SHRI G. S. INSTITUTE OF TECHNOLOGY & SCIENCE, INDORE

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PRACTICAL / TEST ANSWER BOOK

(Contains 8 Pages) 08[illegible]862

Name Sample Answer Copy Subject Code CO34553

Class Roll No. Subject Machine Learning

Enrolment No Class B.Tech III year Test No MST-1

Signature of Internal Examiner Date

Signature of External Examiner Marks / Obtained Out

Q1: a) i) Supervised Machine Learning → Google's Spam to email classification using SVM & naive bayes algorithm.

ii) Unsupervised Machine Learning → Amazon's Recommendation System

iii) Semi-Supervised Machine Learning → Google uses semi-supervised ML to label and rank web pages in their search result.

iv) Reinforcement Learning → Tesla's Autopilot systems.

v) Generative Adversarial Networks → Midjourney, ChatGPT.

Q1 b) As the dependent feature is categorical in nature; we can use classification tasks on this dataset.
Logistic Regression, Neural Network, Support Vector Machines can be used for such task.

Q1 c) No, a sigmoid activation function cannot be used for multiclass classification ~~because~~ ~~and~~ in last because

The output will be generated for multiple classes & sigmoid cannot handle that. It can be used in hidden layers of neural network or for generating the pre-final output of logistic regression.

Q1 d) train data = $120K - (120 \times 0.25) = 90,000$

$X = 90,000/256 = 352$

$Y = 120,000$

$X + 2Y = 352 + 2(120,000) = 240,352$

Q1 e) $P \leftarrow$ Inputs with label 1;

$N \leftarrow$ Inputs with label 0;

Initialize $w = [w_0, w_1, w_2 \cdots w_n]$ randomly;

while !convergence do

Pick random $x \in P \cup N$

if $x \in P$ & $\sum_{i=0}^{n} w_i x_i < 0$ then

$w = w + x$;

end

if $x \in N$ & $\sum_{i=0}^{n} w_i x_i \geq 0$ then

$w = w - x$;

end

end

The algorithm convergence when all the inputs are classified correctly or it doesnot changes the value.

Q2: $a = \bar{y} - b\bar{x}$

soln $b = \frac{S_{xy}}{S_{xx}} = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2} = \frac{\sum (xy) - \frac{\sum x \sum y}{n}}{\sum (x^2) - \frac{\sum (x)^2}{n}}$

$\bar{x} = \frac{\sum x}{n} = \frac{3+4+6+8+26+50}{6} = \frac{97}{6} = 16.166$

$\bar{y} = \frac{\sum y}{n} = \frac{25+30+45+60+100+160}{6} = 70$

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$	$(x_i - \bar{x})^2$
3	25	-13.16	-45	592.65	173.4489
4	30	-12.16	-40	486.8	148.1089
6	45	-10.17	-25	254.25	103.4289
8	60	-8.17	-10	81.7	66.7489
26	100	+9.83	+30	294.9	96.6289
50	160	33.83	+90	3044.7	1144.4689
				$\Sigma = 4,755$	$\Sigma = 1732.8334$

$b = \frac{S_{xx}}{S_{xy}} = \frac{4755}{1732.833} = 2.74406$

$a = \bar{y} - b\bar{x}$

$= 70 - (2.744)(16.17) = 25.62952$

$\hat{y} = 25.6295 + 2.744x$

Q2(b)

x	y	$\hat{y} = 25.629 + 2.7442x$	Residual $(y_i - \hat{y}_i)$	$(y_i - \bar{y})^2$	$(y_i - \bar{y})^2$
3	25	$= 33.861$	$= -8.861$	$= 78.517$	$= 2025$
4	30	$= 36.605$	$= -6.605$	$= 43.6260$	$= 1600$
6	45	$= 42.093$	$= 2.907$	$= 8.4506$	$= 625$
8	60	$= 47.581$	$= 12.419$	$= 154.231$	$= 100$
26	100	$= 96.973$	$= 3.027$	$= 9.1627$	$= 900$
50	160	$= 162.829$	$= -2.829$	$= 8.003$	$= 8100$
	Σ			$\Sigma 301.99$	$\Sigma 13350$

$$R^2 = 1 - \frac{SSR}{SST} = 1 - \frac{\Sigma(y_i - \hat{y})^2}{\Sigma(y_i - \bar{y})^2} = 1 - \frac{301.99}{13350} = 1 - 0.022 = 0.978$$

Q3(a): $J(w) = w_1^2 + w_2^2 + 4w_1 - 6w_2 - 1$; $[w_1\ w_2] = [3\ 4]$ $\alpha = 0.3$

Sol: $\frac{\partial J}{\partial w} = [2w_1 + 4 \quad 2w_2 - 6]$

Iteration (K)	w^k	$\nabla J = \begin{bmatrix} 2w_1+4 \\ 2w_2-6 \end{bmatrix}$	J	$w^{K+1} = w^K - \alpha \nabla J$
0	$[3 \quad 4]$	$[10 \quad 2]$	$= 9+16+12-24-1$	$= [3\ 4] - 0.3[10\ 2]$
			$= 12$	$= [0\ 3.4]$
1	$[0 \quad 3.4]$	$[4 \quad 0.8]$	$= 0 + 11.56 + 0 - 20.4 - 1$	$= [0\ 3.4] - 0.3[4\ 0.8]$
			$= -9.84$	$= [-1.2\ 3.16]$
2	$[-1.2 \quad 3.16]$	$[1.6 \quad 0.32]$	$= 1.44 + 9.98 + 4.8 - 18.96 - 1$	$= [-1.2\ 3.16] - 0.3[1.6\ 0.32]$
			$= -13.34$	$= [-1.68\ 3.064]$
3	$[-1.68 \quad 3.064]$	$[0.64 \quad 0.128]$	$= 2.8224 + 9.38 - 6.72 - 18.384 - 1$	$= [-1.68\ 3.064] - 0.3[0.64\ 0.128]$
			$= -14$	$= [-1.872\ 3.025]$

Q3b) The gradient is moving away from its minimum value.
So its a divergent case.

Q3c) Training accuracy 87.38% } The model learnt well on
Testing accuracy 47.99% } training data set but
was unable to predict on test data - This is the case of high variance & overfitting
Four methods to solve this problem are listed below:

1. Cross Validation
2. Feature selection
3. Regularization techniques
4. Ensemble methods.
5. Early stopping

Q4) a)
```
from keras import layers
from keras import models

network = models.Sequential()
network.add(layers.Dense(6, activation='relu', kernel_initializer='glorot_uniform', bias_initializer='zeros',
                         input_shape=(8,)))
network.add(layers.Dense(3, activation='relu'))
network.add(layers.Dense(1, activation='sigmoid'))
```

b) Model: Sequential

Layer (type)	Output shape	Param #
dense	(None, 6)	(48+6)
dense	(None, 3)	21
dense	(None, 1)	4

4c) network.compile(optimizer='rmsprop', loss='categorical_crossentropy', metrics=['accuracy'])

network.fit(train_x, train_y, epochs=100, batchsize=128)

4d) network.evaluate(test_x, test_y)

1) can add more layers
2) can change the activation function.