

Syllabus

CS 5073 — Artificial Neural Networks and Evolution — Fall 2019

Course Title:

Artificial Neural Networks and Evolution (ANNE)

Instructor:

[Prof. Dean Hougen](#), Devon Energy Hall 242, 405-325-3150, hougen@ou.edu

Class Hours:

Monday, Wednesday, 10:30-11:45, [Felgar Hall 300](#)

Proposed Office Hours:

Monday 9:15-10:15, Wednesday 9:15-10:15; DEH 242

Text Books/Reading Materials:

Each student is required to have access to one or more of the following textbooks:

(The schedule lists appropriate chapters from the first two textbooks. However, there should be free PDFs available of all of these books and you are welcome to find appropriate chapters from the others. [My notes](#) on these and other books are available.)



Computational Intelligence: An Introduction, Second Edition, Andries P. Engelbrecht, 2007, Wiley. (ISBN: 978-0-470-03561-0)



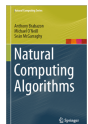
Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, Dario Floreano and Claudio Mattiussi, 2008, The MIT Press. (ISBN: 978-0-262-06271-8)



Computational Intelligence: Synergies of Fuzzy Logic, Neural Networks, and Evolutionary Computation, Nazmul Siddique and Hojjat Adeli, 2013, Wiley. (ISBN 978-1-118-33784-4)



Springer Handbook of Computational Intelligence, Janusz Kacprzyk and Witold Pedrycz (Eds.), 2015, Springer. (ISBN 978-3-662-43504-5)



Natural Computing Algorithms, Anthony Brabazon, Michael O'Neill, and Seán McGarraghy, 2015, Springer. (ISBN 978-3-662-43630-1)



Computational Intelligence: A Methodological Introduction, Second Edition, Rudolf Kruse, Christian Borgelt, Christian Braune, Sanaz Mostaghim, and Matthias Steinbrecher, 2016, Springer. (ISBN 978-1-4471-7294-9)



Neural Network Design, Second Edition, Martin T. Hagan, Howard B. Demuth, Mark Hudson Beale, and Orlando De Jesús, 2014. (No ISBN; self published) (<https://hagan.okstate.edu/NNDesign.pdf>)



Introduction to Evolutionary Computing, Second Edition, A.E. Eiben and J.E. Smith, 2015, Springer. (ISBN 978-3-662-44873-1)

In addition, each student is required to have access to the following textbooks:

Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, 2016, MIT Press. (ISBN 978-



0262035613) [[http://www.deeplearningbook.org/.](http://www.deeplearningbook.org/)]

Writing for Computer Science, Third Edition, Justin Zobel, 2014, Springer. (ISBN 978-1-4471-6638-2)

In addition to the textbooks, there will be readings from the primary, peer-reviewed literature in the field.

Students should read ahead the chapters and other materials that are expected to be covered in the class period. Students should always bring their textbooks with them to class, including lectures/discussions, group work days, and exams.

Expectations and Goals:

The prerequisites for this course are CS 2413 (Data Structures) and Math 3333 (Linear Algebra) or instructor permission. You are expected to have a sufficient background in Computer Science to be able to support team projects involving artificial neural networks and evolutionary computation. You are expected to have a working knowledge of at least one high-level programming language in which you can implement group and individual programming assignments. A background in AI or Machine Learning such as that provided by CS 4013 (Artificial Intelligence) or CS 4033/5033 (Machine Learning) is not a requirement.

This course will introduce students to the state of the art in artificial neural networks and artificial evolution and cover the principles involved.

Topics:

- Overview of Computational Intelligence and Artificial Evolution
- Artificial Neural Networks (ANNs)
 - Introduction to ANNs
 - Learning in ANNs
 - Supervised Learning in ANNs
 - Unsupervised Learning in ANNs
 - Reinforcement Learning in ANNs
 - Deep Learning in ANNs
 - Performance of ANNs
- Artificial Evolution
 - Fundamentals of Evolution
 - Introduction to Evolutionary Computation (EC)
 - Common EC Methods
 - Genetic Algorithms
 - Genetic Programming
 - Evolutionary Programming
 - Evolution Strategies
 - Grammatical Evolution
 - Cultural Evolution
 - Introduction to Artificial Life (ALife)
- Artificial Neural Networks and Artificial Evolution
 - Introduction to Neuroevolution
 - Weight Evolution
 - Topology Evolution
 - Learning Rule Evolution
 - Combinations
 - Deep Neuroevolution
 - ANNs in ALife

- Evolutionary Robotics

Requirements:

The graded assignments and their contribution to a student's grade are given in the table below. (Subject to change.)

Item	Quantity	Portion of Grade
Exam	1	25%
Homeworks	6	5% (1% each, drop lowest)
Small Projects	2	10% (5% each)
Technical Paper Assignments	1	15%
Class Participation		5%
Large Project	1	40%

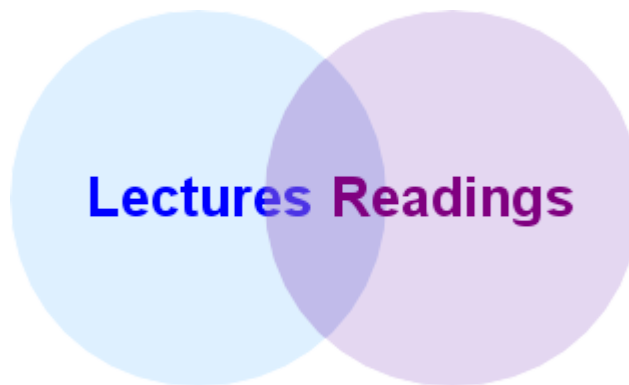
During roughly the first half of the semester, we will cover several chapters from textbooks, as well as additional readings (on grammatical evolution, artificial life, neuroevolution, etc.). You will have homeworks and small projects based on this material and this portion of the course will conclude with an examination. During this portion of the semester, you will also begin to individually explore papers from the primary, peer-reviewed literature on advanced topics in ANNE, and you will begin to develop ideas and find background material for your large project (see below).

During roughly the second half of the semester, you will present papers on advanced topics in ANNE and complete large projects based on these topics. The large projects will consist of several components, including a topic paragraph, references, a proposal, status reports, code, data, analysis, a report, presentation materials, and presentations. This portion of the semester will conclude with presentations on your large projects.

All homework, exams, small projects, and technical paper reviews and presentations in this course are to be done **ALONE**; the work submitted by a student **MUST** be the student's own.

Group work is not required for the large projects but it is allowed. Students will select their own groups and each group will give specific roles and tasks to its group members.

You are responsible for the material covered during the lecture sessions, whether or not it is also found in your textbooks or other assigned reading materials. Similarly, you are responsible for the material found in your textbooks and other assigned reading materials, whether or not it is also covered during the lecture sessions. In other words, you are responsible for the **UNION** of these sources of knowledge, as depicted by the entire shaded region of the Venn diagram below, not merely their intersection (the darkest shaded region).



You may write your programs from scratch or may start from programs for which the source code is freely available on the web or through other sources (such as friends or student organizations). If you do not start from scratch, you **must** give a complete and accurate accounting of where all of your code came from and indicate

which parts are original, which are changed, and which you got from which other source. Failure to give credit where credit is due is academic fraud and will be dealt with accordingly.

All work **must** properly cite sources. For example, if you quote a source in one of your technical paper reviews, you **must** include the quotation in quotation marks and clearly indicate the source of the quotation.

Late assignments will be penalized 20% per day late. (All parts of days will be rounded up.) After five days, you will not be able to turn in that assignment for credit. If you are worried about turning in the assignment late and losing points, turn in the assignment ahead of time. You will be turning in electronic copies of all work via Canvas.

All exams will be open book/open notes. **NO** electronic devices will be permitted in the testing area.

Copying another's work, or possession of electronic computing or communication devices in the testing area, is cheating and grounds for penalties in accordance with school policies.

Please see the [University's web pages on academic integrity](#).

Accommodations:

Any student in this course who has a disability that may prevent the full demonstration of his or her abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate your educational opportunities.

Adjustments for Pregnancy/Childbirth Related Issues:

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact me as soon as possible to discuss. Generally, modifications will be made where medically necessary and similar in scope to accommodations based on temporary disability. Please see <http://www.ou.edu/eoo/faqs/pregnancy-faqs.html> for commonly asked questions.

Title IX Resources:

For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on-call 24.7, counseling services, mutual no contact orders, scheduling adjustments and disciplinary sanctions against the perpetrator. Please contact the Sexual Misconduct Office 405-325-2215 (8-5, M-F) or the OU Advocates 405-615-0013 (24.7) to learn more or to report an incident.

Drop Policy:

Any student who fails to attend the first week of class may be dropped from the class.

Holidays:

It is the policy of the University to excuse the absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required class work that may fall on religious holidays.

Student Evaluations:

"The College of Engineering utilizes student ratings as one of the bases for evaluating the teaching effectiveness of each of its faculty members. The results of these forms are important data used in the process of awarding tenure, making promotions, and giving salary increases. In addition, the faculty uses these forms to improve their own teaching effectiveness. The original request for the use of these forms came from students, and it is students who eventually benefit most from their use. Please take this task seriously and respond as honestly and precisely as possible, both to the machine-scored items and to the open-ended questions."

Related Documents:

Students should also read the related documents on [Replacement Assignments or Extensions](#) and [Discussions of Scores and Grades](#).