**MODULE SPECIFICATION**

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| 1. **Programme title** | MSc Data Science |
| 1. **Module title** | **Deep Learning Applications** |
| 1. **Module code** | CMP020L016 |
| **4. Compulsory for** | All students |
| 1. **Optional for** | None |
| 1. **Pre-requisite / co-requisite** | CMP020L015 Machine Learning |

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| 1. **Module description and context**   Describe the content of, and rationale for, the module. Explain how it fits within the context of the programme as a whole and state the academic and professional benefits to students of studying this module. |
| Deep learning is a machine learning technique that teaches machines by example. Deep learning is a key technology behind driverless cars, voice control devices, disease early detection, investment modelling, among others. Deep learning achieves recognition accuracy at higher levels than ever before. This module will present students with a series of real-life deep learning applications. At the same time, it provides them with a solid foundation to start collaborating in related industries. This module recalls Machine Learning concepts to explain the fundamental models behind several deep learning applications.  The deep learning applications module aims to remark the importance of this paradigm in our lives whilst providing students with the tools to understand its science. |

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| 1. **Module learning outcomes**   List the learning outcomes of the module. Briefly explain how each outcome furthers the programme’s design and aims, as set out in the programme specification and context paper.  **LO1: Demonstrate a comprehensive understanding of current developments in deep learning.**  **LO2: Distinguish deep learning models appropriate for supervised, semi-supervised, and unsupervised learning.**  **LO3: Demonstrate the ability to use deep learning models to define a workflow to solve a given problem and use such models in a high-level programming language.**  These learning outcomes are focuses on students’ understanding of current deep learning trends as well as how deep learning can be applied to different domains. Students will be exposed to more advanced techniques than initial machine learning modules deliver, and then will apply these techniques in different contexts. |

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| 1. **Planned list of topics, arranged sequentially** |
| **Introduction to Deep Learning** |
| **Review of Machine Learning** |
| **Programming tools for Deep Learning I** |
| **Programming tools for Deep Learning II** |
| **Case Study 1 – Object detection** |
| **Case Study 2 – Natural language processing** |
| **Case Study 3 – Advertising** |
| **Case Study 4 – Fraud detection** |
| **Case Study 5 – Autonomous Vehicles** |
| **Industrial talk** |
| **Building a deep learning application** |
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| 1. **Teaching and learning**   Describe how students will be taught and how they will study, providing specific examples of activities. |
| The deep learning applications module will be delivered in a blended manner. Lectures' content will be made available via videos on Moodle. Several videos will support a unit week and form a fundamental part of the learning journey. The videos would test students' programmer skills and level up the whole group. In addition, practical labs and seminars will provide students with hands-on practice working with software and data using the principles described in the lectures and tutorials.    The material will be delivered in a way that students can build their confidence in understanding the basic concepts behind deep learning models. Then, starting from basic programming and mathematical principles, students will build up their skills to define and develop more complex models applied to real-life problems. |

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| 1. **Assessment**   Describe how students will be assessed, providing specific examples of assessment types. Explain how those types are designed to demonstrate achievement of the module learning outcomes listed in section 2. Explain too how they will ensure that all students will graduate with strong prospects for employment or further study. |
| Students will deliver a significant portfolio coursework to examine current trends in deep learning as applied in different contexts (LO1 – LO3). The coursework will feature the development of a deep learning solution using specific tools and the insights gained from the solution presented in a report. The coursework will be delivered in an iterative style throughout module delivery, embedding formative methods to provide feedforward as students refine and develop their solution. This emulates how such work is undertaken in industry – using iterative cycles.  Students will have the opportunity to define the type of problem and solution they will deliver through the coursework, thus recognising the wide range of abilities that a student can have. Students can push their capabilities if they wish or will be able to pass by demonstrating the requirements of the learning outcomes. |

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| 1. **Assessment table**   The terminology in this section is taken from Online Marks Entry (OME) and must be retained for consistency. It is very important that these tables are completed accurately, as failure to do so leads to errors and delays when grades are ratified. Any questions should be addressed to the Academic Office.  Please note the following:   * Table 1 should be completed when there is only one component (assessment), weighted at 100%. Table 2 should be completed when there are two or more components (assessments). * The *component type/titles* must be identical to the assessment types listed in section 28 (“Assessment weighting”) of the programme specification. * The *component type/title* must be one of the following: coursework, examination, presentation, in-class test or practical. If the component type is the same as the title, it only need be stated once. (The title has a maximum of 30 characters.) * For each *coursework component*, specify the assessment type: essay, portfolio, report, review etc. * The *percentage* (%**)** indicates the weighting of the component or sub-component. In the example provided in the green cells of table 2, the two sub-components are each weighted at 50%, which combined comprise 50% of the final grade:   Report 50%  + Essay 50%  = Portfolio 100%  Portfolio 50%  + Exam 50%  =Final grade 100%   * For *result type,* if the outcome is expressed as a percentage, insert M for mark. For pass/fail, insert G for grade. * For *final component*, answer “yes” if this is the last component to be submitted for the module, “no” if not. * For *must attempt*, answer “yes” if the student must attempt the component in order to pass the module, “no” if not. * For *must pass*, answer “yes” if the student must pass the component in order to pass the module, “no” if not. * The *sub-component type/title* must be one of the following: coursework, examination, presentation, in-class test or practical. For coursework, specify the assessment type. * Note: if for this module the mark is calculated on the basis of only selected components (eg. the best three of five components), please place a tick mark here: [ ] |

**Table 1 – one component**

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| **Component (assessment) Type/Title** | **Coursework Volume or Length/Type of Exam** | **%** | **Result type**  **Mark/**  **Grade**  **M/G** |
| Coursework (Portfolio) |  | 100 | M |

**Table 2 – multiple components**

1. **Reading and resource list**

Please refer to the appropriate section below, depending on whether the programme is a Roehampton one, or delivered by a collaborative partner as a validation arrangement, a “typical” franchise, or through QAHE or Croydon College.

1. **Roehampton programme**

The ‘Resource List’ refers to the University’s online reading list software, which offers real-time information about library holdings at the University and easy access to online resources. A variety of resources can be recommended, e.g. books, journals, audio-visual, and online resources. As confirmed by LTQC in spring 2021, all resources deemed to be ‘Essential’ should be provided in a digital format (e.g. an e-journal article, an e-book or a Copyright-cleared digitisation), to maximise ease of access for all students. These lists are linked to the module’s Moodle site.

The Panel will be asked to look at the Resource List online in advance of the Panel meeting. Please ensure that your list is ‘published’ and that you are logged out of the online resource lists system, then copy the URL and paste it into the box below. If you need help please contact [LibraryEngagement@roehampton.ac.uk](mailto:LibraryEngagement@roehampton.ac.uk)’

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| Introduction to Deep Learning: Concepts and Fundamentals: <https://learning.oreilly.com/videos/introduction-to-deep/9781491999608/>  Introduction to Deep Learning Using R: A step by step Guide to Learning and Implementing Deep Learning Models using R:  <https://learning.oreilly.com/library/view/introduction-to-deep/9781484227343/>  Introduction to Dep Learning using PyTorch:  <https://learning.oreilly.com/videos/introduction-to-deep/9781491989944/>  Introduction to Deep Learning: Concepts and Fundamentals:  <https://learning.oreilly.com/videos/introduction-to-deep/9781491999608/> |

If you need a brand new module resource list, please contact [LibraryEngagement@roehampton.ac.uk](mailto:LibraryEngagement@roehampton.ac.uk). If you are making substantial changes to an existing module a new “Module Validation” resource list can be created for you.

All lists are created using the online reading list tool and will follow the guidelines set out in the University [Reading List Framework](https://library.roehampton.ac.uk/ld.php?content_id=33292110). Lists should provide a clear week-to-week or topic guide for students about what they should read, when and why. This reading should be directly related to the work they are doing on a module during any one week or over a period of time studying a specific topic, whatever is appropriate to the discipline. Resources should be representative of our student body and as diverse as possible.

Directed reading should be provided in advance of the class and clearly indicate the importance of the items listed by using the following headings (if appropriate for the programme):

* Essential Reading (all to be provided in a digital format).
* Further Reading
* Further Independent Study (for independent study/assignments)

For new modules, it is not necessary at this early stage to fully meet the requirements of the Framework, e.g. by specifying weekly readings. However, in order for the Library to be able to establish any cost implications, it is very important to bookmark the following:

* All ‘Essential’ books
* All ‘Essential’ journals or databases

Resources already held by the Library should be bookmarked, wherever possible. The library will base any purchasing decisions, on the information provided in the Resource lists and in line with the [Collection Development Policy](https://www.roehampton.ac.uk/globalassets/documents/corporate-information/policies/library-collection-development-policy-may-2018.pdf).

1. **Validated programme**

All library services and support are provided by the partner institution.

1. **“Typical” franchise**

The partner may have access to some e-resources through Roehampton Library. However, they do not use UR’s online resource lists software.

Reading list

A variety of resources can be recommended, e.g. books, journals, audio-visual, and online resources. The university aims to provide all resources deemed to be ‘Essential’ in a digital format (e.g. an e-journal article, an e-book or a Copyright-cleared digitisation), to maximise ease of access for all students. Please list your readings in the box below:

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Reading lists should aim to follow the principles set out in the University’s [Reading List Framework,](https://library.roehampton.ac.uk/ld.php?content_id=33292110) (with the exception of the use of the Talis Aspire resource lists software which is not required). Reading lists should provide a clear week-to-week or topic guide for students about what they should read, when and why. This reading should be directly related to the work they are doing on a module during any one week or over a period of time studying a specific topic, whatever is appropriate to the discipline. Resources should be representative of our student body and as diverse as possible.

Directed reading should be provided in advance of the class and clearly indicate the importance of the items listed by using the following headings (if appropriate for the programme):

* Essential Reading (all to be provided in a digital format).
* Further Reading
* Further Independent Study (for independent study/assignments)

Resources that are already available to students should be selected, wherever possible. If you have access to any library resources through the university, you will be made aware of those.

1. **QAHE and Croydon College (full UR students)**

These institutions have access to almost all resources, including online resource lists. Thus, the standard UR template as it appears in section A applies in these cases.