CS 136: Elementary Algorithm Design and Data Abstraction

Official calendar entry: This course builds on the techniques and patterns learned in CS 135 while making the transition to use of an imperative language. It introduces the design and analysis of algorithms, the management of information, and the programming mechanisms and methodologies required in implementations. Topics discussed include iterative and recursive sorting algorithms; lists, stacks, queues, trees, and their application; abstract data types and their implementations.
Winter 2022 & planning with uncertainty

We planned for this term to be a triumphant return to in-person learning.

December 16 the university announced that this term will begin online ("remote learning") with the tentative plan to resume in-person learning January 24.

We do not know if that plan is feasible, or how the remainder of this term will unfold.

We will continue to adapt and adjust to these uncertain times as best as we can.
Welcome to CS 136 (Winter 2022)

**Instructors:** Tim Brecht, Anton Mosunov, Adrian Reetz, Dave Tompkins, Stacey Watson and Olga Zorin.

**Other course personnel:** ISAs (Instructional Support Assistants), IAs (Instructional Apprentices), ISC (Instructional Support Coordinator): see website for details

**Lectures:** Tuesdays and Thursdays (only if in-person resumes)

**Tutorials:** Wednesdays

**Assignments**: released Fridays, due the following Friday at 11am

(* typically)
Course website

The course website:
https://student.cs.uwaterloo.ca/~cs136/

Has lots of useful links and resources.

The *How Do I...?* web page is a good starting point and explains how to accomplish some course-related tasks and find additional resources.

There is also a *request system* for submitting requests.
Announcements

All course announcements will be made on piazza.

Pinned piazza posts are mandatory reading.
Main Topics & Themes

- imperative programming style
- elementary data structures & abstract data types
- modularization
- memory management & state
- introduction to algorithm design & efficiency
- designing “medium” sized, “real world” programs with I/O
Curriculum

Three of the most common programming paradigms are functional, imperative and object-oriented.

The first three CS courses at Waterloo use different paradigms to ensure you are “well rounded” for your upper year courses.

\[
\text{CS 135} \Rightarrow \text{CS 136} \Rightarrow \text{CS 246}
\]

- functional
- imperative
- object-oriented

Each course incorporates a wide variety of CS topics and is much more than the paradigm taught.
Programming Languages

Most of this course is presented in the C programming language.

While time is spent learning some of the C syntax, this is not a “learn C” course.

We present C language features and syntax only as needed.

We occasionally use Racket to illustrate concepts and highlight the similarities (and differences) between the two languages.

What you learn in this course can be transferred to most languages.
Course Notes

These course notes will be the primary source of information and are available free online (at the course website).

Paper copies are available for purchase at the bookstore in South Campus Hall (SCH), which are very useful for adding your own notes.

If you are unable to attend a lecture (or a lecture is cancelled) there are optional voiceover videos available on YouTube.

There are also optional supplemental videos to explain some topics in more detail.
Several different styles of “boxes” are used in the course notes:

**Important information appears in a thick box.**

Comments and “asides” appear in a thinner box. Content that only appears in these “asides” will **not appear on exams**.

**Additional “advanced” material appears in a “dashed” box.**

The advanced material enhances your learning and may be discussed in class and appear on assignments, but you are **not responsible for this material on exams** unless your instructor explicitly states otherwise.
Optional textbook


The textbook is **not** required, and is only recommended if:

- you want a different perspective on some of the material
- you desire additional examples
- you wish to learn more about the C language including topics not covered in this course (for use *after* this course)
Marking scheme

The mark breakdown is as follows:

- 25% assignments
- 5% participation
- 20% midterm exam (in-person)
- 50% final exam (in-person)

To pass the course (achieve at least 50%), you must pass both your assignment average and your weighted exam average.
Adjustments for online exams

If an exam component (midterm and/or final) is held online instead of in-person, its weight will be reduced by $\frac{1}{2}$ with the remaining weight added to the assignments.

For example, if the midterm is held online it would be worth 10% and the assignments worth 35%.

If both exams are held online, the mark breakdown will be:

- 60% assignments
- 5% participation
- 10% midterm exam (online)
- 25% final exam (online)
Cancelled exams

If an in-person exam is cancelled and we cannot switch to an online exam (e.g., a last-minute lock-down) then $\frac{1}{2}$ of the cancelled exam weight will be added to the assignments and the other $\frac{1}{2}$ to the other exam component.

For example, if the midterm is cancelled, the final will be 60% and assignments will be 35%.

A special note for students in the online section (LEC 011). If the midterm is held in-person, students in the online section will not write a midterm and its weight will be re-distributed as if it was cancelled (see above).
Class participation

When lectures are online, we will have self-check quizzes in LEARN. Self-check quizzes are only marked for participation, not correctness. If you complete every self-check quiz on time, you will receive perfect self-check marks.

If in-person lectures resume, we will switch to use i>Clickers and your participation grade will be a weighted combination of clickers and quizzes.

(note: the following slides assume i>Clickers are used all term).

Students in the online section (LEC 011) will use self-check quizzes all term.
Class participation – Clickers

We use i>Clickers to encourage active learning and provide real-time feedback.

- i>Clickers are available for purchase at the bookstore

- Any physical i>Clicker can be used, but we do **not** support web-based clickers (e.g., i>Clicker Go)

- Register your clicker ID in Assignment 0

- To receive credit you must attend your registered lecture section (you may attend any tutorial section)

Using someone else’s i>Clicker is an academic offense
Clicker Participation grading

- 2 marks for a correct answer, 1 mark for a wrong answer
- Your best 50% responses (from the entire term) are used to calculate your 5% participation grade
- For each tutorial you attend, we’ll increase your 5% participation grade 0.1% (up to 1% overall, you cannot exceed 5%)

To achieve a perfect participation mark

- answer 50% of all clicker questions correctly, or
- answer 40% of all clicker questions correctly, and attend at least 10 tutorials
Contingencies for in-person learning

- If an in-person lecture is cancelled (e.g., an instructor is sick or quarantined and no replacement can be found), read the course notes and/or view the available voiceover videos. Remember, clicker grades are only collected when in-person lectures occur.

- If you are in isolation (but not sick), submit a request to adjust your participation grade.

- If you are sick, fill out a Verification of Illness Form (VIF). https://uwaterloo.ca/math/vif-submission
Assignments

Assignments are *weekly* and each assignment is weighted equally (except A0).

- read the assignment instructions carefully
- read the assignment clarifications & FAQ
- read the assignment rules
  (new rules are added as the course progresses)

A0 does not count toward your grade, **but must be completed** before you can receive any other assignment marks.
Assignment Collaboration

Assignment questions are individually colour-coded as either Black or Gold to indicate the level of collaboration permitted.

For Black questions, moderate collaboration is permitted.

For Gold questions, no collaboration is permitted.

Test cases and documentation are part of your assignment and follow the same collaboration rules.
Black Assignment Questions

For **Black** questions (moderate collaboration):

- you may discuss assignment *strategies* openly
- you may search the Internet for strategies or code examples
- you may discuss or show your code with an *individual*, but not with a larger group (piazza, facebook, chat rooms, online forums, *etc.*)
- You may show your code to other individuals to give or receive help, but **copying is never allowed** (electronic transfer, copying code from the screen, printouts, *etc.*).
Gold Assignment Questions

For Gold questions, no collaboration is permitted:

- never share or discuss your code with other students
- do not discuss assignment strategies with fellow students
- do not search the Internet for strategies or code examples

You may always discuss your code with course staff.

Piazza posts regarding Gold questions must be private (post to: Instructors).
Integrity

If you submit any work that is not completely your own (e.g., you receive help) you must cite (identify) the source of the assistance in an integrity statement. Even though moderate collaboration is allowed on Black questions, you must still cite any assistance or collaboration.

You do not have to cite any assistance you receive from course staff (including office hours, piazza posts, videos, course notes, etc.).

If you do not cite a source of assistance, you are presenting work of others as your own; this is called plagiarism and constitutes a violation of academic integrity (policy 71).
Assignments: second chances

Assignment deadlines are strict, but for some assignment questions you may be granted a “second chance” to re-submit your code.

- some assignment questions will have an automatic (or guaranteed) second chance
- other assignment questions may be granted a second chance based on the quantity and quality of submissions
- second chances are due 48 hours after the original deadline (unless posted otherwise)
- Your grade is: $\max(\text{original}, \frac{\text{original} + \text{second}}{2})$ (i.e., there is no risk in submitting a second chance)
Assignment Implementation via Seashell

We use our own development environment called Seashell:

- browser-based for platform independence
- works with both C and Racket
- integrates with Marmoset, our submission & testing environment
- helps to facilitate your own testing

See the website and supplemental videos for how to use Seashell.
Assignment Submission via Marmoset

Assignments are submitted to the Marmoset submission system: http://marmoset.student.cs.uwaterloo.ca/

There are two types of Marmoset tests:

- **Public** *(basic / simple)* test results are available immediately and ensure your program is “runnable”

- **Private** *(comprehensive / correctness)* test results are available after the deadline and fully assess your code

Public tests do not thoroughly test your code.
• Marmoset uses the best result from all your submissions, and we encourage frequent submission and re-submission.

• for questions that are hand-marked (e.g., for style), we mark the submission with the highest score; if two submission have the same score, we mark the one that was submitted closest to the deadline.

• when you submit your assignments, you can view public test results immediately in Seashell.

To view your private test results, you must log into Marmoset after the deadline.
Assignment style marks

Assignment style marks are evaluated based on your adherence to the **course style guide** (available on the cs136 website).

The first four assignments (A1–A4) will not count toward your style grade and will be for feedback only.

Your assignment style grade will be the average of your style marks on the remaining five assignments (A5–A9) and will have the same weight as a normal assignment.

In other words, your assignment style grade will count as the “tenth” assignment.

View your style feedback on MarkUs.
You are not marked for style to “punish” or “torture” you. It is formative feedback to improve both your learning and the readability of your code.

You should follow the style guide even if your work is not being marked for style.

If your code has bad style, course staff may not provide assistance during office hours or on piazza.
Design recipe

In CS 135 you were encouraged to use the *design recipe*, which included: contracts, purpose statements, examples, tests, templates, and data definitions.

The design recipe has two main goals:

- to help you **design** new functions from scratch, and
- to aid **communication** by providing **documentation**.

In this course, you should already be comfortable designing functions, so we focus on **communication** (through documentation).
Documentation

In this course, every function you write must have:

- a **purpose** statement, and
- a **contract** (including a **requires** section if necessary)

Unless otherwise stated, you are **not** required to provide templates, data definitions, or examples.

Later, we extend contracts to include *effects* and *time* (speed / efficiency).
Support – Course Content

If you are struggling with the course content (concepts and material from the course notes) you may:

1. post a public question on piazza

2. ask a question during individual office hours
Support – Assignments

If you are struggling with an assignment you should:

1. carefully re-read the assignment
2. read the assignment clarifications and FAQ
3. re-read the assignment and the FAQ one more time
4. **search** piazza to see if your question has already been asked
5. post a private question on piazza
6. get assistance during individual office hours
Support – Assignments (Black)

For **Black** questions, you may additionally:

- get help from a fellow student
- search the Internet
- post a public question on piazza (but do not post your code)
Support – Other

If you need help with something that is not related to the course content or an assignment (e.g., an administrative issue):

- file a request (via the website)
- post on piazza
- discuss the issue during office hours
- write an email to the course ISC
Piazza etiquette

- **read** assignments & FAQs **thoroughly** before asking a question
- **search** to see if your question has already been asked
- **use** meaningful titles (*not* just “A1Q1”)
- **ask** *clarification questions* for assignments (do not ask *leading questions* for *Gold* questions)
- **do not** discuss strategies for *Gold* questions
- **do not** post any of your assignment code *publicly*
- you can post your code (*with good style*) *privately*, and an ISA or Instructor *may* provide some assistance
Course Learning Goals

At the end of each Section there are learning goals for the Section (in this Section, we present the learning goals for the entire course).

These learning goals clearly state what our expectations are.

Not all learning goals can be achieved just by reading the notes. Some goals require completing the assignments.
Course Learning Goals

At the end of this course, you should be able to:

• produce well-designed, properly formatted, documented and tested programs of a moderate size (200 lines) that can use basic I/O

• use imperative paradigms (e.g., mutation, iteration) effectively

• explain and demonstrate the use of the C memory model, including the explicit allocation and deallocation of memory

• explain and demonstrate the principles of modularization and abstraction
• implement, use and compare elementary data structures (structures, arrays, lists and trees) and abstract data type collections (stacks, queues, sequences, sets, dictionaries)

• analyze the efficiency of an algorithm implementation