ENSF 619.02 - Advanced Topics in Image Analysis and Machine Learning

Course Overview

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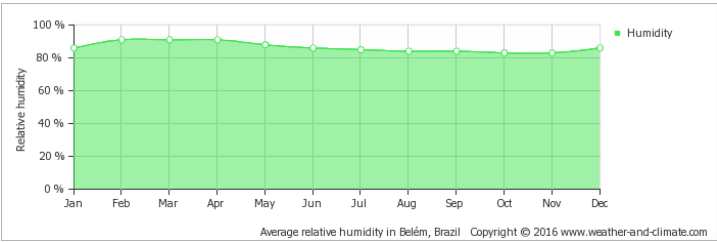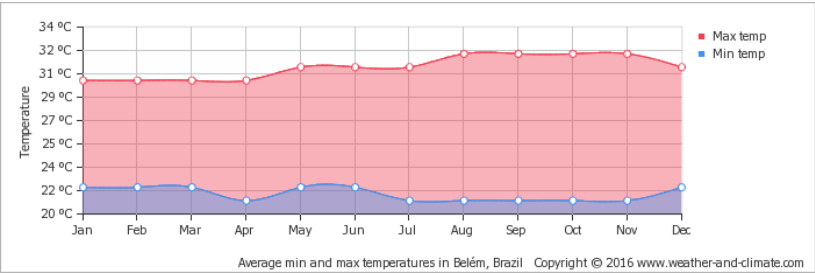Schulich School of Engineering

W2024

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First Class Goals

- Get to know the class better and vice-versa

- Set expectations and prepare you for what will come

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Belém/Brazil

Average min and max temperatures in Belém, Brazil   Copyright © 2016 www.weather-and-climate.com

Average relative humidity in Belém, Brazil   Copyright © 2016 www.weather-and-climate.com
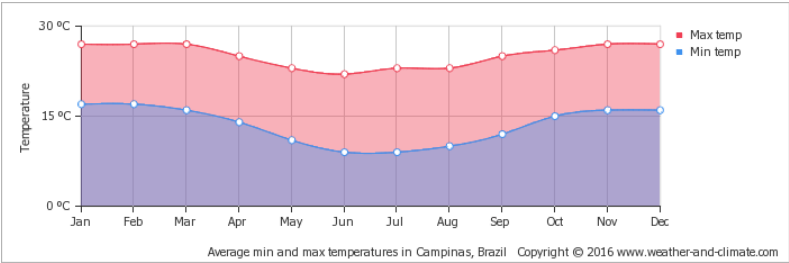
**Electrical Engineering
B.Sc. - 2011**

6-month exchange

Campinas/Brazil

Penn UNIVERSITY of PENNSYLVANIA
3-month exchange

UNICAMP
Computer Engineering
M.Sc. – 2014
Ph.D. – 2017

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6-month exchange

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Calgary/Canada

Postdoctoral Fellow
June 2017 – June 2020
Assistant Professor
July 2020 - present
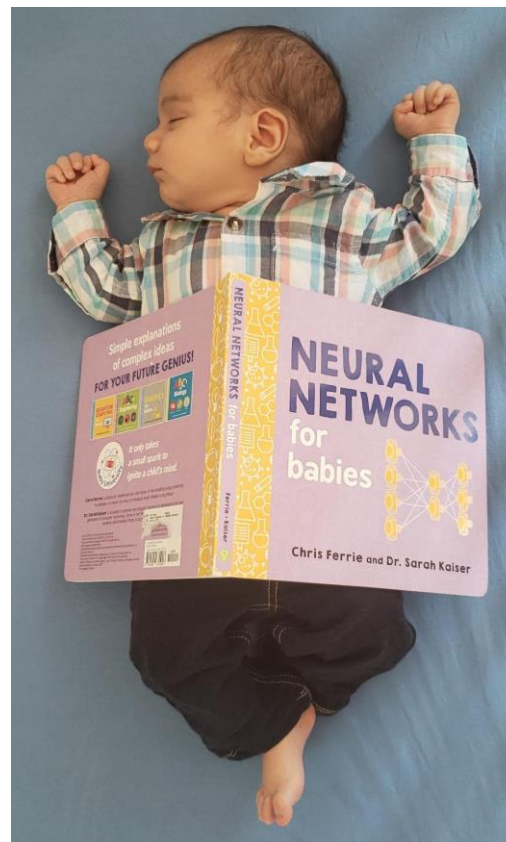
Baby Jorge – Born 12 September 2019

My wife (Mariana) also a researcher in AI
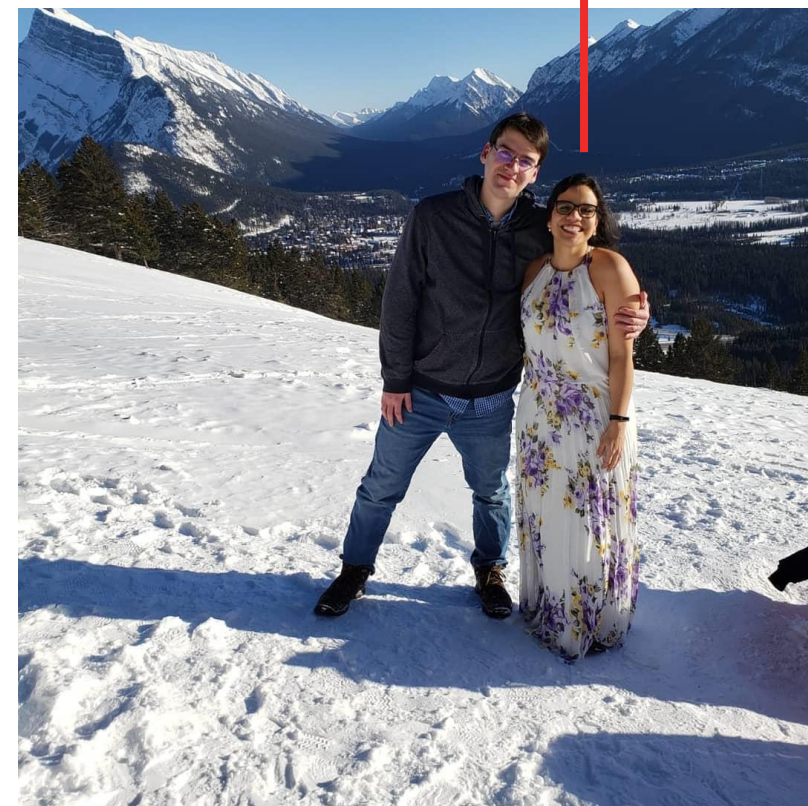
Wedding in Banff (-30C!)
March 2019

AI runs in the family...

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Meet and Greet

- Let's get to know you. If you are comfortable, please share:

    - Name

    - Supervisor

    - Background

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Course Delivery

- Synchronous and in-person
  - MF – 11:00 am to 12:15 pm
  - Room ENF 334

- Let's use D2L to ask general questions

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Course Syllabus

This course focuses on advanced machine learning and image analysis techniques. The course will cover the following topics: models of image segmentation, state-of-the-art methods on ImageNet, self-supervised learning, domain adaptation, generative models. A special emphasis will be given to recent cutting-edge techniques. The course will be hands-on.

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Course Syllabus (main topics)

- Python Bootcamp and machine learning concepts

- Data preparation and pre-processing

- Regularization techniques

- Neural Networks

- Transfer Learning and Domain Adaptation

- U-net model of image segmentation

- Generative models

- Self-supervised learning

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Learning Outcomes

1. Acquire significant knowledge about cutting-edge image analysis and machine learning methods.

2. Design and develop image processing and machine learning solutions for relevant problems.

3. Acquire hands-on experience with image processing and machine learning programming frameworks (e.g., OpenCV, scikit-image, PyTorch, etc.).

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What this course is about?
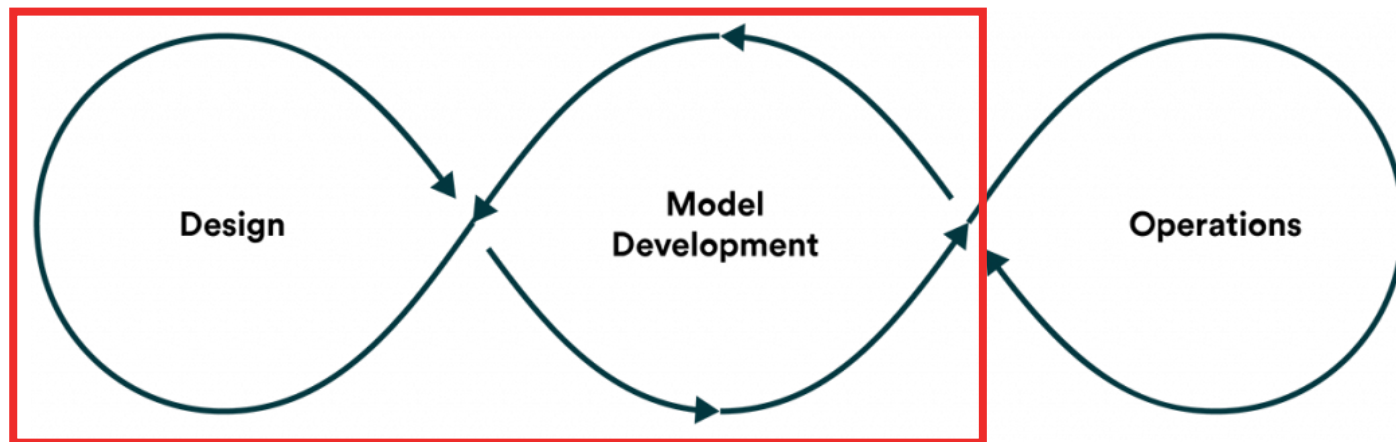
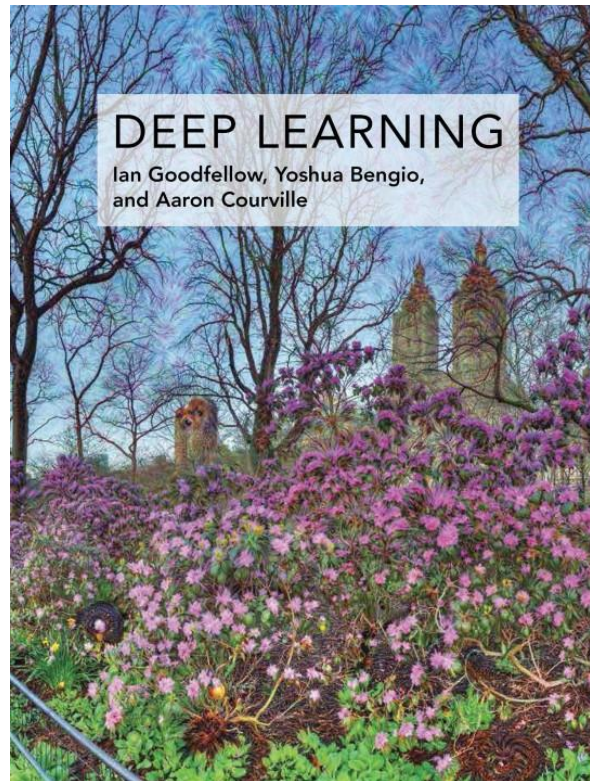

- **Model deployment**
- **CI/CD pipelines**
- **Monitoring & triggering**

This course is about designing and developing machine learning models to achieve the best quantitative metrics* to the problems being modelled.

*Quantitative results are determined on a problem-by-problem basis.

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Textbook

- No mandatory textbook for this course

Starting at chapter 5

Course Assessment

Component	Learning Outcomes	Weight
Participation	1, 2	5%
Assignments (2)	1, 2, 3	40%
Quizzes (2)	1, 2	10%
Final Project	1, 2, 3	45%

- The lowest quiz grade will be dropped

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Participation (5%)

- Student participation will account for 5% of the final grade. How participation will be measured?

  - Students questions and answers during class

  - Students participation on the D2L discussion board

  - Students helping each other during class

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Assignments (40%)

- Individual or in pairs

- **Assignment 01** (20%)**:**
  - Create a machine learning hands-on tutorial
  - **Due:** February 26th (midnight) | **Delivery method:** D2L dropbox

- **Assignment 02** (20%):
  - Reading assignment – present in class
  - **Due:** presentations will be scheduled in class | **Delivery method:** D2L dropbox

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Quizzes (10%)

- 2 quizzes –highest grade is kept

- Quizzes are individual

- Content: all topics covered until the day of the quiz

- **Quiz 01: February 2nd**

- **Quiz 02: March 1st**

- The dropped quiz is to accommodate potential student absence

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Final Project (45%)

- 5-page report + 1 additional page only with references (if necessary)

- Report template
  - <u>Overleaf</u> - please make a copy for your team.
  - <u>Microsoft word</u>

- Report due date: **April 5th at 9 am**

- Final project presentations: **April 5th and 8th**
  - 10-minute presentation + 5-minutes for questions
  - Send slides one day before your presentation

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Grades

Letter Grade	Total Mark (T)
A+	T≥95%
A	90% ≤ T < 95%
A-	85% ≤ T < 90%
B+	80% ≤ T < 85%
B	75% ≤ T < 80%
B-	70% ≤ T < 75%
C+	65% ≤ T < 70%
C	60% ≤ T < 65%
C-	55% ≤ T < 60%
D+	50% ≤ T < 55%
D	45% ≤ T < 50%
F	T < 45%

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The Programming Environment (Part 1)

https://colab.research.google.com/

https://jupyter.org/

https://github.com/rmsouza01/deep-learning

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Research Computing Services

https://rcs.ucalgary.ca/index.php/RCS_Home_Page

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The Programming Environment (Part 2)

- Python 3

- Python libraries:
  - siamxt
  - NumPy
  - SciPy
  - Matplotlib
  - Scikit-learn
  - Scikit-image
  - Pandas
  - Tensorflow (version ≥ 2.0)
  - PyTorch

- Please have your programming environment in your computer or on Google Colab set up asap

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Deep Learning Framework

I hope you enjoy the class ☺

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Questions?

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