MACHAZINE

Volume 24 - Issue 4
July 2020

Wiskunde Informatica Studievereniging 'Christiaan Huygens'

INTRODUCING THE NEW BOARD

Board 64

COMPANY VISIT 2020

Business Tour

TEACHING FROM HOME

Teaching Team

MODELLING OF DISEASES

Kees Vuik

CONTAINING:

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Editorial

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Chief Editor
Maxima Hoekstra, Louise Leibbrandt
Editorial staff
Hiba Abderrazik, Kilian Buis, Sterre Lutz
Art Directors
Annerieke Ohm, Kasper Wolsink, Tom Saveur, Boaz van der Vlugt
Contact address
Mekelweg 4, 2628 CD Delft
E: machazine@ch.tudelft.nl
T: 015-2782532
Concept and design
$G_2$0 Kesteren
Publisher
BladNL
Cover
https://www.pexels.com/photo/close-up-of-wheat-326082/
Cooperating on this issue:
Diederik Heijbroek, Bhoomika Agarwal, Doris Aafjes, Boaz van der Vlugt, Jorick de Vries, Max Le Blansch, Charlotte Eijkelkamp, Belal Koukouh, Hiba Abderrazik, Shivani Singh, Marc Corstanje, Taico Aerts, Kees Vuik, Jan-Willem Manenschijn, Joost de Groot, Martin van Gijzen, Maxime Hoekstra, Annerieke Ohm, Louise Leibbrandt, Kilian Buis, Tom Saveur, Sterre Lutz, Kasper Wolsink, Akash Singh

Despite the intelligent lockdown, the MaCHazine continued working hard to put together this Machazine for you (at a safe distance of course), because in these times it might be extra pleasant to find the Machazine on your doormat! Find out below how we are spending our time at home.

How do you spend your time in quarantine?

Maxime - 'Next to the online education I need to follow, I still try to keep moving! I have done more workouts than before and dance classes on youtube are a good and fun replacement for my usual dance classes. Also, I found a new hobby: jigsaw puzzles. They are very addictive.'

Louise - 'Besides my research project, I've been keeping myself busy by doing plenty of reading. Books like Hyperion and Do Androids Dream of Electric Sheep have renewed my love for sci-fi books. I've also found that there is no greater feeling than sitting in the sun and listening to a crime podcast.'

Kilian - 'Since I am almost done with my Bachelor, I do not follow any courses at the moment. I am fully concentrating on my BEP. Besides that, I have a lot of zoom meetings every week and at least twice a week I go jogging to keep my stamina at a good level.'

Tom - 'When I am not working on my BEP I practice a lot of sports to keep myself busy. I am fortunate enough to have my own place to go and keep on practicing MMA while keeping away from others. I also try to grab my skateboard as much as possible. Keeping busy is the best remedy for boredom. '

Kasper - 'I am actually quite busy with the software project of Computer Science right now. I have a lot of zoom meetings and quite a lot of deadlines. I think this is good though as it forces you to keep a healthy rhythm during these times where it is very easy to become lazy. Overall I am doing good!'

Annerieke - 'I try to keep up with my courses as much as possible. Besides studying, I have an increasing number of skype/zoom meetings with friends each week. We play games or just talk. I like that I'm able to stay in contact that way. I also started a 3000 pieces jigsaw puzzle with my mom and it's far from finished.'

Sterre - 'After an initial week of bingeing all the good stuff on Netflix (Tiger King!), I had to pull myself together and get some routine in my life: wake up, make a nice cappuccino, water my 21 houseplants, stare at the wall, type one word for my Research Project, stare at the wall, make another cappuccino, and stare at the wall some more. Yes, my Research Project is going great.'

Hiba - 'During this quarantine I have tried to make sure I am staying on top of my final research project. Apart from that I spend my time hanging out and playing games with my friends online and I also find this a good time to pick up old (and new) hobbies like cooking, playing music instruments, reading and catching up on shows and movies on Netflix.'

Boaz - 'I'm continuing my work for the CH board. Even though all the activities and events have been cancelled, we still have enough to do! Luckily a lot of our work can be done from the comfort of our own homes. All our board meetings are held through Zoom, which works surprisingly well.'

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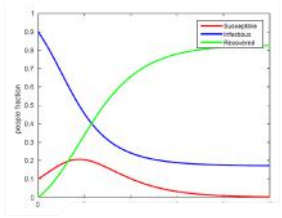

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MAGAZINE

From the Board

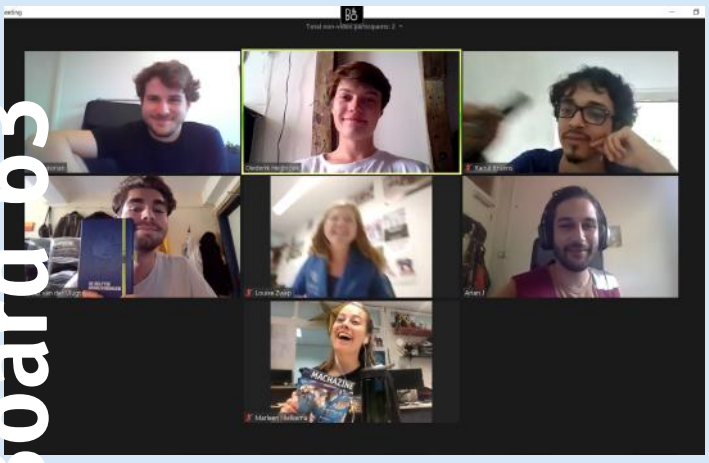
Diederik Heijbroek, Career Affairs Board 63

The end of this academic year is almost in sight, and so is the end of my board year. It was a year full of great activities and experiences from which I learned a lot. I like to look back at the many different events that have taken place this year, but there was one big event, which now affects the whole world, the coronavirus.

Halfway through March we were told that the faculty would close. This meant a lot to us as a board, but it also meant a lot to our members. For us, as a board, we had to make a lot of quick decisions on how to operate at home. We had to cancel the activities for the next month, assuming that we could perform them later this year. For our members, it also meant that large activities, such as the business tour and dies week would not take place. At this moment we thought we only had to survive for a month, but that turned out to be a lot different.

It became clear that there would be no more physical activities until the first semester of next academic year. This changed a lot, because now we had to prepare for half a year instead of a month. We could not afford to cancel all activities, so we had to come up with online alternatives. We had to be creative, because there are a lot of new challenges. How could we maintain the interest of participants and how could we keep in touch with them? How could we obtain the purpose of the activities that were planned?

I myself was responsible for the first event that took place online. This event was the Mathematical Career Orientation Day, an event intended for Applied Mathematics students to give them a better idea of their career opportunities. There would be one-on-one conversations that were eventually replaced by online conversations via Microsoft Teams. In addition, there were two presentations, of which one took place via a YouTube livestream. Both participants and companies were very pleased with the rapid transition to digital platforms and it was a very successful event.



We also wanted to keep our members enthusiastic about their studies and the study association. To achieve this, we had to organize several social online activities. One of these activities was a pub quiz. Here all participants were in a Zoom call with each other. Everyone was able to talk, which recreated the atmosphere of a regular pub quiz. In the meantime, the participants could answer Kahoot questions at home. At the end of the night, the winner of the quiz was rewarded with a prize. During this quiz we noticed that the participants really appreciated the interaction with each other. With that in mind, we tried to ignite social interactions within our upcoming activities.

Apart from keeping our members connected with our study association, we also have to enthuse new members. The first possibility to do this, is at the start of next year, when an online Freshmen Weekend will take place. This is also the opportunity for our new members to meet their fellow students. We are working very hard to make this an interesting and interactive weekend.

In addition to the Freshmen Weekend, we are also elaborating the first semester for our upcoming board. They will have to work with the same uncertainties we had, which will put them in difficult situations. However, we have every confidence that board 64 will have an amazing year. We wish them the best of luck and above all a lot of fun.

We were probably not the only ones who had to adjust. I heard from other study associations how they dealt with the same problems. I also noticed that other students were no longer enthusiastic. They compared their current situation to what it could have been, which I secretly did too. When I listened around me, I often heard the same. “If there had not been a coronavirus now, we would have just...” Of course, I was also a little disappointed sometimes, because my board year did not end the way I expected. Although we are still confronted with the current situation, I have become more optimistic.

It is actually very interesting to be fully responsible of a large study association in these difficult times. I am proud of the quick adjustments that we as a board have made. The challenges we had to face, make our board year unique. I hope that future boards, who might run into the same challenges, will ask themselves: What would board 63 do?

Board 63

Current Affairs

TU Delft News

Srinath Jayaraman, Student Computer Science

The Delft University of Technology is the biggest and oldest public technical university in the Netherlands, established by King Willem II on January 8th, 1842. But what is currently happening in and around TU Delft? This article will list the most important events of the recent months.

TU Delft develops low cost working prototype for emergency ventilator

A group of 50 Masters' students from various degree programmes, including Clinical Technology, Mechanical Engineering and Electrical Engineering, led by Professor Jaap Harlaar, Director of Studies at Clinical Technology, has developed a working prototype for an emergency ventilator. They started working on it on March 16, and the preliminary design was ready within a week. The design was created based on close consultation with Erasmus MC and LUMC (Leiden University Medical Center).

On April 3rd, 18 days after the start of "OperationAIR", a working prototype, "AIRone", was ready. The week leading up to the 3rd of April, the prototype was subjected to a variety of tests using a mechanical phantom of the lungs to see if the prototype met the functional requirements.

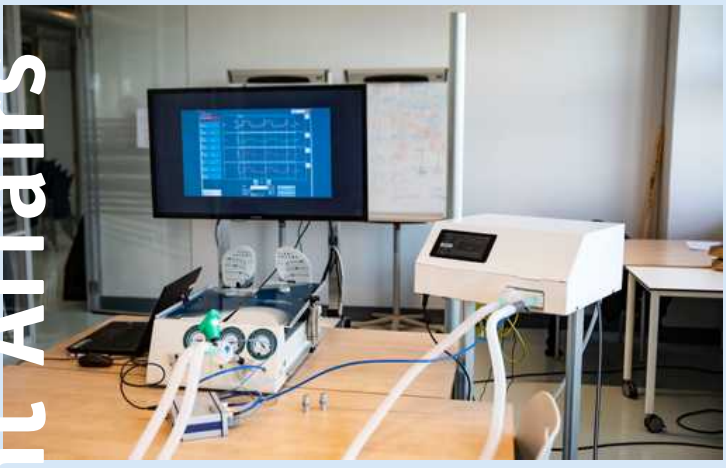


Figure 1: AIRone working prototype

Once testing was complete, all necessary documentation was submitted to the Ministry of Health, Welfare and Sports, as the start of the clinical tests are required to be authorized by them. If clinical approval is granted, the Ministry of Health, Welfare and Sports will instruct production of these ventilators.

The team working on AIRone received feedback from medical professionals from LUMC and Erasmus MC. Positive feedback as well as useful tips for further improvements were given. The following days the team focused on incorporating this feedback into an improved version of the AIRone. As a result, different additional modules were built into the ventilator, such as an alarm that triggers when an excessive or insufficient tidal volume is observed.

On Monday, the 6th of April, the team welcomed the Minister of Economic Affairs and Climate Policy, Eric Wiebes. He was given an explanation about OperationAIR and what the team was working on. Also, the team demonstrated the use of the AIRone ventilator and spoke with him about the OperationAIR initiative.

Figure 2: Minister of Economic Affairs and Climate Policy, Eric Wiebes

The AIRone team has been working long hours to get this project off the ground and into production for hospitals around the country. From 9 in the morning until 10 in the evening, people are working at the university every day of the week. One day, however, work did not stop at 10 pm, as a small group of students spent the night at the faculty to test whether or not the AIRone could run for 12 hours straight. Luckily, the next morning the AIRone was still running: **It passed the test!** Other tests followed on Tuesday and Wednesday, such as the mechanical strength test. This was performed in line with the official protocol, in which a metal ball was dropped on the casing. The AIRone also survived this test, with not a scratch visible!

To improve testing efficiency with different sub-teams, a second AIRone prototype was built on Thursday. At this moment, two prototypes can be tested; one is always available for tests at *external facilities*, while the other one remains at the faculty. On Friday afternoon, a small group of team members paid a visit to the Erasmus Medical Center, with an AIRone prototype.

At this hospital, electrical safety tests as well as user-friendliness tests were performed by an ICU doctor and nurse. These tests went well and some useful feedback was given by the medical staff. Based on this feedback, the team is currently exploring the possibilities to build in a nurse calling system into the AIRone. Also, they will be trying to further increase the maximum breathing frequency the AIRone can offer, as well as a clearer graph visualization on the screen. Every week the team takes big strides and keeps raising the bar.

On April 15th, the AIRone team welcomed a *very* special guest, Mark Rutte, the Prime Minister of The Netherlands. The Prime Minister came to the university to see the AIRone. Due to the measures taken to control the spread of the coronavirus, many team members worked from home. To ensure the whole team had the opportunity to be present for this special visit, a video conference was set up for the team members working from home. Prime Minister Rutte had taken the time to get to know the team members, discuss the urgency for ventilators in the Netherlands and other countries and answer questions from the students.

Since the visit of the PM to TU Delft on April 15th, the impact of the measures to control the spread of COVID-19 in the Netherlands became noticeable. A decrease in new hospitalisations was seen in the Intensive Care Units in the Netherlands. At the start of OperationAIR, the goal was to produce 500 emergency ventilators for the Netherlands to contribute to possible shortages in the worst-case scenario. With the current decreasing trend in new hospitalisations and with consultation from the ministry of Health, Welfare and Sports, it is expected that this amount is not required anymore. Therefore, production will be limited to 80 emergency ventilators. These ventilators can be used as a buffer in case of a shortage.

As the urgency seems to diminish in the Netherlands, OperationAIR has the opportunity to contribute in other ways during the coronavirus pandemic. The shortage for ventilators is still present in other countries. At the start the goal was to share the design publicly on the website for other countries to use. Now, potentially, the opportunity to take this a step further has presented itself. We can, for example, offer active support to similar initiatives abroad or give advice on setting up a supply chain. Either way, this project has been a success in not only demonstrating the talent and skill-set of TU Delft students, but also their ability and willingness to step up and get to work during an emergency, something we can all take inspiration from in these trying times!

Source: https://www.operationair.org/en/developments

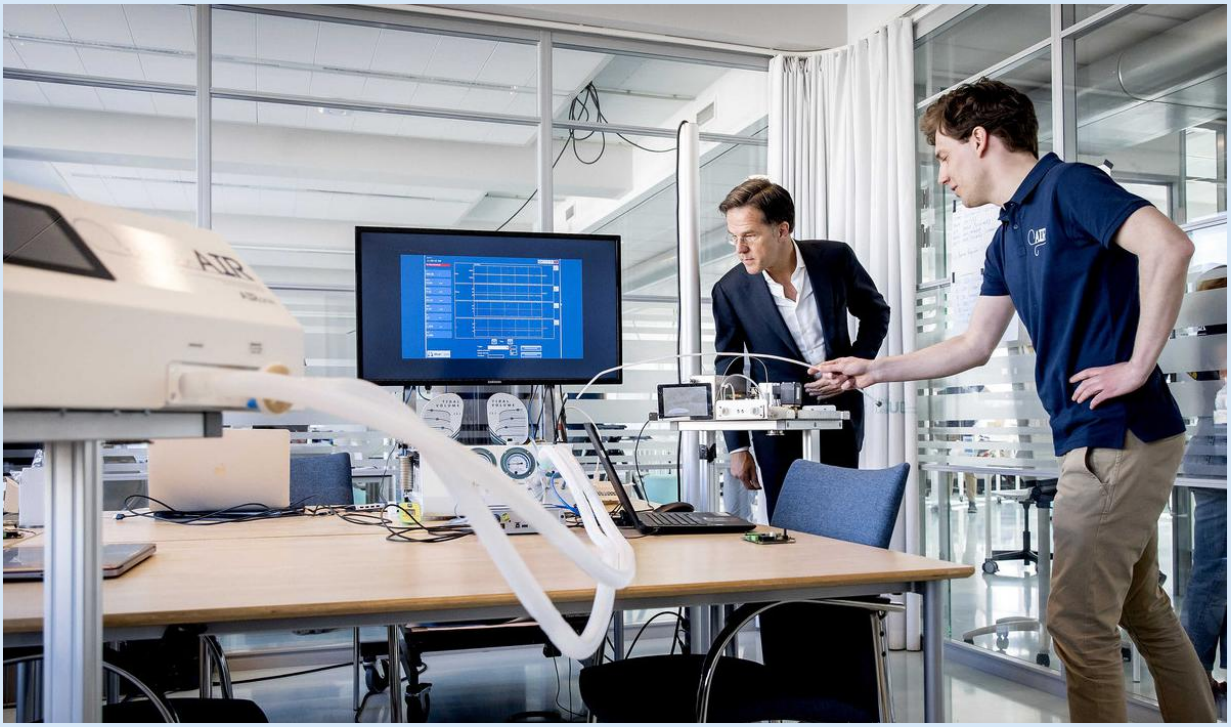


Figure 3: PM of The Netherlands, Mark Rutte, visiting TU Delft

The Aftermath of the Lockdown

Bhoomika Agarwal, MSc. Computer Science

At the time when I'm writing this article, it has been about 2.5 months since the lockdown started. However, it seems like 2.5 years. The coronavirus has affected our lives and brought it to a stand-still. So many businesses have been adversely hit and the economy has taken a huge dip. In my opinion, it has become the embodiment of the David-Goliath effect, uniting all of mankind against the virus that has caused mayhem in our lives. In terms of scale, it is ironic that a microscopic virus has now become the equivalent of a 'giant' monster that we are facing. However, the lockdown has brought us closer as a community and caused us to introspect on our prime directives a lot. In this article, I want to talk about some of these effects that I have noticed.

Figure 1: David vs. Goliath effect

Firstly, the lockdown has brought us closer to our loved ones. Not physically, but emotionally and mentally. We are all spending more time with our families and reaching out to long-forgotten friends and cousins. I have spent hours playing online games together with family and friends back at home. Funnily enough, I used this time to connect to one of my flatmates pretty well. Pre-lockdown, we both used to spend a lot of time away from home in the university and had barely any common time at home. Now that we both had to stay locked in at home, we got to talking a lot and have been spending a lot of time together. Being away from home, locked out in a foreign land and feeling homesick, we talked about our feelings and empathized with each other. It is ironic how it took a lockdown for this to happen when we were living in the same building all along. It was a bit of a relief to know that I was not alone in this journey and that other friends were also experiencing this with their flatmates and neighbors. This lockdown has made us a more tightly-knit society indeed. We have begun the search for our support vectors.

Another amazing trend that I noticed is how student associations and communities took to online platforms to compensate for the lack of physical contact. It is lovely how we have managed to stay connected despite the physical distances separating us. I found it really fascinating to see platforms like Stay Delft[1] connecting people with common interests together. Through this platform, I was able to connect to fellow poets, origami enthusiasts and food lovers and organize virtual meet-ups to share common interests, irrespective of the barriers of geography and time. It made me feel like I belonged and less lonely while staying alone and far away from home. People have been very creative and moved so many games and activities online- the extent of creativity and adaptability is just astounding and threw me for a loop.

Figure 2: Staying connected with online events. Image credits: https://www.purpur.nl

This lockdown has given us more time to spend by ourselves and explore our interests and hobbies. Personally, I finally started exploring cooking and tried out various dishes that I had been procrastinating for a long time now. I also started exploring more origami and organized and attended workshops to meet more origami enthusiasts. I was surprised to know that there were established communities that I was unaware of. I have noticed a spike in creativity in general and it is breath-taking to see everyone's creative juices flowing. We have finally returned to our long-forgotten hobbies and begun learning new skills. From a data science perspective, we have begun looking inwards and identifying our salient features and principal components. To quote Arthur Golden - "Adversity is like a strong wind. It tears away from us all but the things that cannot be torn so that we see ourselves as we really are."

One of the most prominent side-effects of this lockdown is that it has made us more aware of our own well-being. This includes not only physical well-being but also mental well-being. It has made us realise the importance of having a strong immune system and how fragile we are as human beings. Looking at the large number of daily deaths has made me aware of my own mortality, thereby spurring me to eat healthier and exercise more. I have been experimenting with healthy food through quick and easy-to-make recipes that help me maintain a balanced diet. Growing up, I was a stubborn child who did not like eating my veggies but my mother always found ways to still get them to me by blending them into my diet in creative ways. Now, staying away from home and realising the importance of my physical health, I am taking a page from my mother's book. I have learnt the significance of consistency in my daily exercise, food habits and meditation when I stuck to it daily for 2 months and saw the compounded effects.

Figure 3: Consistency is the key to health.
Image credits: https://notjustdiets.com

For my mental well-being, I have been able to take some time out to meditate at the end of each day and resolve the cacophony of thoughts in my mind before going to bed. I have also organized and attended some meditation workshops online with the Heartfulness institute[2] that has helped me attain a stabler state of mind and dig deeper into my conscious. I have seen a positive effect in my levels of focus and productivity both. This, in turn, has led me to the realisation that the untrained human mind is the biggest barrier and barricade to our personal development. It is a powerful tool that needs to be taken care of and used in the right ways. Meditating has helped me become more aware of my surroundings and be more present in the moment.

Figure 4: Meditation for a healthier mind
Image credits: https://www.freepik.com

Zooming out, I have a new-found appreciation for life and the things that really matter. I miss the little things that I have always taken for granted until now - hugs from friends and family, spontaneous plans to hang out with friends, cook-outs with friends, the beauty of spring walks and my awesome flatmates (who are now thankfully back home safely). Spring is finally here and the weather is splendid but we are locked in at this time unfortunately. I cannot imagine doing this same lockdown in the midst of a cold winter. I feel more awake to the beauty around me and understand the importance of spending time with those around me better. The folly is that all of this has always been there but we realise its significance only in its absence.

Needless to say, these are highly uncertain times and the situation is far from ideal. All we have is each other. More than ever, we need to be united and use the combined powers of data, science and technology to combat this pandemic. We are faced with an enemy that we know very little about and that is shrouded in a cloak of mystery. We do not yet have a well-tested vaccine or cure against it. Mathematicians and data scientists are building predictive models to try to map every phase of this lockdown but human behavior is too stochastic and we are basing these models on assumptions about the virus. The only fool-proof strategy we have right now is to that we are stronger as a community and we need to take the necessary precautions and follow social distancing as much as possible. On a personal level, we need to cope with the effects of staying socially isolated by gaining a better understanding of ourselves and finding ways to work or study effectively from home. We need to look inwards and identify what is most essential to our being and hold on to those features.

The biggest question is - what will happen once this lockdown is over and things start returning to normal (assuming that a normal still exists)? How will the economy bounce back and what effect will this have on our livelihoods? How will this disrupt our future plans? Can we hold on to our core values and emerge as better individuals and a stronger society? Will the aftermath of this lockdown contain these positive side-effects? Can we mark this catastrophe in our calendars with a positive highlight and make the post-lockdown era better than the pre-lockdown era?

To conclude, I would like to leave you with a poem that I wrote recently in the midst of this lockdown. Hopefully, it will serve as food for thought.

Unlockdown

So all those fears have come true,
So the lockdown is now real,
But we've been locked in for much longer,
Locked into the cages of our minds.

We have had blinders all along
Running on the race course of life
Too busy to stop and think
Too focused to look around us.

Tunnel vision has consumed us,
Our barricades have concealed us,
Our minds have locked us in,
Our walls have fortified us.

Can we now break free?
Can we release our locks?
Can we break the chains of our own minds?
Can we unlock ourselves?

Can we find our principal components?
Can we find our support vectors?
Can we find our salient features?
Can we unlock ourselves?

References

[1] "@StayDelft | Linktree", https://linktr.ee/StayDelft

[2] "Heartfulness: Meditation | Relaxation | Yoga | Spirituality", https://heartfulness.org/

[3] "Living Consciously - Your Future ", Tom Marshall, https://tommarshall.substack.com/p/living-consciously

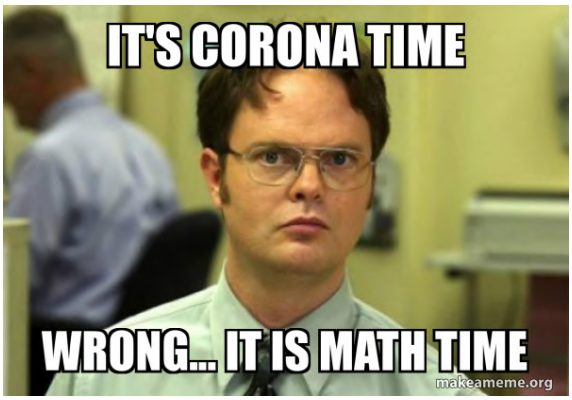
Mathematical Proof

Doris Aafjes, Student Applied Mathematics

Whenever I tell people I study Applied Mathematics I always get similar reactions. These reactions can be divided into three different categories. The first one is a surprised reaction where the person in question is very impressed: "Wow, mathematics? That seems so hard." In 9 out of 10 cases they also have to give the side note that mathematics is really not their cup of tea. My answer to this is the same as well: "Yes, math is something you are either very good at or you are very bad at".

In the second category of reactions they ask what kind of job I will have in the future. But before I can even respond, they answer their own question: "Probably a math teacher". At this moment I always give the same reaction. I tell them that mathematicians are needed everywhere, at a variety of companies. This obviously gives them a very vague idea in what way mathematicians contribute to those companies. They don't understand why companies need someone who can solve equations like $x^2 + 4x + 4 = 0$.

The last category of reactions is simply a combination of the first two: They are fully surprised and wonder what kind of job I can get with this study. As a true mathematician, my response is a combination of my reactions to the first two questions: "Mathematicians are needed everywhere, so being good at it is of great value."



As a matter of fact, the reactions on my study are always kind of 'distanced'. It is way too difficult and there is no notion about what kind of cool job I might have in the future. A lot of people really don't know in what way mathematicians contribute to society. They have a certain image of math, because of what they got taught in high school. The good news is: thanks to the corona crisis this is changing. In high school, you did not understand why you needed to know what an exponential curve is. Now everyone is talking about exponential growth and how to 'flatten the curve'. Even your grandma is telling you about it.

Mathematicians make predictions based on models of how the Corona virus will spread in the coming weeks. Because of these predictions, we can try to find the best strategy to tackle the virus. We obtain an indication of how many people will be in hospitals, so the hospitals can be prepared for all the people who need medical help. You can basically say that math is really essential right now (as it has always been). And without bragging too much: because of mathematicians a lot of lives are saved.

Hopefully, because of the Corona Crisis people will have a better idea in what way math contributes to our society. So the next time I tell someone I study mathematics, I hope the new standard reaction will be: "Wow that's so nice, because of your predictions we can limit the spread of a future pandemic!"

Association

Introducing Candidate Board 64

Bastiaan Bakker, Bram van Kooten, Vera Plomp, Frederiek Backers, Sterre Lutz, Kilian Buis and Max Le Blansch

The new candidate board, 'EPA 64', has been presented; 7 enthusiastic people who most of you are going to see a lot next year. Who are they and what role are they going to play for W.I.S.V. 'Christiaan Huygens' next year? We prepared a few questions for them so we can get to know more about who they are.

Bastiaan Bakker - Chairman

Age: 22

Place of birth: Haarlem jwz 023

Study: 4th year Applied Mathematics

Previous committees: Sjaarcie, Match, Reis, Pub bestuur, FSR, FIlmcrew, SteCHkcie

Hobbies: Football addict, DJing, watching Netflix, travelling, watching Sluipschutters and Streetlab videos on YouTube, cooking

Favorite food: Risotto or liquorice ("dropjes!")

Favorite Zoom Background: Anything with people from my current meeting

Bram van Kooten - Secretary

Age: 22

Place of birth: Sassenheim

Study: 4th Computer Science

Previous committees: HackDelft, LANcie, FlitCie

Hobbies: Korfball, video games, Rubik's cubes, yo-yoing, binge watching YouTube videos, drinking with friends

Favorite food: My mother's lasagna

Favorite Zoom Background: Duck playing the drums

Vera Plomp - Treasurer

Age: 21

Place of birth: Leiden

Study: 4th year Applied Mathematics

Previous committees: FaCie, Dies, GalaCie, Symposium committee, SteCHkcie

Hobbies: Sports, watching Netflix, chilling with friends (on the CH couches), going to the Steck

Favorite food: CHEESE

Favorite Zoom Background: Rollercoaster

Frederiek Backers - Applied Mathematics Education Affairs

Age: 20

Place of birth: Nieuwegein

Study: 3rd year Applied Mathematics

Previous committees: MeisCie (when it still existed), /Pub board!!

Hobbies: Play professional tennis (#FrederiekFederer), winning at beerpong, spiesen, winning in Snapchat games from Bastiaan, going to het tokaat aka toko (sometimes hihi)

Favorite food: frieeeeeeeeees

Favorite Zoom Background: The Pub!

Sterre Lutz - Computer Science Education Affairs

Age: 20

Place of birth: Purmerend

Study: 3rd year Computer Science

Previous committees: FaCie, AnnuCie, FlitCie and MaCHazine

Hobbies: Raising my 64 beautiful plant babies, winning at board games, showing funny cat videos to anyone with eyes

Favorite food: My mom's homemade lasagna (Come fight me, Bram!)

Favorite Zoom Background: The Teletubbies sun so that I am the giggling baby

Kilian Buis - Public Relations

Age: 20

Place of birth: The Hague

Study: 3rd year Applied Mathematics

Previous committees: CHoCo, MaCHazine, GalaCie, iCom

Hobbies: Football, football, football, chilling & partying with friends, watching Netflix

Favorite food: Risotto, hamburgers & shoarma

Favorite Zoom Background: Max's dad

Max Le Blansch - Career Affairs

Age: 19

Place of birth: Bergen

Study: 2nd year Computer Science

Previous committees: SjaarCie, WiFi

Hobbies: Indoor football, escalation with friends, epic Mario karting sessions

Favorite food: CHapsalon

Favorite Zoom Background: Rollercoaster

Running CH during a crisis

Boaz van der Vlugt, Public Relations Board 63

Last September, I took on the challenge of spending a year running our beautiful study association full-time together with 6 fellow students. Over the next few months, we would arrive at EEMCS every day at 9:00 (sharp!) to perform our duties as board members of CH; meeting with faculty members about educational affairs, closing sponsorship deals, or organizing the various social activities on offer for the students of Applied Mathematics and Computer Science. The fun didn't stop at 17:00, however; the evenings were usually filled with network drinks, parties, or other exciting events.

All of this changed quite abruptly on March 13th, when the prime minister announced that all big events for the coming weeks would be postponed, and that everyone should work from home as much as possible. At the time, we believed that the world would be 'back to normal' within a few weeks and we would be back at EEMCS in no time. Sadly, as we all know, the measures were extended to beyond the summer, and here I am 2 months later still working from my bedroom.

As soon as the 'intelligent lockdown' started, I got the question from my housemate: "Isn't your board year basically over, now that all the events have been cancelled?". I must admit, I was worried at first that the workload of our board duties would drastically decrease and I would have far too much free time on my hands. As it turned out, however, this was not the case at all. It actually surprised me to discover how little of our time throughout the year was devoted to organizing events and activities.

One of the first agreements we made with the board when we learned that we would all be working from home, was that we would do our best to keep the same structure in our days as before. This meant being available from 9:00-17:00 for CH-related business and holding our usual meetings at the same times as before. It took some getting used to, logging on to Zoom for every meeting, but after a couple of days we were already starting to get comfortable in our 'new' environments. Admittedly, it is still very strange to run an association without seeing your members every day and not being able to turn around to ask a quick question to your fellow board member. However, the transition was much easier than expected and I've found that it's actually possible to be productive at home.

One of the things that has been keeping us busy the most is working on plans for the association for next year. In a 'normal' year, the board can build on the work that the previous boards have carried out, so to speak. However, the corona crisis brings various consequences with it that may temporarily (or permanently) affect the daily state of affairs of our association, like the cancellation of certain events or the current state of the economy (with regards to sponsorship deals). Our number one priority right now is to make sure that CH can still function at a high level next year, even though the circumstances are a little different than usual.

Aside from this, we are doing our best to ensure that we can still offer some of the most valuable things that CH usually offers to students. Student panels are held online to discuss feedback on the ongoing courses from the students. Student feedback is incredibly valuable to the TU Delft, especially in these times! For the rest, we are organizing various online social and career-related activities, such as a pub quiz, movie night or company webinars. Even though these digital activities don't quite have the allure of a real-life /Pub evening, we've found that these are still good ways of keeping students connected and entertained during these unusual times.

Overall, even though this year turned out quite different to how we had pictured it, the challenges that the crisis brings with it have proven to be very interesting. Additionally, I've found that there are quite a few positive aspects to working from home. No more arriving at CH out of breath at 9:00 because I left my house just slightly too late, a little more free time to spend with housemates, and a chance to experiment with different productivity methods in order to learn to ignore distractions at home. I'm positive that, even though we've had some setbacks, we can get CH through this crisis safely!

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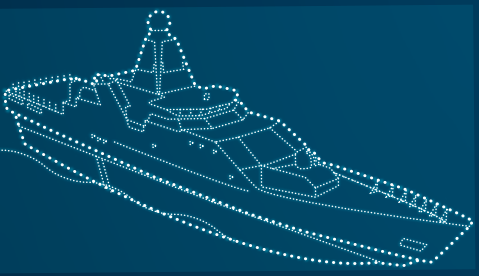

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Business Tour

Accenture, Bol.com, Ciphix, Flow Traders

The Business Tour is an annual 7-day trip in which students visit various companies to investigate career opportunities. This year the trip was supposed to take place in the beautiful Dublin! Unfortunately, the Business Tour got cancelled due to COVID-19, even though the Business Tour committee had practically everything arranged already. Nevertheless, some of the participating companies still would like to introduce themselves through this MaCHazine! The pictures in this article were taken during the pre-Business Tour inhouse day, which took place at Deloitte and Shell.

Accenture

Accenture is a worldwide IT-Consultant with offices in 120 countries and more than 400.000 employers in total. Accenture offers an elaborate range of services and solutions concerning strategic consulting, digital, technology and innovation and operations.

Together with the clients, Accenture helps the organizations to transform into high performance companies through innovations and new technologies. To do so, we use a combination of unparalleled knowledge and experience in all industries and business functions and thorough research to world's most successful companies. At Accenture are career opportunities and development a central part. Furthermore, this organization cares a lot about diversity and the social interest.

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Bol.com

Bol.com is the largest online shopping platform in the Netherlands and Belgium. Together we change retail to make everyday life easier. The code of our 500+ software engineers offers our 10 million customers more than 21 million products and an inspiring and personal shopping experience. Technology and innovation are essential parts of the bol.com culture and tech run through the veins of all bol.commers. Because of our complex and fast-paced environment, we can't work with one-size-fits-all solutions. Every piece of code has an impact on our customers and partners.

Data-driven, realistic (mistakes are fine, as long as learnings are shared) and boldly going where no online retailer has gone before, we want to deliver upon our promise to engage and inspire all of our customers. Sound like something worth going for? We offer IT talent a unique opportunity to become an all-round Software Engineer. When you join the IT Young Professional program, we'll take you on an unforgettable 4-step, 2-year journey through an innovative IT landscape! Want to know all about it? Check https://careers.bol.com/vacature/it-young-professional

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Ciphix

Ciphix is a Rotterdam-based AI-service company dedicated to helping organizations unlock human potential through smarter business process automation. With an integrated approach to Robotic Process Automation, Artificial Intelligence and Conversational Automation, we're able to offer our clients – including global brands and government organizations – uniquely robust solutions to their business challenges.

With the RPA branch we try to automate the repetitive, boring and time-consuming jobs, so employee's can focus their attention to more interesting tasks. Hereby you can think about invoice automation and administrative tasks, to more complex automations like processing care referrals at specialized healthcare clinics.

These software robots can be made smarter by adding AI models to the decision making of the robot. This, of course, is done by the AI team of Ciphix. This team mainly focusses on intelligent email automation and classification at the moment. The artificial intelligence models are not always used in combination with RPA projects. The AI team also has projects where just the AI models are the end product. These projects often contain natural language processing and entity extraction and are made with Python.

The third and final branch of Ciphix is the Conversational Automation. As the name describes their focus is on automating user machine conversation. This team is working on the development of intelligent chatbots, which can be deployed at companies and governmental institutions. This can be of use for helpdesks and Human Resource departments. The goal is to develop a chatbots which can extract the underlying intent from a lot of differently formulated sentences. Since intonation and sentence order can vary, this is a complicated task.

Ciphix consists of a rapidly growing team of young and dynamic software enthusiasts. The atmosphere in the office can be described as professional but amicable. Work events and non-work events are organized regularly. This can range from the weekly Friday afternoon drinks to technical specific dinner readings and company trips. All events are voluntary, but highly recommendable.

For more information about Ciphix or want to apply, visit our website at www.ciphix.io

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Flow Traders is a principal trading firm founded in 2004. We are a leading global technology-enabled liquidity provider, specialized in Exchange Traded Products (ETPs). Flow Traders is at the intersection of finance, cutting-edge technology and scientific research. We are able to grow our organization further, thereby ensuring that our trading desks in Europe, the Americas and Asia provide liquidity across all major exchanges, globally, 24 hours a day. Financial markets have rapidly shifted from trading in the pit to algorithmic trading, and our business model has made us an entrepreneurial and competitive firm in the FinTech space. We use our principal technology platform to quote bid and ask prices in thousands of ETP listings. We are also active in other asset classes such as bonds, FX, cryptocurrencies and similar financial products. On top of that, we provide liquidity to institutional counterparties off-exchange across all regions.

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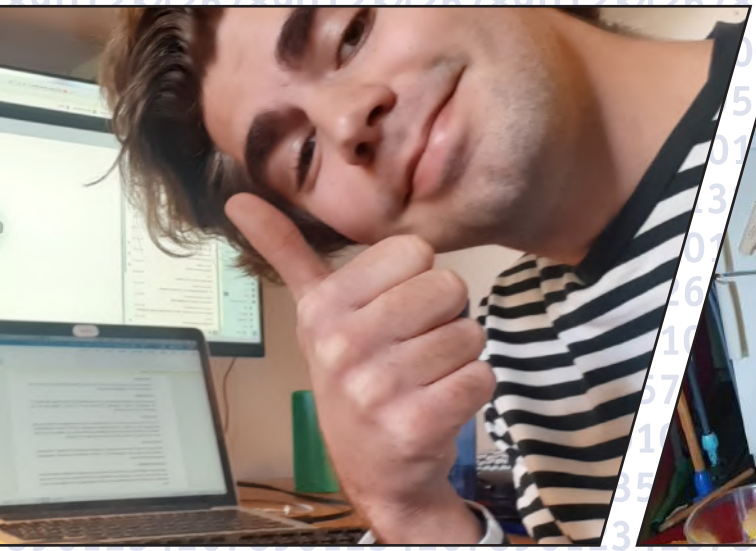


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Internship at NII in Tokyo

Yorick de Vries, MSc Student

Between November 2019 and April 2020, I had the unique opportunity to do an internship at the National Institute of Informatics (NII) in Tokyo. During this time, I got the chance to perform research into computer science while having the experience of living in Japan as well.

Tokyo? But how?

It is strange to think back how fast things can go, considering a year ago I did not know the NII yet. During the MSc course Web-scale Data Management in Q4, Christoph Lofi mentioned paid internship opportunities at NII for master students. He used to work at NII and every year he is in charge of sending in internship applications on behalf of TU Delft students. After some discussion about the internship, I decided to apply. One month later I got a reply; I was accepted and would spend half a year in Japan, starting in November!

Working at NII

I needed the first few weeks of my internship at NII to adjust to the new culture. At Japanese workplaces there is quite a bit of hierarchy. My supervising professor was located on another floor than his students and contact was limited. Being a student at NII meant that I needed to be very autonomous and be working solitary, which is quite a characteristic of the Japanese culture as well. However, while working at NII I found out that I was very free in what I did and could deviate very much from my initial topic. This came to quite a bit of surprise as I was expected that I would have a defined research topic and direction before I came. Japan is also infamously known for its intense working culture with long days. However, opposite to what I have read about it, there were no expectations of making long days at all. Actually, the very opposite was the case; I could decide my own work schedule and was also encouraged not to work too hard and to explore Tokyo instead.

The group of students I was part of consisted of mainly PhD students and a few MSc students. We all had our own project in the field of machine learning and/or knowledge graphs. Tough we all had a different focus, we were able to give valuable advice on each other's progress. We did this in weekly meetings together with our supervising professor. Every week also one student gave a long presentation which could be focused on his/her own research or be a scientific paper presentation.

Apart from the other intern in my research group, there were quite a lot of interns in other research groups as well. The pool of interns was a very international mix. However the French were overrepresented as many French universities have a connection with NII. This multicultural setting was both fun and very helpful while doing research and exploring Tokyo.

Biological pathways

My research at NII was focused on biological signaling pathways in human cells (GPCR signaling, if you want to look it up). Perturbation of such signaling cause diseases like cancer and heart diseases, so thorough understanding is desired. A lot of research is already done, but focused on short pathways from sole initiating molecules. My job was to integrate the knowledge of a large corpus of manually curated research papers to form a large biological interaction network. Furthermore, as the data is noisy and is far from complete, I did some attempts in predicting new links with machine learning and graph embedding techniques. This analysis indicated that link prediction is possible and focus on such predictions in a biological lab could lead to new discoveries.

Tokyo life

Apart from doing research at NII, I took the opportunity to explore Tokyo quite a bit. The city is very different from cities in Europe; there isn't one city-center but quite a few, each with its own character. To just name a few; on a nice sunny day, you can visit one of the many shrines or temples in Asakusa or Ueno. During the weekend there is no place better to go out than in Shibuya or Shinjuku, where people tend to aim for the first train rather than the last train home. And if you are in search for the stereotypical Japanese gaming/anime culture, Akihabara (also called Electric town) is the place to be.

Furthermore, outside of the concrete jungle of Tokyo are also lots of interesting spots to visit. South of Tokyo you can go to the old temples and shrines in Kamakura (the old capital of Japan) or visit Chinatown in Yokohama. If you really want to escape the city, you can climb mount Fuji or mount Takao (I did only the latter as it is only safe in summer to climb mount Fuji).

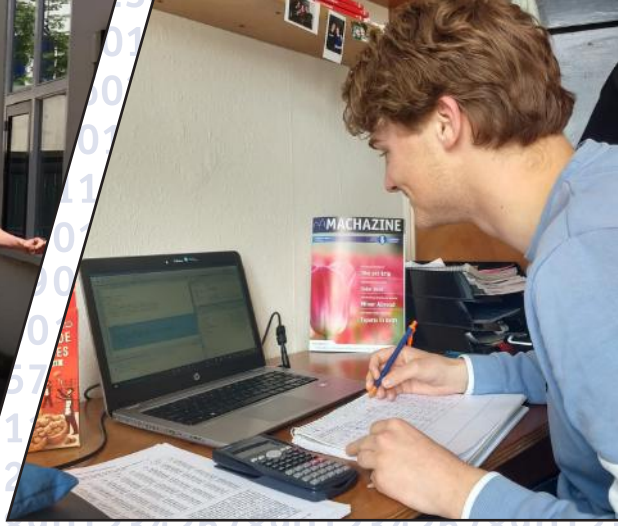
During my time in Japan I met quite some new friends, both international and Japanese. I spent quite a few evenings at the English Only Cafe, a small coffee place focused on language exchange between English and Japanese speakers. This cafe was a 5 minutes' walk away from the NII and I often spent it a visit after work. Furthermore, there are also quite a bit of Dutch people in Tokyo. Occasionally there is a party at the Dutch embassy or the Dutch pub (called Lighthouse), which was good to recover from being lost in translation. Lastly, I went to a few international meetups as well. These meetups are very suitable to meet English speaking expats and local Japanese people. Fun-fact: Many of the expats I met were either English teachers or were doing something in IT. Apparently those are the two branches which lead to work in Japan.

Corona impact

All good things come to an end, and unfortunately due to the current corona pandemic this came a bit earlier than planned for me. I came back halfway April on advice of both TU Delft and NII as there was a risk that I could not return to the Netherlands in May. Luckily, the virus did not have a drastic effect on daily life for most time I was in Tokyo. Only in my last few weeks I was required to work from home due to the increasing number of virus cases. In my final time in Japan, I was able to wrap up my work in a report, give a final presentation (via a web conference) and say goodbye to my new friends.

Became enthusiastic?

My internship at NII in Tokyo was a unique experience for me and I would certainly recommend to go abroad during your study if you have the chance. Not only because it adds to your CV, but it is a very good experience as well. The internship program by the NII is a good opportunity to experience working abroad in an academic environment and exploring Tokyo. If you want to know more about my experience, feel free to contact me. By the time this MaCHazine is published, the next call for NII internships (starting around the beginning of 2021) should be available. In case you want to apply, contact Christoph Lofi about all the details (the sooner the better). You can apply for an internship duration between 3 to 6 months, so you might be able to experience the Tokyo Olympic games as well!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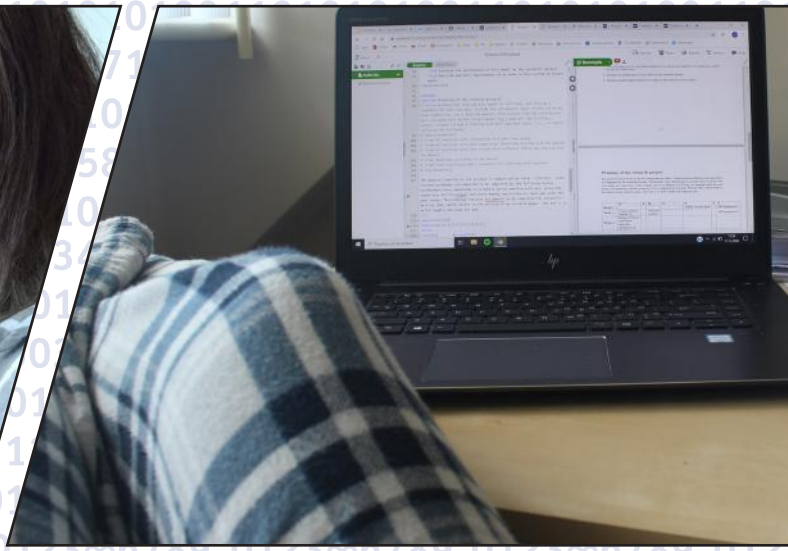

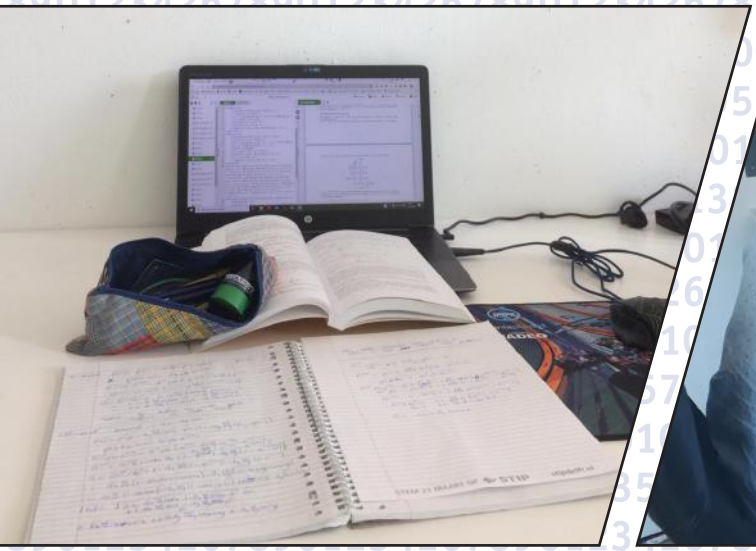

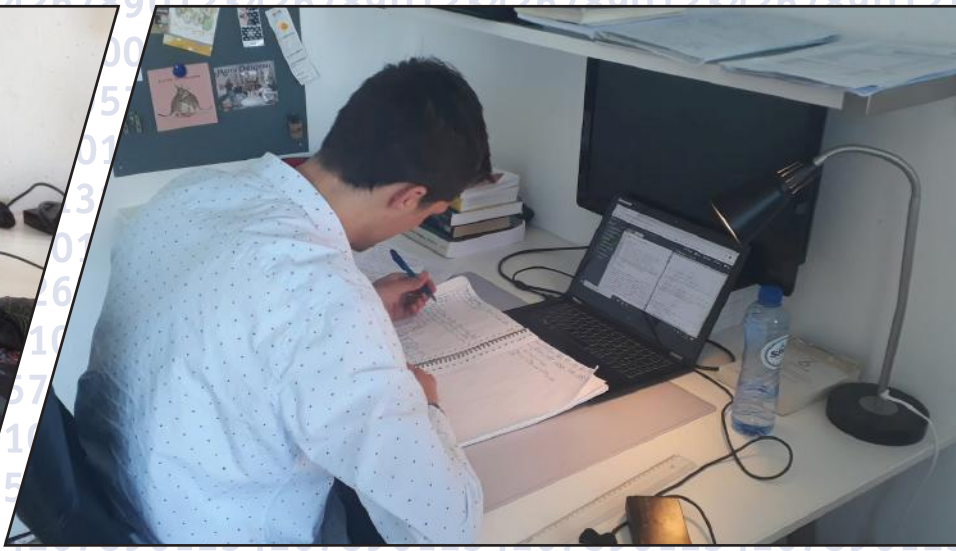

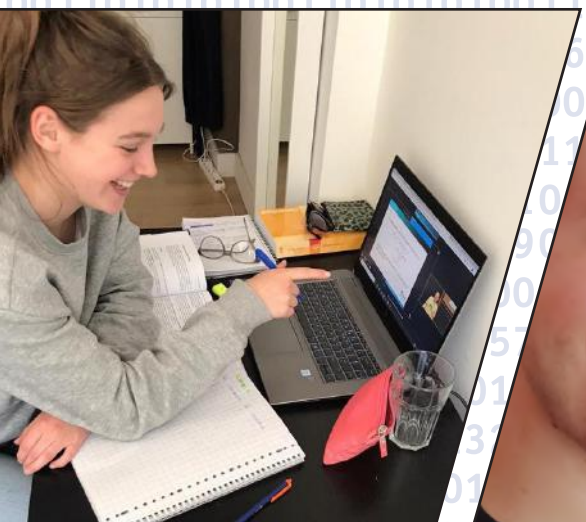


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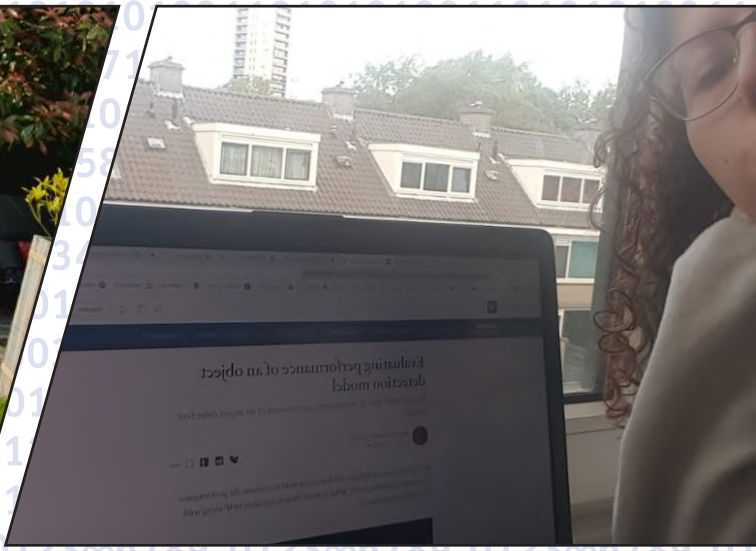


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Second year variants

Max Le Blansch, Charlotte Eijkelkamp, Belal Koukouh, CSE students

Right now the first year students have to choose their variant courses for the computer science bachelor. At the same time, the second year students just finished theirs. We asked three students that just finished their variants to share their experiences.

Data variant - Max Le Blansch

Choosing a variant at the end of my freshman year seemed pretty hard at first, since I didn't know much about any of the courses of those variants. However, the initial choice was not that hard without looking at the individual courses of the variants. I didn't like mathematical courses that much, which ruled out the multimedia variant, and Embedded systems being more of the Computer Organisation course didn't sound so good to me either. The courses of the data variant seemed interesting with Computational Intelligence being kind of related to AI and machine learning stuff.

Having completed all the courses now, I'm glad to say I'm happy with my choice.

The Q1 course of the data variant is Big Data Processing. In this course you learn to process and format data in different ways. You start with a Unix console, followed by Scala and finally spark.

Before this course I wasn't familiar with any of those. Fortunately, the lab assignments where really good practice and had a good starting level to get used to the new 'language'. You have to complete the assignments in pairs for a grade which is a nice way to figure out how things work together. The slides and lectures slides are a good backup to find useful information. The final exam of this course was a multiple choice exam which was doable, especially if the completed the lab successfully.

This variant's course in the second quarter was data mining. This course focusses on the information you can gather (mine) from big data sets. The lab was optional formatted as a competition with the prize being bonus points on your final grade if your solution to the 'Netflix challenge' was better than most people's. The course featured pretty interesting topics which made studying for the final exam a bit easier. For the final exam you needed to know a lot of practical things which is in my opinion better than having to mostly recite definitions and such.

The final course of this variant is Computational Intelligence. This is the course I was looking forward the most when choosing this variant. This course has a project that consists of 3 parts you have to complete as a group of 4. In each part you have to implement different 'AI' algorithms to which are each used to solve a different problem that is related to the other problems. This is quite challenging but really fun, especially when you manage to make it work. I cannot say anything about the final exam, since it got postponed to the end of Q4 which I still need to make at the time of writing this.

Embedded Systems variant - Charlotte Eijkelkamp

Sadly I was never able to attend an information session planned in one of the general assemblies, so to be fair I was quite clueless considering my variant decision. I remembered enjoying Computer Organization in my first year so I started looking into the courses of the Embedded Systems track. It turned out to be right up my alley, so ES it was.

In the first quarter of year two you start off with Digital Systems. This course for me was really similar to Computer Organization. The similarities were found most in the theoretical part (so the lectures) of the course. Think about logical circuits and state machines.

The biggest difference between CO and DS was the lab. This was also what I personally really liked about DS. Every week you teamed up with your lab partner to make actual physical logical circuits using a breadboard and a hardware modelling language. Giving a more hands-on experience than the CO Assembly lab, this lab was more exciting than CO. All in all, similar to CO, but in my opinion even more engaging.

The variant course in quarter two was Embedded Software. In the lectures we talked a lot about software ran on a low-level piece of hardware and all the complications that come with it. Then there was of course also a lab. First you had to do some C-programming and after you partnered up with somebody to work on a line follower. For this lab you had to do Arduino programming, c programming and a bit of image processing.

Quarter three went by a bit differently than normal, but I can still talk about my on-campus experiences with Operating Systems. The lectures were pretty straight forward and we discussed, as expected, the design of and problems with operating systems. The lab of this course consisted of creating small programs on a raspberry pi. These assignments varied between enabling small LEDs from kernel mode to creating stack exploits.

So for a decision mostly based on me liking CO I was pretty content with the decision I made. I really liked all the courses and especially all the labs that came with them. If reading this made you enthusiastic I would recommend the Embedded Systems track!

Third year electives

Hiba Abderrazik and Shivani Singh, CSE students

In the third quarter of the third year, Computer Science students get to follow electives. We have called in two students to give more insight about the elective they have followed in order to help future elective-choosers with making their decision.

Multimedia variant - Belal Koukouh

When I had to choose a variant choose I was hesitating between multimedia and data. I decided that Image Processing sounded like a really interesting course and eventually ended up choosing the multimedia variant.

The first course in the variant is Signal Processing. In this course you will take a look at audio plots just like you see on Soundcloud for example. However, in this course you really delve deep into it and you are going to look at that plotted wave at bit-level. You learn how you can magnify or diminish certain frequencies and also learn about Fourier transformations which I thought was really interesting.

Next we have Image Processing, the course I initially chose the variant for. At the beginning you learn about certain photoshop techniques like adjusting the contrast. Then you do some more crazy stuff like image segmentation. Next you learn about some of the challenges you face in image processing and finally you can apply all your knowledge in a project. The project was really fun in my opinion, you had to find a way to extract serial numbers of cars from a video, which was very exciting.

Finally we have multi media analysis, which was actually my least favorite course out of the three. You learn about the way recommendation algorithms (think Youtube) work for example. Then the next part is about matching certain videos and/or audio for applications like copyright strikes. There is also a part where you use machine learning for image classification. This part was a little similar to image processing. This course also has a final project where you get to choose you favorite of certain problems and you have to solve them using the knowledge you acquired during the course.

Overall I am quite happy I chose this variant and if you are interested in image processing and audio manipulation, I would highly recommend this!

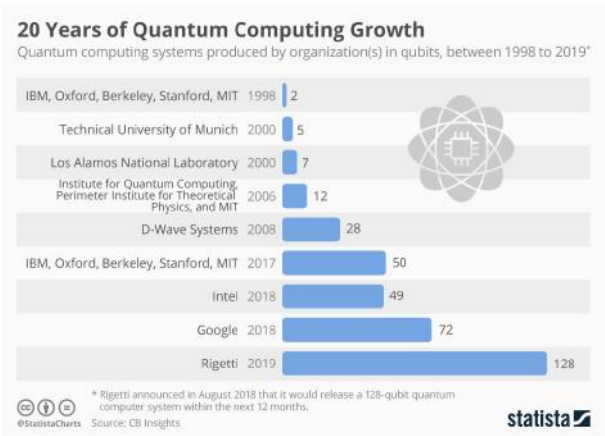
Variant course A
CSE2220 Signal Processing
CSE2420 Digital Systems
CSE2520 Big Data Processing

Variant course B
CSE2225 Image Processing
CSE2425 Embedded Software
CSE2525 Data Mining

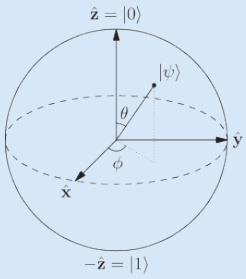
Variant course C
CSE2230 Multimedia Analysis
CSE2430 Operating Systems
CSE2530 Computational Intelligence

Introduction to Quantum Computer Science - Hiba Abderrazik

Supercomputers and quantum computer science are on the rise (figure 1), yet up until this year quantum computer science was not a part of our CSE curriculum at all. That is why I was excited when I saw the elective Introduction to Quantum Computer Science, which is given by David Elkouss. As the name suggests this elective introduces the key principles of quantum computing. It is a nice change from the topics discussed throughout the rest of the curriculum, which is what led me to pick this elective.



Although there are implementation exercises throughout the course, the main focus lies on the theory behind quantum computing. We were expected to independently brush up on our linear algebra during the first week. Linear algebra is definitely a prerequisite for this course, since it is pretty much the foundation of quantum computing. Many principles in quantum computing rely on manipulating qubits (quantum bits). Qubits can be represented as vectors on the Bloch sphere (figure 2). You can perform rotations of certain vectors on the Bloch sphere by performing matrix multiplications. Apart from that, a lot of properties in quantum computing can be deduced from certain rules and properties we have learned during linear algebra.



You are not expected to have a background in or thorough understanding of (quantum) physics. Of course physics plays a big role, but this course is specifically made for CS students without that knowledge. Overall, since this is an interdisciplinary domain both physicians and computer scientists need to gain basic understanding of each others work.

Every week we had two lectures. The course does not have any TAs or instruction/lab sessions, but there are two assignments every week: the written exercises (not mandatory) and the implementation assignments (graded). This means that a lot of independent self-study is expected from you and it is your own responsibility to reach out to the professor via email or during the lecture breaks if you have questions about the assignments. The written exercises were more mathematical questions about the theory of that week, where you might be asked to prove, reason about or execute theory from the book. Though these are not mandatory, they help with understanding the concepts better and are representative for the majority of the final exam. The implementation assignment is meant to help your understanding of the given material through actually executing principles and algorithms from the book.

These assignments were valuable, because they helped me understand some theoretical principles that otherwise would have remained very abstract and they also help demonstrate the power of quantum computing.

The way the course is taught is a bit different than we are used to during the bachelors. There is a lot of emphasis on self-study, but even though I had to get used to that at first, I did not mind that too much. If you like the more mathematical/theoretical courses in the curriculum and are excited to learn something completely new I would definitely recommend this course!

Human Computer Interaction - Shivani Singh

The course Human-Computer Interaction (CSE3500) was given for the first time this year.

It is a course that teaches you techniques and methods on how to develop the side of a program that will be shown to users. You learn skills to elicit requirements for a project, to prototype your final product and to evaluate it. Questions like “How do I involve future users in various stages of the design and development process?”, “How do I include perspectives and values of multiple stakeholders in one design?” or “How do I ensure maximal inclusivity in my product, for users with special needs?”, and many more, will be answered if you choose this elective.

You learn a lot about the part of a project that might be less important to us, as the software engineer, but are essential for users to be able to operate the systems we create.

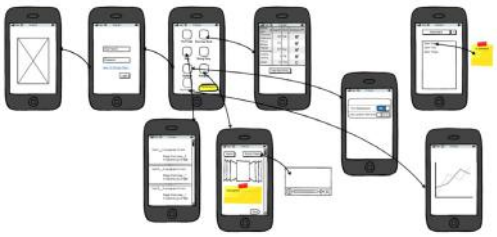
Next to a weekly lecture and a weekly lab, there is a group project.

For this, we had to hand in a report in which we described the process of developing our product. In our case that was a web application for illiterate people to be able to independently plan holidays. We did this by identifying requirements, then designing a system and prototyping it, and finally evaluating it. We did not have to present a final product or actually program anything.

Basically, we learned the theory behind methods of user-centred engineering (UCE) in the lectures, and then applied certain methods to examples in the lab, and finally had to use this knowledge to make a report.

The concept of how the course seems very nice because it covers all the different tools to learn UCE. However since the course was given for the first time this year, it was not very well organised. For example, we were supposed to start with the group work in our free time, next to the lectures and lab, but that was not entirely made clear from the beginning. It probably would have been nicer to just be able to use the lab time, to work on our reports and learn the methods directly applied our system. But who knows, maybe this will change this year!

I found the content of the course overall to be appealing and would definitely recommend anyone who is interested in e.g. finding out the difference between UX and UI, or learning about different ways to get feedback from the beginning till the end of a project, and much more, to take this elective!



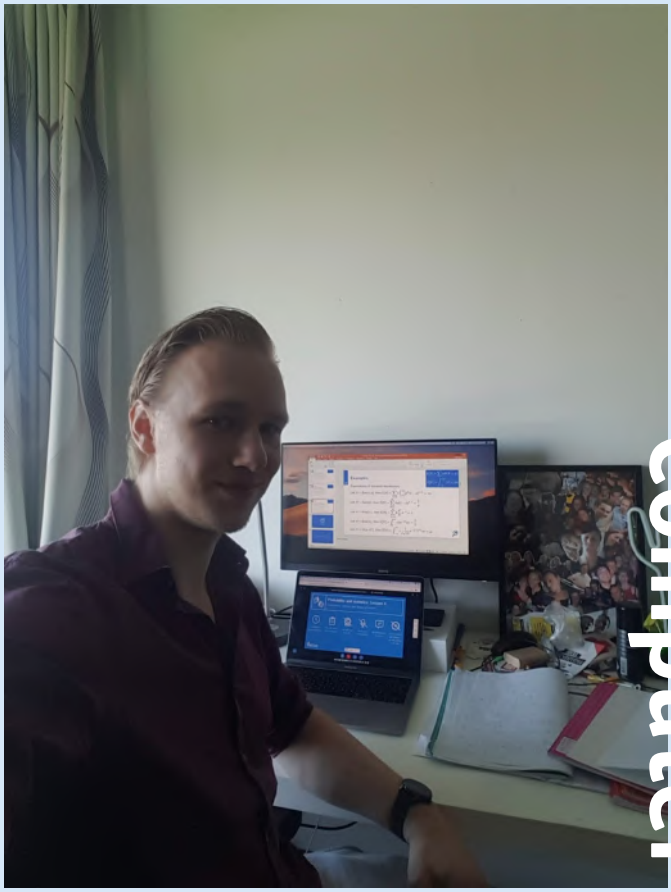
Teaching online during COVID-19

Marc Corstanje, Taico Aerts, Teachers CSE

During the ongoing COVID-19 pandemic, universities all across the country remain closed. In a very short time, all lectures and lab sessions have been moved online. We were wondering, what is teaching like in the digital environement?

Marc Corstanje - Lecturer Probability and Statistics

Hi there! I am writing this article on a Monday morning while looking at the nice weather from the window. It still feels like a weekends' day to me; I started the day by putting on my sweatpants and making myself some breakfast at home. Something is different however; I am about teach a lecture in Probability and Statistics for CSE! Today, we talk about covariance and correlation; a topic that has always interested me. Therefore, I don't mind studying it at home. Let's see how the students feel about that. It's 10:30 now so I have to open the Virtual Classroom. Some eager students immediately join me and the first messages are sent in the chat. Luckily, I am not teaching alone. My colleague Nestor Parolya is there to help me monitor the chat. It's 10:45, let's start the lecture! In most mathematics courses taught at other studies nowadays, we make use of the "colstruction" format. This means we take some time to introduce new theory, but also include some time for students to work on exercises. In these strange times, we just have to hope students actually use this time for exercises and not as an extended break.



It's 12:45 now and after answering some final questions, the lecture is finished. This was a difficult lecture, so I hope the students understood the contents. Not being able to see them made it difficult to get a feeling of their understanding of the theory. Now it is time for different teaching duties that have to be done in times of digital education. After an afternoon of digitizing exams, monitoring the discussion forum and preparing for the next lecture my day of teaching is finished.

While writing this, I again realize how strange these times are. We are giving entire lectures from our homes. Students can see and hear us, but we can't see or hear them. Interaction with students seems almost impossible, so we'll have to make do with the polling option in virtual classroom. We are doing our best to keep the lectures interesting, but for all we know, students could be doing something entirely different on the side. Right now, it is essential to keep trusting our students. All we can do is trust that everyone takes a bit more responsibility while working at home and hopefully we all get through this with maximal ECTS. As for me, I can't wait to teach on campus again!

Taico Aerts - Developer and Lecturer Operating systems and CPL

I would like to share a bit about my experiences with the switch to online education. As a lecturer I am involved in Operating Systems and Concepts of Programming Languages, where my main role is organizing everything regarding the labs. The first week after the lockdown started was quite difficult. We suddenly had to figure out how to use all kinds of different platforms to hold digital lectures and lab sessions. I was having late night discussions with colleagues, testing different tools and setups and writing recommendations and tutorials for others.

Even with good preparation, there is still a lot that can go wrong. For Operating Systems (where we have mandatory sign off sessions) we successfully used talky.io for multiple lab sessions. However, halfway through the third lab session talky.io partially stopped working, so we had to switch to another solution. Communicating this to the students was a problem. Not all our students were on Mattermost and many don't see Brightspace announcements quickly. Even reaching all our TAs was difficult, because some had muted notifications to focus on the sign-off sessions. We had to schedule another lab session to make up for this, resulting in a lot of extra work for everyone.

For Concepts of Programming Languages, we wanted to still give students grades rather than pass/fail. However, a full oral exam of 30 minutes with 400 students was not feasible. Instead, we opted for using the lab grade and having a short 10-minute oral exam to mainly check for fraud, which could also be conducted by our TAs. Organizing these digital oral exams was quite a challenge. Even though there are so many different platforms available for video calls, we found only one that has the features for a large-scale oral exam and "just works out-of-the-box" for 99% of students.

With 10 minutes per student and 400 students, we did not have the luxury to deal with any kind of technical issues during the oral exams. Some tools only worked some of the time, required making separate links and appointments for each student (by hand) or didn't support all operating systems. We chose Zoom because it works everywhere and is easy to use.

Even small problems can become much bigger because we are all working from home. Due to changes to Zoom after half our exams, I had to find another TU Delft staff member early in the morning to set up a new Zoom session for the day. With many of my colleagues starting to work at very different times now, this was easier said than done. If we were still working in the office, walking up to someone to resolve this would have been easy.

Overall, the week with the oral exams meant during the day I was resolving problems and conducting many oral exams myself. During the evenings I was preparing everything for the next day, sending the schedules to students and TAs, preparing the sheet for the verdicts and collecting recordings and notes of the day. It was an exhausting week, but we managed to get through without major problems.

There are also some positives that come out of all of this. Students have been very understanding of all the problems that we encounter. They have been very supportive of our efforts to keep education going. Their appreciation helped many of us to keep putting in effort to make things work. In addition, all of it would not have been possible without the huge help from all the TAs. Thanks everyone!

Mathematics

Teaching online during COVID-19

Wolter Groenevelt, Joost de Groot, Martin van Gijzen, Mathematics Teachers

Not only students are working from home right now, all their teachers are as well. Three Mathematics teachers tell about their experiences teaching from home and how it is different from lecturing in real life.

Wolter Groenevelt - Complex Function Theory

On March 13th (yes, Friday the 13th) we had a meeting with all DIAM teachers to discuss moving all the teaching online because of the Corona virus. For me it meant preparing to teach the course Complex Function Theory online.

I was not really prepared to teach from home (who was?) and there were some practical problems I ran into. For example I have an old laptop, which turned out not to be the best choice for recording videos. I also have a desktop computer (which is much faster than the laptop), but without a webcam. And of course webcams are sold out now that the whole world has started streaming.

Then about the course itself. Providing online lectures turned out to be quite easy: there are Collegerama lectures available from 2016 by Klaas Pieter Hart, so there is no need for me to make extensive lecture videos. I do have to make a few short videos, because we don't use the same book as in 2016. There is one minor problem with the Collegerama lectures: they are in Dutch and there are a couple of students who do not understand Dutch. With them I agreed they read the book and we have a weekly online session for questions about the theory.

So the main issue was how to give online exercise classes. Based on experiences of colleagues I decided to use Virtual Classroom in Brightspace for this. We have two sessions each week; I do one session and Joost de Groot does the other one. During these exercise sessions we briefly highlight the main results of the new theory and answer student's questions, which are mainly about exercises. In these Virtual Classroom sessions the communication is a little different from usual exercise classes. The students ask their questions in the chat, and we answer them on camera. Besides the exercise classes the students can ask questions on the forum on Brightspace or through email. There are also weekly feedback exercises graded by teaching assistants.

And finally, since Complex Function Theory started in the 4th period when the lockdown was already in place, I did not see any of the students following the course in person. By now I am used to the names on screen but it would be nice to also see their faces.

Joost de Groot - Applied Algebra

March 16, 2020: emergency meeting with 40 teachers (just sitting next to each other). It is really going to happen, no more teaching on the TU. Nobody knows what to do, nobody is prepared for this.

The message: try to work from home as much as possible and try to continue the lessons as much as possible.

Working from home was no problem. I'm writing this on May 5th and since March 17th, I've been at the TU exactly two times. Wow, I've been able to sleep so much! I don't have to wake up at 6:00 AM anymore and don't have to travel from Amstelveen to Delft and back. Huge advantages, without a doubt.

However, it is also lonely. No more colleagues and students... and of course that big question: how am I going to teach? My subject Applied Algebra still has 3 weeks to go and we still have to cover the most difficult part. There is already a lecture scheduled for Monday and an instruction for Tuesday. And that while I have no idea what tools are available.

During the weekend, I decided on two things. First, to be able to keep in contact with my students, I created two WhatsApp group chats, one about the lectures and one about the exercises. I was surprised when in no time 24 of the 25 students that followed the course were in the chats.

Furthermore, I decided to expand the slides in the same way as I do for linear algebra 1: popups with proofs and examples. Together with the book and the reader, this should be enough for self study, I hoped. Expanding the slides was a lot of work... a great challenge!!

Then in the first week you start questioning everything. Are the students working? Do they read/study the material? Are they doing the exercises? Did I make the correct decisions? Are the students aware of the fact that they have to continue and are they able to?

I had to encourage them, but slowly questions started coming in via WhatsApp and it became clear to me that some students were working and which topics and exercises they found difficult. By the way, I'm a big fan of these WhatsApp group chats!! It is an accessible way to ask questions and it is surprisingly easy to answer. If it is difficult to type out the math, you just write it on a piece of paper and send a picture. Way easier than the discussion forum on Brightspace. Unfortunately, it is less structured.

Furthermore, my daughter filmed me explaining some exercises, which I posted on Brightspace. I signed up for making collegerama-recordings of the lectures, but I had to cough a lot, so I didn't find it a good idea to actually do. I tried recording lectures on the school my daughter works at, but the board was not compatible.

In the first week of such a crisis, a lot happens!! Suddenly, you're working with zoom, skype, mattermost, jitsi, virtual classroom, whatsapp video-calls, recording videos, publishing pictures of solutions, working with an ipad. None of which I really knew much about. And that continues: teams, discord, Kaltura, turniton. I focused on one method, but whether that is the best one...? At the beginning of week 2 I namely discovered how to use virtual classroom with my smartphone as second webcam filming a piece of paper while I wrote on it. It is almost an actual lesson. A big difference: instead of students you see yourself. I can tell you: that is lonely!!! I long to see students, speaking faces that show whether they are still following, or whether they have questions. Hopefully we will find a solution for this. See you soon!!??

Note: I'm not nearly done with my story, exams, new experiences... but I'm not allowed to continue.

Note: There are so many online tools available!! I'd love to hear which you like and which not. And what is best for instructions?

Martin van Gijzen - Numerical analysis 2

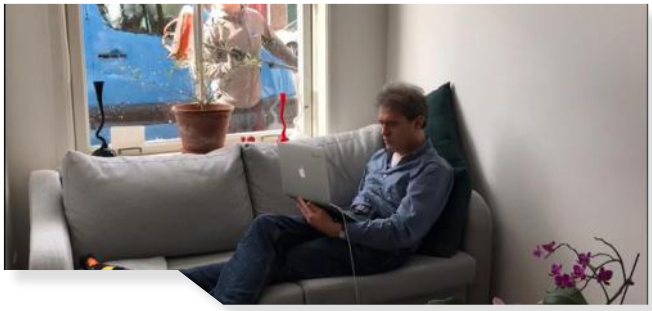
On March 12th, a colleague and I were discussing when we would have to start online teaching. There was little doubt in our minds that it would be soon. It turned out to be the next day. That meant that things had to be organised quickly since I had to teach the following morning. It concerned a small master course (CSE - special topics) with only eight students. I had prepared the lecture already on slides. So it was a good opportunity to try things out! On Thursday evening, I looked into some options and decided to use Skype.

My wife wanted to document this historic event so she took a photo (and recorded videos!) of me teaching my first online class. The window washer was also quite interested in the lesson... Apart from a slight technical problem (I could not share my screen, so a student volunteered to share his) it went okay so I decided to use this method also for my larger Numerical Analysis 2 class (40 students). The virtual classroom, which works very well, became available a few days later.

Naturally, there were big changes in the way of teaching. I usually give the classes for numerical analysis in the classical way: on a chalkboard. Now I had to prepare the lessons on slides. Since I do not have an iPad with a special pen, writing was virtually impossible (only by using the built-in trackpad of my MacBook Air). This meant I had to think carefully about the design of the lessons and spend a lot of time preparing them. The online lessons were attended well (about two-third on average participated in the online classes), and questions were asked using the chat function so there was even some interaction. Numerical Analysis 2 requires a big project, with four hours of instruction per week. During the online instruction hours, students could ask me to call them through Skype, and many did.

So how did I experience this? Well, first of all, I was happy that we managed to continue with the courses. But it was a lot of work! On the bright side, much of that work resulted in additional teaching material that I can use in the future. What I missed most during the lessons was the normal interaction with the students. Being able to see students, to ask questions and to make jokes. It makes teaching easier. It brings energy. Using the slides with limited feedback on the other hand, drains energy and always made me feel exhausted after the lesson. The instruction hours were well used. There was a continuous stream of contact requests, but students sometimes had to wait for a long time. The oral exams were also online. Overall it went well, but some students got very nervous for oral exams, and the online component adds to the anxiety. I also supervise group projects for two master courses, using Skype as well. What I notice there is that students find it hard to get the project started when it is not possible to meet in person.

I have learned a lot from the whole experience. I learned that online teaching can work well! But I miss the personal interaction. I am tired of looking at the computer screen the whole day, and I miss having to go up and down the stairs to meet with colleagues. So yes, I am looking forward to our usual ways, but only when we can do that safely. Stay safe!



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Mathematical modelling of infectious diseases

Kees Vuik, Departement Numerical Analysis

In this paper we discuss the effect of mathematical modelling for infectious diseases. Examples are: cholera, fever, malaria and also the recent disease caused by the Covid-19 virus. We only consider 'simple' models in order to explain the ideas and conclusions one can draw from these models. The models can not directly be used to predict for instance the number of people infected in the coming period for a certain disease. For the models two disciplines are important: mathematical biology (to develop the models) and numerical analysis (to approximate the solution of the models).

Modelling of the number of infected people

In this section we consider the modelling of the spread of an infectious disease in a population. We use the so called SIR model, where the letters SIR stand for: Susceptible, Infectious, and Recovered. In the literature this is also known as a compartmental model. To explain the different compartments we note that susceptible people are persons who are healthy but can be infected with the disease. The infectious are (in general) sick people who can infect other people. The final compartment, recovered, are persons who have been ill, but who are recovered so they are healthy again. In this model we assume that the recovered people are immune for the rest of their life. Although this model can be too simple for real predictions it can help to understand the spread of a disease. Furthermore, it can be used to see what the effect is of certain interventions, like developing a medicine, diminishing contact between infectious and susceptible persons, etc. In order to keep the model simple, various assumptions have been made. We mention only a couple of them: we assume that there is no change in the size of the population, the population is isolated so there is no interaction with other regions or countries, the patients become and remain resistant for the rest of their lives, etc. This is in line with the general remark: a model should be as simple as possible, but no simpler. The question "what is a good model?" always depends on what you would like to use it for. A complicated model that describes every aspect can be useless from a practical point of view for various reasons: it is hard to understand, difficult to analyse, finding all the parameters used in the model can be nearly impossible etc.

Now we start by deriving the mathematical model for an infectious disease. The various compartments are described by S, I, and R. We assume that these quantities are functions of time. Furthermore, we assume that they represent a fraction of the population, so they are all between 0 and 1 and the sum $S(t)+I(t)+R(t)=1$ for all t. The next step is to investigate the growth or decline of the various compartments. We start with S. There can be a change in S when a susceptible person becomes infected by an infectious person. This implies that the compartment of S becomes smaller so the term should have a negative sign. Furthermore, it is accepted that the probability for this is described by the product of S and I multiplied with some constant, which is denoted by b. This motivates the first ordinary differential equation (ODE):

$$\frac{dS}{dt} = -bSI.$$

For the change in I we can use the same approach. First people who are leaving compartment S are transferred to compartment I, so there is an increase of bSI. Furthermore, we assume that a fraction of the infectious (sick) people will recover. This amount is proportional to I with a proportionality constant c. Its value is inverse proportional to the time for a patient to recover. This results in the following ODE:

$$\frac{dI}{dt} = bSI - cI.$$

For the final differential equation we use that if an infectious person becomes healthy (recovered) again it will move to compartment R. So the third ODE is:

$$\frac{dR}{dt} = cI.$$

This makes the model complete. The only input needed is: what are the values of b and c and the initial value of the quantities S, I, and R. We will choose some values and give the effect of changing these parameters (parameter variation). For the remainder of this paper we take $c=1$. Let us start with some analysis. First of all we know that the total population in reality is constant. Does our model also have this property? The answer is yes. Adding the three ODE's shows that $\frac{dS}{dt}+\frac{dI}{dt}+\frac{dR}{dt}=0$ which implies that $S(t)+I(t)+R(t)$ is constant and when the initial values are chosen such that $S(0)+I(0)+R(0)=1$ the sum of the fractions remains equal to 1. This implies that it is sufficient to use the first and second differential equation because if S and I are known R can be easily computed from the relation $R(t)=1-S(t)-I(t)$.

Another question is: what is the final situation when we start with certain initial conditions? In order to study this we consider the so-called stationary points. These are values of S and I such that $\frac{dS}{dt}=0$ and $\frac{dI}{dt}=0$. From this it follows that if $I=0$ then both derivatives are equal to zero so for a stationary point $I=0$ and the value of S is arbitrary. The next question is: is a stationary point stable or not? We call a stationary point stable if the solution remains in the neighborhood of the stationary point when the initial condition is close to the stationary point. To analyze this we have to consider the sign of the derivatives. We know that $\frac{dS}{dt}\leq 0$ for all situations. This is different for $\frac{dI}{dt}$. If $S>\frac{c}{b}$ then $\frac{dI}{dt}>0$ otherwise $\frac{dI}{dt}\leq 0$. This has an important implication, because in the first situation the number of sick (infectious) persons increases whereas in the second situation it decreases. Since we have chosen $c=1$ we can investigate what happens when the value of b is changed. This value is also known as the reproduction rate. If $b<1$ holds, then $\frac{dS}{dt}\leq 0$ for all values of S. So the disease can not spread and the number of sick people decreases to zero. When $b>1$ we can be in a dangerous situation. Let us take $b=2$. If the fraction of susceptible people is larger than $\frac{1}{2}$ we have an increase of the disease, whereas if it is smaller than $\frac{1}{2}$ we have a decrease. In this example the herd immunity is equal to 50% of the population.

From this simple model and analysis we can already understand why it is so important to have the reproduction rate less than 1. Furthermore, we can see that relaxing the measures to keep the reproduction rate less than 1 leads to

the possibility of a "second" wave. As long as the reproduction rate is in balance with the fraction of recovered people we are on the safe side, otherwise a new epidemic can occur.

Another way to analyze the model is to use numerical methods. Both ways theoretical analysis and numerical analysis should go hand in hand. Dependence on the parameters can easily be done by a theoretical analysis whereas to determine how many people become ill can be done by numerical methods [1]. Figure 1 contains the well known picture. We start with many susceptible people. Then the disease sets in and leads to an epidemic peak. Finally, most of the people are recovered (and in this model thus immune) so the disease disappears.

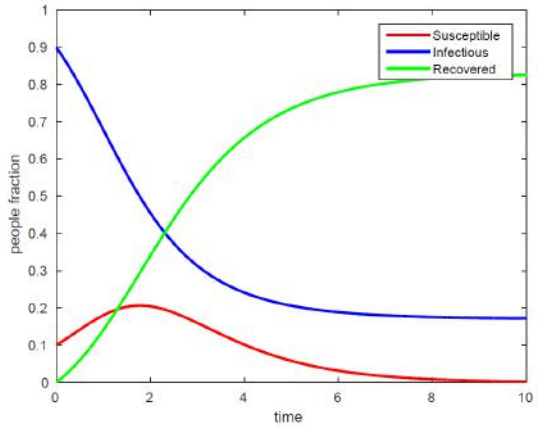


Figure 1

Modelling of the disease within a patient

In our second model we describe how the disease develops in an infected person. Again we simplify as much as possible. We assume that the concentration of the disease (bacteria, parasites, virus, ...) is denoted by z. In this model there is a medicine available which concentration is given by m. Furthermore, we assume that the medicine is given by intravenous drip. For this reason the added concentration medicine is given by the constant c. To model the change in time for m we distinguish three effects: biological decay, decay due to the interaction with the disease and the increase by the intravenous drip. For the first term we assume exponential decay with parameter a and the interaction with the disease is modelled by the product of m and z multiplied with parameter b. This leads to the following ODE:

$$\frac{dm}{dt} = -am - bmz + c.$$

To model the disease z we assume exponential growth with factor f and a decrease due to the medicine with product of m and z multiplied with parameter g. So the second differential equation is given by:

$$\frac{dz}{dt} = fz - gmz.$$

Again we can use both a theoretical and numerical analysis. If $\frac{cg}{bf} > a$ there are two stationary points:

- $m = \frac{f}{g}$ and $z = \frac{cg}{bf} - a$, and
- $m = \frac{c}{ab}$ and $z = 0$.

We can show that the first stationary point is a saddle point and thus unstable, whereas the second stationary point is stable. The second stationary point is the desired solution, the medicine has a certain positive value and the concentration of the illness is equal to 0. The other stationary point is very dangerous. A perturbation in the 'good' direction leads to healing, but a perturbation in the 'wrong' direction leads to an exponential growth of the disease and the patient dies.

We now give a numerical experiment to illustrate the theory. We take all parameters equal to 1 except the concentration of the added medicine which is taken equal to 2 ($c = 2$). We now consider various initial values for z, whereas $m(0) = 0.5$ remains the same. Figure 2 contains the results for three different values of $z(0)$. Note that if there is a mild infection the patient has a low value of z which moves fast to zero. If the infection is stronger $z(0) = 0.8$ the curve comes close to the stationary point but then it moves again to $m = 2$ and $z = 0$. So it was dangerous but the patient recovers. However, for a slightly higher value of $z(0) = 0.82$ we observe that again the solution comes close to the stationary point but then it explodes and the patient will die.

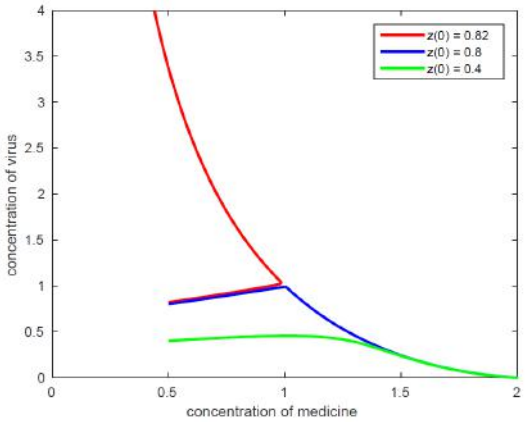


Figure 2

Conclusions

We hope that this paper leads to a better understanding of the models which are used to predict infectious diseases.

References

[1] C. Vuik, F.J. Vermolen, M.B. van Gijzen, and M.J. Vuik. *Numerical Methods for Ordinary Differential Equations*. Delft Academic Press, Delft, 2018.

Keeping your spirit high during coronatimes

Jan-Willem Manenschijn, Cofounder Raccoon Serious Games

When our minister initially announced the intelligent lockdown on Sunday, I was anxious. So much was said, yet so much was not told. Everyone should work from home, all events are cancelled, public transport should not be used anymore, but schools would stay open. What would that mean for our company? What would that mean for our lives?

Everyone was watching and all of a sudden, restaurants and cafes had to close. My first thought was "Shit, I don't have food yet, and it's Sunday!". Luckily for me, our closest snackbar ignored the rules and was still serving food. It felt so surreal. I gave the man an extra tip, thinking he would be impacted hard as he had to close shop. He didn't, as he classified himself as a takeout restaurant.

When I finished my food, other thoughts arose. Our project for VMBO schools had to be closed down. It was the last week of exploitation, and the whole project had its big opening the Wednesday before, so that wouldn't impact us so much. We wouldn't be able to create our physical games, which was just the thing we wanted to expand in our company. All our planned events cancelled.

Now, at the time of writing (end of May), the whole world is working from home. Employees and companies alike have created new habits. Managers cannot watch over your shoulder anymore. Teams stay connected, but always with a screen in between.

People discover the meaning of real connections. Physical connections. We discovered that physical connections are so much more than touching each other. It is being at the same location with each other. Having experiences together. Seeing each other in real life and making eye contact when talking.

We, at Raccoon Serious Games, have tried bringing these spontaneous moments to the digital world. I even wrote a blog post about it: 10 tips for your digital spirit. We experimented a lot with different methods and had a whole lot of fun doing so! But still, it lacks the spontaneity of the office area.

And it is difficult. Especially for the people working in markets which are hit hard. But it is really important to embrace the change. You cannot change the situation, so make the best out of it. It is really inspiring to see that we, as humans, have the capacity to adapt to these changes. It doesn't go without blood, sweat and tears, and it doesn't have to. It has been hard, it is going to be hard.

The first thing we did was brainstorm over possible experiences in the "anderhalvemetersamenleving". We are going to create meaningful experiences which combine physical and digital connections, to accommodate hybrid events. We are fueling our rockets to be ready when events are starting up again. We will skyrocket out of this crisis!

I want to end with some events you can do with your team to have fun:

Pubcrawl: Everyone hosts a bar or activity at home. You will all visit each other's places and do a short activity. You can do a casino card-game, game show, karaoke campfire, guess the object, mimic objects in pairs, using the camera feeds, etc. Let your creativity sparkle with this one!

Escape room
There are many digital escape rooms, from doing live escape rooms using a 360 camera view and a gamehost which acts on your voice, to whatsapp escape rooms. Fun guaranteed.

Pub Quiz
Easy to do, works the same as you are used to, but the people are not together and are watching a stream.

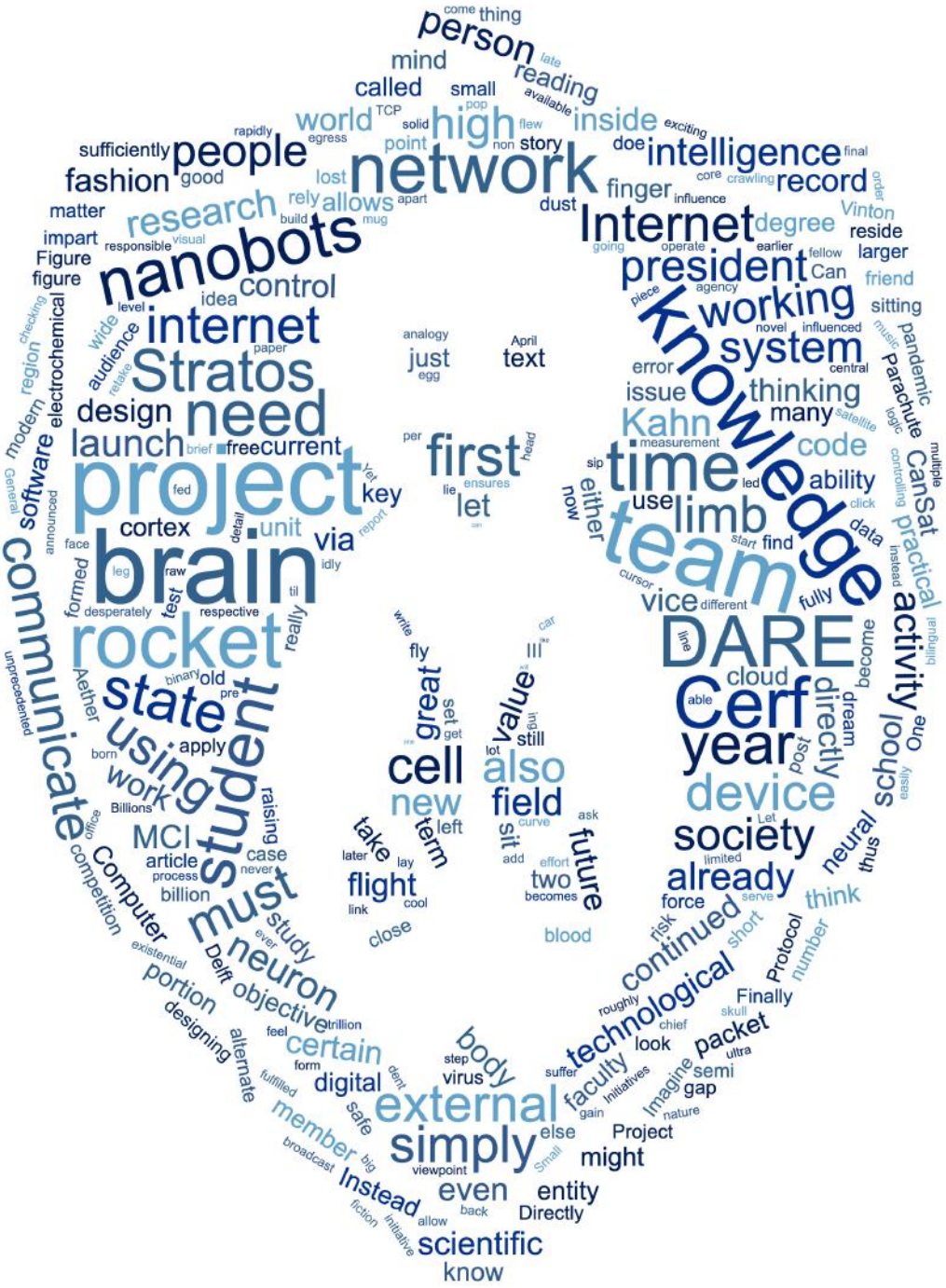
Netflix-party
Watch the same movie together, there are many online tools to synchronize Youtube or Netflix movies.

Inhouse sprint-day
Set clear small goals to reach at the end of the day and sprint towards it together. It is a really motivating way to work together on the same goal. Celebrate the result!

Lunch-break yoga
Get all those strained muscles from working at your kitchen table loosened up by doing a yoga session together. Fun and impactful activity together.

Online board games
Most common board games have free to play versions online. You can play with your friends as you used to do physically. A fun way to discover and try out new games!

Miscellaneous



DARE – A Student Space Project

Antonio Lopez Rivera, Commissioner of External Relations

Delft Aerospace Rocket Engineering is one of the older dream teams. The society itself was founded in 2001 with the goal to provide engineering students of all faculties with hands-on practical experience in the field of rockets and launchers.

Project Stratos

The flagship project of DARE is project Stratos. With the first launch in 2009, the rocket set the altitude record for amateur build rockets. The society then continued with a new iteration of the rocket which flew in 2015 and increased the record to a stunning 21.5 km. The record was taken from DARE the year after by the HyEnD team from Germany. Of course, the society did not sit idly by and continued with Stratos III. This rocket was launched in the summer of 2018 and unfortunately broke up in flight. Directly after the campaign, the Stratos IV project was started to improve the design of Stratos III and retake the record. The launch was planned for the summer of 2020 but will be moved to the summer of 2021 due to the current Corona pandemic.

Projects

DARE has many other Research and Development projects that perform research to increase the general knowledge in the society. These teams include a structures team, electronics team, simulations team, parachute research group, solid propulsion team, and cryogenic propulsion team. These teams all work on advancing the knowledge in their respective fields and gaining knowledge for current and future DARE missions.

Besides the R&D teams, DARE has three larger projects including CanSat, Aether and the Supersonic Parachute Experiment Aboard REXUS. CanSat is a launcher for the annual CanSat competition. This competition organised by the NEMO science centre and ESERO allow high school students to fly a small satellite launched on a sounding rocket. The Aether project is a launcher that will enable DARE to perform supersonic experiments and to serve as a testbed for future Stratos technology. Finally, the Supersonic Parachute Experiment Aboard REXUS or SPEAR, in short, is a project that enables testing the Stratos parachute system at supersonic conditions.

Multidisciplinary

Any project within DARE is not merely an autonomous team. All projects form a complex multidisciplinary cooperation with other disciplines. Teams also rely on other departments in one way or another. This provides students with an environment that is remarkably close to what can be expected in the post-graduation world.

To provide an example: a parachute system, such as the one for the Stratos IV payload, needs to be sufficiently sized for a safe landing of the rocket. But is also limited in the forces it can exert on the rocket, as the structure of the payload must withstand these forces and decelerations. This design therefore takes place in close cooperation with the structures department. Next to this, the parachute system needs to be actuated based on in-flight measurements and a pre-set timer window. This actuation logic is designed together with the electronics and simulation department.

Learning curve

Nobody that enters DARE is a rocket scientist. Most people are in their late bachelor or early master, but the society also recruits first-year students. A new member can apply for a team and when accepted, is trained by the team. This ensures a knowledge transfer from the "old" generation to a new generation. When you apply as a first-year student, it is recommended to start with the "Small Rocket Project". In this project, you are tasked with the safe launch and landing of a raw egg to 1000 meters. During the project, you will work together with other first-year students from different faculties and will be mentored by one or two experienced members.

There are quite some EWI students amongst DARE members. One of these students is Hidde Leistra:

The experiences I have had in DARE are among the best I have had during my studies in Delft. My personal highlight is designing and building a flight computer with like-minded students. Real-time computing does not click as much until you have to design it on a real-world application. Going on launch campaign and flying your hardware never gets old, it is a unique experience each time. Because we launch multiple times a year and our rockets are reusable (before SpaceX made it cool!) I have been able to rapidly iterate and test our flight software. Unlike courses where you are graded on a scale, the work you do has a binary outcome: you fly, or you crash and pick up the pieces. This makes working on your projects very exciting. The society has a great can-do mentality that values initiative and encourages you to come up with your own ideas.

Historical Figure: Vinton Cerf

Annerieke Ohm, Editorial Staff MaCHazine

Currently, we are all sitting at home and so are probably most people you know. In these strange times, we are all working in our own houses instead of at school, in the office or somewhere else. Due to that, we rely on the internet more than ever, to watch our lectures, to communicate with colleagues or friends or to know what has been going on in the world. That is why, this issue's version of 'Historical figure' is about Vinton Cerf, also known as one of the 'Fathers of the Internet'.

Vinton Grey Cerf was born on June 23rd, 1943, in New Haven, Connecticut. While in high school, he already worked at Rocketdyne, an American rocket engine design and production company, where he helped in the Apollo program and in the writing of statistical software for one of these engines. After high school, he went on to study Mathematics at Stanford University, where he received his bachelor degree in 1965. He then started working at IBM as a systems engineer. After two years, he decided to continue his studies and went to the University of California (UCLA), where he received a master degree in Computer Science in 1970 and a doctorate in Computer Science in 1972.

For his PhD, Cerf worked at the laboratory of Leonard Kleinrock on the project to write the communication protocol for the ARPANET. ARPANET was the first computer network based on packet switching, which was a new technology at the time. Here he met Bob Kahn, the other 'Father of the Internet'.

In 1972, Kahn moved to work at DARPA, an American government research agency, where he started working on a network of packet-switching networks. This is essentially what later developed to be the internet. Around the same time, Cerf had moved back to Stanford, where he became a professor at the faculty of Computer Science and Engineering.

In 1973 Kahn approached Cerf to assist him in the designing of this network. Together, they soon formed a first vision of what they called 'the ARPA internet'. They published the details of this network in a joint paper in 1974.

Up to this point, Cerf was still working at Stanford, but in 1976 he joined Kahn at DARPA. Together with many colleagues there, they produced an electronic transmission protocol that separated packet error checking from issues related to domains and destinations, known as TCP/IP (Transmission Control Protocol/Internet Protocol).

In 1982, he left DARPA to become a vice president at MCI Communications Corporation, where he continued working on making the internet publicly accessible. Here, he also led the effort to develop the first commercial e-mail service connected to the internet, MCI Mail.

In 1986, he became a vice president at the Corporation for National Research Initiatives, which was formed by Kahn, to develop network-based information technologies for the public good. From 1992 to 1995, Cerf served as founding president of the Internet Society. In 1994 he returned to MCI as senior vice president and from 2000 to 2007 he was chairman of the Internet Corporation for Assigned Names and Numbers, the group of people overseeing the internet's growth and expansion. In 2005 he left MCI to become vice president and 'chief Internet evangelist' at Google.

Since at least 2015, Cerf has been raising concerns about the wide-ranging risks of digital obsolescence, the potential of losing a lot of historic information about our time. These concerns are for example about the long-term storage of, and continued reliable access to, our storages of current digital data and the associated computers, systems and programs, to access these.

In March 2020, Cerf confirmed via Twitter that he had tested positive for COVID-19. In the same tweet, he criticized president Donald Trump for the way he was handling the pandemic in the United States. Fortunately, on April 3, 2020, he announced, also via Twitter, that VA Public Health had certified his wife and himself as no longer contagious with the virus.

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Computer Science Puzzle

Louise Leibbrandt, Editorial Staff MaCHazine

Inverting a Coin Triangle

Consider an equilateral triangle formed by closely packed pennies or other identical coins like the one shown in Figure 1. (The centers of the coins are assumed to be at the points of the equilateral triangular lattice.) Design an algorithm to flip the triangle upside down in the minimum number of moves if on each move you can slide one coin at a time to its new position. Give a compact formula for the number of minimum moves.

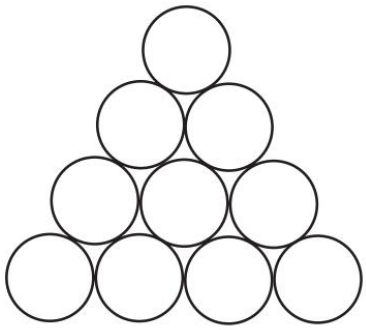

Figure 1: Equilateral triangle of coins to invert.

Solution to last issue's computer science puzzle: Killing Squares

The following recursive algorithm solves the puzzle by removing the minimum number of toothpicks, which is equal to $n^2/2 + 1$ for $n > 1$ (and, of course, is equal to 1 when $n = 1$). If $n = 1$, 2, or 3, the solutions are given in Figure 2.

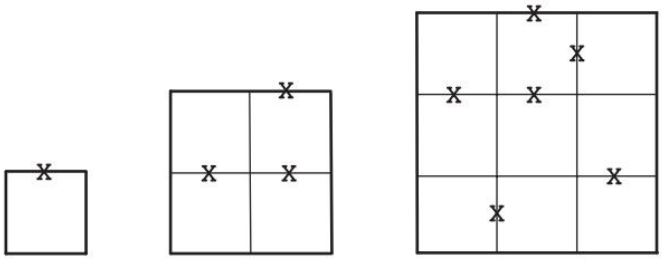

Figure 2: The Killing Squares solutions for n = 1, n = 2, and n = 3.

If $n > 3$, do the following. Consider the frame of width 1 formed by the perimeters of the square given and the square of size $n–2$ inside it. Starting with the top left corner of the frame and going counterclockwise, remove every toothpick that would have been the middle line of the domino ring tiling the frame except for the toothpick of the last domino in the ring. For that last domino, remove the second horizontal toothpick in the upper side of the square given. Then solve recursively the puzzle for the square of size $n–2$ inside the smaller border of the frame.

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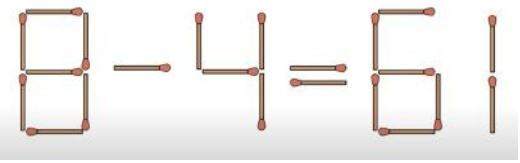
Mathematics Puzzle

Kilian Buis, Editorial Staff MaCHazine

Problem 1

Move only 2 sticks to make a correct equation.



Problem 2

What 5-digit number has the following features:

If we place an extra numeral 1 at the beginning, we get a number three times smaller than if we put that numeral 1 at the end of the number.

Solution to last issue's Problem 1

To solve this problem we need the following equality

$$\log_b(u) = \frac{\log_e(u)}{\log_e(b)} = \frac{\ln(u)}{\ln(b)}. \tag{1}$$

Using Equation 1, we can rewrite our problem

$$\log_2(3) \times \log_3(4) \times \ldots \times \log_{127}(128)$$

into

$$\frac{\ln(3)}{\ln(2)} \times \frac{\ln(4)}{\ln(3)} \times \ldots \times \frac{\ln(128)}{\ln(127)}.$$

This simplifies to

$$\frac{\ln(128)}{\ln(2)}.$$

Using Equation 1 again, we get

$$\frac{\ln(128)}{\ln(2)} = \log_2(128) = 7.$$

Hence, the solution to our problem is 7.

Solution to last issue's Problem 2

We have the following system of equations

$$ax + by = 5 \tag{2}$$
$$ax^2 + by^2 = 10 \tag{3}$$
$$ax^3 + by^3 = 50 \tag{4}$$
$$ax^4 + bx^4 = 130 \tag{5}$$

and want to calculate the value of

$$13(x + y - xy) - 120(a + b).$$

Note that we need three expressions to get this value, namely $x + y, xy$ and $a + b$. We start by considering Equation 3 and multiply both sides by $x + y$. This gives

$$\begin{aligned}(ax^2 + by^2)(x + y) &= 10(x + y),\\ ax^3 + by^3 + ax^2y + by^2x &= 10(x + y),\\ 50 + ax^2y + by^2x &= 10(x + y),\\ 50 + xy(ax + by) &= 10(x + y),\\ 50 + 5xy &= 10(x + y),\end{aligned}$$

where we used Equations 4 and 2.

We do the same process by considering Equation 4 and multiply both sides by $x + y$. This gives

$$\begin{aligned}(ax^3 + by^3)(x + y) &= 50(x + y),\\ ax^4 + by^4 + ax^3y + by^3x &= 50(x + y),\\ 130 + ax^3y + by^3x &= 50(x + y),\\ 130 + xy(ax^2 + by^2) &= 50(x + y),\\ 130 + 10xy &= 50(x + y),\end{aligned}$$

where we used Equations 5 and 3.

But this will give us the following system

$$50 + 5xy = 10(x + y) \tag{6}$$
$$130 + 10xy = 50(x + y). \tag{7}$$

Multiplying Equation 6 by 2 and subtracting the two equations, gives us

$$x + y = 1.$$

Substituting this into Equation 7, gives us

$$xy = -8.$$

Lastly, we consider Equation 2 and multiplying both sides by $x+y$. This gives

$$\begin{aligned}(ax + by)(x + y) &= 5(x + y)\\ ax^2 + by^2 + axy + byx &= 5(x + y)\\ 10 + xy(a + b) &= 5(x + y)\\ 10 - 8(a + b) &= 5.\end{aligned}$$

Solving this for $a + b$ gives

$$a + b = \frac{5}{8}.$$

With this information, we can give an answer to the question. Namely,

$$13(x + y - xy) - 120(a + b) = 13(1 - -8) - 120(5/8) = 42.$$

Science Trends: The Brain Machine Interface

Akash Singh - MSc. Computer Science

On this page you will find some brief information on recent scientific breakthroughs or interesting news. Whether they're big or small, if we think they might interest you, we will mention them here! Do you miss a certain trend or want to inform your fellow readers of an interesting innovation? Feel free to contact us.

We communicate with machines and the cloud on a regular basis when we code, send texts, or post pictures. The role of a smartphone/computer in this process is irreplaceable. Or is it? Can we communicate with machines using nothing but our thoughts? Can we communicate with other people using nothing but our thoughts?

When the industrial revolution happened, it gave us machines which did the physical labour for us. Instead of walking 5 miles, you could simply sit in a car and let it do the 'walking' for you. At present, we are in the middle of a technological revolution, one which lets us outsource our intellectual labour. Instead of hiring a bilingual to translate a short story from a foreign language to one we understand, we simply let google translate do the translation for us. Instead of then reading that story to report the literary themes of it, we simply can use a python library to extract those themes for us. This article that you are reading has been proofread, like all articles need to be before publication. But even if no human proofreads it for me, I can still be certain that there are no grammatical or spelling errors in it; simply because almost every text editing software does these things for you. Since a great portion of the global economy and scientific research now involves intellectual labour, and a great portion of modern intellectual labour is now performed by machines, inevitably, we store a great portion of humanity's cumulative knowledge digitally. Add to this fiercely intense technological whirlwind the need for computers to communicate with each other, and you find yourself making friends with the internet. Now, let us add a final element in this context, the human mind. In the modern world where everything is connected in a huge network, humans sit at the core nodes, communicating with the machines and making the network breathe and thrive. Without people uploading photos, Instagram and Facebook will be just a bunch of code sitting in a server. This is why stopping and thinking about the nature of human-machine communication becomes important. When you are writing code, you are essentially communicating with a machine using your fingers. When you are typing a text on WhatsApp, you are communicating with a machine using your thumbs. No matter how fast you can think about things to say or code, you will always be constrained by this annoying bottleneck called your thumbs/fingers. Let's think about this – apart from your brain and the machine's processing unit, is anything else (your fingers, the computer/smartphone screen, the keypad) an essential component of this communication pathway? Hopefully you are thinking, "not really". Imagine simply speaking and the computer understands, and even responds. Devices like Alexa have already achieved that. So what is the next step here? It is frightfully simple – imagine having a thought, and the computer immediately understands you. Imagine thinking, "I want to know the value of pi" and suddenly it pops up in your head. This stream of thoughts is composed by an algorithm crawling through information available on the cloud and is then fed directly to your brain via billions of nanobots residing inside your skull. How is all of this anything but science fiction you ask? Read on.

The human brain is a living tissue composed 75% of brain cells, 15% of blood, and 10% of cerebrospinal fluid (by volume). 'Brain cells' roughly means either neurons, or glial cells. These brain cells communicate with each other using synapses. Essentially, any brain activity – thoughts, reading, listening to music et cetera can be understood in terms of a bunch of brain cells communicating with each other via these synapses. To communicate this brain activity to an external entity (another human or a computer) we use communication tools like language or a keyboard. This is where we take a shortcut – if we can directly monitor the state of a person's neurons over time, that person simply needs to have thoughts in order for the external entity to understand him/her. Currently, the scientific research which will enable this is motivated by many objectives. Directly monitoring the neuronal state of an individual, which lies at the heart of our discussion here, allows us to gain unprecedented understanding of brain disorders like Alzheimer's [1]. This understanding, hopefully, will pave the path for the second key activity, influencing the state of neurons externally. Another important motivation for this field is that people who have lost the use of their limbs to an accident usually suffer damage not in the neuronal cluster responsible for the limb's control but somewhere further down the line – either the communication pathway to the limb is damaged, or the limb itself is lost. In either case, since the mind retains the ability to move that limb, installing an alternate connection/limb and controlling it synthetically by transmitting the neuronal states in an alternate fashion should do the trick. Systems like BrainGate have already enabled test patients to move cursors on screens or take a sip from a mug using nothing except their thoughts.

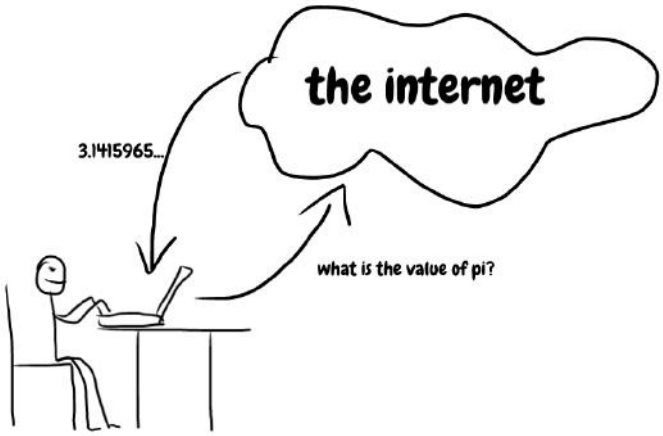


Figure 1: ***How to look up the value of pi - present***

A growing understanding of the cellular genesis of diseases has in turn, influenced the growth of a scientific discipline important to our idea – medical nanorobotics. In principle, nanobots can reside inside an organic body and perform functions in a semi or fully autonomous fashion. In the specific context of the human brain, neural nanobots can reside inside the human brain, continuously monitoring key electrochemical signals, transmit them to an external device (a prosthetic limb or a supercomputer), and even influence these electrochemical states. Simply monitoring the neuronal states allows the individual to control an external device while influencing these neuronal states allows for sensory feedback from an external device. However, these immediate objectives, once fulfilled, will lay the road to more ambitious objectives, like establishing a brain-brain interface which is exactly what it sounds like – connecting two brains in this fashion [2]. For instance, connecting the sensorimotor cortex of one individual to the visual/motor cortex of another. This can enable one person performing an activity, for instance, skydiving, and 'broadcast' the experience directly to the sensory cortex to an 'audience'. Except, the audience, in this case will feel like they directly are participating in the activity. "Vicarious" just acquired a whole new level of possibility. [3]

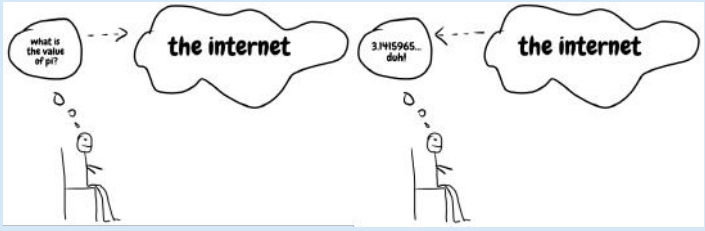


Figure 2: ***How to look up the value of pi - future***

Any technological paradigm which achieves such fantastical dreams must first satisfy certain fundamental requirements [1]. First, the nanobots must possess ultra-high resolution in monitoring and resolution. The reason is simple, the human brain is composed of approximately 86 billion neurons and 200 trillion synaptic connections. Yet, all of these intimidating number of processing units are packed within an intracranial volume of 1700 cm3. In terms of computation-per-volume, these are not just really good but extraordinary figures. To interface with such a dense network of processing units with any practical competency, the devices in question must possess equivalent resolution in their sensitivity and local mobility. Then, these nanobots must operate in a semi or fully autonomous fashion. Third, which is both essential and complicated, is that these nanobots should not be physiologically intrusive. What that means is that the body must not reject these devices. Billions of years of evolution has made our bodies extremely sensitive to entities external to the body – bacteria, virus, even cells of another human (this is why blood types need to be matched before a transfusion). Injecting nanobots inside a person can easily freak out the immune system and result in complicated inflammations. Therefore, the ideal nanobot will 'blend-in' with the rest of the cells without raising any physiological alarm. The ingress and egress of these nanobots is a significant technological challenge which needs to be solved with the highest degree of competency possible. Finally, these devices must enable transfer of information with sufficient and robust bandwidth for it to be practical. If these nanobots are connecting a person's brain to prosthetic legs, the connection cannot be overloaded or sketchy. There are several solutions which are already developed or are being researched like 3D nanotubes (neural lace) and nanoparticles. The most promising one is a project called "neural dust" [1] which uses high number of independent, free-floating sensor nodes to monitor extracellular data. A central device establishes power and communication links with all the "dust particles".

Cumulative human knowledge doubled approximately every century until 1900. By 1950, human knowledge was doubling every 25 years. As of 2006, on average, human knowledge was doubling every 13 months, and the "Internet of Things" is expected to further lower the doubling time of human knowledge to 12 hours [1]. To keep in pace with this march of knowledge, we will soon need an upgrade in the cognitive abilities of humans. Neural nanorobotics promise, by influencing the physiological state of neurons and synapses, to impart instantaneous learning. Another possibility is by establishing a sufficiently wide bandwidth between the mind and the cloud, knowledge will simply be a matter of thinking about a concept and immediately knowing about it (like the pi example earlier). Proof-of-concepts have already been performed where external stimulus like a directed magnetic field was used to impart instantaneous learning [3].

Research has shown that high IQ brains are integrated with pathways which connect distant brain regions, thus employing larger regions of the brain when focusing on a certain problem. Through a paradigm described here, it will be possible to establish such novel pathways. These pathways can be a hybrid of biological and non-biological networks, thus expanding the cognitive abilities of humans the extent of which is difficult to imagine.

One of the most important challenges of our times is the existential risk posed by AI. A key point of this issue is the fact that the digital intelligence which we are trying so hard to create these days might speed past human intelligence itself and we will face the daunting task of trying to control algorithms which are much smarter than us. The viewpoint of leading thinkers and entrepreneurs in this field culminates to this analogy – it can be like a monkey trying to control a human where we humans are the monkeys and the algorithms are humans. Except, some experts suggest the intelligence gap between Artificial General Intelligence and the smartest human can be exponentially higher than the gap between the intelligence of humans and monkeys. Therefore, enhancing the intelligence of humans using a brain/machine interface will provide us an advantage which we might desperately need in the future.

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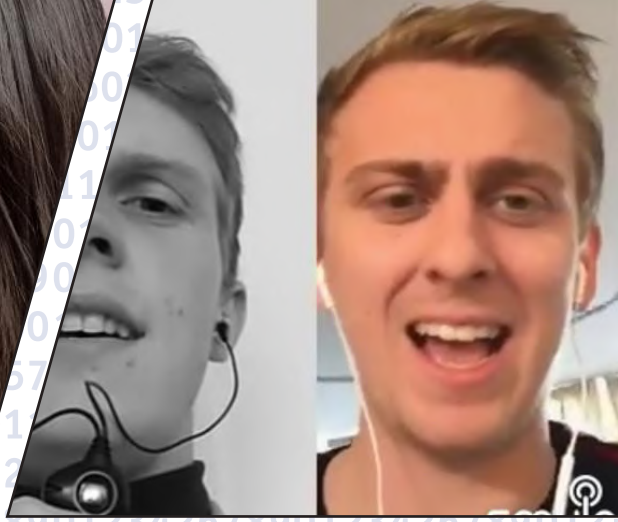
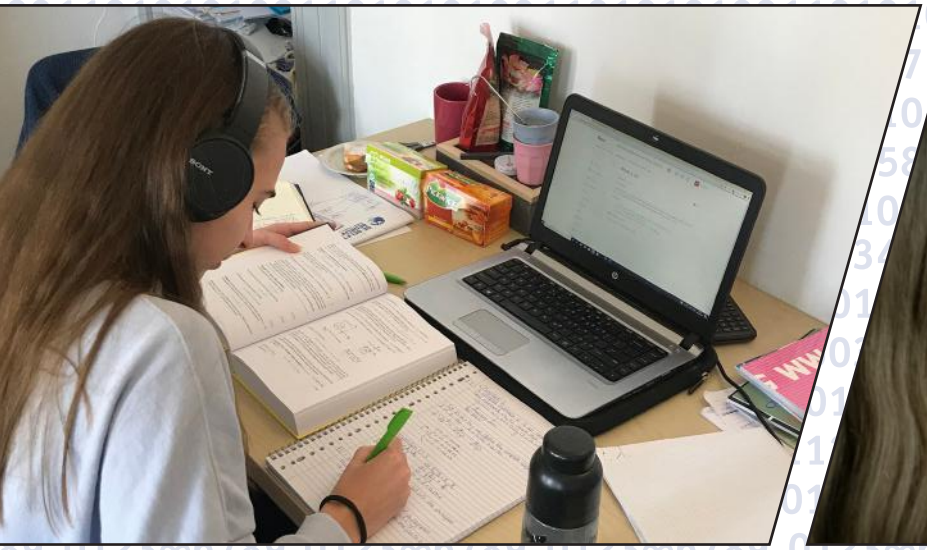
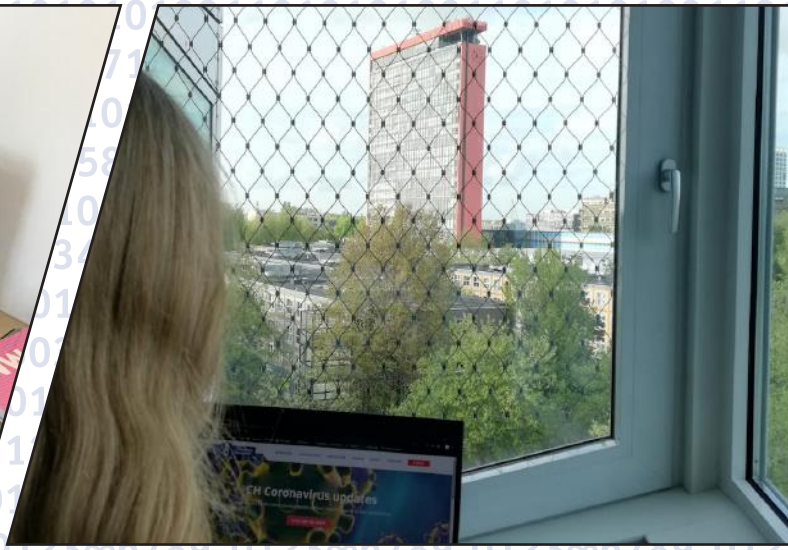
FROM TRIP TO STOCKHOLM



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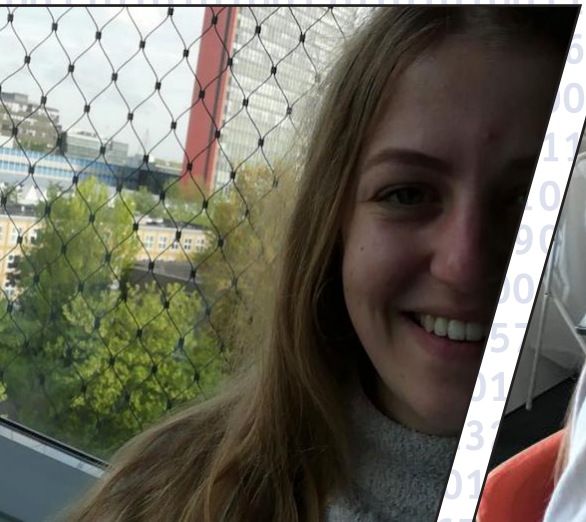

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QUARANTINE LIFE

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