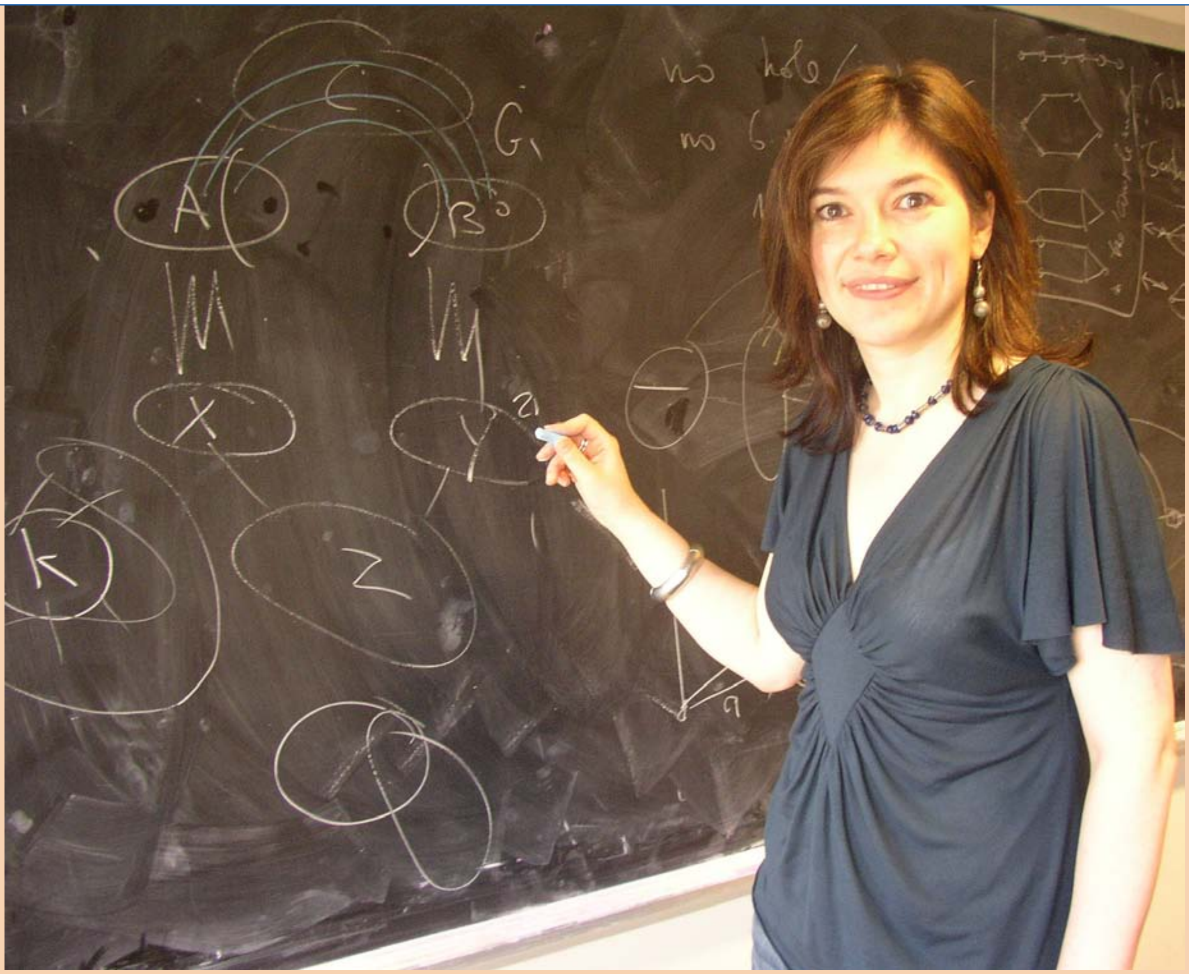
Interview with Research Fellow Maria Chudnovsky



Maria Chudnovsky. Photo by Dona Vukson, 2006

Maria Chudnovsky received a BA and MSc from the Technion and a PhD from Princeton University in 2003. Currently she is a Clay Research Fellow and an assistant professor at Princeton University. Her research interests are in discrete mathematics and, in particular, graph theory. Recently, she was part of a team of four researchers that proved the Strong Perfect Graph Theorem, a forty-year-old conjecture that had been, arguably, the central open problem in graph theory. For this work, she was awarded the Ostrowski foundation research stipend.

What first drew you to mathematics? What are some of your earliest memories of mathematics?

What I have always liked about mathematics is that everything can be explained from "first principles." If you understand something, you really understand it all the way through; it's all in your head, and you can always go and check it.

My first memories of mathematics are probably of elementary or junior high school geometry. That must have been the first time I saw a proof – I realized for the first time that there is no place for any further discussion. Another memory was when a teacher in junior high school mentioned, in passing, that there was more than one kind of infinity. I knew I had to grow up and find out what he meant.

Could you talk about your mathematical education in Russia and Israel? What experiences and people were especially influential?

I went to elementary school and junior high in Russia and to high school in Israel. I have been very fortunate in my mathematical education. In Russia I went to a special school that emphasized the study of mathematics. Back then it was called School #30, in St Petersburg. It is probably called something different now. In Israel I was in a program that followed the "Columbia System." As far as I know, this is a program of study that was developed at Columbia University. The idea was to introduce some pretty abstract notions quite early on. For example, we first learned what a group was in 9th grade. In both Russia and Israel, I was very lucky to have great teachers, teachers who had passion and enthusiasm for mathematics, and who made us, the students, believe that what we were learning in that class was the most interesting thing in the world.

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Did you have a mentor? Who helped you develop your interest in mathematics, and how?

Here I must mention a "math circle" I went to in 11th and 12th grade. I lived in Haifa, and a friend from school told me that on Thursday afternoons one could go to the Technion and take this informal class run by mathematics graduate students. It was an absolutely amazing experience! Sometimes we would think about problems, other times the teachers would tell us a simplified version of a lecture that they themselves had heard a few days earlier. Again, we all felt that nothing out there could even compare to what we were doing. That was when I decided that I would major in math in college. As I studied more mathematics over the next ten years, the problems got harder, the lectures got more complicated, but the feeling that there is nothing better I could possibly do with my time is still there. On a slightly more serious note, I should, of course, mention and thank the people who guided my studies in college and throughout graduate school – professors Ron Aharoni and Abraham Berman at the Technion, and professor Paul Seymour at Princeton.

You served in the Israeli military from 1996 to 1999. Did the military make use of your mathematical talent?

One of the greatest things about mathematics is that it teaches you to think clearly and to be very critical of the logic of your arguments. My experience in the military showed that this skill is valuable in other areas.

How would you compare your mathematical experiences in Russia, Israel, and the US?

I am not sure I can answer this question, as I have spent different periods of my life in these three countries. Thus I did not really get a chance to make a comparison.

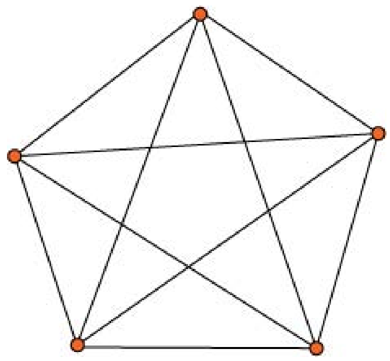
What attracted you to combinatorics and the particular problems you have studied?

Most of these problems are very easy to describe, but they do not have simple solutions. In fact, the reason for the answer being one way or another is often quite deep. In order to find the solution, one needs to uncover layers of phenomena that seem to have nothing to do with the original question.

Can you describe your research in accessible terms? Does it have applications to other areas?

One of the greatest things about mathematics is that it teaches you to think clearly and to be very critical of the logic of your arguments. My experience in the military showed that this skill is valuable in many other areas.

I study objects called "graphs." A graph is a collection of points, called "vertices," such that some pairs of points are "adjacent" and others are not. In many cases a set of data can be conveniently viewed as a graph: for example, take a graph whose vertices are train stations, and two vertices are adjacent if and only if there is a direct train running between the two stops. Finding a quick way to get between two stations can be formulated as an abstract problem about graphs. The Internet can also be viewed as a graph. What I do is study properties that graphs



Complete graph on five vertices

have. While I doubt that there are any immediate applications of what I do to any practical problems, graph theory in general is a useful tool in computer science and operations research.

What research problems and areas are you likely to explore in the future?

So far most of my work has been on families of graphs defined by the absence of a certain substructure (called an "induced subgraph"). I would very much like to know if there is a general theory of "excluded induced subgraphs," meaning that there are some phenomena that happen in graphs no matter what specific induced subgraph you exclude.

How has the Clay Fellowship made a difference for you?

In many ways! First of all, it allows me to travel to conferences and to discuss my work with other people. In my opinion this is one of the most important ingredients of the work of a researcher. Also, my fellowship is for five years, and it is really great to have the kind of stability that allows me to work on longer term projects, and not worry so much about the immediate output. This is something that most people do not have right out of graduate school, and I value it very much. Finally, the fact that Clay Fellows get to choose how much teaching they want to do, is, of course, a big benefit. To summarize, when I was applying for jobs after graduate school, being a Clay Fellow seemed like a perfect arrangement, and now I know that it really is.

What advice would you give to young people starting out in math (i.e., high school students and young researchers)?

I really do not like giving advice, especially to such a large and heterogeneous group of people... But maybe this – if you think math is what you want to do, give it a chance.

How do you think mathematics benefits culture and society?

Mathematics teaches us to think abstractly, and as time goes on this ability becomes more and more commonplace in society in general. In my view, this is the biggest contribution of mathematics to culture.

Please tell us about things you enjoy when not doing mathematics.

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I have to say mathematics is the only "productive" thing that I do. I do not have any (other) hobbies with an actual "outcome," like painting, or playing an instrument. But there are many things that other people have already done that I enjoy. I read quite a bit. I like art. Right now I am trying to learn more about photography and photographers. I live in Princeton, which is only a one-hour drive from New York City. During my time here I have been trying to take as much advantage of this as I can.

Recent Research Articles

"The Strong Perfect Graph Theorem," with N. Robertson, P. Seymour, R. Thomas, to appear in the *Annals of Mathematics*.

"Recognizing Berge Graphs," with G. Cornuejols, X. Liu, P. Seymour, and K. Vuskovic, *Combinatorica* Vol. 25 (2005), 143-187.

"The Structure of Clawfree Graphs," with Paul Seymour, Surveys in Combinatorics 2005, London Math Soc Lecture Note Series, Vol. 327.