Periodiek

Recurring at regular intervals Issue 2025-3

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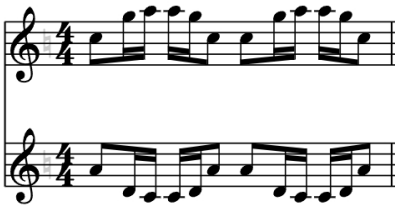

6 - Symmetry of Music

From classical to EDM to gamelan to punk rock, symmetries can be found in every music style. Explore the different types of symmetries and more in this issue.

Perio Interview: Alef Sterk - 10

What did Alef Sterk do before teaching in Groningen? What does he do in his free time? Find out this and more in this issue's interview.

26 - A Day in the Life of a PhD Student

Have you ever wondered what doing a PhD is like? What does a PhD'er do all day? We asked PhD student former board member Robbert Scholtens to give us a peek behind the curtain of the daily life of a PhD student.

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From the Editor in Chief

Surely publishing an issue of the Perio*diek* shortly before the trasnfer GMA won't outdate two articles immediately. But we're really happy to start the academic year with a full Perio*diek*. In this issue we talked with a bunch of interesting people to learn about their experiences as a lecturer, PhD student, (candidate) board member, or Satellite Competition team member.

For the science readers, we still have two interesting pieces, about a Group Theory and Music, and CRISPR-Cas9. And of course, what would an issue of the Perio*diek* be without the Brainwork and a recipe.

I hope you all have a great academic year and keep enjoying the Perio*diek*.

Robert Mol

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ISSN 1875-4546

The Periodiek
is a magazine from the Fysisch-Mathematische Faculteitsvereniging and appears three times per year. Previous issues can be found at perio.fmf.nl. The board of editors can be reached at perio@fmf.nl.

From the Board
Secretary

AUTHOR: **I. BALINT**

Hello everyone! My name is Ioana and I am the secretary (and vice chairwoman) of the 66th Board of the FMF! My time as board is coming to an end and with it, I am flooded with memories of the past year.

If you would have asked me what I imagined my third year of University to be like, I never would have thought a board year would have been included in the answer, but boy am I glad I did it. For better or for worse, and trust me, there has been plenty of each, I have loved being part of my board and will treasure it forever. If you were around last year, you probably remember me opening the room and complaining about it, reading a book all morning, and having way too many broccoli and cheese instant mashed potatoes. Writing this right now (after I put it off for quite a while, to the despair of our editor-in-chief) actually makes me emotional because I can't believe the year has already passed by, a year I dedicated most of my time to the FMF, its members, and its committees. Everyone says that you have rose coloured glasses when something is about to end and I can see they're right, because I can't imagine not missing it at least a little bit.

Now, for those unaware, you might wonder what I do as secretary of our study association, and the answer is I type. Minutes, emails, members' information when necessary - the secretary is the one who types it all. I'm sure you'd all be glad to know that even after a whole year of taking minutes weekly, I still type using a maximum of four fingers. I guess some things never change. I do have to say though – while an ending is always at least a little bit sad, I am happy about the beginning of our candidate board's future with the FMF, for every predecessor needs their rest. I hope they have just as much fun as we did.

"I can't imagine not missing it at least a little bit."

In the end, what made this year so special wasn't the minutes, the emails, or even the broccoli mashed potatoes, it was the people. Thank you all for making this board year one I'll always cherish.

"I still type using a maximum of four fingers."

Figure 1: Ioana in the FMF room in the Nijenborgh 4

Chair

AUTHOR: **M. ERIKS**

Well, the time has finally come for me to write a piece for the Perio*diek*! A bit later than first planned, but as we know I was busy with not writing things over the summer. I would like to use my (hopefully) last moments of being the chair (supreme leader according to my old Pienter kid) to reflect a bit on the past year.

There were of course many highs for me personally: the FMF top 100, the Flunkyball tournament, and getting kandies were one of the most joyful moments in my life. There was something about the feeling of securing your retirement which brought a peace of mind which I find difficult to describe.

"Straightforward does not mean easy, but at least the goal is clear."

After the euphoria of getting kandies died down a little, the feeling of responsibility kicked in. There are two very important things to do when you get kandies: raising them and teaching them. In a way the latter is straightforward. Over your board year you learn things with every new experience, it is your task to make sure your knowledge is brought upon your kandie. Straightforward does not mean easy, but at least the goal is clear. The former is less clear, how do you raise your kandie? It is important to keep in mind that a big part of growing up is making mistakes. Therefore it is important to allow your kandies the freedom to make mistakes and be responsible for them. While it might be difficult to let your kandie do things without you, it is important for them to learn how to do it.

"It is important to keep in mind that a big part of growing up is making mistakes."

This might actually be the biggest challenge in nearing the end of your board year, letting go. FMF has been such a big thing of my life over the past year, I have had so many fun experiences. But the party sadly won't continue forever, it's time for me to focus on studying again. I hope you aren't too attached to "Marnick's Bangerlist" (which if anyone would like to know, ChatGPT describes as Party Bangers, Groovy Swing, and Chill Rock), since it will be playing a lot less the coming year.

"It's time for me to focus on studying again."

Figure 2: Marnick Eriks, Chair of the FMF

Symmetry of Music

AUTHOR: **A. NIJLANT**

Last April, during the CO-LES that was organized by our beloved Mathematica committee, I held a ten minute talk about symmetries in music. Combining my two greatest passions, mathematics and music. As a disclaimer, I want to say music does not come from mathematics, but we can use mathematics to describe music.

Recap of Group Theory

Firstly, I want to recall some definitions of a group theory. A *group* is a triple $(G, \cdot, e)$ where G is a set, $e \in G$, and $\cdot$ is a map from $G \times G$ to G, which we write as $(x, y) \mapsto x \cdot y$, satisfying:
G1) (closure) For all $x, y \in G$ it holds that $x \cdot y \in G$.
G2) (associativity) For all $x, y, z \in G$ we have $(x \cdot y) \cdot z = x \cdot (y \cdot z)$.
G3) (unit element) For all $x \in G$ we have $e \cdot x = x = x \cdot e$.
G4) (inverses) For all $x \in G$ there exists a $y \in G$ such that $x \cdot y = e = y \cdot x$.

Frieze Groups

There are four types of symmetry: translations, reflections across a vertical line or horizontal line, glide reflections and rotations of 180 degrees. Frieze groups are a type of symmetry groups, they are a repeating patterns of elements along a strip or a line. There are seven types of such symmetries, I will list them.

1. Translations only: This is the translation by the smallest distance over which the pattern is periodic.

2. Glide-reflections and Translations: This is a glide reflection, with translations being obtained by combining two glide reflections.

3. Translations and 180° Rotations: The group has a translation and a 180° rotation.

4. Vertical reflection lines and Translations: The group is the same as the non-trivial group in the one-dimensional case; it has a translation and a reflection in the vertical axis.

5. Vertical reflection lines, Glide reflections, Translations and 180° Rotations: The translations here arise from the glide reflections, so this group has a glide reflection and either a rotation or a vertical reflection.

6. Translations, Horizontal reflections, Glide reflections: This group has a translation and the reflection in the horizontal axis. The glide reflection here comes from the composition of translation and horizontal reflection.

7. Horizontal and Vertical reflection lines, Translations and 180° Rotations: This group requires three generators, with one generating set consisting of a translation, the reflection in the horizontal axis and a reflection across a vertical axis.

Application to Music

In this section I will show you some examples of the frieze groups stated previously. Can you find all the symmetries?

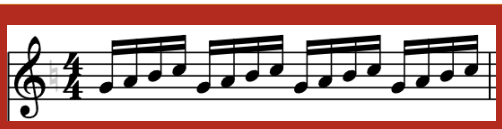

Figure 3: Translations

This is a really common Frieze Group in music. It is a translation in horizontal direction, a repetition. Repetitions like these are the most easy for the listener to recognize. Many pop songs have these repetitions and usually form the basis for a song, which will make a song sound "catchy" and get stuck in your head.

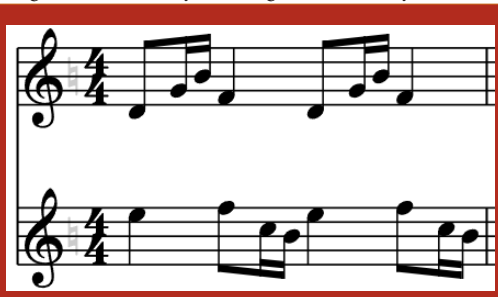

Figure 4: Glide-reflections and Translations

When played by two different people, a symmetry like this can feel like a conversation. Especially when you have longer excerpts, symmetries like this are used in music to mimic a question and answer conversation. This is because the notes go higher is the first voice and go lower in the second voice.

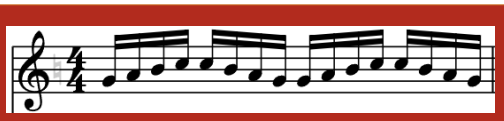

Figure 5: Translations and 180° rotations

Classical composers love this Frieze Group. Me as a flute player, I like it too, because it can look really difficult in some pieces, but it is really easy and non-musical people are easily impressed, hehe.

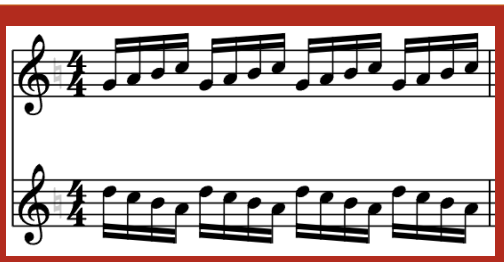

Figure 6: Vertical reflection and translations

Here you can see that the second voice is obtained by putting a mirror under the first voice, this is what is called a vertical reflection. It is used a lot in classical music.

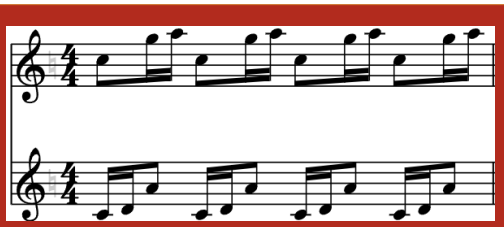

Figure 7: Vertical reflections, glide reflections, translations, 180° rotations

Notice that a 180° rotation give the same result as a horizontal reflection + a vertical reflection. If you have taken the course Group Theory, you could recognize something like a dihedral group in here.

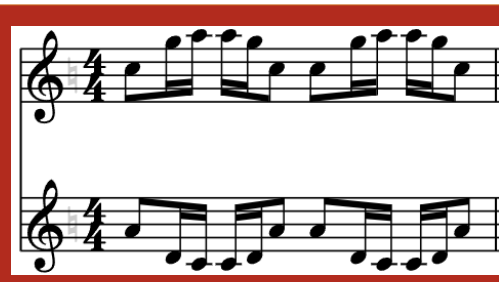

Figure 8: Translations, horizontal reflections, glide reflections

This is definitely the most difficult Frieze Group to spot in music. It is also not used a lot due to its complex structure of translations and both vertical and horizontal symmetries.

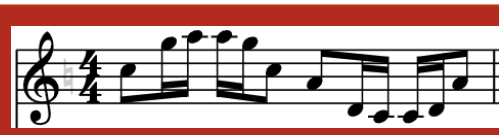

Figure 9: Horizontal and vertical reflections, translations

This type is very similar to type 3, but has also just horizontal reflections on its own. If you look very carefully, then you see that the second group of notes is a horizontal refection of the first group, the third group of notes is a horizontal and vertical reflection (so, a 180° rotation) of the second group and the last group is again a horizontal reflection of the third group of notes. Meanwhile in type 3 you only have the 180° rotations.

The next time you listen to your favourite song on repeat, try if you can find some of these symmetries.

Algebra in Music

We can assign the semitones to the numbers 0 to 11, which represent the elements of the $\mathbb{Z}/12\mathbb{Z}$ group. Instead of putting them in a table we can put them in a circle like a clock. So we have created a group isomorphic to $\mathbb{Z}/12\mathbb{Z}$. We can call the numbers representing the notes, the pitch class of that note.

We can put operations on these pitch classes. Let us define 3 operations: transposition, inversion and permutation. Sometimes it happens that flute players need to play a trumpet part. However, a flute and a trumpet is in a different key (C and B flat resp.) so the piece need to be transposed such that the band will not have their ears bleeding. So if I want to play a piece

from my trumpet friend, I need to add 10 semitones to each note to get the piece in the right key. This is called transposition. Because we add 10 semitones, we can say that transposing notes is the same as adding notes. One can see that transposition is the same as rotating the pitch class circle.

Then there is inversion. When we look at the circle with the semitones, say we start at the note C then the note D will be two semitones off to the right with respect to C. Two semitones to the right will be $A\sharp$. If we look at the circle and we put a mirror right in the middle, then $A\sharp$ and D are each others inverse with respect to the horizontal symmetry of C. One can see that inversion is the same as reflecting the pitch class circle.

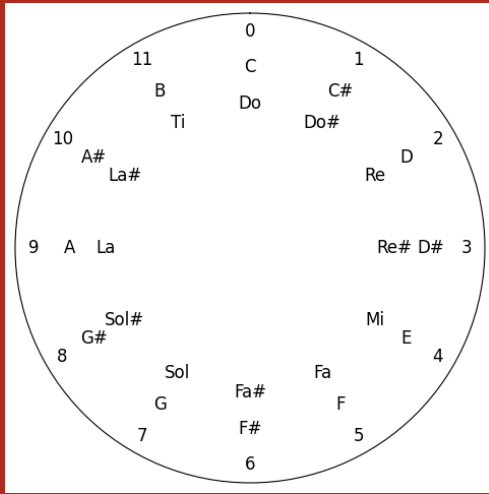

Figure 10: Pitch Classes represented on a clock

When a chord is near a symmetrical chord, we use some inversion to find the inversion of that chord which is another chord that is near symmetrical. So if you can relate a chord to its near symmetrical chord, then you can also relate the inverse of that chord to a symmetrical chord. In mathematical words; let A be a near symmetrical chord. Let the symmetrical chord be S and let I_x map a chord to its inversion. Then if we can relate A to S by a minor change, we can relate $I_x(A)$ to $I_x(S)$ in the same way.

The last musical operation is called permutation. Let us have a set of notes, for example $\{C, D, E\}$. Then putting this in a different order would be a permutation of this set. For example, with this set, one can have $\{D, C, E\}$. Just like the inversion, the permutation of a near symmetrical chord can relate to the closest symmetrical chord. However the difference is in the nature of this symmetry.

These are not the only mathematical topics that appear in music, for example, we can use mathematics to explain why an interval of 6 semitones sounds absolutely horrible and it makes me want to rip my ears off, but other intervals are a pleasure to listen to. One can also find fractals and chaos theory in music, but let me stop here before this becomes a 10 page article.

If you want to read more about this topic, I can recommend a few books. The first one is *Math & Music* by Julia Winterson and there is also *A Geometry of Music* by Dmitri Tymoczko. I will leave the details below. Do note that both writers are musicians, so these books are more about music theory rather than mathematics, but both capture the essence very nicely.

Further reading

[1] J. Winterson, *Math & Music*, University of Huddersfield Press, 2024.

[2] D. Tymoczko, *A Geometry of Music*, Oxford University Press, 2011.

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Perio Interview: Alef Sterk

AUTHORS: **R. MOL, A. NIJLANT**

Alef Sterk is a widely beloved lecturer of Mathematics who taught Analysis for years and is praised for his clear and structured way of teaching. In this issue of the Periodiek, we get to know him a little better.

What research are you currently working on?
I had a bit of a strange career path. When I was a master's student, I specialized in Analysis. I'm still benefiting from that today because I teach a lot of Analysis. But I also wanted to do a PhD in that direction, and it was really, really difficult to find a PhD position in that field. And, also, I was warned that if I would do a PhD position in that field, it would be very difficult to to find any job after that. I also had an interest in dynamical systems and I took some master courses on that subject. Then one of my professors had a PhD project funded, I applied for it, and I got that. So that's how I ended up in Dynamical Systems, and that's still what I do today. But my research profile shifts a little bit between applications and in pure things. And I still I like that. I think there's this famous quote for from Robert Heinlein, *"Specialization is for insects"* and I think I more or less agree with that.

Figure 11: Alef Sterk

How did you decide to go into Mathematics?
In secondary school, I started doing programming just as a hobby. And initially I wanted to do computer science. I was really keen that, but then I saw that if you do some programming with graphical objects, you can use sines and cosines to rotate stuff on the screen and suddenly it also sparked my interest in mathematics a little bit. Also, if you think about using algorithms to solve problems, it's of course very close to mathematics. Think of binary tree algorithms, search algorithms, efficiency of algorithms. And that's how my interest in mathematics actually was sparked. And, eventually, I had to make a choice. Will it be Mathematics or Computer Science? And my reasoning was if I do Mathematics, it's easier to go into Computer Science than the other way around. So I decided to go for Mathematics. But to this day, I still regret a little bit that I didn't do Computer Science besides Mathematics. Though, I'm not sure if I would have made it. Doing two degree programmes at the same time, it's just a lot of work. I'm not sure if I was up to that at that age. So, initially, I wanted to do Computer Science, but I don't regret my choice. I still love Mathematics, but the spark came from somewhere else.

How did you end up in Groningen at the University of Groningen?
I was lucky. I studied here and when I studied there was no difference between a Bachelor's and a Master's degree, so you did your first year, your propedeuse. And then you immediately went to your Master's. So it was one year and then four years on top of that. So I did my Master's here, or what was equivalent to the Master's degree, and then I also did my PhD here. So I spent nine years here in Groningen. And if you do your PhD and you want to have an academic career, then typically you are expected to do postdoc positions. If you really want to have a permanent position, you need to have some experience abroad. So after my PhD, I went to University of Exeter in The United Kingdom where I did a postdoc of almost two years.

I wanted to continue, but it was really difficult to find a job at the time. It was somewhere in the middle of 2012. I applied all over the world. I applied in Australia. I applied in The United Kingdom. I applied in The United States. I applied in Germany. I applied in France. And almost all my applications were rejected. And there

was also very little funding for for research at the time. It was five years after financial crisis and most of the budgets had dried up. England used to be a very good country for postdoc positions. You could easily get postdoc positions for two or three years. But when I applied, there were only positions for six or nine months. Typically, you wouldn't qualify for such position simply because they prefer to give such a position to somebody who already is very specialized in a certain field. So it was really difficult to get anything. I was invited for some positions. I also applied in at the University of Portsmouth to do a position as a lecturer. But at that time, the people said "You have a good profile, but you're not senior enough. You would need a little bit more experience." I also applied for temporary positions, teaching. First in Delft, and I was invited so I probably was deemed to be a serious candidate, but they had so many interested people and I didn't get the job. And then they told me that they are also looking for temporary teachers at the University of Twente. And then I was invited there and I got that. So then I moved to the University of Twente. So I applied all over the world, and I ended up back in The Netherlands for some reason. And that was 80% teaching and 20% research. Well, I can assure you there's no such thing as doing 20% research. I mean, if you do 80% teaching, it's 100% teaching.

I learned a lot. A lot of teaching tricks that I learned there, I still apply today. And I think it was a good experience for me to teach for different audiences. I taught Linear Algebra for Chemical Engineering. I taught Signals and Systems for Physics. I taught Calculus for Technical Medicine. So I saw a lot of different students and a lot of different kind of Mathematics courses. And, yeah, it was a temporary position, so meanwhile, I kept applying. And then there was a position here in Groningen. For a long time, Groningen had a vacancy stop, but suddenly they had a vacancy again. I applied for it, and it was a bit lucky that I got it. If the vacancy had come one year earlier, I would probably have not been qualified enough. If it had come maybe one year later, I would probably already have left academia altogether. So it was really lucky that I ended up in the place where I also started. It was not a deliberate choice. I do enjoy it here, but I would also have enjoyed my work somewhere else.

And you mentioned some teaching tricks that you learned. Which ones would that would that be?

What I try to do is to look for examples that illustrate a certain point, but it's always difficult to come up with a good example of something because some examples are misleading that suggest something that is not there. So trying to find good examples, but also the pacing of the lecture. I basically discovered how you do that during my time in Twente. Also, the need for different styles of teaching for different audiences. Currently, I teach Complex Analysis for Physics, and I really need to do it in a slightly different way than the usual mathematics courses. You need to focus much less on proofs and a bit more on computations and physical relevance. But I think I really benefited from my time in Twente having seen many different audiences, and you also learn a lot by doing it. In hindsight, I have been quite happy with how I ended up in Twente, what I learned over there. And I also met a lot of people who were really dedicated to teaching, so you'll learn a lot from those people as well.

"Research is a sort of hobby that I can do in the summer."

What is your favourite theorem?

Oh, my favourite theorem. Oh, now you're asking a difficult question. It's really hard to pick one. I think the Cauchy integral formula from complex analysis, I like very much. I also like the Hahn-Banach Theorem a lot. I would say those are my favourites, but it's really hard to stick to just one.

What would you have done if not Mathematics or academia?

If not Mathematics, then probably Computing Science. I think I would still have done a PhD in Computing Science if I had the opportunity, but then I would probably have ended up in in industry. So working at a company like KPN or any other large company that has connections with with the Computing Science. That's a very likely scenario.

I don't think if I would have done Computing Science, I would have ended up in academia. I probably would have done a PhD, but then stopped after the PhD. It was also a different time at the time. When I started as a student in 2001, everybody who could more or less handle a keyboard could get a job as a at a computer company. It was a very different time. But soon that bubble burst, and later, it became a little bit harder to find jobs. But I think industry would have been a likely option for me, if not Mathematics.

Do you have any summer plans?

I have still a lot of books to read. I'm not going on holiday this summer, so I'd like to stay at home and read those. That's one of my problems. You buy a lot of books, but you don't have time to read them. So, I need to work on my backlog. And in the summer, I also have a little bit more time to think because I have a

lot of management, a lot of teaching. And you cannot do research in a spare hour. That doesn't work. If you really need to have some time to sit down and think about things, you need to have some time without distractions, and that's something that you typically have in summer. So I always say jokingly, "Research is a sort of hobby that I can do in the summer" and I don't perceive it as work anymore. Doing administration, that's a lot of work. But in the summer, I have time to do some thinking again. I'm looking forward to that.

What are your hobbies?
Reading, like I said. I also am an adult fan of LEGO. So I do enjoy that. So I like these these architecture sets of famous buildings and that keeps me busy. It's nice to to work with your hands once in a while. Most of my interests are confined to what you do on paper or with a computer. When I was younger, in secondary school, I did a lot of programming, but I don't enjoy that as much as when I was in school because most of my work is already so much by means of a computer. So at some moment, you just wanna do something else that doesn't involve a computer any more.

What do you like to read?
I read a lot of literature, so novels. One of my favourites are this Japanese author, Haruki Murakami. He has a very nice range of of books that he has written, and I like the themes that he has in his books, and I like the way they are written. Of course, I cannot read them in the original language because I don't read Japanese, but I do like those books a lot. But I will say my taste in books does vary a little bit. I'm not confined to one specific taste.

So LEGO architecture sets, which ones have you built?
I've built a lot of those. Technically, the last one was not an architecture set, but it was the Colosseum from Rome. It's a bit of an oversized object. I think it was around 50 centimetres across or so. Nine thousand pieces. It keeps you keeps you busy for a while. And you don't need to be afraid of repetition because there are some sections that you need to repeat over and over again. But somehow that's mindfulness for me. It's a hobby that I seem to share with other people because, I am not sure if you have seen what's on the desk in the office next to me, there's there was Julian Koellenmeier. He also has his large LEGO rockets. So there are more people around somehow have this hobby.

What did you have for breakfast this morning?
Oatmeal. That's a standard for me. Oatmeal in the morning, a fried egg, a banana, and a cup of black coffee. That's more or less the standard breakfast for me.

Figure 12: The LEGO Colosseum

Do you prefer teaching or researching?
My interest has shifted a little bit from research to teaching. I feel that I'm also more successful in doing that. For research, you need to fight for funding, and that's really difficult. And others are more successful in that. So I also do a little bit more management in teaching. But I do like that I still can do a little bit of research. But when I was a postdoc in England, initially, I started with 100% research, and I didn't like that at all. I do need some teaching just to get my mind off research and do something else. So I was really happy when in England I could do some tutorials for Differential Equations or for Probability Theory just to work with students and to explain things. I would not want to have 100% research. I don't think I would be able to cope with that.

You teach multiple courses, what is your favourite course to teach?
I would say Functional Analysis is one of my favourites because it's also close to what I did in my Master's thesis and it's Analysis. It's in infinite dimensional spaces. It has nice applications to Differential Equations. It has nice applications in Numerical Analysis. It's a very versatile subject that you need for a lot of different fields. You have really deep proofs and I really like that. So it's one of my favourites. And Complex Analysis is also nice, but I do teach it for the first time now. But because I teach it for the physicists, I do it in a little bit of a different way. But I would definitely say that functional analysis is one of my favourites.

You are also the program director for the BSc of Mathematics. What is that like?
A lot of work. So, basically, I have the final responsibility for the program. So that means every year you need to update the teaching exam regulations. You deal with quality control of courses. You deal with

student behaviour. There are unfortunately students who misbehave, that's also on my plate. The faculty sometimes issues new policies and we need to implement it in our programs. Sometimes they are policies related to to spending money. Currently, well, the financial situation of the University is not that great. That's not only for Groningen but for many universities. So there are measures that are being taken to cut the budgets a little bit. So then there are ideas issued by the faculty board and you need to implement them. That's not always fun, but it's something that needs to be done to keep a healthy program. It's a lot of paperwork, we have the teaching and exam regulations. We have the assessment plans. This year, we had a midterm evaluation for our program, so we needed to write a report for that. Sometimes you are asked to join the midterm panels for other programs, so you need to read those reports. So it's a lot of paperwork. It's interesting, but it is not the same as research or teaching. I consider that more as work than research or teaching.

Who is a colleague who you really admire?

I would say Tamás Görbe. He's really good in teaching and because of his enthusiasm and the ideas that he has about teaching. I think he's one of my favorites. I also like Marcello Seri a lot. He knows really a lot of Mathematics, and he can also explain it very well. He's also enthusiastic. So, yeah, I like them a lot.

Could tell us what this thing on the table is?

It's a Kapitza pendulum. There's a whole story about this. This has been constructed with all these metal rods and gears. It's a system that was made in the 60's, but it's still produced today and this came from a former professor here who worked here in the early 1960's and he brought it to the University of Groningen and then he handed it over to professor Arthur Veldman. So this goes a long time back. It's indeed a pendulum and I can show you how it works. So it's a little bit stiff because its old, but you have this wheel that you can spin. You can see that the pendulum goes up and down, the idea is that I can also put it upside down and then if I spin it fast enough it will stay in it's upright position. So that is interesting. I think you can explain this with a mathematical model, but that's not so trivial. But its quite interesting, it has a long history and it's a little bit dusty and a little bit greasy so I probably need to wash my hands afterwards, but I think its a fun object and the fact that it has been in the University for so long, has a little bit of history behind it, that's quite nice.

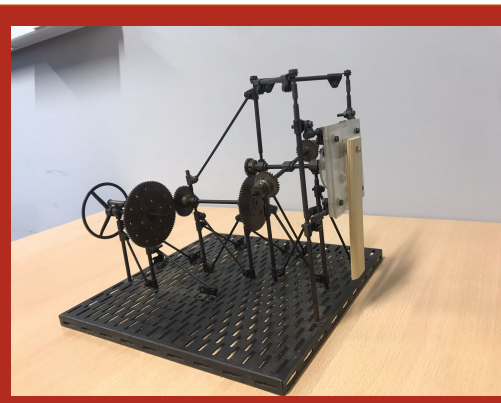

Figure 13: The Kapitza Pendulum from the side

What is currently, according to you, the most important problem or unsolved problem in Mathematics?

It's so difficult to make a definite choice here. It also depends a lot on on taste. Of course, there are all these problems in Algebra, the abc-Conjecture and the Goldbach Conjecture, but they are outside of my own field. A little bit closer to my own world is questions related to Dynamical Systems. So the Collatz Conjecture, $3n + 1$. That's a famous one. But also existence and uniqueness for the solutions of 3D Navier-Stokes equations are still unsolved. I think they are important, but I'm not going to solve them.

Figure 14: The Kapitza Pendulum in motion

What music do you listen to?
A lot of electronic, a lot of ambient. That's something that I can listen to when I'm at work. So not things with singing or vocals because it distracts me from doing the things. It's not that I dislike anything that has vocals in it, but it's not something that I can do while working. I also like jazz, but, again, that's not something I can do when I'm working because somehow it messes up with my brain. I just cannot handle it when I do things.

What is your favourite song?
Favourites are always so difficult. You force me to make a choice. Oh God. Making choices. That's also the the problem with Spotify. You just can listen so much. Right? I mean, that's just crazy. It's really crazy. According to Spotify, I listen most frequently to Repair Techniques by Sophie Birch. So it's instrumental, but that's apparently what I listened to in the last weeks.

Do you have any pets?
No, I live alone and I'm away from home a lot, so a cat or a dog isn't going to work. I do like cats and dogs however. My brother had a dog who passed away, sadly, but now they have a new dog. I like it a lot when I'm visiting. But no, I don't have any pets. Some people have a goldfish or hamsters, but that's not for me and a cat or a dog is not feasible for me. It would be really sad if the cat or the dog would be sitting at home all the time. I don't think it would be a good idea. But I do like them. And the funny thing is as a kid, I didn't like dogs so much. As a kid, I was once bitten by a dog, so that was more or less my the end of my love for dogs. But I also have learned that most dogs can be trusted. It's also you need to read their behaviour a little bit to see if they want attention or not. And that sometimes may be difficult to see maybe as a kid. But I know I don't have any pets.

And what has been your most memorable or inspiring experience within academia?
I think the the publication of my very first paper. It was actually when I was doing my Master's degree. So based on the research I did there, we wrote a paper on it, and it was published. Yeah, that I think that the first paper always sticks somehow. I would say that's the most inspiring moment.

What was this paper about?
It was about Sturm-Liouville problems. It's a particular type of differential equations on the interval with boundary conditions, and you can associate a linear operator to that. And it happens to be symmetric, but not self-adjoint. So that's a little bit outside of the scope of Functional Analysis where we only look at self-adjoint operators, but then you can look at self-adjoint extensions and to what boundary conditions they correspond. And that was a very nice paper. And I still remember the day that I had to solve a certain certain subproblem for that project, and I managed to solve it. So that was quite nice.

"If I'm correct, there are still exams in that database that I uploaded there myself."

Do you think that there are more doors or wheels in the world?
Oh, that's difficult. I would go for wheels. You know why? You know what the largest manufacturer of tires is? It is LEGO. So that's why I would say there are more wheels.

Do you have anything else you want to add?
When I was a student I wasn't so active in FMF but I was active in the Huygens committee. Part of Huygens did excursions in the Netherlands and the other part managed the exam database and I did that part and it was actually quite nice to do that. If I'm correct, there are still exams in that database that I uploaded there myself. I think some really old exams can still be found there, from the early 2000's, so 25 years ago. I don't think it's a problem students use this database, we did exactly the same. Some teachers are a bit paranoid about students taking the exam home after the exam. But I think "Why?" the exam has already happened so I can only understand it if you wanna re-use certain questions. And by the way if you have many exams from the past, students typically don't practice all of them. I once re-used questions and people failed miserably even though I posted all the exams on Brightspace. It doesn't matter I think, I'm not so concerned about it.

Your text could be here!

Are you a student or staff member and do you have an interesting or fun contribution to the Perio*diek*?

Get in contact!

at perio@fmf.nl

Also for questions.

From Egg-cellent Engineering to High-Flying Adventures

Team vMajorz in the Mundial CanSat 2025 Challenge in Mexico City

AUTHOR: **A. HIRSCH**

This year, not one, but two student teams from the University of Groningen competed in the Mundial CanSat 2025 challenge! One of them was vMajorz, a seven-person team with big dreams. But you might be wondering what is this about, and what even is a CanSat?

A CanSat (Canned Satellite) is a model satellite used commonly in student challenges. It has very specific requirements like the compact form factor that makes it challenging to integrate various functions, such as sending telemetry data and protecting a payload compartment.

The Mundial CanSat competition, hosted by Universidad Nacional Autónoma de México located Mexico City, expands on this challenge even more: teams must build a 2U-sized satellite, mostly out of wood, which has to meet some restrictive technical criteria before being released from a drone and dropped 400 meters.

The mission objectives consist of:

- Transmitting telemetry data during descent and for 30 seconds after landing.
- Fitting into strict size and weight limits.
- Deploying an autogyro system after 200 meters of free fall.
- Protecting a delicate payload of water, seeds, and most importantly an egg.

Our CanSat is split into two main compartments:

Top compartment
The top floor contains all of our electrical components. Here lives our radio communication module, which lets us transmit data to the ground in real time. We also used the Arduino Nicla Sense ME, a little powerhouse equipped with sensors for pressure, temperature, humidity, and CO2 levels. Additionally, we include an autogyro system that deploys in mid-fall to slow the whole CanSat down. It releases the wings, attached to the top of the CanSat that rotate during the fall like helicopter wings.

Bottom Compartment
Our payload chamber includes a 3D-printed PETG water compartment, a specially-engineered egg protection system (rocket foam and sorbothane padding lined on the inside of the walls), and our battery, strategically placed low to balance the satellite's center of mass.

In figure 15, you can see our final model.

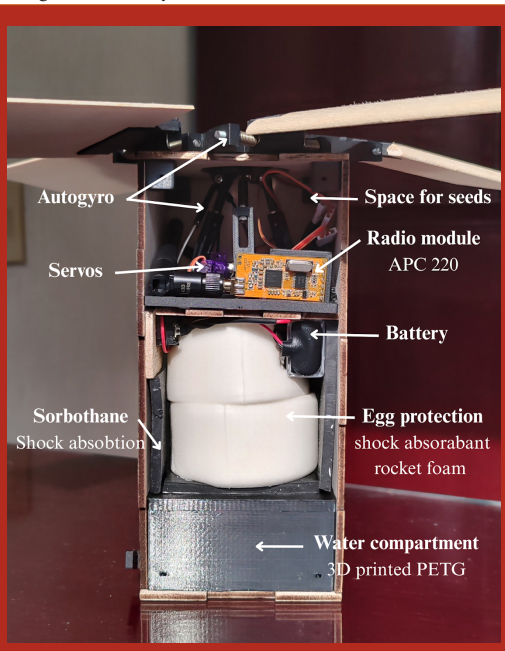

Figure 15: Compartments of our CanSat

Who are we?

In simple terms, we are just a group of friends. We all study Astronomy, Mathematics and Physics at the University of Groningen and partially met at Pienter and through the project we did the year before. We found the project through brightspace and immediately started to try and find a fitting supervisor in the university staff, especially since none of us had any engineering expertise. We initially saw this project as a fun hobby to do on the

side of our studies, which quickly escalated to taking it much more serious than anticipated. We still had a lot of fun, which always remained our highest priority and quickly grew together as a little family.

Figure 16: Team vMajorz

- **Vilte Petrauskaite** - Team Leader (BSc Physics & Mathematics)
- **Olivier van der Woerd** - Head of Mechanics (BSc Astronomy)
- **Annika Hirsch** - Secretary & Treasurer (BSc Applied Mathematics)
- **Julian Overschie** - Head of Design & Electronics (BSc Astronomy)
- **Zara Siyal** - Head of Testing & External Affairs (BSc Astronomy)
- **Raf Brenninkmeijer** - Head of Programming (BSc Physics)
- **Sofia Mendonça** - Head of Manufacturing (BSc Astronomy)

The finale and results

After months of soldering, printing, coding, testing, breaking things, and patching them back up, our hard work finally paid off: we made it through the first four stages of the Mundial CanSat 2025 challenge with flying colors, placing 8th, 6th, 3rd, and 3rd respectively. This qulified us to attend the grand finale in Mexico City.

Thanks to the support of the School of Science and Engineering (SSE), we were able to fly out five days early with our supervisor, Dr. Bahar Haghighat. The beginning of our trip consisted in working in the hotel to fix all last issues and making our CanSat ready for the competition.

On the day of the competition, we arrived early and started talking to other teams from all over latin America. They were incredibly nice and we also filmed some interviews, which you can find on our instagram page.

Preparing the CanSat on the day of the finale went pretty smoothly. We recieved the egg, water and seeds and inserted them carefully into the respective compartments. We did have a last-minute weight issue, which we were able to resolve quickly.

The launch itself was a different story. During the deployment of the autogyro, three of our wings snapped off, which caused our CanSat to hit the ground with much more force than anticipated. Our egg sadly did not survive the crash, but we were able to retrieve about 50% of the water and of course the seeds. At the groundstation, we were able to recieve all neccessary data until the crash, which was a success.

We ended up placing 23rd out of 44 teams, which considering the catastrophic wing incident, was a result we were proud of.

After the competition, we had five more days to explore the city, which was truly magical. We visited the pyramids of Teotihuacán, the cable cars that went accross large parts of the city and the National Museum of Anthropology, as well as trying as much of the local food as possible.

Conclusion

Overall we are super grateful for getting this opportunity and for all of the people helping us along the way.
We can only encourage others to take initiatives for projects like this, they are incredibly valuable and teach you a lot.
Maybe, if the university approves, you could join the next CanSat team yourself!

If you'd like to see more of the journey along the way, check out our Instagram @vmajorz.

CRISPR-Planck9: Editing life at the smallest of scales

Exchange article

If you've been busy doing LHC calculations or chasing down rogue tensors in your quantum field theory class, you may have missed some major developments in the world of biochemistry. Enter CRISPR-Cas9: a gene-editing tool so precise, it makes your spectrometer alignment look sloppy.

CRISPR-Cas9 allows us to precisely edit individual genes in adult humans or even modify the entire genome of an embryo. This opens the door to curing genetic diseases and treating serious conditions, such as the inexplicable urge to become a physics student. And if you let your imagination (or ethical boundaries) stretch a bit, the concept of designer babies isn't entirely off the table either. Before tackling this we need to understand how this tool works.

Clustered regularly interspaced palindromic repeats (CRISPR) are part of the immune system in certain bacteria. E.coli is a bacteria that lives in your stomach and houses such an immune system. Meanwhile, Cas 9 is an enzyme which cleaves sequences based on guide-RNA. RNA is similar to DNA, being made up of nucleotides with varying nitrogenous bases. While DNA has ATGC, RNA consists of AUGC, and is single-stranded rather than double stranded. When bacteria are very rudely attacked by bacteriophages, which are bacteria form of viruses, a foreign piece of DNA is injected into the bacterial cell. This injection of DNA can cause all kinds of issues for the bacterial cell, so the piece of DNA is cleaved by the Cas9 enzymes into small fragments known as protospacers (has nothing to do with protons or space). These fragments get stored in the bacterial genome in CRISPR arrays, like storing spectral fingerprints for future detection. Later, if that phage shows up again, CRISPR uses this region to produce pre-crisprRNA (pre-crRNA). The palindromic repeats fold into hairpins, basically the bio-version of a standing wave, and the Cas9 enzyme processes these into mature crRNA.

Now armed with a guide, the crRNA binds to the Cas9 enzyme, forming a search-and-destroy unit that patrols the cellular cytoplasm. Once it finds a sequence matching its stored memory, it locks on like a heat-seeking missile and cleaves the DNA.

The CRISPR-Cas9 complex has two domains: one for recognition (matching the sequence) and one for nuclease activity (cutting it, clean as a neutrino interaction in a bubble chamber). For CRISPR-Cas9 to lock onto its target, it needs a PAM sequence, short for Protospacer Adjacent Motif, which in this case is "NGG" (N being any nucleotide). It's a bit like needing an anchor point before initiating quantum teleportation, no PAM, no target.

Once locked, Cas9 makes a double-strand break (DSB) in the DNA, but with blunt ends, so no sticky residues left behind like a badly aligned laser beam. The two active sites, HNH (which cuts the complementary strand) and RuvC (which cuts the non-complementary strand), work in tandem like synchronized clocks.

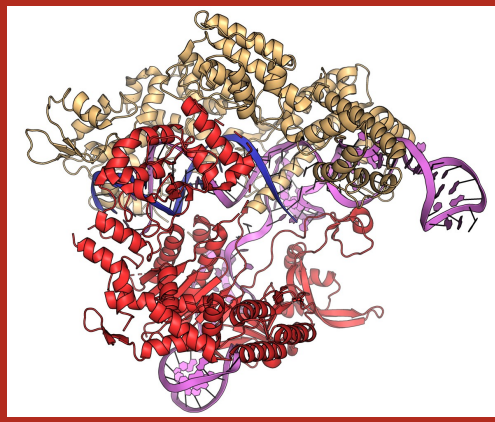

Figure 17: Cas9 bound to sgRNA (purple) and target DNA (blue) duplex. The recognition lobe (orange) is essential for binding sgRNA and DNA and the nuclease lobe (red) hydrolyses the target DNA

But like most things in nature and thermodynamics, entropy can creep in. If the g-RNA isn't specific enough, off-target effects can occur, leading to unintended deletions, basically CRISPR's version of Heisenberg uncertainty in action. To increase specificity, researchers created "nickase" versions of Cas9, mutating one of the domains so it only cuts one strand. Using two nickases on opposite strands ensures a DSB only occurs at the right place, a clever strategy that feels like using constructive interference to build precision.

When a break is made, the cell rushes to repair the damage. If you want to insert a new gene, you hope the cell uses homology-directed repair (HDR), specifically synthesis-dependent strand annealing (SDSA), rather than the messier non-homologous end joining (NHEJ). Think of HDR as reassembling a circuit using the original schematic, while NHEJ is like soldering random wires and hoping it works.

So what's the takeaway? CRISPR-Cas9 lets us design a guide RNA like setting initial conditions in a Schrödinger equation: choose your target sequence, introduce it with a nickase or wild-type Cas9, and with a bit of molecular finesse, you can create precise edits in the genome. The implications are vast: disease treatment, crop enhancement, or building a DNA-powered fusion reactor. Okay, maybe not the last one.

In conclusion, while physicists measure the universe one Planck length at a time, biochemists are out here rewriting the instruction manual for life, one base pair at a time. So next time you align your interferometer, spare a thought for the tiny molecular machines doing precision work long before it was cool.

Which board member are you?

Take the quiz!

AUTHORS: **Q. HUANG, R. MOL**

They have been running the association for nearly a year now, but do you know these people really? Who are they behind the board suit and tie, and find out who you are most alike.

1. What is your favourite animal?

Dragon
Goat
Humans
Otter
Rabbits

2. What is your go-to snack at the FMF?

Broccoli & cheese potato
Haribos
Noodles (Duck flavoured)
Toblerone
Torondo

3. What was the last boardgame you played?

Catan
Codenames
Here to Slay
Monopoly
Ticket to Ride

4. What is your favourite part of the Perio*diek*?

Art section
From the Board
Interviews with Professors
Jorian's 'From the Board'
Reviews

5. What is your favourite number, other than 66?

7
24
42
71
16,777,216

6. What is your favourite equation?

coim $\varphi \cong \operatorname{im} \varphi$
$E = mv^2/2$
Maxwell's equation
Saha equation
Schrödinger's equation

7. If you could revive one person, who?

A random caveman
Albert Camus
Hans Knook
Marie Curie
My great-grandmother

8. What is your favourite dinosaur?

Ankylosaurus
Chicken
Stegosaurus
The one with the very long neck
Triceratops

9. Which fictional universe would you want to live in?

Harry Potter
Kabouter Plop
Minecraft
Star Wars
The 'Throne of Glass' series

10. What was your average screen time last week?

1 hour and 56 minutes
3 hour and 29 minutes
4 hour and 3 minutes
4 hour and 30 minutes
5 hour and 25 minutes

11. What would you name the 8th day of the week?

Day
Earthday
Neroday
Sunsetday
The 8th day of the week

12. What is the most annoying thing a member has done during your board year?

Breaking a beer bottle during Flunkyball
Breaking the FMF website, so I have to keep fixing it
Breaking the VIA chair in the room
Forget the boardgames for the Boardgames Evening
Letting Mascie continue to exist

13. What is the first thing you'd do during a zombie apocalypse?

Find a place to hide
Get food
Steal a car
Try to find a water supply
Videogaming

14. What terrain would you want to live in?

A valley, surrounded by mountains
Forrest cliffs by the sea
Mountains
Rocky flat mountains
The seaside

15. Which superpower would you want to have?

Being focused while studying
Elemental manipulation
Healing
Mind reading
Teleportation

16. What is the first thing you'd buy if you won a million?

Car
Drumset
Excursion
Steak
Vacation

Answers!

Now that you completed the quiz, you have a chance to compare the answers with the board's.

1. What is your favourite animal?

Dragon	**Ioana**
Goat	**Marnick**
Humans	**Jorian**
Otter	**Yoana**
Rabbits	**Aurel**

2. What is your go-to snack at the FMF?

Broccoli & cheese potato	**Ioana**
Haribos	**Jorian**
Noodles (Duck flavoured)	**Marnick**
Toblerone	**Yoana**
Torondo	**Aurel**

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42	**Aurel**
71	**Ioana**
16,777,216	**Jorian**

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Maxwell's equation	**Yoana**
Saha equation	**Ioana**
Schrödinger's equation	**Aurel**

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Hans Knook	**Marnick**
Marie Curie	**Yoana**
My great-grandmother	**Ioana**

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Triceratops	**Aurel**

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Kabouter Plop	Marnick
Minecraft	Jorian
Star Wars	Aurel
The 'Throne of Glass' series	Ioana

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4 hour and 30 minutes	Yoana
5 hour and 25 minutes	Ioana

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Neroday	Marnick
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Forget the boardgames for the Boardgames Evening	Ioana
Letting Mascie continue to exist	Jorian

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Elemental manipulation	Ioana
Healing	Aurel
Mind reading	Yoana
Teleportation	Jorian

16. What is the first thing you'd buy if you won a million?

Car	Jorian
Drumset	Aurel
Excursion	Yoana
Steak	Marnick
Vacation	Ioana

Meet the Kandies

Have a quick glimpse into the 67th Candidate Board of the FMF!

AUTHOR: **Y. SAVOVA**

On June 4th, the FMF board revealed their successors to the members. Now that the candidate board is settling into their new functions, they are also excited to introduce themselves to the rest of the association. Perio has their back! We have collected these short introductions from each of the kandies so you can get to know the people who will *potentially* be steering FMF in the coming year.

Remco

Name: Remco de Jong

Study: MSc Applied Mathematics

Year started: 2020

Position: Candidate Chairman

Favourite committee: Mathematica

Favourite event: Holiday Potluck

Thing you love most about the FMF: The people, vibes and the events organised by the members

Annika

Name: Annika Kristin Hirsch

Study: BSc Applied Mathematics

Year started: 2023

Position: Candidate Secretary and Commissioner of Internal Affairs

Favourite committee: Fotocie (obviously)

Favourite event: Membersweekend

Thing you love most about the FMF: The people, it's like a family <3

Kara

Name: Kara van der Meulen

Study: BSc General Creative Media and Game Technologies

Year started: 2022

Position: Candidate Treasurer

Favourite committee: Pienter

Favourite event: FMF Top 100

Thing you love most about the FMF: The People, I love hanging out, going to events together and just in general vibing <3

Alexandra

Name: Ioana-Alexandra Branut

Study: BSc Physics

Year started: 2022

Position: Candidate Commissioner of External Affairs

Favourite committee: Lecie

Favourite event: Symposium

Thing you love most about the FMF: Socializing with people in the room after a long day at uni <3

Ilinca

Name: Ilinca Maria Antonache

Study: BSc Mathematics and BSc Physics

Year started: 2023

Position: Candidate Commissioner of Educational Affairs

Favourite committee: Mathematica

Favourite event: Bracelet Making

Thing you love most about the FMF: The exam database (and the people) <3

A Day in the Life of a PhD Student

AUTHOR: **R. SCHOLTENS**

In some way, it's seen as the natural step – and ambition – after you've completed your Master's degree: pursue and complete a PhD. However, it's only one of the myriad of possibilities open to you upon your graduation. Like any other major step, therefore, it deserves careful consideration: is doing a PhD for me? What's it like to do one? In this article, I want to shine a light on what "doing a PhD" actually means, via 3+ years experience of being one.

Before anything, though, it should be stressed that I can speak mostly only from personal experience. Every PhD project is different, from guidance intensity to working schedule and expectations to opportunities. So, for full context: I am a PhD student in theoretical cosmology, working in the Bernoulli (mathematics) and Kapteyn (astronomy) institutes. My project is mostly "pen and paper" based, working in a small group, and without need for experimental apparatus (excluding computer services).

What's a PhD about?

Attaining a PhD degree shows that you have the ability to independently conduct research, and are able to report and communicate your results in accordance with the standards of scientific publications; in effect, it's saying that you have become a mature researcher. As realizations of these goals, think of: being able to find publications and judge their relevance, writing papers about your findings, and presenting at conferences of your peers. Most importantly: writing the PhD thesis at the end of your project runtime. Indeed, PhD projects have a finite runtime, and, with varying standards, at the end of it you must have produced a defensible thesis that encompasses what you have researched.

Sounds like a lot, right? Fortunately, one is not expected to do all of this spontaneously and overnight. The PhD is a learning process. And not just for the acquired knowledge, but also on how the knowledge is gained. Just as much as the formal goals mentioned above, the PhD project is about experiencing this process and through the ups and downs – and ups and downs there will be aplenty – keeping your eye on the "prize": conducting rigorous scientific research, independently. In my opinion, this also distinguishes the PhD project from, say, a Master's project. By the end, you're expected to lead your own research forward, formulating your own questions based on gaps in the existing literature.

Moreover, during your PhD you are supported by your supervisors. They know about your topic and so aid and supervise – what's in a name – you in your research. But, perhaps more importantly, they also act as your mentor in your journey to completing the project and maturing as a researcher. Oftentimes, the supervisors are a key determinant in whether or not the project is a success, both scientifically and from a working experience perspective.

In broad strokes, the four years of PhD project are spent like such. (In the Netherlands at least, the PhD projects are four years in length. This varies from country to country.) The first year or so is spent familiarizing yourself with the topic. Then you start answering some of your initial research questions, and gradually formulate and answer more of your own. Depending on the results, you also start writing publications and presenting at conferences. This continues until ~ 3 years in, at which point it becomes time to start writing the PhD thesis. The writing will take the rest of your project duration.

Figure 18: A layman presentation I gave

The daily life

Though the ambitions for the PhD project are lofty, in the day-to-day, for me, it boils down to an office job. Barring exceptions (see later in the article!), after a morning swim I come into the office at approximately 8.45, have some breakfast whilst opening my laptop, and start the day. My first go-to is checking newly uploaded preprints on arxiv using arxivist, and reading the abstracts of the ones I fancy most. Afterwards, the researching starts.

The set of research activities is a diverse one, and what its elements are varies depending on project and current topic. In broad strokes, for me, it's a mix between familiarizing myself with the existing literature, working out ideas I have in order to advance my research (mostly by doing calculations), and doing some programming. One day I could spend reading a textbook or closely studying an article, and the next I'm working through my own calculations to see where the minus sign was forgotten. In this way, it resembles projects you might already be familiar with from your studies, such as your Master's project.

It's a fact of life that for most jobs there's many things going on in parallel, and the PhD is no different in that regard. I could have writing a paper, working on the research for another one, grading exams, and preparing a presentation all going on at the same time. Depending on deadlines and priority, the time needs to be divided between all of these. Sometimes it's difficult, because what needs doing does not always want to come out of my head, but by planning ahead and setting deadlines (or having them be set), I somehow mostly manage to do things in a timely way. However, it's very much up to the person: different strokes for different folks.

Nothing can go on continuously, though, least of all creativity; breaks are required. These mostly come in the form of small moments in which I replenish my coffee and chat a bit with the colleagues. More than quenching my thirst – PhD students require a lot of coffee – it momentarily grounds me and gets me up and moving periodically. The lunch breaks do much the same for me, providing a natural "before" and "after" for the day, and allowing me to get my mind off of the work for a bit. It also helps the lunch chats are usually amusing.

In addition to the daily routine, there's usually weekly seminars or colloquia to attend. These are on various topics, and both by people from inside the departments as well as visiting guests. Although they're rarely on a topic I'm working on, I find attending them one of the best parts of being a PhD student.

Being exposed to and trying to understand new ideas, and potentially finding connections to my own research, "refreshes" my mind in a certain, delightful way.

The undaily life

Slotted in between all the "routine" days are the days on which something special happens, which comes in various shapes and sizes. One such occasion that comes to mind is when a special symposium/workshop is hosted at the institute, faculty, or university level. For me, these are a welcome break from the daily life. Even if the content of the activity is not so strictly related to my research, the more important reason to attend is to build a network and exchange ideas, whether related to science or otherwise.

Figure 19: "Practice for the PhD defense"

Of course, one cannot forget conferences, at which speakers present their latest research ideas, and the atmosphere is (or ought to be) such that ideas can be exchanged freely and new collaborations forged. Since part of the goal of a PhD project is to communicate your research to the community, presenting your work at a conference is an excellent idea if you get the chance! I find conferences interesting mostly for the breadth of topics that are considered, which gives me a better overview of what the rest of my "community" is thinking about.

In addition to the above two "mainline" special activities, there's a multitude of others: special talks by unique speakers or on unique topics; mini-courses, which is essentially a small lecture series on a specialized topic; <insert season> schools, at which a variety of topics is presented in a more in-depth way than would be encountered at conferences; fun activities hosted by the institute, which are an invaluable addition to the atmosphere at work; giving talks for the general public at outreach events; and so on, and so forth. These are amazing and should be attended when give the chance!

Aspects which are not so splendid

Like perhaps as life itself, the PhD project is best visualized as a bumpy road toward the goal of graduation. And as is the way with such things, there will be things on this journey that really take the wind out of your sails once encountered.

One of the most common ones is a setback in the research, whether or small or large. It's a guarantee that there will be setbacks in the research, and so a subgoal of the PhD project is to develop the resilience to handle such setbacks. When I think back to setbacks I encountered, (i) they really sucked, but (ii) I found I got through them by talking about it to my colleagues and supervisors: they've been (or are) there as well, and therefore understand. In addition, as an advantage to having parallel topics, you can switch to another temporarily if one isn't working out. I find that coming back after a little bit replenishes my motivation and mental accuracy.

Many PhD students – myself included – also experience imposter syndrome: roughly speaking, you feel as if you're the dumbest in the room and don't contribute anything to the conversation. And it should be noted it's not limited to PhD students: a good share of academics feels this way as well. Reminding yourself that imposter syndrome exists already goes some way to nullifying its effect on your mental state, or so I have found; but even now, I do sometimes still feels its effects.

Final thoughts

To round off this piece, let me just highlight what I find the most rewarding aspects of my job as PhD student. One of these is the constant exposure to new ideas, whether it's in the research I'm doing, people I'm meeting, or talks I'm attending. It keeps my mind active and looking for connections to my own interests, whether scientific (related to my topic or not), or personal. The deepening of understanding and appreciation for science in general keeps me motivated to continue my project.

As a close addition to this point: it's about the people. This is not something one can always choose, and so I'm doubly glad to be as lucky with the people surrounding me – fellow PhD students, supervisors, colleagues in the departments, and so on.

And finally, I much enjoy both the variety and flexibility of the job. Except for some set obligations (like TAing a class) and expectations, I can pretty much decide on my own when, where, and how I work: from home, in the evenings, on the weekends, it's up to me. Being able to move a workday to the weekend sometimes, plan a vacation when I want, or decide it's a work-from-home day, e.g, suits me very well, and so I'm glad he PhD position is open to that flexibility.

To close the circle: a PhD project is first and foremost a job, and so it deserves the close examination and consideration as one would give to any other. I hope that having shared my experience, the reader has a clearer idea of what to expect – in broad strokes! – from pursuing a PhD project.

Recipe
Mămăligă (Polenta)

AUTHOR: **I. BALINT**

If you grew up in Romania, chances are everyone and their mom tried to feed you this dish. If you didn't, well—you've been missing out on one of the simplest, most comforting dish we've got. It's warm, it's filling, and it goes with almost anything (cheese, sour cream, a stew, or any grilled meats at the family barbecue). My mom would always make this when she did not feel like cooking for a long time, she would add white cheese, sour cream, and a boiled egg. It was delicious and a staple in our household.

Recipe

Preparation time: ~ 30 minutes

Allergen information: This recipe mentions dairy but you can leave it out.

Main Ingredients

- 1 liter water
- Around 300 g coarse cornmeal
- 1 tablespoon butter (optional, but makes it extra creamy)
- Salt to taste (do not forget the salt otherwise it will taste like nothing)
- Whatever toppings make you happy: cheese, sour cream, egg, or anything else

Cooking Instructions

1. Boil the water: Put the water in a pot, add the salt, and bring it to a boil.
2. Add the cornmeal: Here's the trick: pour it in slowly while whisking constantly. If you do not have a whisk and use a spoon you have to be especially attentive, otherwise it will be lumpy and sad.
3. Stir until you feel like your hand will fall off: Turn the heat down and keep stirring with a wooden spoon. After 20–25 minutes, it should be thick, creamy, and stick to the sides of the pot. The longer you cook it for, the more dense and solid it will get. For a more soupy mămăligă, shorten the cooking time. It all depends on preference.
4. Finish: Stir in the butter at the end, taste and add extra salt if need be.
5. Serve however you like: Slice it if it's thick, scoop it if it's soft, and definitely add toppings. Then you're ready for a cozy meal.

Figure 20: My first time making mămăligă like my mom

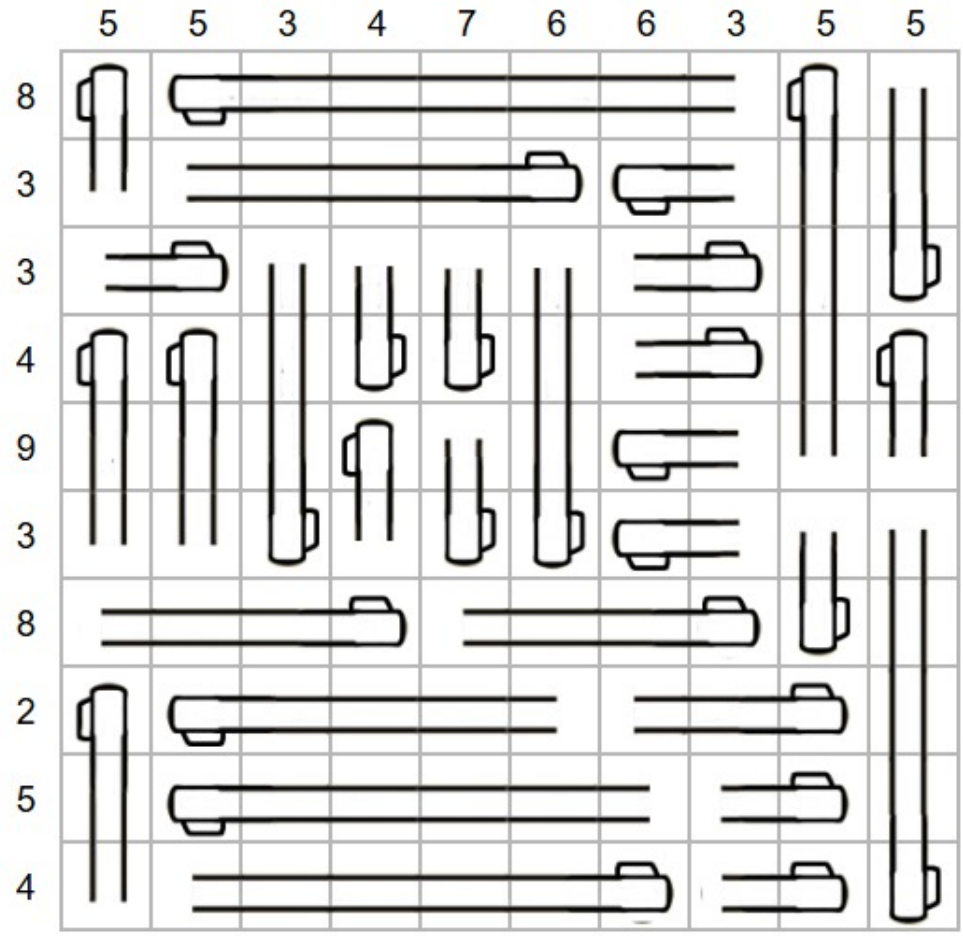
Brainwork
Beerwork

AUTHOR: **R. MOL**

Below are a number of beer glasses. Your task is to fill them with beer (by colouring the squares) such that the total amount of beer (coloured squares) in each row and column matches the number on the edge of that row/column.

When filling a beer glass, of course you have to start at the bottom (the square with the handle) and fill towards the open end, i.e. if a square is filled, then all squares between it and the handle square are coloured, and vice versa if a square is empty, then all squares between it and the open end are empty.

For example, if the top right square is filled, then the two squares below it are filled, and if the top left corner is empty, the one below it is also empty, but the inverse is not true!

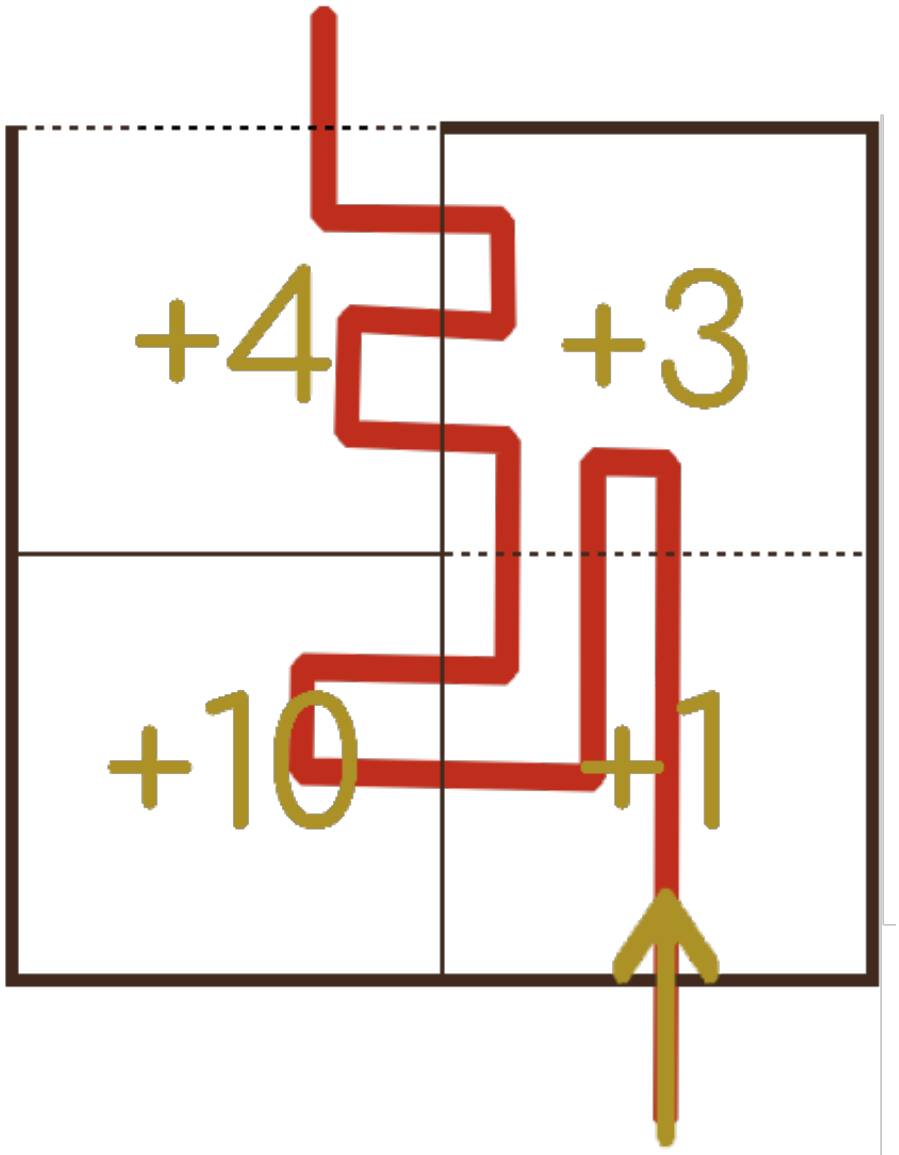


Tip: While you are colouring, use grey to indicate squares you have determined are empty. Think of it as foam on a poorly poured beer.

Send your solutions to perio@fmf.nl to be featured in the next issue!

Solution to the previous Brainwork

The smallest number that can leave the maze was 31, shown below.



The previous puzzle was solved by Max-Friso Schaap and Richard Harnisch. Both of which also solved the added challenge of getting stuck in the maze by finding a way to get 91 and 59 in the bottom left corner, respectively.