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Hey Brian,

I was so pleased to receive your letter. To be honest with you, I don't think I have ever received a hand-typed letter before in the mail. It was a nice break from the usual impersonal text messages the modern day is used to.

I actually have a great story for you about a challenging class I took, and how it frankly changed my career path.

I was in my junior year of my mechanical engineering degree when a graduate class called 'Linear Algebra for Machine Learning' was announced it would be offered. It was taught by a new assistant professor in the department named Ben Erichson. He was more of a statistics background, so I was very curious how the class would be taught. Plus, who isn't interested in machine learning?

Let me tell you about an early hiccup in that class. Did you know that the least squares estimate, a.k.a. a linear fit, can be written like this?

$$\min_{\mathbf{x}} (\mathbf{Ax} - \mathbf{b})^T (\mathbf{Ax} - \mathbf{b}) \quad (1)$$

where $\mathbf{x}$ is the set of parameters, $\mathbf{A}$ is the input data, and $\mathbf{b}$ is the measured output. Basically, you choose $\mathbf{x}$ such that you minimize the error when you multiply it by the input and subtract the expected output. You can get the best linear estimator by doing:

$$\hat{\mathbf{x}} = (\mathbf{A}^T \mathbf{A})^{-1} \mathbf{A}^T \mathbf{b} \quad (2)$$

If you do it for a two dimensional case, you'll find you get exactly the result a linear fit in Excel will give you.

Anyways, the derivation of this and the proofs were all in the first 60 minutes of class. My cocky ass didn't even know you could write vectors as bold small letters at that point. This class became the most difficult class I had taken to that point. But, in the struggle that class presented, the learning of difficult concepts provided me a sense of accomplishment and satisfaction that no other

class previously had. I knew at that point that I needed to find somewhere I could keep learning and tackle hard problems. For me, that was a PhD. I don't use the material from that class on a day to day basis, but I still think about it a lot.

So let me answer your question. When it comes to focusing on a concentration, taking more harder classes or taking the easy road, I say take what classes you find *interesting*. Even if those classes are "difficult", they will be easy because you won't mind working on them. To that end, I don't think certificates or concentrations are too important. I'd ask your dad if he cares about a concentration when hiring someone, or would rather have someone who's curious, versatile, and challenges themselves.

There is another important angle to consider when choosing classes. Certificates and concentrations are attractive. But, consider that if you're choosing between a class that'll give you a subtitle on your degree and one that you're curious about, remember that this is the *only* time you will get to choose. When you finish school, you won't have an opportunity to take that 'interesting' class again, or really any class. Cherish the fact that you're able to pursue different courses now.

Workload be damned. You're a very smart guy—you'll figure it out. If you want to do great things, they won't come easy, but they won't come at all if you don't push yourself. It's a privilege to be able to do this difficult work.

Your cousin and friend,

Dane

P.S. Proofread your prose. You have typos in there! Most people will only know you through your writing, and you don't want to give a bad impression.

P.P.S. I love the Leo picture and am keeping it in the office :)