

Exam 3

■ Name or ID: _____

■ Question 1

■ [1 points] Given the following confusion matrix, what is the precision for class Dragon?

Class \ Predict	Cat	Dog	Dragon
Cat	40	10	0
Dog	10	20	10
Dragon	0	0	30

3/4

1/2

1

1/4

■ Question 2

■ [1 points] What is `matrix.argmax(axis = 1)`, where `matrix = numpy.array([[1, 2, 3], [4, 5, 6]])`?

[2, 2]

[1, 1, 1]

[2, 2, 2]

[3, 3]



Question 3

[1 points] There are 4 documents, and 3 of these documents contain the token "Groot". In document 1, there are 10 tokens in total, and 5 of them are "Groot". What is the bag of words feature (without normalization) of document 1 feature "Groot"?

3

5

4

10

Question 4

[1 points] What is a valid simplification of `numpy.linalg.solve(X, X @ y)`, assuming the code runs without error (and numerical instability)?

y

$y @ X$

X

$X @ y$



■ Question 5

■ [1 points] The shape of A is (3, 2), the shape of B is (3, 3), and the shape of C is (4, 3). What is the shape of $A @ B @ C$?

?

(3, 3)

(4, 2)

(Error)

(2, 4)

■ Question 6

■ [1 points] If x_0 has two columns, and $x = \text{sklearn.preprocessing.PolynomialFeatures}(2).\text{fit_transform}(x_0)$ is used as the design matrix, how many weights (include coefficients and biases or intercepts) will a linear regression estimate?

4

6

5

2

■ Question 7

■ [1 points] `df` has 10 columns and 5 rows. After applying `p = PCA(3)` and `p.fit(df)`, what is the shape of `p.components_`? Note: the rows of `p.components_` are the principal components.

(3, 10)

(3, 5)

(5, 3)

(10, 3)

■ Question 8

■ [1 points] Given points `[[1], [2], [3], [4]]` and starting centroids `[0]` and `[7]`, what are the centroids after the first iteration of assigning points and updating centroids, using the iterative K-Means Clustering algorithm with Manhattan distance?

[0, 7]

[1, 3]

[2, 4]

[1.5, 3.5]

■ Question 9

■ [1 points] The gradient vector dw at $[w_1, w_2, w_3, w_4] = [-1, 1, 2, -2]$ is $[2, -2, -1, 1]$, if gradient descent $w = w - \alpha * dw$ is used, which variable will increase by the largest amount in the next iteration?

w_2

w_3

w_4

w_1

■ Question 10

■ [1 points] Suppose $dxy = \text{skimage.filters.sobel}(img)$ produces the dxy matrix in the following table. To highlight the edge pixels in the original image in green, $\text{image}[dxy > t] = [0, 255, 0]$ is used, and 2 pixels are highlighted. Which value of t is used?

0	0	0	0
0	1	1	0
0	0.5	0.75	0
0	0	0	0

0.8

0.25

1

0.7

■ Question 11

■ [1 points] One-vs-one support vector machines are trained and produce the following the confusion matrix. How many training items are used in training the "0 vs 2" support vector machine?

Count	Predict 0	Predict 1	Predict 2
Class 0	10	20	10
Class 1	0	10	0
Class 2	10	0	10

70

60

10

40

■ Question 12

■ [1 points] The 3-fold cross validation accuracy for four different neural networks is summarized below. Which model is the most preferred one based on cross validation accuracy?

Network	Fold 1 accuracy	Fold 2 accuracy	Fold 3 accuracy
W	0.5	0.5	0.5
X	0.6	0.8	1
Y	0.7	0.8	0.9
Z	0.8	0.8	0.8

X

Y

W

Z

■ Question 13

■ [1 points] What is the optimal solution $[x_1, x_2]$ to the linear program $\max x_1 + 2 * x_2$ subject to $x_1 + x_2 \leq 1$ and $x_1 \geq 0, x_2 \geq 0$?

[1, 1]

[0, 0]

[1, 0]

[0, 1]

■ Question 14

■ [1 points] Suppose the standard form of a linear program $\max c @ x$ subject to $A @ x \leq b$ and $x \geq 0$ has $\text{len}(c) = 5$, $A.\text{shape} = (3, 5)$, and $\text{len}(b) = 3$. What is the number of dual variables $\text{len}(y)$? Note: the dual problem is $\min b @ y$ subject to $A' @ y \geq c$ and $y \geq 0$ where $'$ means transpose.

1

3

15

5

■ Question 15

■ [1 points] Suppose all the random vectors generated from a multivariate normal distribution are on the same line, using `numpy.random.multivariate_normal([0, 0], [[1, c], [c, 4]], 1000)`. What is the value of c ?

0

-1

-2

-4

■ Question 16

■ [1 points] Consider a Markov chain with the following transition matrix with three states $[0, 1, 2]$. What is the probability a sequence $[0, 0, 2]$ is observed (given it starts with 0)?

From \ To	0	1	2
0	1	0	0
1	0	0.5	0.5
2	0.5	0	0.5

0.25

0.5

1

0

■ Question 17

■ [1 points] For a logistic regression `lr`, if `lr.predict_proba(x)` for some item `x` is `[0.3, 0.5, 0.2]`, what is `lr.predict(x)` for the same `x`?

3

0

1

2

■ Question 18

■ [1 points] What is the complete linkage Manhattan distance between `c1 = [[5], [4], [0]]` and `c2 = [[2], [1]]`? Note: `c1` is a cluster with 3 points and `c2` is a cluster with 2 points.

2

3

1

4

■ Question 19

■ [1 points] Given the principal components $u_1 = [0, 0, 1]$, $u_2 = [1, 0, 0]$, $u_3 = [0, 1, 0]$, and the PCA (principal component analysis) features of an item x is $y = [-1, 0, 1]$, what is x ?

$[-1, 0, 1]$

$[1, 1, 1]$

$[0, 1, -1]$

$[1, 0, -1]$

■ Question 20

■ [1 points] If you think any of the questions are not clear or incorrect, please explain here; otherwise, enter "none". Please do not leave the answer blank:



■ END OF EXAM

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