Interview with Tony Chan (???)

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Professor Tony Fan-Cheong Chan is currently President of the Hong Kong University of Science and Technology. He was previously Assistant Director of the US National Science Founda-tion (NSF) in charge of the Mathematical and Physical Sciences Directorate, which is the largest directorate of the NSF in funding. Prof Chan had been in the NSF position from October 2006 to August 2009, upon taking temporary leave from the University of California at Los Angeles (UCLA), where he was Dean of Physical Sciences from July 2001. He was Director of the Institute for Pure and Applied Mathematics from 2000-2001 and Chair of the Department of Mathematics from 1997-2000. Prof Chan received his BS and MS degrees in Engineering from the California Institute of Technology (Caltech) and his PhD in Computer Science from Stanford University. He has published over 200 refereed papers and is one of the most cited mathematicians.

APMN: Was Mathematics your first career choice when you were at university?

Chan: When I was in high school back in my secondary school days in Hong Kong, I had always known that I was interested in Mathematics and good at it. I have always been more inclined to the application of Mathematics. My undergraduate major in Engineering is actually very much related to my interest in Applied Mathematics.

For my university education, I only applied to one university in the US: the California Institute of Tech-nology (Caltech). At that time, which was the late 60s, Feynman and Gell-Mann had just won Nobel Prizes and I was very motivated to go to Caltech to study physics. However, even though I did well in Physics courses, when it came to choosing a major, I realised I was good at solving the mathematics problems arising in physics but not so much in coming up with the equations which require physical insight. This naturally led me to the use of mathematics to solve science and engineering problems.

I then realised that there is a lot of applications of mathematics in engineering. I took courses in fluid dynamics — Caltech is famous for pioneering research in aerospace (the famous Jet Propulsion Laboratory is run by Caltech). In order to design an airplane, math-ematics and physics are the keys. I then found that they could build an airplane even if they didn't know how to solve the equations. They used computers to model the structure and the aerodynamics. At that time, computer science was a fairly new subject and I came to realise that the computer is a tool for aerodynamics.

The Boeing 747 was the first commercial plane almost completely designed by computer, which was completed in the early 70s. Intrigued, I searched for places where I could learn this new subject. The new computer science department at Stanford University was highly recommended to me and I was lucky to get in, not having much background in the subject. While I studied Computer Science at Stanford, I always kept in mind that the use of computers and mathematics is for science and engineering and that this was what I always wanted to do.

After my PhD degree, I returned to Caltech as a postdoctoral fellow in Applied Mathematics. I then joined the computer science department at Yale University as an Assistant Professor in 1979. In 1986, when I was spending my sabbatical leave in Hong Kong University, Stanford urged me to return as a Research Professor in their Computer Science Department. I was very tempted. But at the same time, the Mathematics Department of the University of California, Los Angeles (UCLA) also came to recruit me. The people at UCLA working in my field were in the Mathematics Depart-ment, not Computer Science. I told them I do not have a formal degree in mathematics. They said, "It's fine. You are doing Computational Mathematics, Department of Mathematics should be your choice." Thus I joined the Mathematics department in UCLA in 1986 and I stayed there until I joined HKUST in 2009. So it doesn't matter what title you carry, what is important is what you do and whether it will be recognised.

After 40 years, the two fields are becoming closer than ever now. Computer scientists do all sort of things we think only mathematicians do... Google, Netfix, internet search, etc. are good examples. They use all kinds of theories and techniques, as long as they deem them valuable. Neither community is entitled to monopoly over their discipline.

APMN: You were the Assistant Director of the US National Science Foundation (NSF) in charge of Mathematical and Physical Sciences. Could you share with us some of your experiences, challenges and achievements during your assistant director-ship?

Chan: This was a challenging, exciting and interesting job that I could not refuse. In the US, there are many research funding agencies. It must be noted that the role of NSF is to support basic research, for which the government must be involved. Basic research cannot rely solely on the private sector. In the old days, some companies were able to afford to do this, like Bell Labs, because at that time, the telephone industry basically was a monopoly. Bell Lab researchers could get Nobel Prizes in Astronomy. They also invented new communication technologies and the transistor. Microsoft Research is one of the few major industrial research laboratories today.

So NSF has a major responsibility in supporting all basic research in the US. Most of the research is done in academic institutions and universities. Since the US is the dominant global player in the basic research in science and technology, NSF is like the biggest funding agency in the world funding such research. It was a privilege to work there and a great learning experience.

My main responsibility as Assistant Director for Mathematical and Physical Sciences was not to deal with individual proposals but with policies. I was in Washington so I learned about policies for, as well as the politics of, funding for science and technology. I learned about how the role of funding basic science is part of the national fabric. The US Congress does not fund basic science in isolation but ultimately wants to see the connection of the fruits of research to society in general. We need to consider how funding basic research impacts the economy, and the number of jobs created.

In short, NSF funds talents and ideas. If enough of them are funded, some of them will succeed. Histori-cally, NSF funded research started new industries, and contributed significantly to prosperity and progress of society. So in some sense, NSF is like a national venture capital firm.

In my job I also had to cooperate with other agen-cies — for example, the Department of Energy, as we fund a lot of joint projects. The Large Hadron Collider experiment in Switzerland is one example.

I also needed to coordinate with the National Aero-nautics and Space Administration (NASA). NSF funds ground-based astronomy and NASA funds space-based astronomy (e.g. the Hubble Telescope). Coordination is essential — when we saw something in outer space we told them, and when they discovered new things, they informed us too. I had to go to Chile several times a year, as we had a joint project on radio astronomy with the Europeans, Japanese, and Taiwanese. From there, I got a lot of experience working with people from other nations. We had the chance to understand the role of basic research on a global level.

All these experiences turned out to be very useful for my current job as President of Hong Kong University of Science and Technology (HKUST). As a public university in science and technology, we need to convince society of our inherent value. This is chal-lenging because Hong Kong's economy is not as big as the US's and also not based on science and technology industry. But we do train future leaders in these areas and we want our research to be known internationally.

APMN: How would you compare the standard of Mathematics in the Asia Pacific region with that of the US?

Chan: The standard of science, in particular Math, has gone through tremendous change over the recent 40 years. The Asian economy has changed, the outlook is positive and universities have greater ambitions. We are now able to attract the cream of the crop trained in the West as they are willing to come (return for some) and serve in Asia, especially in fields like Mathematics, where large equipment, big machines or huge funding, are not needed. In actual fact, the level and quality of mathematics here have gone up.

One good example is the latest International Congress of Mathematicians held in India. Mathemati-cians do this every four years, and it is something like the Olympic Games in Mathematics. If one is invited to give a talk, it is akin to winning a medal in the Olympic event. During the last international congress, there have been many speakers from Asia, around five to six from China, and another five to six from India.

The world today is much more globalised and people are much more mobile. We at Hong Kong recruit primarily from outside. Singapore does the same and China now recruits a lot of people globally. There is incredible mobility amongst the nations. The landscape has changed completely. The trend of making fast progress is very real.

APMN: Has this anything to do with tradition or race? People used to believe that the Chinese and Indians are good at Mathematics and calculation.

Chan: There are intelligent people everywhere. Social environmental factor is much more important in this aspect. The system is the key and there's much similarity between this and training athletics.

You need talents; you need the correct system to train them. The tradition in Asia for basic science is that it emphasises on the fundamental training more than the system. The Singapore Mathematics curriculum is well known as Singapore students always score well in international contests. China, too. This is connected with the school system rather than the people's talents per se.

In the US, there is a greater emphasis on exposing students to a broader spectrum, training people to be more creative and focusing on self-initialisation. Schools in the US are more relaxed on discipline and students generally wear no uniforms. The schools would like students to be able to write something of their own rather than just recite known materials.

In the Third International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA), Singaporean, Japanese, and Chinese students always do well, with students from the US always way behind them. But then the US has people like Steve Jobs, Bill Gates, people who started Facebook, Google... All these are rare talents. Somehow the cultures and systems are different. That is the challenge for Asian educators.

APMN: Terence Tao (2006 Fields Medalist) and Ngo Bao Chau (2010 Fields Medalist) were originally from the Asia Pacific region, but they are now working in the US universities. What can the universities or governments in the Asia Pacific region do to attract these talents back?

Chan: I personally recruited Terry Tao to UCLA. I was his Dean and Chair. His parents are from Hong Kong, but he was born in Australia. When he was 10, people knew he was good at Mathematics. He was trained under the Australian system.

Ngo Bao Chau is a Vietnamese. He was born in Vietnam but he went to France and now the US. There is something about the Western system that provides the kind of intellectual environment and standard that encourages this extreme level of excellence. Again, that is the system. You need to have a system that attracts the best minds to it. Asia is fast changing but nowhere near that yet. In the West, the US attracts the best talents around the world.

Somehow we want the system to create this kind of environment — one that provides the space for the best talents they need and leave them alone. "This is a good place for me, I can concentrate on my work and I can get the support I need". So we created a feedback system, a good system.

I came back from a recent trip to India, where we were trying to recruit students to Hong Kong. All the best students, however, want to go to the US, and they can afford to do so. They would have been unable to do so 40 years ago, but times are different now. Appar-ently the US is able to attract the best talents. Actually Singapore and Hong Kong are doing quite well too, as the culture of these two Asian cities is believed to be somewhat of a fusion between the East and the West.

APMN: Could we say that there is not much we could do to get the talents back then? What would be your major challenge as the President of HKUST?

Chan: No, that is not true. I was saying that the situation in Asia is changing in a very positive way. The economy is doing better, hence the employment situation and living conditions are improving. If you are a Westerner, when you come to Singapore or Hong Kong, it is relatively easy to fit into the societies. The compensation and remuneration is of world standard. It was not like this 40 years ago.

We are trying to build an Institute of Advanced Study (IAS), here in HKUST. We have been successful in recruiting Prof Henry Tye back from Cornell to be our new Director. He has been away in the US for over 40 years.

We have to create an environment that will attract the best talents to come, a place that will allow these talents to work and allow them to bring other talents here as well. We need a favourable environment, sufficient resources, and a good system. For resources, Asia is doing much better than before, especially for China. As for our system, we still need to change for the better. For the environment, Hong Kong can attract more people now, including more people originally from the Mainland. For Chinese scholars who went abroad to study and establish their career, it is also an attractive option for them to return to a place where they are close to home and know the culture.

I hope I can further improve the research quality in HKUST, with my work and wide network of contacts. Our Mathematics discipline is strong. We should be able to hire the best people and work hard to improve our core strengths.

APMN: What are the hottest topics and trends in Applied Mathematics?

Chan: One important trend is the development of data as driver. Today, from the camera to the cellphone, medical imaging to automate genomic sequencing, from the stock market to internet commerce, all these generate huge amounts of data. In order to manage and analyse the huge amount of data, we need mathematical tools and analysis. It should be a real once-in-a-life-time goldmine for mathematicians and statisticians.

The second important trend is life sciences. There is fundamental paradigm shift. Our physical world can be depicted via elegant and simple equations, derived by Einstein or Newton. The whole world, in fact, the whole universe, obeys them. Biology is not like that. Because of evolution, our biological system is not the only solution to some neat mathematical formulation. Why do we have five fingers and not six? Many such questions cannot be answered by a simple equation, hence we need a different approach.

Then there is genetics. Genes are discrete, there are only four amino acids, ATGC, but somehow the whole recipe of life comes from that, including evolu-tion, mutation, everything. How do the genes produce proteins? How does a cell work? I am sure mathemati-cians can contribute enormously to answering these important questions.

The challenge, however, is that these new fields requires new thinking, frameworks and tools in order for mathematicians to make real contributions. There is no guarantee of easy success, few low hanging fruits. For mathematicians, taking up the challenge involve major commitment and risk. But the reward could also be great.

APMN: What would be your advice to young Mathematics graduates?

Chan: I will tell them: Firstly, don't worry about your title, degree, major... I myself would be a good example. You got to know what you?e talented in and interested in. To be really good at something, you've got to have a passion for it. Find your own interests and talents and not just study what your parents or teachers asked you to study.

Secondly, you need to have vision as the world is changing quickly. We wouldn't have foreseen that there would be Google, Facebook, etc. 40 years ago. I always recommend a "T" model for our learning methods" we need to have both depth and breadth in our learning. The best way to prepare for a future unknown world is to learn and possess some basic knowledge in depth, subjects like language, history, Mathematics, basic science; these subjects would always be useful. If you study some trendy subjects after 20 years, they might be useless. The "T" also indicates a wide reaching breadth in our learning. When you study in university, don't just stay in classrooms and libraries and limit yourself to your major subject. You need to explore fields other than your major. You need to communicate with your fellow students and your professors. Once you leave campus to start work, you won't have such a conducive learning environment.

You should also learn how to learn new things on your own. HKUST emphasises on research, even at the undergraduate level. When you are doing research, you need to learn how to formulate the problem and find new tools to solve them. Through this process, you gain confidence and experience in tackling new problems not to be found in textbooks.

According to a survey done by the Wall Street Journal on the best careers in 2009, the ranking goes like this: Mathematician is No. 1, actuary No. 2 and statisti-cian No. 3. All three are related to Mathematics in some way. So our younger generation should be confident in choosing Mathematics as their area of study.

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