CPSC 121 - Models of Computation
Module 00. Introduction

Prof. Karina Mochetti

2020.W1
UBC’s Vancouver campus is located on the traditional, ancestral, unceded territory of the Musqueam People.
Our shared work to resist anti-Black violence follows from the intellectual, emotional, and creative labours of Black intellectuals, activists, scientists, artists, designers, writers, poets, curators, illustrators, filmmakers, and cultural producers. They form a critical part of our collective learning environment as students, faculty, and professional staff.

**Dorothy Vaughan**
Taught herself and other women from NACA (called human computer) programming languages to prepare them for the transition to machine computers.

**Jerry Lawson**
He led the development of a console, that used swappable game cartridges, replacing ROM storage that was soldered onto the game hardware.
I was born in Brazil, where I was a professor at Rio for 5 years.
About Me

- I was born in Brazil, where I was a professor at Rio for 5 years.
- Please, don’t need to call me doctor or miss! Karina is just fine, I like my name! :)

I love to learn and I love to teach!

My favorite bands are Metallica and the Spice Girls.

I watch a lot of movies and TV shows.

I have two dogs that I rescue from the streets and they come with me to Canada from Brazil.
I was born in Brazil, where I was a professor at Rio for 5 years.
Please, don’t need to call me doctor or miss! Karina is just fine, I like my name! :)
I love to learn and I love to teach!
• I was born in Brazil, where I was a professor at Rio for 5 years.
• Please, don’t need to call me doctor or miss! Karina is just fine, I like my name! :)
• I love to learn and I love to teach!
• My favorite bands are Metallica and the Spice Girls.
I was born in Brazil, where I was a professor at Rio for 5 years. Please, don’t need to call me doctor or miss! Karina is just fine, I like my name! :) I love to learn and I love to teach! My favorite bands are Metallica and the Spice Girls. I watch a lot of movies and TV shows.
I was born in Brazil, where I was a professor at Rio for 5 years.
Please, don’t need to call me doctor or miss! Karina is just fine, I like my name! :)
I love to learn and I love to teach!
My favorite bands are Metallica and the Spice Girls.
I watch a lot of movies and TV shows.
I have two dogs that I rescue from the streets and they come with me to Canada from Brazil.
Instructors: Karina Mochetti and Patrice Belleville
Course Coordinator: Trey Schiefelbein
TAs: Adam Chen, Alan Chen, Alara Celik, Armin Talaie, Arya Stevinson, Charlie Lake, Dingchen Wei, Donson Dong, Elizabeth Xiao, Hao Tian Gong, Jack Rong, Jasmine Kwong, Junze Wu, Justin Chan, Karry Yang, Karim Halaseh, Kerry Zhou, Khanh Linh Tran, Loren Oh, Mai Linh Phan, Martin Yushko, Naomi Graham, Philip Mak, Preet Nakrani, Rui Ge, Ruinan Jin, Skye Methven, Vandy Liu, Jin Kim, Zhen Hao Li
Learning Tips

Triune Brain

We all have three brains that depend on each other to properly work. They communicate all the time and influence each other.

- **Reptilian or Primal Brain**: responsible for instincts.
- **Paleomammalian or Emotional Brain**: responsible for emotions.
- **Neomammalian or Rational Brain**: responsible for reasoning.
Learning Tips

Triune Brain

We all have three brains that depend on each other to properly work. They communicate all the time and influence each other.

- **Reptilian or Primal Brain**: responsible for instincts.
- **Paleomammalian or Emotional Brain**: responsible for emotions.
- **Neomammalian or Rational Brain**: responsible for reasoning.

Learning is creating **connections** between the problem and the solution on the Rational Brain!
Reading and understanding the answer to a problem is NOT learning!!!
• Reading and understanding the answer to a problem is **NOT** learning!!

• **Frustration** is part of learning. Learning is a stair, not a ramp, suddenly, we climb a step.
Learning Tips

- Reading and understanding the answer to a problem is **NOT** learning!!

- **Frustration** is part of learning. Learning is a stair, not a ramp, suddenly, we climb a step.

- **Hunger** makes the Primal Brain give warns that you need to eat, disrupting the Rational Brain.

---

Prof. Karina Mochetti  
CPSC 121 - Models of Computation
• Reading and understanding the answer to a problem is **NOT** learning!!!

• **Frustration** is part of learning. Learning is a stair, not a ramp, suddenly, we climb a step.

• **Hunger** makes the Primal Brain give warns that you need to eat, disrupting the Rational Brain.

• A deep sleep (usually at night) helps to **consolidate** memory.
Learning Tips

- Reading and understanding the answer to a problem is **NOT** learning!!!
- **Frustration** is part of learning. Learning is a stair, not a ramp, suddenly, we climb a step.
- **Hunger** makes the Primal Brain give warns that you need to eat, disrupting the Rational Brain.
- A deep sleep (usually at night) helps to **consolidate** memory.
- Moments of **relaxation** and fun are beneficial to the brain, activating the Emotional Brain related to pleasure and reward.
Learning Tips

- Reading and understanding the answer to a problem is NOT learning!!!

- **Frustration** is part of learning. Learning is a stair, not a ramp, suddenly, we climb a step.

- **Hunger** makes the Primal Brain give warns that you need to eat, disrupting the Rational Brain.

- A deep sleep (usually at night) helps to **consolidate** memory.

- Moments of **relaxation** and fun are beneficial to the brain, activating the Emotional Brain related to pleasure and reward.

- Make summaries teach the subject to someone else or compare your solution of exercises and problems with friends.
Learning Tips

- Reading and understanding the answer to a problem is NOT learning!!!
- **Frustration** is part of learning. Learning is a stair, not a ramp, suddenly, we climb a step.
- **Hunger** makes the Primal Brain give warns that you need to eat, disrupting the Rational Brain.
- A deep sleep (usually at night) helps to **consolidate** memory.
- Moments of **relaxation** and fun are beneficial to the brain, activating the Emotional Brain related to pleasure and reward.
- Make summaries teach the subject to someone else or compare your solution of exercises and problems with friends.
- **Effort** does not generate immediate reward and generates expectation, but without effort we can hardly get the reward.
If you can, try to simulate a real class, close all tabs from your browser, act like I can see what you're doing with your computer.
If you can, try to simulate a real class, close all tabs from your browser, act like I can see what your doing with your computer.

Always watch the live classes, if possible. If not, try to act like you’re in a regular class, don’t pause or speed up the video. Don’t watch more than one per day (try to watch it twice a week like in class).
Learning Tips for the Online Classes

- If you can, try to simulate a real class, close all tabs from your browser, act like I can see what your doing with your computer.
- Always watch the live classes, if possible. If not, try to act like you’re in a regular class, don’t pause or speed up the video. Don’t watch more than one per day (try to watch it twice a week like in class).
- Don’t count on recording to get something you didn’t get first. Ask questions when you have the chance, use office hours. Pay attention as this was your only chance.
Zoom Rules

- Don’t post or share the link or the password for this meeting.
- Please keep muted during lecture, unless asked otherwise or during breakout rooms.
- I cannot pay attention to chat or reactions while sharing screen at Zoom! Please, raise your hand if you need something, you will be asked to unmute yourself.
- We will have a form so you can leave questions if you don’t feel comfortable with zoom: http://www.cs.ubc.ca/~mochetti/askCPSC121.html.
- We will have breaks for questions.
- When in a breakout room you can ask a question by clicking "Ask for Help".
Your goal is to sort all dates.
You can only swap adjacent cards.
How Many Swaps?

In the worst case, the dates are sorted in reverse

For 5 cards:

- It takes 4 swaps to bring the smallest value to the first position.
- It takes 3 more swaps to bring the second smallest value to the second position.
- Then it takes 2 moves and finally 1 move bringing the last two value to the right place.

\[4 + 3 + 2 + 1 = 10\]
In the worst case, the dates are sorted in reverse

For 5 cards:

- It takes 4 swaps to bring the smallest value to the first position.
- It takes 3 more swaps to bring the second smallest value to the second position.
- Then it takes 2 moves and finally 1 move bringing the last two value to the right place.

\[ 4 + 3 + 2 + 1 = 10 \]

For \( n \) cards:

\[ (n - 1) + (n - 2) + \cdots + 2 + 1 = n(n - 1)/2 \]
Computing $n(n - 1)/2$ using Dr Racket

(define (how-many-swaps n)
  (/ (* n (- n 1)) 2))

(how-many-swaps 5)
10

(how-many-swaps 1000)
499500

(how-many-swaps 1000000)
499999500000
Computing $n(n - 1)/2$ using C

```c
#include <stdio.h>
#include <stdlib.h>

int main(int argc, char **argv) {
    char *p;
    int n = strtol (argv[1], &p, 10);
    printf("%d", n*(n-1)/2);
    return 0;
}
```

```
./computesteps 5
10
./computesteps 1000
499500
./computesteps 1000000
-364189984
```
How can we prove that $n(n - 1)/2$ is the largest number of swaps needed for $n$ birthdays?

*Direct Proof or Mathematical Induction*

Why did our C implementation print a negative value, but not the Racket implementation?

*Number representation*
How can we prove that $n(n - 1)/2$ is the largest number of swaps needed for $n$ birthdays?

*Direct Proof or Mathematical Induction*

Why did our C implementation print a negative value, but not the Racket implementation?

*Number representation*

1. How can we convince ourselves that an algorithm does what it’s supposed to do?
2. How do we determine whether or not one algorithm is better than another one?
3. How does the computer (e.g. Dr. Racket) decide if the characters of your program represent a name, a number, or something else?
4. How can we build a computer that is able to execute a user-defined program?
A Working Computer

This is a working computer you will learn about in the labs:

To get inside a module:
1. Make sure you're in "pale" mode, the finger button in the upper left.
2. Click the module you want to open.
3. Click the button the magnifying glass that appears.
Course Goals

After you complete the course, you will be able to:

- Model important problems so that they are easier to discuss, reason about, solve, and test. Learn new modeling formalisms more easily.
- Communicate clearly and unambiguously with other CS experts on complex topics.
- Characterize algorithms (CS problem solutions), by proving their correctness or efficiency.
- Critically read proofs: justifying why each step is correct and judging what the proof means.
- Explain how computers work.
Your final grade will be computed as follows:

- Assignments (5): 14%
- Labs (9): 14%
- Pre-class quizzes (11): 4%
- Take-home tests (2): 18%
- Midterm: 14%
- Final Exam: 32%
- Clicker questions: 2%
- Participation: 2%

To pass the course you must:

- Obtain a total score of at least 50%.
- Obtain at least 50% on the weighted average of the labs and assignments.
- Obtain at least 50% on the weighted average of the two take-home tests, midterm and final exam.
Course Structure

Labs
- Start on Wednesday September 16th, 2020.
- You must attend the lab you are registered for.
- Pre-lab work must be done **before** you get to the lab.

Tutorials

Participation
- The largest of tutorial attendance and weighted average of all other course components.

Worksheets
- Will be posted on the course web site ahead of time.
- We will use breakout rooms while you work on them:
  - Form groups of 4 or 5 students.
  - Include the group name in parentheses in front on your name in zoom. E.g. (KarinaIsTheBest) Karina Mochetti
Course Structure

Tests
- Wednesday September 30th, 2020 PDT
- Friday November 13th, 2020 PDT

Midterm
- Friday October 23rd, 2020, 5:00 pm to 6:15 pm

Final
- To be determined by Enrollment Services

Academic Conduct
- Please read the rules in the syllabus and follow them.
- Not following these rules will be unpleasant for all of us.
- Several academic misconduct cases were referred to the Science Dean’s office in 2019W2.
- We really, really don’t want to have to go through this this term (but we will if necessary).
<table>
<thead>
<tr>
<th></th>
<th>SUN</th>
<th>MON</th>
<th>TUE</th>
<th>WED</th>
<th>THU</th>
<th>FRI</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week 01</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06-Sep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Today!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-Sep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 02</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-Sep</td>
<td></td>
<td></td>
<td></td>
<td>Lab 01</td>
<td>Lab 01</td>
<td>Lab 01</td>
<td></td>
</tr>
<tr>
<td>19-Sep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 03</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-Sep</td>
<td>Lab 01</td>
<td>Lab 01</td>
<td>Lab 02</td>
<td>Lab 02</td>
<td>Lab 02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26-Sep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 04</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27-Sep</td>
<td>Lab 02</td>
<td>Lab 02</td>
<td><strong>Test 1</strong></td>
<td>Lab 03</td>
<td>Lab 03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>03-Oct</td>
<td>Ass 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 05</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04-Oct</td>
<td>Lab 03</td>
<td>Lab 03</td>
<td>Lab 03</td>
<td>Lab 04</td>
<td>Lab 04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-Oct</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week</td>
<td>SUN</td>
<td>MON</td>
<td>TUE</td>
<td>WED</td>
<td>THU</td>
<td>FRI</td>
<td>SAT</td>
</tr>
<tr>
<td>----------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Week 06</strong></td>
<td>11-Oct</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Holiday</td>
<td>Lab 04</td>
<td>Lab 04</td>
<td>Lab 05</td>
<td>Lab 05</td>
</tr>
<tr>
<td></td>
<td>17-Oct</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 07</strong></td>
<td>18-Oct</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mid term</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lab 04</td>
<td>Lab 05</td>
<td>Lab 05</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24-Oct</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 08</strong></td>
<td>25-Oct</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lab 05</td>
<td>Lab 06</td>
<td>Lab 06</td>
<td>Lab 06</td>
<td>Lab 06</td>
</tr>
<tr>
<td></td>
<td>31-Oct</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 09</strong></td>
<td>01-Nov</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lab 06</td>
<td>Lab 07</td>
<td>Lab 07</td>
<td>Lab 07</td>
<td>Lab 07</td>
</tr>
<tr>
<td></td>
<td>07-Nov</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 10</strong></td>
<td>08-Nov</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Test 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lab 07</td>
<td></td>
<td>Holiday</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14-Nov</td>
<td></td>
<td></td>
<td>Ass 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SUN</td>
<td>MON</td>
<td>TUE</td>
<td>WED</td>
<td>THU</td>
<td>FRI</td>
<td>SAT</td>
</tr>
<tr>
<td>------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td><strong>Week 11</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-Nov</td>
<td></td>
<td></td>
<td>Lab 08</td>
<td></td>
<td>Lab 08</td>
<td></td>
<td>Lab 08</td>
</tr>
<tr>
<td>21-Nov</td>
<td></td>
<td>Lab 08</td>
<td></td>
<td>Lab 08</td>
<td></td>
<td>Lab 08</td>
<td></td>
</tr>
<tr>
<td><strong>Week 12</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22-Nov</td>
<td>Lab 09</td>
<td></td>
<td>Lab 09</td>
<td></td>
<td>Lab 09</td>
<td></td>
<td>Lab 09</td>
</tr>
<tr>
<td>28-Nov</td>
<td></td>
<td>Lab 09</td>
<td></td>
<td>Lab 09</td>
<td></td>
<td>Lab 09</td>
<td></td>
</tr>
<tr>
<td><strong>Week 13</strong></td>
<td></td>
<td></td>
<td>Ass 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29-Nov</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05-Dec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Clickers

Clickers are devices that allow students to respond individually to in-class polls and quizzes, sending instant responses from the whole class to the instructor’s computer.

For CPSC 121, we will used it for questions during lectures.

Notes:
https://www.iclicker.com/
We’re still figuring things out as IT services has been making changes to Canvas’ clicker support until the last couple of days.
We will post detailed instructions on Piazza by the end of the week-end.
We will first use clickers on Tuesday September 15th.
Piazza

Piazza is a forum where you can ask questions and interact with the instructors, TAs and other students.

For CPSC 121, we will used it for discussions.
Canvas

Canvas is UBC’s online learning platform, where you can find course material, discussion board, quizzes and more.

For CPSC 121, we will used it for lab grades and pre-class quizzes.
Overleaf is a collaborative cloud-based editor used for writing and editing documents for LaTeX.

For CPSC 121, we will use it to write assignments and turn them into PDFs.
Gradescope is grading software where exams and assignments can be uploaded and graded.

For CPSC 121, we will used it to submit assignments, receive feedback and grades for assignments and midterms, and submit regrade requests.
Padlet is an online notice board.

For CPSC 121, I will use it for our announcements, so it is easy for you to follow them even if you miss class.
Ask CPSC 121

http://www.cs.ubc.ca/~mochetti/CPSC121.html
Ask CPSC 121

http://www.cs.ubc.ca/~mochetti/askCPSC121.html