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**APPENDIX GA36d**

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| **LEVEL 7 ASSESSMENT SPECIFICATION** |

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| **Student name:** |  | **Student ID number:** |  |
| **Programme:** | **MSc Software Engineering and AI** | | |
| **Module:** | **L7 – Application of Machine Learning** | | |
| **Module code:** | **ACCA7025** | Contribution to Overall Module Assessment (%): | **50%** |
| **Lecturer:** | **Mark Huntly** | **Internal Verifier:** | **Gordon Dickers** |
| **Assignment Title:** | **Classification using Aritficial Neural Networks** | **Word count (or equivalent):** | **3000** |
| **Submission deadline:** | **11th January 2024** | **Return date of provisional marks & written feedback:** | **5th February 2024** |
| **Submission method:** | All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students’ submissions.)  **Late submission of the assessment will result in a late penalty mark.** Penalties for late submission: Up to one week late, maximum mark of 50%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates. | | |
| **Academic honesty / referencing:** | Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment. | | |

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| **Module Learning Outcomes**  **(from module syllabus)** |
| * Critically analyse and justify the application of selected machine learning methods and techniques used to solve complex problems. * Apply and evaluate a range of machine learning methods used to solve given problems * Analyse given problems and subsequently synthesise and evaluate appropriate solutions using deep learning methods |

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| **TASK DESCRIPTION** |

## Introduction

In this assignment, you will be using your knowledge of artificial neural networks and the methods used to generate a Neural Network model capable of classifying images, and to describe a use case for a recurrent neural network. For this assignment, you are asked to write a report (3000 words), excluding references and appendices, in word or pdf format that includes an abstract, introduction, related work in the literature, methodology, results, discussion, conclusion, references and an appendix.

This report should be submitted alongside the scripts you developed. Additionally, you are asked to provide a short (approximately 5 minutes) demonstration video showing your code working and describing the various functions of the code. Instructions for uploading your report, code and video will be provided on Moodle and described in class.

**You will submit:-**

You will submit a written report as detailed above.

Include references using the School’s agreed standard (see referencing document on our Moodle course page).

All your source code as an appendix to your main report.

Your source code - uploaded to Moodle, separately.

A 5 minute video demonstrating your working code and highlighting key aspects of your code/model/results. Provide a link to this video in your report and email a link to your tutor. Alternatively upload a copy of your video with your source code, or email a copy to your tutor.

**Task**

You are expected to review the literature and related work relevant and appropriate to Artificial Neural networks, and methods used to optimise them and discuss use cases for both Recurrent Neural Networks and Convolutional Neural Networks.

You will then create a classifier capable of classifying an image dataset using a neural network chosen to best fit the use case based on the above research. **You must use Python-based scripts using Scikit Learn, TensorFlow or both**.

**Your aim is to keep the model as simple as possible without compromising the effectiveness of your network**.

You are expected to modify hyperparameters to get the best performance from your neural network, evaluate its performance and optimise your network as necessary. You will need to discuss and justify the choices you make,and evaluate your neural network using established metrics and discuss the results by, for example, comparing parameters chosen to optimise performance.

For this task you will use the more sophisticated **Cifar10 image** dataset that has been introduced and classified using ML methods and models. Don’t forget to provide suitable graphs and tables that will clearly help illustrate your results, analyses and discussions.

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| **GUIDANCE FOR Students IN THE COMPLETION OF TASKS** |

**NOTE: The guidance offered below is linked to the five generic assessment criteria overleaf.**

1. **Engagement with Literature Skills**

Your work must be informed and supported by scholarly material that is *relevant* to and *focused* on the task(s) set; you should make use of scholarly reviews and primary sources, as appropriate (for example, refereed research articles and/or original materials appropriate to the discipline). You should provide evidence that you have accessed a wide *range* of sources; these sources may include academic journal articles, textbooks, , and websites. Academic journals are normally highly credible sources while websites require careful consideration/selection and should be used sparingly. Any sources you use should be current and up-to-date, mostly published within the last five years or so, though seminal/important works in the field may be older. You must provide *evidence* of your research/own reading throughout your literature review section, using correctly a suitable referencing system, including in-text citations in the main body of your work and a reference list at the end of your work.

***Guidance specific to this assessment:***

***You should show a wide level of reading, a minimum of 7 references, from a variety of sources including textbooks, academic journals and academic based websites. Do not use less credible sources, for example internet sites such as Tutor2U and Wikipedia.***

***Use the School’s agreed referencing system (IEEE). Refer to landmark papers and identify leading authors in the field where appropriate. Give credit to respected authors on whose work your discussion is based; this avoids accusations of plagiarism and reflects the breadth of your research. Cite ALL your sources - every paragraph should contain at least one in-text citation. Your use of in-text citations and the reference list at the end of the report will be closely examined to ensure that you are conforming to referencing convention. An extensive reference list and good use of in-text citations will earn marks, limited references and errors in citations will result in a loss of marks.***

1. **Knowledge and Understanding Skills**

At level 7, you should be able to demonstrate a systematic understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of your academic discipline, field of study or area of professional practice, with a comprehensive understanding of techniques applicable to your own research or advanced scholarship. Your work must demonstrate your growing mastery of these concepts, principles, current challenges, innovation and insights associated with the subject area. *Knowledge* relates to the facts, information and skills you have acquired through your learning. You demonstrate your *understanding* by interpreting the meaning of the facts and information (knowledge). This means that you need to select and include in your work the contemporary concepts, techniques, models, theories, etc. appropriate to the task(s) set. You should be able to explain the theories, concepts, etc. meaningfully to show your understanding. Your mark/grade will also depend upon the *extent* to which you demonstrate your knowledge and understanding; ideally each should be complete and detailed, with comprehensive coverage.

***Guidance specific to this assessment:***

***You are expected to demonstrate a systematic understanding of concepts and methods related to the tasks. Based on your knowledge of the subject, select appropriate techniques, concepts and principles appropriate to the tasks in this assignment and discuss them in sufficient detail to demonstrate your understanding.***

1. **Cognitive and Intellectual Skills**

You should be able to: evaluate critically current research and compare the performance of your model the similar systems that have been reported in the literature; evaluate methodologies and develop critiques of them and, where appropriate, to propose new hypotheses; deal with complex issues both systematically and creatively. Your work must contain evidence of logical, analytical thinking, evaluation and synthesis. For example, to when you compare the performance of the different solution you and break information down into parts, make inferences, compile, compare information. This means not just describing what results you got! But also justifying: Why? At all times, you must provide justification for your arguments and judgements. Furthermore, you should provide evidence that you are able to make sound judgements and convincing arguments using data and concepts. Sound, valid, persuasive conclusions are necessary and must be derived from the content of your work.

***Guidance specific to this assessment:***

***The report should introduce lines of reasoning, using literature to critically evaluate alternative perspectives to strengthen your arguments and justify the results. When comparing the different models, you train /approaches/methods, identify the critical factors or metrics that should be used to analyse their strengths and weaknesses.***

***In the related work section, discuss the relevant literature, cite references for the different methods and techniques that have been used to classify your dataset(s). Don’t just LIST the different published papers (avoid bullet points). Instead, try to compare the different developed solutions, and interpret what they mean. Don't over-use direct quotes as they are someone else’s words, and do not fully demonstrate your skills of interpretation.***

1. **Practical Skills**

At level 7, you should be able to demonstrate originality in the application of knowledge, together with a practical understanding of how develop machine learning-based systems. You should be also able to demonstrate understanding of techniques of research and enquiry are used to create and interpret knowledge in the discipline. This includes acting autonomously in planning and implementing tasks at a professional or equivalent level, originality in tackling and solving problems, and decision-making in complex and unpredictable contexts or situations.

You should be able to demonstrate mastery of the leading edge subject-related concepts and ideas as they relate to real world situations and/or particular contexts. How do they work in practice? You will deploy models, methods, techniques, and/or theories, in those contexts or circumstances, to assess your work as well as other researchers’ work, justifiable recommendations to solve problems. Demonstrating your understanding of how the boundaries of knowledge are advanced through research and/or application.

1. **Transferable Skills for Life and Professional Practice**

Your work must provide evidence of the qualities and transferable skills necessary for postgraduate-level employment in circumstances requiring sound judgement, personal responsibility and initiative in complex and unpredictable professional environments. This includes demonstrating: the independent learning ability for continuing professional development to advance existing skills and acquire new competences of a professional nature that will enable you to assume significant responsibility within organisations; that you can initiate and complete tasks, projects and procedures, whether individually and/or collaboratively, to a professional level; that you can use appropriate media to effectively communicate information, arguments and analysis in a variety of forms for a variety of audiences; fluency of expression; clarity and effectiveness in presentation and organisation. Work should be coherent and well-structured in presentation and organisation.

***Guidance specific to this assessment:***

***Writing style: All writing should be academic in style, formal, focused, concise and subject specific. You should write in the third person. For example, rather than ‘I found…’ you should say something like ‘It was evident…’. Do not use contractions (for example, it should be written as ‘it is’), and avoid slang and clichés (such as 'if you pay peanuts, you get monkeys'). Be concise, adopt a writing style that is clear, simple, and direct.***

***Presentation: You should use appropriate word processing software features such as the automatic generation of a table of contents (e.g. via the use of outline view or by applying styles), tables/graphs, e-Referencing, use of templates. When using graphs, charts, and figures they must be labelled and then referenced within the text. Where possible they should not be on separate pages but should be incorporated within the text. Ensure there are no spelling errors by spellchecking your work. Also undertake a grammar check in Word, and it may help you to ask somebody to proof-read your work to identify errors.***

***Format and structure: You should use a report format. It should include an introduction, main findings and conclusions and the headings should be numbered. You may choose to include sub-headings.***

***The structure of the report should be as follows:***

***Introduction: The introduction section should give a clear idea about the central issue of concern, and why it is worth examining/ investigating. It should give the general background to the issue rather than the specific detail (which you will discuss in the main body). Outline the objectives of the report, what you will achieve - this serves as a 'route map' to let the reader know what to expect in the rest of the report.***

***Related work: This is where you discuss the proposed systems in the literature (subject knowledge, analysis and where relevant, the implementation details).***

***Main body: This is where you explain the machine learning pipeline, the methodology of comparing different classifiers with different settings and explain your reasons for choosing a hyperparameter, a particular dataset, etc.***

***Results and discussion: In this section, you demonstrate the results of your experiments, interprets the results for readers and provides the significance of the findings, discuss the effect of decisions you make on the overall performance. Try to compare your results with some of the previous studies that you have discussed in the related work section.***

***Conclusion: In this section you should draw together the themes you have previously discussed (synthesis). Try not to just re-hash the discussion from the main body; ask yourself questions such as 'so what?', 'what does this mean?', 'what are the implications for the organisation, its stakeholders, industry…the future…etc.?' Ensure you have addressed the objectives you laid out in the introduction section.***

***References: Use the School’s agreed referencing system (IEEE).***

***Essential Resources:***

***• Resources listed on the lecture schedule and on Moodle***

***• The student handbook***

***Appendices: Where relevant. Avoid ‘padding’***

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| **Student FEEDBACK FORM** |

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

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| **Generic Assessment Criteria** | **Marks available** | **Marks**  **awarded** |
| **1. Engagement with Literature Skills**  . |  |  |
|  |  |  |
| 15 |
| **2. Knowledge and Understanding Skills** |  |  |
|  |  |  |
| 15 |
| **3. Cognitive and Intellectual Skills** |  |  |
|  |  |  |
| 30 |
| **4. Practical Application Skills** |  |  |
|  |  |  |
| 30 |
| **5. Transferable Skills for Life and Professional Practice** |  |  |
|  | 10 |  |
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| **Assessment Mark** (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed. ) | **Late Submission Penalties (tick if appropriate)** | | **%** |
| Up to 1 week late (50% Max) |  |
| Over 1 week late (0%) |  |

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| **GENERIC ASSESSMENT CRITERIA** |

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| **Level 7** |
| In accordance with the Framework for Higher Education Qualifications, at the end of Level 7 students should be able to demonstrate: a systematic understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of their academic discipline or area of professional practice; a comprehensive understanding of techniques applicable to their own research or advanced scholarship; originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in the discipline; conceptual understanding that enables the student to evaluate critically current research and advanced scholarship in the discipline to evaluate methodologies and develop critiques of them and, where appropriate, to propose new hypotheses. They will be able to deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data, and communicate their conclusions clearly to specialist and non-specialist audiences. They will demonstrate self-direction and originality in tackling and solving problems, and act autonomously in planning and implementing tasks at a professional or equivalent level to continue to advance their knowledge and understanding, and to develop new skills to a high level. They the qualities and transferable skills necessary for employment requiring the exercise of initiative and personal responsibility; decision-making in complex and unpredictable situations/professional environments; and the independent learning ability required for continuing professional development. |

| **Level 7** | **FAIL** | **FAIL** | **MARGINAL FAIL** | **SATISFACTORY**  **(Pass)** | **GOOD to VERY GOOD**  **(Merit)** | **EXCELLENT**  **(Distinction)** | **EXCEPTIONAL**  **(Distinction)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Category** | **0-29%** | **30-44%** | **45-49%** | **50-59%** | **60-69%** | **70-84%** | **85-100%** |
| **Engagement with literature** (including current research, referencing,  academic conventions and  academic honesty) | Little or no evidence of reading and/or reliance on inappropriate sources.  Views and findings mostly unsupported and non-authoritative.  Referencing conventions used incoherently or largely absent. | Poor engagement with essential reading. No evidence of wider reading. Reliance on inappropriate sources, and/or indiscriminate use of sources. Heavily reliant on information gained through class contact. Inconsistent and weak use of referencing. | Engagement with a very limited range of relevant and credible sources. Some omissions and minor errors.  Referencing conventions evident though not always applied accurately or consistently. | Engagement with an appropriate range of research-informed literature, including sources retrieved independently. Some over-reliance on texts. Referencing may show minor inaccuracies or inconsistencies. | Engagement with a wide range of research-informed literature, including sources retrieved independently.  Selection of relevant and credible sources. Very good use of referencing, with no/very few inaccuracies or inconsistencies. | Engagement with an extensive range of relevant and credible literature, informed by the latest research. Consistently accurate application of referencing. | Exceptional engagement with an extensive range of relevant and credible literature, informed by the latest research. High-level referencing skills consistently and professionally applied. |
| **Knowledge and understanding** (A systematic, conceptual understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of the discipline; a comprehensive understanding of techniques applicable to their own research) | Major gaps in knowledge and understanding of the subject matter is not systematic. Substantial inaccuracies. No awareness of current problems, insights or the latest research and/or advanced scholarship within the discipline. | Gaps in knowledge, with only superficial systematic understanding. Some significant inaccuracies and/or irrelevant material. No critical awareness of current problems, insights, or latest research within the discipline. | Limited knowledge and systematic understanding of the concepts and principles within the subject area, which to some marginal extent, is informed by current research and scholarship. Some critical awareness of current problems and/or new insights, but often under-developed. | Knowledge is accurate and reasonably detailed. A systematic understanding of the field of study informed by, to some extent, current research and scholarship, A critical awareness of current problems and/or new insights though this may be under-developed occasionally. | Knowledge has a well-defined focus, which is reasonably extensive, coherent and detailed, with a critical awareness of current problems and/or new insights. Exhibits good understanding of the breadth and depth of contemporary and established views, and the work is, at least in part, well-informed by current research and scholarship. | Excellent mastery of a complex and specialised area of knowledge. A systematic, excellent understanding of the concepts of the subject informed by current research and scholarship. Highly critical awareness of current problems and/or new insights. A critical, awareness of how the boundaries of knowledge are advanced through research. | Exceptional mastery of a complex and specialised area of knowledge. An exceptionally critical awareness of current problems and/or new insights. An outstanding understanding of the concepts of the subject, well-informed by current research and scholarship. A critical, sophisticated and nuanced awareness of how the boundaries of knowledge are advanced through research. |
| **Cognitive and intellectual skills**  (Critical evaluation of current research and methodologies and develop critiques of them and, where appropriate, to propose new hypotheses; make sound judgements in the absence of complete data.) | Wholly or almost wholly descriptive work. Little or no evaluation or critique or attempt at a systematic approach.  Failure to develop arguments, leading to illogical or invalid judgements. Unsubstantiated generalisations, made without use of credible evidence. | Largely descriptive work, with superficial use of critical evaluation of research and methodologies. Absent or weak development of hypotheses and judgements. Information accepted uncritically, uses generalised statements made with scant evidence and unsubstantiated opinions. Ideas sometimes illogical and contradictory. | Limited attempt at critical evaluation/ critique of current research and methodologies, tending towards description.  Limited attempt to propose new hypotheses. Can deal with complex issues but not systematically or creatively. Some evidence to support emerging judgements but these may be underdeveloped or with a little inconsistency / mis-interpretation.  May assert rather than argue a case. | Some critical evaluation/ critique of current research and methodologies, though slightly underdeveloped in places, Proposes adequate but limited new hypotheses, where relevant. Can deal with complex issues but not fully systematically or creatively. Ability to make judgements based on data (that may be incomplete) but with some tendency to assert/state opinion rather than argue on the basis of reason and evidence. | Sound critical evaluation/ critique of current research and methodologies, Proposes new hypotheses, where appropriate. Can deal with complex issues systematically and with some creativity. Ability to make sound judgements based on data (that may be incomplete) | Excellent critical evaluation/ critique of current research and methodologies, Proposes innovative hypotheses, where appropriate. Can synthesise complex issues systematically and creatively. Ability to investigate contradictory or incomplete information and make strong, persuasive, arguments and sophisticated judgements. | Exceptional critical evaluation/ critique of current research and methodologies, Proposes innovative hypotheses, where appropriate. Exemplary systematic and creative synthesis of complex issues.  Ability to investigate contradictory or incomplete information and make strong, persuasive, arguments and sophisticated, nuanced, judgements. Potential for journal publication or doctoral research. |
| **Practical skills**  (Originality / creativity in the application of knowledge, tools and techniques and in tackling and solving problems in complex and unpredictable professional situations; practical use of established techniques of research and enquiry to create and interpret knowledge in the discipline.) | Limited or no use of methods, materials, tools and/or techniques.  Little or no appreciation of the context of the application.  Limited understanding of the application of theory to practice or making appropriate links between the two.  Very weak problem-solving skills in complex and unpredictable contexts. | Rudimentary application of methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application.  Weak understanding of the application of theory to practice, with only occasional evidence of making appropriate links between the two. Weak problem-solving skills in complex and unpredictable contexts. | An awareness and mostly appropriate application of well-established methods, materials, tools and/or techniques, with occasional errors.  Basic appreciation of the context of the application. Theoretical knowledge and understanding applied in practice, but not always making logical links between the two.  Can identify problems and propose basic solutions without fully appreciating the complexity of unpredictable contexts. | An appropriate application of standard methods, materials, tools and/or techniques.  Clear appreciation of the context of the application. Mainly consistent, accurate and logical application of theory to practice, making appropriate links between the two.  Can identify problems and propose mostly appropriate solutions in complex and unpredictable contexts, with elements of originality. | A very good application of a range of methods, materials, tools and/or techniques.  Very good consideration of the context of the application, with perceptive insights. Can identify problems and propose appropriate solutions in complex and unpredictable contexts.  Evidence of originality and creativity. | An advanced application of knowledge, methods, materials, tools and/or techniques.  The context of the application is well considered, and insightful.  Can identify complex problems and propose excellent solutions. An excellent grasp of techniques applicable to own research or advanced scholarship.  Shows originality in application of knowledge and techniques, and of how established techniques of enquiry create and interpret knowledge in the discipline. | Exceptional application skills in complex, unpredictable, contexts, drawing skilfully on the latest research within the discipline. Can identify complex problems and propose sophisticated, original solutions.  An outstanding application of techniques applicable to own research or advanced scholarship.  Shows originality in application of knowledge and techniques, and of how established techniques of enquiry create and interpret knowledge in the discipline with assimilation and development of cutting edge processes and techniques. |
| **Transferable skills for life and professional practice**  (Exercise of self-direction, autonomy and personal responsibility; plan and implement tasks at a professional level; independent learning; use appropriate media to communicate effectively and professionally to a variety of audiences; fluency of expression; systematic approach; clarity and effectiveness in presentation and organisation.) | Communication medium is inappropriate or misapplied.  Work is poorly structured, disorganised and/or confusingly expressed. Very weak use of language and/or very inappropriate style. Little or no evidence of autonomy (or collaboration, where relevant) in the completion of tasks. Little or no evidence of the skills required in professional, postgraduate employment. | Communication medium is poorly designed and/or not suitable for the audience.  Work is poorly presented in a disjointed manner. It is loosely, and at times incoherently, structured, with information and ideas often poorly expressed. Weak use of language and/or inappropriate style. Weak independent initiative (or collaboration, if relevant). Limited evidence of the skills required in professional, postgraduate employment. | Can communicate in a suitable medium but with some room for improvement.  Mostly ordered presentation and structure in which relevant ideas / concepts are reasonably expressed. Work may lack coherence in places. Can work as part of a team, but with limited involvement in group activities.  Demonstrates some but not all of the basic skills required in professional, postgraduate employment, with some areas of minor weakness. | Can communicate effectively in a suitable format, but may have minor errors.  Mostly coherent, organised work, in a suitable structure and is for the most part clearly expressed. Can work effectively independently and/or as part of a team, with clear contribution to group activities.  Demonstrates the skills required in professional, postgraduate employment, with some areas of strength and some of minor weakness. | Can communicate well, confidently and consistently in a suitable format.  Work is coherent, fluent, well-structured and organised. Can work very well autonomously and/or as part of a team, with a good contribution to group activities.  Demonstrates comprehensive professional, postgraduate employment skills. | Can communicate professionally confidently and consistently in a suitable format.  Work is coherent, very fluent and is presented professionally. Can work autonomously with initiative. Where relevant can work professionally within a team, showing leadership skills as appropriate, managing conflict and meeting obligations. Demonstrates excellent professional, postgraduate employment skills and a strong appetite for further development. | Can communicate with an exceptionally high level of professionalism.  Work is remarkably coherent, very fluent and is presented professionally. Can work outstandingly well and professionally within a team, showing advanced leadership skills. Demonstrates exemplary professional, postgraduate employment skills and a strong appetite for further development. |