

**COM S 321** Introduction to Computer Architecture and Machine-Level Programming  
**Fall 2016**

**Lectures:** MWF 8 – 8:50 A.M., Agronomy 2050

**Course Web page:** [www.cs.iastate.edu/~cs321](http://www.cs.iastate.edu/~cs321)

(This course is not on Blackboard)

**Instructor:** Prof. G. M. Prabhu

**Office:** Rm 231 Atanasoff Hall

**E-Mail:** [prabhu@iastate.edu](mailto:prabhu@iastate.edu)

**Office Hours:** MWF: 9 to 10 AM

**TAs:** To be announced later

**Prerequisites:** Com S 228, CprE 281, Engl 250

**Course work:** Students are expected to regularly attend lectures and take notes in a wirebound 1-subject notebook. From time to time these notebooks will have to be brought in to the TAs for evaluation. The evaluation of your notes taken in the course notebooks will be weighted at 10% of your overall score.

Other graded course work will consist of homework, programming assignments, occasional quizzes, and three exams. Weights for these will be provided later on the course page.

**Homework submissions:** If your homework consists of more than one page, it has to be stapled before turning it in. Homeworks that are not stapled will receive no credit. Homework is due at the beginning of the lecture.

**Computer and Cell phone policy:** Students are not permitted to use a computer or tablet or cell phone during lectures and exams. Failure to adhere to this policy will result in a failing grade (after two warnings).

**Office hour policy:** I have an open office hour policy if you are not able to see me during my office hours. Please feel free to knock on my door to check if I am in or send me an e-mail requesting an appointment.

**General approach:** Concepts in computer architecture and machine-level programming will be explained as much as possible through solutions of problems in lectures, through in-class activities, and homework. It is a good idea for you to regularly attend lectures. There is no required textbook.

**Academic Honesty:** Homework assignments are individual efforts, not group efforts. You are expected to complete your work on your own. You may discuss ideas about the homework problems with other students, the TAs, and the instructor, but when you turn in your homework solutions you are expected to do them on your own without help from

anyone else. You should not copy verbatim any solutions that are posted on the internet. When in doubt, contact the TAs or the instructor for clarification.

If you turn in the work of another student, both the person presenting the work as their own and the student tendering the information would be guilty of *academic dishonesty*. See the University's [Academic Dishonesty Policy](#) for details. If you are guilty of academic dishonesty on a homework or exam, a report will be turned in to the Dean of Students with a recommended penalty depending on the severity of the academic misconduct.

**Students with Disabilities:** Iowa State University complies with the American with Disabilities Act and Section 504 of the Rehabilitation Act. Any student who may require an accommodation under such provisions should contact me as soon as possible and no later than the end of the first week of class or as soon as you become aware. You will need to provide documentation of your disability to the Disability Resources (DR) office, located on the main floor of the Student Services Building, Room 1076, 515-294-7220. Please request that a Disability Resources staff send a SAAR form verifying your disability and specifying the accommodation you will need.

**Harassment and Discrimination:** Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. Any student who has concerns about such behavior should contact his/her instructor, [Student Assistance](#) at 515-294-1020 or email [dso-sas@iastate.edu](mailto:dso-sas@iastate.edu), or the [Office of Equal Opportunity and Compliance](#) at 515-294-7612.

**Religious Accommodation:** If an academic or work requirement conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be in writing, and your instructor or supervisor will review the request. You or your instructor may also seek assistance from the [Dean of Students Office](#) or the [Office of Equal Opportunity and Compliance](#).

## **Com S 321**

## **Syllabus and Objectives**

**Course Objectives:** To understand aspects of computer architecture and program performance. To adopt an evolutionary approach to learning by presenting fundamental concepts first in the context of an easy-to-understand instruction set such as MIPS, and building more complex ideas from the simpler ones.

**Learning outcomes:** Students will develop the ability to understand computer performance, computer design, and tradeoffs between cost and performance as well as between hardware and software. Students will formulate and solve problems, understand the performance requirements of systems, and communicate effectively and learn to think creatively and critically, both independently and with others. Students will develop the

ability to form their own mental model of the underlying concepts by regularly attending class and taking their own notes.

**ABET Outcomes:** B, C, J

<http://www.cs.iastate.edu/files/page/files/Undergraduate-Student-Outcomes-revised.pdf>

### Topical Outline

- 1. Introduction:** Computer abstractions and technology
- 2. Measuring and evaluating performance:** Metrics of performance; Amdahl's Law; Cost/benefit tradeoffs; Instruction count, CPI, Clock cycle time; Comparing and summarizing performance
- 3. Instruction set architecture of MIPS:** Signed and unsigned numbers; Representing instructions - the MIPS instruction set; Instructions for decision making; Supporting procedures - stack pointer; Arithmetic and Logical operations
- 4. Processor Datapath and control:** Building a datapath; A single-cycle implementation; How control is supposed to work; A multicycle implementation and control
- 5. Memory Hierarchy design:** A framework for memory hierarchies; The basics of caches; Placement, replacement, and memory interaction policies; Measuring and improving cache performance; FIFO, LRU, write back and write through policies
- 6. Enhancing performance with pipelining:** Overview of pipelining; A pipelined datapath; Data hazards and forwarding; Data hazards and stalls; Branch hazards
- 7. Exceptions and exception handling:** Interrupts and exceptions Hardware/software interface; Interrupt handlers