Computer Science I.S. Student/Advisor Guidelines (updated in 2024)

Independent Study is the student's opportunity to do a **significant piece of work in an area of personal interest** and to expand his or her understanding of computer science. This guide provides a description of what the I.S. advisor expects from the student.

1) Project topic Although the faculty advisor must approve all topics, the student is free to pursue virtually any area of computer science that is of interest. The topic should be challenging, but manageable with the resources and time available. A typical I.S. involves a theoretical investigation of a topic in Computer Science accompanied by a software implementation that illustrates concepts developed in the theoretical investigation.

2) Guidelines for professional conduct The student will meet with the advisor once a week and will provide 24-hour notice when unable to attend a meeting due to illness or a personal problem. **The student will come prepared to discuss ideas relating to the project, review progress, and map out work to be done.** It is expected that 10 - 12 hours per week will be dedicated to the I.S. and that **progress toward completion of the project will be demonstrated on a weekly basis.** The student will respond to all email correspondence from the advisor in a timely manner. The student will submit for review all presentation slides and the symposium poster to the advisor, typically a week before their due date. It is the student's responsibility to contact their advisor with questions concerning submission deadlines, submission format, etc.

3) Project submissions It is the **student's responsibility to meet all deadlines and submission requirements**, and to contact their advisor for clarification when necessary.

Junior year spring schedule

Due date	Deliverable	What and how to submit	Check as completed
Week 14	0) Attend preliminary Senior I.S. meeting	Attend meeting, time and location to be announced by Department Chair. Start thinking about an I.S. topic of interest to you – tips on how to start are included below.	
Week 16 (last day of classes)	1) I.S. preliminary proposal	Submit at this link to CS Chair a one paragraph I.S. preliminary proposal. Student is encouraged to briefly discuss their proposal with a CS faculty before submitting it. **Note:** CS double majors may complete Senior I.S. solely in the other major in which case they must take an additional 200 or 300 level full-credit CS course. If considering this option, please reach out to the CS Chair.	

How to begin searching for a topic? Here are some useful tips and resources.
- Reflect on CS courses you have taken to identify a broader area of interest and then continue your research to identify a narrower topic.
- Think of past projects that could grow into an I.S. topic.
- Explore recent I.S.s posted in PDF format at OpenWorks.
  - Peruse exemplar projects. These are good examples to follow.
  - Peruse computer science projects (note that this does not specify the project grade).
- Browse the ACM Digital library which has a multitude of journals and magazines in many CS subfields.

- Browse our Computer Science Subject Guide and Computer Science Subject Guide: Articles. These links take you to many of the commonly used databases (including ACM Digital Library; Computer & Applied Sciences Complete; Web of Science) where you can find a variety of CS articles.
- Browse the Quanta magazine, which has well-written articles in CS, math, physics, and biology, often highlighting new and exciting research in these areas.

Senior year fall schedule - deliverables and grading

Due date	Deliverable	What and how to submit	Check as completed
Weeks 1-16	0) Attend I.S. meetings (15 points)	Attend weekly I.S. meetings with advisor. Come prepared to discuss completed work and future directions. Every week students advance their work via library searches and readings and/or 2-3 pages of writing and/or writing software and/or data analysis etc.	
Week 3	1) Project summary (10 points)	Submit to advisor a one-page project summary – details on required contents are given below.	
Week 6 (last Tue/Th of September)	2) Oral presentation (10 points)	Give a four-minute (4 slides) presentation on your I. S. topic. Time and place will be announced. This is a brief introduction of research topic to peers and professors in the audience. Advisor will give feedback on organization of presentation, use of visuals, use of clear and concise language.	
Week 9 (after fall break)	3) Thesis outline and annotated bibliography (30 points)	Submit to advisor a one-page table of content showing chapter titles and sub-sections to be completed for the final thesis. Submit annotated bibliography with eight or more entries – an example is given below.	
Week 16 (last week of classes)	4) Chapter(s) and preliminary software/ data analysis using software tools (35 points)	Submit to advisor and second reader about 30 well written pages that are free of grammatical errors and that contain proper citations – Moodle link will be provided by your advisor. If applicable, demo your software during I.S. meeting. About 60% of software/data analysis using software tools must be completed – this serves as a prototype showing proof of principle.	

Grade for fall semester CS 451 The number of points awarded in each category will measure promptness, clarity of presentation, thoroughness, and consistency with documents already submitted.
S: 80 to 100 points and student has completed all indicated submissions
NC: 0 to 79 points

Project summary is a formal document, not a slip of paper with a few vague ideas on it about what the student thinks would be interesting to do. To receive approval for a project, the student will present a proposal outlining the following.
- The project's focus (e.g., examine artificial intelligence and speech synthesis, investigate microcomputer security, examine the importance of documentation (human factors), etc.).
- The project's objectives in terms of the topics that the theoretical portion of the IS thesis will cover, the software or documents that the project will produce, and the learning that will result from accomplishing the project.

- The efforts that will contribute to the project: programming, interviews, special library research, trips, and needed materials (languages, machines, documentation, APIs, equipment, etc.).
- Challenges that might be encountered, and whether these potential problems could make the rest of the project impossible if they can't be surmounted.
- A timetable specifying the weeks throughout the semesters that phases of the project will be complete.
- A minimum of five references (journal articles, technical reports, books) on your proposed topic. Only a subset can be online references.

Annotated bibliography is a bibliography in which each entry includes a description of the entry's content and the role it might take in the research. This description is *not* a copy of the entry's abstract. A LaTeX template can be found here: https://github.com/hmm34/example-annotated-bibliography

Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. *Introduction to Algorithms, Third Edition. The MIT Press*, 3rd edition, 2009.

This is a popular algorithms textbook which is well-cited. Part VI on graph algorithms is of particular interest. Chapter 26 discusses flow networks and introduces commonly used notation. It formally describes the problem of obtaining a maximum flow and its equivalence to obtaining a minimum cut. The classical method of Ford and Fulkerson's algorithm for finding a maximum flow is described, and it includes several examples. Additional methods for obtaining a maximum flow, including the push-relabel method, are also described. The chapter notes include additional references to specific articles which may be helpful, such as those of historical interest (the article in which an algorithm was originally proposed) as well as state-of-the-art improvements (more recent articles to improve the approach).

Senior year spring schedule - deliverables and grading

Due date	Deliverable	What and how to submit	Check as completed
Weeks 1-7	0) Attend I.S. meetings	Attend weekly I.S. meetings with advisor.	
Week 7 (Friday, one week before spring break)	1) I.S. complete final draft	Submit to advisor a complete final draft (~70 pages). Feedback will be provided to be incorporated into final thesis.	
Week 11 (Monday after spring break)	2) I.S. thesis as PDF for College	By 5pm submit I.S. in PDF format electronically to Registrar and OpenWorks. Additional instructions will be given.	
Week 11 (last day of March)	3) Software and I.S. thesis for Department	Upload modularized and well-documented software and a PDF copy of the thesis. Advisor provides the upload link.	
Weeks 12-15 (between April 1 and I.S. Symposium)	4) Oral defense	Schedule with advisor and second reader a one-hour I.S. oral presentation. Reserve a room for presentation. Prepare a 25min presentation and, if applicable, a demo of the software; reserve 25min for questions. Grading criteria for the oral presentation is included in the grading rubric for CS 452 and detailed below.	
Week 15 (Friday before last week of classes)	5) Poster for the I.S. Symposium	Prepare and present a poster that summarizes the I.S. work and main findings. A few guidelines for creating an effective poster are included below. Please share poster with your advisor to receive feedback. Additional information regarding printing and presentation time will be provided.	

Grade for spring semester CS 452 Grading rubric is enclosed in Appendix A. The spring semester grade (H, G, S, NC) is an evaluation of the final thesis, the oral presentation, the organization of the project effort, the software/data analysis, and participation in the I.S. Symposium. Part of this evaluation includes attending weekly meetings, providing timely and grammatically clean drafts, and demonstrating weekly progress.

Oral presentation Grading of the oral presentation evaluates the organization, spontaneity, flow, continuity, and comprehensibility of the presentation. It also evaluates the student's ability to respond to reasonable questions and explain points of confusion. The student should use visual aids as a means of guiding the presentation but should avoid reading material to the audience. A major challenge of the presentation is to identify the key points to cover in giving a good description of the project in a relatively short time period.

Poster A poster is usually a mixture of a brief text and tables, graphs, pictures. An effective poster includes a title; student and advisor(s) names; clear and concise bullet points describing the work and the main findings; good use of graphics, fonts, and colors.

4) Paper formatting Two settings for the final thesis are listed below; see additional details in Appendix B.

a) The degree and departmental information on first page of the manuscript must use the following single/double major formats illustrated below for:

- a CS major:

> Presented in Partial Fulfillment of the Requirements for
> the Degree Bachelor of Arts in Computer Science in
> the Department of Mathematical & Computational Sciences
> at The College of Wooster

- a CS and History double major:

> Presented in Partial Fulfillment of the Requirements for
> the Degree Bachelor of Arts in Computer Science and History
> in the Department of Mathematical & Computational Sciences
> and Department of History at The College of Wooster

b) Once your I.S. is nearly complete, change your IS from draft format to a nicer format by commenting out in the file **username.tex** the red line of text below and uncommenting the green one:

```
% use this declaration for a draft version of your IS
\documentclass[10pt,palatino,code,picins,kaukecopyright,openright,woolshort,
dropcaps,verbatim,index,euler]{woosterthesis}

% use this declaration for the PDF version of your IS
%\documentclass[12pt,code,palatino,picins,kaukecopyright,openright,twoside]{
woosterthesis}
```

Appendix A: CS 452 grading

<u>**CS 452 Evaluation Rubric**</u> (revised fall 2017)

This rubric serves as a starting point for discussion among the CS faculty about CS 452 grades. Not all questions apply equally well to every project, and some are only appropriate for the first reader. Roughly speaking, a score of 4 in an area corresponds to Honors-level achievement, 3 to Good, and 2 to Satisfactory, with 1 and 0 indicating substandard performance. However, the way in which these elements are weighted is topic-dependent, and a particular set of scores does not guarantee a certain 452 grade. For double majors, the evaluation of the project from the perspective of the other discipline is also significant in determining the grade.

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1. Depth of Material Covered – Based on the material covered in your weekly meetings with the student, and the final written document, which statement best describes the depth of the student's investigation?
- **(4 - Exceptional)** The student did a thorough investigation into this topic, providing examples and going well beyond the minimum depth required of a 2-semester project.
- **(3 - Strong)** The student did a comprehensive summary of this topic, providing examples and personalizing the material.
- **(2 - Adequate)** The student did a good summary of the material, and went into a depth appropriate for a 2-semester investigation.
- **(1 - Marginal)** The student covered some topics well, but failed to go into enough depth with others.
- **(0 - Unsatisfactory)** The student a brief summary of the material, but did not achieve the depth required of a 2-semester investigation.

2. Student Understanding and Mastery of the Subject - Based on the weekly meetings with your I.S. student and the final written project, which statement best describes this student's understanding of the content in the I.S.?
- **(4 - Exceptional)** The student has a thorough understanding of this material and should be able to answer probing questions on any of the content.
- **(3 - Strong)** The student has a good understanding of this material but may have difficulty answering probing questions.
- **(2 - Adequate)** The student has a good understanding of some portion of this material, but approximately _____% of the work was completed without the benefit of discussion with the advisor.
- **(1 - Marginal)** The student has some difficulty understanding a significant portion of the material and will have difficulty answering questions.
- **(0 - Unsatisfactory)** The student lacks a basic understanding of the fundamental ideas contained in the written document, and will not be able to answer questions.

3. Independence of Learning (for first readers only) – Based on the weekly meetings with your I.S. student, which statement best describes the student's initiative and independence throughout the process?
- **(4 - Exceptional)** The student demonstrated strong initiative and independence, requiring only a minimal amount of guidance.
- **(3 - Strong)** The student demonstrated good initiative and worked mostly independently, requiring an appropriate amount of guidance.
- **(2 - Adequate)** The student was self-directed for some of the thesis, but required lots of guidance on other parts.
- **(1 - Marginal)** The student was unable to work without strict deadlines and lots of guidance regarding the direction of the thesis.
- **(0 - Unsatisfactory)** Despite deadlines and guidance from the advisor, the student failed to complete work in a timely manner.

4. Assimilation of Material – Based on your discussions with this I.S. student, the bibliography, and the final written document, which statement best describes the student's assimilation of the material?
- **(4 - Exceptional)** The student assimilated material from a wide variety of sources.
- **(3 - Strong)** The student used material from multiple sources and did some assimilation of that material.
- **(2 - Adequate)** The student used material from multiple sources.
- **(1 - Marginal)** The student primarily used one source, but did use some material from at least one other source.
- **(0 - Unsatisfactory)** The student used one primary source from which all material is taken.

5. Form/Writing Quality – Which statement best describes the quality of the student's writing in the thesis including organization, readability, form (grammar, spelling, typesetting), and style?
- **(4 - Exceptional)** The I.S. is written in a clear and well-organized manner, with excellent grammar, spelling, and typesetting. Moreover, it is written in the student's unique style and directed toward an audience of peers.
- **(3 - Strong)** The I.S. is well-organized and very readable, with very few errors in spelling, grammar, or typesetting.
- **(2 - Adequate)** The I.S. is well-organized and readable, despite some errors in spelling, grammar, or typesetting.

- **(1 - Marginal)** The I.S. is somewhat difficult to read because of weak organization, lack of clarity, and a number of errors in spelling, grammar, or typesetting.
- **(0 - Unsatisfactory)** The I.S. is quite difficult to read because of disorganization and of poor grammar.

6. Project – Which statement best describes the quality of the project including project goals, design, and relevance to the thesis?

- **(4 - Exceptional)** Project goals are clearly stated and are complete. The project is an excellent illustration of the thesis topic. Project design is excellent; it is detailed and covers all project goals.
- **(3 - Strong)** Project goals are nicely stated and are mostly complete. The project provides a good illustration of the thesis topic. Project design is good; some details may be missing or some goals not clearly covered.
- **(2 - Adequate)** Project goals are presented and are understandable. The project adequately illustrates the thesis in broad terms with varying degrees of depth. Project design is present, but lacks detail or doesn't include all project goals.
- **(1 - Marginal)** Project goals are incomplete or unclear. Some aspects of the thesis are not covered or are covered only superficially by the project. The design exists in broad form only and doesn't clearly cover some of project goals.
- **(0 - Unsatisfactory)** Project goals are unclear, vague, or missing altogether. The link to the thesis is unclear or the project is not relevant to the thesis topic. Design is missing or very superficial.

7. Project Implementation – Which statement best describes the quality of the project implementation including completeness, quality, correctness, planning, use of resources, documentation, etc.?

- **(4 - Exceptional)** The project is completed as designed and is of high quality. Correctness can be demonstrated. Resources (equipment, software tools, library, etc.) are used creatively and code is well documented.
- **(3 - Strong)** Most of the project is completed as designed and is of generally high quality. Some components may be missing, incomplete or incorrect. Good use of resources.
- **(2 - Adequate)** Most of the project is completed as designed and is of generally good quality. Some components are missing, incomplete or incorrect. Resource usage is adequate.
- **(1 - Marginal)** Many components are incomplete or incorrect. Overall quality of the project components is poor. Poor use of resources; lack of awareness of available resources.
- **(0 - Unsatisfactory)** Project largely incomplete or incorrect. Very poor use of available resources or resources used inappropriately.

8. Project Results – Which statement best describes the quality of the project results including relevance to thesis and completeness (Note: results need not be positive)?

- **(4 - Exceptional)** All components of the project produced results that are clearly relevant to the thesis. All of the thesis' goals are covered by the results.
- **(3 - Strong)** All or most components produced results relevant to the thesis. Most of the thesis' goals are covered by the results.
- **(2 - Adequate)** Most project components produced results relevant to the thesis topic. Most of the thesis' goals are covered by the results.
- **(1 - Marginal)** Results are largely incomplete or are only loosely relevant to the thesis. Many aspects of the thesis are not present in the results.
- **(0 - Unsatisfactory)** No results or results irrelevant to the thesis. Much of the thesis is not demonstrated in the results.

9. Presentation – Which statement best describes the quality of the student's final oral presentation, considering organization, knowledge of content, audience awareness, and professionalism? (For double majors whose oral exam begins from a poster, rather than an oral presentation, consider the poster instead.)

- **(4 - Exceptional)** The presentation was excellent overall, and strong in each of these aspects.
- **(3 - Strong)** The presentation was solid, with only minimal problems in any of these aspects.
- **(2 - Adequate)** The presentation was acceptable, despite some weakness in one or more aspects.
- **(1 - Marginal)** The presentation was substantially hampered by a pronounced weakness in at least one aspect.
- **(0 - Unsatisfactory)** The presentation was unacceptable, with pronounced weaknesses in multiple aspects.

Appendix B: Paper formatting

Overall Document Left margin 1.5 in Right margin 1.25 in Top margin 1 in Bottom margin 1 in Pages should also be numbered Double-sided and Spiral bound Chapters start on a new page Theorems, lemmas, examples, corollaries, definitions, propositions, remarks, notation, terminology, figures, and tables numbered within Chapters. **Title page** (no page number - everything centered except Advisors which are on left margin) Title Independent Study Thesis Presented in Partial Fulfillment of the Requirements for the Degree Bachelor of Arts in Computer Science in the Department of Mathematical & Computational Sciences at the College of Wooster by Author The College of Wooster Year Advised by: Advisors **Frontmatter** (Page numbers at bottom of pages) Blank page hidden page number Copyright page (optional and hidden page number) Abstract (roman page number (ii or iii based on copyright or not)) Dedication (optional) Acknowledgments (optional)	Vita (optional) Table of Contents List of Figures (only needed if there are figures) List of Tables (only needed if there are tables) List of Listings (only needed if there are code listings) Preface (optional) (A chapter which is not numbered or lettered) **Mainmatter** Numbered Sections (Page numbers in arabic, first page number of chapter centered at bottom, remaining page numbers in upper right and running header on upper left (Chapter number Chapter title)) Introduction (Chapter 1) Body (Chapters 2-?) **Backmatter** Lettered Sections (Page numbers in arabic, first page number of appendix centered at bottom, remaining page numbers in upper right and running header on upper left (Appendix letter Appendix title)) Appendices **Sections not lettered or numbered** Afterword (optional) References Index (optional) (two column alphabetized) Colophon (optional) Blank page (hidden page number) An example of a completed thesis can be found at: https://github.com/jbreitenbucher/exampleis/releases

Appendix C: AI Policy

AI generators such as ChatGPT, Gemini, Claude, etc., have proliferated across almost evert spectrum of technology. These tools bring with them many ethical questions, particularly concerning academic integrity. The line between original thought and cited work can become blurry when AI is utilized for writing or coding. But new technology is always changing how we work, write, and produce mathematics, and AI is not going away. Hence, it is the policy of the MCS department that the use of AI is not expressly forbidden. However, care should be taken when utilizing this new technology: ***any use of AI must be documented and cited according to the guidelines below***.

AI may be used for:
1. Brainstorming, idea generation - No citations necessary.
2. Providing ideas for ordering and outlining writing - Cite your prompt and the provided output in an appendix.
3. Providing feedback on writing - No citation needed.
4. Providing revision ideas on specific sentences, passages, or paragraphs, reflecting no more than 20% of a section/chapter.
    a. Why not the whole work? Because we want you to be able to discern where you think you need the help – even if a friend, your advisor, the Writing Center, or AI helps you make that discernment.
    b. Documentation: either include a footnote at the end of any sentence that had AI-assistance noting that it was revised with AI or include a list at the end of the IS of the sentences you had AI help you revise.
    c. You do not need to document if you used AI to help provide you with synonyms, key terms, or alternate wording of a small phrase.

AI may not be used for: Creating new content: whether that be full sentences, paragraphs, summaries, sections, chapters, or the entire IS.

Please consult with your IS advisor on how they would prefer your citations and documentation regarding AI usage.

Disclaimer: The above AI guidelines serve as a bare minimum for AI usage. Your IS advisor may demand stricter citation and documentation of any AI use. It is also up to the discretion of your IS advisor whether any AI use is permitted at all.

Document Tracking Best Practices

Being able to track revisions of your IS work is beneficial for both you and your IS advisor. Revision/document history exists natively in *Microsoft Word.* It also exists for the online LaTeX editor *Overleaf*, but only for paid subscriptions. Version-control platforms like *Github* allow you to manage document history and are a great free option for projects written in LaTeX. **Note:** You can download an MS Word template here and a LaTeX template here.

In summary, please adhere to the following best practices for your IS Project:
1. **For Everyone:** Use your College of Wooster OneDrive to save your IS documents. Share your project files with your IS advisor. By using your OneDrive, you don't have to worry about losing IS progress if your local hard drive decides to give up the ghost.
2. **MS Word User:** Ensure that track changes is turned on. This helps keep your project a living document and aids in revision work.
3. **LaTeX Users:** Use Git for version control of your LaTeX documents. There are many free GUI clients for using Git. Lots of businesses use GitHub Desktop or Github on the web. Here is a quick start guide to using GitHub.