

## Undergraduate Admissions for Computer Science (UK)

### Personal Statement Exercise January 2021

#### Background

The University of Bath typically seeks to recruit 120 UK students each year into our Computer Science degrees (which include the joint degree in Computer Science and Artificial Intelligence and a new single honours degree in AI) and a further 25 students in the joint degree in Computer Science and Mathematics. In 2020 there were around 1260 UK applications for all the Computer Science programmes, and there has been steady growth in application numbers; over the last three admissions cycles we have seen a 29% increase in UK applicants for the Computer Science degrees, and this trend appears to be continuing for 2021 entry.

Selection for the programmes in Computer Science is highly competitive, with around 50% of applicants receiving an offer. All offer holders will be required to achieve the equivalent of an A grade in A-level Mathematics (HL 6 in either Maths course for the International Baccalaureate, D3 in the Pre-U). A-level or equivalent Physics and/or Computing strengthen an application as does Decision Maths modules within A-level Maths/F Maths.

Selection is primarily made through an assessment of the UCAS application, including prior academic record and subject mix for post-16 studies. The personal statement should demonstrate enthusiasm for studying the chosen degree and might include relevant reading, voluntary or work experience, hobbies or other relevant extra-curricular and co-curricular activities. Candidates who undertake MOOCs (Massive online open courses), have developed their knowledge of programming languages (C+ and C++) and have coding experience, and who have participated in initiatives such as Project Euler, Codecademy, or engaged with relevant TED talks will be strongly preferred.

All of our our Computer Science degrees provide the opportunity for up to a year on a placement or internship, or to undertake an integrated Masters course. No distinction is made at the point of admission if a student is applying for a placement or Masters as students have up until the end of the first year of their degree to decide which options they wish to follow.

Candidates need to show a strong performance in Mathematics as part of their entry qualifications. We prefer applicants who can demonstrate evidence of logical and analytical thinking such as through the study of decision Mathematics, Computing or science subjects. Applicants who have previously studied Computing will be particularly positively viewed. This does not need to have been through achievement of a qualification in the subject but could be demonstrated through super-curricular activities or project work such as an EPQ.

A typical offer requires a student to achieve A\*AA at A-level, with a minimum of an A grade in A-level Mathematics. For the IB we require 36 points overall, with HL766 (including a 6 in either HL Maths course). Pre-U applicants need to achieve D2,D3,D3 (including D3 in Mathematics). A BTEC applicant will need to achieve DDD in the Computing or IT RQF version, plus an A in A-level Mathematics. Ideally a BTEC applicant will have taken modules in data modelling, software testing, object-orientated programming, systems analysis and systems design. Candidates taking a mix of qualifications will also be considered (e.g. two A-levels with BTEC National Extended certificate) as well as candidates taking the Access to HE Diploma.

Bath particularly values project-based qualifications, so a student completing an EPQ an achieving an A, or the Welsh Baccalaureate skills challenge certificate who achieves a B grade will have their offer reduced by one A-level grade.

## **The Task**

You have been provided with four personal statements, and additional information drawn from the candidate's UCAS application (prior and current academic qualifications, material from the reference, contextual information on socio-economic and educational disadvantage). One application is outstanding and receives an offer. Three are borderline for an offer; one receives an offer, one is considered for an alternative offer in Computer Systems Engineering, and one does not receive an offer.

You have 20 minutes to decide which applicant receives which of the four possible offers.

**If you want a copy of the solution for this activity please contact me at the e-mail below.**

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## Candidate A

I started programming at age 10 with Python and by creating simple HTML websites. Soon I wanted to create a website where a user can login, so I learnt PHP by reading "PHP for the web" by Larry Ullman. I found that with PHP, the code can get very complex as most of the server-side code is in the same file as the client-side code which was when I discovered Representational State Transfer Application Programming Interfaces (REST API) which allowed the frontend codebase to be separate from the backend. This allowed for more freedom of choice for languages and allowed me to create more modern Single Page Applications with frameworks such as React, Vue, and my favourite, Svelte which compiles into plain JavaScript allowing for very small runtime code.

I first built an API with Python by using Flask, but I soon started to use Node.js as it meant that I could use JavaScript for both client-side and server-side. By using Node.js and Svelte, I have been building an open-source livestreaming platform which allows user to host their own "instance" giving full control of their data. The main issue I had to tackle was reducing bandwidth as much as possible to reduce strain on servers. I solved this by implementing a peer-to-peer video player where users will receive the stream via the viewers that have already downloaded the stream from the server, reducing bandwidth significantly. Having realised the real-world limitations of Node.js, such as it being single threaded, I decided to build a simple cryptocurrency in multiple languages to see which one I preferred. I found that Java was well structured, but it was very resource intensive even on simple tasks, while Rust was too low level and web frameworks like Rocket were too early in development to rely upon. I decided to learn Go as it was very efficient on resource usage and is designed in a way that projects are well organised. I found reading "Mastering Go" by Mihalis Tsoukalos and following blog posts a very effective way of engaging in the language.

After developing numerous websites, including one which taught my peers Python, earning me a Headmaster's Award, I realised the importance of being protected against common threats. Vulnerabilities, such as 'cross-site scripting (XSS)' and 'SQL injections', often go undetected as there are a multitude of techniques that can be used to exploit them. I found HackTheBox and TryHackMe, which teach penetration testing by challenging you to break into vulnerable servers, highlighting the importance of keeping software up to date. During an online internship, I experienced a professional demonstrate a realistic scenario. Many real-life examples of exploits are described in "Ghost in the Wires" by Kevin Mitnick such as how the employees are the main security risk as they can easily become victims of social engineering. For example, an attacker would send an email or place a call to an employee posing as a fellow colleague (known as phishing) with the hopes of gaining access or information. This normally works as employees, believing that they are helping a colleague, let down their guard.

I achieved a Gold Award in a recent programming challenge involving cryptography, which allowed me to utilise what I have learnt in Further Maths and Physics. These subjects also open endless opportunities such as building a neural network or simulating complex mathematical models. Economics enables me to understand further economic developments in countries, which could have a large influence on the computing world such as China developing their own cryptocurrency "E-Yuan".

My participation in the Adventure Education program has taught me invaluable leadership skills and has led me to become the Chief Instructor of the program. Working in a team is vital in the technology sector.

Studying computer science will help me to widen my knowledge and understanding further in a world where the demand is ever increasing with more and more connected devices.

## **Candidate A Background**

The applicant is attending a high-achieving independent school for both GCSE and post-16 studies.

Additional learning support has been provided to the student since the start of their Sixth Form courses; a statement on additional needs is pending.

Subject teachers commend the student's attention to detail, with strong problem solving skills. They show a willingness to move outside their comfort zone with their work and are a highly independent learner. They show competency in their use of mathematics across all of their subjects. The applicant is a very active participant in the school's Outdoor Education programme, particularly as a canoeist and mountain biker. The student has worked particularly well during remote learning, remaining very focused and on-task.

Computer Science is not available as a subject at the school.

The student's home postcode puts them in the most advantaged quintile for progression to higher education, and the second most advantaged quintile in the indices of multiple deprivation.

Pending Subjects:

Pre U Further Maths (D3), Pre U Mathematics (D2), Pre U Economics (D3), A-level Physics (A)

Existing Subjects:

Additional Maths (FSMU) – C

GCSE: 8 (Mathematics, Physics), 7 (Latin, Biology, French, English), 6 (Chemistry, Geography), 4 (Chinese)

## Candidate B

Computer Science provides an opportunity to explore and innovate in a limitless field. Programming is key to solving the undiscovered, "to solve problems that did not exist before" (Bill Gates) whilst enhancing the solution with your own creativity and innovation. For this reason, I want to pursue a degree in Computer Science, delving into new challenges and deepening my knowledge with the drive to become a Software Developer.

I have always had a passion for programming and I explore this by working on tutorial sites such as Codecademy, using it as a foundation to develop complex projects. This led into learning the basics of C++ programming: taking full advantage of its object-oriented nature with encapsulation and data hiding, and its closeness to the hardware level when programming with it. Using my studies in Further Mathematics and knowledge in C++, I applied this into a project using OpenGL4, an Application Programming Interface that interacts with the Graphics Processing Unit to render 2-dimensional and 3-dimensional graphics. The project included setting up an environment, and adding features such as shaders, textures, and virtual cameras. This showed me new and innovative ways on how you can take advantage of pre-existing libraries such as GLEW and GLFW to assist in quicker, robust and efficient programming. I hope that during my time at university, I can expand upon my work into the fields of 3D graphics and API design.

For my A-Level Computer Science NEA Project, I chose to create a Hotel Management System in Visual Basic. In preparation, I read "Learning to Program in Visual Basic" by S Langfield and Microsoft's documentation on Visual Basic which were both invaluable to the success of my project. I created a sophisticated plan to gain a clear picture of the scope of the program, that I then iterated based on my client's feedback. The program stores and manages the hotel's booking details, customer details, and more, taking advantage of iterative loops and classes. The data is stored into a normalised relational database, created, and queried using the declarative language, SQL (Structured Query Language). Through this project, I have gained 3 core skills. One being time management, as I had to meet multiple deadlines. Second being listening, as I worked with a hotel manager, communicating frequently on what he requires and how it should operate. Finally, my problem-solving skills specifically when implementing code; for example, coding a subroutine that analyses commonalities in the type of customer booking and the room sizes frequently booked.

I have thoroughly enjoyed being part of a plethora of activities and clubs. For two years, I have been a facilitator for my school's Year 7 Code Club where I taught students how to program in Python. Additionally, I have provided mentoring to Computer Science and Maths students in Year 11. This has been an enriching experience for me as I have been able to share my passion for Computer Science and inspire them to feel the same. I was also a Violinist in the borough String and Symphony Orchestra for 6 years and I am currently part of my school orchestra. This continues to develop my teamwork and leadership skills when working with other musicians and assisting them in any problems. Furthermore, I am a graduate of the National Citizen Service Programme and HeadStart Programme. We focused primarily on public speaking skills which was particularly useful when I was part of the British Science Week Committee, presenting speeches and leading lessons.

From my time at school and my experiences with Computer Science, I wish to continue to develop my passion at university. In an evolving industry, I am excited to gain the skills to adapt and tackle ever-growing challenges and problems.

## **Candidate B Background**

The candidate attended an 11-16 Academy at GCSE, transferring to a large faith-based state comprehensive school for Sixth Form.

The referee reports that the candidate has settled well at the school establishing a reputation as a hard-working and reliable student, who is highly determined and self-motivated. The candidate has self-taught Python and C++ and quickly grasps harder mathematical and logical concepts. All the internal assessment that the student has completed for Computer Science have achieved a minimum mark of 80%. In Mathematics he has achieved 90%+ for pure maths components of the A-level. Particular areas of strength include calculus (differentiation/integration) and numerical methods. Their written work shows great care and attention to detail, and their mathematical skills cope effortlessly with the demands of the course. Scores in Mathematics are excellent, having achieved 100% in Kinematics and Probability tests. They also support mathematics mentoring in school for younger pupils in fortnightly one-to-one sessions. The candidate also has an extensive range of volunteering roles outside the school community, completing the NCS programme during Year 12 and volunteering at a charity shop. They are also a youth leader for their church.

The student's home postcode puts them in the middle of the distribution range for both progression to higher education and socio-economic circumstances.

Pending qualifications:

A levels: Computer Science (A), Mathematics (A\*), Further Mathematics (A)

Existing qualifications:

GCSEs: 8 (Maths), 8/7 (Combined Science), 7 (English Language, Music, Religious Studies, Computer Science, History), 5 (English Literature, Spanish)

## Candidate C

When I was younger, I started to make strong connections between computers, mathematics and the sciences, experimenting with language coding and Raspberry Pi desktop kits. In Year 10, I secured a place on a newly introduced computer science GCSE course which was oversubscribed and highly competitive with only 30 places available. Before this, I regarded my interests in computing and coding to be mainly recreational, having grown up using computers and being regularly called on to assist family and friends with their computing and technical issues. However, shortly after I started the GCSE, I knew this was the field I wanted to pursue academically and devote myself to studying long term.

From the outset, computer science challenged me in a very positive way. I wanted to strive to learn more, and I quickly realised the range of possibilities for study and research are infinite. The course firmly established my future academic and career aspirations whilst offering opportunities for me to engage in practical group project work. Additionally, from learning programming skills, I was able to independently develop a game which opened up a whole new world of technology. Python was my first introduction to serious programming; thereafter, I acquired skills in C++. While the programs themselves were practical, it was the actual coding processes that I found most interesting.

I enjoy my extra-curricular activity, the Maths Academy, where we collaborate on problem-solving and discuss methodologies. During the lockdown, I enrolled on edX online courses for Year 13 A level mathematics to ensure that I was engaging with maths and using my time productively. I also registered on the Problem-Solving Matters course to experience maths at undergraduate level and have enjoyed using problem-solving websites such as NRich and Project Euler. In addition, I completed a Python Data Science course from IBM Programming to refresh my prior understanding of Python. I have been teaching myself Java, intending to develop a simple app. I appreciated the additional time to explore advances in machine learning. For example, I read an article in 'The Scientist' that reported machine learning is being used in cancer treatments, predicting with relatively high accuracy if cells are healthy and if not, whether they could become cancerous. Additionally, the work of Boston Dynamics has intrigued me and influenced my desire to discover more about how robotics can assist in industry, some with machine learning, but not all completely autonomous yet.

I am currently on the STEM Potential programme at Imperial, which has strengthened my resolve to study computer science at degree level by exposing me to maths and science in a university environment. The programme has escalated my confidence that I will be well suited to a highly academic, investigative, problem-solving setting. The experience I gained from working within groups on seminar days was incredibly beneficial. During one group experiment, through the use of LED lights, we found Planck's constant. For me, these discoveries and experiences present just the tip of the iceberg and make me wonder what other rich sources and exciting research I will be able to discover and participate in within an innovative university setting.

My enthusiasm to study the scope of concepts within the technological domain of computer science has led me to the considered choice of opting for the computer science degree rather than with joint specialism, to optimise my learning and understanding before later specialising in my undergraduate and leading into my Master's degree.

I have come to realise the possibilities of interlinking sciences with technology are as broad as they are deep. This state-of-the-art world is one in which I want to play a significant role. I wish computer science to be at the core of my future career and feel fortunate to have found passion in my vocational direction of study.

## **Candidate C Background**

The candidate attended a high-performing 11-18 state comprehensive for GCSE and then transferred to a large ethnically and socially diverse state-funded Sixth Form College for A-levels. Most students study three A levels and a small minority study four A level subjects over the two-year duration of the course.

The College reference indicates that the candidate is a highly intelligent student who clearly enjoys the STEM subjects. They possess an inquiring mind and an intellectual curiosity which is complemented by a strong work ethic. The candidate is an excellent mathematician and possesses an analytical mind and a deep conceptual understanding, asking insightful and intelligent questions. They possess excellent algebraic skills and enjoys the challenge of solving complex problems. The candidate is an active participant in the Mathematics Academy where the group explored challenging and complex problems beyond the scope of the A-level course. They have a strong penchant for Physics, at ease with the mathematical demands of the subject, quick to pick up difficult concepts and enjoys solving advanced problems. Practical skills are excellent, showing both rigour and initiative in experiments. In Chemistry they are an academic high-flier and an independent thinker with a natural aptitude for the subject. They are always fully engaged, picks up new ideas quickly, thinks logically and has an excellent grasp of the concepts applying their knowledge in unfamiliar situations with ease. They are able to work independently, enjoy reading around the subject and enjoy being challenged beyond the confines of the specification. They work safely and methodically in the lab, producing accurate results that they can interpret well.

The candidate has personal experience with managing illness in his family. A parent has been diagnosed with a degenerative condition and receives most of their care support from the applicant. This has been a longstanding commitment over several years. They will be the first generation in the family to attend university.

The candidate's home postcode places them in the most advantaged quintile for progression to higher education, and the middle quintile for socio-economic circumstance.

Pending qualifications:

A-levels: Maths (A\*), Chemistry (A\*), Physics (A\*), Further Mathematics (A) plus EPQ?

Existing qualifications:

GCSE: 9 (Maths, Physics), 8 (Chemistry, Biology), 7 (Computer Science), 6 (Geography), 5 (English Literature, Engineering, Spanish), 4 (English Language).

## Candidate D

Technology is incredible in achieving our most ambitious goals, connecting with people across the world and improving our daily lives by solving everyday issues. After receiving a national award for technology I feel a degree in Computer Science is the next step in my digital journey to gain an in-depth understanding of algorithms and different aspects such as artificial intelligence, software engineering and computer systems architecture. Using HTML and CSS, I created a website to showcase my art. This aspect of coding encouraged me to join the Engineering Society, where I worked in a team to build, code and race robots, enhancing my coding and team-building skills. Lectures at the Royal Institution on "The future of Artificial Intelligence" and "3D Printing" inspired my LAMDA Grade 6 Public Speaking Exam topic "The impact of 3D Printing on the Biomedical World" where I explored 3D printed organs. These experiences motivated me to study Computing at GCSE where I learned Python giving me the basics of algorithms, data flow and problem-solving. Using these concepts I created a python program for users to generate random descriptions of characters to help artists with a creative block. My favourite creation was a game to showcase the creative potential of emoji's programmed in JavaScript. This endless runner game explored a sweet themed world allowing players to collect doughnuts, avoid tomatoes and score points. Completing an online course and reading Jon Duckett's JavaScript book deepened my understanding of JavaScript. Problems identified in the game were fixed using a combination of p5.js documentation and JavaScript principles. Developing this game helped me understand collisions and interactions between characters and objects. My role as a developer in the Deloitte Digital IoT Summer Challenge required me to develop an Alexa Skill. This skill "WorkSpace" aided staff and students to find and book available rooms in college, thus reducing the ambiguity over room availability and ease booking. This project improved my Python, Alexa skill-building techniques using utterances and intents. Our group won the "Best Technical Implementation" award. Recently I worked with the Royal Institution to run the first-ever Primary Computing Masterclasses. Students learned mathematical magic tricks, created musical instruments and controlled scratch characters with micro:bits. Teaching primary school students to code micro:bits weekly has enhanced my leadership, communication and organisational skills as the activities are prepared in advance. I speak at Tech panels to motivate students, especially girls, to study STEM subjects and to recognise the positive potential of technology. Subjects discussed were Teaching Tech to GenZ, Girls in Tech for a school leaders' event, and Smart Cities at a major national conference. Working on the 100 days of code challenge improved my coding skills by coding consecutively on multiple projects, for example, developing a "Dark Mode for WhatsApp Web" chrome extension to improve my CSS and JavaScript. In 2016 I won an Arkwright Engineering Engineering Scholarship, where I built a self-balancing robot. The knowledge gained included soldering electronic components, designing and programming the software to allow the robot to self-balance using an Arduino, motors and a gyroscope. Presenting the portfolio of all the development stages gave me an insight into product development. My work placements at IBM, Microsoft, Cisco and Vodafone gave me an insight into time and project management, customer-facing meetings and product development. Studying Computer Science at University will expand my knowledge of computer systems and develop my technical skills for a future in technology. I am excited to further my learning about Human-Computer Interaction and the shift in designing for computers to designing for humans and their needs, as this is a part of my current course.

## **Candidate D Background**

The candidate attended an academically-strong all-female state-funded faith-based 11-18 school and transferred to a specialist technology College for post-16 studies.

The candidate has worked exceptionally hard through their computing course and is expected to achieve the highest results. They have a specific talent in system analysis and design, able to collate research of an existing system used by a game developer client, identify its weaknesses and design a solution that met all of the client's requirements. They also successfully configured a Linux database server to a professional level using industry standard encryption and cybersecurity techniques. They are a founding member of the college's Primary Computing Club, developing education materials to teach 8 to 10 year olds how to code. The candidate was project manager and winning finalist of the Deloitte industry project where she successfully guided her team in creating an Amazon Alexa Skill designed to manage availability of work spaces at college. In A level Maths they consistently demonstrate an outstanding work ethic. Their written work gives insight into excellent mathematical understanding, accurate and concise in applying standard methods while confident in their approach to unfamiliar problems. They take a leading role in classroom discussions and asking pertinent questions on new topics. They are successful in both making links to existing knowledge and creating a strong basis of understanding that can be applied to complex problems. The candidate has established a routine of effective independent study to achieve this, making full use of all resources including exam questions in order to arrive to workshops with specific problems to work on. The candidate is an outstanding student in their college, making significant contributions to the lives of the student body as President of the Student Voice, representing the college at events both internally and externally. They take an active role in preparing assemblies, introduced fundraising activities for the first time at the college and is now leading on a new buddy scheme for vulnerable students.

The candidate's home postcode places them in the middle quintile for progression to higher education, and the second-most advantaged quintile for socio-economic factors.

Pending qualifications:

BTEC National Extended Diploma in Computing (D\*D\*D\*), A level Maths (A)

Existing qualifications:

7 (Maths, English Literature, Computing, Physics, Chemistry, Art and Design, Religious Studies), 6 (English Language, Biology, Geography), 5 (French)