

**Fall 09**

# **CS 35101 – 600**

## **Computer Architecture**

*Department of Computer Science*  
*Kent State University Stark*  
**TR 2:00 PM – 3:15 PM - Room MH 303**

**Instructor:** [Dr. Angela Guercio](#)

**Office:** 424, Main Hall

**Phone:** 330 244-3424 (KSU ext. 53424)

**Office Hours:** TR 10:00am - 10:55am 12:25pm - 1:55pm 4:55pm - 5:25pm

other times are available by appointment

**Best way to contact me:** e-mail to [aguercio@kent.edu](mailto:aguercio@kent.edu)

### **Course Information**

**Class Webpage:** <http://www.personal.kent.edu/~aguercio/Fall09/CS35101-600Fa09.html>

- all important class information will be posted on the class webpage, readings, assignments, notes, deadlines, cancellations, etc..
- You must **CHECK THE CLASS WEBSITE REGULARLY!!!**

**Prerequisites:** CS23021 with *a grade of C or better.*

This means that a C- in CS23021 is not sufficient to meet the prerequisite.

For more details, please visit

<http://www.cs.kent.edu/programs/ugrad/planner.html>

**Credit:** 3 Credit Hours

**Required Text:**

D. Patterson, J. Hennessy – *Computer Organization and Design* – Morgan Kaufmann  
Elsevier, 4<sup>th</sup> Edition, 2005, ISBN: 978-0-12-374493-7

**Companion site of the book:**

<http://www.elsevierdirect.com/companion.jsp?ISBN=9780123744937>

**Emergency:** In case of an emergency please contact the security on campus.

**Security phone on campus:** #53123

**Security cell phone** (330) 705-0430 or, of course, 911.

I recommend that you program into your cell phone the previous numbers.

## Course Outline and Objectives

This course will introduce you to the fundamentals of computer architecture. The course provides a functional overview of computer systems, interconnection of basic components, system performance measures, instruction set design, arithmetic logic unit, control unit, memory system, pipelining, interrupts and input-output.

The course covers topics such as:

- Computer Architecture Intro
- Instructions: Language of the Computer
- Intro to MIPS instruction set, addressing in MIPS
- Arithmetic for Computers (Datapath)
- Datapath elements overview
- Assessing and Understanding Performance
- The Simple Processor: Datapath and Control (Datapath, Control)
- Single cycle implementation, multi-cycle implementation, interrupts and exceptions
- Enhancing Performance with Pipelining (Datapath, Control)
- Large and Fast: Exploiting Memory Hierarchy (Memory)
- Memory Hierarchy, Cache and virtual memory Storage, Networks, and Other Peripherals (Input , Output)
- I/O Control methods, System Bus, Synchronization of control

Students will

- deepen the knowledge of the components of a computer;
- learn in depth a sample machine language;
- become familiar with the path that data follow during execution;
- learn how to measure computer performance;
- understand how to improve performance with pipelining;
- be exposed to efficient memory storage;
- understand how the communication computer-external environment occurs.

The course satisfies a requirement for the Computer Science major and minor and is the prerequisite of other courses in the CS major.

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## Class Requirements and Expectations

- **Regular class attendance is REQUIRED.**

 There tends to be a strong correlation between class attendance and grade performance. If you will miss a class, **let me know ahead of time**. In any case, you are responsible for bringing yourself up to date on class material and assignments.

 Since class participation and regular attendance are part of the final grade, **if you miss more than 4 classes without a documented reason or without making prior arrangements with me, your final grade will be dropped one grade (A to B, B+ to C+ and so on).**

- **Reading ahead is REQUIRED.**

 The readings are posted online on the class webpage. You must read the material **before** class **and again after** the class.

 Regular study of the material is REQUIRED.

- **COMPLETE the assigned homework (i.e. projects and exercises).**

 There will be 8 assignments in the course. I will retain the right to change the number of assignments if necessary.

 The class webpage will list the assignments for each week at the beginning of that week so that you can better schedule your work.

- **REVIEW the graded Homework/Projects.**

 Homework and Projects will be graded and difficulties will be discussed in class. Review the mistakes after discussion and learn from them.

 Late Homework/Projects will not be accepted if returned after the solution is given or discussed.

 If you have difficulties doing your homework or your project please contact me or come to see me. **Do not procrastinate!**  
**Homework and Projects should be started immediately.**

- **Return work ON TIME**

 All the homework and project should be e-mailed as an attachment to [aguercio@kent.edu](mailto:aguercio@kent.edu). Multiple files should be zipped. In any case a printed copy MUST be returned to the instructor as well unless stated otherwise.

 All the printed copies of the Homework or the Projects are due ***before or at the beginning of class***. All assignments, either printed or submitted via e-mail, turned in one day late will get **3 points per day penalty** including those returned after the beginning of class.

 For all Homework or Projects that are e-mailed, the instructor will acknowledge the receipt within 24 hours via e-mail. The time of your e-mail will be compared against the work deadline. The reply is your receipt that the work has been turned in (not that it is correct!). If you do not receive a receipt, it is YOUR responsibility to contact me to see if the assignment has been lost in transmission. ***Important:*** once you submit your files **DO NOT OPEN THEM AGAIN!** If your e-mail didn't reach me or something happened to your files, I may need to ask you to resubmit your files by logging on in my presence to check the modification dates on your files and make sure that they haven't been modified after the due date.

## **What to expect to find in your Computer Architecture class**

- The class should be interactive. In-class exercises are designed to encourage participation. There will be cooperation between you and I, open discussions about problems and possible solutions. You are responsible for taking good notes. Handouts will be given only when necessary.
- You will be exposed to traditional lecture methods on the blackboard as well as PowerPoint presentations. You will participate in group activities and collaborative learning will be used to discuss possible solutions to problems as well as to provide critical observation to problem solutions. Formal and informal groups will be formed in class to work together. In some cases, you will be required to work on your own. In those cases, I expect appropriate academic behavior from you. Exchange of information, when forbidden, will not be tolerated.

- In this course you will work mostly without a computer. However you will perform simulation of computer execution over the computer blueprints. The projects are designed to complement the theoretical studies and deepen your understanding of the architectural complexity of a computing machine. Exercises will be given to analyze and measure computer performance, to simulate data behavior and to reinforce the ability to strive for the optimal design of computer architecture.

**The Secret Key (not so secret after all!) of how to succeed in this CS class is to:**

1. work conscientiously and do all the homework that has been assigned;
2. extrapolate, from the examples provided to you, techniques and answers to problems;
3. spend several hours to solve problems as well as reading material;
4. be alert and participate in class discussions;
5. learn from other people mistakes;
6. be critical of your own work. Question every step you are making; ask yourself “Is this step correct?” “Are there other easier or alternative and more efficient steps? Did I use the theory in the appropriate way?”
7. attend class regularly;
8. spend time studying the theoretical concepts. Memory helps, but it is practice that reinforces the theory;
9. do all the above consistently through the whole semester, be confident about what you are doing and don’t be afraid to ask for help;
10. Think, think, think.... and enjoy!

I am very confident that you can make the above commitment and that you can maintain it during the semester. I am sure that you have all the ability to be successful!

## Exams

-  There will be 2 100-points Mid-Term Exams which will cover the topics of the previous 5 weeks.
-  The 100-points Final Exam will cover the topics of the last 5 weeks of the course.
-  All exams are closed books, closed notes.
-  Retake exams are not available.
-  Make-up exams will only be given in case of serious need (written verification for your inability to take an exam is required) and only when I have been notified **prior** to the exam

being issued, otherwise you are considered absent for that exam and the grade of your exam is automatically 0.

## Grading

Your grade will be based on

1. Your homework/projects
2. Your participation in discussions concerning the homework/projects and class topics
3. Your participation in class discussions about reading material
4. Your attendance in class
5. Your exams

|                       |     |
|-----------------------|-----|
| Participation         | 5%  |
| Attendance            | 5%  |
| Homework and Projects | 40% |
| Exam 1 and 2          | 30% |
| Final Exam            | 20% |

| Points    | Grade |
|-----------|-------|
| 92.5-100  | A     |
| 89.5-92.4 | A-    |
| 87-89.5   | B+    |
| 82.5-86.9 | B     |
| 79.8-82.4 | B-    |
| 77-79.8   | C+    |
| 72-76.9   | C     |
| 70-72     | C-    |
| 60-69.9   | D     |
| 00-59.9   | F     |

Even though I have never found it necessary to change the grading distribution and the number of assignments and exams specified in the syllabus during the semester, I reserve the right to change the method of assigning grades, including changing the number of assignments or exams if I consider it necessary.

## Course Withdrawal

If you are considering withdrawing from this course, please inform your instructor and consult with a staff member in the Student Services Office, 134 Main Hall. Withdrawal from a course can affect financial aid, student status, or progress within your major. For withdrawal deadlines, please refer to [http://www.registrars.kent.edu/home/TermUpdate/sche\\_adj.htm](http://www.registrars.kent.edu/home/TermUpdate/sche_adj.htm).

## Academic Honesty Policy

When assignments must be individually and independently done, if some students turn in substantially the same solution or program of another student, in my judgment, the solution will be considered a group effort. All involved in the group effort homework will receive a zero grade for that assignment. Policy on academic

dishonesty involving programming can be found at <http://www.cs.kent.edu/programs/grad/DishonestyPolicy.pdf>.

Use of the intellectual property of others without attributing it to them is considered a serious academic offense. Cheating or plagiarism will result in a failing grade for the work or for the entire course. Repeat offenses result in dismissal from the University. University guidelines require that all infractions be reported to the Student Conduct Officer on our campus.

### **Students with Disabilities**

Kent State University recognizes its responsibility for creating an institution atmosphere in which students with disabilities can succeed. In accordance with University Policy Subpart E...104.44, if you have a documented disability, you may request accommodations to obtain equal access in this class. Please contact the disability coordinator on campus, Kelly Kulick in Student Accessibility Services, located in the Student Success Center, lower level of the Campus Center, phone (330) 244-5047, or [kkulick@kent.edu](mailto:kkulick@kent.edu). After your eligibility for accommodations is determined, you will be given a letter which, when presented to instructors, will help us know best how to assist you.

### **Classes Canceled – Campus Closings**

Announcements of class cancellations and/or campus closings will be made on the campus home page. In the case of an emergency, weather-related or otherwise, please check the web page at [stark.kent.edu](http://stark.kent.edu) for information on the buildings and times of the closing. While information may be broadcast by radio and television, this should be confirmed by the web page, which is the official announcement of the campus and which will be the information used to determine issues related to student attendance, rescheduling of tests, and other concerns.

### **Conduct**

Students and faculty behavior at the Stark Campus is governed by the guidelines set forth in *The Digest of Rules and Regulations*. That document can be found in the University telephone directory. Information can be found at the Office of Judicial Affairs at <http://www.kent.edu/administration/emsajudicial.cfm>.

### **Recycling**

KSU Stark Campus recycles! Recycling saves energy, which is currently generated by expensive and vanishing fossil fuels. Recycling one aluminum can saves enough energy to run a TV for three hours! Please take a few seconds to separate your trash. Aluminum cans and plastic and glass bottles may be placed in the blue recycling bins, and all types of paper may be placed in the blue recycling trash cans. All other waste may be placed in the black, brown or gray trash cans.

### **Important Dates to Remember**

- Last day to withdraw **before grade W** is assigned, is Sept.13, 2009
- Last day to drop the class is Nov. 8, 2009
- Exam 1 is Thursday, Oct 1

- Exam 2 is Thursday, Nov 10
- Final Exam is Tuesday, Dec. 15 (1:00 pm – 3:00pm)

**Thanksgiving Recess:** Nov. 25 – Nov. 29

**Classes End:** Dec. 15, 2009

## Tentative Outline of the Course

## The Course

|    | Month/Day | Topic                                                              | Reading                   | Assignments and Deadlines                        |
|----|-----------|--------------------------------------------------------------------|---------------------------|--------------------------------------------------|
| 1  | Sept 1    | Introduction to Computer Architecture course                       | <b>Read Ch. 1</b>         |                                                  |
| 2  | Sept 3    | Intro to the Language of the Computer: MIPS                        | <b>Read Ch. 2.1 - 2.3</b> | <b>HW1:</b><br><a href="#">Deadline:</a> Sept 8  |
| 3  | Sept 8    | MIPS – Ch.2.3 – 2.5                                                | <b>Read Ch. 2.3 - 2.5</b> | <b>HW2:</b><br><a href="#">Deadline:</a> Sept 15 |
| 4  | Sept 10   | Video Lecture                                                      |                           |                                                  |
| 5  | Sept 15   | MIPS – Ch.2.6 – 2.9                                                | <b>Read Ch. 2.6 - 2.9</b> |                                                  |
| 6  | Sept 17   | Arithmetic for Computers: MIPS for ALU                             | <b>Read Ch. 3.1 - 3.3</b> | <b>HW3:</b><br><a href="#">Deadline:</a> Sept 24 |
| 7  | Sept 22   | Arithmetic for Computers: Overflow, Sign Extension, Multiplication | <b>Read Ch. 3.4 - 3.5</b> |                                                  |
| 8  | Sept 24   | Arithmetic for Computers: Division, Floating Point.                | <b>Read 3.6 and 3.8</b>   |                                                  |
| 9  | Sept 29   | Review                                                             |                           |                                                  |
| 10 | Oct 1     | <b>Exam 1</b>                                                      |                           |                                                  |
| 11 | Oct 6     | Amdahl's Law – The Datapath and Control                            | <b>Read Ch. 4</b>         |                                                  |
| 12 | Oct 8     | The Datapath and Control                                           |                           | <b>HW4:</b><br><a href="#">Deadline:</a> Oct 15  |
| 13 | Oct 13    | Multicycle Datapath                                                |                           |                                                  |
| 14 | Oct 15    | Pipelining and Data Hazard                                         |                           |                                                  |
| 15 | Oct 20    | Review                                                             |                           |                                                  |
| 16 | Oct 22    | Overcoming Data Hazard                                             |                           | <b>HW5:</b><br><a href="#">Deadline:</a> Oct 22  |
| 17 | Oct 27    | Control Hazards - Reducing Branch cost                             |                           |                                                  |

|    |                  |                                      |                               |                                                 |
|----|------------------|--------------------------------------|-------------------------------|-------------------------------------------------|
| 18 | Oct 29           | More on Branch                       |                               | <b>HW:</b><br><a href="#">Deadline:</a> Nov 3   |
| 19 | Nov 3            | Understanding Performance            |                               |                                                 |
| 20 | Nov 5            | Review                               |                               |                                                 |
| 21 | Nov 10           | <b>Exam 2</b>                        |                               |                                                 |
| 22 | Nov 12           | Exploiting Memory Hierarchy          | <b>Read 5.1-5.2</b>           |                                                 |
| 23 | Nov 17           | Exploiting Memory Hierarchy: Caches  | <b>Read ahead 5.3 and 5.5</b> | <b>HW7:</b><br><a href="#">Deadline:</a> Nov 19 |
| 24 | Nov 19           | Improving Cache Performance          | <b>Read ahead 5.4</b>         |                                                 |
| 25 | Nov 24           | Virtual Memory                       |                               |                                                 |
|    | <b>Nov 25-29</b> | <b>Thanksgiving Recess</b>           |                               |                                                 |
| 26 | Dec 1            | Virtual Memory Support Hardware      |                               | <b>HW8:</b><br><a href="#">Deadline:</a> Dec 3  |
| 27 | Dec 3            | Virtual Memory completion - Review   | <b>Read ahead Ch. 6</b>       |                                                 |
| 28 | Dec 8            | Storage and Other I/O topics         |                               |                                                 |
| 29 | Dec 10           | Review for final                     |                               |                                                 |
| 30 | Dec 15           | <b>1:00 pm - 3:00pm - Final Exam</b> |                               |                                                 |