Computer Science meets Philosophy

Introducing the Oxford degree in

Computer Science & Philosophy

And why you might want to consider it

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Organisation of this Presentation

1. Links between Computer Science and Philosophy (3)
   a. Logic and Inference
   b. Artificial Intelligence
   c. Morality
   d. Automated thinking and thought-experiments
   e. Examples of the many other connections
2. Explore more on all this at www.philocomp.net (8)
3. Computer Science & Philosophy: what it involves, why it's interesting and fun, and why the world needs it (9)
4. Using computers to model natural and social phenomena – an illustration using Schelling's Segregation Model (21)
5. Find more examples at www.turtle.ox.ac.uk (24)

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(a) Logic and Inference

- LOGIC is central to both Computer Science and Philosophy – invented, extended and analysed by Philosophers; applied throughout Computer Science.
- Oxford modules currently offered include:

Computer Science	Philosophy
Introduction to Proof Systems	Philosophical Topics in Logic and Probability
Logic and Proof	Philosophical Logic
Automata, Logic and Games	Philosophy of Logic and Language

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(b) Artificial Intelligence

- AI is a huge and varied research area within Computer Science, raising a host of philosophical problems about the nature of intelligence, and the possibilities and limits of machine sentience, freedom, responsibility, etc.
- Oxford modules currently offered include:

Computer Science	Philosophy
Artificial Intelligence	Alan Turing on Computability and Intelligence
Knowledge Representation and Reasoning	Philosophy of Cognitive Science
Machine Learning	Philosophy of Mind

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(c) Morality (or Ethics)

- ETHICS is a long-standing focus in Philosophy, but many important new issues have arisen from widespread use of computers – to store and analyse data, to control vital systems, to influence people and society, and to operate robots (from cars, to healthcare machines, to weapons).
- Oxford offers courses on Ethics, Practical Ethics, and – especially designed for Computer Science & Philosophy – Ethics of Artificial Intelligence and Digital Systems.
- We also have a multi-disciplinary Institute for Ethics in AI (website at https://www.oxford-aiethics.ox.ac.uk/). Take a look at the range of AI Ethics posters around the CS Department at the Open Day to get a flavour of the wide range of important issues that arise here.

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(d) Automated Thought-Experiments

- Philosophers since Aristotle have tried to analyse what it is to think rationally.
- Computer Science offers techniques for *automating* rational thinking.
- Computers and the programs they run are like prostheses to the mind …
  - Where information and methods of inference can be captured appropriately, the computer enables us to reason *far more accurately, and much faster, about anything at all!*
  - This provides a wonderful tool for thought-experiments.



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Computer Science meets Philosophy

(e) Some Examples of the Many Other Connections …

- AESTHETICS: Can a computer create genuine art?
- METAPHYSICS: What kind of thing is a program?
- PHILOSOPHY OF MATHEMATICS: Should we accept computer-generated proofs we cannot fully grasp?
- PHILOSOPHY OF SCIENCE: How far should computer simulations (e.g. of global warming) be trusted?
- PHILOSOPHY OF SOCIAL SCIENCE : Can computer models revolutionise the study of Economics and Politics?

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3. The Oxford degree in *Computer Science and Philosophy*

For more on the degree, see

http://www.cs.ox.ac.uk/compphil

http://www.philocomp.net/home/oxford.htm

For questions, email:

undergraduate.admissions@cs.ox.ac.uk

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What to look for in a degree programme

- *Interesting*, with lots of *variety* and *flexibility* (in case you discover 3 years from now that after 2 years of studying *X-ology* in great depth, you really want a change – and many students do!);
- *Empowering*, developing you to maximise your potential in a rapidly-changing world, where you might have to rethink your life plans repeatedly;
- *Economically valuable*, bringing you a wide range of excellent employment opportunities, with high salary *and* great conditions (ideally, using some of the skills you have practised for 3 years or more).

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The Joy of Joint Honours

- There is a hugely enjoyable contrast between:
  - Solving technical problems, finding a "right answer" or creating a program that *does something*.
  - Grappling (often through enjoyable discussion) with deep questions about "Life, the Universe, and Everything".
- *Don't be put off by the prospect of essays*: working out your thoughts on such fascinating topics is very rewarding, and very different indeed from writing school essays! (Schools tend to treat Philosophy as an "Arts" subject, but at university it's *much more* like science than literature.)

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The Super-Flexible Oxford Course in Computer Science and Philosophy

- Year 1 Functional Programming, Imperative Programming, Design and Analysis of Algorithms, Discrete Mathematics, Probability,
  General Philosophy, Philosophical Topics in Logic and Probability, Turing on Computability and Intelligence
- Year 2 50% Computer Science, *50% Philosophy*
- Year 3 25%-75% Computer Science, *25%-75% Philosophy*
- Year 4 0%-100% Computer Science, *0%-100% Philosophy*

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Computer Science meets Philosophy

Applying for CS&P

- Maths and Further Maths A-Level (or Higher Maths in IB etc.) are *strongly recommended*.
  - Apart from that, *do what you like!* Sciences are most common, but Art, Languages, Literature, Music, Religious Studies (etc.) are all fine.
- There's no disadvantage at all if you …
  … have never studied Philosophy before;
  … have only studied "sciences" in the sixth form;
  … are applying for some other subject (e.g. pure CS) at other universities, and hence don't mention CS&P on your UCAS "Personal Statement" – *no problem!*

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Philosophy as an Academic Subject

- The skills required by Maths/Computing and by Philosophy significantly overlap:
  - Analysing hard problems into sub-problems, then linking the solutions to these together in logically watertight ways: this could apply equally to a computer program, or a philosophical argument.
  - Intellectual creativity – thinking through a problem that maybe nobody else has considered before.
- But adding Philosophy brings other – equally important – skills, as well as lots more *variety*, (with plenty of intellectual excitement and fun).

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A Wealth of Fascinating Problems

- Is there a God (and how can we know)?
- What is it for something to be "right" or "wrong"?
- What is the basis of political obligation?
- Are we "free", and does it matter?
- Is mathematics just a product of human thought?
- Do the paradoxes of modern physics matter?
- Could a machine think, or be free, responsible … ?
- Can we trust science (e.g. of health or climate change)?
- Are artistic judgments merely subjective?
- … *(etc. through all the disciplines)* …

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Will I Enjoy Philosophy?



- There are lots of excellent books that you can dip into, for example Stephen Law's *Philosophy Gym*.
- If you'd like to sample some Oxford lectures, Peter Millican's 2018 *General Philosophy* lectures are available at:
  http://podcasts.ox.ac.uk/series/general-philosophy-2018

  Or find this link (and lots of other relevant videos including lectures and talks on Alan Turing) at:
  www.philocomp.net/videos.htm

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A Brilliant Combination for Both Study and Employment

- Computers are being increasingly applied to almost every new area of study and thought …
  - This requires *intellectual flexibility* and *imagination*, as well as technical skill.
  - Studying Philosophy is ideal for developing the ability to think "outside the box".
- Technical skills are not enough for high-level management positions …
  - Philosophy teaches you to *synthesise written material*, to *argue and present a case*, *understand other points of view*, to *write good reports,* etc.

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The Employers' View of *Computer Science and Philosophy*

"We believe that the degree is likely to produce high-value graduates who combine technical and analytical skills with rhetorical and literary skills. These are just the kind of people that industry, and we believe society generally, wants. The degree will produce graduates who can potentially become members of executive boards of companies, where clarity of thinking combined with knowledge of technology issues will be vital. … It will also produce software engineers with the skills to analyse, and intelligently explain and document, complex problems. We believe that the new degree is likely to excite and attract strong, ambitious candidates."

Oxford Computer Science External Advisory Board

(see www.philocomp.net for more)

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Computer Science meets Philosophy

A Multitude of Problems to Solve

- Consider, for example:
  - Climate change, ecosystem stress, famine, mass migrations; cultural conflicts (e.g. racial or religious), political instability, crises of authority, economic instability; healthcare crises, drug resistance, epidemics.
- Add to these some specific AI risks:
  - Economic polarisation (from domination of "big tech" business, automated financial trading etc.); Political manipulation (from money, targeted advertising, etc.); Widespread unemployment (as people lose economic value to computers, self-driving cars, and robots etc.). For more on all this, visit https://podcasts.ox.ac.uk/series/futuremakers.

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Not "Business as Usual"

- These new problems require a generation of thinkers who can *both* understand the relevant technologies, *and* think creatively "outside the box" to help find new solutions.
  - Philosophers specialise in this sort of creative, critical thinking about standard assumptions; and much of the modern world has built on their ideas (e.g. moving from the medieval to the scientific world-view, from religious authority and "divine right of kings" to democracy etc.).
  - But modern problems are so complex, that future philosophers will need AI to help solve them!

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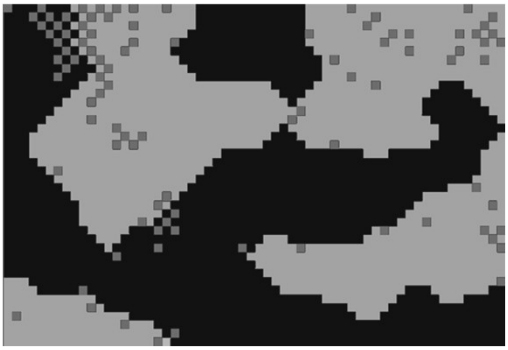
4. Using computers to model natural and social phenomena

- Mechanising deduction allows a novel form of investigation, where we:
  - Formally define some set of rules;
  - Implement those rules in a computer program;
  - Run the program to apply the rules entirely *mechanically* (hence *enforced honesty*);
  - See what happens, and use the outcome to inform our refinement of the rules.
- This combines *deductive* "reasoning" with *experiential* discovery and investigation.

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Schelling's Segregation Model



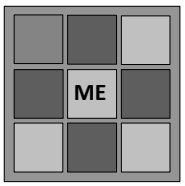
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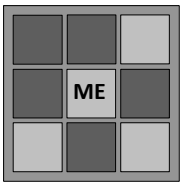
How the Model Works

A 60 x 40 grid with 100 random green spaces, but blues and reds evenly distributed everywhere else. Individuals are "unhappy" – and therefore attempt to find a green space they can move to where they will be "happy" – if the other colour has a majority of 2 or more amongst their neighbours:

Happy:



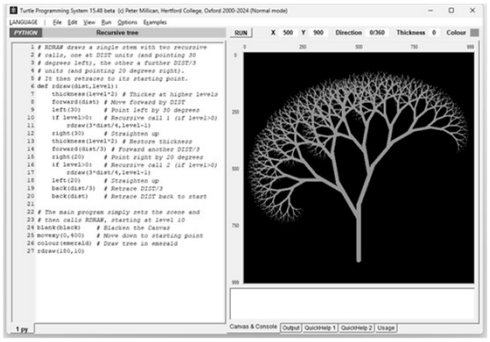
Unhappy:



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Explore This and Other Interesting Models at www.turtle.ox.ac.uk



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