Artificial Intelligence 2 Student Guide, 2004–05

This document describes the administrative arrangements for AI2A and AI2B (the two half courses which constitute AI2). You can find an electronic copy, along with material on the content of the course and its constituent modules, via the course Web page at:

`http://www.inf.ed.ac.uk/teaching/courses/ai2/`

Information in the AI2 Course Guide may be updated from time to time during the year. The definitive version will be maintained on-line on the AI2 web page. Any major alterations will be publicised to the class at the time of amendment.

Large print versions of the course guide and lecture notes are available on request.

Registration

To register for this course, attend the first lecture on Tuesday 21st September at 16:10 in Room G8, 1 George Square (the Neuroscience building). There you will be handed a registration form - once processed, you will then be added to the mailing lists, your tutorial group will be assigned, and your matriculation card will be enabled for the appropriate building access. It is vital that you attend this initial lecture.

Lectures

There are three lectures per week, from 16:10 to 17:00 on Monday, Tuesday and Thursday. The timetable in Section 10 shows these and tells you when the lectures for each module take place. The Monday and Thursday lectures are in Lecture Theatre 3, Appleton Tower, whereas the Tuesday lectures are in Room G8, 1 George Square (the Neuroscience building).

The **required** textbook for the course is *Artificial Intelligence: A Modern Approach, 2nd Edition*, by Stuart Russell and Peter Norvig, published by Prentice Hall. In this guide this is sometimes abbreviated to AIMA.

The textbook will be supplemented by copies of lecture slides and extra information provided through the course Web page as appropriate. Note that while there is required reading in AIMA each week, these readings are intended to support the lectures, not to replace them. You should allocate around 5 hours per week to reading specified sections of the text book and the lecture slides/articles provided.

There are a limited number (6) of copies of the 2nd edition in the library - 3 for short loan (i.e. 1 week) and 3 for standard loan. There are 14 copies of the 1995 edition - 6 standard loan, 5 short loan and 3 on reserve (i.e. for consultation in the library for a 3 hour loan). Students are strongly advised to purchase a copy of the 2nd edition.

Further reading material in the form of books and articles can be found in the University Main Library in George Square.

Practical work

The teaching is supplemented by several assessed practicals. For the purpose of practical work, AI2 students are encouraged to use the machines in the Computer Lab North, Level 5, Appleton Tower, which contains around 40 DICE machines.

1 Module Descriptions

There are four main groups of lectures (we call them "modules") which are run in sequence through the year. Each covers two smaller components called "tasks".

Module 1

Task 1: Using Constraints to Solve Problems

The emphasis here is on using problem constraints to avoid doing search. We consider how important it is to decompose problems into appropriate subproblems. The general notion of a Constraint Satisfaction Problem is introduced, and Constraint Propagation techniques are illustrated. Mechanisms in Prolog (including some simple Constraint Logic Programming techniques) which can be useful for exploiting problem constraints are introduced. Several techniques are illustrated by material on computer vision.

Task 2: Solving Problems by Other Means

Here the "other means" are mainly search methods of one form or another. We consider what search spaces can be like and how they can be visualised, as well as briefly surveying a range of search algorithms and some of their relevant properties. We take logical reasoning as a major example, motivating the tasks of testing validity and satisfiability. We see how different logical formalisations give rise to different kinds of search spaces. For satisfiability, we see that relatively recent stochastic techniques (GSAT) are now competing with older systematic search procedures. This leads to a consideration of stochastic search methods in general.

Module 2

Task 3 : Symbolic pattern matching, reasoning and analysis

We consider Symbolic patterns of reasoning that allow an agent to draw conclusions about what to believe and/or how to act, given what they observe, and to verify the truth of a hypothesis. We will compare the power and complexity of reasoning with basic inference rules, a more complex inference rule called *Generalised Modus Ponens*, and a third rule called *Resolution*.

Task 4 : Analysing complex phenomena

We consider the related problem of how an agent can *analyse* complex phenomena such as sentences, scenes, lines of music, genomes, etc., in terms of arrangements of patterns. We will examine (a) the power of various kinds of patterns and ways of combining patterns (i.e. regular expressions, context-free (CF) languages, and context-sensitive (CS) languages); (b) various forms of ambiguity that can complicate analysis; and (c) how ambiguity is handled efficiently by analysing strings by chart parsing. We link back to **Task 3** by seeing how this analysis allows strings to be mapped into facts and rules that an agent can use in reasoning.

Module 3

Task 5 : Learning from Data

Task 6 : Coping with Incomplete Knowledge

Through the treatment of these two topics, two aspects often needed in Artificial Intelligence are examined: the modelling of problems or situations and the development of algorithmic ideas for solving them. The techniques introduced are general and should be useful in other contexts as well. The syllabus for this module includes:

- machine learning systems, learning as search, decision trees, perceptrons, and neural networks.
- modelling uncertainty, probabilistic modelling using Bayes Nets, and inference and learning in Bayes Nets.

Module 4

Task 7 : Coping with a Changing World

We will look at AI plan formation techniques. We will model the effects of actions in changing the world to meet the goals of agents. A plan is a sequence of actions that take us from an initial situation to a final situation in which an agent's goals are satisfied. We will show how plans can be automatically constructed via a process of reasoning using logical representations of situations, actions and action effects.

Task 8 : Dealing with Other Agents

We will look at logics which have been specifically designed to represent the knowledge of agents. These logics are called *modal* logics. We will show how the plan formation techniques from task 7 can be used plan communicative acts between agents, so that knowledge can be passed from one to another.

2 Assessed Practical Exercises

There will be two pieces of assessed practical work (hereafter called "Practicals") to be handed in for each of the four modules. Details of how to submit each practical will be issued with the practical itself. The deadlines for handing in completed exercises are given below. Each piece of practical work will be marked out of 100. The overall practical mark for AI2A will be calculated as the average of the marks for the four AI2A assessed exercises, and similarly for AI2B.

Teaching assistants may also be present to help demonstrate in some of the assessed practicals. Please refer to the module webpages to see when this help is available.

Many of you will be doing practical work for other courses in addition to the AI2 practicals. It is important that you pace your work so that you don't end up spending all your time on one course, to the detriment of others. As a rough guide, you should spend an average of about 13 hours per week on AI2 of which 3 hours is taken up by lectures and 1 hour by your tutorial.

Submitting AI2 practicals electronically

Please see the site `http://submit.inf.ed.ac.uk` for details.

Practical deadlines

The table below gives the deadlines for submission of AI2 practicals. The instructions for submitting practical work will be issued with the practicals themselves. Submission deadlines for all practicals are at **4pm on Fridays**. If you have a lecture at this time, you must hand in your practical before the lecture. Marked practicals normally will be returned to you by the ITO.

Practical	Set by	Deadline
A1	Bob Fisher	Friday 15 Oct (Week 4)
A2	Bob Fisher	Friday 5 Nov (Week 7)
A3	Bonnie Webber	Friday 19 Nov (Week 9)
A4	Bonnie Webber	Friday 3 Dec (Week 11)
B1	Mark Steedman	Friday 28 Jan (Week 3)
B2	Mark Steedman	Friday 18 Feb (Week 6)
B3	Alan Bundy	Friday 11 Mar (Week 9)
B4	Alan Bundy	Friday 25 Mar (Week 11)

Late submission of AI2 practicals

The deadlines given above are hard, and late work will not be accepted except in exceptional circumstances and with the prior approval of the course organizer. AI2 does *not* have a system of first and final deadlines.

There must be a genuine reason for a late submission to be allowed. If you are ill or have some other serious problem in meeting a deadline, you should contact the course organiser in good time to request an extension. Depending on the circumstances, support from your Director of Studies may be required for an extension request to be granted.

Retaining your practicals after they have been marked

Marked coursework that is returned to you must be retained throughout the year and resubmitted at the end of the year, in case the Board of Examiners wishes to examine it. Details of how and when to resubmit coursework will be given at the end of the AI2 lecture series.

3 Tutorials

There are tutorials every week in both semesters, beginning in the second week of the each semester. After registering for the course you will be assigned to a weekly tutorial group; you will then be able to find out which group you are in, and when and where it meets, via the course Web page. Occasional changes to the time and place of your tutorials may be necessary in some weeks.

Each week a tutorial assignment will be issued consisting of You are expected to work on the tutorial assignment *before* you come to the tutorial. **Experience has shown that students who don't attend or don't prepare for tutorials do poorly or even fail the course.** If someone misses two consecutive tutorials we will become worried that they are falling behind in the course and will send formal letters to you and to your Director of Studies to find the cause of the problem. Please avoid false alarms by attending tutorials regularly or, if you have to miss one for a good reason, arranging this with your tutor in advance.

4 Degree examinations

The AI2A exam (which is a two-hour paper) takes place during the period 6–18 December, and covers Modules 1 and 2. The AI2B exam (which is also a two-hour paper) takes place during the period from 18 April to 27 May, and covers Modules 3 and 4. You will be required to answer questions from each module. Full course AI2 students sit both the AI2A and AI2B exams. The precise dates of the exams will be published by Registry later in the year.

5 Problems

All sorts of problems can arise in a large course like AI2. The main thing to remember is that you shouldn't let niggling worries fester until they become major crises - talk to your tutor or the course lecturers. If in doubt, talk to the course organiser. You should also be aware of the University codes of practice and regulations as detailed at

`http://www.registry.ed.ac.uk/Student_Information_Pages/Codesofpracticeandregulations.pdf`

(this also contains information on complaints procedures), and the University code of practice for dealing with personal harassment as detailed at

`http://www.registry.ed.ac.uk/Student_Information_Pages/Harassment.pdf`

6 Illness

If you are ever ill for some substantial period (say more than a week), you should get a medical certificate from your doctor and give that to the course secretary (Marie Hamilton). For short illnesses of less than a week, a note from your Director of Studies will suffice. We can then argue for an extension of practical deadlines, as appropriate, at the Board of Examiners meeting which decides your final mark at the end of the year. If you become ill for a long period then try to get word to us as soon as possible so that we can try to avoid any problems caused by a prolonged absence.

7 Feedback mechanisms

At the start of the course you have the opportunity to elect two class representatives who have the job of representing your interests, both personally with the course organiser and publicly at the AI2 staff-student liaison (SSL) meetings (held once for each half course). You may also occasionally be invited to attend the School of Informatics Teaching Committee meetings, which are held about twice per term and are the major public forum for discussing teaching policy in the School.

Another way in which you can make your opinions known is by filling in the questionnaires which will be made available to you at the end of each half course.

8 Extra Prolog tutorials

Some students struggle somewhat with Prolog. To address this, extra tutorials have been set up that students may wish to attend if they feel they need extra help with Prolog. It may be that your lecturer recommends that you attend such sessions.

The tutorials will take place on Mondays at 10:00–10:50am in the Faculty Room North, David Hume Tower, beginning in Week 2 (Monday 27 September), for the first semester at least. Please contact the tutor, Aroosha Laghaee (`a.laghaee@sms.ed.ac.uk`) if you have any questions regarding the tutorials.

9 Bulletin Board

Under the AI2 course website is a link to a Bulletin Board. This is intended for students to contact each other easily and exchange ideas and information. Please be considerate in your usage and be aware that the board may be monitored.

10 Lecture timetables

Below are the timetables for lectures for each half course, also showing the topic of each week's tutorial assignment. Note that Monday and Thursday lectures are in Lecture Theatre 3, Appleton Tower, whereas Tuesday lectures are in Room G8, 1 George Square (the Neuroscience building).

AI2A timetable

Week	w/c	Monday	Tuesday	Thursday	Tutorial topic
1	20 Sept	holiday	Intro (jrl)	Task 1	–
2	27 Sept	Task 1	Task 1	Task 1	Task 1
3	4 Oct	Task 1	Task 1	Task 1	Task 1
4	11 Oct	Task 2	Task 2	Task 2	Task 2
5	18 Oct	Task 2	Task 2	Task 2	Task 2
6	25 Oct	break	break	Task 2	Task 2
7	1 Nov	Task 3	Task 3	Task 3	Task 3
8	8 Nov	Task 3	Task 3	Task 3	Task 3
9	15 Nov	Task 3	Task 4	Task 4	Task 3
10	22 Nov	Task 4	Task 4	Task 4	Task 4
11	29 Nov	Task 4	Task 4	–	Task 4

Monday 20 September (the first day of the University's new semester system!) is a public holiday. There is a mid-semester break from Sat 23 Oct to Tues 26 Oct.

AI2B timetable

Week	w/c	Monday	Tuesday	Thursday	Tutorial topic
1	10 Jan	Task 5	Task 5	Task 5	–
2	17 Jan	Task 5	Task 5	Task 5	Task 5
3	24 Jan	Task 5	Task 5	Task 5	Task 5
4	31 Jan	Task 6	Task 6	Task 6	Task 5
5	7 Feb	Task 6	Task 6	Task 6	Task 6
6	14 Feb	Task 6	Task 6	Task 6	Task 6
7	21 Feb	Task 7	Task 7	Task 7	Task 7
8	28 Feb	Task 7	Task 7	Task 7	Task 7
9	7 Mar	Task 7	Task 7	Task 7	Task 7
10	14 Mar	Task 8	Task 8	Task 8	Task 8
11	21 Mar	Task 8	Task 8	–	Task 8

11 Marking and Requirements

Requirements for passing the course

All Informatics first and second year courses have the same requirements for passing. In order to pass each half course you must satisfy the following requirements:

- achieve at least 35% in the examination;
- achieve a total of at least 25% in practical work (this course guide describes elsewhere how the total practical mark is calculated);
- obtain a combined total mark of at least 40% (this course guide describes elsewhere how the combined total mark is calculated from the examination and practical marks).

For progression to Honours from second year to third year there are further requirements on relevant second year courses which are stated in the University Calendar.

It is important to understand that while there are resits for examinations there are no resits for practical work. Therefore if you do not meet the requirement on practical work the only way to pass the course is to retake it the following year. You will still be able to take the resit examination if you wish but this can only act as a practice run to help you with your reattendance of the course. Note that as usual the requirements can be waived by the Board of Examiners if there are sufficiently strong mitigating circumstances; it is therefore vital that you inform your Director of Studies of any such circumstances.

Checking your progress

In order to succeed in your studies you should keep up with the material of the course and make a good attempt at all the practicals. The requirements stated above represent a bare minumum and do *not* indicate good progress. Your marks for each practical will be returned to you as soon as they are available so that you can (and indeed should) keep your own record.

A	$70 \leq \text{mark} \leq 100$	(CS Honours degree standard)
B	$60 \leq \text{mark} < 70$	(CS Honours degree standard)
C	$50 \leq \text{mark} < 60$	(CS Honours degree standard)
D	$40 \leq \text{mark} < 50$	(CS Ordinary degree standard)
E	$35 \leq \text{mark} < 40$	(Fail)
F	$25 \leq \text{mark} < 35$	(Fail)
G	$0 \leq \text{mark} < 25$	(Fail)

Figure 1: The University-wide marking scale, and its CS2 interpretation

For your convenience and as a means of helping you to check your progress, the ITO will do its best to collect the following information for you at just after half way through each half course and email it to your University sms account:

- the record of your practical marks so far (note that in some cases there might be marks pending for recently submitted practicals);
- the record of submitted practicals.

It is your responsibility to check your sms email account regularly. If for some reason the information does not reach you then ask the ITO either in person or by email (`ito@inf.ed.ac.uk`) quoting your full name, matriculation number and the half course(s) for which you are seeking information.

Requirements for entry to Honours courses

Certain degree programmes require more than a mere pass in AI2A and AI2B in order for you to progress to Honours. For such degree programmes, the requirement for entry to Honours is typically that you should achieve a pass in each half course at Grade C (50%) or above *at the first attempt* (i.e. the first time you sit the exam). **If you fail the exam but get a good mark on the resit, you will be awarded a pass but will still not be able to progress to Honours.** Your Director of Studies will be able to advise you on the precise requirements for entry to Honours on your degree programme.

In exceptional circumstances, the Head of School may give special permission to students not meeting these requirements to continue with Honours courses. It is very important to let your Director of Studies know of any mitigating circumstances (such as prolonged illness) as early as possible so that these may be taken into account.

Marking Procedure

All work in CS2 is assessed according to the Univerity's standard marking scale, see Figure 1.

The two half courses are marked separately. Under normal circumstances, the final mark for each half course is given by the formula:

$$\text{Final mark} = \tfrac{1}{4}\text{ Practical mark} + \tfrac{3}{4}\text{ Exam mark.}$$

However, as explained above, in order to pass you must have an exam mark of at least 35%, and a combined practical mark of at least 25%.

Nota Bene

Whilst there are resits for examinations, there are no resits for practical work. Therefore, if you do not meet the requirement on practical work, the only way to pass the course is to retake it the following year. If you fail because of the practical marks, you will still be allowed to take the resit examination if you wish, but this can only act as a practice run to help with re-attendance of the course. The Board of Examiners will still be able to waive these requirements if there are sufficiently strong mitigating circumstances it is therefore vital to inform your Director of Studies of any such circumstances.

Practicals

When each marked practical is returned to you, it should have the mark allocated by the lecturer on the front. You should regard these marks as provisional, subject to approval by the Board of Examiners when deciding your final mark at the end of the year. All AI2 practicals count equally toward the mean practical mark. Students doing a half course (AI2A or AI2B) do only two modules, while those on the full course (AI2) do all four modules. Any queries concerning the marking of an assessed practical should be addressed to the module lecturer concerned.

Plagiarism

Don't use other people's work and pretend that it is your own. Use of computers makes some kinds of plagiarism easy but don't be tempted. Plagiarism is often easy to detect. The university uses a variety of methods, including both human and automatic checking for plagiarism. If you are caught, the penalty can be severe – you could lose part or all of a practical or even fail the course. The person from whom you copied could also be penalised if they were willing participants to the scheme. If you are in any doubt about what counts as plagiarism then ask us. You should also consult the Informatics guidelines on plagiarism at

`http://www.informatics.ed.ac.uk/admin/ITO/DivisionalGuidelinesPlagiarism.html`

12 Computing Etiquette

Much of the practical work of the course is done on computers and (unless you have access to appropriate facilities elsewhere) you will spend quite a bit of time in the computing labs. The labs are shared, open-plan areas so please be considerate to others by being as quiet as you can. You should also be kind to the computers - in particular, don't eat or drink in the terminal room because we aren't insured against equipment damaged by things like coffee spilled over them. If you ever need to run really large programs, especially if left running as background jobs, then try not to let these degrade the performance of the system too much for other users. The 'nice' program can be used to ensure that big background jobs can run at lowered priority, and the 'polite' program will suspend a big job as long as someone is using that computer's console. We strongly discourage you to lock your terminals for anything longer than a few minutes. The commands 'screen' and 'nohup' can be used to run processes even though you have logged out of the computer.

Feel free to ask demonstrators or our computing staff if you feel that you could be using the machines more effectively. A little extra thought from all concerned is often enough to make everyone's work run a lot more smoothly.

General computing regulations for the University may be found at:

`http://www.ucs.ed.ac.uk/EUCS/regs.shtml`

13 People and places

Name	Job	Location	Phone	Email
Bob Fisher	Teaches Module 1	Room 2107D, JCMB (KB)	651 3441	`rbf@inf`
Bonnie Webber	Teaches Module 2	Room 3R10, 2 Buccleuch Place	650 4190	`bonnie@inf`
Mark Steedman	Teaches Module 3	Room 2R14, 2 Buccleuch Place	650 4631	`steedman@inf`
Alan Bundy	Teaches Module 4	Room 3.09, Appleton Tower	650 2716	`bundy@inf`
John Longley	Course Organizer	Room 2603, JCMB (KB)	650 5140	`jrl@inf`
Marie Hamilton	Course Secretary	Room 5.03, Appleton Tower	650 2706	`mhamilt1@inf`

The ITO office in 5.03 Appleton Tower opens at 9.00am and closes at 5.00pm on working days. It is also **closed** 11.00am – 11.30am, 1.00pm – 2.00pm and 3.30pm – 4.00pm.