

Billion Transistor Computer Architecture

EEL 6935

Class Periods: M, W, F | Period 2 (8:30 am – 9:20 am)

Location: On-line

Academic Term: Spring 2021

Instructor:

Dr. Tao Li

Email: taoli@ece.ufl.edu

Office Phone Number: (352) 392-9510

Office Hours: W | 9:30 am – 10:30 am (On-line)

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

Teaching Assistant	E-mail Address	Office Hours	Location	Phone
Xiangru Chen	cxr1994816@ufl.edu	Tue. 2:00pm-3:00pm Fri. 2:00pm-3:00pm	On-line	5713761966

Please contact TA/instructor through Canvas. We may not be able to respond to emails sent to our individual email addresses.

Course Description

This course covers advanced computer architecture topics, and quantitative analysis approaches to design tradeoffs in terms of cost, performance, and power/energy efficiency, etc. The topics covered include, but are not limited to, multicore design, thread level and data level parallelism architecture, data center architecture, GPU architecture, domain specific architecture for AI and machine learning.

Course Pre-Requisites / Co-Requisites

Students are expected to have background on introductory computer architecture concepts, such as those covered in EEL 5764 Computer Architecture. Additionally, students must have basic experience in a programming language such as C/C++, debugging, Linux operating system, and shell scripting.

Course Objectives

Upon completion of the course, students should have a good understanding of the following state-of-the-art computer architecture design:

- Multi-core, chip multiprocessors, and multiprocessors
- Architecture design for exploiting thread-level, data-level, and request-level parallelisms
- Data center architecture
- GPGPU architecture design and optimization
- AI (deep neural network) accelerators
- Quantitative evaluation of design tradeoffs in terms of different parameters

Students will also gain understanding of the interplays between architecture design and software, and how they can impact each other.

Required Textbooks

Computer Architecture: A Quantitative Approach - 6th Edition, John L. Hennessy, David Patterson, ISBN-13: 978-0128119051, Publisher: Morgan Kaufmann Publishers, December 2017

Recommended Materials

Programming Massively Parallel Processors – A Hands-on Approach, D. Kirk, and W. Hwu, Third Edition, December 2016

General-Purpose Graphics Processor Architectures (Synthesis Lectures on Computer Architecture), Tor M. Aamodt, Wilson Wai Lun Fung, Timothy G. Rogers, May 2018

Efficient Processing of Deep Neural Networks (Synthesis Lectures on Computer Architecture), Vivienne Sze, Yu-Hsin Chen, Tien-Ju Yang, and Joel S. Emer, June 2020

Course Schedule

- Multiprocessors and Thread-Level Parallelism
- Data-Level Parallelism and Vector Processing
- The Warehouse-Scale Computer and Data Center
- GPGPU Architecture
- Architecture Design for AI and Deep Learning

Online Course Recording

Our class sessions will be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance Policy, Class Expectations, and Make-Up Policy

This class will be presented online using Zoom and requires access to a stable internet connection.

Excused absences must be in compliance with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation.

Evaluation of Grades

Assignment	Percentage of Final Grade
Class Participation	5%
Homework Sets (~5)	25%
Labs (~6)	30%
Course Project	40%
	100%

Grading Policy

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

All homework will be submitted electronically via e-learning system. Note that the homework submission deadline is automatically controlled by the system. Late homework will not be accepted. Arrange your homework submission ahead of deadline will prevent such situation.

All homework assignments are individual. You can discuss the general area with other students, but not the solution to the specific problem. The final submission must be your own work.

Requests for re-grading must be submitted via email within one week since the graded assignment is returned.

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TA in this class.

Cheating

Cheating will not be tolerated. If you are caught, you will fail the course and get reported to the honor court. There are no excuses and no exceptions. You may talk to other students about homework and project, but the final work must be your own. If you are caught cheating on any assignment, exam and project, the smallest penalty possible is failure of the course.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://care.dso.ufl.edu>.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.