ECE 449/590 – Object-Oriented Programming and Machine Learning
Fall 2022

Instructor: Professor Jia Wang
E-Mail: jwang34@iit.edu

Prerequisites: You are assumed to have experiences on the following topics: computer programming (CS 115/116/201 or equivalent); computer organization (ECE 242 or equivalent); linear algebra (Math 333 or equivalent); probability (Math 374 or equivalent). If you haven't been writing programs for a while, please refer to the following book for introductory C++ programming.

- "Programming – Principles and Practice Using C++"
  B. Stroustrup, Addison-Wesley, 2014. ISBN 978-0321-992789

Class Time and Location: Mon./Wed. 3:15 PM – 4:30 PM, Robert A. Pritzker Science Ctr 111

Class Home Page: `http://www.ece.iit.edu/~jwang/ece449-2022f/`

Required Textbook:

- [A] "Accelerated C++: Practical Programming by Example"
  A. Koenig and B.E. Moo, Addison-Wesley, 2000. ISBN: 978-0201703535
- [D] "Deep Learning" `http://www.deeplearningbook.org`
  I. Goodfellow et al., MIT Press, 2016.

Recommended Textbooks:

- "The C++ Programming Language: 4th Edition"
  B. Stroustrup, Addison-Wesley, 2013. ISBN: 978-0321563842
- "Design Patterns: Elements of Reusable Object-Oriented Software"
  E. Gamma et al., Addison-Wesley, 1994. ISBN: 978-0201633610

Computer Requirement: A computer desktop or laptop that is able to run VirtualBox is required for this course. Computers with solid-state drives, at least 16GB of memory, and at least 4 physical processor cores are recommended.

Course Summary: This course gives students a clear understanding of the fundamental concepts of object-oriented design/programming (OOD/OOP). Languages addressed include C++ and Python. Key topics covered include introduction to machine and deep learning, software development life cycle, core language and standard library of C++ and Python, class design and design patterns, OpenMP and CUDA platforms. Students will implement a machine leanring library, and in addition graduate students will design a complex machine learning application, using these concepts and Agile software engineering practices.

ECE 449 Grading: Homeworks 10% / Projects: 120% (30% extra).
A: $\geq$ 90% / B: $\geq$ 80% / C: $\geq$ 60% / D (undergraduate only): $\geq$ 55%.

ECE 590 Grading: Homeworks 10% / Projects: 100% (10% extra).
A: $\geq$ 90% / B: $\geq$ 80% / C: $\geq$ 60%.

Homework and Project Policy: Late homeworks and projects will not be graded. Homeworks will be graded based on general approach and completion, and solutions will be released shortly after due date. Discussions on homeworks/projects are encouraged, but copying will call for disciplinary action.

Lecture Schedule (tentative):

No.	Date	Topic	Chapters	HW Out	Project Due
1, 2	8/22, 8/24	Introduction, Python			
3, 4	8/29, 8/31	Project and C++ Overview	[A]0–4		
5	~~9/5~~, 9/7	String and Vector	[A]0–4	#1	
6, 7	9/12, 9/14	Containers and Algorithms	[A]5–8		1
8, 9	9/19, 9/21	The Builder Pattern	[A]9		
10,11	9/26, 9/28	Class Invariant and Class Design	[A]9	#2	
12,13	10/3, 10/5	Polymorphism and Design Patterns	[A]13		2
14	~~10/10~~, 10/12	Machine Learning Basics	[D]1–5		
15,16	10/17,10/19	Deep Feedforward Networks	[D]6		3
17,18	10/24,10/26	Convolutional Networks	[D]9	#3	
19,20	10/31,11/2	Back-Propagation and Training	[D]6–8		
21,22	11/7, 11/9	C++ Resource Management I	[A]11,14		4
23,24	11/14,11/16	C++ Resource Management II	[A]11,14	#4	
25	11/21,~~11/23~~	OpenMP			
26,27	11/28,11/30	CUDA			5
	12/5–12/9	**No Final Exam**			6

Course Objectives (ABET)
After completing this course, the student should be able to do the following:

1. Identify objects and their interactions for machine learning applications.
2. Utilize object lifetime for resource management considering object composition, inheritance, and exception handling.
3. Understand typical machine and deep learning algorithms.
4. Reuse existing class libraries to improve code quality and productivity.
5. Utilize class invariants to design class types. Document and validate pre-conditions and post-conditions via assertions.
6. Construct reusable class libraries using polymorphism.
7. Utilize design patterns when designing and reusing class libraries.
8. Implement a machine learning library following test-driven and iterative/incremental software engineering practices.

ADA Statement: Reasonable accommodations will be made for students with documented disabilities. In order to receive accommodations, students must obtain a letter of accommodation from the Center for Disability Resources and make an appointment to speak with me as soon as possible. The Center for Disability Resources is located in the Life Sciences Building, room 218, 312-567-5744 or `disabilities@iit.edu`.

Sexual Harassment and Discrimination Information: Illinois Tech prohibits all sexual harassment, sexual misconduct, and gender discrimination by any member of our community. This includes

harassment among students, staff, or faculty. Sexual harassment of a student by a faculty member or sexual harassment of an employee by a supervisor is particularly serious. Such conduct may easily create an intimidating, hostile, or offensive environment. Illinois Tech encourages anyone experiencing sexual harassment or sexual misconduct to speak with the Office of Title IX Compliance for information on support options and the resolution process. You can report sexual harassment electronically at iit.edu/incidentreport, which may be completed anonymously. You may additionally report by contacting the Title IX Coordinator, Virginia Foster at `foster@iit.edu` or the Deputy Title IX Coordinator at `eespeland@iit.edu`. For confidential support, you may reach Illinois Tech's Confidential Advisor at (773) 907-1062. You can also contact a licensed practitioner in Illinois Tech's Student Health and Wellness Center at `student.health@iit.edu` or (312)567-7550 For a comprehensive list of resources regarding counseling services, medical assistance, legal assistance and visa and immigration services, you can visit the Office of Title IX Compliance website at `https://www.iit.edu/title-ix/resources`.