

Deep Learning for Computer Graphics

CAP 4613 Section 9ZED (31264)

Class Periods: MWF, Period 5, 11:45am-12:35PM

Location: FLG 0230

Academic Term: Spring 2022

Instructor:

Corey Toler-Franklin

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CSE 332 (Lab CSE 319)

Office Hours: TBD, Zoom conference

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

Please contact through the Canvas website

- Dipali Patidar,, Zoom conference

Course Description

This undergraduate course covers deep learning basics, related math and the fundamental theory and application of AI algorithms most popular in the field of computer graphics. Programming assignments will help students develop GPU programming skills while implementing concepts learned in lectures and readings using deep learning APIs on a GPU cluster. Convolutional neural networks (CNNs) for colorizing black and white movies is an example.

Course Pre-Requisites / Co-Requisites

COP 3530, MAS 3114 or 4105

Course Objectives

This undergraduate course covers the fundamental theory and application of AI algorithms in the context of computer graphics. This course begins with deep learning basics including several lectures that cover related math (numerical analysis, gradient optimization, singular value decomposition and math for computer graphics). Students will then learn fundamental deep learning concepts including: supervised and unsupervised learning, convolutional neural network architectures, backpropagation, autoencoders and fine-tuning. In this undergraduate level course, there is an emphasis on developing GPU programming skills while implementing concepts learned for real computer graphics applications. CNNs for colorizing black and white movies is an example. Students will complete programming assignments using a GPU cluster. Weekly quizzes are designed to help students access their understanding of course material on a regular basis. These quizzes also provide preparation for the written homework and take-home exam which are designed to help students develop problem solving skills that use mathematical concepts covered in the course material.

Materials and Supply Fees

N/A

Professional Component (ABET):

Students will learn fundamental concepts for solving engineering problems related to deep learning. Students will apply mathematical concepts to develop AI algorithms in a semester long programming project.

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High

2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3. An ability to communicate effectively with a range of audiences	Medium
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Medium
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	Medium
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	High
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	Medium

Required Textbooks and Software

- Title: Deep Learning
- Author: Ian Goodfellow, Yoshua Bengio and Aaron Courville
- Publication date and edition: Latest Online
- ISBN number: 9780262035613

Course Schedule

Date	Topic	Reading	Assignments
5-Jan	Introduction		
7-Jan	Machine Learning Basics	Goodfellow 5-5.2.0, 5.3	course survey out
10-Jan	Machine Learning Basics		course survey due
12-Jan	Math: Numerical Analysis: Gradient Optimization	Goodfellow 4.3	
14-Jan	HiPerGator Training - Zoom + In-Person Options		
17-Jan	* Martin Luther King, Jr. Day - NO CLASSES		
19-Jan	Math: Numerical Analysis: Gradient Optimization		
21-Jan	Math: Numerical Analysis: Gradient Optimization		
24-Jan	* Neural Networks	Goodfellow 6, 6.1, 6.4, 14, 14.1, 14.9	Proj 1. Classification/Regression
26-Jan	Neural Networks	Goodfellow 5.9, 6.5	
28-Jan	Neural Networks	Goodfellow 7.12, 8.4, 8.7.1	
31-Jan	* Python, Torch, CUDA, cuDNN, TensorFlow		
2-Feb	Python, Torch, CUDA, cuDNN, TensorFlow		
4-Feb	Python, Torch, CUDA, cuDNN, TensorFlow		
7-Feb	* Training, Testing, Fine-tuning	Goodfellow 15.2, 7.4	Proj 2. CNNs for Graphics
9-Feb	Training, Testing, Fine-tuning		Proj 1. due
11-Feb	Convolutional Neural Networks	Goodfellow 9-9.3	
14-Feb	* Convolutional Neural Networks		
16-Feb	Traditional Machine Learning	Toler-Franklin 2010	
18-Feb	Final Project Discussion		
21-Feb	* Recurrent Neural Networks	Goodfellow 10-10.2.2, 10.10.1	
23-Feb	Natural Language Processing		
25-Feb	Math for Computer Graphics		

28-Feb	*	Math for Computer Graphics		Proj 2. due
2-Mar		Math for Computer Graphics		Final Proj. Proposal due
4-Mar		TBD		
7-Mar	*	Spring Break - NO CLASSES		
9-Mar		Spring Break - NO CLASSES		
11-Mar		Spring Break - NO CLASSES		
14-Mar	*	Deep Learning - inverse Graphics Problem		
16-Mar		Deep Learning in Graphics: Recent Trends		written hw out
18-Mar		Deep Learning in Medicine	Zhang and Toler-Franklin 2020	
21-Mar	*	Generative Adversarial Networks	Goodfellow2014	
23-Mar		Generative Adversarial Networks		Final Project .mid eval
25-Mar		Reinforcement Learning	Mnih2013	written hw due
28-Mar		Take Home Exam		Take Home Exam: March 30
30-Mar		Reinforcement Learning		Take Home Exam Due
1-Apr		Image Synthesis	Song 2021	
4-Apr		Image Denoising	Bako2017	
6-Apr		Motion from Video		
8-Apr		Learning from Physics		
11-Apr		Learning from Physics		
13-Apr		Autonomous Driving	TED Talk 1.	
15-Apr		Autonomous Driving		
18-Apr		TBD		
20-Apr		Robotics	Pinto 2017, TED Talk 2.	Final Project due

* **weekly in class quiz dates**

Online Course Recording

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is expected and taken in class. One half of a letter grade will be deducted (e.g. an A becomes a B+) for missing more than 3 classes for the semester without a documented university excuse. Make-Up homework, projects and exams will be coordinated with the instructor for university excused absences. Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

Evaluation of Grades

Assignment	Percentage of Final Grade
Programming Assignments (2)	40%
Take Home Exam (1)	15%
Written Homework (1)	15%
Final Project	20%
Quizzes (~weekly)	10%

Grading Policy

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Late Policy: Late programming projects will receive a late penalty of 10% per day late up to a maximum of a 50% reduction unless there is a documented university excused absence. Students are permitted 1 free late pass for 1 programming assignment (not including the final project which is due at the end of the semester). No late penalties will be applied for up to 1 week over the deadline when using a late pass. The written homework is reviewed in class in preparation for the exam and cannot be turned in late without a documented university excused absence.

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Programming assignments are done on the HiPerGator GPU cluster.

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://care.dso.ufl.edu>.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.