How to Write a Great Research Proposal

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Currently applying for a PhD & want a mentor?
Please fill in the Google form!

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A "*Great Research Proposal*" in context

What is a research proposal?

A description of the work that you want to do during your PhD (3-5 years worth of research) and the motivation behind it.

- Something **new** that has not been done before.

- Something **better** (more accurate or more efficient).

Example

- "Problem P is important because of A1 and A2 applications or reasons. I'm passionate about it because of F factors.

- So far, people have come up with S1 and S2 solutions. However, they are slow or inaccurate or not applicable sometimes.

- I propose instead to solve the problem with S3. The reason it has not been done before is R. But we can get around it by doing this other thing T.

- The exact way I would start the project is by doing experiment E collecting data D."
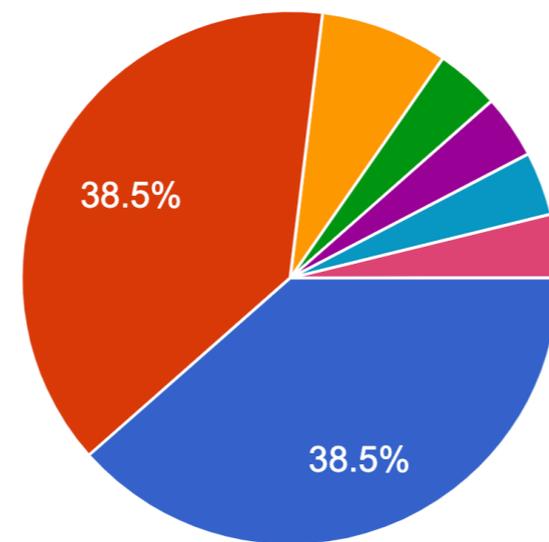
When is it used?

- PhD applications!

- Grants: Funds given for projects, often coming from government, companies, etc. Senior people (like professors

- Fellowships and scholarships: funds for students, postdocs, or even professors.

In other words: research proposals show up often!

Why is it important?

How important is the research proposal in a PhD application?

26 responses

- One of the most important parts of the application
- Second most, after grades or publications
- Not very important
- Very important, but less for its content than to demonstrate the student's a…
- Maybe third after reference letters,…
- Third, after letters and publications
- Third, after recommendation letters…

38.5%

38.5%

77% of people think it's either the most or second most important document in your PhD application

What exactly is a PhD?

A PhD is a university degree that credits your ability to do research.
- Different countries have different requirements:

  - **In the US**: a PhD is 5-6 years, 2 of which involve taking courses, and the rest doing research. Masters degree might be a plus, but it's not necessary. Students tend to graduate with 3 strong conference papers where they are the first author.

  - **In the UK, Germany, Sweden, etc**: a PhD is 3-4 years, and coursework is often optional, so coming with a Masters degree might be helpful, though not required. Top students might also graduate with 3 papers, but it's not a requirement.

  - **In Africa**: a PhD is typically a 3-year, thesis-only degree that follows a Master's degree.

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Why do a PhD in CS now?

- Interesting and **exciting work**. Some examples of where you could work:

  - University professor: does research, teaches, mentors.

  - Research Scientist (eg: at a company): writes papers, maybe does some product development…

  - Research Engineer (eg: at a company): develops the engineering infrastructure needed to make research happen.

- **Flexibility**: easier to get a visa, more independent work, more creative work, could choose to do pure research or applied to a field that you care about (eg: medicine, environment, etc).

- **Money**! If you look for the high-end paying jobs in companies salaries can be easily above $120K per year.

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What's in a PhD application?

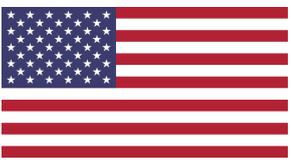- Research proposal (Europe) or Statement of Purpose (US).

- Resumé.

- Transcripts of your grades.

- 2-3 Letters of recommendation, from people who have worked with you. The better the writers know you, the more meaningful the letter is. Make sure to ask for them 1-2 months in advance.

- Personal statement.

- Language Test (eg TOEFL, IELTS)

- GRE (eg US, Canada...)

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What's in a PhD application?

- Research proposal (Europe) or Statement of Purpose (US).

- Resumé.

No picture, no description of personality, just specific list of degrees, publications, appointments, awards, etc.

- Transcripts of your grades.

- 2-3 Letters of recommendation, from people who have worked with you. The better the writers know you, the more meaningful the letter is. Make sure to ask for them 1-2 months in advance.

Make sure your writers do not focus on character description but on on specific facts, and that they put your accomplishments in context of people around you (eg: this was the best student in the class)

- Personal statement.

- Language Test (eg TOEFL, IELTS)

- GRE (eg US, Canada…)

Make sure to give yourself enough time to prepare these, and even take them twice! Check locations around you.

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US: Statement of Purpose

Not a research proposal!

- Why you want to do research.

- What you want to do research on and why (*very* broadly).

- Why you will be a good researcher - provide evidence. Show, do not tell. Concrete, specific, detailed evidence is the best.
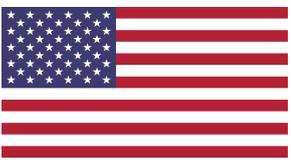
Possible SoP Structure

Para 1: Introduction, area you want to study, and why.

Paras 2 - (n-1): Describe your background, experiences that led you to want to do research, and most especially specific examples of where you have exhibited the attributes of a researcher:

- Creative
- Stubborn
- Technically deep
- Mathematically sophisticated
- Good judgement
- Thoughtful
- Able to have new ideas, and carry them through from conceptualization, design, refinement, experiment, writing, result

Para n: (swappable) *I want to join this school because* … mention specific professors in bold, one or two sentences each that shows you have read and understood their work.
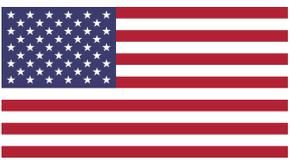
Tips for US PhD Applications

- Don't pay

- Apply widely

- Focus on advisor match

    - Watch talks - don't use last paper!

- Focus on demonstrating research potential

- Do use SoP and letters to situate your university and inform the committee

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What's the process of a PhD application?

NOW: Start thinking about the topic and select the professor and school accordingly.

September / October:

- Have a shortlist of schools and professors you'd like to apply to.

- Ask professors, mentors or collaborators for letters of reference

October / November:

Take all your certification exams (GRE, TOEFL, etc). If you can do it earlier, that would be best: then if you don't like your grade you can take it again.

December / January:

Applications are due (varies by country and school)

Look for your own funding!

Approach professors, find out all documents you need to apply

Iterate on your proposal and prepare your application materials

Leave buffer for unexpected things

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Fellowships

- Commonwealth PhD Scholarships

- Rhodes Scholarship

- Erasmus Mundus

- Emerging Scholar Fellowship

- Gates Cambridge Scholarship Program

- Microsoft Research PhD

- MasterCard Foundation (only for Masters level) https://www.ed.ac.uk/student-funding/mastercard-foundation

- British Council:
  https://www.britishcouncil.co.bw/study-uk/scholarships-funding

Timelines
Motivate
Remember your audience
Be resilient
Funding -> Win

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Partial Funding

- University of Edinburgh Principal's Career Development PhD Scholarship (https://www.ed.ac.uk/student-funding/postgraduate/uk-eu/university-scholarships/development)

- DAAD for Masters level in Germany

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Creativity exercises

Ice breaker

- Turn to 2-3 neighbours and tell them

  - Your name

  - Where you're from

  - Your dream job

  - One random fact about yourself

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Finding your purpose

What am I
passionate about?

What am I
good at?

What does
the world
need?

★ Your purpose

[Thanks to Hive for lending the model]
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Take 1 min to answer…

What am I passionate about?

- What am I grateful for? (it can even be small daily things)

- What is important to me? What are some of the values I hold most dearly?

- What makes me come alive? When am I most in flow? When am I the happiest? What type of work do I love doing?

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Take 1 min to answer…

What does the world need?

- What opportunities do I see?

- What needs do I see in my community?

- What needs do I see in the field?

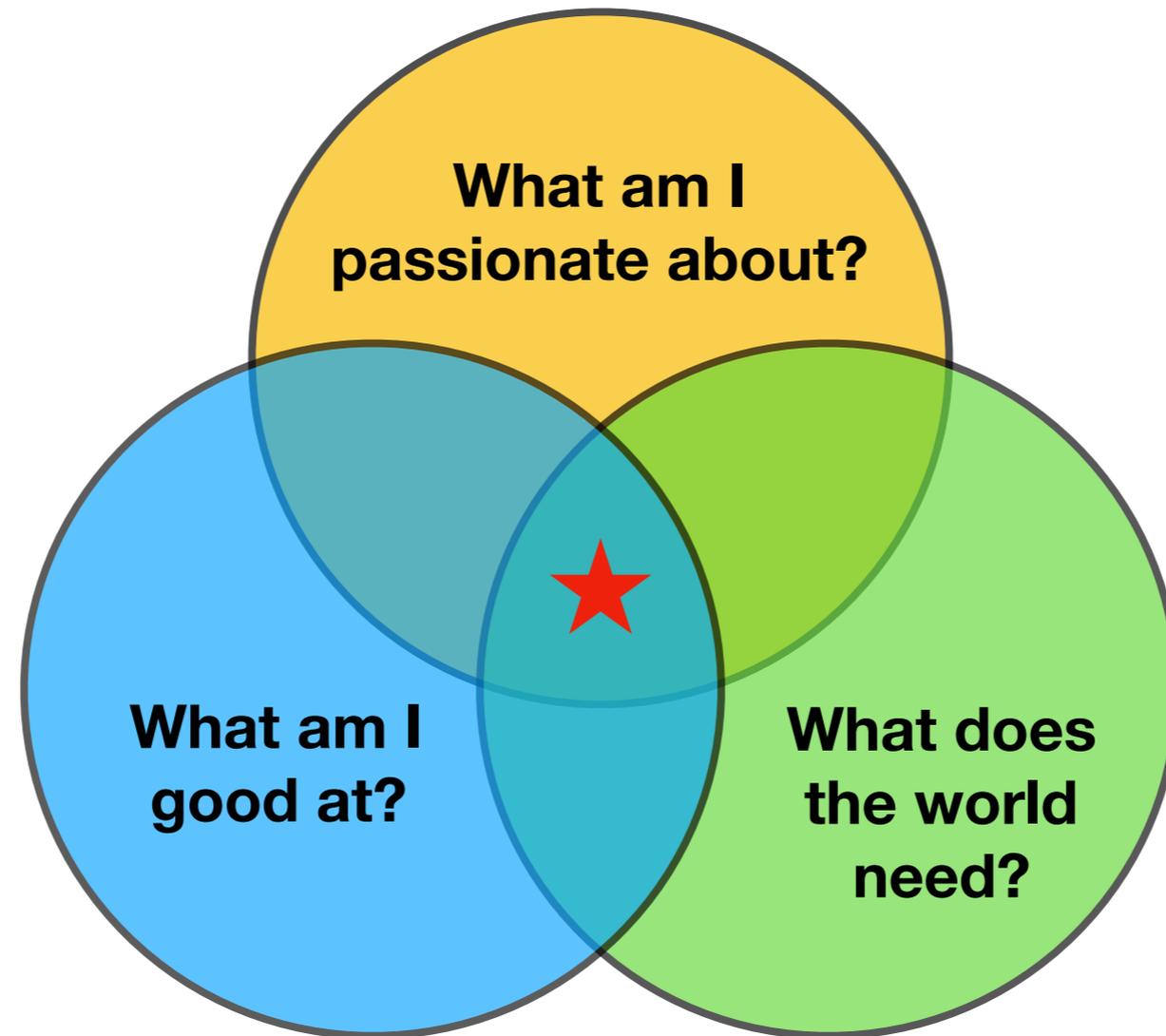- What needs do I see in humanity at large?

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Take 1 min to answer...

What am I good at?

- What am I good at?

- What work have I done that has impressed or helped others greatly?

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Bringing the pieces together

- What could I do professionally that would light me up inside and bring a positive contribution to my community and the world? Brainstorm!

Flesh out the idea

- What would I do if I were unreasonable?

- What's holding me back?

- What needs to change?

- What are some steps I could take to get started?

What does the end result (a great research proposal) look like?

Parts of a research proposal

- **Introduction/motivation**: Why should we care about this problem, what approaches have been done before and what they're missing. **Answers the question WHY?**

- **Your research idea**: What is your approach and why it's better. **Answers the question WHAT?**

- **Your plan**: Description of the first steps needed, such as data collection, experiments, resources, anticipated obstacles, etc. **Answers the question HOW?**

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Most important characteristics

- **Originality** of the idea

- **Feasibility**

- **Relevant literature** is included

- Grammar and clarity

- Shows that the student has thought deeply about the subject and are **passionate about the problem**

Common mistakes

- Too **general** (75% of people agree!)

- Topic **unrelated** to professor's interest (70% of people agree)

- Too **ambitious**

- Too **long** (70% of people spend less than 30 min reading it)

- No sign of having **read the relevant papers** from lab and field.

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Deal breakers

- Quality of writing is too poor to convey the idea

- Research topic is unrelated

- Proposal is not connected to current work

- Lack of technical specifics

Examples of proposals that professors liked

- Clarity, one clear idea, personal and **related to own background**

- Includes the **state-of-the-art**, critical thinking (identifying their strengths/weaknesses), **feasible** research directions

- **Match** with my research interests, shows that the student have a clear goal in mind, brings on some novel ideas

- Decent proposals have a **well defined goal** (plus, ideally, how solving the goal will be important for some application or task), understand how SOTA relates to that goal and identifies how they fall short, and evidence of creative flair in that there is a nub of an original idea on how to solve it.

- I distinctly recall an application that showed the student was thinking about exactly the questions that drove me to study my field. The student didn't mention me or my research area at all, but I could see that it was what they were looking for. In their first semester they took my course and since then have been fascinated by the topic and motivated by their own curiosity.

- One of the best contained **preliminary (promising) results** for well-motivated, new-ish and plausible idea.

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Examples of proposals that professors did NOT like

- Too general and too high-level, poorly written (spelling and grammar)

- Poor proposals tend to be over ambitious, poorly structured, too general, demonstrate lack of understanding of the existing literature.

- A lot of statements use buzzwords, to the point where buzzwords *hurt* your statement now because we've read too many that overuse them. I remember one that stood out to me with bold buzzwords scattered throughout. Use buzzwords as sparingly as possible, and only when necessary. Don't throw them in because you think having the word will help - it won't.

Additional tips

- Reading papers can be useful since it can help you delineate what is already known and what isn't. But I think **starting primarily from a point of curiosity is important**. A PhD is a multi-year commitment, so you definitely want to focus on a problem or question that interests you. It's ok to be somewhat speculative (as a reader, I understand that most proposed ideas won't work), but at the same time, ground the speculation in reality: how do things work today, and what incremental steps can you take towards a different future?

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Additional tips

1) Your first paragraph needs to grab my attention - if it's just about the history of your learning CS as a build up to some story it will be skipped.

2) Do not use buzzwords unless necessary.

3) Do not mention my papers by name unless you actually read them and have something to say that convinces me you've actually read them.

4) Don't try to convince me that you're already a researcher - convince me that you're motivated by curiosity about the right questions (it will be my job to make you a good researcher). You can discuss past work in the context of showing your passion for the topic and the questions you would like to answer. Don't just list your accomplishments (papers published, projects completed) thinking it will impress me [unless you're at the 3+ ICML/NeurIPS first-author level].

Additional tips

- Figure out a good place, and then write a strong application for that place.

- Spend time finding labs that are a good match with your interests

- Make your idea concrete using examples. Prefer simple language rather than jargon---your reader might not be a specialist in your niche area (this is true in my department).

- Be honest! We can often tell when you're saying you're interested in an area but really aren't. We can often tell when you spent 5 minutes (or even just an hour) looking at our webpage, and are then trying to say why this is the area that interests you. We can also tell when you're making up research directions that you think we want to hear. Also, if it's published and on our webpage, there's a good chance we're not working on that anymore or that this direction is already claimed by a student. We aren't looking for another student to continue that line of work. So, don't pick projects from our webpages and say you want to study those problems. Instead discuss how the whole research area interests you, what topics you really do want to study, and if those happen to align with something on the webpage, then you can say that you're excited to see that this topic is also of interest to the lab.

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See you on Thursday
Interactive Research Proposal Session
2.30-4pm
EBR 432

Bring your research proposal drafts
& discuss it with expert researchers in

Machine Learning
Computer Vision
Natural Language Processing
Reinforcement Learning
Robotics
Applied ML

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