

## Syllabus

— SUBJECT TO CHANGE —

**Time:** Monday, Wednesday and Friday 1:10 PM – 2:05 PM

**Classroom:** Centennial 1401

**Professor:** Dr. David Mathias

**email:** [dmathias@uwlax.edu](mailto:dmathias@uwlax.edu)

**website:** <https://cs.uwlax.edu/~dmathias>

**Office:** Wing Technology 212

**Office Hours:** Monday 2:15 – 3:15, Tuesday 3:00 – 4:00, Wednesday 12:05 – 1:00,  
and Friday 2:15 – 3:15.

**Text Book:** We will read articles from the literature.

**Learning Management System:** We will use Canvas in this course.

**Catalog Description:** Three hours. Prerequisite: Junior standing. An introduction to the principles and applications of genetic algorithms (GAs). Topics include the biological inspiration for evolutionary computation and the origins of GAs; an overview of optimization problems; fundamentals of GAs and encoding a problem in a genome; common operators for reproduction, mutation and selection; multi-objective optimization and GA models for solving multi-objective problems; Pareto optimization; applications of GAs as well as current topics in the field.

**Student Learning Outcomes:** By the end of the course, students should be able to:

- Discuss fundamental concepts of evolutionary computation and its biological underpinnings.
- Design genomes for simple optimization problems.
- Choose appropriate genetic operators for use in a genetic algorithm.
- Write genetic algorithms for both artificial and simple real-world problems.

- Discuss multi-objective optimization.
- Write multi-objective genetic algorithms.
- Use popular genetic algorithms such as NSGA-II.

**Homework:** There will be a small number of written homework assignments in the class. For some of these, you may be allowed to work in small groups.

Rules for homework submission:

- Solutions are due at the beginning of class. There are no exceptions. The reason is that we may go over the problems when I collect them so that you see a solution (or sketch of a solution) while the work is still fresh in your mind.
- Write on one side of the page only.
- Put your name, the due date and the assignment number on separate lines in the upper left corner of the first page.
- If your solution is multiple pages, **staple** the pages in the upper left corner. Do not simply fold the corners of the pages – use an actual metal staple.
- Write legibly – I can't grade what I can't read.
- Did I mention that solutions are due at the beginning of class?

**Programming Assignments:** There is a programming component to the course work. These assignments will give you an opportunity to apply the concepts we discuss. Programming assignments are due at 11:59 PM on the due date. Late assignments are accepted for up to 24 hours after they are due. The penalty for late submission is 25%. In this class, you will program in Python 2.7. If you don't already know Python, view this as an opportunity to learn an interesting and useful language. No class time will be devoted to Python instruction. You all know how to program and should be able to acquire skills in a new language on your own. Note that I don't expect you to become a Python expert and will not test you on Python. You simply have to acquire a working knowledge of the syntax and key concepts. There are many excellent resources online.

- <https://docs.python.org/2.7>
- <https://docs.python.org/2.7/tutorial/index.html>
- <https://www.learnpython.org>

**Quizzes:** In most of the first 10 weeks of the semester, there will be a weekly quiz. In these quizzes, you will be tested on material covered during class and on scientific articles assigned for reading. For undergraduates, quizzes will be graded 5, 4, 3, 0. For graduates, quizzes will be graded 5, 4, 0. Your lowest quiz grade will be dropped.

**Paper Presentations:** All students will present a research article, from the genetic algorithms literature, to the class. Presentations will be done in groups of three (to the extent that our class size is congruent to  $0 \pmod{3}$ ). Such presentations require that you gain a *deep understanding* of the paper, present a summary of the main result, and lead a class discussion. Everyone in the class will have each article and will be expected to be moderately familiar with the contents. These presentations will take place in weeks 11–14 of the semester. Dr. Mathias will give an example of such a presentation prior to the first student presentations.

**Graduate Student Requirement:** Those taking the class for graduate credit must complete additional work. These students will be assigned five additional research articles. They must read the articles and summarize each in a one-page abstract.

**Undergraduate Evaluation and Assessment:**

- 25% – Quizzes
- 20% – Homework/Programming
- 10% – Presentation
- 20% – Project
- 25% – Final

**Graduate Evaluation and Assessment:**

- 20% – Quizzes
- 15% – Homework/Programming
- 20% – Paper Summaries
- 10% – Presentation
- 15% – Project
- 20% – Final

**Exams/Quizzes:** There will be no makeup exams or quizzes except with advance notice (at least one week) of an approved UWL activity or with a doctor’s note confirming serious illness. In all cases, it is the student’s responsibility to provide written documentation. Late assignments will not be accepted barring exceptional circumstances. There will be no extra-credit work.

**Grading Scale:** Letter grades will be assigned according to the table below. Note that if a curve is applied, it will work in your favor, not to your detriment. Let  $x$  be your weighted average for the course. Then your letter grade is:

- A:  $x \geq 93$
- AB:  $89 \leq x < 93$
- B:  $83 \leq x < 89$
- BC:  $79 \leq x < 83$
- C:  $70 \leq x < 79$
- D:  $60 \leq x < 70$
- F:  $x < 60$

**Attendance:** You are expected to attend class. Attendance will constitute part of the participation portion of the course grade. In addition, your participation grade will be determined by how much you engage with the class. This includes asking questions, answering questions, completing in-class exercises, etc.

**Academic Integrity:** Academic misconduct is a violation of the UWL Student Honor Code (<http://catalog.uwlax.edu/undergraduate/academicpolicies/studentconduct>) and is unacceptable. I expect you to submit your own original work and participate in the course with integrity and high standards of academic honesty. When appropriate, cite original sources, following the style rules of our discipline.

PLEASE NOTE that whenever a grade penalty is imposed due to academic misconduct, the instructor is required to write a letter documenting the misconduct. Copies are sent to the student, to the Office of Student Life (where the letter remains on file in the student's record), and to the Dean of the student's College. Refer to <https://www.uwlax.edu/student-life/student-resources/student-handbook> for a detailed definition of academic misconduct, and for possible sanctions and consequences. The Office of Student Life can also assist.

Plagiarism or cheating in any form may result in failure of the assignment or the entire course, and may include harsher sanctions. Refer to the Student Handbook #14.02 for a detailed definition of academic misconduct.

For helpful information on how to avoid plagiarism, go to "Avoiding Plagiarism" on the Murphy Library website (<http://libguides.uwlax.edu/plagiarism2>). You may also visit the Office of Student Life (<https://www.uwlax.edu/student-life/>) if you have questions about plagiarism or cheating incidents. Failure to understand what constitutes plagiarism or cheating is not a valid excuse for engaging in academic misconduct.

**Course Policy on Collaboration:** For assignments in this course, you may discuss **general concepts** with classmates. However, you should not collaborate in the preparation of solutions or programs, except as explicitly allowed by Dr. Mathias. Using any

solution that you did not create yourself, including but not limited to solutions found on the Internet, is considered academic misconduct.

item [Inclusive Excellence:] UWL's core values include "Diversity, equity, and the inclusion and engagement of all people in a safe campus climate that embraces and respects the innumerable different perspectives found within an increasingly integrated and culturally diverse global community" (<https://www.uwlax.edu/chancellor/mission>). If you are not experiencing my class in this manner, please come talk to me about your experiences so I can try to adjust the course if possible.

**Student Evaluation of Instruction:** UWL conducts student evaluations electronically. Approximately 2 weeks prior to the conclusion of a course, you will receive an email at your UWL email address directing you to complete an evaluation for each of your courses. In-class time will be provided for students to complete the evaluation in class. Electronic reminders will be sent if you do not complete the evaluation. The evaluation will include numerical ratings and, depending on the department, may provide options for comments. The university takes student feedback very seriously and the information gathered from student evaluations is more valuable when a larger percentage of students complete the evaluation. Please be especially mindful to complete the surveys.

**Useful UWL Resources:** The following links are provided for your convenience. This is not an exhaustive list of services available on campus.

ACCESS Center: <http://www.uwlax.edu/access-center>

Student Support Services: <http://www.uwlax.edu/student-support-services>

For statements regarding Sexual Misconduct, Religious Accommodations, Students with Disabilities, and Veterans and Active Military Personnel, please see:

<https://www.uwlax.edu/info/syllabus>

**Approximate schedule:**

Week of:	Topics:
September 2	Course intro; examples
September 9	Optimization problems Biological inspiration; Darwinian evolution; Genetics
September 16	Population-based search
September 23	Representation and common genetic operators
September 30	Managing the population; DEAP
October 7	Population management continued
October 14	EA variants; Parameters
October 21	Multiobjective GAs
October 28	Coevolution
November 4	Selected topic TBD
November 11	Paper presentations
November 18	Paper presentations
November 25	Paper presentations
December 2	Paper presentations
December 9	TBD
<b>Final</b>	Tuesday December 17 at 4:45 PM