COMS BC 3499: Applied Computing - Research and Industry Perspectives

Semester: Fall 2024 | **Instructor**: Brian Plancher
Credit: 4 points (Seminar) | **Meeting time:** M 6:10-8:00pm | **Room:** TBD
Prerequisites: COMS W3134 Data Structures (or equivalent)
**Enrollment Capped at 16 Students (Instructor-Managed Wait List)*

You need to fill out this entry form to be considered for the course!
And your mentor must fill out the mentor form which
you will upload as a part of the entry form!

Description:

This course is designed as a **companion to mentored research and industry projects** in computer science that enable students to apply their learning in real-world contexts. While the course staff can provide general support for projects, they may not have the technical expertise to support all projects in depth. **Therefore, students are expected to have arranged for a *mentored* project during the course registration period and will need to present their project topic *in the second class*.** For example, a student could be working on a research project mentored by a professor or helping a local company develop a web interface to their product mentored by a company software engineer. **Mentors must commit to meeting with students at least every other week.** The course will be run through a mix of lecture and group work led by the course instructor as well as guest instructors from both industry and academia. Lectures cover a variety of applied computing topics designed to complement student projects and engage students with often underexplored considerations for effective and sustainable real-world projects. Students are evaluated both by their mentor on their project progress as well as by the course staff and peers on written deliverables and presentations.

Note: Per Barnard and Columbia policies, you cannot both receive payment and course credit, or credit in two courses, for a single project. However, expanded projects may be acceptable. Similarly, projects done in groups will need to have larger scope. If your project falls into any of these categories, please reach out to the course staff.

Learning Outcomes:

By the end of the semester, students will be able to:

- Develop long-term open-ended project management skills
- Write up a formal academic report in LaTex
- Give formal project presentations
- Learn and practice a series of practical real-world skills to empower you in your future courses and careers (exact skills depend on the particular content of your project)

Grading:

- 40% Written Reports
- 20% Presentations
- 35% Mentor Evaluation
- 5% Attendance and Participation

Note: requests for regrades can only be made for 1 week following the return of a grade.

Student drop-ins (Office Hours)

See brianplancher.com/office_hours for the most up-to-date schedule!

- These are scheduled time-slots for us to chat and I will also be available by appointment in case the scheduled slot doesn't work for you!
- I strongly encourage you to come to at least one student drop-in slot per semester.
- This is your time, so you can use it however you want! Stop by for a quick chat, ask questions about the course (or give feedback), ask questions about research, ask questions about getting jobs in finance/consulting/tech, tell me about a new hit TV show, any reason is a good reason!

Course Outline:

This course meets once a week and covers a variety of topics aimed at ensuring that all students have a productive and valuable experience during the research and applied internship projects that they undertake during the semester. View the Preliminary Course Schedule below for more information.

Readings and Materials:

The course will involve the reading of technical papers, chapters of textbooks, and technical blog posts and the watching of technical videos. Specific readings and videos are listed in the detailed reading list and course scheduled below and can be accessed for free either as they are either open-source or will be posted to Canvas. Students will not need to purchase any textbooks or other materials for this course.

Late and Regrade Policy:

As assignments in this class revolve around longer-term project development, students, in general, will not be allowed to turn in assignments late and will receive a letter grade deduction for each day (24-hour period) an assignment is late (e.g., the maximum grade for an assignment due two days late is a C+). Late hours round up the nearest day. **However, as the goal of the class is to work toward a semester-long project and learn along the way, all written deliverables can be revised and resubmitted for an improvement of up to one letter grade (e.g., B- to A-) in the final report.** Given this policy, regrades and late assignments outside of this policy will only be considered under exceptional circumstances through a private message with the course staff on Slack.

We hope this course helps you develop your skills in longer-term project management. However, of course, exceptions will be made in extenuating circumstances.

Email Policy:

I request that as much as possible you use Slack (instead of email) for all course-related questions. If you do need to reach me via email, please send the email to bplancher+courses@barnard.edu so that it is routed appropriately. I will try to respond to all emails within 2 business days.

Slack Policy:

Slack is our primary tool for communication for this course. Please post liberally as if you have a question, another student likely has a similar question. There is also an anonymous bot if you would like to submit anonymously. I will try to respond to all Slack posts as soon as possible during working hours and at least within 1 business day during the weekdays and within 2 business days over the weekend. **(Link TBD) to sign up for our course Slack.**

Academic Integrity:

You are expected to hold yourself to the highest standard of academic integrity and honesty, as reflected in the Barnard Honor Code. Approved by the student body in 1912 and updated in 2016, the Code states:

"We, the students of Barnard College, resolve to uphold the honor of the College by engaging with integrity in all of our academic pursuits. We affirm that academic integrity is the honorable creation and presentation of our own work. We acknowledge that it is our responsibility to seek clarification of proper forms of collaboration and use of academic resources in all assignments or exams. We consider academic integrity to include the proper use and care for all print, electronic, or other academic resources. We will respect the rights of others to engage in pursuit of learning in order to uphold our commitment to honor. We pledge to do all that is in our power to create a spirit of honesty and honor for its own sake."

This course's policy on academic honesty builds on the honor code and is best stated as "be reasonable." We recognize that interactions with classmates and others can facilitate mastery of the course's material. As this course revolves mostly around team projects we expect students to collaborate heavily and work together on those assignments. Even on individual assignments students should feel encouraged to ask classmates and others for conceptual help. However, there remains a line between asking for help and submitting someone else's work. Especially on individual assignments, make sure this collaboration does not reduce to your classmate doing your work for you (e.g., writing your response, copy-pasting code, or making your slides). If in doubt as to whether some act is reasonable, ask first! The course staff would much rather have a conversation about extensions than about academic integrity! We hope you are reading these policies (or at least skimming them), so if you are, please send the course instructor an email with a (robotics) pun/joke/meme with the subject "academic integrity easter egg" and if you come by office hours I'll give you a prize (exact prize subject to availability)! Acts considered not reasonable will be referred to the Barnard Honor Board, and the course reserves the right to impose local sanctions on top of that outcome. **If you commit some act that is not reasonable but bring it to the attention of the course staff within 48 hours, the course may impose local sanctions, but the course will not refer the matter further except in cases of repeated acts.**

Diversity, Inclusion, and Accessibility:

In an ideal world, science would be objective. However, much of science is subjective and is historically built on a small subset of privileged voices. We acknowledge that it is possible that there may be both overt and covert biases in the material due to the lens with which it was written, even though the material is primarily of a scientific nature. Since integrating a diverse set of experiences is important for a more comprehensive understanding of science please contact the course staff (in person or electronically) or submit anonymous feedback if you have any suggestions to improve the quality of the course materials. We would like to create a learning environment that supports diversity of thoughts, perspectives, and experiences, and honors your identities. If you have a name and/or set of pronouns that differ from those that appear in your official records, please let us know! If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to contact us. If you prefer to speak with someone outside of the course, the Center for Engaged Pedagogy (CEP) or the office of vice president for Inclusion and Engaged Learning are excellent resources.

If you believe you may encounter barriers to the academic environment due to a documented disability or emerging health challenges, please contact the course staff or the Center for Accessibility Resources & Disability Services (CARDS). So that the course staff has enough time to implement accommodations, we request that any student with approved academic accommodations contacts the course staff within the first three weeks of the semester. If you have questions regarding registering a disability or receiving accommodations for the semester, please contact CARDS at (212) 854-4634, cards@barnard.edu, or learn more at barnard.edu/disabilityservices. CARDS is located in 101 Altschul Hall.

Wellness Statement:

It is important for undergraduates to recognize and identify the different pressures, burdens, and stressors you may be facing, whether personal, emotional, physical, financial, mental, or academic. We as a community urge you to make yourself– your own health, sanity, and wellness–your priority throughout this term and your career here. Sleep, exercise, and eating well can all be a part of a healthy regimen to cope with stress. Resources exist to support you in several sectors of your life, and we encourage you to make use of them. Should you have any questions about navigating these resources, please visit these sites:

- barnard.edu/primarycare
- barnard.edu/about-counseling
- barnard.edu/wellwoman/about
- health.columbia.edu/stressbuster

Affordable Access to Course Texts & Materials:

All students deserve to be able to study and make use of course texts and materials regardless of cost. Barnard librarians have partnered with students, faculty, and staff to find ways to increase student access to textbooks. By the first day of advance registration for each term, faculty will have provided information about required texts for each course on CourseWorks (including ISBN or author, title, publisher, copyright date, and price), which can be viewed by students. A number of costfree or low-cost methods for accessing some types of course texts are detailed in the Barnard Library Textbook Affordability guide (https://library.barnard.edu/textbook-affordability). Undergraduate students who identify as first-generation and/or low income students may check out items from the FLIP lending libraries in the Barnard Library (library.barnard.edu/flip) and in Butler Library for an entire semester. Students may also consult with their professors, the Dean of Studies, and the Financial Aid Oce about additional affordable alternatives for having access to course texts. Visit the guide and talk to your professors and librarian for more details.

Use of AI Content Generators:

I view AI tools as a powerful resource that you will likely leverage in the future. As such, the use of AI-based content generation tools, such as ChatGPT, is permitted in this course. However, you will be required to disclose any use of AI tools for each assignment.

The goal of this policy is to help you develop your resilience to automation, as these tools will become increasingly prevalent in the future, and also to learn about their weaknesses. By incorporating these tools into your work process, you will be able to focus on skills that will remain relevant despite the rise of automation. However, **it is important to note that AI tools are susceptible to errors** (e.g., most citations are incorrect). As a student, it is your responsibility to ensure the quality and appropriateness of the work you submit in this course. As such please make sure to read carefully (and likely heavily edit) the output from such tools. Also, please be mindful of the data you provide to these systems, as your work may contain private information, not just your own but also that of others. For example, you should never enter the names of study participants into ChatGPT. Furthermore, there is a risk of inadvertently plagiarizing when using these tools as they often draw content without proper citation. Standard plagiarism policies will apply to all assignment submissions, and “AI did it!” is not a sufficient excuse. To prevent this, you can consider using more responsible tools that are designed to cite their data sources, such as Perplexity AI, and in either case you should make sure to add citations where appropriate yourself. Lastly, be aware of the dangers of becoming overly dependent on these tools. While they can be incredibly useful, relying on them too much can diminish your own critical thinking and writing skills.

If you do not wish to use these tools, that is a valid decision. The use of AI tools in education can be messy and unpredictable due to the risks mentioned earlier. You may have moral confusion or concerns about the uncertainty associated with using AI tools in their coursework. If you do not wish to use them, that is a valid decision. This policy aims to anticipate and mitigate any potential harms associated with AI tool usage, rather than promoting their use.

As mentioned above, for every assignment submission, you are required to include an "AI Tool Disclosure" paragraph which states to what extent you used AI tools. We will not mark you down for the use or non-use of AI tools. The course staff simply wants to understand the prevalence of AI tool use and methods of use to better adapt course policies and teaching practices for the future.

Assignment Descriptions:

Project Presentations (20%) and Written Reports (40%)

Written Report Purpose:

- Develop the skill of developing a project report
- Get feedback on technical writing skills (and practice using LaTeX)

Presentation Purpose:

- Develop the skill of presenting a project to an audience
- Get feedback on presentation skills both in terms of delivery and slides

Students will need to write sections of a written technical report throughout the term and then deliver a final report at the end of the term. Similarly there will be an initial, midterm, and final project presentation. The report will be in the form of a standard academic publication. A few resources on writing academic papers can be found here, here, here, and here. We will use LaTeX for writing the report, as it is standard practice in computer science. Overleaf is an online editor (think Google Docs) that allows you to write LaTeX and never have to work on package management, installation, setup etc. Overleaf also has a great guide for getting started (and the course staff has developed a skeleton project you can copy with all of the necessary templates which is linked from this paper writing guide). Student presentations should be supported by slides. Two guides for good slide design can be found here and here. Also, here is a guide on effective presentations. Below you can find detailed descriptions of the various deliverables and how they will be graded.

Written Deliverables (40%):

Sections of your final full report will be due and graded throughout the semester with each section being worth 7.5%. These sections will then be integrated and extended into a Full Final Report which will be worth an additional 10%. **As the goal of the class is to work toward a semester-long project and learn along the way, all written deliverables can be revised and resubmitted for an improvement of up to one letter grade (e.g., B- to A-) in the final report.** All written deliverables will be graded by the course staff in the context of an academic paper. This document provides some detailed examples and descriptions of what makes a good academic paper and should serve as a guide for what to accomplish to achieve a high grade. The specific deliverables will be (in order):

1. *Background and Related Work (7.5%):* this section is due first as you should make sure to analyze the relevant literature before diving too deeply into your project and design your approach to fill gaps in the literature.
2. *Design / Algorithm / Proof / Implementation / Methodology (7.5%):* this section describes your overall approach and design.
3. *Preliminary Evaluation / Results and Discussion (7.5%)*: this section describes your experiments and results that demonstrate the impact of your *Design / Algorithm / Proof / Implementation / Methodology.* While at that time that this is due you may not have your final data, this does not

mean that you cannot mock up your results and get feedback on how you aim to structure and present your evaluations.

4. *Introduction (7.5%)*: this section is done last in order to develop a complete unified storyline after understanding the outcomes of your project.
5. *Full Final Report (10%)*: This will integrate all of the previous sections, adding a conclusion and abstract, and including the final evaluations. Make sure to integrate feedback given on the previous sections as grades can be increased by up to one letter grade per the regrade policy!

Presentation Deliverables (20%):

Project Overview Presentations (5%): In the second class, all students will give a brief 2-minute (1-2 slide) presentation outlining the methods and motivation for the project that they hope to pursue. The intended audience is both the course instructor as well as the other students in the course.

Project Midterm Presentations (5%): In the middle of the term, all students will give a 5-minute presentation outlining their early results, current challenges, and plan for the rest of the semester. This presentation should be done in the style of an academic conference presentation and is also designed as an opportunity to practice for the final presentation and get feedback.

Final Project Presentations (10%): In the last two weeks of the semester, students will give a 10 minute presentation on their final results from the semester in the style of an academic conference presentation.

Presentation Grading: Your grade will be based on how successfully you communicate the content and significance of your work to both the course instructor and your peers across 3 dimensions: project motivation and background, project execution and design, and presentation quality. Therefore, you should give presentations that do not assume familiarity with the subject matter of your project. As peer and instructor grades may vary you will receive the median grade. All presentations will be done in person; exceptions may be made in extenuating circumstances.

Well planned and executed projects that failed due to unforeseen challenges can still receive high marks, so long as the deliverables are of high quality.

Mentor Evaluation (35%)

Purpose:

- Ensure you are progressing sufficiently in your project
- Ensure there is a domain expert evaluating your work

As all students will need to have a (technical) mentor who can provide project support, be the domain expert, and meet with students weekly. The mentor is also the project expert and as such will be relied upon to evaluate progress on the project deliverables.

Attendance, Collaboration, and Participation (5%)

Purpose:

- To develop collaboration and teamwork skills

This course is deliberately kept small in order to facilitate interaction. You are expected to attend lectures and participate in class discussions.

Preliminary Detailed Reading List:

As mentioned above, this course will involve the reading of technical papers, chapters of textbooks, and technical blog posts and the watching of technical videos. Specific readings and videos are listed in the detailed course scheduled below. Readings and videos can be accessed for free either as they are open-source or through the school library or will be posted to Courseworks. Students will not need to purchase any textbooks or materials for this course.

Peer-Reviewed Articles

- Shao, Yakun Sophia, and David Brooks. Research infrastructures for hardware accelerators. Springer Nature, 2022.
- Crispin Cowan, F. Wagle, Calton Pu, Steve Beattie, and Jonathan Walpole. "Buffer Overflows: Attacks and Defenses for the Vulnerability of the Decade." *DARPA Information Survivability Conference and Exposition*. Vol. 2. IEEE, 2000.
- Joseph Bonneau, Cormac Herley, Paul C. Van Oorschot, and Frank Stajano. "The Quest to Replace passwords: A Framework for Comparative Evaluation of Web Authentication Schemes." *IEEE Symposium on Security and Privacy*. 2012.
- Nayan B. Ruparelia. "Software development lifecycle models." *ACM SIGSOFT Software Engineering Notes* 35.3. 2010.
- David Sculley, Gary Holt, Daniel Golovin, Eugene Davydov, Todd Phillips, Dietmar Ebner, Vinay Chaudhary, Michael Young, Jean-Francois Crespo, and Dan Dennison. "Hidden Technical Debt in Machine Learning Systems." *Advances in Neural Information Processing Systems*. 2015.
- Stefan Berner, Roland Weber, and Rudolf K. Keller. "Observations and Lessons Learned from Automated testing." *International Conference on Software Engineering*. 2005.
- Srinivasan Keshav. “How to Read a Paper.” *SIGCOMM Computing Communications Review* 37, no. 3. 2007.

Other Resources

- Lorenz Froihofer. “How to Write a Computer Science Paper.” https://www.froihofer.net/en/students/how-to-write-a-computer-science-paper.html
- Global Journals. “Tips for Writing a Good Quality Computer Science Research Paper.” https://globaljournals.org/journals/tips-for-writing-a-good-quality-computer-science-research-paper
- Anand Seetharam. "How to Write Your First Computer Science Research Paper?” 2019. https://www.youtube.com/watch?v=j1DvCavAmhE
- Jean-luc Doumont. “Creating Effective Slides: Design, Construction, and Use in Science.” 2013. https://www.youtube.com/watch?v=meBXuTIPJQk
- Jean-luc Doumont. “Communicating Science to Nonscientists.” 2012. https://www.youtube.com/watch?v=IFu3jaLmse0
- The Harriet W. Sheridan Center for Teaching and Learning at Brown University. “Effective Multimedia Lecture Slides.” https://www.brown.edu/sheridan/teaching-learning-resources/teaching-resources/classroom-practices/classroom-communication/multimedia
- Manoel Cortes Mendez, “How to Read Code with Felienne Hermans,” https://www.classcentral.com/report/how-to-read-code-guest-talk/.
- “A Beginner’s Guide to Writing Documentation” https://www.writethedocs.org/guide/writing/beginners-guide-to-docs/
- “Barnard CS Research Guide” https://guides.library.barnard.edu/c.php?g=1089427
- “Memory Hierarchy Design and its Characteristics” https://www.geeksforgeeks.org/memory-hierarchy-design-and-its-characteristics/

Preliminary Course Schedule:

Week	Day	Date	Topic	Description	Deliverables	Readings
0	M	Sep 9	Intro, Presentations and Technical Writing	Overview of the Course and Nuts and Bolts, Typical Structure of Papers and Presentations, Best Practices, Tips and Tricks		Tips for Presentations [1,2,3] Tips for Writing (CS) Papers [0,1,2,3]
1	M	Sep 16	Background Research, Project Overview Presentations	Background Research Best Practices, **Project Overview Presentations (2 minutes each)**	Presentation: Project Overview	Requirements Engineering Tips for Reading (CS) Papers Barnard CS Research Guide
2	M	Sep 23	Startup Engineering	Guest Lecture by TBD		
3	M	Sep 30	Performance Engineering	How do you make code fast?	Report: Background and Related Work (Due W)	Memory Hierarchy Design and its Characteristics Research Infrastructures for Hardware Accelerators Ch 1
4	M	Oct 7	Accessibility and UI Design	Guest Lecture by TBD		
5	M	Oct 14	Privacy and Security	Guest Lecture by TBD	Report: Design / Algorithm / Proof / Implementation / Methodology (Due W)	
6	M	Oct 21	**Project Midterm Presentations (5 minutes each)**		Presentation: Midterm Update	
7	M	Oct 28	Ethics	Guest Lecture by TBD		
8	M	Nov 4	Election Day Holiday			
9	M	Nov 11	Business	Guest Lecture by TBD	Report: Preliminary Evaluation / Results and Discussion (Due W)	
10	M	Nov 18	Sustainability	Guest Lecture by TBD		
11	M	Nov 25	TBD	Guest Lecture by TBD		
12	M	Dec 2	**Final Project Presentations (10 minutes each)**		Presentation: Final Report: Final Full Report (Due M)	
13	M	Dec 9				