School of Informatics Course Proposal Form (version: May 2021)

Please see Page 2 for instructions on which parts of this form to complete, whom to consult with to avoid unnecessary effort, and where to send the completed form.

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Date: 11/08/2021

Cover page: Basic permanent course information

Unless otherwise noted, items in this section are entered into EUCLID and **cannot** be changed without creating an entirely new course.

Course Name	Applied Machine Learning
Is this an EPCC course?	_x_ No (default) *(If you don't know what EPCC is, this is the right choice.)* __ Yes *(If so, leave Course Acronym blank, to be filled in by ITO as EPCC/<number> for Theon and our Sortable List.)*
Course Acronym *(used only School-internally)*	AML
SCQF Credit Level and Normal Year Taken	**Standard options for Informatics courses:** __ Level 8/Year 1 __ Level 8/Year 2 __ Level 10/Year 3 (also available in Year 4). *[In practice, most level 10 courses have many students in both UG3 and UG4. MSc students may take up to 20 credits at Level 10.]* __ Level 11/Year 4 (also available in Year 5 and MSc). *[These courses are listed as options in both UG and MSc DPTs.]* __ Level 11/PG (also available in Year 5). *[These courses are normally for MSc and UG5 students. They are not explicitly listed in UG4 DPTs, but UG4 students can take limited credits of them.]* _x_ Level 11/PG (only). *[These courses are not available to UG4 or UG5 students. Examples: CDT courses; CPD courses.]* **Other options. Please provide justification if using:** __ Level 9/Year 3 *[Deprecated except for compulsory UG3 courses. The course will not be available to other years.]* __ Level 10/Year 4 __ Other:
SCQF Credit Points	__10 _x_20 __40 __60 __80 __Other:
Delivery Location	_x_Campus __On-line Distance Learning
Course Type	_x_Standard (default) __Dissertation __Online Distance Learning __Placement __Student Led Individually Created Course __Year Abroad
Marking Scheme	_x_Standard (numerical) __Letter grade only __Pass/Fail *[Normally only for externally delivered courses]*

Guidance for remaining sections:

Before starting your proposal: please contact the DDoLT (Curriculum) informally before starting to complete this form, with at least the following information:

- Tentative course title, level, year, and number of credits
- Who the target audience is, and why the course is needed.

The DDoLT (Curriculum) or delegate will schedule a meeting with you to discuss your plans and whether a full course proposal makes sense. If so, you will be provided with further instructions.

Deadlines: New courses must be approved by the December BoS meeting to ensure allocation of teaching staff for the following academic year. Since it may require considerable discussion and iteration to prepare the proposal, you should **contact the DDoLT (Curriculum) as early as possible, ideally in spring or summer**, and you should **plan on submitting your full proposal by November.**

Submitting your proposal: When your proposal is complete, please submit to **iss-bos@inf.ed.ac.uk**.

Colour coding and item-by-item guidance:
Guidance is provided in italics for each item. Please also refer to the guidance for new course proposals at http://www.inf.ed.ac.uk/student-services/committees/board-of-studies/course-proposal-guidelines. Examples of previous course proposal submissions are available on the past meetings page http://web.inf.ed.ac.uk/infweb/admin/committees/bos/meetings-directory but note that the proposal form was updated in Apr 2021.

Sections in gold are for student view and are required before a course can be entered into DRPS.
Sections in orange are for School use but are still required for all courses (even those that have already been approved based on other documentation).
Section in gray are for consideration by the Board of Studies. They are normally required for all new course proposals but may be omitted in some cases, with permission (e.g., for invited proposals).

Glossary of terms:

(D)DoLT: (Deputy) Director of Learning and Teaching.

DRPS (The Degree Regulations and Programmes of Study): Provides the University's official listing and descriptions of courses, degree programmes, and the regulations that govern them; updated annually in April. Course information in DRPS is considered a contract with students.

DPT (Degree Programme Table): Lays out the course requirements for each year of a degree. All UoE degrees have a DPT in the DRPS.

Path: A system that students use to help choose courses and view options in their DPT. The information feeds through from DRPS but has a more student-friendly interface (e.g., by highlighting courses that are not running or where the student hasn't satisfied prerequisites).

SCQF (The Scottish Credit Qualifications Framework): Lays out the requirements for courses at different levels and with different numbers of credits.

1. Course overview and case for support

Except as noted, all fields are required and will go into the DRPS (course catalogue) entry for students. Important: Text in DRPS is effectively a contract with students, so should not include details that are likely to change from year to year.

Summary Description (for DRPS)

Provide a brief official description of the course, around 100 words. This should be student-friendly, as it is the part of the descriptor a student is most likely to read. If this course replaces another course, please say so in this summary.

Machine learning is the study of computer algorithms that learn and adapt from data, as opposed to being programmed to explicitly follow instructions. This course will discuss two main branches of machine learning: (1) Supervised Learning, which is concerned with learning to predict an output, given inputs, and (2) Unsupervised Learning, by which we wish to discover the structure embodied in data, without having access to additional information about the data, e.g. labels.

This course will equip the students with knowledge and a set of practical tools that can be applied to solve real-world machine learning problems. This achievement of this aim is underpinned by a principled approach to understanding the problem space and formulating a solution.

This course replaces Introductory Applied Machine Learning (INFR11182), which was available to L11 students prior to 2022/23.

Contribution to curriculum; target audience and expected demand; consultation (for BoS only)

Why is this course needed and how does it relate to existing courses and degree programmes (including any prerequisite courses)?	**Need:** This course addresses the large demand for an applied machine learning course, where the focus is on practical applications of existing supervised and unsupervised approaches, rather than the mathematical construction and principles of these methods. **Relationship to Existing Courses:** This course replaces L11 IAML (INFR11182), by updating the syllabus and aspects of how the material is delivered. The pre-recorded lecture materials will be redesigned with asynchronous delivery in mind and recorded from scratch. The new content will provide running examples throughout to demonstrate the different methods presented in the course along with expanding some content e.g. the discussion of ethics. The removal of the L10 cohort from the course also frees us up to explore material that was previously already partially covered by the L10 cohort in FDS (or Inf2b). This BoS submission only relates to the semester one L11 course, not the semester two instances of IAML (i.e. INFR11205 and INFD11005). All IAML instructors were involved in the initial discussion of the revisions. Changes in

	the semester one material, and mode of delivery, will be available to the semester two courses. However, there will presumably be some small adaptations at the course level required, e.g. more business focused examples or distance learning considerations. **Summary of Changes:** We will address some common student concerns with INFR11182. For example, we will (1) reduce the workload for students by decreasing the number of tutorials; (2) provide more structure to the live class sessions so that they will not introduce new material; (3) use the time in the live class sessions to cover case studies and example questions; and (4) provide more feedback, at the course-level, for the assessed coursework. The more applied focus is suitable for students who do not have the required mathematical background for more advanced courses such as MLPR (INFR11130). It also provides students with the necessary foundation for other popular courses such as MLP (INFR11132). **Prerequisite Courses:** n/a
What is the target audience, in terms of background and interests, and what is the expected demand (class size) for the course? *State what your estimate is based on: e.g. by referring to projects in an area, sizes of similar courses, employer demand, etc. A survey of students may be requested once the main descriptor information is ready.*	**Background:** The target audience are students with limited to no formal prior experience in machine learning. These students should possess a solid foundation in computer science / engineering undergraduate-level math (i.e. linear algebra, calculus, probability theory, …) along with being comfortable with programming in a language such as Python (preferably), R or MATLAB. Upon successful completion of the course, students should be able to apply existing machine learning techniques to identify and address machine learning problems either in industry or research. The skills required to innovate upon existing methods and to develop novel machine learning tools are out of scope for this course. **Expected Demand:** 150-200. This is based on the size of the previous L11 cohorts for IAML.

Has this proposal been discussed with the DDoLT (Curriculum) or DoLT prior to BoS submission?	_x_ Yes __ No
Who else has been consulted? *Proposals should typically be discussed with relevant colleagues, including the programme director (for MSc courses). Summarize their comments if needed.*	Chris Williams, Iain Murray, Pavlos Andreadis, David Sterratt, Nigel Goddard, Tiejun Ma, and Amos Storkey

Course Description (for DRPS)

*This student-facing description should normally include **(a)** a more in-depth description of the learning aims, nature and context of the course, **(b)** a rough outline of the content, and **(c)** a description of how the course will be taught, and how students are expected to engage with it and to demonstrate their achievement of the learning outcomes.*
***Note:** Please keep this section general enough to avoid the need for yearly updates, and keep in mind that you should have only around 15 lecture hours of examinable material per 10pts of a course. (10pt courses may have 18-20 lecture hours, but the rest should be used for guest lectures, revision sessions, assignment feedforward/feedback, etc.)*

Delivery:
The course will be delivered through a combination of: (1) pre-recorded videos lectures, (2) live question/answer and example sessions, (3) practical labs, (4) tutorials, and (5) an online discussion forum.

Content:
The exact set of methods and algorithms explored in the course will vary slightly from year to year, but will include many of the following topics:

- Introduction to machine learning
The learning problem, supervised vs unsupervised learning
- Representing data
Categorical vs real valued attributes, feature extraction, basis expansion
- Classification
Naive Bayes, logistic regression, nearest neighbours, decision trees, neural networks
- Regression
Linear regression
- Ethics of machine learning
Fairness, biases in data, responsible application of machine learning methods
- Fitting models to data
Optimization, generalization
- Unsupervised learning
Dimensionality reduction, PCA, clustering
- Evaluating machine learning models
Accuracy, precision and recall, ROC curves

Assessment Weightings (for DRPS)

These should correspond approximately to the proportion of learning outcomes (below) that each component assesses. Note that assessed coursework is typically more time-consuming than exams for both students and staff. A typical course is based no more than 30% on coursework and doing so requires justification.

Written Exam __70_%
Practical Exam __0__% (*for courses with programming exams)*

Coursework __30_%

Additional Information, Assessment (for DRPS)

State briefly for students what type of coursework to expect, including whether implementation is required. E.g., "Coursework will involve implementing some of the methods discussed" or "The coursework will assess students' analysis and proof skills. No implementation is required." More specific information can be useful, but please keep it high level and do not include details that are likely to change from year to year.

Coursework will involve comparing and evaluating the methods discussed in the course using real-world datasets in a Python-based environment. Short written explanations along and discussion will also be evaluated as part of the coursework.

Non-assessed quizzes and example questions will also be utilized to help students better understand the course material. Feedback for the quizzes will be immediate, and feedback for example questions will be provided from the instructors or via peer discussion.

Learning Outcomes (MAXIMUM OF 5; for DRPS)

List the learning outcomes (LOs) of the course. These must be assessable (i.e., observable), so must specify what the student should be able to do concretely, not simply what they should "understand". Use concrete verbs that indicate (a) what type of assessment would be appropriate, and (b) what level of knowledge/thinking is expected (from recall to analysis to novel creation). ***Example verbs:*** *define, explain, implement, compare, justify. Assessments (described later) should be tied to the LOs.*

LOs should focus more on the types of thinking/skills developed than on the detailed course content, and should be appropriate to the level of the course: e.g., LOs at Level 11 should include more higher-level thinking skills than at Level 8. See how to write good learning outcomes and the descriptors of the SCQF Levels. Also, please consider including LOs related to ***social or ethical implications*** *or* ***meta-skills*** *as well as technically-focussed LOs.*

On completion of this course, the student will be able to:

1) Explain the scope, goals, and limits of machine learning, and the main sub-areas of the field.

2) Describe and critically compare the various techniques covered in the syllabus, and explain where they fit within the structure of the discipline.

3) Apply the taught techniques to data sets to solve machine learning problems, using appropriate software.

4) Analyse machine learning techniques in terms of their limitations and applicability to different machine learning problems and potential ethical concerns.

5) Compare and evaluate the performance of applicable machine learning techniques in a systematic way.

Graduate Attributes, Personal & Professional Skills (for DRPS)

Please list the generic transferrable skills that this course will develop, as aligned with the UoE's Graduate Attributes framework. Examples from the four skills categories in the framework include:

Research and enquiry: *problem-solving, critical/analytical thinking, handling ambiguity, knowledge integration*

Commented [KN1]: Verbs selected in line with Bloom's taxonomy

Personal effectiveness: *leadership, planning and organizing, flexibility and change management, entrepreneurship*
Personal responsibility and autonomy: *ethics and social responsibility, independent learning, self-awareness and reflection, creativity, decision-making*
Communication: *interpersonal/teamwork skills; verbal, written, cross-cultural, or cross-disciplinary communication*

The student will be able to do the following:

- Apply critical and analytical thinking to real-world data problems.
- Develop their problem-solving skills so they can better create, identify, and evaluate options in order to solve complex problems.
- Develop the technical skills required to manipulate data and apply computational tools in order to make predictions from data.
- Recognise and understand the ethical questions related to the application of machine learning algorithms.

2. Additional information on course design and resourcing (for BoS only, except where noted)

Breakdown of Learning and Teaching Activities (for DRPS)

Please fill in the number of timetabled hours per student for each type of activity. Do not include non-timetabled hours.

***A typical 10pt Informatics course** has:*

- *18-20 lecture slots (2/wk), but only ~15h should be examinable lectures, with the rest used for guest lectures, revision sessions, assignment feedforward/ feedback, etc. If unsure of plans, count these under 'lecture hours' but please explain tentative plans in the free text below.*
- *No more than 4-5 lab or tutorial hours. Please consider whether fewer can be used, e.g. by using some lecture hours for whole-class discussion/feedforward.*

***A typical 20pt course** has 30 lecture slots (3/wk) and no more than 8 lab/tutorial hours.*

Timetabled Hours	Type
20	Lecture Hours
2	Seminar/Tutorial Hours
0	Dissertation Project Supervision Hours
5	Supervised Lab/Workshop/Studio Hours
2	Feedback/Feedforward hours
2	Summative assessment hours *[Normally 2h if using an exam; otherwise 0]*
2	Revision Session Hours

(Note for ISS: Remaining hours should be allocated to Directed and Undirected Learning Activities.)

Use of timetabled activities (not to be included in DRPS)

If labs or tutorials are planned, please describe their role in the course (e.g., as support for assessed coursework, review of exercises, discussion of ethical questions, etc). If a non-standard pattern or style of lectures is planned, please explain.

Overview:

Each week there will be two hours of pre-recorded lecture material and two one-hour live class sessions. The class sessions will be an opportunity to cover additional practical examples not explored in the lectures, in addition to Q&A and revision.

There will be a lab session every other week (five in total), in addition to two tutorials towards the end of the semester.

Lectures and Live-sessions:

- 20 hours of pre-recorded videos. A preliminary draft of the weekly lecture schedule can be found here. This topic list is subject to further refinement, e.g. we may reduce some of the methods covered in order to have more time to go deeper in others. Also, some content will potentially be revisited over multiple weeks, e.g. the discussion of the ethical implications of machine learning.
- 10 hours of live classes featuring practical case studies and additional examples. Students will also be presented with questions in advance of the live sessions and provided with an opportunity to try to answer the questions themselves, or in small groups, before the live sessions.
- The remaining 10 hours of the live-sessions will cover Q&A, feedback, and revision

Labs:
The labs provide students with the necessary skills and practical experience to attempt the assessed coursework. 5 hours total.

Tutorials:
The tutorials provide the students with experience with exam-like questions. These two hours will be supplemented with additional example questions that will be presented in the live sessions – see above. 2 hours total.

Summative assessment and time spent on assignments (not to be included in DRPS)

*Please describe your plans for summative assessment, in more detail than in the student-facing description: How many and what types of assessment are planned (oral presentation, report, programming, etc)? For each piece of assessment, please indicate **(a)** which learning outcome(s) it assesses; and **(b)** how many hours students are expected to spend on it.*

*Please minimize the time spent on summative assessments (for both students and markers) while robustly assessing the learning outcomes. See the School policy on Workload and Assessment, which places limits on the number of summative courseworks and time expectations: to ensure a 35-40h working week, we must limit time asked of students to **6-7h/wk in total per 10 credits, including contact hours, self-study, and coursework.***

We will have one piece of summative coursework, worth 30% of the overall grade. This coursework will primarily assess ILOs 3, 4, and 5 (while the exam will focus on ILOs 1, 2, 4, and 5). Students will be provided with different datasets and will be asked to (1) apply the different techniques covered in the course to answer questions about the data and (2) to critically compare and contrast different techniques. They will also be expected to answer more open-ended questions related to the limitations of current approaches in the context of the examples provides. Submitted solutions will be provided by students in the form of a PDF document containing text, plots, and numerical outputs.

The coursework will be provided to students two and a half weeks before the final submission deadline in (which will be in week 8/9). It is expected that it will take them on average 15en hours, over two weeks, to complete the coursework. This work will be completed individually.

Tentative plans for feedback/formative assessment (not to be included in DRPS)

Please describe your current plans for providing feedback to students: e.g. oral feedback during labs/tutorials, automarked solutions to in-lecture or online quizzes, peer feedback, etc. We also encourage submission of at least one piece of (individual or group) written work, with formative feedback emphasizing how students can improve.

Some useful guides for planning effective and efficient feedback:

- *Two short IAD web pages: Five basic principles for feedback and Tips for improving feedback*
- *EngagED in... assessment and feedback. This flyer from IAD discusses assessment **of**, **for**, and **as** learning, and includes examples of innovative approaches that could help both with scaling to large courses and with causing students to reflect on and become engaged with their own assessment.*
- *Considerable further reading is available at the University pages on Enhancing Feedback.*

We will utilize auto-marked multiple-choice quizzes for each topic covered on the course. These quizzes can be taken multiple times and will provide the student with instance feedback. They will be delivered using an online platform (e.g. via Learn).

In order to prepare students for the assessed coursework, we will also have a non-assessed coursework in weeks 4/5. This will give students the opportunity to familiarize themselves with the format of the assessed coursework and the submission process. Feedback will be provided at the course level during a live class session for this non-assessed piece of work. Students will be permitted to work in small groups for this non-assessed coursework.

For the assessed coursework, detailed feedback will be provided via the marking rubric (e.g. from Gradescope). We will also provide course level feedback during one of the live sessions.

Students will also have the opportunity to ask questions via an online forum (e.g. Piazza). They will be encouraged to provide peer-feedback, but the instructors and TA will also be available to answer questions. Students will also be able to ask these questions during the live weekly sessions.

Decolonisation and Inclusivity (not to be included in DRPS)

*What actions are you taking towards making your course inclusive for all students, in terms of both **content** and **delivery**? Please be as specific as possible. If you are not taking any action, please justify. See suggestions and guidance here.*

Content:

- We will be mindful of the unnecessary usage of exclusionary terminology (e.g. "black-box" machine learning algorithms).
- The presented case-students will be carefully selected so that they do not reinforce negative stereotypes or common tropes. The case studies will also explore social and cultural questions related to applications of machine learning, e.g. who decides which problems are important, how they get addressed, and to what extent the target audience or the source of the data is consulted.
- There will also be an explicit lecture on Ethics in ML. This lecture will include examples of bias, e.g. in the data collection, and in assessing outcome fairness for differing values of a protected attribute.

Delivery:

- The pre-recorded lecture material will be made accessible via clear audio and subtitles where possible.

Anticipated Resource Requirements

If tutorials are needed, how many students per tutors? (*Please provide your desired number, and the maximum feasible number.)*	2 tutorials in total over the semester, each 1 hour long, with 15 students per group, requiring ~16 tutors i.e. 16 tutors x 2 tutorials
If labs are needed, how many students per demonstrator? (*Please provide your desired number, and the maximum feasible number.)*	5 labs in total over the semester, each 1 hour long, with 25 students per lab, requiring ~10 demonstrators i.e. 10 demonstrators x 5 labs
Please estimate the number of hours required for marking, per student.	15 markers x 15 hours for the assessed coursework 8 markers x 15 hours for the exam
If any other teaching support resource will be requested in order to **develop** or **maintain** the course, please provide an estimate of that here.	1 TA for monitoring Piazza 1 TA for developing the coursework

	1 TA for general tasks e.g. ensuring the package versions in the labs are up-to-date, setting up Gradescope, etc.
Do you anticipate any difficulty recruiting enough teaching support? *(For example if the course is very large or very specialized.)*	No
Does the course have any scaling limits due to available space or equipment?	n/a
If equipment is required, please state how it will be procured and maintained.	n/a
Does the course have any external funding? *(Typically only for CPD courses)*	n/a
Does the course need any special arrangements such as quotas, agreements with other schools, or registration arrangements? Does it have any atypical characteristics that may affect finance or student registration? Please specify if so.	No

3. Further information for BoS consideration

A full proposal for a new course must include examples of exercises and assessment. Please provide these below, along with publicity information.

Course information and publicity

The course web page (typically the Learn landing page) will be linked from the Sortable Course List, and information such as timetables and assignment deadlines must be made available prior to the start of the academic year. Please specify here if any additional info/publicity is needed for your course, especially if it is aimed largely at non-SoI students.

It will be important to clearly communicate to prospective students what we expect in terms of prior knowledge, what the scope of the course is, and how it differs from other related courses. For example, we anticipate a lot of questions from PGT students regarding the choice of this course (AML) versus MLPR. This should be addressed via the MSc handbook machine learning page, at the MSc programme welcome events, and via personal tutors. We would like to minimize the number of students who enrol in one course and then change later, or who take AML when MLPR might have been a better fir for them – and vice versa.

As machine learning is a popular topic, it will be important that non-SoI students are aware of the pre-requisite requirements before attempting to take the course.

Sample tutorial/lab sheet questions

Provide a list of tutorial questions and answers and/or samples of lab sheets. These need not be fully fleshed out but should indicate what sort of exercises will be provided to help students learn the material.

An example lab question and solution can be found here. This lab sheet is from IAML, but was developed from scratch in 20/21. It involves aspects of data loading, visualization, model training, model comparison, performance evaluation, and model introspection. It is representative of the types of labs we intend to use in AML.

Sample assessment materials

*If the course is primarily assessed by **exam**, provide a sample exam question with model answers. The online list of past exam papers gives an idea of typical and alternative exam formats.*
*If the course is largely or primarily assessed by **coursework**, provide a sketch of a possible assignment with an estimate of effort against each sub-task and a description of marking criteria.*

An example exam question (from the 20/21 IAML exam) can be found here. This particular question examines ILOs 2,4, and 5.

Any other relevant materials

Include anything else that is relevant, possibly in the form of links. If you do not want to specify a set of concrete readings for the official course descriptor, please list examples here.

n/a

4. Additional Course Details for DRPS

Except where otherwise noted, these fields are required for entry into EUCLID and will be visible to students in the DRPS entry.

Planned Academic Year of Delivery *(The first year you anticipate the course running, e.g. AY 2019-20)*	2022-23
Keywords *Give a list of searchable keywords for the course.*	Machine Learning, Supervised Learning, Unsupervised Learning, Data Science, AML
Course Organiser *(By default, the course proposer)*	Oisin Mac Aodha
Intended Delivery Period	_x__Semester1 ___Semester 2 ___Full Year ___Summer ___Other (please specify):
Timetable considerations/conflicts *For School use. Please specify any constraints to be considered (e.g. overlap of popular combinations, other specialism courses, external courses etc). Include whether the semester delivery is constrained or could be flexible.*	It is anticipated that many students will also take MLP (INFR11132) concurrently.
Reading List/Learning Resources (for DRPS) *You are encouraged to create resource lists using LEGANTO*	Books that may be useful, but are not required: - Hands-On Machine Learning with Scikit-Learn and Tensor Flow, Geron. - Pattern Recognition and Machine Learning, Bishop. - Probabilistic Machine Learning: An Introduction, Murphy. - Bayesian Reasoning and Machine Learning, Barber. - The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Hastie, Tibshirani, and Friedman.
Feedback Information *Provide a high-level description of how and what type of feedback will be provided to students, for inclusion in DRPS.*	Some of the live class sessions will be devoted to discussing practical examples (including some exam-like questions), and providing feedback on student answers at the course level. Feedback at the course level will also be provided for the assessed and non-assessed courseworks. Piazza will be utilized for peer-feedback.
Is this course available to visiting students?	_x__Yes (default) ___No **If no, please provide a justification here:**

Required pre-requisite courses *Use sparingly: these are enforced in PATH and can only be waived by approval from the School's Curriculum Approval Officer. Note that cross-year required pre-requisites may prevent MSc students from registering; consider using recommended pre-requisites or "other requirements" instead.*	_x_No ___Yes (please specify full course name(s) and code(s)):
Recommended pre-requisite courses	_x__No ___Yes (please specify full course name(s) and code(s)):
Required co-requisite courses *Specify any courses that must be taken in parallel with the existing course. Note that this leads to a timetabling constraint that should be mentioned elsewhere in the proposal.*	_x__No ___Yes (please specify full course name(s) and code(s)):
Prohibited Combinations *Specify any courses that may not be taken in combination with the proposed course].*	___No __x_Yes (please specify full course name(s) and code(s)): MLPR - INFR11130 IAML Distance Learning - INFD11005 IAML Sem 2 Business School - INFR11205
Other Requirements/Additional Information *This information is often used by MSc students and students from other Schools to see if they have appropriate background without having done our School's courses. So please avoid course titles, instead list specific knowledge and skills (such as mathematical concepts, programming ability or specific languages, etc).* *Also list any other constraints on registration, for example: "Only available to 4th Year Informatics students including those on joint degrees." or "This course is open to all Informatics students including those on joint degrees, and to students in the School of Mathematics. Other external students whose DPT does not list this course should seek permission from the course organiser."*	___No __x_Yes (please specify): Maths requirements: Linear algebra: Vectors: scalar (dot) product, transpose, unit vectors, vector length and orthogonality. Matrices: addition, matrix multiplication, matrix inversion, eigenvectors and determinants. Special functions: properties and combination rules for logarithm and exponential. Calculus: Rules for differentiation of standard functions. Geometry: Basics of lines, planes and hyperplanes. Coordinate geometry of circle, sphere, ellipse, and n-dimensional generalizations. Probability theory: Discrete and continuous univariate random variables. Expectation and variance. Univariate and multivariate Gaussian distributions. Joint and conditional distributions. Programming requirements: Students should be familiar with programming in a modern object-oriented language, ideally Python which is the course language.

Visiting Student Pre-requisites	__x__Same as “other requirements” ___Different than “other requirements” (please specify):

5. Placement in degree programme tables: for level 9-11 courses only (except EPCC)

This section is for consideration by the Board of Studies and will be used later by ITO to determine where the course will be added to existing degree programme tables.

Is this course restricted to students on a specific degree? *E.g., some courses are only available to students on a specific CDT or MSc.*	_x_ No ___ Yes (please specify and provide justification):
Is this course compulsory for students on any degree(s)?	_x_ No ___ Yes (please specify and provide justification):
Any issues for part-time students? *Normally, part-time students have access to the same courses as full-time students on the equivalent degree. If you anticipate any problems with this, please specify here.*	No issues anticipated as long as they are able to engage in all the necessary course activities.

Commented [MO2]: Check BioMed CDT

For optional courses:

If this course is available but non-compulsory for students on various degrees (most courses), please fill in this section. The choices here determine where the course appears in degree programme tables (DPTs) and the 2-3 character tags are displayed in the Informatics sortable course list.

Should this course be tagged as 'ML' (machine learning foundations and methods)? *Courses with the ML tag are typically very high-demand and most degrees limit the number of ML credits. If your course might appeal to a similar audience but draw off students from these large courses, please select 'no' and choose one of the tags below.*	__No _x_ Yes
If you chose 'no', please choose at least one of the following tags… *Ideally, select exactly one, unless there is a good argument for more than one. These three are used in various combinations for many of our degrees.*	__**FSS** (CS foundations, systems, and software) __**AIA** (artificial intelligence applications and paradigms) __**COG** (cognitive science: including HCI and NLP courses, but not most other AI courses. Please restrict to courses most relevant to natural cognition.)
…and also tick if any of the following tags or categories apply. *Do not tick any of these if you selected 'ML' already.*	__**SE** (software engineering: including courses that are highly relevant to SE degrees. All SE courses should also be FSS. This tag is mainly relevant for UG SE degrees.) __Databases and data management systems (used for Data Science MSc and MSc(R)) __Unstructured data and applications (used for Data Science MSc and MSc(R)) __Level 11 Security courses (used for Security MSc) __ATFC Optional courses (used for ATFC MSc)

If you are not sure which tags are most appropriate or have other questions about this section, please note any comments/issues here.	n/a