ECH 6937 Fundamentals of Artificial Neural Networks
Spring 2021

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E-mails must include a call-back phone number.
Without it, they may not receive a response.
Office Hours via Zoom: TBA, https://ufl.zoom.us/j/6379945549

Schedule: MWF 4:05-4:55 PM, https://ufl.zoom.us/j/6379945549

Specific course information

The course will teach many of the core concepts behind artificial neural networks (ANNs) and deep learning. Important concepts, such as the backpropagation algorithm, will be mathematically derived. To reinforce understanding, the concepts will be put to practice with Python code written by the students. To that end, instead of relying on existing ANN libraries, the students will write code from scratch and develop their own libraries. As the code is developed, it will be continually tested on the problem of handwritten number recognition utilizing 70,000 28x28-pixel grey-scale images (the MNIST set). As intermediate Python programming skills are required (including object oriented programming), it is estimated that a third of the lectures will be devoted to teaching Python programming. However, students must have the ability to code in some programming language because fundamental programming concepts (looping, if statements, etc.) are assumed to be known.

Prerequisites: Chemical Engineering student with programming ability in at least one programming language (not necessarily Python).

Elective Course

Course Topics:

1. Introduction to artificial neural networks (ANNs) and deep learning
2. The beginning: Perceptrons
3. Sigmoid neurons
4. The basic structure of ANNs
5. Steepest descent
6. Fitting and overfitting
7. Lessons in Python developing part of the code to be used later (several weeks)
8. The first ANN program without explanation of backpropagation
9. The backpropagation algorithm and its coding
10. The cross-entropy cost function
11. Regularization methods
12. Initializing weights
13. Heuristics for hyper-parameter tuning
14. The vanishing gradient problem and deep learning
15. Deep convolutional networks
16. Recurrent neural networks (if time permits)

Required Texts:

1. *Neural Networks and Deep Learning* by Michael Nielsen,
   http://neuralnetworksanddeeplearning.com/
   Cost: Free, a $5 donation is suggested
2. *Python in easy steps* by Mike McGrath
   https://www.amazon.com/s?k=python+in+easy+steps&ref=nb_sb_noss_1
   Cost: $10.69 - $15.99
3. *Automate the Boring Stuff with Python* by Al Sweigart, no starch press
   https://automatetheboringstuff.com/
   Cost: Can read on-line for free, $24.99 for paperback printing

Computer: Laptop computer running Windows and Excel is **required**

Attendance Policy:

Attendance is required. 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. Unexcused absences will significantly impact the class participation grade (see below).

Course Assessment:

1. A midterm exam weighing 30% of the grade.
   Date: Tuesday March 2 (6:15 PM)
2. A final exam weighing 35%.
   Date: Tuesday April 27 (5:30 PM)
3. Homework weighing 30%. Each homework problem will be graded in a scale from 0 to 3 with a 3 earned only for perfect answers.
4. Class participation weighing 5%.

Detailed Explanation of Grading:

1. For each student, Overall points are calculated as follows:

Overall Points = 0.30*MidtermGrade +0.35*FinalGrade+
+0.30*HomeworkGrade+0.05*ClassParticipationGrade

where

- Exam grades are 0-100
- HomeworkGrade = (Total homework points earned)/(maximum possible points) *100
- Class participation grade:
  85 if student never misses class (without excuse) and never speaks or messages. This number is multiplied by the fraction of times the student was present in class. Then the grade is raised according to how frequently a student answers or asks questions. Corrections of my lecture errors are especially noted. Also, participation during breakout room problem solving sessions may have a positive impact.

2. The students are sorted in the order of decreasing overall points.

Grades are then decided as follows:

Division between A and A-: Largest gap between two students with 87.5 >= overall points > 82.5
Division between A- and B+ : Largest gap between two students with 82.5 >= overall points > 77.5
Division between B+ and B : Largest gap between two students with 77.5 >= overall points > 72.5
Division between B and B- : overall points > = 70 (no gap here, 70 is B, 69.9 B-)
Division between B- and C+ : Largest gap between two students with 65 >= overall points > 60
Division between C+ and C : Largest gap between two students with 60 >= overall points > 55
Division between C and C- : overall points > = 50 (no gap here, 50 is C, 49.9 C-)
Division between C- and D+ : Largest gap between two students with 40 >= overall points > 30
Division between D+ and D : Largest gap between two students with 30 >= overall points > 20
Division between D and D- : Largest gap between two students with 5 >= overall points >= 0
(never happens)
E: Given to students for honesty violations

The class participation grade is designed so that a student who attends class regularly will not have an A grade lowered even if s/he never speaks. It helps attending students with lower overall points. Even though it is only 5%, it may have 1/3 grade point effect by moving a gap. And it may be critical in helping a student reach 70%

Other: Do not hesitate to ask questions both in class and outside class.

ADDITIONAL INFORMATION

Class Recordings

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. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, https://www.dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure 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://www.dso.ufl.edu/sccr/process/student-conduct-honor-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 (Me or Cynthia Sain)

• 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.

Campus Resources:

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 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 suppor*t*, 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.