Students, Parents, faculty and members of the staff,

"How do you get to Carnegie Hall?"

The wife of violinist Mischa Elman is credited with having perhaps the best story of the origin of this quote. "One day, after a rehearsal that hadn't pleased Elman, the couple was leaving Carnegie Hall by the backstage entrance when they were approached by two tourists looking for the hall's entrance. Seeing his violin case, they asked, 'How do you get to Carnegie Hall?' Without looking up and continuing on his way, Elman simply replied, 'Practice!.'

The quote has come to mean, all over the world, what it takes to reach greatness in any field. So what does it mean for you? Were you a graduate student in mathematics it would mean greatness in maths as your career direction is very likely mathematics research with some teaching. Perhaps about fifteen of you would go on to mathematics doctorates and math research. Perhaps about 30 of you would strive in math-related fields such as computer science, engineering, and the natural sciences. The remainder would be the wealthy – doctors, executives and successful entrepreneurs.

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The Carnegie hall quote is relevant to all wanting excellence. You have heard about the 10000 hour rule to base camp of the ascent to greatness. That is about 9 years at 3 hours a day devoted to your pursuit beginning how.

You see, one major mistake a person can make is to pursue an area for quite a while, such as earnestly studying history till age 23 and then trying to switch to physics. You are unlikely to reach greatness in the new pursuit although you will not be bored.

This camp and others similar to it in curricular structure offer you two things: They spread before you the rich variety of mathematics. You get to have a feel for the different fields - not just number theory, Euclidean Geometry, Combinatorics, elementary probability – as important as they are - which together with a few topics like Inequalities make the tool bag of national math competitions. You were able to choose 8 from 48 courses in various fields we taught here over the past 4 weeks.

How do you get to Carnegi Hall? Most people go to the Port Authority terminal and take the A train. But you are NOT the most people. You are not the ones who waste away their life as consumer fodder for the latest craze like the latest cell phone and the media sites. \*\*\*\*\*\*\*\* You live in your mind. You think for yourself. You do not follow what others say regardless of who they are. You are the ideal American, free from dogmas and instruction.

Ha! The practice that Misha Elman was referring to was rote practice. But practicing for greatness in mathematics or the natural sciences means feeding on **concepts** as a caterpillar on leaves to become a butterfly.

Yes, you will take calculus way ahead of others in your age group in your neighborhood. That is okay -- even though it is white-washed calculus that is available everywhere. Except for the concepts of continuity and limit what you would get is a bag of tricks. But that is okay. You can get differentiation and integration out of the way. Then you can take a course called mathematical

analysis in university – this is the first sign of the serious pursuit of mathematics – and understand differentiability and integrability not only over the real field.

In a sense Calculus is the greatest technical innovation. Being without a knowledge of calculus is like being color blind. You will still see the scene but you won't often see the colors. Calculus in school or first year university would suffice to understand a vast majority of the phenomena that need Calculus to understand. And if you strike out of math later, at least you have calculus. \*\*\*\* This camp does not offer calculus, for two reasons. One, school calculus is a well-trodden path. Any school can offer it. It does not take a professional mathematician lecturing at Mathpath to introduce you to the high school version calculus. Two, it is in the DNA of this camp to offer courses that are neither in the school curriculum nor what you can get elsewhere. So I would not even want to offer an introduction to graph theory, but an advanced version would be in line with our philosophy and useful for those who already have been introduced to it elsewhere.

So how do you get to Carnegie Hall? If you were a few years older I would talk about REU's (Research experience for undergraduates) all over the country which are led by professors in math and in the sciences who know their fields and who can help to launch you in to your fields. You are at least five years away. Some of you will be lucky to get a mathematician or a scientist who has not only published but whose publication has been cited in the articles in scholarly journals, whose results are used by others in their own proofs. Such a mathematician or scientist works in the border of knowledge and the problems he or she gives you will be important problems that do not just give you a PhD.

Many of you will get to the Carnegie Hall of math, physics and other fields. Your parents have given you the starting blocks. This camp has helped you stay the course. If your love for the field remains and you have what it takes – they call it grit, watch a rock climber – you will get there.

So you are on your way to Carnegie Hall. But not all of us will get there. I am not at all worried. Only the other day I told Professor John Conway that I am equal to him \*\* in one view – namely, the measure of our ignorance which is infinite for each.

The world has a need of each of us. We will help the world in the various roles we occupy, but some of you will reach Carnegie Hall. Your mind will have attained a vast view and even a scorn for the attainment. Then you will know that nothing makes a difference in the vastness of time that stretches before all.

We the staff and faculty have tried to deliver a safe camp that is a version of Plato's Academy. We have discussed mostly pure mathematics. Our greatest moment has been the light on your face when the idea under discussion dawned on you. This light is my reward. I thank the parents who sent you here.Thank-you all!