WHAT EVERY ELECTRICAL ENGINEERING STUDENT MUST KNOW

A STEP-BY-STEP GUIDE TO FIND YOUR AREA OF FOCUS, BUILD YOUR NETWORK, AND DESIGN YOUR CAREER

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Find Your Area of Focus, Build Your Network, and Design Your Career

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"Psychologically, you have to have confidence in yourself and this confidence should be based on fact."

-Robert James Fischer

Table of Contents

1

Hi, My Name is Ali

HELLO! If you're reading this, you probably are considering or are enrolled in an electrical/computer engineering program of some sort. Maybe you belong to another major or profession, or maybe you're just curious. A few years ago, I was in your shoes, and what came next was so bizarre that I felt the need to write this short book. My first two years of college were stressful. I would wake up every day thinking "today I need to figure out what I want to major in, I need to figure out the rest of my life". This frenzied feeling pushed me to go ahead and figure out my future. I began my program in Mechanical Engineering, then switched to Aerospace, then to Biomedical, and then finally decided to try Electrical Engineering (EE). I took a few pre-med classes and even looked at law school. I'll talk more later about how my roller-coaster of switching majors has made me a better engineer, and why I think you should experiment with taking courses from different engineering disciplines. Eventually, I did get my B.S. and M.S. in EE, but before I go over any of that, let me introduce myself.

My name is Ali Alqaraghuli, I'm a Ph.D. student at Northeastern University, and I am 23 years old. I attended high school in suburban upstate New York, then attended University at Buffalo having no clue what I wanted to do with my life. During my first year, I almost failed my first physics and calculus exams. I considered dropping out of college, but thankfully my father

talked me out of it. Ever since then, I (somehow) went on to work as an intern for NASA, twice! I also got to work for a private company, work for a small company, work for a big company, work in an undergraduate research lab, work in a graduate research lab, work as a tutor, teaching assistant, research assistant, study abroad, win many scholarships and fellowships, teach English abroad, and eventually met a phenomenal professor and joined a Ph.D. program. I also represented my university in state and federal education programs, mentored undergrads and high-schoolers, and most importantly, I figured out what I want to do with my life. I'm here to tell you how I did it and what I've learned in the process. More importantly, I want to show you how you can do it too, without much of the hassle I had to go through.

I would like to emphasize that I am your normal everyday guy. My goal is to help you realize we are not different; I just figured out a system that works. Like you, I am a somewhat social person and have other interests beyond engineering. I don't have perfect grades. My grades suffered many times because I chose to do fun things (or take care of serious responsibilities) over studying, but it was worth it (I still got my work done, eventually). During my undergraduate four years, I was still able to play soccer regularly, travel to 10+ countries, spend time with my family, make many amazing friends, attend school events, play chess, produce music and release an album, and spend countless hours chilling or playing video games. So how did all of this happen? How can one accomplish so much in such a little time while trying to figure out what to do with their life? I'll thoroughly answer these questions through the principles I've established in the next chapters. We have a lot of challenges in our world. It is, therefore, more efficient if you can figure out what type of electrical engineer (and person)

you want to be so you can excel at that, and live a well-accomplished enjoyable life.

In this book, I will break down how to design your career and achieve your goals with ease, alongside tips and tricks for how to get the internship or job you want amongst other opportunities. I'll also reveal some secrets on how to succeed in the workforce whether you are in research or industry, and how to even choose between a job and grad school. To help you build your network, I will highlight the value of mentorship I received, and the people who helped me along the way so you can find similar people. You can consider me a mentor. We already have two shared interests (engineering and desire to self-improve), that's why you're reading this book. My email is listed on my website (www.alialqaraghuli.com) so you can reach out to me with questions regarding career advice or any engineering-related material matters. I am here for you!

HOW TO USE THIS BOOK: I've written this book as a combination of what I've done in engineering school and the real world, and what I think you should do in engineering school and the real world. As a result, this book is a mixture of sharing experience and summarizing what I've learned in the form of strategic instructions and suggestions to get the career you want. Towards the end, I will offer some advice to help you work smarter, and that will help your career and personal life expand.

Feel free to skip around to the chapter of your interest based on what you're looking for. However, I recommend you read all the chapters in order so you can get the complete picture. I made this as short as I could so you can read it in one sitting. *Ready? let's dive in!*

2

Are You in the Right Place?

Are you in the right place? Before we get started, I want to congratulate you. You chose, in my opinion, the most valuable college degree. With a 4-year electrical engineering bachelor's degree, your options are endless. You can work as an engineer, but you can also go on to do anything else now that you'll have a fair understanding of everyday physics, how to solve problems, and how technology works in general. EE's make some of the most competitive applicants for medical school, dental school, and law school. You are the pretty person (skilled, versatile, problem-solver) at the party (the world crowded with problems). The nice thing about EE is that it's so broad that there's something for everyone. There's something good here for you, and I will work with you in this book to find it.

There are two types of engineering students; those who are gifted engineers, and those who aren't. Those who were taking things apart when they were little kids, and those who weren't. You can quickly figure out which one you are. The good news is, you can be a great engineer in either case, you just have to be smart about knowing how to use your skills to find the right position for yourself. For me, I was definitely not born with any engineering gift or talent. I was not hands-on, and I was fairly lazy. I enjoyed music, movies, writing, and hanging out around people. When the time came for college, I wasn't sure what to major in, but I knew

that engineers can make good money after only 4 years of school, so it seemed like a nice back up to buy myself more time. I figured I could just work my 9-5, make my 80k a year, and go watch movies and play guitar in the evening. A few years later, I am absolutely fascinated by electrical engineering. I could talk about electromagnetic waves for hours. I enjoy learning a lot more. It's crazy how my experiences and the people I met totally changed my outlook on what I want in a career. This could be the case for you!

Is EE the right place for you? There're many engineering majors out there, mechanical/aerospace, biomedical, chemical, civil, amongst other branches. How do you find the right one? Even if you find it, how do you know it's the right one for you? Well, I want you to answer the following questions:

- What excites you more, physical objects, or abstract ideas? Do you think designing an airplane wing is cooler than designing an antenna that radiates invisible waves? Do you need to see what you work on? Or do you enjoy using your imagination? Are you terrified by vague things and like to think about tangible things? Or are you bored by tangible things and could use a little more excitement?

I ask you because I initially thought I wanted to be a mechanical engineer (ME). I took ME classes and had to draw endless free-body diagrams and think about motion and forces on a large scale. I got bored with solving problems on the macroscopic level and quickly lost motivation to even finish my homework. For some reason, mechanics didn't click very well for me, mostly because it bored me, so I struggled more than my peers. I knew I wasn't

stupid, but I wasn't interested enough to try harder -- I knew deep down I was interested in something else. I realized that I enjoyed movies and writing stories because I am an imaginative person. I don't like to draw or physically build, but rather paint pictures and organize them in my mind. Now don't get me wrong, good mechanical engineers need a solid imagination in order to carry out creative solutions, but there's no doubt that electromagnetic physics (the foundation of EE) is more abstract and requires more imagination than mechanics (the foundation of ME). You can touch objects, but you cannot touch electromagnetic fields. Vague concepts excited me more because I could paint my own pictures in my head and add my own creativity to make learning more fun.

I think you can still be a good electrical engineer if you're not quite imaginative, that is, you have a procedural thought-process, are hands-on, or simply have a good grasp of math. As an EE you will deal with plenty of equations, and you'll need to be hands-on sometimes. You will have to build and test circuits. You will touch things. I just think that having an imagination can make electrical engineering a lot more exciting. Luckily your "imagining" skills are growable and something you develop with time and experience. Still not sure if this is for you? *I went ahead and did some research for you, and I am giving you options. Let's dive into the next chapter to see the different types of electrical engineers you can be, let's see who you like the most!* After that, we will walk through the process of figuring out precisely where you should be and how to get there. I call this the stairway to heaven.

3

The Types of Electrical Engineers

Not all electrical engineers are equal. Some work as design engineers, where they usually use some sort of design software for a specific component or system. Some work as field engineers where they travel often and are deployed to do hands-on technical work. Others work as test engineers, where they test components designed by design engineers to make sure they work properly. System engineers look at systems rather than individual components and make upper-level decisions. Research engineers solve more complex problems and push boundaries in their respective fields. This list goes on and can be a long one, but whether you become any of those, you will be doing it in one (or a combination) of the following areas:

1. Electronics

Electronics engineers like circuits so much, they decided to make a career out of them. You can gift them a bunch of diodes for their birthday and they will love you forever. This branch is at the core of V=IR, where you can design your own circuits, build them, and test them. This area is so popular that there's actually a large group of "hobbyists" who do it for fun, meaning there's plenty of resources online to learn. Those circuits can either be at DC

(frequency = 0) or AC (frequency > 0), but good electronics engineers are usually skilled in both (assuming low-frequency AC). If frequency becomes really high, then circuits start behaving differently, and you'll need RF training. Some casual tasks for electronics engineers involve the design of oscillators, amplifiers, filters -- characterize transistors, sensors -- simulate circuits using software like Multisim or LTSPice -- debug circuits using oscilloscopes through looking at waveforms -- read plenty of datasheets -- design circuit board layouts using software -- this list can be really long, but you get the idea. Power electronics engineers focus on how to deliver the proper voltage/current to components in the circuits. All electronics engineers must meet certain requirements in integrating their circuits into larger systems. Any device requires an electronic engineer who designs its circuit and decides how it's going to interface with other components.

I must be clear that I'm describing analog circuit design and that digital circuit design is very different, and for more sophisticated applications you need to be specialized in one or the other. You can read books on each, they are used for different things; we will always need analog to interface with the real world (sensors, actuators) and to do the things that digital circuits can't do. *Afrotechmods* is my favorite YouTube channel to learn analog electronics, make sure to spend a good few hours there. I'll cover digital circuit design more when I talk about Computer Engineering.

I was an electronics engineering intern at NASA Kennedy Space Center, working with 7 amazing engineers to develop electronics for a moon lander. I designed PCBs, did a bit of analog design,

and helped my mentor troubleshoot scientific instruments. I also watched plenty of rocket launches and landings, how cool is that?

2. Computer Engineering

In many universities, CE is its own program. Lucky for me, my best friend in college was a CE, so I learned everything from him. Remember those digital circuits I mentioned above? Computer engineers know them very well. They are what make processors, RAM, and other digital circuits involved in any computer. Additionally, CEs sometimes work on the upper layers of networks. Their skills are a good balance of hardware and software, as software-hardware integration is a huge part of this playground. Although they are usually skilled in high-level software (python, java, etc.), they are better at the low level (C, C++) and REALLY low level (assembly) software. This makes them very powerful at interfacing with the hardware.

In my senior year, I took a Computer Architecture class, which helped me wrap my head around CE concepts. I partnered with my best friend to build a calculator using VHDL (hardware-programming language), which is a way to "program" digital circuits. Verilog is another one. If you like computers and would like to learn more about them, dive into this area for some time. Also, look up VLSI if you're interested in learning more about chip (integrated-circuit) design.

3. Computer Science/Software Engineering

If you absolutely hate coding, run as fast as you can from this one. If you hate hardware and electromagnetic physics, but still love logic and abstract ideas, run as fast as you can towards this one. Programmers don't care or need to know what your hardware

looks like (they only like to know what your hardware is capable of). They build things at the very upper level, almost out of nothing. This is what makes CS so powerful, all you need is a laptop and an internet connection, and you're good to go. Combine that with endless free online courses, and you have found your way out of poverty. Many CS jobs don't even require a college degree nowadays. If you've heard of artificial intelligence, machine learning, and all that other cool stuff, this is where it happens. If that sounds too intense, and you just want to dabble with simpler code, then web design is a good place to start. You can make freelance money out of it with minimal effort if you work smart.

Every EE will have to write code at some point, but if you really like it, you might as well spend more time doing it through working as a software engineer.

4. Embedded Systems:

Now that I've introduced Electronics, CE, CS, I'd like to tell you what happens when we combine all three. Embedded systems engineers write code for smaller computers (as small as a board the size of your nail) and then interface it with external circuits. Embedded systems are designed for a specific purpose, and require lots of integration (putting things together) to make the whole system work. If you like software, but also like hardware, look no further. You'll have to choose your board carefully based on computer engineering requirements such as how fast your processor is and how many input/output interfaces you will have. As we require smarter devices to do convenient things for us, embedded systems engineers will be the ones making it happen. The boom of internet-of-things has started already, you've

probably heard about all the cool wearable devices and what not, those guys have a decent background in embedded systems. You might want to brush up on your coms/networking knowledge and help them out.

5. Antennas:

With the rise of wireless devices and our huge dependency on them, antenna design and fabrication is a great area to work in. All wireless devices need to radiate energy, using an antenna. Because devices come in at different shapes and sizes and operate at different frequencies, there is a demand for different types of antennas. Antenna engineers usually focus on design, using antenna simulation software such as ANSYS HFSS or CST, which calculate Maxwell's equations for a given enclosed volume and display radiation patterns -- in simpler terms, they predict how electromagnetic waves will behave coming out of the antenna for a given distance. A good understanding of antennas results in a good understanding of electromagnetics and vice versa.

I designed a patch antenna for a cube satellite mission for my university, and it was a cool project. Anybody can learn to design antennas online, antenna-theory.com is an amazing website to get started. I plan to design more antennas in the future.

6. RF/Microwave:

Radio-frequency engineers or microwave engineers (both terms used interchangeably since most RF engineers nowadays work in the GHz range, aka microwaves) work on designing and integrating alternating-current circuits that operate at higher frequencies. The higher the frequency, the lower the wavelength, which means at higher frequencies the wavelength becomes

shorter and comparable to the length of wires, which means that the phase of your sinusoidal signals (alternating current) can no longer be taken for granted, and must be tracked and matched. If you hear someone say things like "transmission lines" or "s-parameters," or using coax cables and waveguides instead of good old wires, they are hanging out in the RF realm. Microwave engineers can design amplifiers, filters, mixers, multipliers, and even antennas, amongst other devices. Those components can be used for communications or sensing applications like radars. You can learn more on *microwave101.com* -- it's a great place to get started!

As we push for higher frequencies (to be able to communicate faster, sense more accurately, and go smaller), we run into more challenges. At the NASA Jet Propulsion Laboratory, I interned at the Sub-Millimeter Wave Advanced Technology (SWAT) Group. Sub-mm wave refers to the wavelength of the signals we deal with (just smaller than 1 millimeter), which are in the 100s of GHz and few THz frequencies. As you can imagine, at such high frequencies, you need very skilled RF engineers to design, test, and fabricate such components. My mentor at NASA is an excellent researcher and RF engineer who designs such components and systems, and has helped me grow interested in this area. He has been working with my Ph.D. advisor to develop cutting-edge communication systems at THz frequencies (collaboration is key to solving complex problems).

7. Photonics/Optics:

If you thought classical electromagnetics was wild, wait until you combine it with quantum mechanics. After your first time hanging

out with optics people many things will fly over your head; they speak of wavelengths and their wizardry make you question everything you had previously known in the RF/Microwave world, but when you look close enough, the physics is the same; they just at it from a different lens (no pun intended). In the previous century, photonics engineers worked mainly on fiber optics, making components and systems that delivered information much faster than wires in thin glass tubes, using light. Photonics engineers have helped build our internet infrastructure. A branch of photonics ditched the fibers and went wireless, and is being used for many applications including communications and sensing. If you like lasers and could use a lightsaber looking beam to transmit and receive information, look into this area. The RP Photonics encyclopedia (www.rp-photonics.com) is a great place to get started.

During my Masters, I worked on designing a laser communication system for a cube satellite mission. The idea was to have two satellites facing each other in space and using lasers to communicate with one another. This was one of the most valuable experiences I had as an engineer as I had to learn everything from scratch, using google, YouTube, google scholar, and textbooks. I instantly met with the mission's payload engineer and got right to work. We quickly formed a team and branded ourselves "Laser Com" subsystem, we were the coolest kids in the lab (at least we thought so).

8. Telecommunications/Signal Processing:

If you think of how information is created, transmitted, received, and then stored, think signal processing. To communicate, you

first need to generate some signal and then equip it with the information you want to send over, send it over, then it will have to go through some "system" that may weaken or distort it, so at the receiver, you have to recover the original signal back to interpret the sent information. Get used to block diagrams in this area. This is why the "Signals and Systems" course is the foundation for this area where Fourier transforms are the main tool. Fourier transforms simply allow us to break signals down into their frequency components, and be able to filter stuff out or play around with the shape (content) of the signals. If you're making or mixing electronic music, signal processing is what allows all those cool filters, plug-ins, compression, and equalization to happen. I wonder if Joseph Fourier would've ever imagined that his equations would be used to make people dance at the clubs!

When it comes to signals to process, my Ph.D. advisor is king, and I continue to learn from him. I've done a fair share of signal processing in my research through developing synchronization algorithms for a millimeter-wave system (5G) and equalization algorithms for a terahertz system (6G). I got plenty of help from my lab-mates on both projects -- this area needs good collaboration. Even though we're good at it, we do a lot more than signal processing. To learn more about what we do in my lab visit our website (www.unlab.tech).

9. Networking:

Say I have a friend in London who I would like to say hi to. From the time I open my texting app in New York state, until the time my friend across the ocean gets a notification on his phone, what

steps take place? How does it happen in an instant? Introducing network engineers: You see, in the early 1980s, a bunch of telecommunication engineers got together and agreed that we should have some system of transferring information globally, and that system should layer the different steps involved as layers. Look up the "OSI" model to see what the final product was, you'll see a nice pyramid of 7 different layers that each does different things. At the very bottom are the people who are ensuring the signal physically goes through NY state to England, such as through the optical fiber cables underneath the ocean (yes we have wires underneath the ocean that carry information between continents, the internet doesn't just magically happen). At the very top, there's your application built on software. Network engineers usually work on the middle layers managing the traffic of data and ensuring low errors happen when data is distributed to many users. If you've ever wondered how your high-quality Netflix videos show up every time with no errors, or how the ATM gives you the amount you asked for at high security, here is how. There's a combination of software and mathematical algorithms involved, so it's worth a shot if you think this could be a cool area for you to dive into.

10. Controls:

Control engineers do many things between system modeling, design, and verification. Wait, what systems? I'm talking about any systems that monitor inputs and adjust outputs accordingly. Control engineers wear many hats, using their various skills to keep things under 'control'. If a device or machine requires monitoring and optimizing (especially in real-time), you need controls. As we push for more automation, we need more robust

control algorithms and models to ensure systems can be efficient and safe on their own. Think about how crucial this is if we all end up using automated vehicles in the future.

At the NASA Jet Propulsion Laboratory, I built a PID control system using an embedded system (Arduino Development Board). Based on my input current into my Arduino development board, some code was making adjustments to an equation that would constantly change an output voltage. This is an example of how different areas in EE can interface to get your task done, and why you should be well-rounded early on in your career.

11. Power:

This one is quite popular, as many electrical engineers find themselves uninterested in the small stuff, and want to work on the big stuff. In electronic circuits, we deal with small numbers like millivolts (10^-3 V) and microamps (10^-6 A), and in communication systems, we detect signals as weak as in the picowatt (10^-12 W) range. For power/energy systems engineers, they deal with up to Gigawatts (10^9 W) -- now that's a lot of power. Power engineers are all about the generation and delivery of energy as efficiently as possible. This power is distributed using complex networks and requires good system-level understanding. There's a bit of economics involved here as well, but the math involved is fairly simple. With the growth of renewable energy such as wind and solar, power engineers have more opportunity to design greener systems for our future consumption which isn't slowing down anytime soon.

12. Microelectronics/Microfabrication:

This is a branch of EE that interfaces with materials science. When you learn about how a transistor works, you'll realize all of modern technology relies on semiconductors that are slightly altered to do different things. Microelectronics engineers design circuits at the micro/nano level, and microfabrication engineers go into the cleanroom and synthesize those materials and turn them into devices. Simply put, this area is at the forefront of pushing technology forward, as our biggest challenges in devices await better materials to be designed and fabricated. At higher frequencies, higher electron mobility is desired, so III-V semiconductors such as GaAs and InP are heavily researched right now. Another hot topic is 2D (one-atom-thick) materials like graphene, which have wonder properties on paper but need to be turned into reality. In my research lab, we are working to make novel transceivers out of graphene, maybe by the time you're reading this, it's already out there!

13. Biomedical Engineering:

BMEs can do many things, but a good bunch of work on electrical engineering concepts that are applied to medical projects. An example is designing circuits for a pacemaker or making a battery for it. If you want a wearable device that measures your heart rate, you need electrical sensors. You need a communication system to transmit the data somewhere where it can be processed. If you want to make a better X-Ray or MRI machine, you need to build devices that emit such waves/fields. You get the idea. If you like medicine/health, an electrical engineer is very much in demand to develop technologies to help people in those areas. Go for it.

When I was a freshman, I worked in an MRI lab that looked at brain images of multiple sclerosis patients, looking for lesions, alongside iron and calcium deposits. I wrote a Matlab script to localize where the lesions were on the scans, and although it wasn't used in the long-term, I was proud of it. I absolutely loved learning about neurology -- the very complex circuit of the human brain.

14. Physics:

Some EEs realize they aren't as application-oriented as they thought, and figure they enjoy the theory a lot more. They stop thinking about how and think more about the "why", they dive very deep into the "why". Many of them work on solving problems in particle physics, quantum mechanics, astrophysics, and other areas. They can solve equations and think about ideas all day, but also simulate their ideas on multi-physics software. They can be experimental physicists and test their ideas in the real world, at that point, what can't they do?

15. Literally Anything Else:

As I mentioned, training in EE simply gives you the ability to think and solve problems logically, with a bonus of sounding cool since you talk about fields and waves. From here on you can go do anything with your life. But whatever you do, there are ways you can optimize yourself and become good at it. We just bombarded you with many options, how do you even know what you really want to be? Let's see!

4

Stairway to Heaven

Before we put you on the stairway to heaven, let's take a step back and think, how did we end up here in the first place? Let's be real folks. Many of us initially got into this whole college thing because someone told us we have to. They could have been your parents, high school counselor, or simply you because you didn't know any better. So, we said what are the options? Should we be doctors? Should we be lawyers? Should we major in business? Should we be engineers? If so, what kind of engineers? Is it okay to be undecided? We'd hear the famous "Do what you love", which in my opinion is not a concrete enough piece of advice. I've seen many friends take this advice literally and go down the drain, it's not quite that simple. I'm not saying give up on your dream of becoming a Rockstar, if you really enjoy rock music and only see that as an enjoyable career even if there are high risks, go for it! You don't want to regret not pursuing your dreams. But you also don't need a college degree for that. Many of us don't have one absolute passion that we are willing to risk everything for, so many of us end up going to college to find out what to do. Now college is an amazing place to go from no skills at all to conquering the world, or at least a good place to start. But if I were to rephrase the "Do what you love" advice I would say: *"Find a few things of value that you enjoy or are at least interested in, do your research and experiment, eliminate the ones you don't like. Expose yourself*

to new things. Repeat."

To help you get the most out of this advice, let's turn it into a process. Let's break it down one by one to fully explain what I mean:

Find a few things. There's no way you know off the top of your head exactly what you want. Very few people do. You simply don't know enough about yourself, the world, or college yet to have an accurate idea. Think about (and even better, write down) all the things you enjoy doing and think about which ones you wouldn't mind doing for a third of your day for the rest of your life. But first, write a list of things you do NOT want to do. This quick elimination will save you loads of time and help you have a better idea early on.

Of Value. Notice how I underlined this in the sentence. This is crucial. You want to make sure whatever you're about to invest a massive amount of time and money will have a return on investment. Make sure it's useful to society, and it can help people even if not directly. If you can find a career in helping people, you have won the career satisfaction lottery for life. Engineering is excellent for this as you can easily build/design/implement/test something that will help at least someone, somewhere.

That you enjoy or are at least interested in. If you can't think of anything you love or enjoy, think of things you can tolerate. It doesn't sound great, but it's a starting point. The idea is you have to start somewhere. If you keep waiting to carve the perfect

picture, time will pass by and you will make no progress. Start with something you don't hate, and from there you will calibrate. I listed some options in the previous chapter, I hope at least one of them didn't sound too bad!

Do your research. Find your favorite search engine and spend hours looking things up about things on your list. Go one by one. What is work-life balance like? What is the current job market for it? Is it fun? Is it boring? How much money do they make? What industries do they work in? How do people who have retired from this area feel about it? Is it worth taking out loans and investing years in? Go on job searching websites such as Indeed and type the position. In what locations do these jobs exist? Can you imagine yourself living in these places? You see the direction this is heading. Now be creative with this one.

Experiment. The internet has massive amounts of information that could transform your life from rags to riches. The internet is also a place where you can waste endless hours of your precious time. Don't get stuck on the search engine! Go out and take action. Think you want to be a programmer? Go talk to a programmer! Even better, watch some YouTube videos about Python (my favorite programming language), and download Python yourself and start playing around with it. Think you want to be a power engineer? Try to find one and email them some of your questions. Ask your professors who teach power courses on the industry and what they think a job there is like, and what skills you need. Engage in clubs and societies that offer opportunities related to that field. Join clubs where people do hands-on activities related to that thing, you're interested in. Talk to as many people

as you can about this. Find a family friend who does this and ask them questions. And last but not least, take courses in this area. This is kinda obvious, but take those courses seriously and constantly ask yourself if this completely bores you or if you can work with it. Work on projects in this area. This could be for credit, or just simply online courses that you can find for free. Experiment! Experiment! Experiment! This is the fun part.

Eliminate the ones you don't like. As simple as that, now you have a smaller pool to choose from. Although now that you have experimented, more things have appeared on the list, which brings us to the next point. Immerse yourself in more things and mentally keep track of what you like and don't like. This will happen naturally when you first take action. In later chapters, I mention "random" things I would do that have exposed me to great opportunities. You will expose yourself to things beyond what you do on a daily basis, and that will help you gain new perspectives and develop new interests. The earlier this happens in your life, the better.

Repeat. Do it again. And again. This completes the "calibration" process.

Let's hear it again: "Find a few things of value that you enjoy or are at least interested in, do your research and experiment, eliminate the ones you don't like. Repeat."

At the end of this process you'll magically find yourself in a place where you at least know what's going on, can see where things are heading, and you're totally cool with it. If you're like me, you'll find out you enjoy more than one thing and struggle to combine

them. In later chapters, I elaborate on how to balance your different interests and find connections between them. Once you find an area, you'll want to adopt some habits and principles to ensure you are the best engineer you can be. Let's dive in!

5

The Best Engineers

The best engineers are not necessarily the most technically gifted, but rather the engineers who can have the biggest impact. Imagine if Elon Musk was unable to communicate his ideas, how useful would his ideas be? -- This is a big eye-opener. Let's say you are unable to understand a concept and go seek help. If you can explain exactly where you are stuck, whoever is helping you will give you the push you need forward. You will have an "aha moment", solve the problem, and become smarter. Everybody wins. Now if you can't communicate where you're stuck, you may be stuck there forever. Everybody loses.

Communication and soft-skills are extremely important. You will work in teams. You will have partners. You will need to present your work. You will get stuck and explain where you are stuck. If you can't, you're dragging everyone behind. Good communication skills mean you're going to be more likable in the workforce, which is important. In chapter 9 "How to Become Smarter" I will tell you how you can improve your soft skills.

The best engineers LOVE learning. They chase knowledge, they constantly grow.

The best engineers maintain honesty, not just with others, but more importantly with themselves. They learn from their mistakes and admit to making mistakes. When you're 17 years old, you'll make plenty of mistakes, and you'll probably deny many of them,

but you'll learn from them. When you're 23, you'll make fewer mistakes, you'll own up to more of them, and you'll learn more from them. You see the trend. Everybody makes mistakes, you need to hold yourself accountable and know how to improve, but not be too harsh on yourself. If you show growth, people will forgive you for your previous mistakes. I know I've made countless mistakes, but others will usually see my good intent and hard work and help me learn from my mistakes. Learn from other people's mistakes while you're at it, it saves time.

The best engineers are not afraid to share their well-thought-out opinions and ideas, and always provide feedback to help calibrate and push everyone else forward. The best engineers are nice and kind, treat everyone with respect and try to always lift everyone upwards with their enthusiasm. They take their work relationships seriously and maintain their professionalism. I find it most effective to combine positive and negative feedback when addressing someone directly. My mother is a social worker and often works with members of society who need help getting their life back together. If she tells them straight that they have made terrible decisions in life, they will be too hurt and won't be excited to improve. Instead, she finds the good decisions they have made in their lives and uses that as the foundation. She uses the "sandwich method" to give them feedback on things that they could improve without feeling hurt or demotivated. Let's say you just built your first electronics project but it's not working and you come to me for help. I could be blunt and tell you your choice of components is wrong, or I could first tell you that you chose the right board and can have good interfaces, and then tell you your components aren't the best and show you how to find better components. The positive and negative feedbacks sandwiched together to address the issue while giving you a boost of

confidence that you're moving in the right direction. Use this sandwich method when you need to confront others about things they're doing wrong, and their human instincts of hating you a little for calling them out won't be too bad. This is one example of soft skills that can help you.

The best engineers can be really good in one area, but are they a well-rounded problem-solver? Are they able to learn any skill if they were given all the time and resources they needed? Are they ready to adapt to new changes and take on challenges? Are they constantly learning and growing? Are they hanging out with people outside of their areas?

The best engineers must possess the ability to work independently, and come up with their ideas and solutions. This is crucial. When you work with well-accomplished overly-occupied engineers, their time is extremely valuable, and you don't want to waste it asking stupid questions. It's important to do your research first, try to find answers on your own, and when you're really really stuck, you can finally reach out to those engineers. When you value other people's time, you will start to value your own time, and great things will happen from thereon. When people sense you value their time, and are asking them good questions, they probably like you a lot more. This is the simple truth folks, no other way around it. You'll meet many nice people who will still answer your stupid questions and encourage them, those people are angels, be sure to value their time and thank them for being such amazing human beings.

I could write a whole book on what I think the best engineers look like, but I want you to know that the best engineers are the ones who believe in themselves and won't let anything tear them down. They are titanium. If there's anything I want you to take away from

this chapter, it's this one. I am no by no means the best engineer, but I try hard to be. When you set certain principles and standards for yourself to follow, it slowly becomes who you are.

Now I hear you. You want to be the best engineer, but you think in order to be excellent at something, you have to love it. I agree. It's easier to learn independently when you like what you're learning, even better when you love it, so let's jump into the next chapter and see how you can make learning more fun.

6

Loving the Game

Loving the game is crucial to any game you play in life, and engineering is no exception. You want to choose a job that you'd still go to work for without pay. The less you love what you do, the more work is going to feel like work. I spent quite some time explaining how to find an area you like, leading you to like what you do. But now let's take things to the next level, how can you go from liking it to loving it? There are four ways to do this: Use fun ways to learn it, be good at it, find like-minded people, and teach it.

1) **Use fun ways to learn it:** Have you stopped for a second and thought about the things I work on? Lasers? Satellites? Space? Brain-communication? They all sound like science fiction, and in a way, they are, I'm just helping make them more of a reality. For me it's almost a prerequisite that what I learn has to be cool and fascinating, and if it's not, I find ways to make it so. I struggled with signal processing; those Fourier transforms and endless other algorithms just flew over my head. I could not understand what's going on. This was a big problem as this is the area I wanted to specialize in, I was in big trouble! So, I decided to study it through the lens of something that I love, **music**!

You see, any song requires lots of signal processing to make it sound nice. If you go on YouTube and type how to make a simple

electronic song, you'll hear the video maker talk about things like gain, compression, frequency domain, phase, filtering, and they will play around with some buttons and knobs and show you what those things mean. The concepts are the same in communication systems, so once you understand them there, you can bring them over. It's like a life hack almost, you learn about signal processing while being able to make music as a result, funny, right? I found this highly effective as I started DJing when I taught communication systems, and many of my students instantly understood concepts mentioned like frequency domain, filtering, gain, phase, which previously seemed like absolute black magic to them. Imagine walking into recitation and your TA is blasting music and teaching you how to mix music for your next party, learning doesn't sound too bad now does it?

2) **Be really good at it:** If you're going to do something and get paid to do it, why not do it really well? Immerse yourself in your field. See what the cutting-edge technology is. Understand all the basic principles and see how they can apply to the work you do. Read books, watch YouTube videos, read articles online. Learn! Learn! Learn! Your brain is a sponge, and the more time you spend immersing it into something it will grow very rapidly. If I'm going to be a communication engineer for the next few years or decades, I want to be a kick-ass one. I want to know it all, and if not, at least be able to know where to find information I need to know. The better you are at something, the more you will enjoy it, and the more you will feel that it's a part of who you are.

3) **Find like-minded people:** who share this interest, the better

they are, the better you'll become. From experience, I can tell you that learning is a lot more fun when you're doing it in groups, even if it's just you and someone else. When I started out as a freshman, I hated how much I struggled in physics and calculus, and it was only when I met my friend Dan who shared my struggle for these subjects and we started studying together, it started clicking a lot quicker. When two brains go at something, they solve it much quicker, and even better expose each other to new perspectives. Dan and I were both like-minded in that we knew engineering is a good field and we had a burning desire to be better engineers, so naturally by studying physics together we aced it. Till this day Dan and I are close friends, and having that friendship makes me enjoy engineering a lot more than I would have on my own.

Later, wanting to expand into a larger group of more like-minded people, Dan joined the University at Buffalo Nanosatellite Laboratory (UBNL) and I soon followed. At UBNL, we were amazed by all these kids who went on to intern at NASA, SpaceX, and are building satellites and rockets when they're our age or even younger. They were like gods that we worshipped. For my first year hanging out in that lab, I felt dumber than almost everybody in there, but I enjoyed that every time I was there, I was learning something new. The more I understood, the more knowledgeable I became, and the more I liked what I did. Besides Dan, I met many other people who could talk about things I wanted to learn all day, and hanging out with them was an insane transformation for my brain. A year later after Dan and I, both were serving as lead engineers for the lab, managing our own groups and guiding others in our areas to what to do, we realized that that you don't have to be a genius to go on to do all the amazing work in research and industry. Most of genius are not

geniuses, they are just normal people like you and me who decided to work hard in an area that they found interesting and used momentum to carry themselves away, and that's a pretty good formula for success. If you want to love what you do, find others who love it, and hang out with them.

4) **Teach it:** to people who value learning. Perhaps one of my most rewarding experiences was getting a job as a teaching assistant. When you teach something, you have this impression that you own it and that it's yours, and you're presenting a part of who you are to others. Naturally, as humans, we love ourselves, so if we combine something to our perception of ourselves, we will subconsciously love it more. I taught communication systems for two semesters to two different groups of students, and each time I teach it, I like it more. I get very flattered when students come to me and say they also want to pursue communications as their area in EE. It means they've liked what I have presented so much that they want to be a part of it too.

Teaching does not necessarily mean that you need a classroom and a whiteboard. Anybody can be a teacher. If someone asks you a question, you have an opportunity to teach. At the UBNL there was a huge culture of sharing information and teaching things to others. In this community, everybody naturally becomes smarter and likes what they do more because there's this amazing circulation of information all around. You're constantly giving and absorbing, and through meetings, you have to present your findings and expect others to question/challenge you on them, and when that happens and you know your stuff, it feels really good.

As you can see, those 4 steps can take place simultaneously and

affect each other. For example, when you teach something, you'll come across concepts you don't know, and you'll go and look them up. Whoever is asking you is interested in the same thing you are, hence they are in a way like-minded, and you can talk more with them about the topics shared in common. This can be mixed and intertwined in endless scenarios, that's why I find those 4 most effective.

As engineers, we build, create, fix, and brainstorm about things that will help other people. You need to install this drive in you to get satisfaction from what you do, or else you won't love it. If you don't care about others at all, you'll have a hard time going off of just personal satisfaction. Start with being grateful. First of all, acknowledge you are lucky to live in a place where you have flexibility of choice in what you do. You have family members who love you, and have friends and teachers who you can learn from. You live during the time of the internet where anything you want to learn is a click away, which makes your time more precious than ever. Find your balance of gratitude and ambition.

So far, I've been giving you a lot of guidelines on how to choose a good area for you, be good at it, and like it more than you have imagined. Now let's go into a more concrete direction where we establish some goals you need to target and how to go after them in the real world. Let's start by showing you how you can get your first internship.

7

The Road to Your Internship

The road to your first internship can seem tough and draining. If you're an international student, even more, but with good planning and execution, any internship can be yours. Having an internship is the ultimate undergraduate engineering experience. It's like being a pawn up in chess, as long as you don't blunder, you're on your way to victory. I call it a road because it requires many steps before you reach the destination. It requires perseverance and will, but it's also an enjoyable journey. Everything we've been talking about in the past 6 chapters has been focused on you choosing your area of interest, becoming good at it, and understanding where you want to go from there. Think of that ground zero that you need to find the internship you want. A typical internship in the United States takes place during the summer and lasts around 3 months. But before we dive in, why do I think internships are so important? Here's a few reasons:

1. An internship allows you to be an actual engineer in the real world. You work for a company, and are in the same environment as those engineers who are working full time.

2. It helps you see whether you enjoy the area you're studying. Classes and assignments can only "simulate" what the field may look like, but there is no better way to find out than to go out there and dive in head first.

3. It allows you to make connections and build a network in industry. If the company likes you, they will usually give you a full time offer.

4. You know it's only a short period that will eventually end, so you stay energetic the whole time and try to make the most out of it. In other words, you learn A LOT in very little time.

5. Last but not least, it plays a big role in your decision whether you want to work in industry right after graduation or continue and go to grad school (or even switch careers).

So now that we agree this is something worth chasing, how do you do it? Obviously, you can go online right now and apply to endless internship postings (in fact, I encourage you to, just make sure your resume looks great). This chapter is all about increasing the probability of someone actually reaching back once you apply. This will be mainly determined by your experience that you've gathered along the road.

To build your way towards having the experience that will help you increase the probability of landing your desired internship, you will need to build that experience!

If you have absolutely no experience, I suggest you start with undergraduate research. Many engineering schools hire faculty based on their research abilities, and most of those faculties are open to working with undergraduate students since they are usually motivated and are free labor. In many cases, you would work with a graduate student and not always directly with the professor, but what's even better, as the grad student can give you more of their time to walk you through what you need to learn. I personally started with undergraduate research in my freshman

year working at an MRI lab and was fascinated by the cool electromagnetics that enabled us to look inside the human body. I wrote a Matlab script that measured the size of lesions in the brains of multiple sclerosis patients. That was the first thing I put on my resume and from there, I had the experience to apply for more advanced work.

Another thing you can pursue is a club or an independent project. Again, most engineering schools will have engineering clubs in which students engage in an activity such as building a car, a cube satellite, a wind turbine, or even paper airplanes. The idea is you want to engage in some club where you work with a team of other engineers to solve a common problem. This again serves as a great pre-requisite to applying for an internship since you already have the skills of working in a group and solving problems in a real-world setting. I would say an ideal internship candidate is someone who has good grades, been involved in undergraduate research, and has been involved in independent projects. Prior internship experience is even better!

It's that simple. If you can get those things, you will highly increase your chance of landing an internship. Obviously, the actual process of getting the internship will require a good resume and some serious networking skills but don't you worry, we will cover those in the next two chapters.

The key idea I want you to take away is to not be intimidated and overwhelmed. Work towards small incremental increases to reach one goal at a time. In my case, first I joined a research lab and did very minor things. Then I joined another one which interested me more (remember the calibration process) and also worked on small things. Then I took on more work. Then I became a lead and had more responsibility. Then I managed and

led people. Then I finally got accepted for two internships! I got an offer from Ford in Michigan, and Northrop Grumman in LA, which at the time was building NASA's James Webb space telescope. And then I went to KSC, and then JPL. You see the pattern. Once you pass a certain threshold, you are golden.

Once you do engage in these valuable experiences, you will want to document and showcase them properly. Let's jump into the next chapter to see how we can do that.

8

The Ideal Resume

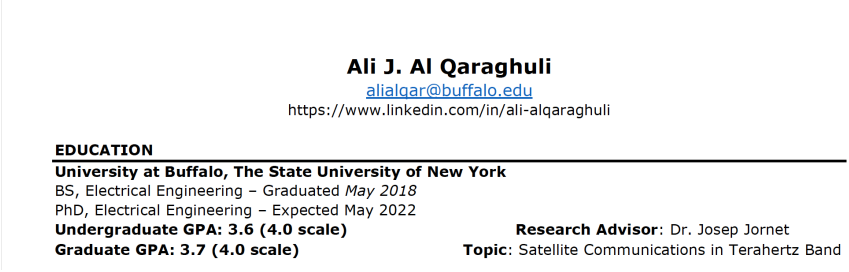
When a recruiter looks at your resume, they usually have about 30 seconds to scan the whole thing with their eyes. You want to make sure that within 30 seconds they see something they're looking for. If I were a recruiter, I'd want to see something cool and applicable. Your grades are nice and all, they tell me you care and you can finish tasks, but they don't say anything beyond that. What have you done? What have you built? What makes you stand out in contrast to countless other applicants (who also have good grades)?

Generally, your resume should be a 1 page, nicely formatted, description of what you've accomplished, and what you're capable of, with a hint of what you'd like to do next. This can be actually declared in something such as an objective, or it can just be "felt" from the direction that the experience listed pushes the recruiter. I spent countless hours perfecting me up to date resume and before I give you specific concrete tips on what to do or not to do, let's take a look at it.

I am going to break down my old resume to explain what's worth having and in what order. This resume was written when my advisor was still a professor at UB (he's now at Northeastern University as of the time I am writing this book, where I will be joining him to complete my Ph.D.), but it serves the purpose of this chapter. You can find my newest resume on my website

here: https://buffalo.digication.com/ali-alqaraghuli/academics

Name and Education:



Ali J. Al Qaraghuli
alialqar@buffalo.edu
https://www.linkedin.com/in/ali-alqaraghuli

EDUCATION

University at Buffalo, The State University of New York
BS, Electrical Engineering – Graduated *May 2018*
PhD, Electrical Engineering – Expected May 2022
Undergraduate GPA: 3.6 (4.0 scale) **Research Advisor**: Dr. Josep Jornet
Graduate GPA: 3.7 (4.0 scale) **Topic**: Satellite Communications in Terahertz Band

This is what the very top part of my resume looks like. You can see my name, my e-mail, and a LinkedIn link to get a more detailed history of what I've accomplished. You can see that first thing on top is education, my university, and since I'm a graduate student, I showcase my advisor as well (if you have a well-accomplished advisor, this only makes your resume stronger).

Many people wonder if it's okay to not include your GPA. I think anything above 3.0 should be included. Engineering school is tough, so don't freak out about your GPA, although try to improve it as much as possible - the higher your grades are, the better off you are, especially if you have no work experience. The current education system can be a bit dry and boring, but still, you gotta play the game. Get good grades. It'll open doors.

Next is **industry experience**:

INDUSTRY EXPERIENCE

Command and Data Handling Intern *June 2019 – August 2019 (3 months)*
NASA Jet Propulsion Laboratory – Pasadena, LA
- Designed PID control system for automatic gain control device for use on balloon missions
- Tested and characterized sub-millimeter wave RF devices for frequencies around 240 GHz
- Developed link-budget analysis for terahertz in comparison to laser communication technology
- Attended workshops and presentations highlighting topics for communication and spectroscopy
- Documented work on modifiable automatic gain control system through writing a detailed tutorial

Electronics Design Intern *August 2017 – December 2017 (4 months)*
NASA Kennedy Space Center – Titusville, FL
- Designed analog circuits and developed circuit boards for NASA's next moon lander mission
- Developed hardware-in-the-loop test to simulate sensors feedback from flight avionics
- Troubleshot power and communication anomalies regarding scientific instruments of payload

Communication Systems Intern *June 2017 – August 2017 (3 months)*
Northrop Grumman Aerospace Systems – Redondo Beach, CA
- Solved on-orbit satellite issues for cross-link communication through link budget analysis
- Developed a tool to predict signal strength for all-on orbit channels prior to data acquisition
- Won best group presentation poster demonstrating knowledge of communication satellites

You want to show your most recent internship on top. Pay attention to how I decide which sentences to bold, which one to italicize, and which ones to leave as is. Notice how the font I use is elegant and friendly for the eye. The dates are very well laid out. I choose to include the location to showcase the specific branch of each company -- this could help for networking purposes, which I discuss in the next chapter.

Notice how every bullet starts with an action. I designed. I developed. I tested. I won.

You want to showcase what you've done, so the recruiter gives you the appropriate amount of credit. If you have one internship and one research experience, you might just want to have one "experience" section that groups everything. But if you're like me and have multiple projects in each, you might want to include another section, a separate **Research Experience** section like this:

RESEARCH EXPERIENCE

X60: A MIMO Cross-Layer Reconfigurable Multi-Gigabit WLAN Testbed at 60 GHz – *Spring 2018*

- Developed frequency synchronization algorithm for mmWave link physical layer communication
- Utilized knowledge of principles of networking in programming PHY/MAC layer protocols
- Gained experience working with phased-array antennas in establishing highly directional signals
- Attended virtual tutorials hosted by National Instruments introducing X60 hardware and software
- Gained strong fundamental knowledge of 5G technology based on IEEE 802.11ac standard

TeraNova: Channel Equalization and Characterization at true THz frequencies – *Summer 2018*

- Developed pre-equalization algorithm for a functional communication system at THz frequencies
- Set in motion versatile design of the algorithm to be compatible with various external equipment
- Aided in design of post-equalization algorithm, in addition to frequency and phase synchronization
- Contributed to establishing a 2-km terahertz communication link at 240 GHz - first ever of its kind

Lay out your projects and highlight what your contributions were. Since both of my projects were at my university with my advisor, there was no need to repeat that information. Again, notice how I start each sentence with an action. This is a bit outdated since I don't have my recent research projects, but serves to show my undergrad and MS level projects. Next, you want to highlight your **Skills**:

SKILLS

- **Software:** LabView, MATLAB, Python, Altium, GNURadio, LT Spice, Orbitron, Creo, Microsoft Office
- **Personal:** Native in *English*, Native in *Arabic*, Proficient in *Spanish*

I like to break it into two sections since I am trilingual, and I like to showcase that. If you only speak English, ignore the languages part, and emphasize any software skills you have. You can also include soft skills like public speaking or leadership - for me I

would rather people find those out through experience from interacting with me as an engineer and as a person.

Last but not least, you want to showcase your **Awards**:

HONORS AND AWARDS

CSTEP Student of the Year Award – May 2018
NASA *Award for "Designing Electronic Circuits Surviving Heavy Ion Radiation" – November 2017*
Northrop Grumman *Best Intern Poster Award – July 2017*
Western New York *Prosperity Fellowship – 2016/2017*
HSBC Bank *Scholar Program Award – May 2017*
University at Buffalo Excellence in Research Award, – April 2015

Brag, but be humble. This can be a mixture of technical and holistic awards, I like to keep those at the very bottom in my resume since they make for a nice conclusion -- when you put the resume together, it flows quite nicely. It shows you this person is educated, has worked well in industry, has worked well in research, has gained valuable skills, and has been awarded for them.

Keep in mind that based on what the application requires, you will have to slightly change your resume to showcase what they're looking for. If they want to see leadership, emphasize that. If they want to see purely technical, focus on that, and so on. It is likely that you will have more than one version of your resume.

Now I know what you're thinking -- I have a lot of experience, it's not so difficult for me to make a solid resume. But I wasn't born with these experiences. Each one of them was their own journey and had its own hard work. The resume is just the picture that you paint to highlight what you've done. Your resume can look a lot better than this if you work harder and smarter than I did.

My goal here is to show you proper formatting and what looks aesthetically pleasing to the recruiter, but the key idea is this: your resume is your chance to highlight whatever it is that you have

done well. If you've only worked on one project, you want it to be the center of attention of the resume - talk about it in detail. If you've only done classes and got good grades, talk in more detail about classes and maybe some projects you did in those classes, even if they're little assignments. If you've only done research, include a lot of detail about that research. Don't make your resume look half empty, but at the same time don't just fill it with useless information.

You want to showcase whatever it is to help you get to the next level. As you get more and more experience, you'll erase the old stuff and add in the cool new stuff. You can try to use my template, but feel free to look around and experiment with whatever pleases your eye.

Keep your resume short, brief, and to the point. **One page maximum** unless you're so accomplished, but at that point should you even worry about making a resume?

Use sites such as LinkedIn to showcase whatever you can't fit on that one page. Remember, recruiters on average have 30 seconds on a good day to read your work -- can you grab their attention?

You might ask: "how do I even run into a recruiter in the first place?", well, for that, let's take a look at the next chapter.

9

Your First Job Offer

Your first job offer can determine the direction in which your career takes off. It is important to get multiple offers so you can choose the best one on your own criteria. Usually, people pay attention to the following criteria when searching for a job:

- Salary
- Company Size
- Location
- Vacation Time
- Development programs
- Grad-school assistance programs

These things are important and you should consider them, but I would argue that the most important thing about a job is the people you work with. That's why internships are so important since they expose you to work cultures and help you define what your ideal work environment looks like. Even if you don't have an internship, you can usually get a feel for the company culture from speaking to the recruiters who are sometimes engineers.

Some companies offer you to tour their facilities, I would highly recommend you ask about those types of exposure

opportunities.

Now that you have your resume nicely polished and ready to go, how do you go about landing those job offers? How do you meet those recruiters? Of course, you can go ahead and apply online, and you should, but applying online should not be your primary method of job searching, simply because most companies hire engineers through recruitment in conferences and events. I highly suggest you sign up for a conference or event of some sort that is sponsored by employers of interest to you.

When I was in undergrad, I applied to countless internships and programs, and most of them I was able to get through some type of program or networking event. Only for my NASA Kennedy Space Center, was I able to land the internship by applying online. You could say I got lucky, but even that required a very good letter from my undergrad advisor amidst a long and tedious application process that not many were willing to go through. You want to attend good networking events.

Here's a breakdown of what kind of networking events I'm talking about:

1. Society Conferences:

In almost any engineering school in the US, there are engineering clubs and societies that are aimed to assist undergraduate students. Where I attended school at the University at Buffalo, those societies included:

- American Society of Mechanical Engineers (ASME)
- Institute of Electrical and Electronics Engineers (IEEE)
- Society of Biomedical Engineers (SBE)
- Society of Automotive Engineers (ASE)
- Society of Women Engineers (SWE)
- Society of Hispanic Professional Engineers (SHPE)
- National Society of Black Engineers (NSBE)
- Society of Asian Scientists and Engineers (SASE)
- Organization of Arab Students (OAS)

The list is much longer, but these are some of the ones I've attended. Believe it or not, I was a member or attended one event in all of those societies listed. While some of them are focused around a certain group of people, they are non-discriminatory and welcome people from all backgrounds. In fact, I've found that such societies appreciate people out of that culture that join in to learn more. For example, I am not Hispanic, but being part of SHPE made a big difference in my career. Not only did I learn so much about Hispanic culture, and make life-long friends from central and south America, but the SHPE conference helped me land my first internship and my first research opportunity. Without attending those meetings, I would've still been applying online by now and who knows, I would probably be in a very different life trajectory.

I must bring to your attention that being part of these societies is about giving, and not just taking. If you solely join such organizations to see what you can get out of them, and not

contribute anything, you are in the wrong mindset. Before I reaped my SHPE benefits, I had joined in countless events in the city of Buffalo and I even tried to run for office. I did those things out of passion for the society and wanting to spend good time with the people, and I was unexpectedly rewarded elsewhere. This applies to anything in life. If you focus on giving instead of receiving, you will receive more than you can imagine.

2. Research Conferences

If you decide to do undergraduate research, do whatever it takes to be part of some publication or publish your project in a conference. This is another phenomenal experience you can benefit from. I presented my undergraduate research at the McNair Conference in Niagara Falls in 2016, and it was a great opportunity to showcase my experience and also a great opportunity to be noticed and discovered. In the research conference world, you'll meet many companies that are doing cutting edge research in the area you are presenting. Having them capture your enthusiasm is a great place to land an internship or a job!

3. Job Fairs

Most universities have some type of job fair in which local companies come to recruit talent. This is something you must attend, since it is free and sponsored by your own school. I attended my university's job fair a few times, and while I did not receive any offers from attending, I learned a great deal about how to interact with recruiters, what information they're looking for, and how to calibrate my resume to fit what they want to see.

Contrary to my experience, I've had many friends land internships and jobs from the career fair at my school, so that alone could be a good enough option for employment.

4. Workshops

Sometimes companies hold workshops to either present new technology or showcase their products in an attempt to attract more customers. However, at those events, recruiters may also be present since some of the audience is made of engineering students who are either interested or involved in the technology. I attended a Keysight workshop on the basics of RF testing tools that they were selling, and right there they announced they were interested in RF engineers to apply! Coincidently, the guy sitting next to me was working for a photonics company and since I asked him a few good questions that demonstrated I know a bit about photonics, he asked me to apply to his company's internship program! I had a chance at two internships simply by showing up to a free event that was suggested by one of my professors. Never say no to opportunities, especially free ones!

5. Shadowing Events

While this is more common in the medical field than in engineering, shadowing consists of you showing up and just observing what a professional does in their job. When I used to want to be a doctor, I shadowed many doctors of different specialties and each one of them taught me something valuable. When you shadow you simply get to watch and ask questions. Lucky for me, I was able to find a program that could get me to shadow an engineer in Buffalo. I spent a whole day at a company called Greatbatch Medical. That whole day I spent touring their

facilities, shadowing an awesome design engineer, and experiencing what it's like to be an engineer in the real world. While companies usually do this as a way to give back to the community, it also can be a recruitment opportunity! Through my interactions there, I made great connections that I could have used down the line to try and get an internship. More importantly, the mentorship I received helped me learn about what I want in a career. Look out for those types of events as they are usually offered by the leadership office at your school.

6. Referrals

While you're in school, I highly suggest you make a larger number of friends than you would like. Your peer group is your future network, and the more time you spend with each of them to learn about what they're interested in, not only are you exposed to new perspectives and ideas, but those same friends could refer you to a job in the future!

I have a friend who was in the grade below me, and he is the definition of a social butterfly. He is genuinely interested in asking good questions to just about everyone he meets. He genuinely cares to know and learn from others, and therefore others are more than happy to share and connect with him. I am willing to bet he will not have a hard time finding a job in the future, simply because he can get referred to a job by his friends, who also are aware of his good engineering skills. You don't ever want to make enemies in engineering school, and you never want to burn a bridge. Your friends and peers could be your ticket to a good job in the future!

7. LinkedIn

This has been kind of a hot trend in the recent few years, LinkedIn is becoming a very popular place where recruiters meet talent online. As I mentioned in the previous chapter, you want to make sure your LinkedIn profile is updated and looking good. It may be even more important in the future than your resume, who knows?

Simply by having a good profile that shows your skills and experiences, and turning on the option to be noticed, you will receive messages from recruiters. Even better, you can take a proactive approach and find recruiters from companies that interest you and message them -- make your message as brief and to the point as possible, but showcase what makes you stand out.

At the end of the day, you will end up with a good job, don't stress about it, but don't sit around and do nothing. If you apply online and do some of the 7 things I listed, you are increasing your probability to be noticed. Exposure to internships and jobs is so important, the more you do the more you figure out what you want to do next. You may do all of that and then realize you want to take a completely different path! Let's go into the next chapter and see what I'm talking about.

10

Industry vs. Grad School: Does the Learning Ever Stop?

If you're like me, you will reach your senior year and realize that your goals have changed since you joined college. You will panic. All of a sudden, the 80k a year on a 9-5 schedule isn't as great as you've thought. This journey is coming to an end and you need to make a decision quickly on where to go next. Most people you're surrounded with will be accepting their job offers, but you did work in industry through internships, and you think there might be something more exciting out there. What's the other option? You start looking into graduate school.

When I first started looking into graduate school, my initial thought was I need more time to figure out my next step. I had received a job offer from the company where I interned in my junior summer. While I liked it and liked the people I was surrounded with, I didn't want to lose the benefits of being a student such as learning in freedom and managing my own schedule to do the things I like. When I worked in a company, learning felt like work, but when I was in a university, learning felt like something more.

Should you go to graduate school? It depends.

Do you enjoy the university environment? Or you can't wait to be done?

Can you handle an additional few years of being broke? Or do you need to make money urgently?

Do you think you're "ready" for the workforce? Or could you use more time in school?

Now that you've answered those, let's move on to the more important questions.

Is there a certain area you like in your major that you could specialize in?

Is there a certain professor you've found who does fascinating research you see yourself doing?

Is there anything you haven't accomplished in undergrad that you wish to do in grad school?

Does a higher degree offer you access to more job opportunities, or benefits within a company (higher salary, better projects, etc.)?

By now you see I can't give you answers. I can only ask you questions. It all comes down to your goals and whether graduate school can add value specifically for you. One general rule I would recommend is for engineering, you should not pay for engineering graduate school. Usually someone else should pay, whether it be a scholarship/fellowship, your advisor, or an employer.

If you want to dive more deeply into learning something and still want to have the luxury of being a student, and you've got the funding, then it's a no brainer. If not, think about it more carefully.

When you go to industry you will be doing a lot of learning. It's your choice if you have reached your saturation point with formal education, or if you want to continuously grow and chase more challenging research as a student. This will largely depend

on where you work, and that's why you should choose carefully.

For me, going to graduate school was the best decision I could have made. Not only did it allow me to be part of a phenomenal laboratory and work under an incredible advisor, but it has allowed me to study abroad in Spain for a semester, to teach, and to travel to conferences. These are just some benefits. The biggest is it has allowed me to maintain my creativity and flexibility which would otherwise be more difficult to maintain in industry.

If you do pursue a Master's degree, try to do a thesis, or at least work with an advisor on a research project so you can showcase you've done more than take some classes and pass.

If you plan on pursuing a Ph.D., you want to very carefully consider your school and your advisor. Your advisor will determine your future, and therefore you should choose a person who's compatible with your personality. For example, I'm very growth-oriented as a person. I am an effective communicator, and I am radically open-minded and like to dive into new ideas. I, therefore, made sure that the advisor I work with possesses those traits as well, such that we work together in harmony and don't come across many disagreements. To this day, my advisor and I have never had a disagreement lasting more than a few minutes. We work quickly and efficiently to solve problems of all sorts. Make sure you have this mutually respectful relationship with your advisor, it will make your Ph.D. a lot more enjoyable.

In summary, think of graduate school as a luxury that you can obtain if you can do your research and find what you're looking for in terms of school, advisor, funding, and what you hope to gain out of the program. You can learn a lot more in industry, and make more money as well, so weigh your pros and cons and see what's best for you. Either direction is good, but either way, you

go, you want to make sure you are growing and continuously becoming smarter. In the next chapter, I will share my set of principles for how to become smarter, you will love them!

11

How to Become Smarter

This is perhaps the most important chapter in the book since anybody outside of engineering can still gain a lot from it. There are multiple areas you can improve in. I could have written a whole book on this, and I probably will, but I'll keep it to the few key ideas that I think you should start with.

You've probably heard people try to measure intelligence -- to me that is nonsense. Intelligence is growable and not static. I know this from personal experience. I am much smarter than I was one year ago because in this past year I have designed my first antenna, designed a laser communication system, learned about nutrition, attended physical therapy and learned about ligaments to heal my knee and (understood the mechanics of the human body as a result), read books about finances, chess, health, self-improvement, wrote my first book (which you're reading now!), released my first electronic music album, and done countless smaller things that make me smarter than who I was before. I didn't only get smarter from doing them, but also from all the challenges that I had to solve in order to do them. Any problem you solve makes you smarter, even if by a tiny amount. Those tiny amounts add up.

How do you get yourself to do things efficiently so you can become smarter? Let's look into it:

○ **Improve your soft skills.** It may be a shocker that this is actually, the first thing on my list, but here's the reasoning behind it: without good soft skills, you won't be as efficient in learning from others and you won't get your ideas across. Warren Buffet has once said that not having good communication skills is like winking at a girl in the dark. I learned this from personal experience after thinking back and evaluating how I evolved into such an effective communicator. In high school I wanted to make a career out of writing fictional stories and making films. I spent the majority of my time in high school watching movies, writing stories, listening to rap and rock music, playing sports, and engaging in all sorts of random activities. All these things forced me to meet many people and interact with them, alongside showcasing my work to them. This built my ability to interact with others, as well as my ability to sell. My parents were concerned that I was wasting my time and not unlocking my potential, but I had a stubborn habit of going with the flow and following my gut, so I kept doing these things anyway. Turns out all those years "wasted" not studying science ended up being the reason I can communicate and explain scientific matters exceptionally well. The takeaway: nothing is wasted when it comes to working on your soft skills, they are the ultimate transferable skills!

○ **Hang out with smarter people.** Usually smart people are nice and willing to share information, as long as they see you're interested and not just wasting their time. No, I'm not saying completely ditch your party friends, but go hang out more with people who are smarter than you. I started hanging out with people from the CubeSat laboratory at my university. These kids were building a satellite to fly in space, to me it was insane. A few

months later I felt normal around them, and a year later I was leading some of the newer members and making critical decisions. I remember giving a presentation about optical communication and explaining it well, everyone was mind blown. Have I just become much smarter simply by hanging out with smart people too often? I like to believe so!

○ **Use social media wisely.** As someone who's travelled and lived in many places, I like to keep up with my friends all over the globe, and also post interesting things about my life that connects me and allows me to inspire others. I understand that many people will totally bash on social media, and the reality is you are probably better off without it, but it's all in how you use it. You have to make sure you're using it as a means of communication (and sometimes entertainment) and not just a slot machine. I try to limit it to keeping up with friends and occasionally checking funny memes, but not deplete my dopamine and not have the will to do anything else. Look up "dopamine detox" to see what I'm talking about.

○ **Organize your time.** Once you've gotten rid of the things that waste your time, you want to figure out what to do with your time. If you wake up every day with no plan whatsoever, you float by and the whole day passes and you get nothing done. There are three tools you can use to organize your time:

■ **Calendar:** This is the best way to keep track of all the things you need to do and make sure you never ever miss an

appointment and avoid feelings of irresponsibility and incompetence.

■ **Sticky Notes:** It could be physical or on your laptop, but having something in your face reminding you of things you need to do will ensure you don't forget them, and will actually help you get them out of the way.

■ **Reminders:** You can tell your phone to remind you to do something at a specific time. It helps me stay on track. Always make reminders for important meetings.

○ **Read**. Read books. Read 10 pages a day. Read at least 1 page. Don't stop reading. When I read about successful people, they all read multiple hours a day. There's got to be something with reading such that almost all successful people have it in common. Hate to sit down and stare at pages? Read e-books, read online. Hate to use your eyes? Use audiobooks! I have spent countless hours listening to books while I'm driving, riding my bike, cleaning the garage, or any activity that doesn't involve much thinking. Audiobooks are a lifehack because it's as if the author is telling you a story, it makes it much more engaging. I have read 60+ books in the first half of this year, and plan on sharing my library on my website (www.alialqaraghuli.com) sometime in the future. Stay tuned!

○ **Write**. Answer people's questions. Helping others solve their problem will help you go through the process of problem-solving (becoming smarter) without having the problem yourself. That

goes along the line of learning from other people's mistakes. By the end of writing this book, I am smarter because I went through the research process of what it takes to write a good book, how to make a cover page, and think about what content would help people the most. I had to go through my older resumes and think about how I got started earlier, which helped me see how I evolved in the recent years (and made me think differently about the years to come).

○ **TEACH.** This is how you find gaps in your knowledge - Richard Feynman, who was a phenomenal teacher, gave credit to his teaching ability on his way to winning a Nobel prize. He emphasized that only when you have a deep understanding of something, you can explain it in simple terms to someone else, and vice versa. I personally attest to the Feynman method!

○ **Learn how to market yourself.** In order for others to take you seriously and give you their precious time, their first impression of you will matter a lot. Learn how you present yourself and try to highlight what you wish for others to see in you. For me, I like to showcase my enthusiasm and creativity in problem-solving, as well as my passion for working with other people. This is easier to do when you're self-confident.

○ **Practice self-confidence.** Yes, practice. What you tell yourself on a daily basis eventually reflects how confident you are in yourself. As humans, we are living research laboratories that focus on negative things that we'd like to improve. Make sure you're shedding plenty of light on the positive things you do and the good

qualities you have, and come up with good plans to fix any fixable issues you see in yourself. Muhammad Ali would often say "I'm the greatest!", Arnold Schwarzenegger would say "Live Strong!" -- they didn't start saying these things to themselves once they became successful, it was actually the reason they gained success in the first place. If you don't believe in yourself nobody will. It's that simple. ¯_(ツ)_/¯

○ **Take care of your health.** You cannot separate the mind from the body. Learn about what's a proper diet for your body type. Avoid added sugar at all costs. Avoid plant-seed oils. Learn about these things. Learn about oxidation and inflammation of the body. Eat real food, eat what your body is used to eating! Learn to be in control of your desires and don't succumb to what feels good at the moment. Experiment with the right diet until you find what increases your mental sharpness the most. For me, I try to stay away from refined carbs and sugars and get my energy from eating whole foods. Make sure you're frequently moving around and aren't being a couch potato all day. Ride a bike. Go for a walk while thinking through a problem or listening to a podcast (or audiobook). You can do other things like lifting weights, playing sports, or anything that can get you to move around. ALL are helpful to keep the mind sharp and inspired. You can check out the best diet books I've read from my online book library.

○ **Wish well for the world.** You have a finite amount of mental energy daily, a part of that is towards your emotions. If you hold grudges, constantly criticize without providing suggestions, hate on people/things, you are wasting your precious emotional energy.

Forgive people. Remove toxic people from your life, but still forgive them on any damage they've caused you. Success is the best revenge. Your energy should be optimized to improve yourself. No energy drained on the no-longer-controllable past! The past is only for reflection and good memories, which should not drain your mental energy.

○ **Have good mentors.** This one is so important that I'm writing an entire chapter on it, let's check it out!

12

The Value of Mentorship

The value of mentorship cannot be quantified. It is of infinite value. It's the closest thing we have to time travel. Someone with more knowledge and experience can simply pass it onto you. It's a "life hack". I attribute most of my success to having met the right people at the right time, although I wish I had met most of them earlier.

There are two types of mentors: those you meet in your real life and directly interact with, and those you "virtually meet" through things like books, TV, or any online content. Both are important, and both can impact your life dramatically.

You need personable mentors, like professors, who you can interact with. Those you can develop a relationship with. The reason I talk about internships a lot in this book is because a company will pair you with a mentor, an engineer usually, and that person will have a dramatic impact on your work experience and subsequently your career. They will point you in the right direction and answer your questions, and pretty much "calibrate" you into being a real engineer and not just a student. I am lucky to have had incredible mentors in all my internships,

Through books and the internet, you have access to countless mentors online. I am constantly mentored by Cristiano Ronaldo, Bobby Fischer, Ray Dalio, Elon Musk, Muhammad Ali, and many others. I am also mentored by individuals who lived a long

time ago, such as Leonardo DaVinci, Avicenna, and Confucious. They figured out a system that works, and that it's worth transferring to others. Lucky for me, they documented their life principles and I can follow them and learn from them. Lucky for me, I live in the age of the internet where you have access to anything with a few clicks, usually for free. I read their autobiographies, I learn from how they behave, how they think. I learn from engineers, craftsmen, entrepreneurs. I learn from everyone. Everybody has something to offer. If you get good at the skill of taking the good and throwing away the bad from anything you encounter, you're on your way to victory.

When I made my first electronic music album, I could have fully relied on free online content from random youtubers (some are great), but I chose to invest my time into two online production series by Deadmau5 and Armin Van Buuren. From the inspiration I got from Deadmau5, in addition to my desire to make good music, I was able to start from scratch and release 7 tracks in less than a month!

However, don't spend time only with virtual mentors! Find real mentors! The more experience you get, and the more valuable your time becomes, you want to carefully invest in your mentors. My biggest mentorship investment is my PhD advisor. He is my mentor in conducting scientific research, but he also mentors me in other areas; from how to think about abstract scientific ideas, all the way to how to simply make Matlab plots look nicer. Real-life mentors that you can approach and ask questions are of infinite value. They are the ones who will help you in times of difficulty and will celebrate you when you prosper. I've covered this in my previous chapter on graduate school, but now you see

it entirely from the mentorship lens. Professors can be phenomenal mentors.

This brings me to an important point. In a way, everybody in your life can be a mentor, you just have to manage which mentors you pay close attention to. Your mentors have to be believable people who have ideas worth sharing. The better your mentors are, the better you will be.

Mentors are not only walking organisms of knowledge, but they are drivers of inspiration. The key takeaway here is you will need good mentors to succeed. How do you find good mentors? Well, think back to our discussion of what you like, or would like to achieve. Think of who's done that. Look through them and see which one you empathize with the most, now spend time going through their ideas and principles. Take the good throw away the bad.

Keep in mind that a mentor is not necessarily always one person, but can be in the form of a support group. I owe a huge chunk of my undergraduate experience to UB CSTEP, where I was pushed forward and hyped up beyond belief! While CSTEP is an organization to help economically disadvantaged and minority students fulfill their potential in STEM, it felt more like a family of amazing people who share similar difficulties in life. This level of mentorship can be a game changer!

Speaking of family, family members can be amazing mentors, but keep in mind that their advice will always have an emotional aspect to it that could be protective or unrealistic. If you're confident and positive, you will prove to them you're capable, and you will win their support.

Last but not least, you should be a mentor yourself. Through mentoring others, you will find out what you would like to see in a mentee (a person being mentored), and it will allow you to make changes to how you interact with your mentors to make a more efficient use of their time. I have mentored countless people in academics, work, sports, music, social life, and countless other areas. While you may think they're getting the better end of the deal, think of how much I've learned from their experiences and especially mistakes, and how much life experience I've gained in the process. The less you expect in return, the more you enjoy the process!

This wraps everything I wanted to cover in this book, but now I've thrown a lot of information at you -- sooo.... now what?

13

Where Do We Go from Here?

Where do we go from here? Everything you've read this far should hopefully help you think about what you'd like to achieve, the goals you need to set, and the type of people you need to spend more time with whether in person or virtually. I'd like to use this chapter to give direct advice based on which stage you are in your journey from my own personal perspective, so here it is:

If you're a *Freshman*:

Congrats, you are in college! This is an amazing time in your life, filled with learning and meeting new people/ideas. A crucial factor to your success and happiness in the next four years is the people you meet, especially if you live on campus. You'll meet many people, some are school focused, some just want to party, and some are a mix of both. Identify your goals early on and find out what kind of people you'd like to surround yourself with. You are an approximation of the people you hang out with.

Figure out early on what you want to major in. Don't let this over-stress you, turn it into a fun process. Use chapter 2 and 3 in this book as a reference to finding the answer, and chapter 4 if you're considering Electrical/Computer Engineering. Make sure you have good grades, as this will make applying for research/internships/jobs later on much easier -- aim high. Spend

time in your winter and summer breaks after each semester to think deeply and evaluate how your first semester/year was, and what you'd like to do differently in college.

If you're a Sophomore:

You are in an exciting year, now you've gotten the hang of things and are probably having a hard time balancing things out. You're starting to take more intense classes, but by now you should also be involved in outside of class activities. Remember, everyone, takes classes and can get good grades, the only way to stand out is to do things outside of class that involves anything from coming across new ideas to being involved in hands-on learning.

Figure out what you want to do this summer. Since internships are difficult to get as a sophomore, apply for undergraduate research programs. If applying for undergraduate research programs is too overwhelming or requires lots of experience, consider staying at your university over the summer to do research with a professor or work on a school project. You can also look up countless free online websites to learn skills such as coding a certain language. Not having classes frees up your mind and schedule tremendously and allows for more efficient learning. If you switched your major and are behind on classes, consider summer classes to get caught up, although there's absolutely nothing wrong with graduating a semester or a year later assuming you have a better idea of what you want to do.

If you're a *Junior*:

This is perhaps the most difficult time in your undergraduate career. You are taking your most difficult classes, applying for internships, and possibly starting to panic about what to do when you graduate. The best thing you can do for yourself is to do everything in parallel. Get your classes done, maintain involvement in clubs and projects, and find time in your week to apply for internships for the summer. Attend as many networking events as you can. Your junior year internship can help kickstart your career as it often results in a full-time offer.

If you're a *Senior*:

By now you know what you're doing and there's not much for me to add. Make sure you have thoroughly thought about deciding between full-time and graduate school. Taking a year off is not a bad idea, but only if you continue moving forward. Trust your gut and don't feel rushed by other people's schedules/expectations. If going full-time, make sure you find a company you can see yourself grow in.

If you're a *Graduate Student*:

In most cases, you've made a good decision. Specialize, but keep general problem-solving skills and keep being engaged outside your area. If you're in graduate school you should be getting really good at one of the areas in your major, and not just juggling around random courses. If you are not on a thesis track, try to be a part of a project or voluntarily do research with a professor, this can help ensure your skills are fresh and you aren't getting too comfortable taking classes only. As you're missing out on a full-time engineer salary, make sure you take this time to learn

financial literacy and have a plan with what to do with your money once you start making more.

If you're a fresh Engineer:

Congrats, you're in the real world. Once you're all settled in, don't get too comfortable. Soon enough you will be much busier outside of work and may not have all the energy you have now, so use it properly. Complete your tasks on time, and always look for growth opportunities. Don't be afraid to get involved in new projects, but be smart about it -- if done right, this can help you move up quickly in your career. Make sure you have time for yourself. Do something extraordinary every once in a while. You don't have to commit to anything extraordinary, but small incremental changes will do. I HIGHLY suggest you watch this ted talk which is my absolute favorite: Look up "How to Achieve Your Most Ambitious Goals by Stephen Duneier" -- it's a good place to start.

You may run into some office politics. I find the best way to go about it is to be radically transparent and open-minded. That's just about the most efficient way, it has worked for me every time so far. I leave everyone happy and never in confusion. Speak up if you see something wrong but be smart about it. I suggest you read the book Principles by Ray Dalio to get a better idea of the ideal business environment and how you can shape it.

Use your money wisely and invest before you spend. You won't get rich by saving your money, learn how to invest it properly, and diversify that investment to reduce risk. Don't rely on some magical company package as your only source of investment, take the time to learn about all the options. If you're smart enough to be an engineer, you're smart enough to learn how to manage your funds optimally. Money is important, but keep in mind that you

should be doing your job because you like it, not because you desperately need the money.

As the years go by you will have an incredible amount of knowledge and experience. You will influence many people directly and indirectly. You will have information worth spreading. The internet has made it such that you have immediate access to questions from people around the globe who need help or advice, such as on websites like Quora. Document as much as you can that you think is worth spreading to the next generations. Write an autobiography and pass it on to your kids and grandkids who can pass it on to their grandkids -- if even one random person benefits from anything you write, it's already worth the effort. You'll spend your life building an empire, no matter how big or how small, make sure to document it. Write about your ideas, how you evolved, mistakes you went through. Even if you don't want to share it, document it for your own benefit. Self-journaling as the years go by will help you reflect and see in detail how you evolve. Finally, I want you to keep in mind that you don't have to be a teacher to be an educator. People can still learn through your actions and interactions with others. Act wisely, but be yourself, always.

We've reached the end of this book, I hope you learned at least a few things while being here. Thank you for taking the time to read this, now go make something out of it!

Please consider leaving a review. It gives me feedback on my content and writing style. A review allows the search algorithms to expose this book to more people. More reviews would help me as an author reach a larger audience for this book and my future books!

Feel free to share this with your non-EE friends. Most information in this book can be applied to any major, even outside of engineering. You don't even have to be in college to make valuable use of this information!

If you have questions/comments regarding this book or anything you'd like to share, please feel free to reach out! My e-mail is listed on my website at www.alialqaraghuli.com

Best of luck!

Ali Al Qaraghuli