

CSCI 6751 V1 | Artificial Intelligence

Midterm Examination

Oct 14, 2025

Total 50 points

Time: 15 minutes

GOOD LUCK

Group 1

Student Name & ID _____

MCQ: Select only the most appropriate option.

Question 1. (5 points)

A key difference between a classical set and a fuzzy set is that:

- a) Fuzzy sets can have an infinite number of elements, while classical sets are finite.
- b) Classical set membership is binary, while fuzzy set membership is a matter of degree.
- c) Fuzzy sets are used only in control systems, while classical sets are used in logic.
- d) Classical sets are a subset of fuzzy sets, but not vice versa.

Question 2. (5 points)

The correct order of the four steps in a Mamdani-style Fuzzy Inference System is:

- a) Rule Evaluation → Fuzzification → Defuzzification → Aggregation
- b) Fuzzification → Rule Evaluation → Aggregation → Defuzzification
- c) Aggregation → Fuzzification → Rule Evaluation → Defuzzification
- d) Defuzzification → Aggregation → Rule Evaluation → Fuzzification

Question 3. (5 points)

The primary reason to use Gradient Descent for linear regression instead of the Least Squares Solution is when:

- a) the model is severely underfitting.
- b) the number of features is very large (e.g., >1000), making LSS computationally expensive.
- c) the relationship between variables is perfectly linear.
- d) you need a 100% accurate model.

Question 4. (5 points)

You are building a linear regression model and suspect that only 5 out of 100 features are truly predictive. Which regularization technique would be most appropriate to help identify these key features?

- a) L2 Regularization (Ridge)
- b) L1 Regularization (Lasso)
- c) ElasticNet with a higher weight on the L2 part
- d) No regularization is needed.

Question 5. (5 points)

Observing a plot of model complexity (e.g., polynomial degree) vs. error, you see training error monotonically decreasing while test error decreases initially and then starts to increase. The point where test error is minimized indicates:

- a) The optimal model complexity before overfitting dominates.
- b) The point of maximum bias.
- c) The point where the model is underfit.
- d) The point of irreducible error.

Question 6. (5 points)

In the multivariate linear regression normal equation $\theta = (X^T X)^{-1} X^T Y$, if the design matrix X has dimensions $m \times (n+1)$ (m examples, n features plus intercept), and Y is $m \times 1$, what are the dimensions of the resulting parameter vector θ ?

- a) $m \times 1$
- b) $(n+1) \times 1$
- c) $m \times (n+1)$
- d) $(n+1) \times m$

Question 7. (5 points)

A model has high error on both training and test data. Increasing model complexity reduces training error to near zero, but test error remains high. This sequence describes the transition from a model suffering primarily from _____ to one suffering primarily from _____.

- a) High variance; High bias
- b) High bias; High variance
- c) Underfitting; Optimal fitting
- d) High bias; Low bias

Question 8. (5 points)

You apply L1 (Lasso) regularization to a linear model with 100 features. As you continuously increase the regularization parameter λ from zero to a very large value, what is the correct sequence of model behaviors?

- a) Underfit \rightarrow Optimal \rightarrow Overfit
- b) All coefficients become zero immediately.
- c) Overfit \rightarrow Optimal \rightarrow Underfit (with some coefficients exactly zero)
- d) The model's bias decreases monotonically.

Question 9. (5 points)

$A = \{(x1, 0.3), (x2, 0.7)\}$ $B = \{(x1, 0.9), (x2, 0.2)\}$

What is the membership value for element $x1$ in the union $A \cup B$?

- a) 0.3 **b) 0.9** c) 0.27 d) 1.2

Question 10. (5 points)

Given a rule "If X is A and Y is B then Z is C," with input membership values $\mu_A(x)=0.6$ and $\mu_B(y)=0.9$, the firing strength for the antecedent is:

- a) 1.5 b) 0.54 c) 0.9 **d) 0.6**