

Great Ideas in Computing

University of Toronto CSC196
Fall 2026

Class 1: September 8 (2026)

Preliminaries

Instructor: Allan Borodin <http://www.cs.toronto.edu/~bor>

TA: Elise Shen

More course information will follow but first:

What is this course about?

- FAS Calendar about First Year Foundational Seminars
<https://www.artsci.utoronto.ca/future/academic-opportunities/first-year-opportunities/first-year-foundations-seminars>
- Seminars enable students to engage in discussions and develop strong written, oral and teamwork skills. Small classes help students build relationships with professors early in their academic career.
- One might say that all of these first year foundational seminar courses are an “Introduction to Critical Thinking”.
- But what is critical thinking in the age of AI, Machine Learning (ML) and Large Language Models (LLMs)?

What is critical thinking?

What I can definitely say is that the few weeks has forced me to rethink this question and I am sure the next couple of months will likely make me rethink things again.

How would you define or characterize critical thinking?

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How would you define or characterize critical thinking?

I asked this question to ChatGPT and here is the reply (which is then followed by a list of “several components hidden in that conclusion”):

I would characterize critical thinking as:

The disciplined practice of deciding what to believe or do by examining reasons, evidence, assumptions, and alternatives rather than accepting the most immediate or convenient conclusion.

Another question: How Would You Define or Characterize Creative Thinking?

Your thoughts on this question?

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Again, I asked ChatGPT this question and here is the response (followed by a list of “several important aspects”):

I would characterize creative thinking as: The ability to generate ideas, representations, questions, or approaches that are both novel relative to the thinker's current perspective and potentially valuable for the problem at hand.

The two qualifications matter. Novelty alone is not creativity—randomness can easily produce something new. And usefulness alone is not creativity—applying a standard technique correctly may be excellent problem solving without being creative.

Creative Thinking vs Critical Thinking

The last important aspect given in ChatGPT's response to "What is creative thinking" is the following: Tolerating initially bad ideas. I am now going to quote or paraphrase the rest of ChatGPT's response:

"Creative thinking requires temporarily separating generation from evaluation. If every idea is criticized immediately, unconventional possibilities are eliminated before they have a chance to develop.

This last point suggests an interesting relationship with critical thinking. I would regard them as complementary modes. Creative thinking expands the space of possibilities; critical thinking contracts it.

Creative thinking asks: What might be true? What haven't we tried? Is there another way to see this?

Critical thinking asks: Which of these possibilities survives careful examination? What evidence supports it? Where could it fail? "

End of the ChatGPT response.

The Elephant in the Room: With every significant scientific and technological advancement come issues, misuse, potential disruptions in our societies

Is the impact today of AI, ML, LLMs different from previous “technological revolutions”?

For now, I will just call attention to a recent noteworthy warning from Bill Gates, and a New York Times (NYT) announcement of a podcast (both of which I posted on the course web page).

In the NYT interview, Bill Gates Warns “A.I. Is More Dangerous Than Big Tech Will Admit.”. He said his industry was downplaying the risks, which he believes include mass unemployment and bioterrorism.

The podcast discusses recent rogue AI agents that coordinated a cyber attack and then tried to cover up their actions.

End of Introduction to the Course

We will be returning to AI, ML and LLMs including at least one guest expert presenter. Our TA Elise Shen also studies the impact of LLMs in her research.

To make things more personal, you may be wondering if a University education is still valuable?

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I hope that this course (by exploring Great Idea in Computing) and all your University courses will foster critical and creative thinking. That plus curiosity, perseverance and an ability to collaborate are a good bet for success and enjoyment in your careers.

Course Organization

Course Instructor: Allan Borodin

- **Course email:** csc196-2026-09@cs.toronto.edu
- **Course web site:** <http://www.cs.toronto.edu/~bor/196f26>

Teaching Assistant : Elise Shen

As I hope you can see, I strongly encourage questions and discussions in class. In addition, we are also using quercus and piazza for questions and discussions.

You can access Piazza from Quercus.

Using piazza, you can also answer questions posed by others. You can pose or answer questions anonymously or using your name. The benefit of in class and quercus or piazza (over email) is that the entire class benefits from the discussion. Please sign up at "piazza.com uoft" if you wish to be part of the piazza discussions. But best of all is in person discussions in class and in the tutorials.

Course organization continued

The class meets 3-4 on Mondays (SF3202), Wednesdays (SU 440) and Fridays (BA 025)

Usually I will be presenting on Mondays and Wednesdays and the tutorials will be on Fridays. You should not have a course conflict with any of these three 50 minute classes. **If you have a conflict then you must resolve the conflict; that is, drop one of the courses..**

There might be some exceptions to the usual schedule (for example. if we have to accomodate the schedule of a guest presenter).

My slides will be on the web page. I will try to post slides “soon” after each class. **Why not before?**

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I will be using Quercus and/or the Course Web Page for Announcements. Please check the web page frequently. I posted the course syllabus on both the web page and Quercus.

Grading Scheme

The grading scheme consists of four assignments (12.5% each), two term tests (15% each), and class participation (20%). Students are expected to attend all classes regularly and participate actively and that is the basis for the participation part of the grade. The term tests will be closely related to the assignments. There is no final exam.

All assignments must be submitted on Markus. You can access Markus from Quercus.

Advice regarding assignments: Do NOT spend an excessive amount of time on any questions and especially not on (if any) bonus questions. If you wish to spend “free time” thinking about any questions that is fine but you should not sacrifice time needed for other courses.

It is difficult but not impossible to fail this course. Mainly do NOT plagiarize. If you have any questions about plagiarism, ask me. See comments regarding the University's guidelines on the use of Generative AI including LLMs.

Relevant Calendar Dates and Tentative Due Dates

- A0 September 16. 2:30 PM
This is part of the participation grade and worth 2%. This will allow me to know something about you and will give you an opportunity to submit an assignment on Markus.
- A1 September 30 at 2:30 PM
- Monday, October 12 Thanksgiving No Classes.
- A2 October 21 at 2:30 PM
- T1 October 23 To be held in the tutorial room
- Reading Week No classes
- A3 November 11 at 2:30 PM
- A4 December 2 at 2:30 PM
- T2 December 4 To be held in the tutorial room
- Fall classes end December 7 for most courses with December 8 as a possible makeup date for the missed class on Thanksgiving.

Announcement: RSGs

Recognized Study Groups (RSGs) are voluntary, peer-led study groups of up to eight students enrolled in the same Arts and Science course. The RSG program is designed to increase student engagement in individual courses, support academic skill-building and keep students socially connected. During the 2024-26 academic year, over 4500 Arts and Science students participated in an RSG.

Each RSG requires a student to sign-up to be an RSG Leader. RSG Leader applications are now open. All RSG Leaders receive training under Student Success staff supervision. Students will also be able to join an RSG starting September 2nd 2025, with new RSGs added daily as students sign up to be leaders. If a student cannot find an RSG for your course, they can volunteer to lead an RSG or check back regularly.

RSG Poster



UNIVERSITY OF TORONTO
FACULTY OF ARTS & SCIENCE

Lead or Join an **RSG**

Recognized Study Group

- Meet weekly with up to eight classmates and build connections and friendships
- Gain a better understanding of course material
- Prepare for tests and exams

Theme of our CSC196 Course: Great Ideas in Computing

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I asked this question in previous offerings of CSC196 before ChatGPT and other LLMs were so good at such questions. If you ask that question to ChatGPT **last fall** you got a great answer: Novelty, Simplicity with depth, Generativity, Impact, Timelessness, Intellectual Beauty.

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ChatGPT then asked if I wanted to frame this specifically in the context of computer science and mathematics. I said yes and I received a list that looks (suspiciously?) like topics we have discussed in previous offerings of this course. ChatGPT's "top five": Universal Turing Machine (Turing 1936), NP Completeness (Cook, Levin 1971), Public key Cryptography (Diffie and Hellman 1976, , RSA 1977), Relational Databases (Codd 1970), Internet Protocol and Packet Rounting and TCP (Kleinrock, Cerf, Kahn 1960s-70s).

More Thoughts on What Constitutes a Great Idea

Here is what I said in previous years:

Impact, surprise, elegance. Of course, it is easier to agree on great ideas in retrospect rather than as ideas are being introduced.

And of course ideas rarely occur in a "vacuum"; usually there are similar ideas known and often the timing of when an idea becomes viable is very critical.

It is also the case that credit for an idea is not always completely fair to all those involved.

And More Thoughts on What Constitutes a Great Idea

- “It is a breakthrough”; meaning it accomplishes something that was not possible before.
- “It allows for new (possibly unexpected) possibilities”
- “It provides an *optimal* solution to a problem”
- When you say “I wish I would have thought of this”

Great ideas, good decisions, good plans

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A point of view: perhaps one should not judge the quality of a decision by outcomes. The quality of a good decision may simply be whether or not, given all the information available at the time the decision was made, the decision was a good or the best decision one could make.
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- Decisions can be irrevocable or can be modified. Plans usually do evolve over time.
- It is important to understand that in all ideas, decisions, plans, there is always some degree of **uncertainty** as to how the “world” will unfold.
- In research and development (and more generally in life) how long should we stick with our intuition or when do we see that our beliefs and plans are inconsistent with facts or “common wisdom”?

Asking ChatGPT again: “What Constitutes a Great Idea”

The is the response I received on Tuesday, September 1, 2026

A great idea is one that meaningfully improves a situation and has a realistic path to becoming valuable.

It typically combines:

A real problem: It addresses a genuine need, frustration, or opportunity.

Useful impact: It creates clear value—saving time, reducing cost, increasing enjoyment, improving outcomes, or solving something important.

Originality or insight: It offers a fresh approach, even if the underlying problem is familiar.

Feasibility: It can actually be built, tested, or implemented with available resources. **I am not sure about this criteria.**

Desirability: The people affected genuinely want it, rather than merely agreeing that it sounds interesting. **The people affected may not even know they are affected**

More criteria provide by ChatGPT on September 2, 2026

Clarity: It can be explained simply and understood quickly. **Can the general theory of relativity or quantum physics be explained simply?**

Leverage: A relatively small amount of effort can produce a disproportionately large benefit. **This statement and the previous one seem to be trying to define “conceptual simplicity” which is desirable but is it necessary?**

Adaptability: It can survive feedback and improve as circumstances change.

A useful test is: Who does this help, what problem does it solve, and why is this a better way to solve it?

Great ideas are not always entirely novel. Often, they are familiar elements combined in a new, timely, or unusually effective way—and then developed through testing and execution.

One Final Thought on Great Ideas

The following is what my co-author (on a current graduate text I am writing) Denis Pankratov said:

One thought came to mind in response to your question about what makes an idea great. Great ideas often become part of how people think or act, sometimes for many generations. Graphs seem like a good example: there are many ways to think about objects and their pairwise relationships, but once we learn about graphs, they can become a natural language for recognizing and reasoning about that structure in very different settings.

Perhaps one aspect of an idea's greatness is how widely, deeply, and enduringly it shapes our collective thinking—not just how much we think about it, but how much we think with it.

End of first class

We will start the second class with the following question: Can great ideas have negative consequences