Instructor: Brad Barnes (bjb211@uga.edu)
Office: Boyd 216
Office Hours: Tuesday and Thursday 3:30PM–4:30PM

Lecture Times & Locations: Monday 10:10AM–11:00AM in BOYD 328
                        Tues, Thurs  9:30AM–10:45AM in Driftmier Engineering Center 110A

Brief Description:
Design and analysis of the structure and function of modern computing systems. Topics studied include
combinational and sequential logic, number systems and computer arithmetic, hardware design and organization
of CPU, I/O systems and memory systems, instruction set and assembly language design, performance
characterization and measurement, and current trends and developments in computer architecture and organization.

Extended Description:
A hierarchical and holistic view of computer organization and architecture is presented - from the logic
design level right up to the virtual machine level. Tradeoffs associated with design choices at each level
of abstraction are identified and quantified. Tradeoff parameters such as performance (speed), hardware
complexity (cost), memory footprint and power consumption are analyzed in juxtaposition. The impact of
the design of the instruction set architecture on performance and complexity of compiler design, impact of
various organizational features on the operating systems overhead, relationship between locality and latency
in the context of hierarchical memory design and the impact of the design of the instruction set on locality
are quantified and analyzed.

This course will cover the fundamentals of Computer Architecture and Organization. The necessary topics
in Logic Design will also be covered. The course will cover chapters 1-6 from the textbook supplemented
with material from appendices A-E and additional material provided by the instructor. Select material from
chapter 7 will also be covered if time permits.

Prerequisites: CSCI-2670 (Introduction to Theory of Computation) – Prerequisites are strictly enforced.

Topical Outline:

1. Introduction to Computer Architecture – Chapter 1
   (a) Introduction
   (b) Performance Measurement and Evaluation
   (c) The Power Wall
   (d) Basics of Parallel Processing and Amdahl’s Law
2. Logic Design Basics – Appendix C
   (a) Combinational Logic
   (b) Sequential Logic
   (c) Truth Tables, Boolean Algebra, Circuit Diagrams
   (d) Basic Gates
   (e) Multiplexors and ALU Design
3. Instruction Set Architecture Design – Chapter 2
   (a) Introduction to ISA Design
   (b) Registers
   (c) Number Systems, Binary Arithmetic
   (d) Introduction to Assembly Language Programming
4. Assembly Language Programming - Appendix B
   (a) Additional Material on Assembly Language Programming
5. Computer Arithmetic – Chapter 3
   (a) Addition / Subtraction
   (b) Multiplication / Division
   (c) Floating Point Numbers
6. CPU Datapath Design – Chapter 4
   (a) Introduction to Hardware Design
   (b) Basic Datapath and Control
   (c) Pipelining
   (d) Trace Instruction Execution through the Processor
7. Memory Subsystem Design – Chapter 5
   (a) Spatial and Temporal Locality
   (b) Caching
   (c) Virtual Memory System
8. I/O Subsystem Design – Chapter 6 (if time permits)

General Course Objectives: By the end of the course, students should be able to:

1. Design a combinational logic circuit using logic gates and programmable logic arrays (PLAs) given a functional description.
2. Perform functional analysis of common combinational logic circuits such as adders, decoders, encoders, multiplexors, demultiplexers and switches/routers.
3. Design a sequential logic circuit using flip flops and combinational logic given a functional description of a finite state automaton.
4. Design and perform functional analysis of common sequential logic circuits such as sequence detectors and counters.
5. Design memory elements such as registers and RAM using flip flops.
6. Design hierarchical memory using register files, caches and RAM modules.
7. Analyze the performance of computer systems in terms of commonly used metrics such as CPU execution time, MIPS, MFLOPS, power consumption and reliability and the speedup resulting from system optimization using Amdahl’s law.
8. Analyze the tradeoffs in Instruction Set Architecture design using the MIPS assembly language as an example.
9. Design and analyze algorithms for fixed-point and floating-point binary arithmetic.
10. Design and analyze the data path and CPU control for a subset of the MIPS assembly language.

Required Texts, Software, and Materials:

2. You must bring your valid UGACARD to all lectures, labs, and exams

eLearning Commons: In this class, we will use the new eLC. Students should regularly check the course site on eLearning Commons (eLC): http://elcnev.uga.edu. Important links to needed websites, grades and some course content will be made available there.

Piazza: All students must enroll in the CSCI 4720 course on www.piazza.com. You will receive a confirmation e-mail to your uga e-mail account before class begins. If you have any questions on how to enroll, please see your instructor. This website will be used for course discussions and Q & A. If you have a question about anything pertaining to course material, please post the question to piazza before asking your professor or TA during office hours. Typically, many students have the same questions and others will benefit from seeing the Q & A on piazza. Students who frequently answer other students’ questions on piazza may receive extra credit toward their final letter grade in the class. You are NOT allowed to post any code or solutions to homework or projects on piazza. This is used only for general Q & A.
Lectures: Lectures will be held twice a week for 75 minutes (Tues, Thurs) and once a week for 50 minutes (Monday). Lectures will cover the textbook (and other material). Textbook readings will be assigned beforehand, and students should finish these before class. Students are required to bring their UGACARD to all lectures. Also, students are required to attend all lectures, and students must arrive to lectures by the start of the period and be in the class for the duration of the period unless otherwise stated. Attendance is required and will be recorded. An unexcused absence will be recorded for students who miss a lecture attendance check. Failure to bring your UGACARD to an attendance check will result in an unexcused absence. At the end of the semester, the attendance grade will account for 5% of the total grade.

Written Homework and Programming Projects: Several written homework assignments (approximately 5-7) and programming projects (approximately 2-4) will be assigned during the semester. All written homework and programming projects are individual assignments (no collaboration is permitted). These will be submitted either through the nike submission system or handed in at the start of class on the due date. If programming assignments do not run without errors, you will receive a 0.

To submit a program, put its source code and its readme file in a single directory (the name of the directory will given in a homeworks or projects directions) on nike, and use the submit utility to submit the directory to the cs4720 account on nike. For example, if you are submitting project 1, you would place all files in a directory called p1 and then execute the command submit p1 cs4720 on nike to submit the project. Programs must have a readme file that states what the project does and how to run it.

After submitting a directory, you are responsible for checking if the submission was successful by checking if a file beginning with rec was created in the submitted directory. The rec file will show a record of all files submitted along with their timestamps. If a rec file does not appear in the directory after submitting it, then the submission was unsuccessful, and you must resubmit. If you cannot submit a project or homework via nike, then email your source code to the instructor before its deadline. Students are responsible for saving and backing up their source code.

Late Project Submission: Except in the cases of serious illness or emergencies, projects must be submitted before the specified deadline in order to receive full credit. Projects submitted late will be subject to the following penalties:

1. If submitted 0–24 hours after the deadline, then 25 points will be deducted from the project score.
2. If submitted 24–48 hours after the deadline, then 50 points will be deducted from the project score.
3. If submitted more than 48 hours after the deadline, a score of 0 will be given for the project.

Students unable to submit a project due to a serious illness or other emergency should contact the instructor as soon as possible before a project’s deadline. Based upon the circumstances, the instructor will decide an appropriate course of action.

Exams: There will be two exams and a comprehensive final exam in this course. Students are required to bring their UGACARD, number two pencils, and an eraser to all exams. All instructions written on an exam or stated by the instructor before or during an exam must be followed. Students late to an exam may have points deducted from their exam grade. If you arrive late to any exam after someone else has finished the exam, then you will not be permitted to take the exam, and you will receive a zero on it. No restroom breaks allowed during an exam unless you’ve obtained a class accommodation from the instructor before that exam begins. Exam dates will be announced at least one week in advance. The final exam date is set by the university for Thursday, May 1st from 8:00AM-11:00AM in our regularly scheduled Tuesday/Thursday lecture classroom.

Makeup tests will rarely be given. If an exam is missed due to an extreme and verified emergency, then it might be excused by the instructor. To be considered for an excused exam absence, students must bring detailed documentation explaining the circumstances to the instructor during office hours no more than 7 days after an exam is missed. Student must leave a copy of their documentation with the instructor. The instructor has full authority to decide whether or not to excuse an exam absence. If the absence is excused, then either a makeup exam will be given or the final exam score will be counted for the missed exam (this
is completely up to the professor). If the absence is not excused, then a grade of 0 will be given. Exams will not be handed back to students to keep. You can, however, look over your exams during office hours. Exams must be taken at the scheduled time and place unless a class accommodation or petition to reschedule is approved by the instructor at least two weeks before an exam’s date.

**In-Class Quizzes:** In class quizzes will be short, unannounced quizzes taking approximately 10-15 minutes at the start of class. The quiz questions will come from the textbook readings (or supplements given by the instructor) or contain questions from previous lectures.

**Grade weights:** Exam 1 (15%), Exam 2 (20%) Final Exam (25% - 30%), Written Homework and Programming Projects (30%), In-class quizzes (0% - 5%) **, In-class participation and Attendance (5%)

**The implementation of in-class quizzes depends on the amount of TA resources assigned to the class. In the event that quizzes are cancelled, this portion of the course grade will be added to the final exam– making the final exam worth 30%**

**Final Letter Grades:** Final letter grades will be determined according to the following scale:

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<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>90%</td>
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<tr>
<td>A-</td>
<td>88% - 89%</td>
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<tr>
<td>B+</td>
<td>86% - 87%</td>
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<tr>
<td>B</td>
<td>80% - 85%</td>
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<tr>
<td>B-</td>
<td>78% - 79%</td>
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<tr>
<td>C+</td>
<td>76% - 77%</td>
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<tr>
<td>C</td>
<td>70% - 75%</td>
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<tr>
<td>C-</td>
<td>68% - 69%</td>
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<tr>
<td>D</td>
<td>60% - 67%</td>
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<tr>
<td>F</td>
<td>&lt; 60%</td>
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The instructor reserves the right to curve grades. Grade curves will not lower a student’s grade. The students most likely to get grade curves are those that help answer questions on Piazza. Students must be registered for this course in order to receive any grades.

**Regrading:** With the exception of the final exam, students may request a reevaluation of graded materials. In order to be considered, students must send a regrade request within 7 days after the grade was posted on eLC for grades posted to eLC before reading day. For grades posted on or after reading day, students must send a regrade request within 3 days after the grade was posted on eLC. All regrade requests must be emailed to the lecture instructor from your UGA email account with a subject that contains “cs4720 regrade request for y”, where y is the name of the assignment. If a rubric is posted for an assignment, then the regrade request must include which parts of the grading rubric were incorrectly graded. Regrade requests may result in a lower grade.

**Electronic Devices:** Students may not use personal electronic devices (including laptops, tablets, and phones) during lectures or labs unless the instructor has explicitly given them permission to do so.

**Email:** Students must use their UGA email accounts and put a [cs4720] tag in the subject of their emails when corresponding with the instructor or TA on course-related matters. Email communication should NOT be treated as an alternative to meeting with the instructor (or TA) during office hours. Email should be used when the topic is private – always go through Piazza for general questions before sending direct e-mail to the professor or TA. Email will not be used to provide private tutorials or to explain material that was covered in missed lectures. If an email question cannot briefly be answered with a reply email, the instructor will indicate to the student that she or he should see the instructor (or TA) during office hours. Professors and TAs will not be able to debug programs through email. This must be done during office hours.

**In-Class and Online Behavior:** Students are expected to be courteous and respectful in all interaction with other members of the class (whether this interaction occurs online or in class). Disruptive or disrespectful behavior might result in the student being asked to leave the classroom. In extreme cases, or if the behavior persists, a formal report might be filed by the instructor or the student withdrawn from the class.

**Academic Honesty:**

As a University of Georgia student, you have agreed to abide by the University’s academic honesty policy, “A
Culture of Honesty,” and the Student Honor Code. All academic work must meet the standards described in “A Culture of Honesty” found at: http://honesty.uga.edu. Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation. Questions related to course assignments and the academic honesty policy should be directed to the instructor.

In addition, students are expected to abide by the CS Academic Honesty policies below.

**Computer Science Departmental Policy Statement, Academic Honesty:**

All academic work must meet the standards contained in “A Culture of Honesty.” Students are responsible for informing themselves about those standards before performing any academic work.

The Computer Science Department recognizes honesty and integrity as necessary to the academic function of the University. Therefore all students are reminded that the CS faculty requires compliance with the conduct regulations found in the University of Georgia Student Handbook. Academic honesty means that any work you submit is your own work.

Common forms of academic dishonesty against which students should guard are:

1. Copying from another student’s test paper or laboratory report, or allowing another student to copy from you;
2. Fabricating data (computer, statistical) for an assignment;
3. Helping another student to write a laboratory report or computer software code that the student will present as her or his own work, or accepting such help and presenting the work as your own;
4. Turning in material from a public source such as a book or the Internet as your own work.

Steps to help prevent academic dishonesty are:

1. Familiarize yourself with the regulations.
2. If you have any doubt about what constitutes academic dishonesty, ask your instructor or a staff member at the Office of the Vice President for Instruction.
3. Refuse to assist students who want to cheat.
4. Do not allow anyone to copy any of your work, and report anyone who tries to copy from you to the instructor or TA as soon as possible.

Furthermore, selling, posting, or giving away course content such as slides, notes, or any information about exams, homeworks, projects, or lectures is considered an act of academic dishonesty (unauthorized assistance) unless you have written permission from the instructor. The instructor has the right to run programs to detect evidence of unauthorized assistance (usually in the form of copying from another person or unauthorized source) in any assignment submitted by a student in this semester, previous semesters, or future semesters. Also, the instructor has the right to record exams for academic honesty purposes. All faculty, staff, and students are encouraged to report all suspected cases of academic dishonesty. All cases of suspected academic dishonesty will be referred to the Office of the Vice President for Instruction. Penalties imposed by the Office of the Vice President for Instruction may include a failing grade in the course and a notation on the student’s transcript. Repeated violations are punishable by expulsion from the University. For further information please refer to the UGA Code of Conduct, available at the URL below.

http://www.conduct.uga.edu/code_of_conduct/codeofconduct.pdf

**Class Accommodation:** Students with a disability or health-related issue who need a class accommodation should make an appointment to speak with the instructor as soon as possible. Students who require such an accommodation for an exam must contact the instructor at least two weeks before the exam is scheduled.

**Syllabus Policy:** Students are responsible for learning and following all policies stated in this syllabus. This course syllabus is a general plan for the course; deviations announced to the class by the instructor may be necessary.
Syllabus Agreement:

By signing below, I agree that:

I have received the syllabus for CSCI 4720, Computer Architecture, for Spring 2014. I acknowledge it is my responsibility to read, understand and comply with the terms and policies outlined in the syllabus and academic honesty policies of the university and the CS department. I also understand that it is my responsibility to receive all course announcements by checking my official UGA e-mail account, the course website, and the course piazza account on a daily basis.

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Student Name (Signature)

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Student Name (Print)

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Today's Date