0: Introduction

- Your instructor
- Terminology
- Evolution
- Course expectation and schedule
- Course assessment
- Learning outcomes

Your instructor

- Prof. Ting Hu (email: ting.hu@queensu.ca)

  https://www.cs.queensu.ca/people/Ting/Hu

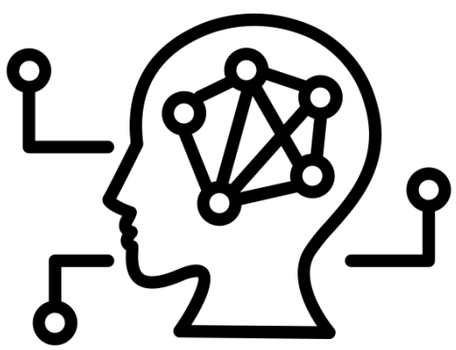
- Office hours (Goodwin 730): Wednesday 11 - 1

- Courses: CISC121, CISC365, CISC455/851

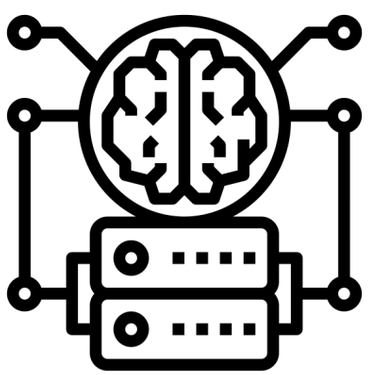
- Research interests:

  - Evolutionary computing
  - Machine learning and AI
  - Biomedical computing

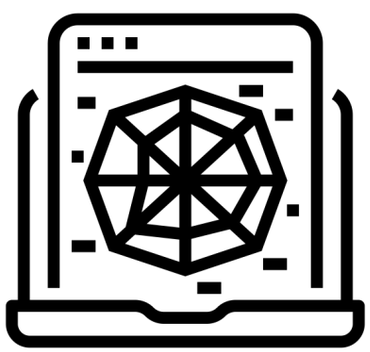
Terminology



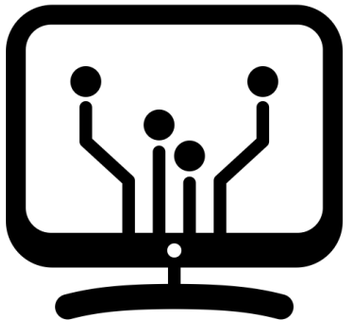
Artificial Intelligence



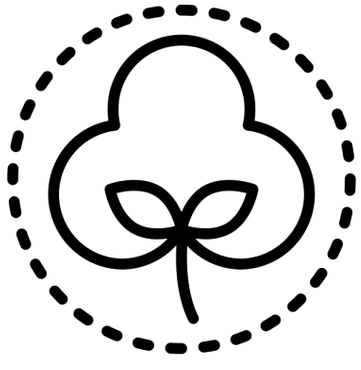
Machine Learning



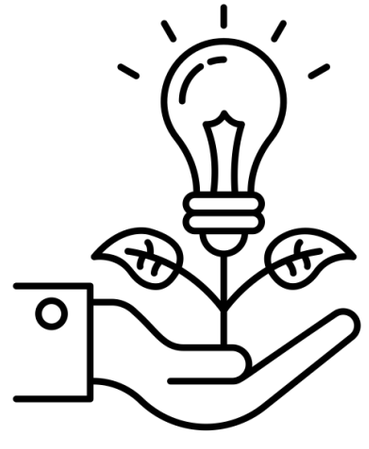
Metaheuristic



Computational Intelligence



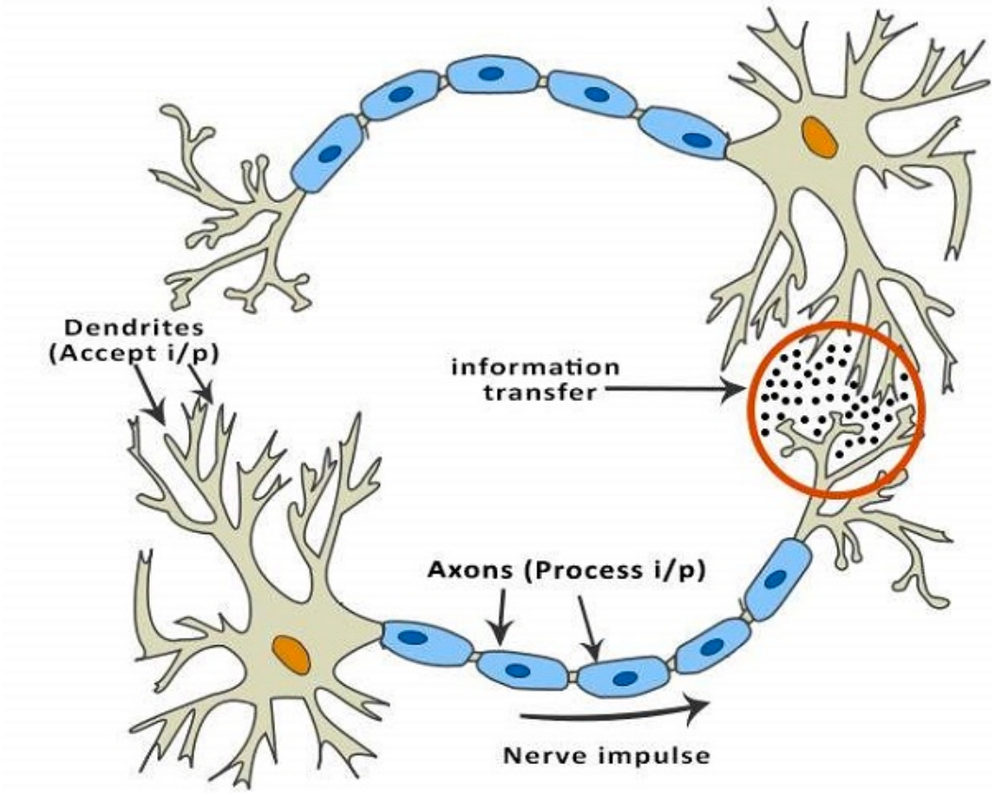
Soft Computing

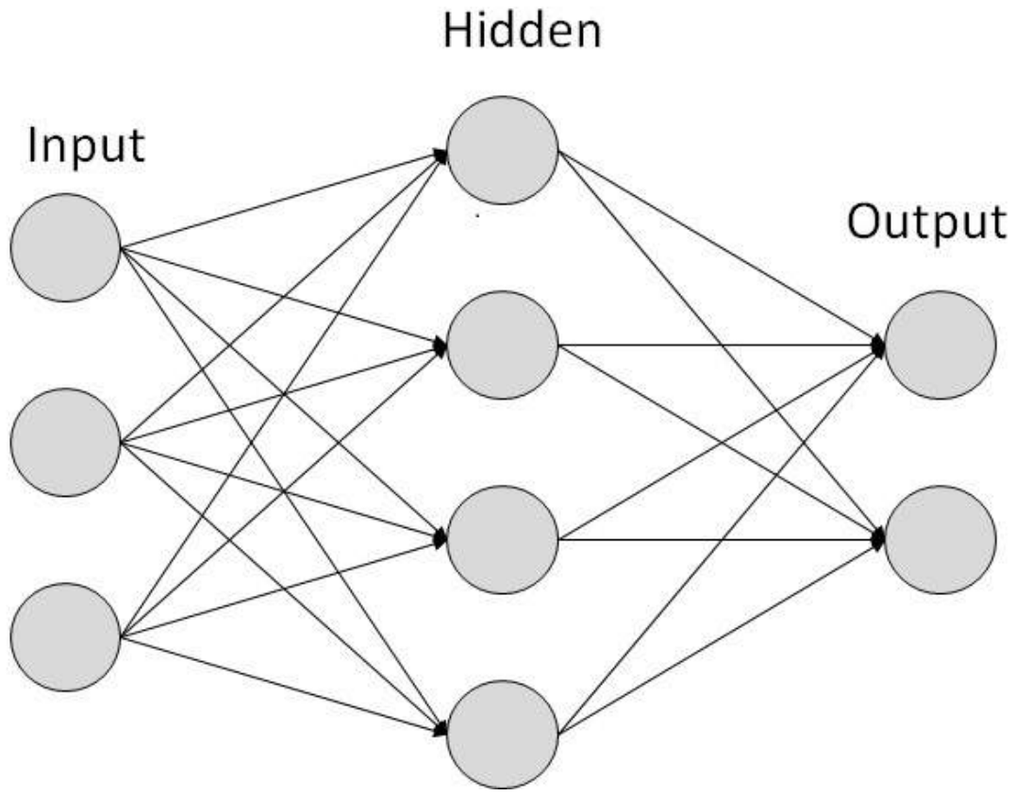


Nature-inspired computing

Why learn from biology?

- The research areas where researchers try to extract more or less abstract principles and procedures from living organisms, and realize them in computational (algorithmic, software) settings.





Human brain ⟶ Artificial neural networks

Bird flocking, ant colonies, fish schooling ⟶ Swarm intelligence

Artificial immune network algorithm

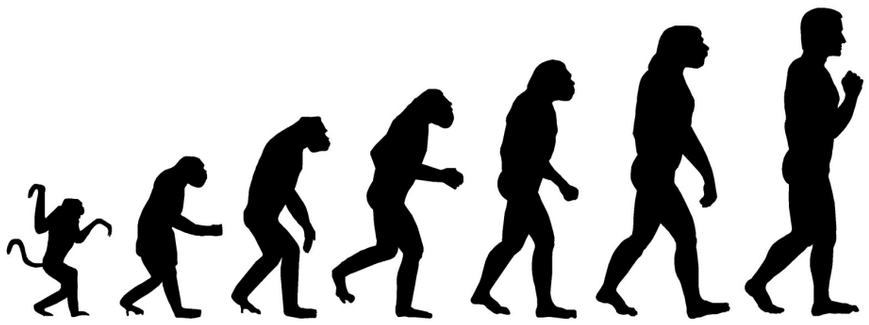
Colonal selection algorithms

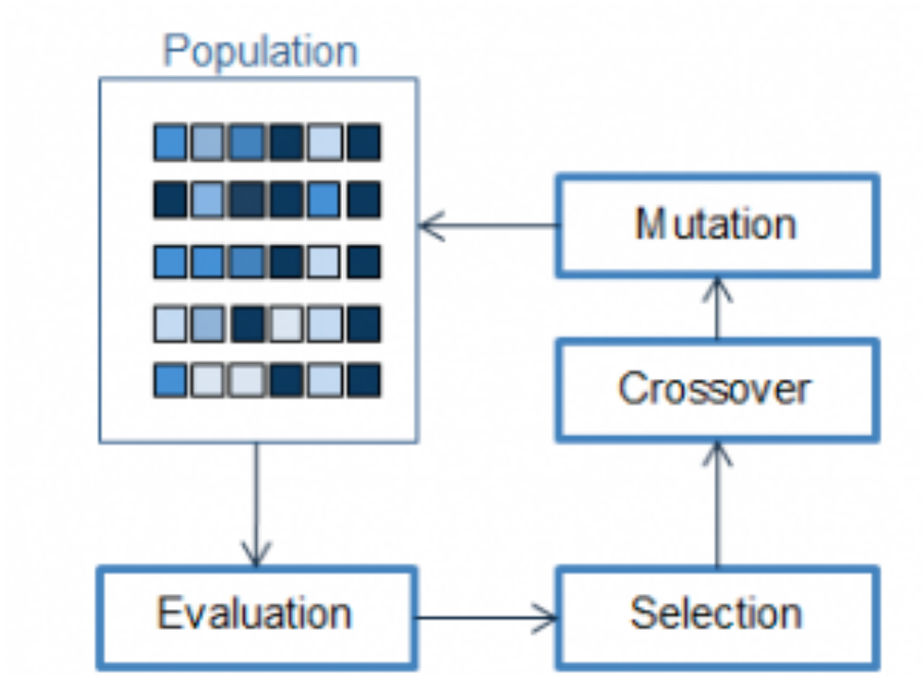
Negative selection algorithms

Danger theory inspired algorithms

Dendritic cell algorithms

Vertebrate immune system ⟶ Artificial immune system





Natural evolution and genetics ⟶ Evolutionary algorithms

Evolution

- The change of traits of biological populations/species over generations
- The interaction between traits and environment
- Why's in biology find their answers in evolution
  - Early birds vs. night owls
  - Instinct to fit in
  - The negativity bias

Comparison

- EC vs. reinforcement learning
- EC vs. deep learning
- Fusion and meta-learning

Course expectations

- Apply evolution concepts to optimization and learning problems
- Evaluate and choose among evolutionary computing solutions for applications
- Formulate and implement evolutionary algorithms
- Present and defend designs of evolutionary algorithms

Really, what can we benefit from this course?

- A creative and fun AI technique
- Challenging and complex real-world problems
- Group collaboration on a complete project
- Peer review and self-reflection
- Research

What is scientific research?

- Research is an attempt to discover (new or better) answers to questions or solutions to problems
- Education vs. research
- Why do research?
- How to do research?
  - Observation/question
  - Get to the knowledge boundary by background research
  - Primary and secondary literature
  - Identify the knowledge gap and propose a hypothesis
  - Design and implement your own method
  - Collect, analyze, and interpret your results

What makes research challenging?

- The knowledge boundary is not always clear
- No roadmap
- No answer-key

What makes research exciting?

- Intellectually stimulating
- Stretch your limit
- New discoveries
- Never-ending learning

Week	***Dates***	***Topic(s)***
1	January 9 - 13	Introduction
2	January 16 - 20	Evolutionary computing overview
3	January 23 - 27	Genetic algorithm
4	January 30 - February 3	Genetic algorithm
5	February 6 - 10	Evolution strategies
6	February 13 - 17	Genetic programming
	February 20 - 24 **(Mid-term Break)**	
7	February 27 - March 3	Pitch presentations
8	March 6 - 10	Linear genetic programming
9	March 13 - 17	Evolutionary computing applications
10	March 20 - 24	Parameter setting
11	March 27 – 31	New techniques
12	April 3 - 6	Evolution and learning

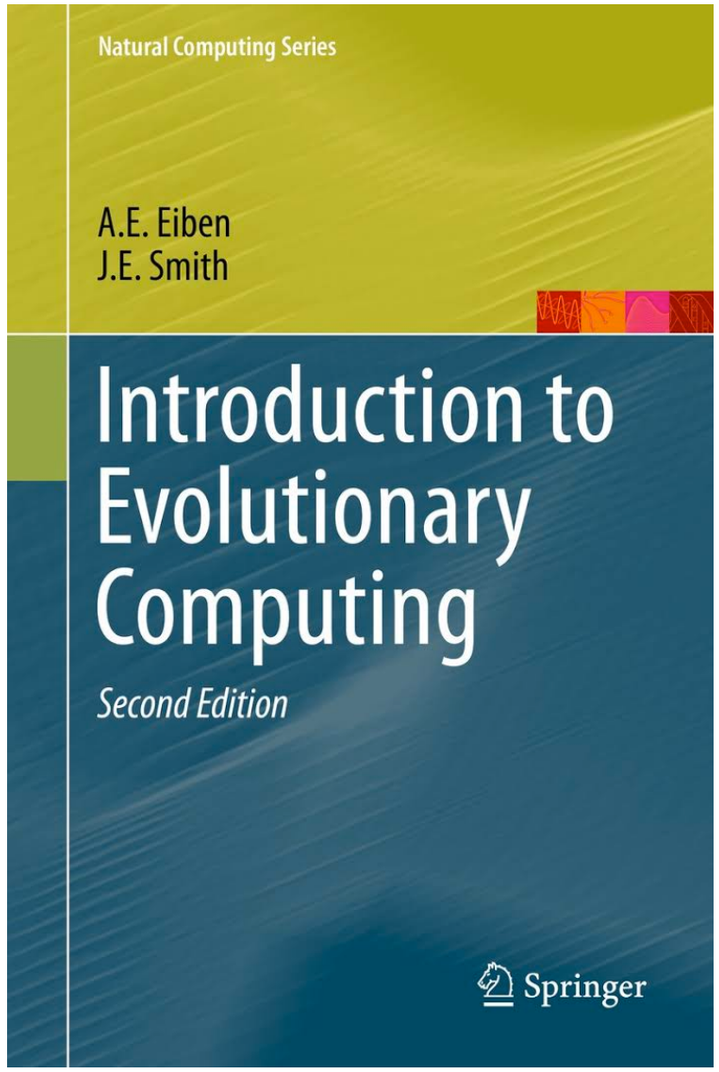
Learning outcomes

- How to learn and implement a new technique
- How to solve a novel and challenging problem
- How to present an idea
- How to conduct research
- How to write a scientific research report
- How to work with a team
- How to incorporate feedback
- Perseverance, confidence, and optimism

Assessment

- Assignment (10%)
  - A full implementation of an evolutionary algorithm, due on February 7th
- Test (25%)
  - Fundamentals of evolutionary computing, March 7th, in-class
- Group project (groups of three)
  - Proposal (10%)
  - Pitch presentation (10%)
  - Final report (40%)
  - Individual students receive group grades adjusted with peer evaluations
- Peer review contribution (5%)

Textbook and communication



- *Introduction to Evolutionary Computing*, 2nd edition

  Eiben and Smith, Springer, 2015

- OnQ for all course material

- MS Teams for QnA and discussion

- Email: ting.hu@queensu.ca ([CISC455] or [CISC851] in the title)


Welcome
Glad you're here!