Recommended reading & activities

Prospective undergraduate students

For prospective undergraduate students, or those just wanting to learn a bit more about what Computer Science is really about, we encourage you to read any relevant materials that you find interesting. Some examples are provided below to get you started.

BOOKS

Your local library should be able to help with many of the books listed:

- ***Computational Fairy Tales*** by Jeremy Kubica. ISBN: 978-1477550298 - a romp through the principles of computational thinking, illustrating high-level computer science concepts, the motivation behind them, and their application via the medium of a fairy tale. Aimed at secondary school students. "Bonkers, but very enjoyable."
- ***Artificial Intelligence: A Ladybird Expert Book*** by Michael Wooldridge. ISBN: 978-0718188757 Written by our Head of Department, this book "…chronicles the development of intelligent machines, from Turing's dream of machines that think, to today's digital assistants like Siri and Alexa."
- ***Once Upon an Algorithm: How Stories Explain Computing*** by Martin Erwig. ISBN: 978-0262036634. Concepts in Computer Science explained through familiar stories such as Hansel and Gretel, Sherlock Holmes, the movie Groundhog Day, and Harry Potter.
- ***Computer Science: An Overview*** by J. Glenn Brookshear. ISBN: 978-0321544285 - overview of what computer science is all about: each topic is presented with its historical perspective, current state, and future potential, as well as ethical issues.
- ***Code: The Hidden Language of Computer Hardware and Software*** by Charles Petzold. ISBN: 978-0735611313 - "What do flashlights, the British invasion, black cats, and seesaws have to do with computers? ...see how ingenuity and our very human compulsion to communicate have driven the technological innovations of the past two centuries."
- ***Out of Their Minds*** by D Shasha and Cathy Lazere. ISBN: 978-3540979920 - the lives and discoveries of fifteen unsung computer scientists whose programs have helped people from factory owners to cartoonists.
- ***The Pattern on the Stone: The Simple Ideas That Make Computers Work*** by Daniel Hillis. ISBN: 978-0465025961 - explains the basic concepts of the computer in everyday language.
- ***The Information: A History, a Theory, a Flood*** by James Gleick. ISBN: 978-0007225736 - a chronicle that shows how information has become "the modern era's defining quality - the blood, the fuel, the vital principle of our world."
- ***Outnumbered: From Facebook and Google to fake news and filter-bubbles – the algorithms that control our lives*** by David Sumpter. ISBN: 978-1472947413. An applied mathematician takes a look at what algorithms are doing with our data and how they are changing our lives.
- ***AI: Its Nature and Future*** by Margaret A Boden. ISBN: 978-0198777984. "…reviews the philosophical and technological challenges raised by Artificial Intelligence, considering whether programs could ever be really intelligent, creative or even conscious, and shows how the pursuit of Artificial Intelligence has helped us to appreciate how human and animal minds are possible."
- ***The Pleasures of Counting*** by Tom Kôrner. ISBN: 978-0521568234 - puts Maths into the context of how it is used to solve real-world problems.

- ***The Code Book by Simon Singh***. ISBN: 978-1857028898 - not strictly about Computer Science, but an interesting introduction to code-breaking and cryptography, fields that have a strong connection to Computer Science.
- ***Closing the Gap: The Quest to Understand Prime Numbers*** by Vicky Neale. ISBN: 978-0198788287. Oxford Mathematician Vicky Neale looks at recent progress towards resolving the long-standing Twin Primes Conjecture, including exciting work done as part of huge online collaborations such as the Polymath Projects.
- ***Algorithmic Puzzles*** by Anany Levitin and Maria Levitin. ISBN: 978-0199740444 - "... The emphasis lies in training the reader to think algorithmically and develop new puzzle-solving skills: the majority of puzzles are problems where we are asked to find the shortest distance or the fewest moves to get from A to B, or construct a proof that a puzzle has no solution ..."
- ***The New Turing Omnibus*** by A Kee Dewdney. ISBN: 978-0805071665 - mini articles on Computer Science topics.
- ***Hello World:*** How to be Human in the Age of the Machine by Hannah Fry; Black Swan, 2019. "...a tour of the good, the bad and the downright ugly of the algorithms that surround us."
- ***The Road to Conscious Machines:*** The Story of AI by Michael Wooldridge; Pelican, 2021. "...elucidates the discoveries of its greatest pioneers from Alan Turing to Demis Hassabis, and shows us what today's AI researchers actually think and do. AI appeals to fundamental questions about what it means to be human; so too do the failures and limitations of its past."
- ***Hidden Figures:*** The American Dream and the Untold Story of the Black Women Who Helped Win the Space Race by Margot Lee Shetterly; HarperCollins, 2016. The story of NASA's African-American female 'Human Computers'.
- ***Computing with Quantum Cats:*** From Alan Turing to Teleportation: From Colossus to Qubits by John Gribbin; MIT Press, 2015. Pioneering study of the science behind quantum computing and what the new quantum reality will mean for mankind.
- ***Alice in Puzzle-Land*** by Raymond M.Smullyan;Dover Publications Inc., 2011. Characters from Alice's Adventures in Wonderland and Through the Looking-Glass populate these 88 intriguing puzzles. Mathematician Raymond Smullyan re-creates the spirit of Lewis Carroll's writings in puzzles involving word play, logic and metalogic, and philosophical paradoxes. Challenges range from easy to difficult and include solutions, plus 60 charming illustrations.

WEBSITES, BLOGS, MAGAZINES, ETC

- **CS4FN** (www.cs4fn.org) (Computer Science for Fun) is a magazine on computer science aimed at school students "Explore how computer science is also about people, solving puzzles, creativity, changing the future and, most of all, having fun." It is printed twice a year and has an associated website with additional articles.
- **Computer Science Unplugged** (csunplugged.org) - a Computer Science curriculum for pre-university students developed in New Zealand.
- Free, online lectures and courses from Academic Earth (www.academicearth.org/subjects/computerscience). You may find the maths section interesting as well as the Computer Science one.
- **BBC's Make IT Digital initiative** (www.bbc.co.uk/makeitdigital).
- Making sense of artificial intelligence This A-Z guide offers a series of simple, bite-sized explainers to help anyone understand what AI is, how it works and how it's changing the world around us.

- **The A-Z of AI - Computational Thinking** (https://www.cs.cmu.edu/~15110-s13/Wing06-ct.pdf) by Jeannette Wing of Carnegie-Mellon University - It represents a universally applicable attitude and skill set everyone, not just computer scientists, would be eager to learn and use.

MATHEMATICAL ACTIVITIES

Computer Science is a mathematical subject, and we are looking for students who enjoy mathematics as well as computing. Here is a selection of resources which may help you to develop your abilities in this area.

- **The United Kingdom Mathematics Trust** offers a range of Challenges and Olympiads for UK students, and also publishes books on mathematical problem-solving: www.ukmt.org.uk
- **Art of Problem Solving Resources**: https://artofproblemsolving.com/resources
- **Underground Mathematics**: https://undergroundmathematics.org
- **Nrich**: https://nrich.maths.org/
- **STEP Support Programme**: https://maths.org/step/ [Note: we don't require our applicants to take STEP, and we don't make it part of our conditional offers. But the STEP Support Programme can help you to develop your problem-solving skills, and that's useful even if you're not taking STEP.]
- **Numberphile videos**: www.numberphile.com
- **Chalkdust magazine**: http://chalkdustmagazine.com/
- Blogs, videos and books by Alex Bellos: www.alexbellos.com
- Vicky Neale's homepage: http://people.maths.ox.ac.uk/neale/index.html
- ***Oxford Mathematics Alphabet*** (www.maths.ox.ac.uk/about-us/life-oxford-mathematics/oxford-mathematics-alphabet).
- ***3Blue1Brown****: YouTube channel* *https://www.youtube.com/channel/UCYO_jab_esuFRV4b17AJtAw*
- ***Python Challenges page*** https://www.chch.ox.ac.uk/admissions/python-challenges-page

FOR A YOUNGER AUDIENCE

These activities are a great way to start your first steps into Computer Science if you're 12 or younger.

- *Just Add Imagination* – Fire up your 7–11 year old's imagination. www.oxfordsparks.ox.ac.uk/node/1154
- ***Scratch*** is a programming language and online community where you can create your own interactive stories, games and animations. scratch.mit.edu (Great for an older audience too)

SOME PRACTICAL ACTIVITIES

Don't forget: programming goes far beyond creating web pages, so don't restrict your reading and practical experimentation to this one area.

- You may like to look at our GeomLab website (www.cs.ox.ac.uk/geomlab) which will introduce you to some of the most important ideas in computer programming in an interactive, visual way through a guided activity.
- **The Turtle System** (www.turtle.ox.ac.uk) is a graphics programming environment designed to provide an enjoyable introduction to programming in Java syntax, together with a practical insight into fundamental concepts of computer science such as compilation and machine code.

- **The Alice system** (www.alice.org) from Carnegie Mellon University provides a point-and-click environment for designing 3-D animations and is a useful introduction to object-oriented programming.
- **Elizabeth** (www.philocomp.net/ai/elizabeth.htm) is an automated conversation and natural language processing program that provides an enjoyable introduction to natural language processing, and that can give insights into some of the fundamental methods and issues of artificial intelligence within an entertaining context.
- **Codecademy** (www.codecademy.com) providers a fun introduction to programming.
- **Young Rewired State** (www.yrs.io) is a series of collaborative hacking events for under 18s. It brings together young developers to build web and mobile applications that attempt to solve real world problems.
- **Project Euler** (projecteuler.net) is a series of challenging mathematical/computer programming problems.
- Female prospective students (and their teachers) might be interested in the work of the National Centre of Women and Information Technology (www.ncwit.org).
- **The British Informatics Olympiad** (www.olympiad.org.uk) is a national computer programming competition for British Schools and Colleges.
- **CodeClub** (www.codeclub.org.uk) is an after school activity for children.
- **UK Bebras Competition** (www.bebras.uk) – A problem solving competition for years 2 – 13, with a focus on computational and logical thinking, designed to get students excited about computing and computational thinking. It does not require any preparation for the contest. The competition is completed online in schools, and registration takes place through school coordinators.
- **Khan Academy** (www.khanacademy.org/partner-content/pixar) - Pixar in a Box is a behind-the-scenes look at how Pixar artists do their jobs. You will be able to animate bouncing balls, build a swarm of robots, and make virtual fireworks explode.
- **Cyber Discovery** (www.joincyberdiscovery.com) – an extracurricular cyber security learning programme for Y10–13 students from across England.

Candidates with offers

The following are suggestions for summer reading once you've been offered a place on an Oxford undergraduate Computer Science course (including joint honours courses). You do not necessarily need to purchase these – your local library can probably help, and there will be copies available in your College library once you get to Oxford.

- A functional programming book:
  - *Programming in Haskell* by Graham Hutton. ISBN: 978-0521692694 OR
  - *Introduction to Functional Programming using Haskell* by Richard Bird (2nd edition). ISBN: 978-0134843469

  The first is more accessible but the second covers more areas relevant to the Oxford Computer Science degrees. These books are intended to be challenging so please don't worry if you find them difficult. Richard Bird's book is the set text for the Functional Programming (www.cs.ox.ac.uk/teaching/courses/2017-2018/fp/) course that you will take in your first term: during this course you will have the benefit of tutorials and lectures to help your understanding, not just the text book in isolation.

- A background text on discrete Maths, for example one of these (there are many others):

- *Discrete Mathematics* by Kenneth Ross and Charles Wright (5th edition). ISBN: 978-0130652478
- *Discrete Mathematics* by A Chetwynd and P Diggle. ISBN: 978-0340610473
- *Discrete Mathematics for Computing* by Peter Grossman (3rd edition). ISBN: 978-0230216112

plus the useful *Mathematics for Computer Science Facts & Formulae* leaflet available free from the Maths, Stats & OR Network, which contains common formulae and information on mathematical topics that are particularly relevant to Computer Science, including sets and Venn diagrams, set algebra, logic, truth tables, binary relations, complexity functions, and combinatorics. (www.mathcentre.ac.uk/resources/uploaded/43799-maths-for-computer-sci-ff-for-web.pdf)

- A study skills guide:
  - *The Sciences Good Study Guide* by Andrew Northedge, Jeff Thomas, Andrew Lane and Alice Peasgood. ISBN: 978-0749234113

Students without Further Maths

Although an A-level in Further Maths is not a requirement for studying Computer Science at Oxford, it is recommended. If you have only studied a single A-level in Maths, it would be helpful for you to do some preparatory work particularly focusing on discrete Maths and logical thinking, before coming up in October. Please see the free resources from the Oxford University Mathematical Institute (www.maths.ox.ac.uk/study-here/undergraduate-study/how-apply/single-level)

Other useful texts:

- *How to Prove It: A Structured Approach* by Daniel Velleman. ISBN: 978-0521446631

- *Algorithmics: The Spirit of Computing* by David Harel. ISBN: 978-0321117847 – the concepts, ideas, methods and results fundamental to Computer Science, in a way that is independent of the details of specific computers, languages, etc.

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