COMPUTER SCIENCE 373

Senior Research Seminar

CSCI 373 Handbook

Fourteenth Edition

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Handbook for CSCI 373, 14th Edition

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Course Overview

Course description, objectives, expectations and frequently asked questions (FAQs).

T he Computer Science Department Senior Research Seminar (CSCI373) is a capstone course for Computer Science majors in their senior year. It is the alternative to an Honors Thesis and can be considered a more highly structured and regulated thesis development process, with a special emphasis on topics for students who will become professionals in the computing field. Computer science is a rapidly changing field. Successful professionals in this field must keep up with new research and development, even after leaving an academic setting, and must be able to communicate clearly and convincingly on new topics. Overall, this course is intended to equip successful students with an appreciation for and desire to continue their education in computer science and related fields, and to further improve their research and communication skills in computer science and technology.

Course Objectives

Upon successful completion of this course, students should have made substantial academic progress in the following ways:

1. **Research**: Students will have an ability to conduct research in new science and technology areas using library resources, journals, online courses and materials, search engines, news groups, subscription services and informal communications. Thorough research is important to provide context for new work and to avoid redundancy (and the associated embarrassment). Through research, students will be aware that new science and technology is not developed in isolation. In particular, it is important to be aware of the history that leads to new developments, to be sensitive to any ethical issues related to new developments, and to be aware of future research and development trends.

2. **Writing:** Students will improve their abilities in scientific and technical writing. The written word carries an influence that is independent of the writer. Well-

written text can have an influence that exceeds the time and breadth of any other form of communication. Technical reports, position papers and even email can have tremendous sustained value for the purposes of retaining and communicating technical information. The ability to write well is essential for the students' long-term success.

3. **Live Speaking:** Students will improve their speaking skills, developing a sense of comfort and authority. They will learn to choose the scope of their presentations to best hold audience attention and make points clearly and efficiently. Good speaking skills compliment good writing skills. Both are important to any computer professional who wants to succeed beyond the role of an individual contributor on a project.

4. **Recorded presentations:** Students will learn to develop effective recorded presentations for the purposes of informing and instructing listeners and viewers. Audio and video recordings are ubiquitous and provide a preferred mode of learning for many people. Audio podcasts, TED[1] talks, Khan Academy[2] lectures, MOOCs[3] and recorded conference presentations are just a few of the sources for knowledge delivery. Similar to written content, recorded presentations can have broad and sustained impact.

5. **Discussion:** Students will improve discussion skills, learning how to carefully listen to other participants, contribute clearly and succinctly, and elicit contributions from all members. Good discussion skills are important for clear communication in professional setting, building a respectful and comfortable work environment and developing strong professional relationships.

6. **Continuing Education:** Students will increase their appreciation for the value of continued, self-initiated education in computer science and technology, and the role of technology in society. Furthermore, they will experience concrete approaches for building habits that will foster this continuing education. Computer science is a rapidly changing field and its impact on society is always changing. Thus it is very important that professionals develop habits to promote continued education from a variety of information sources.

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[1] Technology, Entertainment and Design (TED) provides a large collection of short presentations on many topics, http://www.ted.com.

[2] Khan Academy provides a large collection of instructional talks and other material in many academic subjects, https://www.khanacademy.org.

[3] Massive Open Online Courses (MOOCs) are an alternative and complement to in-person classroom learning. http://en.wikipedia.org/wiki/Massive_open_online_course.

Course Expectations

Students of this course are expected to do the following:

1. **Attendance:** Attend all class sessions, or receive prior approval for absence from the instructor.

2. **Discussion:** Participate in class discussions. We will have a variety of in-class discussions and exercises. Exercises will include activities to develop good skills in technical discussion, title and abstract writing, and technical presentation. You will develop the ability to discuss technical topics with peers at a concrete and abstract level, using basic skills of respectful discourse, inclusion of all group members, eliciting contributions from all members and bringing decision-making discussions to group consensus.

3. **Assignments:** Complete all assignments on time, following general class guidelines as well as specific assignment instructions. Late assignments will not be accepted unless the instructor grants prior approval.

4. **Self-teaching reflections:** Each Friday before noon (except when on break), I expect you to submit a reflection on articles you have read, viewed or heard as described in the recurring assignments discussion in Chapter 5. You may not make up these assignments since the whole point is to help you build a habit of self-teaching through regularly learning new ideas on your own.

5. **Resources:** Use credible sources for research content. Integrate and synthesize source material into an informed personal perspective on a topic. **Plagiarism will not be tolerated. It is grounds for dismissal from class and further discipline at the college.**

6. **Remedial work:** Meet with the instructor if there may be potential difficulties in basic writing and presentation skills. It is expected, prior to starting this class, that students have at least average general writing and presentation skills, as would be obtained by successful completion of prior college courses. Students should be able to adequately structure a written document, provide citations to published works and use computer tools for writing reports and giving presentations. The instructor should be consulted early in the semester about any potential difficulties in these areas so that accommodations can be put in place to help the student succeed.

Academic and Real World

One overarching theme of this course is to help you experience "real world" situations in an academic setting. Several experiences in this course might be unusual for you:

1. **Paper lengths:** *You will not be asked to write papers of a minimum length in this course.* You will be asked to provide sufficient content to satisfy the assignment and given an indication of approximately how many words that might require. However, even that value is a suggestion. In fact, as in real life, you will be expected to use **as few words as possible** in order to convey your ideas. Our motto is: *Enough words, No More.*

2. **Topic repetition:** *By the end of the semester you will write about and present your topic several times.* You will have both the opportunity and requirement to write and present your topic material several times. This is good from the perspective of building expertise, but also means good self-discipline to take advantage of the opportunities to delve deeper into your topic.

3. **Owning the topic:** *You are the owner of your topic, especially the details of what you will study and develop.* In most professional settings, you will have latitude and responsibility to define your work agenda. This may not be true immediately, but will become a greater part of your role as you gain experience. Having control over the details of your work can be extremely satisfying and rewarding.

4. **Self-learning:** *You will be in charge of what you learn after graduating.* The computing field changes rapidly from year to year, at least on the surface. The "future you" will thank the "present you" if you build a habit of continued learning. Many resources are available for self-learning, including excellent online courses, technical web portals and thought leader blogs.

5. **Intellectual challenge:** *Your topic will present you with significant intellectual challenges that you must face and own.* Your topic (if it is a good one) will present a significant challenge for you intellectually. You will have technical papers and other resources that require significant study, and you will not understand them right away. You will need to find additional resources (papers, faculty members, community experts) to help you understand the required concepts, and you must find them.

6. **Structured content:** *Large projects require several elements for delivering content. You will need to package content in several ways for various audiences.* Your presentations, abstracts and conclusions play an important role to help your potential audience understand and want to learn more about your work.

Frequently Asked Questions (FAQs)

7. **How do I select a topic for my project?**
   This is the most important question to answer well. Chapter 3 discusses this issue in detail.

8. **Can I fail this course?**
   Yes, it is possible to fail this course.

9. **What happens if I fail this course?**
   You will need to repeat it or write an Honors Thesis in order to graduate as a computer science major.

10. **I cannot find resources for my topic. What should I do?**
    First, read Chapter 3 to make sure you have considered all of the suggested approaches. If you are still having trouble finding sources, you should consider broadening the topic scope, if possible. As a last resort you should consider switching topic areas.

11. **I have too many resources for my topic. What should I do?**
    In this case, you should try to reduce the scope of your topic, focusing on a subset of the original scope.

An Overview of a State-of-the-Field Project

Overview of a state-of-the-field project and discussion of its components.

The overall focus of this course is a state-of-the-field (SOTF) project involving the full development of a topic that is of current interest in the scientific or technological community. Some topic areas in past years have been:

1. Digital Currency.

2. Computing on Emerging Architectures.

3. Natural Language Processing.

4. Computational Financial Modeling.

State-of-the-Field Components

Understanding the present state and future trends of any given topic requires an understanding of its related history and of the societal issues that may be important to current and future developments. As a result, an SOTF project contains the following five components:

1. **History:** What basic human/societal need is met? How was it met in the past?

2. **Technical Analysis:** What are the technical underpinnings for your topic area?

3. **Demonstration/Prototype:** What experiments do I need to perform to test ideas?

4. **State-of-the-Field:** What is the current state of the field?

5. **Future trends:** What are the likely developments in this area in three to five year?

The first major assignment will be a preliminary SOTF paper and presentation. You can think of this as an extended abstract. For the remainder of the semester we will proceed to fill out each of the above components, resulting in the final SOTF paper and presentation. Details for each assignment are found in Chapter 5.

Why a State-of-the-Field Project?

There are many forms of writing that are appropriate for scientific and technical material. Our motivation for focusing on a state-of-the-field project is that it gives students an opportunity to experience several styles of writing, while keeping focus on a single topic area. Also, the SOTF form appears in many professional settings. It is a composite form of communication that allows the writer to both inform and influence the reader. For professionals in computer science and related fields, situations often arise where this type of writing is essential.

How To Succeed in this Course

General policies and advice for succeeding without unnecessary effort.

T here are several issues that, if well-addressed will help a student succeed in this course. Probably the most important is the selection of a good topic.

Select a Good Topic

We cannot overstate the importance of selecting an appropriate topic for success in this course. Two aspects are important:

1. **Topic Area:** This is the broad description of the topic of interest, e.g. Iris recognition. We often refer to this as your topic.

2. **Topic Scope:** This is the specific level of detail and emphasis that you will address within the topic area.

Generally we first focus on selecting the topic area and an approximate topic scope. It is generally easy to adjust the topic scope as needed during the semester but it is very difficult to change topic areas.

The first phase of selecting a topic is best described as brainstorming, listing multiple topics in computer science or computer-related fields that are of potential interest to you. A good way to seed this process is to review a number of general computer science journals and magazines such as Communications of the ACM, IEEE Computer, or IEEE Spectrum. Once you have listed a number of topics, consider the following questions for each topic:

1. Does it have a significant computer science component? (Does it require your computer science background in order to do the research?)

2. Are there sufficient high-quality resources at your disposal?

3. Does it address a perennial societal/human issue?

4. Is it an active field in the computer science community?

5. Can I develop a demonstration or prototype capability in this topic area?

6. Is there a rich history related to this topic?

7. Can I identify what people in the 19th century were doing to address the same societal/human issue?

Often, a good way to limit the scope of a topic area is to look at the intersection of a technology and an application area. For example, if you start with the broad topic of Artificial Intelligence, you may want to first narrow it to Artificial Intelligence as applied to role-playing games. If your topic of interest is iris recognition, you may want to focus on iris recognition in security applications. Looking at an application area as well as a technology helps to sharpen focus on specific issues regarding the technology.

Plan Ahead, Work Ahead

The nature of this course and how it is scheduled allows the motivated student to complete much of the course work in the early part of the

> If I had eight hours to chop down a tree, I'd spend six hours sharpening my ax.
> — Abraham Lincoln

semester. In particular, you should consider the following issues:

1. **Plan ahead:** Once you have selected your topic, it is in your best interest to identify and gather research material early in the semester. Finding credible, relevant resources takes time; both an investment of your time, and patience waiting for the arrival of remotely located resources.

2. **Work ahead:** Your final SOTF paper and presentation is a synthesis of your previous papers and presentations. High quality work on early assignments not only improves your grade but also makes your final paper and presentation easier to complete.

Locate Credible and Relevant Resources

The Internet and the ever-growing availability of online information has been a great asset for gathering research materials. At the same time, it is a challenge to isolate credible resources amidst all of the information we can find. This is sometimes referred to as "finding a needle in a needle stack." If you do not plan ahead, or do not make an effort to go beyond a first-level web search on your topic, you will not find sufficient high-quality resources for your work. To improve the quality of your resources, consider the following approaches:

1. **ACM Digital Library:** We have access to the ACM digital library, which provides a wealth of journal articles and conference proceedings that will provide a foundation for your research.

2. **IEEE Computer Society Library**: Through the CSB/SJU Library, we also have access to a subset of the IEEE Computer Society Library. These publications also provide a broad base of material for your research.

3. **Web searches engines:** Although web search engines are usually not sufficient for finding credible, relevant resources, they can be a good starting point. Careful selection of key words can help to identify issues related to your topic and, even more importantly, the leaders doing work in your topic area. Overall, search engines are bad way to directly find topic resources, but an excellent way to identify potential resources.

4. **Library search engines:** Our library websites contain excellent search engines that go beyond what is readily available on the Internet. These tools search a variety of collections of peer-reviewed publications that are the most reliable and high-quality source of material on your topic. These search engines are available from the main library website.

5. **Inter-library loan:** Our libraries have access to almost any printed material (via inter-library loan) in original form as a book, as a photocopy of a journal article, or in electronic form. This is an excellent resource, but it requires planning ahead.

6. **Bibliographies:** One of the best ways to obtain resources is from the citations of articles and books you have already acquired. This is probably the best way to get a complete picture of what is important in your topic area.

7. **Contact experts:** Once you have identified an expert in your topic area, an excellent way to get more information is to contact this person. Experts are accustomed to answering queries and are often excited when a new person shows interest in their subject matter.

How Many Resources Do I Need?

A healthy project will typically have 15-20 resources (books, articles, experts or substantial websites) that you study and understand well. You will usually acquire these resources through the first half of the semester and assimilate their content during the first two-thirds of the semester. These resources form the foundation for your project.

Writing and Presenting

General rules for improving your writings and presentations

This chapter lists a set of general rules-of-thumb for improving your writings and presentations. These are not hard and fast rules to be obeyed blindly, but are suggestions that can be useful to many people.

General

1. **Avoid grandiose language:** Avoid superlatives such as "huge", "fantastic", "are endless". These are essentially meaningless terms that belong in a marketing brochure, not a technical presentation or document.

2. **Justify strong assertions:** When you make a strong assertion such as "X is the best method for…" justify your assertion with:

    a. Objective data.

    b. Extrapolation of existing data.

    c. Quotes from recognized experts in the field.

    d. Correlation to trends in a related field.

3. **Avoid informal and imprecise language:** Phrases such as "X is flaky", "Y will take over the industry" are not appropriate for professional presentations or documents.

4. **Use spelling and grammar tools:** Use the spelling and grammar checking tools in your document management software.

5. **Read for spelling and grammar errors:** Automatic tools are not perfect. You should still read the text for errors. For example, grammar tools will not detect use of "lead" where "led" should have been used.

Writing

Writing your ideas into paragraphs is often the most important process for clarifying your thoughts. A well-written paragraph is the indivisible "atomic unit" of good writing.

> Writing is nature's way of letting you know how sloppy your thinking is.
> — Richard Guindon

Writing a complete idea in a few sentences best generates a good paragraph, worrying first about capturing the full idea you want to express. The paragraph is improved by iteration:
1. Correct grammar and spelling errors.
2. Confirm word selection in order to say precisely what you mean.
3. Reduce word count while retaining original message.
4. Repeat.

For the writer who is used to producing a paper the night before it is due, this process will be foreign, but will help produce shorter and better documents.

For most of your academic life you have likely been told to write your papers with a minimum length measured in pages or word count. In contrast, in professional life, almost

> Enough words, no more.
> — Class Motto

everything you write will be limited to a *maximum* page or word count. In this course we will emphasize the latter.

Consider the following general rules when writing your papers.

1. **Say what you will say, say it, say what you said, but not quite:** Instead, provide motivation and background for your readers, bringing them into the context you will create. Then, present your major ideas in tightly written, compact paragraphs that flow logically from one to the next. Then review your main points and synthesize points that were implicit, so that your conclusion has impact.

2. **Enough words, no more:** This is our class motto for writing. Each paragraph should be compact, using only a sufficient number of words. The best way to create a compact paragraph is through

> All good writing is done by compression.
> — Terry Moore

iteration; repeatedly review the paragraph until it cannot be improved.

3. **Complete a draft of your paper before the due date, then iterate:**
   Almost certainly, an unreviewed draft of your paper can be improved.
   Plan for this and complete it 2 – 3 days before it is due, then iterate on it
   using the recommendations in this chapter.

Presentations

Giving a good presentation is challenging. It is not like giving a classroom lecture; so avoid that assumption. Instead it is more like being an actor in a play. When acting,

> As an actor engages with the scene, so should you interact with your slides.

would you recite the scene description? No, these facts are obvious from the scene itself. In the same way, in a presentation your spoken words and slide content should complement and enhance each other.

In a technical presentation, slides are very useful for diagrams, pictures, detailed lists of items and quotes. You may describe a slide's content, but do not repeat the words that are on it. Your audience can read much more quickly than you can recite!

Consider these additional general rules when preparing for and giving a presentation.

1. **Assume a comfortable, authoritative presentation position:** Look at the wall projection with us or at the audience, not the computer screen. Avoid a rigid stance behind the podium.

2. **Avoid "My topic is…":** Avoid "My topic is…" as the introduction to your presentation.

3. **Avoid "They say…":** Avoid "They say…". Who is "they"?

4. **Be prepared to answer questions:** If you mention a term or concept in your presentation, or make an assertion, be prepared to answer questions about it. If you are not familiar with the idea, leave it out of your presentation.

5. **Do not use slides as note cards:** Use figures, pictures, icons and (modest amounts of) motion in your slides. Avoid large amounts of text on slides. With the exception of quotes, do not read from your slides.

6. **Perform sanity test:** Before you give your presentation, walk through the process of setting it up.

7. **Deliver key points in conclusion:** A typical audience member will remember only a handful of key points from a presentation. Because of this, you should design your presentation as follows:

   a. Develop a draft of your presentation.

   b. After reviewing the draft, decide what handful of points you want your audience to remember. These points will be your conclusions.

c. Remove content from your presentation that is not essential to making your key points.

d. Add content that will support your key points.

e. Foreshadow your key points, individually or as a thesis, in the introduction of your presentation.

Course Assignments

Detailed descriptions of course assignments for the entire semester

This chapter describes all major course assignments in detail. In addition to the assignments described here, we will have smaller exercises as part of class discussions.

Recurrent Assignment: Self-teaching reflections

Due: Each Friday by noon (except during break).

Description: One of the primary objectives of this course is to foster habits of continuing educations. In support of this objective, each student will complete regular reading, viewing and listening assignments.

Requirements:

1. Read, view or listen to three articles or presentations between class meetings. At least one source must be text and at least one source must be audio or video.

2. At least one source must be peer-reviewed. Any of the journals published by the Association for Computing Machinery (ACM) would be appropriate.

3. The second and third source can be from any resource including business and technology newspapers, as long as the article has some connection to computing. TED talks, MOOCs, Khan Academy, or similar resources are acceptable.

4. Before each class meeting, the student will submit (using an online form available from the class website) reviews for two of their sources from the previous week along with the citation for the third source. The reviews should include a summary and any reaction you had to it contents.

5. NOTE: After the first two weeks, sources must be selected from **outside** your SOTF topic area.

6. **NOTE: Excessive failures to submit these assignments is grounds for failing the course.**

Recurrent Assignment: Class Discussion

Due: During in-class discussion and exercises.

Description: Discussion of scientific and technical information requires the ability to communicate using precise language, good listening skills, persistence in clarifying technical ideas, respect for discussion participants and inclusion of all participants. If decisions are to be made as part of the discussion, a good discussion leader will work to reach consensus and identify points of contention. All discussion members will respect the time of others by speaking clearly and succinctly.

Requirements:

1. Participate in discussions as part of in-class exercises.

2. Exercises will include practice of basic scientific and technical discussion skills, and group exercises on title and abstract writing and presentation development.

3. We will also discuss current topics in computer science on a regular basis using articles that were assigned for reading between classes.

4. Class members are expected to come prepared for discussion, participate by speaking, listening, drawing others into the conversation and treating others with respect. Furthermore, when appropriate, group members should work toward bringing the group to consensus when making decisions.

5. Class discussion skills will be assessed three times during the term.

Assignment 1: Preliminary State-of-the-Field Paper

Description: You will write a paper and give a presentation briefly discussing the state of the field for a topic of your choice.

Requirements:

1. Typically 2000 to 2500 words of **compact**, original content.

2. **The content must be of sufficiently narrow and technical scope so as to clearly require your computer science background in order to do the research.**

3. Address the following questions:

    a) What is the history of this topic?

    b) What are the technical underpinnings of this area?

    c) What kind of demonstration or prototype will you develop?

    d) What is the state of the field?

    e) What are some trends for the future?

4. Presentation will be 10 minutes.

5. Remember to cite sources in your paper and in your presentation.

Resources for Topics:

1. Communications of the ACM (available in libraries)

2. ACM digital libraries.

3. Current events in technology.

4. Various websites including http://libguides.csbsju.edu/cs.

5. Use of computing in related technical field.

Assignment 2: Survey Paper

Description: You will write a paper on the history of your topic.

Requirements:

1. Typically 2000 to 2500 words of **compact**, original content.

2. The purpose of this paper is to provide sufficient background for an intelligent but ignorant reader to understand what you write for your technical, state of the field and future trends segments.

3. For example, consider addressing the following questions *as appropriate* (but do not make these questions into section heading for your paper!):

    a. What was status quo prior to new technology?

    b. What was the pressing need addressed by new technology?

    c. What were the catalysts that caused development and introduction of new technology?

    d. What was the introduction phase (of this new technology) like?

    e. What was the new status quo?

4. **No presentation required.**

5. Remember to cite sources in your paper.

6. Although this paper will eventually become part of your final state-of-the-field paper, it must be a complete paper for this assignment. It must have an introduction and conclusion.

Assignment 3: Technical Analysis

Description: You will write a paper with an in-depth description and analysis of one or more technical aspects of your topic. You will also complete the initial implementation of your demonstration or prototype and incorporate its discussion into your presentation and paper.

Requirements:

1. Identify the technical aspect(s) of your topic, explain the relevance to your topic, and provide an in-depth description and analysis of the technical component along with issues and open research questions. Think in terms of algorithms, architecture, system design, etc. For example, if your topic is digital rights management, you might compare and contrast different algorithms for digital watermarking.

2. You must have at least 10 authoritative sources that you understand well. 15-20 is even better.

3. A typical paper may have 3000 – 5000 words of **compact** text.

4. Presentations will be 15-20 minutes with time for questions.

5. Although this paper will eventually become part of your final state-of-the-field paper, it must be a complete paper for this assignment. It must have an introduction and conclusion.

Assignment 4: Future Trends Paper

Description: You will write a paper on future trends for your topic.

Requirements:

1. Based on your informed opinion, predict what the state-of-the-field will be like for your topic area in the next three to five years.

2. Provide evidence to support your claims; avoid exaggerated claims and substantiate your predictions with:

    a. Facts.

    b. Observed trends.

    c. Theoretical limitations.

3. Typically 2000 to 2500 words of **compact**, original content.

4. No presentation is required.

5. Although this paper will eventually become part of your final state-of-the-field paper, it must be a complete paper for this assignment. It must have an introduction and conclusion.

Assignment 5: State-of-the-Field Paper and Presentation

Description: You will write a paper and give a presentation on the comprehensive state-of-the-field for your topic.

Requirements:

1. You will give a detailed assessment of the state-of-the-field for your topic, including all appropriate material previously developed throughout this semester.

2. You will present a 3 – 5 minute recording of your demonstration or prototype and use it to illustrate or justify conclusion or ideas you present.

3. You will include a survey, ethical considerations (if appropriate), the present state-of-the-field and future trends.

4. You will include a 2 to 3 page section that explicitly identifies the previous course work and experience you used to complete the current course project. You will also identify how the current project has deepened and integrated previous course work and experience.

5. Include charts and diagrams to illustrate trends. Include table of contents, lists of figure/tables, section headings and other navigational aids.

6. There is no minimum or maximum length required for the paper. Presentations will be given in formal setting and will be 25 minutes long.

Note: The paper you write for this assignment will be much longer than those for the previous assignments. As are result, structuring your document becomes much more important. In particular, the following elements will be necessary:

1. An abstract or substantial introduction (or both) previewing the thesis and content of your document.

2. Table of Contents (can be generated for you by MS Word) listing section, subsection and possibly sub-subsection headings and associated pages.

3. Lists of Figures, Tables if you have more than one of each.

4. Numbered section, subsection (and possibly sub-subsection) headings. Refer to a section as "In Section 2…". Refer to a subsection as "In Section 2.1…". Using the Heading 1, Heading 2, and etc. styles in MS Word.

5. Numbers and captions on all figures and tables, including source of information. In the text of your document, figures and tables should be referenced by their numbers. For example: "In Figure 1 we show…"