Autonomous Driving
using Machine Learning

Discovering causal
relationships
between time series

AR Filters
A guide for Beginners

The Age of
Streaming
A brief history of music
streaming

Work from Home
Escaping the office jungle

Corona credit
Mass surveillance in practice

And more...

Columns
Company visits
Cartoon
Puzzle

Inter-*Actief*

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Nu ook in Deventer!

I/O VIVAT

//Editorial

Dear reader,

During the process of creating this I/O Vivat, quite a few things happened. Of course, the biggest setback that we encountered was the lockdown of the University due to COVID-19. However, this edition is now finished and available for you to read while waiting for this crisis to end.

In this edition, you will not find articles about conspiracy theories that link 5G and corona, but you *can* read about the impact of corona on the surveillance systems in China in the article Corona Credit by Sven. In case you prefer articles that are closer to your home, Niels has written a column about how people work from home during these times and how this may influence the future of working.

For the people who get bored of all the corona news, there are articles from Adeline and Mihnea. Adeline writes about how IEM students use VBA for data management. Mihnea focuses more on the fun things to do with technology, like creating AR filters and streaming music.

A lot of the pages this edition are filled with articles from people who are not currently a member of the I/O Vivat committee but do have something to write about, for which we are thankful. The board and candidate board of both ENIAC and Inter-*Actief* have written about their experiences as a board and their expectations for the future. Meika Nauta, the winner of the ENIAC Thesis Award 2018 and one our previous chief editors, has also written an extensive article about TCDF, a framework with which she hopes to improve the quality of predictions made by machine learning systems. Lastly, the programme directors of TCS and BIT talk about the way they see their study programmes and students evolve.

Of course, like every edition, there are some interesting articles from companies about how it is to work with them. Lastly, on the backside of this edition, you can find a puzzle by Prodrive that you can solve, should you find your mind start to drift during the endless video conferences.

I hope you enjoy reading this edition as much as we enjoyed creating it!

Emma Sloot
Chief Editor I/O Vivat

Puzzle Prodrive

On the back of this I/O Vivat you will find a puzzle created for you by Prodrive. Send in your solution to the puzzle through https://puzzle.prodrive-technologies.com/inter-actief and maybe you are in a for a prizel

//Content 35.1

Multidisciplinary: IEM

Programme director TCS
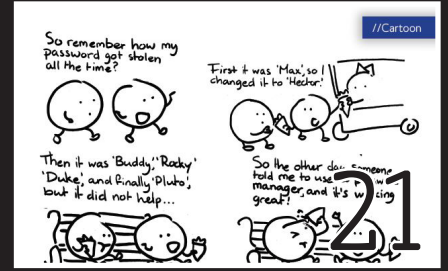
Cartoon
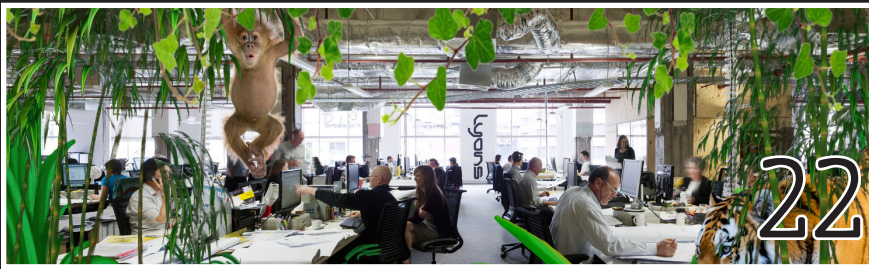
Work from Home: Escaping the office jungle

Witteveen+Bos

From the ENIAC board
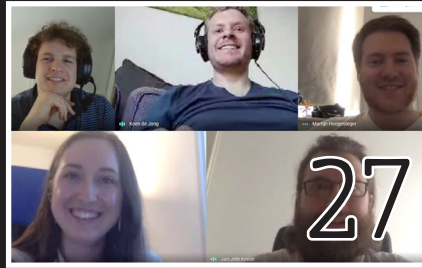
From the ENIAC candidate board

Corona credit

From the Candidate Chairman

Programme director BIT
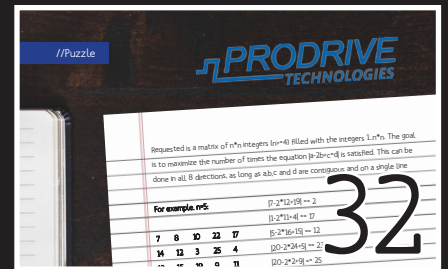
Prodrive: Puzzle

Cars, Darwinism and Data Science

By: Florian Mansvelder
Editor I/O Vivat

The Basic Machine Learning course at the University of Twente is a mandatory part of the Data Science master track of Computer Science. With a deadline every week, you will be up till late and you will be tired in the morning. Nevertheless, it is extremely fun and very beneficial for any Computer Science student, so I guess it is a bit like a Tuesday Afternoon Drink. However, it is also the prerequisite course for following Advanced Machine Learning the next quartile. During this second course you get to show what you have learned in the last few months - and expand on it - by creating your own research project in a group of four students.

Among other topics, Basic Machine Learning covers Neural Networks (NN). My group and I were very interested in this topic, which is why we decided to give it a shot for our project. Related to Neural Networks is the subject of so-called Genetic Algorithms (GA). As is the case for NNs - which are inspired by the workings of a human brain - GAs are also based on a concept found in nature; natural selection. Now we had a topic from the previous course and we chose GAs as something to figure out for ourselves. All we needed now was an actual use for these topics to call it a proper project. Coincidentally, Elon Musk is making a lot of money by making autonomous cars. Since we happen to want to make a lot of money as well, we came up with the following: "Autonomous Driving Using a Neural Network Trained by a Genetic Algorithm"[1].

So, first things first. Since I have been throwing a lot of fancy words at you and you might have not heard of any of this, in order to get you rich, I will start by explaining what exactly we made use of to do what we did.

Neural Networks

To understand Neural Networks we need to understand its parts. A Neural Network is comprised of... as you'd guess - neurons! So first we need to know how a neuron works. Let's create an imaginary neuron which guesses whether something is either a bike or a car. This neuron would take in two of inputs, let's say the color and maybe the number of wheels of a 'thing' (the car or bike). Based on these inputs, it provides an output between 0 and 1. Let's say that an output below 0.5 corresponds to "bike" and anything between 0.5 and 1 to "car".

Now comes the magic. The neuron goes through all the inputs and guesses whether or not something is a car or bike... and performs horribly. However, we know which guesses were right and wrong. We get mad at the neuron for all the mistakes it made with some healthy feedback and the neuron adequately adjusts its "weights" based on the right and wrong guesses. These weights are values linked to the two inputs we spoke of (the color and number of wheels), as a sort of fancy multiplier. We run the inputs again and again through the neu-
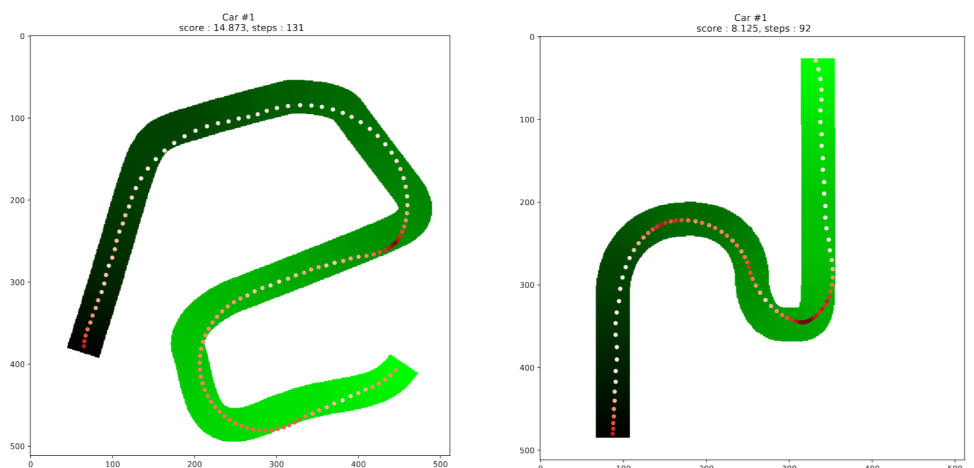

Figure 1: Training for many generations results in clear racing lines.

ron and we keep telling it what was right and what was wrong. Since the color input has no added value to correctly

real-life car. However, it can still 'drive', virtually... sort of... On to the learning algorithm.

new generation. As in real life, inbreeding produces faulty offspring, which is why fresh, completely new agents are also constantly added to the mix.

"Pretty cool right? Well, this was cool in 1953"

guessing the answer, its weight will be continuously reduced until the color of a thing has virtually no impact on the output. At the same time, the weight related to the number of wheels is very relevant, and over time it will be adjusted to exactly the right number, so that everything with 4 wheels is guessed to be a car, and everything with 2 wheels is guessed to be a bike - regardless of whether it is red or blue.

Pretty cool right? Well, this was cool in 1953 when Frank Rosenblatt invented this. Now imagine fancy 2019 neurons complete with confusing mathematical formulas to improve the output. To be precise; 9 of them (called the input layer), connected to another 6 neurons (called a hidden layer), connected to another 3 neurons (another hidden layer), which are then connected to 2 output neurons acting as a steering wheel and a gas pedal (the output layer). These hidden layers kind of manipulate and process the dataflow, in order to convert "how close am I to a wall?" into "how much should I turn left?" And there we have it, enough brain cells to drive a car! It cannot yet send a text while driving - but neither can humans. Sadly, this is just a tiny pixel in the race track-matrix of our computer program and not a

Genetic Algorithms

Although it is important to know whether you are in fact riding a bike or driving a car, the number of wheels on your vehicle is not related to deciding on a left or right turn when speeding towards a concrete wall; we need a different strategy. This is why we are going to look at - in my humble opinion - one of the coolest learning strategies, a Genetic Algorithm. GAs are based on natural selection. We start with a generation of so-called "agents". These agents all have their own Neural Network and are all created with randomised weights. They then go about their business, all in a different way based on those weights. However, as in nature, some agents are more "fit" than others. This means these agents get to get it on and thereby produce offspring. This offspring is a new agent, whose weights are heavily influenced by one or more well-performing mummies and daddies and slightly "mutated". GAs can either be continuous, in which agents die off and spawn new offspring individually, or they can run per generation, waiting until every agent is "terminated", and only then deciding which agents were most fit and get to produce a completely

Now, our agents all have their own little car which they drive around in based on their own little NN. This means that every car responds differently to their proximity to a wall. After the entire generation is "terminated" (i.e. drove right into the concrete wall), we create a new generation as mentioned above, in which the cars that got the furthest on the track are the "fittest". At some point, the cars will be able to reach the end of the track. Eureka! However, when an autonomous car goes 30 on the highway it is not really "functional". This is where the second fitness test comes into play. Not only must the agents try to get as far as possible, now they also need to do it in as short a time as possible. Reaching the end is achieved in just a few generations, yet the speed at which agents do so keeps improving over hundreds of generations. In the end, we saw clear racing paths taken by the agents where they adequately speed up and slow down near turns.

Now you know the process of creating a potentially priceless project using NNs and GAs (if you use the abbreviations it seems like you know what you are doing). And did we fare? We went straight to Elon and the people from Formula 1 to sell our project. This was followed by a series of insurance claims and ongoing lawsuits regarding cars and concrete walls. It might be that a GA is not the best learning strategy for live cars and that we should just stick to counting wheels.
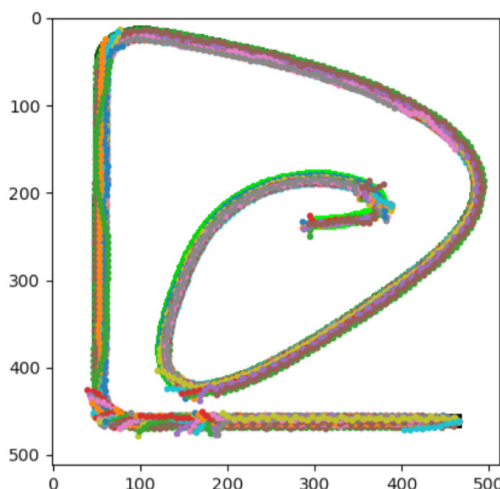

Figure 2: In early stages of the algorithm, the cars still make a lot of mistakes.

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Belastingdienst

By: Niels de Groot & Sven Mol
Editors I/O Vivat

Anton de Ruiter
Belastingdienst

The Belastingdienst (Tax and Customs Administration) is perhaps one of the IT companies that almost every Dutch citizen has to deal with. But how do you ensure that, every year, millions of people can report their taxes without too many problems? And who is behind those systems? We visited their office in Apeldoorn and spoke to Anton de Ruiter, Manager and Coordinator Java at the Belastingdienst.

In our preparation for this interview, we naturally looked at the website of the Belastingdienst and there we found the remarkable statistic. You maintain more than 300(!) applications. The logical question is of course: why, and how?

The Belastingdienst is one of the the largest government organizations in the Netherlands, and currently still includes customs and the FIOD (Tax Information and Investigation Services). The Belastingdienst runs the declaration and collection processes, and the allowances (toeslagen). And then of course we have the whole range from private individuals and small self-employed entrepreneurs to large companies.

As a small independent entrepreneur, Sven already uses six or seven of those applications. Why is the process so complex?

Well, of course he sees those applications, but you also have a lot of applica-

tions that a customs officer at Schiphol or in the Rotterdam harbour needs, or which are used for administration purposes at the offices. All kinds of applications have different user groups. In addition, all these applications must communicate with each other in a safe manner, so that is also an important part of our systems.

The largest government organization in the Netherlands, so many applications; a dream for a data scientist, wouldn't you agree?

The Belastingdienst works with no less than 7.3 petabytes of data, only that is not even what makes it so complex, it is the big picture. We are, of course, directed by the government, and if new tax regulations are devised, we must implement them. However, often the old systems do not disappear completely, so our total number of systems start to build up fairly quickly. This means that our systems are complex and, to make matters worse, also have to communicate with each other through all kinds of different links and dependencies. That is what really makes it complicated.

Tax declaration, well-known to all of us. It does happen that 70,000 people want to report their taxes simultaneously. That seems like quite a challenge.

Yes, we can handle a maximum of

between 70,000 and 100,000 users at once in our data center, which is at a different location than where we are now. We have everything on-premise, and we have our own cloud. Each year, there are about 9 million people who have to file their income taxes in the Netherlands and they have about two months to do so. There are people who make it a sport to do it right on the first day, and you have latecomers who have to quickly fix it on April 30th, right before the deadline, so there are several peaks in usage to take into account. I have to say that with our current capacity we are able to provide the service that our citizens need.

What is your task within this hugely complex organization?

I am responsible for the professional development, training and knowledge sharing for the more than 300 Java developers who work here. That's about 100 scrum teams working on a multitude of applications. Sometimes there is one team for an application, but for larger systems, teams often work together. I organize many knowledge sessions where different government services come together to share their experiences so that we can learn from each other. We sometimes also involve external parties, such as the Apeldoorn JUG [ed. Java User Group], with whom we hold a session once a month where other interested parties from the area are also invited. I also do this government-wide with the Rijksbrede JavaTafel in Utrecht

so that all kinds of services do not have to reinvent the wheel every time they try something new.

And you are also responsible for new Java talent.

Yes, I am also responsible for the training classes. I hire many IT professionals with a HBO or university degree. They often think that they have learned Java (SE) in their education, but then it turns out that it is only a very small part of it. With a traineeship we then really teach them Java (SE & EE) as we use it here, together with all the tools and frameworks. Our class starts twice a year, the March 2020 participants will soon start their 'learning on the job' part and I am now busy with the selection for the new class of September 2020 which is already almost full.

Almost completely full, is it so popular?

There is a lot of interest, I have received 70 applications for one such class and there is ultimately only room for 12 people. It is quite easy to find people, because it is honestly a very nice job. You are employed by the state of the Netherlands, and are working for the Belastingdienst. When at some point you were to say 'I want to go to another government service, for example Rijkswaterstaat or DUO', that is easier. Provided there are vacancies, of course. You are a civil servant, which opens up quite some paths for you.

How exactly does such a traineeship work? It takes a full year, and after that?

We always offer people a one-year contract first, subject to proper functioning, which can then be converted into permanent employment. We hire people with IT education, but also hire people from different sectors who can demonstrate that they have already done some self-study in computer science. Ultimately, everyone has to go through a technical assessment and then they have to pass their OCA and OCP [ed. Certificates from Oracle]. Then comes the 'training on the job' where you slowly become more and more integrated in the project after which you can start working as a permanent employee.

We sometimes hear in the media about a lack of IT workers and that companies find it difficult to find new people. That does not seem to be a problem here…

Well… Let me put it this way: it is quite simple for all kinds of companies to find people, if you look broadly - not just with an IT background. However, there is a lack of seniority. You see few shifts in the senior positions. In that respect, I notice that Java developers are fairly steadfast, once they are having a good time they will stay put.

With such a complex system as here, I can also understand that it can be nice to keep people on the same project for a longer time, to really get them to know what they are working with.

It has its advantages, yes. We believe that you are well versed in a project if you have been there for at least a year. Before then, you have not yet discovered all the hidden caves of that application. We often stick to a 3-5-7 rule: you actually have to stay at a particular application for at least three years. If it is a somewhat simpler application, it can of course also be shorter, it is not a very strict rule. After 3 years, I often advise junior Java developers to go to a new project. After 5 years we are going to stimulate more, and after 7 years you should really be stimulated to move to another project. There are, of course, exceptions, for example for real specialists or people who are about to retire, then it makes little sense to make another move.

Do young people, students or recent graduates, also provide more innovation?

Once a system has been designed, you can often not completely change the architecture. However, there will certainly be a point where you have to adjust the system to new demands. You then build a new system and at a certain point you pass over. What I have noticed in the past five years is that there is

more focus on the younger generation. I often hear from older employees that they can certainly appreciate young people, who are creative in spirit, fast, want new things. So innovation is certainly going in the right direction.

As a government organization we want to provide our citizens and our employees with the systems they need

"The Belastingdienst works with no less than 7.3 petabytes of data"

to perform their tasks. Thus, we do work with proven technology, and not with all kinds of hip new things that have just come out of beta, because the risk of something going wrong is too big for a government organization. We bring in 230 billion euros a year, which is about a billion per workable day. We must ensure that the company called 'The Netherlands' keeps running, that money goes to education, healthcare, defense, and so on. We cannot afford not to collect that money.

So every cocky student who often claims that the government IT is no good …

Come and see! You can register for the traineeship twice a year, the next application deadline is on July 18th 2020 and if you clear the application process you can start in September!

Sign up for the traineeship!

Interested to be an ICT trainee Java developer at the Belastingdienst? More information and registration can be found on their website.

https://werken.belastingdienst.nl/

Discovering causal relationships between time series

A summary of an award-winning Master's thesis

By: Meike Nauta
Guest writer

What makes a stock's price increase? Which factors influence the number of students at the UT? Although machine learning has been successfully applied to predict these kind of variables, most predictive models (such as decision trees and neural networks) cannot answer those causal questions: they make predictions on the basis of correlations alone, but correlation does not imply causation [1].

Where correlation is a symmetric measure only telling us that there exists some relationship between variables, causation can actually tell us the relationship between variables. An example: the number of car accidents (C) is probably correlated with the number of people in a wheelchair (W). Causation can actually tell us whether car accidents is a cause of the number of people in a wheelchair (C → W), or that being in a wheelchair is very dangerous because it causes car accidents (W → C). The notion of time aids the discovery of the directionality of a causal relationship, since a cause generally happens before the effect.

However, it is getting more complicated when so-called confounders come into place. A confounder is a common cause of multiple effects. For example, it turns out that the number of Nobel prize winners is correlated with the chocolate consumption of that country (Figure 1).

Does that mean that we need to ask the Dutch government to start a campaign that motivates citizens to eat more chocolate? Of course not, these two variables are correlated because of the confounder: wealth. Correlation which is not causation often arises if two variables have a common cause.

A predictive model based on correlations alone cannot guarantee robust relationships, making it impossible to foresee when a predictive model will stop working [2]. You can imagine that a model predicting the Nobel prize winners solely based on chocolate consumption will not be robust: a big discount on chocolate (especially the Dutch are sensitive to this) would then lead to an overestimated number of Dutch Nobel prize winners. If a model would learn causal relationships, we can make more robust predictions. Furthermore, knowledge of the underlying causes allows us to develop effective policies to prevent or produce a particular outcome [2].
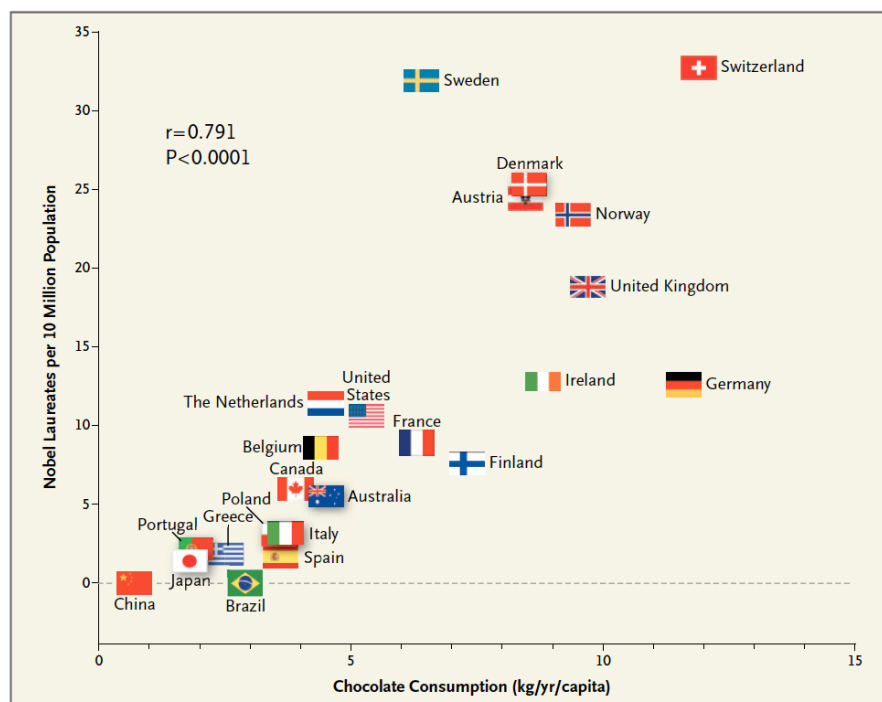

Figure 1: Correlation between countries' annual per capita chocolate consumption and the number of Nobel laureates per 10 million population.
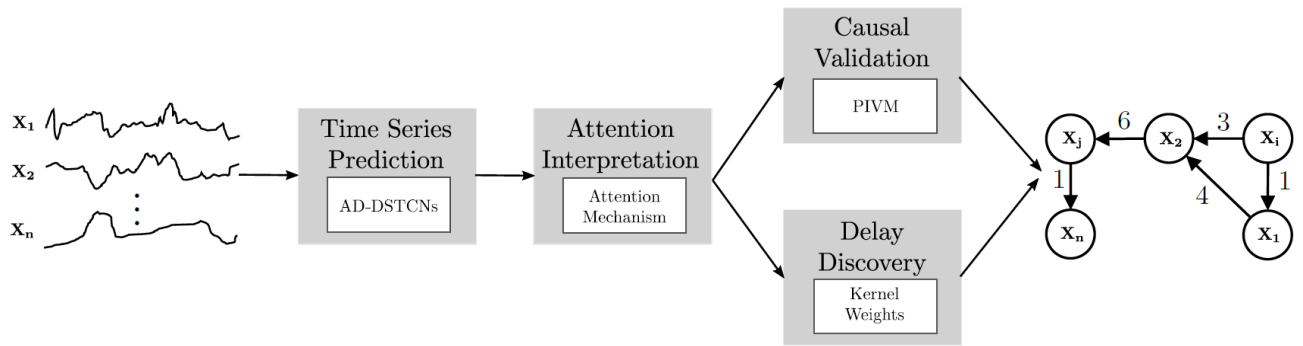
Figure 3: An overview of the Temporal Causal Discovery Framework (TCDF)

Causal Discovery

The traditional way to discover causal relations is to do real-life experiments. In an experimental setting, all other influencing factors of the target variable can be held fixed, such that it can be tested if manipulating a potential cause changes the target variable. The growing amount of observational data allows us to do causal discovery, i.e. reveal (hypothetical) causal information by analysing data. Since a causal discovery method based on observational data cannot intervene in a system to check if manipulating the cause changes the effect, causal discovery methods are prin-

that can explain how they arrive at their decisions [4].

As the notion of time aids the discovery of the directionality of a causal relationship, time series data is convenient to use. However, most algorithms that have been developed to discover causal relationships from multivariate temporal observational data are statistical measures, which rely on idealized assumptions that rarely hold in practice. In my thesis, I exploited the representational power of deep learning by using neural networks for both time series prediction and temporal causal discovery.

TCDF - Temporal Causal Discovery Framework

The Temporal Causal Discovery Framework (TCDF) consists of multiple Convolutional Neural Networks (CNNs), where each network is trained to predict one time series, based on the past values of all time series in a dataset. While a CNN performs supervised prediction, it trains its internal parameters. We use these internal parameters for causal discovery and delay discovery. Figure 3 gives a global overview of TCDF, showing the four steps to learn a temporal causal graph from data.

"A big discount on chocolate would then lead to an overestimated number of Dutch Nobel prize winners"

cipally used to discover and investigate hypotheses which can subsequently be confirmed by a domain expert or experimentation. However, whereas real-life experiments are considered the "gold standard" for causal inference, they are often costly, time-consuming, unethical or even impossible to carry out. For example, suppose that I want to find out whether one stock market has a causal effect on another stock market. I cannot simply close all other stock markets for a while to measure the causal effect between the two. Thus, causal discovery from observational data is often the better (or only) option. Since humans use causal beliefs and reasoning to generate explanations [3], causal discovery is also an important topic in the rapidly evolving field of Explainable Artificial Intelligence (XAI) that aims to construct interpretable and transparent algorithms

My framework, called the Temporal Causal Discovery Framework (TCDF), receives multiple time series as input and outputs a temporal causal graph. Each directed edge shows a causal relationship between two variables. Each edge is annotated with a number indicating the delay. For example, we can have a dataset with the prices of apples (A), butter (B), cheese (C) and milk (M). TCDF will find two causal relationships: 1) when the price of milk increases, the price of butter increases as well with a delay of one month 2) when the price of milk increases, the price of cheese increases as well with a delay of three months (because of the longer storage time of cheese).
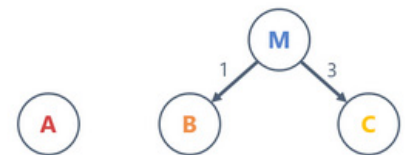
Figure 2: Causal graph showing the causal relationships between the prices of apples (A), butter (B), cheese (C) and milk (M).

About Meike

Meike Nauta finished her master Computer Science cum laude in August 2018. With her Master's thesis, Meike won the KNVI Thesis Prize for Informatics and Information Science (€ 5000), awarded by the Koninklijke Hollandsche Maatschappij der Wetenschappen. In April 2019, she also won the ENIAC Thesis Award for academic year 2017-2018.

She is currently doing a PhD at the University of Twente on the topic of Explainable AI.

More specifically, TCDF applies attention mechanisms that allow us to learn to which time series a CNN attends to when predicting a time series. Figure 4 shows an example of a network with an attention mechanism for image classification. The attended time series are labeled as 'potential causes' of the predicted time series, since the CNN is apparently mostly focusing on those time series when making a prediction.

Going back to the milk example: TCDF will contain 4 CNNs: one to predict the price of apples, one for butter, one for cheese and one for milk. The cheese-CNN is trained to predict the price of cheese based on the past values of apples, butter, cheese and milk. The attention mechanism will show that TCDF attended to the prices of butter and milk when predicting the price of cheese. Thus, the price of apples is apparently not correlated with the price of cheese.

After training the attention-based CNNs, TCDF validates whether a potential cause (found by the attention mechanism) is an actual cause of the predicted time series by applying a causal validation step. In this validation step, the values of a potential causal

butter is only correlated but not causally related to cheese. However, shuffling the prices of milk will result in bad cheese predictions; indicating that the price of milk is an actual cause of the price of cheese.

TCDF also includes a novel method to learn the time delay between cause and effect, by interpreting the CNN's kernel (containing the internal parameters that are learned during training). All valida-

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"TCDF receives multiple time series as input and outputs a temporal causal graph"

time series are randomly shuffled and TCDF evaluates whether the prediction error of the CNN increases when predicting the target time series. It will find that the network can still perfectly predict the price of cheese when the prices of butter are shuffled; indicating that

ted causal relationships and their time delays are included in a temporal causal graph. These graphs can include confounders (common causes: such as the milk price for butter and cheese), loops and instantaneous effects.

Figure 4: Attention mechanism in a neural network shows where the network attends to.

How to make an AR filter

Filter in 6 steps, using Spark AR
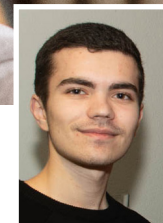
By: Mihnea Udrea
Editor I/O Vivat

Remember 2016 or the year of the dog filter? It was iconic, representing a turning point in the world of social media. Not only did Snapchat attract millions of new users, but it also made rivals like Instagram copy its features. Last year during the F8 event, the company announced Spark AR Studio and a closed beta with popular accounts like Ariana Grande, Kylie Jenner, or Gucci. The tool just became available to everyone and, with over 500 million active users, expressing yourself creatively has never been this easy. The future is now, old man. And it is AR.

Step 1: Get started

Go to sparkar.facebook.com/ar-studio/download and download the latest versions of Spark AR Studio and the Spark AR Player. Spark AR Studio is an augmented reality platform for Mac and PC that allows users to effortlessly create filters for Instagram, Facebook, and Messenger. Spark AR Player is the mobile companion app dedicated to testing. Then go to github.com/positlabs/ spark-lut-patch and download the arp file from the patches folder.

Step 2: Create a new project

Open Spark AR Studio and log in with your Facebook account. A new window with sample projects will open. You can use these to learn how effects are put together. We ignore them for now and click Create Project.

Step 3: Add objects

The Scene panel is the place where you add objects to your effect. Click Add Object and select Rectangle. We can see that two new objects were added to the Scene panel (canvas0, and rectangle0). To change different attributes of an object (e.g. visibility, position, or size), we use the Inspector panel on the right side of the interface. Adjust the Size of our Rectangle so that it fills the width and height of our Simulator (device screen).

Step 3: Add assets

Click the plus next to Materials to create a new Material for our Rectangle.

Switch to the Camera object and click the plus next to Texture Extraction. We just added two new assets to the Assets panel (material0, and cameraTexture0). Here you can also add 3D models, animations, and audio files. Click Add Assets and import the LUT file and the FastColorLUT patch.

Step 5: Patch editor

Use the Ctrl+Alt+P shortcut to open the Patch Editor at the bottom of the screen. We need it to create effects with logic. Switch to material0 and click the arrow next to Texture in the Inspector panel. Drag the FastColorLUT patch, the LUT file and the cameraTexture0 texture into the editor and link them like this.

Step 6: Testing

Hooray! You just created your first AR filter! To test it, simply connect a mobile device with Spark AR Player to your computer and click Test on device in the bottom left of the interface.

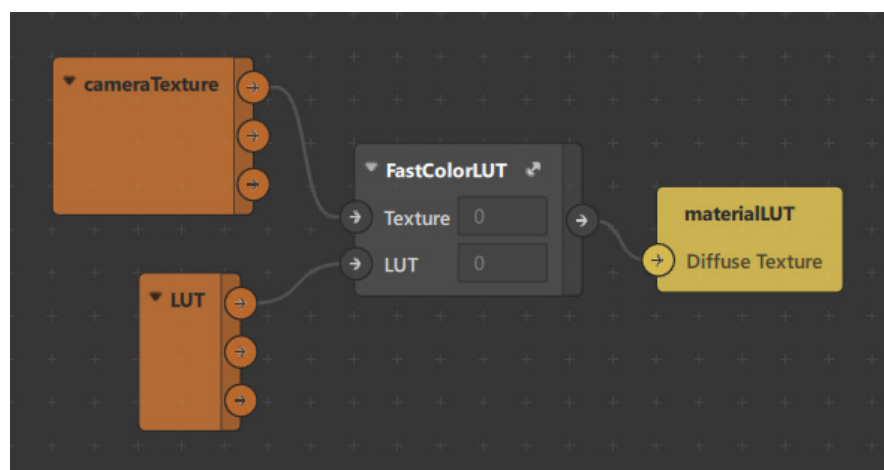Figure 1: How to use the Patch Editor to create effects with logic.

AR Filters worth trying

"Odyssey" from @johwska
"Gasolina" from @johwska
"no.mango" from @basphi
"banana" from @bashpi
"water.melon" from @bashpi
"bury a friend" from @billieeilish
"Truth Hurts" from @lizzobeeating
"scribbled feelings" from alfredocarpetti
"Neone" from baugasm
"Flora" from @nahir.esper
"goldblitz" from sinelkaar_
"textme" from sinelkaar_

From the Chairman

What a year it has been

By: Kevin Witlox
Chairman I.C.T.S.V. Inter-Actief

As I begin to work on this column, I realise that this will be my first and last column as the chairman of Inter-*Actief*. My board and I have had a great year, and what a year it has been. Any former board member will tell you that nothing can fully prepare you for a board year, and every board will say their year was the most challenging and exciting year yet. Needless to say, I will make the same assertion, as I look back on what has been an eventful year.

When you start off your board year, no challenge seems impossible. You have a full work-week to dedicate yourself to the association; anything is achievable. However, you soon learn your many responsibilities as a board member. There are all these tasks to complete and meetings to attend, simply to keep up-to-date. Issues arise on a daily basis, ranging from minor to major. As a rookie board member, all of this can be quite overwhelming. Balancing your workload through planning and prioritisation is the first thing you learn as a board member, such that you can make time for goals you set out to achieve for the association.

For us, one of our main goals was to ensure that all first-year students were given the opportunity to find their place in our association, as Inter-*Actief* has always strived to do. Since the internationalisation, we have seen a drastic

increase in interest for our study programmes. As a consequence, we faced an unprecedented number of freshmen and thus we had to come up with some novel ideas to reach this goal.

The TCS study programme prepared for the increase by adopting the new Student House structure. Instead of managing the new student population as a whole, each student is assigned to one of four Student Houses. The goal of the structure was to provide the students with a smaller community through the course of their Bachelor. We have worked in close collaboration with the programme to establish this new structure and adapt our association to the new system. Our policy plan contained our ideas for how to start off the academic year with this new structure, and we are

content with how our ideas unfolded. The concept of Student Houses will be thoroughly evaluated and we are curious to see how the structure will evolve in the upcoming years.

As the sitting board, you focus on your own plans for the association, but you also come to learn what the association can still improve on. We have focused on adapting activism and involvement with the association to the increased number of students. However, maintaining our activism is not the only challenge. The increased influx to our study programmes has also made it harder than ever for the association to reach all of its students. Inter-*Actief* is a study association and represents the voice of the students of our study programmes. We should therefore strive to have a repre-

Figure 1: Board change GMM, September 3rd, 2019.

sentative member composition. Therefore, maintaining a strong connection with the growing student population will be a challenge for the years to come.

Unfortunately, not everything can be achieved in the span of a single year, but that brings me to the candidate board. As you are reading this, they have already been announced for quite some time. The candidate board will pick up where we left off. The question of what the focus will be for the next academic year, is for them to answer. Nevertheless, I am sure that they will come up with their own innovative ideas, and leave a lasting mark for the years to come on our ever-changing association.

I should address the elephant in the room, a topic that will certainly be part of the board's focus for the next academic year. Of course, I am referring to the current pandemic raging across the world. These times make it abundantly clear that student life is so much more than just studying. Unfortunately for us, the pandemic means we have to drastically alter our daily operations. Our goal is to provide our students with the opportunity to meet each other, develop themselves, and kick-start their career, but currently our options are limited.

Nevertheless, many members and committees rose to the occasion and made the best out of a difficult situation. We have seen many different creative digital alternatives to our usual activities, ranging from online gaming events to an online craft beer tasting. I would like to take this chance to thank everyone who took initiative in these troubling times, and supported us as a board.

"My board and I have had a great year, and what a year it has been"

Even though the crisis has been an abrupt conclusion to our board year, we look back fondly on what has been a great year. While we were working on our responsibilities and executing the policy plan, our close to two hundred active members have once again done a great job at supporting our association. I would like to thank all sectors for their amazing work.

For me personally, the highlights of the year include the activities organised at the initiative of our members. At the start of the year, a few members took the initiative to organise a Bob Ross Painting Workshop. This evening was full of color and creativity, and was very well received by its many attendees. Then just before the Christmas break, another initiative gathered to organise the

second edition of our very own Top 100 Café. Thanks to their campus-wide promotion efforts, Inter-*Actief* got to end the year 2019 together with many of its brother and sisters associations.

Then lastly, as a final highlight, this year's SNiC congress was organised by no less than our very own members. ResilIT, on the impact of IT in the preservation and recuperation of our society, is the latest edition of the annually organised congres by the Stichting Nationaal informatica Congres. The conference has gone through quite an evolution since Inter-*Actief* last organised it in 2013. I am curious to see what the event will look like the next time we get another shot at organising it.

I hope these last paragraphs brought up some of your favorite memories with the association this year. I am confident that next year will be just as great, no matter the obstacles.

Stay safe!

Signing off,
Kevin Witlox

Figure 2: SNiC Congress 'ResilIT', November 26th, 2019.

About Kevin

Kevin Witlox was born on the 8th of October, 1998. He was raised in Velp, where he lived up until University. With an enthusiastic father working in technology, Kevin grew an interest for computers and electronics at a young age. Starting with Game Maker, he self-taught programming and built his first applications in Java.

After graduating from the Stedelijk Gymnasium Arnhem, Kevin moved to Enschede at the age of 17 to start his Bachelor in Technical Computer Science. Next to his studies, he became an active member at Inter-*Actief*, where he helped organise symposium Vigilance in 2018. Before taking on a board position at Inter-*Actief*, Kevin functioned as an Officer of External Affairs for the SNiC-congress 2019 ResilIT.

More than a tech job

By: Pieter Smorenberg
ASML

Meet Pieter Smorenberg, a 2017 Delft University of Technology graduate who recently found himself back at university, this time explaining to students how technologically fascinating his job is. Originally from Amsterdam, Pieter couldn't have guessed that he would find so many technical and social opportunities in Veldhoven at ASML, the fast-growing tech giant.

Pieter studied precision and microsystem engineering, and now works as an applications engineer in customer support at ASML. He also spends some of his time as one of over 400 'ASML Ambassadors', giving guest lectures at his alma mater university or promoting STEM among school-aged children in the region.

"The more I tell people about working here, the more things I realize I appreciate about the company," he says. "A lot of people don't realize just how big ASML is in the semiconductor industry. You realize it when you visit the campus in Veldhoven. You see the big tower, the cleanrooms, the huge gardens and parking lots; it's impressive. And then at the complete other end of the scale, almost all of the metrics we work with here are practically at an atom level – no other company is producing such advanced chip-making equipment." ASML is the world's leading provider of semiconductor lithography equipment, in an industry worth $438 billion. All of the world's top chipmakers are our customers, including Samsung, Intel, and TSMC.

"A lot of people don't realize just how big ASML is in the semiconductor industry"

Pieter has certainly found more than he expected in Eindhoven. "Coming from Amsterdam and Delft, I was a bit uncomfortable about moving to Eindhoven. But actually it seems like everyone is moving here. A lot of my friends from university are here, and there's a lot going on that you only discover after

you get here. It's not a 'small city'. It's a melting pot – people come from all over the world to live here."

Pieter has also found more than a career at ASML. "There's so much going on in our company, technically as well as socially. We have annual technology conferences where you can learn about what's going on in your department, and across the company. This is really unique to ASML. You can develop your

Figure 1: ASML Tech Talk

Get in touch with your ASML campus recruiter!

◀ Danique Lummen
danique@workingatasml.com

About ASML

ASML provides chipmakers with everything they need—hardware, software and services—to mass produce patterns on silicon, helping to increase the value and lower the cost of a chip. Our key technology is the lithography system, which brings together high-tech hardware and advanced software to control the chip manufacturing process down to the picometer. All of the world's top chipmakers like Samsung, Intel and TSMC use our technology, enabling the waves of innovation that help tackle the world's toughest challenges.

ASML has 19,000 employees worldwide. We are headquartered in Veldhoven (The Netherlands) and have over 60 offices in 16 countries.

network, and learn a lot about what other people are working on, and get ideas for yourself. I'm like a kid in a candy store at these conferences."

Celebrating our technology isn't the only way we have fun at ASML. "I sometimes go for drinks with the 'Young ASML' group for young ASML professionals," Pieter says. "You get to meet colleagues from all kinds of different departments. It's a really open-minded atmosphere, because everybody is there for the same reason: to share a good evening with each other." The ASML campuses are like small cities – more than 12,000 people work just at the Veldhoven campus alone. Young, old, male, female, LGBTI+, living abroad, you name it – it's easy to feel at home at ASML.

As a customer support engineer, Pieter also gets to travel a lot, listening to ASML's customers and helping them to achieve their technology roadmaps. During his travels he experiences other cultures first-hand. "You learn a lot – socially and culturally as well as technically. It's been an eye-opener for me. We're diverse, in terms of education, background, and nationality, but we're all working together as one team because we all have the same goal: make this incredibly complicated technology a reality."

Want to help us make our technology a reality? Find out more at asml.com/careers

The Age of Streaming
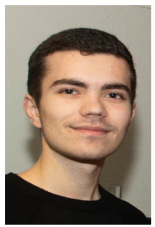
By: Mihnea Udrea
Editor I/O Vivat

Music is a form of art. A whisper that inspires a revolution. A vibration that puts a soul into motion. Its life began once with the universe itself and it evolved till it became vital for all living creatures. Hunted by it from dusk to dawn. From birth to death. It comes in different shapes and forms, varying from classical to trap, organic to electronic, and live to streaming, one of the most popular ways in which end-users interact with multimedia.

In the age of digitization, the music industry suffered terribly when the private consumption of music transformed into a public good. Napster launched in early 1999 and broke all conventions with its peer-to-peer file sharing network where users could upload and download mp3 files freely. It proved the power of torrents and shaped the current distribution of music on the internet. Various labels filed numerous lawsuits against Napster on grounds of unauthorized distribution of copyrighted material, which ended its reign after only two years. Even though the website garnered over 80 million users globally at the peak of its existence, and was considered one of the biggest businesses in history, the problem was not the P2P platform itself, but the revenue not being shared with the artists.

Later that year, the iPod was released as a response to all the existing digital music players that were lacking good designs and user interfaces. Furthermore, Steve Jobs saw the opportunity to open a digital marketplace for music and contacted all five major record labels before introducing the iTunes Store at the Worldwide Developers Conference in April 2003. In less than 5 years, the new platform became the largest music vendor in the United States and shortly after the largest music vendor in the world. According to Apple, as of January 2017, iTunes offered over 40 million songs and served over 575 million active user accounts.

Having grown rapidly in popularity in recent years, streaming platforms like Spotify, Apple Music, Prime Music, SoundCloud and Deezer have shifted music streaming to a club-type good. A customer pays a monthly fee (student, regular or family plan) for access to a music library, but their use does not diminish another's. The response to music streaming was initially negative because of the market disruption these services caused. The result was that labels invested more money in top charting artists and neglected rising artists with different sounds. Last year, however, music streaming revenue exceeded the traditional sales and downloads, becoming one of the largest driving forces in the industry.

Launched in October 2008, Spotify is the most relevant music streaming service, offering over 30 million DRM-protected tracks. While most platforms operate under a premium subscription model, Spotify gives access to a freemium service that enables the use of limited features for exposure to advertisements. Users can create, edit, share, and download playlists; listen to custom-made mixes and keep up with friends and artists by following them. Available on most of the smart devices, the Swedish company always keeps their apps fresh by adding new features like "Canvas" (a short video playing in the background while listening to a track), "View lyrics" (a card giving the story behind the song currently playing) and "Playlist Takeover" (when a celebrity becomes the curator of the week).

On March 24, 2012, Billboard premiered its On-Demand Songs chart (expanded later to a broader Streaming Songs chart), and incorporated its data into the formula that generates the Hot 100 (sales - 35-45%, airplay - 30-40%, and streaming - 20-30%). As of January 1st 2019, Spotify is the industry leader with over 207 million monthly active users (including 96 million paying subscribers) spread across five different continents. In comparison to traditional sales, artists are paid royalties based on the number of streams as a proportion of total songs streamed. Approximately 70% of the total revenue is distributed to the rights holders.

The age of streaming let different artists around the world collaborate and get recognized by the record labels. Artists like Post Malone, Travis Scott and XXXTentacion would not be around if it were not for the existence of SoundCloud. For now, it seems that everyone in the industry is happy with how things go. But is this just the calm before the storm?
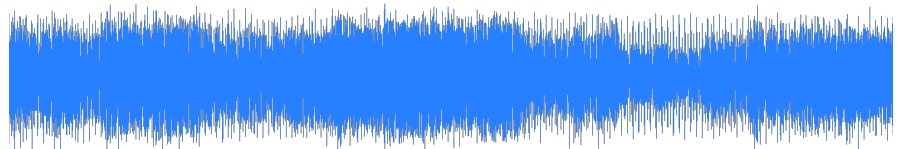
Multidisciplinary

Industrial Engineering & Management
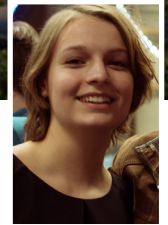
By: Adeline Stiny
Editor I/O Vivat

When studying Industrial Engineering and Management (IEM) it quite quickly becomes clear that handling a lot of data is a very important part of the study. During the IEM freshman year, students learn to use several computer programs. One of the programs that is introduced is Microsoft Excel. Most people have already used this program. However, 'IEM programming' introduces a less known part of Excel: Visual Basic for Applications (VBA) (not to be confused with Visual Basic) which can be found under the developer tab. Code is written in workbooks and can be applied to sheets and tables. VBA is considered to be a difficult subject for most IEM students. This programming language has a lot of advantages and disadvantages. Is this a good language to start with if you want to learn programming?

Working with VBA has several advantages. First of all, it is a relatively easy language to learn compared to languages such as C++ and Haskell. Once you know the basics of Excel, the syntax is straightforward and almost every issue could be solved by simply googling it. Beginning programmers can choose out of a lot of programming languages. When choosing one it is crucial to keep in mind the amount of resources available for that language. When you're stuck on a line of code, you want to be able to find information about it online. Therefore, it is smart to start off with a relatively old language. VBA fits into that perspective since it was already launched in 1993.

The basics of VBA look alike with a lot of other programming languages. Which is another advantage of VBA. VBA has a lot of transferable skills for learning additional languages. Once you have mastered this language, stepping up to a more complex programming language such as Java is much easier.

However, working with VBA also brings along some difficulties. Currently, VBA cannot be accessed on Excel mobile or Excel online for example. Which can be rather annoying when trying to open an Excel file on another computer that requires code that you have written on your laptop.

Another disadvantage is that VBA cannot be used in other applications. Just like Visual Basic (VB), VBA is an object-oriented programming language. The big difference between the two languages is that VB can produce programs that can work on their own. Whereas VBA needs an interpreter (Microsoft Excel) to execute its code. When writing code, it would be expected that the code remains functional if it isn't altered. However, this is not the case with VBA. This language is part of Microsoft Excel, which means it can change every time that Excel is updated. Your code could basically become incompatible with newer versions of Excel.

As already said before, VBA uses Object Oriented Programing. VBA supplies its users with a set of objects. Sadly, this set if often quite lacking. Last but not least, VBA enables a lot of ways for viruses and other malware to end up in files. In some cases, system administrators strictly control or even ban VBA altogether.

Even though VBA might not be the best programing language when wanting to write very complex programs, it is a very suitable programming language for beginning programmers. It teaches you the basics in a relatively easy way and gives you a good basis for learning other languages.

'Multidisciplinary'

In every issue of I/O Vivat, we highlight a different area of expertise by leaving our own comfort zone and taking a peek at our neighbours. What keeps our fellow students at other study programmes busy? How do they experience their programme and field of work? And... is the grass really greener on the other side?

We kick off the rubric by listening to our own editor Adeline, who, after studying Technical Computer Science and Mechanical Engineering has now found her calling at Industrial Engineering and Management!

Programme director TCS

So small a thing

By: Arend Rensink
Programme director TCS

A virus is not even counted a living being. Left alone, it can't reproduce. If only we could leave it alone, or more to the point, it us. So small a thing.

Yet a thing that small has knocked our entire society out, in a way that very few would have thought possible as little as three months ago. As part of that society, university life: your life, my life. Things that were so obvious that we didn't even realise we took them for granted suddenly are not true any more, and we have had to reinvent the ways education can happen. No more classes, no more group work, no more blackboards, beamers or borrels. More screen time, much much more of that, flattening space and time until everything runs together and you start forgetting what day of the week it is.

So far, the general feeling is that we've done well, considering. At least, that's the predominant sentiment on the teaching end, and by and large that's the vibe we get from the student body. Attendance is actually up from what it was in olden times when we all had to troop into a lecture hall at 8:45. Of course "attendance" itself has changed its meaning: from physically present (the mind sometimes left behind) to digitally present (where the entire body may be elsewhere). Who knows what you guys are up to?

One aspect where we're not doing so well these days is in the area of testing. The need for testing has always been the weak part of our educational system. For the most part, we can act as though education is all about the collective growth of knowledge and skills, the students and the teachers all working towards the same end, the enrichment of humankind. When it comes to testing though, all of a sudden it's one party assessing the other, the teachers giving the students fail, pass or cum laude grades and holding the keys to their future - or so it may very well feel. This is what gives rise to aberrations like the impression that the test is what you study for, and to phenomena like cheating and fraud in all their guises. In turn, this gives rise to the need for controlled circumstances where fraud is harder to carry out and/or easier to detect. And now that same pesky virus has taken away the single most effective control method known to mankind: to stick everyone physically into a single room and watch them closely.

When you think about it, you will realise that in the long run, it's very much in the interest of all students that testing is reliable. I'm sure you're unhappy when you fail a test, but I hope and expect that you will admit that such a failure is caused by a less than perfect mastery of the subject matter. Without wanting to get into the knotty question of exactly how good is good enough (in other words, where exactly the dividing line between a pass and fail should lie), if passing a test is not an indication of skill in the subject matter of the course but in deceiving the system, diplomas become worthless. The university would very quickly lose its ground for existence.

As you know, we have continued testing by taking them online and calling on you to preserve the fragile system by refraining from cheating. This has not been universally successful: there are, to our regret, students that do not feel bound by their own word or pledge. Besides concrete cases of provable fraud (which will be dealt with harshly), there are tests that will likely have to be declared invalid in part or in whole, because of grave doubts regarding the reliability of the results. The situation is comparable to that of a calamity (like a fire alarm) during a written test: the results of all students become worthless for the purpose of determining pass or fail, let alone a grade. No one wants that, especially if the calamity is human-made and thus avoidable.

We will get back on campus, after the summer break. It's clear that adjustments will continue to be necessary for some time to come: lectures with hundreds of students might simply be impossible in the near future. Apart from such obvious observations, no one yet knows exactly how things will shape up. One thing you can count on, however, is that as teachers and management of Computer Science we will continue to do everything in our power to offer you the best education possible. But this also requires your understanding, perseverance and cooperation. The general slogan: "Only together we can get corona under control" also applies here: "Only together we can maintain the quality of our study programme". Please bear this in mind and let it be a leading thought in decisions you make.

Not so small a thing!

About Arend

Arend Rensink has been a full professor at the University of Twente since 1998. Since the academic year 2018-2019, he is programme director for the Bachelor and Master programmes of Technical Computer Science.

So remember how my password got stolen all the time?
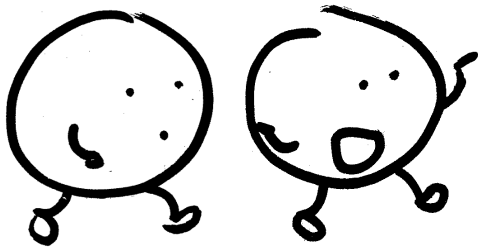
First it was 'Max', so I changed it to 'Hector.'

Then it was 'Buddy', 'Rocky', 'Duke', and finally 'Pluto', but it did not help...
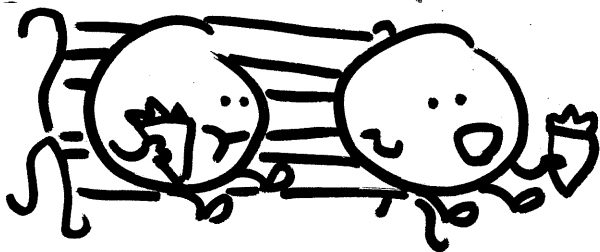
So the other day, someone told me to use a password manager, and it's working great!
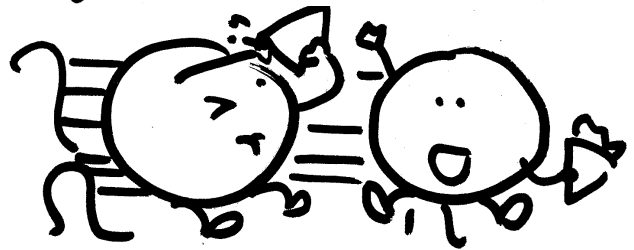
It's harder to get his attention now though...
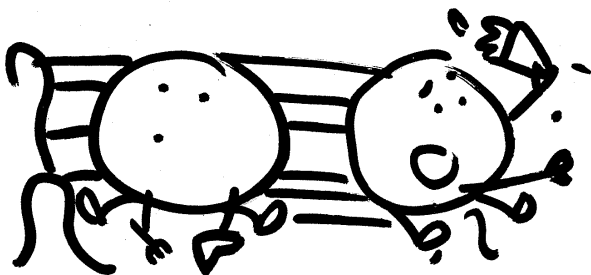
Qx5zA3!@F3k, here boy!
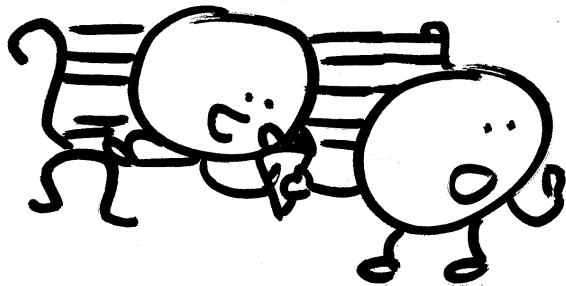
The password manager does require a unique password for every account

So I'm also thinking about getting a cat.

by Florian Mansvelder

Work from Home

Escape from the office jungle

By: Niels de Groot
Editor I/O Vivat

No roaring tiger, but a roaring copying machine. No toucan calling from afar, but your colleague Dave who is - once again - in a heavy argument with his scrum master. No lianas to sway across treetops, just the ordinary elevator. And the weather? Not even vaguely similar, unless Karen has touched the heating again. Not everyone likes to be an adventurer of the office jungle. For those, quarantine came as a blessing in disguise.
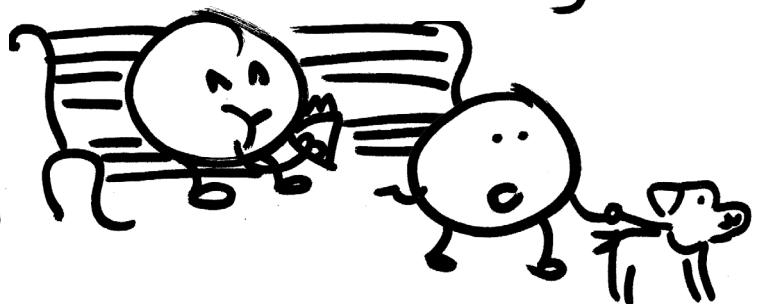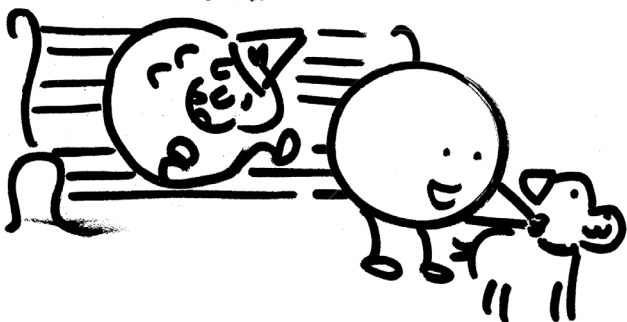
It seems ages ago that everyone commuted to work, walked into the umpteenth meeting of their careers and had lunch together with their colleagues. The corona crisis has led a lot of us to work from the confinement of our own homes, sometimes with very limited facilities at our disposal. There are enough drawbacks to be found in wor-

king from home, especially after having been condemned to do so for months on end, with little choice to go back to the office - even if you would want to. However, the current crisis also shows how ingenious some digital tools really are in helping you work from a distance.

In non-crisis situations, sufficient arguments can be made in favour of working from home. A commute to work is not necessary, resulting in fewer emissions with positive effects on the environment, workers can concentrate better

when not surrounded by the noises of the office and employees can be way more flexible, to name a few. Not to forget that you can sleep in, prepare your own fresh lunch instead of having soggy sandwiches from the canteen and you can have way more spare time. Ir-

> "The current crisis shows how ingenious some digital tools really are in helping you work from a distance"

respective of all these advantages, many people seem to be currently getting a little bit sick of working from home. But why?

Well, the biggest benefit is in the variation. The best combination for most people seems to be to vary working days at the office and at home. Whereas the usual situation at most employers nowadays allows for this variation, the

office is - at the time of writing - still a no-go zone for a lot of companies and institutions. The lack of choice with respect to your working environment is what - probably - causes many to feel less motivated and makes them feel like they are stuck in a rut.

Nonetheless, there will be a time to go back to the office, and when we do we will have learned a lot about working from home. Many organizations were forced to adapt to doing their business online, changes have been made that would otherwise never have been set in motion, and in the future, we will be thankful for it. After all, who, after all these months, does not know how to use video conferencing software? And think of all the useful online tools teams might have discovered; Discord, Teams, Zoom, et cetera. Tools that to many software developers among us may al-

most feel like they have been in use since the stone ages are now used by a wide variety of users who were not used to this before, significantly increasing employee productivity.

tration, separation of work and leisure, and privacy. After all, who hasn't had an awkward experience with a family member disturbing you in a meeting by now?

"There will a time to go back to the office, and we will do so having learned a lot about working from home"

Whereas that knowledge mostly contains useful tools, a lot of change also comes from people's attitudes. We have learned that many meetings could have just been emails. We have learned that some appointments can just as easily take place over video call instead of traveling for hours to meet face to face. We now know the importance of concen-

One thing is for certain, once we all get back to the office after all of this is over, no matter how much you loved or hated working from home, we will be glad to be back. Because from the comfort of your home you can never experience the adventure of the jungle.

Figure 1: Privacy is an important factor in being able to productively work from home.

Figure 2: "This could have been an email, guys!"

Tips to Work From Home

1. Prevent distraction

Now that you are at home, many temptations may be close at hand.. However... you've got work to do! Separate work and leisure spaces, kick family members out of your room and a door hanger (see figure 1) may do wonders to prevent disturbance!

2. Make clear agreements with colleagues

Whether you work with colleagues or project teams with fellow students, make sure to make clear agreements on, for example, working times. When at home, jumping on you're computer to quickly answer that one email happens more easily. Keep your working hours for work and relax afterwards.

3. Keep up the good spirit

Working from home can be relaxing, but it can also be lonely and sometimes stressful. A daily online coffee break with colleagues to pause and socialize can do wonders for your motivation!

Working at Witteveen and Bos

By: Ruud Tuitert
Witteveen+Bos

Witteveen+Bos is an engineering and advice agency, providing solutions to complex technical and societal issues regarding water, infrastructure, natural and build environment. Witteveen+Bos is all about bringing together the right knowledge to solve these issues. It is built on a network of 21 offices in 11 countries, where 1.100 engineers work together on creating a better environment for everyone, now and in the future.

When you read this company profile, it probably isn't the first company that comes to mind for a job in information technology. At least that's how I felt when I decided to leave my previous employer, a true IT company, in search for a new challenge. After a little bit of research on the company and a nice job interview I started as an IT advisor at Witteveen+Bos.

Digital Transition

Witteveen+Bos has a lot of ambition when it comes to IT. At this moment, we are in a digital transition. An organizational change in which the analog services are being expanded with new digital products and services, including new business models. Where a lot of companies choose to outsource IT, Witteveen+Bos is making the transition itself, by developing their own software and making the entire organization more IT savvy. IT is conside-

"This is both a huge opportunity and challenge for IT specialists."

red as an integral part of engineering, and to realize the right solutions software engineers need to work closely with domain experts.

This is both a huge opportunity and challenge for IT specialists. For example, how do you manage all data available in the different domains? Especially with the latest's IoT [ed. Internet of Things] developments, enormous amounts of data are available, such as data to monitor ship movements which is used to optimize harbor occupation. Or data about wave heights, used to prevent damage to underwater gas pipes in the Atlantic ocean. And perhaps it would be nice to combine these data sources to gain new insights, or provide new services.

Figure 1

Within the digital transition I'm part of the digital tech team. This is a group of forerunners on the digital front, helping the organization in its transformation. One of the initiatives originated in this team is the development of a digital product portfolio. This portfolio gives the organization insight in all digital products and services currently available or in development. A first assessment resulted in more than 100 initiatives already available within our organization. This varies from simple scripts to automate repetitive tasks to complex and innovative products, such as the Smart Engineering Information Management System (SEIMS). SEIMS

developers, back-end developers and geographic information system (GIS) specialists. Examples of some web applications made by our team are A58inbeeld.nl and samenwaterproof.com.

Within the team my responsibilities are the planning and coordination of the software development and the gathering of requirements from our customers. These customers can be both internally and externally. Examples of external customers are Rijkswaterstaat (responsible for the maintenance of the main infrastructure facilities in the Netherlands), Tennet (the Dutch electricity transmission system operator) and the Port of Amsterdam. Because our

standalone product) and a helpdesk. All these pioneering challenges we faced for this product pave the path for the digital transition and development of future products.

Wednesday Hackday

Another initiative from our team to help the digital transition is our 'Woensdag gehacktdag' (Wednesday Hackday), On this innovation day our team helps colleagues in the organization to realize their ideas for new digital products. An example of a product we've realized is a tool which assesses the lakes in the Netherlands for their suitability for solar panels. The gehacktdag is not only helping the digital transition, it's also an opportunity for our team to try out new technologies and frameworks. And by working together with other disciplines such as ecology, hydrology and architecture we learn a lot about those fields to.

"This dynamic environment offers a lot of freedom to suggest and implement new ideas."

is a product that makes it possible to generate a dynamic data model on which an information system can be generated. During the use of the system the data model can be updated based on new insights. SEIMS is currently being used by customers in the chemical industry to manage their assets. We hope the product portfolio will make SEIMS more visible within the organization, and hopefully expands the market for this product.

The assessment helps us not only with the market expansion of current products, it also gives insight in new product opportunities (for example, a script for automating tasks might also be interesting for customers) or new innovations by combining products and thereby offering new services.

Digital Technologies

Besides the tasks for the organization wide transition my work is organized within the product-market combination (PMC) Digital Technologies. PMC's are small organizational units ranging from 20 to 50 employees. Digital Technologies works on IT solutions for an involved society and improved living environment. Within this PMC I'm part of a development team with front-end

projects are often part of a larger project Witteveen+Bos is doing for these customers, we have a real impact on the efficiency and effectiveness both internal and external. For example, the online participation platform A58inBeeld.nl offers an easy and cost efficient way to reach a much larger audience than the traditional offline residential meetings organized to receive feedback on plans within the public environment.

The concept for a digital participation platform turned out to be a very successful project. Therefore we decided to off this platform as an online product, available for both consumers and business users. We called it the inBeeld.app ('InThePicture.app'). In a project oriented organization this turned out to be quite a challenge, although we learned a lot and it is very valuable for the development of future products. One of the main challenges was the adoption of a new business model within the organization. Where the entire organization was designed for billable hours, we now had to think about product pricing. Also we first needed to invest a lot of money in the development of the product, for which the returns were still uncertain. We also needed to think about marketing (as we now have a

To keep our own knowledge up to date, colleagues organize tech catch-ups. During these sessions we share knowledge about actual topics such as DevOps and the use of open data and choosing the right technology for each project.

All together this dynamic environment offers a lot of freedom to suggest and implement new ideas. And there is a lot to learn, both in the field of information technology, as well in the other engineering disciplines.

Interested?

If you'd like more information about working at Witteveen+Bos, you can contact Ruud at ruud.tuitert@witteveenbos.com or check out the website at http://witteveenbos.com, which also lists the available internships and graduation assignments.

From the ENIAC board

Opportunity taken!

By: Lisa de Wilde
Chairman ENIAC

A few months ago my boss asked me how I would feel about helping a customer in Germany with a major security incident for at least a week. This is something entirely different from my normal work as a Security Officer for which I am working on planned tasks from office of the customers no longer than one day a week. While looking at my agenda, I discovered that it would fit perfectly into my schedule and since there would be no better moment in the coming months to do something like this, I decided to take this opportunity! I did this without even knowing exactly what my role would be.

Once I agreed with my manager I would go to the customer, I drove to Germany and called my customers and colleagues to inform them I would be away for the coming week, but that I would be reachable by phone. Not knowing that one week would become four...

After a long trip, I arrived at the hotel where two of my colleagues were waiting to update me, over dinner, about the situation and my added value within the crisis team. It was an information overload and a lot of names and applications to remember. But, I was ready to go!

Now, four weeks later, I am the only one of my company left in Germany and I am looking back to four amazing and exhausting weeks. While looking back at this adventure, I can conclude that I had a lot of fun during this trip. We celebrated the successes with the customer (with a bit of whisky). Had great dinners. Drank cocktails while my colleague was playing piano. Chilled in the sauna. I almost hit two deer while driving back to the hotel which was extremely funny due to my screams according to my colleagues. And I learned that not all my colleagues are early birds and are suffering from a morning mood.

Another conclusion that can be made is that I learned a lot during this trip. Not only on a security and management perspective but also on a personal level. Changing plans on such short notice and being abroad for multiple weeks is a bit more in my comfort zone now.

But above all, it feels really good to add value to an organization and feel their honest appreciation. When I arrived at the customer, I saw many committed, but exhausted IT employees who were not quite sure whether the organization would survive the crisis. And now, four weeks later, they are still exhausted, but the sparkle in their eyes is back and they will survive!

Lessons to share: take opportunities as they come and do not click on phishing emails!

ENIAC activities in 2020

5th of September
General Members Meeting

11th of September
Region drink Deventer

13th of November
Region drink Leiden

Update from the ENIAC board

We would like to inform you that the board of ENIAC is going to be changed at the next general members meeting and we are glad to announce the following candidate board:

Kimberly Hengst
Chairman

Jan-Jelle Kester
Secretary

Koen de Jong
Treasurer

Ruben Groot Roessink
General member

Martijn Hoogesteger
General member

ENIAC is the alumni association for the bachelor programmes Technical Computer Science and Business & IT and the related master programs at the University of Twente. The as-sociation has the mission to stimu-late the contacts between alumni and with the faculty of EEMCS. Therefore, ENIAC regularly organi-ses meet-ups and events, which is a great way to keep in touch with your former study mates!

ENIAC
Enschedese Informatica Alumni Club

From the ENIAC candidate board

An introduction!

By: Kimberly Hengst
Candidate chairman ENIAC

I do not think I can ignore it: the Corona crisis. It has been a weird time for me. Two weeks before the lockdown, I graduated from the master Cyber Security. During the lockdown, I applied to many organisations (with all the necessary adjustments) and eventually started my new job. I will probably move from my student apartment in Enschede to a multiple floor house somewhere else during this crisis as well. But above all, I became part of the new candidate board of the alumni association ENIAC. This candidate board consists of five members, who will introduce themselves below.

Jan-Jelle

Hi, my name is Jan-Jelle Kester. From 2012 I studied Computer Science at the University of Twente with Software Technology as master specialization. At Inter-*Actief* I have organized the 2015 symposium MoveIT on the use of IT in transport and logistics. Currently I'm working as Software Engineering Consultant at Info Support, focusing on the finance sector. In my spare time I do volunteer work as live lighting and sound technician in a small theatre.

Koen

I'm Koen de Jong and some of you might know me as one of the former commissioner External Affairs of the most fun association of the balcony: W.S.G. Abacus. After finishing a master in cyber security at the end of 2019, I started working at InnoValor as advisor digital identities. I spend most of my spare time on cycling, both on the mountain bike, the cyclocross bike and road bike and like to visit (mostly rock and metal) concerts from time to time. In the new board of ENIAC I will fulfil the role of the treasurer. Hope to see you at one of the ENIAC activities, so that I can buy you a beer (at the expense of ENIAC of course ;))

Ruben

Hi all, I am Ruben Groot Roessink. Some of you may already know me as the Officer of Internal Affairs of Inter-*Actief* in 2015-2016. Currently, I am writing my graduation thesis and will finish my masters Cyber Security soon. In my free time I play (field) hockey. In the candidate board of ENIAC I am a general member, just as Martijn, which means that I will likely take up projects that come up throughout our time as board. I hope to meet you soon at the ENIAC activities!

Martijn

Hi I'm Martijn. For the third year in a row I want to become a board member of ENIAC! I have decided to continue with my ENIAC endeavours, because I've thoroughly enjoyed the past few years. By applying the experience I've gained with new colleagues, I hope to lift ENIAC to even greater heights. I work in the Cyber Security field as the Manager of Northwave's Incident Response team.

Kimberly

And finally, I am Kimberly, the chair of the candidate board. I graduated from the master Cyber Security as well. I was part of the board of Inter-*Actief* in 2016-2017 as Officer of External Affairs. I like to game and watch a lot of movies and series (which I like to watch again a lot).

We do not yet know which activities can continue in 2020. However, we have many activities in mind for when this is possible again. Examples of activities to look forward to are drinks in your region, a day out with other alumni, and graduation speeddates.

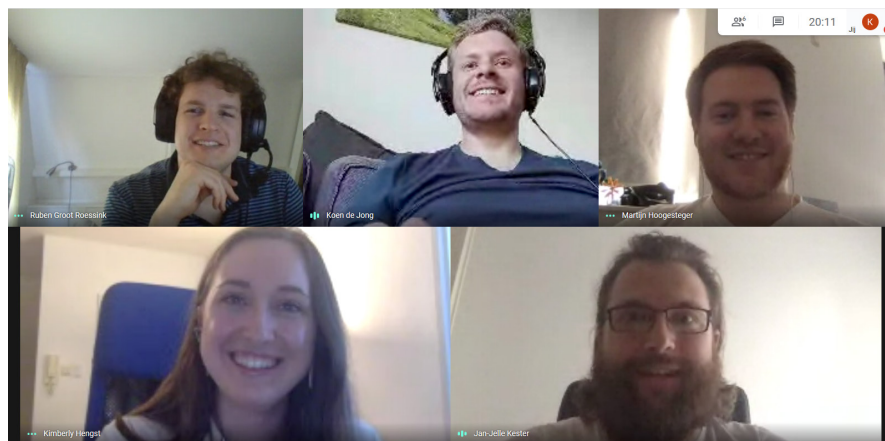*Stay safe and we hope to see you all soon!*

Figure 1: The ENIAC candidate board: Ruben, Koen, Martijn (top), Kimberly, Jan-Jelle (bottom)

Corona credit
Mass surveillance in practice

By: Sven Mol
Editor I/O Vivat

I n issue 33.2, we wrote about China's proposed social credit system and the various pilots that were running. The Communist Party intended for the system to go into production this year, but due to difficulties in the implementation, this hasn't happened on a large scale yet. One recent development, however, could not be foreseen. After the outbreak of the new coronavirus, SARS-CoV-2, Ant Financial introduced the Alipay Health Code, an app that assigns people a color code indicating the risk they pose.

The app was introduced to provide an alternative to the city-wide lockdowns that were put in place. It takes in information on who you are, where you have been and who you have been in contact with, and classifies into one of three risk groups, green, yellow or red. But, red does not mean someone is infected with the virus. It only means that there is a some risk the person might carry the virus. There are reports that people can get reclassified if they happen to come across someone assigned yellow or red.

The system has already been rolled out to two hundred cities in China, mainly in the Zhejiang region, and is expected to soon be active throughout the Chinese mainland. Citizens are automatically ordered to quarantine themselves or to avoid certain public spaces. But neither the Chinese government nor Ant Financial has explained how the classification works. Decompiling the app has shown that the system bases its decision, in part, on location. But for those who are ordered to isolate, there is no clear way to ensure they are reclassified as safe.

This has instigated fears that the might encourage regional prejudices. Some employers and housing complexes are already requiring people to show their code, and bar anyone who isn't classified as safe. The New York Times spoke to one woman who was visiting family in Hubei when the virus was first identified. This has caused her to be classified as unsafe, even though she hasn't been ill. In turn, this caused her employer to temporarily suspend her, which has meant she is forced to stay with her family.

Human Rights Watch points out that China often uses major events to introduce new monitoring applications. The Beijing Olympics of 2008 and the 2010 World Expo also saw the introduction of similar programmes. But these apps are not deactivated once the event comes to a conclusion. Some fear that this outbreak will prove "to be one of those landmarks in the history of the spread of mass surveillance." Chinese companies often share data with the government, but it is rare to see it happen this directly.

Proponents, however, argue that collaboration between public and private sectors is a common practice for epidemics. The only difference is the speed and volume at which it happens in this case. They also note that companies like Ant Financial already have access to this kind of data, and they are now using it for good.

Figure 1: The Alipay Health Code app.

China has been experimenting with versions of its Social Credit System since 2009, and it is meant to capture a person's value to society in a single number. If your score is too low, you might get barred from public transport, your internet connection may be slowed down and official paperwork might take longer or be outright denied. How the score is determined is currently unknown, but it is expected to largely be based on how loyal you are to the Communist Party.

From the candidate chairman

All the possibilities

By: Jelle Maas
Candidate chairman I.C.T.S.V. Inter-Actief

On the tenth of April, 2020, we were officially announced as the candidate board of Inter-*Actief* for the academic year of 2020/2021. That means we have been working from home as candidate board for around six weeks at the time of writing. During those weeks, we have already learned a lot even though it was via different online platforms.

I joined the university in 2016 and I did not live in Enschede or even close to the campus, but I enjoyed the activities of Inter-*Actief*, so I stayed at activities until the very last possible moment and then left to my home. After a few months, I did not want to travel back and forth anymore and got a place on campus to live. From this moment on I could stay until the end at every activity and got to know more and more people. At Inter-*Actief* I felt like I was in the right place. I could listen to people who had interesting ideas in the field of Computer Science and Business and IT. Besides the talks with your fellow students there is a great atmosphere at every activity, be it at the Abscint or an external location. Inter-*Actief* just has all the possibilities a

student would like to see in an association: from the technical side to the sports side, and from parties to education.

At this moment the 42nd candidate board of Inter-*Actief* is working, at home, on our policy for the next academic year which will be presented during the board change GMM. So while everyone from the candidate board is working on their study and settling in, we are also working on our policy plan which should inform you - our members - about the things we plan to accomplish during our board year. We hope that we will have a great year, but we would like for all members of Inter-*Actief* to have an even better year.

In the near future, we as candidate board will learn more and more, and we are thankful and proud that we have a chance to lead an association which keeps on getting better and better. We are all looking forward to a new year where we will hopefully see you all walking around on campus safely. For now, there is only one thing left to say, which is that any input that you might have can help us during these weeks and is very much appreciated. You can contact us at cb@inter-actief.net. Besides this

you can always find us on the Inter-*Actief* Discord server, so you are very welcome to talk to us there!

The candidate board hopes to see you soon at Inter-Actief!

About Jelle

My name is Jelle Maas, I am a fourth-year student and I just finished my Bachelor degree. I am 21 years old and I was born and raised in Ugchelen. I always have been an active child and since I moved to Enschede I also became active at Inter-*Actief*. After three and a half years I have experienced enough nice things, especially with Inter-*Actief*, but also with friends or with other associations, but next year will mainly be about managing Inter-*Actief* which will be a big but fun challenge.

In recent years I have organized and participated in small and large activities. I have been part of six committees and each committee is just as varied as the previous one. In addition to the committees at Inter-*Actief*, I am also active at the knotsbal association and the soccer association and enjoy playing sports. I am also a big music lover and I make music with my band every Monday. So, I hope that, with all the variety and experience, I can manage everything. I hope to meet you soon, be it via an online medium or, hopefully, in real life after the holiday.
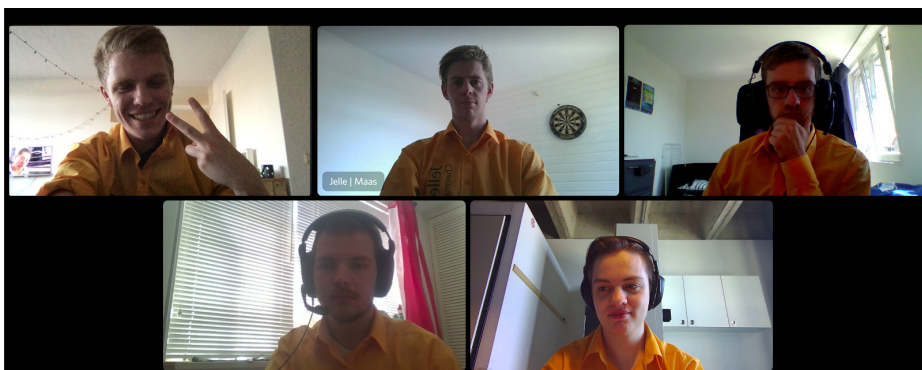
Figure 1: The candidate board meeting by video conference.

Programme director BIT

A very hectic year

By: Niels de Groot
Editor I/O Vivat

Maria Iacob
Programme director BIT

Maria Iacob has been programme director of the Business & IT programme for little over a year now. We spoke to her about her experience and the topics she deals with on a daily basis. What are her thoughts on the programme and her first year as director?

This was probably the most hectic period of my life, but I have learned a lot and am quite positive about it. I took over right after the BIT programme was visited. The visitation went very well, as BIT got an amazing evaluation report, but revealed one thing: after 5 years of TOM, the Bachelor had reached a balanced state; and students were satisfied with the programme, quality of the courses and the content of the curriculum. Still, when looking at the NSE results, our BIT Master students were significantly less satisfied. For me, this meant that the first thing I had to do was to take really a good look at the Master as well. The Bachelor had a full transition that paid off, now it was time to work on the Master.

You think this was because the Master programme was left relatively unchanged over the past years?

Yes, for quite a long time there was no major revision of the BIT master curriculum. Of course, over the years, the usual regular quality improvement cycles were carried out, but a thorough in-depth analysis of the architecture and content of the curriculum has not been done, maybe for a decade. Thus, there were objective reasons to start a curriculum redesign of the Master.. One of those reasons is the retirement of some teachers, who were the owners of certain courses, so we had to quickly figure out how we would handle them after their departure. One of the courses was already quite old and, though it was very well-evaluated, the course was not deemed a hot topic anymore and there was no one to take over, so eventually we decided to discontinue it. Another course had significant overlap with Foundations of Information Systems, so the two courses will be merged as of 2020. These kinds of operations have made room for new courses. After a number of consultations with our advisory board (representing the work field), staff and students we ended up with a list of topics that are missing and should be added to the master. To name just the most important ones, we will add more Data Science, and Enterprise Security, Smart Industry applications and Low code software development in the specialisation and elective space.

These content changes led to changes in the way the master programme is structured as a core entailing six courses, and two specialisations namely 'IT Management & Enterprise Architecture' and 'Data Science & Business'. Before, we had four compulsory courses in each specialization. I wanted to make this structure a little bit more flexible, so to-gether with the programme committee and this advisory board, we changed it to have six courses in each specialisation from which students are obliged to choose four. This way, students have the opportunity to show what their interests are, and we can easily measure which courses are popular and well-evaluated and which are not. Courses failing to attract sufficient students and not performing well, could be moved to the elective space and be replaced with successful electives. In this way, the quality of the main part of the programme should increase and we will have a built-in mechanism to continuously re-evaluate, maintain, and modernise the curriculum.

We are also working with the University of Munster on the development of a double degree BIT-like programme, taking a little more than two years: students would do a 120 EC one Master, with the name "Business Information Systems and Data Science" master, and receive a diploma from both universities. We plan to offer one half from our side and the other half will be given by our German partner. The graduation will then be supervised from both sides. At this time the detailed plan of this double degree is undergoing the official approvals on both sides.

The whole redesign seems like quite the challenge, and most deadlines are for the academic year 2020-2021. The upcoming academic year will be a busy one for you then?
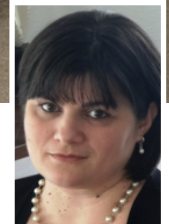
Yes, my ambition is to push hard and start this process in September 2020, but if things turn out to be slower than expected then I will have to accept that. A complicating factor is of course the restrictions imposed by the COVID -19 pandemic, so the timing of this re-design is not ideal. Especially when starting new courses one needs quite a bit of interaction with students to be able to fine-tune the content and teaching forms. This is going to be a challenge, in the current context. Of course, this change will not take place over night. Every redesign takes at least a couple of years to implement and another 3-4 years to reach stability, as we have experienced with TOM, which is still perfected after seven years since the introduction..

Now, all of this is for the Master, but at the same time, we are also - still - looking at some Bachelor reforms taking place. Why is that?

Over the past few years, both Technical Computer Science (TCS) and BIT have started to grow enormously. BIT went from 35 students per year in 2015 to about a hundred fifty in 2020, which is a huge increase. In the same time TCS went from 70 students to 350-400. Of course, we are still doing things together with computer science and the prognosis looks good, but with Corona and the current growth, it becomes increasingly difficult to continue doing this. For this reason, we started to split some parts of the programmes. Module 1 has been separated from TCS starting 2019-2020. This also meant I could introduce some changes to the programme. We have some new lecturers, we went from four computer science topics to three, and we give more room and time to learn programming, which hopefully helps in the second module. This redesign has already made for some improvement in the programming part; a lot more students passed those components this year. We will continue to improve next year, but it remains difficult to bring all students to the same level (in terms of programming skills) in such a short period. This is why module 2 will also be split from TCS starting from 2020-2021, in order to create our own cus-

tomised programming education. The tempo will be somewhat slower and the content will be slightly changed to make it more suitable for BITers.

Over the coming months, we will look at the registration numbers to see if this growth is going to continue, and if it

does, we will look into separating module 4 from TCS as well starting from 2021.

Since Business & IT is promoted as the combination of Industrial Engineering and Management and Technical Computer Science, do you feel that by physically separating these students from each other, this feeling might be lost?

On the contrary. If BIT students have their own modules and a curriculum aligned to their own needs, a "BIT" identity will start to emerge, and students will stop having the feeling that their study is just a combination of of bits and pieces from two other programs. I hope his will improve the experience of students. I have to stress that these changes and the separation from TCS is not going to affect the learning goals and content significantly. The main goal is to deliver this content in a manner which is more appropriate for the BIT students. Let us not forget that most computer science students come in with programming experience and pursue their programming interests, while BIT students come in because the combination business administration and IT is attractive, and they want to do that. However, they sometimes don't realize how technical it actually is. In the last few years I am trying to make this as clear as possible during the open and matching days, but some students still come in with wrong expectations.

Lastly, the Twente Educational Model itself is up for redesign too. What are the effects on the BIT programme?

I got the task to prepare the new test plan for TOM2.0, in which we men-

tion all the grades we want to register in Osiris for each and every module. The core idea that triggered for TOM2.0 was to drop the 0/15 EC rule. Before, you could either receive 0 or 15 EC for a module and now we are moving away from this binary situation. We can now divide modules into so-called educational units, and once you pass a unit, you will be awarded the EC's corresponding to that part. These will also be added to the count for a BSA.

Now, the BIT programme being between Technical Computer Science and Industrial Engineering and Management has a difficult position. On the IEM side, the philosophy is to split up as much as possible, while TCS would like to keep larger blocks. It is their opinion that in this way students will be motivated to pass large blocks and that strategic behavior and cherry picking courses [to pass over some to later years, ed] are to be avoided. Because of this 'tension' I chose to stick to the definitions provided to us by the TOM2.0 team and we carefully looked at each and every module to understand whether it was truly integrated or not. At this moment, almost all modules are split into parts with the exception of modules 4 and 6.

So this will all definitely happen?

Everything I just described is still a work in progress, but we will definitely happen as of September 2020. One thing we are currently working on already are the transitional agreements, to work out how students that now pass certain components will receive their EC's next year and the years after that. We still have a lot of things to figure out before September, but it's definitely quite exciting, that so many things are happening at the same time! Last but not least, we should not forget the whole Corona situation, which in the beginning seemed to be quite a serious set-back (and it still is to a certain extent), but it is amazing how fast we all dealt with the situation and how much we are learning from it. I think that our education system will become far more resilient and effective than ever before.

> "BIT students come in because the combination business administration and IT is attractive"

Requested is a matrix of n*n integers (n>=4) filled with the integers 1..n*n. The goal is to maximize the number of times the equation |a-2b+c=d| is satisfied. This can be done in all 8 directions, as long as a,b,c and d are contiguous and on a single line

For example. n=5:

7	8	10	22	17
14	12	3	25	4
13	15	19	9	11
18	16	6	2	1
23	5	24	20	21

$|7-2*12+19| == 2$

$|1-2*11+4| == 17$

$|5-2*16+15| == 12$

$|20-2*24+5| == 23$

$|20-2*2+9| == 25$

$|21-2*20+24| == 5$

For this puzzle the values of n are 5,10,..,125.

For each n, you will get a subscore between 0 and 1. The subscore is calculated by dividing your best score by the best score of any contestant. Assume you are the first to submit a solution for n=10 with a score of 30. Since this is the only submission for n=10, it is also the best score currently submitted for n=10, resulting in a subscore of 1.0 points. Another contestant submits a solution for n=10 with a score of 34. Now your subscore is reduced to 0.88 (=30 / 34).

Your total score is the sum of all of your subscores. This means your total score is between 0 and 25. The goal is to maximize your total score. Note that your total score is not fixed! As other people submit solutions your total score might drop, so keep an eye on the submission page.

How to participate

You can submit the matrix as a comma separated list of the integers, e.g.: 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,21,18,22,20,23,25,24,19Y

You can submit multiple solutions at once, by separating them with a new line. A newer solution for a value of n replaces the older solution for that n, but only when it is better, i.e. when the number of reversals is larger. This means that in a new submission you only need to submit the solutions for n where your solution is better than before.

To see the current standing, deadline and to submit your solution, go to: https://puzzle.prodrive-technologies.com/inter-actief