

WORKING IN RESEARCH

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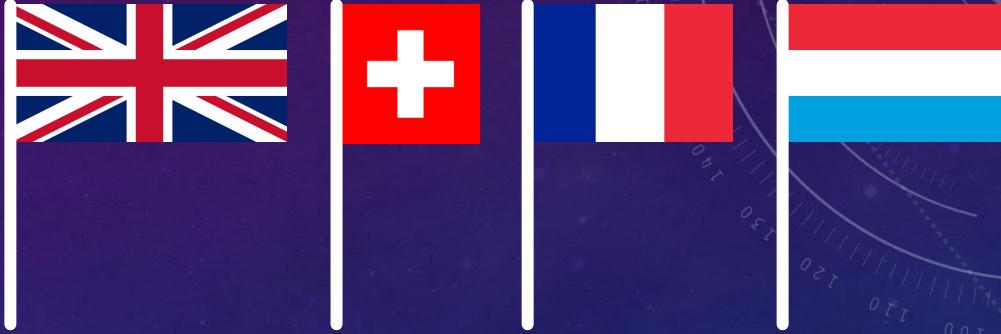
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(VERY) QUICK INTRODUCTION

- I was born in Burnley and I'm 26.
- I speak English and French.
- I have lived in the UK, Switzerland, France and Luxembourg.
- I'm a **researcher** at a research group called **SnT**, in **Luxembourg**.
 - I research things that fit into what I would call Mathematical Computer Science.
- I did my PhD at CERN in Geneva, Switzerland.
- In general, I love maths, computer science, and combining them to do wonderful things ☺



MY PATH SO FAR

- **A-Levels at NCC – Maths, Computing and Physics.**
- **Bachelors degree** (with a year at CERN) in Computer Science and Mathematics at **Manchester**.
- Whilst keeping my Manchester affiliation, I did my **PhD in Computer Science at CERN in Geneva, Switzerland.**
- Now, researcher in Luxembourg + external consultant with CERN.



THE THINGS I DON'T PUT ON MY CV

- A-Levels did not come naturally to me and I had to work really hard!
- At NCC, the only subject in which I had some of the best grades was Computing.
 - Because I'd been programming since I was 13.
- Got a D in my first A-Level maths exam... Jo Turner worked miracles and I eventually got an A overall!
- I did an EPQ and got an E!
- **I only just** got into Manchester's bachelors degree programme.
- I arrived in Manchester expecting to just hang on, and never do very well.

BUT THEN...



Graduated from my bachelors at Manchester with an excellence award



Went to CERN when I was 20

Got a fully-funded PhD position at CERN when I was 22

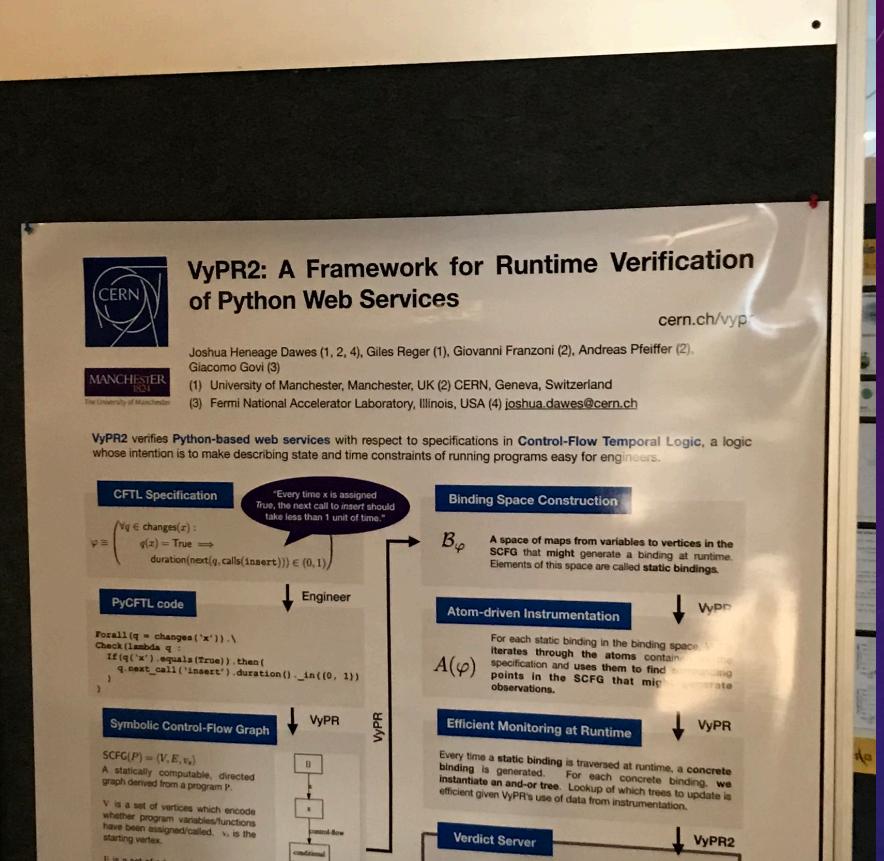


MY FAVOURITE BITS SO FAR

- 4 years at CERN working with extremely talented people.
- Leading a small team at CERN to develop my PhD research.
- Seeing programs run for the first time that took months of theoretical development and software engineering.
Knowing that you're the first person ever to do it is a special feeling 😊

MY FAVOURITE BITS SO FAR

- Giving talks around the world to describe research – I've been fortunate to give talks in the UK, Switzerland, the Czech Republic, Portugal and Australia.
 - That list would have included the US if COVID hadn't happened 😞



MY LEAST FAVOURITE BITS SO FAR

- The PhD was stressful!
- It feels good when you're the first person to do something.... but if it goes wrong.... you're the only person in the world who can fix it!
 - Not normally a problem, but tiredness can make it worse 😞
- For the 3 years of my PhD in Geneva, my partner had to live in the UK.
 - Approximately 60 flights in 3 years – I'm easyjet's biggest fan.

WHAT ABOUT THE RESEARCH?

- In general, I work on developing mathematically-founded ways to analyse computer systems.
- This involves using tools from maths such as graphs, sets, functions, (temporal) logic, differential and integral calculus.
- Problems are usually mixtures of many different areas – we never solve a problem and think “okay this is a differentiation problem”.

WHAT DO I RESEARCH?

How can we formally describe the behaviour of a computer system so that we can automatically check and perform diagnostics when something goes wrong?

- **Key problems**
 - Developing a mathematical formalism with which we can say what should be true during an execution of a computer system.
 - Deciding how to get the information we need out of a computer system in order to check whether things are true.
 - Deciding whether the information we get is what we expect.
 - If the information we got wasn't what we expected, working out why.
- Multiple areas of maths and computer science are needed.
- One problem could need many areas.

WHAT SKILLS DO I USE?

- Mathematics (or whatever the skill equivalent of maths is)
 - In my case maths A-Level, half-maths Bachelors, maths-based PhD
- Programming and Software Engineering
 - If writing the code to solve a problem is difficult, things will be slowed down.
 - I have to write a decent amount of code and design software.
- Public speaking
 - A key part of disseminating and developing research is being able to present it to peers.
- Writing
 - A key part of a researcher's job is writing up work and publishing, as a way to disseminate knowledge.

$\forall i \in R(\downarrow)$
 $\Leftrightarrow \forall v \in \text{verb}(i)$
 $\forall p \in \{\forall v \in \text{verb}: \forall t \in \text{verb}(v) \text{ and } R(v) \neq \emptyset\}$
 such $v \in p$, until the loop inside
 which v lies and
 adjusts v in $\text{verb}(i)$
 for each $t \in \text{verb}(v)$.
 π is a path from i to change
 to p a change. $(\bigcup_{B \in B_1} B(t)) \supseteq \left(\bigcup_{B \in B_2} B(t) \right)$
 all $v \in \text{verb}$
 s.t. v is
 in a loop
 and is an
 instrumentation
 point.
 for any atom a
 we have $\exists t \in \text{verb}(v)$
 $\exists p = \text{verb}^T(p \geq 3)$,
 and nothing exists (not = gives no
 other $a \in T$ exists). If verb^T , then
 $a \in T$.

in a to x , then
 $(\bigcup_{B \in B_1} B(t)) \subseteq (\bigcup_{B \in B_2} B(t'))$
 if a , then
 can exists come e (call to f)
 path π from a to a , home
 in $\bigcup B(t')$. similar for $a \sim a$.
 if f_k is called by f_i ; there are
 minimums D_k and D_i in OR; and
 word is an atom ($\text{duration}(f_k) \leq B$) in $\Phi(t_k)$,
 then all atoms ($\text{duration}(f_p) \leq B_i$) in $\Phi(t_k)$
 must have $(\sum \text{duration}(f_p)) \leq B$ for every cell
 to f_k during Φ_k .
 $n = f(t+g)$ and g before.
 Need to address
 nested instruments (affine home a cell
 time measurement)
 and measurement of time
 lines

My old office at CERN
Geneva, Switzerland

HOW DOES MY RESEARCH WORK?

- We identify a problem, then decide whether there is already something that can be used (somehow).
- From there, we develop the theory that we need.
 - A lot of whiteboards are involved!
 - A lot of mathematical tools are involved!
- We give talks, and see if there's anything we should improve.
- We build tools to see if the maths we've written down behaves as we expect.

WHY I LEFT THE UK

- I never intended to leave the UK...
- But I got a 1-year position at CERN when I was 20, so I got to give it a try!
- After that 1 year in Switzerland, I didn't want to go back.
- Moving country can be daunting!
 - Admin, new culture, new language

THE SMALL MATTER OF NEXT STEPS

- There is a lot of stress around deciding what to do next.
- I can give my opinion on the university path.
- Your choice should be **yours**, not what the people around you tell you is the best option.
- **The most famous university isn't necessarily the one for you.**
- **If you decide to go into research, the place you did your bachelors matters less and less the further away from your bachelors you get.**
 - In my case, pretty much no one cares (either what I studied or where I studied it).
 - Academic prestige is not the only factor – lifestyle, surroundings, language, etc...
 - My biggest regret from my bachelors: **I worked too hard.** Find somewhere where the balance is right for you.

TAKING CARE OF YOURSELF

Success is not worth burning out for.

- Achievement is part of your life, not all of it ☺
- Other aspects are just as important: exercise, eating properly, socialising (maybe not right now...).

In general, it shouldn't be hard to answer the question "What do you do for fun?"

A BIT OF A PARADOX

- During my PhD, I would often think “but I’m enjoying it – why is it a problem if I work 12 hours in a day?”
- Even if you enjoy something, your brain needs a break from it ☺

IF YOU HAVE NO IDEA WHAT TO DO NEXT?

- I was very lucky – I realised very young that I love Computer Science. Maths – not so much.
- I heavily disliked Maths until I was around 18 (thanks Jo!).
- **I took the Maths A-Level because it was a prerequisite for the courses at University that I wanted to do.**
- You may be the same! You may not have realised yet what you're really passionate about.
- To find the thing that makes you want to give up your free time to work.... can take a while 😊

SO TO RECAP

- Find what you love – **you will spend 40 hours of your week in work...** make sure you enjoy it ☺
- Explore – **find where you like to live, learn a new language, do things that aren't related to your studies**
- Remember that work/studying is **a part of** your life. You're allowed to do other things.

ANY QUESTIONS? ☺