

## Deep Learning for Computer Graphics

CAP 5404 Section 1ZED(27623)

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

**Location:** FLG 0230

**Academic Term:** Fall 2022

### **Instructor:**

Corey Toler-Franklin

[ctoler@cise.ufl.edu](mailto:ctoler@cise.ufl.edu)

CSE 332 (Lab CSE 319)

Office Hours: TBD, Zoom conference

### **Teaching Assistant/Peer Mentor/Supervised Teaching Student:**

Please contact through the Canvas website, or directly by email

- **Sudarshan Khasnis**, [khasnis.s@ufl.edu](mailto:khasnis.s@ufl.edu), office hours, TBD Zoom conference,

### **Course Description**

Covers fundamental theory and application of popular artificial intelligence (AI) algorithms in computer graphics. Introduces several neural network architectures and the mathematical principles behind them. A semester-long project motivated by research publications teaches technical writing and graphics processing unit (GPU) programming on a GPU cluster. Convolutional neural networks for denoising movies and generative adversarial networks for animation are project examples.

### **Course Pre-Requisites / Co-Requisites**

Proficiency in a programming Language (Python and/or C++ recommended), Data Structures and Algorithms, Linear Algebra, and Calculus.

### **Course Objectives**

This course teaches students the mathematical principles behind deep learning AI algorithms and how to implement them to solve research problems in computer graphics. Concepts presented include: supervised, unsupervised and reinforcement learning; neural network (deep learning) architectures including convolutional neural networks (CNNs) and autoencoders; and related algorithms and techniques like backpropagation and fine-tuning. Topics presented in this graduate level course are explored through a semester-long project where students use GPU programming to implement theories and concepts they have learned in the course. Some project examples include, CNNs for denoising movie frames, and generative adversarial networks (GANs) for facial animation. Several lectures focus on technical paper writing and presentation skills. In the second half of the course, students read research papers that incorporate deep learning concepts in the context of computer graphics research. Weekly quizzes are designed to help students gauge their understanding of course material. These quizzes prepare students for the written homework assignment and take-home exam which are designed to develop problem solving skills using mathematical concepts covered in the course material.

### **Learning Objectives:**

Students will learn fundamental concepts for solving engineering problems related to deep learning. They will apply mathematical concepts to develop AI algorithms in a programming project. Students will gain experience with GPU programming.

### **Expected Outcomes:**

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to communicate effectively with a range of audiences.
3. 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.
4. An ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering

- judgment to draw conclusions.
5. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

**Materials and Supply Fees**

N/A

**Required Textbooks and Software**

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

**Recommended Materials**

N/A

**Course Schedule**

Date	Topic	Reading	Assignments
24-Aug	Introduction		course survey out
26-Aug	Machine Learning Basics	Goodfellow 5-5.2.0, 5.3	
29-Aug	Machine Learning Basics		course survey due
31-Aug	<b>HiPerGator Training -Zoom + In-Person Options</b>		
2-Sep *	Neural Networks	Goodfellow 6, 6.1, 6.4	
5-Sep	<b>Labor Day: No Class</b>		
7-Sep	Neural Networks	Goodfellow 4.3, 5.9, 6.5	
9-Sep *	Course Project Discussion   Neural Networks	Goodfellow 7.12, 8.4, 8.7.1	course proj. out
12-Sep	Neural Networks	Goodfellow 14, 14.1, 14.9	course proj. part1 out
14-Sep	Neural Networks		
16-Sep *	Python, Torch, CUDA, cuDNN, TensorFlow		
19-Sep	Python, Torch, CUDA, cuDNN, TensorFlow		
21-Sep	Training, Testing, Fine-tuning	Goodfellow 15.2, 7.4	
23-Sep *	Training, Testing, Fine-tuning		
26-Sep	Convolutional Neural Networks	Goodfellow 9-9.3	
28-Sep	Convolutional Neural Networks		course proj. part2 out
30-Sep *	Traditional Machine Learning		course proj. part1 due
3-Oct	Transformers, Recurrent Neural Networks	Goodfellow 10-10.2.2, 10.10.1	
5-Oct	<b>No Class: Deep Learning in Medicine</b>	Zhang, Heldermon &Toler-Franklin 2020	
7-Oct *	<b>Home Coming</b>		
10-Oct	Natural Language Processing		
12-Oct	Deep Learning in Graphics: Inverse Graphics		
14-Oct *	Deep Learning in Graphics: Recent trends		
17-Oct	Generative Adversarial Networks	Goodfellow2014	course proj. part3 out
19-Oct	Generative Adversarial Networks	Song 2021, Li 2021	course proj.part2. due
21-Oct *	Reinforcement Learning		course proj. proposal
24-Oct	Reinforcement Learning	Mnih2013, Peng 2018	
26-Oct	Technical Writing   Discussion Course Proj.		

28-Oct	* Technical Writing   Discussion Course Proj.		
31-Oct	Technical Writing   Discussion Course Proj.		
2-Nov	Image Synthesis	Pandey 2021	written hw out
4-Nov	<b>Holiday Place Holder</b>		
7-Nov	* Image Denoising	Bako2017	
9-Nov	Motion from Video	Karpathy 2014	
11-Nov	<b>Veteran's Day: No Class</b>		course proj.mid eval
14-Nov	Motion from Video	Habibie 2022	written hw due
16-Nov	<b>Take Home Exam</b>		<b>Take Home Exam</b>
18-Nov	Learning from Physics	Lerer2016	
21-Nov	Autonomous Driving	TED Talk 1	
23-Nov	<b>Thanksgiving: No Class</b>		
25-Nov	<b>Thanksgiving: No Class</b>		
28-Nov	Autonomous Driving	Janai 2017, Yuan 2022	
30-Nov	Robotics	TED Talk 2.	
2-Dec	Robotics	Pinto 2017	
5-Dec	TBD		
7-Dec	TBD		course proj.part3. due

### **Attendance Policy, Class Expectations, and Make-Up Policy**

Attendance is expected and noted. 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 excused absence. 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 graduate catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation.

### **Evaluation of Grades**

Assignment	Percentage of Final Grade
Course Project (submitted in three parts)	60%
Take Home Exam (1)	15%
Written Homework (1)	15%
Quizzes (~weekly)	10%

### **Grading Policy**

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

[UF Graduate Catalog](#)  
[Grades and Grading Policies](#)

**Late Policy:** The course project is submitted in three parts. Late programming project submissions 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 submission (course project Part I or Part II only). No late penalties will be applied for up to 1 week over the deadline when using a late pass. Part III of the course project is due at the end of the semester and students will not be able to apply the free 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.ua.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.ua.ufl.edu/public-results/>.

### ***In-Class Recording***

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### ***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/process/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
- Jennifer Nappo, Director of Human Resources, 352-392-0904, [jpennacc@ufl.edu](mailto:jpennacc@ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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:***

Students will have access to the HiPerGator GPU cluster for completing the course project.

### ***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](mailto: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:** <https://counseling.ufl.edu>, 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](mailto: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](mailto:Learning-support@ufl.edu).  
<https://lss.at.ufl.edu/help.shtml>.

**Career Connections Center**, Reitz Union, 392-1601. Career assistance and counseling; <https://career.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://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

**On-Line Students Complaints**: <https://distance.ufl.edu/state-authorization-status/#student-complaint>.