**Birla Institute of Technology & Science, Pilani**
**Work-Integrated Learning Programmes Division**
**First Semester 2019-2020**
**Comprehensive Examination (Regular)**

| | |
|---|---|
| Course No. | : PCAM* ZC311 |
| Course Title | : CLASSIFICATION |
| Nature of Exam | : Closed Book |
| Weightage | : 40% |
| Duration | : 3 Hours |
| Date of Exam | : 03/11/2019 (FN) |

No. of Pages = 2
No. of Questions = 4

**Q1.**

**A.** Explain the advantages of probabilistic generative models over probabilistic discriminatory models with examples

**B.** Calculate TPR, FPR, Precision, Recall and F1 for the confusion matrix given below

| | | Predicted class | | | |
|---|---|---|---|---|---|
| | | ***C1*** | ***C2*** | ***C3*** | Total |
| **Correct class** | ***C1*** | *15* | *2* | *3* | *20* |
| | ***C2*** | *7* | *15* | *8* | *30* |
| | ***C3*** | *2* | *3* | *45* | *50* |
| | Total | *24* | *20* | *56* | *100* |

**Q2.**

**A.** Discuss the performance and interpretability of Naïve Bayes classifier

**B.** A bag has 3 balls (red or blue). If 5 random pick and replacement events result in the following results – blue, red, blue, blue, red; what is the n umber of blue balls that gives max probability for the observed data

**Q3.**

**A.** Using relevant metrics, determine the best attribute to split the below data at root level

| Name | Body Temperature | Skin Cover | Gives Birth | Aquatic Creature | Aerial Creature | Has Legs | Hiber-nates | Class Label |
|---|---|---|---|---|---|---|---|---|
| human | warm-blooded | hair | yes | no | no | yes | no | mammal |
| python | cold-blooded | scales | no | no | no | no | yes | reptile |
| salmon | cold-blooded | scales | no | yes | no | no | no | fish |
| whale | warm-blooded | hair | yes | yes | no | no | no | mammal |
| frog | cold-blooded | none | no | semi | no | yes | yes | amphibian |
| komodo dragon | cold-blooded | scales | no | no | no | yes | no | reptile |
| bat | warm-blooded | hair | yes | no | yes | yes | yes | mammal |
| pigeon | warm-blooded | feathers | no | no | yes | yes | no | bird |
| cat | warm-blooded | fur | yes | no | no | yes | no | mammal |
| leopard shark | cold-blooded | scales | yes | yes | no | no | no | fish |
| turtle | cold-blooded | scales | no | semi | no | yes | no | reptile |
| penguin | warm-blooded | feathers | no | semi | no | yes | no | bird |
| porcupine | warm-blooded | quills | yes | no | no | yes | yes | mammal |
| eel | cold-blooded | scales | no | yes | no | no | no | fish |
| salamander | cold-blooded | none | no | semi | no | yes | yes | amphibian |

**B.** Solve the following optimization problem using Lagrange multiplier and KKT conditions (with intermediate steps)

$$\begin{aligned} \text{Min}: \ f(\bar{x}) &= x_1^2 - x_2, \\ \text{st}: \ x_1 + x_2 &= 6, \\ x_1 &\geq 1, \\ x_1^2 + x_2^2 &\leq 26. \end{aligned}$$

**Q4.**

**A.** Derive the maximum margin classifier (in terms of input and output values) using optimization techniques and dual functions to maximize the margin ‘d’

**B.** Compare and contrast Bagging and Boosting with examples