ISSN 1754-3657 (Print)
ISSN 1754-3665 (Online)

CS4FN

Computer Science for Fun

Issue 29

Diversity Computing by all, working for all

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The father of robotics

The abandoned baby who became a tech star

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Queen Mary
University of London

Diversity

by Paul Curzon, Queen Mary University of London

The unfortunate, misleading, but self-reinforcing, stereotype that computer science is only for white men is finally being beaten. In fact, from the 1940s when the first computers were built, people from all backgrounds whether male, female, black, white, deaf or blind, gay, straight, and of whatever religion, have been involved, including making key leaps forward. Computing is something anyone can excel at if they put their mind to it and work hard to develop the skills. It is naturally a subject where people from many different disciplines meet and work together and, as we will see, to get computing right it is important for those of all backgrounds to be involved. The way the world works does make it harder for many to get the breaks that let their abilities shine, but there are people working on that too, providing support for those who need the help. This issue will give you a taste of the diversity that has always been there.

Computer science is too important to be left to white men.

Adapted from Karen Spärck Jones

Image by Alexey Hulsov from Pixabay

Black Girls Code

by Jo Brodie and Paul Curzon, Queen Mary University of London

Anyone can learn to code, but not everyone has the opportunity, and many are put off because they feel like outsiders. It doesn't have to be like that though... if we make an effort to help. Kimberly Bryant did.

In 2011 Kimberly's daughter wanted to learn to program but nearly all the students on the nearest courses were boys and there were hardly any African American students enrolled. Kimberly had been enthusiastic about maths and science in school, describing herself as a 'nerdy girl', and went on to study Electrical Engineering with Computer Science and Maths at university. A successful career working in the pharmaceutical, biotechnology and energy industries followed. However, she had felt isolated as an African American girl interested in technology and didn't want her daughter to feel the same … so she created Black Girls Code to provide after-school and summer school coding lessons for African American girls. Kimberly thinks big, so Black Girls Code has a goal of teaching one million black girls to code by 2040 … and every year thousands have been doing so.

She has made a big difference and has received awards and recognition for the support she has given to girls in her local community and beyond. In 2013, she was included on a list of the 25 most influential African Americans in technology and when Barack Obama was the US President, the White House website honoured her as one of its eleven Champions of Change in Tech Inclusion – Americans who are "doing extraordinary things to expand technology opportunities for young learners – especially minorities, women and girls, and others from communities historically underserved or underrepresented in tech fields."

If you see a problem and have the ability to make a difference, then do it. Computing skills are now important for everyone to learn. Perhaps, you feel aiming for helping a million is beyond you? So start small! Perhaps create your own club, just to help your friends or classmates learn to code (it's fun) and work from there.

Images by Gerd Altmann and Valéria Rodrigues Valéria from Pixabay

Protecting your fridge

by Jo Brodie and Paul Curzon, Queen Mary University of London

Ever been spammed by your fridge? It has happened, but Queen Mary's Gokop Goteng and Hadeel Alrubayyi aim to make it less likely…

Gokop has a longstanding interest in improving computing networks and did his PhD on cloud computing (at the time known as grid computing), exploring how computing could be treated more like gas and electricity utilities where you only pay for what you use. His current research is about improving the safety and efficiency of the cloud in handling the vast amounts of data, or 'Big Data', used in providing Internet services. Recently he has turned his attention to the Internet of Things.

It is a network of connected devices, some of which you might have in your home or school, such as smart fridges, baby monitors, door locks, lighting and heating that can be switched on and off with a smartphone. These devices contain a small computer that can receive and send data when connected to the Internet, which is how your smartphone controls them. However, it brings new problems: any device that's connected to the Internet has the potential to be hacked, which can be very harmful. For example, in 2013 a domestic fridge was hacked and included in a 'botnet' of devices which sent thousands of spam emails before it was shut down (can you imagine getting spam email from your fridge?!)

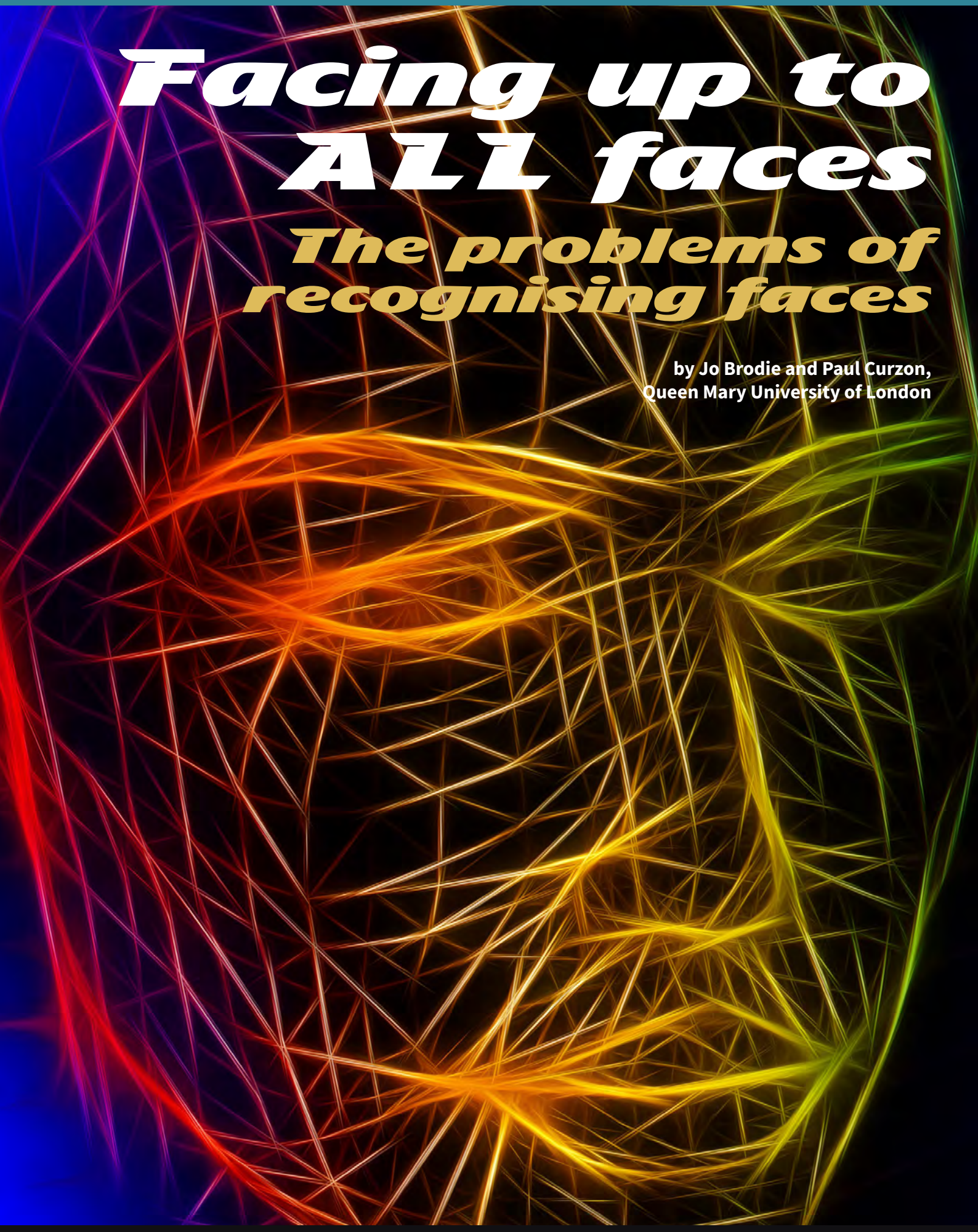
A domestic fridge was hacked and included in a 'botnet' of devices which sent thousands of spam emails before it was shut down

The computers in these devices don't usually have much processing power: they're smart, but not that smart. This is perfectly fine for normal use, but to run software to keep out hackers, while getting on with the actual job they are supposed to be doing, like running a fridge, it becomes a problem. It's important to prevent devices from being infected with malware (bad programs that hackers use to e.g., take over a computer) and work done by Gokop and others has helped develop better malware-detecting security algorithms which take account of the smaller processing capacity of these devices.

One approach he has been exploring with PhD student Hadeel Alrubayyi is to draw inspiration from the human immune system: building artificial immune systems to detect malware. Your immune system is very versatile and able to quickly defend you against new bugs that you haven't encountered before. It protects you from new illnesses, not just illnesses you have previously fought off. How? Using special blood cells, such as T-Cells, which are able to detect and attack rogue cells invading the body. They can spot patterns that tell the difference between the person's own healthy cells and rogue or foreign cells. Hadeel and Gokop have shown that applying similar techniques to Internet of Things software can outperform other techniques for spotting new malware, detecting more problems while needing less computing resources.

Gokop is also using his skills in cloud computing and data science to enhance student employability and explore how Queen Mary can be a better place for everyone to do well. Whether a person, organisation or smart fridge Gokop aims to help you reach your full potential!

Image by Gerd Altmann from Pixabay



Facing up to ALL faces

The problems of recognising faces

by Jo Brodie and Paul Curzon,
Queen Mary University of London

How face recognition technology caused the wrong Black man to be arrested.

The police were waiting for Robert Williams when he returned home from work in Detroit, Michigan. They arrested him for robbery in front of his wife and terrified daughters aged two and five and took him to a detention centre where he was kept overnight. During his interview an officer showed him two grainy CCTV photos of a suspect alongside a photo of Williams from his driving licence. All the photos showed a large Black man, but that's where the similarity ended. It wasn't Williams on CCTV but a completely different man. Williams held up the photos to his face and said "I hope you don't think all Black people look alike", the officer replied that "the computer must have got it wrong."

Williams' problems began several months before his arrest when video clips and images of the robbery from the CCTV camera were run through face recognition software used by the Detroit Police Department. The system has access to the photos from everyone's driving licence and compares faces until it finds a potential match. In this case it falsely identified Robert Williams. No system is ever perfect, but studies have shown that face recognition technology is often better at correctly matching lighter skinned faces than darker skinned ones.

Check the signature

The way face recognition works is not actually by comparing pictures, but by comparing data. When a picture of a face is added to the system, lots of measurements are taken such as how far apart the eyes are, or what the shape of the nose is. This gives a signature for each face made up of all the numbers. That signature is added to the database. When looking for a match, from say a CCTV image, the signature of the new image is first determined. Then algorithms look for the signature in the database "nearest" to the new one. How well it works depends on the particular features chosen, amongst many other things. If the features chosen are a poor way to distinguish particular groups of people then there will be lots of bad matches. But how does it decide what is "nearest" anyway given it is essentially just comparing groups of numbers? Many algorithms are based on machine learning. The system might be trained on lots of faces and told which match and which don't, allowing it to look for patterns that are good ways to predict matches. If, however, it is trained on mainly light skinned faces it is likely to be bad at spotting matches for faces of other ethnic backgrounds. It may actually decide that "all black people look alike".

Biassing the investigation

However, face recognition is only part of the story. A potential match is only a pointer towards someone who might be a suspect and it's certainly not a 'case closed' conclusion: there's still work to be done to check and confirm. But as Williams' lawyer, Victoria Burton-Harris, pointed out, once the computer had suggested Williams as a suspect that "framed and informed everything that officers did subsequently". The man in the CCTV image wore a red baseball cap. It was for a team that Williams didn't support (he's not even a baseball fan) but no-one asked him about it. They also didn't ask if he was in the area at the time (he wasn't) or had an alibi (he did). Instead, the investigators asked a security guard at the shop where the theft took place to look at some photos of possible suspects and he picked Williams from the line-up of images. Unfortunately, the guard hadn't been on duty on the day of the theft and had only seen the CCTV footage.

Robert Williams spent 30 hours in custody for a crime he didn't commit after his face was mistakenly selected from a database. He was eventually released and the case dropped but his arrest is still on record along with his 'mugshot', fingerprints and a DNA sample. In other words he was wrongly picked from one database and has now been unfairly added to another. The experience for his whole family has been very traumatic and sadly his children's first encounter with the police has been a distressing rather than a helpful one.

Remove the links

The American Civil Liberties Union (ACLU) has filed a lawsuit against the Detroit Police Department on Williams' behalf for his wrongful arrest. It's not known how many people have been arrested because of face recognition technology but given how widely it's used it's likely that others will have been misidentified too. The ACLU and Williams have asked for a public apology, for his police record to be cleared and for his images to be removed from any face recognition database. They've also asked that the Detroit Police Department stop using face recognition in their investigations. If Robert Williams had lived in New Hampshire he'd never have been arrested as there is a law there which prevents face recognition software from being linked with driving licence databases.

In June 2020, Amazon, Microsoft and IBM denied the police any further access to their face recognition technology and IBM has also said that it will no longer work in this area because of concerns about racial profiling (targeting a person based on assumptions about their race instead of their individual actions) and violations of privacy and human rights. Campaigners are asking for a new law that protects people if this technology is used in future. But the ACLU and Robert Williams are asking for people to just stop using it – "I don't want my daughters' faces to be part of some government database. I don't want cops showing up at their door because they were recorded at a protest the government didn't like."

Technology is only as good as the data and the algorithms it is based on. However, that isn't the whole story. Even if very accurate, technology is only as good as the way it is used. If as a society we want to protect people from bad things happening, perhaps some technologies should not be used at all.

Image by Gerd Altmann from Pixabay

The gender shades audit

by Jo Brodie, Queen Mary University of London

Face recognition technology is used widely, such as at passport controls and by police forces. What if it isn't as good at recognising faces as it has been claimed to be? Joy Buolamwini and Timnit Gebru tested three different commercial systems and found that they were much more likely to wrongly classify darker skinned female faces compared to lighter or darker skinned male faces. The systems were not reliable.

Face recognition systems are trained to detect, classify and even recognise faces based on a bank of photographs of people. Joy and Timnit examined two banks of images used to train the systems and found that around 80 percent of the photos used were of people with lighter coloured skin. If the photographs aren't fairly balanced in terms of having a range of people of different gender and ethnicity then the resulting technologies will inherit that bias too. The systems examined were being trained to recognise light skinned people.

The pilot parliaments benchmark

Joy and Timnit decided to create their own set of images and wanted to ensure that these covered a wide range of skin tones and had an equal mix of men and women ('gender parity'). They did this using photographs of members of parliaments around the world which are known to have a reasonably equal mix of men and women. They selected parliaments both from countries with mainly darker skinned people (Rwanda, Senegal and South Africa) and from countries with mainly lighter skinned people (Iceland, Finland and Sweden).

They labelled all the photos according to gender (they had to make some assumptions based on name and appearance if pronouns weren't available) and used a special scale called the Fitzpatrick scale to classify skin tones (see **Different Shades** below). The result was a set of photographs labelled as dark male, dark female, light male, light female, with a roughly equal mix across all four categories: this time, 53 per cent of the people were light skinned (male and female).

Testing times

Joy and Timnit tested the three commercial face recognition systems against their new database of photographs (a fair test of a wide range of faces that a recognition system might come across) and this is where they found that the systems were less able to correctly identify particular groups of people. The systems were very good at spotting lighter skinned men, and darker skinned men, but were less able to correctly identify darker skinned women, and women overall. The tools, trained on sets of data that had a bias built into them, inherited those biases and this affected how well they worked.

As a result of Joy and Timnit's research there is now much more recognition of the problem, and what this might mean for the ways in which face recognition technology is used. There is some good news, though. The three companies made changes to improve their systems and several US cities have already banned the use of this technology in criminal investigations, with more likely to follow. People worldwide are more aware of the limitations of face recognition programs and the harms to which they may be (perhaps unintentionally) put, with calls for better regulation.

Different shades

The Fitzpatrick skin tone scale is used by skin specialists to classify how someone's skin responds to ultraviolet light. There are six points on the scale with 1 being the lightest skin and 6 being the darkest. People whose skin tone has a lower Fitzpatrick score are more likely to burn in the sun and are at greater risk of skin cancer. People with higher scores have darker skin which is less likely to burn and have a lower risk of skin cancer.

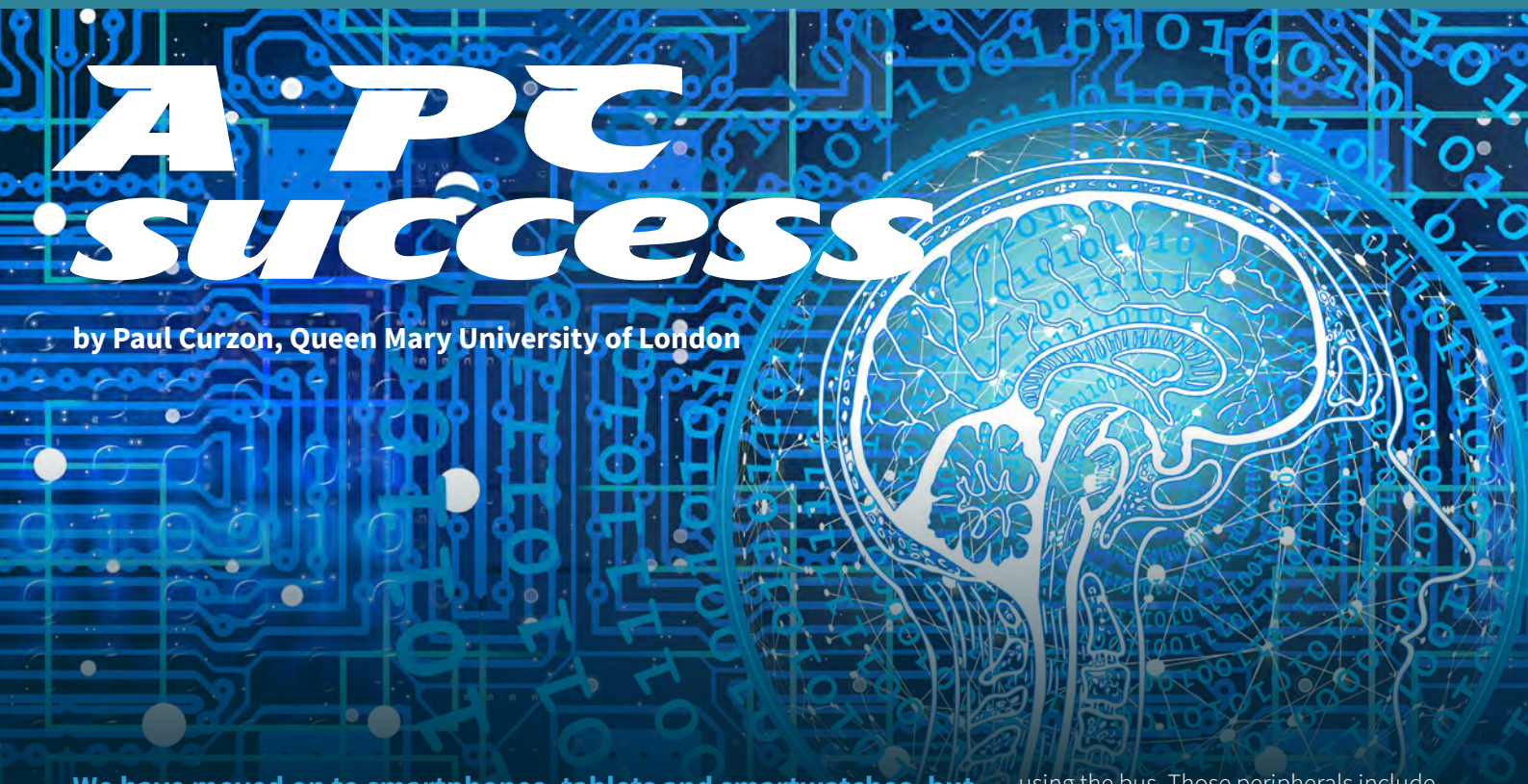
A variation of the Fitzpatrick scale, with five points, is used to create the skin tone emojis that you'll find on most messaging apps in addition to the 'default' yellow.

Image by Stefan Schweihofer from Pixabay

Inset image: John D'Orazio, Stuart Jarrett, Alexandra Amaro-Ortiz and Timothy Scott, CC BY 3.0 via Wikimedia Commons

A PC success

by Paul Curzon, Queen Mary University of London



We have moved on to smartphones, tablets and smartwatches, but for 30 years the desktop computer ruled, and originally not just any desktop computer, the IBM PC. A key person behind its success was African American computer scientist, Mark Dean

IBM is synonymous with computers. It became the computing industry powerhouse as a result of building large, room-sized computers for businesses. The original model of how computers would be used followed IBM's president, Thomas J Watson's, supposed quote that "there is a world market for about five computers." They produced gigantic computers that could be dialled into by those needed computing time. That prediction was very quickly shown to be wrong, though, as computer sales boomed.

Becoming more personal

By the end of the 1970s the computing world was starting to change. Small, but powerful, mini-computers had taken off and some companies were pushing the idea of computers for the desktop. IBM was at risk of being badly left behind… until they suddenly roared back into the lead with the IBM personal computer and almost overnight became the world leaders once more, revolutionising the way computers were seen, sold and used. Their predictions were still a little off with initial sales of the IBM PC 8 times more than they expected! Within a few years they were selling many hundreds of thousands a year and making billions of dollars. Soon every office desk had one and PC had become an everyday word used to mean computer.

Get on the bus

So who was behind this remarkable success? One of the design team who created the IBM PC was Mark Dean. As a consequence of his work on the PC, he became the first African American to be made an IBM fellow (IBM's highest honour). One of his important contributions was in leading the development of the PC's bus. Despite the name, a computer bus is more like a road than a vehicle, so its other name of data highway is perhaps better. It is the way the computer chip communicates with the outside world. A computer on its own is not really that useful to have on your desktop. It needs a screen, keyboard and so on. A computer bus is a bit like your nervous system used to send messages from your brain around your body. Just as your brain interacts with the world receiving messages from your senses, and allowing you to take action by sending messages to your muscles, all using your nervous system, a computer chip sends signals to its peripherals using the bus. Those peripherals include things like mouse, keyboard, printers, monitors, modems, external memory devices and more; the equivalents of its way of sensing the world and interacting with it. The bus is in essence just a set of connectors into the chip so wires out with different allocated uses and a set of rules about how they are used. All peripherals then follow the same set of rules to communicate to the computer. It means you can easily swap peripherals in and out (unlike your body!) Later versions of the PC bus, that Mark designed, ultimately became an industry standard for desktop computers.

> Mark Dean was the first African American to receive IBM's highest honour.

Mark can fairly be called a key member of that PC development team, given he was responsible for a third of the patents behind the PC. He didn't stop there though. He has continued to be awarded patents, most recently related to artificial neural networks inspired by neuroscience. He has moved on from making computer equivalents of the nervous system to computer equivalents of the brain itself.

Image by Gerd Altmann from Pixabay

In space, no one can hear you...

by Paul Curzon, Queen Mary University of London

Image by SnottyBoggins from Pixabay

Johanna Lucht could do maths before she learned language. Why? Because she was born deaf and there was little support for deaf people where she lived. Despite, or perhaps because of, that she became a computer scientist and works for NASA.

Being deaf can be very, very disabling if you don't get the right help. As a child, Johanna had no one to help her to communicate apart from her mother. She tried to teach Johanna sign language from a book. Throughout most of her primary school years she couldn't have any real conversations with anyone, never mind learn. She got the lifeline she needed, when the school finally took on an interpreter, Keith Wann, to help her. She quickly learned American Sign Language working with him. Learning your first language is crucial to learning other things and suddenly she was able to learn in school like other children. She caught up remarkably quickly, showing that an intelligent girl had been locked in that silent, shy child. More than anything though, from Keith, she learned never to give up.

Her early ability in maths, now her favourite subject, came to the fore as she excelled at science and technology. By this point her family had moved from Germany where she grew up to Alaska where there was much more support, an active deaf community for her to join and lots more opportunities that she started to take. She signed up for a special summer school on computing specifically for deaf people at the University of Washington, learning the programming skills that became the foundation for her future career at NASA. At only 17 she even returned to help teach the course. From there, she signed up to do Computer Science at university and applied for an internship at NASA. To her shock and delight she was given a place.

Hitting the ground running

A big problem for pilots especially of fighter aircraft is that of "controlled flight into terrain": a technical sounding phrase that just means flying the plane into the ground for no good reason other than how difficult flying a fighter aircraft as low as possible in hazardous terrain is. The solution is a ground collision avoidance system: basically the pilots need a computer to warn them when hazardous terrain is coming up and when they are too close for comfort, and so should take evasive action. Johanna helped work on the interface design, so the part that pilots see and interact with. To be of any use in such high-pressure situations this communication has to be slick and very clear.

She impressed those she was working with so much that she was offered a full time job and so became an engineer at NASA Armstrong working with a team designing, testing and integrating new research technology into experimental aircraft. She had to run tests with other technicians, the first problem being how to communicate effectively with the rest of the team. She succeeded twice as fast as her bosses expected, taking only a couple of days before the team were all working well together. Her experience from the challenges she had faced as a child were now providing her with the skills to do brilliantly in a job where teamwork and communication skills are vital.

Mission control

Eventually, she gained a place in Mission Control. There, slick comms are vital too. The engineers have to monitor the flight including all the communication as it happens, and be able to react to any developing situation. Johanna worked with an interpreter who listened directly to all the flight communications, signing it all for her to see on a second monitor. Working with interpreters in a situation like this is in itself a difficult task and Johanna had to make sure not only that they could communicate effectively but that the interpreter knew all the technical language that might come up in the flight. Johanna had plenty of experience dealing with issues like that though, and they worked together well, with the result that in April 2017 Johanna became the first deaf person to work in NASA mission control on a live mission … where of course she did not just survive the job, she excelled.

As Johanna has pointed out it is not deafness itself that disables people, but the world deaf people live in that does. When in a world that wasn't set up for deaf people, she struggled, but as soon as she started to get the basic help she needed that all changed. Change the environment to one that does not put up obstacles and deaf people can excel like anyone else. In space no one can hear anyone scream or for that matter speak. We don't let it stop our space missions though. We just invent appropriate technology and make the problems go away.

Image by Bruno Albino from Pixabay

Clarence Ellis: writing together

by Paul Curzon, Queen Mary University of London

Back in 1956, Clarence Ellis started his career at the very bottom of the computer industry. He was given a job, at the age of 15, as a "computer operator" … because he was the only applicant. He was also told that under no circumstances should he touch the computer! It's lucky for all of us that he got the job, though! He went on to develop ideas that have made computers easier for everyone to use. Working at a computer was once a lonely endeavour: one person, on one computer, doing one job. Clarence Ellis helped change that. He pioneered ways for people to use computers together effectively.

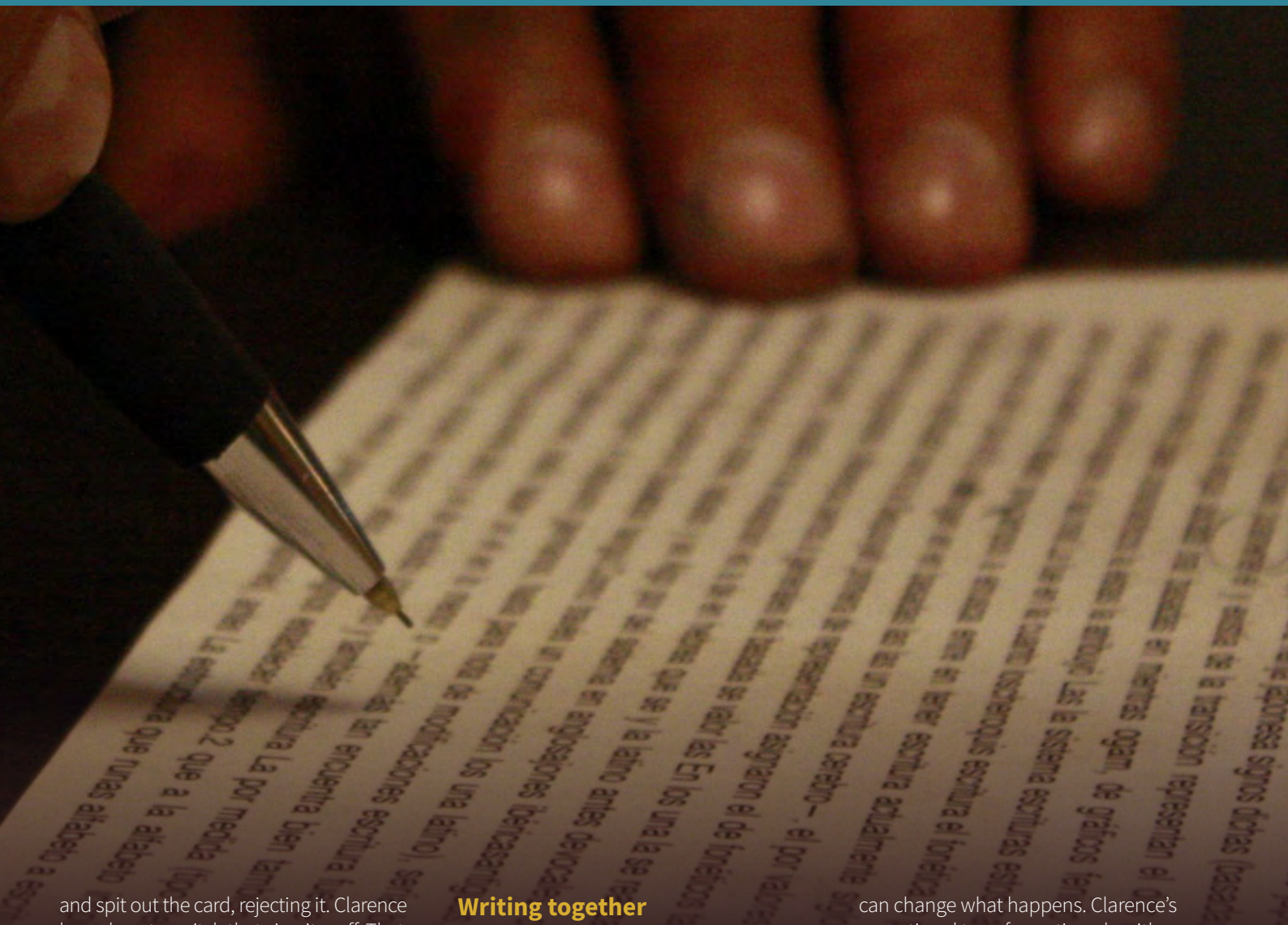
The graveyard shift

The company Clarence first worked for had a new computer. Just like all computers back then, it was the size of a room. He worked the graveyard shift and his duties were more those of a nightwatchman than a computer operator. It could have been a dead-end job, but it gave him lots of spare time and, more importantly, access to all the computer's manuals … so he read them … over and over again. He didn't need to touch the computer to learn how to use it!

Saving the day

His studying paid dividends. Only a few months after he started, the company had a potential disaster on its hands. They ran out of punch cards. Back then punch cards were used to store both data and programs. They used patterns of holes and non-holes as a way to store numbers as binary in a way that a computer could read them. Without punch cards the computer could not work!

It had to though, because the payroll program had to run before the night was out. If it didn't then no-one would be paid that month. Because he had studied the manuals in detail, and more so than anyone else, Clarence was the only person who could work out how to reuse old punch cards. The problem was that the computer used a system called 'parity checking' to spot mistakes. In its simplest form parity checking of a punch card involves adding an extra binary digit (an extra hole or no-hole) on the end of each number. This is done in a way that ensures that the number of holes is even. If there is an even number of holes already, the extra digit is left as a non-hole. If, on the other hand there is an odd number of holes, a hole is punched as the extra digit. That extra binary digit isn't part of the number. It's just there so the computer can check if the number has been corrupted. If a hole was accidentally or otherwise turned into a non-hole (or vice versa), then this would show up. It would mean there was now an odd number of holes. Special circuitry in the computer would spot this



and spit out the card, rejecting it. Clarence knew how to switch that circuitry off. That meant they could change the numbers on the cards by adding new holes without them being rejected.

After that success he was allowed to become a real operator and was relied on to troubleshoot whenever there were problems. His career was up and running.

Clicking icons

He became the first Black man to gain a doctorate in Computer Science and later worked at Xerox Parc, a massively influential research centre. He was part of the team that invented graphical user interfaces (GUIs). With GUIs Xerox Parc completely transformed the way we used computers. Instead of typing obscure and hard to remember commands, they introduced the now standard ideas of windows, icons, dragging and dropping, using a mouse, and more. Clarence, himself, has been credited with inventing the idea of clicking on an icon to run a program.

Writing together

As if that wasn't enough of an impact, he went on to help make groupware a reality: software that supports people working together. His focus was on software that let people write a document together. With Simon Gibbs, he developed a crucial algorithm called Operational Transformation. It allows people to edit the same document at the same time without it becoming hopelessly muddled. This is actually very challenging. You have to ensure that two (or more) people can change the text at exactly the same time, and even at the same place, without each ending up with a different version of the document.

The actual document sits on a server computer. It must make sure that its copy is always the same as the ones everyone is individually editing. When people type changes into their local copy, the lead copy is sent messages informing it of the actions they performed. The trouble is the order that those messages arrive can change what happens. Clarence's operational transformation algorithm solved this by changing the commands from each person into ones that work consistently whatever order they are applied. It is the transformed operation that is the one that is applied to the lead copy. That copy is the version everyone then sees as their local copy. Ultimately, everyone sees the same version. This algorithm is at the core of programs like Google Docs that have ensured collaborative editing of documents is now commonplace. (That is how we write the CS4FN magazine!)

Clarence Ellis started his career with a lonely job. By the end of his career he had helped ensure that writing on a computer at least no longer needs to be a lonely affair.

Find out more about Clarence Ellis by listening to the Red Hat episode (Season 6) of Command_Line Heroes about him. See www.redhat.com/command-line-heroes

Image by Quidec Pacheco from Pixabay

The abandoned baby who became a runaway telecom tech star

by Jo Brodie, Queen Mary University of London

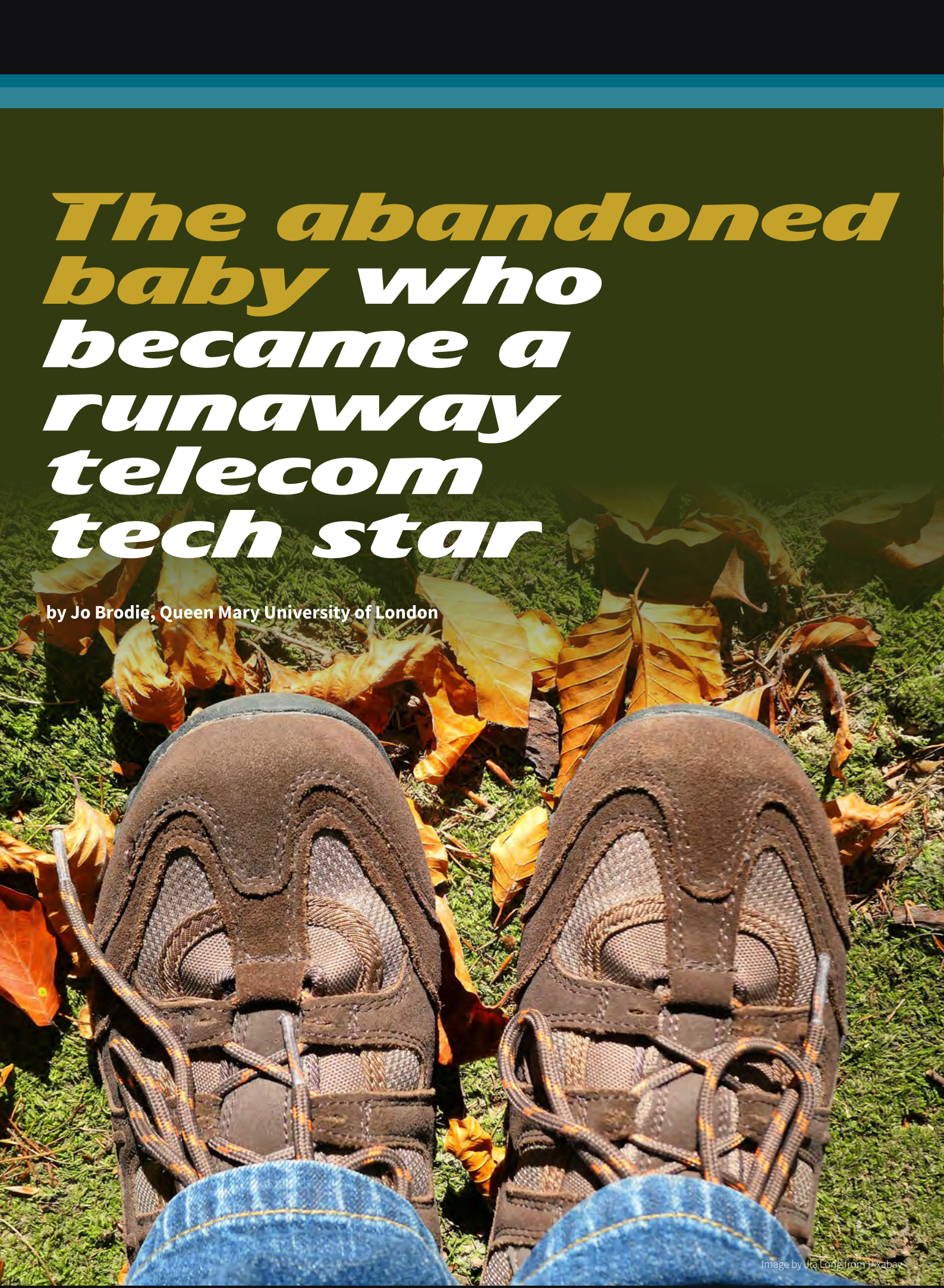
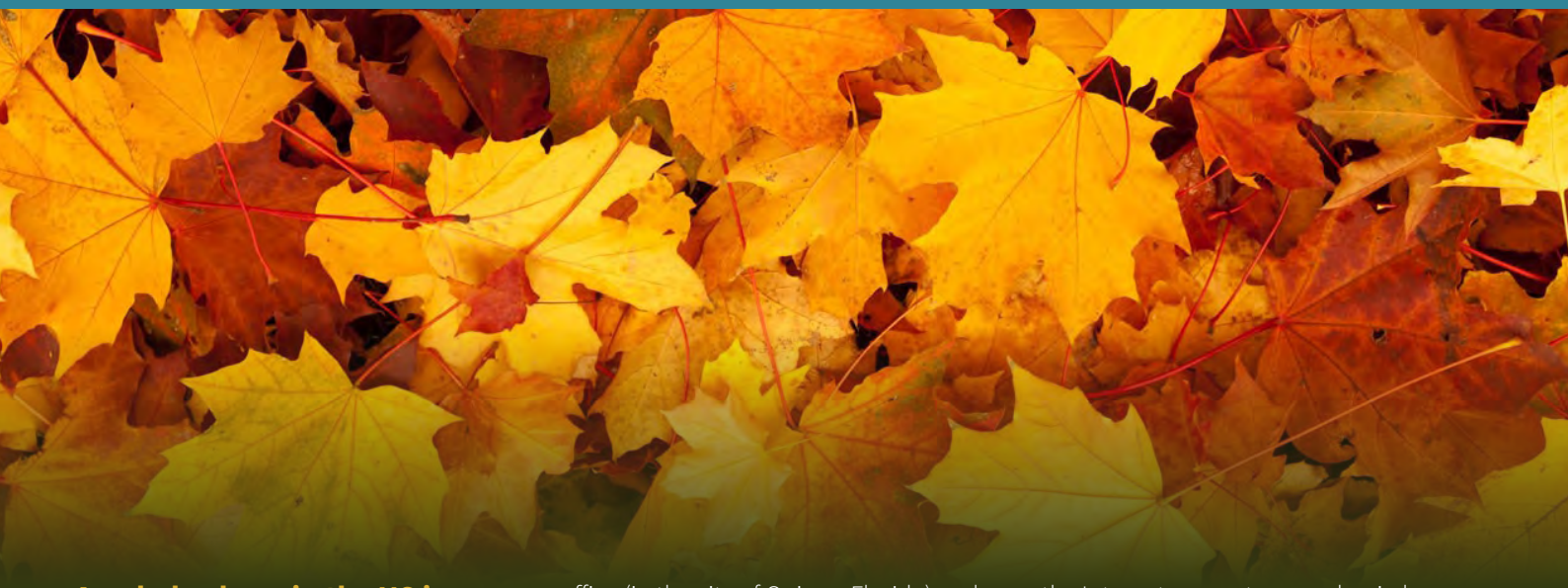


Image by Jia Long from Pixabay



As a baby, born in the US in 1989, Freddie Figgers was abandoned by his biological parents. He was brought up with love and kindness by two much older adoptive parents who kindled his early enthusiasm for contraptions and especially for fixing things which then inspired his work in smart health. He now runs the first Black-owned telecommunications company in the US.

Fixing things

When Freddie was 9 his father bought him an old (broken) computer from a charity shop to play around with. He'd previously enjoyed tinkering with his father's collection of radios and alarm clocks and when he opened up the computer could see which of its components and soldering links were broken. He spotted that he could replace these with the same kinds of components from one of his dad's old radios and, after several attempts, soon his computer was working again: Freddie was hooked, and he started to learn how to code.

When he was 12 he attended an after-school club and set to work fixing the school's broken computers. His skill impressed the club's leader, who also happened to be the local Mayor, and soon Freddie was being paid several dollars an hour to repair computers for the Mayor's office (in the city of Quincy, Florida) and her staff. A few years later Quincy needed a new system to ensure that everyone's water pressure was correct. A company offered to create software to monitor the water pressure gauges and said it would cost $600,000. Freddie, now 15 and still working with the Mayor, offered to create a low-cost program of his own, saving the city thousands in doing so.

Head in the cloud

He was soon offered other contracts and used the money coming in to set up his own computing business. He heard about an insurance company in another US city whose offices had been badly damaged by a tornado and lost all of their customers' records. That gave him the idea to set up a cloud computing service with the data stored in multiple places so that if one is damaged then the data can easily be recovered from the others.

Follow those shoes

His father, now quite elderly, had dementia and regularly wandered off and got lost. Freddie found an ingenious way to help him by rigging up one of his dad's shoes with a GPS detector and two-way communication connected to his computer. If his dad was missing Freddie could talk to him through his shoe, find out where he was and go and get him. Freddie later sold his shoe tracker for over $2 million

Telecom star

Living in a rural area, he knew that mobile phone coverage and access to the Internet was not as good as in larger cities. Big telecommunications companies are not keen to invest their money and equipment in areas with much smaller populations so instead Freddie decided to set up his own. It took him quite a few applications to the US' Federal Communications Commission, who regulate Internet and phone providers, but eventually, at 21, he was both the youngest and the first Black person in the US to own a telecoms company.

Most telecoms companies just provide a network service but his company also creates affordable smart phones which have 'multi-user profiles' (meaning that phones can be shared by several people in a family, each with their own profile). The death of his mother's uncle, from a diabetic coma, also inspired him to create a networked blood glucose meter that can link up wirelessly to any mobile phone. This not only lets someone share their blood glucose measurements with their healthcare team, but also with close family members who can help keep them safe while their glucose levels are too high or too low.

Hidden Figgers help

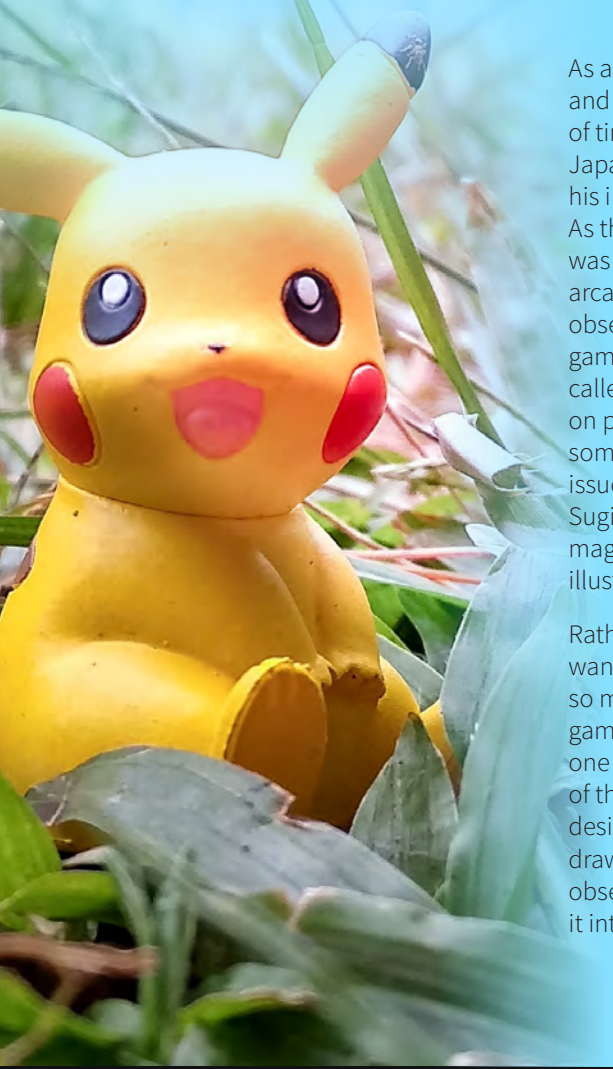
Freddie has created many tools to help people in different ways through his work in health and communications. He is even helping the next generation too. He's created a 'Hidden Figgers' scholarship to encourage young people in the US to take up tech careers, so perhaps we'll see a few more fantastic folk like Freddie Figgers in the future.

Image by PublicDomainImages from Pixabay

Collecting minibeasts and pocket monsters

by Paul Curzon, Queen Mary University of London

Satoshi Tajiri created one of the biggest money-making media franchises of all time. It all started with his love of nature and, in particular, minibeasts. It also eventually took gamers back into the fresh air.



As a child, Satoshi Tajiri, loved finding and collecting minibeasts, so spent lots of time outside, exploring nature. But, as Japan became more and more built up, his insect searching haunts disappeared. As the natural world disappeared he was drawn instead inside to video game arcades and those games became a new obsession. He became a super-fan of games and even created a game fanzine called Game Freak where he shared tips on playing different games. It wasn't just something he sold to friends either: one issue sold 10,000 copies. An artist, Ken Sugimori, who started as a reader of the magazine, ultimately joined Satoshi, illustrating the magazine for him.

Rather than just writing about games, they wanted to create better ones themselves, so morphed Game Freak into a computer game company, ultimately turning it into one of the most successful ever. The cause of that success was their game *Pokémon*, designed by Satoshi with characters drawn by Ken. It took the idea of that first obsession, collecting minibeasts, and put it into a fun game with a difference.

It wasn't about killing things, but moving around a game world searching for, taming and collecting monsters. The really creative idea, though, came from the idea of trading. There were two versions of the game and you couldn't find all the creatures in your own version. To get a full set you had to talk to other people and trade from your collection. It was designed to be a social game from the outset.

It has been suggested that Satoshi is neuro-diverse. Whether he is or not, autistic people (as well as everyone else) found that *Pokémon* was a great way to make friends, something autistic people often find difficult. *Pokémon*, also became more than just a game, turning into a massive media franchise, with trading cards to collect, an animated series and a live action film. It also later sparked a second game craze when *Pokémon Go* was released. It combined the original idea with augmented reality, taking all those gamers back outside for real, searching for (virtual) beasts in the real world.

Image by Ramadhan Notonegoro from Pixabay

Al-Jazari: the father of robotics

by Paul Curzon, Queen Mary University of London

Science fiction films are full of humanoid robots acting as servants, workers, friends or colleagues. The first were created during the Islamic Golden Age, a thousand years ago.

Image from wikipedia

Robots and automata have been the subject of science fiction for over a century, but their history in myth goes back millennia, but so does the actual building of lifelike animated machines. The Ancient Greeks and Egyptians built Automata, animal or human-like contraptions that seemed to come to life. The early automata were illusions that did not have a practical use, though, aside from entertainment or just to amaze people.

It was the great inventor of mechanical gadgets Ismail Al-Jazari from the Islamic Golden Age of science, engineering and art in the 12th century, who first built robot-like machines with actual purposes. Powered by water, his automata acted as servants doing specific tasks. One machine was a humanoid automaton that acted as a servant during the ritual purification of hand washing before saying prayers. It poured water into a basin from a jug and then handed over a towel, mirror and comb. It used a toilet style flushing mechanism to deliver the water from a tank. Other inventions included a waitress automaton that served drinks and robotic musicians that played instruments from a boat. It may even have been programmable.

We know about Al-Jazari's machines because he not only created mechanical gadgets and automata, he also wrote a book about them: The Book of Knowledge of Ingenious Mechanical Devices. It's possible that it inspired Leonardo Da Vinci who, in addition to being a famous painter of the Italian Renaissance, was a prolific inventor of machines.

Such "robots" were not everyday machines. The hand washing automata was made for the King. Al-Jazari's book, however, didn't just describe the machines, it explained how to build them: possibly the first text book to cover Automata. If you weren't a King, then perhaps you could, at least, have a go at making your own servants.

Image by TheUnitala from Pixabay

Reclaim your name

by Jo Brodie and Paul Curzon, Queen Mary University of London

In June 2021 the Canadian government announced that Indigenous people would be allowed to use their ancestral family names on government-issued identity and travel documents. This meant that, for the first time, they could use the names that are part of their heritage and culture rather than the westernised names that are often used instead. Because of computers, it wasn't quite as easy as that though …

Some Indigenous people take on a Western name to make things easier, to simplify things for official forms, to save having to spell the name, even to avoid teasing. If it is a real choice then perhaps that is fine, though surely we should be able to make it easy for people to use their actual names. For many it was certainly not a choice, their Indigenous names were taken from them. From the 19th century, hundreds of thousands of Indigenous children in Canada were sent to Western schools and made to take on Western names as part of an attempt to force them to "assimilate" into Western society. Some were even beaten if they did not use their new name. Because their family names had been "officially" changed, they and their descendants had to use these new names on official documents. Names matter. It is your identity, and in some cultures family names are also sacred. Being able to use them matters.

The change to allow ancestral names to be used was part of a reconciliation process to correct this injustice. After the announcement, Ta7talíya Nahanee, an indigenous woman from the Squamish community in Vancouver, was delighted to learn that she would be able to use her real name on her official documents, rather than 'Michelle' which she had previously used.

Unfortunately, she was frustrated to learn that travel documents could still only include the Latin alphabet (ABCDEFG etc) with French accents (À, Á, È, É etc). That excluded her name (pronounced Ta-taliya, the 7 is silent) as it contains a number and the letter í. Why? Because the computer said so!

Modern machine-readable passports have a specific area, called the Machine Readable Zone which can be read by a computer scanner at immigration. It has a very limited number of permitted characters. Names which don't fit need to be "transliterated", so Å would be written as AA, Ü as UE and the German letter ß (which looks like a B but sounds like a double S) is transliterated as SS. Names are completely rewritten to fit, so Müller becomes MUELLER, Gößmann becomes GOESSMANN, and Hämäläinen becomes HAEMAELAEINEN. If you've spent your life having your name adapted to fit someone else's system this is another reminder of that.

While there are very sensible reasons for ensuring that a passport from one part of the world can be read by computers anywhere else, this choice of characters highlights that, in order to make things work, everyone else has been made to fall in line with the English-speaking population, another example of an unintentional bias. It isn't, after all, remotely beyond our ability to design a system that meets the needs of everyone, it just needs the will. Designing computer systems isn't just about machines. It's about designing them for people.

Image by tookapic from Pixabay

Black in Data

by Paul Curzon, Queen Mary University of London

Careers do not have to be decided on from day one. You can end up in a good place in a roundabout way. That is what happened to Sadiqah Musa, and now she is helping make the paths easier for others to follow.

Sadiqah went to university at QMUL expecting to become an environmental scientist. Her first job was as a geophysicist analysing seismic data. It was a job she thought she loved and would do forever. Unfortunately, she wasn't happy, not least about the lack of job security. It was all about data though which was a part she did still enjoy, and the computer science job of Data Analyst was now a sought-after role. She retrained and started on a whole new exciting career. She currently works at the Guardian Newspapers where she met Devina Nembhard … who was the first Black woman she had ever worked with throughout her career.

Together they decided that was just wrong, but also set out to change it. They created "Black in Data" to support people of colour in the industry, mentoring them, training them in the computer science skills they might be short of: like programming and databases; helping them thrive. More than that they also confront industry to try and take down the barriers that block diversity in the first place.

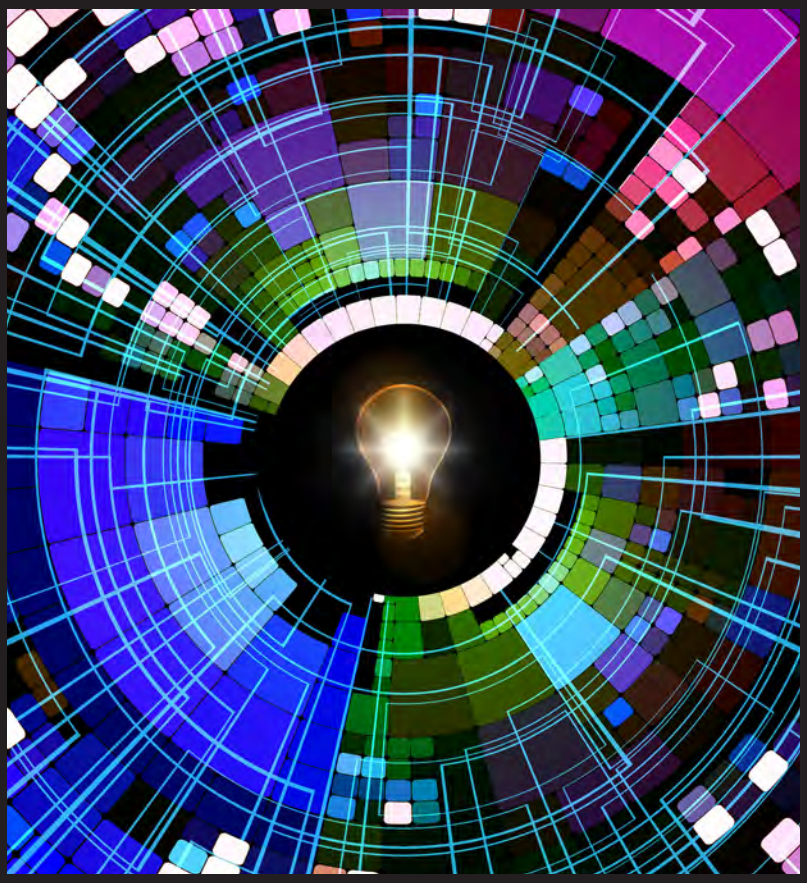
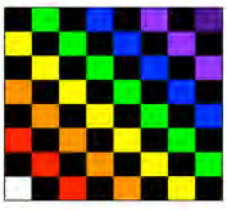


Image combines images by Gerd Altmann from Pixabay

The first computer wizard

by Paul Curzon, Queen Mary University of London



Christopher Strachey did a series of firsts in computer programming, and that was just when he was playing.

With father a cryptographer, mother a suffragist, Christopher Strachey was a school teacher when he first started 'playing' with computers in the early 1950s. He had been given the chance to write programs, first for the National Physical Laboratories' ACE computer and then the Manchester Mark 1: two of the earliest working computers in the world. The range of things he achieved is amazing. He probably created the first serious computer game you could play against (a draughts playing game), the first recorded computer music, the first "creative" program (a love letter writing program) … and he was just enjoying himself.

He went on to do serious computing, becoming an early computer consultant and later led the Oxford University Programming Research Group. He invented the idea of time-sharing computers, developed the CPL language (the ancestor of C and so many modern programming languages, so has had a powerful effect on all subsequent programming language design). Perhaps most notably, with Dana Scott he pioneered the idea of using maths to describe the meaning of programming languages, called denotational semantics. Oh, and he was a wizard debugger too, famous for quickly debugging his own and other people's programs.

He achieved all of this despite poor performance at school and university when younger, and despite suffering a nervous breakdown when at university that interrupted his studies. It has been suggested that the breakdown might have been due to him coming to terms with the fact that he was homosexual: now legal, homosexuality was then illegal in the UK.

Image by Paul Curzon

Follow those ants

by Paul Curzon, Queen Mary University of London

Ant colonies are really good at adapting to changing situations: far better than humans. Sameena Shah wondered if Artificial Intelligence agents might do better by learning their intelligent behaviour from ants rather than us. She has suggested we could learn from the ants too.

Inspired by staring at ants adapting to new routes to food in the mud as a child, and then later as adult ants raided her milk powder, Sameena Shah studied for her PhD how a classic problem in computer science, that of finding the shortest path between points in a network, is solved by ant colonies. For ants this involves finding the shortest paths between food and the nest: something they are very good at. When foraging ants find a source of food they leave a pheromone (i.e., scent) trail as they return, a bit like Hansel and Gretel leaving a trail of breadcrumbs. Other ants follow existing trails to find the food as directly as possible, leaving their own trails as they do. Ants mostly follow the trail containing most pheromone, though not always. Because shorter paths are followed more quickly, there and back, they gain more pheromone than longer ones, so yet more ants follow them. This further reinforces the shortest trail as the one to follow.

There are lots of variations on the way ants actually behave. These variations are being explored by computer scientists as ways for AI agents to work together to solve problems. Sameena devised a new algorithm called EigenAnt to investigate such ant colony-based problem solving. If the above ant algorithm is used, then it turns out longer trails do not disappear even when a shorter path is found, particularly if it is found after a long delay. The original best path has a very strong trail so that it continues to be followed even after a new one is found. Computer-based algorithms add a step whereby all trails fade away at the same rate so that only ones still being followed stay around. This is better but still not perfect. Sameena's EigenAnt algorithm instead removes pheromone trails selectively. Her software ants select paths using probabilities based on the strength of the trail. Any existing trail could be chosen but stronger trails are more likely to be. When a software ant chooses a trail, it adds its own pheromones but also removes some of the existing pheromone from the trail in a way that depends on the probability of the path being chosen in the first place. This mirrors what real ants do, as studies have shown they leave less pheromone on some trails than others.

Sameena proved mathematical properties of her algorithm as well as running simulations of it. This showed that EigenAnt does find the shortest path and never settles on something less than the best. Better still, it also adapts to changing situations. If a new shorter path arises then the software ants switch to it!

There are all sorts of computer science uses for this kind of algorithm, such as in ever-changing computer networks, where we always want to route data via the current quickest route. Sameena, however, has also suggested we humans could learn from this rather remarkable adaptability of ants. We are very bad at adapting to new situations, often getting stuck on poor solutions because of our initial biases. The more successful a particular life path has been for us the more likely we will keep following it, behaving in the same way, even when the situation changes. Sameena found this out when she took her dream job as a Hedge Fund manager. It didn't go well. Since then, after changing tack, she has been phenomenally successful, first developing AIs for news providers, and then more recently for a bank. As she says: don't worry if your current career path doesn't lead to success, there are many other paths to follow. Be willing to adapt and you will likely find something better. We need to nurture lots of possible life paths, not just blindly focus on one.

Sameena won the award for the best PhD in India

To watch Sameena's inspiring TEDX talk follow the link from this article at **cs4fn.blog/diversity-issue29/**

Image by Puckel from Pixabay

Image by Gerd Altmann from Pixabay

Back (page) away from bias

by Paul Curzon and Jo Brodie, Queen Mary University of London

Technology has long been created with biases. Here are some examples.

Racist soap dispensers?

One automatic soap dispenser would only dispense soap if the hand placed underneath it was white. A Black man tried and no matter what he did it would not release soap … until he covered his hand with a white paper towel at which point it was happy to.

Moral: *Sensors need to clean up their act*

Back to black

The colours cameras record don't exactly match what we see, so "colour balancing" algorithms are used to improve images. In the days of film photography the technician would use a special calibration card called a "Shirley Card" to do this, adjusting the colours to be more "natural". It was a picture of a brown haired, white woman wearing brightly coloured clothes. It meant colours were adjusted to be right for light skinned people only. Eventually, the Japanese created their own, but it was only more generally fixed after manufacturers of things like chocolate complained their products looked wrong!

Moral: *One reference is never enough*

Image by vixrealitum from Pixabay

Bad character

For computers to use written text, they need a way to represent characters in the binary code of 1s and 0s that they use to store all data. Early computers used a code called ASCII (an American Standard). However, it only includes the latin upper and lower case alphabets along with some punctuation and a few other characters. It doesn't cover the majority of world languages. Now, we use Unicode, which includes binary representations for characters from just about all the world's languages and more (it includes Vulcan for example).

Moral: *Don't forget the other languages*

Learn to love

The developers of chatbots have been struggling to stop them spewing out racist, sexist and homophobic nonsense. The trouble is they have been "trained" using Internet data and work essentially by deciding what to write next based on the probability of what came next in the training data…and sadly social media is now full of hatred. That means the machines judge that nasty things have a high probability of being the "right" thing to say next. Rules have been added to stop them but that is like taking a nasty person and telling them not to say anything bad. It doesn't change the deep nastiness inside.

Moral: *Make machines with morals*

Follow you, follow me

When Desi Cryer, who is Black, bought a new computer with a face-tracking camera he found it didn't track his face … at all. As his White colleague stepped in front of the camera and moved from side to side, the camera obediently tracked her face: wherever she moved the camera followed. When Desi moved back in front of the camera it stopped again…

Moral: *Computers need to learn about everyone*

cs4fn is edited by Paul Curzon and Jo Brodie of Queen Mary University of London. Summer 2023.Thanks to Sue White for proofreading. Paul Curzon writes and edits cs4fn in his own time. This magazine was funded by UKRI/EPSRC, through grant EP/W033615/1. Cover Image by Gerd Altmann from Pixabay.
Magazine design by Kelly Burrows, kellyburrows@ gmail.com

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