# San José State University
## Computer Science Department
## CS247, Advanced Computer Architecture, Section 1, Fall 2024

## Course and Contact Information

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|---|---|
| **Instructor:** | Robert Chun |
| **Office Location:** | MH 413 |
| **Telephone:** | (408) 924-5137 |
| **Email:** | Robert.Chun@sjsu.edu |
| **Office Hours:** | MW 6:00pm-7:00pm |
| **Class Days/Time:** | MW 3:00pm - 4:15pm |
| **Classroom:** | MH 422 |
| **Prerequisites:** | CS147 (Introductory Course in Comp. Architecture), also Operating Systems |

## Faculty Web Page

Course materials such as presentation slides, notes, assignments, etc. can be found on my faculty web page at http://www.sjsu.edu/people/Robert.Chun/courses

## Course Description

Detailed analysis of high-performance computer systems. Survey various machine architectures including implementation alternatives for major processor sub-systems. Pipelined, vector, VLSI, multi-core and dataflow architectures are examined. Discussion includes data representation, arithmetic logic unit operations and algorithms, rounding algorithms, control unit operation and instruction formats. Performance measurement and speedup techniques are studied to perform tradeoff analysis and design optimization. Discussion of safety and fault-tolerance issues are included. Digital breadboard labs and programming projects with the VHDL language and simulation environment will be used to demonstrate computer-aided design and functional verification techniques for digital systems. A written report and oral presentation on a relevant and approved topic of interest to the student will be required.

**Course Learning Outcomes (CLO)**

Upon successful completion of this course, students will be able to:

- Understand combinatorial and sequential circuit structures and Boolean number representation schemes
- Appreciate how the fundamental core mathematical operations such as addition, subtraction, multiplication, and division can be optimized with appropriate number representation, rounding, and digital circuit implementation schemes.
- Explain the tradeoffs between complex instruction set computers (CISC) and reduced instruction set computers (RISC).
- Discuss non-classical architectures such as parallel processors, multi-core chips, pipelined and VLIW machines which are used to accelerate hardware performance without impacting legacy sequential software programming languages or techniques.
- Emphasize the importance of fault-tolerant design techniques and examine various methods of error detection and correction such as TMR and Hamming Codes.
- Analyze and perform tradeoffs between the cost, performance, and reliability of alternative computer architectures.
- Utilize computer-aided design tools and hardware description languages useful to computer architects in performing functional verification and performance measurements of digital systems.
- Use industrial-grade field programmable gate array chips and their associated CAD toolsets.
- Appreciate how hardware and software (especially the operating system and compilers) must work synergistically together to provide optimum throughput.
- Perform an in-depth investigation of an architecture related topic of interest to them and present their findings to their classmates in an oral and written report using a venue similar to that used in formal professional technical conferences.

**Required Texts/Readings**

**Textbooks**

*Computer Organization and Design: The Hardware/Software Interface,* 4th Ed., Revised Printing, D. Patterson, 2009, Morgan Kaufmann, ISBN 9780123744937

*A VHDL Primer,* J. Bhasker, 3rd Ed., 1999, Prentice Hall, ISBN 9780130965752

*CS 247 Course Reader,* Chun.  Instructor will distribute to all enrolled students.

**Course Requirements and Assignments**

Assignments include two midterms, one final, a written and oral Term Paper/Project report, a set of homework projects (consisting of a combination of written problems and VHDL programming assignments), and active participation during student presentations, weighted as shown below.  All assignments (especially the oral presentation) must be completed by the student on the due date specified in order to receive credit for the class.  Late assignments (including the scheduled oral presentations) or exams are not accepted and will be graded as 0 (zero) points earned.  All students must uphold academic honesty, especially for the required term paper, per university policy detailed at this official SJSU website: http://www.sjsu.edu/specialed/docs/current-forms/AcademicIntegrityPolicy.pdf

**Final Examination**

The final exam for the class will be held on Tuesday, December 17, 2024  12:15pm – 2:30pm.

**Grading Information**

Assignments include two midterms, one final, a written and oral Term Paper/Project report, a set of homework projects (consisting of a combination of written problems and VHDL programming assignments), and active participation during student presentations, weighted as shown below.  All assignments (especially the oral presentation) must be completed by the student on the due date specified in order to receive credit for the class.  Late assignments (including the scheduled oral presentations) or exams are not accepted.  All students must uphold academic honesty, especially for the required term paper, per university policy detailed at this SJSU website:

http://www.sjsu.edu/specialed/docs/current-forms/AcademicIntegrityPolicy.pdf

     15%    Midterm Exam 1
            Approximately beginning of October

     15%    Midterm Exam 2
            Approximately beginning of November

     30%    Written Term Paper/Project (15%) & Oral Presentations (15%)
            Mid-April for Written Report; Due date for Oral Presentation to be specified per student

     20%    Final Exam
            Tuesday, December 17, 2024  12:15pm – 2:30pm.

     10%    Combined total of Three HW and VHDL Projects
            HW Projects will be due immediately before each exam

     10%    Participation, especially as an active audience member during Student Presentations

A plus = 100 to 97.0 points
A = 96.9 to 93 points
A minus = 92.9 to 90.0 points
B plus = 89.9 to 87.0 points
B = 86.9 to 82.0 points
B minus = 81.9 to 80.0 points
C plus = 79.9 to 77.0 points
C = 76.9 to 72.0 points
C minus = 71.9 to 70.0 points
D plus = 69.9 to 67.0 points
D = 66.9 to 62.0 points
D minus = 61.9 to 60.0 points
F = 59.9 points or lower

## University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' <u>Syllabus Information web page</u> at http://www.sjsu.edu/gup/syllabusinfo/

## CS247 Fall 2024 Tentative Course Schedule

| Lecture | Chapter | Topic |
|---|---|---|
| 1-4 | 1, 2 | Introduction, VHDL |
| 5-6 | 3 | Data Representation |
| 7-10 | 3 | High Speed Computer Arithmetic |
| 11 | Notes | Rounding |
| *Midterm 1* | | *Approximately early October* |
| 12-16 | 6 | Pipeline and Parallel Processing |
| 17-21 | Notes | Fault-Tolerance |
| *Midterm 2* | | *Approximately early November* |
| 22-27 | | Term Papers & Oral Presentations |
| *Final Exam* | | *Tuesday, December 17, 2024  12:15pm – 2:30pm* |

# General University Policies

**DISABILITIES:**

If you need course adaptations or accommodations because of a disability, or if you need special arrangements in case the building must be evacuated, please inform the instructor as soon as possible.  Presidential Directive 97-03 requires that students with disabilities register with DRC to establish a record of their disability.

**ACADEMIC INTEGRITY:**

Academic integrity is essential to the mission of San José State University.  As such, students are expected to perform their own work (except when collaboration is expressly permitted by the course instructor) without the use of any outside resources.  Students are not permitted to use old tests or quizzes when preparing for exams, nor may they consult with students who have already taken the exam. When practiced, academic integrity ensures that all students are fairly graded.

We all share the obligation to maintain an environment which practices academic integrity.  Violations to the Academic Integrity Policy undermine the educational process and will not be tolerated.  It also demonstrates a lack of respect for oneself, fellow students and the course instructor, and can ruin the university's reputation and the value of the degrees it offers. Violators of the Academic Integrity Policy will be subject to failing this course and being reported to the Office of Judicial Affairs for disciplinary action which could result in suspension or expulsion from San José State University.

**CHEATING:**

At SJSU, cheating is the act of obtaining or attempting to obtain credit for academic work through the use of any dishonest, deceptive, or fraudulent means. Cheating at SJSU includes but is not limited to:

Copying in part or in whole, from another's test or other evaluation instrument; Submitting work previously graded in another course unless this has been approved by the course instructor or by departmental policy. Submitting work simultaneously presented in two courses, unless this has been approved by both course instructors or by departmental policy.  Altering or interfering with grading or grading instructions; Sitting for an examination by a surrogate, or as a surrogate; any other act committed by a student in the course of his or her academic work which defrauds or misrepresents, including aiding or abetting in any of the actions defined above.

**PLAGIARISM:**

At SJSU plagiarism is the act of representing the work of another as one's own (without giving appropriate credit) regardless of how that work was obtained, and submitting it to fulfill academic requirements. Plagiarism at SJSU includes but is not limited to:

The act of incorporating the ideas, words, sentences, paragraphs, or parts thereof, or the specific substances of another's work, without giving appropriate credit, and representing the product as one's own work; and representing another's artistic/scholarly works such as musical compositions, computer programs, photographs, painting, drawing, sculptures, or similar works as one's own.

**Additional Information:**

http://www.cs.sjsu.edu/greensheetinfo/index.html