ILLINOIS

ECE101
Exploring Digital Information Technologies for Non-engineers
Spring 2025
Course Duration: Full Semester

Contact Hours: Monday & Wednesday 11-11:50am; two 50-minute lecture periods and
Friday 10:00-11:50am or 12:00-1:50pm one 110-minute lab each week
Course Format: In-person
Course Location: Lectures in ECEB Room 3081(MW);
Labs in MEL 1009 (F)
Weekly Hours of Expected Student Work, apart from instruction time: 1 hour outside of
class per week
Credit Hours: 3

Course Website: https://courses.grainger.illinois.edu/ece101/sp2025/

Canvas: https://canvas.illinois.edu/courses/54050
Communication: Canvas will be used for all class announcements,
assignment submissions and for posting grades.

Instructor Information
Instructor: Abrita Chakravarty
Instructor contact information: abrita@illinois.edu
Instructor drop-in hours for students: Mondays & Wednesdays, 11:50am - 12:20pm at ECEB
3081or by appointment (send email)
Instructor office location: ECEB 1060

Teaching Assistant Information
Teaching Assistant: Sattwik Basu
Teaching Assistant contact information: sattwik2@illinois.edu
Teaching Assistant drop-in hours for students: Tuesdays, 4:00-5:00pm
Teaching Assistant office location: ECEB 4034

Course Description
This course will give students from outside of engineering an under-the-hood view of 12
important technologies that will impact their daily lives in the next decade:

1. WiFi and Cellular networks
2. Internet
3. File Systems
4. Search Engines
5. Recommendation Engines
6. Social Networks
7. Machine Learning
8. Authentication and Security
9. Computer Vision and Image Processing
10. Speech Recognition and Natural Language Processing
11. Self-driving Cars
12. Augmented and Virtual Reality

For each technology, students will:
a. understand the core technical challenges in realizing the technology
b. gain intuition on how the challenges are being solved
c. appreciate how such technologies translate to business and revenue, and
d. identify implications in areas such as privacy, fairness, policy, ethics, and other paradigm shifts.

Technical subjects to be considered include basics of sensing, computing, communication, and control, the four pillars of technology. To help students better relate to the topics discussed in the course, each technology will highlighted one or more well-established companies using/ promoting the technology (e.g., Comcast, ATT, Microsoft, Google, Amazon, Meta, Verisign, ADT, Apple, OpenAI, Tesla, etc.).

Learning Outcomes

After taking the course, students will be able to:

1. Use scientific concepts, theories, and principles to explain:
   a. how digital technologies work—from representation of data as bits (1s and 0s) to application of advanced techniques like machine learning to that data in order to obtain useful insights and results.
   b. how signals (in form of bits) are transmitted through wires and/or wirelessly in computer networks
   c. how different types of sensors capture information from the physical world and convert them into digital data—cameras capture images, microphones capture sound, IMUs (Inertial Measurement Units) capture motion, GPS units provide location etc.
2. Identify and abstract relevant information to clearly define problems related to
   a. design and function of a computer network, especially one as large as the Internet
   b. reliable communication over an unreliable network
   c. routing and forwarding of data packets as well as distribution and streaming of digital content over networks.
3. Interpret data, such as graphs representing computer networks (e.g. Internet), hyperlinked websites (e.g. World Wide Web) and human social networks (e.g. Facebook), to draw conclusions about
   a. connectivity between parts of the network

b. identification of "important" nodes

c. other characteristics of the state of the world represented by the network.

4. Identify problems, as well as construct/select and execute a logically appropriate process for solving those problems, in the context of using the internet and the vast amount of digital data that is both used by and created during regular use of the Internet and the Web. For example:

   a. An efficient way to "search" the vast array of information available on the web and how search engines currently solve this problem.

   b. How recommendation engines work to enable users find relevant content and products on websites and applications they use

   c. Identifying different types of machine learning that can be applied to data depending on the task that needs to be solved

   d. Issues with communication of sensitive information over open networks and solutions for ensuring secure communication

   e. Technology-related issues in ethics, privacy and fairness arising due to proliferation of digital technologies

5. Recognize problems in the present-day world around them as well as in the near future that could be solved by application of digital technologies and

   a. Frame currently available solutions using the sense-compute-communicate-actuate loop.

   b. Formulate, present, and justify their own solutions to problems using digital data and technologies

   c. Integrate abstract thinking with other problems or disciplines, that could be solved by transferring knowledge from this course

General Education Categories

Physical Sciences
Quantitative Reasoning I

Prerequisites

N/A

Learning Management System

Canvas: https://canvas.illinois.edu/

Recommended Materials

1. Lecture 1-2
   - How computers work: Binary and Data
   - What is a zip file?
   - Image compression

2. Lecture 3-4
   1. A day without Wi-Fi
   2. Wires, Cables and WiFi

6. GPS
    1. [KQED Quest: How your smartphone knows where you are](#)

    2. [TED-Ed: How does your smartphone know your location](#)
    3. [Navy Hidden Hero: Gladys Mae West and GPS](#)
7. [A peek at MEMS IMU](#)
12. Lecture 22-24
    1. [Chat bots and Large Language Models](#)
    2. [How generative AI works](#)
    3. [What is computer vision and why does it matter](#)
    4. [How computer vision works](#)
13. Lecture 25-26
    1. [How self-driving cars work](#)
    2. [LiDARnet DNN for self driving cars](#)
    3. [Why LiDAR is doomed](#)
    4. [Virtual reality explained](#)
    5. [What is Augmented Reality](#)
    6. [Augmented reality vs. virtual reality: AR and VR made clear](#)
    7. AR/VR examples
        1. [Advertisement](#) at a Bus Stop
        2. [Apple Vision Pro](#) ad
        3. [Microsoft](#) holo lens
        4. [Metaquest](#)
        5. [Google lens](#) helping a mom

Required Equipment

Optional: Laptop
(Labs will be done in the engineering workspace labs. However students can install Wolfram Mathematica on their laptops if they want to work on assignments outside lab hours.)

Required Software

The course will use Wolfram Mathematica in the labs. Labs will be conducted in MEL 1009 which has Windows workstations with Wolfram Mathematica installed on them. Students can access these computers and the software using single sign-on access with their netID and passwords.

If they choose, students also have the option to download and install Wolfram Mathematica on their own computers from [the webstore](#) (free of cost using their netID and password).

Grading Breakdown

The final grade will be based on a weighted combination of the following:
- Classroom participation: 15% (6 absences allowed)

- Homework: 10%
- Weekly Labs (best 10 out of 11): 30%
- Three Midterm Exams: 3 x 15 = 45%
  (Regrade policy: Correct mistakes and turn in for half of the points lost.)

Late Assignment Policy

Late submissions for **class participation assignments and homework will be accepted on a case by case basis**. Late submissions will be penalized for 50% of the points.
No late submissions are accepted for labs.

Class Attendance

Students are expected to attend all lectures and labs. However, we understand life happens and sometimes can get in the way of their attending class. Students are allowed **6 free absences** during the semester (lectures and labs included).

The calendar for the course (schedule of lectures and labs) is available on the course website:
https://courses.grainger.illinois.edu/ece101/sp2025/#calendar
Students should notify the instructor in advance of missing any class or as soon as possible. Best way to notify the instructor would be via email.

Absence Policy

Beyond the 6 free absences, if a student needs to be absent from class on account of illness or any other obligations, they should refer to the student code for useful information on having the absence excused. Please note that the code stipulates the conditions under which an absence letter from the Office of the Dean of Students may be requested. Note, a brief illness (less than 3 days) would not qualify for an absence letter.

Participation

Every lecture will pose a simple question (that can be answered through Canvas). The answer will count towards class participation points. Participation in class discussion either in person during lectures or online by replying to canvas discussions will also me considered in order to award class participation grades.

Exam Information

The course has three midterm exams. There will <u>NOT</u> be any final exam.

Each exam will be 50 mins long. You are allowed 1 letter-size (8.5" x 11") handwritten cheatsheet (you may use both sides). The exam is closed book/notes, and calculators are not allowed.
Detailed information on logistics, format, and grading will be provided during exam review sessions.

Exam 1
Exam 1 will be on Fri, Mar 4. This exam will test concepts covered in the Past & Present module.

Exam 2
Exam 2 will be on Fri, April 11. This exam will test concepts covered in the Intelligence & Implications module.

Exam 3
Exam 3 will be on Wed, May 7. This exam will test concepts covered in the Future module.

Final Letter Grades.

Percentage Range	Grade
98.00% - 100.00%	A+
93.00% - 97.99%	A
90.00% - 92.99%	A-
87.00% - 89.99%	B+
83.00% - 86.99%	B
80.00% - 82.99%	B-
77.00% - 79.99%	C+
73.00% - 76.99%	C
70.00% - 72.99%	C-
67.00% - 69.99%	D+
63.00% - 66.99%	D
60.00% - 62.99%	D-
59.00% and below	F

Academic Integrity

The University of Illinois 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/.

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.

ECE Diversity, Equity, and Inclusion Statement
"We in the Illinois ECE community are committed to understanding, empathizing with, and respecting each other, embracing the many differences among us."

Students with Disabilities

The University of Illinois is committed to ensuring that all students, including those with disabilities, do not experience barriers to learning and participating fully in class. If you have a letter of accommodation from DRES and have not already given it to me, please do so as soon as possible to ensure your accommodation needs are met.

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-1970, email: disability@illinois.edu, or go to the DRES website.

Family Educational Rights and Privacy Act (FERPA)

Please visit http://registrar.illinois.edu/ferpa for information about the Family Educational Rights and Privacy Act (FERPA).

Mental Health

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. 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.

Community of Care

As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regard to their well-being or yours, we encourage you to refer this behavior to the Connie Frank CARE Center (formerly the Student Assistance Center) in the Office of the Dean of Students. You may do so by calling 217-333-0050 or by submitting an online referral. Based on your report, staff in the Student Assistance Center will reach out to offer support and

assistance.

Further, as a Community of Care, we want to support you in your overall wellness. We know that students sometimes face challenges that can impact academic performance (examples include mental health concerns, food insecurity, homelessness, personal emergencies). Should you find that you are managing such a challenge and that it is interfering with your coursework, you are encouraged to contact the Connie Frank CARE Center (formerly the Student Assistance Center) in the Office of the Dean of Students for support and referrals to campus and/or community resources.

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 (https:// conflictresolution.illinois.edu; conflictresolution@illinois.edu; 333-3680) for disciplinary action.

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.

Religious Observances

It is the policy of the University of Illinois Urbana-Champaign to reasonably accommodate its students' religious beliefs, observances, and practices that conflict with a student's class attendance or participation in a scheduled examination or work requirement, consistent with state and federal law. Students should make requests for accommodation in advance of the conflict to allow time for both consideration of the request and alternate procedures to be prepared. Requests should be directed to the instructor. The Office of the Dean of Students provides an optional resource on its website to assist students in making such requests.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sex-based misconduct. Faculty and staff members are required to report any instances of sex-based misconduct to the University's Title IX Office. In turn, an individual with the Title IX 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, can be found here: wecare.illinois.edu/resources/students/#confidential.

Other information about resources and reporting is available here: wecare.illinois.edu.

Course Schedule

Date (Week #/Class #)	Topic
Introduction	
Wed, Jan 22 (Week 1/**Lecture 1**)	**Course Introduction & Landscape** Logistics, topics, grading, prerequisites, etc. 10 thousand foot view (Internet) to 100 feet view (programming)
Fri, Jan 24 (**Lab 1**)	Introduction to Wolfram Notebooks
Past & Present — Connecting the World	
Mon, Jan 27 (Week 2/**Lecture 2**)	**History & Map of Keywords**
Wed, Jan 29 (Week 2/**Lecture 3**)	**WiFi**
Fri, Jan 31 (**Lab 2**)	WiFi and Cellular
Mon, Feb 3(Week 3/**Lecture 4**)	**Cellular**
Wed, Feb 5 (Week 3/**Lecture 5**)	**Internet 1: Connectivity, Forwarding, and Routing**
Fri, Feb 7	No Lab
Mon, Feb 10 (Week 4/**Lecture 6**)	**Internet 2: HTTP and DNS**
Wed, Feb 12 (Week 4/**Lecture 7**)	**Internet 3: TCP and Layering**
Fri, Feb 14 (**Lab 3**)	Internet and Graphs
Mon, Feb 17 (Week 5/**Lecture 8**)	**Client-Server**
Wed, Feb 19 (Week 5/**Lecture 9**)	**Distribution and Streaming**
Fri, Feb 21 (**Lab 4**)	Distribution and Streaming; Intro to Social Networks
Mon, Feb 24 (Week 6/**Lecture 10**)	**File Systems**
Wed, Feb 26 (Week 6/**Lecture 11**)	**Social Networks**
Fri, Feb 28 (**Lab 5**)	Social Networks
Mon, Mar 3	Catch-up Lecture
Wed, Mar 5	Exam Review
Fri, Mar 7	**Exam 1**
Intelligence & Implications	
Mon, Mar 10 (Week 7/**Lecture 12**)	**Introduction to Machine Intelligence**
Wed, Mar 12 (Week 7/**Lecture 13**)	**Search Engines**
Fri, Mar 14 (**Lab 6**)	Search Engines

Sat, Mar 15	Spring Break Begins
Sun, Mar 23	Spring Break Ends
Mon, Mar 24 (Week 8/**Lecture 14**)	**Recommendation Systems**
Wed, Mar 26 (Week 8/**Lecture 15**)	**Machine Learning I**
Fri, Mar 28 (**Lab 7**)	Machine Learning
Mon, Mar 31 (Week 9/**Lecture 16**)	**Neural Networks and LLMs**
Wed, Apr 2 (Week 9/**Lecture 17**)	**Security and Authentication**
Fri, Apr 4 (**Lab 8**)	Neural Networks and Authentication
Mon, Apr 7 (Week 10/**Lecture 18**)	**Ethics, Privacy and Fairness**
Wed, Apr 9 (Week 10)	Exam 2 Review
Fri, Apr 11	**Exam 2**
Future	
Mon, Apr 14 (Week 11/**Lecture 19**)	**Sense-Compute-Communicate-Actuate I**
Wed, Apr 16 (Week 11/**Lecture 20**)	**Sense-Compute-Communicate-Actuate II**
Fri, Apr 18 (**Lab 9**)	Sense-Compute-Communicate-Actuate
Mon, Apr 21 (Week 12/**Lecture 21**)	**Computer Vision**
Wed, Apr 23 (Week 12/**Lecture 22**)	**Speech and Natural Language Processing**
Fri, Apr 25 (**Lab 10**)	Computer Vision & NLP
Mon, Apr 28 (Week 13/**Lecture 23**)	**Augmented and Virtual Reality**
Wed, Apr 30 (Week 13/**Lecture 24**)	**Self-driving**
Fri, May 2 (**Lab 11**)	Working with Data
Mon, May 5 (Week 14)	Exam 3 Review
Wed, May 7 (Week 14)	**Exam 3**