TALES OF ACADEMIC LIFE

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1. FOREWORD

This article is a follow-up to the original essay I wrote on "Tales of a Group Leader: Building Leading Academic Research Groups." Colleagues, students and friends who read that were appreciative of this peeling back of the academic curtain to demonstrate and provide advice on some of the inner workings of leadership. At the same time, there were specific requests to discuss topics of interest, including how to maintain work-life balance with family, and how to recruit and mentor students. I had avoided these and other topics when writing the original article, in order to keep it focused on its core theme of building academic research groups. But there were other reasons beyond that. In some ways, I felt uniquely qualified to write about my journey as a group builder and leader. Few academics have gone beyond their own research goals to having the opportunity to build a larger research group in their area from scratch, fewer still have done so at multiple universities, and none that I know of has written about this important but under-appreciated experience. As such, I felt my article served a niche but unfulfilled gap in writing about academia.

On the other hand, I feel qualified, but certainly not uniquely qualified, to opine about many important aspects of "ordinary" academic life. Indeed, many other authors have written books about these experiences, and today there are organized seminars and mini-courses on topics like time management, mentoring students, maintaining work-life balance, and teaching effectively. In fact, there is an entire business and industry specialized at training junior faculty for their roles. I view these developments very positively. Becoming a faculty member is a challenging endeavor, with many new responsibilities. When I was first hired at Columbia in 2002, there was no formal initiation into the role per se, and I was simply given the key to my office. I did of course benefit immensely from my mentors there, Profs. Nayar and Belhumeur, but everything I learned was by doing, osmosis, or advice from these senior faculty, and I never had any formal training on the many non-research aspects of the job. Indeed, I never had any kind of formal orientation. If today's faculty receive a formal orientation and formal training on mentoring, teaching, fundraising, or any other aspects of the profession, it is a valuable and positive change to be lauded. At the same time, it is clear that many of my colleagues want more advice on these aspects, and are interested in my own views on these matters. Therefore, I have decided to add my name to those of many other authors, giving my view on the academic profession.

This is intended as an article focused specifically on academic life, as experienced by a faculty member in a top-tier research university in science and engineering (my own research is in computer science, within the areas of computer graphics and computer vision). However, at least some of the advice should be applicable more broadly to related professionals in many fields, to students just entering the academic adventure, and to members of the general public wanting some demystification of the academic ivory tower. My original request was to write about recruiting and mentoring students, and work-life balance issues. I will get to these critical topics, but I feel I first need to set the stage by discussing the basics of academic life, and I also discuss a number of other topics relevant to academics. While I do draw from my own experience, this article is intended to provide general background and advice, not serve as an autobiography, and I include historical and contemporary details only as needed for making the relevant points. Note also that this article reflects my own, at times idiosyncratic views, and is colored by survivor bias.

Once again, I want to express my sincere appreciation and acknowledgement to my own faculty mentors, especially Prof. Shree Nayar at Columbia who taught an immature 25-year old new Ph.D. graduate more than anyone how to actually be a faculty member, Prof. Jitendra Malik at U.C. Berkeley who gave me a deep intellectual perspective on academic life, and Dean Al Pisano at UCSD for hiring and having the confidence in me to build a new center for visual computing. I wish to thank my own advisors over the years, Al Barr, Jim Arvo, Pat Hanrahan for modeling and providing insight into how to be an exemplary faculty member. I owe a debt of gratitude to all of my own students, other trainees and collaborators, and colleagues over the years. A special thanks to Michael Reed and Adrien Bousseau for first encouraging me to expand my original article. Finally, my greatest debt goes to my own family and my wife Padmini Rangamani for her support through all of these years, and for encouraging me to put my many thoughts on these topics into the written word.

2. THE MANY JOBS OF A PROFESSOR

The general public has little understanding of the real complexities of the job of a tenure-track or tenured professor at a major US research university. At best, they may regard a faculty member as a teacher, akin to a high-school teacher. And in fact, this may reasonably accurately describe the career of most college professors not at research universities, from community to teaching colleges. Or if thinking about a researcher, the public's mental model may be closest to the individual geniuses of the past century such as Albert Einstein or Marie Curie. However, the job of a modern tenure-track faculty member at a top-tier research university has evolved to be vastly more complicated than either of those views. Since academe has given little thought to explaining the many roles or jobs of a modern professor, the general public can hardly be blamed for their lack of knowledge about the true structure of the ivory tower. Indeed, even graduate students at the university don't usually understand the full nature of the roles their advisors play. The goal of this chapter is to peel the curtain back somewhat, and explain the nature of the modern faculty job. This in turn helps explain many aspects and peculiarities, and sets the stage for discussion of other topics.

A faculty position at a research university is really an amalgamation of (at least) six different jobs or roles:

1. *Research*: Of course, faculty are hired primarily for their research excellence at top-tier research universities, and research is the primary role of faculty. But here, I am using it only for individual research the faculty member does primarily on their own or as a leader, much like they would as a graduate student or postdoctoral researcher. While many senior faculty members may perform research primarily through their graduate students, some do continue to make individual research contributions, and junior faculty will often be doing their own research for quite a while. Beyond this, I think it is a good idea for faculty to spend at least some time doing their own research, rather than simply being a manager (a view that was first made explicit to me by Prof. Shree Nayar), even if one is only running initial experiments or reading papers in a new field.

2. *Funding:* Modern academic research involves money for students, equipment, travel, summer salary etc. and a faculty member will spend considerable time writing proposals, and then managing the resulting projects. Ambitious faculty may seek to lead large multi-PI or center or institute-scale multidisciplinary grants.

3. *Teaching:* Faculty on the tenure-track usually teach both undergraduate and graduate classes. The teaching load is light (typically one course a quarter or semester), but this remains a key part of the job. Note that it's not just classroom teaching, but the time required to develop and maintain courses can be enormous, especially in this era of remote education. Ambitious faculty may also develop textbooks or online courses.

4. *Advising:* I include within this all aspects of working with students and postdocs, including recruiting, mentoring, bringing them up to speed on the field, and performing research and writing papers with them. In practice, at least for senior faculty, most of one's research output will actually come from this aspect of the job, and it may be the most time-consuming. We hear a lot about faculty positions integrating research and education, and advising is the one area where this is truer than any other.

5. *Service:* Faculty are called upon to offer service to many beneficiaries, including their own departments, the university, the profession, and in some cases the broader public. For example, one may serve on or head a departmental or university committee, or serve as a reviewer or on the program committee for a conference. There is service which nobody gives you credit for, like writing recommendation letters. For those with interest, they may aspire to leadership roles (chair, dean, papers chair, center director).

6. *Consulting:* While certainly not required or a condition for merit advancement, universities may be unique in allowing their faculty to consult for outside entities (usually industrial companies in the field), and in this way provide their expertise to the profession and the public. There are many other possible outside activities.

A number of observations immediately follow. First, this is an incredibly challenging and rewarding job, where one has so many different roles, and so many different ways in which one can make contributions. Second, this is a huge leap in complexity, and time and effort, from being a graduate student or postdoc, where one's role is largely only #1, *Research*, hence the difficulty of transitioning into the faculty role and the insatiable need for advice and mentoring. Third, just time management of these different roles can be daunting. Each of the jobs above could be a full-time or at least a half-time endeavor (incoming junior faculty were in fact paid full-time for doing just *#1 Research* as graduate

students or postdocs, and college professors in non-research universities are paid full-time for doing mostly just *#3 Teaching*). Nobody can physically work 240 hours a week, and no sane person even works 120 hours a week, so proper time management is critical, especially to balance work and family, and I devote the following chapter to it.

Another way of describing the faculty role among my colleagues is as akin to a startup founder. The concepts of teaching and service are well understood and are in essence a regular "job." But the research aspect is usually way more complicated than a faculty member locking themselves in their own office or home and conducting experiments by themselves as a personification of the lone genius or mad scientist we often see in the movies. Rather, one is managing a small research group, usually of 5-10 graduate students. In this endeavor, one is operating much like a startup founder. You have a cool initial idea, often based on your Ph.D. thesis or postdoctoral work, that you now need to turn into a larger product, where the product in this case is often academic papers or publications. The way you do this is to first obtain funding from the funding agencies *(#2 Funding*), much as you would from venture capitalists in a startup. In the early stages, you may also need to spend considerable time yourself on building the product (in this case, writing your own research papers, *#1 Research*, above), as well as traveling to conferences, giving talks as a way of promoting yourself and your startup and product. Of course, you need to hire and manage employees, who will ultimately end up doing most of the work. In the academic context, this involves recruiting and mentoring students *(#4 Advising*). One might think, continuing the analogy, that tenure is akin to something like an initial public offering or IPO, when one's startup is successful, and you have graduated from startup status to mature company. There are indeed some similarities, as getting tenure in a research university is often the jackpot that all junior researchers dream about, and one becomes a mature faculty member after tenure. However, academic research groups always remain relatively small, and so one operates one's entire career in startup mode.

About a decade ago, Forbes magazine threw the serene world of academia into a tizzy, designating college professor as one of the least stressful jobs. This immediately led to uproar and pushback from academia, and indeed looking at the list of different jobs a faculty member must do, this "least stressful" designation seems laughable. But Forbes did not back down, and compromised only slightly to qualify their rating as applying only to tenured professors. In a sense, they are correct. This also reminds me of an episode in the acclaimed British television series, "Yes Prime Minister". The Prime Minister is complaining to his cabinet secretary about all the work he has to do, and the cabinet secretary responds that indeed he has a lot on his plate, but if read literally, the work he **absolutely has to do** is quite minimal. Indeed, the only job that a tenured professor actually has to do to not get fired is *#3 Teaching*. But this is just one course a quarter, meeting 3 hours a week, with perhaps availability for a couple of office hours, so maybe 5 hours a week only for those times school is in session, which is about 33 of the 52 weeks in a year, i.e., about 165 hours per year of actual work, less than 10% of what a typical office employee puts in. And I have seen (rare and transient) examples of colleagues who have reduced their workload even further. Of course, this does not count course preparation, but the amount of time to prepare a course one has already taught before can be pretty minimal. Now, tenured faculty can in principle be fired for a lack of productivity, but this requires several years without publishing at all, and the clock can be restarted simply by putting some sort of preprint up on arXiv or submitting an article to any venue. More critically, dismissal of tenured faculty is a time-consuming process that the university is going to reserve for documented cases of misconduct (sexual assault/harassment, financial embezzlement, criminal convictions, scientific fraud and most recently, undisclosed links to Chinese entities). A well-liked professor who simply stops doing research (within academia we refer to this as "deadwood") is just not a priority for action.

The issue with Forbes' article comes down to the definition of a "job." For most professions outside academia, a job is relatively well-defined, and there is a narrow band of effort, below which you will be fired or above which you will be promoted to a new position. In contrast, for academics, at least tenured faculty, there is a very wide range of effort that can still encompass the same faculty position. You could spend 5 hours a week, as noted above, or 120 hours per week, be deadwood or a Nobel Prize winner, and your title in academia will remain the same. This article is aimed at dedicated faculty active in research, who are putting their full effort into all the jobs of a professor listed above, but do note that most of this effort, at least for tenured faculty, is in principle, voluntary. Again, this is in contrast to other jobs. Professionals in other occupations may go above and beyond the requirements, but effort is usually spent either doing what is required to keep the job, or in the expectation of monetary rewards through bonuses or promotions. I have a separate chapter on academic compensation, but at the core, most compensation is fixed, flowing from the minimal effort in teaching. All of the other effort on research excellence, fundraising, advising etc. while not quite having zero financial benefit is relatively very poorly compensated in incremental terms. In fact, to the extent this takes away time from *#6. Consulting*, all this voluntary effort can lead to significant negative financial returns. Academics spend countless hours on their research, because it is their passion rather than typically for any immediate

financial gain. But in the outside world, time (and money) spent on something one enjoys for pleasure rather than financial gain is usually classified as a hobby/passion rather than a job/business. As such, academia and research in general in many ways blends between a job and a hobby/passion. This dissonance can often cause discomfort to non-academics, and even lead to troubled relationships when professors marry non-academics (what do you mean you are still working even harder after tenure, but you don't get any financial compensation for all the additional hours, and remain poorly paid relative to industry?)

An interesting question is that given the perverse financial and other incentives in academia noted above, why doesn't everyone simply deadwood out and enjoy life after tenure? Probably the most important reason is that faculty who have gotten this far through a Ph.D., maybe a postdoc, gotten a top-tier research faculty position, and then managed to get tenure, have a great deal of passion for their work and research, and continue to take things to even greater heights further in their careers. Given the opportunity costs in these earlier stages, these are also unlikely to be the individuals who want to simply stop working so early, nor those for whom the financial factors are the primary motivation (otherwise they may have left academia for industry much earlier). There remain some external motivators in terms of recognition and awards in your professional community, and a sense of duty to perform, given the extraordinary opportunity one has been provided (no other profession pays you so much while giving one such immense freedom to pursue one's interests). And there is also inertia; once one is on the train of obtaining funding, recruiting students to do the work, and then obtaining more funding to keep them employed, it's hard to get off, and senior faculty often work ever harder. At the same time, this is all predicated on high standards for faculty hiring and tenure; without those, the chance of faculty becoming inactive after tenure increases substantially and in practice, there is a lot more deadwood at lower-tier institutions with lower standards for hiring and tenure.

Finally, I'd like to briefly touch on why one would pursue an academic career as opposed to other options in industry. In many fields, the choice is very clear. There are no research positions in industry or government. While there are many options post-Ph.D., one typically enters the degree with the intent of doing research and pursuing a research career, and academia is the only option for doing so, whether or not one actually likes the various aspects (#2-#5 above) of the academic job, beyond individual research. Also, leaving the academic track after one's Ph.D. can feel like a failure; some writers draw an analogy to failing kindergarten. For fields such as computer science that do have attractive research careers in industry, the situation is more nuanced. Indeed, most students nowadays go directly to industry research careers, and the Ph.D. degree with industrial internships prepares them remarkably well for this role. The working hours are often more reasonable, industry jobs are often in desirable locations or can be done remotely, two-body situations are easier to resolve in major metros, and pay and options to impact industry directly are greater. Besides, the industrial research job is much closer to being a graduate student (most of the focus is still on *#1 Research*, at least in the early stages), and is what the Ph.D. degree has actually trained you for. On the other hand, academia offers the greatest intellectual freedom and job security. In today's fast-moving world, no current company knows it will still be in operation throughout your career, leave alone continuing to support a research organization, while universities have remained stable for centuries (millennia for some of the older civilizations). Beyond this, academia offers the opportunity to work closely over a longer period with, and mentor students (and junior colleagues), which can be some of the most rewarding and long-term experiences. Besides, one can make contributions in so many different aspects from writing field-defining textbooks to leading large centers. Moreover, there is no boss per se, and no external control of working hours, so one has much greater flexibility, which can also be beneficial for attending to family issues. It can also be a curse, in that the flexibility can lead to one working all of the time.

I do want to close by pointing out that in today's world, questions of either-or have sometimes been replaced by "why not do both?" and indeed, it is not uncommon nowadays for faculty to also hold an industrial research lab appointment (see *#6. Consulting*). While this can have many benefits, the resulting conflict of commitment and conflict of interest issues require some effort to navigate, and this can turn into a further challenge for time-management. Whatever may be the percentages of one's appointment on paper between academia and industry, it is fairly likely in practice to turn into a 100% commitment in both places. While academia is filled with highly driven individuals, who may truly enjoy working 200%, it can make work-life balance much more challenging. Which brings us to the topic of the next chapter, where I discuss some strategies for time management, and navigating the complexities of the six jobs university professors need to do. Within that context, I also discuss work-life balance, and how to balance family commitments and starting a family with professional advancement.

3. TIME MANAGEMENT, WORK-LIFE AND WORK-FAMILY BALANCE

When Padmini and I were first hired at UCSD in July 2014, the Dean Al Pisano very graciously invited us immediately upon our arrival to dinner at Sammy's Woodfired Pizza. A very interesting conversation followed, extolling the many virtues and interesting developments at the university and within the engineering school, and he looked forward to our leadership going forward. Then, he turned to me and made what he surely felt was a rather innocuous remark, saying something like: "I am looking for leaders with a lot of energy, not interested in *sleepy* academics." This comment sent Padmini and me into delirious laughter, leaving the Dean rather non-plussed. Not receiving any explanation from us, he moved on. The truth of the matter is that I've always had a high need for sleep, i.e., quite literally "a sleepy academic" (although I do not necessarily view this as inconsistent with being energetic). While the demands of modern academic and personal life have necessitated my having a "normal" sleep routine and 8+ hours a day in recent times, this is still significantly more than most workers and academics sleep in our high-strung society.[1] Though it is rarely mentioned, time management is going to be easier for individuals with lower sleep needs than those with higher requirements, since everyone ultimately has the same 24 hours in a day. More commonly discussed, time management is easier for single individuals than those with family or other care responsibilities. As someone with a family and with high sleep needs, I believe I have some authority to discuss these issues, and work-life and work-family balance.

Note that there are entire books and seminars written about time management in and out of academic life, and the discussion below is my own unique and possibly idiosyncratic perspective, but I feel it may be helpful to many readers. My basic framework is to prioritize the six jobs of a faculty member, discussed earlier, and assign them loosely to days of a week as a mental model. The same mental model has worked for me in dealing with work-family issues, new babies, etc. wherein one re-prioritizes (de-prioritizes) some of the aspects of faculty life to temporarily or permanently free up more time when there are greater family and personal demands.

A typical mental model of my week is as follows. On Tuesday, Thursday and Friday, I teach and have meetings with students (typically teaching Tuesdays and Thursday mornings, and having faculty meetings and our weekly pixel café seminar on Fridays, with research meetings at other times). This corresponds to *#3 Teaching and #4 Advising* in my list of jobs of a professor in the previous chapter, and is largely non-negotiable (one is required to teach as a condition of one's job, and advising one's students is a critical part of the job). The remaining time is used for all the other jobs a faculty member must do and is somewhat more elastic. A typical schedule for me might look like: Monday, consulting (#6), Wednesday administrative/service (#5) and research (#1), Saturday proposal writing (funding #2) and teaching preparation (#3). Note that teaching preparation is applied not just to the current class, but potentially also in terms of preparing new future classes, or additional efforts when teaching a new class. Sunday is unscheduled, ideally for a day off, but in practice there will likely be spillovers that will require work to be finished. Yes, academia is often a seven day a week enterprise, especially when juggling family and other commitments. A couple of comments are in order. First, this is a loose guideline. In practice, emails take up a considerable part of the day, and immediate concerns are responded to on any day, so the allocation of days to activities should be viewed flexibly and loosely. Second, the schedule above actually assumes a relatively light administrative and teaching preparation/proposal writing load, allowing multiplexing of two activities in a single "day." At times when one is really busy with proposals, one might need to reserve a day a week (or more) solely for that effort.

As can be seen above, doing everything at full effort would exceed the number of days in a week (if I had allocated a full day to research, service, teaching prep and proposal writing). Indeed, we all long for an additional day in the week, if not more, as faculty. This is now the critical part of being faculty, in that one needs to balance and spread out the other activities so one isn't at full pace in all respects simultaneously. For example, to the extent possible and allowable, one can engage in proposal writing or teaching preparation, or even reading of papers and your own research in the summer or during breaks, even for courses taught in later quarters of the academic year or proposals due later in the year. One might drop consulting temporarily or permanently during busy periods. Non-teaching quarters or sabbaticals can be used for some activities. One may completely forgo doing one's own research in a busy quarter. In a year where one is writing several proposals, one should probably defer the development and introduction

[1] The lack of sleep, and especially glorification of the lack of sleep in our society, without acknowledging different biological needs of different individuals (something which is well known and well-grounded in scientific research) leads to various health issues and is not really a good trend or aspect of modern life, but that is a topic for a different time.

of new courses, keeping teaching to well-prepared courses one has taught several times before. Through mechanisms such as these, I seek to balance out and keep the workload within reasonable limits. Nevertheless, academics should recognize that the myriad opportunities and challenges of the job will likely make this well more than a 9-5 Monday to Friday effort. Finally, in terms of advising students too, there comes a time when one needs to hunker down and focus on papers, either for a paper deadline, or even asynchronously for journal submission. This effort may require canceling meetings that are not immediately relevant to the paper or reducing those meetings to once in two weeks.[2]

We now come to issues of work-life and work-family balance. First, my definition of a "day" above does not include the full 24-hour day, rather a more common workday, say arriving at the office at about 8:30 and leaving at 4pm, with maybe an hour or more of work after returning home. I find that once one has children, one is largely forced into a very regular work schedule, dictated largely by the timings of their schools or daycares, and their bedtimes. It also requires a much higher level of organization to get work done during the available time. Long spontaneous chats with colleagues or students in the middle of the day may be difficult to sustain, given the pressing need to finish the meetings and tasks on this day, until one needs to pick up one's kids. This contrasts sharply with the more unstructured timings and perhaps longer hours one can maintain prior to having children or other family constraints (however, even in those cases, the loose assignment of tasks to days of the week can be helpful, and can help provide a modicum of work-life balance in leaving some hours or a day of the week free for personal tasks).

A second issue of balance is in terms of prioritizing work and family/child raising versus hobbies, socializing and other activities that you may have been involved in prior to having family/children. For me at least, the choice and prioritization were clear: once I got married and subsequently had children, my entire focus was on work/professing and family (and sleep, see the first paragraph). In essence, there was no time for hobbies, and I consider myself lucky if I get a couple of hours for self-care or relaxation by myself in a week. A story in this regard may be worthwhile to tell. When I was still a carefree single Ph.D. student, I was fairly involved in the card game bridge, and I played on the Stanford Bridge team that took part in the intercollegiate championships in Toronto. It's actually the only time I've played under real tournament conditions behind screens, as professional players do. At least three of my teammates have gone on to distinguished Bridge careers, in addition to their regular jobs, and even high-level administrative positions in the US Bridge Federation. While none of them has (as yet) played a Bermuda Bowl, they have routinely played in the top divisions at national tournaments and won titles including the junior world championships and the mixed pairs at the North American Bridge Championships. On the other hand, I haven't really played the game at all in two decades, since getting married and starting a family. However, it should also be noted that while a couple of my erstwhile teammates did start tenure-track academic positions at top-tier computer science departments, neither received tenure or is still in academia. In a related story, a former mentor and very highly distinguished professor confided in me that he was a national backgammon champion as a graduate student, but then gave it up when he decided he needed to be serious about his academic career. While these are small-number statistics from which few global conclusions can be drawn, it does suggest one does need to prioritize one's interests. In defining work-life balance, you first need to define what aspects of "work" are of highest priority to you, and similarly what aspects of "life."

You may not have to, or be willing to, make this particular draconian choice in terms of hobbies or other interests, and it will of course be easier if your sleep needs are lower. However, it is still worth the exercise to re-prioritize your life. The early and mid-career academic stages can be amongst the most demanding, when you are trying to set up your lab, develop a record for tenure, or climb to a leadership position. At the same time, you may be newly pregnant/breastfeeding/caregiving for an infant or young child, and these challenges of time may well return in dealing with the angst of a teenage high schooler. At the same time, you are often the sandwich generation, between needy children and aging parents with a growing variety of health and care needs. Moreover, society's expectations of what is required in terms of one's job (and now often with both spouses holding equally demanding jobs) and in terms of parenting have grown exponentially over the last generations. And if health issues arise, that just throws another wrench in the works. At some point in time, you should take a moment to simply pat yourself on the back for actually shouldering this impossible burden. Nobody else will do it for you.

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[2] My style is the standard of meeting with each student/project once a week, with meetings scheduled for an hour (they don't always go that long, often being shorter). Various alternative advising styles depending on progress have been proposed, which may be more efficient. But I also advance a somewhat contrary view; the actual time spent by a faculty member on a paper is quite small, given multiple projects and other responsibilities, so if I don't even have a weekly meeting with a student, I'm not sure I feel comfortable being an author on the paper. In this vein, different faculty may also have different comfort levels in how many students/projects they are willing to advise/participate in.

In these circumstances, instead of doing the myriad tasks demanded of one, each imperfectly, it is worth spending some time doing a deep reflection on what is important to you, and you may be better off making a draconian choice to excise some aspects of your early faculty/graduate student single/newly married life completely. I mentioned my own choice (or perhaps necessity) to essentially remove anything not related to work or family. Within the academic profession itself, a choice that can relatively easily be made, professional goals and financial issues permitting, is to completely zero out *#6. Consulting* (indeed, that is often recommended for junior faculty), and perhaps at least for a limited time *#1. Your own research* (for example, don't try to continue to write first-authored papers after you are established faculty). In modern academic research in science and engineering, it's not generally considered practical to give up completely on students or funding (*#2* and *#4*), but there may be disciplines where that is in fact the draconian choice you can and prefer to make.[3] Within the personal realm, faculty have been known to put off or completely give up having children, and there are various other adjustments and compromises to be made. Only you can decide in terms of your entire life and professional goals what makes sense, but it is worth having a serious introspection with yourself on what aspects of these amazing opportunities in both academia and life are most important to you, and whether you can live with giving up some aspects completely, or otherwise prioritize some things over others.

Note that much of the discussion above is in an American context, although it certainly applies globally. In countries where work-life balance is more ingrained into society by law and culture, it seems it should be easier. If everyone, including academics, is working only 35 hours a week 44 weeks a year, it's much easier to fit in family and other responsibilities in the remaining time, rather than when culture demands that academics work 70 hours a week, 50 weeks a year (the last one is likely an exaggeration, this workload seems unmanageable for faculty with families). Ultimately, even if tenured, there is a sense that if one wants to play in the big leagues, one needs to work hours similar to other faculty without family concerns, and that is a challenge. One solution would be to limit everyone's work hours to level the playing field, and indeed that's what is effectively happening in cultures with stronger appreciation for limited hours, relaxation and vacations. However, this philosophy will not fly in an American context. At the core, people join academia because they are passionate for what they do. As noted in the first chapter, the academic enterprise blends a job and a hobby. Given the poor pay and longer work hours compared to industry, faculty are essentially volunteering their time for free to perform the duties of a job they love. As such, it would be ridiculous to try to impose any limits by law or culture on working time, much like imposing a time limit on family or hobby time. Therefore, one needs to find a way to manage time and try one's best, given many other competing responsibilities. Realistically, there may as a result be periods in life where one's career moves faster than other periods. In the grand scheme of life, children do actually grow out of diapers in a few years, even though you may not think so at the time, and they do grow up and go to college within 18 years. An academic career is much longer.

I want to acknowledge that while this article is written from the perspective of time management and compromises made by an individual faculty member, it remains true that it takes a great deal of family and community support to raise a child(ren) and pursue (dual) careers. For example, my wife's parents stayed with us for extended periods of time for the birth of both children and both faculty moves, and it was no doubt easier that neither my wife nor I was a pre-tenure faculty member when we had children (Padmini was still a Ph.D. student and later a postdoc, while I had submitted my tenure package at Columbia prior to the birth of my first child). It is also important, especially in modern society, to acknowledge the need to support a spouse's career and address two-body concerns. Of course, women have long supported their husband's careers, but the converse level of support for women's careers is equally critical in sustaining modern families; there is often no "stay-at-home parent". The specifics of course depend on the individual family, but for example you should expect to work less and possibly cancel meetings when one spouse is traveling. And partners (and institutions) should of course be sensitive to the demands on birth mothers for lactation and breastfeeding in the year after the baby is born, among many other things. In general, academia has a great deal of flexibility in when you work; the only time that is sacrosanct is when you teach. This flexibility can be exploited, and can also help in adjusting to children's after-school activities, school closures, illnesses and the like. At the same time, it is worth carefully thinking about commitments, especially travel, and perhaps setting a limit on how many conferences or invitations you are willing to accept in a year. Beyond this, two body and indeed multi-body issues (involving the children as well) can become quite involved as both partners develop and build a successful career and family. Again, the specifics of this depend on the individual situation, and there are many other resources that discuss

[3] Note that students, like children, are a responsibility for advising/mentoring, and you have much more flexibility in adapting your own research to the rise and fall of personal commitments, if you're only responsible for doing your own research yourself.

these issues. I just want to mention that I ended up moving faculty jobs I loved and was thriving in twice because of family and two-body concerns, and that this can be a quite challenging set of issues to navigate to support one's family.

Finally, I want to talk about temporarily reducing your academic workload during periods of sudden stress and family responsibilities. This is focused on the birth of a new child, but most of what I say can apply to many other situations. First, academia generally prides itself as its own little corner of Scandinavia[4] with respect to starting a family. University accommodation for faculty, at least in the USA for the birth/adoption of each child, generally involves one semester or two quarters (sometimes a full year) of no teaching (and often no service) responsibilities, akin to a free paid sabbatical (but staying at home, a stay-battical). This is in addition to a one-year extension on the tenure clock if one is untenured (so in principle at least, no research expectations either in the first year). This is wonderful, and faculty should certainly take advantage of their university's policies, but also as with most things in academia, isn't as simple as it looks. First, of course we must acknowledge that starting a family brings great joy but also severely restricts one's working hours, and not just in the first year. Second, one is expected to, and has a responsibility to, continue mentoring and advising one's students *(#4. Advising*). This is one of the most critical responsibilities in academia, and conscientious faculty will not shed it, even when moving institutions or leaving the academy. Indeed, the University of California calls its childbirth accommodations ASMD or Active Service Modified Duties, emphasizing that one is in active service advising and continuing research with one's students, but one's teaching and service duties are modified. It is possible to adjust the rest of your workload temporarily to further reduce stress (indeed this applies to any other source of temporary stress). One of the things I focused on was to adjust things so I did not have to write grants *(#2. Funding)* or prepare new courses (note that *#3. Teaching* is not just classroom teaching, but also the preparation required, especially for new classes), for about the first year and a half after the birth of both my children in order to adjust. Of course, this presumes you have developed your funding situation beforehand to be in a good position and are teaching courses you've already prepared for. One could also avoid taking on new Ph.D. students during this timeframe. Needless to say, it would be prudent to also limit one's responsibilities in terms of external commitments on *#5. Service* and *#6. Consulting* during this time, among other duties.

In this way, one can temporarily reduce almost all commitments apart from advising your students. More broadly, a faculty member is an essential worker, and the student group should not be penalized for their advisor's personal family or other choices, especially since given research specializations, advising cannot usually be transferred to another faculty member, unlike teaching and service. Assuming your students stay productive, your research program will continue to move forward, providing a win-win for all concerned. (In situations where students have co-advisors, it may even be possible to scale back on advising, but this needs to be addressed on a case-by-case basis.) Note that essentially the same approach can be followed in many other circumstances, such as taking a leave of absence for medical/eldercare reasons or to spend some time in industry/start a company. Of course, this is only temporary. A year and a half after the birth of my first child, I moved from Columbia to Berkeley, and then had my second child a year and a half after that. In the interim period when starting at Berkeley, I was in the start-up phase with a full program of writing proposals, creating new classes, etc. and this created an enormous amount of stress, given the personal challenges of moving to a new university and starting from scratch with a young family in tow. But it would not have been practical to go nearly 5 full years (from the birth of my first child to a year and half after the birth of my second) without worrying about funding, creating new classes, or performing all the other standard duties of a faculty member. So, bear in mind that one can reduce one's load temporarily, but it is only temporary.

While this chapter has necessarily presented a somewhat dry and prescriptive view on time management, don't let the nitty-gritties of the situation detract from the fundamental excitement and opportunity of the faculty position, as well as (if relevant in your case) the excitement and love of starting a family. It is an incredible delight and privilege to do either, and the joy and excitement of both should be what one primarily looks forward to.

[4] The Scandinavian countries of Norway, Sweden and Finland are generally regarded as having the best parental leave policies worldwide, often up to a year of paid leave for new parents.

4. STUDENTS, THE COIN OF THE ACADEMIC REALM[5]

When I was a young graduate student, my Ph.D. advisor explained some of his philosophy on the types of people who would thrive in an academic career. For example, are you the scholarly type, who wants to develop the literature in the field, and would be happy just spending an afternoon in the library reading background papers? But most important, are you the type of person who likes to and enjoys working with students? If the answer is yes, it's likely that academia will be a good fit for your career goals. If not, other career paths may be more rewarding. Indeed, much of the research that faculty do is "vicarious"[6], in the sense that the students do most of the work (and first-author papers) with guidance from faculty (the faculty job *#4 Advising* is loosely analogous to coaching a sports team of players). As such, much of faculty success is derived from student success when their papers and projects are successful, and beyond that, when the students graduate to successful careers. Indeed, academia, retains more than any other profession, the expert-apprentice practice of the medieval European guilds, or the guru-shishya (teacher-disciple) tradition in Indian religions. People remember who someone's advisor was, and the future success of one's students also accrues to one's credit. Indeed, the most successful faculty often have legions of highly accomplished students, many of whom may themselves be distinguished faculty or leaders in industry. This is the reason why David Patterson has called students the coin or currency of the academic realm. Note that when talking about students in this article, I primarily refer to Ph.D. students, but an academic research group typically also includes postdoctoral researchers, Masters students, and even undergraduates and high schoolers, to all of whom the generic "student" title applies.

This chapter refers to my views on students through the entire pipeline from recruiting to mentoring to graduation. It corresponds to *#4. Advising* in my earlier classification of the list of jobs as a professor and may be the most important thing faculty do. Indeed, as the department chair who hired me at UCSD, Rajesh Gupta has noted, "our products in academia are the people." The views expressed here are my own; some may be idiosyncratic, and most are hardly unique as entire books have been written about the subject. While I consider myself a reasonably successful advisor, having graduated 30 Ph.D. and postdoctoral students, many of whom have won highly selective dissertation awards and fellowships, there are no doubt many others who have been much more successful at advising[7], and where appropriate I have directly used quotes and advice various colleagues and mentors have themselves provided.

It is perhaps best to start at the beginning. In order to advise students, you need to first admit and recruit them to the Ph.D. program at your institution. In modern US academic research, this is typically left to individual faculty or groups, who will directly select the students they want to make offers of admission to from the pool of incoming applicants. Usually, faculty will have to agree to fund these students with their research grants for part or all of the first year (and beyond of course), so it is a significant commitment. A few institutions do still do admissions through a centralized committee with student-advisor matches via a rotation system, but even there, the opinions of individual faculty may be giving significant weight. Philip Guo at UCSD, who has written many excellent articles about being a graduate student, characterizes a Ph.D. application accurately as applying for the job of a research assistant, and indeed faculty are on the other side of this, choosing research assistants carefully.

Let's first look at it from the perspective of a Ph.D. student. Your application essentially involves three components. Obviously, you will have a transcript and grades from your undergraduate and/or master's institution. Second, and perhaps most important, you will have letters of recommendation from three faculty. Third, a typical successful applicant will have some significant research experience, often leading to publications. Finally, the statement of purpose can have some importance, mostly in identifying which faculty you want to work with. If you pass the shortlist for a given faculty member or group, you will likely have a short 30 minute to 1 hour interview over zoom, skype or phone, after which a final decision will be made. Thereafter, your prospective advisor and other faculty are likely to call you a few times, you can attend the campus visit where many aspects of the research will be on show, and you will need to make a final decision on where to spend the next 5+ years on your Ph.D.

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[5] Students being the coin of the academic realm is a quote taken from David Patterson's many excellent advice talks on academia, which I highly recommend (although I am not sure if he originated the term).

[6] This terminology comes from Peter Feibelman's "A Ph.D. is not enough" which again I would recommend reading.

[7] Within computer science, the example of Manuel Blum at Berkeley and later CMU, who has so far graduated 3 Turing award winners in addition to winning one himself, comes to mind.

What makes a compelling Ph.D. application? The "perfect" application has the following elements. Most critically, you have at least one and ideally three letters from respected faculty at respected institutions who attest to your excellent performance in research, ideally calling you the best undergraduate student they have ever worked with, and saying you are already performing at the level of their best Ph.D. students. It is nice icing on the cake if this is backed up with an ideally first-authored publication(s) at the major venue(s) in the field, for instance the SIGGRAPH conference in computer graphics (this is more or less expected at top institutions for those coming in with a master's degree; publication requirements are lower for those joining the Ph.D. immediately after undergraduate studies). Having a perfect GPA/being the topper or very highly ranked at a top-tier undergraduate institution also helps, and in some cases can even be the primary basis for admission. However, research is typically the major criterion, and students with strong research records and imperfect or middling GPAs are often admitted without a second thought. Finally, factors like already having an external fellowship or having a particularly good fit or already having a relationship with a faculty member from conferences and the like can play an important role.

The truth of the matter is that there are few "perfect" applications. So, if you're the number one faculty member in a field, and every student wants to work with you, then you can restrict yourself to these perfect cases. Otherwise, you're going to have to decide which of the more numerous "imperfect" applications you want to consider, i.e., which of the criteria above you are going to give greater weight to. In our own admissions decisions at UCSD, we have tended to focus more on research than other schools, often weighting research fit, publications and performance at the interview more highly. Others may tend to focus more on strong letters from faculty they know, or strong GPAs from institutions they know, especially if these institutions are from foreign countries and less well known among peer US universities (and therefore there is less competition for these students). Either way, the key thing as a faculty member is to formulate, often from experience, what factors you feel are most important for students to be successful in working with you. At the same time, competition among universities and advisors for top Ph.D. students is intense, perhaps more so in computer science than in other fields, since many of the top students directly go to industry. Finally, I've focused so far on selecting applicants, but especially as new faculty you may first need to make sure desired candidates actually apply. This may require sending email to respected faculty in the field asking their best undergraduates to apply and casting your net broader in terms of leveraging master's and in some cases undergraduate or visitor programs. I even had a colleague and mentor who traveled on his visits to his home country to interview students from an institution not otherwise well known in the US.

The bottom line is that as a faculty member, you will likely need to spend more time to find the "diamonds in the rough": imperfect applications that may really go on to be stars but will be missed by competitor schools. If done successfully, this can yield great dividends. For example, I once admitted a student at Berkeley whom I believed from the interview and from reading his paper would be a real star and very well aligned with my research, and indeed he turned out to be one of my best students ever and subsequently a leader in the field. But he wasn't selected elsewhere, because his grades/class rank were not at the top, even his Math GRE was imperfect, rare for our field, and his one publication at the time of application was in a lower-tier venue. It required seeing something interesting in the application, reading the paper and talking to him to see this as a star applicant, an amount of effort peer faculty at other institutions were simply not willing to put in. One of my colleagues at about the same time made an admission offer to a candidate who had a very high GPA at a foreign institution, but no real research experience or publications, again not an applicant receiving numerous other offers, but one who has turned into one of the real stars in the field. To balance that, there have surely been other times I took a risk that didn't pan out, either that the student didn't graduate or they didn't perform as well as I'd have expected. You live and you learn, and you celebrate your success stories. Ultimately from the student's perspective too, it doesn't matter how qualified you were or not before being admitted. Now that you've been given the chance of an admissions offer from somewhere, whether or not that was the place you really wanted to go, it is up to you to take the opportunity with both hands and do the best that you can.

Of course, for any student you end up admitting, you should make every effort to recruit, and departments nowadays have quite elaborate rituals involving multiple contacts, an all-out two-day visit day to showcase your best research and so on. My advisor, Pat Hanrahan said it most succinctly, "Be selective. Be aggressive." Ultimately, a large part of the decision is the personal relationship established between the advisor and the prospective recruit. My former colleague at Columbia, Eitan Grinspun, comes to mind as perhaps the best Ph.D. recruiter I have known (winning students from MIT, Stanford, Washington, CMU, Berkeley etc. during the time we were there), mostly because he is a genuinely nice and extraordinarily persuasive individual pursuing a very highly innovative research agenda. On this note, I often get asked by prospective faculty something like "How [good] are the students at [UCSD]?" This may have been a reasonable question a generation ago, or in referring to the undergraduate students, where we have

little control on admissions or recruiting. But it's simply the wrong question today; it's not like some central body decides the students you will be advising. How good the students are will depend on how good a job you personally do on selecting and then recruiting the students you want. At the very least, the question needs to be more nuanced in terms of for example, what fraction of the top students are applying to your university (although that will also change once new faculty are hired and visible; why would students interested in your sub-field apply before you were there?) Or how much does the reputation of the group or university help or hinder the recruitment process (and again, as my colleague Stefan Savage pointed out "ranking is not destiny"; ultimately your success is in your own hands.)

Finally, I want to address the research focus of modern Ph.D. admissions at top universities. In many countries one still follows the model that undergraduates take courses, then master's students specialize to a sub-area, and finally Ph.D. students conduct research. As such, undergraduates often have little research experience and course marks and overall grades and class rank are most important. On the other hand, the United States is a country where college counselors routinely tell high schoolers that research experience is needed for admission into the nation's top science and engineering undergraduate programs. As such, undergraduate research experience, as attested by letters from leading faculty and in many cases, publications are key for admission into Ph.D. programs, and we find that students with prior research experience have much more success; otherwise, the probability of success for a student is often a gamble. Indeed, to be admitted as an undergraduate to top Ph.D. programs often requires the equivalent of a master's thesis, whether or not the student is formally enrolled in a master's program. This is often the biggest bottleneck to applying for top-tier Ph.D. programs since very few undergraduates engage in or are given the opportunity to perform research, and this may be amplified in foreign countries.[8] There certainly are faculty who will do "pure GPA" admits, and I myself have done this in some cases, but students will greatly strengthen their Ph.D. applications with strong research experience. Moreover, for those from foreign countries, whose advisors are not well known in the US, the letters of recommendation may not be as well respected. In these cases, the bar is often higher, in terms of demonstrating actual top-tier publications. Often, students will pursue an M.S. degree to bolster their research credentials in the hope of being more competitive for Ph.D. programs (since M.S. admission usually only requires the transcript/GPA and decent letters), and indeed this is a good path for those who have not yet had enough research. Note however that the expectations of M.S. students are usually higher, requiring a concrete publication at top-tier universities.

We now switch from admissions to mentoring students. Of course, each advisor will have his or her own unique mentoring style, so I can only offer some general observations. First, I will quote Jitendra Malik at UC Berkeley in saying that the eventual goal of a Ph.D. program is "to give students a taste for problems." That is, the most important thing students will learn is what problems are important to solve. A Ph.D. program is often touted as where "you learn to do research." Indeed, this is important and one of the greatest things I learnt from my advisor, in how to best "think like a scientist" or apply the scientific method, ranging from the way to systematically analyze alternatives to present one's data, to write papers. But as my advisor Pat Hanrahan said, it's possible to teach someone how to be a scientist. What is hard to teach is the creativity and taste to select the most important problems that one can actually solve and enjoy doing so. Indeed, with the focus on undergraduate research discussed in the previous paragraph, many students coming into Ph.D. programs largely know how to do research and apply the appropriate mathematical and computational tools. But they typically don't know how to formulate a Ph.D. thesis, or which problems they should work on. This is ultimately the role of an advisor, but there is no real magic bullet... much of the teaching and learning happens by weekly and daily exchange of ideas, and critiques of the student's own ideas. Every student would like for their advisor to give them a problem that will win the Nobel Prize or Turing Award, and then show them how to work it, and this does sometimes happen, but is exceedingly rare of course.

Incidentally, this relates to discussions I've had with colleagues or former colleagues in industry of how it seems easier to manage junior employees in industry. Or more colorfully, how students who seemed unmanageable in academia and could never quite be gotten to do any work, somehow manage to suddenly have productive "normal" careers in industry. But there are at least two reasonable explanations. First, students are not actually unproductive or unmanageable. Around paper deadlines, where the goals and next steps are very clear, students can be immensely productive and this progress is an enormous success for management. Bear in mind that the rest of the time, the goal is often to "find a problem." It's very hard to manage the creative or problem exploration process and hold it to rigid

[8] This issue has been recognized, with a proliferation of summer visitor programs to gain research experience, and most recently open summer schools and early-stage research programs that all aim to increase the pipeline of undergraduates participating in research. That is a topic for a different time, but the opportunities to get involved in research are increasing for motivated undergraduates.

timelines. In contrast, in industry, junior employees are not usually tasked with determining the problems and goals for the organization, tasks are more clearly defined and management is easier. A second important difference is that the internal carrots and sticks are minimal in academia. Students are paid poverty wages and their salaries don't really go up or down based on how successful or not they are in the Ph.D. program. The reward system is entirely external, in how fast they graduate and what kinds of jobs they are eligible for. An advisor can certainly motivate and give feedback to students. However, in terms of real action within the program, the only thing they can really do is graduate the student or stop advising them (the latter of course being an extreme action, akin to firing an employee in industry). But many students are quite happy being students (indeed, it's one of the best times of my life, when I look back on my days as a Ph.D. student), so the external motivation can sometimes at best be a distant thought. And students enter the Ph.D. program rather than industry for the freedom to pursue problems they are truly motivated by, and indeed to develop the creativity and taste for problems to solve, rather than to be managed on a strict timeline. One of the goals of a Ph.D. advisor is to direct students towards problems they would be most interested in. My advisor Pat Hanrahan mentioned that he thinks individually for each student about "what would really excite" them.

Switching from generalities to specifics, I have a template in terms of the timeline for advising Ph.D. students that may be worth sharing. Of course, I emphasize that advising always needs to be tailored to each individual student, and timelines can be adjusted in both directions based on progress and other specific circumstances. In the first year, my criterion for satisfactory progress is that the student should be engaged in the group, be contributing to a research project or doing their own research. Success or a paper isn't required, but some of my students have had their most successful research in that initial year. In the first year, it is acceptable to give them a problem to solve, or for them to work on a senior student's project in a more junior (second-author role). In the second year, the student must complete the equivalent of a master's thesis, with a first-authored publication that can be submitted to a top-tier venue. At this time, I'm more interested that they went through all the steps of research to complete and write up a project than whether they came up with the idea themselves or wrote the paper themselves, or whether this is ultimately relevant to their Ph.D. thesis. Of course, there are students who do much more than these minimums in all cases. I view years 3-5 as being the core of the Ph.D. thesis, where students formulate their own research ideas (and ultimately their dissertation), conduct their research with guidance from me, but largely independently at the end, and are able to largely write the resulting papers and talks themselves. As a rule of thumb, students will be submitting a first-authored paper every year, although research has ups and downs, and a year where the research fails is certainly not unusual.

I said that I expect students to ultimately formulate their own research ideas and Ph.D. theses and communicate those ideas in papers by themselves. I do see the current trend of students doing internships every summer in industry and continuing those projects collaboratively at the university later as having immense benefits, but also a threat to these ideals. If not done properly, students may end up sub-contracting the problem selection aspect of the Ph.D., which is often the most crucial aspect of what they should learn, to individual researchers in industry, not even in a coherent fashion or affiliated with the university, and never learn to write papers themselves if collaborators do it. On the other hand, I believe the top Ph.D. students can even go beyond simply formulating their own research ideas within the broad general thrust of their advisor's research programs and grants, to formulating entirely new research directions that their advisors or even better, they themselves, will pursue in their independent research careers. In any event, as noted at the start of this discussion, the taste that students obtain in formulating research problems and conducting scientific research will probably be what they most take away from their Ph.D. experience. Indeed, students start and go through their Ph.D.'s usually with some sense of confusion, but by the end grow to be strong independent researchers. That is perhaps the most rewarding experience for a Ph.D. advisor.

Finally, like many other things, advising is a learned skill. New assistant professors are usually inexperienced in advising, and their early students may bear the brunt of this. But this is not to say that as a new Ph.D. student you should avoid assistant professors. Indeed, they often have the most time for students, are likely to work most closely with their students and often have the best ideas (as they were just hired for the quality of their ideas and are closer to the day-to-day research). Moreover, they are likely to share their best ideas with their students. Philip Guo says this best in terms of the "critical path" or topics a faculty member is most interested in. New assistant professors want to get tenure and are likely to give their best ideas to their students and work closely with them to succeed, even if they are inexperienced as advisors, and it can more than compensate. More experienced faculty are likely to be more hands-off, and new students are unlikely to be on their critical path, but students may be given much more leeway to pursue their own projects, and older faculty are also much more experienced in terms of advising, with a strong student group and alumni network and contacts. Which will work better for individual students depends on their personalities, but in general I would encourage students to go to the departments/groups/faculty they believe are conducting the

most exciting research; ultimately that's what will pay off five years from now when one gets one's Ph.D. And students are ultimately responsible for their own success; going back to the analogy at the start of this chapter, they should view the advisor as a guide or a coach, but they are ultimately the players that will make the research happen. (At the same time, advisor-advisee fit is important, and certainly don't ignore red flags in an advisor or conversely in a student, if one feels the relationship will be problematic and you will not be able to work well together).

As in the previous chapter, this one has been a prescription for how to recruit, mentor and ultimately graduate students. But it should not take away from or dull the excitement of shaping young minds to become independent and successful researchers, while having them undertake some of the most innovative and exciting explorations of new topics. Academia is one of the last bastions of expert-apprentice training, forming close relationships and benefiting hugely both the advisor and advisee. We return to the title of this chapter; students truly are the coin of the academic realm.

I have started this article with a chapter on the many jobs of a professor, something which is not always well understood. In this chapter, I went into detail on one of these, involving advising and students. Perhaps surprisingly, I have little to say in this article, or advice to give, about the other five jobs of a professor, beyond what I have said in Chapter 2. This is mostly because these roles are very field-specific (indeed, perhaps the only commonality is a sense of time management for the different roles, which has been discussed in Chapter 3). I do discuss some of my general thoughts in my chapter on "Research, Teaching and Students" in my earlier article on "Tales of a Group Leader: Building Leading Academic Research Groups," which I would encourage readers to refer to. As noted there, Peter Feibelman, author of "A Ph.D. is not enough" makes clear that "I am not going to tell you how to win a Nobel Prize… I can't even tell myself how to do so," and it's difficult to give specific advice on research. Similarly, while there are general points to be made about funding, where and how you apply for funding is fairly specific to the field, one's own personality (as to whether one wants to prioritize funding from small grants, large programs, industry or government, or all the above), and one's local environment and national funding agencies. As such, I would echo the advice many previous authors have provided, to find a senior mentor within your research area who can provide insights tailored to your field of study. A similar argument applies to teaching; you know your field and subject matter best in terms of the design of new courses, or what content to use and re-design for existing courses in the field. Beyond this, there are many books on the mechanics of teaching, many excellent teachers to provide advice in most departments, and even institute-wide organizations that help improve your teaching. While I have been a pioneer in massive open online courses, there is probably little I can add to the existing body of work in terms of classroom teaching or the writing of textbooks. Finally, service both within the university and professionally, and opportunities to go beyond the university are again rather department and field-specific and usually flow organically from one's expertise and interests. In all cases, a very worthwhile investment is to find a senior mentor, ideally one who is well versed and well respected both within the research field and within the department and local university environment.

In the next chapter, I close this article by focusing on a topic rarely discussed in much depth in the academic ivory tower: how faculty get paid, how it compares to industry, and the many nuances that are not well understood and usually lost in most people's understanding of academic compensation.

5. MONEY

It is generally well understood, and has been stated earlier in this article, that academic pay pales in comparison to similar jobs in industry. Academics do not go into the profession in the hopes of monetary compensation, but rather from the passion for their subject and love of the freedom and inspirational qualities of the academic lifestyle. This is almost always accurate and an adequate summary for most people, and some may want to skip this chapter on a first reading. Nevertheless, over the past two decades, I have come to appreciate that a true discussion of academic compensation and comparisons to industry are more nuanced, and not well understood even by most faculty. A counterpoint to the statement at the start of this paragraph is perhaps provided by an early interaction I had as a new faculty member. A senior colleague mentioned to me that he chose the academic job rather than one in a respected industrial research lab among other things for the much greater financial rewards academia offers. This contrarian statement sounds rather puzzling at first glance. Indeed, if we move to the pinnacles of financial success, in the annual Forbes list of billionaires, all the top ten and indeed top hundred and beyond are titans of industry, some without college degrees, none in academia and essentially none even having a Ph.D. Few will be surprised in any way by this. What is perhaps more surprising is that if we instead restrict our comparison to researchers in industrial labs versus faculty researchers in academia, there are in fact at least three (computer science) professors on the Forbes list of billionaires (my Ph.D. advisor, Pat Hanrahan, Amnon Shashua, David Cheriton), while to my knowledge nobody in an industrial research lab has reached these hallowed heights. To understand what's going on here, we need to understand the potentially complex nature of academic compensation, much as we had to first discuss the multiple jobs of a professor in Chapter 2. It's a topic rarely discussed in the ivory tower, where money is often a mildly taboo topic in a profession that prides itself on the creation of knowledge, not wealth. But knowing the inner workings of how money is made in academia is itself a form of knowledge, which I hope to make somewhat more widely available.

Academic compensation, at least in science and engineering departments in the United States consists of the following major components, not all of which most faculty receive any actual income from. Note that I focus on science and engineering, particularly computer science, and I haven't included medical practice plans common in the health sciences.

1. *Base Pay.* All academics have a base salary. For many faculty, especially those in the humanities departments with few opportunities to raise outside funding or income, this may be their entire salary. There are a few subtleties regarding one's base salary. First, in the US, this is supposed to be for the 9-month academic year only and does not cover the summer (it is usually paid over 12 months for 9 months of work, presumably to ensure faculty don't starve during the summers). In principle, faculty are free to take a vacation in the summer (much like high-school teachers), take up other employment, or more commonly pay themselves from external research grants (or in many cases actually work voluntarily for free; remember that this is both a hobby/passion and a job. In practice, working in the summer is often needed to keep up with the field and/or achieve tenure if everyone else is doing it). Second, the starting pay is usually low compared to industry and subsequent raises are often even lower (so academia being poorly paid relative to industry follows naturally). However, academic pay is still quite significant compared to the average worker. New assistant professors usually have base salaries north of $100K and the most senior faculty in science and engineering have base salaries upward of $300K. The biggest stars can even receive $500K+ offers, with even larger sums in business, law and medicine.

2. *Summer Salary (or more generally funding-based salary augmentation).* Remember that I said academic salaries were paid over only 9 months. Faculty are usually able to pay themselves another 3 months over the summer from outside funds, if they are successful in raising grants. The university benefits from this, since they don't have to pay those months, and moreover they get to take a cut (the famous "indirect costs") from faculty grant funds used to pay for summer months. In fact, some universities like mine figured out that if we can do this for summer, why don't we do it for the academic year too? In other words, if faculty are willing to fund some of their academic year salary from external funds, we can offer them a higher salary (salary augmentation). At my university, the coupling of this augmentation and summer salary means faculty can effectively earn nearly 75% above their base salary. In many ways, this is not unlike industry. Within computer science, industry compensation of course involves the base salary and perhaps a small annual bonus (plus perhaps a signing bonus; one-time bonuses are omitted in our discussion for simplicity; my own university has a generous initial bonus as well mainly for housing). But half and even more of compensation, especially at senior levels in industry, can come in terms of stock, and in times of rapidly appreciating stock, the sky is the limit for industrial compensation (conversely, industry compensation can wane in a declining market). Academia being a non-profit, there are no

stock options, but summer salary and salary augmentation can help in providing a similar add-on to salary. But even with this, pay usually trails industry, even without considering the potential for stock appreciation.

3. *Housing and Schooling/Tuition Benefits.* Universities in high cost-of-living areas, especially private universities often offer special benefits to make housing affordable. This can include a variety of options such as low-interest loans, loan forgiveness, special payments, low-rent apartments or homes, co-owned housing etc. These benefits can often allow faculty to live fairly well even when their salaries would not be adequate given housing prices. Similarly, many private universities often pay for the college tuition of their faculty's children (and even give preferential admission to their own universities, which may ultimately be the biggest perk... consider the market value of this perk compared to how much private citizens were willing to pay for these admissions in the college admissions scandal). And some universities go further in subsidizing elementary private schooling and even childcare (at least Columbia University, UCLA and the University of Chicago operate K-8 schools though not always with a guarantee of admission for faculty children. Among others, Barack Obama's children went to the Lab School at the University of Chicago; it is unclear if they were admitted because of his adjunct role with the university or as community students). In other benefits, my employer, the university of California was known for its extremely generous defined benefit retirement plans. Indeed, a report at Columbia around the time I was there characterized the university as being a "company town"; faculty lived in university housing, had their medical needs serviced by Columbia faculty in the medical school, and used University daycare, school and college facilities, in all cases heavily subsidized compared to the market cost of these facilities in the most expensive Manhattan, New York location in the country.[9] Industry rarely gives these benefits, arguing in general that their higher salaries and stock appreciation should make it possible for one to buy housing (and schooling/college tuitions) on the open market if one is successful. But as a result, many otherwise better paid employees in industry may not in reality be able to afford the same lifestyle provided to university faculty, at least initially. Another way of looking at it is that some parts of academia effectively provide the welfare state more common in European countries: free or heavily subsidized healthcare, housing, retirement, schooling and college tuition, which in turn makes accepting a lower salary much more practical, while living in some of the most desirable areas of the country and the world. Note that these benefits are uneven: universities in lower-cost areas and public colleges usually provide many fewer of these benefits. On the other hand, being able to take a professionally satisfying academic job in a low cost-of-living area may itself be a benefit (if two-body issues can be worked out), as there are usually no comparable industry alternatives (high-paying industry jobs are usually only available in high-cost metropolitan areas).

4. *Administrative Stipends and Additional Teaching.* Universities do have several other less well-known forms of compensation, which only some faculty benefit from. At my university, the most common are administrative stipends, for roles such as department chair or center director, and compensation for additional teaching beyond the load in self-supported master's programs and the like. The amounts are generally relatively small, perhaps nor more than a month of summer salary, and are rather uncommon, but can still add in excess of ten thousand dollars to the compensation of some faculty. In addition, faculty without grants may be able to teach rather than perform research in the summer, and similarly supplement their salaries.

5. *Textbook and MOOC Royalties.* We now come to some of the lesser-known forms of academic compensation, and the vast majority of university faculty will not benefit from these. But for those that really hit the jackpot, the income can be enormous, with no comparable benefits in industry. Academics are inherently educators. While those teaching large classes generate huge amounts of tuition revenue, they typically don't get any direct benefit beyond their base pay, as teaching is a part of the job. But for those who are successful in generating external teaching revenue through widely adopted textbooks, or more recently, massive open online courses (MOOCs), the rewards can be very significant. For textbooks, faculty contract directly with the publisher. By convention, the copyrights rest entirely with the faculty member and publisher, and the university takes no share of the revenues. The most successful textbook authors can earn millions of dollars from royalties. For MOOCs, the publishers like edX and Coursera share royalties with the universities, who in many cases pass on a cut to the individual faculty. Again, highly popular MOOCs can make their creators millions of dollars. Of course, the faculty who benefit from this are very few and far between, and indeed most faculty earn exactly 0 from textbook

[9] If this sounds too good to be true, it is. Ultimately, with faculty growth, pressure on the system meant it couldn't satisfy the needs of all or most faculty, which is the primary reason I left the university for personal reasons.

and MOOC royalties. Nevertheless, it is a compensation source uniquely available in academia. In industry, there is rarely an opportunity to write a textbook or create a MOOC.

6. *Software and Patent Royalties.* Universities fundamentally differ from companies in how intellectual property is handled. While both require signing of a patent acknowledgement that assigns inventions to the employer, a university provides faculty with much greater reward and control of their inventions. A company will typically pay an employee a $1,000 bonus for a patent and a pat on the back. There is no commitment to give the employee any share of the revenue the invention/patent generates, even when this is clearly known if the patent is sold or licensed to another company. Moreover, any employee who leaves to found a new company even loosely related to intellectual property generated at their previous employer will be acting in bad form and likely sued. Academia operates very differently. Inventors get a cut, often in the range of 30-50% of any patent or software licensing revenue (even if they subsequently leave the university) and are encouraged to start a company licensing this technology if that is appropriate.[10] When I was at Columbia, I lived in the same building at Richard Axel, whose "Axel patents" for DNA insertion into a host cell are likely the most successful academic patents ever developed. Columbia made hundreds of millions of dollars from them, and you can bet Axel himself got a comparable amount through his cut. Former colleagues in computer science at Columbia were recently awarded tens to hundreds of millions of dollars for their security software in a lawsuit against a major software vendor. The opportunities for those who can license their technology are boundless. On the other hand, this again impacts only a very small number of faculty. Within computer science and software, there is very little culture in licensing patents (rather than buying companies) and much research software is made publicly available. The net licensing revenue for most academic departments is negligible. But for those who hit the home runs, the rewards can be quite extraordinary.

7. *Consulting and Outside Activities.* Faculty can engage in various consulting and outside activities. The exact amount of compensation available is usually shrouded in secrecy, and there is a vast range from 0 for the vast majority of faculty to those who make millions. In general, faculty are typically allowed to engage in outside work for one day a week or 20% of their time (and potentially full-time in the summer). It would seem reasonable to assume they can make at least 20% of the salary of a comparable position in an industry research lab, which at least alleviates the income differences with industry. Note that this is in addition to all the forms of income listed above. Those who are better able to monetize their expertise or engage in legal expert witness work which often pays the highest salaries may be able to make a good deal more. There is no comparable opportunity in industry. There is no way any company will let you consult at other companies in the same field, and permission is required to engage in any outside activity. Finally, it may be possible for faculty to use their general knowledge of their field or industry to help in investing or playing the stock market in a perfectly legal way, without any specific inside information. If one believes certain companies have great potential because of one's intimate knowledge of the field, even without working at them, it would be possible to acquire their stock.

8. *Entrepreneurship.* Entrepreneurship is where the greatest faculty fortunes are made. Of course, this applies not just to faculty, and indeed today the majority of the Forbes top ten are tech entrepreneurs. One certainly doesn't have to be a faculty member to be an entrepreneur and this may actively hurt, since one also has a real job to do. Nevertheless, faculty do have some unique advantages. Much of the early work and research exploration is funded by government and industry contracts, which is not usually something ordinary entrepreneurs have access to. Universities actively encourage faculty to start companies based on intellectual property developed at the university; a researcher in an industrial research lab who tried to do the same would immediately be sued for patent infringement. A faculty member has instant credibility with venture capitalists and the like, technology that is novel and differentiated with respect to the market, and the ability to hire their and other students. And they still retain their academic jobs, providing an easy cushion should the venture fail. Those academics who become successful entrepreneurs can make fortunes, often more than they would have been able to do in industry. All while retaining their academic privileges. Note that I started this chapter by talking about the billionaires in the Forbes list. But one doesn't need to IPO for tens of billions on the Nasdaq to become rich; any faculty member who has a successful exit for tens of millions of dollars will make enough from the deal to be in the top one percent of all Americans by wealth, if not much higher. We hear about the billionaires, but many academic computer science departments have at least a few decamillionaires walking about the hallways. Of course, I do

[10] Faculty inventors can even double dip, licensing their own invention to start a company and being paid for both the license and by stock ownership in the company they founded.

want to balance this by pointing out that the vast majority of faculty, including in computer science and engineering departments and including myself, actually do not engage in (successful) entrepreneurship, and make 0 dollars from many of the academic compensation strategies discussed so far. Nevertheless, for those who are successful, the sky is the limit, both in terms of real-world impact and in terms of financial benefit.

6. IN CONCLUSION

Having a modern academic faculty job, especially with tenure, is perhaps one of the greatest privileges in our society. Academia is often referred to as an ivory tower, largely divorced from the real-world. To some extent this is true. Academics have an extraordinary degree of freedom in terms of how they spend their time, what problems they work on, and the job security that is provided, with little accountability in these aspects to their employers or the general public (some greater level of accountability to the funding agencies is often required however). Perhaps for this reason, there is a limited understanding among the general public, and even among students and junior faculty of what the position entails. But there is really no reason for this mystery; academia is not a secret cabal seeking to initiate new converts. It benefits everyone to clarify the unique opportunities and demands of the position, and to provide some advice on how to be successful, how to manage one's time, and how to work with students, the coin of the academic realm. In this article, I have strived to pull back the curtain on the ivory tower and explain some of the less well-known aspects of the academic life.

Throughout the chapters I have emphasized that the at-times dry recollection of what a faculty position involves, or advice on how to navigate it, should not take away from the unique excitement of the role, the ability to influence young minds through teaching and advising, the ability to lead the next generation forward, and the ability to generate extraordinary new knowledge for society's benefit. At the same time, in the previous chapter, I have tried to demystify the nuances of academic compensation, showing how those academics who are inclined can also have a significant real-world impact and be compensated very well for it.

Ultimately, one of the core tenets of entering the academic profession is to use but not abuse the flexibility it provides. As such, the goal is to chart one's own path through an academic career, devoting one's time to topics and aspects one is most interested in; of course, one's priorities and interests may change with time. As such, my advice is not intended to be the only possible way of doing things but rather a guide to find your own best path forward. Ultimately one's best advice is perhaps provided by one's own senior colleagues and mentors you can trust.

In conclusion, I can only say that it has been my joy and my privilege to have spent two decades in this profession at some of the best universities in the country and the world, and I look forward to the decades to come. I hope this article helps to share some of the insights I have gained during that time with prospective faculty, researchers, and anyone who is interested. For those who want the veil drawn from the ivory tower, I hope to have somewhat demystified the faculty career. And for those whose goal is to join the academy, I look forward to welcoming you as a colleague.