Meeting Agenda

Informatics Board of Studies

2.10pm Wednesday 6 February 2013
Appleton Tower Level 4

Agenda

1. Apologies for Absence
2. Minutes of the Previous Meeting
3. Matters Arising
4. (15 mins) Opening Courses Across Years — I. Stark (Proposal)
5. (15 mins) Course Proposal: Introduction to Quantum Computing — E. Kashefi
   (Proposal, Sample Questions)
6. (10 mins) Course Change: Computability and Intractability — R. Santhanam (Proposal,
   Sample Questions)
7. (15 mins) Changes to Courses in Artificial Intelligence — A Smaill (Proposal)
8. (15 mins) New Course Proposal Template — M. Rovatsos (Case for Support, Template)
9. (10 mins) Informatics Course Review Project — M. Rovatsos (Summary)
10. (10 mins) CDT Planning — N. McGillivray (CDT Structures)
11. Notice of items for future meetings
12. AOCB
Meeting Minutes

Informatics Board of Studies

2pm Wednesday 7 November 2012
Appleton Tower Level 4

Minutes

Present: I. Stark (Convenor), M. Rovatsos (Academic Secretary), P. Stevens, J. Oberlander, C. Sutton, K. Kalorkoti, S. Goldwater, P. Anderson, I. Murray, A. Lascarides, D. Sanella, T. Komura, M. Cryan, N. McGillivray, G. Bell, S. King (PPLS), J. Wright (Maths), J. Hulme (School Rep), B. Hong (Class Rep), V. Swann (Secretary)


I. Stark opened the Board of Studies, welcoming all Board Members. An amendment to the start time of the Board was suggested in order to bring this into line with the recent changes to the Academic Timetable. I. Stark proposed that all subsequent meetings of the Board should start at 2.10pm. This was approved by the Board.

It was noted that the MLnf Project Proposal has now moved to Item 4.

2. Minutes of the Previous Meeting

The minutes of the previous meeting were accepted as a true record. Most actions have now been completed, as recorded by notes in the minutes. The following action remains:

3.2. M. Rovatsos to raise the issue of course workload for IJP and AGTA at Teaching Committee

4. M. Rovatsos to raise the issue general issue of coursework load at Teaching Committee

3. Matters Arising

Nothing further reported.

4. Course Proposal: MLnf Project (Part 1) and MLnf Project (Part 2) — K. Kalorkoti (Case for support and Course Descriptors)

K. Kalorkoti outlined the proposal to amend the MLnf Project. The primary motivation to introduce the 40 credit project in year 4 is to create an exit route so that students not progressing to the final MLnf year can leave with an Honours Degree. Currently students are only able to leave with an Ordinary Degree and this is not considered to be representative of the work achieved by the end of fourth year. Further motivations are outlined in detail in the Case for Support.

The MLnf Project (Part 1) taken in year 4 would follow a similar format to the standard UG4 Project, with the additional requirement that the student provides an outline of the intended direction for MLnf Project (Part 2). The MLnf Project (Part 2) would be similar to the existing Phase 2, but reduced from 60 credits to 40 credits. This would bring the overall project...
scale, from 100 credit points to 80, closer to the practice of other schools and still above the University minimum 60 for Integrated Masters. Students would be required to include a fixed-length summary of work undertaken in Part 1 at the start of their final dissertation before presenting new material developing from this.

Both Student Reps reported their approval of this proposal. J. Hulme, currently in the fourth year of the MInf programme, feels that this would benefit the programme. He particularly praised the introduction of an appropriate exit route from year 4.

I. Stark, as convenor, relayed some concerns raised by email from those not able to attend the meeting. K. Kalorkoti had already responded to these directly, and reported on these to the Board.

One such concern was that reducing the project in year 5 from 60 to 40 credits would require students to take a further 20 credits of Level 11 courses. The demanding nature of Level 11 courses are often a strain on MSc students and the requirement for MInf students to undertake a project simultaneously might cause difficulties for some. K. Kalorkoti suggested that MInf students are in a stronger position to meet that burden than external MSc students, having much more specific experience with Informatics during their previous 4 years of study. MInf students are also well underway with their project and will have completed Part 1 with a clear understanding of what they wish to achieve in Part 2. B. Hong, as MInf year 5 class rep, said he felt a 40 credit project alongside 80 credits of technical courses would be wholly appropriate.

More generally, K. Kalorkoti suggested that there might indeed be a problem with workload on some of our Level 11 courses, but that the appropriate response would be to address that problem directly rather than compromise the MInf project. Members of the Board recommended some monitoring of the impact on study hours in MInf year 5.

A further concern was the loss of an identified planning phase. K. Kalorkoti explained that planning will still be an integral part of MInf Project (Part 1) and that Part 2 would enable the students to delve deeper than would be possible in a standard Honours Project.

It was suggested that staff may find it difficult to switch between different marking requirements for the UG4 Honours Project and the MInf Project (Part 1). K. Kalorkoti recommended that two distinct webmark forms should be created with specific guidance for markers. Using different prompt questions on the form could also highlight the specific requirements of this project.

I. Stark asked about the timing of introduction, and whether Part 2 could be introduced immediately for 2013/2014. K. Kalorkoti acknowledged that this was possible, but he did not recommend it, and the Board concurred.

P. Stevens noted that a change in project details was relevant for professional accreditation of the degree programme, and the BCS should be contacted regarding this.

The introduction of an Honours exit route allows the possibility of a hurdle for progression to MInf year 5, as already exists between years 3 and 4. This would lead weaker students to exit with Honours, avoiding the risk of failing to meet the demands of the MInf final year. The current proposal only allows the exit route, and does not enforce it. K. Kalorkoti recognised that the introduction of such a hurdle was possible, but he was not proposing it and recommended the topic be left until we have more experience with the revised programme.

In contrast, the similarity between the MInf Project (Part 1) and the standard Honours Project might enable strong Honours students to transfer to the MInf. This was previously not possible due to the discrepancy between the two projects.
The Board voted and the proposal was passed 11 to 2 with 2 abstentions.

**OUTCOME:** Approved.

**ACTION:** Create Courses in EUCLID for 2013/2014 (Part 1) and 2014/2015 (Part 2). Close existing courses when appropriate.

**ACTION:** Contact BCS regarding approval for this course.

**ACTION:** Monitor workload in 4th and 5th Year using an MInf work diary.

**ACTION:** Create new marking forms for Inf Project (Part 1) and MInf Project (Part 2), clearly distinguished from those for the Honours Project.

5. **Opening more higher-level courses across years** – I. Stark (Proposal)

I. Stark spoke to the item tabled. Presently the School of Informatics offers Honours courses across three years, based on a scheme that students take SCQF level 9 courses in year 3, level 10 in year 4, and level 11 in year 5 or MSc. However, this does not reflect actual practice: many courses are offered at two different levels with sometimes only minor differences in work required, so that they can be taken in different years; and students often take one or more courses at other levels. The University model curriculum identifies year 3 as normally level 10, and many schools treat level 10 as the standard level for Honours with students taking level 10 courses in both third and fourth year. The proposal is that courses should be delivered at a single level and the DPTs amended to allow students to continue to attend them. This is a pre-proposal and if Board Members are in favour, I. Stark will bring the item back to the Board at a later date with specific DPTs for approval.

There was general approval for this proposal in principle, in particular to allow third-year students to take level 10 courses. There was concern that if the level 10/11 distinction is removed, fourth-year students would be overloaded with the more demanding level 11 versions. However, it was noted that often the only difference is an additional piece of coursework included purely to provide a distinction, and it may be appropriate to retain the lower workload for the single-classification level 11 course. This would also address some concerns raised in the previous discussion about the high workload in some level 11 courses.

K. Kalorkoti expressed concern that some level 10 courses may be inappropriate for third-year students. He identified Computer Algebra as having no specific UG3 pre-requisite courses yet requiring a level of sophistication and maturity appropriate only to students who have already completed year 3. Some members of the Board challenged this. I. Stark noted that courses would still retain a "normal year taken" and DPTs could restrict access by third-year students to particular level 10 courses intended for fourth-year students only.

There was concern over the requirement to provide resit exams for courses taken by 3rd Year students in the cases where a student has Special Circumstances or will resit courses to exit with an Ordinary Degree. I. Stark confirmed that any level 10 course newly opened up to third-year students would have to be prepared to provide resits for students seeking the Ordinary degree. There was, however, no requirement to provide separate level 9 versions of such courses for Ordinary students.

S. King from PPLS noted that many of their courses have versions at level 10 and level 11 where the courses are identical but rated at 20 credit points for level 11 and 10 credit points for level 11.

I. Stark highlighted that the intention is to retain current Level 9 courses where appropriate, but that the proposal would allow some courses currently listed at level 9 to seek reclassification at level 10 if the existing course content meets that standard. This would mean students could take these courses in either third or fourth year. It was emphasised
that such reclassification must not lead to courses becoming more difficult and thereby
narrowing the options available to third-year students. Lecturers should operate on the
assumption that courses cannot be changed but might be reclassified.

There was a further possibility raised that Informatics might follow PPLS and designate all
Honours courses as level 10, allowing students yet more flexibility to take them across
years. This was not supported by the Board, with strong individual objections. This will not
be pursued.

OUTCOME: Many Board members are in favour of this change in principle, subject to
provision of further details.
ACTION: I. Stark to bring this item back to the Board with further details and specific DPTs
for approval.

6. Student access to third-year courses in fourth-year - J. Hulme (Proposal, Student
Survey)

J. Hulme reported on some problems and limitations for students in choosing Honours. In
particular, many popular courses are available only in third year which constrains choices
and makes some desirable course combinations impractical. This also causes problems
for students spending year 3 abroad, who cannot do these course at all. He had surveyed
current students to assess the extent of concern, which courses are particularly in demand
to be taken in either year, and any possible resolutions.

M. Rovatsos had investigated the University regulations and raised with College the
question of fourth-year students taking level 9 courses. It is clear that this it is not possible
to give Senior Honours credit for this, and he cannot even award a concession to do so in
individual cases.

Student responses to the survey had highlighted the importance of progression from year to
year as part of the overall structure of the degree programme. One possibility would be to
declare all Honours courses level 10, as in some other schools, designating the as year 3
or year 4 as appropriate. However, the Board saw several disadvantages to this, as already
discussed in the previous item, and did not wish to take that course.

Nonetheless, it was clear that the previous proposal on cross-year availability may make
solutions for some combinations possible, and the Board agreed this should be taken into
account when developing the proposal in item 5.

OUTCOME: No immediate change, but the problems identified will be taken into account
when following up the action from item 5.

7. Course Proposals: Design Informatics (Case for Support, Course Descriptors: Case
Study 1, Case Study 2, Placement, Dissertation)

I. Stark explained to the Board that the Design Informatics programmes had previously been
approved by the Board of Studies and College, and are being advertised in the University
prospectus for 2013 entry. This item is to consider the individual courses, which had been
proposed in draft form at the time of programme approval but are now presented for final
confirmation.

J. Oberlander described changes since these were last presented to the Board. The earlier
proposal to offer an Informatics course for design students has now been withdrawn, and
Informatics only need to offer 4 courses as part of the Design Informatics Degrees. All
other courses will be offered by Edinburgh College of Art. Amendments to the Case for
Support and Course Descriptors have been implemented following suggestions by M.
The Dissertation will be very similar to the standard Informatics Dissertation, in particular being judged on the dissertation alone. The 1 year Masters in Design Informatics will undertake this over Summer, whilst the 2 year Advanced Masters in Design Informatics will complete the Dissertation during Semesters 1 and 2 of Year 2. The structure in the Case for Support provides an overview of the timing of the Dissertation within the two degrees. There was some discussion around the technicalities of course descriptors: although the content of these will be identical to the standard Informatics Dissertation, timing differences may require separate entries in the course catalogue. The key difference is the flexible delivery, which is not available to Informatics MSc students.

J. Oberlander noted that the Course Descriptor for Case Study 1 provides an outline of procedure rather than content, reflecting the fact that specific topics of case study will change year to year. The Case Study 1 exemplar gives an indication of possible content.

Clarification was requested for the content of the Case Study each year. J. Oberlander confirmed that in a given academic year, the students on Case Study 1 and Case Study 2 will study the same material but with differing responsibilities and will each produce their own Case Study. Students on the two year programme will undertake a different Case Study during each year of their programme. In addition, students undertaking Case Study 2 will develop the project to allow this to be retaught at a later stage.

A concern was raised that the numbers for each cohort would need to match appropriately. J. Oberlander confirmed that there is flexibility in group size for smaller and larger cohorts in Year 1. The first year of the programme will be led by tutors as Year 2 students are not yet in place to lead the Case Study. It was recommended that the short course descriptor should specify minimum and maximum group sizes.

It was noted that the short course descriptors given were rather academic, and might better be used to give a summary of the courses for prospective students.

There was a recommendation that the 1 week symposium should be removed from the Course Descriptor to avoid specific commitments in terms of course delivery. This could be included in the study pattern using the free text. It is also important to consider the timing of the symposium alongside other courses to ensure students are not overloaded.

J. Oberlander also confirmed that the dissertation would be marked in accordance with standard MSc Dissertation guidelines and no separate marking form is required. The mark would be given on the Dissertation itself rather than the artefact produced and externals would consider borderline cases using similar criteria. In particular they will not be asked to take the aesthetic value of the artefact into consideration.

I. Stark suggested that the Course Descriptors are accepted subject to the changes discussed. The Board Approved these courses.

**OUTCOME:** All courses are approved subject to changes.
**ACTION:** J. Oberlander to make required changes and submit to M. Rovatsos for final approval.
**ACTION:** Create courses in Euclid for 2013/14 and 2014/15 as required.
**ACTION:** Submit courses to College Learning and Teaching Committee for ratification.

8. Notice of Items

I. Stark listed items in preparation for future Boards, and invited anyone interested in these to contact the named proposers.
9. AOCB

E. Dickson is preparing for the PG Open Day. There are currently only 17 people registered to attend so academic staff are asked to publicise this to 4th Year and MSc students who might be thinking of applying for an MSc or PhD.
Opening Courses Across Years

Summary

At present the School of Informatics offers over 20 courses at more than one SCQF level, usually 10/11 but also 9/10. This incurs considerable overheads for us, yet many students and their personal tutors anyway report that courses are often not available in years when students could usefully take them. I propose that we revise our degree programmes and course levels so that courses are usually delivered in just a single version, but may be available at more than one year of study. This makes precise a pre-proposal approved at the last meeting of the Board.

Background

At the meeting in November 2012 the Board discussed this as a possible course of action, and approved proceeding to a full proposal.

Links: Paper on cross-year courses; Minutes of discussion.

Subsequently I met with K. Kalorkoti and D. K. Arvind to discuss details and implications of these changes. They corrected an item of history: the dual listing of 10/11 level courses in many cases arose as a way to lift final-year undergraduate courses into the MSc programme, not the reverse.

At the Board itself, and in following discussions, staff did express interest in re-classifying or opening up individual courses, but there was no enthusiasm for imposing this across the board. Hence this proposal is written to permit changes to courses and their availability across years, but not to uniformly demand them.

Proposal 1/2: Courses

All existing courses remain valid at their current level or levels. All courses should continue to be assigned to one or more programme area out of AI, CogSci, CS and SE, recognising the degree programmes to which they make specific contribution.

However, rather than proposing dual-level versions, new courses should fit exactly one of the classes listed below. Existing two-level course pairs could also convert, subject to the Board's approval of an appropriate course descriptor. Single courses might be reclassified to recognise that their existing content is in fact appropriate for certain students across more than one taught year. Note that the level refers to the depth and sophistication of the course material, not the scale of work or effort required.

Level 9 third-year courses

Introductory courses directed at honours students. Level 9 courses can only be taken in the third year. Resit examinations must be set for any students requiring them to qualify for an Ordinary Degree.

Level 10 third-year courses

Courses suitable for honours students in the third year of the appropriate degree programme, and available to all honours students in their fourth year. Resit examinations
must be set for any students requiring them to qualify for an Ordinary Degree.

Examples from existing courses:

- Several external courses already listed on our degrees fall into this class, such as *Speech Processing* from PPLS and *Pure and Applied Analysis* from Mathematics.
- The two courses *Agent-Based Systems Level 9* and *Agent-Based Systems Level 10* might seek reclassification to run as a single level 10 third-year course.
- Level 9 *Algorithms and Data Structures* might seek reclassification with its existing material as a level 10 third-year CS course, so as to make it available to Honours students in their fourth year.
- Level 9 *Introduction to Vision and Robotics* might seek reclassification as a level 10 third-year AI course, making it available to third-year AI and CogSci students taking it as a precursor to *Intelligent Autonomous Robotics* in fourth year and to fourth-year students on any Informatics degree taking it standalone.
- Level 10 *Communication and Concurrency* might seek reclassification as a level 10 third-year CS course, opening it up to third-year CS students who can currently take it but only with special permission.

**Level 10 fourth-year courses**

Courses suitable for honours students in their fourth year of study.

**Level 11 fourth-year courses**

Courses suitable for honours students in the fourth year of the appropriate degree programme, and also open to all MSc students and final-year MInf students. These courses may not hold their exams at the end of Semester 1, as those weeks are dedicated to the fourth-year student project.

Examples from existing courses:

- Some external courses already listed on our degrees fall into this class, such as *Dynamical Systems* from Mathematics.
- Some of our existing level 11 courses are also specially listed as available to fourth-year students, so fit this heading, such as *Automatic Speech Recognition* and *Machine Learning and Pattern Recognition* on the AI degree.

**Level 11 MSc courses**

Courses only open to MSc students and final-year MInf students.

**Proposal 2/2: Degree Programmes**

For all of the active degree programmes in the School:

- Artificial Intelligence (BSc Hons)
- Artificial Intelligence and Computer Science (BSc Hons)
- Artificial Intelligence and Mathematics (BSc Hons)
- Artificial Intelligence and Software Engineering (BEng Hons)
Artificial Intelligence with Management (BEng Hons)
Cognitive Science (BSc Hons)
Computer Science (BEng Hons)
Computer Science (BSc Hons)
Computer Science and Electronics (BEng Hons)
Computer Science and Management Science (BSc Hons)
Computer Science and Mathematics (BSc Hons)
Computer Science and Physics (BSc Hons)
Computer Science with Management (BEng Hons)
Informatics (MInf)
Software Engineering (BEng Hons)
Software Engineering with Management (BEng Hons)

Also, in recommendation to the School of Engineering, who host the following degree programmes:

Electronics and Software Engineering (BEng Hons)
Electronics and Software Engineering (MEng Hons)

the following changes.

**Third year**

Degree programmes currently have the form

120 credit points of courses, comprising
   Some compulsory courses
   So many credit points of level 9 courses in the degree programme area
   So many credit points of level 9 courses in the joint degree programme area, if any
   So many credit points of level 9 courses from anywhere in Informatics
   So many credit points of level 9 courses from any school.

"With the permission of the School Curriculum Approval Officer, an additional 10 points may be taken at level 10 to assist in preparation for the Honours project."

Note that in this presentation of exact credit points, students will often satisfy their "level 9 courses from any school" requirement with an Informatics course; and it's a moderately complex problem to work out which courses should be entered under which heading.

This should be replaced with the same credit points in each heading, but different content classes:

120 credit points of courses, comprising
   The same compulsory courses
   At least so many credit points of level 9 and level 10 third-year courses in the degree programme area
   At least so many credit points of level 9 and level 10 third-year courses in the joint degree programme area, if any
   Up to so many credit points of level 9 courses from elsewhere in Informatics
Up to so many credit points of level 9 courses from outside Informatics

The note about additional permission from SCAO can be dropped.

The addition of "At least" and "Up to" clauses is intended to simplify matching students course choices; removing the need to work out which course should use the "any school" clause --- a student taking courses only from Informatics need never reach that part.

**Fourth year**

Degree programmes currently have the form

120 credit points of courses, comprising
   40 credit points Honours project
   So many credit points of level 10 courses, possibly one level 11 course, in the degree programme area
   So many credit points of level 10 courses, possibly one level 11 course, in the joint degree programme area if any
   So many credit points of level 10 courses from anywhere in Informatics
   So many credit points of level 10 courses from any school.

This should be replaced with the same credit points in each heading, but different content classes:

120 credit points of courses, comprising
   40 credit points Honours project
   At least so many credit points of level 10 and level 11 fourth-year courses, in the degree programme area
   At least so many credit points of level 10 and level 11 fourth-year courses, in the joint degree programme area if any
   Up to so many credit points of level 10 courses from elsewhere in Informatics
   Up to so many credit points of level 10 courses from outside Informatics

**Fifth year and MSc**

No change.

If all these were applied to the current year, it would leave the specific courses available in each degree programme unchanged. The difference is that new and reclassified courses, as discussed above, could be placed within this framework and thereby be more widely available.

**Motivation**

(As from the previous paper, with small modifications following feedback.)

While some courses do sincerely differentiate between different level versions, in many cases the variation is minimal and dual-listing is a fig leaf to admit students from more than one year. Even where there is variation, it is generally only in coursework, and often in magnitude rather than depth or sophistication.
The nominal 9/10/11 strict assignment to years does not reflect practice either in delivery or student course choices; and this mismatch misleads both staff and students, as well as being an administrative headache.

The existing 10/11 dual listing is based on a presumption that our final-year undergraduate students are uniformly less academically mature and prepared than incoming masters students. Many staff report that for their classes this is false, and sometimes precisely reversed.

This change would make available to all our Honours students a broader range of courses at a wider range of levels, with more flexibility over which year they are taken.

There is significant effort for both teaching and administrative staff for duplicated courses: keeping track of different cohorts, assignments, multiple mailing lists, entry and examination results. It is not clear to me that this is worth the cost.

All student course choices are automatically validated against our stated degree programme. Where the stated programme does not match practice, as here, many student entries must be individually processed by hand as “non-validated”.

**Action**

If approved, this proposal would change our guidance on course proposals, and may lead to certain specific reclassification requests at future Boards.

The Degree Programme Tables in EUCLID would not change immediately. The proposal would enable some behind-the-scenes simplification in how those tables are generated from pre-defined course lists. Reclassification of individual courses would mean moving them from one list to another, and they would then appear in the appropriate years of the relevant degrees.
Informatics Board of Studies - Course Proposal  
Proposed course title: Introduction to Quantum Computing  
Proposer(s): Elham Kashefi  
Date: 30/01/2013

1. Case for Support

1a. Overall contribution to teaching portfolio

Quantum Computation has been a rapidly growing field of research, attracting scientists from various native disciplines including Physics, Mathematics and Computer Science. Quantum Information Processing has resulted in a range of spectacular results from the foundations of quantum mechanics to the realization of actual quantum-based security protocols. Recent breakthroughs on the practical implementation of long-distance and networked quantum key distribution protocols have made quantum technology a realistic enterprise for our lifetime. Despite this diverse interest, this topic is not covered at all at the University of Edinburgh, and in Scotland in general it has been reserved for Physics students, at the PhD level. Even within the physics community the only existing course, called Quantum Information, offered through SUPA (Scottish Universities Alliance in Physics) for the Physics degree in Photonics, does not cover the computational aspects of the field.

In contrast, essentially all top universities in Canada, the US, and various countries in Europe and Asia offer courses in Quantum Computation. Within the UK, top universities such as Oxford, Cambridge, Imperial College, UCL and etc, also offer such a course, very often in the departments of Computer Science or Applied Mathematics. Quantum Computation is an emergent field stemming from both the foundations of Quantum Mechanics and theoretical Computer Science, and as such, has an overlap with other courses in both the foundations of computer science and quantum physics. Given the continued growth of the field, Quantum Computation is becoming an indispensable element of the computer science curriculum, and as such should be taught at University of Edinburgh, having one of the strongest departments for computer science in Europe.

The aim of this course is to bring this hot topic closer to students in the equally suitable field of Computer Science. During this course, the mathematical framework required to understand the basics of Quantum Computation is given and two models, the commonly used Quantum Circuit model and the more recent Measurement-Based Quantum Computing model, will be explained. Possible applications of quantum computing will be presented along with a couple of more interesting quantum algorithms. The final lectures will cover additional topics, such as the novel cryptographic protocol of Universal Blind Quantum Computing and Quantum Verification scheme.

1b. Target audience and expected demand

Any student from Physics or Informatics who has passed Quantum Mechanics has the required background. However for the student from Informatics or Mathematics it is also suffices to have passed only the Introduction to Linear Algebra and Probability with Applications. In general any undergraduate or master student from the college of science with basic knowledge of linear algebra, vector spaces, probability theory, complex numbers, models of computation, computability and intractability would be able to take the course. I anticipate good turn out for this course as almost all students from Physics and Informatics will take the above courses and in the past I have been approached at many occasions by for project within this topics. Up to my knowledge all the similar courses run in Europe and Canada and other UK based university have been very popular and packed with minimum 50 students.
1c. Relation to existing curriculum

This course is primarily assigned to the CS programme areas however it is open to MSc students in other areas as well. In particular the course should be listed for the following specialist areas:

Analytical and Scientific Databases  
Computer Systems, Software Engineering and High Performance Computing  
Knowledge Management, Representation and Reasoning  
Theoretical Computer Science

Given the importance of quantum information processing and its effect on the security infrastructure of our current system, the basic familiarity with the concepts are also essential for undergraduate students in the following degrees. This is the case of all the standard computer science degree in North America and we would prepare our student in a competitive market by offering them the choice.

Artificial Intelligence and Computer Science (BSc Hons)  
Artificial Intelligence and Mathematics (BSc Hons)  
Computer Science (BEng Hons)  
Computer Science (BSc Hons)  
Computer Science and Electronics (BEng Hons)  
Computer Science and Mathematics (BSc Hons)  
Computer Science and Physics (BSc Hons)  
Informatics (MInf)  
Software Engineering (BEng Hons)

I have already contacted the Physics department and the director of teaching has agreed to make this course as one of the option to their degree program. The lecturer of the Quantum mechanics course (Prof. Del Debbio) has informed me of the students’ great interest in the topic of quantum computing (that appears only as the last lecture in his course) and their eagerness to continue their project and graduate study in quantum computing. However despite the success of Quantum Information Scotland Network (QUISCO) we seem to be losing these talented students due to the lack of an appropriate bridge to link them to the ongoing research activity in Scotland. It is worth mentioning that Quantum Mechanics (PHYS09017) has 87 students this year, who are eligible to take the Quantum Computation course.

1d. Resources

This is a level 11 fourth-year course in Computer Science, open to undergraduates taking CS degrees in their final year; to MInf students in year 5; and to all MSc students. Contents of approximately 16 out of 20 lecture hours will be examined, whereas the last remainder will be reserved for the purposes of material reviewing and discussions of advanced topics in Quantum Computation (not appearing in the final exam). If the number of registered students goes above 20, I would need a tutor to run an hour session per week. Both my current Ph.D. students, Einar Pius and Theodoros Kapourniotis and my postdoc Vedran Dunjko are able to do so. I am also interested to make the course to be a 20 credit one instead by expanding the advance topics specially if by teaching this I could cover my teaching duties.

2. Course descriptor

Course Title: Introduction to Quantum Computing

SCQF Credit Points: 10
SCQF Credit Level: 10
Normal Year Taken: 4/5/MSc

Appropriate for the following Degree Programmes:

Artificial Intelligence and Computer Science (BSc Hons), Artificial Intelligence and Mathematics (BSc Hons), Computer Science (BEng Hons), Computer Science (BSc Hons), Computer Science and Electronics (BEng Hons), Computer Science and Mathematics (BSc Hons), Computer Science and Physics (BSc Hons), Informatics (MInf), Software Engineering (BEng Hons), Analytical and Scientific Databases (MSc), Computer Systems, Software Engineering and High Performance Computing (MSc), Knowledge Management, Representation and Reasoning (MSc), Theoretical Computer Science (MSc)

Timetabling information: Semester 1
School Acronym: INF-?-???

Short Course Description:

The aim of this course is to give students a basic overview of the rapidly growing field of Quantum Computation (QC). The course will start with a brief introduction of the mathematical framework of QC. The two models of quantum circuit and measurement-based quantum computing, will be introduced. Through these models various key concepts in QC such as entanglement and teleportation will be discussed. In order to compare QC and classical computing, simple quantum algorithms with their complexity analysis will be presented. We finish the course by highlighting the recent development of the field in secure delegated QC.

Pre-Requisite Courses:

Co-Requisite Courses: None

Prohibited Combinations: None

Other Requirements:

Basic knowledge of linear algebra, vector spaces, probability theory, complex numbers, models of computation, computability and intractability.

Undergraduate students must have passed either PHYS09017 (Quantum Mechanics) or both MATH08057 (Introduction to Linear Algebra) and MATH08067 (Probability with Applications).

Postgraduate or visiting students must have taken similar courses providing this background in their undergraduate degrees.
Available to Visiting Students: Yes

Summary of Intended Learning Outcomes:

A student who has successfully completed this course should be able to:

1 - use the mathematical framework of quantum computing
2 - critically read and understand scientific papers on quantum computing
3 - explain and analyse any quantum algorithms described in quantum circuit or measurement-based quantum computing models
4 - relate quantum complexity classes to the classical ones

Assessment Information

Assessment Weightings:

  Written Examination: 80%
  Assessed Assignments: 20%
  Oral Presentations: 0%

The students who successfully complete the course will have a general understanding of the current topics in Quantum Computing, and will be able to critically read and understand scientific papers pertaining to the field. This being one of the main purposes of the course, it will be examined via oral presentation of well chosen articles. Indeed in Quantum Computing there are many elementary concepts in the field that are still under investigation and we aim to encourage the students to get familiar with these ongoing research topics as part of their study. The students will be also required to complete a moderate amount of independent one take-home assignments, the main purpose of which will be to aid the students in understanding the presented material and help in the preparation for the final exam. A written examination contributes 80% of the final grade. The remaining 20% will be based on two assessed coursework, one of which is the oral presentation of a research paper. Each student will get a 10 minutes slot to discuss the main points of the paper. We plan to arrange this outside of the required lectures hours. However if the number of students exceeds 20 the oral presentation option will be replaced with another take home coursework.

Academic description:

Syllabus:

- Basic concepts from Linear Algebra necessary for understanding the axioms of Quantum Mechanics,
- Axioms of Quantum Mechanics, describing quantum system, quantum operators, composition, entanglement and measurements
- The no cloning, no deleting theorems and the consequences for computation
- Quantum Computing via quantum circuit model: Description of qubit and universal set of gates.
- Quantum space and depth complexity and oracle model
- Classical simulation of quantum circuit and Gottesman-Knill Theorem
- Quantum Algorithms: Grover’s Search and Deutsch-Jozsa problem
- The first quantum protocols: Quantum teleportation and super dense coding
- Quantum Computing via measurement-based model: Description of graph state and measurement calculus
- Advance Topics: Information flow in measurement-based model, unconditionally secure quantum cloud computing

Relevant QAA Computing Curriculum Sections:

Transferrable skills:

Ability to analyse complex system and to design syntaxes to capture computational phenomena, familiarity with information encoding in natural system and distinguishing the boundary between classical and physical computation

Reading List:

The principal source will be lectures slides provided during the course. Other textbook for the course are “Quantum Computation and Quantum Information” by Nielsen and Chuang, “An Introduction to Quantum Computing” by Kaye, Laflamme and Mosca. Also a useful supporting textbook for the course is “Quantum Information” by Stephen Barnett.

Study Abroad: None

Study Pattern:

2 lecture hours and 1 tutorial hour each week, with 2 coursework assignments.

Lectures 20
Tutorials 8
Timetabled Laboratories 0
Coursework Assessed for Credit 12
Other Coursework / Private Study 60
Total 100

Keywords: Quantum computing, quantum algorithm, quantum mechanics, quantum complexity, quantum protocol
3. Course materials

Please see attached PDF files for sample question

3d. Any other relevant materials

None

4. Course management

4a. Course information and publicity

There will be a website for the course available at the start of the term where the slides of the first 5 lectures and general introduction including the course structure will be made accessible. During the course period further slides will be uploaded. Also tutorial materials and assignments together with any other paper references will be distributed through this website. The course itself will be advertised on QUISCO (quantum information Scotland network), SUPA and SICSA mailing list.

4c. Feedback

4b. Management of teaching delivery

All the required communication with the students will be performed via the course website. The other staff of the course if approved will be the tutor from my current quantum group at the school where we have already weekly meeting. Any required discussion about the course and the progress of the students will be covered in these meeting.

5. Comments

All the comments I have obtained from Jane Hilston, Ian Stark and Michael Rovatsos have been already incorporated in the proposal.
Introduction to Quantum Computing

Elham Kashefi

Tutorial Sample

Question. Most unitary transforms are hard to approximate.

1. Show that there exist $O(2^{n^2})$ distinct boolean functions of $n$ bits.

2. Show that a (classical) circuit composed of $n$ NAND gates can implement at most $O(n^{2^n})$ distinct boolean functions.

3. Show that an arbitrary unitary transform applied to $n$ qubits is described by $O(2^{2n})$ real degrees of freedom.

4. How many distinct unitary transforms can be produced by a quantum circuit composed of $n$ controlled-Not, Hadamard, and T gates?

Solution.

1. We are dealing with boolean functions that take $n$ bits as input and output $n$ bits. Each boolean function function has $2^n$ possible inputs, and its output for each of these is described by $n$ bits. Therefore, since it takes $n2^n$ bits to describe an arbitrary boolean function, meaning that there are $2^{n2^n}$ different boolean functions which take in $n$ bits and output $n$ bits.

2. Any circuit of $n$ NAND gates can take at most $2n$ bits, and can be described (redundantly) by a sequence of $n$ steps each involving a single NAND gate. At each step, there are $\binom{N}{2}$ possible ways to have a NAND gate (You choose each of the two inputs). Since there are $n$ such steps, there are at most $(\binom{N}{2})^n$ possible circuits. $(\binom{N}{2})^n < (n^2)^n = n^{2n}$, and thus a classical circuit composed of $n$ NAND gates can implement at most $O(n^{2n})$ boolean functions.

3. An arbitrary $NN$ matrix has $N^2$ complex degrees of freedom. For a matrix to be unitary there are $\binom{N}{2} + N$ complex constraints (Each pair
of columns is orthogonal + Normalization of each column). Therefore, an arbitrary unitary matrix has $O(N^2)$ degrees of freedom. For a system of $n$ qubits, $N = 2^n$, and therefore an arbitrary unitary transform has $O(N^2) = O((2^n)^2) = O(2^{2n})$ degrees of freedom.

4. We use a similar reasoning that we did in part 1. Any quantum circuit of $n$ CNOT, Hadamard, and T gates can affect at most $2n$ qubits and may be described (redundantly) by a sequence of $n$ steps, each involving a single CNOT, Hadamard, or T gate. At each step, there are $\binom{2n}{2} + 2n$ possible gates to apply, and thus there are at most $O((2^n)^n) = O(n^{2n})$ possible unitary transforms.
Course Change: Computability and Intractability

Proposal for Re-weighting of Assessment for Computability and Intractability

As of now, the Computability and Intractability (CI) course is assessed as 100% final exam. I'd like to propose shifting this to 75% exam, 25% coursework, as used to be the case before the 100% exam default for 3rd year courses was introduced. CI is a heavily mathematical course, and an important part of the learning experience is to work out coursework problems — this helps both in understanding the basic concepts, and as rehearsal for the problem solving required during the exam. I've noticed that making coursework non-compulsory has disincentivized students from doing it, especially the weaker ones, with negative consequences for their performance in the exams. I understand there is a concern about the amount of coursework 3rd year students have to handle, but I anticipate that students should not have to spend significantly more than 10 hours of their time working on the CI coursework.

Rahul Santhanam
31 January 2013

Course Descriptor Modifications

Assessment Information:

Written Examination 75
Assessed Assignments 25
Oral Presentations 0

Assessment via Written Examination and Assessed Assignments.

Assessment Weightings: 10 + 10 + 5 (3 Assignments in total)

Study Pattern:

Lectures 20
Tutorials 8
Timetabled Laboraties 0
Non-timetabled Assessed Assignments 10
Private Study/Other 62
Total 100
The deadline for this coursework is 4pm on Friday 19 October; submit your solutions to the ITO. Please note that multiple submissions are not allowed. Your work will be marked and returned, but the mark will not contribute to the overall mark for the course. Note that the marks for questions are not always related to their length or difficulty.

In your answers you should aim for clarity, conciseness and correctness; look at your answers with an objective eye, e.g., imagine that somebody else gave them to you to check. You should therefore make an early start to give yourself time to consider your answers before submitting the final version. This coursework should take about 10 hours of work to complete.

1. For this question we use the notation of NOTE 1 and assume that both inputs and outputs are encoded as natural numbers.

Recall that a partial function from \( \mathbb{N} \) to \( \mathbb{N} \) is a function that takes a natural number as input and is either undefined for that input or returns a natural number as result.

Let \( f \) and \( g \) be partial functions from \( \mathbb{N} \) to \( \mathbb{N} \). We say that \( g \) extends \( f \) if for all natural numbers \( n \) such that \( f(n) \) is defined we have that \( g(n) \) is also defined and \( g(n) = f(n) \). (In other words \( g \) might be defined for more inputs than \( f \) but whenever \( f \) is defined then so is \( g \) and it agrees with \( f \).)

Define the function \( f \) by

\[
 f(n) = \begin{cases} 
 P_n(n) + 1, & \text{if } P_n \text{ returns a result on input } n, \\
 \text{undefined,} & \text{otherwise.}
\end{cases}
\]

(a) Do you think that \( f \) is computable (see p.5 of NOTE 1)? Give a brief justification of your answer (bear in mind that there are infinitely many \( P_n \)). [3 marks]

(b) Let \( g \) be any computable function that extends \( f \). Prove that \( g \) is not total, i.e., there is at least one natural number \( m \) such that \( g(m) \) is not defined. [4 marks]

(c) Use the preceding two parts to define a total function that is not computable and explain why this is the case. [Note: You must answer this question as asked, i.e., an alternative proof that does not rely on parts (a) and (b) is not acceptable.] [4 marks]

2. Design a Turing machine copy with input alphabet \( \{0, 1, $, @\} \) having the following behaviour:
• When started with an input string $B@$ where $B$ is any binary string (including the empty string) the machine accepts the input and the final tape is $B@B$. It doesn’t matter which symbol is scanned when the machine stops so you can make this as simple as possible; there are two natural choices.

• When started with any other input we do not care about the behaviour of the machine—so you need not even think about this case.

(a) Create a file containing your machine in the format used by the Turing machine simulator. Submit a printout of this and email a copy to your tutor. [6 marks]

(b) Run your machine with input $@$ and submit a printout of the trace (make all transitions printable). [2 marks]

(c) Run your machine with input $101@$ and submit a printout of the trace (again make all transitions printable). [3 marks]

3. Let $\Sigma$ be a finite alphabet and $L$ a recursive language over $\Sigma$, i.e., there is a Turing machine that recognizes $L$ and always halts. Define the language $L'$ (over $\Sigma$) by

$$L' = \{ w \mid \text{there is a string } u \in \Sigma^* \text{ s.t. } wu \in L \},$$

i.e., a string is in $L'$ if and only if it is a prefix of a string in $L$.

(a) Prove that there is a Turing machine that recognizes $L'$ (the machine might not always halt). For this part you should outline the proposed machine in fairly high level terms but take care of any important points. (You may assume that there is a Turing machine that lists the strings of $\Sigma^*$ using some sensible convention.) [7 marks]

(b) Can the assumption that $L$ is recursive be weakened to $L$ is recursively enumerable? (Of course even if the answer is “yes” it would probably be necessary to change the construction used in the preceding part.) For this part you need only justify your answer in very high level terms. [4 marks]

Rahul Santhanam, Thursday 4 October
Symbolic AI teaching: proposed new and updated courses

Alan Smaill
30 January, 2013

1 This document

This is a preliminary outline of changes and new courses that are expected to come to the next meeting of the Board of Studies. It follows discussions with various people in the context of CISA-related teaching: J. Cheney, J. Fleuriot, P. Jackson, E. Klein, D. Robertson, M. Rovatsos, A. Smaill. Comments from the Board will be helpful in taking these ideas forward.

2 Background

With changes in staff circumstances, courses have disappeared from the MSc offering (Advanced Planning and KMM); this has impacted badly on the MSc specialism Knowledge Management, Representation & Reasoning. On the other hand, there is an opportunity to introduce modern topics into the syllabus. This is an opportunity to strengthen the syllabus in this area.

The following courses are under consideration:

1. Artificial Intelligence Foundations: a new 10 point course at MSc level.

2. Changes to the teaching of Automated Reasoning: instead of the current Artificial Intelligence Foundations 4th year/MSc course, the material rearranged and extended in:

   (a) Automated Reasoning: 10 point course in year 3, and
   (b) Formal Verification: 10 point course at MSc level, available to year 4.

Comments on these proposed courses follow. We propose to offer these courses as follows:

1. Artificial Intelligence Foundations: semester 1
2. Automated Reasoning: semester 1

3. Formal Verification: semester 2

Some changes to Agent-Based Systems and Multi-Agent Semantic Web Systems are also being considered.

3 Artificial Intelligence Foundations

We propose a new 10-point Level 11 MSc-only course to cover formal logic, heuristic search, constraint satisfaction, knowledge representation and automated planning as fundamental knowledge-based AI techniques. This course will be mandatory for the Knowledge Representation & Reasoning specialism, and will provide the necessary background for the other specialist courses in the area. It could also help remove a lot of redundancy in teaching some of this material in other courses. Finally, it would complement core courses in other areas of AI (Machine Learning, NLP, Robotics) to provide solid foundations in another core thematic area of the subject.

It may be possible to incorporate into the teaching some of the material being developed currently in a MOOC on Planning.

The textbook by Russell and Norvig has a plentiful supply of associated teaching materials, and it is possible to cover this material rapidly following the book. This would use about half the material in Russell and Norvig.

4 Automated Reasoning

This will be revamped as a Level 9 course to provide a more thorough grounding in interactive theorem proving and model checking. Currently, AR is a level 10/11 course, which has Informatics 2D as a prerequisite for undergraduates but assumes no pre-requisites for MSc students. This disparity forces a significant portion of its materials to cover basic logic (for the sake of MSc students), thereby preventing a more detailed (and unhurried) look at some of the existing topics, while excluding other relevant ones due to lack of time. The overhauled course, which will retain Inf2D as a prerequisite, will free up lecture slots and thus enable better coverage of concepts such as unification, rewriting, and sequent calculus and allow the addition of new topics such as declarative proof languages, SAT, and bounded model checking. We believe that the change will have a beneficial effect on the number of students taking final year projects in AR-related areas – this has plummeted since the course was changed to Level 10/11 about 6 years ago.
5 Formal Verification

This will be a new 10-point Level 10/11 course. One half of the course will focus on approaches and tools for formal verification of software, both sequential and concurrent. For example, it will look at assertion-based verification as exemplified in tools such as Why and Spec#, and software model checking in SLAM/SDV. The other half will look at formal reasoning techniques that are realised in SMT solvers, which are the core reasoning engines inside many formal verification tools. Topics will include decision procedures for linear arithmetic, equality and uninterpreted functions, and methods for combining these. Weaved in will be non-examinable lectures on cutting-edge topics in formal verification. This course will be suitable for inclusion in the Cyber Security CDT bid and other bids involving verification and correctness.

6 ABS and MASWS

Here the changes are relatively minor.

1. **Agent-Based Systems** Currently a mixed Level 9/10 course, the proposal would be to discontinue the level 9 version and offer the level 10 version to UG3, UG4, and MSc students alike. The difference between the existing two versions is that the level 9 version has no assessed coursework, which has proven counter-productive for UG3 student engagement with the course, and led to a number of students failing the exam. Adding the level 10 version to the AI course list for UG3 would avoid restricting (already limited) AI choices in third year. The level 10 version would also be open to MSc students, with Artificial Intelligence Foundations (or equivalent prior learning) as a prerequisite.

2. **Multi-Agent Semantic Web Systems** We propose to rename this course to Semantic Web Systems (SWS), and to replace intelligent agent related material from the syllabus by more technical material on description logics, ontological reasoning systems, and linked/open data material. The current syllabus involves too much overlap with ABS, and the two parts of the course have always been hard to combine from a teaching perspective. We also propose to discontinue the level 10 version of the course, and to list the level 11 version as a course routinely taken by UG4 students. The current difference between the two versions is only one final piece of coursework, which should be omitted so that the two other assignments can become more manageable and cover more in-depth learning objectives.
Case for Support

A new template for course proposals is suggested that better reflects the information that has been requested of proposers at recent Boards. In particular, it puts more emphasis on providing samples of course materials, and on gathering comments from relevant members of staff (year organisers, degree programme co-ordinators) prior to presenting a new course proposal. The Board is requested to endorse the template so it can become part of the official guidelines for course proposals, or to suggest improvements to the current draft so it can be revised and presented to a future board.
Informatics Board of Studies - Course Proposal

Proposed course title:

Proposer(s):

Date:

This template contains the following sections, which should be prepared roughly in the order in which they appear (to avoid spending too much time on preparation of proposals that are unlikely to be approved):

1. Case for Support
   – to be supplied by the proposer and shown to the BoS Academic Secretary prior to preparation of an in-depth course description
   1a. Overall contribution to teaching portfolio
   1b. Target audience and expected demand
   1c. Relation to existing curriculum
   1d. Resources
2. Course descriptor
   - this is the official course documentation that will be published if the course is approved, ITO and the BoS Academic Secretary can assist in its preparation
3. Course materials
   - these should be prepared once the Board meeting at which the proposal will be discussed has been specified
   3a. Sample exam
   3b. Sample coursework
   3c. Sample tutorial/lab sheets
   3d. Any other relevant materials
4. Course management
   - this information can be compiled in parallel to the elicitation of comments for section 5.
   4a. Course information and publicity
   4b. Feedback
   4c. Management of teaching delivery
5. Comments
   - to be collected by the proposer in good time before the actual BoS meeting and included as received
   5a. Year Organiser Comments
   5b. Degree Programme Co-Ordinators
   5c. BoS Academic Secretary

[Guidance in square brackets below 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://www.inf.ed.ac.uk/admin/committees/bos/meetings/.]

1. Case for Support
   [This section should summarise why the new course is needed, how it fits with the existing course portfolio, the curricula of our Degree Programmes, and delivery of teaching for the different years it would affect.]

1a. Overall contribution to teaching portfolio
   [Explain what motivates the course proposal, e.g. an emergent or maturing research area, a previous course having become outdated or inappropriate in other ways, novel research activity or newly acquired expertise in the School, offerings of our competitors.]

1b. Target audience and expected demand
Describe the type of student the course would appeal to in terms of background, level of ability, and interests, and the expected class size for the course based on anticipated demand. A good justification would include some evidence, e.g. by referring to projects in an area, class sizes in similar courses, employer demand for the skills taught in the course, etc.]

1c. Relation to existing curriculum
[This section should describe how the proposed course relates to existing courses, programmes, years of study, and specialisms. Every new course should make an important contribution to the delivery of our Degree Programmes, which are described at http://www.drps.ed.ac.uk/12-13/dpt/drps_inf.html. Please name the Programmes the course will contribute to, and justify its contribution in relation to courses already available within those programmes. For courses available to MSc students, describe which specialism(s) the course should be listed under (see http://www.inf.ed.ac.uk/student-services/teaching-organisation/taught-course-information/year-guides/taught-postgraduate-year-guide/degree-requirements/specialist-areas), and what its significance for the specialism would be. Comment on the fit of the proposed course with the structure of academic years for which it should be offered. This is described in the Year Guides linked from http://www.inf.ed.ac.uk/student-services/teaching-organisation/taught-course-information/year-guides.]

1d. Resources
[While course approvals do not anticipate the School's decision that a course will actually be taught in any given year, it is important to describe what resources would be required if it were run. Please describe how much lecturing, tutoring, exam preparation and marking effort will be required in steady state, and any additional resources that will be required to set the course up for the first time. Please make sure that you provide estimates relative to class size if there are natural limits to its scalability (e.g. due to equipment or space requirements). Describe the profile of the course team, including lecturer, tutors, markers, and their required background. Where possible, identify a set of specific lecturers who have confirmed that they would either like to teach this course apart from the proposer, or who could teach the course in principle. It is useful to include ideas and suggestions for potential teaching duty reallocation (e.g. through course sharing, discontinuation of an existing course, voluntary teaching over and above normal teaching duties) to be taken into account when resourcing decisions are made.]

2. Course descriptor
[This is the official course descriptor that will be published by the University and serves as the authoritative source of information about the course for students. Current course descriptions in the EUCLID Course Catalogue are available from http://www.star.euclid.ed.ac.uk/ipp/cx_sb_infr.htm.]

Course Title:
[Name of the course.]

SCQF Credit Points:
[The Scottish Credit and Qualifications Framework specifies where each training component provided by educational institutions fits into the national education system. Credit points per course are normally 10 or 20, and a student normally enrolls for 60 credits per semester. For those familiar with the ECTS system, one ECTS credit is equivalent to 2 SCQF credits. See also http://www.scqf.org.uk/The%20Framework/Credit%20Points.]

SCQF Credit Level:
[These levels correspond to different levels of skills and outcomes, see http://www.scqf.org.uk/The%20Framework/Level%20Descriptors. At University level, Year 1/2 courses are normally level 8, Year 3 can be level 9 or 10, Year 4 10 or 11, and Year 5/MSc have to be level 11. MSc programmes may permit a small number (up to 30 credits overall) of level 9 or 10 courses.]
Normal Year Taken: 1/2/3/4/5/MSc
[While a course may be available for more than one year, this should specify when it is normally taken by a student. “5” here indicates the fifth year of undergraduate Masters programmes such as MInf.]

Appropriate for the following Degree Programmes:
[Please list all programmes from http://www.drps.ed.ac.uk/12-13/dpt/drps_inf.htm for which the course would be appropriate. Some courses may be specifically designed for non-Informatics students, please describe this here if appropriate.]

Subject Area and Specialism Classification:
[Any combination of Computer Science, Artificial Intelligence, Software Engineering and/or Cognitive Science as appropriate. For courses available to MSc students, please also specify the relevant MSc specialisms (to be found in the online MSc Year Guide), distinguishing between whether the course should be considered as “core”, “recommended”, or “optional” for the respective specialism.]

Timetabling Information:
[Provide details on the semester the course should be offered in, specifying any timetabling constraints to be considered (e.g. overlap of popular combinations, other specialism courses, external courses etc).]

School Acronym: INF-??-???
[This can be provided by the Informatics Teaching Organisation.]

Short Course Description:
[Provide a brief official description of the course, around 100 words. This should be worded in a student-friendly way, it is the part of the descriptor a student is most likely to read.]

Pre-Requisite Courses:
[Specify any courses that a student must have taken to be permitted to take this course. Pre-requisites listed in this section can only be waived by special permission from the School's Curriculum Approval Officer, so they should be treated as "must-have". By default, you may assume that any student who will register for the course has taken those courses compulsory for the degree for which the course is listed in previous years.]

Co-Requisite Courses:
[Specify any courses that should be taken in parallel with the existing course. Note that this leads to a timetabling constraint that should be mentioned elsewhere in the proposal.]

Prohibited Combinations:
[Specify any courses that should not be taken in combination with the proposed course.]

Other Requirements:
[Please list any further background students should have, including, for example, mathematical skills, programming ability, experimentation/lab experience, etc. It is important to consider that unless there are formal prerequisites for participation in a course, other Schools can register their students onto our courses, so it is important to be clear in this section. If you want to only permit this by special permission, a statement like "Successful completion of Year X of an Informatics Single or Combined Honours Degree, or equivalent by permission of the School." can be included.]

Available to Visiting Students: Yes/No
[Provide a justification if the answer is No.]
Summary of Intended Learning Outcomes:
[List the learning outcomes of the course, emphasising what the impact of the course will be on an individual who successfully completes it, rather than the activity that will lead to this outcome. Further guidance is available from http://www.ssdd.bcu.ac.uk/outcomes/.

A student who has successfully completed this course should be able to:

1.
2.
3.
...

Assessment Information
[Provide a description of all types of assessment that will be used in the course (e.g. written exam, oral presentation, essay, programming practical, etc) and how each of them will assess the intended learning outcomes listed above. Where coursework involves group work, it is important to remember that every student has to be assessed individually for their contribution to any jointly produced piece of work.]

Assessment Weightings:

Written Examination:     ??%
Assessed Assignments:    ??%
Oral Presentations:      ??%

[Weightings up to a 70/30 split between exam and coursework are considered standard, any higher coursework percentage requires a specific justification. The general expectation is that a 10-point course will have an 80/20 split and include the equivalent of one 20-hour coursework assignment (although this can be split into several smaller pieces of coursework. You should not expect that during term time a student will have more than 2-4 hours to spend on a single assignment for a course per week. Please note that it is possible, and in many cases desirable, to include formative assignments which are not formally assessed but submitted for feedback, often in combination with peer assessment.]

Academic description:
[A more technical summary of the course aims and contents. May include terminology and technical content that might be more relevant to colleagues and administrators than to students.]

Syllabus:
[Provide a more detailed description of the contents of the course, e.g. a list of bullet points roughly corresponding to the topics covered in each individual lecture/tutorial/coursework. The description should not exceed 500 words but should be detailed enough to allow a student to have a good idea of what material will be covered in the course. Please keep in mind that this needs to be flexible enough to allow for minor changes from year to year without requiring new course approval each time.]

Relevant QAA Computing Curriculum Sections:
[Please see https://www.qaa.ac.uk/academicinfrastructure/benchmark/statements/computing07.asp to check which section the course fits into.]

Transferrable skills:
[Include any transferrable skills that are explicitly taught in the proposed course. It is not necessary to include skills that are indirectly learned in any course as a side-effect of successful completion.]
Reading List:
[Provide a list of relevant readings. See also remarks under 3d.]

Study Abroad:
[Only to be included if part of a study abroad programme.]

Study Pattern:

?? lecture hours and ?? tutorial hours each week, with ?? coursework assignments.

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Tutorials</th>
<th>Timetabled Laboratories</th>
<th>Coursework Assessed for Credit</th>
<th>Other Coursework / Private Study</th>
<th>Total</th>
</tr>
</thead>
</table>

[These should be listed in hours, with the total being 10 x course credits. Assume 10 weeks of lectures slots and 10 weeks of tutorials, though not all of these need to be filled with actual contact hours. As a guideline, if a 10-pt course has 20 lecture slots in principle, around 15 of these should be filled with examable material, the rest should be used for guest lectures, revision sessions, introductions to assignments, etc.]

Keywords:
[A list of searchable keywords.]

3. Course materials

3a. Sample exam
[A sample exam with model answers to the individual questions should be provided. A justification of the exam format should be provided where the suggested format non-standard. The online list of past exam papers gives an idea of what exam formats are most commonly used and which alternative formats have been http://www.inf.ed.ac.uk/teaching/exam_papers/]

3b. Sample coursework
[Provide a sample assignment with an estimate of effort against each sub-task, a solution sketch, and a description of marking criteria.]

3c. Sample tutorial/lab sheets
[Provide a list of tutorial questions and answers and/or samples of lab sheets.]

3d. 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.]

4. Course management

4a. Course information and publicity
[Describe what information will be provided at the start of the academic year in which format, how and where the course will be advertised, what materials will be made available online and when they will be finalised. Please note that University and School policies require that all course information is available at the start of the academic year including all teaching materials and lecture slides.]

4b. Feedback
[Provide details on feedback arrangements for the course. This includes when and how course feedback is solicited from the class and responded to, what feedback will be provided on assessment (coursework and exams) within what timeframe, and what opportunities students will be given to respond to feedback. The University is committed to a baseline of principles regarding feedback that we have to implement at every level, these are described at http://www.docs.sasg.ed.ac.uk/AcademicServices/Policies/Feedback_Standards_Guiding_Principles.pdf. Further guidance is available from http://www.enhancingfeedback.ed.ac.uk/staff.html.]

4c. Management of teaching delivery
[Provide details on responsibilities of each course staff member, how the lecturer will recruit, train, and supervise other course staff, what forms of communication with the class will be used, how required equipment will be procured and maintained. Include information about what support will be required for this from other parties, e.g. colleagues or the Informatics Teaching Organisation.]

5. Comments
[This section summarises comments received from relevant individuals prior to proposing the course.]

5a. Year Organiser Comments
[Year Organisers are responsible for maintaining the official Year Guides for every year of study, which, among other things, provide guidance on available course choices and specialist areas. The Year Organisers of all years for which the course will be offered should be consulted on the appropriateness and relevance on the course. Issues to consider here include balance of course offerings across semesters, subject areas, and credit levels, timetabling implications, fit into the administrative structures used in delivering that year.]

5b. Degree Programme Co-Ordinators
[Degree Programme Co-Ordinators are responsible for maintaining the official Degree Programme Specifications and Degree Programme Table for a given subject area which, among other things, specify the content of courses taken in a Degree Programme. The Degree Programme Co-Ordinators of the relevant subject areas that the course is proposed for should comment on the fit with the current curriculum of the relevant Degree Programmes. Issues to consider here are dependencies arising from pre-, co-requisites, and forbidden combinations, balance of different topics in a Degree Programme, etc.]

5c. BoS Academic Secretary
[Any proposal has to be checked by the Secretary of the Board of Studies prior to discussion at the actual Board meeting. This is a placeholder for their comments, mainly on the formal quality of the content provided above.]
Informatics Course Review Project
M Rovatsos, tabled at Board of Studies meeting 6th February 2013

Our course portfolio and the documentation describing individual courses (course descriptors and web pages) have grown organically over the years and exhibit great variability in terms of quality and structure. While a Curriculum Review was conducted by Kyriakos Kalorkoti in 2010, no systematic effort to revise and streamline it has been undertaken. I propose to initiate such a systematic review across all our Honours courses over several BoS meetings, with the aim of completing this project by the end of 2013. Non-Honours courses are more tightly co-ordinated with each other and their documentation is in good shape, no changes are suggested there.

I propose to proceed in three stages, across several BoS meetings, and to ensure sufficient discussion prior to the actual meetings among course lecturers, year organisers, degree programme co-ordinators, and the ITO to be able to approve suggested changes “in bulk” at the actual meetings:

1. **Year 3 course review**
   This comprises 22 courses normally taken in Year 3, i.e. all Level 9 courses plus Professional Issues, and excluding Introduction to Java Programming which is an MSc-only course. This is already underway and should be complete by the next BoS meeting in March. A document has been created at [https://docs.google.com/document/d/1fqtTdSy1yir0xXodqEGjG9PWRv5dnbv9CtvIlu-RFA/edit](https://docs.google.com/document/d/1fqtTdSy1yir0xXodqEGjG9PWRv5dnbv9CtvIlu-RFA/edit) for all to contribute to this discussion, and relevant staff members have been specifically approached to contribute.

2. **Year 4 course review**
   This comprises 29 courses, where many are shared with year 5. It seems reasonable to deal with courses that have a level 10 and level 11 version at the same time.

3. **Year 5 course review**
   This comprises 27 courses, given that those shared with year 4 will have been dealt with in phase 2.

While I expect that most changes will be minor, I suggest we take this opportunity also to re-consider the structure of courses at an academic level, in particular regarding the following issues:

1. The level 9/10/11 classification of individual courses. This relates to recent discussions on opening up level 10 courses to Y3 students and level 11 courses to Y4 students by default, and potentially re-classifying some level 9 courses as level 10 to enable Y4 students to access them.
2. Rethinking coursework load. Given perennial problems of heavy workload among our students, I would suggest introducing a “a total of 10-15 hours worth of assessed assignments for every 10 points of course weight” default.¹
3. Considering combining two existing 10 point courses to 20 points, or making individual 10 point courses be worth 20 points in the future. This would help better reflect the workload of some demanding courses, and reduce the complexity of our course portfolio. Also, it would reduce administrative overhead, exam setting requirements etc, simplify duties allocation, and enable lecturers to focus on one larger teaching duty.

The Board is asked to comment on the suggested way of proceeding. I am planning to also conduct a similar review at the degree programme level after this course-level review is completed.

---
¹ Students have around 2-4 hours to work on each assignment per week (during term time: average 4 x 2 = 8 hours of lectures, 4 x 2 = 8 hours of labs/tutorials, another 10-14 hours for self-study if we want them to engage with courses, this leaves around 10-14 hours for coursework per week over four courses). Most assignments of the 10-15% weight category can usually be worked on during three to four weeks.
Possible CDT Bid Degree Structures

Staff working on the preparation of CDT bids should be aware of the following advice, making a distinction between a taught and research component for the first year of a 1+3 programme. This is a revised version of the document previously approved by both Strategy Committee and Research Committee. Note that a mix of these models is not encouraged, and will not be considered.

The 12/13 University degree regulations now contain the option of a "consecutive registration" for MRes and PhD degrees at the time of application; with alternative routes of exit – this is recommended for options 1 and 2 [see: http://www.drps.ed.ac.uk/12-13/ regulations/postgrad.php#a16] and may be considered for option 3.

In all of the following options the first year is considered to be the training element, followed by a three year prescribed PhD period. The first year of the PhD must be probationary in-line with University regulations, and follow the existing Graduate School milestones framework. For the two MRes training options, the MRes Dissertation must not be considered as a PhD proposal.

1 - Research Programme ['taught' MRes]

This option uses an MSc by Research (MRes) programme to deliver a training framework for the first year of a 1+3 programme. Bids electing to follow this route must provide a 180pts DPT proposal, of which 140pts must contribute to the MRes Dissertation. This model is commonly used by Schools in HSS, with College wide agreement that MRes programmes structured in this way are administered under the taught assessment regulations, via both Stage 1 and Stage 2 BoE meetings. A typical DPT for this model would look like:

- MRes Dissertation – 140pts ['long thin' compulsory course]
- Choice of Taught Courses – 40pts [a compulsory choice, selected from a collection of courses, minimum of 40pts]

This option involves registering students onto a PGR programme, admitted in the usual way via a PGR Selector, but accepting that a defined DPT will be administered by the ITO during the first year, that all progression rules be presented in the DPT and that the MRes Dissertation be marked and assessed by the BoE [numerical mark returned to Registry etc].

At the Stage 2 BoE, ITO will declare a pass/fail result in the usual way. The consecutive registration regulation states that a passed MRes is sufficient to gain entry to the subsequent PhD programme.. meaning there is now no need for additional local meetings or decisions on progression for those who have achieved the MRes. CDT bids are therefore encouraged to think of ways to include a PhD proposal type course as part of the DPT, enabling this to form part of the assessment prior to award and progression.

2 - Research Programme ['dissertation' MRes]

This option uses an MSc by Research (MRes) programme to deliver a training framework for the first year of a 1+3 programme. Unlike the ‘taught’ MRes option, this programme would not require a specified DPT of courses, but does require students to submit a more traditional MRes Dissertation at the end of their first year. This Dissertation must be examined under existing research assessment regulations, administered by IGS and College Office. Bids electing to follow this route could informally encourage students to audit taught courses, although must not require these courses as part of the DPT

This option involves registering students onto a PGR programme, admitted in the usual way via a PGR Selector, administering student progress via the existing IGS milestones process and supporting the training element of the bid via a series of workshop type events hosted by industry, IAD.
3 - Taught Programme ['normal' MSc]

This option uses a standard taught MSc, used as a taught first year element of a 1+3 programme. Bids electing to follow this route must provide a 180pts DPT proposal, in line with the School's existing MSc programmes [see: http://www.drps.ed.ac.uk/12-13/dpt/drps_inf.htm], and aim to make best use of the current MSc structure where possible. In order to minimise disruption and make effective use of resources it is anticipated that a new CDT would effectively create a new specialist area, to be delivered to a restricted cohort of students under the existing MSc set up, administered by ITO, examined by the MSc Board of Examiners. Any taught bid may include the proposal of new specialised courses and/or a set of restricted course choice constraints, these would have to operate within the existing regulatory framework of our existing PGT degree programmes, and be approved through the normal procedures. The recruitment and admission of students to the taught first year is an issue; currently College Office admit all MSc students on behalf of the School meaning a CDT might have less control over student selection.

Neil McGillivray
[Revised 18th January 2013]
Notice of Items for Future Meetings

The following proposals are expected to arrive at a future meeting of the Board:

- MSc course prerequisites — Iain Murray

Please contact the proposers if you wish to comment or be involved in preparing these items.