

Computer Science Degrees

Computer Science degree courses all require good mathematical skills, however the extent of the mathematics required will vary depending upon the topics in which you choose to specialise. On some courses you will be taught the mathematics required during your first year, although for other courses some mathematical knowledge may be assumed. In both cases, having studied mathematics at A-level will be beneficial as is reflected by the fact that 40% of computer science courses either require or prefer students to have taken A-level Mathematics.

"The modern world depends on technology for everything from the financial markets to your weekly shop, and a good computer science degree will teach you all you need to know to create the next generation of technology and beyond. Computer science would suit you if you like to solve puzzles, enjoy mathematics at school and want a degree that involves technology and creative thinking, with a good blend of practical and theoretical work."

Robert Harle and Alastair Beresford, Computer Laboratory, University of Cambridge

<http://www.independent.co.uk/student/into-university/az-degrees/computer-science-754571.html>

Overview of Mathematics covered in Computer Science Degrees

Whilst the mathematical content varies from course to course, the following are some examples of mathematics you may encounter: -

In A-level Mathematics		
Core Modules	Statistics Modules	Decision Modules
Calculus Vectors	Probability Statistics	Graph Theory
In A-level Further Pure Mathematics Modules		
Complex numbers Matrices		

Material not met at A-level but which would benefit from A-level mathematics

Vector Calculus

Combinatorics

Propositional and predicate calculus

Logic

Set theory

Abstract Algebra (including groups and fields)

How is Mathematics used in Computer Science?

To give some examples of why mathematics is important for computer science consider the following examples: -

Computer Games

Consider writing a simple 2D pool game. When you hit the ball how do you know the angle at which it will bounce off of a cushion? How does the strength at which the ball is hit affect how far it will go? What impact does the direction the ball is spinning have on what happens when the ball hits a cushion? Or another ball? The answers to all of these questions lie in mathematics. And of course this is just in 2D - even more advanced mathematics is needed in programming 3D games.

Cryptography and Internet Security

Mathematics is essential to modern cryptography. There are many examples we could have chosen to illustrate this but we limit ourselves to the following two: -

1. Public key cryptography (the technology that allows you to send a message to someone without meeting beforehand to agree a secret key) is now essential to our everyday lives. Without public key cryptography we would not have internet commerce as we could not securely send payment details to companies.
2. Perfect forward secrecy is a the technology which if implemented essentially means that if your password is compromised that past communications you have made cannot be decrypted. While the mathematics needed to understand this is beyond the scope of A-level Mathematics but is built upon the foundations laid in A-levels.

If this is an area in which you have an interest you should strongly consider A-level mathematics, and possibly also further mathematics.

Useful Links and Recommended Reading

Computer Science for Fun (<http://www.cs4fn.org/>)

A site developed by Queen Mary University of London to highlighting the fun and exciting side of computer science. Many of the example on this site involve some mathematics

Security Now (<https://www.grc.com/securitynow.htm>)

A weekly podcast about computer security. This long standing show has been running for over 10 years and during this time has, among other things, covered much of the mathematics behind modern computing, the internet and cryptography.

The Use of Mathematics in Computer Games (NRICH) (<https://nrich.maths.org/1374>)

An article showing where mathematics is important to first person shooters, strategy and simulation games

An Introduction to Computer Programming and Mathematics (NRICH) (<https://nrich.maths.org/6873>)

An article introducing some basic mathematics and programming concepts in C++.

National Cipher Challenge

(http://www.southampton.ac.uk/maths/outreach/activities/national_cipher_challenge.page)

An annual cipher challenge from the University of Southampton.

The Alan Turing Cryptography Competition

(http://www.maths.manchester.ac.uk/cryptography_competition/)

An annual cipher challenge from the University of Manchester.

Coding Links (<http://www.mei.org.uk/coding>)

A page of fun and useful links from MEI relating to coding.