**Department of Computer Science and Engineering**

**University of Asia Pacific (UAP)**

**Program: B.Sc. in Computer Science and Engineering**

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| **Final Examination** | **Spring 2021** | **4th Year, 1st Semester** |
| **Course Code: CSE 427** | **Course Title: Machine Learning** | **Credits: 3.00** |
| **Full Marks: 120\* (Written)** |  | **Duration: 2 Hours** |
| \* Total Marks of Final Examination: 150 (Written: 120 + Viva: 30) | | |
| **Instructions:**   1. There are **Four (4)** Questions. Answer all of them. All questions are of equal value. Partial marks are shown in the margins. 2. Non-programmable calculators are allowed. | | |

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| **1.** | **a)** | Explain cross-validation in machine learning. Explain the different types of cross-validations. | [10] |
|  | **b)** | Explain with simple example the confusion matrix of a binary classification problem? Assume the following: A database contains 100 records on a particular topic of which 65 are relevant to a certain investigation. A search was conducted on that topic and 55 records were retrieved. Of the 55 records retrieved, 45 were relevant. Construct the confusion matrix for the search and calculate the precision and recall scores for the search. | [20] |
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| **2.** | **a)** | What are Regression trees? Explain the concept of a regression tree using an example. | [10] |
|  | **b)** | Use ID3 algorithm to construct a decision tree for the data in the following table: | [20] |
|  |  | Age Competition Type Class  Old Yes Software Down  Old No Software Down  Old No Hardware Down  Mid Yes Software Down  Mid Yes Hardware Down  Mid No Hardware UP  Mid No Software Up  New Yes Software Up  New No Hardware Up  New NO Software Up |  |
|  |  |  |  |
| **3.** | **a)** | Why dimensionality reduction is useful in machine learning? Describe the forward selection algorithm for implementing the subset selection procedure for dimensionality reduction | [10] |
|  | **b)** | Explain the method of principal component analysis in machine learning. Given the following data, compute the principal component vectors and the first principal components: | [20] |
|  |  | x 2 3 7  y 11 14 26 |  |
|  |  |  |  |
| **4.** | **a)** | Explain briefly the terms: Norm; Inner product; Angle between two vectors; Perpendicularity using following data: n=4; x=(-1, 2, 0, 3); y=(2, 3, 1, -4). | [10] |
|  | **b)** | Illustrate the basic concepts and terminology of the theory of support vector machines by the following simple example where to develop some criteria for determining the weather conditions under which tennis can be played: |  |
|  |  | Temperature humidity play  85 85 no  60 70 yes  80 90 no  72 95 no  68 80 yes  74 73 yes  69 70 yes  75 85 no  83 78 no | [20] |
| **Or,** |  |  |  |
|  |  |  |  |
| **4.** | **a)** | Describe a hidden Markov model in general case. What are the basic problems associated with a hidden Markov model? | [10] |
|  | **b)** | Describe a discrete Markov process with an example. Let there be a discrete Markov process with two states S1 and S2. Given the following sequences of observations of these states, estimate the initial probabilities and the transition probabilities of the process. | [20] |
|  |  | S1S2; S2S2; S1S2; S2S1; S1S1; S2S1; S1S2; S1S1. |  |