香港中文大學數學系 The Chinese University of Hong Kong

Department of Mathematics

Issue 17

Newsletter 2019-2020

From the Editor's Desk
編者的話

For many reasons, the year 2020 will definitely be remembered well by future historians. To a teacher working in our university, this year meant the "starting point" of full-fledged deployment of E-learning. Due to COVID-19, all of us had to use Zoom to teach – a brand new experience to all of us, especially those who were used to the traditional practice of teaching mathematics via Socratic dialogues.

As such, in this issue we have chosen to focus on pedagogical efforts put in by our colleagues in this difficult time. Included are three interviews, with a retired school principal working with young kids through math games, a young research assistant professor and an experienced lecturer, both having obtained high scores in their teaching evaluations.

Related to the buzzword "game", we also have a guest article on the late Prof. John Conway, eminent mathematician and polymath par excellence, most commonly known as the inventor of the Game of Life.

Soap Bubbles
by Hermann Hesse

From years of study and of contemplation
An old man brews a work of clarity,
A gay and convoluted dissertation
Discoursing on sweet wisdom playfully.

An eager student bent on storming heights
Has delved in archives and in libraries,
But adds the touch of genius when he writes
A first book full of deepest subtleties.

A boy, with bowl and straw, sits and blows,
Filling with breath the bubbles from the bowl.
Each praises like a hymn, and each one glows;
Into the filmy beads he blows his soul.

Old man, student, boy, all these three
Out of the Maya-foam of the universe
Create illusions. None is better or worse.
But in each of them the Light of Eternity
Sees its reflection, and burns more joyfully.

Table of Contents 目錄

遊戲中學習	p.2
Interview with Professor Andrew Lam	p.3-4
與Charles Li一夕談	p.5
Memories of Professor John Conway	p.6-7
Honours and Awards	p.8

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遊戲中學習

龍德義先生
(現任香港中文大學數學系校友會會長)

龍德義先生於1984年中大數學系本科畢業。畢業後，到保良局李城璧中學任職教師一年，其間跟同事一起出版中學教科書。任職教師一年後再回到中大修讀碩士，於1987年取得哲學碩士（數學），其後回到原校任教。龍德義先生於2000年當上保良局朱敬文中學校長，於2015年榮休。龍先生早於 1996 年已擔任教育局馮漢柱資優教育中心增益課程導師，亦曾被委任為課程發展議會數學教育委員會主席。

前言: 龍先生多年致力於資優教學，今天我們就談談香港資優教學的發展。

為什麼會選擇在資優教學方面發展？

我當初不是刻意向資優教學發展，當年修讀教育心理學碩士，正值美國和台灣大力提倡資優教育。當年一面倒傾向輔導教育，主力幫助學習較弱的學生。同時社會有人反思，忽略資優的一群是對社會一種損失，所以培育資優學生就在當時開始醞釀。1994年香港正值教育改革，開始試驗課程。我在1996年開始擔任教育局馮漢柱資優教育中心增益課程導師，對象是小四至小六學生，主要透過遊戲學習讓學生學到更寬更廣的數學。當時主要有兩種學習模式，分別是加快學習和深化學習，我設計的課程屬於深化學習。後期我到中文大學教育學院的資優計劃擔任導師至今。

怎樣看香港資優教學的變化?

最初資優教學的對象主要是學生，到2006年，服務對象開始擴展到家長層面，當中包括開辦講座和工作坊給家長參與。事實上，家長的參與對整個資優教育的幫助很大。說到改變，現今世代的小朋友大多數比較自我，尤其資優的一群。幸好我累積了一些教學心得可以啓導他們，當一個老師能夠掌握教導資優生的策略，不單能協助他們發揮潛能，更能提升整體學與教的效能。家長方面，現今家長的要求也相對地提高，比以往更著緊孩子的學習進度。學校和老師對資優教學的關注都大大提升。當老師發掘出資優學生不同的潛質和才能後，會為他們安排適當的培育機會。值得一提，現今互聯網發達也對學生的學習有幫助。學生更容易搜集資訊，很多資料都可以在網上找到。

最理想的香港資優教學模式？

一般政府資助學校沒有校本資優課程。由於資優教育有好多方面，例如數學，科學，語文，視藝……學校要在校內開辦個別的課程，服務個別資優學生是困難的。現在運行模式是，政府設立「資優教育基金」，資助中、小學的資優學生參加合適的校外進階學習課程，學校可以自行提名學生參加課程和申請基金資助，使他們能夠在富彈性的教學方法和環境下，充分發揮個別潛能。校外辦學機構的質素也很重要。當然最理想就是每間學校都設立校本資優課程。

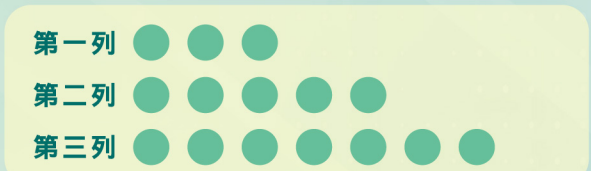
可以講講你在中大教授的資優課程嗎？

我的課程專為小學三至六年級的資優學生而設，旨在透過數學智力遊戲，讓學生了解橫向思維和擴散性思考在解決難題時所扮演的角色。通過學員的親身體驗、自我探索，和課堂練習，從而提升學員的解難能力、全面觀察能力和創造力。

後記:

龍德義先生在訪問中講述一個拈(NIM)數學遊戲，小編在此跟大家分享一下這個遊戲吧!

最有名的玩法是將十五枚銅板分三列排成「三、五、七」的遊戲，如下圖：



遊戲的規則很簡單。兩人輪流取銅板，每人每次需在某一列取一枚或一枚以上的銅板，但不能同時在兩列取銅板，直到最後，將最後一枚銅板拿走的人贏得此遊戲。 也可以做相反的規定：將最後一枚銅板拿走的人輸。

Interview with Professor Andrew Lam

Professor Andrew Kei Fong LAM joined our Department in 2017. He earned his PhD at the University of Warwick. Among his numerous fields of interest are mathematical modelling with continuum mechanics, and analysis and optimal control of elliptic and parabolic partial differential equations.

Seeing that his teaching at CUHK was very well-received by our undergraduate students, we conducted this interview to explore Lam's teaching philosophy.

What was your teaching experience prior to coming to CUHK?

After I graduated in the UK with my PhD, I went to Germany in 2014 for a three-year postdoc at the University of Regensburg. Teaching-wise, I didn't have any teaching duties there because the lessons were conducted in German, and I didn't know any German. So, before coming to CUHK I had no teaching experience, only some supervising experience with a bachelor's and a master's theses.

Where did you complete your undergraduate studies?

I did my undergraduate studies in the UK, also at the University of Warwick.

How is teaching in the UK like compared to Hong Kong?

If I remember correctly from 10 years ago, the curriculum was very similar. I think you had your basic core courses with analysis, algebra, linear algebra, and maybe some geometry and some complex analysis and then further on, we had something more specialized. There were some lecturers who were very good at teaching. They used a lot of humor. They really engaged the class and of course there were some who were rather boring, where they just read off the lecture notes on the slide, or they just kept writing and writing and writing.

In Hong Kong when you first started teaching, did you have a specific role model for yourself?

I didn't have a role model. I try to remember how I was in my undergraduate days: What I was feeling when I sat in a lecture, what kept me interested in the lecture and what disengaged me during the lecture. I kept those things in mind and tried to remember how the lecturers back then were teaching.

What was the first math class that you taught at CUHK?

The first math class I taught here was ordinary differential equations (ODE).

What did you think would keep students interested in ODE?

Because ODE has a lot of real-world applications, I thought maybe I should introduce them more towards the practical applications of the theory. So in my lectures, I tried to give a lot of examples in physics, in mechanics, to try to keep them interested.

What was the class at CUHK that you most enjoyed teaching?

I think I most enjoyed teaching this master-level class on computational mathematics in 2019. This involved roughly some linear algebra, mainly on matrix algorithms. We discussed how to decompose a matrix, and how to solve problems. I found this topic much more interesting. My target audience were master's students, and they already knew a little bit of mathematics. All of them had backgrounds which were a little bit different from

one another, and some would know a little bit more in one area, while some knew a little bit less.

I initially found the topic quite boring, because with matrices and linear algebra you could not do so much in an undergraduate course. But at the graduate level, I could do a little bit more, so I could show them a little bit how these algorithms operating on matrices could actually be used in real life.

And there was more student engagement, because at that time I also switched from writing on the whiteboard to using slides. Very much like the "Zoom style" of teaching, but I taught with the slides in a face-to-face setting.

And the students actually like that?

Yeah, because in some ways what I can do here is I can shorten the amount of material on each slide. On each slide, there are not so many main points, maybe one or two, and the students can focus on that. Secondly, they don't have to take any more notes because the notes have already been produced. They can just print off the notes, and on their own printed copies they could add a little bit more material, maybe some calculations or highlights.

And it's very easy for me just to face the students instead of turning my back while writing on the board every time. There's no need to waste time wiping the board. I can just talk to the students face-to-face.

What is your impression of undergraduate students in Hong Kong?

Mostly very shy, I think. My impression is that you get one or two out of 20 or 30 that are attentive, who try to participate. And the rest usually are just focusing on copying down notes.

I remember from my Warwick days, that there were many people, maybe 6 to 7 in a class, that really engaged with the lecture. They would be some of the first students who answered questions, or pointed out mistakes, so they were not shy.

What brought you to studying Mathematics at Warwick?

I just looked at what I was good at: maths, physics, biology, chemistry. When I talked to my school teachers, they gave some advice. The mathematics teacher told me that, "Why don't you choose maths? Because with maths, you can do a lot more than maybe just having a chemistry degree." <chuckles> I know, I know, I know now that's not exactly true.

I did not have very strong feelings for choosing maths. I liked the subject, but it was just something I thought maybe it would be useful when I finished university. I also thought about becoming a school teacher, because back in the UK, there were not enough maths or science school teachers. But when I was deciding between graduate study or an education degree, one of my professors told me it'd be easier for me to get a PhD first and then become a school teacher, than the other way around.

Tell us about your research area.

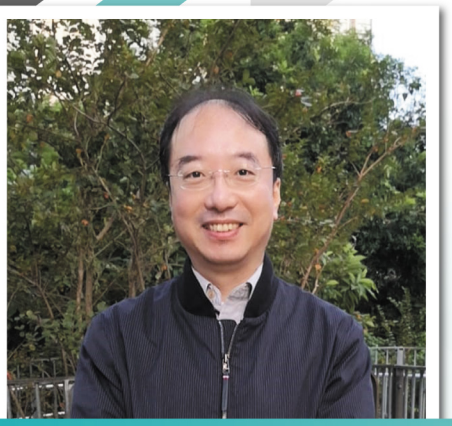
My main research interest is mathematical modelling. In recent years, since coming to CUHK, my focus is on cancer growth. What I do is I think about what sort of mechanism is in a cancer.

First of all, cancer cells need nutrients. When they grow, they sometimes experience some sort of pressure from either the environment, or the immune system tries to push back, or maybe they are competing with other types of cancer cells. So, I try to build all this into a mathematical model. And then what I do with the model is I try to prove some mathematical theorems, like whether this model comes out as a partial differential equation system, and I prove something like whether there is a solution, whether the solution is unique. Once I have this, I usually work with other people to look at optimal control problems. For example, if I were to introduce a cancer drug, to kill the cancer cells, what should be the dosage of the drug, or how frequently should I administer the drug to the patient in order to keep the cancer cells small or even to eliminate the cancer cells?

We build a model. And we have a medical expert to give us advice, what is realistic or not. And once we have the model, we do some numerical simulations. We have another guy doing the coding and also simulating what the cancer growth looks like, and then my job is to provide the mathematical "backup": We have the biological background, we have the numerical simulation to show what the model looks like, and my job is to say that mathematically this model makes sense, that this looks like a good model to start investigating with maybe real data.

Professor Andrew Lam is now Assistant Professor at Hong Kong Baptist University.

與 Charles Li 一夕談



前言：李俊捷博士（即Dr. Charles Li）是數學系四改三那年的學生。Charles非常受學生歡迎。學期內外，不時都會見到他跟學生開討論班。2019-20年度，他任教的是math2221，一門關於電腦程式設計的課。以下是編者與Charles一次訪談的擇要。

Charles，你好，不如先講一講你的背景。
我1991年考進中大1995年畢業，之後到美國修讀博士。

長話短說，你認為on-line教學最大的挑戰是什麼?
要重新準備，例如要拍video。

你覺得上課的反應如何？
是否所有內容都會刊載到數學系通信 (笑)？

不。
其實，我先把錄製好的教學片段，預先放在中大的教學平台Blackboard上，我在Zoom上堂時，是播放預先錄影的video的，所以有時根本不知道他們的反應。不知應否告訴學生這個 —— 事實上，Blackboard有很好的數據分析，我知道那一些學生看了video，甚至知道看了多少分鐘。但由於是video，我不知道他們的反應。回頭看，錄video（英語板，廣東話版）非常花時間。另外，TA也功不可沒。他們也拍video給學生。還有，我留意到學生特別喜歡廣東話版。

也許是受歡迎的原因。
另外，網上教學的好處是學生可以隨時觀看。但另一方面，上課的人數就變動較大。收看錄影的人多的話，上課的人數就減少。

講講Lab吧。
上Lab時，我都會給他們作業。另外，這一次的考試跟以前不一樣，不是兩小時，而是一周。但題目比較難。

剛才你說網上教學，不知學生反應，那跟他們的關係跟之前差很遠嗎？
不一定。網上教學後，我卻收多了e-mail，跟某一些學生建立了好關係。每星期的功課，他們都會給我回應（feedback），而且很快。可謂教學雙長。

網上教學和面對面教學兩者，你喜歡哪一個？
面對面。因為網上教學後，我在街上遇見學生，我也不會知道他是我的學生。上課時，我也不知道他們在做什麼。

談了這麼久，不如我們轉話題吧。你可以介紹一下自己嗎？比方說，你的research是那一方面的呢？
我是研究數論的。主要研究trace formula，跟Langlands program有關。

你畢業時，是否已經想清楚到那一間學校跟誰？
不是。當時我不知這麼多，但系主任鄭紹遠教授幫我找到funding，所以去了UCLA。

你何時找到PhD的題目？
我PhD第一年是念代數幾何的。但當我讀Hartshorne的名著Algebraic Geometry，覺得非常枯燥難讀，所以轉了方向。當時也想過當programmer。

畢業後，為何會回亞洲?
畢業後我曾留在UCLA四年，教JAVA，C++，也跟我的博士導師每週見面。

然後呢？
我找到一份在Utah的工，但沒去。之後去了台灣中央研究院，工作了兩年。當時跟的是余家富教授。那段日子，我正在寫一本書，所以時間都放在這方面了。

你是怎樣認識他的？
在conference上。最後，不如讓我分享我教學課堂上的一些有趣的東西吧。

好。
我有一次，是情人節，我給了學生出了一道題，要要他們使用軟件畫出方程式。

$$(y^2+x^2-1)^3-x^2y^3=0$$

我知有學生真的把此方程式發送給女友。

是一顆心吧？怪不得你這麼受他們歡迎!（笑）

Memories of **Professor John Conway**

Article by Andy Loo
Illustrations by Helsa Chan

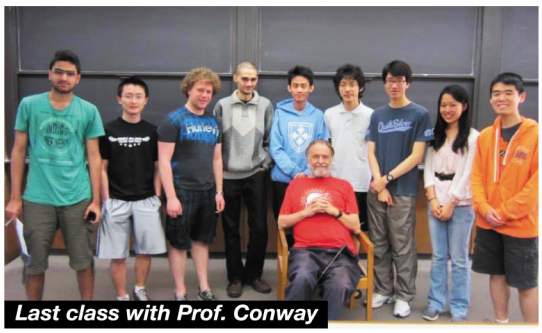
The recent passing of Prof. John H. Conway, one of the world's most creative mathematicians, brings my thoughts to my first encounter with him eight years ago.

I was a freshman at Princeton University who couldn't wait to dive into the ocean of mathematical knowledge. On the first day of school I learned there was going to be a dinner reception with the Math Department at Palmer House, a guesthouse near campus. Although only the faculty, graduate students and third- and fourth-year undergraduate math majors were invited, I decided to try my luck nonetheless.

It was in the garden of Palmer House that I spotted Prof. Conway. After I went up and introduced myself, Prof. Conway asked me for my birth date, and I said, "June 24, 1994." In a split second, Prof. Conway replied, "That was a Friday, wasn't it?" I was awed despite having long known he was the inventor of a formula for calculating the day of the week, and even used to have questions of this type pop up on his computer in place of a password.

Meeting Prof. Conway, Prof. John Nash and Mrs. Nash

In the spring semester of freshman year I had the honor of taking Mathematical Logic with Prof. Conway, which turned out to be his last course before retirement. He would show up in a T-shirt with math formulas or slogans, sit on an armchair, and, instead of following the textbook, give a free-flowing presentation on his proud mathematical discoveries, from the elegant construction of surreal numbers to the esoteric programming language FRACTRAN.



Last class with Prof. Conway

Prof. Conway was not known for punctuality and logistical organization. He would often be late for class, and, when I asked the Math Department's secretary to call him, she told me, "It isn't his age. He's been like this since I got here 27 years ago!" Throughout the semester he didn't mention a final exam, and we didn't remind him either, hoping to get away with it. But on the last Monday of class he suddenly said, "Oh, by the way, how about having a final exam on Wednesday?"

In preparing for the exam I found yet another mark of Prof. Conway's unconventional style. In his past exams for different courses, he would have such open-ended questions as, "Talk about open sets," "Talk about the Bernoulli numbers," and even, "As a substitute for any of the above, write about anything else that you think might impress me!"

In my later years at Princeton I happily kept in touch with Prof. Conway outside of the classroom. Rather than using his office, he would sit on a couch outside the common room of Fine Hall, the Math Department building. I would chat with him about math as well as listening to his playful anecdotes.

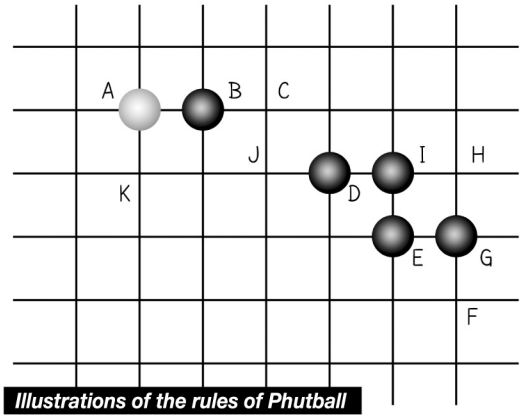
In the mid-1980s, when Prof. Conway was still a professor at the University of Cambridge, he visited Princeton for a year. One day, Prof. Elias Stein, then Department Chair, invited Prof. Conway and his then-wife to a meal at Palmer House. Her sixth sense telling her Prof. Stein was going to offer a permanent position, Mrs. Conway told her husband discreetly, "Don't promise anything on the spot. Let's talk about it

when we get home." But when Prof. Stein really raised the issue during the meal, Prof. Conway answered right away, "Sure!"

Soon after Prof. Conway's move to Princeton, he was to give a two-hour lecture to a large audience. There were four "Fields medal-level mathematicians" seated in the front row. In the first hour Prof. Conway talked about a mathematical game that seemed too frivolous for the academic setting. At one point he even heard a slight scoff from the front row. But in the second hour, Prof. Conway talked about some very serious mathematics that was, surprisingly, connected to the earlier game! In the end, his colleagues admiringly congratulated him on the lecture.

Running into Prof. Conway on Nassau Street

In popular culture Prof. Conway is decidedly best known for the Game of Life, but I would like to end this article by introducing what is perhaps Prof. Conway's second most famous game invention – Philosopher's Football, or Phutball. He would play this game with students on blackboards from time to time.



Illustrations of the rules of Phutball

Phutball is played by two players on a rectangular grid (usually 19 by 15), which serves as the football pitch. In the beginning there is a football in the middle of the grid. The players take turns to act. Each turn, a player may either add a man to a vacant point on the grid or move the ball according to the following rules: (1) The ball makes a finite series of jumps. (2) Each jump is to the first vacant point along some horizontal, vertical or diagonal (45-degree) ray. (3) Each jump goes over at least one man. (4) Any man (or group of men) jumped over is removed before the next jump occurs. Note that a man does not have any team identity; either player can use any existing man.

In Figure 1, an example of a valid move is the series of jumps A → C → F → H. However, A → C → F → H → J is not allowed because after the jump from C to F, the man at D is already removed. Instead, A → C → F → H → D would be allowed. Also, the jump A → K is not allowed because there is no man between A and K, violating condition (3) above.

A player's aim is to move the ball to the leftmost or rightmost column of the grid (or, under an alternative convention, the second leftmost and second rightmost columns), in which case the player scores a point. This is similar to ordinary football, but now the goal is as wide as the pitch. Another difference is that a player is allowed to move the ball in and out of his own goal as long as it stays outside at the end of the series of jumps.

I'd like to think that as Prof. Conway looks down on us, he will smile at the sight of us enjoying his legacy, not least by playing the games that he had so much fun inventing.

Andy Loo is a PhD student at the Economics Department of Stanford University and a JD student at Stanford Law School. He obtained a bachelor's degree in mathematics from Princeton University in 2016.

Helsa Chan obtained a bachelor's degree in mathematics from the Chinese University of Hong Kong in 2016, and a master's degree in computational mathematics from the University of Waterloo in 2017.

Honours and Awards

2020

XPLORER Prize 2020 (科學探索獎 2020), XPLORER Prize Foundation
- Prof. Xuhua HE

Excellent Young Scientists Fund 2020, National Natural Science Foundation of China (NSFC)
- Prof. Martin Man Chun LI

Hong Kong Mathematical Society Young Scholar Award
- Prof. Kwok Wai CHAN
- Prof. Renjun DUAN

2019

Fellow, Society for Industrial and Applied Mathematics
- Prof. Jun ZOU

Zhong Jia Qin Mathematics Award
- Prof. Guohuan QIU

Qin Yuanxun Mathematical Award, Qin Yuanxun Mathematical Prize Foundation
- Prof. Zhouping XIN

ICCM Best paper award
- Prof. Kwok Wai CHAN
- Prof. Conan Nai Chung LEUNG

University Exemplary Teaching Award in General Education
- Dr. Chi Hin LAU

Vice-Chancellor's Exemplary Teaching Award
- Prof. Ronald Lok Ming LUI

Faculty Exemplary Teaching Award
- Prof. Ronald Lok Ming LUI

Personalia – New Faculty

Professor Chenyun Luo | Assistant Professor

Prof. Chenyun LUO's research areas include partial differential equations with free surface boundary, fluid dynamics, magnetohydrodynamic (MHD), general relativity. Prof. Luo obtained his BSc degree from University of Rochester in 2011, and his PhD degree from Johns Hopkins University in 2017. He has worked as non-tenure track Assistant Professor at Vanderbilt University, before joining our Department as Assistant Professor this year.

Professor Liu Liu | Assistant Professor

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