ECE 449/590 – Object-Oriented Programming and Machine Learning
Fall 2020

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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

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`.

Class Time and Location: We will use a combination of streamed lectures Mon./Wed. 3:35 PM – 4:50 PM and recorded lectures.

Class Home Page: `http://www.ece.iit.edu/~jwang/ece449-2020f/`

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

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	8/24, 8/26	Introduction, Python			
3, 4	8/31, 9/2	C++ Overview I	[A]0–4		
5	~~9/7~~, 9/9	C++ Overview II	[A]0–4	#1	
6, 7	9/14, 9/16	C++ Containers	[A]5–8		1
8, 9	9/21, 9/23	Builder Pattern	[A]9		
10,11	9/28, 9/30	C++ Class Design	[A]9	#2	
12,13	10/5, 10/7	Design Patterns	[A]13		2
14	~~10/12~~, 10/14	Machine Learning Basics	[D]1–5		
15,16	10/19,10/21	Deep Feedforward Networks	[D]6		3
17,18	10/26,10/28	Convolutional Networks	[D]9	#3	
19,20	11/2, 11/4	Back-Propagation and Training	[D]6–8		
21,22	11/9, 11/11	C++ Resource Management I	[A]11,14		4
23,24	11/16,11/18	C++ Resource Management II	[A]11,14	#4	
25	11/23,~~11/25~~	OpenMP			
26,27	11/30,12/2	CUDA			5
	12/7–12/11	**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.

We may utilize traditional classrooms to stream lectures for this course at a later time. Please refer to the next page for **COVID-19 Precautions and Face Coverings in Class** if you would like to attend in person.

COVID-19 Precautions and Face Coverings in Class

Illinois Tech students are required to wear face masks at all times and maintain social distancing (6 feet between individuals) in traditional classrooms, instructional laboratories, and similar settings. In general, individuals should spend as little time as practicable in closer proximity when doing so is necessary to achieve learning objectives. Students who are feeling ill or experiencing symptoms such as sneezing, coughing, or a higher than normal temperature will be excused from class and are expected to stay at home.

Instructors have the right to ask those who are not complying with these requirements to leave class in the interest of everyone's health and safety. In the event that a student refuses to comply with instructor directions regarding face masks and/or social distancing, the instructor has the right to ask the student to leave, and/or cancel class. A student who refuses to comply with these requirements will be referred to the Office of the Dean of Students for possible disciplinary action under the Student Code of Conduct.

Additionally, as a reminder, following other simple practices such as frequent and thorough hand washing, wiping down desks and seats with disinfectant wipes when possible, not sharing personal items such as pens and cell phones, and avoiding crowded hallways and other enclosed spaces will promote good health in and out of the classroom.

Visit `iit.edu/COVID-19` for details on Illinois Tech's response to coronavirus (COVID-19). For information from government authorities, please see the Centers for Disease Control and Prevention website at `cdc.gov`.