Personal Essay

Academically, nothing could be more valuable for me during my time at Caltech than a term spent studying abroad. The reason for this is simple. Caltech's greatest strength is also its greatest weakness: its size. In my time at Caltech, I have been surrounded by brilliant minds and have received untold opportunities, including the opportunity to perform research on robotics in Professor Chung's lab, due in part to the small size and close-knit nature of Caltech; however, it is this same size that has prevented me from fully exploring my passion: robotics. Although Caltech does offer some robotics and controls related classes, some of which I have already taken, many of the robotics classes here focus more on the mechanical side of robotics or have mechanical engineering classes as pre-requirements, such as ME 72 and ME 133. However, the large size of these universities abroad allows them to offer a much wider array of courses. For example, Cambridge in the Lent term offers 3 robotics-related classes that I hope to take: Mobile Robot Systems, Mobile and Sensor Systems, and Computer Vision; none of these are currently offered at Caltech. When considered alongside the other classes that I have oft-dreamed of taking but have been unable to, such as Compiler Construction, studying abroad will afford me the chance to truly explore multiple fields that have long interested me, yet that I have been unable to fully examine in my time at Caltech. It will also teach me the skills I need as I begin to pursue a graduate degree in robotics, giving me the knowledge-base to conduct research on a variety of different topics in modern robotics, of which mobile systems and computer vision are two of the most important. In a slightly different vein, studying abroad will also help prepare me for graduate school by allowing me to learn in an environment that is much less structured than Caltech, where I will be forced to grow and take the onus of learning more upon myself rather than rely on weekly problem sets to ensure that I am learning the course material.

In addition to growing academically, studying abroad will also greatly help me develop personally. Over the course of a term abroad, I will be able to embrace an entirely new culture and gain an essential perspective on life. As someone who has never left the continent of North America, I want to understand. I want to understand what it is like to live in a country with thousands of years of history coursing through its veins, whose most proud and most notorious moments were chronicled by the famed Bard whose histories I adore. I want to understand how people who live a small skip over the Atlantic pond go about their daily lives and interact with one another. I want to see the way they laugh while walking along the River Thames, the way they curl up into a cozy shop for a cup of tea. I want to see what makes them like the people I already know and care about, and I want to see how their differences enhance them. I want to understand what makes them human, what makes them a people. I want to understand them. Because only once I understand them as a people can I more critically view my own actions, my own thoughts, and my own latent beliefs in contrast, and truly make a conscious effort to change myself to become the better person I hope to be. Through a term abroad, I hope to not only come to understand the British people better, but also to reflect on who I currently am, and who I am capable of being.

Program Fit

Cambridge (Lent):

As I briefly mentioned in my essay, studying at Cambridge in the Lent term will give me an unparalleled opportunity to explore topics in robotics that I have not previously been able to investigate. I cannot overstate how much the opportunity to study such fascinating topics will help me in my goals to one day become an accomplished roboticist. For example, the Mobile Robot Systems sounds like the class I've most wanted to take in my time at Caltech but have not found to exist. It covers all the components of robotics systems that I am least knowledgeable about, and yet that are crucial to constructing a functional robot. Namely, it describes important algorithms for how to model a robot, determine optimal trajectories and paths, keep track of robot location and state, and even covers the up-and-coming topic of multi-robot systems. Mastering these algorithms will greatly help me in constructing solutions to problems of the future. In a slightly different vein, Computer Vision will help refine and formalize skills that I have been developing on my own through independent study and through my role as the software lead of the Caltech Robotics Team, wherein I constantly explore new computer vision techniques to apply to our submarine. Mobile and Sensor Systems will help me develop skills and techniques for working with drones and other small, mobile robotics systems. Finally, Topics in Concurrency and Compiler Construction are classes that offer me a chance to explore topics that I became interested in after taking the Operating Systems class here at Caltech, but which we do not currently have available. On a more procedural note, the credits I earn abroad will likely serve as credit for my Computer Science major under the categories of either Advanced CS or Breadth.

Cambridge (Michaelmas):

The 36 units I earn will likely serve as credit for my Computer Science major under the categories of either Advanced CS or Breadth, although the units for Quantum Computing may fall under the category of Scientific Fundamentals. Regardless of the units, these five courses will both serve to give me an introduction to principles of Electrical Engineering that I feel I lack a sufficient background in for my desired career of robotics (Digital Electronics) as well as improve my overall programming skills in important contemporary fields such as highly-parallel computing (Multicore Semantics and Programming) and security (Computer Security). In addition, highly-parallel computing is a perfect match for the real-time, processing-intensive, distributed workloads of robotics and drone swarms that I will likely work on. Finally, Meta-Programming and Quantum Computing will both give me an opportunity to explore fields of Computer Science that I have not previously investigated.

Proposed Course List

Cambridge (Lent)

Total CIT Units for term abroad: 42
Course by Correspondence/Units: 0

Course	Week							
	1	2	3	4	5	6	7	8
Compiler Construction								
Mobile and Sensor Systems								
Mobile Robot Systems								
Computer Vision								
Topcis in Concurrency								

1. Compiler Construction
Tripos: Computer Science
Subject: Computer Science
Part: 1b
Term: Lent
Number of Lectures: 16
Lecture Times: MWF, 10 a.m.
Caltech Units: 9
Caltech Evaluator: Prof. Thomas Vidick
Type of Credit: Option
CIT Equivalent Course: N/A
Course Description: This course aims to cover the main technologies associated with implementing programming languages, viz. lexical analysis, syntax analysis, type checking, run-time data organisation and code-generation.

2. Mobile and Sensor Systems
Tripos: Computer Science
Subject: Computer Science
Part: II
Term: Lent
Number of Lectures: 12
Lecture Times: MWF, 11 a.m.
Caltech Units: 9
Caltech Evaluator: Prof. Thomas Vidick
Type of Credit: Option
CIT Equivalent Course: N/A
Course Description: This course will cover topics in the areas of mobile systems and communications, and sensor systems and sensor networking. It aims to help students develop and understand the additional complexity introduced by mobility and sensing, including energy constraints, communication in dynamic networks and handling measurement errors. The course will be using various applications to exemplify concepts.

3. Mobile Robot Systems
Tripos: Computer Science
Subject: Computer Science
Part: II
Term: Lent
Number of Lectures: 12 + 4 practicals
Lecture Times: Tu/Thu, 11 a.m.
Caltech Units: 9
Caltech Evaluator: Prof. Thomas Vidick
Type of Credit: Option
CIT Equivalent Course: N/A
Course Description: This course teaches the foundations of autonomous mobile robots, covering topics such as perception, motion control, and planning. It also teaches algorithmic strategies that enable the coordination of multi-robot systems and robot swarms. The course will feature several practical sessions with hands-on robot programming. The students will undertake mini-projects, which will be formally evaluated through a report and presentation.

4. Computer Vision
Tripos: Computer Science
Subject: Computer Science
Part: II
Term: Lent
Number of Lectures: 16
Lecture Times: Tu/Thu, 12 a.m.
Caltech Units: 9
Caltech Evaluator: Prof. Thomas Vidick
Type of Credit: Option
CIT Equivalent Course: EE/CNS/CS 148. Selected Topics in Computational Vision
Course Description: The aims of this course are to introduce the principles, models and applications of computer vision, as well as some mechanisms used in biological visual systems that may inspire design of artificial ones. The course will cover: image formation, structure, and coding; edge and feature detection; neural operators for image analysis; texture, colour, stereo, and motion; wavelet methods for visual coding and analysis; interpretation of surfaces, solids, and shapes; probabilistic classifiers; visual inference, recognition, and learning.

5. Topics in Concurrency
Tripos: Computer Science
Subject: Computer Science
Part: II
Term: Lent
Number of Lectures: 16
Lecture Times: MWF, 2 p.m.
Caltech Units: 9
Caltech Evaluator: Prof. Thomas Vidick
Type of Credit: Option
CIT Equivalent Course: EE/CNS/CS 148. Selected Topics in Computational Vision
Course Description: The aim of this course is to introduce fundamental concepts and techniques in the theory of concurrent processes. It will provide languages, models, logics and methods to formalise and reason about concurrent systems.

Cambridge (Michaelmas)

Total CIT Units for term abroad: 39
Course by Correspondence/Units: 0

Course	Week							
	1	2	3	4	5	6	7	8
Computer Security								
Quantum Computing								
Digital Electronics								
Meta-Programming								
Multicore Semantics and Programming								

1. Computer Security: Principles and Foundations
Tripos: Computer Science
Subject: Computer Science
Part: III
Term: Michaelmas
Number of Lectures: 16 (8 x two-hour seminar sessions)
Lecture Times: Monday 3 p.m.
Caltech Units: 9
Caltech Evaluator: Prof. Thomas Vidick
Type of Credit: Option
CIT Equivalent Course: N/A
Course Description: This course aims to provide students with an introduction to the history and central themes of computer security, from its 1970s foundations to some current research topics, with a theme of how to defend cloud-based systems against capable motivated opponents. The course considers first local computer systems and then distributed systems; however, we will rapidly discover that this is an artificial distinction that only becomes more awkward as we enter the current period. Throughout the course, we will consider proposed systems along with the adversarial research intended to identify gaps and vulnerabilities.

2. Quantum Computing
Tripos: Computer Science
Subject: Computer Science
Part: II
Term: Michaelmas
Number of Lectures: 8
Lecture Times: MWF 11 a.m.
Caltech Units: 3
Caltech Evaluator: Prof. Thomas Vidick
Type of Credit: Option
CIT Equivalent Course: N/A
Course Description: The aims of the course are to introduce students to the basics of the quantum model of computation. The model will be used to study algorithms for searching and factorisation. Issues in the complexity of computation will also be explored.

3. Digital Electronics
Tripos: Computer Science
Subject: Computer Science
Part: 1a
Term: Michaelmas
Number of Lectures: 12 + 7 practicals
Lecture Times: MWF 12 a.m.
Caltech Units: 9
Caltech Evaluator: Prof. Thomas Vidick
Type of Credit: Option
CIT Equivalent Course: N/A
Course Description: The aims of this course are to present the principles of combinational and sequential digital logic design and optimisation at a gate level. The use of n and p channel MOSFETs for building logic gates is also introduced.

4. Multicore Semantics and Programming
Tripos: Computer Science
Subject: Computer Science
Part: II
Term: Michaelmas
Number of Lectures: 16 (8 x two-hour sessions)
Lecture Times: Friday 2 p.m.
Caltech Units: 9
Caltech Evaluator: Prof. Thomas Vidick
Type of Credit: Option
CIT Equivalent Course: N/A
Course Description: The aims of this course are to present the principles of combinational and sequential digital logic design and optimisation at a gate level. The use of n and p channel MOSFETs for building logic gates is also introduced.

5. Meta-Programming
Tripos: Computer Science
Subject: Computer Science
Part: II
Term: Michaelmas
Number of Lectures: 12 + 4 practicals
Lecture Times: Tu/Thu 11 a.m.
Caltech Units: 9
Caltech Evaluator: Prof. Thomas Vidick
Type of Credit: Option
CIT Equivalent Course: N/A
Course Description: This course surveys principled approaches to metaprogramming; writing programs that manipulate programs. Topics include evaluators, reflection, writing programs that write programs, designing domain specific languages and meta-linguistic abstractions, synthesis.