INTRODUCTION TO CSC228

Reading:

- none on this topic
- but see the week-by-week handout for readings you should start (now) on upcoming topics

Scenario: You work for Statistics Canada and your job is to write a program that will give government statisticians easy access to the census data, going back over several decades. They want to retrieve data and perform interesting queries.

Scenario: You want to make your first million by writing a web search engine with some amazing new capabilities.

Coming fresh out of csc148, what will be your biggest stumbling blocks?

Problem 1: The data is HUGE; it won’t all fit in memory.

Solution: Leave it in a file but bring smaller pieces in memory when needed.

Problem 2: How are you going to perform operations like searching?

The only way we’ve taught you to read a file is to start at the top and read through to the bottom. This rules out fast algorithms like binary search. With so much data, that’s disastrous.

Solution: Adapt clever data structures (like trees), but build them in the file rather than in memory. Now we call them “file structures”.

A pointer will now reference a location in the file, rather than a location in memory. (We’ll learn how to implement file pointers in C.)

Facing another reality

When you follow a pointer in memory, what has to happen?

When you follow a pointer in a file, what has to happen?

Problem 3: Following a file pointer is so slow that we have to be extremely careful to minimize the number of times we do it.

Solution: Use a binary search tree, but make sure it stays balanced.
Think of the census data. \( O(\log n) \) used to sound good, but now the constants are so big that we have to care about them.

- What we have to do \( O(\log n) \) times is follow a file pointer (plus some faster in-memory work) — and that’s a very slow operation.

Plus, if \( n \) is huge, \( O(\log n) \) itself can be big.

- If your file contains an index of web pages around the world, \( n \) could be 20,000,000. What’s \( \log_2 20,000,000 \)?

How can we speed things up?

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**What 228 is all about**

This course is about how to manage LARGE amounts of data.

- Understanding how files work so that we can better appreciate these issues
- Clever data structures and algorithms that try to offer efficiency in the face of these issues
- Programming techniques that allow us to implement the clever data structures and algorithms

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**ADMINISTRATIVE DETAILS**

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**Reading:**

- csc228 Course Information Sheet
- csc228 Course Guide
You

How many …

• have taken csc209:
• have taken csc258:
• have taken csc238:
• have taken some third year:

How many …

• are very comfortable in C:
• feel somewhat weak in C:
• are very comfortable in C++:
• feel somewhat weak in C++:

Computers (St George only)

You will be using the CDF lab.

Account name: a228xxxx
Password: your student number
Internet address: @cdf.utoronto.ca

You can phone the CDF facility from your home computer. See the CDF guide for details.

You are also free to do your assignments on your own computer.

But, warning: you will be required to hand in all assignments electronically, and they must run on the CDF machines.

Plagiarism; Helping each other

The usual.

• In brief: you must submit work that is your own.
• But you should get to know other students and work together to learn course material.
• You will have an opportunity for group work on the project.

BASIC CONCEPTS: PHYSICAL FILES, LOGICAL FILES, RECORDS

Reading:

• FZR chapter 1. Warning: 1.4 and 1.5 (on C++ basics) are confusing
• FZR sections 2.1–2.5
• FZR sections 3.1, 3.3, 3.4, and 3.6–3.9
• FZR chapter 4
• FZR sections 5.1 and 5.2

Other homework:

• Review C++ basics from csc270
Algorithm for Master-file Update

read the first master file record, m
read the first transaction file record, t

while (at least one file has not been completely read)

    if (m.key > t.key)
        // No master record exists for this transaction.
        if the transaction can be processed
            process it
        else
            read the next transaction file record into t
        end if
    else
        log an error
        end if
    else if (m.key < t.key)
        // No transaction exists for this master record.
        print the [probably unchanged] record m
        to the new master file
        read the next master file record into m
    else both keys are equal
        // Transaction t applies to record m.
        apply transaction to to record m
        read the next transaction file record into t
        // There may be more transactions for m, so
        // don’t read the next master record.
    end if
end while

Reading:

- FZR section 8.1–8.3