

Xi'an Jiaotong-Liverpool University

西交利物浦大学

PAPER CODE	EXAMINER	DEPARTMENT	TEL
CSE315		CSSE	_____

1st SEMESTER 2019/20 FINAL EXAMINATION

Undergraduate – Year 4 & Postgraduate – Year 1

MACHINE LEARNING

TIME ALLOWED: 2 Hours 0 Minutes

INSTRUCTIONS TO CANDIDATES

1. This is a closed-book examination, which is to be written without books or notes.
2. Total marks available are 100.
3. This exam consists of 7 questions requiring written answers. The figure in [] denotes the number of marks available for that question or part of question.
4. Answer all questions. There is NO penalty for providing a wrong answer. Partial marks may be awarded depending on the degree of completeness and clarity of your answers.
5. Answers should be written in the answer booklet(s) provided.
6. Only English solutions are accepted.
7. The university approved calculator – Casio FS82ES/83ES can be used.
8. All materials must be returned to the exam supervisor upon completion of the exam. Failure to do so will be deemed academic misconduct and will be dealt with accordingly.

Question 1 [30 Marks]

Answer the following FIVE questions. Each question is worth 6 marks.

- a) In terms of experience/data E , some class of tasks T , and performance measure P , how can we say a machine learning algorithm is learning from data? [6 marks]

- b) What are the main categories of machine learning? Give an example method of each type of machine learning. [6 marks]

- c) What is the difference between regression and classification? [6 marks]

- d) In machine learning, the training dataset can sometimes be overfitted. What does this mean? List the two main options for addressing such overfitting problems. [6 marks]

- e) What is the main idea of Principal Component Analysis (PCA) and how can it be achieved? What are the characteristics of these principal components? [6 marks]

Question 2 [10 Marks]

What is the squared error loss function of linear regression? Express it in matrix form and derive its ordinary least square (OLS) solution accordingly.

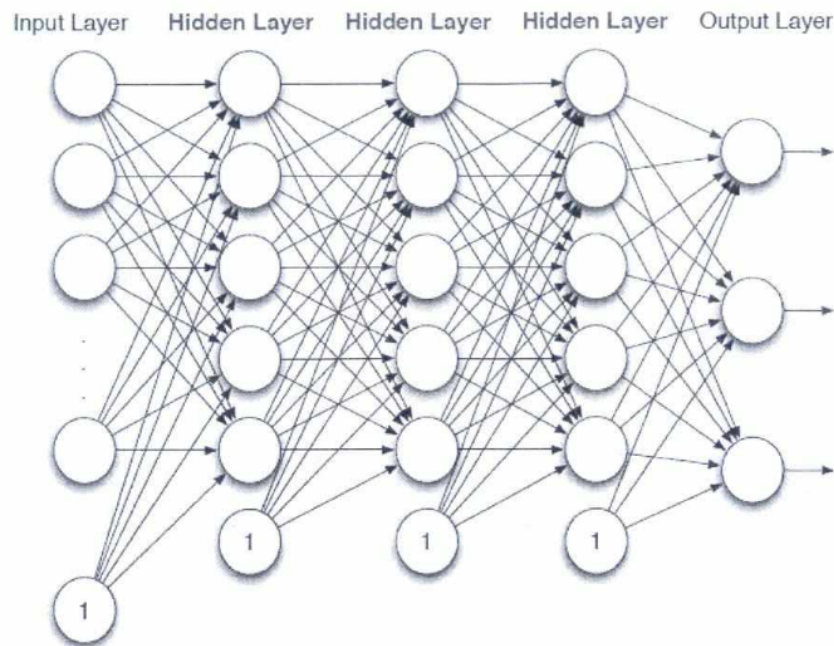
Question 3 [10 Marks]

Given the data in the following table, whether to play tennis depends on a number of factors such as the weather (outlook), temperature, humidity, and wind. Explain what entropy means for a dataset S consisting of C types of samples, write the equation of entropy, and then calculate the entropy of "normal humidity" and "strong wind".

Day	Outlook	Temperature	Humidity	Wind	PlayTennis
D1	Sunny	Hot	High	Weak	No
D2	Sunny	Hot	High	Strong	No
D3	Overcast	Hot	High	Weak	Yes
D4	Rain	Mild	High	Weak	Yes
D5	Rain	Cool	Normal	Weak	Yes
D6	Rain	Cool	Normal	Strong	No
D7	Overcast	Cool	Normal	Strong	Yes
D8	Sunny	Mild	High	Weak	No
D9	Sunny	Cool	Normal	Weak	Yes
D10	Rain	Mild	Normal	Weak	Yes
D11	Sunny	Mild	Normal	Strong	Yes
D12	Overcast	Mild	High	Strong	Yes
D13	Overcast	Hot	Normal	Weak	Yes
D14	Rain	Mild	High	Strong	No

Question 4 [10 Marks]

For a multi-layer perceptron given below, if 15 attributes are used at the input layer, what is the total number of parameters needed?

**Question 5** [10 Marks]

Draw the structure of a deep neural network with three input nodes, two hidden layers (4 nodes for each layer), and one output node.

Question 6 [10 Marks]

Answer the following THREE questions.

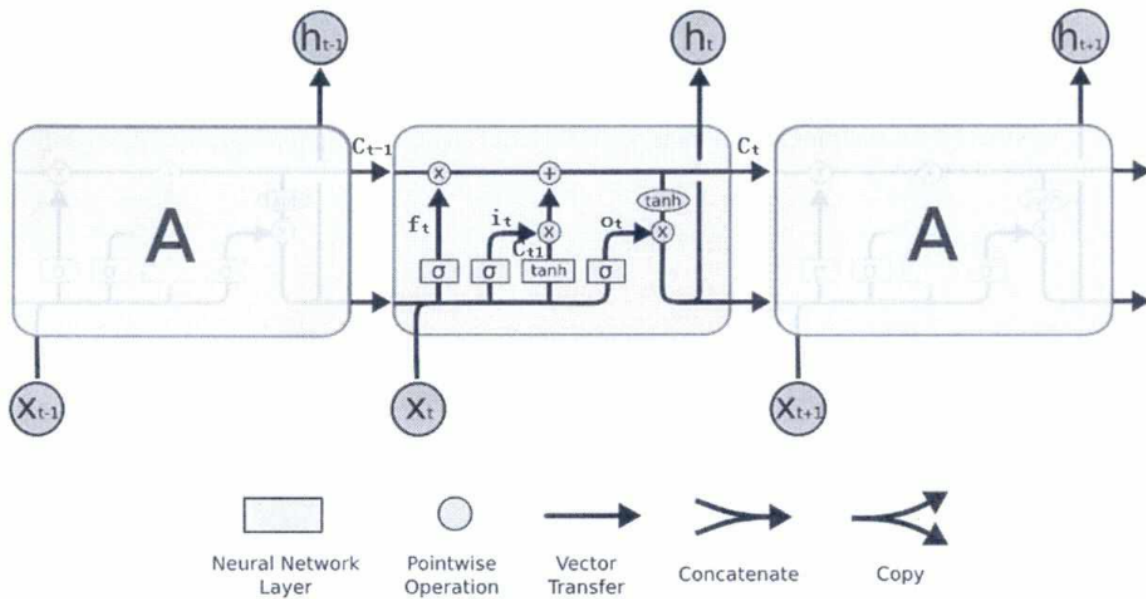
- a) What are the four main layers of a simple convolutional neural network? [4 Marks]

- b) Suppose you have a $227 \times 227 \times 3$ image at the input layer, applying 48 7×7 filters at stride 4 and with two zero padding at the first convolutional layer, what is the output volume size of this layer? [3 Marks]

- c) At the subsequent max pooling layer, 256 3×3 filters at stride 2 and with no zero padding are applied, what is the output volume size of this layer? [3 Marks]

Question 7 [20 Marks]

For an LSTM network model illustrated below, explain each component (forget gate f_t , input gate i_t , output gate o_t , and cell state C_t) in the highlighted cell and give their corresponding output equations (i.e., f_t , i_t , C_{t+1} , C_t , o_t , and h_t).



END OF EXAMINATION PAPER