BRAIN STORM

22. Parody city

8. Thinking about simulated thinking

TABLE OF CONTENTS

●○○ Entertaining article, no scientific content. A puzzle or a Cover related article are examples of this category.

●●○ Easily readable article on a scientific topic. Should be comprehensible, even without any prior knowledge.

●●● Scientific article that explores a certain topic in depth. Might assume the reader has taken a course that's related to the topic.

EDITORIAL

BY: *Arnoud van der Meulen, editor*

Sims (or simulations) are, in the traditional sense of the word, imitations of a real world situation. You can look at these imitations in a very broad sense: simulations are used for pilot training, simulations are used in science to find certain effects and there are simulations that are used for day-to-day entertainment.

Although I have no personal experience with training simulators, I have plenty of experience with the other two. I have used and written my fair share of agent simulations, exploring social effects - like the spread of secrets and gossip - or simply exploring the flow of a population. Of course, none of these simulations have grand consequences for how we think about the world, but they do provide an insight into the world we live in.

I must admit to having played way too many simulation games: all versions of SimCity, all main versions of the Sims (and their expansion packs!), and some beautiful classics like SimCoaster or SimA(a)nt. My most vivid memories are from Sim Theme Park (Theme Park World) and Theme Hospital. Special mention here should go to this very Theme Hospital: the dark humor in this game can cause quite a laugh. Next to the Sim and the Theme games, we of course have the business simulation games: the Tycoon branch. Who doesn't remember classics like Rollercoaster and Railroad Tycoon?

In this edition of the Brainstorm, Harmen de Weerd will educate you about the effects of Theory of Mind. Readers will also learn something about our very own introductory camp from Oscar Bocking. On top of that, you can find out where to order your spare ribs in the future, and Arryon's column might help you relive some fond childhood memories. I know I have relived quite a few.

A final aspect of simulations that deserves attention is its application in the future: virtual reality. While most simulations are simply on your computer nowadays, how cool would it be if you could see a simulation around you? Just think of all the possibilities! Virtual reality is for example used in visualizing things to make them easier to understand, or in psychology to help people overcome their fears. Of course, what most AI and CS students really care about is the application in gaming: these simulations could result in the coolest RPGs ever. That, or you could play The Sims in virtual reality! Who knows what the future will bring?

PHOTO: *Arnoud van der Meulen*

BY THE BOARD

BY: Jip Maijers, treasurer

Well, here it is: the first brainstorm of the year, and man, what a year it is going to be for me and my fellow board members. At the time of writing, we just finished our first few weeks as the official board of study association Cover. It feels a little strange to finally be at this point. Of course, our predecessors have readied us for this task, we attended board meetings and gradually took over more of their work. It was almost as if we were trained in a simulator.

That brings me to the theme of this issue: sims. There are many simulators in existence, from simulators used to train astronauts, to less serious ones - I'm looking at you, grass simulator. Some of them are fun to play, others are more... how should I put it... artistic.

But all of these games have something in common: they offer us a chance to be in another person's, animal's or thing's shoes. I could never fly a plane (let alone be an actual goat) but because of these simulators I can still kind of experience it.

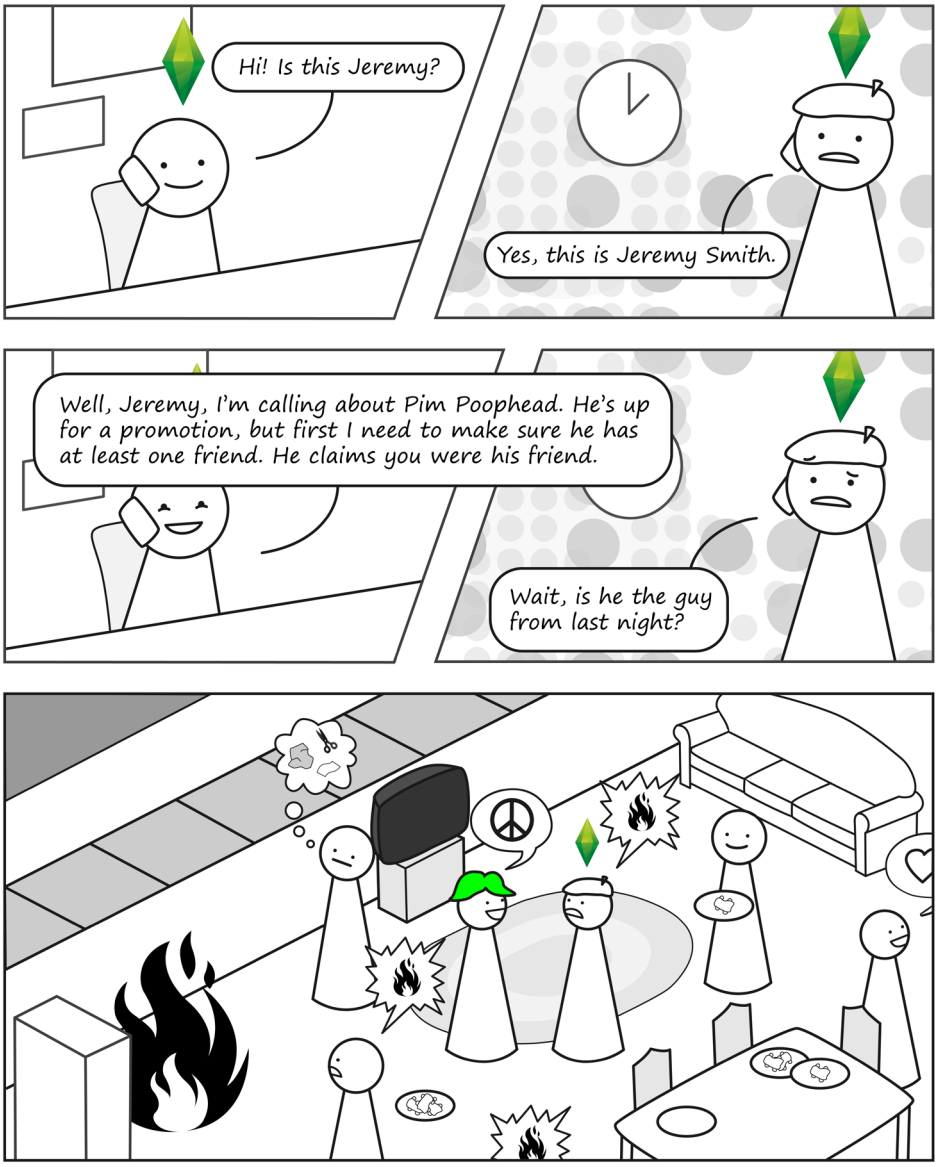
The beauty of sims is in their scope: while some are very accurate representations, others are nothing more than two paint frames that switch when a button is clicked (*cough* ducksimulator *cough*). Sims can be very funny or of more serious nature. Some sims are used to train people for their jobs, and others are used by these same people to relax.

It is almost as if the concept of simulators is not that different from being on the board of Cover; me and my fellow board members have already shared many amazing moments, but also very serious ones. I am looking forward to the coming year and everything that goes along with it. Well, I guess this is enough for this time. Now, if you'll excuse me, I am going to be a goat for a while.

PHOTO: Jip Maijers

COMIC

BY: Ben Wolf



SIMS COLUMN

BY: *Arryon Tijsma*

Sims. The illustrious genre of computer products where nothing has to be as it is in the real world. There are many interpretations for 'sims'; however, nobody really takes you seriously if you nerdgasm over some state-of-the-art weather simulation or spend your couchpotato time peering at the financial forecast of EU countries. Simulated A.I. is already a bit more fashionable, since it's pretty hype and can at times be weirdly funny, but what makes our hearts secretly beat faster, and brings out the best and absolute worst in us, is video game sims.

I, the certified college gramps, grew up in unconditional adoration of what I consider the most epic, undisputed king of sims: Roller Coaster Tycoon (RCT). Its sequels couldn't even come close to the galore that the first installment in the series brought to our eager, secretly sadistic young minds. A while ago I saw a video on the dark side of Youtube featuring PewDiePie: child-loving, narcissistic, generally overdone

> we unanimously become cruel motherfuckers

SCREENSHOT: *Fire in the Sims*

Swede. But! To my joy he was reviving some of my childhood love by playing RCT, and I suddenly remembered the hours I spent only playing the fucking demo of that game because it was so bad-ass. I repeated the first level until I was afraid the game's bytes had actually been worn down and it wouldn't start anymore.

The best part about RCT, and many sims in general, is that at some point they bring out the absolute worst in anyone. Most of you lot probably spent your childhoods playing The Sims, but the same principle holds: from Truck Simulator to Farming Simulator to Goat Simulator to Rock Simulator (yes, it exists, this is the internet we're talking about). When faced with the opportunity to play god, at a certain point we get bored, and we unanimously become cruel motherfuckers. Some examples:

In RCT, I would randomly throw people that puked in the swimming pool to "cool them down". They actually drowned horrible deaths, and oh, did I know. I also took away the exit so at its peak capacity my visitors would roam my amusement park FOREVER *insert Dr. Evil laugh here*! Crashing attractions was also one of my favorites, but oddly enough my visitors would all run away because of it. No, you had to be more subtle. Raising the price of umbrellas when it rained by a hundred dollars, re-routing the exit of a roller coaster back to the entrance. You name it, I did it. Giddy.

The Sims series, of course, had its own awesome share of godly pranks you could pull off on your inhabitants to make their lives more miserable and keep yourself entertained. The problem with The Sims however, becomes the fact that the morbid action is pretty up close. Where in some games people are just nice, vague pixel blobs, in The Sims they become eerily human, and suddenly you have to be a real sadist pro to not feel guilty when your sim suffocates to death in the pool, or your children are set on fire after you locked them in the basement with no toys to play with. I guess that's what separates the wannabes from the real psychopaths.

Crashing attractions was also one of my favorites

BY: Harmen de Weerd

Thinking about simulated thinking

Agent-based models of higher-order theory of mind

Introduction

On a daily basis, people reason about the beliefs, desires, and intentions of others. When someone is reading a book, for example, he or she makes use of this so-called theory of mind ability (Premack & Woodruff, 1978) to identify with the protagonist, and to understand that this person may have beliefs or goals that are different from his or her own. People can even take this ability one step further, and use second-order theory of mind to reason about the theory of mind of others. Suppose, for example, that Angela Merkel believes that Alexis Tsipras believes that Merkel wants to avoid a Grexit. In that case, Merkel is using second-order theory of mind to reason about Tsipras' beliefs concerning her goals.

Experimental evidence shows that people can make use of orders of theory of mind beyond the second, but also that there are limits to the theory of mind abilities of participants (Liddle & Nettle, 2006). One possible explanation for these limits is that at some point k, it becomes too difficult or too resource-demanding to reason beyond k^{th}-order theory of mind. Alternatively, it is possible that reasoning beyond k^{th}-order theory of mind is no longer beneficial. In this article, we put the latter hypothesis to the test using agent-based simulations. We make use of an agent model rather than human participants so that we can construct agents to be restricted to a given level of theory of mind reasoning. Additionally, the use of agents allows us to monitor precisely when our test subjects make use of higher-order theory of mind and how they benefit from it.

According to the Machiavellian intelligence hypothesis (Byrne & Whiten, 1988), theory of mind is especially useful in competitive settings. This hypothesis claims that individuals that make use of higher orders of theory of mind can outsmart more opponents. For this reason, we investigate the effectiveness of higher-order theory of mind in a competitive setting. The competitive setting that we consider in this paper is rock-paper-scissors.

Agents playing rock-paper-scissors

Rock-paper-scissors (RPS) is a simple game in which two players simultaneously choose one of the three possible options "rock", "paper", or "scissors". When both players choose the same option, the game ends in a draw. Otherwise, "rock" beats "scissors", "scissors" beats "paper", and "paper" beats "rock". The simplicity of RPS makes this game an ideal candidate to investigate the effectiveness of higher-order theory of mind.

According to game theory, the only Nash equilibrium in RPS is when both players play randomly (see for example Binmore, 2007). The reason for this is that, unless both players play the game randomly, at least one player has an incentive to change its strategy to get a higher score. However, experimental evidence shows that people play RPS in a non-random way (Cook et al, 2012). Over repeated games of RPS, players could therefore benefit from adjusting their strategy to the patterns of behavior of their opponent.

In this section, we will discuss how agents play RPS using different orders of theory of mind reasoning. To avoid confusion, we refer to focal agents as if they were male, while we refer to their opponents as if they were female.

Zero-order theory of mind

A zero-order theory of mind (ToM_0) agent does not make use of any theory of mind. Such an agent cannot reason about the goals of others. In particular, a ToM_0 agent does not understand that his opponent wants to win the game. Instead, he attempts to predict the future behavior of his opponent by looking at her past behavior. Figure 1 shows an example of this process. Based on the previous actions of the red agent, the blue ToM_0 agent believes that his opponent is going to play "paper". The blue agent therefore decides to play "scissors", because "scissors" beats "paper".

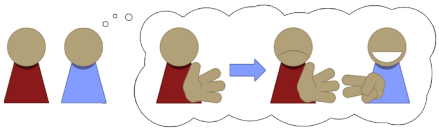


Figure 1: The blue zero-order theory of mind agent attempts to model the behavior of his opponent.

Formally, a ToM_0 agent's zero-order beliefs $b^{(0)}$ specify what he believes to be the probability that his opponent is going to play some action. For example, $b^{(0)}(R) = 0.5$ means that the agent believes that there is a 50% probability that his opponent is going to play "rock". Given these beliefs, the ToM_0 agent can calculate the expected values of playing the actions "rock", "paper", and "scissors", and select the action that has the maximum expected value.

Whenever the ToM_0 agent observes his opponent performing some action a*, he updates his zero-order belief $b^{(0)}$ using a method similar to leaky integration:

$$b^{(0)}(a) \coloneqq \begin{cases} (1-\lambda)\cdot b^{(0)}(a) & \text{if } a = a^* \\ (1-\lambda)\cdot b^{(0)}(a) + \lambda & \text{if } a \neq a^* \end{cases}$$

The parameter λ measures the agent's learning speed, which may be different for each agent. This way, a ToM_0 agent adjusts his behavior to the observed behavior of his opponent.

First-order theory of mind

A first-order theory of mind (ToM_1) agent believes that his opponent may be trying to win the game for herself and that she acts accordingly. To predict what his opponent will do, a ToM_1 agent puts himself in her position, decides what action he would have performed, and believes that his opponent will do the same.

Figure 2 shows an example of the thought process of a ToM_1 agent. Suppose that the blue agent is a ToM_1 agent, who realizes that he has been playing "paper" a lot. By taking the position of his opponent, the blue agent believes that the red agent predicts that he is going to play "paper" again, and that she therefore believes that she should play "scissors". Since the best response to his opponent playing "scissors" is to play "rock" himself, the ToM_1 agent decides to play "rock".

To achieve first-order theory of mind, a ToM_1 agent forms first-order beliefs $b^{(1)}$ that specify what the ToM_1 agent's zero-order beliefs would have been, if he has been in the position of his opponent. That

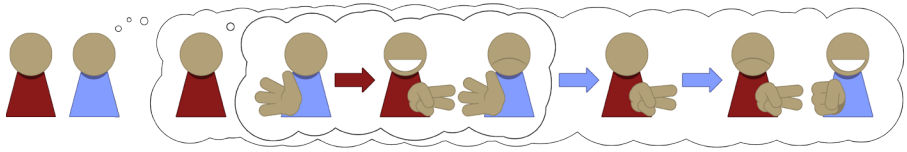


Figure 2: If the blue agent is a first-order theory of mind agent, he believes that the red agent might be trying to model his own behavior.

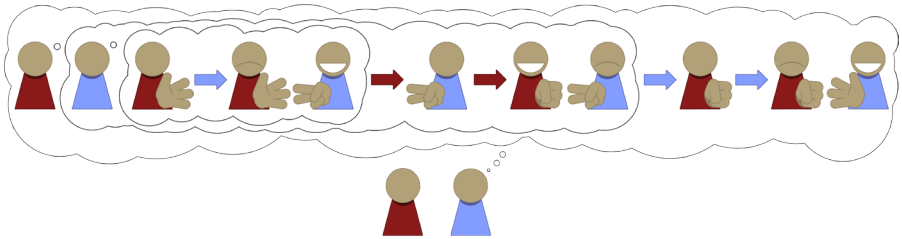


Figure 3: If the blue agent is a second-order theory of mind agent, he believes that the red agent may be a first-order theory of mind agent, who believes that he is trying to model her behavior.

is, $b^{(1)}(R) = 0.2$ indicates that if the ToM_1 agent would have been in the position of his opponent, he would believe that there is a 20% probability that he himself is going to play "rock". A ToM_1 agent can use these first-order beliefs to predict what action his opponent is going to perform, and adjust his behavior accordingly.

Although a ToM_1 agent can make use of first-order theory of mind, he may come to believe that his first-order beliefs do not accurately predict his opponent's behavior. For example, he may notice that his opponent is always playing "scissors", which would mean that the agent's predictions of his opponent's behavior based on first-order theory of mind are consistently incorrect. In this case, the agent then decides to rely on his zero-order beliefs instead.

Higher-order theory of mind

Similar to the way a ToM_1 agent treats his opponent as if she were a ToM_0 agent, a second-order theory of mind (ToM_2) agent considers the possibility that his opponent is a ToM_1 agent. That is, the ToM_2 agent believes that his opponent may be trying to put herself into his position, and that she is trying to predict his behavior by assuming he is a ToM_0 agent.

Figure 3 shows a possible thought process of a ToM_2 agent. Suppose that the blue agent is a ToM_2 agent that has noticed that his opponent mostly plays "paper". By putting himself in the position of his opponent, the ToM_2 agent believes that his opponent knows that she has been playing mostly "paper", and that she believes that he intends to take advantage of this situation by playing "scissors". The ToM_2 agent reasons that if the red agent believes that he is going to play "scissors", she will play "rock". As a result, the ToM_2 agent believes that he should play "paper", since "paper" beats "rock".

For every order of theory of mind beyond the first, a k^{th}-order theory of mind (ToM_k) agent holds k^{th}-order beliefs, which specify what the agent's own $(k\text{-}1)^{st}$-order beliefs would have been, if he had been a ToM_{k-1} agent in the position of his opponent. The ToM_k agent can use these beliefs to generate a prediction of his opponent's behavior and adjust his behavior accordingly.

Note that for each order of theory of mind, a ToM_k agent obtains a prediction of his opponent's next action. After each round of play, the agent compares his opponent's actual choice a^* with the predictions of each order of theory of mind. This helps the agent to decide what order of theory of mind reasoning he should use in future rounds.

Simulation results

To test the effectiveness of reasoning at higher orders of theory of mind, we simulated competition between the agents described in the previous section. Pairs of agents played 20 consecutive RPS games. The performance of each agent was determined as the average score over these 20 games, averaged over 500 runs. The results of these experiments are presented in Figure 4. Each graph shows the performance of a focal theory of mind agent playing against a theory of mind opponent as a function of both their learning speeds. Higher and lighter areas indicate that the focal agent performed better than his opponent, while lower and darker areas show that the focal agent lost more games than he won. To emphasize the shape of the surface, the grid that appears on the bottom place has been projected onto the surface as well. In addition, the plane of zero performance appears as a semi-transparent plane. Red areas indicate that the score did not differ significantly ($p > 0.01$) from zero.

Figure 4a shows the performance of a ToM_1 agent playing against a ToM_0 opponent. The Figure shows that the ToM_1 agent obtains a positive score whenever his learning speed λ is at least 0.1, irrespective of the learning speed of his opponent. This shows that theory of mind is very effective in RPS. However, note that the ToM_1 agent has more difficulties winning from a ToM_0 opponent that has a learning speed around 0.2.

A similar result holds when a ToM_2 agent plays against a ToM_1 opponent, as shown in Figure 4b. The ToM_2 agent mostly obtains a positive score. However, note that the performance of the ToM_2 agent in Figure 4b is slightly lower than that of the ToM_1 agent in Figure 4a. That is, the advantage of a ToM_2 agent over a ToM_1 opponent is slightly less high than the advantage of a ToM_1 agent over a ToM_0 opponent.

Although Figure 4a and Figure 4b show a strong advantage for theory of mind reasoning in RPS, Figure 4c shows that the advantage of third-

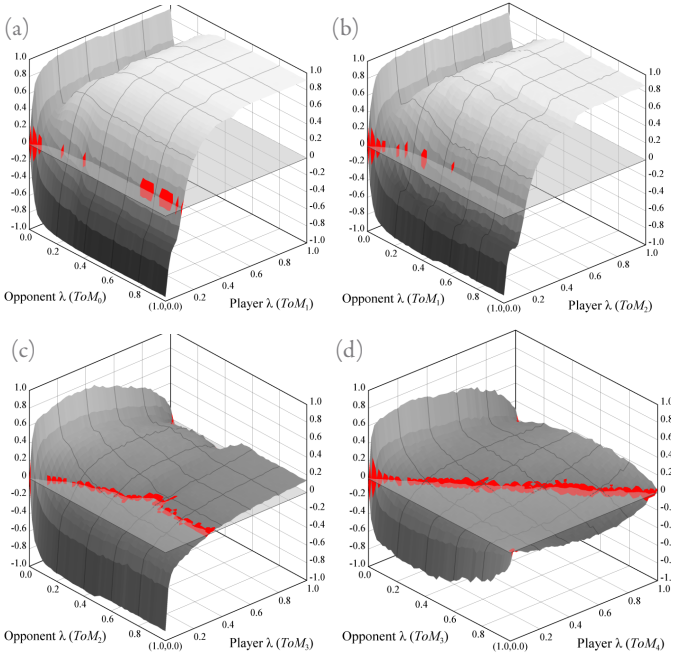


Figure 4: Average performance of theory of mind agents playing 20 rounds of RPS against an opponent that is exactly one order of theory of mind lower than they are themselves. Insignificant results ($p > 0.01$) are highlighted in red. (a) ToM1 versus ToM0 (b) ToM2 versus ToM2 (c) ToM3 versus ToM2 (d) ToM4 versus ToM3

order theory of mind is low in comparison. Although a ToM_3 agent still wins from a ToM_2 opponent, he does so by a small margin. In addition, Figure 4d shows that the advantage of a ToM_4 agent over a ToM_3 opponent is virtually nonexistent. As Figure 4d shows, when a ToM_4 agent plays against a ToM_3 opponent, the winner is determined more by which player has the highest learning speed than which player reasons at the highest order of theory of mind.

Discussion and conclusion

Experimental evidence shows that while people are able to use higher-order theory of mind, there are limits to the depth of theory of mind reasoning (Liddle & Nettle). In this paper, we have used agent-based simulations to determine whether this can be explained by limits in the effectiveness of reasoning at increasingly higher orders of theory of mind. The results of our simulated interactions between agents of different orders of theory of mind in repeated rock-paper-scissors games suggest that there are indeed such limits.

Our simulations show that first-order theory of mind agents clearly outperform zero-order theory of mind opponents, and that second- order theory of mind agents clearly outperform first-order theory of mind opponents. However, while third-order theory of mind agents still outperform second-order theory of mind opponents, the advantage of third-order theory of mind reasoning is relatively small.

Moreover, there seems to be no additional advantage for fourth-order theory of mind reasoning. Our results therefore suggest that there are diminishing returns to reasoning at increasingly higher orders of theory of mind, which may explain why people are limited in the depth of their theory of mind reasoning as well. Note, however, that we only consider one particular type of game. Although our results in rock-paper-scissors extend to more complex settings such as rock-paper-scissors-lizard-Spock and limited bidding as well (de Weerd et al, 2013), there may be settings in which there is a stronger additional benefit of higher-order theory of mind reasoning.

References

- Binmore, K. (2007). Playing for Real. Oxford, USA: Oxford University Press.
- Byrne, R. W., & Whiten, A. (Eds.). (1988). Machiavellian Intelligence: Social Expertise and the Evolution of Intellect in Monkeys, Apes, and Humans. Oxford, UK: Oxford University Press.
- Cook, R., Bird, G., Lünser, G., Huck, S., & Heyes, C. (2012). Automatic imitation in a strategic context: Players of rock–paper–scissors imitate opponents' gestures. Proceedings of the Royal Society B: Biological Sciences, 279 (1729), 780–786.
- Liddle, B., & Nettle, D. (2006). Higher-order theory of mind and social competence in school-age children. Journal of Cultural and Evolutionary Psychology, 4 (3-4), 231–244.
- Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? Behavioral and Brain Sciences, 1 (04), 515–526.
- de Weerd, H., Verbrugge, R., & Verheij, B. (2013). How much does it help to know what she knows you know? An agent-based simulation study. Artificial Intelligence, 199-200 , 67–92.

THE BEST RIBS IN TOWN

BY: Joris de Keijser, Sybren Römer, Maikel Grobbe and Jouke van der Weij

Once upon a time, five young men had a craving for meat, a craving so strong there was only one remedy: a roasted swine off the spit. Unfortunately, this goal was out of reach for these men. They sat together and thought long and hard on how to satisfy their manly hunger. They scourged the internet for the Nobel Prize winning piece of meat for hours on end, until finally Jonathan, later to be known as The Deserter, found a perfect solution. And so began their quest to randomly - not really - pick five different suppliers claiming to have found the recipe for the best spare ribs which a guy from Groningen could deliver, for nothing trumps the mighty city of Groningen. Their adventures are written down in the annals below.

Spare Rib Express

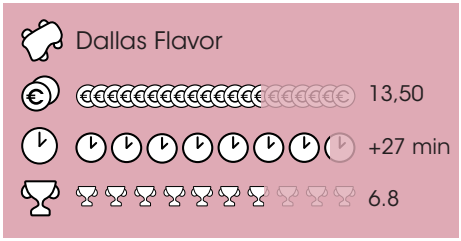
The first thing you see when greeting the delivery guy at the door is in what a fine box Spare Rib Express delivers its ribs. Even though their name might suggest otherwise, they were certainly not on time. Whilst giving every supplier 75 minutes to complete our order, they needed an additional 24 minutes to deliver. This most certainly did not help their case, although both the ribs and the jacked potatoes were certainly still hot. When opening the box it became clear that they took their time putting in promotional items, even having their own engraved peppermints. Although it did look like a pig gave its life to supply these ribs, it must have been a lean one, as there was not a drizzle of grease to be found, which would have been a nice addition. Both the taste and structure of the meat were disappointing at best. It tasted very dry and even the hungriest of men did not finish their ribs. Even the seasoning of the meat was subpar. The jacked potatoes were savorless and delivered without any sour cream. When we were done, we were so disappointed, we called Spare Rib Express and after having heard Karin's voicemail the first time, Nico was kind enough to offer us a free and better pig on our next order. Conclusion: do not judge a book by its cover...

No Limits

On the way to the door, the delivery guy was greeted by two of his colleagues, who were also exactly on time. With a big smile he handed over the bag with two boxes. In one we found the most crunchy deep fried potato slices we ate during this test. However, they were mighty salty, not doing them justice. Next to

these we found a nice salad which even included some slices of egg. However, the ribs were not to our liking. The amount of meat served was decent, but the quality lacked inspiration. The meat was though and wasn't sauced leaving you with some dry ribs. The taste was OK, but it didn't live up to the expectation. The added cooked green beans and the dessert did help make up for some of the damage that the image of No Limits got, but it wasn't enough. In the end, if No Limits would be the only place that is open at a given time, you can get rid of your hunger here and leave with some slight satisfaction; otherwise don't order here.

Spareribs Mobiel & Venezia Turbo



Last, but certainly not least, they delivered their ribs. Although they were half an hour late, the saying "better late than never" certainly applied here seeing as their ribs were quite decent. That, however, was not true about their deep fried sliced potatoes. They were gross and went straight into the garbage bin. They were tougher than Chuck Norris, but their ribs made up for it. Even though it was clear that the sauce on the meat was placed there after cooking, the taste was quite nice, although a bit overwhelming compared to the taste of the meat itself. The meat itself was quite tender, which made up for its weak taste. Not the best that we had, but most certainly not the least. Even while being among the cheapest in the test, we recommend to read on and see other even cheaper, and better ribs.

El Torro & Texas Ribs

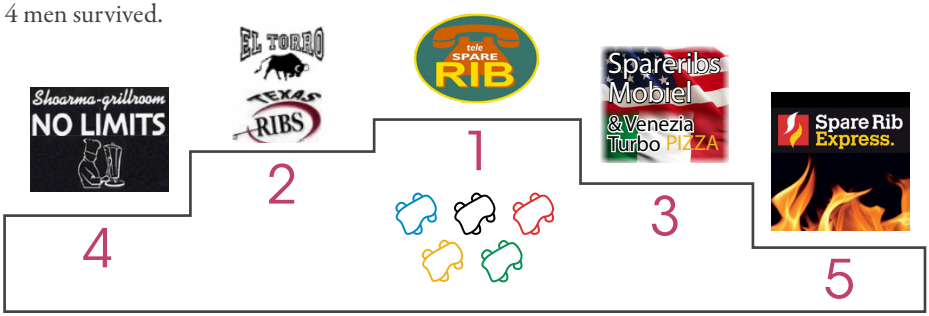
Also exactly on time, being the first supplier to ring the bell, we were delighted when opening our two bags. In one we found some french fries that were perfectly seasoned and quite crunchy for a delivery service. When looking at the ribs, we were slightly less happy with El Torro & Texas Ribs. Some of the ribs got some black burn marks on them. Luckily only a small portion of the ribs was affected and the ribs that weren't were nice, juicy and tasty deliciousness. On top of the taste, these ribs were also the most tender ones that we have tested. They weren't too salty and the flavors were all nice and balanced. They were one of the priciest in this test, but only if you factor in the delivery costs. At a standard of €1.75 for delivery, this rockets the price of a single meal. However, if you are with friends these costs are

not that bad. It all depends on your choice of flavor when it comes to whether you want to order these. The ribs from El Torro & Texas Ribs were quite sweet, so if that is your thing, go ahead and order these, you will not be disappointed.

Teleribs

Just like the ribs from the Spare Rib Express, the ones from Teleribs came in a box. What it lacked in commercial flyers and other niceties, it made up for with awesomeness embedded in every single rib. Tender, a good and rich flavor, a little smokey, and with hints of cinnamon. These are the ingredients of near perfection - perfection only happens in pig heaven. They might not have been as tender as the ribs from El Torro & Texas Ribs, but the flavor was definitely better. We chose a side dish of creamed potatoes since they were the default. These were quite ok, with a good flavor although a bit salty. The cream didn't overwhelm the taste of the potatoes, which we think was a good thing. Overall, combining all the assets of the meal and considering the ribs are the main attraction, we suggest that everyone put the phone number of Teleribs on speed dial, in case of acute rib emergencies. On top of all these great things, they are also the cheapest that we bought, giving them a clear cut winner status.

When the stomachs stopped growling and the men tamed their unquenchable hunger, they rested their minds and let their experiences set in. The men encountered some genuine threats, from weapons of ass destruction to pigs who most certainly have given their lives in vain. But in the end they succeeded and thus reached their final verdict. Many lives were lost, many suppliers given a bad name, but in the end five men fought, pigs were slaughtered and 4 men survived.



{kxa} De dataspecialisten

Software Innovations

KxA software innovations is gevestigd in de provincie Groningen. Het is een uniek bedrijf dat innovatieve, gekke, grote, kleine, spannende, mooie, maar natuurlijk ook normale maatwerk software-opdrachten uitvoert. De overeenkomst tussen al deze projecten is dat het gaat om data in alle vormen en maten, bijvoorbeeld:

- Het Nederlandse verkeer in 400 miljard metingen toegankelijk opslaan
- In een stal het gedrag van koeien monitoren
- Software ontwikkelen voor de gigantische SKA radiotelescoop

van BIG BANG tot

- Hulpverleners in de zorg ondersteunen met VCA

Werken bij KxA

Bij ons vind je allerlei achtergronden (natuurkunde, informatica, AI, etc). Iedereen deelt het enthousiasme voor softwaretechniek en wat je daar allemaal mee kunt doen.

We hebben regelmatig afstudeeropdrachten, stageplekken én vacatures. Je krijgt hierbij een opleidingstraject om je helemaal in ons vakgebied te bekwamen.

Ben jij geïnteresseerd in het werken bij een High Tech bedrijf? Kijk dan eens op **www.kxa.nl**, of neem contact met ons op via mulder@kxa.nl

PUZZLE

by: Steven Warmelink

You are given a cipher that is encoded by taking a 13-letter phrase with no repeating characters and writing the unused (remaining) letters of the alphabet under it in alphabetical order. For example, the cipher below is encoded this way.

```
TROUBLEMAKING
CDFHJPQSVWXYZ
```

Letters are encoded by substituting them vertically, so - using the cipher above - KEYBOARD encodes as WQNJFVDR.

The three words below are encoded using a different (single) cipher. Can you find out the cipher?

```
REMOTE    STRIVE    ARCHED
ZFPYXF    JXZNLF    WZGKFB
```

Send your answer to brainstorm@svcover.nl before February 29th to have a chance to win a prize!

Winner of last edition

In the last edition we asked you to find out what Aliene's favorite programming language is. By finding out Aliene prefers to code in Scala, Eric Jansen was the lucky one among the correct submissions to receive the prize. Congratulations Eric!

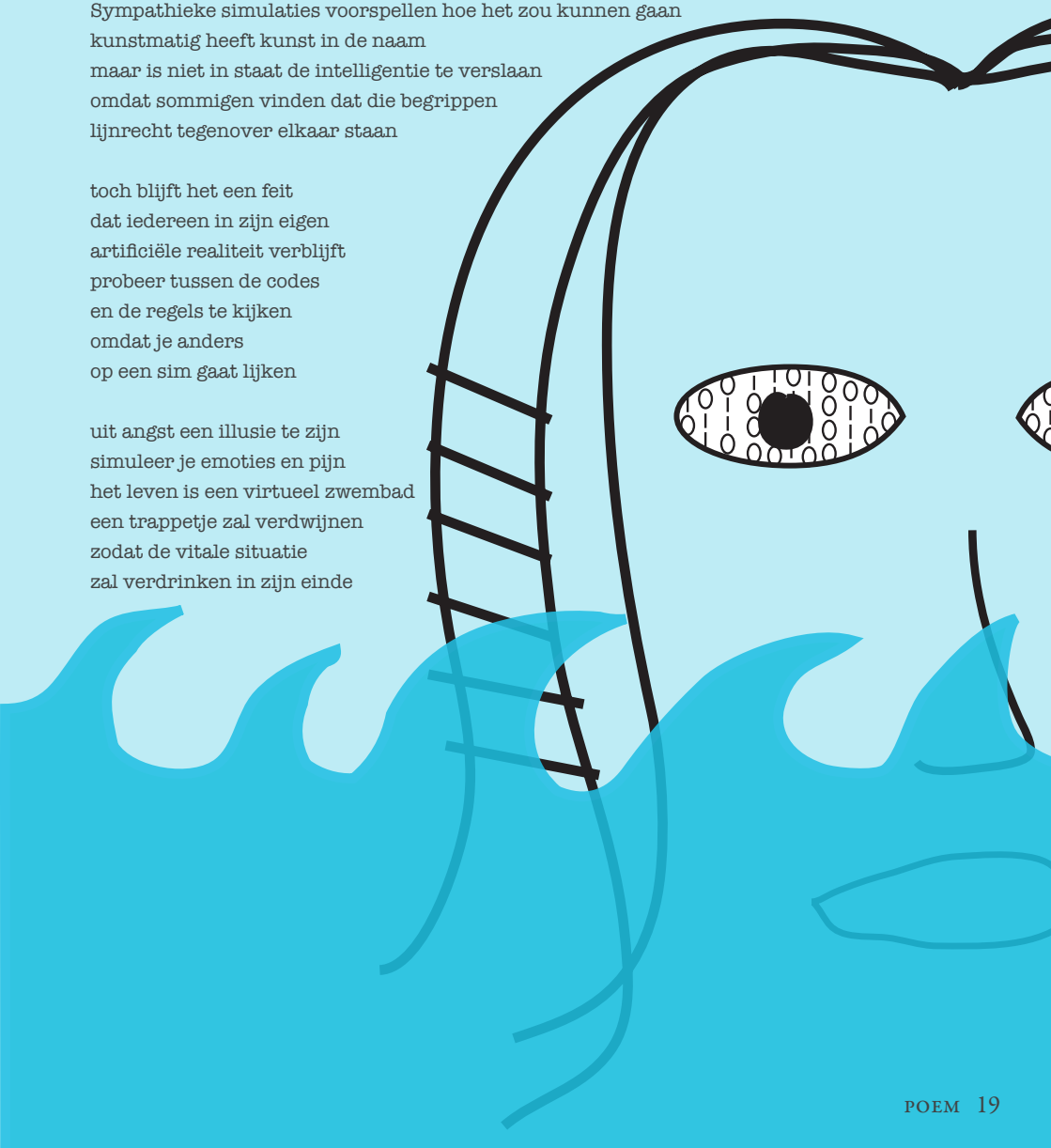
POEM

BY: *Tijdelijke Toon*

Sympathieke simulaties voorspellen hoe het zou kunnen gaan
kunstmatig heeft kunst in de naam
maar is niet in staat de intelligentie te verslaan
omdat sommigen vinden dat die begrippen
lijnrecht tegenover elkaar staan

toch blijft het een feit
dat iedereen in zijn eigen
artificiële realiteit verblijft
probeer tussen de codes
en de regels te kijken
omdat je anders
op een sim gaat lijken

uit angst een illusie te zijn
simuleer je emoties en pijn
het leven is een virtueel zwembad
een trappetje zal verdwijnen
zodat de vitale situatie
zal verdrinken in zijn einde



GESTREEPT, GEVLEKT OF GERIBBELD

BY: *Charlotte Vlek*

Ongeveer zestig jaar geleden formuleerde Alan Turing, beroemd om zijn Turingmachine en het ontcijferen van de Enigma, een wiskundige theorie die verklaarde hoe patronen als strepen en vlekken ontstaan op de vacht van dieren. Turing stelde dat het een subtiel samenspel moest zijn tussen twee stoffen die de pigmentvorming beïnvloeden. Onder die aanname kon hij met behulp van wiskundige vergelijkingen precies aantonen hoe de karakteristieke patronen ontstonden bij giraffen, tijgers, zebra's en allerlei andere dieren. Turings artikel werd alom geprezen, en is al veelvuldig geciteerd. Pas onlangs toonden onderzoekers bij muizen het bestaan van de twee stoffen aan.

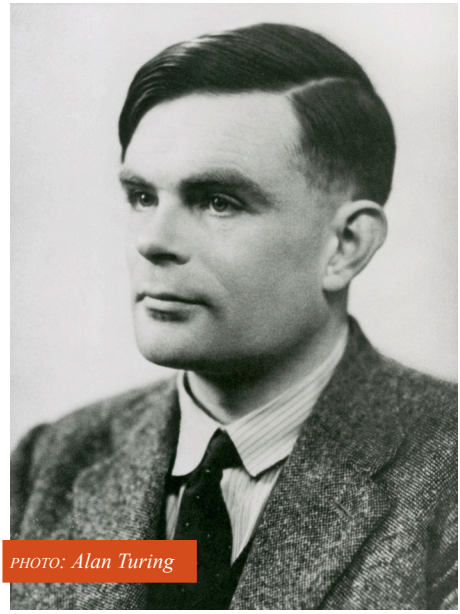


PHOTO: *Alan Turing*

De onderzoekers van het King's College in Londen publiceerden in Nature Genomics over hun vondst. Ze bestudeerden de vorming van ribbels in het gehemelte van een muis. Het patroon dat hieraan ten grondslag ligt, ontstaat door het samenspel van FGF (Fibroblast Growth Factor) en Shh (Sonic Hedgehog). Een van deze stoffen stimuleert de aanmaak van zowel FGF als Shh, en is daarmee een activator. De andere stof remt de aanmaak van beide stoffen: het is een inhibitor.

De theorie die Turing in de jaren '50 van de vorige eeuw formuleerde verklaarde hoe patronen konden ontstaan, uitgaande van stoffen met zo'n remmende en stimulerende werking. Dat patroon kan zich vervolgens uiten als strepen of vlekken op van de vacht van een dier, maar ook ribbels in het gehemelte van een muis. In alle gevallen gaat het om een patroon dat zich geleidelijk ontwikkelt. Turing argumenteerde dat de inhibitor en de activator bij een embryo in het begin nog gelijkmatig verdeeld waren, waardoor er nog geen kleur- of ribbelpatroon zichtbaar was. De beide stoffen waren dan precies in balans. Wanneer echter door een kleine verstoring op een bepaalde plek een overschot zou ontstaan van de activator, dan zou dit als een sneeuwbaleffect leiden tot de bekende patronen.

Stel namelijk dat er op een bepaalde plek iets meer van de stimulerende stof, de activator, aanwezig is. Beide stoffen worden daar dan vervolgens extra geproduceerd,

waarna ze zich verspreiden over het omliggende gebied door diffusie. Als de inhibitor zich daarbij sneller verspreidt, zal dat betekenen dat de productie van beide stoffen in omliggende gebieden wordt afgeremd. Maar op de plek waar om te beginnen een overproductie was, zal de activator langer achterblijven dan de inhibitor.

PHOTO: Zebras

Het effect versterkt zichzelf dus: daar waar door een kleine disbalans een klein overschot van de activerende stof aanwezig is, zal steeds meer van de activator aanwezig zijn. Daaromheen wordt de productie juist geremd. Er ontstaan kleine eilandjes: vlekken of strepen, of ribbels zoals in het gehemelte van muizen. Hoe die patronen er precies uit zullen zien hangt helemaal af van de vorm en de grootte van het oppervlak waarop zulke patronen zich vormen. Dieren hebben op de staart bijvoorbeeld vaak ringen terwijl ze op het rest van hun lijf vlekken hebben. Dat heeft alles te maken met de kleine omtrek van die staart.

De onderzoekers van King's College claimen nu dat ze de eerste zijn die een experimenteel bewijs hebben kunnen leveren van Turings theorie, zo'n zestig jaar na dato. Overigens hebben ze hiermee een fantastische timing: ze deden deze claim in 2012, precies honderd jaar nadat Alan Turing geboren werd.

Dit artikel verscheen eerder op www.sciencepalooza.nl

PHOTO: Oscar at the camp

BY: Oscar Bocking

Introductory camp: Parody city

I was unaware of the introductory camp until just a few days before it started, but I'm glad that I was persuaded to take part in what turned out to be a great weekend away, and a way to get to know my fellow students. The journey began from the Bernoulliborg in rather unpleasant rain, but once we were on the busses and on our way we could forget about that and focus on trying not to make fools of ourselves in front of all of the potential friends we had found ourselves with.

Upon arrival to De Lauwer, the first activities we took part in were a series of name games to help us get to know each other better. However I soon found myself taking part in a thinly-veiled excuse to hit people with a newspaper. Supposedly this is a well known game, and it did involve having to shout the names of the people around you, but I stand by my statement that the organizing students were looking for an excuse to clobber each other. Of course, there were nonviolent activities too, but where's the fun in that? This percussive game was definitely the one in which I learned the most names.

the organizing students were looking for an excuse to clobber each other

After these games there was a little downtime for those of us not expected to slave away in the kitchen, producing a vat of food for the very hungry masses. It was at this point also that the beer began to flow, before a pleasant dinner and then yet another round of fun and games; this time however, it was competitive. For me the highlight of Friday night was taking part in the pizza toss, a game that combined the aerodynamic qualities of Italian cuisine with the generally lacking finesse of a group of beer-fueled AI and CS students, resulting in a messy but satisfying event that I hope to see included in the 2020 olympics. Once the organized events for the day had drawn to a close, we finished it off with beer and music into the early hours of the morning. I don't know exactly what time it was that I went to bed, but suffice it to say that it was late enough to feel it the next morning.

PHOTO: *The pizza toss*

Saturday began suddenly, as we were awoken by a godawful noise (courtesy of Emilio and some assorted kitchen equipment), far earlier than it should be allowed to wake up a hungover student. To add insult to injury, the first activity of the day was to go out onto

PHOTO: *Oscar exercising*

a field and exercise; not something I would normally do the morning after a few beers. Fortunately, this endeavour was cut short by some well-timed rain, allowing us to head back inside, have some breakfast, and nurse our headaches. The next item on the agenda was "dirty games", a name that certainly sparked our curiosity; however, much to my relief (and maybe a little disappointment) it soon became clear that they were dirty in that they involved mud and yoghurt as opposed to deviant behaviour. Thankfully, the rain had stopped by this point, allowing the assortment of substances I was getting covered in to really stick in my hair. Pizza toss was pretty messy, but it was nothing compared to what happened on Saturday. Events included playing rugby with a sack of dirt instead of a ball, wrestling in a pool of floury water, and my personal favourite: sliding tinned fruit through yoghurt into the mouths of our peers. This particular game I enjoyed from both perspectives, few things are as satisfying as throwing a pineapple ring at someone's face along with a handful of yoghurt; yet being on the receiving end was inevitably delicious.

"dirty games", a name that certainly sparked our curiosity

PHOTO: *Oscar, yogurt and peaches*

After a much needed shower and lunch, and as the last of us managed to get out of bed, we started the main event, the reason the camp was called Parody City: the role playing game, puzzle, thing. Essentially this was the most elaborate wild-goose chase that the world has ever seen; senior students dressed up in a range of costumes, each of them having a problem for us to solve, and a clue to give us if we helped them. These clues could then be applied to a logic puzzle, to solve a mystery. I'll admit it, I didn't have much of a clue what was going on, but after some matchmaking, singing, and running of ridiculous errands, my team somehow managed to win! Our victory (and the accompanying cake) tasted ohsosweet as we watched other teams finish

the puzzle just minutes after us.

Saturday evening from this point on played out similarly to the one before, only with even more excessive drinking than the night before, as we knew that it would be our last night of frivolity before we would return to Groningen. Most of that night escapes my memory, but one moment I remember vividly was when "Het Gras Van Het Noorderplantsoen" was played, and it became immediately clear who all of the first year international students were: we were the only ones looking confused rather than singing our hearts out. Several times during the course of the song I noticed slightly alarmed looking students making eye contact with me or each other from across the room, before shrugging it off and swaying with everyone else.

one moment I remember vividly was when "Het Gras Van Het Noorderplantsoen" was played

When we woke up on Sunday, none of the ten people in my room could explain why there was a squashed banana on the floor right in the middle of the room. I was pretty sure that I didn't put it there or step on it, but so was everyone else, and we were mostly just thankful that a banana was all that was on our floor, having heard that on Saturday some people had woken up to vomit besides their bed. Too tired to make any attempt to solve the mystery, we went to eat breakfast and prepare for the final morning of activity, starting with the auction. Leftover food and lost items were sold to the highest bidder, including but not limited to: someone's lost phone, a large hammer, and beers being sold for over €20! Unfortunately, I did not win anything, despite my best attempts to get myself a few cheap bottles of wine.

Before leaving, we needed to clean up the accommodation, as we had sort of trashed the place. Up until this point, I had been lucky enough to avoid cooking and cleaning all weekend, and I very much intended to keep it that way. Sadly, my dream was not realized, as everyone had to help out with this last effort to make the place look presentable and karma came crashing down on me: I ended up cleaning a pukey toilet. While this was not a pleasant experience, scrubbing the half-digested diced vegetable off a porcelain bowl was a small price to pay for a fun weekend. The introductory camp was an awesome way to have a laugh with and get to know the other people from AI and CS, I would implore all of next year's new students to go, and I think I'll be going along again myself.

STUDY ASSOCIATION Cover

COLOPHON

The Brainstorm is a magazine published by study association Cover and is distributed among its members, staff members and other interested people. The Brainstorm comes out at least three times a year in an edition of 600.

Contact
Study Association Cover
attn. The Brainstorm
PO box 407
9700 AK Groningen
brainstorm@svcover.nl
www.svcover.nl