

CS Independent Work Getting Started

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Outline

- What is independent work/research ?
- Schedule and course work
- Tips for effective communication
- Summary
- Faculty presentations



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What is Independent Work ?

- Exposure to research
- Opportunity to work with faculty and graduate students
- So, what is research ?
 - Formally: advance state of art
 - Informally: tell people something new



What is Research and What is Not?

- Non-research
 - My advisor gave me this mpeg decoding algorithm
 - I implemented it
 - And it worked



What is Research and What is Not?

- Research
 - I took two existing mpeg decoders
 - I took some sample movies
 - I studied the decoders qualitatively
 - I measured them quantitatively
 - I concluded why one is better



What is Research and What is Not?



- Research
 - My advisor gave me this mpeg decoding algorithm
 - I implemented it
 - I measured it
 - I analyzed its bottleneck
 - I instrumented the code to prove the hypothesis
 - I recommend and conclude

What is Research and What is Not?



- Research
 - I was given an mpeg decoding implementation
 - I identified its bottleneck as above
 - I proposed an improvement
 - I implemented the improvement
 - I measured it again to prove/disprove I'm right
 - I generalize and conclude

What is Research and What is Not?



- Research
 - My advisor asked me to implement an mpeg decoder
 - I came up with 2 alternative designs
 - I analyzed qualitatively why one might be better
 - (I experimented to directly or indirectly deduce I was right)
 - I implemented the best design
 - I summarize and conclude

Designing a website: research or not ?



- How would a CS major do it differently from a high school kid ?
- Flexible design – can be created, configured, changed from parameters and scripts
- Automatically testable and demoable
- Careful comparison of implementation technologies – languages, databases, OS environments
- Software engineering exercise in portability, robustness, performance, interface design
- Use the stuff you learn in the CS department !

What is Research and What is Not?



- Research
 - Many other possibilities
- So, what is research ?
 - Formally: advance state of art
 - Informally: tell people something new
 - Not necessarily much more work
 - Just need to “go the extra mile”

What is research ?



- Combination of work done before and new insights
- Literature survey + understanding + innovation

Other traits of a Good Project



- Interesting/important problem
- Non-trivial challenge(s)
- Exploration of new technology
- Can be finished in allotted time
- Effective communication (talks, reports)

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Who does Independent Work ?



- AB students
 - Junior independent work (JIW) for two semesters
 - Senior independent work (SRT) for two semesters
 - Automatically registered

Who does Independent Work ?



- BSE students
 - At least one semester during junior or senior year
 - Encourage more than one semester (2nd semester counts as departmental)
 - Juniors: COS 397 in Fall, COS 398 in Spring
 - Seniors: COS 497 in Fall, COS 498 in Spring

Independent Work Schedule (COS 397, COS 497, COS JIW)



- By 10/4: Project plan
 - Find an advisor and a project
 - Fill out at "Independent Work Project Form"
 - Register online
- 10/11 to 10/14: Project proposal talks
 - 5 minute presentations to students and prof.
- During the project
 - Work 10-15 hours per week
 - Meet regularly with your advisor

Independent Work Schedule (COS 397, COS 497, COS JIW)



- 11/14: Project checkpoint
 - 4-5 slides report progress and remaining plan
- 12/7 – 12/9: Project results talk
 - 13 minute presentation to students and profs.
- 1/9: Final written report

Independent Work Schedule (COS SRT and BSE Thesis)



- By 10/10: Project plan
 - Find an advisor and a project
 - Fill out at "Independent Work Project Form"
 - Register online
- 10/19: Project proposal talks
 - 8 minute presentations to students and prof.
- During the project
 - Work 10-15 hours per week
 - Meet regularly with your advisor

Independent Work Schedule (COS SRT and BSE Thesis)



- 11/18: Project checkpoint
 - 4-5 slides report progress and remaining plan
- 12/7 – 12/9: Project results talk
 - 13 minute presentation to students and profs.
- 1/9: Progress report

Find an Advisor and a Project



- Get info about profs' research
 - Independent work page, home pages, research papers, word of mouth, ...
- Schedule meetings with several professors
 - email, office hours, appointments
- Choose a professor
 - Must be from CS dept
 - Can be jointly advised by someone else
- Profs on sabbatical: Andrew Appel, Bernard Chazelle

Find an Advisor and a Project



- Decide on a project
 - Profs suggest choices
 - Students come up with their own
 - A combination
 - Mutual agreement, interest, enthusiasm
- Submit "Independent Work Project Form" and register online

Find an Advisor and a Project



- Past popular topics/areas that may not be obvious research areas of profs:
 - Game playing (appel, schapire)
 - Education aids (bwk, wayne)
 - Language recognition/translation (bwk, schapire)
 - Display wall (li)
 - Cross-discipline (econ, history, math, psych, wws/politics, sociology, etc.) (aslp, bwk, ken, wayne)

Project proposal talk



- Problem description
 - What am I going to do
 - Why is it important
 - Why is it hard
- Approach
 - Previous approaches
 - My approach
 - Why is mine better

Project Proposal Talk



- Methodology, milestones, deliverables
 - Specific steps
 - What steps/deliverables will be done by checkpoint
 - What other steps/deliverables will be done by end of semester
 - What might be hard and what's the fall-back plan
- Summary

Project Proposal Talk



- Don't have to talk about everything
- But include everything (in "notes" section or other places)
- Be specific, give details of plan
- Tell me what's the new/clever/cool nugget
- Proposal talk is **not** your starting point: much preliminary work should have gone into the project by then

Project Proposal Talk and Beyond



- Scope
 - Not too little
 - Not too much (carve out a subpiece, limit functionality, reduce measurements)
 - If you're ambitious, have a longer term plan but the short term plan should still be doable
 - Don't be afraid of negative results
 - Have intermediate results

Project Proposal Talk and Beyond



- Be conscientious
 - Start early
 - Define small milestones for yourself
 - Work continuously to meet milestones
 - Meet with your advisor regularly
 - Don't hesitate to get help

Project Checkpoint



- 4-5 slides
- What you proposed to have done by checkpoint
- What you have actually accomplished by checkpoint
 - Steps
 - Deliverables
- Difficulties/surprises/deviations ?
- What more do you expect to do
 - Steps
 - Deliverables

End-of-Semester Talk



- Review the problem description and proposed approach – give "the theme"
- Give details (e.g., of implementation) to support "the theme"
- Give key results to support "the theme"
- Summarize "the theme"

End-of-Semester Report

- Introduction
 - Background
 - Problem description: include goal
- Approach
 - Previous approach(es)
 - My approach
 - Why is mine better
- Detailed description of methodology or implementation

End-of-Semester Report

- Experimental results
 - Analyze/interpret data, don't just give numbers
 - What does this have to do with your theme?
- Conclusion
- Acknowledgements and bibliography

Grading

- Project form/registration: 1%
- Proposal talk: 7%
- Checkpoint: 7%
- End-of-semester talk: 15%
- End-of-semester report (may include "participation", "draft", "general quality/difficulty of work, etc.): 70%

- No grade inflation !
- All steps count

Grading guidelines

- **A+**
A fantastic project. Far exceeded my expectations. Certainly one of the best 2-3 projects this year. This deserves an award!
- **A**
A well executed project. Met my initial expectations. The talk was well organized and presented. The report was well written, quite thorough, and meets the standards for a scientific paper. The student put in steady hard work through the semester with lots of attention to detail.

Grading Guidelines

- **A-**
The student made regular progress through the semester. The final report had minor flaws. (e.g. one or more of the following: inadequate description of the problem, prior work, the approach taken, methodology, results and analysis, writing style not appropriate for a scientific report). The student worked hard and learned a lot. Some aspects of the project could have been done better. This is in the top 50% of the projects I have supervised in the department

Grading Guidelines

- **B+**
The final report had some flaws. (e.g. more than one of the following: inadequate description of the problem, prior work, the approach taken, methodology, results and analysis, writing style not appropriate for a scientific report). Not all initial expectations were met. The student did not work as hard as I had hoped. The end result was not commensurate with the students prior knowledge and experience. I cannot confidently say that this is in the top 50% of projects supervised in the department.

Grading guidelines



- **B**
This project fell short of my expectations. The final report had several flaws. The student was irregular in making progress through the semester, and did not take my suggestions for improvement (or did not seek my guidance). This project was definitely not in the top 50% of projects supervised in the department.
- **B-**
The student did put in some work, but the end result was well below my expectations.
- **C+/C**
A disappointing project. I don't think the student put in much effort into this. I don't think the student learnt much from the experience.

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Effective Writing



- Concepts
 - Focus on key ideas
 - Expose, weave it in the body, conclude
 - Why, not what
 - Don't get trapped by details and artifacts
- Flow: be a good story teller
 - Pay attention to order, and smooth transitions

Effective Writing



- Simplicity
 - Simple exposition, simple styles
 - Make it intuitive rather than formal
 - Be specific, use examples
- Pitfalls
 - Too vague: for example, no examples
 - Contributions non-obvious
 - Too much "what", not enough "why"

Talk Tips



- Focus on key ideas
- Choose carefully a sub-story out of a full story
- Understand the nature of oral communication (no pause, no rewind)
- KISS principle (Keep It Simple, Stupid)
- Repetition is useful
- Give outline: some amount of predictability is comforting

Talk Tips



- Explain, interpret, justify, not just describe
- Write large
- Use color, but sparingly, consistently
- Use pictures (and even animations)
- No full sentences (just terse outline)
- Make the sub-story coherent and self-contained
- One corollary: no standalone graphs

Talk Tips - Preparation



- Practice
- Dry run followed by slide-by-slide analysis
- Pay attention to time and practice for time
- Practice for varying audience backgrounds

Talk Tips – Presentation



- Speak clearly, make eye contact
- Don't read slides
- Pay attention to posture
- Eye contact, shift gaze
- Plan on shedding slides
- Admit shortcomings, don't wait for questions
- Analogies and jokes and help

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Summary



- What is research ?
 - Teaches people something new
- Course work
 - Be conscientious and stick to a plan
- Effective communication
 - Stick to a theme and tell a good story

Faculty interests and project suggestions



- **Andrea LaPaugh**
 - Delivering or analyzing information in non-trivial ways. E.g. combining heterogeneous sources, data mining, recommender systems.
- **Jennifer Rexford**
 - Internet measurement, network troubleshooting tools.
- More information at
<http://www.cs.princeton.edu/academics/ugradpdm/topics.php>