Term Projects: Why They Matter and How to Get it Right

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Why is this the most wonderful time to be in computer science?

• Hardware innovations
  • At scales, big and small
• Big Data
  • Datasets are available in nearly all domains
• Model-fitting algorithms and open-source implementations
• What’s the next disruption on the horizon?
  • 30 billion IoT devices this year
  • A trillion over the next 10 years
Two sides of the same learning coin …

Assignments …

- Focused mastery of a technical skill
  - Emphasis on skills that are deemed important for the particular course
- Training wheels are still on
- Constrained problem space
- Often comprehensively specified
  - Do this, then that, etc.
A term project is …

• Not your typical programming assignment
  • You have a lot of freedom and power
• Not done in isolation
  • Scale precludes this
• Not a duplication of what someone else has done
  • Not innovation!

With great power comes great responsibility.
Voltaire

Term Projects

You have a lot of freedom and a lot of power
Why term projects matter – Part I

Creative

- The problem you solved
- How you solved it?
- Possibilities it opens up:
  Where to, next?

Technical Sophistication

- The methods you bring to bear
- Mastery of Tools
  Not just hammers ...

Perseverance

- Challenges
- Setbacks

Why term projects matter – Part II

• Transferrable skills
  • Skills you hone, can be brought to bear on other problems
  • Gift that keeps on giving

• Interviews
  • Keeps the conversation going
  • Who can make the most persuasive argument for you?
    • Someone else!
    • You are providing ammo for those who are championing your case
But term projects end up …

- With the **lowest priority** and are subject to **procrastinations**
- Being an exercise in passing the buck
  - Easier to assign blame than to shoulder responsibilities
- With the team never really coming together
  - Either you are working with
    - Your friends who are loathe to provide critical feedback
    - Folks who you don’t know, and so you don’t interact with at any meaningful level

The Current Journey for Term Projects

Tech Requirements → Put something together → Assessment → Report

- Looks good to me!
- Target required word counts/pages
- Pad word counts
- Images to get to page limits

Tasks are not apportioned well. The *(perceived)* best parts are worked on by the lead, scraps for the others.
You can’t use up creativity. The more you use, the more you have.
Maya Angelou

How to get there …

What is a term project?

• Fundamentally, involves story-telling
  • Something that has not been told before
  • Guided in many ways by your own unique experiences

• It’s not just about what you have done, but in equal parts, also about how you think?

• Involves some constraints
  • There may be required hardware or software elements
Every good story in the sciences begins with ... a question

Why asking the right question matters ...

- Forestalls fishing expeditions
- Guides you (it’s your North Star)
  - Team is looking in the same direction
  - Use it to inform micro-corrections
- Allows you to explore, compare, and contrast different approaches to the problem
Are you asking the right question?

- Any random question is not a good question
- Should be grounded (to some extent) in reality
  - Your expertise, experiences, etc.

Don’t go off into the dark!

Things you know about.

Some examples of questions …

- Why is the pine beetle population exploding?
- Given my budget, where can I travel to soon and for how long?
- From a crime perspective, which streets should be avoided?
  - Depending on the time of day/week/season/event

- Examples from my research
  - VitalHome
  - Sketching algorithms
How do you ask the right question …

Introspection

Pose several questions

This is your ideas phase … no such thing as a bad idea.

Assess, discard, and refine

Iterative Process

Be your harshest critic!

Be mindful of the scope

There will always be something lacking

• Desired number of resources (CPUs, GPUs, etc.) may be unavailable
• Data may be unsatisfactory
  • Not the right size, format, etc.

• Solution: Work at a smaller scale
  • Testing is often more exhaustive and productive on a smaller set of machines
  • Working with a smaller dataset (or a synthetic one that you created) helps you understand the data space better
How do you demonstrate technical sophistication?

- By leveraging the right tools for the task and using them correctly
- Technical sophistication = Elegance
- Assessing how well the goals are achieved
  - Quantitative and/or qualitative

“Everything should be made as simple as possible, but no simpler.”
Albert Einstein

The Journey I Hope You Will Take …

- Problem Space
  - Defines and controls the problem space
  - Question
  - Broad brushstroke assessments
  - Subproblems
- Tech that informs solution
- Demonstrate technical sophistication
- Calibrate Design
- Constrained by course
- When does it work? When does it not?
- Does it scale?
- Is it correct?
- Instrument experiments
- Quantitative & Qualitative
- What? Why? How?
- Assessment
- Report
- Future Extensions
  - Tell the world: Videos and Publications
Projects are not a straight line from start to finish

• Iterative process that involves detours
  • Detours are what makes a story interesting
    • What did not work and why
    • Informs why you did what you did

• Side effect
  • A holistic understanding of the problem space

Other things that will help you get there

• Set up longer brainstorming sessions

• Meet early and often; and engage all team members
  • Zoom, Slack, GitHub, etc

• Every team member works on every phase of the project
  • Ideas, methodology formulation, implementation, report writing
Why we are having in-class project pitches

- Help with refining questions (micro-calibration, if needed)
- You can learn from how other projects are being formulated

You start a conversation, you can't even finish it
You're talking a lot, but you're not saying anything
When I have nothing to say, my lips are sealed
Say something once, why say it again?

Psycho Killer, Talking Heads

The writing component

Term project report
Writing

• Take the reader on a journey
  • Watch for the flow
  • Curate what you choose to say and what not to
  • The rationale, key methodological aspects, justifications, and performance discussion should all be there

• Make it interesting
  • Always emphasize why some aspect is salient
    • Don’t leave it to the reader to figure this out somehow

• Ensure that the takeaways come through
  • These are points you reinforce multiple times

Questions?