Y]$

(C) $\mathbb{E}[aX + bY] = a^2\mathbb{E}[X] + b^2\mathbb{E}[Y]$

(D) All of these are true.

6. Basic Graph Theory

Let G be a bipartite graph with N vertices, where N is even. (A bipartite graph has two groups of vertices and edges can only connect vertices in different groups.) What is the maximum number of edges that G can have?

(A) $N(N-1)/2$

(B) N^2

(C) $N^2/4$

(D) $N(N-1)/4$

7. Basic Probability

Which of the following probability identities is false?

(A) $\Pr(A, B) = \Pr(A \mid B)\ \Pr(B)$

(B) $\Pr(A \mid B) = \Pr(B \mid A)\ \Pr(A) / \Pr(B)$

(C) $\Pr(B \mid A) = \Pr(A, B) / \Pr(A)$

(D) All of these are true.

8. Integral Calculus

What is the value of the integral

$$\int_{-\infty}^{\infty} f(x)\, \delta(x - a)\, \mathrm{d}x$$

where $\delta(z)$ is the Dirac delta function?

(A) $f(a)$

(B) $f(-a)$

(C) a

(D) $f(0)$