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| Faculty of Engineering and Technology | | | | | | | | |
| Ramaiah University of Applied Sciences | | | | | | | | |
| Department | Computer Science and Engineering | | | | | | | |
| Programme | M. Tech. in Machine Learning and Intelligent Systems | | | | | | | |
| Batch | Full-Time □ Part-Time ☒ 2018 | Module Start Date | | 09-Sep-2018 | | | | |
| Module Code | MIS502 | | | | | | | |
| Module Title | Neural Networks and Deep Learning Algorithms | | Laboratory | | Y | ☒ | N | □ |
| Module Leader | Dr. Raghavendra V. Kulkarni | | | | | | | |

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| Module Assessment | | | |
| Reg. No. | 18ETCS224001 | Name of the Student | Anuj Kumar |

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| Component -1: (Assignment, Presentation on assignment submitted and Laboratory Test) (1.A+1.B+1.C) | | | | | | |
| 1.A Assignment (100 Marks) | | | | | | |
| Sections | Marking Scheme | | Marks | | | |
| Max Marks | First Examiner Marks | Part Total | Second Examiner Marks |
| Part-A | 1.1 | A critical review of cognitive capabilities of ANNs | 10 |  |  |  |
| 1.2 | The application areas in which ANNs have potential to deliver human-like autonomous learning | 05 |  |
| 1.3 | Stance taken with justification | 10 |  |
| 1.4 | Conclusion | 05 |  |
| **Part-A Max Marks** | | **30** |  |
| Part-B | 2.1 | Architecture and the mathematics of the ANN | 05 |  |  |  |
| 2.2 | ANN training algorithm | 10 |  |
| 2.3 | Results of nonlinear classification | 10 |  |
| 2.4 | Conclusion | 05 |  |
| **Part-B Max Marks** | | **30** |  |
| Part-C | 3.1 | Architecture of the ANN | 05 |  |  |  |
| 3.2 | ANN training algorithm | 15 |  |
| 3.3 | Results for Function Approximation | 10 |  |
| 3.4 | Conclusion | 05 |  |
| -- | References and citation of references | 03 |  |
| -- | Benefits derived by solving the assignment and the discussion on the ability of the assignment to assess module learning outcomes | 02 |  |
| **Part-C Max Marks** | | **40** |  |
| **Total Assignment Marks** | | | 100 |  |  |  |
| **If the module has Laboratory element, 30% weight of Total Assignment Marks**  (i.e. 1.A Marks = Total Assignment Marks X 0.3) | | | | |  |  |
| **If the module does not have Laboratory element, 40% weight of Total Assignment Marks**  (i.e. 1.A Marks = Total Assignment Marks X 0.4) | | | | |  |  |

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| 1.B Presentation on assignment submitted (20 Marks) | | | | |
| Attribute | | Max Marks | First Examiner Marks | Second Examiner Marks |
| Technical Content | | 05 |  |  |
| Grasp and Explanation | | 05 |  |  |
| Quality of Slides and Delivery | | 05 |  |  |
| Q & A | | 05 |  |  |
|  | Total | 20 |  |  |
| (20 marks reduced to 10 Marks) Total 1.b Marks | | |  |  |

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| 1.C Laboratory Exam / Tool Test (20 Marks)  IMPORTANT: If a module does not have laboratory content, 1.c should be shown as ‘0 Marks’ | | | | |
| Attribute | | Max Marks | First Examiner Marks | Second Examiner Marks |
| Laboratory Examination / ~~Tool Test~~ | | 15 |  |  |
| Viva Voce | | 05 |  |  |
|  | Total | 20 |  |  |
| (20 marks reduced to 10 Marks) Total 1.C Marks | | |  |  |

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| Component -2: Examination | | | |
| Examination | Max Marks | First Examiner Marks | Second Examiner Marks |
| Written examination | 100 |  |  |
| Written examination marks reduced to 50 Marks | |  |  |

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| **Module Marks Tabulation** | | | | | | |
| Component-1:Assignment | First Examiner | Second Examiner Marks | **Result** | | | |
| 1.A |  |  |
| 1.B |  |  |
| 1.C |  |  |
| Component-1 Total |  |  | Pass |  | Fail |  |
| Component-2: Examination |  |  | Pass |  | Fail |  |
| Module Marks (Max 100 ) |  | | Pass |  | Fail |  |
| IMPORTANT: 1. Component 1 and 2 total marks have to be rounded off to the next higher integer and entered in the above fields.  2. A minimum of 40% required for a pass in both components. | | | | | | |
| Signature of First Examiner Signature of Second Examiner | | | | | | |

**Please note:**

1. Documental evidence for all the components/parts of the assessment such as the reports, presentation slides, posters, laboratory exam / tool tests are required to be attached to the assignment report in a proper order.
2. The First Examiner is required to mark the comments in RED ink and the Second Examiner’s comments should be in GREEN ink.
3. The marks for all the questions of the assignment have to be written only in the **Component -1: Assignment** table.
4. The individual question marks have to be entered on the table of the **Answer book** for **written exam** and only the total marks are entered in **Component-2: Examination** table.
5. The First Examiner (Module Leader) has to submit the following to Examination and Assessment Section after the review process: Assignment documents, Grade-sheet data file and Module marks card (PMAR).
6. If the variation between the marks awarded by the first examiner and the second examiner lies within +/- 3 marks, then the marks allotted by the first examiner is considered to be final. If the variation is more than +/- 3 marks then both the examiners should resolve the issue in consultation with the Chairman BoE.

**Assignment**

**Instructions to students:**

1. The assignment consists of 3 parts.
2. The assignment has to be neatly word processed as per the prescribed format.
3. The maximum number of pages should be restricted to **35**.
4. Use only SI units.
5. Submission Date: **03-Nov-2018**
6. Submission after the due date is **not permitted**.
7. Method of evaluation is as per the submission and marking scheme
8. At the end, you are required to comment on:
   1. Benefits you have derived by solving this assignment
   2. Whether assignment was able to assess *module learning outcomes* or not?
9. IMPORTANT: It is essential that all the resources used in preparation of the assignment must be suitably referenced in the text.

**Introduction:**

This module aims to lay the foundation of the architecture, training and applications of varieties of Artificial Neural Networks (ANNs). The objective of this assignment is to assess the students’ ability to construct, train and apply basic artificial neurons and neural networks to tackle engineering problems independently.

Part-A of the assignment requires the student to write a critical debate on whether ANNs have been successful in delivering tools for human-like autonomous learning. Part-B of the assignment requires the students to design a Rosenblatt’s perceptron and train it to function as a linear binary pattern classifier. Part C of the assignment involves the construction and the training of a multilayer feedforward neural network for the prediction of time-series data.

**Part –A (05 + 10 + 10 + 05= 30 Marks)**

ANNs are very efficient in solving a wide variety of problems. Image recognition, speech processing, prediction and generalization are the legendary applications of ANNs. On the one hand, researchers are continually developing more and more advanced ANNs to address varieties of challenges. On the other hand, some scientists argue that ANNs cannot deliver human-like autonomous learning since they make over-simplified assumptions about the structure of the biological nervous system.

**Problem statement:**

In this part of the assignment, the student has to author a debate on the topic “**ANNs have potential to deliver human-like learning in all domains of applications**.”

The report should comprise the following:

1. A critical review of cognitive capabilities of ANNs
2. The application areas in which ANNs have potential to deliver human-like autonomous learning
3. Stance taken with justification
4. Conclusion

**Part –B (05 + 10 + 10 + 05 = 30 Marks)**

Rosenblatt’s perceptron is the simplest computational model of a biological neuron. The legendary *Perceptron Convergence Theorem* proves that a perceptron can solve any binary pattern classification problem if the patterns are linearly separable. The Boolean Ex-OR gate cannot be implemented using a single perceptron because its patterns are linearly non-separable. Therefore, an alternative ANN structure is required to implement an Ex-OR gate.

**Problem Statement:**

In this section, the student has to construct and train an ANN that functions as a two-input Ex-OR gate. The ANN should have two inputs and a single output. The mapping of the input space to the output is well-known; therefore, supervised learning is recommended.

The student is free to choose the number of training epochs and the rate of learning. The implementation can be in Matlab, Python, C or any other language/environment of student’s choice. The student has to demonstrate the functional ANN to the module leader.

The report should include the discussion on:

1. **The architecture and the mathematics of the ANN**: This should include the number of weights and the type of activation function used in the ANN.
2. **The training algorithm:** This should include the mathematical details of the training algorithm, the number of training epochs, the training equations used and the learning rate chosen.
3. **Results of non-linear classification:** This should include the plot of the decision surface and the testing exemplars plotted in such a way that the exemplars that fall in different classes are coloured differently. Statistical summary in the form of mean square error over testing trials is necessary.
4. **Conclusion**

**Part –C (05 + 15 + 10 + 05 = 35 Marks)**

Neural networks are known for their ability to learn from examples. This makes them a perfect choice for the approximation of nonlinear mapping between inputs and outputs using a set of known input-output pairs. Nonlinear function approximation is the essence of Part-C of the assignment.

**Problem Statement:**

In this section, the student has to construct and train a multilayer feedforward neural network to approximate the function , where and .

The student is free to choose:

* Any feedforward architecture of suitable types of neurons
* The number of layers, the number of neurons in each layer and the pattern of interconnectivity
* Any suitable training algorithm and appropriate algorithmic parameters

The student has to justify the chosen architecture, training algorithm and its parameters. The implementation can be in Matlab, Python, C or any other language/environment. The student has to demonstrate the functional ANN to the module leader.

The report should include:

1. **The documentation of the architecture of the ANN:** This should include the number of layers, the number and type of neurons in each layer, the connectivity pattern between the neurons and the type of activation functions used in neurons. The report should also include the justification for the choices made.
2. **The documentation of the training algorithm**: This should include the name of the training algorithm, the number of training epochs, the training equations used and the weight update method, and the justification for the choices made.
3. **Results of nonlinear function approximation:** This should include the 3-dimensional surface plot of the test inputs on two axes and the output approximated by the ANN on the third axis. Statistical summary in the form of mean square error over testing trials is necessary.
4. **Conclusion**

In addition, the student has to present his/her views on:

* Benefits derived by solving this assignment
* Whether the assignment was able to assess module learning outcomes

**Guidelines for Submission:**

* Citation of the references in the text is necessary in **all the parts**
* Restrict your report for Part-A to **3 pages** only
* Use of figures could be avoided in Part-A
* Divide your discussions clearly as per the sections mentioned above
* Restrict your report for Parts B and C to a maximum of 12 and 20 pages, respectively
* Divide your discussions clearly as per the sections mentioned above and draw appropriate conclusions at the end of each Chapter
* Please note: Marks will be awarded only to the sections and sub-sections clearly indicated as per the problem statement
* A presentation on the assignment should be given to the Examiner in **MSRUAS format** only

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