

Master Course Syllabus

Course Discipline and Number: CSCI 210

Year: 2023-2024

Course Title: Computer Architecture and Organization

Credit Hours: 3

I. Course Description: This course develops basic concepts of electronic computers and introduces the subject of computer architecture. Assembly language programming is covered in considerable detail. Other topics include machine language, addressing techniques, subroutines and control linkage, and macros. Prerequisites: CSCI 205; MATH 138 or higher; prior completion of, or concurrent enrollment in, ENGL 100 or ESL 120, 121, and 122 if required by placement. 3 Cr. (2 Lec., 2 Lab.) Spring semesters.

II. Additional Course Information:

1. CSCI 210 is required for degree completion in the Computer Science A.S. degree.
2. Students must have access to a computer with Windows, Mac OSX or Linux installed. ChromeBooks and iPads are not appropriate for this course.
3. All software and tools used in the course are free and platform independent. Students will need to be able to install and configure software on their machines.
4. Students will be provided access to Raspberry Pi computers and breadboard kits
5. Class is offered spring semesters, in-person only. Hyflex sections may be created.

III. Student Learning Outcomes

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

1. Communicate an understanding of the fundamental hardware, organization, and operation of typical microprocessor-based computer systems.
2. Create programs that demonstrate proper methods of writing, documenting, debugging, and executing assembly language code for the ARM family of microprocessors.
3. Work with various binary encoding schemes for common data
4. Describe the relationship between high and low level programming languages

IV. Tompkins Cortland Institutional Learning Outcomes; Program Learning Outcomes; SUNY General Education Competencies and Knowledge and Skills Areas

Tompkins Cortland ILOs – N/A

Complete this section for “service” courses only (e.g. courses that are required of all students; courses that are not program specific but satisfy liberal arts requirements; or commonly used in multiple academic programs to meet non-program-specific requirements). Check only Institutional Learning Outcomes (ILOs) that are meaningfully developed and assessed in this course. For each ILO chosen, include the SLO to which it aligns.

Students will:

☐ Communicate effectively, in oral and written forms, taking into consideration audience and purpose.

☐ Apply principles and methods of scientific inquiry and quantitative reasoning appropriate to their discipline.

- ☐ Use information, critical thinking, and the creative process to solve problems and reach conclusions.
- ☐ Use technology appropriate to their discipline.
- ☐ Describe the ways in which social, economic, or environmental sustainability depends on their own and the collective contributions of a diversity of ideas and people.

Program Learning Outcomes: Computer Science-General A.S. and Computer Science-Engineering A.S.

1. **CS PLO:** 1. Describe the architecture and organization of modern computer systems along with the abilities and limitations of common devices.
 1. **SLO:** Communicate an understanding of the fundamental hardware, organization, and operation of typical microprocessor-based computer systems.
2. **CS PLO:** 4 Demonstrate and apply problem solving and mathematical abilities appropriate for computer-based solutions.
 1. **SLO:** Demonstrate an ability to work with various binary encoding schemes for common data

SUNY General Education Competencies N/A

If this course assesses a SUNY GEN ED Competency, check all that apply and indicate which course outcome(s) address each checked item:

☐ **CRITICAL THINKING & REASONING-** Students will:

- a. clearly articulate an issue or problem;
- b. identify, analyze, and evaluate ideas, data, and arguments as they occur in their own or others' work; acknowledge limitations such as perspective and bias; and
- c. develop well-reasoned (logical) arguments to form judgments and/or draw conclusions.

☐ **INFORMATION LITERACY -** Students will:

- a. locate information effectively using tools appropriate to their need and discipline; evaluate information with an awareness of authority, validity, and bias; and demonstrate an understanding of the ethical dimensions of information use, creation, and dissemination.

☐ **SUNY GENERAL EDUCATION KNOWLEDGE AND SKILLS AREA(s):** N/A

For courses that are approved to meet one (or more) of the ten SUNY General Education Knowledge and Skills Areas, indicate which area the course fulfills, and which outcome(s) are aligned with the SUNY outcomes for that area:

- ☐ This course does not address any of the above Tompkins Cortland ILOs, PLOs, or SUNY General Education Competencies or Knowledge and Skills Areas.

V. Essential Topics/Themes

1. Fundamental hardware, structure, and operation of typical microprocessor-based computers and computer systems.
2. Translate values between base 2, base 8, base 10 and base 16 number systems
3. High level language structure and execution through compiler output analysis
4. Binary encoding schemes for signed and unsigned numbers using 2's complement
5. UIEEE754 Floating Point encoding
6. Bitwise logical operations: and, or, not, or, and logical and arithmetic shifts and rotations
7. Byte addressable memory and apply various memory allocation and addressing schemes

8. Conditional branching and its effect on the instruction pipeline
9. Debugging assembly language programs
10. Linking assembly language programs with high level language programs and data transfer between those languages.
11. Methods of transferring data and the common use of the stack in procedure calls

VI. Methods of Assessment/Evaluation

Method	% Course Grade
1. Lab Assignments	30 – 50%
2. Final Project	20 – 40%
3. Exams	20 – 40%

VII. Texts – ☐ Required ☒ Recommended ☐ Used for more than one course (list courses)

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1. Learning Computer Architecture with Raspberry Pi, Eben Upton, Jeffrey Duntemann, Ralph Roberts, Tim Mamtara, Ben Everard https://www.wiley.com/en-us/Learning+Computer+Architecture+with+Raspberry+Pi-p-9781119183938	☐
2. ARM Assembly Language: https://www.oreilly.com/library/view/arm-assembly-language/9781482229851/	☐

Editions listed are current as of date of syllabus. More recent editions may be used.

VIII. Bibliography of Supplemental Materials

1. ARM Processor Documentation: https://developer.arm.com/documentation/dui0473/c/writing-arm-assembly-language
2. ARM Tutorial: https://azeria-labs.com/writing-arm-assembly-part-1/
3. ARM Assembly Language Programming Peter Knaggs: http://www.rigwit.co.uk/ARMBook/ARMBook.pdf

IX. Other Learning Resources

Audiovisual: Hours of YouTube tutorials on ARM Assembly on Raspberry Pi: https://www.youtube.com/results?search_query=arm+assembly+language+tutorial
Electronic: God Bolt Compiler Explorer: https://godbolt.org/ Online Hex Editor: https://hexed.it/ Online GDB Debugger: https://www.onlinegdb.com/
Other: None specified

Attendance Policy: To maintain good grades, regular attendance in class is necessary. Absence from class is considered a serious matter and absence never excuses a student from class work. It is the responsibility of all instructors to distribute reasonable attendance policies in writing during the first week of class. Students are required to comply with the attendance policy set by each of their instructors. Students are not penalized if they are unable to attend classes or participate in exams on particular days because of religious beliefs, in accordance with Chapter 161, Section 224-a of the Education Law of the State of New York. Students who plan to be absent from classroom activity for religious reasons should discuss the absence in advance with their instructors. See college catalog for

more information.

Services for Students with Disabilities: *It is the College's policy to provide, on an individual basis, appropriate academic adjustments for students with disabilities, which may affect their ability to fully participate in program or course activities or to meet course requirements. Students with disabilities should contact the Coordinator of Access and Equity Services, to discuss their particular need for academic adjustments. All course materials are available in alternate formats upon request.*

Academic Integrity: *Every student at Tompkins Cortland Community College is expected to act in an academically honest fashion in all aspects of his or her academic work: in writing papers and reports, in taking examinations, in performing laboratory experiments and reporting the results, in clinical and cooperative learning experiences, and in attending to paperwork such as registration forms.*

Any written work submitted by a student must be his or her own. If the student uses the words or ideas of someone else, he or she must cite the source by such means as a footnote. Our guiding principle is that any honest evaluation of a student's performance must be based on that student's work. Any action taken by a student that would result in misrepresentation of someone else's work or actions as the student's own — such as cheating on a test, submitting for credit a paper written by another person, or forging an advisor's signature — is intellectually dishonest and deserving of censure.

Several degree programs offer student learning opportunities (such as internships, field work, and clinical experiences) outside the standard classroom setting. As part of the learning process, students must understand and engage in conduct that adheres to principles guiding employment within the professional workplace. These behaviors include, but are not limited to, academic integrity, accountability, reliability, respect, use of appropriate language and dress, civility, professional ethics, honesty, and trustworthiness. Disciplinary action may be initiated for inappropriate conduct occurring while participating in any course-related project or event.