Featured, History
# Weird Computing I: Like Clockwork

One of the most important and powerful facts about computing is that the top level doesn't need to know what the bottom level is doing. It is this single idea that allows computer scientists to design algorithms and not care how they're used, allows software engineers to write programs and not care how they're run, allows computer engineers to design processors and not care how they work, and finally, allows the physics nerds in OMB to design transistors without needing to be friends with anyone in K17. In fact, this very same boon is what allows my mum to work her iMac without having the vaguest idea what the magical box is actually doing.

That being said, it is a lack of understanding how computers work on a basic level that leads to the 'magical smoke' problem – computers work on magic smoke, and if it gets out of the box, you're screwed. Neither the average person, nor the average computer science student, has a strong handle on what computing is at the bottom level.

In this series of articles, I plan on shining the bright light of Learning into the murky depths of the actual implementations of computers, especially the ones that aren't common (while mixing in a brief guide to good speculative fiction, because everybody needs a hobby). In this opening foray into the unknown, I decided to cover a bit of history and have a look at the very first Computer ever designed, (and maybe a little bit of steampunk). In the future, we can look forward to non-deterministic molecular comput-
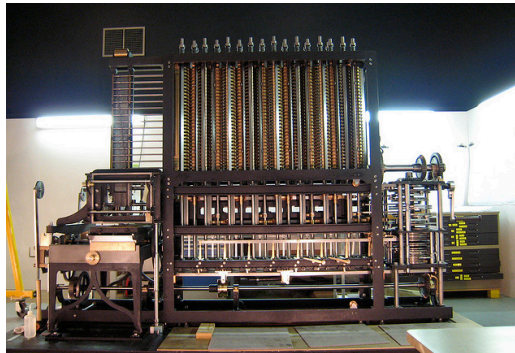
Replica of Babbage's Difference Engine

ers, mind bending quantum computers and gooey brain computers. But first we really need a bit of background. So let's get started.

A Computer is defined as a device which can be programmed to carry out logical operations. In particular, I'd like to take note of the 'programmable' requirement – this means you have to be able to given the computer not only a set of inputs, but also be able to tell it what to do with those inputs. This is the bit that lets us do whatever we want with the thing, so really it's quite important. It's also pretty difficult to manage. So how did they go about managing it?

Well, up until 1800, the best things anyone ever used were computational aids or Calculators. These are things like abacuses and slide rules – they are distinctly non programmable, but allowed people to do complicated operations much more quickly. Everyone from University students to great physicists hated doing maths back then as much as we all do today, and so there was much interest in figuring out ways to make something else do it for you. To this end, a bright bean named Charles Babbage was designing a mechanical calculator called the Difference Engine, which was capable of calculating polynomial functions, thereby approximating the logarithmic and trigonometric functions that nobody really likes. (What is the $\ln(148.42)$ to 4 decimal places? No? It's 5.) Babbage finished his very expensive hand cranked monstrosity, and thought to himself 'Hang on a minute, why stop at polynomials?'. So Charles designed the Analytical Engine, the first Real and Actual Computer, and promptly died.

TECHNOLOGY

Nvidia 800M Series - More Power. More Gaming.

Yes, the 800M series. We're talking about laptops here. Now, obviously this isn't as exciting as the more heavily anticipated GeForce 800 series graphics cards for desktops, but the 800M cards are still a step in the right direction for laptop gaming.

Games that have previously been utterly unplayable on a laptop such as Far Cry, Crysis, the Metro series, and many others, have now become passable thanks to advances in portable graphics technology. It is not uncommon for high end games to play at over 30fps, which for most people is considered to be "Good Enough". The 800M series also includes smarter battery optimisation software. In certain test scenarios it is even able to run Borderlands 2 at 1080p and 30fps on a 70 Wh battery for 2 hours and 11 mins. That's impressive. Of course, you would have to consider the fact that laptops also run in a low-powered state when off of the power plug, so plugging in the laptop would grant it a significant boost in gaming performance. In fact, according to NVIDIA, the lower end 850M card is a full 60% faster in terms of gaming performance. Making laptops that possess one of these cards to be a sound economical choice for gamers on the go.

Even though gaming laptops are notorious for having low battery life, the 800M series' battery saving features enable laptops to last 5+ hours by switching over to Intel Integrated Graphics whenever the computer is under light load such as web browsing or idling. Speaking from personal experience, I have a laptop with a 770M and the battery lasts a bit over 6 hours under light load and that's more than enough for me to do whatever I want without charging.

So if you're a gamer and looking to purchase a gaming laptop with one of these graphics cards , you might want to check out these laptops that are coming out this year:

GTX880M
• MSI GT70 Dominator
• Alienware 17
• Asus G750

GTX870M
• Razer Blade

GTX860M
• Lenovo Y50
• Gigabyte P34
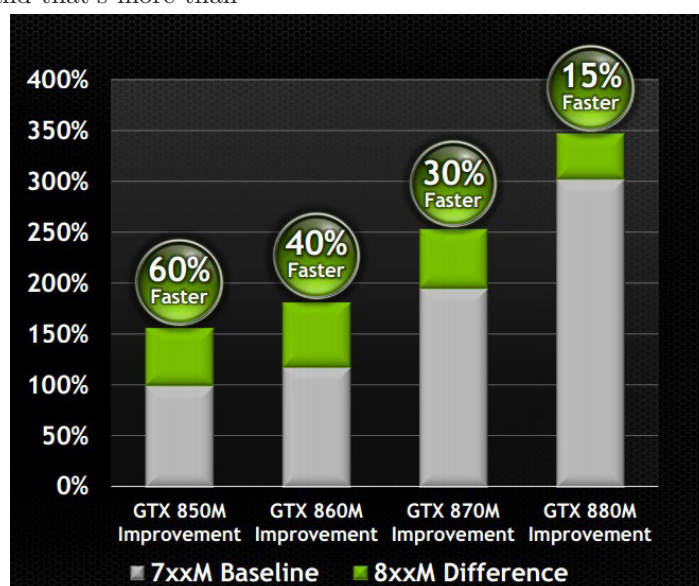
OMAIR ALI

FEATURED, HISTORY

Weird Computing I: Like Clockwork - contd.

It took about another century before someone else tried the same trick, and I think we all have a pretty good handle on what followed. (Hint: Computers.) But what if Babbage has actually managed to build an Analytical Engine before he kicked the bucket? And why did it count as a Real Computer? About 60 years after Babbage sodded off, a totally different smart bean called Alan Turing was working at Cambridge on what 'computable' actually meant. Turing developed the idea of the Universal Turing machine here, a dirt simple device which could be proved to be able to compute anything that was theoretically computable. This theoretical machine and all other machines with the same characteristics are called Turing Complete, or Universal.

Despite the obvious handicap of dying before Turing's father was born, Babbage's Analytical Engine was also Turing Complete. Babbage exclusively used mechanical gears in his design: he stored numbers in registers by rotating gears into various positions. It took inputs on punched cards, which were stacked in an input track and sucked in by the machine one by one. The real kicker in Babbage's design is that he included the ability to execute commands out of order – he had a Program Counter and a conditional branch (which, by the way, worked by mechanically preventing the jump unless a certain gear was in the 0 position). This allowed the creation of loops, by jumping back to an earlier punch card command and continuing to execute, along with all the other programming structures available to Turing complete systems. If you have done Microprocessors (2121) or Computer Architecture (3222), looking at Babbage's design is a real hoot.

The Engine was divided into 'chunks', the most important of which was the Mill, or 'CPU'. The entire engine used decimal encoding exclusively, and the mill was no exception. In order to implement addition, subtraction, multiplication and division, it sported 2 Ingress Axes, which were stacks of 50 gears each representing a digit (along with a switch representing the sign). The First Ingress Axis also featured a Primed Axis of another 50 digits for use in division. It also possessed an Egress Axis of 50 Digits for output, accompanied by another Primed Axis for the most significant bits in multiplication, and the remainder in division. It was also quite capable of handling fixed point arithmetic for fractions, and the engine was capable of converting between different floating points. The Mill also possesses a 'Run-Up lever' which would be flipped on arithmetic overflow, or if the divisor was 0, and which could influence the subsequent execution of the program. The Engine also possessed a bell to alert the attendant to its halting, and a printing machine to punch out its results, and a bank of a thousand 50 digit registers (which Babbage called Store 000 to 999). It was capable of drawing graphs of its results, ignoring 'comment' cards, and, get this, had specific cards for debugging.
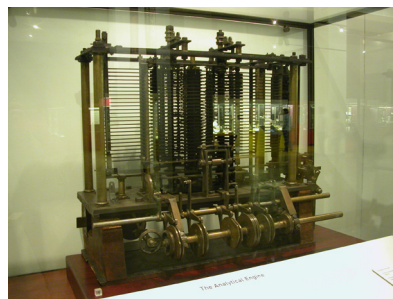
Analytical Engine

Just checking that you didn't miss any of that – the Analytical engine natively computed on signed 50 digit numbers, had flow control and flags, could handle floating points, has 1000 registers, could print numbers and graphs, and had Victorian era GDB.

Exclusively using gears and rods.

I hope this has sufficiently blown your mind. Incidentally, a very nice repository of information about it is held on the website of John Walker, the inventor of AutoCAD, and can be found at http://www.fourmilab.ch/babbage/

So what would the world have been like if Babbage had been trusted with more money and a longer life? For starters, Bugs would probably be called Wrenches – gears have a tendency to be much less merciful to moths than electromechanical valves. Other than that, society could have gotten their hands on computability and mass data about a century earlier than it actually did. That looks like fertile ground for speculative fiction. In 1990, the Cyberpunk genre was finishing up its golden age, and SF authors were looking for new ideas to play with. Bruce Sterling and William Gibson, two of the giants of the Cyberpunk movement, sat down at their respective computers and started collaborating on a new kind of punk. The resulting book, The Difference Engine, was set in 1855, in an alternate history where Babbage got his chance. It proceeded to win a serious number of very important SF awards and is widely considered the first book in the new genre of Steampunk. Steampunk is characterized by its anachronistic treatment of history, providing Victorian-era societies with far more tech than it ever knew what to do with. The results are intercontinental blimp flights, moving cities, the omnipresence of mechanical computers, and fantastic fiction.

So hopefully this article has given you a little bit of the 'truth is stranger than fiction' feeling with regards to Mister Babbage and his Analytical Engine. If you're ever in London (don't question it), I highly recommend visiting the Science Museum, where you can see a testing model of a small bit of the Analytical engine, along with modern replicas of his Difference engine and a whole bunch of other weird computing artifacts. Unfortunately, there still does not exist an actual replica of the whole machine, but there are a bunch of cool people trying to build one (In time for Babbages 150th birthday in 2021). They live at plan28.org, check them out.

Tune in to the next Beta for some fun with molecular computers and non-deterministic machines (and possibly a crash course in post-cyberpunk science fiction).

MATTHEW MCEWEN

News

News In Brief

Barley a Difference
CenturyLink Arena in Idaho is being sued by fans for $10,000 for being ripped off into believing that the $7 large beer gives the same amount of beer as the $3 small beer. The large cups are tall and narrow, whereas the small cups are shorter, yet wider, but ultimately, they serve the exact same amount.

Wanted: Giant Mango Thief
A 10 metre high fibreglass replica of a mango has gone missing in Bowen, Queensland. Security footage shows that a crane was driving in the direction of the mango at 2am, and the following morning, the giant mango had disappeared. I wonder how much a giant mango goes for in the black market?

Kettle Chips: A surprising new flavour
After finishing half a pack of kettle chips, a couple was shocked to find a dead shrew inside. Taking the case to Kettle, and after much investigation, it is clear that the shrew did not enter the bag at Kettle foods, nor did it enter during distribution. Further, the shrew had been dead for quite a short time, puzzling everybody how it got there at all. Although the most puzzling thing to me is why the couple was so shocked. They must have been vegetarians.

A Look into the Past
Scientists in Western Australia have captured pictures of an explosion that occurred 12.5 billion years ago. The explosion is that of a star blowing up, and is classified as a Gamma Ray Burst. These images were taken by the University of Western Australia's Zadko Telescope, designed to capture flashes in the sky, after it had been alerted of activity.

CSESoc Beta Head

	COMMENT	DATE
O	CREATED MAIN LOOP & TIMING CONTROL	14 HOURS AGO
O	ENABLED CONFIG FILE PARSING	9 HOURS AGO
O	MISC BUGFIXES	5 HOURS AGO
O	CODE ADDITIONS/EDITS	4 HOURS AGO
O	MORE CODE	4 HOURS AGO
O	HERE HAVE CODE	4 HOURS AGO
O	AAAAAAAA	3 HOURS AGO
O	ADKFJSLKDFJSDKLFJ	3 HOURS AGO
O	MY HANDS ARE TYPING WORDS	2 HOURS AGO
O	HAAAAAAAAANDS	2 HOURS AGO

AS A PROJECT DRAGS ON, MY GIT COMMIT MESSAGES GET LESS AND LESS INFORMATIVE.

Poetry

A Dingo ate my Laptop

Bright sunny morning, a new semester calls,
With great adventures waiting to befall.
Humming and happy, I skip through the park,
Until I'm startled by a horrific bark.

Tearing from the bushes it agiley dives,
The bane of all of mankinds' lives.
A dingo most queer indeed,
Which for our flesh it longs to feed.

Orange fur, and canine teeth,
With long lithe legs left underneath.
Its beadlike eyes seek yet more prey,
To sate its longing for the fray.

Sniffing the air to catch a scent,
Its ears prick upward to my lament.
"I'm next"! I panic, yet freeze with fear,
As its gaze locks upon me with a mesmorising leer.

One foot placed forward, and then the next,
But then it pauses, with hind legs flexed.
A moan escapes me, but I still can't budge,

Alas - am I soon.... to meet my judge?

It bounds the distance with powerful strides,
And with graceful splendour it pounces and glides.
But breaking free from its enthralling spell,
Its burning hunger, I refuse to quell.

I raise my arm to guard the blows,
Caution to the wind, my bloodlust grows.
Swinging my bag like a flat-head mace,
The dingo meets it with a willing face.

Its teeth sink in and there's a splitting crack
as my bag is wrenched away, I'm taken aback.
It gnaws at my laptop, its wires torn free.
Like eating the intestines of my 15.6" baby.

And that sir, is why I was late to class,
With no code for your dryruns, that adequately pass.
So always remember to keep a backup,
Cos' a dingo may just eat your laptop.

Angelo Tamayo

ADVICE

Survival Guide From a Fifth Year

Nelson Rigby offers a reflection of his experiences at uni

As someone who went from failing half my courses to a HD average for the last few years, I thought I'd write something on how to approach Uni. In particular, how to manage the Uni workload. This is essentially what I'd tell a younger first year version of myself. I hope people find it helpful.

The first key variable is course selection. For many, a lot of academic bravado enters into the decision making here. There can be this need to overload or do lots of hard courses. This can sometimes manifest in the advice given by other students about which courses to take. It is fairly common to see some of the best students proselytizing about hard course X or insane course Y. While word-of-mouth can be a great resource, I think its important to filter all advice through your own "applicability" filter. How applicable is this advice to me, given my strengths and weaknesses? Can I afford the likely workload imposed by course X?

Obviously answering these questions can be hard if you're a little unsure of your own abilities. I think evaluating yourself becomes easier, but can initially be difficult. I know when I started, I had an inflated concept of my own abilities. This was quickly met with a dose of reality therapy. As time passes, the gap between your self-concept and your actual abilities diminishes. You may be unable to hack NASA, but you can implement A*. In other words, you gain a better understanding of what you are capable of. I also found that the further I got into my degree, the less I felt I knew. If you experience this, it's a good sign and means you've probably gotten better.

Instead of an ego-driven approach to course selection, I think it's better to engineer a workload rationally. There are two key criteria I use. First, I can learn enough useful information. Second, I can get good grades if I work hard.

This is why I think judicious underloading can be a good idea. If executed properly, you still learn the same net amount of information. You just trade breadth for depth. In this sense, it satisfies the first criterion. It also maximises your chances of better grades, fulfilling the second criterion. There is an invisible benefit to good marks, outside of the gain in knowledge: motivation. To sustain motivation/ willpower, you need a cycle of positive feedback. If that's not there, you incur a willpower debt and eventually burn-out.

Having experimented with different loads, I've found three courses to be the sweet spot. You may respond better to more or less, but I know that any less and I'm not learning enough / not challenged enough.

These are obviously nebulous rules, but they are still useful for organising my thoughts about my workload. While ultimately a judgment call, there are some important factors that can inform your assessment. Although it seems vacuous to mention, one critical thing to look at is the assessment scheme of a course. This corresponds best with where you will actually be spending your time and therefore gives you a good idea of the course workload. So, for example, I recently did a course in Computer Vision. If I had started my assessment of the course difficulty by reading through the lecture slides, I would have pretty quickly ran into some deep dark Fourier analysis stuff and fled in terror. Instead, I looked at what would actually be assessed (basically, two programming assignments and a few written problem sets), and decided the course met both my criteria. I ended up being right.

Also, in general, I prefer weighting towards assignments than a final exam. This is because assignment results are much more controllable, and their scope more transparent. They've also been tested and refined on waves of past students, so you know that with a bit of effort you should at least do respectably. So look for that too, although I wouldn't use it as the main criterion (more as a tiebreaker).

At a more macro level, how do you approach course sequencing? As in, course choice over time / in a sequence. Many, myself included, lacked a coherent, synergistic sequence of courses and instead chose things on a more ad-hoc "this looks interesting" basis. Essentially, this is greedily traversing course search space -- opting for locally optimal courses at the long-term expense of deep knowledge in any particular area.

I don't think this approach is ideal. To use an obvious RPG analogy, building your IRL skills is a bit like building the skill tree of a character. You don't aim for breadth in the skill tree. You pump all your points on a few bread-and-butter moves, and anything remaining on synergistic skills. Having said that, prematurely investing in an area you later find uninteresting is also not ideal. Clearly, there's a trade-off between getting locked in an area you may not enjoy and depth of knowledge. This is obviously a judgement call again. My take on it, and maybe this is a bit of a non-answer: know enough to make a career switch viable, but recognise that you'll be competing with people who do know your particular area well. I think in practice, most choices of courses in a CSE program will leave you quite marketable. So I ultimately wouldn't stress too much.

NELSON RIGBY

ENTERTAINMENT

Crossword
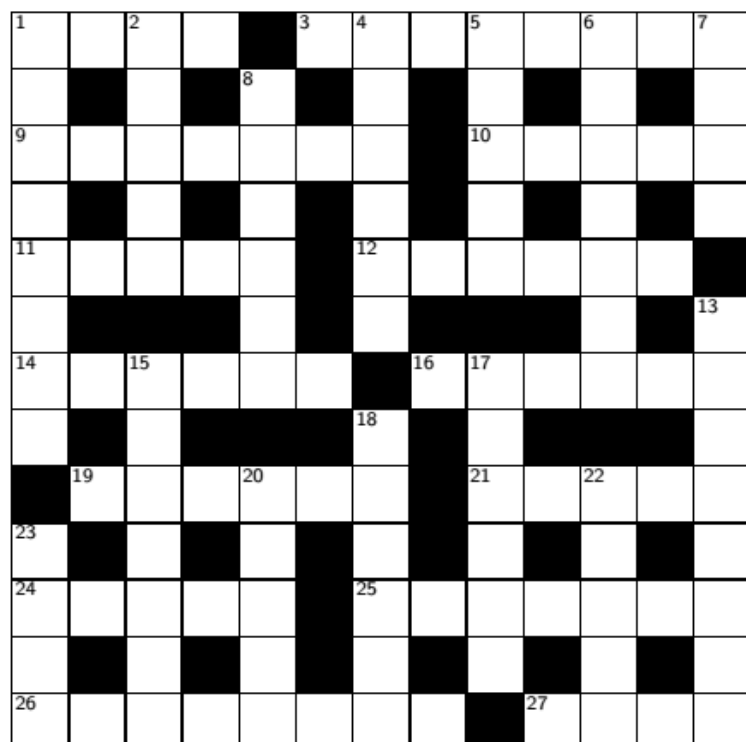
Down
1. Future event
2. Rate of movement
4. Anger or upset
5. Improvise
6. Allow oneself to enjoy
7. Level
8. Measure
13. Subject to pressure
15. Copy
17. Divide in two
18. Small nation in Borneo
20. Section of a song
22. Overweight
23. Fool

OSWYN BRENT

Across
1. Display of excessive concern
3. Monarchist/Imperialist
9. Of the thing just mentioned
10. Soup serving spoon
11. Object detection system
12. Interstellar cloud
14. Video streaming platform
16. OOP - ? Oriented Programming
19. Latin - Argentum
21. Range of requirements of a project
24. Broadcasting
25. Core component
26. Frantic, frenzied
27. CRUD - Create, ?, Update, Delete

Target Puzzle

T	J	T
I	R	G
N	I	E

5 Letters

7 Letters

9 Letters

4 Letters

6 Letters

How to play:
Make as many words as you can out of the letters in the box. You cannot reuse letters, and you must use the letter in the center. Have fun, and don't forget to submit your solutions to:
beta.puzzles@cse.unsw. edu.au

Last week's 9 letter word was: **CIVILISED**

Last week's Crossword:

B	E	D	R	O	O	M		B	E	A	N	S
R		R		N		A		U		R		T
E	P	I	T	A	P	H		G	A	M	M	A
A		F		R		L		L		B		R
M	O	T	T	O		E	L	E	G	A	N	T
				L		R			N		L	
S	T	A	B	L	E		M	E	D	D	L	E
C		L			W		N					
H	I	G	H	T	E	A		V	O	I	C	E
O		E		I		S		I		D		N
L	A	B	E	L		T	W	O	F	O	L	D
A		R		T		E		U		L		E
R	O	A	C	H		D	I	S	U	S	E	D

ENTERTAINMENT

Puzzles!

1. It takes two gardeners 8 days to mow a lawn. One is lazy and one is energetic. The energetic one would only take 12 days to mow it on his own. How many days would the lazy gardener take to mow the lawn on his own?

2. There are 5 girls in a long row. Each girl has a favorite chocolate bar, color, pet, hobby, and would like to go on a certain holiday. All the girls like different things. Find out who owns a crocodile given the following clues:

- Jo likes the Wispa Bite
- The person with the hamster likes swimming
- Hannah eats Dairy Milk
- Jessica is on the left of Georgina
- Lucy is the first on the left
- The first person on the right likes swimming
- The person who eats Milky Bars owns a horse
- The person in the middle eats Dairy Milk
- Jessica likes green
- The person on the left of the middle wants to go to Tobago
- The person who wants to go to the Maldives likes lilac
- The person who likes Wispa Bites sits next to the person who wants to go to Florida
- The person who likes pink wants to go to Florida
- the person who sits first on the left likes lilac
- The girl that likes blue owns a puppy

- The person who likes skiing sits next to the person who has a hamster
- The girl on the right of the girl who likes tennis likes horse riding
- The girl next to the girl who likes Milky Bars likes Boost
- The girl who likes purple wants to got to Canada
- The girl who likes Crunchies owns a rabbit
- The girl who likes skiing sits next to the girl who plays ten-pin bowling
- Jessica wants to go to Australia

Puzzle by pupils from Wadebridge School in Cornwall

3. Replace the letters with numbers to make the following sum true:

$$
\begin{array}{r}
T\ W\ O \\
T\ H\ R\ E\ E \\
+\ S\ E\ V\ E\ N \\
\hline
T\ W\ E\ L\ V\ E
\end{array}
$$

Don't forget to submit your solutions to: **beta.puzzles@cse.unsw.edu.au**

CSESOC BETA TEAM

VOLUME(R) = (4/INT(PI)) * PI * R^INT(PI)

PROGRAMMING TIP: THE NUMBER "3" IS CURSED. AVOID IT.

Note: If replacing all the '3's doesn't fix your code, remove the 4s, too, with 'ceiling(pi) / floor(pi) * pi * r^floor(pi)'. Mmm, floor pie.

ENTERTAINMENT

Overheard

Facing Reality
CSE Student: I feel so underqualified for all of the job listings. *"Must be competent in C#"* It's going to be so hard to get a job.
Arts Student: At least you'll get a job.

Dead or Alive?
In a class discussing John F Kennedy
Student 1: Is JFK still alive?
Student 2: He was president in like the 1960s wasn't he? I think he would be dead now.
Student 1: *(nodding)* Yeah, you're right. He's probably dead.
Student 3: Idiots. JFK is famous for being assassinated.

For the sake of Overheard
Student 1: Beta is awesome!
Student 2: Did you only say that just so you could submit it to the Overheard section?

Ever heard something that sounded slightly strange, wheher in context or not? Send it over to **beta.overheard@cse.unsw.edu.au**, where weird is normal!

CSESOC BETA TEAM

CSE Events and Societies
Upcoming Events

CSESoc Weekly Barbecue
Every Monday 1-2pm
Physics Lawn
Come for your weekly dose of free barbecue, and pick up a fortnightly Beta while you meet your friends, and hopefully make new ones!

First Year Camp
Friday-Sunday 21-23 March (End of Week 3)
Wombaroo Adventure Centre
CSESoc once again brings you its epic First Year Camp, where first years camp!

Microsoft Tech Talk
Wednesday 19 March 10-11am
Seminar Room, Level 1 K17
Microsoft is in the middle of a massive reinvention. Windows Operating System Principal Engineering Manager, Dona Sarkar, will share the company's views around this new Data-Driven Validation Strategy, focus on Data Science, and what it means to be "One Microsoft." She will focus on tough technical challenges the Operating Systems Group is facing, including managing files in a modern way across multiple platforms, including Phone, PCs and Tablets. Bring your resume for a chance to win a new Surface!

Open Gueest Lecture
Wednesday 19 March 10-12pm
OMB 112, Physics Building
Yaron Minsky, the head of the Technology group at Jane Street, will explain the programming language secret behind the success of their approach to quantitative trading. The presentation will give a glimpse into cutting edge language technology and the technical challenges of quantitative trading. Jane Street is always looking for interested graduates, and Yaron will be able to answer questions concerning job prospects.

Jane Street Networking Event
Thursday 20 March 4:30pm
Bar 333 (Shop 1, 333 George Street)
You are invited to a networking event with Jane Street! There will be three Jane Street representatives (Head of Technology, Trader, HR) to do a meet and greet with UNSW CSE students. Food and beverages will also be served.

Startup Expo
Wednesday 19 March 6-9:30pm
Level 1 K17
The main focus of the Expo is to connect the Tech Startup community with our university students and staff, as well as to let Startup people liaise with other Startup people.

Careers Expo
Wednesday 19 March 12:30-4:30pm
Foyer, Level 1 K17
The CSE Careers Expo is open to all companies that sponsor Prizes, Awards or Scholarships for CSE Students and it is a free event. Come and check out a wide variety of companies and grab some free pens!

Git Workshop
Thursday 27 March 2-4pm
TBA
Do you want to learn what git is and why it's an awesome tool for code projects? Do you want to learn an great skill you will keep for your whole coding career? Did you take COMP2041 and only bother to learn three git commands? Are you far too lazy to read tedious things like documentation? This free workshop is for you! Keep your eyes peeled for the location.

CSESoc Beta Team

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