If you are considering grad-school in CS

Disclaimer: The entire content of this document reflects solely the personal opinion of its writer. Its content does NOT, have NOT and will NOT reflect any official policy of the University of Alberta, the Faculty of Sciences, the Computing Science Department, or any other institution for that matter. The content of this document should only be taken as an advice, nothing more.

TL;DR

1. Know why you are applying to grad-school, align your expectations accordingly.
2. Advisors are a HUGE deal when it comes to your grad-school success. Ask yourself – is this advisor a good match for me? Am I a good match for her/him?
3. Know what your future institution expects in terms of admission and grad-school work.
4. Be prepared for grad-school and independent work, know that your goal is to establish a good pattern with your advisor, colleagues and anyone you comes across.
5. Serious academic difficulties can arise. Be prepared.
1. Motivation: Why are you going to grad-school?

Allow me to begin this document with what is probably the most important question anyone applying for grad-school should ask herself/himself: why am I doing this?

This may seem like a psychological/philosophical question to you, but I believe it is quite an important question. The answer is, often, aligned with your expectation of grad-school and may indicate whether your time at grad-school would be a good one. And though there could be many answers to this question – in fact, chances are your own answer is a combination of several different motivations – the following lists a few of the more common reasons.

- “I want to get a competitive edge in the industry world.”
  On the plus side: it shows you have ambition. On the negative side: MSc or PhD are rarely the things that the “industry” (with a few notable exceptions) likes. In fact, they will probably make you over qualified for most jobs. For the most part, the number one thing that would make the “industry” appreciate you more is experience – programming experience, managerial experience, algorithmic design experience. On the other hand, I cannot say advance studies aren’t related with some of industry’s needs: getting a good MSc / PhD degree shows the ability to adapt, to learn on your own, to ask good research questions and give interesting answers. These are of importance in some of the industry positions, but I believe that the list of positions looking for such personal traits is significantly shorter than the list of positions looking for good programmers… Nonetheless, I have yet to meet a graduate of CS grad school who wanted to go to the industry and failed to find a good job.

- “Undergrad was neat! Look at all those ‘A’s that I got – I want more!”
  On the plus side: School is awesome. Trust me, you are going to learn a LOT during your MSc and PhD studies. And if you got lots of ‘A’s, it is likely because you loved what you studied, so you are going to see many many more beautiful results. On the negative side: PhD for sure and Masters for the most part, indicate the transition from classroom studying of the material that is known, to independent studying and trying to solve new questions – and I mean NEW questions. Those that have never been tackled before. It may not sound as though there’s a big difference, but there’s a huge leap between the two. It’s very unlikely you are going to see many ‘A’s in your grad-level studies, or get any type of other immediate reward in the same abundance you are used to from undergrad. So if this is your main motivation, consider non-thesis MSc.

- “I am not content with the place/country I am living in. I wish to move to a different country and see more of the world or settle in a better place.” / “I don’t want my life to start just yet, I still want an adventure.”
  I’ve included the two here together, as I believe the two mainly refer to international students (though the latter reasoning does apply to domestic students as well). But let me start by refraining: if you are a prosecuted minority in a foreign country – this of course does not apply to you. This bulletin refers to those who seek better life “elsewhere” or those who say “hey, I’ll go for a few years abroad – and if it doesn’t pan out, at least I had an adventure.”
First, I can relate to the bizarre feeling of living in a chaotic country and to the excitement of seeking life abroad. (After all, I did move to the US for my PhDs.) Yet while the move to a new country is a huge adventure, I would suggest that there are much better ways to experience this transition. (Working within an international company and relocating abroad is one way. Traveling internationally is another. Numerous forums online can suggest additional alternatives.) Indeed, moving abroad, obtaining visa and/or residency is a complicated matter and I have zero qualifications in terms of offering legal advice – but at the rate things are changing, I am not sure such legal issues become simpler when you are a student. And while there’s a good chance that you would be exposed to a fair share of Canadian/International employment opportunities *upon graduation*, you still need to graduate and no one guarantees you will find a job in the country you relocated to. Moreover, no advisor likes a student who’s just ticking off days till graduation and constantly looking for a job. Hence, merely graduating from your MSc/PhD studies is going to require some effort... So take that into account.

My advice, again, is that in this case you should consider course-based MSc; and/or to judge the merits of your advisor based on her/his industry contacts.

• “In undergrad I dabbled in some research project and I want to do more. I want to see if the academia is for me.”

Ding ding ding! We have a winner! If ever there was one “right” motivation to continue for advance studies, this is it. (Again, in my humble opinion.) Grad-school should give you a taste of what it is like to be an actual scientist: to pose a research question and do serious and inventive research; to delve deeper into one particular topic; to find new results and invent new techniques and even methodologies; to publish, present and write your results; and to have the opportunity to teach (mostly TA) new undergrads/grad-students.

On the negative side: Sometimes this attitude can cause you to put too much pressure on yourself in an effort to prove yourself. This can lead to frustration if and when research becomes tough, with slow-to-zero progress. Yet, I do believe that this is the right approach: treat grad-school as an opportunity to see if you like the academic world and if you like research. Just be aware that (for most of the people) the answer isn’t an unequivocal ‘yes’ or ‘no’. Treat your grad-school as an academic adventure that is bound to have more pleasant and less pleasant experiences, and try to enjoy it.
OK. I’ve decide I’m going to grad-school. But... How do I pick an advisor that’s good for me? How do I pick a place that’s good for me?

If there’s one thing I know I (and other professors) don’t like is receiving a generic email of someone looking for *any* advisor. Such an email is typically very easy to write, as the potential candidate describe her/his grades and technical knowledge (“GPA of 3.4, fluent in C++, Java and SQL”) attaches a CV, and sends the same letter to all potential advisors. But just as it is easy to write, it is also easy to ignore - 9 out of 10 times I ignore such emails. They weren’t meant for me, not the letters (which are undeniably generic) but more importantly --- nor their writers. If I am to consider someone a potential grad-student, this student has to, at the very least, understand the overwhelming importance of the advisor on your academic career.

Two main factors will determine the level to which you will enjoy your grad-school studies. The #1 factor is you yourself. The #2 factor – and by a slight margin – is your advisor. Your advisor can make your life really easy or really hard (most will do somewhere in between); your advisor can be highly involved in any aspect of your grad-life should s/he chooses to be; your advisor can enable you to go as far as you want, or put obstacles in your way. You want to be very careful as to whom you want as your advisor.

Before I continue and discuss the multiple axes on which one can judge the merits of a potential advisor, let me refrain and deal with one special case. Some grad-school candidates, especially people who are currently MSc students and continuing to PhD, might have already met or even worked with their potential advisor. (It could be that this potential advisor is a close colleague of your current advisor, or it could be someone with whom you’ve worked on an undergraduate project, or even as a summer intern, or maybe even had some serious research-based conversation in a conference.) Such experience and existing contact is no less than priceless! This means that by now you ought to have a pretty good idea about most of the questions listed below, thus resolve many of the unknowns that determine whether you are a good advisor-advisee match.

Here are a few directions you ought to consider.

- What is the professor’s field of interest?
  Probably the first factor you ought to consider is what is this advisor working on, and does that excite you or not. Needless to say, you’re not expected to know much about the prof’s field. (I mean, if you do, it’s wonderful. But let’s face it – most people move into MSc/PhD without knowing exactly what are the type of problems they wish to work on.) But you should be able to mention the prof’s field of research and the type of work s/he does and her/his students do. (For example: “X is in software verification, her approach is mostly methodological, working on large volumes of code; her students put lots of hours into writing code and checking whether certain types of violations occur”; “Y is working in machine learning, with lots of connection to industry. Her students deal a lot with real-life data and adjust existing techniques to work with new types of datasets”; “Z is in theory, her work deals with hardcore complexity questions and designing communication complexity protocols, and her students work is composed mainly of proving new theorems.”)

- How well do the interests of this professor and mine mesh? or - Why am I a good fit for this professor?
Probably the second question you ought to ask yourself is – am I a good fit for this professor’s interests? I mean, you might value theoretical work, but hate proving theorems yourself, which may make you unsuitable to work with a theory prof. Or, you might only care about writing high-level code and not stressing performance, whereas this certain prof cares a lot about code optimization and makes you write some code in assembly, in which case – no go.

Another question is for prerequisites. Does working with this professor mean you have to learn a lot of new material, or add a little more to stuff you already know? Chances are that if you are keen about some approach, you have done some work in it; and if you’re eager about a new field, you have read a bit about it on your own time. Do this professor’s interests go nicely with the stuff you’ve already done / read about? If so, that’s a major plus – both for you and for this potential advisor.

- What is this professor’s style of work?
  - How many students does this prof have, and how many does s/he plan on recruiting next year?
  - How often does s/he meet with her/his students? Are these meetings individual or in a group?
  - A hands-on/hands-off prof – will s/he be looking over my shoulder in everything? Will they give me a task and tell me to return only when it’s done?
  - Does this professor do a lot of co-advising? (If you are considering more than one professor)
  - Will I be focusing on research, or will I spend a lot of time working on purely programming tasks / administrative tasks?
  - How will I start (choose my research topic)? How will I proceed?
  - Does this professor have any other major obligations outside of research and teaching (works in a major administrative role, in the university or even nationally?)

None of these questions have a right or wrong answer: some people love the hands-on approach as it makes them feel secure whereas others despise it as it makes them feel under constant surveillance; some people insist on a weekly individual meeting, others require far less meetings. Personal and working-style traits are very individual and there are as many styles as there are advisors. Moreover, often these styles aren’t set in stone from the get-go – most advisors (try to) adjust to their advisees. However, knowing the answers to such questions will allow you to know what to expect, and potentially identify some red-flags in advance.

- What’s the funding situation of this professor?
  Some students come up with a scholarship, which makes this question mostly obsolete. Other don’t, and may need to worry about the funding opportunities of their potential advisor. After all, a good professor without the means to keeping a student for a few years is, unfortunately, useless. Even if you do come with a scholarship, funding for travel, lab-equipment (if you need any) or the ability to sponsor colleagues’ visits is of importance to your PhD studies.

- Is the professor young and new or veteran and well-respected?
  This question, in my opinion, is of smaller importance than you think. Granted, advisor reputation is awesome. Undeniably, young professors have more to prove and are
potentially more eager on getting publications done. Nonetheless, even young professors (should) have a standard of quality as to what is a worthy publication and what isn’t; and even veteran professors should be eager about their profession. Furthermore, you might be eager to work with the “father of” so-and-so field, or “the inventor of...” – but they could have moved on, or decided to focus on a small niche within this field or could be focusing only on “big” questions – making them less than desired match for a more novice grad-student. Lastly, in my opinion, a glorifying recommendation letter from a starting professor is worth far more than “a fine student”-letter from a world-renowned professor.

Also, it is important to know a few things about the institution this potential advisor sits in.

- What are the requirement for getting in?
  Some institutions publish some threshold they require candidates to pass; some don’t. Some require GRE, some don’t; most will require TOEFL / other test to prove you know the teaching language. Every institution has its own hoops you must jump through. Do you know what they are and whether or not you are able to pass them?
  Of particular importance is the notion of whether you are joining a program vs joining a professor’s team. At UofA, Master students join the program and then pick an advisor coming the end of their first year; whereas PhD students must have an advisor willing to sponsor them from day one. This means that contacting a professor before joining a MSc program cannot be of tremendous help; whereas contacting a professor (about advising) before joining the PhD program is vital.

  Since it is probably worth discussing, allow me to go on a separate tangent, and address the issue of reference letters (a mandatory part in applying to any grad-school). One cannot underestimate the importance of reference letters – they are no less than vital. Essentially, they are the only real way we can distinguish between candidates. Make sure your reference letters come from people who know you and can attest as to your capabilities and strong points. Of the highest priority are people who worked with you on research (namely, your MSc advisor, your undergrad research project advisor, collaborators, your boss in a past internship, and so on). The more they write about your involvement in a project, your contribution to it, your development as a researcher, your capabilities of writing/presenting it – the better. Of lower importance are course lecturers where you’ve done well. A letter that can be summed as “got an A+ in my course”, does not, to be honest, say a lot about you... (All grad-students have excelled in one course or another of their undergrads.) A letter from a course instructor needs to elaborate more as to what make you “tick” to be of real value. Did you ask to read more? What made the course particularly appealing to you? Where did they challenge you and how did you rise to the challenge? (Remind the professor, in case they’ve forgotten.)

- What are the requirements for completing the degree?
  How many courses do I have to take, and in what fields? How many TA sessions? Are there qualifying exams or not? How much focus is put on research in the program and how much on course-work? (Similarly, how much focus on each is put by your potential advisor?)
How many students finish their program, and why? Some schools have a completion rate of 25% and some schools have a graduation rate of 80%, why is that? Is it that the load is too heavy? Is it that the school is too tough? Is it that the school is too easy?

- What resources are available to you, in your field of interest?

  How many courses are offered in the field I would like to focus on? (E.g., if the place has tons of programming-language professors and offers many grad-level courses in that field, it is a great plus if you’re working in the field of programming languages, and a great minus if you are in systems...) Is there a weekly seminar for people in my field? Are there any reading groups in my field and/or how hard is it to create a reading-group? How often do they get visitors giving talks that are of relevance to me? How many industry contacts does this institution have, and are they organized or informal?

- How much freedom/variability is there in switching a professor? in switching a field (within CS)?

  As a pessimist, I always recommend you consider your fallback options. Suppose things do not work out with the professor you are currently set on working with – are there other professors in similar fields in the same institution? (Also, how comfortable is your potential advisor with switching advisors?) And if you decide you don’t at all like the field – what are your options then?

  How easy is it to switch advisors and/or to find an alternative advisor, and how late in the process is it still an option?

- Preparing for the worst: if my professor leaves / runs out of funds – what’s the university policy to make sure I will continue as a grad student?

Where do you get answers to these questions?

- Anywhere you can.
- Departmental websites, personal homepages and Google should be your first go-to.
- But my biggest advice: Talk to the intended advisor. Ask her/him plain and simple and see what answers you get.
- Also recommended – talk to other students in the department, current and former students. See what they say.
3. What to expect during grad-school?

- As mentioned earlier - the quality of your (academic) life depends to an astounding degree on your advisor.
  Your advisor determines which and what projects you will work on, whether those projects are built on questions/ideas you bring to the table or that s/he does, if you will be teamed with other grad-students, the extent of coding / math / hardware manipulation you will have to do, and of course – s/he will deem your work as satisfactory or non-satisfactory. That is why my key advice to you is to **constantly keep open and honest communication** with your advisor. You ought to know clearly what is expected of you, and they ought to know what it is you can (and know how to) deliver. Remember, your success is your advisor success – they are not only rooting for your success, they are there to enable it. Most advisor-related problems are due to not being on the same page as to what “success” means.

- Despite the differences, it is safe to say that the majority of advisors are going to expect a lot of independent work on your part. Namely, there’ll be no official deadlines, no one standing over your head as you code / work on your notepad, no one counting attendance during lab-meetings, no one standing with grades from F to A judging your progress. All this freedom comes with the price of responsibility. If you don’t get this work done, no one is going to do it for you. It’s also quite unlikely that you’re going to get away with “half-assing” some work (as oppose to some parts of your undergrad studies). As the one who writes a piece of code / devises a proof / presents a paper, you will be the one to blame when the code crashes / errors in the proof are found / the presentation shows lack of understanding.

- That is not to say that grad-school allows for no errors. Errors happen. They have happened to each and every one of us and they will happen to us all in the future. But grad-school is about establishing a **pattern**. Your rule-of-thumb should be to deliver on tasks correctly and on time, or communicate as soon as you realize some task is far more complicated than anticipated. Your advisor needs to feel that for the bulk majority of the time s/he can count on you and your work. This will require a lot of self-discipline.

- As part of the honest communication between you and your advisor, you should receive feedback about your pattern, and you can and should give your advisor feedback about either your work or your advisor’s. I.e., if you feel your progress is too slow – let your advisor know. If you feel your advisor is stretching you too thin – let your advisor know. If you think your advisor is absent minded in your meetings – let your advisor know. And of course, if you think your advisor is the most wonderful person on the planet – let your advisor know! I trust you know how to approach someone with dignity and without an accusatory tone. Do NOT get into fights with your advisor, do not shout and definitely do not swear. Similarly, there’s no need to discuss every minor issue that comes to mind. Share your thoughts about the overall pattern of work in a respectful tone, and listen to the answer you are getting. It may not be what you wish to hear, but it should be valuable advice. Remember: your success is your advisor’s success, chances are you are being steered in the right way.

- You should always remember that **even work with no “progress” is progress**.
This means that even if you’ve spent your time during tasks that may seem menial and that will no produce an immediate reward, you’re still gaining something. If you end up re-writing the lab code for weeks/months and making it more modular, it may not get published, but the new code will be of tremendous service to you in future experiments. If you bang your head against a conjecture and are unable to prove it or disprove it – you are making progress, especially the more venues you try in tackling the problem. If you spend weeks reading papers rather than working on your own – you are gaining lots of knowledge that you will end up using in the most unexpected ways. If you designed a system and your experiments failed, it is important to see why they failed and what have you learnt in the process. And of course, some of your submissions that will be repeatedly rejected. This goes back to the ‘A’ section in the Motivation part: as opposed to undergrad, it is unusual to always succeed in whatever you do in grad-school. There will be a lot of work done “in vain” or “for nothing” or that “ends up in a failure.” These set-backs do not make you a failure. Those merely mean you are learning, trying, failing, and then learning from your failures – and trying again.

• But when “progress” does happen – do not forget to enjoy it! When your paper finally does get published, when you give a talk to a new audience, when as a TA you made some student understand the material - give yourself a good pat on your shoulders. You’ve discovered something that was never known before! You are the one responsible for making this result see the light of day, and it’s your “baby.” Allow yourself to enjoy it. These are the moments that make all the hard effort worth it.

• Secondly, remember to avoid comparisons – with other grad-students, with your advisor as a grad-student, with people from other departments or schools, with your undergrad friends who didn’t go to grad-school… with anyone. Your progress is your own, your pace is your own, the type of problems you work on are your own. Grad school isn’t a race, and the one with the most publications isn’t winning. Jealousy is natural and unavoidable (in all levels of academia), but it should merely work as a driving force and not be detrimental. Do not fall into the imposter syndrome trap! (i.e., walk around the halls of the school thinking you are an imposter that was accidentally admitted to grad-school…)

• And these are just the first couple of years, where your advisor is all you need to care about… From the get-go, you will get to interact with other professors in your school (classes, seminars, socializing, doing research). You want to establish the same pattern with them. Later on in grad-school you will go on conferences, give talks, present, discuss research with other people from different schools (advisors and grad-students alike). Similar advice applies to these interactions too – aim to establish a pattern of a knowledgeable and smart person with whom it would be great to collaborate, by delivering on your word and communicating honestly what you can and cannot do, what you know and do not know, and to what venues you are, and are not, willing to dedicate time and energy.

---

1 Admittedly, the “imposter syndrome” is a far more complex issue than can be discussed in this document. My goal here is just to state that (a) you should know it exists and that it is only natural to feel it; (b) many, if not all, of your peers feel it too; and (c) most of you have no objective reason to feel it.
4. Serious academic difficulties.

So yes, we’ve established that grad-school is hard and requires lots of independent work that sometimes pan out and sometimes doesn’t. But sometimes you may encounter difficulties that go beyond that standard “I’m not making enough progress here.” After all, grad school takes several years and in those years – your life may alter. For better (marriage, kids) or for worse (separation, sickness, loss). Sometimes you and your advisor, despite everything, just don’t get along. (Sometimes the situation can be worse, with various types of harassment, but that’s a matter for the police…) Of course, when you need some outside help – you should go and seek it (be it a doctor, counseling, parental guidance etc). But difficulties that are purely academic can arise too.

What should you do in case of a serious academic difficulty?

• As before, my first advice is to communicate the difficulty to your advisor. Sometimes it is concrete and merely temporary (you are having a baby and you need parental leave). Sometimes it is more obscure. Sometimes it is about you and your advisor / you and your field of studying. Nonetheless, your advisor should be informed. (Also, they might have dealt with a similar case in the past, so you should also listen to his/her advice.) Know this: if you are struggling while your advisor doesn’t know about it and keeps expecting you to continue with the status-quo – it is a recipe for disaster.

• Sometimes you feel you are on the wrong trajectory – working too much for industry when your heart is in the academia or vice-versa, working on too much math when your heart is in coding or vice-verse, etc. Such problem might be solved by moving into co-advising, with the other advisor serving as a “pulling force” that puts on you a different trajectory.

• Sometimes you might need to switch trajectories completely — i.e. switch advisors and/or fields. Of course, your goal should be to do it as amicably as possible. Give your advisor no reason to object, find a new advisor whom you know and have established some research with, and try to make it as smooth sailing as possible. Do NOT have bad blood with your soon-to-be-ex-advisor!

Of course, you should make sure this is done in accordance with the school’s policy.

• And sometimes, you just need to quit. If the hardships of grad-school are truly too much for you to take and you wish to set your life on a completely new trajectory – you are free to do so. I know of a few people, completely bright and highly-intelligent, that could not make grad-school work for them. So they left grad-school – and lo and behold, they didn’t end up lying in a dark cell waiting in despair for death to come – they simply moved to the industry and are quite happy with their life.
5. Finally, what to expect after grad-school?

Well, everything! It’s your life, and – despite the cliché – you truly can do whatever you set your heart to!

But assuming you wish to build on your grad-school work in some form or another, there are two general venues for life post grad-school: industry and academia.

- Going to the industry: make sure you pick a job that is satisfying for you. After the years of independent work in grad-school, you should by now know what makes you tick and what not, what problems you are good at solving, and what makes you happy. Find a job that allows you to have those. And, of course, do not forget the viable option of making a job that has these traits – namely, you may want to start your own company!

- Going to the academia: the standard track in this case is post-doctoral work and then trying to find a job out there. There are numerous guides out there about how to land a good academia job, yet fewer guides about post-doctorates. So here’s my two cents: a good post-doctorate should allow you to bridge between your PhD work and your academia life. You should get a taste of what it is like to develop your own research agenda (building on the later years of your PhD where such an agenda should begin to emerge), on what is it like to develop and teach your own course, to write grants and work with beginning students.

In either case, it is useful to build a name and a reputation for yourself as early on as possible. Again, not a reputation of a smart person – both the academia and the industry are full of smart people. But also a reputation of a great collaborator, someone who delivers on their word, someone who does devote time and effort for getting work done. And, of course, rely shamelessly on your advisor / your school for those. The bonds between you and your advisor / school do not end when you graduate! Use the resources available to you from your school to get your job, and use the ties your advisor has made to seek opportunities for your future career. Even after grad-school: your success is – still – your advisor’s success.