

**Commencement speech for the Math Department Graduation,
University of California, Berkeley**

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The only way to begin is to start.

So let's start with death. From today onward you will die a little death every time you bother to notice it. By this I mean a death of possibilities. Imagine a tree with many branches, directed into the future. Each is a potential future, a life path. Up until now, you've probably been climbing the large trunk of this tree, following what seems the natural path, ignoring some smaller branches along the way. Looking up, the tree has always been lush, dense and even impenetrable, rich with potential.

And now you must make a choice, to decide what to do next – go to grad school, accept a job, join the peace corps, travel, go home to chill with your family and try to figure things out. That's where I was when I graduated from college 25 years ago this month. A group of friends and I left the graduation ceremony early and as we were escaping the scene, we ran into a TV crew. A reporter pushed a microphone in front of me and asked what this Harvard graduate planned to do next. My response was a simple "I don't know," and that was the truth. Within a few months, however, I had found a job as an actuarial assistant at a large Chicago firm, and the following Fall, I was here at Berkeley, thinking that this PhD thing was probably worth a try.

No matter what you do next, you must chop off some limbs, and with them their branches and the branches' branches and so on. That tree will start looking a lot more barren. You will chop off limbs of the tree that others will choose to follow instead. Some choices will amount to chopping off many future branches – committing to a PhD program means 4-6 more years, a postdoctoral position 3 more, a medical degree 5 years and so on.

This leaves a lot of room for realizing that you've decided not to save the world, or to make a lot of money, or pursue a PhD, or develop your artistic abilities. And this is what I mean by death. It might not concern you much now, but a profound feeling of loss can sneak up on you. And if it does, all I can suggest is to acknowledge it, and grieve. It's a loss, and a necessary one.

This is perhaps the last time in your life when you will feel such unlimited potential, but it is not the first time you've experienced a death like this. Indeed, your brain cells have been dying since you were born – it's called synaptic pruning, and it's a process that allows the brain to organize itself into efficient networks. It's what allows you to learn, but it's also what demolishes a child's ability to play memory games like concentration and set with unparalleled ease. By necessity it kills a large element of surprise in experience.

What you are undergoing now might be called life pruning. And in the end of this process, you might just feel lighter and unburdened. Like someone with a whole lot of hair who got a haircut. In the middle of July. But the process can be a difficult one, something that I have seen many graduate students grapple with, and certainly something I struggled with myself.

As you go about living your life, pruning these branches, you'll find that the focus shifts from what you *will* accomplish to who you actually *are*. You don't need to be a passive observer in this. In fact, let me encourage you to engage as much as possible in a *vigorous internal dialectic*. What do I mean by this?

The notion of a dialectic is ancient and prevalent in both Eastern and Western philosophy. A dialectic is a dialogue between two parties with strongly held but different views. The goal of a dialectic is not to convince the other party of your side of things, but to find the truth. The truth is revealed through exposing and exploring different viewpoints, leading to a deeper understanding than could ever be reached in isolation.

And so by internal dialectic I mean a dialogue within yourself with the goal to understand the truth – about yourself. To have such a dialectic you need the opposing sides, so what are they here? I claim that there is one side you are already familiar with. It is a side of your personality that has always been dominant. What colloquially we call a strength or a weakness.

My dominant traits include creativity, independence, stubbornness, impulsivity, carelessness, and a strong tendency to procrastinate.

What are these qualities in you? You probably know already, but here's a simple algorithm to find out. Do you have friends? If not, there's a pretty dominant quality, right there. Assuming you do have friends, ask them what your strengths and weaknesses are. They'll have a pretty good idea.

And now this is my suggestion: build yourself an *opponent* to this weakness or strength and do *battle* with it. Wait, didn't I say dialectic? Yes, I but said *vigorous* dialectic. It's a dialectic with fangs and claws out. Think of a game of pickup basketball, chess, tennis where you attempt to annihilate your opponent, but then shake hands afterward and say 'good game.'

The main battle as I see it is to stop your dominant traits from taking over. To force other sides of your persona to develop. The dialectic emerges naturally as your inner voice faces a challenge to the accepted wisdom. Have you ever told yourself that you are not the type of person to do such-and-such? Then do it, and watch how you react.

Take a class in an area you don't know. Teach a class in an area you don't know. Take up an insane hobby. If you're shy, try an improv acting class. Asocial – team sport. Sensitive to criticism? Join a creative writing group. Fidgety? – try Zen meditation. For me, who's always been physically awkward, it was bellydance. And much more recently, this essentially impulsive and careless person took up sewing.

If nothing else, the results will almost certainly be interesting. For example, when you mix carelessness with sewing, you can learn some important mathematical life lessons, such as:

- A Mobius strip makes for a poor elastic waistband.
- a sphere cannot be turned inside out through fabric-preserving isotopy.
- the human body has a reflectional symmetry, not a rotational one.

If there's one lesson I've learned about sewing, it's "When in doubt, don't."

Why push yourself like this? Because the hard-won traits can be the most gratifying. And because all of this exercise – and that's what it is – keeps you young. You also can't escape learning *how to work with yourself*, especially with what you might have once regarded as a terrible flaw in your personality.

For me this flaw has been a tendency to procrastinate. It has led me to do unforgivably wrong things. As recently as 10 years ago, I would more than occasionally fail to do something crucial – like writing a letter of recommendation – before the deadline. These events belong to my internal records of shame.

At some point, and I can't pinpoint exactly how, I came to accept my procrastinating tendencies and even begin to regard them as a strength in certain contexts. A thought that has been allowed to evolve in the *background*, in a procrastinating mind, is worked over, contemplated, honed, tossed about. And when it does emerge, at the last minute, it has the joint qualities of being *considered* but also *fresh* and *immediate*.

And now when a student asks for a letter of recommendation, I say the following: "I'd be happy to write a letter for you, but I won't do it until the last minute. To make sure this letter gets in on time, please send me an email a week before the deadline and then bug me relentlessly until I turn it in. Just be an absolute pest." Ah the freedom of it! And remarkably, almost never does the student have to bug me more than once.

The mathematician Dennis Sullivan has been known to ask "where is the tension?" For what is a mathematical result without its own dialectic? Mathematics, like life, is an unfolding story. If you learn to sniff out the tension, you'll find the surprising results, the striking ones, and those that get to the point of this whole math business, in my opinion.

Now in life situations it can be pretty easy to find that tension. A fellow mathematician once asked me: "How do you have time for killer instinct math – with kids and family, can you really focus hard?" My answer was simple: "I just ignore them."

But of course that's easier said than done when everything inside tells you that you don't ignore your loved ones, maybe especially if you're a woman. Which is why I think you must give it a good fighting try. At this point, I've gotten pretty good at it. I've also gotten good at letting the math go, really just blowing it off completely when the time is right. It's not what you would call "career-life balance" in any traditional sense, unless by balance you mean 3 weeks of blowing off the family followed by 3 months of blowing off math, and so on. But it's what works for me, and it took me a while to become comfortable with that.

Here's one more story. In the summer of 2008, I wrote a long paper, a theorem I am very proud of. It took the whole summer to write, but I had set myself a deadline to finish before my older child's 9th birthday the end of August. By end of the summer – I kid you not – the family was literally screaming at me to pay attention to them. I had to lock myself in a room

to finish that damn paper. And I did finish it – 2 days before the birthday deadline.

Not long after I finished it, my daughter handed me a poem she'd written, which I'll share with you, with her permission:

You worked so hard!

It was so fun!

But now your paper is all done.

I congratulate you this lovely day.

So now we'll have some time to play.

And so before I send you off to play, I would like to leave you with one more thought. A graduation speech is a good occasion for an exhortation, and here's mine: don't forget what it's like not to know anything, and if you've already forgotten, learn what it's like not to know anything. I don't care if you are super-autistic – and some of you are! – you are capable of learning how to inhabit another person's confusion. At some point you will realize that everyone is confused most of the time. And that realization is surprisingly gratifying.