AMACHAZINE

Volume 20 - Issue 3 March 2016 Wiskunde Informatica Studievereniging



LAN PARTY AreaFiftyLAN FACULTY UPDATE Faculty Student Council

INTERESTING TALKS WITH OUR TEACHERS

Staff interview

MASTER THESIS

Stimulating fat tissue

CONTAINING:

CURRENT AFFAIRS | ASSOCIATION | COMPUTER SCIENCE | MATHEMATICS | MISCELLANEOUS





De gezelligste borrels



Leuke activiteiten



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Al je nieuwe collega's

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Advertiser index

Websend	Inside Front Cover
9 to 5	18
Keylane	24-25
Magnus blue	36-37

Arthur Breurkes

With spring on its way and daylight taking over the winter darkness, we enter a new term of intense studying, interesting events and awesome parties. Everybody's mood flourishes, our level of motivation peaks and vacations are already being planned by most of us!

Right now - while I'm writing this - a lot of events are coming up. De Delftse Bedrijvendagen (an event where companies meet students and vice versa) is on its way and bigger than ever. What's more, the Dies week is coming closer and closer as well. In about a month from now we will celebrate the Dies Natalis (date of birth) of our beloved association and cherish the warm feeling we always get when we're there. I'm a part of the Dies committee and together with six of my colleagues I am responsible for organizing an awesome week and pre celebration.



As of the moment you read this, we've already passed the Dies week,

which you might be able to read about in our next issue. For me, this means I can completely get back to studying and have no more worries but my grades and art directing the MaCHazine. I never thought I would even be art directing anything, let alone the MaCHazine. But I've got to say, it's actually real fun to do, especially in this committee. We're a really diverse team, but we all get along really well. And because of the MaCHazine being a continuous committee (instead of being re-chosen each year), there are always a lot of changes going on and a lot of different stories to be heard. This year Maikel, Ghiline and I joined the committee and even though it hasn't even been a year yet, we're about to experience some changes. First of all, Saskia took over the title of chief editor as Anouk left for Brazil. However, Saskia might leave us soon as well, at which point we've asked Maikel to take over the job of chief editor. Second of all, many more members may leave the committee later this year as they've been in it for long enough. This means that we need a lot of new people to fill up the team again. It might sound very pessimistic, but honestly, renewal is great if you combine it with experience. Finally, we strive to have a fully English MaCHazine at the end of this year. The current board (59) wants to introduce more internationality to the whole association and thus also in its MaCHazine.

Apart from everything I do for the study association, I also have to study, obviously. After passing year one of my bachelor in Computer Science, I was rather shocked about how big a difference the first and the second year already have in terms of pace, pressure and amount of study material. Now, this shouldn't be a problem to handle if I wanted to study all day, every day. But I figured a student's life should not just be about studying hard to get a good job. Of course it's a key element, but I'd rather also enjoy myself and relax from time to time. This means that I've put my focus on about two courses each period. It might slow me down, but it's a great way to master the courses better and have more fun while practicing one.

All right, enough of the semi-inspiring talk. It's time to rep up this editorial and to let you, the reader, enjoy the rest of this MaCHazine and all its awesome articles. If there's anything on your mind that you wish to share with us after reading this issue, you can always send us an email on the following address: *machazine@ch.tudelft.nl*. Thank you very much for reading and enjoy!

Editorial

Table of Contents











Current Affairs

From the Board	4
FSR	5
We want women!	(
International Student	8
TU Delft News	9

Association

/iFi Skiing Trip	12
reaFiftyLAN	13
Com	14
ustrum	1
laster Activities	16
oH	17
ymposium	1

Computer Science

Via Nova	20
Personalised Gaming Using Learning Technology	22
Web Information Systems	26
Interview: Nils Bulling	27
Puzzle - Nonogram	28

Mathematics

Simulate the in- or decrease of fat tissue	30
Internship at Leiden University Medical Center	33
The power of shaking hands	32
Internship University of Waterloo	34
Interview: Leo van Iersel	38

Miscellaneous

MaCHazine Survey	4
Science trends	4
Blaise Pascal	4





From the Board

Eline Kleimann

While writing this piece from the board, a part of our association is on their winter sports trip in St. Francois Longchamp. Since I wasn't going this year, I had to decide what to do with this free week. On top of my

list was spending some time with my family, friends and roommates. Also

sleeping a lot more than in a normal week had a high priority.

Sleeping in was a bit tough considering I wake up around 8 o'clock automatically every morning. Usually it's quite convenient to have this biological wake up, when you forget to set your alarm or the fuses in the house are blown. When you're trying to have some extra sleep however, it's a little bit disappointing. Therefore I found myself quickly sitting at my usual spot at CH going through some mails and minutes. The faculty was pretty empty this week, although not all students were enjoying this free 'ski-week', but were studying for a course, working on a case or busy graduating. Luckily, they regularly came by at our association for a break and some coffee such that it was not too quiet there. Another group that hasn't had a free week are the board members organizing 'De Delftse Bedrijvendagen' (DDB). With the application training, the first activity on the program, starting next week, they are working hard to make the whole event possible. After this, the board of DDB is organizing the Presentation days, the In-house days and the Interview days.

The realization that we're now halfway the academic year kicks in. Everybody in Board 59 is fully settled and all our usual tasks can be done more efficiently. A good development since the busier days are ahead of us. During the examination period CH organizes almost no activities and our association room is emptier than usual. A new semester means that the new books have arrived and that there are many exciting activities planned. Calm surroundings might help to get more work done in a day, but I must confess that I look forward to the fuss that comes with the start of a new semester.

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The first activity, the department symposium, is planned on the first day of the third quarter. On this day the morning is filled with speakers of all the different departments telling what their section does. During the afternoon there will be presentations to inform about the Master's programs at EEMCS and the Bachelor thesis. After that I'll be having one committee meeting less during the week, because then the work of the VerdiepCie, organizing this symposium, is done.

Other upcoming activities are DDB activities, the SjaarCie party and the ComMA activity. Before you realize it, the time to celebrate the birthday of our association has come. Unfortunately, this year's date is during the examination period and therefore our celebrations are postponed till the week after.

You might wonder what I, as Chief Commissioner of Applied Mathematics Education, do all day. Helping to improve education is something that the chief commissioners of education do throughout the whole year. To achieve this my agenda is mostly filled with meetings: feedback groups with students, education committee meetings, meetings with teachers, the director of studies, the master coordinator, the Programme Coordinators and other members of the Education and Student Affairs department. This year, we focus extra on the Master students to make sure their program is evaluated properly. Also we're trying to expand our offer of activities, such that we have special activities for master students.

Slowly, more and more time is available to work on the plans of our policy, which we wrote before the start of our year. Among other things, we are working on a plan that investigates the way our tasks are divided and we are making an information brochure about minors. This brochure will shed light on choosing a minor from the view of a mathematics or computer science student.

Apart from my tasks related to education, I'm also concerned with the well-being of four committees. Two first-year committees, the AkCie and the MaPhyA, and the VerdiepCie, which I mentioned above. Another committee, which doesn't exist every year, is the study visit committee. This summer we will travel to Brazil for a three weeks lasting visit. On the program are visiting some companies, universities and culture in Porto Alegre, São Paulo and Rio de Janeiro.

Hence, enough to do for me and my board members. For any questions regarding mathematics, a discusion about improvement of education or just to drink a cup of coffee, you can always come to me. Hope to see you back at CH this second semester!



In this FSR update we would like to tell you what is currently on our mind

at the FSR. The FSR is the student chosen faculty council. Our current

affairs include the availability of working places, internationalizing the

bachelor curriculum, and the renewal of regulations.

Work spaces

There is a growing interest in studying at our lovely university. This resulted in a capacity problem at the start of the academic year. At our faculty this resulted in the number of available work spaces. Especially with the closure of workspaces at the Drebbelweg (building 35). As FSR, we talked to the dean about this issue on multiple occasions. However, it is not possible to realize this on the short term.

We proposed something relating the reservation of meeting rooms. Currently you have to reserve a room, and then you can use a small meeting room at the faculty. If you want to use a room, practically the only possibility is to reserve it a month in advance, as they are usually fully booked. If we walk along the meeting rooms, we see them often not used. Therefore we proposed if it is possible to void the reservations if they are not used, for instance if somebody does not collect the key after 15 minutes, the reservation is void.

Internationalizing

Stoan coal English is something you might associate with another study at our university, however this is still an issue at our university. The faculty is planning on making the bachelor curriculum for Computer Science and Electrical Engineering taught solely in English. First we will list the reasons the faculty has for doing this, and then we will present our concerns.

First of all, most of the curriculum is already taught in English. Especially the books and other study material are almost exclusively in English. Furthermore, most of the academic staff is of non-Dutch origin, this means that English is the best language which can be used for communication. From this point of view it is only a small step to change the curriculum to English.

Secondly, making the bachelor curriculum fully accessible for international students opens doors for new students. The faculty firstly aims at attracting only 10% international students. The supposed 'market' is only Europe, and not the whole world, as is the case in the masters. The reason to attract foreign students is supported by the demographic developments in the Netherlands, apparently there will be less student aged people in the future, therefore to sustain the student levels we need to attract students from other countries.

On the other hand, we think that there are few hurdles to overcome in internationalizing the bachelor curriculum. As this section started with, we think that the quality of some Dutch teacher's English is subpar. The dean assured us that as part of the contract for teaching staff, there is a requirement on the level of English proficiency. We noted, as FSR, that this level might not be good enough, as we see in the masters that there are teacher with subpar levels of English.

Moreover, relating to the capacity problem, attracting extra students might not be a good idea. We expressed this concern, but the faculty assured us that this won't cause a problem.

Finally we saw problems with the transition between middle education and higher education. For a lot of people it is already a hurdle to switch between VWO and a university style of working. The coaching of people in this transition phase is of central importance. The transition might be more difficult if there is also a language transition involved. We expressed this concern, a solution offered by the faculty is that it still will be possible to have some Dutch interaction with academic staff.

Regulations

The FSR has right of consent on faculty regulations. These regulations, however, are a little bit outdated. Therefore we are updating these regulations. By law these regulations are primarily written in Dutch, which might sound a little bit confusing relating to our previous point. These regulations arrange a number of important subjects, as the examination procedure. The plan is to update these regulations, we do this with a lot of help from supporting academic staff.

Final Remarks

This year I have the privelege of being chairman of the FSR-EEMCS. Together with four people from Electrical Engineering, three from Applied Mathematics, and three from Computer Science, we form the Faculty Student Council (FSC).

Each year, the FSC is chosen by students. Students have the right to be elected. For next year, we are looking for new people who would like to express there opinion about the course of the faculty, and thereby improve the overall experience of studying in Delft. We have a weekly meeting, and about once every one and a half month we have a central meeting with the dean, supporting staff and directors of education.

If you are interested in being elected for Faculty Student Council, please send me, or the whole FSC an e-mail (*fsr@ch.tudelft.nl*).



We want women!

Fred Vermolen

Nowadays the university wants to attract more girls as students and

women as staff members. The author of this column is not able to judge

whether this is something good or bad.

In the past, the TU Delft carried out several campaigns to attract girls to the university. One of the campaigns was called 'Thea studeert techniek', which is translated by 'Thea studies technology'. The influx of female students increased and at some studies that are offered by the university, women currently outnumber male students. Some examples of these studies are architecture and industrial design. The number of female students also increased at the study of mathematics, which was already relatively popular among women (in particular compared to physics, computer science and electrical engineering).

Personally, I think that it is a good thing that more and more women study at our university, and for most male students, it is more attractive to drink beers with female students than with male students only. Since this trend has developed over several years, the number of PhD-students in mathematics at the TU Delft is increasing as well. Though the trend that the proportion of women is increasing in mathematics is clearly visible in the Netherlands, women have outnumbered men in mathematics in countries like Spain for many years. In this sense, The Netherlands are not that much leading as the Dutch always claim The Netherlands to be. In particular, if one looks at the distribution of men and women over the staff at applied mathematics, and in Delft in general, then one still sees a very 'classical' distribution of men and women, where men are still very much overrepresented.

I think that this distribution actually holds for the entire Delft University and probably even over the entire Netherlands. Nowadays, some measures are being taken to make the gap between the numbers of men and women smaller in the framework of the Diversity Policy, where the Delft University is keen to attract women in order to reach full gender diversity, even at the most senior levels.

One of the efforts is the movement of DEWIS (Delft Women in Science), which is a network for female academic staff. This network aims at supporting all female staff members. This network is fully supported and encouraged by the Executive Board of the university. At first glance, one might link this network



to discrimination since all female staff members are automatically a member of DEWIS, whereas male members are not. I am certainly in favour of offering equal chances to everyone in this country (regardless eye-colour, skin-colour, religion or ... gender). In this sense one could argue that it might be a bit odd to create academic positions for women that are not available to men. Given the diversity policy at the Delft University, one would expect more women at senior positions. This number is certainly increasing, but not as quickly as I would expect. What are the reasons for this? I do not know this well despite I supervised many (fe)male students and PhD-students. Let me say that I enjoy working with female students very much, because in general they perform better than men, they are more devoted and hence they seem to work harder.

One of the things that worries me, is that the scientific community is very competitive, and it is getting more and more competitive. Scientists have to publish more and more, carry out peer-reviewing more and more, and they also have to acquire funding for their PhD-students and for their research. I will not say that much about these developments but I can tell (and here I did not talk about all the teaching efforts) that all this work is quite demanding.

Although I consider myself as a blessed person who likes his job very much, this job is more than a nine-to-five job. Many of the young women in academia who I meet are struggling with the question whether to continue in academia or to devote their efforts to the family that they want to have, and to this extent, some women prefer to have a parttime job (like my own wife does).

My personal concern is that academia is extremely competitive and demanding and I wonder whether it is possible for women in academia to raise their children the way they want to. A part-time job in academia, if you still have to develop your reputation, or if you have to fight for your tenure, may, in many cases, be devastating your career. If you want a part-time job then there is a tendency to decrease your research time and to maintain your teaching time as much as possible (since teaching is always needed). Of course, it is technically possible to give birth to babies, have a pregnancy leave, and subsequently to devote all your energy to academia and send the children to the day-care or kindergarten. But do you feel happy about this? An alternative option is





To conclude, it is nice to attract women in academia. Personally, I value diversity (cultural, gender) very much, and I even think that this is good for the development of science as a whole. However, I think that the current measures taken to increase the number of women in science are not enough. I think that the overall mentality should change. The introduction of tenure tracks (where lecturers are evaluated after five years with a decision whether they can stay (and get promoted) or whether they should leave) could be devastating to young women. For women, this way of career building needs to be changed in my opinion.

I am sorry that I bored you with this. I absolutely did not want to hurt anyone, and I like everyone to be happy. Now I am thirsty, I wanna grab a beer right now! Cheers – Skål!







International Student

Emirhan Ilhan

So I'm talking to a friend the other day and he says this to me: "When I first came to the Netherlands, I thought it was going to be heaven."

This sentence is meant to reflect his disappointment upon arriving here

and whenever I think about this nowadays, I remember Johnny Cash's

description of what paradise is.

If my memory serves me right, he refers to June Carter here. But one can imagine that if you are in the right mood, her can refer to a body of land, in our case this can be the country of blue, red and white.

I have recently gone back to Istanbul to visit my parents for about ten days. It's always a peculiar experience to be back. This time around, it seemed to me that back in my country, people were physically less attractive. I realize this is a rather subjective thing, but in my first couple of days back, this felt like a fact to me more than a subjective observation. Food seemed to be far better at first in the country of my origin, back in a day or two, I started to think it tasted so well when I came back home at 10 pm, simply because I was exhausted and starving from a not-so-long flight from Amsterdam. One other thing everyone complains about in the Netherlands is the weather and how wet, windy and cold it is. It didn't feel so much different to me back in Istanbul. I can go on and on about this, but the reality of situation is that the problems we have about any particular place are just our problems reflected on that said place.

Therefore, I call all people reading these words right now to simply stop whining about any country they might reside in and just get on with it. To set an example, this is what I will attempt to do right now. Let us start with the Dutch language considered infamously ugly. I have taken the first two courses of De Delftse Methode at the university and I will strongly oppose anyone who says it is ugly or difficult. Anyone who says Dutch is ugly has either bad intentions or just never really tried learning any other languages. Yes, the pronunciation of the letter g is a bit weird. Yes, some of the words are really long. But it is by far the easiest language for any English speaker in the word. It does not worry you with different cases like in German, it only has two genders and de is clearly a lot more common than het. If you speak a language like French or German in addition to English, het Nederlands almost comes with the package. It is not like any of our languages are any easier than Dutch. (Turkish surely isn't.)

The next agenda will be the weather. I myself am also to blame when it comes to the weather just like everyone else, because I have complained about the weather here in the past. After all, it is very easy to do so when you aren't able to move at all on the bike because you are pedalling against the strong wind and simultaneously getting soaking wet. These things, however, can be turned into fun little nuances in your day if you pay attention to the weather forecast a bit more. There isn't a lot of things that are more enjoyable than



drinking tea and reading a book while it's raining outside and this country gives you many opportunities to just do that.

One thing you sometimes hear is about how people behave. I suppose you can say that you meet some bad apples from time to time and it gets easier to whine about this. Especially when the locals agree with you. But I will take a huge risk here and say: You reap what you sow. What goes around comes around, right? My experience is that people are helpful, regardless of their nationality or social status, as long as you don't act as if you deserve help just because you need it.

Last but not least, the food. Well... the food is bad, there isn't much to say here. And the fact that the entire nation is eating this many sandwiches is slightly worrying. It's not a coincidence that Neverland sounds quite like the Netherlands. Practically everyone is a Peter Pan here, eating sandwiches, burgers, fries, hot dogs all day long. (I am almost certain this statement is going to piss off some healthy-eating and/or vegetarian people) When those are not options, there is always something sweet to be had. I cannot, for the life of me, explain the "tradition" of food here apart from thinking that everyone's trying to keep the child inside themselves alive. But hey! All is not lost. The locals seem to be bothered about the food situation as much as we do, so that's one more thing you can use to bond with people.



TU Delft News

Stijn Ruiter

Delft University of Technology is the biggest and oldest Dutch publicly

available technical university, established by King Willem II on January

8th, 1842. But what is currently happening on and around the TU Delft?

In this article, we will list in short the most important events of the

recent month.

Geospatial Research Institution

TU Delft has been chosen as Geospatial Research Institute of the year 2015. In December 2015, the jury has recognized TU Delft's crucial role in the field of geospatial technology and its applications.

Basically, what this means is that the jury recognized and acknowledged the quality of TU Delft's research. This research contains everything from data processing and positioning to geo-ICT (city, watermanagement, etc).

Earlier this academic year, the university already achieved a 90th place in the Times higher ranking, a top 200 of best international universities!

Working on the future

A relatively new DreamTeam managed to earn a first place for most innovative idea in the Hyperloop Design Contest!

The hyperloop is a conceptual high-speed transportation system, where capsules travel in vacuum tubes. In these tubes, the drag on the capsules is lower, which results in higher speeds and lower energy costs. For this, SpaceX hosted a new competition in which student teams could participate to invent new and more innovative ideas for the hyperloop.

The Delft team entered this competition and managed to become second in the overall contest. Only the MIT team beat their idea. This means that the Delft team has the opportunity to build there idea on scale and test it this summer in California.

Besides a second place, they have also won in the category for most innovative idea. Their idea involved magnets to levitate the capsule, which caused it to be lighter and less energy consuming.

There isn't much time to celebrate the victory; the team has already started building their idea, in order to be ready this summer!

Green energy

TU Delft tries to reduce there ecological footstep on the earth. Nowadays, it uses circa 54 million kWh yearly, comparable to 15.000 households!

Therefore, starting in January 2017, the university will only buy green energy from Dutch soil. This means, that 100% of the energy it buys, is wind energy harvested from six wind mills in the North sea. This will account for 70% of the total energy consumption. The remaining 30% is created at the TU Delft, mainly using the newly installed solar panels, earlier this academic year.

Coffee

As everyone may or may not know, the coffee consumption at the university is high, very high. A whopping five million coffee cups per year! Even though the coffee is perceived as less tasty, these coffee cups only account for the coffee machines. Together with the coffee sold at Sodexo, this number will rise even higher.

This brings some complications with it; all these used cups must be processed. Before, the coffee cups were thrown away, which is a waste. Luckily, now a plan is gradually being integrated around the campus to recycle, after numerous attempt to lower the use of cups.

Prometheus

Four years later, it finally happened! The Prometheus statue that was stolen from the campus, has finally been replaced.

After sixty years of service, the Prometheus statue had been stolen from its plinth in 2012, probably by bronze thieves. To substitute the void left behind, a new statue was designed in a competition.

The new design is an ode to the previous one. A metal plate with the contours of the previous Prometheus cut out, and placed on the same plinth as before. Why it took so long to substitute this statue, is due to copyright infringements. The old statue was still copyright protected and therefore, unable to be copied by other artist. Now, these problems are finally fixed.

This statue can be visited at the Mekelpark, near the Aula.

Delft's quantum computer

Scientist of TU Delft are a step closer towards building a fully operational quantum computer.

In a quantum computer, electrons are being used for qubits, similar to bits in a normal computer. In order for this concept to work, qubits must be writable and readable, and at the same time remain in a particular state, to store information in them.

It was already possible to read properties of a lot of electrons together, but never has it been possible to read the state of a single electron. To be more specific, scientists finally achieved a way to create a block of quantum dots (enclosed electrons). In this block, they could manipulate the spins such that information can be stored in them, similar to 0 or 1 in a regular bit.

With this new achievement, the realisation of a quantum computer is getting closer. After all, we need to read, write and store qubits, in order for a computer to operate!

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WiFi

Friday the 29th of January, after the last exams, a group of 50 members of 'Christiaan Huygens' gathered at CH. In less than an hour, they would leave to Saint François Longchamp for an amazing week with snow, sun and lots of fun. Everybody was excited and ready to have an exhausting

but unforgettable week.

But first we had to get there: we had a long journey in the bus ahead of us. Luckily, time flies when you're having fun, so we made the best of it. Thanks to our amazing bus drivers, we were the first group to arrive in Saint François Longchamp. The luggage was dropped in the depot and skies and snowboards were rented. The lucky ones with a ski pass for an extra day started skiing and snowboarding right away. The others enjoyed the sun (which wasn't too bad either) while waiting to enter the apartments. Unfortunately, the French are not very strict with times but at 5 o'clock we could finally enter our rooms. Even though everybody was very tired from the journey, quite some people decided to take a look at the Yeti bar which resulted in a fun evening there.

The next day was the first day of skiing for some of us. Early in the morning the skiing lessons started and the beginners quickly learned the basics. The more advanced skiers and snowboarders left in groups for a whole day on the slopes. Unfortunately it was very rainy this day so there were also some participants who decided to stay at home and start skiing on Monday.

Monday and Tuesday were good days for skiing and snowboarding and almost everybody could be found on the slopes. The beginners made more and more effort and soon they all dared to descend the blue slopes by themselves. The more advanced skiers tackled the red and black slopes, fortunately without any serious accidents. In the evenings it was time for some party. Of course we could not party too much since everybody needed to be awake and living again for the next days on the slopes. Fun fact: cold weather helps to wake you up real good, in case you had not slept much the night before....

On Wednesday, it was extremely snowy and windy but the real diehards could be found on the slopes anyway. Luckily for them, enough slopes and lifts were still open to entertain them the whole day.

A benefit of the snowstorm on Wednesday, was that we had fresh snow on Thursday. In the afternoon we gathered with the whole group at one of the lifts to go up together. Halfway down the slope, there was a café where we sat down with the whole group for some glühwein or hot chocolate. On Thursday, it was time for a party with all study associations from Delft. After all, we were not the only students from Delft there since the VvTP, ETV and PS had also chosen the beautiful mountains of St. François Longchamp as their destination. It was a fun night in the Yeti bar with lots of onesies and other crazy outfits. The night ended with all associations singing their songs against each other.



On Friday, the WiFi organized a dinner with all the participants. First, we gathered to make a group picture all wearing our brown and pink sweaters and then we had dinner together. To be honest, the food wasn't the best but the fact that we were with such a great group of people made up for it. Unfortunately, this was already the last night and everybody started gathering their belongings and cleaned the apartments.

On Saturday morning we had to leave the apartments again. Luckily the luggage could be dropped in the depot and we had one whole day of skiing left. In the evening it was time to get on the bus again to head back to Delft. On the way back everybody was so exhausted of the whole week of (après-)skiing that most people slept most of the trip. On Sunday morning we arrived at the Drebbelweg. Everybody said goodbye and went home to have some rest before we had to start studying again on Monday.

I believe we can all look back on an amazing trip. It was a week filled with skiing, snowboarding, partying, sledging, laughing and even a little bit of sleeping. There are still so many stories untold, just ask one of the participants and I guarantee you will hear amazing things. The WiFi wants to thank all the enthusiastic participants for coming with us! We can't wait to go again next year.

AREA 51 AN

AreaFiftyLAN

Stijn Ruiter

AreaFifyLAN is an epic gaming event, hosted by CH and organized by the

LANcie. The second edition of this marvelous event, will take place on

3-4-5 June 2016!

Last year, a couple of great committee members organised a new kind of event, that has never been hosted at this university before: a gaming event for more than two hundred people. It was an epic weekend, involving a variety of games like Dance Dance Revolution and yoga, but also hardcore tournaments like League of Legends and Trackmania.

With this event still fresh in our memory, a new committee has taken its place, in order to create an amazing event. This year, we will turn the Drebbelweg into the best gaming event, like you've never experienced before.



The committee consists of a vast variety of people, from rower to surfer, from Wolbodo to Virgiel and from second to fourth year students. But we have all one thing in common, we love gaming and are determined to host the best gaming event possible!

Unfortunately, it is not possible for us to host this event all by ourselfves. Therefore, we need lots of crew member to help us out. If you are as excited as we are and want to help with AreaFiftyLAN, feel free to ask us for more information! Also there is a crew interest list at CH.

Tournaments

This year, there will be four official gaming tournaments; League of Legends (LoL), Hearthstone (HS), Rocket League (RL) and Counter strike: Global offencive (CS:GO). It is not only fun to participate in these tournaments, but the most excelling players will also receive rewards provided by one of our sponsors!

Even though we organise only these four gaming tournaments, there can be even more tournaments! There are also opportunities for others to create and organise custum tournament, like 'Trackmania' and 'Achtung, die kurve!' We might even arrange some epic rewards for them!

Lounge Area

Even though there are only four games with tournaments, there is still a lot to do at AreaFiftyLAN. You need to get your poker face ready in order to win at the poker tournament, or you can let your creative side lose in the massive world of minecraft!

In addition, there is also a lot of other fun stuff to do at AreaFiftyLAN. Play arcade games with friends on the couch, beat your opponent in a karaoke battle, create a new guitar riff on guitar hero or wow your friends with your dancing skills in dance revolution, everything is possible! There will also be pinball machines, airhockey tables, soccer tables, and much more! And everything in the same room!

But there is more

Of course, you can sleep in your own bed and can you eat your own sandwiches, but obviously you don't want that while you are gaming. Therefore, we arranged your entire weekend! You don't have to worry about anything, with available sleeping places and including meals! If you prefer something else, there are lots of snacks available and of course, we'll provide enough to drink for everyone.

Be there or be squared!

The website is live and the ticket sale has already started, so get your tickets before it's sold out! There are only limited places available.



Marjolein Bouwmeester

While this MaCHazine is being made, the trip of iCom 2016 is getting

closer and closer. From the 10th to the 14th of May we - the iCom and 27

lucky members of our study association 'Christiaan Huygens' - will make

Dublin an even brighter place.

For several reasons Dublin already is a bright point on the map of Europe. Let's start with a little note on the weather. Maybe you think: "that will be awful", since Dublin is the capital of Ireland, close to the UK and definitely not known for its great weather. However, May is the sunniest month of the year in Ireland!

And when we walk the streets of Dublin with our sunglasses, what will we see there? For example, the beautiful, historical Trinity College. The University has just been rated 21st in a list of 25 leading world universities over the age of 400. Trinity Provost Dr Patrick Prendergast says: "We have always been immensely proud of Trinity's historical legacy. Our mission in delivering excellence in teaching and scholarship extends over 424 years since its foundation and applies more so than ever today. This ranking is a testimony to our world-class record of research, innovation, and our commitment to the highest standards of teaching. It places the university at the forefront of higher education in Ireland and globally."

With our group, we will visit the university and there will be a lecture that is interesting for both mathematics and computer science students. Students of MathSoc will show us Trinity and let us have a taste of the student culture in Dublin. MathSoc stands for Mathematics Society and when reading about their activities, they sound a bit like our own society, so it will be fun to meet them. They will take us on a tour around the campus to see some of their buildings and of course, the famous library; the largest one of Ireland. It has over 6 million printed volumes with extensive collections of journals, manuscripts, maps and music reflecting over 400 years of academic development. For the attentive reader: the library was on the cover of the previous MaCHazine.

Another great thing about Dublin is the big amount of companies that are located there. Ireland is called a tax heaven and although there are a lot of speculations whether that name is right, it seems to be the reason so many companies have offices there. And since we are choosing Ireland, why not place that office in the capital? This gives us opportunities to visit some really interesting ones. To name one, we will visit TIBCO. The name might not ring a bell, so I will tell a bit more about it. TIBCO Software is a company that empowers executives, developers, and business users with Fast Data solutions. Those solutions make the right data available in real time for faster answers, better decisions and smarter action. Because all technology gets faster and faster, the solutions of TIBCO get more and more important; they can handle the speed. The TIBCO staff is excited to have us over and tell us more about what they do, so I will stop spoiling now.



As we all know, Guinness is the drink of Ireland. It might not be everybody's favourite, but the factory is totally worth visiting and that is what we will do. Next to the amazing city view, you get on the top floor where you can enjoy a glass of your dark beerbuddy, also the story of the beer will be told. And that story is more interesting than it might seem on first hand, as the story of the factory is part of the story of Dublin itself. Back in the days, in 1759, Arthur Guinness edified the factory in Dublin. Arthur was a revolutionary in terms of the way he handled his staff. For example, he paid his people 10 or 20% above average and gave them paid days off (this did not exist back then). In 1930 one out of ten men in Dublin were direct or indirect dependent on the factory. This story will be heard further by our group in the factory.

I'm talking for quite a while about Dublin now, and I haven't even mentioned the nature yet. Dublin is situated at the mouth of the river Liffey and a beautiful haven city. And there are a lot more landmarks worth calling, such as the Dublin castle, which is one of the oldest ones. One of the newest is Dublin's new monument that is called the "Monument of Light". And there are also all the nice parcs, the village culture and much more. We will tell you all about it afterwards!

Lustrum

Felix van Doorn

As many of you know, next academic year W.I.S.V. 'Christiaan Huygens' will celebrate its 60th anniversary! To those who are not entirely familiar with Dutch student culture or who are new to student life in general, this might not seem like such a big deal. We have an anniversary every year right? What makes this one more special than others? To understand this, we'll need to give you a short history lesson.

rendi

In ancient Rome, the end of each five year period, a lustrum, was an important religious and political affair. Government officials would take a census and afterwards they would sacrifice a pig, a sheep and a bull to Mars.(The Roman god of War).

Like many other Roman customs and traditions, this one found its way to the world of (western) academia. Although it has changed quite a bit over the past millennia, it is still widely celebrated by universities, student associations and study associations alike. In their modern form, a lustrum entails a whole year filled with festive activities. For many students, such a year is a highlight of their time at university. Some of these students enjoy it so much, they get to experience two or three of these years!

As you might imagine, organising a year's worth of festivities is time consuming. Luckily, the Lustrum Committee, better known by its Dutch abbreviation LuCie has been working on this since last November!

We can imagine, that very few of you have a clear idea of what we are actually doing all the time, as there is only one Lustrum Committee every five years. You will have probably seen us running around the university, with a seemingly random collection of items. You might have stumbled into our committee room and see us scramble to cover our paperwork and our computers. Or more likely, you were completely oblivious to the fact that there was a actually a group of people putting any effort into organising such an entertaining year. At the start, it takes a lot of brainstorming and discussing these ideas with others. Once we have most of the activities in mind, we can start organising and scheduling events! You would be surprised how much time and effort it takes to schedule these activities. It would be an utter shame if we planned a week's worth of parties just before or during an exam week! On top of that, our association already has a really full schedule each year which will remain largely unchanged. So it's going to be a very busy year next year! Be sure to start scheduling once the preliminary schedule comes out. As for now, the schedule is still subject to quite some change and will reach its more finalized form over the summer.

Luckily, you won't have to wait until next year for all of the fun, we'll also organise two pre-Lustrum activities to get you extra excited for next year!Most of the action will however take place in the academic year 2016/2017. You can expect an immense range of activities to choose from.

You might be quite happy to hear, that we're not planning on sacrificing any animals directly during our Lustrum. We'll be honouring that ancient tradition in the form of a massive barbeque somewhere in the year!

By this time, you'll probably have figured that we'll be hosting a wide range of parties and social mixers throughout the year. To somewhat reduce the pressure on your livers, wallets and academic progress that our Lustrum should consist of more than just parties. We'll also be organising workshops and career-oriented events. Here you can learn all kinds of new skills, get your hands on some of the coolest gadgets and meet interesting companies. Somewhere along the line of, work hard play hard.

We might even get the chance to organise one event in cooperation with the university itself, as they are celebrating their own Lustrum in the same academic year. We're afraid we can't tell you much more than this, dear reader, as we want to leave most of it to your imagination for the time being. If you are only a fraction as excited as we are, we suggest you keep your eyes peeled and come to as many pre-Lustrum activities as you can to find out more about the activities to come.

We'll get to work to ensure that our lustrum year is going to be one you'll remember for years to come!



Master Activities

ComMA

This year there is a new committee in CH: the ComMA! This is short for the Committee for Master student Activities. Specifically we are a Committee for the masters Applied Mathematics, Computer Science, Computer Engineering and Embedded Systems. Whereas the bachelor programs of the studies under CH are currently given in Dutch, the master is given fully in English. That's why you can also find a lot of international students studying in Delft. Since we want to have a committee for all the master students of these four studies and not only the Dutch people, we decided to do everything regarding this committee in English.

As this is the first year a committee organizes activities specifically aimed at the social bonding of master students and the bonding of master students and the study association, we have a big responsibility: we need to promote activities to master students and master students only, which we can tell you, is not an easy task. Since master students for instance do not have a freshman weekend, it makes most of them not really attached to study association CH (yet).

Despite this difficulty, our first activity, "The Culture Games", which we recently had was a great success. This could be best compared with a pub quiz: people made teams and have to answer numerous playful questions, solve mind-bending riddles and complete fun assignments. The team who gets the most points wins an awesome prize! To name one example of our questions: do you guys know what men in Ancient Rome did when taking an oath? No? Well, they placed their right hand on their testicles. The word 'testimony' is derived from this tradition. Another nice question was about what people in Tibet do to their guests: since they actually stick out their tongue. These types of questions, combined with fun assignments like 'the floor is lava', turned it into a great game! After the final round, several teams were tied. To solve this, we had an actual dance-off. Participants danced to Skrillex, Meghan Trainor and more, while showing their ultimate dance skills. It was a hilarious final assignment, and eventually the judges picked their winners. The winners received a nice cultural package, containing delicious Dutch cookies and many other cultural snacks.

Unfortunately, due to some deadlines the CS students were a bit underrepresented. However, both ES and AM were amply present! All the participants really seemed to have enjoyed themselves this evening. It turned out to be a great activity. Besides being a great success, it was a good starting point for the ComMA to get in touch with master students. The pictures show the committee, and our participants enjoying the game.

Our second activity will be Bubble Soccer and Sumo Wrestling with big sumo suits! At the time of writing this article, the activity has not taken place yet, but we can tell you that we are looking forward to it a lot! We will use the Free Zone next to our faculty (or in case of bad weather, we may use a room in the Sports Unit). People can take turns with a team and play a hilarious soccer match in big plastic bubbles, or they can compete in big sumo suits. Afterwards, people can join us for a drink at the /Pub.



Our third activity will probably be an actual International Food Festival! We want to get as many master students together as we possibly can, and enjoy food from each other's countries. We will provide some food ourselves, and participants can bring their own dishes. It will definitely be a tasty activity, where master students can learn more about each other and their cultures. We will keep you posted!

We hope that we have made a good start with the first ComMA. We are sure that a great, new group of people will take over and come up with more activities and tighten the bond between CH and its master students. For now we will enjoy being in the committee ourselves.

See you on our next activity! 🚷



CoH Rebecca Jacobs

On January 8th, CoH, the alumni committee of W.I.S.V. 'Christiaan Huygens', organised their annual new year's drink. To do things slightly different this year, the event was held at the office of Fox-IT instead of

the /Pub.

To wish all mathematics and computer science alumni a happy new year, we organised a new year's reception. This year, the reception took place in the office of Fox-IT. After a warm welcome by employees of Fox-IT a presentation was given by one of our own alumni, Erik Biemans. Erik also works at Fox-IT and told us about some of the work that's being performed by Fox-IT and what the latest tricks are that cybercriminals use to swindle people online.

After Erik's presentation, the alumni got a tour of the Fox-IT building and an opportunity to visit the control room. The control room is the place where analysts monitor all of the security warnings to find out which ones are real threats.

Later in the evening Alexandru Iosup came by to give a presentation for the alumni. Alexandru Iosup is an assistant professor in Computer Science and last year's winner of the teacher of the year awards for Computer Science, EEMCS and the Netherlands. He talked about gamification in education and how he is trying to motivate his students to make the most of their potential.

The responses at this new structure of the CoH new year's reception were very positive so we would like to continue on this course. From now on, we will try to organise the event at a company somewhere in the Netherlands. This way, the yearly drinks will be better to reach for people living in other parts of the country and the alumni get a chance to see how things are going at colleague's offices.

If you have done a bachelor or master in Mathematics or Computer Science in Delft, you're an alumnus at the TU Delft and you are invited to join the activities organised by CoH. We are trying to organise another event for alumni this academic year and the annual CoH alumni bbq will be held in September. To enroll yourself for an activity, take a look at the TU Delft alumni portal: *https://alumniportal.tudelft.nl/AlumniPortal/*. Finally, we would like to wish all the members of W.I.S.V. 'Christiaan Huygens' and all of the mathematics and computer science alumni a happy new year!

Symposium

Stijn Ruiter

And just like that, the holiday was finished. After a week of snowboar-

ding and partying with CH, the wintersport was over. With my snowboard

goggles still visible in my face, I had to go back to studying.

Luckily, the first day was very interesting. February 8th, the annual 'verdiepingssymposium' was held for both studies, Applied Mathematics and Computer Science. At this symposium, we learnt where we could end up with the study we are following and what the future might has to offer. For this day, there were two kind of programs, one for mathematics students, and one computer science students. Since I am a mathematics student, this article is mainly about my experience of the mathematics program.

Morning

It started in the morning with lectures about all the departments in EWI. From analysis to statistics and from optimization to dynamical systems. Even though I already attended this symposium last year, the lectures about the different departments where very informative and great for getting a view on the different aspects of mathematics. There were also short talks about finished bachelor thesis, excellent for creating an bachelor thesis myself.

Lunch

After all these talks and multiple cups of coffee, it was finally time for the lunch break, where all the previous information could sink in and have a chat with our peers. There was an opportunity to lunch with CH alumni and talk about their experience after studying, but I did not attend this meeting. Luckily, it was also possible to get lunch in the /pub. There couldn't be made a single remark about the catered lunch, especially with a sandwich of Leo van Vliet. Needless to say, everyone finished there lunch in no time, and with a satisfied feeling we went back to the second part of the day.

Afternoon

This section was more study orientated. In the afternoon, we got a lecture about the possible tracks in master applied mathematics. And it was an excellent opportunity for me, to finally understand what this master actually consists of. I heard a lot of rumors, but finally, everything was clarified. To finish this day, there was a drink in the /pub. Unfortunately, duty called and I had to go before it started. Nevertheless, it was a excellent day!

GEZOCHTAPP DEVELOPER met enthousiasme



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Via Nova

Sander van den Oever and Shirley de Wit

For our bachelor thesis we developed a game that aims to support patients during their treatments. This project was in assignment of prof. dr. A.W.M. Evers, professor of Health Psychology and head of the Health, Medical and Neuropsychology Unit of Leiden University. The project was guided by dr. ir. Rafael Bidarra.

The aim of our project was to develop a serious game that positively influences the treatment of patients that suffer from chronic diseases. With the use of the game, patients would improve their lifestyle to a healthier one; having a healthy lifestyle can contribute to a good response to treatment. The game should also contribute to the experience of the treatment. Patients with a chronic disease often have negative associations with their disease and related things, such as the treatment of the disease. Playing a (funny) game as part of the treatment will hopefully create positive associations and can therefore have a positive influence on the attitude towards a treatment. The use of our game can provide a closer look at the influence a game may have on the (experience of the) treatment for rheumatic patients. We came up with a health centre called Via Nova, which is Latin for "New Way".

Research phase

To be able to make this serious game, we needed to gain some knowledge about gaming and chronic diseases. We started with looking at existing games in health care. We found games, for children, of which it has been proven that they improve the response to certain treatments. An example of such a game is 'Re-Mission'. In this game children with cancer have to fight against their disease in a game. We also did some research on rheumatism, evaluative conditioning, approach avoidance tasks and the use of an avatar within a game. The main conclusion of our research was that patients should find a game entertaining and fun to play and that they should be challenged to prevent them from getting bored. The use of an avatar, which is chosen by the patients themselves, will also help to reach the aim of the game because of identification.

Design phase

After the research, we started with a lot of brainstorming on how the game should work. We came up with three concrete concepts which we proposed to our client. All concepts were based on having a basic environment with several minigames attached to them. We proposed a village environment, a modern health centre and a world trip. After proposing our ideas, the client decided to go with the modern health centre. To be honest, we preferred the world trip and we were therefore disappointed it was not chosen. This was also a learning point: everything you propose can be chosen by your client. So only propose concepts that are fully supported by the whole team!



Figure 1: Brainstorm session

The health centre we have developed consists out of a central garden which provides access to four different areas, namely a relaxing, sleeping, future and lifestyle area. The first time a user enters the game, he or she creates an avatar and chooses a coach. This coach gives a tour through the health centre and explains the game. The coach stays available for help during the whole game. In every area, the user can play one minigame per day which is rewarded with a medal. By playing minigames, the user can earn furniture to decorate the areas. In the fountain, which can be unlocked by the user after playing several days, the user can replay minigames to earn a better medal.

After we designed the framework of the game, one job was left before we could start implementing. We had to design some minigames with a link to a healthy life. An example of such a minigame is a game where healthy and unhealthy objects fall down. When catching healthy objects, the user will earn points. However, when the user catches unhealthy objects, this will result in a loss of points. Another example of such a minigame is a meditation game, where the user has to stay focused on meditating. Therefore the user has to get rid of distractions that are appearing on his or her screen by clicking on those.



Figure 2: The central garden

8

Tooling

Right at the beginning of our project, we discussed about and agreed on the tools that we would use and the way we would work during the project. We quickly decided to use the Unity game engine. A couple of the members of our team already had some experience with Unity and there is a lot of documentation on the web. Unity uses the C# programming language, which is quite similar to Java. Considering the knowledge we had about Java, this was an easy way to go. From documentation and tutorials about Unity we learned some useful tricks to keep the project simple and maintainable. One of these was the folder structure; having a clear folder structure for the files really helped in finding our way through the project files.

We decided to use GitHub as our Version Control tool so that we could have a better look at the GitHub ecosystem and its possibilities. For documentation we used a shared Google Drive and the tasks were managed through Trello at first, but we switched to GitHub after some weeks. The translation of tasks into issues, allowed direct references from the code-changes to the tasks (issues). This way we could increase the overview of the project.

A disadvantage of using git together with Unity is the fact that Unity uses meta files. These files are being generated by Unity and they contain information about their corresponding files (think of compression settings in the case of images). These files also contain unique IDs. Sometimes, Unity decided to regenerate the IDs (re-importing the Library when something has changed). This caused a lot of conflicts and resolving these was an annoying (and unfortunately recurring) task.

At the beginning of the project we also decided to try out the Git Flow model as described by Vincent Driessen (http://nvie.com/posts/ a-successful-git-branching-model/). The model has worked quite well up until this very moment. All features were developed separate from each other so the code changes made by everyone did not interfere with each other. Whenever someone finished a feature it could be merged into the development branch, where everyone tested the result. If there were no more bugs it could be merged into the master branch and it could be released to the client. This way the master branch always contains the latest working version of the product.

Process

During the project we have used the SCRUM principle, with sprints lasting for one week. After a short period of time we noticed that the communication was not going very smooth. Every Monday two PhD students of prof. Evers travelled to Delft to discuss the progress and ideas. The PhD students had to discuss these during meetings with others every Thursday before deciding which way to go. Because of the gap from Monday to Thursday it took some time before we got approval on our ideas. Fortunately, meeting could be rescheduled which eased the communication. Within the team there was one person responsible for all external communication, so our client knew who to contact and we were able to assure a fast response time to emails.

During the project the client told us that they had not enough insights in what was happening. This was a problem to the client. Every week we received a new Excel sheet with the remaining tasks. This list was not in sync with our own list. Our own list was too detailed for the client, they wanted to know on component-level what was finished and what remained to be done. On the other hand, we as developers wanted to know what had to be done to finish a specific component. After discussing this discomfort a couple of times, we created a Google Sheet where the client could see the progress (live) and where we could add enough details in order for us to work with that list.

One of the lessons we have learned from this project is that you should really formally agree on the requirements of the product. Put them on paper and

sign them with both parties as soon as there is an agreement. We had to deal with several changes in the requirements which caused unnecessary delays and postponed deadlines. Just to give you an impression: we were supposed to build an e-health app for mobile devices, we ended up designing a desktop app that had to run on basically any average household computer. Without this formal agreement we ended up trying to adjust to the new requirements so that the client would be satisfied with the final product. For the client this was ideal because we adapted every time. For us it was more cumbersome; it costed more time which affected both us and the client.

For the graphical design we found ourselves some really awesome artists, Jorick, Pim and Wietse, from (among others) Grafisch Lyceum. They have designed all the artwork throughout the game. Because our project continued after the official end date of the bachelor thesis, we hired some additional developers in order to finish the product for the client. A big part of these developers participated in the Gaming Contextproject and had some experience with game design already.

Final word

We ended our bachelor thesis with a nice grade and we got the opportunity to continue to work on this project. This brought new challenges, such as making cost and time estimations and working with a bigger team. We have learned a lot during the project. Working for a real client that actually wants to use your product was a new, but very valuable, experience. It brings a whole new dimension to a project. A client can give new insights and ideas, but it is your challenge to find out what your client really wants. We are excited about the final product and we are awaiting the first test results.

During our project we, like almost everyone else, encountered some challenges. Our mentor dr. ir. Rafael Bidarra helped us out with those several times, not by forcing us in a certain direction but by giving advice. We are really grateful for his advices and support.

When you are about to start your bachelor thesis you should make sure you choose a subject that you like and make sure that you have an awesome team. The four of us knew each other for over two years. In the third quarter we decided to do our bachelor seminar together, which worked out really well and made us decide to go on the bachelor thesis adventure together.

Chantal Eckhardt Dion de Hoog Sander van den Oever Shirley de Wit



Figure 3: Final presentation (f.l.t.r.: Sander, Chantal, Shirley and Dion)



Personalised Gaming Using Learning Technology

Valentine Mairet

The entertainment industry is one of the biggest, fastest growing, and most popular fields in the world of today. Artificial Intelligence has also been a very popular subject these past decades and is often found in games. The more intelligent and complex a game is, the more

challenging it becomes, and that is a crucial aspect of a good game.

The Game

For my Bachelor's Thesis, I came in contact with a small startup company which saw Artificial Intelligence and learning technology as the future of the gaming world. They asked me and my team to expand on the design and development of a game, to make it both challenging and entertaining. We were also instructed to add a learning element to the gameplay. The skeleton game they provided us with was a simple 3D maze puzzle game programmed using the Unity framework, with a player and a main antagonist (end boss) near the end of the maze. This antagonist would damage the player on collision and vice versa.

After two weeks of intense brainstorming and research, we came up with Portal-Bug: a player represented by a ladybug, a 3D maze puzzle game with adaptive maze generation, multi-mazed levels, and end boss behavioural changes depending on the player's personality. The player's decisions, way of exploring the maze, and additional behaviour were observed and logged for the next level, where based on these variables the game would change.

To spice up the gameplay, we planned to introduce scary elements to PortalBug. Stressful music, sudden explosive sounds, and even the antagonist's appearance were carefully designed according to research we executed in the domain of psychology. That is how we ended up with a dark setting for the environment, and a giant spider as endboss.

At the start of the game, we give the player the option to choose between two types of game: one with adaptive construction, and one with standard difficulties (from very easy to very hard). This way, the player can decide whether the game should observe his or her behaviour, or just generate a level of his or her chosen difficulty.

Maze Generation

The observed player behaviour was translated into seeds for the maze generation. These seeds determined whether the maze was going to have a lot of twists and turns, large halls and rooms, or even more right turns than left turns. The intent was to basically have control over the difficulty of the maze, based on the player's personality.

For simple maze generation, we used a recursive backtracking algorithm, which acts much like a random walk algorithm. Contrary to what the name suggests, the actual implementation is iterative, to lessen the memory footprint. This is a well known design that by default introduces very little bias in the maze. Here is how it works: it basically starts off with a grid, where the lines represent maze walls, and destroys maze walls from an arbitrary starting point following a random path, until the edge of the maze is reached. When that happens, it will walk back to where it can find a new wall to break without causing a cycle, or without creating too large halls (e.g. paths bigger than three tiles).

See figure 1 for visualisation of this:



Figure 1

This maze generation strategy, combined with the delegation of maze rooms and large halls to increase/reduce puzzle difficulty, was compiled into a library that we named Librarynth. This library works independently from the PortalBug game and can hence be used for other applications. It is still however bound by the Unity framework.

Thanks to the ability to manipulate mazes according to the player's behaviour, having control over the difficulty of the maze was rather easy. Large rooms/halls in mazes can serve as reference point for a beginner player, and can help the player to solve the maze quicker. On the other hand, cycles and spirals (which we can also generate at will), seem to considerably increase the difficulty of the puzzle.

Portals

The name PortalBug automatically suggests the presence of portals. That is correct! As mentioned earlier, we have multi-mazed levels, meaning each level consists of multiple mazes. These levels are translated internally into a graph of mazes, where nodes represent mazes and edges are the two-way portals connecting them. We made sure that the graph of mazes could always be solved, so there is always a path from the start to the end node (start and end of the maze).

Mazes do not have to contain only just one portal, but can have multiple connections to other mazes. We have control over the limit of amount of portals per maze, which grants control over the game's difficulty once again. More connections between mazes mean more possibilities of a path to the end maze, and increases the chance for the player to fall into a dead end.

Large levels of hard difficulty contain at least ten different mazes with up to five portals per maze. With this setup, it is quite hard to know how to place/connect the portals such that we increase the amount of dead ends and always have a connection to the end maze. To facilitate this problem, we designed an algorithm to make sure the level was always solvable, while the amount of dead ends is large enough for a difficult game. This algorithm maps the level graph to a level grid for easier manipulation of data.

Artificial Intelligence

In this article, I talked about an endboss shaped as a giant spider. This spider waits for the player at the end maze (where it spawns at the start of the game), and its only purpose is to pursue and kill the player when the latter is detected. Not only did we model the spider ourselves using Blender, but we also used a special Unity AI library (RainAI) to make our spider seem intelligent. Fun fact: we named the endboss Brian, because Brian has a brain...

With the help of RainAI, we could give an "AI rig", which is basically a brain, to the spider. This AI Rig allowed us to give the rigged entity basic senses (such as visual and auditory senses), such that the spider could detect the player without having to hardcode that into the game's source code. For that to work properly, we also needed to rig the player and set it on "detectable". With this AI rig, we could set up a behaviour tree for the endboss. Behaviour trees are simple event-to-action maps which determine what action the spider will take under what condition. A simple example is a basic behaviour tree consisting of three nodes: under event "player detected" do either "pursue player" if own health is high enough, or do "escape from player", in case the player has a much higher health than own. All actions in the behaviour tree had to be programmatically defined, but could easily be added to the tree using the RainAI interface.

For the endboss to be able to navigate properly across mazes, we set up a "navigation mesh" through the RainAI interface. Navigation meshes cover every flat surfaces in the environment with mini points the rigged entities can automatically travel to. With this mesh enabled, the spider can explore the maze and record what entities are encountered. We also programmed into the spider's brain the option to take portals on its own, to find the player faster.

Additional Elements

Additionally to a maze generation library, a level grid algorithm, and an intelligent game antagonist, we also wanted to make PortalBug more interesting by adding special elements to the game. What does a puzzle game need nowadays? Power-ups!

Initially, the player could barely make use of three potions: speed, invisibility, and health. The speed potion doubles the player's speed, the invisibility obviously makes the player invisible for a few seconds, and the health potion recharges the player's health. What we added to this potion functionality is the ability to control the number of potions per maze, but also how the endboss reacts to these potions, especially the invisibility potion. When the player consumes the invisibility potion, the spider will try to look for the player, based on the player's observed behaviour. If the player takes more turns in a certain direction, the spider will go in that direction (from the player's perspective). We increased the endboss' health by factor 10 compared to the player, to make it impossible to kill. However, we came up with the idea to hide a sword and a shield inside the maze, which would allow the player to kill the endboss faster. The sword increases the player's damage value considerably, and the shield reduces any damage done to the player. We modelled the sword and shield using Blender once again, and we randomly placed them (both in different mazes) across the level.

A funny (in our opinion) addition to the game was the bug spray. The player can spray some bug gas that stays hanging in the air at the spot it was sprayed. The player can use this little gas cloud as reference point, to remember where (s)he was standing. The drawback of this power is that the spider can 'smell' the bug spray and immediately detect where the player is. It then runs towards that spot in hope to find the player.

Conclusion

This is it! We created this adaptive maze generation library, the player observer for recording of the player's behaviour, the maze level grid for multiple mazes connected by two-way portals, and we boosted the endboss' intelligence. Additionally we pimped the game by adding better graphics and power-ups for the player. Here is the result in image:



Figure 2

Overall, we had lots of fun doing this, because working on a game is always fun. It taught us a great deal about game design, algorithm design, artificial intelligence, and even psychology! More technical information can be found in our paper [1]. 🚷



Figure 3: The Team, The Coach and The Client

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Keylane

In de snel veranderende markt met stevige concurrentie, richten

verzekeraars en pensioeninstellingen alle pijlen op winstgevende groei.

Dit vraagt om messcherpe strategieën, een uitstekende kennis van de

wensen en behoeften in de markt en perfect geoliede bedrijfsprocessen.

Bij het optimaliseren van de klantenservice, innoveren van producten en diensten, en optimaliseren van processen intern, horen moderne flexibele, geïntegreerde systemen waarmee verzekeraars en pensioeninstellingen kunnen optimaliseren en snel kunnen reageren op veranderingen in de markt. Keylane biedt hierin deze oplossing in de vorm van flexibele geïntegreerde softwareoplossingen. Om de implementatie hiervan in goede banen te geleiden werken er bij Keylane onder andere consultants. Hieronder de ervaringen van junior consultant, Menno Bootsveld!

Ik ben Menno Bootsveld en nu bijna twee jaar werkzaam als consultant bij Keylane. Na mijn master Applied Mathematics aan de Universiteit Twente zocht ik naar een baan bij een bedrijf die uitdaging, doorgroeimogelijkheden en een gezellige werksfeer combineert. Dit vond ik bij Keylane.

Keylane is een softwarebedrijf dat zich specialiseert in het ontwikkelen van verzekeringssoftware, en dan specifiek schade-, levens- en pensioenverzekeraars. Met ons standaardpakket kunnen verzekeraars hun polis- en schadeadministratie volledig automatiseren. Mijn expertise ligt in het domein schadeverzekeraars.

Consultant

Als consultant kun je bij Keylane in aanraking komen met meerdere rollen: functioneel ontwerper (denk aan het leiden van ontwerpsessies en uitwerken van nieuwe gewenste functionaliteiten), docent, inrichten van systemen, tester en meer. Ik ben de afgelopen voornamelijk actief geweest in de rol van systeemtester. Ervaring leert dat de meesten een nogal eenzijdig beeld hebben van de werkzaamheden van een tester. Testen is echter veel meer dan op een knopje klikken en controleren of het systeem de juiste handeling uitvoert. Als tester ben je de eindredacteur van het systeem: als je vindt dat de kwaliteit niet op peil is wordt er niet opgeleverd. Je hebt contact met ontwerpers, testers en de klant en bent dus eigenlijk de spin in het web van het softwareontwikkelproces.

Detachering bij Reaal

Keylane is als softwareleverancier Nederlands marktleider op het gebied van verzekeringen. Een van onze klanten is Reaal, een grote Nederlandse schadeverzekeraar. Vanuit Reaal kwam het verzoek binnen of wij een tester konden leveren die mee kon helpen bij het uitvoeren van de acceptatietest, de laatste test van het systeem die bij de klant wordt uitgevoerd. Aangezien ik inmiddels een klein jaartje ervaring als tester meedroeg en ik een avontuurtje wel zag zitten ben ik de uitdaging aangegaan. Gedurende negen maanden werd ik gedetacheerd en werkte ik op locatie bij de klant mee aan het verzorgen van acceptatietests. Het komt overigens niet vaak voor dat consultants gedetacheerd worden. De meesten werken vanaf één van onze vestiging in hartje Utrecht, Capelle a/d IJssel, Naarden of Den Haag.





Bij Reaal draaide ik mee in het testteam dat speciaal was opgezet om QIS af te testen. Dit was een leuke en leerzame ervaring omdat je als Keylane-medewerker een kijkje in de keuken van de klant krijgt. Zo krijg je pas echt door wat er leeft bij klanten, welke wensen en ergernissen ze hebben en hoe zij ons softwarepakket gebruiken.

Mijn focus lag op het testen van productinrichting die aangeleverd werd door andere consultants bij Keylane. De productinrichting is het vertalen van een verzekeringsproduct van een klant naar dialogen en polisdefinities. Denk bijvoorbeeld aan het ontwerpen van een aanvraag dialoog van een autoverzekering. Ik had wekelijks contact met de teamleider bij Keylane om de kwaliteit van de productinrichting door te spreken. Tijdens deze meetings was het mijn verantwoordelijkheid om de wensen van Reaal kenbaar te maken aan Keylane. Dit was erg uitdagend werk omdat het deels mijn verantwoordelijkheid was dat Reaal de functionaliteit kreeg waar ze om gevraagd hadden, en uiteraard dat het foutloos werkt.

Inmiddels ligt mijn detacheringsperiode bij Reaal alweer achter me en heb ik het werk overgedragen aan een collega consultant. Nu zit ik op een interne testafdeling bij Keylane en komt de volgende detacheringsklus er alweer aan: bij onze klant Ennia op Curaçao! De tropische bestemming, mooi weer en witte stranden incluis, is zeker geen vervelende bijkomstigheid.



Over Keylane

Keylane ontwikkelt en implementeert flexibele standaardsoftware voor de kernprocessen van verzekeraars en pensioeninstellingen. Onze oplossing omvat een complete polis- en schadeadministratie voor verzekeraars, volmachten en intermediairs. Bij de ruim 90 nationale en internationale klanten die wij bedienen is onze software al een begrip en de kans is groot dat je er onbewust al eens mee in aanraking bent geweest. Bijvoorbeeld bij het online berekenen of afsluiten van een verzekering. We hebben sterke internationale ambities en werken vanuit Nederland, Duitsland, België, Engeland, Noorwegen en Zweden.

Contact

Kijk voor meer informatie op careers.keylane.com of neem contact op met één van onze recruiters via telefoonnummer 088 – 404 JOBS of stuur een e-mail naar careers@keylane.com. Volg ons op Twitter of Facebook en blijf op de hoogte van onze vacatures en activiteiten.

Keylane insurance & pension software



Claudia Hauff

Massive Open Online Courses (MOOCs) have changed the landscape of

online education in recent years. Bringing education online at such

unprecedented scales has led to novel data-driven and computational

challenges as well as research opportunities.

Introduction

MOOCs have enabled millions of people to advance their knowledge and competencies in a wide range of fields. TU Delft is at the forefront of this new wave of online learning with more than 20 successful MOOCs and more than 600,000 registered learners from around the globe.

Online learning environments developed for MOOCs (such as edX^1 and Coursera²) log learners' actions in great detail. Data-driven research in MOOC-based learning has enabled investigations in many areas such as the relationship between learner demographics and learner engagement [1], the prediction of learner drop-out based on video interaction traces [2] and the automatic detection of learners' confusion as expressed in their forum posts [3].

Existing research on MOOC data relies mainly on the log traces that learners generate within the learning platforms, such as video interactions, clicks & views as well as forum posts. This data is very limited in the sense that we only observe the learners during the running of a MOOC. We know nothing about their state of knowledge and interests before they enter the MOOC platform or after they leave it. This lack of learner context severely limits the type of research questions we can answer based on MOOC interaction data logs.

To overcome this limitation, we, the **Learning Analytics** team³ at the Web Information Systems group, have begun to combine the data traces learners leave within MOOC platforms and those that learners leave in the wider context of the social Web — thus enabling us to explore accessible, large-scale, relevant and longitudinal data traces & content created by hundreds of millions of users. Analysing the large amount of digital traces learners leave within and outside the online learning environment offers the opportunity to adapt the environment itself, the teaching material and the manner of conveying knowledge to the individual learners' abilities and preferences.

In our research, we make use of methodologies developed across diverse fields such as educational psychology, human-centered design, data science and big data processing. Two concrete examples of research we have conducted in the recent past are *learning transfer* and *incentives for learning*.

Learning Transfer

Measuring the amount of *learning* that takes place in a MOOC is only one indicator of success, the *transfer* of the taught concepts into practice is equally important and often neglected in the investigation of MOOCs. For the specific case of FP101x (a functional programming MOOC taught by TU Delft's Erik Meijer) we investigated the extent to which learners alter their programming behaviour after having taken the course. Do they actually begin to program

¹https://www.edx.org/

²https://www.coursera.org/

³http://www.wis.ewi.tudelft.nl/projects/learning-analytics/

functionally? We linked learners to GitHub, the most popular social coding platform to date and contributed a first exploratory analysis of learner behaviour beyond the MOOC platform. A detailed longitudinal analysis across the 8 weeks of FP101x and two and a half years worth of GitHub traces revealed that only a small minority of learners actually make the transfer and that some types of learners (e.g. the intrinsically motivated ones) are more likely to exhibit transfer than others.

Incentives for Learning

MOOCs aim to educate the world. More often than not, however, MOOCs fall short of this goal — a majority of learners are already highly educated and come from specific parts of the (developed) world. Learners from developing countries without a higher degree are underrepresented, though desired, in MOOCs. One reason for those learners to drop out of a course can be found in their financial realities and the subsequent limited amount of time they can dedicate to a course besides earning a living. If we could pay learners to take a MOOC, this hurdle would largely disappear. In MOOCs, this leads to the following fundamental challenge: How can learners be paid at scale? Ultimately, we envision a recommendation engine that recommends tasks from online market places such as Upwork⁴ to learners, that are relevant to the course content of the MOOC. In this manner, the learners learn and earn money. To investigate the feasibility of this vision, we have explored within the TU Delft MOOC EX101x (Data Analysis: Take It to the MAX()) to what extent online market places contain relevant tasks, and to what extent learners are able to solve these real-world tasks correctly and with sufficient quality. We found learners not only to be as capable as freelance workers to solve MOOC-relevant tasks that pay between \$10 and \$50, but also to be more engaged with the MOOC once they realized the real-world applicability of the course content.

Conclusions

The two research projects outlined here showcase our interpretation of *going beyond the learning environment*. Examining the current nature of MOOCs reveals an important clue as to why MOOCs, as yet, fail to realize their full potential. Although the "MOOC revolution" (starting in 2011) changed the online education with respect to scale and openness, it did not involve any truly novel education technologies. Currently, MOOCs revolve around a set of videos, a set of quizzes and little else. We aim to change that through the intelligent use of social Web data traces. Ultimately, we aim to develop truly personalized learning experiences at scale, that enable learners from all walks of live to succeed and learn.

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⁴https://www.upwork.com/





Interview: Nils Bulling

Rebecca Glans & Mathieu Post

Our Interactive Intelligence Group at EWI gained a new researcher some time back: Dr. Nils Bulling. He came from TU Clausthal in Germany. The most of you probably know him from the Computer Science courses he has been teaching since then. During our interview we found out how this computer scientist ended up in this field of computer science, his joy for

teaching and what kind of research he would like to do in the future.

Habili-what?

After completing his bachelor in Computer Science and Mathematics at TU Clausthal, it was time for his master (back then, it was still called (Vor)diplom). He wrote his master thesis during a study abroad at Durham University in the UK. His supervisor at TU Clausthal – who probably didn't realize his life changing action – gave Nils a paper on "Alternating-time Temporal Logic (ATL)". ATL is a formal logic to describe and reason about computations in multi-agent systems. Another important application in this context is the verification of interactive systems composed of intelligent agents. After his master studies he was offered a PhD position and completed his PhD in 2010. His thesis was awarded the international E.W. Beth dissertation prize (named after the Dutch philosopher and logician) for an outstanding contribution in the fields of logic, language and information. Next up was his "habilitation" – a term we don't know in the Netherlands. In Germany it is (often) a prerequisite to become a professor (think about it as a second PhD thesis which also counts as a university teaching qualification).

Welcome to the TU Delft!

During his time at TU Clausthal, Nils visited the Netherlands several times, also to work with Koen Hindriks (a name Computer Science students know very well). He always returned to Germany until 2015 when he was offered a position at TU Delft in the Interactive Intelligence Group. He accepted the offer and is now assistant professor at our university, involved in three bachelor and one master course. The first course he taught at TU Delft was Logic Based AI. In the course, students learn about automated reasoning, logic programming in Prolog and agent programming in GOAL. This introduction is a prerequisite for the second course he is involved in: Project Multi-agent Systems (MAS). It's a hands-on course -- a lot of fun. In the MAS project students work together in teams to program multiple agents for the ego-shooter Unreal Tournament. The aim is to develop a team of bots that can compete against native bots. The highlight of the course is a competition involving all students' teams. The third bachelor course he is involved in is the Bachelor Seminar; a course where he supervises a group of students in doing a literature study. Together with Catholijn Jonker and Koen Hindriks he also gives the master course AI techniques, where he covers the parts on logic, mechanism design and game theory.

Teaching is fun

I asked Nils about the differences between teaching here and at his previous university. "At TU Clausthal the classes were much smaller; in the bachelor there were around thirty to forty students, and in the master five to fifteen". So, standing in front of a class of 250 bachelor students, was a new experience, but he got used to it very quickly. Another difference to his previous lectures is the strong practical component of the Bachelor courses. In particular, the group work in the MAS project was new to him. Nils says that he really enjoyed the close interaction with the students. It was great to see their enthusiasm for agent programming and for the agent competition.

What does the future hold?

Nils' research is at the intersection of computer science, logic, artificial intelligence and game theory. In the future, Nils would like to continue research in this area, which is becoming more and more popular (again) with the increasing number of intelligent systems in our lives. In particular, he wants to apply his work to the domain of smart systems, such as smart grids and smart industry. What are smart grids? - I had the same question. Smart grids describe the future power grids. A key challenge in smart grids is to ensure stable energy supply given a mix of conventional power plants and renewable energy sources. For example, when considering wind power, the smart grid must take changing and sometimes unpredictability weather conditions into account. Users do not only demand electricity but also generate power, e.g. by means of solar panels on their roofs. Excess energy can be "sold" to the power plant or other users within the smart grid, or stored. On a sunny day, it must be ensured that the smart grid is secured against overloading, as more energy is produced by households. All this requires clever methods including new tariffs and methods to dynamically shift the user behavior. An example of Smart Industry, Nils explains, could be when your car breaks down. The car manufacturer would receive an automatic notification of what went wrong in addition to other useful information, like the car's location and the owner's schedule. Then, a nearby garage could be automatically contacted to book a service date; of course, the production of a replacement part is also triggered automatically. This allows manufacturing to become demand-driven and highly personalized. Nils informed me that Smart Industry describes the Dutch (research) initiative on this topic. In Germany it is called "Industrie 4.0" to refer to the fourth industrial revolution - especially the "vier punkt nul" sounds so cool.

Thank you Nils; it was a fun and formal interview! I hope the teaching never gets old and wish you the best of luck with your future work.



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Simulate the in- or decrease of fat tissue

Seb Harrevelt

The unavoidable consequence of starting your (mathematics) master is that you eventually need to start your thesis project. If you want to receive your diploma of course. Starting your master thesis is like

starting the beginning of the end. Because once you are finished, your

student life is over, forever. But in return, if you do finish it, you can

finally start to earn some money, which is nice.

My thesis was in collaboration with Fred Vermolen. I 'met' him during the regular numerical courses, where he talked from time to time about his biomathematical models. This somehow fascinated me a lot, and so I contacted him when the timing was right.

The objective was to create a model that can simulate tissue of obese/overweight/fat people. The idea was to see if we could simulate the inor decrease of fat tissue, by modeling muscle (in)activity. The starting point of this model was to find an equation which models cell differentiation in a continuous way ¹:

$$\frac{d}{dt}m^{i}(t) = \frac{1}{2}\left(U_{M}^{i}(t) + U_{c}^{i}(t)\right),$$
(1)

$$m^{i}(0) \sim U(0,1), i = 1, \dots, C.$$
 (2)

Here C is the total amount of (discrete) cells in the simulation. The function $m^i(t)$ represents the maturity of cell i, which is closely related to the differentiation process of cell i. This function can only take values in the unit interval. The closer this value is to one, the more mature we consider a cell. Equation (2) shows that the initial distribution of the maturity rate is uniform distributed over the unit interval. Last but not least, the variables on the

right hand side of equation (1) give the *chemical* and *mechanical* stimulus that cell *i* senses. These values can be both positive or negative and will be very small.

The tissue in our body is constantly changing, old cells die and new cells are 'born'. The new cells need to grow and to mature towards a functional cell and towards a specific phenotype. This growth is induced by certain mechanical and chemical stimuli, see the right hand side of equation (1). The fun part of the model is to find out how to define these stimuli-functions in an appropriate way. This means that we need to think of some functions that represent how a cell can sense these components. To see the full details of this, you really need to read my thesis. For now, we can only say that $U_c^i(t)$ depends on a convection-diffusion equation, that models the spread of the chemical soup the cells live in. The function $U_M^i(t)$ depends on the stress/strain field on the computational domain.

By using the values of this continuous field, we try to boil it down to a single number for a cell to grasp. An important part of this 'translation' is the way how we define cells.

Our model is agent-based, which means that cells are discrete entities, like so:



The variables and functions shown here are used to define the position and orientation of a cell over time. If you look closely to the functions $L_k^i(t)$ and $W_k^i(t)$, notice the subscript k. This is used to implement a different shape for different phenotypes. For example, the length and width ratio of a muscle cell will be different than that of a fat cell.

By using this model for each individual cell, we can also incorporate the way a cell exerts force on its surrounding, or how it secretes certain chemicals. All of these properties can be linked to certain phenotypes, so that we have different behavior for different type of cells.

The words we have used so far only describe the basics of the model. This explanation is still far from a practical application. Then we would need to dive deeper into the specific phenotypes, their characteristics and how we can translate this to some mathematical function. Once you get the hang of the basics of the model, you start to see what its potential is. You can think of so many things that can be implemented to make it more realistic. However, one has to keep in mind Occam's razor.

With this concise overview, I hope I gave you an insight in my thesis. Writing down something you have worked on for so long in just a page is quite challenging. For me at least. For those that have yet to start their thesis, I hope you will enjoy it. Take your time. This might be the last time you can work on something with all your (mathematical) focus, and really dive deep into the details. You can make it as awesome as you want it to be!

¹we want a continuous differentiation process, so that we can model the growth of a cell in more detail. This also gives more freedom to the 'destination' of a growing cell.



Internship at Leiden University Medical Center

Chantal Posthoorn

For my master in applied mathematics I did an internship at the Leiden University Medical Center (LUMC) for three months. The project was about improving the hospital bed demand by adjusting the Master Surgical Schedule (MSS).

Currently, when making the schedule for the operating rooms (OR's) the bed demand on the wards (where patients will go after their operation) is not taken into account. This could lead to problems, for example the designated ward for a patient being full. The patient must then be transferred to a different ward, which could not be designed for his type of recovery. This can lead to a higher workload for staff or less good care for the patient. There is no bed shortage at LUMC, but management was still interested in optimising the bed demand of the wards when making the schedule. For my project we were in particular interested in bringing down the variation of bed demand on the wards. With the variation we mean that the number of occupied beds fluctuates on a ward during the week.

Research question

Can we improve the balance between the Master Surgery Schedule and the variation in bed demand?

To answer this question we first modelled the bed demand per ward given the current MSS. We then had the opportunity to validate the model. If the model mimics the realised bed demand we can conclude that the model is a good representation of real system dynamics. Next an optimisation problem can be set up and finally this should be implemented to achieve an optimal MSS with a more evenly distributed bed demand.

Models

Before optimisation we developed a model to determine bed demand per ward per day in the cycle; the duration of an MSS is considered as a cycle. This schedule repeats itself every couple of weeks, for LUMC this is every two weeks. Now the parameters necessary to calculate the bed demand are:

- the number of blocks per specialty per ward per day required
- the number of surgeries per specialty in a block
- the length of stay (LOS) of a patient per specialty per ward
- the cycle length

With the LOS and cycle length — along with basic patient information: the day he was operated on, the concerning specialty and the ward where he will be placed — we can determine the discharge date of a patient. With the discharge dates we can determine the bed demand on any day in the cycle. Together with the number of surgeries and blocks per specialty per ward per day we can calculate the total bed demand per ward per day. Objective

To answer the research question we had the following objective:

${\tt minimise} \quad Total Bed Demand$

Take the sum of bed demands of all wards in one day and call it DayTotal. The TotalBedDemand is then the maximum of all DayTotal values over a selected period of time.

Constraints

The first constraint is that all blocks required per specialty per ward should be planned. Next the capacity of the operating rooms should never be exceeded. And finally because we have a min max problem and want to solve with a linear program, we have the constraint that the total bed demand per ward must be greater or equal to the bed demand per ward per day.

To get more realistic results we added some constraints on for example the number of operating rooms a specialty could at maximum have per day.

Results

For the calculations we used a data set provided by LUMC. The MSS had blocks of operations per specialty and per operation room for each day. With this data and the current MSS the maximum bed demand for all wards together is 117 beds, while if we optimise the schedule we can obtain 103 beds. This means that some improvement is needed to see better results. Not only would the MSS need to be altered, more insight in the length of stay of a patient and to which ward a patient goes after surgery would be needed as well.

Experience

I really enjoyed my internship at LUMC, because it gave me insight in how complicated the logistics are in a hospital. If you change only one thing, for example the OR schedule, it influences almost all wards. Furthermore I got to take a look on the operating floor; it was very interesting to see the numbers of the MSS represented in reality. While I got the tour, the OR manager also mentioned lots of other logistical difficulties in and around the OR's.



Figure 1: Visiting the operating rooms



Dion Gijswijt

Although very simple to prove, the handshaking lemma can be a powerful

tool in the hands of a combinatorialist. Here, I will show you some

colourful applications and pose some challenges to you, dear reader.

Let me start by posing a simple question. Perhaps you already know the answer. If not, take a minute or two to see if you can solve it!

There are seven people at a party. Is it possible that each of them shakes hands with exactly three others?

In the language of graph theory, we are asking for a graph¹ with 7 nodes in which every node has degree 3. The following simple observation will be a central idea in this article.

Lemma 1 (handshaking lemma). Let G be a graph. Then G has an even number of odd degree nodes.

The proof is not hard. For all nodes u, count the edges incident to u. The total count equals the sum of the degrees of the nodes. It also equals twice the total number of edges, since every edge is counted twice. Hence, the sum of the degrees must be *even*. Therefore, the number of odd degree nodes must be even.

Hamiltonian paths

By a *Hamiltonian path* in a graph G, we mean a path that visits every node exactly once. Here, we will be interested in Hamiltonian paths between to given nodes s and t (we ignore the direction in which the path is traversed and only consider the set of edges on the path). Not every graph has a Hamiltonian path, and it is NP-hard to decide if a given graph has a Hamiltonian path between two given nodes. However, if we have one such path, we can sometimes conclude that there must be another.

Theorem 1 (Smith). Let G be a graph. Suppose that s and t are the only nodes of even degree. Then, the number of Hamiltonian paths between s and t is even.

Proof. Make an auxilary graph H. The nodes of H are the Hamiltonian paths in G that end in node s. Given a Hamiltonian path P between s and node u, its neighbouring Hamiltonian paths in H are defined as follows. Take any of the d(u) - 1 edges incident to u that are not in the path P, say edge e. Adding e to P will create a circuit. There is a unique edge $f \neq e$ in the circuit such that after removing f, we obtain a new Hamiltonian path Q = P + e - fbetween s and a node v. Now Q is declared to be a neighbour of P in the graph H. Clearly, if Q is a neighbour of P, then also P is a neighbour of Q.



¹All graphs will be finite and undirected

Observe that the number of neighbours of a Hamiltonian path P between s and u is equal to d(u) - 1. It follows that such a Hamiltonian path has odd degree in H if and only if u = t. By the handshaking lemma, H has an even number of odd degree nodes, which means that G has an even number of Hamiltonian paths between s and t.

As an example, consider the graph in Figure 1. Nodes s and t have degree 2 and all other nodes have degree 3. One Hamiltonian path between s and t is indicated. By Smith's theorem, there are an even number of such paths, hence there must be at least one other such path. Can you find it?



Figure 1: Find the second Hamiltonian s-t path.

The case that s and t have degree 2 and all other nodes have degree 3 is particularly interesting. Indeed, the degrees of the auxilary graph H will be either 1 or 2. The nodes of degree 1 correspond to Hamiltonian s-t paths. Hence, H just consists of disjoint paths linking nodes that correspond to Hamiltonian s-t paths. Simply following such a path from one end to the other gives an algorithm for finding a second Hamiltonian s-t path!

The catch is, that the graph H may be huge and the path we are following may have length exponential in the number of nodes of G. The theoretical complexity of this problem is unknown, but it belongs to a class of similar problems called PPA [2].

Sperner's lemma

Consider a triangulation of a triangle such as in Figure 2 (left). We want to



Figure 2: A triangulation (left) and a possible Sperner colouring (right).

colour the nodes with three colours (say red, green, and blue). A colouring is a *Sperner colouring* if the following are satisfied:

- (i) The three vertices of the large triangle have different colours.
- (ii) The colour of a vertex of the large triangle does not occur on the opposite side of the triangle.

In Figure 2 (right), you see a Sperner colouring. Three of the smaller triangles are shaded because they are *complete*, meaning that their vertices have three different colours. Can you find a Sperner colouring with fewer than three complete triangles? How about a Sperner colouring with *no* complete triangles?

Lemma 2 (Sperner, two-dimensional case). *Given a triangulation of a triangle, every Sperner colouring has an odd number of complete triangles.*

Proof. Make a graph G as follows. The nodes of G are the small triangles in the triangulation. We connect two nodes of G by an edge if the corresponding triangles share a side with a red and a blue vertex. Now we add one special node t corresponding to the large triangle. In G we make a edge from t to every small triangle that has both a red and a green vertex on a side of the large triangle.



Figure 3: The graph corresponding to a Sperner colouring.

It is easy to check that a small triangle corresponds to a node of degree 0, 1, or 2. A small triangle has degree 1 if and only if it is complete. The degree of node t equals the number of colour changes along the red-green side of the large triangle. Hence, the degree of t is odd. By the handshaking lemma, G must have an even number of odd degree nodes. So besides t it must have an odd number of odd degree nodes. That is, the triangulation has an odd number of complete triangles.

The general case of Sperners lemma deals with an n-simplex divided into small n-simplices and colouring the vertices with n + 1 colours, concluding that there is an odd number of complete simplices (i.e. simplices with vertices of n+1 different colours). The proof is almost the same as in the two-dimensional case presented above.

Sperner's lemma can be used to prove Brouwer's fixed point theorem:

Theorem 2 (Brouwer's fixed point theorem). If $f : B^n \to B^n$ is a continuous map from the closed ball to itself, then f(x) = x for some x.

See the wonderful *Proofs from THE BOOK*[1] for a proof.

The many other applications of Sperner's lemma include fairy splitting rent and the possibility of dividing a birthday cake among n people in such a way that nobody prefers someone else's piece over their own. Here people may have different likes and dislikes regarding chocolat, marzipan, whipped cream and various pieces of fruit on the cake, of course [3].

Some puzzles

Now that we have seen some examples, the picture should be clear. To use the handshaking lemma, we first make a suitable auxilary graph. This graph should be such that the odd degree nodes correspond to the objects we are looking for. Here are three puzzles for you that can all be solved using the handshaking lemma. If you want to share a nice solution or other problem involving the handshaking lemma, don't hesitate to contact me!

Problem 1.

In Figure 4, you see a graph related to the board game Hex. The nodes N and S are coloured blue, the nodes E and W are coloured red. Suppose that we colour each of the other nodes blue or red. Prove that there is either a path from N to S using only blue nodes, or a path from E to W using only red nodes.

Hint. Consider the nodes that can be reached from N by a blue path, or from E by a red path. Colour those nodes green.



Figure 4: A graph related to the famous board game Hex.

Problem 2.

Let G be a graph. A set D of nodes is called *dominating* if every node of G has a neighbouring node in D, or is itself in D. Prove that G has an odd number of dominating sets.

Problem 3.

Let $f:[0,1] \to \mathbb{R}$ be a piecewise linear function such that f(0) = f(1) = 0, and f(x) > 0 for 0 < x < 1. Two points (mountaineers) Alice and Bob are moving, in a continuous fashion, along the graph of f (a mountain). Alice starts at (0,0), and Bob starts at (1,0). At any moment in time, Alice and Bob must be at exactly the same height. Show that they are able to meet somewhere on the mountain.





Internship University of Waterloo

Rebecca Jacobs

This fall I did an internship at the university of Waterloo in Ontario, Canada as part of my masters degree in applied mathematics. At this university I did a project on sea ice concentrations in the Gulf of St. Lawrence. In this article I will tell something about my experiences and about my project.

The University and Canadians

During my project I was able to participate in many activities for international students which were organized by other students. During these activities I made many great friends from all over the world. We went in school buses to the Niagara falls, which lay right at the American-Canadian border. We also went to a Santa Clause parade in one of the nearby cities. An event in itself. Americans and Canadians love these locally sponsored parades, which are best comparable to the Carnaval parades we have in the south of the Netherlands. Only now the theme is strictly Christmas, reindeers and snowmen. Sometimes they are in the evening, so all of the trucks are lit with jolly lights.

Canadians are very friendly and I met many students that told me that they want to learn Dutch or that they want to study in the Netherlands. A lot of older Canadians asked me whether we wear wooden shoes — yes this actually happened multiple times.

Canada truly has some magnificent parks and reserves. With some students we went hiking a few times. We had some spectacular views and hiked some impressive trails. Canada has the clearest lakes and enormous forests. If you are lucky you can spot deers, beavers, moose, wolves and many more species. A fellow master student took me and some other international students to go hiking one day. We then also visited a reconstructed Indian village. There you could see exactly how the natives had lived there before the Europeans came. They build these huge tents in which several families would live.

During my stay in Canada I also went to a junior league Ice hockey game. This was a bit of a shock, I must admit. These 15 to 19 year-olds draw full stadiums. People of all ages are very willing to spend lots of money to watch teenagers play hockey in this semi main professional league. Because this is not an adult professional league, the game is a little less violent and you won't see fights on the ice that much...

Studying abroad really opened my eyes to other cultures. Plural, because Canada is built on immigrants who's cultures can now be found all over the place. I went to a Caribbean styled party and to a Indian Bollywood styled party where we did some traditional dancing. In Kitchener, the town next to Waterloo, there was an enormous October fest because that region has lots of German immigrants. Which meant I got to introduce my friends to Sauerkraut. Unfortunately, none of them liked it. Maybe someone should have explained it to them that it would be sour.

To finish up my stay in Canada, I traveled over the border to visit New York City with a friend. Even though the bus ride was tough, it was wonderful to be able to travel a bit and a good way to finish up my stay in North America. After I



Figuur 1: Hiking at Bruce penninsula park

came back from New York city, the international students went home one by one. It was hard to say goodbye to everyone. But I think it was bittersweet for everybody, because it meant that you were going home and would see your family and friends again. Over all I had a magnificent time in Canada and I would love to go back there someday.

Project

Predicting sea ice concentration and ice thickness is an important research topic for Canada. Because of global warning, the Gulf of St. Lawrence doesn't freeze over as often nowadays. This allows for more commercial shipping then before. With increased shipping in the area around winter time however, the demand for up to date information about the sea ice increases. Without accurate information ships run the risk of getting stuck in the ice.

At the university of Waterloo Andrea Scott works, among other things, on creating a system that can predict where the ice will be much like weather predictors try to predict the weather. Predicting ice however is very hard and not nearly as much research has been done so far as has been done for weather prediction.

In many projects where mathematical modeling is used, the researchers use data assimilation. The idea is to use measurements to help the model stay on course so to say. In this particular project the measurements and model are cleverly averaged based on how certain we are of either one. Sea ice thickness or concentration however cannot be measured directly due to its remote nature. This is one of the issues that makes data assimilation for sea ice a hard problem. The ice is always measured indirectly using satellite images that are then processed to give ice thickness.

Another issue is that since the measurements cannot be done directly but must be deduced from other data, the measurements are often significantly biased. Different techniques of coming to different ways to measure the ice also give different biases. Because mathematical models also tend to be a biased representation of reality there is no way to know for sure what the truth is. The goal of this project was to find a method that can reduce the





Figuur 2: NEMO model analysis on the 31st of January 2014



Figuur 3: The PMS measurements on the 31st of January 2014

biases automatically such that a normal data assimilation cycle can be run. The method chosen to use is given in a paper given to my by my supervisor. This method automatically corrects the biases during the assimilation process. A standard assimilation cycle looks at the background state X_n , the measured state Y_n , the positions of the measurements given in operator H and the ratio of trust in the background state versus the measurements K. This K matrix is often called the Kalmann gain matrix. The new assimilation method also introduces a model bias \mathbf{c} , a measurement bias \mathbf{b} and a priori estimate of the measurement bias \mathbf{b}^0 .

For this project there were two types of measurements available and the background state on three different days. As an extra source, ice charts are used. Ice charts are made by experts from satellite images. They are made pixel for pixel and take a lot of manual labor. Because the process of making the ice charts is so time consuming it is not feasible to use them in an automated system. Note that all images in figs. 2 to 5 are of the same day. Since they differ quite a lot from each other clearly the measurements and or the background state must be biased.



Figuur 4: The SAR measurements on the 31st of January 2014



Figuur 5: The ice chart for the 31st of January

Interview Simeon Nieman

Magnus Blue



You study mathematics, but what are your plans for the future? Will you stay in academia or aim for a career in business? If so, why would you choose a job in consultancy? We asked Simeon Nieman, a mathematics graduate who recently joined IT consultancy Magnus in Naarden.

Welcome Simeon! Here's something to warm up with: Pi or E?

That doesn't matter to me, I don't find either of them particularly interesting. Actually, I prefer the square root of 5. It's a beautiful number somehow, maybe because it has to do with the golden ratio. Pi or E, well, they exist, but that's just about all there is to them.

Alright, here's another one. How would you prefer to immortalize yourself: proving the Riemann hypothesis or solving the P=NP problem?

I would prefer to solve the P=NP problem. Riemann has a longer history than P=NP, but given the current situation with the abundance of electronics and computer problems P=NP is a lot more interesting and relevant.

That's clear. So tell us more about yourself?

My name is Simeon Nieman, and I'm originally from Tiel. I studied maths in Nijmegen, then lived in Germany for two years. In my spare time I read a lot, and I enjoy playing the cello.

What's the last book you read?

I'm currently working on Cryptonomicon, a story about security issues. Before that, I read Jules Verne.

Studies, from chemistry to algebra

We are obviously curious about your choice of studies. Why did you choose to study mathematics, and where?

As a matter of fact, I didn't start in maths – I started in chemistry. Mathematics was a gradual addition. I started taking a few maths courses on the side, and eventually did more and more of them until I dropped chemistry entirely. I chose Nijmegen because at the time that was the best place to go for chemistry, but I found out pretty quickly that all the lab work that goes with chemistry is not my thing. Of course there is an exact side to chemistry, but people in this field make a lot of approximations without recognizing them as such. That bothered me a little.

What was your graduation thesis about?

I did my graduation thesis on a purely algebraic structure, the Mathieu space, which is a generalization of the radical. It is a fairly new area of research and I mainly spent my time looking for good examples. In the long run, this area should help us to solve the Jacobian conjecture, though it remains to be seen whether this approach will actually succeed.

After your study you chose to do a PhD. Why?

I went to do my doctorate studies at Münster, in a totally different direction within mathematics: topology. I worked on that for two years, until I came to the conclusion that both topology in particular and mathematics in general – maybe even science in general – just aren't my thing. It ended up being highly focused on the individual, with little contact between or discussion with people. I didn't like that; you end up being restricted to a very abstract frame of inquiry. I wanted a something broader.

Why did you stop?

I wanted to spend more time working with people and solving practical problems. I had always only dealt with very abstract problems. There comes a point where that becomes somewhat boring, and you look for a change.

Switch to a career in consultancy

From a scientific topology problem in Germany to consultancy – that seems like a long way to go. Wat brought you to look for a job in consultancy?

I considered other things as well; for instance, I had a look at job opportunities at TNO. I ended up in consultancy because of the very practical challenges, because of the opportunity to give advice to people, and the opportunity to really use my knowledge and analytical skills in solving all sorts of problems. I really liked that idea.

Why did you choose Magnus?

I had a look at various consultancy companies to see what the options were. What I noticed about Magnus was that they pay a lot of attention to learning and knowledge distribution within the company. I liked that. In addition, the teamwork aspect was very well represented at Magnus.

Do you like your job so far?

Yes, I enjoy working at Magnus. It's an excellent place to work with a good atmosphere.

How would you describe that atmosphere?

They put a group of clever people together in one place, and you notice that. They give you a lot of freedom in what you do. Whenever anyone runs into a problem, they ask around to see if anyone knows something about it. We do a lot of things outside of work, too; every few months we do an activity with everyone. It's fun, and good for teambuilding.

Were you worried that you wouldn't find consultancy work intellectually challenging enough?

I didn't really consider that possibility beforehand. I've never been very worried about it and it turns out I was right not to worry – my work is challenging enough!

8

Analytical thinking in practice

We're very curious about your big transition from science to consultancy. What was your first assignment?

The first thing I worked on at Magnus was designing and building the email marketing system for Beter Bed. The problem was connecting the email package to the systems of the web-shop and the company's administration. I was very glad when it all came together and worked – the idea that someone might go to a Beter Bed store, buy a bed, and then get an email congratulating them on their purchase, and that I had been a part of solving that problem, that gave me a good feeling.

Did it give you the satisfaction you had been missing in mathematics?

Studying mathematics, you feel satisfied when you solve a problem or prove a proposition. It ends up being a lot of work, but it doesn't happen all that often that you actually succeed. If in the end you do succeed it feels really good. But what I do now is more of a continuous process.

Next, you did another project, working on the pricing system of WE Fashion. What problem did you tackle there?

WE Fashion had a pricing engine, a program that calculated discounts and prices. Imagine that you have a shopping basket with lots of different products, and that each product can have different discounts. You buy a red t-shirt, and there's a special half-price sale for red products and there also happens to be a $\in 10$ discount on all t-shirts. Which of these discounts applies to your t-shirt? This is a simple example, but it can rapidly get a lot more complicated if you have more products in your shopping basket or if there are more discount rules available. My work had to do with those calculations.

What did you do, exactly?

I set up the concept together with some of my colleagues. We started with about five of us in a room to consider how we were even going to approach the project; what we could adapt from the existing method, and what we had to do differently. We were able to immediately rule out a number of ideas. By working out the remainder, we came to a final version of our idea. Once the concept was there, my job consisted mainly of actually doing the programming. Afterwards, we did the testing with a slightly larger group of people.

The idea behind the pricing engine is to move efficiently through a decision tree. You take a pricing rule and apply it to all the relevant products in a shopping basket, then consider the remaining items. Gradually you go through all of the products and pricing rules, until you have the optimal result – viewed from the perspective of the customer, who wants the lowest price.

That sounds like an excellent project; teamwork, a happy client, and a problem solved within a short timeframe. What do you enjoy most about your work?

I like the variation. You end up constantly working on something else; no two days are the same.

Working with colleagues

You spend a lot of time working in teams with your colleagues, something you missed in academia. What is your main contribution to the teams you work in?

That's a fun question. I think my colleagues mainly come to me for help if they have conceptually more difficult questions. Working out the details of the problem, that part is usually fine, but if there is a problem where the method for solving it is not immediately clear – that's when my colleagues come to me.

What do you learn from your colleagues?

All sorts of things, in all sorts of areas. There are a lot of technical skills that I don't have or am still developing that my colleagues can help with. There's a lot to learn about dealing with clients. In the academic setting, of course, you don't have clients – only other scientists. There's definitely a lot for me to learn from my colleagues.

What kinds of backgrounds do your colleagues have?

Most people have some kind of scientific education, but the backgrounds are quite varied: we have people with a background in artificial intelligence, mathematics, information technology, energy, animal management – all sorts of things.

Science versus consultancy

What is the difference between science and consultancy?

It is very difficult to compare. In the sciences your main concern is developing and extending knowledge, whereas in consultancy the main concern is applying knowledge. One essential difference is communication – in the scientific community, you only communicate once you have something finished, while consultancy you communicate constantly in order to achieve the result you want.

What are the greatest similarities?

Consultants and scientists are both people, in the end...

Advisory role

Now that you are in an advisory role, what advice would you give the Simeon who applied to Magnus a year ago?

I would prefer to go further back and give the Simeon from three years ago some advice. I would say, "Don't go to Münster, go into business, and consultancy in particular." Those two years in academia I worked very hard but hardly achieved anything at all. Now I feel like I can actually make a difference. It is a lot more satisfying.

Do you have any last tips for students in mathematics?

Know that the world is a lot bigger than just science and orient yourself towards the job market. The knowledge you have gained can easily be applied in practice, which also generates a lot of satisfaction and appreciation. Working in consultancy gave me the right balance between intellectual challenge, variation, and cooperation with clients and colleagues. I can recommend it to anyone!

Magnus blue



Interview: Leo van Iersel

Marjolein Bouwmeester & Ghiline van Furth

An interview with our combinatorial optimization lecturer Leo van Iersel.

He will tell about his study, what he did after that and how he became an

assistant professor at the TU Delft. He has an interesting carrier develop-

ment; for example he travelled a lot, but he will tell about it himself.

To start with, could you give a short introduction of yourself?

Who am I? My name is Leo van Iersel. I studied Mathematics in Twente, after that I went to Eindhoven, where I promoted. Then I left the Netherlands behind me and went abroad. For one and a half years I stayed in New Zealand to do my postdoc, and I spend one year in Tanzania to teach Mathematics there. My next step was going back to the Netherlands, but this time to the capital Amsterdam. For three years I did research at the CWI ('Centrum Wiskunde & Informatica'). And only since last year I started working in Delft, and now I'm an assistant professor at the TU Delft.

That's quite a journey. So Twente is where it all started?

Yes, I did Applied Mathematics there, which is just like the program here in Delft. From the beginning on my interest was always in optimization. That's why I graduated at Thales, which is a company that makes radar systems and where I could use my optimization skills to make a new algorithm.

And then, Eindhoven?

In Eindhoven I kept on working in optimization, but this time with a focus on applications in Biology. I looked at different applications. All the subjects of the applications where related to DNA and, for example, how to use DNA to look at the evolutionary connections between animal species and plants. I made algorithms to link those DNA information and make it possible to put it in a network or (optimization)tree. This was my four year research project to promote.

After that you went abroad?

I was looking for a next step in this direction. Thus I got in contact with Mike Steel, who is a professor of Mathematics and Statistics in New Zealand and has a lot more experience in this particular field of research than I had back then. Luckily he had money for research, so he took me in. I stayed for one and a half year and could even stay longer, but I thought it was time for the next adventure.

And what was that next adventure?

After New Zealand I still wasn't homesick at all. I stayed abroad, but this time in Tanzania. I took a break from my research and did something entirely different. Still in Mathematics though, I started teaching mathematics at schools there. Not at the University level, but in high schools. I taught all different grades, from the highest to the lowest, and I even taught at a primary school.

Did you ever want to teach at high schools in the Netherlands too? Not really actually. The thing I like most about teaching at a university is the combination of doing my own research and being able to teach at the same time, and that I can discuss my research with my students in class.

Then, what did you do back in the Netherlands?

After Tanzania, in 2011, I started doing research in Amsterdam at the CWI (Centrum Wiskunde & Informatica). For three years I worked there in the same research area as before: the design of algorithms for discrete, computational problems, including problems from Biology. I got funded by my personal Veni grant from NWO, which is a grant that allows researchers who have recently obtained their PhD to conduct independent research and develop their ideas. In the meantime I taught Optimization courses at the TU Eindhoven.

But now you're in Delft?

Yes, only since last year I'm an assistant professor here in Delft. About half of my time I spend teaching Optimization courses, the other half I do research. At the moment I have applied for the Vidi grant, which is also from NWO. This grant is meant for researchers who have already spent several years doing postdoctoral research to develop their own innovative lines of research, and to appoint one or more researchers. With this grant I could even hire my own research assistants, AIO's ('assistent in opleiding'). This grant would be a great opportunity for me and the students that will cooperate. I hope that my next MaChazine article will be about the research I am starting with my grant.



MaCHazine Survey

Dear reader,

The MaCHazine has been a quarterly publication of study association W.I.S.V. 'Christiaan Huygens' for the past twenty years. We are constantly trying to improve the MaCHazine to keep it fresh and contemporary. Your feedback in this area is valuable.

We would kindly like to ask you to fill out the following survey about how you read the MaCHazine and where you would see room for improvement.

Your efforts are very much appreciated.

Saskia Vertregt Editor in Chief

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 How would you rate, in general, the different permanent sections of the MaCHazine?



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Please note that this survey is also available online at https://wisv.ch/survey

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Science trends

Rebecca Glans

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

Let's inject ourselves with fluorescing particles!

Biopolos, a research complex in Singapore, has its researchers experiment with virus-sized particles which can fluoresce and use them in biology. PhD candidate at the National University of Singapore Chi Ching Goh hopes to use these particles to find blood vessels that are leaking, detect diseases such as malaria or predict a stroke. Although many compounds can fluoresce – jellyfish proteins are one of them – nanolights are more stable, versatile and easier to prepare. Quantum dots, which are tiny flecks of semiconductor, are the best examples and are prized for their beautiful crisp colours. However, other nanolights are on the rise. Some are made of polymers or small organic molecules. These are less toxic than quantum dots and even outshine them. Outside the research labs, nanolights are already being applied in areas ranging from flat-screen displays to biochemical tests.[1]

BRIDGE THE GAP

Some virus-sized particles can be tailored to absorb light and fluoresce at specific frequencies. Light kicks electrons up to higher energy levels, and the glow is emitted when the electrons tail back past a wide energy gap.

Semiconductor Emission colour changes shell nanocrystal with size of dot

Figure 1: Part of the explanation of nanolights. Full image in source[1].

Einstein is still awesome

There is no doubt you have seen at least one headline stating that gravitational waves have been detected. A phenomenon Einstein already predicted during his lifetime! Gravitational waves are ripples in the fabric of space – similar

to ripples created in a pond by throwing in a rock. These ripples appear to stretch and squeeze back again. February, this year, scientists announced they found gravitational waves coming from another galaxy being up to 1.86 billion light-years away. It seems 2 black holes collided, shaking the fabric of space and time. On earth, it caused two giant detectors in different parts of the united stated to slightly tremble.



Figure 2: Artist representation of gravity waves emitted from the movement of 2 massive celestial bodies[2].

These detectors are together called the Laser Interferometer Gravitationalwave Observatory, LIGO for short. LIGO uses a special mirror to split a beam of laser light. Each beam then travels through one of the two 4 kilometers long tubes. These tubes are perpendicular to each other. Under "normal" conditions the light beams will cancel each other out when they recombine. In case of a gravity wave, one tube will stretch out while squeezing the other (like a ripple). When the light beams recombine, their waves no longer align perfectly.

This signals a passing gravity wave! To make sure local phenomenons don't trigger the LIGO, two detectors are used in different areas. This way you can make sure a gravitational wave is detected if both detectors say so. Having two detectors also means a better way in triangulating the source of the wave. [2]

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Live performance insights & happy users

Worth Internet Systems

Users demand a great user experience, those not delivering, fail.

Technology is enabling users to do things they weren't able to do before. The can for example login to online applications, collaborate with colleagues, access real time dashboards and have this all accessible anywhere, anytime on their smartphone. But when technology gets more mainstream, just having the technology is not enough. Organisations and users demand a great experience using tech and those delivering a great UX are winning. Increasingly organisations are prioritising improving the experience of their users, customers, employees while using their online systems.

User experience requires a multidisciplinary effort, it's not just user interface design

Traditionally user experience is the realm of creatives and designers but IT teams and back end developers have a serious influence on the user experience as well. Let's take one quality attribute that has more influence on user experience than any other system performance. The technical design of a larger scale online system (100.000+ users) needs careful planning to make sure it can deliver the requested rich functionality to all users whilst maintaining healthy response times.

Data is key

System designers need insights about usage patterns to be able to successfully design a system that delivers great performance to a big user base. Often, with running systems obtaining meaningful performance metrics in order to understand the real user experience can be a big challenge. "At Worth Internet Systems, we design big scale systems both for government in The Netherlands and in the UK and regularly build online services for new promising startups. They all need to scale, and to plan for scale we needed to gather the right data. One of our systems was introduced on 'De Wereld Draait Door' a National TV show with over 1 million viewers. This required careful planning and analysis of the patterns of users we could expect.

How to gather data

There are various ways of gathering data about the usage of systems. We've used a realtime analytics platform called New Relic as a key element in the application lifecycle of largescale innovative projects. The platform supports performance decisions based on data from a system in production, without the measurements impacting live performance too much. It uses intelligent agents that collect data in realtime, making it easier to query and analyse the performance of the system in real life.

"We recognise the value of retrieving realtime data and making decisions based on facts," says Ernout van der Waard, director at Worth. "Our teams have developed expertise in interpreting the available data and it has become integral to every stage of our DevOps process. Insights empowers our teams with the information and answers they need to act quickly and uniformly".

Interpreting the data

A recent project illustrates how the company uses the analytics and demonstrates the benefits that are possible.One of their clients based in the United Kingdom operated a platform designed to support more than 100,000 users. They asked them to investigate why the platform wasn't performing at optimum level and was running slowly compared to its original specification. Poor performance meant that many users were abandoning the system. In fact, research indicated that more users dropped off for every second delay.The client assumed that the system was not scalable. They thought that it became slower as more people used it and they were considering a server upgrade. However, by using realtime analytics, they were able to go much deeper into the problem and identify the real cause.

"Instead of trying to reproduce real life usage patterns, we were able to record data in this big scale production system over a 3 week period and analyse this. That's because New Relic on a live server measures everything that's going on," says Ernout. "It analyses what the server is doing and shows the time the server spends on each part of a task in minute detail. We can see how long the platform takes to execute a request and how long it takes to transfer data to the user. It allows you to see exactly how a system operates and highlights the real problem. When we took a look at the analytics, the data revealed that the system actually went faster at scale. As more people used it, response times were quicker. This was because requests are cached by the system so that the next response is quicker.

Going beyond analytics to discover insight

The team's initial conclusion was that there was a problem with slow response times, but the issue was definitely not scalability. They were then able to investigate individual response times because realtime analytics give more accurate insight than measurements based on average response times. Basic analytics showed average response times were approximately 2 seconds. In fact, realtime analytics found that some were in excess of 15 seconds. So, it was no real surprise that users were abandoning the system.

The team was able to go much deeper and look at slow transactions in more detail. They could pinpoint which part of the transaction caused the bott-leneck and tune the application. As a result, the next release gave the client much faster performance. By identifying the real problem and testing different scenarios, the team was able to recommend a series of actions that would improve performance even further. The client could now take action based on fact rather than assumptions.

One metric the team used was the Apdex metric. It's a helpful metric to score how satisfied users are with the performance of the application on a scale from 0 (not satisfied) to 1 (satisfied).

Apdex_t = (Satisfied Count + Tolerating Count / 2) / Total Samples

This data driven approach saved the client money, because they had originally planned to buy new highercapacity servers to cope with the issue of scale. And, by improving the user experience, the team's recommendations also helped to improve satisfaction levels and reduce customer churn.



Example of a scalability chart showing the relation between requests per minute, and the response times.

Realtime data throughout the application lifecycle

The project shows how realtime data can simplify and speed up troubleshooting on an existing application. However, it is important for a DevOps team to continue measuring the environment and testing applications with live data to ensure they meet performance targets.

"Trying to create a realistic test environment for largescale applications is difficult," says Ernout. "To understand and optimise the user experience, developers need to mimic the behaviour of all users. We have found that putting a realtime analytics platform inline on live systems creates only a minimal slowdown. That makes it possible to test largescale operations live and get great insights that are just not possible in a simulated test environment."

The user experience is a key element in the applications that Worth Internet Systems develops. It's essential to measure user experience (and elements of it like performance) on every project, large or small, because even with a great user interface, slow performance will result in a poor user experience.

"That's where live performance data gives us a real advantage and that's why it's an integral part of our business," says Ernout. "Systems are getting more complex, but they must create a simple experience for the user. So, it's important not to just measure, but to understand what to measure. With each project, we plan what we need to measure by identifying the key performance indicators (KPIs) that are important for the client. It gives our team the tools to understand what happens in the real world and create applications that will deliver actual benefits for the client. When the application is running, the available data can be used for troubleshooting or as a proactive tool to identify when programs are getting slower and problems are likely to affect the user experience".



About Worth Internet Systems

Worth Internet Systems is an agile business specialising in digital product development and user experience design for major government and public sector clients in The Netherlands and the UK. The company consists of multidisciplinary teams of highly skilled java developers, front end experts, designers, testers, scrum masters and product owners. They are experienced in delivering largescale interactive combined with responsive and user focused design. Actually, quite a few of them are (recent) graduates Computer Science and Applied Mathematics from TU Delft!

Their development teams are based in either London or Den Haag, and work facetoface with our clients. This has proven to be a successful way of delivering complex projects within short timeframes, resulting in a dynamic, collaborative, fun working environment for clients and the teams. They are always interested to talk to smart, enthusiastic and driven students, so feel free to contact them at any time about job opportunities! You can find more information at *http://worth.systems* or call Irene Sanders on 070 8200998.



Ernout van der Waard (33) is a director at Worth Internet Systems. He founded the company in 2002.



Blaise Pascal

Marjolein Bouwmeester

Think about that quite complex calculator you had in high school (and mostly may not use any more, unfortunately), the simpler one you had in primary school, or the calculator on your mobile phone. Nowadays every phone has one, and you use it without realizing or ever doubting the answer. Someone once started making that. That someone, the first inventor of the mechanical calculator, is Blaise Pascal.

Blaise was the son of Étienne Pascal, a tax collector in Clermont-Ferrand. When the mother of the family died, Étienne sold his work to his brother and focused fully on the raising and the education of Blaise and his two sisters. Étienne taught his children everything he knew, all by himself. By doing this, he discovered very early that his son was extremely talented. From the age of seven years old, he was very eager to learn more and more about mathematics and mechanics. Although Étienne really enjoyed raising his kids the way he did, he had to go back to work as a tax collector, because of some bad investments. A lot of calculations were involved in this job and Blaise helped his father with this. This work inspired him to the invention of the first mechanical calculator.

Back then the Académie Française was a paradise for French scientists. Not by the easiest path, his father did get accepted there. That made it possible for Étienne to get his son in touch with scientists from the highest class. Blaise eventually ended up working with for example Fermat, Christiaan Huygens, Gottfried en Leibniz.

He also got in contact with mathematician Desargues. Blaise Pascal was only sixteen then, in 1639. This contact made him coming up with a theorem. He produced a short treatise on what was called the "Mystic Hexagram" and sent it, what was his first serious work of mathematics, to Père Mersenne in Paris. The theorem, that is still known as Pascal's theorem, states that if a hexagon is inscribed in a circle (or conic) then the three intersection points of opposite sides lie on a line.

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Only three years after that, the invention of the first mechanical calculator happened. In 1642 he invented it in Rouen and called it the "Pacaline". Blaise Pascal found out that the hardest part about the calculation the 'remembering of a transferring number' is in case of big summations. He developed a little wooden box with at first six, later eight, cogwheels that were constructed next to each other. Every kind of coin had his own cogwheel and, when it was turned, let the other cogwheels turn too, which made them leap. The leaping was the effect of the transfer. In that time this invention was revolutionary and is often seen as the precursor of the computer. These machines are pioneering forerunners to a further 400 years of development of mechanical methods of calculation and in a sense to the later field of computer engineering. However, the calculator failed to be a great commercial success. The machine saved time for you, but the costs of making the machine were high. The Pascaline became little more than a toy, and a status symbol, for the very rich both in France and elsewhere in Europe. Eventually only fifty were sold. Eight Pascalines are known to have survived all the years until now.



Figure 1: A Pascaline

Next to the mechanical calculator, where we can all clearly still see the importance of it, Pascal also had more contributions to mathematics. His "Treatise on the Arithmetical Triangle" of 1653 described a convenient tabular presentation for binomial coefficients. The triangle is now called "Pascal's triangle". He defines the numbers in the triangle by recursion: Call the number in the (m+1)th row and (n+1)th column t_{mn} .





Then $t_{mn} = t_{m-1,n} + t_{m,n-1}$, for m = 0, 1, 2, ... and n = 0, 1, 2, ...The boundary conditions are $t_{m,-1} = 0$, $t_{-1,n} = 0$ for m = 1, 2, 3, ...and n = 1, 2, 3, ... The generator $t_{00} = 1$. Pascal concludes with the proof:

$$a_{mn} = \frac{(m+n)(m+n-1)...(m+1)}{n(n-1)...1}$$

In 1654 he proved Pascal's identity relating the sums of the p-th powers of the first n positive integers p = 0, 1, 2, ..., k.

Calendar



WiFi Rally

The WiFi has not been idle since organizing the Skiing Trip, on the contrary! March 26 and 27, they organize a weekend long rally through the Netherlands, Belgium and Germany. The rally consists of multiple stages, each with a different, challenging puzzle to be solved to find the destination.



CHoCo Parents' Day

All students Applied Mathematics and Computer Science are invited to bring their parents and other family members to the Parents' Day at faculty EEMCS on April 23, 2016. Show your parents where you study, what lectures look like and what Delft has to offer!



iCom

The iCom will organize a trip from 10 to 14 May to Dublin. 36 students and two teachers from EEMCS will visit several companies, the Trinity College University and have a look at the cultural aspects of the city and country. Later this year, their students will visit us in a similar fashion.

March

- 22 T.U.E.S.Day Lunch Lecture by Joost Broekens
- 23 Company dinner with Shell, Deloitte and Magnus Blue
- 24 Freshmen Programming Contest
- 26-27 WiFi Rally
- 29 T.U.E.S.Day Lunch Lecture by Keylane
- **30** AkCie KinderSpaceje
- 31 Career after University

April

 T.U.E.S.day Mathematics Lunch Lecture
 MatCH Poker Tournament
 Gaming Friday
 CHoCo Parents' Day
 T.U.E.S.day Lunch Lecture by ING
 ComMA Activity
 CHoCo Brothers/Sisters Party

May

3	T.U.E.S.day Lunch Lecture by Topicus, drinks afterwards
4	General Assembly 5
10	T.U.E.S.day Lunch Lecture by Magnus Blue
10-14	iCom
10-14 17	iCom AkCie Members Lunch
10-14 17 18	iCom AkCie Members Lunch Yearbook Presentation Drink

