Thank you Professor Vera Hur for the introduction! I would also like to thank you and the previous chair Jeremy Tyson and the whole Mathematics Department for the invitation to speak here (by now several invitations as the ceremony was cancelled twice). And a special thanks to Sheldon Katz who has been a friend and collaborator for a long time and has played a central role in bringing me here to speak.

It is my honor today to address the graduating students in Mathematics and Statistics at the University of Illinois in the class of 2022. There is a rich tradition here in these subjects which you are now a part of. Among the many discoveries made in Altgeld Hall, one of the most famous is the proof of the 4-Color Theorem by Professors Kenneth Appel and Wolfgang Haken in 1976. If you thought that at least on graduation day, you would be spared Theorems, you were wrong! The 4-Color Theorem simply states that one needs only 4 colors to color a map so that no two countries with a common border have the same color. While it seems rather a topic for the Geography Department, in fact it is an unbelievably subtle mathematical result which was open for more than a century (and was proven with a then-novel computer checked component).

If you have never thought about 4-colorings, I encourage you to play with the problem – it is just one piece of the tradition you have joined. As a side remark, if you would like something to think about during the proceedings this morning, here is a question: Can you 3-color the states of the continental United States?

We live in a world where mathematics is everywhere, not just in the more traditional mathematical directions of the physical sciences, but also, and maybe especially now, in all aspects of the interactions of computers with data and learning. These latter areas are so important and growing so rapidly that surely many of you will be involved. From the point of view of a pure mathematician, the only advice I can give is to look always for the Theorems: the simple principles which control the phenomena that you are studying. I will also add (for the more practically minded): please don't write an App which steals my data!

I don't have to tell you that you have come through your education at a challenging time. That you have succeeded is already a promising sign for your future. And mathematics is an outstanding choice of field of study: mathematical reasoning and knowledge are crucial for the various problems which face us today (but of course they are not the only requirements). I will test your power of mathematical reasoning with a little story (which anyway might come in handy for you later this evening):

Three mathematicians walk into a bar.

The bartender asks "would all of you like a beer?"

The first mathematician thinks a bit and says "maybe".

The second mathematician says "maybe".

And then the third says emphatically "YES!".

If you laughed, congratulations! – you have learned well. If you missed it, don't worry, there will be a make-up exam later.

It is not possible to predict a path in life as there is no law which governs the motion. To give another person advice is therefore also essentially impossible. The poet Rainer Maria Rilke (who was born in Prague, wrote in German, and is buried in a beautiful churchyard in Switzerland) writes specifically about this point: he says "in the deepest and most important things, we are unutterably alone, and for one person to be able to advise or even help another, a lot must happen, a lot must go well, a whole constellation of things must come right". What Rilke leaves unsaid is that when the constellations align, the experience is truly rewarding for both sides. You will find yourself (today, tomorrow, or someday) in the position of seeking advice and later giving it – everyone who learns something must eventually teach – and my advice for you on either side is to look for the alignment of the stars.

I had the amazing fortune in my life to move 7000 miles to Urbana in 1972 as a child of 3 years. While most of you have taken only 4 or 5 years to earn your degree, mine has come exactly 50 years after moving here. I am deeply honored to receive a doctorate from the University of Illinois for my work in mathematics. To put into words my connection to the university is almost impossible – without it, I would have been a very different person. I have lived in many places (a few more than I had expected) but I will always be grateful for the support given to me by this community. In fact, my family's house in Urbana was not far from the house of Kenneth Appel and his daughter Laurel later tutored me in French. Learning the statement of the 4-Color Theorem is one of the first in a long list of my mathematical memories from Urbana. I also took several classes in Altgeld Hall in the 1980s – and I remember, in particular, beautiful lectures by Professor Stephanie Alexander on calculus on manifolds.

Despite the joy of completing your degree, you should nevertheless feel some sorrow in leaving Altgeld Hall. You will find that it is rare in the rest of the world that the Mathematics Department occupies the most beautiful and interesting building on campus. I have spent a lot of time in the library there. In fact, the musty smell of the Altgeld stacks is one of the distinctive memories of my time in Urbana. I'm sure I follow a long line of students who have been inspired by that library, wandering randomly through the corridors of books. Now that we interact with books online, so much has been lost. Perhaps someone should develop a mustiness feature for Amazon? I guess then that the Altgeld bells should also be added.

About my own later path: I became fascinated by the interplay of mathematical structures related to the moduli of algebraic varieties and had the very good luck to have been young at a moment when many new ideas and techniques were brought into the field through an interface with string theory, representation theory, and mathematical physics. Being open to working on new questions, new geometries, and with people who had very different perspectives from mine has made all the difference for me. My personal view of the mathematical landscape is like the Swiss Alps with all sorts of beauty and richness. You can climb a peak and for a fleeting moment have a view, but for most of the time you are in the valleys and on the rocky slopes. With my research group in Zurich, we are often in the mountains – and I have always secretly viewed these hikes as a form of mathematical training.

In fact, it is always remarkably difficult to see what is around you. The writer David Foster Wallace (who has roots in Urbana) presents this idea in the most concise way I've ever encountered. His story is as follows:

Two young fish are swimming in a pond on a beautiful day. An older fish swims by and asks the two young fish "how is the water?". One of the young fish turns to the other and says "what is he talking about, what is water?".

Whether it is easier for the young or the old to see the water is an open question for me, it is a constant effort for all of us.

To all of the graduates today in Mathematics and Statistics at the University of Illinois, I congratulate you for your achievement and wish you the greatest success along whatever path your life takes you. Remember this university, this town, and Altgeld Hall – I have never forgotten them.

Rahul Pandharipande

15 May 2022