Course Syllabus

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Ve370 Introduction to Computer Organization

Summer 2020

Instructor: Gang Zheng, Ph.D.

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Office Hours: Zoom, W 4:00pm - 6:00pm / Th 8:00am - 10:00am, or on Piazza

Time: T/Th 4:00 – 5:40pm, F 4:00 – 5:40pm (odd weeks),

Classroom: Zoom

TA: Ms. PAN Qiying, sim10_arity@sjtu.edu.cn (mailto:sim10_arity@sjtu.edu.cn)

Mr. XIA Weihao, anthony12590@sjtu.edu.cn

Office Hours TBD

Course Description:

This course is designed to cover basic concepts of computer organization and hardware; instructions executed by a processor and how to use these instructions in simple assembly-language programs; stored-program concept; datapath and control for multiple implementations of a processor; performance evaluation, pipelining, caches, virtual memory, input/output, parallelism.

Credits: 4

Prerequisites: Ve270 and Ve280

Course Objectives (what will be taught):

- To teach students how computers execute machine-level instructions.
- To teach students how to write assembly language programs and translate them to machine level instructions.
- To teach students how to design the datapath and control unit for pipelined and non-pipelined processors.
- To teach students about data and control hazards.
- · To teach students the principles of caches and memory.
- To teach students how processors, memory, and I/O are combined into a computer.

Course Outcomes (what students are expected to achieve):

- Given a simple programming task and an instruction-set architecture, write an assembly language program that implements the task, translate the assembly-language program into machine-level instructions, and trace the execution of the program.
- Model the computer hardware including datapath and control logic for a given instruction-set architecture, both for a single-cycle and pipelined processor, by using schematic capturing tools or hardware description languages (HDLs).
- · Be able to identify and resolve potential data, control, and structural hazards
- Understand the memory hierarchy including cache, main memory, hard disk, and how data is stored in that hierarchical structure, and be able to recognize memory hits and misses
- Understand the memory mapped I/O concept and how I/O devices interface the CPU

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• Be able to use library and internet resources for literature research to learn the current issues, technologies, and future development trends in computing

Textbook:

David Patterson and John Hennessy, *Computer Organization and Design - Hardware/Software Interface*, 4th edition, Morgan Kaufmann, 2008, ISBN 978-0-12-374493-7

Course Outline: (Tentative and subject to adjustment.)

Week	Date	Topics	Reading
	5/12	Course Introduction, introduction to computer	1, Lecture Notes
1	5/14	MIPS assembly, operations and operands	2.1-2.3, 2.6, 2.7
	5/15	Function calls	2.8, 2.12-2.14, B.1-B.4
2	5/19	Assembly programming (Project 1)	Handouts
	5/21	Discussion	
	5/26	Instruction coding	2.5, 2.9, 2.10, B.10
3	5/28	Instruction coding	2.5, 2.9, 2.10, B.10
	5/29	Discussion (Project 1 due)	
4	6/2	Single cycle processor (Project2)	4.1-4.4
	6/4	Pipelined processor	4.5, 4.6
	6/9	Data hazards	4.7
5	6/11	Data hazards	
	6/12	Discussion	
6	6/16	Control hazards	4.8
	6/18	Control hazards	
	6/23	Midterm Exam	
7	6/25	No Class (Dragon Boat Festival)	
	6/26	Exceptions	4.9

8	6/30	Cache memory	5.1-5.3, 5.7
	7/2	Cache memory (Project 2 due)	
9	7/7	Cache memory (Project 3)	
	7/9	Lecture on literature search	handouts
	7/10	Discussion (Project 4)	
10	7/14	Virtual memory, literature review	5.4-5.6, 5.10, 5.12
	7/16	Virtual memory (Project 3 due)	
11	7/21	Virtual memory	
	7/23	I/Os and interfaces	6.1-6.6
	7/24	Discussion	
12	7/28	Parallelism, multiprocessors	7.1-7.4, 7.11, 9.1
	7/30	Review (Project 4 due)	
13	TBD	Final Exam	

Course Policies:

- <u>Honor Code:</u> All students in the class are bound by the Honor Code of the Joint Institute (<u>http://umji.sjtu.edu.cn/academics/academic-integrity/honor-code/</u> <u>(http://umji.sjtu.edu.cn/academics/academic-integrity/honor-code/</u>) as well as the *Addendum to the Honor Code for Online Teaching*. You may not seek to gain an unfair advantage over your fellow students; you may not consult, look at, or
 possess the unpublished work of another without their permission; and you must appropriately acknowledge your use of another's work.
- Test: Test procedure will be announced prior to the tests. Anyone violating the test procedure will be given an 'F' for the test.
- <u>Attendance</u>: Attendance to the lectures is strongly encouraged, not only because difficult concepts are discussed during the lectures, but also because it is an effective way to get engaged in class activities.
- <u>Participation</u>: Active participation is highly expected for all students. This involves participation in interactive activities during the lecture time, proper assistance to other students in group studying, contributions to the Q&A on Piazza, etc.
- <u>Individual Assignments</u>: Project 1 and 4 and homework are individual assignments. Students are encouraged to discuss course topics and help each other understand the project/homework requirements better. However, all submissions must represent your own work. Duplicated submission is absolutely not allowed and will trigger an honor code violation investigation.
- <u>Group Assignments</u>: Project 2 and 3 are team efforts. The work submitted must reflect the work of the team. The grade for a group assignment will be shared among the entire team equally, unless specified differently.
- <u>Submission</u>: All assignments should be submitted electronically on Canvas before the specific deadline. The instructor reserves the right to waive the penalty for emergencies (e.g. hospitalization) or arrangement made with the instructor 24 hours prior to the due date.

Addendum to the Honor Code for Online Teaching

The Honor Code in the Context of Online Courses

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The JI Honor Code applies to courses taught in an online fashion in the same way that it does to all courses. It is worth repeating the central tenets here:

- Engineers must possess personal integrity as students and as professionals. They must honorably ensure safety, health, fairness, and the proper use of available resources in their undertakings.
- Members of JI are honorable and trustworthy persons.
- The students, faculty members, and staff members of JI trust each other to uphold the principles of the Honor Code. They are jointly responsible for precautions against violations of its policies.
- It is dishonorable for students to receive credit for work that is not the result of their own efforts.

In particular, the parts of the Honor Code regarding conduct during in-class examinations, for coursework, projects etc. apply correspondingly for such work conducted in courses taught online. Additional rules adapted to remote examinations, coursework etc. may be imposed as necessary.

In addition, students are required to abide by following rules specific to online teaching. These requirements are provisionally considered part of the Honor Code for the current teaching term.

Due to the new types of interaction and the new forms of learning activities there may be further issues that are not covered below. Students should not hesitate to contact their instructor, the Honor Council (jihonor@sjtu.edu.cn) or the FCD (jifcd@sjtu.edu.cn) if they have any questions.

• Online Presence and Activities

The Joint Institute imposes a "real name" policy for all online activities organized by JI instructors. This policy applies to groups or communication by E-Mail, Canvas, Piazza, Zoom, WeChat and all other platforms where groups are set up by JI or by individual instructors for students attending JI courses, events or other activities.

Students are required to use their actual name (in Pinyin) as part of their online presence for such groups and when communicating online. Individual instructors may also require students to add their name in Chinese characters (if applicable) and/or their Student ID.

Unless otherwise noted, such online activities are intended for the exclusive participation of JI students. Account names, meeting IDs, passwords and other information intended to protect the exclusivity of such activities may not be shared with anyone who is not part of the course or activity.

For example, it is not permissible to give a Zoom meeting ID of a given course to any person who is not enrolled in that course, whether or not the person is a JI student.

Online Etiquette

When communicating or otherwise using online groups, students should follow the regulations set down by instructors concerning the use of online tools. Vandalism, spam messages, verbal and other forms of abuse, violation of English-only policies (as detailed by instructors) and disturbance of the learning experience of other students are not permitted.

• Teaching and Learning Materials

Teaching and learning materials, such as lecture slides, assignments, quizzes, videos etc. are copyrighted and may not be passed on to others without the express permission of the course instructor. This applies in particular to recordings of Zoom lectures and other videos created by instructors.

In particular, it is not permissible to upload videos to sharing platforms (such as Youku or YouTube) or to post lecture slides, assignment questions, project descriptions etc. on public sites such as SlideShare.

Course Assessment Methods:

Homework:

Homework problems are designed for students to revisit and practice the important concepts in computer organization and design. Homework assignments are also assigned for students to gain confidence in solving engineering problems in this class. Tentatively, nine homework sets will be assigned.

Homework for literature search:

The ability to search and find literatures relevant to a specific topic is important for conducting research, resolving real-life engineering problems, and continuing one's intellectual growth in the life time. The homework for literature search is designed for the students to get familiarized with the resources available in a college library physically and online virtually, and to learn tools that may facilitate the searching process.

Examination:

The examinations shall measure the ability to carry out analysis, design, and verification processes of digital circuits and systems. There will be two online or paper-based examinations. The typical types of exam problems include conceptual understanding, computation, procedural development, short answer, analysis and design, and etc.

Project:

The projects are designed for students to practice the important concepts discussed in the lectures on a system level and to have a better understanding of the concepts and techniques with hands-on experience. The design projects utilize contemporary software tools in aid of design. Documented design outcomes and/or demonstration of the projects will be required.

Participation and Etiquette:

Due to COVID-19 impact in this semester, the course will be taught online until further notice. Remote learning makes participation more important. Students are encouraged to actively participate in all kinds of classroom activities including, but not limited to, classroom interaction with the instructor and other students on zoom, effective contribution on Piazza, active participation in team-based projects.

When communicating or otherwise using online groups, students should follow the regulations set down by instructors concerning the use of online tools. Vandalism, spam messages, verbal and other forms of abuse, violation of English-only policies and disturbance of the learning experience of other students are not permitted. Inappropriate behavior will result in deduction of points in this part of course evaluation.

Grading Policy:

Participation & Etiquette	10%
Homework for literature search*	2%

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Midterm Exam	15%	
Final Exam	20%	
Project 1*	5%	
Project 2**	25%	
Project 3**	10%	
Project 4*	3%	
Homework*	10%	
Total	100%	
*Individual assignments		
**Group assignments		

Note: final letter grades may be curved.

Course Summary:

Date	Details	
Tue May 26, 2020	Bi <u>Homework 1 (https://www.umjicanvas.com/courses/1610/assignments/12672)</u>	due by 4pm
Fri May 20, 2020	目i <u>Project 1 Report</u> (<u>https://www.umjicanvas.com/courses/1610/assignments/12292)</u>	due by 11:59pm
FII May 29, 2020	Bi <u>Project 1 Source Code</u> (https://www.umjicanvas.com/courses/1610/assignments/12293)	due by 11:59pm
Thu Jun 4, 2020	Bi Homework 2 (https://www.umjicanvas.com/courses/1610/assignments/12816)	due by 4pm
Thu Jun 11, 2020	Bi <u>Homework 3 (https://www.umjicanvas.com/courses/1610/assignments/13008)</u>	due by 4pm
Thu Jun 18, 2020	Bi <u>Homework 4 (https://www.umjicanvas.com/courses/1610/assignments/13240)</u>	due by 4pm
Tue Jun 23, 2020	Bi <u>Midterm Exam - VE370</u> (<u>https://www.umjicanvas.com/courses/1610/assignments/13522)</u>	due by 7:40pm
Wed Jun 24, 2020	Bi <u>Midterm makeup - VE370</u> (https://www.umjicanvas.com/courses/1610/assignments/13565)	due by 6:30pm
Thu Jul 2, 2020	Bi <u>Homework 5 (https://www.umjicanvas.com/courses/1610/assignments/13372)</u>	due by 4pm

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Date	Details
	Bi <u>Project 2 Peer Evaluation</u> (<u>https://www.umjicanvas.com/courses/1610/assignments/12297)</u> due by 11:59pm
Thu Jul 9, 2020	Bi Project 2 Report (https://www.umjicanvas.com/courses/1610/assignments/12298) due by 11:59pm
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	Bi Literature Search Homework due by 2pm (https://www.umjicanvas.com/courses/1610/assignments/12285) due by 2pm
FII JUI 10, 2020	Bi Project 2 Implementation and Demonstration (https://www.umjicanvas.com/courses/1610/assignments/12296) due by 6pm
Thu Jul 16, 2020	Bi Project 3 Implementation and Simulation due by 11:59pm (https://www.umjicanvas.com/courses/1610/assignments/12300) due by 11:59pm
1110 Jul 16, 2020	Display="block-space-system: system: sy
Thu Jul 30, 2020	Bi Project 4 Report due by 11:59pm (https://www.umjicanvas.com/courses/1610/assignments/12302) due by 11:59pm
	Bi <u>factor (https://www.umjicanvas.com/courses/1610/assignments/12303)</u>
	Bi <u>Final Exam Total Score (https://www.umjicanvas.com/courses/1610/assignments/12277)</u>
	Bi Midterm Exam (https://www.umjicanvas.com/courses/1610/assignments/12286)
	Bi Problem 1 (https://www.umjicanvas.com/courses/1610/assignments/12287)
	Bi Problem 2 (https://www.umjicanvas.com/courses/1610/assignments/12288)
	Bi Problem 3 (https://www.umjicanvas.com/courses/1610/assignments/12289)
	Bi Problem 4 (https://www.umjicanvas.com/courses/1610/assignments/12290)
	Bi <u>Problem 5 (https://www.umjicanvas.com/courses/1610/assignments/12291)</u>
	Bi Project 2 Grades (https://www.umjicanvas.com/courses/1610/assignments/12294)
	Bi Project 2 Grading Factor (https://www.umjicanvas.com/courses/1610/assignments/12295)