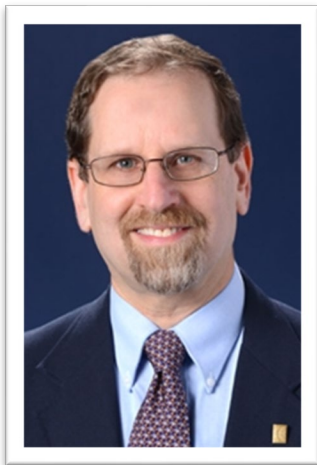# GETTING STARTED: COMPUTER SCIENCE INDEPENDENT WORK

FALL 2024

DR. ROBERT FISH, DR. DAVID WALKER, & MIKKI HORNSTEIN

WELCOME!

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OUTLINE FOR THIS SESSION

- Outstanding IW Awards – Spring 2024

- Overview of independent work in Computer Science

- Details of important steps and deadlines

- Resources for more information and help

CONGRATULATIONS!

Exemplary Spring 2024 Independent Work

Ekene Afulukwe, BSE'25
Pattern Recognition in Figure Skating to Create an Artistic Display

Adviser: Radhika Nagpal

Eden Bendory, AB'25
Prediction Using Partial Matrix Completion

Adviser: Elad Hazan

Matthew Drapkin, AB'25
Locked: The AI-Integrated E-Reader

Adviser: Robert Fish

Irene Kim, AB'25
Butterflies of Resilience: A Kinetic Origami Exhibit for Korean Comfort Women

Adviser: Rahika Nagpal

Javier Linero-Quintana, BSE'25
Improving Interlocking Joint Robustness with Gradient-Descent Based Stiffness Optimization

Adviser: Ryan Adams

Kathryn Postiglione, BSE'25
Exploring Life Indicators on Terrestrial Exoplanets: Machine Learning Approaches to Detect Water, Snow, and Clouds

Adviser: Ryan Adams

Willow Yang, AB'25
Robust Depth Completion for Extreme Sparse Inputs

Adviser: Jia Deng

James Zhang, AB'25
What Does It Say? Post-OCR Correction with OpenAI's GPT Models

Adviser: Brian Kernighan

LET'S GET STARTED!

What Is Independent Work?

■ Independent Work (IW):
   An individual project to study an idea in depth.

■ Examples:

  ➤ Algorithm

  ➤ System design

  ➤ Problem formulation

  ➤ Benchmark suite

  ➤ Proof of a theorem

  ➤ Application

  ➤ Investigate a dataset

  ➤ Etc…

Why Do Independent Work?

- Study a topic in depth
  - Dive into much more detail than is possible in a course
- Learn important skills
  - Technical writing, speaking, project management
- Work closely with faculty
  - Meet weekly, get advice, get to know them, etc.
- Do something interesting to talk about in…
  - Grad applications, job interviews, etc.
- Have fun!!

Types of Independent Work

- Fall Term Project
  - Some BSE juniors/seniors
  - Designed for one term, but can be followed by a related project in a later term
  - IW seminar, or one-on-one/individual advising

- Two-Term/Thesis
  - All AB seniors and some BSE juniors/seniors
  - Designed for a full year
  - One-on-one/individual advising

IW Seminars

- Same as one-on-one projects, but students work on related topics and meet with an advisor together.

  - Enables collaborative projects

  - Enables sharing of infrastructure

  - Enables feedback to/from other students

- Targeted at first-time IW students

  - Provides more help on how to choose good projects, how to manage time, how to design talks, how to write papers, etc.

Important Steps and Deadlines: Fall 2024 Projects

September 26:   Written Project Proposal due, 11:59pm

September 27:   SEAS Funding Application due, 5:00pm

October 22:   Checkpoint Form due, 11:59pm

November 12:   Attend How to Give an IW Talk

December 3:   Attend How to Write an IW Paper

December 8:   Oral Presentation Slides & Link to Video due, 11:59pm

January 9:   Written Final Report due, 11:59pm

https://www.cs.princeton.edu/ugrad/independent-work/important-steps-and-deadlines

Important Steps and Deadlines: Two-Term/Thesis Projects, Fall 2024

September 26:   Written Project Proposal due, 11:59pm

September 27:   SEAS Funding Application due, 5:00pm

October 22:   Checkpoint Form due, 11:59pm

November 12:   Attend How to Give an IW Talk

December 3:   Attend How to Write an IW Paper

December 8:   Progress Report due, 11:59pm

https://www.cs.princeton.edu/ugrad/independent-work/important-steps-and-deadlines

Important Steps and Deadlines: Two-Term/Thesis Projects, Spring 2025

February 14:   SEAS Funding Application due, 5:00pm

February 20:   Written Draft Paper due, 11:59pm

February 27:   Thesis Second Reader due, 11:59pm

April 10:   Thesis Written Final Report due, 11:59pm

April 22:   Oral Presentation Slides due, 11:59pm

April 21-25:   Oral Presentation Week (schedule a time with your adviser to give a live oral presentation)

April 27:   Two-Term Junior IW Written Final Report Due, 11:59pm

https://www.cs.princeton.edu/ugrad/independent-work/important-steps-and-deadlines

QUESTIONS SO FAR?

Onto the specifics…

Written Project Proposals

- Submit a written description of your project plan
- Logistics:
  - Due September 26, 11:59pm Eastern
  - 1-2 page paper
  - Submit PDF document via IW portal

Written Project Proposal (Continued)

- Motivation and goal
  - "The goal of my project is…"
- Related work
  - Survey of prior work with similar goals
- Approach
  - Key novel idea
- Implementation plan
  - Things you plan to implement
- Evaluation Plan
  - Experiment design, data, metrics, comparisons

Checkpoint Form

- Write a short summary of what is done in the first half, and what is planned for the second half
- Logistics:
  - Due October 22, 11:59pm EDT
  - Write two paragraphs
  - Submit via IW portal
  - Get feedback from advisor

Oral Presentation
(Fall-Term Students Only)

- Give a **nine-minute** talk about what you've done over the whole term
  - Required for all seminar students, and any first-time BSE students.
- Logistics:
  - Attend "How to Give an IW Talk" on November 12
  - Submit slides and video link via IW portal by December 8 at 11:59pm
    - Note: You must submit your FULL slide deck by the deadline above

Oral Presentation (Continued)

- Video-recorded oral presentations
  - ▷ Record your oral presentation via Zoom, or
  - ▷ Select another way to record your oral presentation (Loom, etc.)
- Save your recording either on Zoom or in Google Drive
  - ▷ Submit a **link** to your recording to the IW portal
- Submit a pdf of your slides to the IW portal
- Seminar students: your instructor may ask you to practice or present in your group meeting, as well
- One-on-one students: your adviser may ask you to present to their research group, as well

Oral Presentation (Continued)

- Motivation and goal
  - "The goal of my project is…"
- Related work
  - Survey of prior work with similar goals
- Approach
  - Key novel idea
- Implementation plan
  - Things you implemented. How did you do it? What remains to be done?
- Evaluation
  - Experiment design, data, metrics, comparisons, qualitative results, quantitative results, further results needed
- Discussion
  - Conclusions, limitations, future work

Written Final Report
(All IW & Thesis Students)

■ Submit a written description of your project, including results and conclusions

Fall Term IW

■ Due January 9 by 11:59pm

■ Attend "How to Write an IW Paper" on December 3

■ Submit PDF via IW portal

■ 20-25 pages, double-spaced, plus appendix

Senior Thesis

■ Due April 10 by 11:59pm

■ Attend "How to Write an IW Paper" on December 3

■ Submit PDF via IW portal

■ 40-50 pages, double-spaced, plus appendix

Two-Term Junior IW

■ Due April 27 by 11:59pm

■ Attend "How to Write an IW Paper" on December 6 or April 8

■ Submit PDF via IW portal

■ 40-50 pages, double-spaced, plus appendix

Final papers submitted after 11:59pm on the due date will be assigned a 1/3 grade deduction.

Written Final Report (Continued)

- Motivation and goal
  - "The goal of my project is…"
- Related work
  - Survey of prior work with similar goals
- Approach
  - Key novel idea
- Implementation
  - Things you built. How did you do it? ~~What remains to be done?~~
- Evaluation
  - Experiment design, data, metrics, comparisons, qualitative results, quantitative results, ~~further results needed~~
- Discussion
  - Conclusions, limitations, future work

Additional Requirements for Two-Term/Thesis Students

Draft Paper
(Two-Term/Thesis Students, Only)

- Submit a draft for at least the first few sections of your written report

- Logistics:
  - Due February 20 by 11:59pm
  - At least 4-5 pages, single spaced
  - Submit PDF via IW portal

Second Reader Form
(Thesis Students Only)

- Select a member of the Princeton faculty to be a second reader on your project

  - Second readers review your project and provide input on your grade

- Logistics:

  - Due in IW portal on February 27 by 11:59pm

    - Start asking early!

Second Reader Form

Please refer to independent work website for more information about this form.

Name *

Advisor *

Project title *

Who will be your second reader?

Note that your second reader will receive an email letting them know you selected them.

☐ My second reader is not listed above

☐ I confirm that my second reader has agreed to be a second reader for my thesis (you must get confirmation before submitting this form)

Submit

https://iw.cs.princeton.edu/portal

Spring Oral Presentation
(Two-Term/Thesis Students, Only)

- Give a live **12-minute** talk about what you've achieved over the course of the year

  - Required for all two-term and thesis students and all first-time BSE students.

- Logistics:

  - Slides due in IW portal on April 22, 11:59pm

    - Oral Presentations Week, April 21-25

    - Set up a time to present live (in-person or via Zoom) to your adviser.

More Logistics:

- Counts as Senior Departmental Exam for AB Seniors

- Attend "How to Give an IW Talk" on November 12 or March 25

- Utilize campus resources such as McGraw Center and Princeton Writes

Spring Oral Presentation, Continued
(Two-Term/Thesis Students, Only)

- Motivation and goal
  - "The goal of my project is…"
- Related work
  - Survey of prior work with similar goals
- Approach
  - Key novel idea
- Implementation plan
  - Things you implemented. How you did it? What remains to be done?
- Evaluation
  - Experiment design, data, metrics, comparisons, qualitative results, quantitative results, further results needed
- Discussion
  - Conclusions, limitations, future work

Additional Important Information

https://iw.cs.princeton.edu/portal

Manage your independent work

Fall 2024

Project Title	
Advisor	Kaplan, Alan
Written Proposal Due: 9/26/2024 11:59 pm	➜ Submit File
Checkpoint Form Due: 2024-10-22	➜ Click to complete form
Oral Presentation Slides Due: 12/8/2024 11:59 pm	➜ Submit File
Oral Presentation Video Link Due: 12/8/2024 11:59 pm	➜ Click to complete form
Written Final Report Due: 1/9/2025 11:59 pm	➜ Submit File

Funding

- Project-related expenses:
  - Unusual hardware, software, data sets, etc.
- Available funds:
  - School of Engineering and Applied Science
    - Requires an adviser signature, **don't procrastinate!**
  - Support up to ~$500 or more with justification ($300 max for cloud computing services)
  - Open to ANY computer science student
  - Student Activities Funding Engine (SAFE)
    - http://www.princeton.edu/studentfunding

Collaboration

- **__INDEPENDENT__ Work**
  - ➤ Every student must do their own project
- Collaboration
  - ➤ Multiple IW projects can be synergistically part of a larger effort, either with other IW students, or grad students
  - ➤ Each student must carve out a distinct part with a clear goal, novel idea, evaluation methodology, etc.
  - ➤ Each student must submit their own work
  - ➤ Each student will be graded separately

Grading

- IW must be taken for a grade
- Grades are recommended by instructor, confirmed by IW Coordinators

- Grades will depend upon:
  - <u>Student initiative and contribution</u>: the creativity and originality of student ideas and/or degree of technical challenge undertaken
  - <u>Student progress</u>: content, amount of work accomplished to date, clarity and polish of presentations
  - <u>Student presentation and paper</u>: content, eloquence, organization and clarity

Grading (Continued)

- Majority of grade will depend upon quality of work and presentation
  - ▷ Poor presentation and/or missing checkpoints will also have an impact

- **Final papers submitted after 11:59pm on the due date will be assigned a 1/3 grade deduction.**

Grading (Continued)

- A-level
  - ➤ Clear contribution – interesting, creative
  - ➤ Solid execution and results – refined and tested
  - ➤ Excellent talks, papers – thoughtful, thorough
  - ➤ Student has taken initiative and led project
- B-level
  - ➤ Not-so-innovative – possibly obvious from previous work
  - ➤ Working execution and results – not fully refined and tested
  - ➤ Complete papers and talks – limited insights

Grading (Continued)

- C-level
  - ▷ Not innovative
  - ▷ Unfinished or not working implementation
  - ▷ Report looks like workbook or lab report

- D-level
  - ▷ Nothing interesting attempted, nothing gained
  - ▷ Report is stream of consciousness

Common Mistakes

🚫 Mistake: Delaying project planning until last minute

➤ Instead: Get started right away

🚫 Mistake: Postponing meetings with your advisor

➤ Instead: Try to meet once a week, even if it's a brief meeting

🚫 Mistake: Allowing yourself to get stuck

➤ Instead: Talk to your advisor; don't avoid them when you are stuck

➤ TAs are usually assigned to every seminar. Use them!

Common Mistakes (Continued)

🚫 Mistake: Putting off work until the end of the term

➤ Instead: Work consistently during the term (10 hours per week, minimum)

🚫 Mistake: Preparing papers and presentations at the last minute

➤ Instead: Iteratively refine. Get feedback from your advisor.

If You're Having Trouble…

- Examples:
  - If you expect to miss a deadline
  - If you have problems with your advisor
  - If you have problems with your project
  - Other factors in your life (e.g. illness, death in the family, etc.)
- If you tell us early, we might be able to help you
  - We can direct you to the right person
- Fixing problems post facto may be much harder
  - Often involves Deans, etc.

LET US KNOW!

Who/What You Can Ask

- Your Advisor:
  - Anything research related
  - Not: "Can I skip the project proposal or final paper?"
- IW Coordinators (Dr. Fish, Dr. Walker)
  - Anything about mandatory requirements
  - Not: "Is this research interesting?"
- IW Administrator (Mikki Hornstein)
  - Anything about dates, forms, funding, etc.
  - Not: "Can you give me an extension?"

? How to Ask Questions

- Canvas/Ed – Primary Resource
  - https://princeton.instructure.com/courses/16713
  - https://edstem.org/us/courses/65428/discussion/
    - Ask IW staff and other students questions about logistics, advice, toolkits, data sets, etc.
- Email Mikki
  - mhornstein (@princeton.edu)

Where to Find More Information

■ IW Website:

➤ http://www.cs.princeton.edu/ugrad/independent-work

➤ Important Steps and Deadlines

➤ Guidelines and Useful Information

■ IW Handbooks:

➤ AB Handbook: https://www.cs.princeton.edu/sites/default/files/cos-ab-iw-handbook-2024-25.pdf

➤ BSE Handbook: https://www.cs.princeton.edu/sites/default/files/cos-bse-iw-handbook-2024-25.pdf

■ Note: These slides will also be available on the website and Canvas

That pretty much covers it.

Let's summarize the key points…

Immediate Next Steps

- Look over the IW website, IW handbooks, and be aware of important upcoming deadlines

- One-on-one students: Schedule weekly meetings with your advisor

What to Do in September?

- Work diligently to develop your project plan
  - Work hard to define a specific goal
  - Understand all related work
  - Articulate what makes your project novel
  - Know what software and data you will use
  - Have a good idea of what you need to implement
  - Have a specific plan to evaluate your results
- Write your project proposal early, get feedback, and refine multiple times.
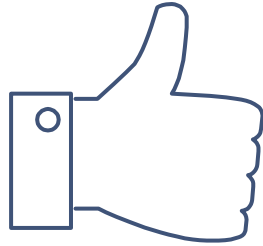
But the Term Just Started!

The first few weeks are really important…

- A good project plan is key to success

- It takes time to understand related work, relevant software, and available data sets

- It take iteration and refinement (multiple meetings with your advisor) to define a good project goal and novel approach

- Working hard in the first few weeks greatly reduces the chances of ending up with a weak project

My Thoughts on IW at Princeton

- This is your chance to do an in-depth project on a novel topic of your own choosing
  - ➤ It doesn't get better than this
  - ➤ It's probably why you came to Princeton
  - ➤ It's certainly what you'll remember most from your academic career at Princeton
- Take the initiative and BE AWESOME!

THANKS!

Any questions?