I decided to attend Caltech less than three hours before the deadline. I'd always been a little indecisive and a little afraid of change, and I was hesitant to go to Caltech because it's so far and so different from Chicago, where I grew up. At the time, I was considering some very concrete things, like academic opportunities and clubs, but also, more abstractly, whether I wanted to go with my "safe" option that is more "traditional" and closer to home – or go all the way out to California to what my friends called "nerd school".

I like to think that my decision to come here is reflective of the philosophy that I've come to adopt in general – it may sound cliché, but I've figured out that I tend to have the most fun and the most interesting experiences when I agree to do something that may sound a little outlandish or, at the very least, outside of my normal routine. This is true for travel, such as when I was invited to go to Boston for a trading competition with just three weeks' notice or Berkeley for a number theory conference with just over one week's notice, but also for other aspects of life, such as when one of my friends convinced me last year to join Glee Club even though I had no experience singing in a choir. This is to say that a lot of my formative experiences (as well as fun times I've had) have come from my willingness to jump into something different with the hope of seeing new places, meeting new people, or learning something new.

Indeed, many who go abroad come back with the same clichéd urgency, insisting that everyone should do it and citing many of the same reasons I quoted above: their experiences, their realization of the myriad options they have in life, their new ability to be nimble in their plans. And indeed, many who decide not to go abroad laud, in broad terms, the willingness of those who do to be a little adventurous and a little impulsive. In large part, all these reasons do feed into why I want to study abroad, but there is more to my decision than the hope of a fun time.

I left North America for the first time as a freshman in high school, when I went to a math competition in Beijing over Thanksgiving break for four days. At home, I mostly stayed within my neighborhood – I rarely even went downtown. I mostly just went to school, came home, and sometimes visited friends who lived nearby. I was barely familiar with how people lived across town, let alone across the world. In contrast, at the competition, I got to know people from all around the US on our own team, and got to meet people from South Korea, Vietnam, Bulgaria, China, and so on. And, as we toured famous attractions in and around Beijing, I caught a glimpse of the daily lives of some of the residents, if only through the windows of a tour bus.

If a local politician is worth their salt, when faced with a big decision, they convene hearings that involve their constituents to gain the perspectives of everyone the decision affects. That way, they can make a more informed decision that is, in turn, more likely to be good for everyone. I ended up going back to Beijing each year of high school, and, much like how a local politician solicits opinions from their constituents, each of my experiences there exposed me a little more to how people live far beyond my neighborhood in Chicago. Learning from these diverse perspectives made me realize how "normal" is different for people all around the world, and that was enough to fascinate me, but learning how people live elsewhere also helped me gain perspective on my own situation. Living for an extended time abroad would allow me not only to learn how others live to satisfy my own curiosity, but also to incorporate positive elements of their habits into my own.

I believe I can apply this to academic habits as well. I enjoy teaching math to elementary- and middle-schoolers, and one of the most important things I've learned how to do is tailor my lessons to each student and teach the same concept in several ways in order to accommodate different styles of learning. I believe that by spending time at another university, I would benefit from different teaching and learning styles and improve my ability to learn at Caltech and in the future by synthesizing the best strategies I find.

Of course, the main reason I want to go abroad isn't so I can study better, although that would be icing on the cake. In general, I think we all have a responsibility to know – or at least care – how others are doing. Indeed, I've learned in college how important open and candid communication is, and I think that, much as the study of linguistics fascinates me, beyond having the opportunity to learn a new language or learn about a new dialect, it's valuable to talk to people that come from different backgrounds than you. Studying abroad is the perfect way to do just that on a large scale, and the perfect way to gain the understanding that's necessary to have productive conversations with people of any background.

Often, when I'm cooped up inside for a while, I stop working and take a walk, just to get outside. And while studying abroad is a good way to "just get outside" of Caltech for a term, it's more valuable than that: studying abroad is the best way for me to learn about and from other cultures, learn to communicate better and even study better, and, yes – have some great new experiences and meet some great new people.

1. DTU

My interest in math is mainly in combinatorics and discrete math more generally, as well as some light algebra. Taking Ph 2b and EE 127 here has allowed me to see how that study of algebra is applicable to other fields (no pun intended), but one prominent application of algebra that Caltech's math department lacks a course in is cryptography, so I want to take Cryptology 2 at DTU so I can learn about that in a formal setting before I graduate. I've also wanted to take machine learning here at Caltech, partially because it's interesting and "the hot thing" in many industries right now, but also because it's potentially relevant to what might be a job in quantitative finance for me in the future. Unfortunately, I haven't been able to work it into my schedule here, but I am hoping to take that at DTU. Also, taking a course in the history of technology would be a way to get a little diversity of material in my otherwise math- and applied math-heavy courseload, given that I would be taking Ma 109a by correspondence, as well. Lastly, my dad has a master's degree in linguistics, and I gained his love of language – I'm told that the Danes speak excellent English, but my dad has demonstrated to me that there's nothing like making someone light up by speaking their own language to them, or at least making the attempt. One of the reasons I want to go to Denmark is to gain enough knowledge of Danish to acceptably hold a conversation – especially since I already know German – so the Danish language requirement doesn't faze me; in fact, I look forward to it.

Total ECTS: 27.5 ECTS
Total CIT Units: 45
Course by Correspondence/Units: Ma 109a, 9 units

1. 01426 - Cryptology 2
Department of Applied Mathematics and Computer Science
MSc. course
Fall semester
Block E3A
Tuesday 8:00-12:00
5 ECTS
9 Caltech units
Caltech evaluator: Tom Graber
Option credit
No Caltech equivalent
Course description:

General course objectives

To introduce the students to advanced concepts and techniques in cryptology.

Learning objectives

A student who has met the objectives of the course will be able to:

- Make computations in rings and finite fields.
- Explain how the symmetric cryptosystem AES works, including the underlying mathematics.
- Outline possible symmetric systems for authentication of data, and explain the advantages and disadvantages of systems, which are computationally secure and systems, which are unconditionally secure.
- Explain the basic ideas of provable security in symmetric cryptography.
- Explain the basic ideas of provable security in asymmetric cryptography.
- Explain the security of the RSA system and its relation to factoring.
- Define elliptic curves modulo a prime number, and discuss the applications of these in cryptology.
- Apply algorithms to compute discrete logarithms.

Content

Rings and finite fields. The Advanced Encryption Standard. Message Authentication Codes. Discrete logarithm algorithms.
Factorisation algorithms. Elliptic curves modulo a prime number. Ideas of provable security.

2. 02450 – Introduction to Machine Learning and Data Mining
Department of Applied Mathematics and Computer Science
BSc. course
Fall semester
E4A
Tuesday 13:00-17:00
5 ECTS
9 Caltech units
Caltech evaluator: Tom Graber
Option credit
One of CS 155 or CS 156a may count as equivalent
Course description:
General course objectives
To provide the participants knowledge of
* fundamental and widely applied methods for data modeling and machine learning,
* a framework for data modeling,
* Matlab, R or Python as a tool for data analysis (the participant can freely choose between these programming languages).
The course enables the participants to apply machine learning for modeling of real world data.
Learning objectives
A student who has met the objectives of the course will be able to:

- Describe the major steps involved in data modeling from preparing the data, modeling the data to evaluating and disseminating the results.
- Discuss key machine learning concepts such as feature extraction, cross-validation, generalization and over-fitting, prediction and curse of dimensionality.
- Sketch how the data modeling methods work and describe their assumptions and limitations.
- Match practical problems to standard data modeling problems such as regression, classification, density estimation, clustering and association mining.
- Apply the data modeling framework to a broad range of application domains in medical engineering, bio-informatics, chemistry, electrical engineering and computer science.
- Compute the results of the data modeling framework by use of Matlab, R or Python.
- Use visualization techniques and statistics to evaluate model performance, identify patterns and data issues.
- Combine and modify data modeling tools in order to analyze a data set of their own and disseminate the results of the analysis.

Content
Structured data modelling. Data preprocessing. Feature extraction and dimensionality reduction including principal component analysis. Similarity measures and summary statistics. Visualization and interpretation of models. Overfitting and generalization. Classification (decision trees, nearest neighbor, naive Bayes, neural networks, and ensemble methods.) Linear regression. Clustering (k-means, hierarchical clustering, and mixture models.) Association rules. Density estimation and outlier detection. Applications in a broad range of engineering sciences.

3. 10610 – History of Technology
Department of Physics
MSc course
Fall semester
E5
Wednesday 8:00-17:00
10 ECTS
9 Caltech units
Caltech evaluator: HSS
Writing-intensive humanities class
No Caltech equivalent
Course description:

General course objectives

The course gives the student an understanding of the interaction between technology and humans, knowledge, culture, economy as well as politics from ancient times to the present. Working with history, the student will gain a greater historical understanding, critical appreciation of source material and knowledge about basic approaches to the history of technology. Communication and argumentation skills will develop.

Learning objectives

A student who has met the objectives of the course will be able to:

- Assess the relationship between a historical age and the technology in that age
- Exemplify elements of the complex interactions between technology, culture, economy, knowledge and society over time
- Apply historical methods and identify which school of thought in the history of technology a method belongs to
- Quickly scan large amounts of information and identify the central arguments contained in books and articles on the History of Technology
- Identify strong and weak points in the argumentation in presentations of history
- Formulate the relationship between information and interpretation in a historical text or other source material
- Apply sources, source criticism and academic referencing techniques
- Present the above in written and oral form, structured and well-argued
- Select a technically related historical issue to be analyzed in an essay. Identify pertinent questions to be answered. Select and critically compare sources related to this issue. Present the analysis and conclusion clearly and to the point

Content

An overview of important technological developments from ancient times until today is addressed through lectures, articles, film, historical artefacts, student exercises and presentations as well as trips to exhibitions and historical sites.
This is supplemented with further analysis of various themes which may include the relationship between technology and science, technology of the home, war and technology, medicine and the body, sustainability as well as chemical industry. Topics span from power sources over work and industry, the influence of natural resources on the development of technology to technology and knowledge transfer, systems engineering and technical innovation processes.

4. Danish Language at KU
Department of Nordic Studies and Linguistics
For international students only
Fall semester
No equivalent DTU block
Monday and Wednesday, 19:00-21:35
7.5 ECTS
9 Caltech units
Caltech evaluator: HSS
Additional HSS
No Caltech equivalent
Course description:
The courses in Danish as a Foreign Language for International Students at the University of Copenhagen consist of intensive language instruction classes. Danish is studied and taught as a foreign language for communicative as well as academic purposes. In accordance with a discursive view of language and a primarily cognitive view of language acquisition the courses integrate theoretical knowledge of lexicon, grammar and phonology in the process of developing communicative competences in modern Danish, spoken and written.

5. Ma 109a by correspondence