

# CS 10 Computer Architecture and Organization

Fall 2018

Section 02W, CRN 21987

**Instructor:** Geri Lamble  
**Email:** lamblegeri@fhda.edu

**Lectures:** online **Labs:** online

## Course Description:

This course is a systematic introduction to the architecture, organization, and machine-level programming of computer systems. Topics include mapping of high-level language constructs into assembly code, internal data representations, MIPS architecture, MIPS assembly language code, comparison of CISC (Intel) and RISC (MIPS) instruction sets, numerical computation, multitasking, interrupts, pipelines, caching, virtual memory, peripheral storage processing and input/output.

**Prerequisites:** One of the following: CS1A, 1AH, 2A, 2AH or 3A.

**RequiredText:** **Computer Organization and Design: The Hardware/Software Interface**, 5<sup>th</sup> edition, by Patterson and Hennessy, Elsevier publisher. ISBN: 978-0124077263.

## Textbook Companion Site

This book can be ordered through the [Foothill Bookstore](#).

**Required Software:** [MARS](#) (MIPS Assembler and Runtime) Simulator. You will need access to a MIPS simulator for RISC (Reduced Instruction Set) assembly language programming. In this class we will be using the MARS IDE (Integrated Development Environment).

## Course Objectives:

The student will be able to:

- 1) Describe the architectural components of a computer system.
- 2) Discuss and demonstrate the use of compilers, linkers, and loaders.
- 3) Describe computer representation of numbers and how computer arithmetic is carried out.
- 4) Describe the representation of nonnumeric data (character codes, graphical data.)

- 5) Demonstrate the knowledge of MIPS assembly language.
- 6) Compare and contrast MIPS architecture and assembly language with IA32.
- 7) Write and debug assembly programs that use load/store, arithmetic, logic, branches, call/return and push/pop instructions.
- 8) Discuss how variable access, arithmetic, function calls, and pointers are translated from a high level language into assembly.
- 9) Write programs that interface between a high level language and assembly.
- 10) Write programs that contain system calls.
- 11) Demonstrate and evaluate the use of efficient programming techniques.

### **Student Learning Outcomes (SLOs):**

- 1) Demonstrate the ability to analyze the assembly language instructions generated by a C, C++ or Java program.
- 2) Demonstrate microprocessor architecture knowledge including the use of registers, the program counter and the arithmetic logic unit.

### **Lecture Objectives:**

The purpose of the lecture material is to provide instruction and examples of weekly topics. Materials will consist of lecture notes, handouts and internet links.

### **Lab Objectives:**

The purpose of the labs is to provide students hands-on independent practice at problem solving using the computer architecture and organization principles covered in the lessons. The lab component is a critical part of the learning tool for this course.

### **Computer Science Support**

**STEM Success Center:** The “STEM Center”, located in the 4200 building, room 4213, will have qualified CS tutors at various times each day.

There is also a dedicated Computer Science lab located in the 4200 building, room 4204.

**Online Tutoring** support is available.

**Class Website:** All instruction occurs online through the Canvas course management system (CMS).

### **Course Site Information:**

The various areas of your course can be accessed through Canvas’ Tools menu on the left navigation bar.

- **Modules:** Weekly topic lecture material.

- **Assignments:** Labs submitted through the *Assignments Tool*.
- **Exams:** Submitted through the *Quizzes Tool*.
- **Public Forum:** Communication using the *Discussions Tool*.
- **Tutorials:** Provides Computer Architecture tutorial links.
- **Documentation :** Provides Computer Architecture documentation links.
- **Gradebook:** Displays updated course grades.
- **Resources:** Supplementary course support materials are provided.

*Format of weekly modules* – Weekly topic material is released on Mondays at 8:00 AM. The first few weeks there are additional resource modules to help you get set up for the course.

*Lab assignments* - Assignment specifications will open on Wednesdays at 8:00 AM and are due on Tuesdays at 11:59 PM (2<sup>nd</sup> week onwards).

*Exams* – timed sessions online. There will be a one hour midterm exam on Tuesday of the 6<sup>th</sup> week and a comprehensive two hour Final exam on Tuesday of the 12<sup>th</sup> week.

*Public Forum* – Student forum discussion opportunities and private communication are supported by posting to the *Discussion and Private Messages Tool*.

*Gradebook* – Displays current course grades for all students per each assessment.

*Tutorials, Documentation and Resources* – Supplementary course support materials are provided in these course links.

### **Course Policies:**

**Attendance and Participation** – Weekly attendance and participation is assessed through exam and lab assignment submissions

You must also post an introduction in the first week to avoid being dropped as a **no-show**. Be sure to include uploading an avatar in your Canvas student profile before you post your introduction. After the first week forum posts are not required.

Students who do not submit the first assignment will be dropped.

Students who do not take the midterm will be dropped.

For additional course participation details, see the syllabus segment below on *Attendance Guidelines*.

It is *ultimately* the student's responsibility to drop or withdraw from the class.

## **Communication and other Activities:**

### **Announcements:**

Weekly announcements and important reminders will be posted to help keep students on track with where we are in the course. If you are not receiving an email after I send out an *Announcement*, then double-check the email address and notification preferences that is on file in your Canvas account.

**Public Forums:** Class forum discussion enhances the course learning experience. Questions and comments should be posted to the Canvas Discussion Forum. Unless a question is of a private nature (i.e. grades, registration issues), please use the public class forum. Also, feel free to answer your fellow student questions, even if you only have a guess as to what the answer is. It is through this opportunity to engage with each other that you can both build your confidence in knowing the material as well getting to know one another.

Weekly discussions will be generated on the topic material and lab assignments. If you want to ask a question “**Post a Reply**” to that discussion.

**Private Messages:** Please use *public* Discussions for any question or comment that relates to the class – this helps everyone to learn. If you have a confidential question (grades or registration) use the Canvas Conversation Private Message Tool (PMT).

### **Checking my messages:**

The best way to get a hold of me is through sending a “private message” via the Canvas Conversation tool.

**Posting Program Code:** You can post code to the public discussions, provided that it is not source directly from your assignment. If you have an assignment question, translate that into a piece of code that does not reveal your answer or submission, exactly.

When posting code fragments (i.e. portions of your program) into questions, make sure these code fragments are perfectly indented and that they are properly formatted.

Be specific in your questions. Find exactly what you want to know about and post only that part of the code. For details, see the syllabus segment below on *How to Ask a Question*.

**How to Ask a Question: Be specific.** Show exactly where you seem to be faltering so that qualified others can know how to help you. This holds true if you are posing your question to the public forums, the [STEM Center](#) or me directly. Questions are encouraged. The engagement of questioning helps everyone learn. Just be sure to have wrestled with the problem first so that you can show you have tried to solve it. If unclear or stuck you then have narrowed down your question specifically. Knowing exactly where you are uncertain allows for incremental progress on each assignment task. Start your labs early – this allows time for the question, answer and progress cycle to happen most successfully.

**Opportunities for CS Students** is a blog that contains announcements of internships, scholarships, software offers, pertinent public lectures and other useful CS updates. Announcements will be posted during the quarter. Students are encouraged to take advantage of CS opportunities available here.

### **Grading:**

Your grades are based on programming **lab assignments** ( $22.5 \times 8 = 180$  points), **and exams** (midterm + final =  $20 + 40 = 60$  points). There is an optional 9<sup>th</sup> bonus assignment that can be used to swap out a low lab score.

### **Grading Scale:**

<b>% need for</b>	<b>this grade</b>
93	A
90	A-
87	B+
83	B
80	B-
77	C+
70	C
67	D+
60	D
< 60	F

### **Continual access to the Internet and Late Policy:**

Since this is a fully online class, it is your responsibility to make sure that you have continuous Internet access. Please plan ahead of time and be aware of the weekly deadlines. If you know that there will be a conflict ahead of time with class responsibilities, then you need to contact me PRIOR to the deadline.

Late lab assignments will be accepted with a two point penalty **per day** late up to two days late after the due date.

Late exams are not accepted.

### **Midterm Exam:**

There is a midterm exam in the sixth week. The midterm is a one hour timed exam. The exam will open at 6:00 PM on Monday Oct 29<sup>th</sup> and must be completed by 11:59 PM on Tuesday Oct 30<sup>th</sup> within a one hour uninterrupted window.

### **Final Exam:**

There is a comprehensive final exam in the twelfth week. The final is a two hour timed exam. The exam will open at 6:00 PM on Monday Dec 10<sup>th</sup> and must be completed by 11:59 PM on Tuesday Dec 11<sup>th</sup> within a two hour uninterrupted window.

### **Participation:**

Regular weekly participation is required by College regulation. To continue in this class you must participate weekly in all assessment areas: lab assignments, and exams. This is part of the class participation requirement that online classes must enforce to maintain their transferability and accreditation.

### **Attendance Guidelines:**

You are expected to sign on and follow the lecture and assignments. If you need to drop the class, this will be your responsibility.

### **Drops and Withdrawal**

#### **You will be dropped by me for non-participation (i.e. any of the following):**

- You must post an introduction in the first week to avoid being dropped as a **no-show**. An Introduction thread can be found in our course Discussions Tool (DT).
- Students who are enrolled in the class but who do not submit the first assignment will be dropped for non-attendance.
- Missing our scheduled midterm exam without prior notice will result in an automatic drop, depending on the situation and my judgment.

#### **You may be dropped by me for non-participation (i.e. any of the following):**

- If you receive a zero on, or fall behind in, two consecutive lab assignments or three lab assignments, total, I may drop you. (See exception below).

**WITHDRAWAL FROM CLASS:** To officially withdraw from a class you must log in to MyPortal and drop the class. You can review important drop deadlines by clicking on *View Your Class Schedule*. After the withdrawal deadline, I cannot give you a “W” grade, but instead must give you the achieved grade based on the assessments you have completed. Before withdrawing, please contact me, perhaps I can help.

Ultimately it is the student’s responsibility to withdraw from the course in the event of non-participation so as not to receive a low course mark on your grade record.

**Exception to Above Policies:**

If the non-participation that has been described above occurs partially beyond the last date to drop with a “W”, I am unable to drop you, and you will receive whatever grade that your points dictate. Therefore do not assume that you can simply stop participating late in the quarter and you will be dropped. If you intend to drop, please do so yourself, so that you do not accidentally end up with an unintended “F”.

If you have any further questions and or concerns regarding these policies feel free to contact me.

If you decide to drop the class, let me know. I cannot allow anyone who has dropped to continue to have access to the course material.

**Fall 2018 Important Dates:**

Monday, Sept 24 <sup>th</sup>	Class Begins
Sunday, Sept 30 <sup>th</sup>	<b>Deadline to Post Introduction 11:59 PM</b>
Sunday, Oct 7 <sup>th</sup>	Last day to drop without “W” and for refund
Friday, Oct 19 <sup>th</sup>	Last day to request Pass/NoPass grade
Monday, Nov 12 <sup>th</sup>	Veteran’s Day
Friday, Nov 16 <sup>th</sup>	Last day to drop with “W”
Thursday, Nov 22 <sup>nd</sup> –	
Sunday, Nov 25 <sup>th</sup>	Thanksgiving
Friday, Dec 14 <sup>th</sup>	Class Ends

**Exam Dates:**

Tuesday, Oct 30 <sup>th</sup>	<b>Midterm Exam</b>
Tuesday, Dec 11 <sup>th</sup>	<b>Final Exam</b>

**Please ensure you have no conflicts with midterm or final exam dates; there will be no make-ups.**

Access your MyPortal.fhda.edu account to verify exact date for each course for the following:

- Deadline to add/drop classes
- Deadline to qualify for and request a refund
- Deadline to drop a class without a grade

Deadline to drop a 12-week course with a “W”

\*\*Take note of the important dates to register and drop the class without a grade or with a “W” or to file a pass/no pass option\*\*

### **Academic Integrity:**

The purpose of this course is to help learn. My goal is to guide you to succeed in your goals for the course.

There are many places to go for help with this class:

- 1) Post a question in the Canvas class forums “*Discussion*” tool
- 2) Tutoring and student support is available at the [STEM Success Center](#).  
[Online Tutoring](#) is available.
- 3) Send me a private message in our Canvas “*Conversation*” tool.

### **Collaboration:**

You are welcome to study with other students in the course - active peer forum engagement is encouraged.

It is OK to ask questions, discuss weekly course topics - use the Canvas public forums or the STEM success center to do so.

However, all class-related assignments are considered individual efforts.

It is NOT OK to work together on the course assessments (labs and exams).

Any infractions will be detected and will result in an automatic 0 on the given assessment. College administrative consequences will also be necessary.

Working together on homework = ZERO + Dean of Student’s Office.

Husbands and wives, roommates, and friends taking the course together: do not discuss ungraded homework with each other outside of the public forums. Instead, direct all of your questions to the public forums or the tutoring available at the STEM center. Do not look for answers on cheater web sites or pay-for-help web sites.

Any variation of collaborating or copying programming lab assignments is prohibited. The assignment must be 100% your own work. Changing a few variables around to make them look different does not qualify as doing your own work. Accepting help from someone who is not trained to teach without giving away the answer will short-circuit your learning process – you will actually become weaker making it very difficult to keep up with the course material.



You can talk about the modules all day long off-line if you wish. This rule only applies to course assessments yet to be submitted. There is a place to ask for help with homework: the Public Forums labeled for that purpose or the **STEM Success Center**.

For those of you wishing to give help in the public forums please do not give away the answer. Either tell the person where they can look to find the solution, give them a general idea or ask them to ask me or tutors available at the STEM Center. Do not post actual assignment solutions.

### **Disability:**

To obtain disability-related accommodations, students must contact the **Disability Resource Center (DRC)** at the start of the quarter.

### **Syllabus Expanded Content:**

**Week 1** – Course introduction, machine and technology history, processor performance.

**Week 2** – Number representation (binary, hexadecimal, octal, decimal, signed and twos complement), data formats: ASCII, BCD, EBCDIC, unicode; endianness.

**Week 3** – Machine basics, MIPS Instruction Set Architecture (ISA) basics, adds, loads/stores.

**Week 4** – MIPS instruction format, logic and control flow instructions.

**Week 5** – Supporting procedures, character data and MIPS addressing modes, RISC vs CISC.

**Week 6** – Arrays versus Pointers. **Midterm Exam.**

**Week 7**– Computer arithmetic (addition, subtraction, multiplication, division, floating point, packed decimal); ALU design; exceptions and interrupts.

**Week 8** – Processor datapath and control.

**Week 9** – Pipelining: Introduction, data hazards and forwarding, control hazards and branch prediction.

**Week 10** – Memory hierarchy: Caches and virtual memory.

**Week 11** – Peripheral storage processing, input/output.

**Week12** – **Final exam.**

**Course Activities:** Every week you will have lessons, *Modules*, to study, and an Assessment to turn in. There is a midterm in the sixth week and a final the twelfth week. This course is a lot of work and hopefully a lot of fun. To pass it you have to make time to do all of these activities. You stand to learn a lot.

### **Weekly Time Estimate**

- Module Reading – about five hours. This includes pasting code examples into your MIPS simulator and trying it out.
- Lab Assignment – about four – six hours. The lab assignments include answering weekly topic questions as well as a programming component. The time required to complete the lab varies greatly with individuals, depending on

the level of background experience with programming. Some students take one hour, some longer.

### **Typical Week:**

Here is the day-by-day breakdown of a proposed *typical* week to help you understand approximately what you are facing on a weekly basis.

Mondays	Module Reading is assigned
Wednesdays	Lab Assigned
Tuesdays (starting 2 <sup>nd</sup> week)	Lab Assignment Due (11:59 PM)

The first few weeks there are additional reference modules that you will need to read to get started. The lab assignments are based on the previous week's topic materials allowing you the flexibility to choose when is most convenient for your schedule to read the current week's lecture materials.

### **Announcements**

There will be course announcements in the top right of your welcome screen every time you login in.

### **Discussions**

There will be weekly topic discussions available in the *Discussion Messages* area. Initiate or read through the recent posts every time you login in to make sure that you gain the benefit of student inquiry and engagement.

Weekly posts are not required. However, if you are having difficulty, or have discussions to share, you are encouraged to reach out. The class forums are there to both engage and support YOU.

### **Lab Assignments**

Only **one** submission allowed per lab assignment. There is a two day late window available on Labs 1-8 with a 2 point penalty for each day late. There is an optional 9th bonus lab available that can be used to swap out a low lab score. **No late submission available on the bonus lab.**

### **Exams:**

There is a midterm exam on Tuesday of the 6th week, and there is a Final Exam on Tuesday of the 12<sup>th</sup> week.

These tests will automatically submit and lock-you-out 1 hour (midterm), 2 hours (final) after you start the exam session. It is important that you can ensure an uninterrupted time interval on a solid computer connection. **Exams are not accepted late.**

**Official Due Dates for Course:**

Date	Day	Read Module	Lab Assignment Due 11:59 PM	Test Due 11:59 PM
Sept 24	Monday	Syllabus & Resources & Module 1		
Oct 1	Monday	Module 2		
Oct 2	Tuesday		Assignment 1	
Oct 8	Monday	Module 3		
Oct 9	Tuesday		Assignment 2	
Oct 15	Monday	Module 4		
Oct 16	Tuesday		Assignment 3	
Oct 22	Monday	Module 5		
Oct 23	Tuesday		Assignment 4	
Oct 29	Monday	Module 6		
Oct 30	Tuesday			<b>Midterm</b>
Nov 5	Monday	Module 7		
Nov 6	Tuesday		Assignment 5	
Nov 12	Monday	Module 8		
Nov 13	Tuesday		Assignment 6	
Nov 19	Monday	Module 9		
Nov 20	Tuesday		Assignment 7	
Nov 26	Monday	Module 10		
Nov 27	Tuesday		Assignment 8	
Dec 3	Monday	Module 11		
Dec 4	Tuesday		Assignment 9 (Optional)	
Dec 11	Tuesday			<b>Final Exam</b>

**Next Steps:**

With all that said, let's begin. Look up and see that in the first week you are supposed to:

- Read this syllabus
- Upload an avatar in your Canvas profile
- Post an Introduction in the Class Forum
- Check your email setting in your Canvas profile
- Read Reference and Unit 1 Lesson Modules
- Software setup: MARS simulator

**Changes:** This syllabus is subject to changes, additions, deletions, and/or corrections.

Last Updated: 08/25/2018 1:32 PM.

## Road Map for CS 10

Topic	Lecture Set(s)
Intro, Processor Performance	1
Representing Information	2
Instruction Sets	3
Assembly and Simulator	4
Addressing Modes	5
Procedures and Stacks	6
Computer Arithmetic	7
Processor	8
Pipelining	9
Memory Hierarchy: Caches and VM	10
Storage and Input/Output	11