



I/O VIVAT

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NUMMER **1**

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of privacy watchdog Bits of Freedom

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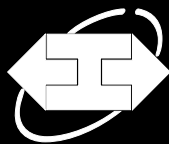
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I/O VIVAT

//Editorial

Dear reader,

Inspired by the 'Wondere Wereld' (Miraculous World) of Chriet Titulaer, the theme of this issue is **disruptive technologies**. Dennis describes current and future uses of drones. What may be the next era of drones? Currently, they are still in the infancy stage in terms of mass adoption and usage, but multinationals, governmental organizations and universities are finding innovative applications in various industries.

However, when talking about futuristic technologies there are always pessimistic people with a negative outlook on the future. For example, two of the industry's most powerful leaders are at odds when it comes to artificial intelligence. Elon Musk has a pessimistic view of the risks of AI while Mark Zuckerberg calls himself optimistic. Marlène describes two fictive scenarios that may take place in 2084: one with a positive view and one with a negative view. Let's hope the first scenario will come true. One of the most common arguments against futuristic technologies is its privacy infringement. Our new editor Niels interviewed Bits of Freedom, a digital civil rights movement that gets you thinking.

Willem describes the history of the brain-machine interfaces and its applications in the future. How has the first BMI in 1969, where a neuron in a monkey's brain learned to control a dial, evolved to its current status and what can we expect in the future? Kyra discusses decision support in health care: can a computer make a better decisions than your doctor?

Another interesting topic is the influence of disruptive technology on education. Keuzegids has chosen Technical Computer Science as a top rated programme in 2018. How has the programme changed since its start in 1981? (Because the programme's history contains many Dutch terms, the article is written in Dutch.)

Furthermore, to welcome our new members, all do-groups of the Kick-In have their moment of fame in this issue of I/O Vivat. Freshmen, can you spot yourself? Members and alumni, is your do-group still existent in 2017-2018? And is the dress code still as awful as back in the days?

Enjoy reading!

Meike Nauta
Editor-in-Chief I/O Vivat

Answer puzzle 32.3

The solution of the puzzle from issue 32.3 was: PASSWORD. We received lots of correct answers, well done!

Winner puzzle 32.3

The winner of the previous puzzle is Ronald Bugter. Congratulations! You will receive your Inter-Actief cinema voucher as soon as possible!

//Content 33.1



Drones and the ways to use them



Interview with Bits of Freedom: Technology disrupts privacy. What can we do about that?



From the ENIAC board



Evolving the brain: brain-machine interfaces and deep brain stimulation



Geschiedenis INF



Do-group photos

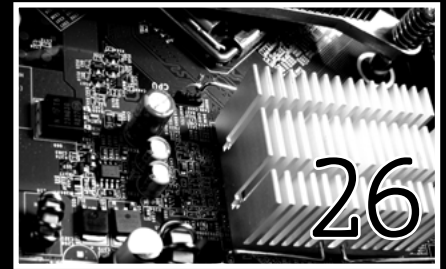
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Rijksoverheid



Decision support in healthcare: will it change the world?



From the programme director BIT



From the programme director TCS



2084: Utopian world



2084: Dystopian world



Augmented reality: how and why Aryzon arose



From the chairman

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	2V									

Nautia Puzzle: Can you solve it?





Drones

and the ways to use them



By: Dennis Aanstoot
Editor I/O Vivat

We live in a time of fast innovation. New technology is developed at staggering speeds and it isn't always clear what the technology will serve. Drones are one of these products have been available for many years. New opportunities to use them are still found these days. The drones also get more useful because they get more features. In the first

years of the drone only a remote to control it was included. Now it's normal for the drone to have a camera attached to it so it can record video's and photo's from the sky. This is used to take photographs of nature, or to film a festival from up in the air. Innovative companies are finding new ways of using the drone to their advantage.

Amazon is looking into ways to innovate their delivery service. The company

has been growing over the last few years and has expanded their innovation department to keep up with the competition. To economize their human resource spending, they are looking into ways to replace their humen delivery personnel with drones to do the transport of the packages for them. In their idea a zepelin will fly over the city who will carry the products to the right part of town, and then drones will deliver the packets to the houses. The drones will be con-

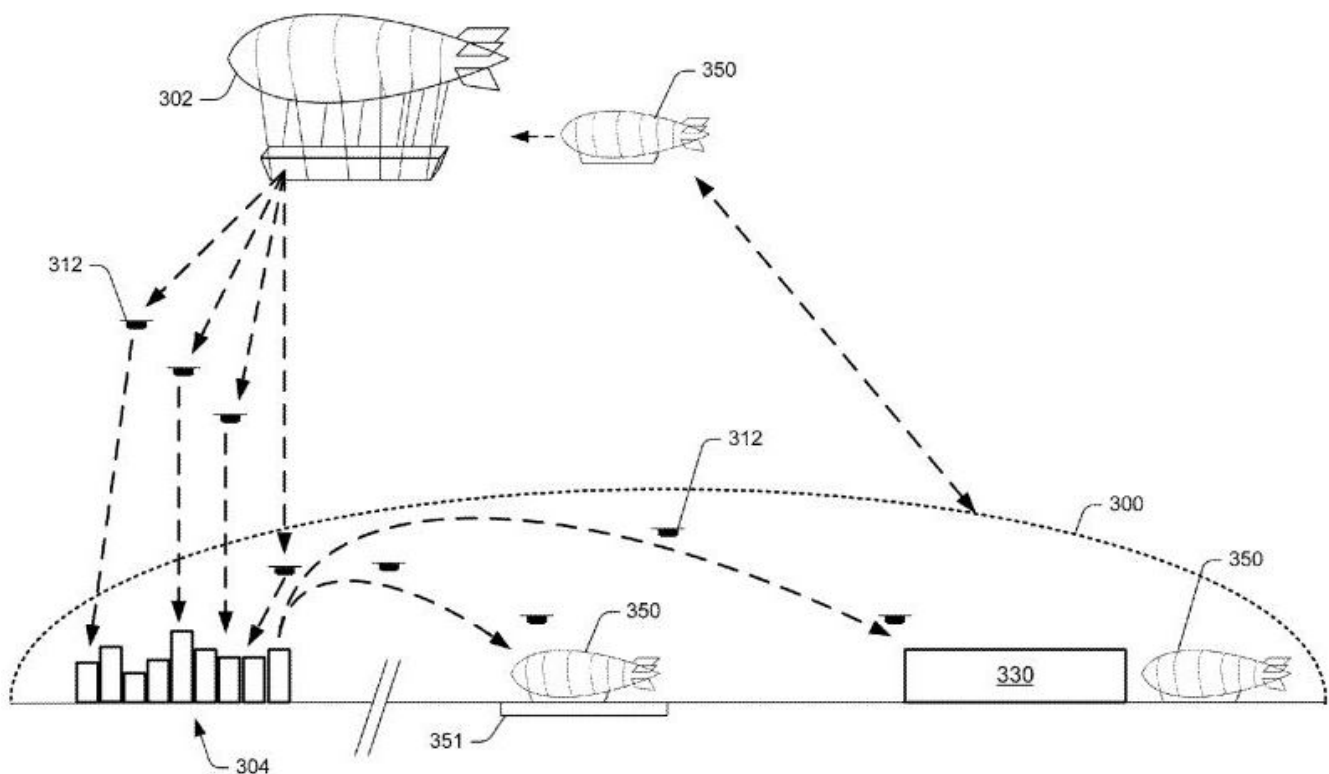


Figure 1: Proposed zappeling by Amazon

nected to share route information and to divide the workload. Charging stations will be places for the drones to recharge themselves. However, the idea is still far from completed, and in the meantime Walmart has been working on the same kind of idea, and has a patent registered around the idea.

The University of North Texas has done research about using drones to provide cell service when the normal cell towers aren't working anymore, for example due to a nature disaster. In this time where everybody is so dependent on reception on their mobile devices this can be an outcome for many people. The drones can temporarily give mobile phone users the reception they need.

Hackers have found ways to use drones for their advantage. they have attached drones with wifi functionality to fly over houses in search for unsecured wifi networks in range to extract information or to infect them with malware. They have developed software that can automatically scout a district of a town, without any intervention of a human being. It won't be long before criminals will find other ways to use drones for hacking computers.

A drone based solution that will be beneficial for humans is the ambulance drone. In the future it will be possible to get a AED delivered in time of need to the right location. At the moment it happens too often that a victim of a

heart disorder will get their help too late. Because drones are becoming faster and faster, and they don't have problems with traffic, they can move very fast through a town. Right now AEDs are placed throughout the city, and when one is needed somebody has to get the nearest and bring it to the per-

"The drones can temporarily give mobile phone users the reception they need"

son whose life is in danger. A drone can be in motion immediately, so it will be there earlier. Because saving a saving someone is a matter of minutes, many lives can be spared when dro+nes take over this job.

In India drones have been used to plant seeds to create forests. The advantage with drones is that they take a picture before dropping the seeds, and can geotag the path. Using this new way of using drones the carbon imprint humans are making on the planet can be reduced . Subsequently, once every three months the drones can fly over that area and see the impact of dropping the seeds.

The army of the US has been using drones, or UAVs, for years now. The Dutch army isn't using them right now because the government of the Netherlands thinks the US is using them for targeted killings, and the Dutch government doesn't approve that. The drones give the army of the United States the opportunity to attack the enemy from a distance. It also is a using drones be-

cause it is a very stealth way to engage the enemy. Also, no US forces will be in danger during the mission. The loss of a drone is expensive, but you won't be losing lives.

Drones will be used more and more in the future. During this time of automation drones will be a help to achieve the goals big companies have to decrease human labour. Maybe drones will be superseded by another technology, and maybe the sky will be filled with all kinds of drones and we will have to solve the problems that will give us.

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Figure 2: Drone used in combat

Interview with Bits of Freedom

Technology disrupts privacy. What can we do about that?



By: *Niels de Groot*
Editor I/O Vivat

Recently I visited a lunch lecture where the person giving the presentation was talking about the fourth industrial revolution. Now, if you look at the history books, you will notice only three have been documented throughout history. The reason the fourth industrial revolution is not in there is quite simple, it's because it is happening as we speak. The current industrial revolution is blurring the lines between physical and digital and is fundamentally changing the way we live our lives.

Disruptive technology brings advantages, it opens up a whole new range of ideas which were previously not technologically possible. However, these technologies are visibly and invisibly deteriorating another important aspect of using the digital world, our privacy. Luckily, there are organizations who are watching out for us. We talked to Rejo Zenger from Bits of Freedom.

A century ago people first started thinking about privacy when the photo camera was introduced. A century later, how has people's view on privacy changed?

Well, the most important laws which concern the internet are - I think - from 1995. From that moment onwards laws have been created with some form of the internet in mind. What you most often see - or what we most often see

- is that until 4 years ago, privacy was actually quite an abstract subject. Most people did not have a clue about the consequences of putting much of their information online for the world to see. With the revelations of Edward Snowden, I think a lot has changed. People suddenly realized they trusted a company with their most intimate details, but it is likely this information will at one point or another fall into the hands of governments, which may be less careful with it. Since then, a lot has changed for individual people; students, employees at a company, more people ask themselves the question whether what they're doing online is actually safe. At Bits of Freedom, we increasingly see these questions too.

What we also see is that - since two to three years - people have started to realize that large parts of our society are dependent on our digital infrastructure. Whenever there happens to be a disturbance in that infrastructure this may have far-reaching consequences. As an example, look at the systems for container terminals in the harbor of Rotterdam which went down last summer due to a cyberattack. Now imagine what happens when the supply of supermarkets in a city goes flat for weeks. Policy makers and others are slowly starting to understand this impact so they are starting to realize the importance of sufficiently protecting our digital infrastructure. Good protection of the infrastructure also means your data is protected better.



Figure 1: Rejo Zenger.

Who is Rejo Zenger?

Rejo Zenger once graduated as an industrial product designer. Not too long after his graduation, the internet was up and coming. Rejo noticed this and became very enthusiastic about it. When the government started trying to get a grasp of this new technology, he noticed the government could use a little help. That's when he got involved in his current field, to which he is still very dedicated to this day.

Awareness is definitely being created, but there are still lots of people who do not have a clue about how privacy is supposed to work. Some say they "have nothing to hide", others just don't care as much that someone knows a lot about them. Does this worry you?

I actually think the number of people saying they have nothing to hide is dropping, since most people have realized by now that they - in fact - do have something to hide. A simple example are your holiday pictures. You wouldn't show your mother-in-law the same pictures you show your friends. The only reason for this is because you only want to tell certain stories in a specific context and would rather separate most of it. I am quite certain there are pictures you would rather not show your mother-in-law since it would distort the image she has of you. Everyone has something to hide and luckily an increasing number of people knows that.

"You wouldn't show your mother-in-law the same pictures you show your friends"

I would like to add - for people that do still think they have nothing to hide - that things that do not seem worth hiding now are things you might still want to hide in the future. Recently in the United States, the Trump administration has requested identifying data of people who visited a certain anti-Trump website. This shows incredibly well how quickly a situation can change, which means you have to be critical about something that may happen in the future. Everything you do online is tracked in one way or another and that makes it difficult to change your mind on an issue, for example. It is possible for you to think of something in a very different way in two years, but if your past opinion is available somewhere you can always be confronted with it at a later stage. That simply isn't possible in our analog world.

Now, there's quite a difference between an individual person who is fairly short-sighted concerning privacy and someone in a major position, within government or business, for example, who has that vision, right?

Yes, and I'm definitely not convinced that everyone has the right vision right now. It is always a matter of weighing certain interests, but I think people are slowly realizing that this is an important topic. You notice that when looking at the Ministry of Economic Affairs, which is increasingly aware of digital topics and is also contributing more and more to a safe digital infrastructure. You can see that when looking at policy too, but you notice it when people reach out to Bits of Freedom to ask how they safely use WhatsApp. It is not as abstract anymore.

Looking at the current state of privacy, what are developments we should currently be distressed about?

I think there are currently two very important developments which I would like to name. The first is that many technological barriers are disappearing which makes things that were difficult before much easier. As an example: the Dutch police has about eight helicopters of which two are grounded at any moment due to maintenance. Keeping one helicopter in the air takes the effort of a pilot, co-pilot and a few ground crew members. Moreover, helicopters use a lot of kerosene, which is very expensive, they make a lot of noise and are quite big, which means they easily disturb the population when they keep circling above a city. All of these factors are reasons why the police is hesitant to use helicopters.

You can imagine that, when you have drones which are nearly the size of your fingernail, many of these limiting factors are omitted. This means that new technology can be used much easier than the old technology. A consequence of that is that we need to think way more carefully about what exactly we want when we are drawing up policy for it. Previously, that question was pretty much answered by the limitations of the technology. Nowadays, we need to decide what's the limit. Unfortunately, it often happens that we skip that step,

experiment with something and start using it without having asked ourselves "Do we really want this?".

"There are always third parties between you and whatever you're doing"

The second thing that is important to mention is that one should realize that with the current design of our systems there will always be a party looking over your shoulder. In the past you would buy a book, take it home and you would be able to do everything you like with it. You could underline things with a pen or pencil, you could rip pages out of it, you could even set it on fire. Nobody would notice. However, when you buy a book at Amazon, they can see which books you read, how fast you read, whether you finish the book, and more.

About Bits of Freedom

Bits of Freedom is a digital civil rights movement which is committed to the protection of fundamental rights in the context of digital communication.

Questions such as "What can Facebook do with your profile?" or "Under what conditions is the government allowed to wiretap your internet connection?" are daily business at Bits of Freedom.

The foundation tries to establish good policies concerning digital freedom by lobbying and analysing the impact of a particular law on your freedom on the internet. In order to do this, BoF does a lot of research and can occasionally be found in court when they're not satisfied with the information the government provides them with.

If lobbying does not have the desired effect, Bits of Freedom sometimes switches to campaigning.

Furthermore, an important goal of BoF is empowerment; trying to let people protect themselves better.

This happens with every technology, with everything you do. Apple sees what you have installed on your phone, Netflix sees what you watched, Google is between you and your search results. There are always third parties between you and whatever you are doing, and that is a very drastic change with respect to the past because you lose control over your data.

“Others decide how you travel which can have lots of societal consequences.”

The fact that a lot of data is saved also provides opportunities in the form of big data. For example, Google can provide its users with useful data about traffic by using their phone's location.

Yes, and that is very useful, but I think it is important to keep an eye on everything that is involved in such a technology. The fact that Google can tell you whether it's a good idea to avoid a highway on your way home is of course convenient, but at the same time it clearly shows how much power Google has over your life. Google could, for example, also decide to not send you through a certain neighbourhood at night because it's known for its high crime rate, and because Google would do that - and I have no idea if they do that, but if they do - there will be even

less traffic going through this neighbourhood and that part of town will be further deprived. In a way, Google can almost literally steer you, but the impact of that goes much further than “Oh, it's busy here, let's take another route”. It means that others decide how you travel and that can have lots of societal consequences.

Do you think that happens consciously or unconsciously?

Well, at least it's not transparent, and that's a big problem because for you as a user it is not clear what decisions Google took in order to advise you to take a certain route. For example, citizens of Hollywood have, in the past, been able to get a navigation company to change the location of the Hollywood sign because they were annoyed by all the tourists. Now, we do not know whether the changed location was an accident, whether the people living on that street paid the company a lot of money to do it or whether the municipality requested the change. What matters is that it is not transparent for you as a user, and that is problematic when you realize they do control your movements with it.

Now, I do not know whether transparency is always possible, but the most important take-away is that transparency is not the norm right now. You named big data as an example, which people trust a lot since the algorithms are supposedly unbiased. However, a lot of the outcomes depend on the data you put into the algorithm, and the data can actually be biased. It often seems quite easy and fine, but that is simply not always the case and we should be careful of that.

In the book '1984' by George Orwell, which is a well-known book from 1949 about the disappearance of privacy, the writer tries to look 35 years into the future. Orwell seemed quite pessimistic in hindsight. According to you, how would privacy look for us in 35 years?

My experience is that looking ahead is of no use because it is very hard to predict. With these kinds of subjects, people tend to look ahead pretty often, of course, for example in science fiction. They tend to be wrong most of the time. My expectation is that it will only get better because I think people will be more aware of the impact of technology on their freedom and the importance of a safe digital infrastructure. That means that there will probably still be a lot of bad policies over the coming years, but I think that in the long term, we will very slowly regain our digital freedom.

So there's a reason for optimism?

Yes, absolutely. Awareness is being created, which takes time, of course, but I am very optimistic.



Figure 3: The Bits of Freedom office is located in a typical canal house on Prinseneiland in Amsterdam where I/O Vivat visited them for this interview.

More info about Bits of Freedom

More information about Bits of Freedom can be found on their website:

<https://www.bof.nl/>

From the ENIAC board

A new year with new challenges!

By: **Sandra Drenthen**
Chairman ENIAC



As the alumni association of the computer science related bachelors and masters of the UT, we host several events for our members (note that the members of Inter-Actief are also welcome to our events!). We organize some regular drinks throughout the Netherlands, including some additional fun and special events.

Graduation speeddates

At the end of last year, we had another successful edition of the graduation speeddates. At that event, students have short dates of 5 minutes with several companies and discuss their interests, expectations and opportunities. If it is a match on both sides, they will get each other's contact details so they can plan a follow up if they want. All students and companies had at least 3 matches this year.



Figure 1: Impression of the graduation speeddates.

Lustrumsymposium

In order to celebrate our lustrum, we held a special event; a lustrumsymposium, by alumni and for alumni, with alumni-speakers from several awesome companies like Spotify and Philips Hue and a great turn-up of around 80 people attending!

Get involved

For this year, we want to give new people the opportunity to be on the ENIAC board and organize cool events for our alumni (and our future alumni as well)! If you are interested in joining our board, or something smaller like a committee, or you have an awesome idea you would like to organize, mail us at bestuur@eniac.utwente.nl and we will see what we can do!

Sandra Drenthen is the chairman of ENIAC: the ENSchedese Informatica Alumni Club. ENIAC is the alumni association for the bachelors and masters of Computer Science, Telematics and Business & IT at the University of Twente.

ENIAC has the mission to stimulate the contacts between alumni and with the faculty of EEMCS. Therefore, the ENIAC Thesis Award is awarded yearly to the best thesis of the college year. ENIAC also regularly organises meet-ups and events, which is a great way to keep in touch with your former study mates!

ENIAC and Inter-Actief have a close collaboration. This means, that while you're a member of Inter-Actief, you are welcome to visit all activities of ENIAC, and conversely, members of ENIAC are welcomed at all of Inter-Actief's activities. You can learn more about all activities through our websites and we'll keep you up to date with our regular mailings.

For only €5,-, you're a member of ENIAC. Members receive several benefits, including the I/O Vivat (like the one you're currently reading) on their doormat and access to all activities. Graduated bachelors are also welcomed. You can find the membership form on the website (www.eniac.utwente.nl).

The blockchain revolution



By: Niels Besseling
Employee OVSoftware

A few years ago, the blockchain suddenly came on the scene; a new technology that interested few people at first. At the time, it was significantly less valuable than it is today. However, companies are now eagerly experimenting to see how blockchain can fit into their organisations. Fundamentally, blockchain is a data structure for digital transactions that are visible to everyone. But how do companies apply this? Niels had the opportunity to get started with blockchain for a government agency.

The basis of blockchain

Perhaps you already know about the possibilities offered by blockchain, and perhaps not. Blockchain technology is an open, distributed and immutable database. In short, this means that the data saved in a block is visible to everyone. The data is not stored in a server; instead, each point in the network has its

own copy, and once the data is stored, it can no longer be changed. Of course, this is a very simplified view, but it is essentially the basis of the technology behind blockchain. It's a smart mixture

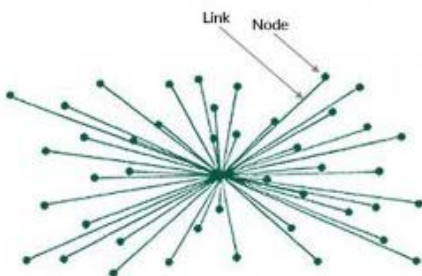
is simply depicted in the illustration below. This clearly shows that all of the points are in contact with one another. Each point possesses its own copy of the blockchain.

"Once the data is stored, it can no longer be changed."

of various familiar technologies, such as cryptography, peer-to-peer networking and consensus theory.

As the name indicates, blockchain is actually a chain of blocks containing data. New data is offered to the network, a new block is created from this data, and the block is then 'linked' to the previous block. This is by no means a simple task. Afterwards, the new block is distributed among all of the points in the network. The blockchain network

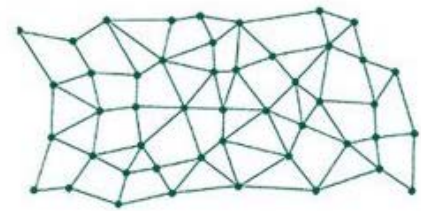
As previously indicated, creating a block is no easy task. There are many requirements associated with creating a block, which means that a lot of processing power is necessary to achieve it. When we talk about processing power, we mean entire sports halls full of computers. This processing power is provided by special miners, who are in turn rewarded for creating a new block. This reward can consist of transaction costs that are paid for the storage of the data, or in the form of bitcoins. A lucra-



Centraal
Huidige (bancaire) betaalsystemen



Decentraal



Gedistribueerd
Blockchain

tive business, the bitcoin has recently been worth around \$20,000. However, it is currently decreased to around \$9,000 which shows that the business remains unpredictable.

New possibilities

Although it's fantastic of course that the bitcoin is still increasing in value, blockchain is primarily interesting to companies for data storage. Because the data is immutable, blockchain technology makes value exchange possible without a trusted third party being necessary, such as a bank.

"We should all work together on this new, cool technology"

In the Netherlands, there is a great deal of experimentation being carried out by various government agencies. Blockchain offers a lot of opportunities. For example, imagine that you would like to purchase a piece of land. Currently, you have to request paperwork from a number of different agencies to prove that you can actually buy that piece of land. This takes a lot of time and money, which nobody finds desirable. This is one of the reasons why there are various pilots running at government agencies. Niels was allowed to work on one such project:

'A while ago, I was allowed to work on a project for a government organisation whose work involves recording a lot of data. At the moment, there are many transactions processed every day, which makes blockchain technology very interesting for them. Blockchain makes it possible to capture transactions unequivocally. Partly because of this, they wanted to start up a pilot to investigate how useful blockchain technology is for their domain.'

During the project, we created a proof of concept application for a defined use case. In this use case, it had to be possible to request data from the agency. It also had to be possible to call on a service to verify the accuracy of the data.

Because this service is based on blockchain technology, no one has to pursue this personally. Users can check for themselves whether all of the data is correct, given that this is immutable in the chain.

A website was also created as part of this proof of concept. It's possible to request data on this website. For this, the website approaches a new service that requests the data, writes a checksum on the blockchain and returns the data. The website can now consult the blockchain and retrieve the checksum of the data.

This means that the retrieved data is also checked for correctness. By recording only a checksum of the data, many requests can be added to the blockchain without the blockchain growing too fast.

I worked on this project with a group, and we carried it out in four sprints of a week each. It was a relatively quick and short project, but the result is fantastic. At the moment we're looking at how we can follow up and further develop the project, so it can actually be used in the future. In my opinion, blockchain is a really great, interesting technology and we're going to hear a lot more about it.'

The future of blockchain

As already mentioned, there is a lot of experimentation going on with blockchain. Whether it's for small projects or large ones, people are eager to find

out how blockchain can contribute. The question now, of course, is whether or not this trend is going to continue. Is blockchain going to have a large impact on our daily lives in the future, or will the interest in it eventually vanish into thin air? Whatever the outcome, everyone's continuing to experiment with it. And if we can believe what Niels says, we should all be working together on this new, cool technology.

About OVSoftware

OVSoftware was founded by the Oude Velthuis family in 1972. OVSoftware is one of the first software companies in East Netherlands. By constantly innovating, OVSoftware managed to survive all the storms of the rapid hardware developments. That's not easy, but all colleagues have a lot of knowledge about the IT world that we constantly share with each other.

OVSoftware is a company with short lines, which means we have an informal environment. This way we can also guarantee that you will work on a project that you like. Because of the long-term relationships OVSoftware has with their customers, they know how their business and IT environment works. This ensures that they can help their customers from scratch and develop custom software in various market segments.

When you are employed by OVSoftware, you have the guarantee to work close to home. OVSoftware has offices in Amersfoort, Apeldoorn, The Hague, Oldenzaal and Munster (D) and focuses on Java and .NET technology.

If you want to see for yourself who OVSoftware is, you can fill in the coffee drink form on their website. Meet them without any obligation!



Evolving the brain

Brain-machine interfaces and deep brain stimulation



By: Willem Siers
Editor I/O Vivat

We can dissect parts of the brain, see all the neurons and neurotransmitters. Furthermore, neuroscience can map out specific areas pretty well: we know which parts of the brain are dedicated to movement of which limbs, and also we know how each coordinate of our vision maps to which part of the visual cortex.

But actually, we don't understand how our brain works. Movement is complex (think of how simply turning this page involves many precise muscle movements). And a simple eye-to-brain coordinate conversion explains nothing as to why we think our world is 3d. Even less understood is how our brain deals with language, or (maybe not so surprisingly) mathematics.

Brain-machine interfaces are hard to make, but not just because our lack of understanding of the brain. Physical challenges make it even harder. Maybe connecting some wires for your Arduino project was easy, but can you imagine doing this with a vulnerable and living thing?

BMI's

A brain-machine interface (BMI) connects a brain to a computer. Some interfaces work in read-only mode, but others stimulate the brain to simulate senses, relieve Parkinson's or OCD,

or make you feel things. You probably know a few: MRI and EEG for example. These two are not invasive at all, but unfortunately only give you fuzzy images at best. We can do slightly better by placing EEG sensors under the skull (EcoG). There are even techniques that place electrode needles directly in your cortex or neuron cells. More interesting experiments involve devices that stimulate the brain, so let's first look at what brought us there.

The first BMI was tested in 1969, when a researcher connected a neuron in a monkey's brain to a dial that was supposed to move whenever the neuron fired. When the dial moved, the monkey was rewarded with a banana-flavored pellet. Soon it learned how it could turn the dial and get more treats, essen-

tially making the dial under control of the monkey.

Fast forward to 2006, BrainGate was founded and managed to get a quadriplegic human (someone with paralysis in all four limbs and torso) to move a mouse cursor on a computer screen. This cursor was completely controlled by the brain, as opposed to hand movements. To do this, BrainGate developed a sensor, consisting of 100 thin electrodes. It was implanted in the brain's motor cortex, and over time the brain learned to control the cursor, similar to how we learn to use our hands. Actually, it's similar to how we control a cursor: we think of moving the cursor, not moving our hand that moves the mouse, that moves the cursor.

Controlling a computer is a great deal for quadriplegic people, but 2-dimensional movement is quite simple compared to moving one's limbs. Just six years later however, a participant of an experiment at BrainGate managed to move a robotic arm, in order to grab, and drink coffee from a cup [2].

A brief note here: we're talking about controlling things directly from the brain. This is different from prosthetics you may have seen, which use sensors in the muscles of, for example, your arm to move a robotic arm (for example https://youtu.be/x_zGiqV7Bmk). This type of prosthetics are for people who lost a limb, but won't work for people with neurological problems.

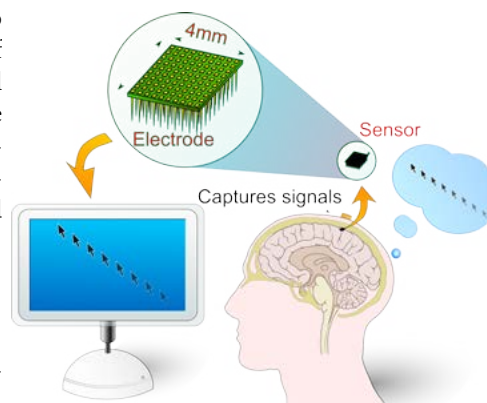


Figure 1: Schematic of telepathy

Unfortunately, the lack of sensory feedback makes it especially difficult to do tasks like grabbing a cup. While previous examples only read information, steps towards stimulating the brain are also being made. A good example is for our hearing. Most deaf people are neurologically just fine. It's just that their ear doesn't generate any electrical impulses when hit with soundwaves. But microphones do just that: convert audio to electric signals. And it turns out that stimulating the auditory nerve with the microphone's signals is, albeit lo-fi, actually good enough for deaf people to have conversations again. Cochlear implants are considered successful BMIs, and are given to deaf children of just a few months old.

Deep brain stimulation

A more current technique is deep brain stimulation, a technique used to treat brain diseases and mental illnesses. It requires brain surgery, where an electrode is placed at a specific area in the brain, depending on the disease that is to be cured. These electrodes are stimulated by signals from a pacemaker. In a recent documentary, this technique is demonstrated to have great results [4]. A patient of Parkinson's disease managed to greatly reduce his tremors by deep brain stimulation in a part related to his motor functions. Another patient, who suffered from chronic depression, received this treatment in a part related to her mood and reported it completely cured her depression. Deep brain stimulation is also applied for OCD, chronic pain and schizophrenia patients.



Figure 2: A cochlear implant

Current and future developments

According to professor Sabes, from UCSF School of Medicine: despite not understanding the brain, progress can be made in creating brain-interfaces. Creating BMI's is engineering. Just like how not fully understanding gravity doesn't prevent us from building bridges,

"The long term goal however, is human enhancement"

the ability to measure and manipulate a brain (might be) sufficient to reach our goal.

Neuralink, a 2016 company developing "ultra high bandwidth brain-machine interface", agrees with this[3]. Short term they "just" want to alleviate brain diseases. The long term goal however, is human enhancement [4]. They hope to spark a BMI revolution, by working enough on the "impossible to overcome" hurdles, so that the industry will perhaps explode into every other industry working together to reach a goal [1]. Just like how the invention of integrated circuits in the 1960's, a miracle device in the eyes of a 1907 vacuum tube inventor, lead to modern smartphones.

According to engineers at Neuralink, the largest hurdle is still technology. Limited bandwidth is a problem, as the current record for simultaneously measured neurons is 500, out of the million they claim would be needed to change the world [1]. Also, with the current growth rate (doubling every 8 years) it will take 80 more years to reach this million.

Another hurdle is the invasiveness of implantation. It requires a neurosurgeon to open up your skull and manually implant the device. Neuralink thinks that automated implantation will eventually be needed, because the amount of neurosurgeons would be a limiting factor. Other problems are space and biocompatibility: there's simply no room for a million electrodes in your skull, and normally our bodies reject foreign objects anyway.

But, technology has often been underestimated. So we may end up measuring

and stimulating a million neurons. At this point we actually get back to understanding what our brain is saying. For a computer to understand what our brain signals mean, and then to learn how to talk back to it will be quite a challenge. I found a somewhat ironic approach for interpreting the patterns that would be coming from the millions of neurons, to be the use of a neural network. These are currently actually used for classifying certain EEG patterns of the brain [6].

To conclude...

The current state-of-the-art of brain-machine interfaces includes cochlear implants, deep brain stimulation, and multi-electrode arrays. These already proved huge benefits for deaf people, quadriplegic people, and sufferers of brain diseases. The future holds more dazzling applications, and if you're interested I can recommend article [1] for a description of this crazy future.

One thing is certain: BMI's are very important now, but are only just starting. Will future generations will look back and think: people used only 100% of their brain?

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De opleiding Informatica: van 1981 tot nu

‘Vroeger was alles beter’?



Door: *Meike Nauta*
 Hoofdredacteur en puzzelmaker

De bacheloropleiding Technische informatica heeft in november 2017 het predicaat ‘Topopleiding’ toegekend gekregen door de Keuzegids Universiteiten. De score van de opleiding steeg ten opzichte van vorig jaar met maar liefst 16 punten naar 78. Een mooie aanleiding om een korte geschiedenis te geven van het studieprogramma van informatica aan de UT. Gaat de welbekende kreet ‘Vroeger was alles beter’ hier op?

Een stukje geschiedenis

In 1964 werd in de afdeling Elektrotechniek (EL) aan de Technische Hogeschool Twente de kiem gelegd voor de faculteit Informatica. EL had in die tijd twee leerstoelen op het gebied van informatica: Numerieke wiskunde en Digitale techniek. Vanaf de jaren ‘70 was Informatica steeds prominenter aanwezig op de THT. In 1974 werd Informatica aangeboden binnen Elektrotechniek en Toegepaste Wiskunde en iets later kwam er ook een afstudeer-variant binnen de opleiding Bestuurskunde. Het bestuur stelde daarom dat de THT tot de eerste instellingen in Nederland zou moeten behoren met een zelfstandige informatica-opleiding. Na veel getreuzel ging de experimentele opleiding Informatica uiteindelijk in 1981 van start, tegelijk met acht andere Nederlandse instellingen. Ruim 150 studenten begonnen aan de nieuwe opleiding, waarmee de THT de grens van 3000 studenten passeerde.

Studieprogramma

Bij de start van de opleiding Informatica wordt een groot aantal nieuwe vakken op de plank gezet. In deze lijst, te zien in Figuur 1, zijn nog enkele vakken te herkennen zoals deze voor de invoering van het Twents Onderwijsmodel in 2013 werden aangeboden, waaronder Programmeren I en Programmeren II, Vertalerbouw, Concrete complexiteit van algoritmen, Gegevensbanken en Informatiesystemen.

De eerste fase van de opleiding in 1981 is een Propedeuse van een jaar, gevolgd door een Doctoraal van drie jaar. In 1995 wordt Informatica een vijfjarige opleiding. Hierdoor wordt het programma beter studeerbaar. Bovendien is projectonderwijs toegevoegd. In 2002 gaan alle universiteiten en hogescholen in Nederland over op de bachelor-masterstructuur. Na de bacheloropleiding, die drie jaar duurt, kan een tweejarige masteropleiding gevolgd worden.

Met invoering van het Twents Onderwijsmodel in 2013 gaat het studieprogramma opnieuw op de schop. Vakken zijn niet meer als zodanig herkenbaar, maar de inhoud is grotendeels opgenomen in zogeheten *modules* die elk 10 weken duren. Elke module is opgebouwd rondom een centraal thema. Projectwerk in groepen staat centraal. Het huidige studieprogramma is weergegeven in Figuur 2. Te zien is dat het informaticavakgebied een stuk breder is geworden met vakken als cybersecurity en human media interaction. [3]

Inleiding digitale techniek (ook 213001)
 Uitrusting van digitale systemen
 Architectuur van digitale systemen
 Interface
 Digitale realisatie
 Architectuur van computernetwerken
 Programmeren I
 Programmeren II
 Programmeren III
 Programmeren IV
 Programmeren V
 Programmeren VI
 Inleiding programmeren
 Voortgezet programmeren
 Bestuurskundige informatica I
 Bestuurskundige informatica II
 Combinatorische algoritmen
 Inleiding in de systeemprogrammatuur
 Inleiding theoretische informatica
 BO theoretische informatica
 Seminarium theoretische informatica
 Vertalerbouw
 BO vertalerbouw
 Gegevensstructuren
 Beheerssystemen
 BO beheerssystemen
 Structuur van programmeertalen
 Concrete complexiteit van algorithmen
 Semantiek van programmeertalen
 Computers en informatiesystemen
 Bedrijfskundige programmatuur
 Gegevensbanken
 Systeemimplementatie-technieken
 Gegevensbanken I
 BO gegevensbanken
 Informatiesystemen
 Formule manipulatie m.b.v. Reduce
 Computer algebra
 Programmeertalen
 Performance van computersystemen
 Correctheid van algoritmen
 Bestuurlijke informatieverzorging I
 Bestuurlijke informatieverzorging II
 Bestuurlijke informatieverzorging III
 Methodieken van systeemanalyse en ontwerp
 Projectmanagement en systeembeheer
 De impact van automatisering voor het bedrijf

Figuur 1: Studieprogramma Informatica 1981

In 2016 wordt de opleiding volledig Engelstalig. Opleidingsdirecteur Geert Heijenk over de ontwikkeling die de opleiding doormaakt: “Ondanks een sterk stijgende instroom, deze is vorig jaar verdubbeld, slagen we erin het karakter van een kleine opleiding met direct contact tussen docenten en studenten te behouden, en onze scores zelfs te verbeteren. Ik ben heel trots dat we zo’n goede, internationale opleiding weten neer te zetten.” [2]

Programmeerpractica

Programmeerpractica zijn al vóór de oprichting van de opleiding aanwezig en deze zijn na al die jaren niet uit het studieprogramma verdwenen. Tegenwoordig volgen eerstejaars studenten de practica in hun tweede module ‘Software systems’. Uiteraard met eigen laptop en met beschikking tot internet.

In de jaren ’70 was dit wel anders: destijds beschikt de THT over het Rekencentrum, de beheerder van de centrale computers. In 1972 werken hier achtoperateurs en vier ponsstypistes. Bij de Algolpractica maken studenten hun programma’s op ponskaarten. Op elke ponskaart gaat één regel van het programma. Een vouw of kreuk in een ponskaart was vaak fataal. De stapel ponskaarten werd bij het Rekencentrum ingelezen door de DEC-10 computer, met een geheugen van 512 woorden (1 DEC-woord is 36 bits). Uiterlijk 4 dagen na inlevering worden de kaarten door het rekencentrum in de daarvoor bestemde kast gelegd. Vooraf goed nadenken was belangrijk, want op het papieren resultaat een foutmelding terugkrijgen was natuurlijk erg vervelend. Door deze manier van werken was fraude vrij eenvoudig: studenten stalen ponskaarten van andere studenten uit de uitleverbakken en gebruikten die vervolgens voor hun eigen practicum.

In 1981, bij de start van de opleiding, zijn voor programmeerpractica zes terminals beschikbaar, die gegarandeerd op het computersysteem zijn aangesloten. Studenten maken op papier een stuk programma en mogen, zodra de docent het in orde acht, de programma-tuur achter de terminal intikken.

het echter nog niet nodig dat een eerstejaars student al over een pc beschikt. De faculteit biedt voorlopig voldoende faciliteiten met onder andere een pc-gebruikerszaal met 54 pc’s met kleurenscherm en print- en scanfaciliteiten. Uiteindelijk wordt pas in 2003 het bezit van een laptop verplicht gesteld [1]. Een

“De stapel ponskaarten wordt bij het Rekencentrum ingelezen door de DEC-10 computer, met een geheugen van 512 woorden.”

Personal Computers

De ontwikkelingen in computers volgden elkaar snel op. In 1984 wordt het grote rekenwerk voor onderzoek, zoals het oplossen van differentiaalvergelijkingen, gedaan op een aantal gemeenschappelijk te gebruiken supercomputers. Het andere werk wordt langzaam overgenomen door pc’s en minicomputers.

Vanaf 1985 verkoopt het Rekencentrum personal computers met grote korting aan medewerkers en studenten. In 1988 kunnen medewerkers via een gunstig project op afbetaling een pc aanschaffen. Voor studenten gelden deze voordelen niet. Om het ook voor studenten mogelijk te maken goedkoop een computer aan te schaffen, wordt eind mei 1988 stichting IAPC (Inter-Actief Personal Computing) opgericht. Prijzen variëren van 1.963 tot 3.549 gulden. In 1993 verkoopt IAPC voor een miljoen aan pc’s. De opleiding Informatica vindt

van de voordelen die de UT noemt is dat lokalen nu efficiënter benut kunnen worden.

Tegenwoordig zijn de meeste computerlokalen verdwenen en dragen studenten hun laptop altijd bij zich. Via het jaarlijkse notebookproject van het Notebook Service Centre van de UT kunnen studenten voor een scherpe prijs een laptop aanschaffen, inclusief dienstverlening. Zo heeft een student binnen één uur weer een werken exemplaar. De voorheen hippe kreet “Bring your own device” hoeft al niet eens meer genoemd te worden. Integendeel, enkele docenten vereisen nadrukkelijk dat de laptop tijdens een hoorcollege in de tas moet blijven. ‘Gelukkig’ hebben studenten hun telefoon en smartwatch nog ter afleiding.

Jaar 1			
Pearls of Computer Science	Software Systems	Network Systems	Data & Information
Jaar 2			
Computer Systems	Intelligent Interaction Design	Discrete Structures & Efficient Algorithms	Elective: Programming Paradigms
Jaar 3			
Elective: Smart Spaces	Elective: Cyber Physical Systems -OR- Web Science	Design Project & Bachelor Report Project	

Figuur 2: Studieprogramma Technical Computer Science 2018

Reageren?

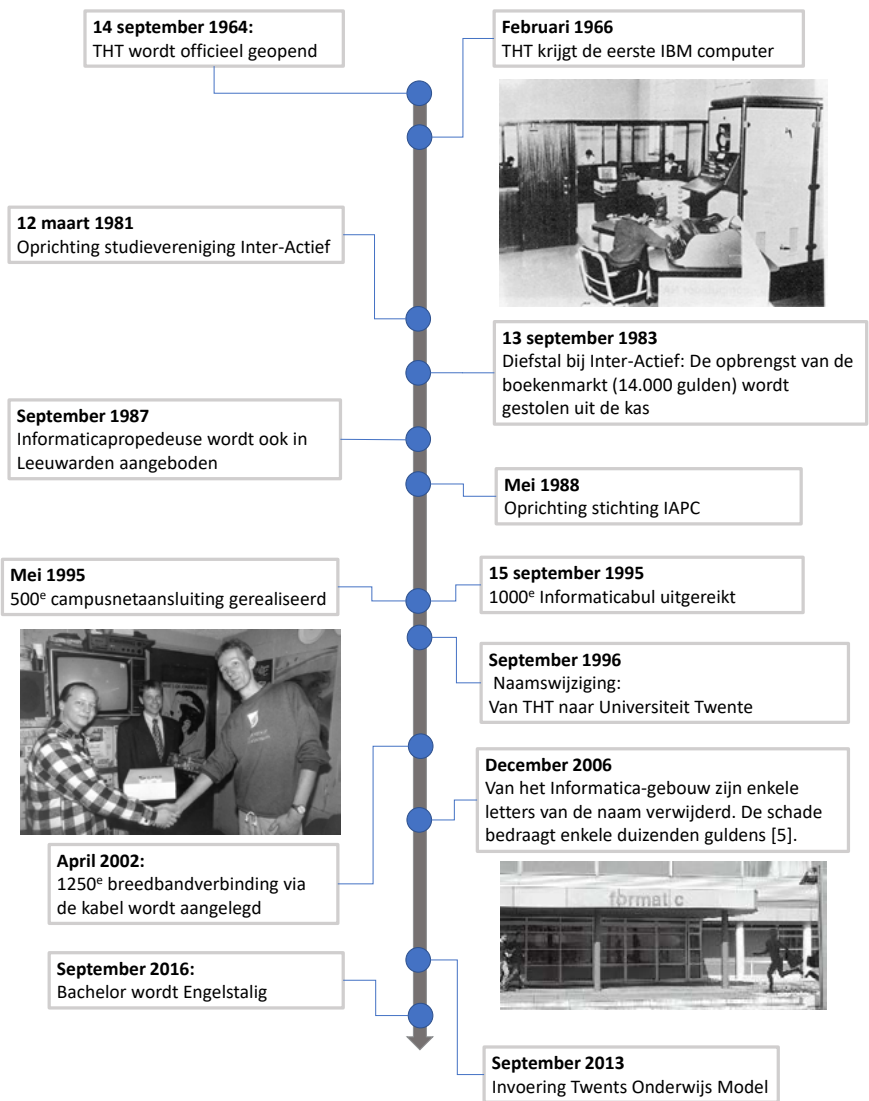
Wat vindt u van dit artikel? Kent u nog leuke anekdotes die niet vergeten mogen worden? Laat het de redactie weten via iovivat@inter-actief.net. Wie weet wordt het opgenomen in een volgende uitgave.

Voor de (oud-) BIT-studenten: In het volgende nummer zal een artikel komen over de geschiedenis van de opleiding BIT. AL ideeën? Laat het ons weten!

Bekende namen

In 1985 komt dr. **Peter Apers** als jongste hoogleraar op de THT. Apers gaat bedrijfs- en bestuurskundige informatica verzorgen op het gebied van databases. Het wordt later uitgebreid naar kennisbanken en gegevensbanken, expertsystemen en kunstmatige intelligentie. Rond de eeuwwisseling wordt hij gevraagd als lid van het College van Bestuur [6]. In 2002 gaat Informatica, voorheen een zelfstandige faculteit, verder als onderdeel van de nieuwe overkoepelende faculteit EWI (Elektrotechniek, Wiskunde en Informatica). Huidige studenten zullen Apers kennen als decaan van deze faculteit wiens benoemingstermijn per 1 februari 2018 afliep [4]. De vertrekkend decaan ziet voor de UT nog volop kansen. 'We moeten en kunnen nog veel meer doen met sensing en big data', aldus Apers. 'We zitten in een nieuwe golf. Na het internet komt nu de data.'

Maurice van Keulen krijgt op 26 juni 1992, precies op zijn 21e verjaardag, zijn Informatica-ingenieursbul en is hiermee de jongst afgestudeerde van de UT. Hij gaat aan de slag als medewerker onderzoek bij de vakgroep Informatiesystemen. Tegenwoordig zullen alle Informaticastudenten hem kennen als docent van o.a. de module 'Data and Information' en als track chair van de masterspecialisatie 'Data Science and Technology'.



Figuur 4: Tijdlijn met highlights

Een volmaakte computer "bij-de-hand"

Gratis SOFTWARE
CP/M - WordStar
MBasic - CBasic
SuperCalc

De Osborne draagbare computer

Een hogeschool-voorbeeld van technisch vernuft, kracht, prijs en betrouwbaarheid. Praktisch om altijd bij de hand te hebben.

OSBORNE STUDENTEN AANBIEDING

f 2.995,-
afhaalprijs inkl. BTW
(afleverkosten aan huis f 100,- meer)

Figuur 3: Advertentie voor een Laptop (1985)

Bronnen

Hoofdbronnen:

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//Kick-In

Do-groups

The Inter-Actief do-groups of 2017-2018 introduce themselves



BIBZ

Fun fact: the mascot of Bibz is a pet rubber duckie.



BIJ

Fun fact: bij is the Dutch word for bee, and is also used to indicate someone will attend an activity.



BITBURGER

Fun fact: Bitburger is a German beer type.



BITTERMAGISCH

Fun fact: do-group organised by *the* fraternity of BIT.



DADDY KOOL

Fun fact: the main do-group parents have an award for 'Best Non-Gay Gay Couple'



GLASHELDER

Fun fact: the name Glashelder was inspired by the slogan of the insurance company Interpolis.



VIS UNITA HERTENJAGERS

Fun fact: they have a fantastic dance choreography.



A Message from the Kick-IT Committee of Inter-Actief

6 committee members, 10 (candidate) board members, 12 bartenders, 17 do-groups, 173(!!) soon to be freshmen and 250 bags of bread. It all started in February 2017 when the Kick-IT started organizing the faculty program during the Kick-In for all new TCS & BIT students in 2017. We hope we are not only speaking for ourselves if we say that it has been an unforgettable time.

It started off with a bicycle tour to the camp location that would only have taken you 1.5 hours directly, but took most of you a bit longer with the new app, around 2 times as long. The second day could be characterized by its heat, 33 degrees at peak time, which we survived with water bottles and a partly suspended program, something you may have wanted for the next day, where all of you got to cycle home in the pouring rain.

You participated in a smuggle game, beer relay, VR soccer, pubquiz, a cantus and got to meet the (then) candidate board. While most of the attendees looked a bit tired and hungover, we are sure it was a success judging by the number of brand new active freshmen, 36, and the overall positive atmosphere during the first semester of the study.

The Kick-IT wants to thank everyone involved in making this camp a success and wishes all freshmen the best of luck during their time as a student!

- Kick-IT Committee 2017



INFLUX

Fun fact: According to themselves they are the Linux of the do-groups.



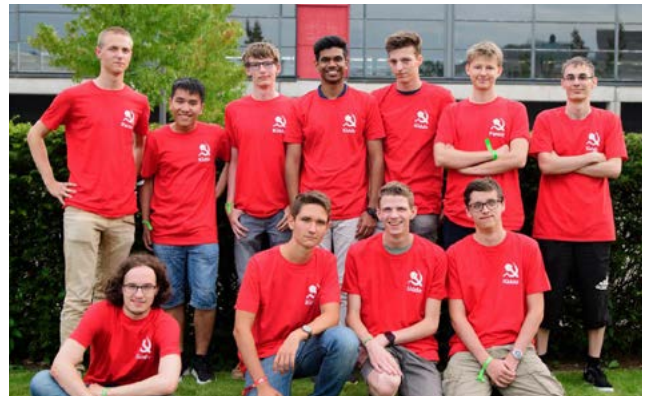
INSOMNIA

Fun fact: they apparently never sleep.



KIINDIMENTUM

Fun fact: for all the do-group parents it is the second time they are do-group parents.



LOREM IPSUM

Fun fact: Lorem ipsum dolor sit amet, consectetur adipiscing elit. Vivamus sed convallis mauris.



MIRANDA

Fun fact: oldest do-group for computer science, this is the 19th generation!



SLAGWAARDIG

Fun fact: It might seem like it, but Slagwaardig is *not* the do-group of Knotsbal association Slagvaardig.



SPIJKERTJES

Fun fact: traditionally, Spijkertjes brew their own beer for the Kick-In.



TEGEL

Fun fact: Tegel is Dutch for tile, which the do-group always carries around.



YOLO

Fun fact: YOLO has their own merchandise, including, for example, YOLO sunglasses.



YORINF

Fun fact: they have - according to themselves - the most fashionable do-group polo shirts.

Interview with Friso van Dijk



By: *Niels de Groot & Florian Mansvelder*
Editors

Friso van Dijk
Trainee RijksICT



Friso van Dijk studied Business & IT at the University of Twente, was active at hockey-club DHC Drienerlo and joined student association Audentis during his time in Enschede.

At the end of his studies, he set up a small company in web development and IT advice for SMEs.

Nowadays, some students start working after their studies, but others simply can't stop learning and reach out to traineeships which many companies offer. Since last year Friso is doing a traineeship at RijksICT, the IT department of the Rijksoverheid.

The Traineeship

The traineeship consists of two tracks. One track is more technical which would suit a study programme like Technical Computer Science better, the other looks at IT advice in more detail and would therefore probably suit Business & IT better. ICT & Law, Blockchain, you name it, are all subjects that are being studied at the RijksICT traineeship.

Friso's personal interest lies with cloud computing and IT governance, these are the topics that are not unknown to him. His master thesis concerned cloud computing and cloud adoption; what capabilities should a company have in order to use the cloud effectively and safely? He has put this in practice at the Rijksoverheid. The follow-up is linked

to the aforementioned IT governance; how can IT help in decision making?

Friso explains about the traineeship: over a total of two years you spend three times eight months at a certain working place, a department within the government. Right now, we meet Friso at the CJIB (Central Judicial Collection Agency or Centraal Justitieel Incassobureau) in Leeuwarden.

He mentions that it is sometimes possible to be at the same spot for two periods of eight months, but there are enough departments that would rather see you switch instead of coming back, so that you can see this organization from a different perspective.

As a trainee you will follow a course about what the government does and how this enormous organization works., next to your fixed working place at a government department. Furthermore, the impact and usage of IT within the government is discussed in this course. According to Friso, it is a lot of fun to see all kinds of different sides of an organization where - nonetheless - IT is always the central topic.

Another important aspect of the traineeship is that your time is flexible which means that there is a lot of room for visiting events such as the CIO day of the government, where many CIOs from different parts of the organization are present.



Through these experiences, you can connect with people in the field easily and in this way many trainees establish long lasting connections.

When asked what is the best part of his current traineeship, Friso answers that the space and freedom which are given to you to look into whatever you may find interesting is possibly the best thing. There is (almost) no fixed programme and you are able to structure your own traineeship quite a lot. For example, Friso recently won a prize for his thesis and was invited to do a talk in Rotterdam because of it, and even those kinds of events are encouraged by the traineeship.

Why Rijksoverheid?

In the beginning Friso did not really mind where he was going to end up working, but he did not really have the ambition to work at very commercial companies. He then came in contact with the Rijksoverheid which eventually seemed like a nice place to work. It is of course easy to say that ICT and governments do not go well together, but according to Friso one can also contribute to improving this, which is a lot of fun. The feeling that you live in The Netherlands and can - in this way - also contribute to that very country is very important to Friso.

In Friso's opinion IT may not go well at the government, but it certainly doesn't always go well at commercial

companies. However, the government is almost always scrutinized by the public, which means problems may appear more often. This does not mean there are no IT problems still, which is why the Rijksoverheid is enthusiastic about bringing in ambitious students with their own refreshing view on ICT.

"The feeling that you live in The Netherlands and can - in this way - also contribute to that very country is very important (...)"

The biggest advantage of students is that they are most often quite cynical because they have not yet adopted the company's views entirely, which means they are the ideal people to improve a company from within.

Personal goal

If you ask Friso whether he has a certain goal for his period at the Rijksoverheid he says that the time period might be too short for any big or very significant goals. However, he does stumble upon things he thinks might be improved within the organization. He might not be able to fix it himself, but he can communicate it to his colleagues so that the situation can be improved in the end. This atmosphere of being able to openly criticize things is important to Friso, it shows that - as a trainee - you are a full part of a team.

The biggest challenge for Friso is his IT governance work. It is a tough problem but also a very new one. Especially since it is new, not many peo-

ple are well-acquainted with it yet, so you work together with many people to find a governance structure that suits the organization of the CJIB. It would be great if people had experience with this subject, which would make it a lot easier. Now, it is quite a challenge, but that also has fun elements, according to Friso.

Furthermore, Friso wanted to develop himself further after his studies, which is why he chose to do this traineeship. He feels that this goal has been reached already, since he has learned and done valuable things over the course of the traineeship. Whereas other traineeships might be more of a retraining track after which you are detached to a company, this traineeship invests much more time in you and your personal interests. You are put into a team, get your own personal mentor and you are creating a powerful network all while being professionally guided.

After the traineeship

By guiding trainees like this, the Rijksoverheid knows that they can expect motivated and developed employees. This is why almost every trainee is offered a contract at their mother organisation after two years (for Friso this is the CJIB), but it is also possible to apply internally for a job within any part of the Rijksoverheid.



About Rijks ICT

RITP is a two year trainee program for (jr.) ICT professionals for the Dutch Government.

You will be working at 3 challenging projects at least 2 different ministries. Training, personal development, intervision, coaching, co-trainees activities are important elements of your program.

You can apply as a native Dutch speaker, with a HBO/WO in informatics or other ICT related background and max. 2 years of working experience. Apply from March 26th until May 6th (dates may change).

Decision support in healthcare

Will it change the world?



By: *Kyra de Lange*
Editor I/O Vivat

Try to imagine yourself: you are seriously ill, there are multiple treatment paths available for your condition and a decision has to be made. One would expect a discussion of the various treatment possibilities and their advantages and disadvantages with reaching a consensus between patient and doctor in the end. Instead, your doctor turns to a computer, enters some information via the keyboard, clicks a few things, and then bluntly tells you which treatment path you are going to follow.

Hard to believe? The field of decision aids in healthcare is booming, and such systems already exist in practice. Scientific literature gives the first notions of decision support systems or aids in medicine in the 70's, 80's. Since then, there have been numerous approaches and attempts to somehow aid clinicians in the decision making process. Those so-called clinical decision support systems (CDSS) can add value by acting as an information management tool, by focusing the attention of the physician to values or aspects of interest, such as abnormalities, or by providing patient-specific recommendations. In the latter case, the system can for example give suggestions for diagnosis or give advice on therapy based on patient data. To determine which advice or suggestion a system has to present, it can for example make use of rule-based logic or reasoning with probabilities.[1]

In 2013, IBM presented the use of its well-known supercomputer Watson in cancer care, labeled 'Watson for Oncology', as a revolution in healthcare. In this case, the system processes loads of medical data in the form of articles, trials or guidelines. When combining this with the electronic health record of the patient, the system comes up with a ranked list of treatment options, presented with supporting evidence. The system is currently trained in a top medical clinic in the United States, and IBM itself presents that it is concordant with tumor board recommendation (a treatment recommendation made by a group of medical specialists after reviewing the patient's case) in 90% of the cases. All of this in a matter of seconds instead of minutes when done by a team of clinicians. [5]

But what is the underlying problem that decision support systems like Watson for Oncology are trying to solve? A degree in medicine is one of the longest educational paths one can follow, with many years of studying and even more training to specialise. Is decision support really needed? Can't we just rely on the knowledge and expertise of our doctors?

Firstly, as a result of decades of biomedical research, the number of illnesses that are treatable and the number of treatments available for each illness have both grown steeply. In addition, we can measure and know much more of each patient than before, which gives us additional factors to consider. Apart from this, new, complex treatments can get very pricy and the financial aspect also enters the decision making process. There are simply too many options avail-



Figure 1: The amount of knowledge available in the medical field is immense.

lable for too many different illnesses for a single healthcare provider to comprehend and keep track of, let alone take all considerations into account.

By introducing sources of medical information that make quick and easy access to usable evidence for clinical decision making, applying scientific findings in practice should be easier.

As for Watson for Oncology, some people begin to doubt IBMs announcement of a revolution in medicine. Feeding the system with the appropriate data has proven to be harder than expected.

“Can't we just rely on the knowledge and expertise of our doctors?”

Secondly, like in many other scientific fields, medicine is constantly emerging. There appears to be a never ending stream of scientific research results. In 1991, the term 'evidence-based medicine' was introduced, which emphasizes the need to use this scientific evidence in daily clinical practice and decision making, instead of 'unsystematic clinical experience'. However, the translation of the available medical knowledge to clinical practice has proven to be a challenge. It will take large amounts of time, money and manpower to summarize all the existing knowledge and in addition, it needs to be updated continuously. [2]

Thirdly, decisions in medicine are more often than not made under uncertainty. One can never be 100% sure of a diagnosis, a test always has a chance of false positives or negatives. Many times decisions have based on incomplete or error-prone information, simply because that is all that is available at the time and there is no time or resources to improve this. On the other hand, wrong decisions in clinical settings can lead to disastrous outcomes. [3]

The rise of clinical decision support systems in the past decades has tried to deal with those problems.

Clinical knowledge is collected in guidelines and presented to clinicians at appropriate moments, or alerts are given when events occur that pose a possible danger for the patient.

Unfortunately, all technological advances have their disadvantages. Situations like the one described in the first paragraph would be considered undesirable by many people. The daily business of healthcare is full of emotions and other factors of subjectivity that can influence the decision making process in a negative way. On the other hand, decision making in medicine cannot be fully rationalized and implemented by machines, as the same emotions and personal preferences of patients are important factors to take into account in clinical decisions. A follow-up article on evidence based medicine also describes this. [2] The authors point out the limitations of using only evidence when making decisions, and emphasize the importance of values and preferences in the decision making process. They see the clinician as the expert to integrate both evidence and patient values and preferences to come to conclusion.

Another problem frequently pointed out is the difference in culture and patient characteristics between countries and even individual hospitals. The top medical center Watson is trained at generally treats complex patients, which asks for other treatment approaches compared to an average patient in an average hospital. When comparing Watsons recommendations to what clinicians would do in the Netherlands, we see a similar problem: the standards in the training center would be considered 'over-treatment' here, because of a cultural difference in cancer treatment in different countries. [4]

So, will clinical decision support systems change the world? Probably, but there are some hurdles to overcome.



Figure 2: Medical electronic devices contain a lot of data

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Keeping up with technologies

How Business & IT education stays up-to-date



By: *Luís Ferreira Pires*
Programme director Business & IT

It all started in 1993, with the Business Information Technology Engineering Programme, Luís Ferreira Pires, Director of the Bachelor Business & IT and the Master Business Information Technology, tells us when we start talking about education. ‘Then, the first personal computers entered the workplace, and with them some weird people and a lot of cables. Now, computers have become commodity, and everybody owes one. This illustrates how technology changes, but the problem remains; business and IT have to be bridged.’ With this illustration, Luís explains us how the education deals with disruptive technology. The rules and the environment keep changing, but as a Business & IT professional, you will still be able to deal with this, since the core of the problem will always be the same.

cepts and including new technologies. Key is to give attention to these fundamental concepts when considering disruptive technologies.’ But this is also a role for everybody related to the education. Keep watching new developments and what they mean for the educational programme.

We also talked with Luís about what he believes is disruptive now. ‘Internet-of-Things and drones are great examples.’ But he also broadens the scope here. ‘Real disruptive techniques remain after they produce disruption, only their role changes. Look at web applications, Scrum and cloud computing. These were all disruptive technologies once. Now they are just standard.’ This is also the moment to include them in the educational programme. These are not trends anymore, but solid IT building blocks.

understood. That is why they can keep each other in balance.’ But not only the volume of IT in businesses is changing, also its role, he explains. ‘The CIO is becoming more important every day. In IT companies, the CIO may even replace the CEO. Especially is IT-intensive SMEs, I think the Chief IT Officer will become by far the most important person in the company.’

Because of the important role of IT in many companies, (Business &) IT graduates are trained so that you can function in a lot of different domains, like health, finance, manufacturing, etc. ‘You need to be able to understand the essential aspects of any domain. Students and professionals therefore need to learn how to do this in their study to be able to apply it in the field.’ But no matter what the domain, volume or role is, we are sure there is a bright future for the Business & IT graduates, which starts with the solid foundation established here at the University of Twente.

Luís Ferreira Pires was born on 7 April 1961 in São Paulo (Brazil). In 1983, he received his engineering degree from ‘Instituto Tecnológico de Aeronáutica’ (ITA) (São José dos Campos, Brazil) and obtained his MSc degree in 1989 at ‘Escola Politécnica da Universidade de São Paulo’ (São Paulo, Brazil). In 1988, Luís moved to the Netherlands to start a PhD project at the University of Twente, and he obtained his PhD degree in 1994. He is currently an Associate Professor at the University of Twente, in the ‘Services, Cyber-security and Safety’ (SCS) group. In August 2013, Luís also became Programme Director of the Bachelor ‘Business & IT’ and the Master ‘Business Information Technology’.

“Key is to give attention to fundamental concepts when considering disruptive technologies.”

When talking about disruptive technologies, Luís tells us about what this means for education. ‘You need to keep an eye on disruptive technologies, because they give great opportunities for education.’ Luís also explains that you cannot change the education for every hype. ‘There needs to be a balance between addressing fundamental con-

Luís foresees a bright future for the Business & IT graduates. ‘The world is becoming more and more technical. Five-year-old kids nowadays already know very well how to use an iPad. The entire society is digitalising. However, you should not only look at the technical side. Business is also getting more complex and stringent, but is also better

Abstraction and building bridges

How Computer Science can handle disruptive technologies



Door: Geert Heijen
Programme director Computer Science

Geert Heijen, educational director of the bachelor programme Technical Computer Science and the masters Computer Science and Internet, Science and Technology, gave us an insight in how our education can deal with disruptive technology. Foundation of this approach is the assumption that technology used in the education gets older, whether this is disruptive or not. However, graduated computer scientists from the University of Twente, can deal with this. How? 'By abstract reasoning about complex systems and topics'.

Geert has a great example of his research area. 'There are several internet patents in my name. That does not mean that I understand how every link in the internet works. However, due to abstract reasoning I know the link exists which

But this is not where the added value of the education stops according to Geert. Another very important aspect is the ability to build bridges, both to other domains as well as to other cultures. The former is relevant because of the changing work field. Geert explains. 'Back in the days you worked at traditional IT firms. However, nowadays you can work in every company, since IT became such an important part of businesses. This also has consequences for the professionals and for the education, since you need to become a domain expert.' Also from this Geert has an example. 'In the old days, a railway company hired an expert in the mechanical aspects of railways to inspect the infrastructure in search for parts in need of maintenance. Now the same company will need a computer or data scientist, to search for anomalies in sensor data, and automatically initiate predictive maintenance on the infrastructure.'

domains in different phases of the study. In the bachelor you have your minor where you can go abroad or participate in a module of a different study. But since this year, also the Computer Science and the Internet, Science and Technology master have a profiling space. With these credits you can learn about other domains, take courses at a different university, or do an internship. How you fill it in, that is up to you. The educational staff is giving us as much opportunities as possible for us, no we have to grab them!

Geert Heijen is an associate professor in Wireless Networks and Mobility at the University of Twente. He received his M.Sc. in Computer Science from University of Twente in 1988, worked as a research staff member at the same university and received his Ph.D. in 1995. From 1995 until 2003, he was with Ericsson EuroLab Netherlands, first as a senior strategic engineer, and from 1999 as a research department manager. He is program director of the Computer Science and Internet Science & Technology bachelor and master programs of University of Twente.

In 2011, he was a visiting professor at INRIA Rocquencourt, Paris. In 2002, he was a visiting associate professor at the University of California, Irvine. In 1992, he performed part of his Ph.D. research at the University of Pennsylvania.

Geert is living near Joppe, a small village between the towns of Zutphen and Deventer with his girlfriend and daughter. He likes outdoor activities, traveling, playing volleyball, music and reading.

"Because of globalisation you are going to be faced with other cultures."

makes me able to contribute to the internet'. Exactly this kind of abstract reasoning makes it possible for computer scientist to keep working in the field, even if the technologies change or there is some new disruptive technology. This does not mean your knowledge stays accurate. You need to participate in trainings of new technologies, trends, or concepts to stay active. But the foundation is made here in the university.

But besides other domains, this is also applicable to other cultures. 'Because of globalisation you are going to be faced with other cultures. We try to confront the student with this already in their studies. Because better to face it now with a study assignment, then when it can be about a million-dollar deal.'

There are opportunities for every student to learn about other cultures and



By: *Marlène Hol*
Editor I/O Vivat

I wake up exactly after my preferred eight hours of sleep. My newest gadget makes sure you fall asleep when you want to, and wakes you up after your preferred time of sleep when your brain starts to get active again. It is amazing, I never felt so rested in my life and waking up feeling tired is in the past now. Next, I start the hologram of my wardrobe. Based on the weather, the time of the year and my sensed mood, the hologram shows me the suitable outfits. Additionally, it also gives suggestions for jewelry and make-up. The system can also select the clothes itself, a feature my boyfriend really appreciates, but I prefer some influence myself. After selecting my outfit, I walk to the shower. Based on the temperature and my skin sensitivity, the shower changes the water pressure, the shower head settings, and the temperature. Taking a shower has never been so relaxed. After I walk out of the shower, lying there is a fresh set of towels. Nowadays you can get help with everything, but I still prefer to dry myself.

When I walk out of the bathroom, my selected set of clothes, my jewelry and my make-up are already lying on the freshly made bed. When I am changing and putting on my make-up, I select my breakfast. My stock is automatically refilled and updated with my preferred foods and food of the current season. If I only think about other food somewhere in the day, it will automatically be put in my stock. You never have to miss food and drinks again. When I am wrapping up my make-up, my food is prepared in the kitchen. It is exactly at

the right temperature when I walk in. When I am done eating, the dishes are automatically done. And not only the dishes, all the cleaning and organizing in my house is done automatically with sensor techniques, robots, etc. And not the cold metal robots you had back in the old days, I barely notice the difference between the machines and real persons anymore.

It is time to go to my “work”. I guess people in the start of the century would not call this work, but my company pays for everything in my life till I die. What I must do? My company makes sure all thoughts of people are translated to a convenient action. So, what actions do people want? I go through all these

thoughts and see how we can improve our product by letting them execute these actions. Because all functionality is generated and tested automatically, people can enjoy our improved product every day. You are probably wondering why we are not using self-learning computers for this right? We do, almost everything is done with machine learning. But by parameterizing some of the data manually, the quality is still improved. Apparently, not everything can be automated.

About work, working is good. Based on my thoughts and my vitals, I get food, coffee, and other beverages delivered. Another benefit, everybody is so healthy. The diets are more balanced, and whether you have enough exercise is

measured. Although, the exercise goals are not that easy to achieve. I can go everywhere by teleport now, which is ideal for lazy persons. However, we should walk at least 30 minutes a day. Therefore, we are not able to teleport within the building. So, if I need to go to the bathroom, I still have to walk there.

After work, I go out for drinks and food. This is always a great experience. Based on your preferences, and once again your thoughts and vitals, food and drinks are recommended. However, you can twist everything to your own taste. Since this is all done automatically, nothing is crazy anymore. I’m however totally in love with the surprise settings. They just deliver everything based on you. Even

though I have my favorites, I’m always surprised in a positive way. Another fun fact.

Due to all the technology, restaurants and bars have all become a social place. You are constantly introduced to new people based on your interest, moods, and preferences. Life is never boring, and I never felt so connected with the outside world.

After coming home after a long day of work, it is time to go to bed. It will not surprise you anymore, but my bed is made, my pajamas are soft and warm, and I fall asleep relaxed and satisfied. I did not have time to tell you about all other great things; the massages, the interaction technology, the drones and much more. But believe me, the future is bright; you totally want to be here.

“My stock is automatically refilled and updated with my preferred food.”

2084: The dystopian world

The government has a new law, you need to have your brain thoughts monitored. We can improve the quality of your life, they say on the news. Well I do not trust them. And besides the current government, what about the next government? And the one after that? My personality is saved forever and there is nothing I can do about it.

I wake up after my alarm rings. Many people are talking about a gadget to control your sleep, but I do not believe in this. Another thing monitoring, like the government does not know enough about you already. They try to cheer me up by giving me suggestions for breakfast and clothes, but I choose to ignore everything. I feel like my life is controlled by somebody else. But what if the government loses their power? Or they cannot supply for the internet and enerworse, what if there is a hack on the government system? How am I supposed to trust all this technology, when I do not have any control over it?

After my shower I realize again I am gaining weight. Based on my thoughts, my stock is automatically refilled. Great invention you would say, right? Well, this also means that all the unhealthy stuff and plenty of nice food is in the house. Perfect for people who have self-control, but for me this means that every evening I eat a snack. Something that is not good for my health. They call it a balanced diet, but there is no one forcing me to eat the healthy stuff. When it is past its expiration date it is thrown

out by the technology, so I do not even have the negative triggers anymore. But I do not want to complain about this more, since next there will be a robot arm in my house feeding me fruit and vegetables against my will.

I do not have a job anymore. I used to be a programmer, but this is all automated now. They offered me another job to look for features in the thoughts of other people. However, I like to respect everyone's privacy. I like to keep some things to myself as well. It does not feel right to make money by looking into what other people are thinking. Even though the government does not give us any choice anymore, I would like

“Next there will be a robot arm in my house feeding me fruit and vegetables against my will.”

to show them as much as possible that some people prefer another life. But it's hard. Take for example payments. Even though it is done with a cryptocurrency nowadays, every payment we make is still checked and saved by many organizations. To banish the black market, they say. In the meantime, they know all my associations and relations because of this.

Also, I believe there is a corrupt officer in charge of the payments. If we do not spend enough money at the places he gets sponsored by, there are immediate consequences. It can't be a coincidence that all the ads I get are filled with food and cloud-software with whom the officer is friends. They normally have

software to check this kind of corruption. However, this seems quite useless if the person in charge is responsible for the software. And of course, my brain thoughts are not monitored to find out this shadiness; not if it is one of them.

I believe people are also lonelier. I know I am. Last week, my back was hurting. I would like to talk about this with my physical therapist, however this is also robotized. And even though some robots are good enough that they really talk with you, it is not the same. I do not feel like they understand me. I do not know with whom I can talk about this. You do not just walk into people anymore. The world has become lonelier.

Life feels empty. I lost control and there is no one around to talk about it. The government records everything. I do not know who I am and what identifies me. They

already know everything about me. Besides that, due to its perfection everything became repetitive. It is quite boring if everything is always perfect and the same. Do you still believe the future is better? Please hold all the technological developments. It only makes the world better for some people.

Hydrological Modelling

Using Big Data



By: *Joost Icke*
Employee Deltares

Hydrological models are essential tools when dealing with flood risk, water scarcity and pollution. In times of crisis, the models must be available on call. A sufficient level of detail and accuracy is required to assess the situation, predict the near future and simulate potential countermeasures. Furthermore, the simulation results need to be intuitive for decision makers and stakeholders.

At Deltares, multidisciplinary teams are working on solutions for vulnerable delta areas. Our software engineers develop the software that warns people for floods and droughts. We provide civil engineers with the tools for water management and flood protection. Our research themes are closely linked to the major societal issues of the 21st century, such as adaptation to climate change, management of water resources, rapid urbanisation, the production of sustainable energy and ecosystem restoration.

New scientific and technological developments are shaping the future of hydrological modelling at Deltares.

1. Take a 3D point cloud and add some water

The world is being digitised at a rapid pace. Three-dimensional point clouds are digital geometric structures that can be used as the basis of a water model. Point cloud visualisations of the current

situation can be made quickly. You can show simulated water levels in the point cloud, for instance to demonstrate the impact of a flood. The 3D visualisation makes the situation recognisable for citizens and mayors.

2. River networks from satellite data

Satellite images can be used to map the water systems of a region from above. Clever algorithms determine the position of rivers and the size of reservoirs, thus providing in the basis of a hydrological model. Ideally, a modeller needs no more than three clicks to model the hydrology of a catchment.

Satellite images provide a high resolution picture of the impact of human activities. Arrange these images in sequence and you see the changes taking place like in a film. Large-scale infrastructure projects such as the construction of water reservoirs and land reclamation are easy to follow from space. The Aqua Monitor is a new web app that allows you to observe how water systems change over time. (<http://aqua-monitor.appspot.com/>)



3. Big data and high performance computing

As the level of detail of simulation models grows, the required computational power increases as well. We are working towards direct access to cloud computing services from our simulation software. Copying terabytes of data is not always the most efficient way to work. One of the trends is to do the computations where the data is, for instance on earth observation platform such as Google Earth Engine.

4. Digital pioneers discover new data sources

In former times, the modeller received the data from the client. Nowadays, modellers are using a multitude of data sources. Crowd sourced data from OpenStreetMap (land use) and Twitter (messages about floods) can have added value in data-scarce environments.

Extracting information from those data sources requires skill and creativity from a modeller. For example, as individual tweets can be inaccurate, a method was developed that uses the 'wisdom of the crowd' to derive a map with the most likely flooded areas. The flood maps can be of great value during disasters, because they can be produced very fast.

5. From global to local

Water related crises can happen anywhere around the globe. To understand

the situation quickly, Deltares uses one of the global water models. At Deltares, we now have a number of global models, such as a Delft3D Flexible Mesh model that spans all the seas and oceans, and groundwater models for all continents on earth. Flexible computational grids make it possible to refine a local grid. The global models can be accessed in our iD-Lab, an interactive data research laboratory. One of the challenges is to zoom in on a particular catchment or coast, by making refinements of the model and adding local information.

6. Serious Gaming meets Numerical Simulation

The latest trend is the fusion of several types of software. For a long time, serious gaming, numerical simulation and decision support systems were separate applications. Now we have brought them together, with very promising results: water models can be operated interactively from a game engine.

Tailor made software solutions are getting easier to develop. The same numerical simulation models can be embedded in products that serve different purposes, from quick scans to early warning systems to interactive decision support systems.

7. Mapping water systems with drones

Rivers and drainage channels must be kept in shape to discharge the water when it rains. The natural growth of

vegetation tends to clog the water system and without proper maintenance, farmland and cities will suffer from inundations. Drones and autonomous boats can map larger areas in more detail than an inspector can do.

Drones equipped with full spectrum cameras and smart algorithms can find the bottlenecks in rivers and channels with a surgical precision. Artificial intelligence can support water managers in taking quick and efficient measures to solve potential threats, by focused maintenance of watercourses.

Conclusion

Hydrological modelling is evolving very fast these days. Automatic model building is within reach and even in remote areas, modelling becomes feasible. Big data allows for sophisticated models that run on high performance computers. Thanks to the fusion of serious gaming with numerical simulation, models are no longer the exclusive domain of experts. Future innovations can be achieved when data scientists, hydrologists and software engineers work together closely.

About Deltares

Deltares is an independent institute for applied research in the field of water and subsurface. Throughout the world, we work on smart solutions, innovations and applications for people, environment and society. Our main focus is on deltas, coastal regions and river basins. Managing these densely populated and vulnerable areas is complex, which is why we work closely with governments, businesses, other research institutes and universities at home and abroad. Our motto is Enabling Delta Life. As an applied research institute, the success of Deltares can be measured in the extent to which our expert knowledge can be used in and for society. For Deltares the quality of our expertise and advice comes first.



Augmented Reality

How and why Aryzon arose



By: *ir. Leon E. Schipper*
Co-founder & CCO Aryzon

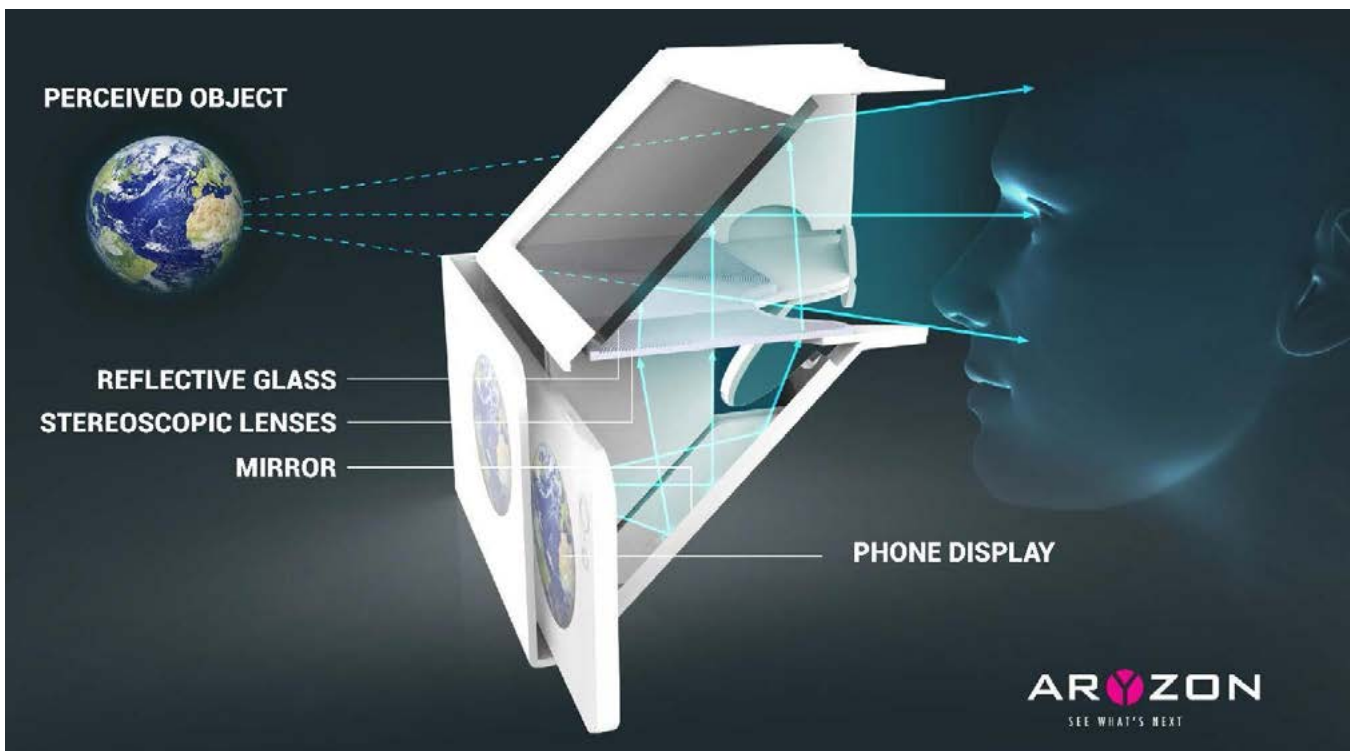
As a company, Aryzon's mission is to stimulate the global use of Augmented/Mixed Reality (AR) by making it accessible and affordable to anyone. Aryzon fills the gap between 2D AR (for example Pokemon Go) and the 3D AR devices like the 3000\$ Microsoft HoloLens. By continuously offering solutions that fill this gap, anyone can visualize and communicate digital information. The Aryzon Headset enables anyone that owns a smartphone to experience the world of 3D Augmented Reality.

What is Augmented Reality?

Augmented Reality overlays the real world as you can see it with digital content, whereas in Virtual Reality you are immersed in the virtual environment, not able to see the real world around you. Both technologies have different applications and sometimes they can be combined. With AR, the applications are typically those in which you still need or should be able to see the real world.

Where did the idea for the Aryzon come from?

Well, at some point at the University of Twente one of us wanted to experiment with 3D Augmented Reality. However, the HoloLens was not there yet in the Virtual Reality lab and buying the HoloLens is like impossible as student. So then how would it be possible to move away from traditional 2D, as seen on your smartphone and tablet displays, and see any model, animation or interactive experience, in truly stereoscopic 3D. How would it be possible to make this affordable to anyone, with the only



prerequisite of already owning a smartphone? That's the start of the Aryzon development!

Most important applications of AR?

Well, this is a difficult question as there are infinite applications. Every company is able to use AR in some way. We see a lot of potential in leisure like museums, in creative engineering, medical segment and education. How cool and useful would it be to see that human cell popping out of your book in which you finally can see in 3D how it really really looks like!

Technical challenges?

The optics are a challenge, and remain one. The problem is, your eyes focus on a plastic layer 4 cm in front of the eyes; which makes it like impossible to simultaneously focus on a real-world object 10 meters away. The challenges for Aryzon to solve is how to make it easy to fold the cardboard, and of course decreasing production costs. Also reflections due to outer light sources can be annoying, which is interesting to solve.

What does the future of AR hold?

At some point, AR will replace the smartphone and the AR device is as small as a contact lens in your eye. AR is a future technology which will create many new jobs. For example, 10 years ago the job 'BIM Engineer' was never heard of. Nowadays you have BIM Engineers, BIM Consultants and so on. Augmented Reality will definitely do the same in every market!

"At some point, AR will replace the smartphone"

What does

AR enable that we aren't able to do with existing technologies?

We need it to add an extra dimension in the world as we can see it now; enabling more information sharing in cases of need. For example Pokemon Go as 2D AR; it is nice and useful, you put the phone in your pocket and can play it whenever you like. However, for some applications it is either nicer or more valuable to have 3D objects, to give feedback or simple showcase a new product. The technology is simple, and the HoloLens is capable of. However, most are too expensive. Aryzon wants to boost it a bit!

Software side of things

In general Aryzon uses the game engine Unity to create the apps and Vuforia for tracking. However, we stimulate everyone to develop the apps via the method they prefer, as this will only boost the development for the Aryzon globally. The recent developments of Apple's ARKit and Google's ARCore makes it even easier to create magnificent AR experiences. Aryzon uses these toolkits to realize perfect tracking. Combining them with the Aryzon AR headset allows best of both worlds.

Tips for starting your own company?

When you have an idea and want to work it out and start developing, most important is the team. Don't do it on your own, you really can't, and find a good team to work things out! After that step, think about what problem it solves and for who! Work it out on paper or a napkin or a "Grolsch bierviltje". And find the resources within the University of Twente and Novel-T; there are many!



Leon E. Schipper - Co-founder & CCO Aryzon & Alumnus Industrial Design Engineering

About Aryzon

For more information, visit <https://aryzon.com/>

Time flies when you are having fun



By: *Wouter Kobes*
Chairman I.C.T.S.V. Inter-Actief

While I write this on the Deutsche autobahn, traveling back from my skiing holiday, I came to realise the following: this is my first column as chairman of the association, while at the same time we are already approaching the second semester of this year! Time flies when you are having fun!

And what fun we had until now, with (record) breaking drinks, unique new ideas and of course the golden classics, like the LAN party. Our members have broadened their perspectives in the world of Virtual Reality, saw a miniature version of the Netherlands and visited the Weihnachtsmarkt in Dusseldorf.

Time going by so fast also makes us as a board realise that we have to concretise what we want to achieve regarding our points of focus. Our most significant point would be "Association Legacy" as is further described in our policy plan. Legacy itself does not sound that disruptive, however we believe that it is important to have insight in the history of the association.

What is disruptive, are the renovations on the balcony that have been going on. The slightly delayed construction work gave us an elevator, a new floor and a whole new area to use. On top of that, we relocated the kitchen which gives the opportunity for a bigger sofa. Let's be honest, the old one was really demanding replacement.

You might be wondering what our quest for legacy has delivered so far. We went through old photo albums, almanacs and magazines. Currently, most of those

items are being digitalised and will be available online in the future!

Our association is solely defined by its members, as is true for all associations. This means that an association changes over the years. Looking back in the archives of *Inter-Actief* gives a lot of insight in how the association has grown and changed over the years. This is not only fun, but also a very educative experience!

In its 36 years of existence, our association has of course also changed a lot. Already 38 boards have preceded us, all with their own ideas, achievements and mistakes. It is fascinating to read through years of decision making and to see the broad range of activities that have been organised in the past.

One of the things that fascinate me most are the almanac and year books that have been published between 1989 and 2008. The first editions were paper versions, and the last versions were completely digital. We are also currently working on digitising these books and will be available for members to read in the future as well.

For the rest of this year, we of course can expect a large amount of activities that are worth to be remembered. Thanks to video and photo material, the experiences will be captured and published on our website. Activities still to come are for instance the RIAly, the week of Pandora and the Kick-IT camp this summer.

Of course, there is no better way to experience an activity than actually being there. Do whatever is your thing, which can be joining our many drinks, go tra-

vel on the International Business Course or throw an old computer of buildings. It's for a reason that 'It's crazy beyond all imagination' is one of the sentences in our association's song.

I hope to see you soon at Inter-Actief!

Wouter Kobes was born on the 13th of February, 1996, in Leusden. After his elementary school he moved to outside the city and went to Stedelijk Gymnasium Johan van Oldenbarnevelt in Amersfoort. His affections with computers was already noticeable at a young age, as well as his preference for the exact subjects.

After his graduation, he moved towards the University of Twente's campus in 2014 to study Technical Computer Science. Next to studying, he co-organized symposium Cashflow in 2016, was a participant of study tour MISC and took place in several other committees at I.C.T.S.V. Inter-Actief. Currently, he is the chairman of the study association.

Nautia puzzle: the rules of play

Tetris and Nurikabe combined



By: *Meike Nauta*
Editor-in-chief and Puzzle maker

A brand new I/O Vivat means a brand new puzzle! In this issue, we can take 'brand new' literally, because I present you a new type of puzzle. Let's call it "Nautia", my surname scrambled with the Inter-Actief acronym. The Nautia puzzle is inspired by Nurikabe and Tetris.

The puzzle is played on a rectangular grid of cells, some of which contain clues. Cells are initially of unknown color, but can only be black or white. However, a cell with a dot already indicates that it's a white cell. Two same-colored cells are considered connected if they are adjacent vertically or horizontally, but not diagonally. Connected black cells form 'islands', while connected white cells form the free space. The challenge is to paint each cell black or white, subject to the following rules:

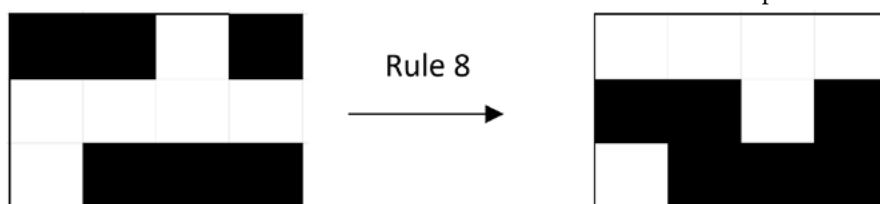


Figure 1: Example for rule 8 - gravity is turned on

The rules of play

1. Each island must contain exactly one clue.
2. The number of cells in each island equals the numeric value of the clue.
3. All islands are isolated from each other horizontally and vertically.
4. All white cells need to be connected, either horizontally or vertically (i.e. there must be exactly one free space of white cells).

5. When a cell contains a clue with the letter 'H', the island has a horizontal length of the numerical value of the clue, and a vertical width of 1 cell.

6. When a cell contains a clue with the letter 'V', the island has a horizontal length of 1 cell, and a vertical width of the numerical value of the clue.

7. When a cell contains a superscript lowercase letter, the island neither has a length of 1 nor a width of 1. The form is explained in the description below the puzzle corresponding to the superscript letter. More information about this rule is given in the next paragraph.

8. When all islands are colored, gravity is turned on and all black islands fall down (just like Tetris). (Unlike Tetris, islands cannot be rotated.) An example to clarify is shown in Figure 1.

9. The black islands will form a word that describes a 'disruptive technology' which is the solution to the puzzle.

a sub-island of 3 horizontal cells and a sub-island of 2 vertical cells. All possibilities for this are shown in Figure 2. Note that in this case there is one cell that exists in both sub-islands. This cell is not necessarily the cell containing the clue.

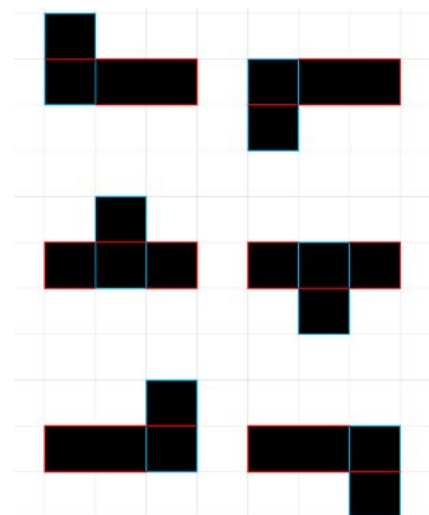


Figure 2: All possibilities for 4, 3H+2V

Explanation rule 7

The cells with a superscript lowercase letter, have a special form which is described below the puzzle. The + means that the island is a combination of multiple 'sub-islands'.

A sub-island will either have a width of 1 (indicated with H) or a length of 1 (indicated with a V). Let's have a look at the upperleft cell in the puzzle, which contains 4^a. Its description is: 3H+2V. This means that there is an island of 4 connected black cells which consists of

A few strategy hints

- A cell with a clue that equals '1' needs to be black.
- Dot a non-numbered cell when you've determined that it needs to be white.
- Since two islands may only touch at corners, cells between two islands must be white.
- Don't forget rule 4.
- Use the top puzzle to color the cells and the bottom puzzle to apply rule 8.
- When you solved the puzzle but you cannot read the word, ask the person next to you or look at it from a distance.

Good luck and enjoy!

See inside for the rules to solve this puzzle!

4 ^a			3H		3H		1			4H			
	.					1			3H				
		2H		1		1			3H		1		1
3H			.			2H		1		5 ^d	.	.	.
		6 ^b							4V				6 ^e
			.		3V			4 ^c		.		.	.
		2V					.						
2V					3H	3V	.			5H			1

a: 3H + 2V

b: 5H + 2V

c: 2H + 3V

d: 3H+3V

e: 4H+2V+2V

4 ^a			3H		3H		1			4H			
	.					1			3H				
		2H		1		1			3H		1		1
3H			.			2H		1		5 ^d	.	.	.
		6 ^b							4V				6 ^e
			.		3V			4 ^c		.		.	.
		2V					.						
2V					3H	3V	.			5H			1

Send in your solution

Turn this page for the explanation how to solve this puzzle. Use the top puzzle to colour each cell, and use the second puzzle to find the word.

The solution after solving this Nautia puzzle is a word describing a disruptive technology. Send this word before the 1st of June 2018 to puzzle@inter-actief.net and get a chance to win a €10 IA-cinema voucher!

The answer and winner of the puzzle of the previous edition (32.3) can be found on the editorial page.