

MITOCW | mitres16-9960-managing_a_research_project_captions

[Morse code beeps] [Whoosh] [Helicopter rotor]

Hi everyone.

My name is Nick Rober. I am a Fellow with the AeroAstro Comm Lab.

And today we're going to be talking about managing a research project.

So the lesson goals for today are first to identify ways that we can both define and scope a research topic.

We'll talk about how we can learn strategies for, breaking projects into manageable bits.

And then we'll also practice, tracking our progress for a given research topic, and adapting your plan as things change.

So first I want to jump into why actually managing a research topic is important.

So if you haven't figured this out by now, research can be very messy.

So things don't usually go according to plan.

Things change as you, as you go through, researching a topic, and what we call a scope creep can be very normal.

And what scope creep is, is just the gradual changing of your scope of your research.

So as you go through a project, maybe you add things, maybe you remove things.

The scope of what you're actually researching changes as you go, and this is super super common.

And so what we see is that if you're, if you have poor project management, there can be a lot of wasted time, a lot of frustration, a lot of, you know, difficult meetings with your advisor.

But if you have very clear, and efficient management, you can make progress a lot faster, and your impact is usually pretty, is usually higher.

So the thing to keep in mind is that even from very early stage, stage planning of your research topic, this is something that you should keep in mind.

You want to be able to identify what you're going to be doing next, how that might change, and then avoiding getting stuck in kind of cycles of reading and, and going back to the drawing board.

And then also you, with good project management, you can notice quickly when a direction isn't really working or probably won't pan out.

So what are the common research challenges that make this difficult?

People will often try and address a topic that is either too broad or too vague.

This usually leads to kind of just reading without much focus and and trying to get as much information, but you don't necessarily know what information you're trying to get.

And then if you have difficulty explaining your project in 1 or 2 sentences, that can be an indication that you're working on something a little bit vague.

Trying to solve a lot of stuff at once.

So we'll talk about this a little bit later, but if you're doing a lot of things it makes it a challenge to actually get anything done because, the amount of stuff that you're doing is really difficult.

So what this often manifests as is feeling busy but not actually getting much done.

Another thing that is important to keep in mind is, is your project progress trackable?

Is, the, are the things that you're doing, measurable in some way?

And another important challenge that we'll talk about is communication with your advisor.

So if you're meeting, if your meetings feel unproductive, or if you're getting a lot of contradictory feedback that seems different from one meeting to the next, it may be an indication that you're, you're not moving with enough focus.

So the important thing to kind of begin with is you want to start with a very clear question.

So keep in mind that research is ultimately a practice of asking and answering questions and you shouldn't be trying to accomplish everything in one go.

So whenever you're starting or working on a research project, a very key question that you should ask yourself is what gap am I addressing.

So this could be through the form of you know what.

So what doesn't work, what isn't understood, or what is missing in current approaches?

You may ask why, why does a gap matter?

Why does this thing happen?

Or how?

So how can this be addressed with, you know, a given set of tools that may exist?

Or how can we develop new tools to address this problem?

And the thing to keep in mind is that you want to keep it narrow enough that it's something that is achievable, but not too narrow, that it becomes uninteresting or trivial.

So one way to do this is, with what I call the scope matrix.

So there's three axes to the scope matrix.

One axis is the problem.

So how big or small, easy or hard is the problem?

One axis is the method.

So, is your method that you're going to try to apply super, super new never been done before, or is it something that's maybe a little bit more standard?

And then the third axis is the domain.

So you know, how broad or narrow is the set of problems that you're trying to address.

And ultimately what this boils down to is that increasing along one axis will usually require a decrease in the other to remain feasible.

So for example, consider we have some problem, and we want to, we want to solve that problem.

If I want to take a standard method and update it so that I have some new method, maybe the problem can stay the same, but the domain of types of, things that it applies to is reduced.

So that is represented by this diagram here.

An overambitious example for this scope matrix.

So you could imagine if we have our problem is safety performance and stability, so three properties of a system, maybe what we're trying to do is develop a unified control and verification framework. So that does a lot of stuff.

And then the domain is for all autonomous aerospace vehicles.

These are all three different things that have kind of maxed out one of the axes of the scope matrix, and solving this problem would be super, super hard.

So you kind of need to reduce one or more of the axes to actually, you know, think about actually solving this problem.

So with that in mind, we will launch into our first activity of the day.

So open the Apply the Scoping Matrix file, and take about five minutes to complete that.

[Alien spaceship beeps]

Okay, so once we've kind of thought about our project and scoped it out and have some idea of what we're doing that's reasonable and achievable, the next piece of managing a research project is to break your project into units.

So I have what I like to call the minimum research unit.

So this is just a small and meaningful result that can be, achieved by you know, 1 or 2 actions.

But basically what you want to do is you want to start with 1 or 2 small questions, that can be answered through one experiment and it produces maybe a tangible figure, or graph, or a result that you can kind of point to and say, you know, "I answered this question, with this result." These minimum research units help to decide what to work on next.

They help to recognize you know, progress when you're making it.

So once you get this figure, you say, you know, this is progress.

And then it helps to avoid getting stuck in these loops where you kind of have this vague idea of your direction you're moving, but not actually, getting any progress in that direction.

So some examples of a minimum research unit could be, implementing a turbulence model and comparing it to baseline CFD.

You might study the flow separation for one angle of attack of, of a wing, or you might evaluate the aerodynamic performance, for some airfoil modification.

So let's, go into the next activity.

So find the file.

Break Down Your Project and take roughly five minutes to complete that.

[Alien spaceship beeps]

So the next piece of managing a research project is, is very important, this is, milestones and tracking.

So there's a couple of different types of milestones.

We have short term milestones.

So these are usually on the order of days to weeks, maybe a month, Where.

you have a focus on doing and accomplishing something.

Maybe you're learning something.

Maybe there's something you need to understand better.

But it's often tied to one of these single kind of minimum research units that we talked about previously.

So these short term milestones ultimately, what they help you do is, make progress in a visible way that, helps you, you know, track whether or not you're moving in the right direction.

And it also helps you avoid getting overwhelmed.

So by breaking things into smaller pieces, they feel more manageable and you can move more consistently in the right direction.

Long term milestones, on the other hand, are usually more on the order of a month to a year.

They're really good for kind of motivating your research direction.

They can be used to, kind of choose what short term goals you have.

But ultimately they're, they're focused on kind of high level outcomes.

So it could be something like, I want to finish my thesis, I want to get this journal paper done, something like that.

And that is what you can use to kind of build your short term milestones, to build up to that.

And what long term milestones do is they will give you direction and motivation for your research.

They'll kind of teach you or show you what you need to prioritize in your short term work.

And then they'll also anchor your project's overall purpose into something real and achievable.

And throughout all of these milestones, you want to be tracking your progress in some way.

So there should be some amount of, you know, here's this output that I got from this milestone.

And then that can be applied, you.

know, iteratively through your long term horizon so that you're able to keep track of the fact that you're actually doing things, tangibly.

And then the final piece of, managing a research project is adapting and refining your, your approach.

Because, like I said at the beginning, rarely does a research project go fully to plan without any changes.

So you should always expect that, you know, as you go through researching a specific topic your ideas about that topic and your approaches might change.

This can happen for a bunch of reasons.

Maybe, you learn that the problem you're working on is actually either much easier or much harder than you expected.

So you'll need to change to accommodate that.

Maybe something you thought would work actually didn't, so you need to find either a new method or a new problem.

You might discover prior work that you didn't really previously know about, and that's something that you'll have to go back and say, okay, does this, does this compete with my method, is this complimentary to my method, how can we deal with that?

Additionally, as you're, as you're working on a project, you know constraints or issues with, the approach might become more clear.

So you might have, you know better ideas or different ideas from what you previously had.

And then ultimately, your interest can also evolve.

So you may find that you know, as you're researching something, maybe you become interested in something else and that's something that you want to look at in the future.

So these are all different ways that, you know as you're going through research the things that you're working on might tend to change.

So the thing to keep in mind is that, you know, just because, something is changing, does not mean it's failure.

It's it's all part of the research process.

These are just things that happen, and it's it's very, very natural for the trajectory of research projects to change as you become more informed.

But what you want to keep in mind is that you should always be kind of checking in with yourself.

Asking yourself, is the scope still manageable?

So has this project become so big and so broad that, you know, I can't reasonably actually achieve it anymore?

Or is it still something that is achievable, just maybe different than before?

Are the methods still feasible?

So is is the approach that you had given, you know, maybe you've learned some new things, is this still a good approach or the best approach?

And then as you go, you should also be checking in with the milestones that you'd previously set and asking if they're realistic.

There may be things that you know took longer than expected or were faster than expected, and you should be updating kind of your, your plan as you go through your research project.

So with that, you should now be able to deliberately manage scope, by making trade offs between, you know, the problem, the method, and the domain of the research that you're pursuing.

You should be able to break your work into small, trackable units.

And you should be able to plan your project communicate with your advisor, and adapt your research over time.

So thank you.

[Morse code beeps]