Elizabethtown College

EGR/CS 230 Computer Architecture

and Hi-Tech Fundamentals

Spring 2022

An introduction to Computer Engineering including hi-tech fundamentals, trends, and computer architectures. Ethical impacts in global, economic, environmental, and societal contexts.

Prerequisite: Computer Science 121 or permission of instructor

PROFESSOR

Joseph T Wunderlich PhD

Associate Professor of Engineering and Computer Science

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Office Hours & Calendar: Wednesdays12:30-2:00pm, Fridays 1:00-2:00pm,3:30-4:00pm EST

MEETING TIMES

WEDNESDAY & FRIDAY 2:00PM - 3:20PM

Other times:

- Mondays at 2:00PM, or Wednesdays at 11:00AM, but only when announced
- Guest Lecture by U.S. Ambassador John B Craig on U.S. National Security Policy on my YouTube Channel (viewing day TBA)
- Elizabethtown College "Ware Lecture" Cybersecurity-Symposium, with three of world's top experts on my YouTube Channel (viewing day TBA)
- Scholarship & Creative Arts Day ("SCAD") talks

READINGS

All readings are in outline below, which includes lecture notes and required readings from many sources including:
David A. Patterson, John L. Hennessey, ***"Computer Organization & Design,"*** 5th. ed., Morgan Kaufmann, October 10th 2013. (ISBN: **0124077269**).

GRADING

55% Exams, Quizzes, and/or Assignments *(Due dates to be announced at least one week in advance in Canvas)*
20% Paper *(Due date to be announced in Canvas)*
25% Final Exam

COURSE GRADE:
(60-62)=D-, (63-67)=D, (68-69)=D+, (70-72)=C-, (73-77)=C, (78-79)=C+, (80-82)=B-, (83-87)=B, (88-89)=B+, (90-92)=A-, (93-100)=A
(with any fractional part rounded to the nearest integer)

ATTENDANCE

Class participation is part of your course grade. Also, exams cover mostly material that is only presented in lecture.

SCHOOL CLOSURE / CLASS CANCELATION

Additional work assigned to cover any class cancelation

NO CELL PHONE OR LAPTOP USE DURING LECTURES

This can very much affect your grade. No laptop use is allowed during lectures without a documented need by Elizabethtown College student services. Research now shows that taking hand-written notes is better for learning:
http://www.npr.org/2016/04/17/474525392/attention-students-put-your-laptops-away

ACADEMIC HONESTY

Elizabethtown College Pledge of Integrity: *"Elizabethtown College is a community engaged in a living and learning experience, the foundation of which is mutual trust and respect. Therefore, we will strive to behave toward one another with respect for the rights of others, and we promise to represent as our work only that which is indeed our own, refraining from all forms of lying, plagiarizing, and cheating."*

See the 2016-17 Elizabethtown College Catalog, "Standards of Academic Integrity"
(http://catalog.etown.edu/content.php?catoid=10&navoid=507#Academic_Judicial_System)
or Academic Integrity at Elizabethtown College, 11th ed.
(https://www.etown.edu/offices/dean-of-students/files/academic-integrity-handbook.)

EGR/CS 230 Computer Architecture *and Hi-Tech Fundamentals*

J Wunderlich PhD

COURSE OUTLINE

Spring 2022

Lectures are Linked below – see canvas for supplemental videos, readings, etc. And all are available in my "Intro Hi-Tech LECTURES" playlist on my YouTube Channel
* = extra Narrative and visuals added in 2022 to earlier videos

1. Powers of 10 and 2 PDF -- *no video of lecture, but video review in #7 below*
2. Chip Manufacturing Process PDF --- *no video of lecture, but video review in #7 below*
3. Atoms and Transistors PDF -- *no video of lecture, but video review in #7 below*
4. Moore's Law PDF -- *no recording of lecture, but video review in #7 below*
5. PAPER: Transistors Stop Shrinking PDF -- *part of an assignment, so no lecture or video, just class discussion*

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6. BOOK CHAPTER: Computer History PDF -- *part of an assignment, so no lecture or video, just class discussion*
7. Tech History & Economics PDF (**MP4* YouTube***) *–videos includes review of #1 to #4 above (in the beginning)*

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8. Conceptual Computer Architecture PDF (**MP4* YouTube***) *– videos include #9 below*
9. Levels of Computing, Microcontroller vs Microprocessors, Robotics, IBM quality control PDF PPT (MP4* YouTube*) *–videos include #8 above*
10. Microcontroller vs Microprocessors PDF (**MP4* YouTube***)
    Wunderlich, J.T. (1999). **Focusing on the blurry distinction between microprocessors and microcontrollers.** In *Proceedings of 1999 ASEE Annual Conference & Exposition, Charlotte, NC*: (session 3547), [CD-ROM]. ASEE Publications. **PAPER**
11. IBM/Wunderlich *"Controlled Randomness"* Quality-Control PDF PPTX-w/audio (MP4* YouTube*) -- *EGR433/430 Advanced Computer Engr/Parallel Processing*
    Wunderlich, J.T. (2003). **Functional verification of SMP, MPP, and vector-register supercomputers through controlled randomness.** In *Proceedings of IEEE SoutheastCon, Ocho Rios, Jamaica*, M. Curtis (Ed.): (pp. 117-122). IEEE Press. **PAPER**
12. Intro to Cache Design PDF (**MP4* YouTube***) --*This is just an intro to basics; see this advanced course for much more: EGR433/430*
13. Number Representations PDF PPTX-w/audio MP4 YouTube
14. Fractional part of IEEE Floating Point PDF PPTX-w/audio MP4 YouTube
15. IEEE Floating Point example PDF PPTX-w/audio MP4 YouTube
16. Design a PC 1 PDF PPTX-w/audio (**MP4* YouTube***) *–videos include #17 below*
17. Design a PC 2 PDF PPTX-w/audio (**MP4* YouTube***) *–videos include #16 above*
18. BOOK CHAPTER: RISC vs CISC, HLL vs Assembly PDF PPTX-w/audio (**MP4* YouTube***) *–videos include #19 below*
19. High Level Language vs Assembly Language 2 PDF PPTX-w/audio (**MP4* YouTube***) *–videos include #18 above*

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20. Physics and Technology of Waves PDF PPTX-w/audio (**MP4* YouTube***)
21. Human vs. Machine Vision PDF PPTX-w/audio (**MP4* YouTube***) *–videos include excerpts from #22 below*
22. *"Natural & Man-Made Lighting" from EGR353 Green Architectural Engineering* PDF PPTX-w/audio MP4 YouTube
23. Physics of Color, and Display Technologies PDF PPTX-w/audio (**MP4* YouTube***)
24. BOOK CHAPTER: Computer Graphics PDF PPTX-w/audio MP4 YouTube
25. Graphics Boards PDF PPTX-w/audio MP4 YouTube

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26. BOOK CHAPTER: Memory PDF PPTX-w/audio MP4 YouTube
27. BOOK CHAPTER: Storage PDF PPTX-w/audio (**MP4*YouTube***)

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28. BOOK CHAPTER: Processors PDF PPTX-w/audio (**MP4* YouTube***) *–videos include all of #29,30,31,32 below*
29. AMD ZEN core PDF PPTX-w/audio MP4 YouTube Video: "How did AMD make Zen 2 faster?"
30. Amdahl's Law for Parallel Processing PDF PPTX-w/audio MP4 YouTube
31. PAPER: Breaking Multicore Bottleneck PDF PPTX-w/audio MP4 YouTube
32. Recent Intel microprocessors Wikipedia Video: "Intel's new processors and GPUs in under 10 minutes | CES 2022"

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33. Routers PDF PPTX-w/audio MP4 YouTube

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34. Clean Power 1 PDF PPTX-w/audio (**MP4* YouTube***) *–videos include #35 below, plus notes on Power Factor*
35. Clean Power 2 PDF PPTX-w/audio (**MP4* YouTube***) *–videos include #34 above, plus notes on Power Factor*

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36. Intro to Machine Intelligence Symbolic AI vs Neural Networks PDF PPTX-w/audio (MP4* YouTube*) *–videos include #37 below, plus video on Machine-Learning Math*
37. Neural Network Code runs (part of my 1991 Neurocomputer chip development) MP4 YouTube

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38. Virtual & Augmented Reality PDF PPTX-w/audio MP4 YouTube
39. 2020 Etown Oculus Rift VR of Campus in 1924 and Present, and in Revit, *by JJWIV* YouTube

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40. 2006-present 3D Architectural Renderings + 2012 Wunderlich Minecraft World-Servers Website, Student Builds: 1,2,3,4,5 (**MP4* YouTube***)
    Wunderlich, J.T. and Wunderlich, J.J. (2013). **Green architecture and environmental design using rapid-prototyping social-networking sandbox tools, followed by professional architectural software.** *Asian Conference on Sustainability, Energy & the Environment* (ACSEE 2013), June 6-9, Osaka, Japan. [key-note talk] TALK PAPER
    Wunderlich, J.T. and Wunderlich, J.J. (2014). **Crowdsourced Architecture and Environmental Design.** 2nd *International Conference on Emerging Trends in Engineering and Technology (ICETET'2014)* May 30-31, **London**, England. TALK PAPER
    - Revit vs. Sketchup Architectural Rendering Software *by JJWIV* YouTube

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41. Human vs Machine Intelligence PDF PPTX-w/audio (MP4* YouTube*)
42. Technology and Humanity III PDF PPTX-w/audio MP4original YouTube ; *with class discussion:* (MP4* YouTube*) Also watch Star Trek episode "Measure of a Man" or "Brothers"

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43. Robotics & Machine Intelligence at Elizabethtown College since 1999 PDF PPTX MP4 YouTube

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44. Guest Lecture by U.S. Ambassador John B Craig on U.S. National Security Policy YouTube
45. Elizabethtown College "Ware Lecture" Cybersecurity-Symposium, with three of world's top experts YouTube
    - 101 Questions compiled from Students and Faculty PDF

SEMESTER PROJECT

- Individuals only
- On project due-date, both written and oral reports are due **(submit in CANVAS).** Oral report must be done using PowerPoint created by you for this course. It should take **5 minutes max IN PPTX-WITH EMBEDDED AUDIO or a YOUTUBE VIDEO,** and contain an appropriate number of visuals.
- Paper requirements:
  - 10 point, two-column format, single-spaced, **4 to 6** pages unless you build something that functions, in which case you may submit only 2 to 3 pages
  - **IEEE formatting standards for citations, equations, and paper structure** as specified here:
    - http://users.etown.edu/w/wunderjt/IEEE_CONF_PAPER_FORMATTING.
  - Include at least one paragraph in sections titled:
    - ABSTRACT (one or two paragraphs)
    - INTRODUCTION (brief summary of historically significant contributions to topic)
    - DISCUSSION (or DESIGN DECISIONS if you are creating something)
    - CONCLUSIONS
    - REFERENCES (i.e., bibliography)
      - Excessive use of Wikipedia and non-peer-reviewed citations will be penalized
    - APPENDICES for supporting materials if you have any (e.g., simulation code, sketches, data collected, manufacturers literature, industry standards, etc.)

Some possible topics are:

- Medical applications such as:
  - Sensing contaminants
  - Mitigating environmental impacts
  - Biological implants
  - Medical Imaging
  - Medical Databases
  - Bioinformatics
- Assistive technologies for the disabled
- Psychological effects of excessive gaming
- Hi-Tech Environmental sensing and Clean-up in Buildings, Cities, Mass-Transit, and Entertainment venues
- Virtual and/or Augmented Reality
- Supercomputer applications
- Cybersecurity
- Cloud Computing
- Ubiquitous computing
- Simulations for discrete Mathematics
- Supercomputer hardware design
- Application Specific Integrated Circuits (ASIC's)
- Digital circuit simulators
- Industrial automation – e.g., PLC's (Programmable Logic Controllers)
- Embedded system design
- Neural network hardware
- Machine Learning
- Digital controllers for toys such as model railroads
- Smart-house computer hardware
- Applications for space exploration
- Enterprise Servers
- Hi-Tech investment algorithms and AI techniques
- Remote-learning technology improvements
- Remote-work technology improvements
- Robotics (e.g., assisting people in quarantine, space-exploration, search & rescue, hazardous waste removal)

TIPS ON PRESENTATIONS:

- **Minimize unnecessary details**
- Less than 30 words per slide
- Don't have too many slides
- Ensure good contrast between text and background (will the lights be on?)
- A picture is worth a thousand words -- an equation or graph can be worth much more
- Put an image on every page (clip-art, photo, animation) which is an abstraction of the subject
- Don't read from script
- Don't speak monotonically
- Make eye contact with audience (or if recorded, consider a small window with your face narrating in the corner (but not blocking slide content)
- Have a clear objective (to entertain, to sell, to motivate, or to report findings)
- Have a good opener (an agenda, a quotation, a question, or a declaration)
- Be organized and logical (present problem then solution; or have priorities – least-to-most or most-to-least)
- Have audience's expectations understood (provide meaning and/or motivation); assume your peers may see & hear it
- Have good transitions between main points
- Have a good closing (summarize main ideas, restate purpose of presentation)
- Be flexible (adapt if questions are allowed to be asked during presentation)
- Any embedded video clips should only be a minute long, at most

LEARNING OUTCOMES

COMPUTER ENGINEERING Targeted Tasks Rubric

J Wunderlich PhD
Program Coordinator

Yellow / Highlighted = Graded student works collected in Binders for internal & external-ABET review

2018/19 New ABET Learning Outcomes An ability to:

(ABET-1) Identify, formulate, and **solve** complex engineering problems by applying principles of engineering, science, and mathematics.

(ABET-2) Apply engineering **design** to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

(ABET-3) **Communicate** effectively with a range of audiences.

(ABET-4) Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the **impact** of engineering solutions in global, economic, environmental, and societal contexts.

(ABET-5) Function effectively on a **team** whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

(ABET-6) Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (**LAB's**).

(ABET-7) Acquire and apply new knowledge as needed, using appropriate **learning** strategies.

Pre-2018/19 ABET Learning Outcomes

(ABET-a): An ability to apply knowledge of mathematics, science, and engineering.
(ABET-b): An ability to design and construct experiments, as well as to analyze and interpret data.
(ABET-c): An ability to design a system, component, or process to meet desired needs.
(ABET-d): An ability to function on multi-disciplinary teams *if possible, or to draw on the talents of others*
(ABET-e): Identify, formulate, and solve engineering problems
(ABET-f): An understanding of professional and ethical responsibility
(ABET-g): Communicate effectively orally and in writing
(ABET-h): A broad education necessary to understand the impact of engineering solutions in a global and societal context
(ABET-i): Recognition of the need for, and an ability to engage in life-long learning
(ABET-j): Knowledge of contemporary issues
(ABET-k): An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

H = High Emphasis in Course
M = Medium Emphasis in Course
L = Low or no Emphasis in Course

	Solve Problems	Design	Communication	Ethics & Impacts	Teamwork	Labs	How to learn	CREDITS	CONTACT HOURS
2018/19 New ABET Learning Outcomes:	1	2	3	4	5	6	7		
Pre-2018/19 ABET Learning Outcomes:	aek	ck	g	fhj	d	bk	i		
CS 121 Computer Science I	H	H	M	L	L	H	H	4	4
CS 122 Computer Science II	H	H	M	L	L	H	H	4	4
EGR 191 Introduction to Engineering I **LECTURE & LAB**	M	M	H	M	M	H	H	4	**6**
EGR 192 Introduction to Engineering II	H	H	M	H	H	L	M	2	4
EGR 210 Circuit Analysis **LECTURE & LAB**	H	H	M	L	L	H	L	4	**6**
EGR/CS 222 Systems Programming	H	H	M	L	L	H	H	4	4
EGR/CS 230 Computer Architecture & Hi-Tech Fundamentals	L	M	M	H	L	L	H	4	4
EGR 310 Signals and Systems	H	M	M	L	L	H	L	4	4
EGR 311 Electronics **LECTURE & LAB**	H	M	L	L	M	H	M	4	**6**
EGR/CS 332 Digital Design I	H	H	M	L	L	L	M	4	4
EGR/CS 333 Digital Design II, Assembly Language, & Interfacing **LECTURE & LAB**	H	H	H	L	H	H	M	4	**6**
EGR 410 Control Systems **LECTURE & LAB**	H	M	M	M	M	H	L	4	4
EGR/CS 422 Operating Systems	H	H	M	L	L	H	H	4	4
EGR/CS 433 Advanced Computer Engineering **LECTURE & LAB**	H	H	H	L	H	H	M	4	**6**
ELECTIVE: EGR/CS434 Green Robotics & Machine Intel, CS342 Networking, or EGR315 Communication Theor	Variable							4	4
EGR 401 Senior Project in Engineering I	H	H	H	M	M	H	M	2	
EGR 402 Senior Project in Engineering II	H	H	H	M	M	H	M	2	

DISABILITY SERVICES, RELIGIOUS OBSERVANCES, and COVID EXPECTATIONS *if and when put in effective for current semester*

https://elizabethtown-my.sharepoint.com/:w:/g/personal/ouimetc_etown_edu/EfZ-QooKt_VPjgwsWJz230wB3Rb6CIHsPvE0xuqWCpr-UA?e=4%3acZzjpW&at=9

DISABILITY SERVICES: Elizabethtown College welcomes otherwise qualified students with disabilities and is committed to providing access for all students to courses, programs, services, and activities. If you have a documented disability such as a learning disability or chronic illness or a new circumstance such as a concussion and would like to request accommodations please contact the Director of Disability Services by phone (717-361-1227) or e-mail (daviesl@etown.edu). The Office of Disability Services can provide resources to you and facilitate communication with faculty about reasonable accommodations. After meeting with the Office of Disability Services, please set up an appointment to meet with me, the instructor, to discuss the accommodations as they pertain to my class.

RELIGIOUS OBSERVANCES: The College is eager to facilitate individual religious beliefs and practices whenever possible while retaining course student learning outcomes. It is your responsibility to meet with the class instructor in advance to request arrangements related to your religious observances that may conflict with this class, and to make appropriate plans to make up any missed work.

COVID-RELATED EXPECTATIONS: All students are expected to adhere to the established community expectations around safety, including: daily digital health reporting, physical distancing, proper wearing of facial coverings within buildings and classrooms and when within six feet of individuals outdoors, frequent handwashing, and participation in cleaning and sanitizing protocols as requested. You will be turned away from class if you do not have a face covering. Students diagnosed with a health condition that precludes mask wearing can contact Lynne Davies in Disability Services (daviesl@etown.edu) to request remote learning as a reasonable accommodation. **If you are exhibiting any symptoms of COVID or fail to pass the daily health screen, do not come to class.** Failure to adhere to the established community expectations around safety will result in notification of Campus Security and application of the student conduct process for failure to comply, endangering the well-being of others, and/or disorderly conduct. The student code of conduct applies also to participation in all virtual activities, including Zoom sessions and discussion boards.