



Challenges of a Graduate Program in Mathematical Sciences: a student's viewpoint

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Outline

Challenges of
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Outline

Frontiers

Subject

Supervisor

Thesis

Summary

- 1 The frontiers
- 2 Choosing the subject
- 3 Choosing the university and the supervisor
- 4 Qualifications and getting the degree
- 5 Summary



The Millennium Problems

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The Frontiers!

- Poincaré Conjecture (Solved by Grigori Perelman)
Announcement Nov. 2002, Approved Aug. 2006
Awarded the Fields Medal (\$15000 CAD) and the Millennium Prize (\$1 Million USD) both rejected by Perelman!
- Yang–Mills and Mass Gap
- Riemann Hypothesis
- P vs NP Problem
- Navier–Stokes Equation
- Hodge Conjecture
- Birch and Swinnerton-Dyer Conjecture

The **Clay Mathematics Institute**:

<https://www.claymath.org/millennium-problems>



Where to go?

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Should I work **on** the **frontiers** as a graduate student?

Definitely **NO!**

Should I work **towards** the **frontiers** as a graduate student?

This is one of your choices if you are **brave enough!**
(having the time and prerequisites **already**)

Fact!

There are **many other choices** for you to **get an excellent PhD**
and become a **real professional** in mathematical sciences!



An amazing lecture!

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R. W. Hamming (February 11, 1915 – January 7, 1998),
Turing Award 1968: "You and your research", Bell
Communications Research Colloquium Seminar, 7 March
1986, Transcription by J. F. Kaiser.

All quotations from Hamming is from this lecture!



A fundamental question!

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R. Hamming: "Why do so few scientists make significant contributions and so many are forgotten in the long run?"

You choose your side!

R. Hamming: "If you are to do important work then you must work on the right problem at the right time and in the right way."

What is right for **your time** as a graduate student!

R. Hamming: "There is no simple formula for doing great science or engineering, I can only talk around the topic."



On the "importance" of a problem!

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I am **not** talking about **absolute importance**, but the **relative importance**, in relation to YOU as a graduate student!

R. Hamming: "It's not the consequence that makes a problem important, it is that you have a reasonable attack."

"Importance" depends on your ways, means and strength!

R. Hamming: "There are a pair of errors that are often made when working on what you think is the right problem at the right time. One is to give up too soon, and the other is to persist and never get any results."

On the stages of commitment!



On becoming a researcher!

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There is nothing as a part-time researcher!

R. Hamming: "It is not about managing research, it is about how you individually do your research."

R. Hamming: "Why shouldn't you do significant things in this one life, however you define significant?"

R. Hamming: "You need a vision of who you are and where your field is going."



Prepare your mind

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R. Hamming: "If you really want to be a first-class scientist you need to know yourself, your weaknesses, your strengths, and your bad faults, like my egotism."

R. Hamming: "The particular thing you do is luck, but that you do something is not."

R. Hamming: "But great work is something else than mere brains."

The critical mass phenomenon:
Listen to the Japanese story I am telling!



Courage, drive and commitment!

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R. Hamming: "One of the characteristics of successful scientists is having courage."

R. Hamming: "Most great scientists have tremendous drive."

R. Hamming: "Most great scientists are completely committed to their problem."

How you get committed to your problem?



Work hard and effectively

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R. Hamming: "Knowledge and productivity are like compound interest."

R. Hamming: "If you believe too much you'll never notice the flaws; if you doubt too much you won't get started."

R. Hamming: "Just hard work is not enough - it must be applied sensibly."

R. Hamming: "It ain't what you do, it's the way that you do it."



Put the blame on yourself!

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R. Hamming: "People are often most productive when working conditions are bad."

R. Hamming: "It is a poor workman who blames his tools. The good man gets on with the job, given what he's got, and gets the best answer he can."

T. Edison: "Genius is 99% perspiration and 1% inspiration."



Mostly pressed!

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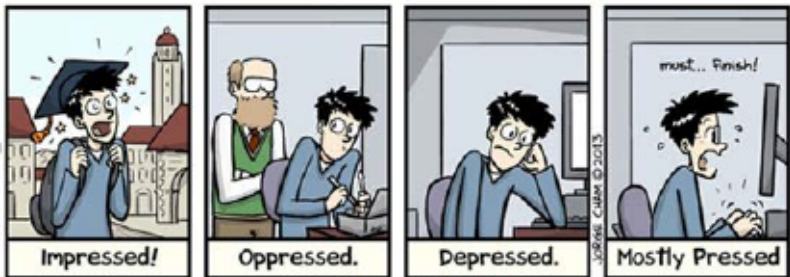
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Supervisor's viewpoint!?

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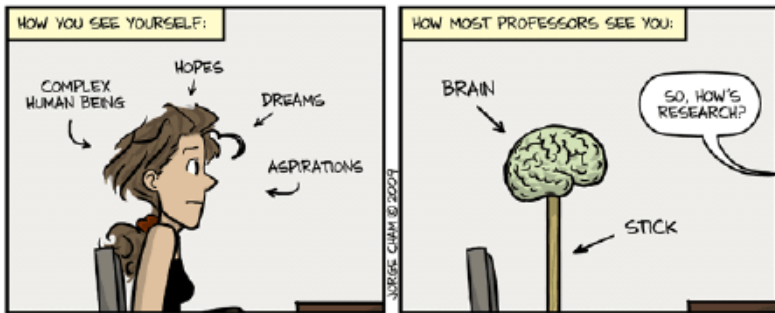
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Some supervision factors

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E. van Rooij, et.al., *Factors that influence PhD candidates' success: the importance of PhD project characteristics*, *Studies in Continuing Education*, (2019).

A nice article!

- Academic, personal, and autonomy support
- Relationship, availability, and expectations
- Psychosocial factors
- Project characteristics



On the concept of "originality"

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I. Newton: "If I have seen further than others, it is because I've stood on the shoulders of giants."

If you can find some giants and you can stand on their shoulders, FINE! If not, just try to find some tall scholars!

R. Hamming: "You should do your job in such a fashion that others can build on top of it."

This means that you have to build on top of what your predecessors have already done!



You have to "sell" it!

R. Hamming: "It is not sufficient to do a job, you have to sell it."

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On presenting your results

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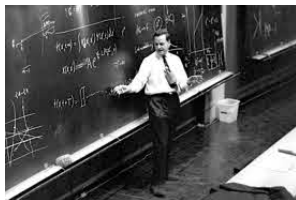
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You can not sell your goods if you can not present them properly!



- Learn to write perfectly
- Learn to talk perfectly

Some references:

<http://math.sharif.ir/faculties/daneshgar/page/show/161/My+Students>



Your academic character!

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- Making a resume or Making a resume?



"I didn't get the job. They said I was over-qualified."



Your academic character!

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- A **resume** is a document that tells prospective employers exactly what you want them to know about you. It should **advertise your skills in an easy-to-read, logical, and concise format.**
- A **resume** of yours is a **reflection** of part of your **academic character.**
- Try to **make a perfect academic character of yourself** instead of **tuning all you do to a resume full of wish-lists!**



Sum up!

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- Study broadly
- Choose your problems carefully
- Be brave, hard working and organized in your research
- Choose your supervisor carefully
- Chosen your supervisor, feel as a member of a team
- Learn the **process of research**
- Learn to write perfectly
- Learn to talk and lecture perfectly
- Value your time and your supervisor's time
- **Do things that at least appear in the footnotes!**
- **Have fun!**



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Thank you!

Comments and Criticisms are Welcomed

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