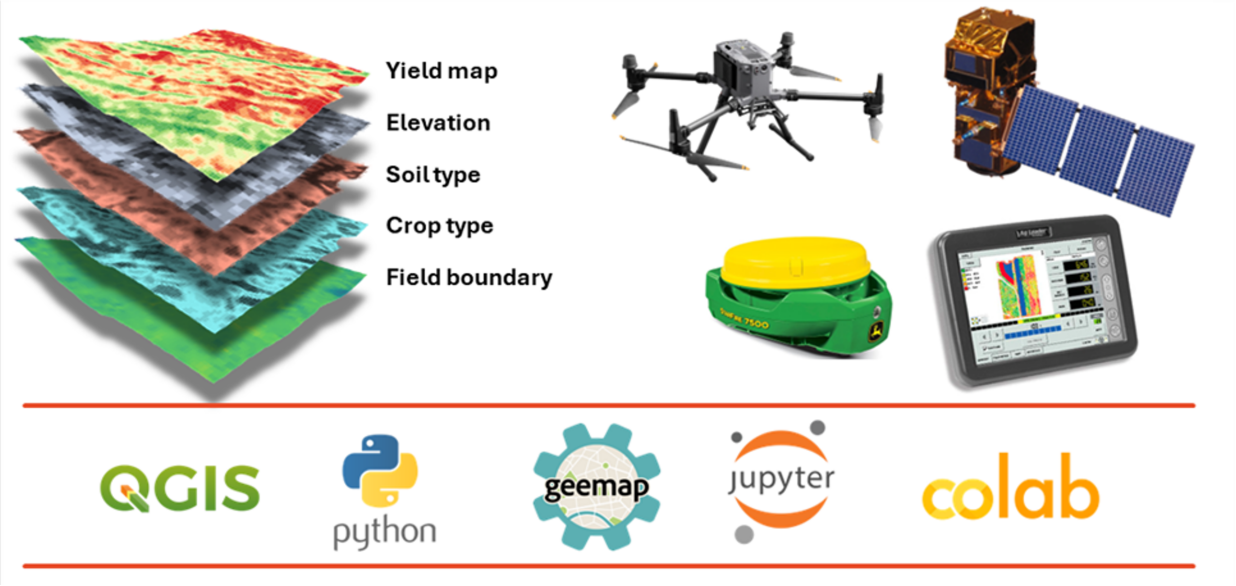
ABE 498 – Special Topics
Precision Agriculture Engineering



Credits and location

Instructor: Sunoj Shajahan, 332C AESB, sunoj@illinois.edu
Office hours: Thursday 1 to 3 PM. Other times by appointment (Please feel free to email!)

Class	Time	Days	Room
Lecture	2:00 to 2:50 PM	Mon. & Wed.	ABE 248
Lab	10:00 to 11:50 AM	Thu.	ABE 248

Credit: 3 hours (Undergraduate or Graduate)
Mode of delivery: In-person & Online
Course website: https://canvas.illinois.edu/courses/73533

Course overview

1. This course explores engineering principles in modern farming, focusing on GPS, GIS, precision planters, soil sampling, variable rate technology, spatial statistics, remote sensing with drones and satellites, and creating prescription maps. Students will learn how these technologies enhance agricultural productivity.
2. The course builds on foundational knowledge in agricultural and engineering studies, aligning with the department's focus on developing a digital agriculture concentration.
3. Students will gain valuable skills in knowing the commercial precision agriculture technologies on the market, how it works, what are its capabilities, how much information can be gathered from these technologies, what to do with the data collected, gather information about additional data layers to enhance decision making, techniques including geospatial analysis, and remote sensing, which are crucial for careers in agricultural engineering and addressing practical challenges.
4. The course combines lectures, hands-on labs, and fieldwork. Students will use QGIS and Google Earth Engine with Python to conduct practical geospatial analysis and develop solutions for agricultural applications.

Course objectives

1. Identify and apply GPS, GIS, remote sensing technologies, and prescription map creation techniques to enhance agricultural practices.

2. Analyze and interpret geospatial data using QGIS and Google Earth Engine with Python to address agricultural challenges in small and large-scale analysis.
3. Design and implement technology-driven solutions to improve precision and productivity in modern farming.
4. Apply engineering principles to solve real-world agricultural problems using advanced technological tools, including GeoAI techniques for geospatial problems.
5. Conduct and evaluate fieldwork and laboratory analytical exercises to gain practical skills and theoretical knowledge in precision agriculture.

Prerequisites

Experience with Python programming is recommended but not required. The course will utilize free and open source software (FOSS) applications, providing students with practical skills transferable to their future careers. **Bringing your own laptop** is encouraged to maintain continuity; however, computers with the necessary software are available in the lecture halls for those who do not have one.

Suggested reference books

- Shannon, D. K., Clay, D. E., & Kitchen, N. R. (2020). Precision agriculture basics (Vol. 176). John Wiley & Sons. https://acsess.onlinelibrary.wiley.com/precisionagbasics
- Clay, D. E., Clay, S. A., & Bruggeman, S. A. (Eds.). (2017). Practical mathematics for precision farming. American Society of Agronomy. https://www.wiley.com/en-us/Practical-Math-for-Precision-Ag
- Pierce, F. J. & Clay, D. E. (2007). GIS Applications in Agriculture (Volume I). CRC Press. Taylor & Francis Group. https://uodiyala.edu.iq/uploads/PDF
- Wu, Q. 2021. Earth engine and geemap: geospatial data snce with python. Locate Press. https://locatepress.com/book/gee
- Lawhead, J. 2015. Learning geospatial analysis with Python. Unleash the power of Python 3. Packt Publishing. https://packtpub.com/LearningGeo.
- McClain, B. P. 2022. Python for geospatial data analysis: theory, tools, and practice for location intelligence. O'Reilly Media, Inc.. https://archive.org/details/python-for-geospatial

Software

- QGIS 3.44 LTR – Available for Mac and Windows – Download link
- Miniconda – Available for Mac and Windows – Download link

Lecture and lab schedule for Fall 2026

Week	Date	Lecture	Labs
Week 1	8/24–8/27	Introduction, course overview	Setting up Python, QGIS, coding environment
Week 2	8/31–9/3	GPS – theory, working, mathematics of coordinates	GPS accuracy comparisons
Week 3	9/7–9/11	Geographic Information System (GIS) – Overview and applications	GIS hands-on exploration
Week 4	9/14–9/18	GIS vector and raster analysis	GIS rasters and vectors – hands-on
Week 5	9/21–9/25	Quiz-1; Remote sensing - platforms, basics, sensors, GeoAI	Satellite/drone data – raster analysis
Week 6	9/28–10/2	Proximal sensing for soil and vegetation	Soil and vegetation analysis – VERIS, hand sampling
Week 7	10/5–10/9	Yield monitors – data, cleaning, interpretation	Yield monitors data and Yield Editor
Week 8	10/12–10/16	Quiz-2; Soil variability – theory, mapping, equipments	Soil quality, DEM, tillage
Week 9	10/19–10/23	Nutrient management – strategies, VRT, on-farm trials, prescription maps	On-farm research trial evaluation
Week 10	10/26–10/30	Quiz-3; Precision planting – goals, technology, seeding decisions	Planter mapping, efficiency and accuracy
Week 11	11/2–11/6	Pest and weed detection – imaging, robots, ML approaches	Computer vision – Deep learning pest/weed detection
Week 12	11/9–11/13	Sensing to management – data pipelines, decision support	Geospatial foundation models
Week 13	11/16–11/20	Quiz-4; Emerging trends – precision ag adoption, environmental impacts	Map-a-thon – Fun activity for lab wrap-up
Week 14	11/23–11/27	Fall break	Fall break
Week 15	11/30–12/4	Project presentation	Project presentation
Week 16	12/7–12/9	Wrap up/no class	Guest lecture

Assignment

The assignments are usually the lab exercise followed by an assignment activity related to the lab. Each lab will include an in-class exercise using QGIS and Google Earth Engine (GEE), followed by a related assignment. The lab instructions will be posted on Canvas before the lab period and will include step-by-step instructions. You can complete the exercise during class and ask questions if anything is unclear. The assignment can be done either in class or at home and must be submitted within one week, before the next lab session. If you need more time, please ask me for permission in advance. Late submissions without prior approval will be penalized by 10% per day, and no points will be given once next week's assignment is posted. For submissions, please upload all files to Canvas: use a *.zip file for QGIS-related files, *.pdf or *.doc for reasoning questions, and *.ipynb for code.

Final exam

A take-home exam will be assigned during the last week of instruction and must be submitted through Canvas. The exam will include various types of questions related to QGIS, GEE, and reasoning applied to a practical precision agriculture scenario.
Question will be posted in Canvas on Dec 14, 2026 at 10:00 AM.
Responses to be submitted as a PDF on Dec 16, 2026 at 1:00 PM

Project

Each student will work on an individual project that focuses on practical aspects of the course. If you already have a research project and would like to align this assignment with one of its objectives, that is perfectly fine with me. These projects are meant to help you solve real-world problems in precision agriculture, and if you are motivated, I will support you in developing the work into a publication. Project report to be submitted as a PDF on or before Dec 18, 2026 at 5:00 PM

Grading Criteria

Final exam	15%
Assignments	50%
Quizzes	10% (4 quizzes – one-page cheat sheet is allowed)
Project	25% (Presentation = 10%; Report = 10%; Participation = 5%)
Total	**100%**

Reference grades

A+ = >97;	B+ = 84–87;	C+ = 72–75;	D = 60–64
A = 91–96;	B = 80–83;	C = 69–72;	F = <60
A− = 88-90;	B− = 76–79;	C− = 65–68;	

Attendance policy

Your attendance at all scheduled classes is essential for success in this course. However, circumstances may occur where you may need to miss a class. If you need to miss class for any legitimate reason, you must make arrangements to make up the missed work. If you are seriously ill or experiencing a family emergency and cannot attend the scheduled class, inform the instructor via email.

Academic Integrity

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: http://studentcode.illinois.edu/part4/1-402.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: https://studentcode.illinois.edu/article1/part4/1-401/. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Policy on the use of GenAI tools: Using AI tools like ChatGPT to complete assignments without proper acknowledgment is considered a violation of academic integrity. When you submit your work in this course, you are confirming that it is your own and that you have clearly mentioned any tools or sources you used. For programming tasks, you may use GenAI tools to assist your learning, but please follow the format I provide in the sample code. These examples are meant to help you understand the structure and approach. Use GenAI tools to support your learning, not to replace it. Be thoughtful and responsible in how you use them.

Mental Health *

The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year) If you are in immediate danger, call 911.

*This statement is approved by the University of Illinois Counseling Center

Students with Disabilities

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor as soon as possible and provide the instructor with a Letter of Academic Accommodations from Disability Resources and Educational Services (DRES). To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should apply for services with DRES and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me or see me during my office hours. DRES provides students with academic accommodations, access, and support services. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 217-333-1970, e-mail disability@illinois.edu, or visit the DRES website at http://www.disability.illinois.edu/. Here is the direct link to apply for services at DRES, https://www.disability.illinois.edu/applying-services.

Disruptive Behavior

Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (conflictresolution@illinois.edu; 333-3680) for disciplinary action.

Religious Observances

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. Students should complete the Request for Accommodation for Religious Observances form should any instructors require an absence letter in order to manage the absence. In order to best facilitate planning and communication between students and faculty, students should make requests for absence letters as early as possible in the semester in which the request applies.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality. Other information about resources and reporting is available here: wecare.illinois.edu.

Emergency Response Recommendations

Emergency response recommendations and campus building floor plans can be found at the following website: https://police.illinois.edu/ em/run-hide-fight/. I encourage you to review this website within the first 10 days of class.

Run > Hide > Fight

Emergencies can happen anywhere and at any time. It is important that we take a minute to prepare for a situation in which our safety or even our lives could depend on our ability to react quickly. When we're faced with almost any kind of emergency – like severe weather or if someone is trying to hurt you – we have three options: Run, hide or fight.

Run

Leaving the area quickly is the best option if it is safe to do so.

- Take time now to learn the different ways to leave your building.
- Leave personal items behind.
- Assist those who need help, but consider whether doing so puts yourself at risk.
- Alert authorities of the emergency when it is safe to do so.

Hide

When you can't or don't want to run, take shelter indoors.

- Take time now to learn different ways to seek shelter in your building.
- If severe weather is imminent, go to the nearest indoor storm refuge area.
- If someone is trying to hurt you and you can't evacuate, get to a place where you can't be seen, lock or barricade your area if possible, silence your phone, don't make any noise and don't come out until you receive an Illini-Alert indicating it is safe to do so.

Fight

As a last resort, you may need to fight to increase your chances of survival.

- Think about what kind of common items are in your area which you can use to defend yourself.
- Team up with others to fight if the situation allows.
- Mentally prepare yourself – you may be in a fight for your life.

Please be aware of people with disabilities who may need additional assistance in emergency situations.

Other resources

- **police.illinois.edu/safe** for more information on how to prepare for emergencies, including how to run, hide or fight and building floor plans that can show you safe areas.
- **emergency.illinois.edu** to sign up for Illini-Alert text messages.
- **Follow the University of Illinois Police Department** on Twitter and Facebook to get regular updates about campus safety.