Syllabus HORT 4710 / 6710 – "Plant Phenotyping Technologies"

Spring 2026

Course information

Weekly schedule: 3 credit hours. Two 50-minute lectures and one 2-hour hands-on lab per week.

Department: Horticulture

Format: The class is in person only (UGA Athens campus)

Prerequisite: STAT 2000(E) or PHYS 1112(L) and HORT 2000(L)

Meeting times and locations:

Lectures are held from 9:55 to 10:50 on Mondays and Wednesdays in Aderhold Hall, Room 0627.

Labs are held from 2:55 to 4:55 on Wednesdays in Aderhold Hall, Room 0531.

Instructor information:

Name: Dr. Zhihang Song

Title: Assistant Professor of CEA Phenomics, Department of Horticulture, CAES

Email: zsong@uga.edu

Office location: Miller Plant Science Building, Room #1311.

Office hours: By appointment only.

Instructor Accessibility: Generally, email communication and an appointment are preferred. In-person and walk-in without an appointment is also accepted only for quick questions. To schedule an appointment with the instructor, please email the instructor with your questions/topic, including the course number in the email subject line, i.e. HORT 4710 or 6710.

Course details

Course Description

This course will introduce students to the emerging digital plant phenotyping technologies. Initial introductions start with how phenotyping was done in traditional agricultural practices, followed by topics including how this type of technology has been rapidly revolutionized recently, and how this technology can bring benefits to modern agricultural research and production activities. This

course will also cover some practical knowledge, including the working principle of an imaging system, how phenotyping data should be managed, and how to develop a computer program (Python) to extract phenotypic information from a plant image in a high-throughput manner. Students will learn about python programming from a beginner level to the usage of advanced packages related to computer vision. Lab activities will reflect what is taught in lectures and provide students with opportunities to develop their own plant phenotyping software. Activities will emphasize practices including image data analysis, oral presentation, and scientific writing.

Disclaimer: *The syllabus is a general plan for the course; deviations announced to the class by the instructor may be necessary.*

Course-level Learning Outcomes

Upon successful completion of this course, students will:

- be able to introduce and explain the principles of plant phenotyping technologies and have the ability to identify the advantages and limitations of each type of system.
- be able to list, explain, and quantify multiple critical plant phenotypes and analyze the phenotypic traits in digital images by developing a Python program.
- be able to design and implement a plant imaging system for a real-world application and have the ability to diagnose its limitations and interpret the data.
- be able to work on a research project in a team with independent responsibility and perform self-reflection.
- be able to present and document the project results in professional oral presentations and scientific reports.

Lecture topical outline:

1. Introduction of plant phenotyping
    - Introduction to phenotyping, including its importance and applications in agriculture.
        - Shoot, root, fruit, and seed phenotypes.
        - Importance in breeding, crop protection, product quality control, etc.
    - Overview of traditional and modern phenotyping methods.
2. Essential knowledge of the basics about plant phenotyping equipment
    - Basics in optical systems and electronic systems.
        - Components of an optical system, light, how photons are captured and transformed into information.
    - Basics in camera systems
        - RGB camera, 3D camera, image distortion, color calibration
    - Spectral imaging technology
        - Multispectral, hyperspectral

- High-throughput plant phenotyping
    - Introduction of automation systems, robotics, and remote sensing

3. Process and interpretation of plant phenotyping data
    - Basics in data management.
        - How data is stored, organized, corrected, and analyzed
    - Basics in Python programming language.
        - Python *Hello World*. Will be taught using Google Colab notebooks
    - Basics in computer vision algorithms and spectral analysis.
        - Usage of OpenCV
    - Experiment design and project preparation.
        - How to design your own plant phenotyping experiments based on what you need and what you have.

Lab session topical outline:

- Observe, record, and understand plant phenotypes.
- Manual measurement of plant phenotypes using traditional methods.
- Practice in Python coding.
- Python coding for controlling a digital camera.
- Python coding for processing images.
- Assemble a basic image processing pipeline.
- Organize and output phenotypic data.
- The lab time in the second half of the semester will be used for students to work on their class projects.

Final project:

Students will pick their interested project to work on. Near midterm exam. The instructor will prepare the list and share it with students. Students are encouraged to propose a project, while the graduate student must obtain approval from the course instructor no later than one week after the midterm exam. All students will deliver a final presentation and a project report at the end of the semester.

- For undergraduate students, please pick from the undergrad project list. Maximum two undergraduate students can be included in a group work for one final project. If the class has an odd number of students, then there will be one group with 3.
- For graduate students:
    - Pick one project from the graduate-level list and must work independently.

Course materials

- Students must bring their own laptop computers to lab activities and the course projects.
- If any additional equipment is needed for the final project, this course or the instructor will NOT able to provide any funding resources for the students. Students must consult their major advisor.
- No textbook is needed. Handouts will be uploaded to eLC if needed. Some parts of the handouts will be left blank for students to fill in by taking notes on the lectures.
- Students will need a Google account to have access to the Colab online Python notebook.

Assessment & grading components:

Component	Total Points	% Final Grade
In-lecture quizzes	100	10%
Homework assignments	200	20%
Lab checkup	100	10%
Midterm exam	250	25%
Final project presentation, per team*	150	15%
Final project report, per team	150	15%
Team peer evaluation and self-reflection	50	5%
Total**	**1000**	**100%**
Bonus points	50	5%

* Instructor grade counts for 10%, class grading counts for 5%

** Digits in the tenth place will be rounded up to the nearest integer.

Final grading scale

A: >=94, A-: 90~93, B+: 87~89, B: 84~86, B-: 80~83, C+: 77~79, C: 74~76, C-: 70~73, D+:67~69, D: 64~66, D-:60~63, F: <=59

In-lecture quizzes: A quiz sheet will be given almost every week near the end of a lecture throughout the semester. The one with the lowest score will be dropped. Each quiz will have single or multiple-choice questions covering the topics taught in the last two lectures and assigned reading materials. Quizzes are closed-book. Access to Internet or AI tools is strictly prohibited.

Homework assignments: There will be homework assignments due on the Friday of next week when the assignment is released. The exact deadline will be posted for each one and marked with the assignment on eLC. Students must submit their assignments on eLC, either typed or scanned-hand-written in Word, PDF, JPG, or PNG format. Handwriting must be clean and readable. Any unclear answers may be subject to point loss or resubmission.

Midterm exam: The midterm exam will cover class and lab materials, homework assignments, and readings from the beginning of class. It will primarily be a mix of multiple-choice and short-answer questions.

- There will likely be questions that require mathematical calculations, so students may need to bring a calculator, which will be announced along with the exam schedule.
- Only paper books or notebooks are allowed in the exam. The use of any electronic devices (Computers, phones, tablets, smart watches, etc.), except a basic calculator, is NOT permitted during exams.

Lab checkup: Students are required to attend ALL lab activities. To earn the lab checkup points, students must show up and complete the required lab activities within the scheduled time. The absence of any scheduled lab time will require approval from the instructor at least one week prior to the lab time, except in the event of an emergency.

Final project presentation: Each student, regardless of undergraduate or graduate level, is required to present their final project to the class at the end of the semester. A detailed rubric and evaluation form will be provided. Every student must attend class, regardless of whether they will be presenting on that day or not. The absence will result in a loss of the peer evaluation points. Tips on how to give great presentations will be provided on eLC.

Final project report: Each group of undergraduate students and every graduate student must submit their final project report prior to the scheduled presentation day. A template, format requirement, and grading rubrics will be provided.

Bonus points

- An undergraduate student team may opt to earn extra points if they select **one** from the following. The amount of bonus points will depend on how well the project is completed or the quality of the essay.
    - independently work on a graduate-level project, or
    - write a minimum 1-page essay about "*How the knowledge learned from this course can benefit or change your career choice, your life, and the future of agriculture.*" Submit the essay to Brightspace prior to the due date. Pick your own title and unique stories to tell.
- A graduate student may opt to earn bonus points if the outcome or discovery of the project turns out to be a novel and publishable research in a peer-reviewed journal. The student must submit a draft of the manuscript as their final project report and work closely with the instructor. This requires prior approval with a signature from the graduate student's academic advisor.

Course statement & policies

Tips for success in the course: Read the class syllabus carefully, attend class regularly, be involved in class, take good notes, review your notes as soon as possible after class, use your time wisely, use a calendar, watch online videos, use the time allocated by the instructor to ask questions. More resources can be found:

- Note-Taking Skills, Effective Note-Taking in Class, and The Ultimate Guide To Note-Taking
- What does it take to succeed in college?

Use of AI in this Course: To ensure you develop and master the foundational knowledge and skills in this course, the use of generative AI (GAI) is strictly prohibited. This includes all stages of your work process, even the preliminary ones. Certain AI tools, such as Grammarly, are only allowed for grammar checking but cannot be used to write for you. This prohibition extends to AI writing tools like ChatGPT, Copilot, Writesonic, Rytr, Rtutor, etc. If you are uncertain about using a particular tool to support your work, please consult with the instructor before using it.

Attendance and participation policy: Attendance is essential to your grade, and you are expected to attend all class sessions. Accommodations will be made if you are sick, have ill family members, are attending a conference, etc. Please note that you are responsible for obtaining any information presented in class and keeping up with assignments & deadlines, regardless of the reason for your absence.

Make-up procedures for exams and assignments: Make-up work will be given only for previously excused absences for a university-approved reason. If you need to reschedule an exam, you are responsible for notifying the instructor by email at least two weeks earlier than the exam date.

Diversity/Inclusion/Community statements: The diversity that students bring to the class is considered a resource, potential strength, and benefit to the learning process. I intend that students from diverse backgrounds and perspectives be well-served by this course. The student learning needs will be addressed both in and outside class. My objective is to prepare activities that are respectful of diversity, considering gender, sexual orientation, disability, age, socioeconomic status, ethnicity, race, culture, perspective, and other background characteristics. We encourage and appreciate suggestions about improving the value of diversity and inclusion in this course. Please let me know ways to improve the effectiveness of the course for you personally or for other students.

UGA Honor Code

"I will be academically honest in all of my academic work and will not tolerate academic dishonesty of others." A Culture of Honesty, the University's policy and procedures for handling cases of suspected dishonesty, can be found at honesty.uga.edu.

Violations generally fall into one of three categories:

- Plagiarism
- Unauthorized assistance (e.g. cheating)
- Falsifying data/results

Any form of academic dishonesty or mis-use of technologies, such as AI tools, will result in immediate point lost or failure for the course.

Accommodation for disabilities: If you plan to request accommodations for a disability, please register with the Disability Resource Center. They can be reached by visiting Clark Howell Hall, calling 706-542-8719 (voice) or 706-542-8778 (TTY), or by visiting http://drc.uga.edu

Electronics: Prior to class beginning, please turn off all electronic devices, including laptop computers, phones, etc., to minimize distractions. If a class activity requires electronic devices, the instructor will provide permission to use them at that time.

Well-being resources

UGA Well-being Resources promotes student success by cultivating a culture that supports a more active, healthy, and engaged student community. Page 5 of 5 Anyone needing assistance is encouraged to contact Student Care & Outreach (SCO) in the Division of Student Affairs at 706-542-8479 or visit sco.uga.edu. Student Care & Outreach helps students navigate difficult circumstances by connecting them with the most appropriate resources or services. They also administer the Embark@UGA program which supports students experiencing, or who have experienced, homelessness, foster care, or housing insecurity.

UGA provides both clinical and non-clinical options to support student well-being and mental health at any time, any place. Whether on campus or studying from home or abroad, UGA Wellbeing Resources are here to help.

- Well-being Resources: https://well-being.uga.edu
- Student Care and Outreach: https://sco.uga.edu
- University Health Center: https://healthcenter.uga.edu
- Counseling and Psychiatric Services: https://caps.uga.edu or CAPS 24/7 crisis support at 706- 542-2273
- Health Promotion/ Fontaine Center: https://healthpromotion.uga.edu
- Disability Resource Center and Testing Services: https://drc.uga.edu
- Additional information, including free digital well-being resources, can be accessed through the UGA app or by visiting https://well-being.uga.edu