## CSC 120 Lab 03

Use the **emulator** to find the answers to your work. The goal of this lab is to understand how to use the emulator and run instructions on it. You should be able to make sense of the values returned by the emulator.

**Emulator link below**

https://joeledstrom.github.io/brookshear-emu/#AA01

**Appendix C link below**

https://blackboard.waketech.edu/bbcswebdav/pid-18088193-dt-content-rid-148874207\_1/xid-148874207\_1

### (10 points) The following table shows a portion of a machine's memory containing a program written in the language described in the language description table. See the first page of this lab Answer the questions below (there are two) assuming that the machine is started with its program counter containing 00. Recall the language requires two bytes per instruction

### Address Content Interpretation

### 00 21 Execute the instruction 210B

### 01 0B

### 02 14 Execute the instruction 1404

### 03 04

### 04 C0 Execute the instruction C0000

### 05 00

### What bit pattern will be in register 4 when the machine halts?

### A A5 B. C0 C. 27 D. C7

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### What bit pattern will be in the program counter when the machine halts?

### A 05 B. 06 C. 07 D. 04

**(10 points) The following table shows a portion of the machine's memory written in the language described in the language description table. Answer the questions below assuming that the machine is started with its program counter containing 00.**

**Address Content Interpretation**

00 25 Execute instruction 2503

01 03

02 A5 Execute instruction A502

03 02

04 35 Execute instruction 3503

05 03

06 24 Execute instruction 2400

07 00

08 34 Execute instruction 3404

09 04

0A B0 Execute instruction B003

0B 03

0C C0 Execute instruction C000

0D 00

What bit pattern will be in memory location 03 when the machine halts?

A C0 B. 05 C. 00 D. A0

**(15 points) The following table shows a portion of a machine's memory containing a program written in the language described in the language description table (adopted from Chapter review problem #15 ) Use the emulator**

**Address Content Interpretation**

0x00 1C Execute instruction 1C03

0x01 03

0x02 2B Execute 2B03

0x03 03

0x04 5A Execute 5ABC

0x05 BC

0x06 3A Execute 3A00

0x07 00

0x08 C0 Execute C000 (Halt)

0x09 00

What bit pattern will be in register A when the machine halts?

A. 30 B. 03 C. C4 D. 06

What bit pattern will be in memory address (cell) 00 when the machine halts?

A. 30 B. 03 C. C4 D. 06

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### (15 points) Explain briefly the concept of opcode/operand and the types of load instructions for the Vole architecture. What is the general format of the instruction? Give examples

The opcode is any sort of instruction that can be executed by the CPU. An opcode it can be a binary or a hexadecimal such as 0001. An operand is the location used to execute the opcode instruction. It helps specify which data is being manipulated. A operand is 12 bits. Vole architecture instructions explain how to put data into the emulator. An example is “Load register 00 with A0.” Usually, the format is in short sentences to explain what to do.

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### Section B Exploration Challenge (20 points)

In this module, we learned about processor architecture. In recent years, deep learning and AI advances are creating a revolution in processor design. Researchers and engineers today are having to rethink the idea of chip design. It is a very exciting time to witness this change. Therefore, your role in this assignment is to research how the field of artificial intelligence and deep learning is revolutionizing chip design. Use google as well as Google Scholar or ACM Digital Library. You can start by reading the below article which was published in Communications of the ACM

[Making Chips Smarter](https://cacm.acm.org/magazines/2017/5/216326-making-chips-smarter/fulltext)

URL: https://cacm.acm.org/magazines/2017/5/216326-making-chips-smarter/fulltext

Your answer should be 2-3 paragraphs and should try to answer the following questions.

* Summarize 3 key points from the article.

Whole AI and machine learning has advanced greatly over the past decade, there is always the task of making systems max out their performance. This overall is the fastest way to produce the best results. Researchers are trying to create new chip designs to increase performance, but it is a challenge. They are trying to create specialized designs to do the task that they need it to do. GPU’s are the next best thing to make the computer process fast, but specialized AI chips will deliver better performance that either CPU’s or GPU’s. This will increase performance and limit costs for companies developing. GPU’s have been delivering superior speed and can be applied to many different tasks. New models are emerging such as Google’s TPU that has application specific integrate circuit. The unit has reduced precision so it can commutate super-fast. These sorts of chips that have low precision are the ones emerging as most popular. They can conform better to platforms and accelerate the training of deep learning algorithms. They can produce result faster with less power.

* How are chips developed for deep learning different from traditional processors?

They have more AI technology and machine learning. They also have a much higher bandwidth so they can have a much higher performance.

* What are some of the emerging technologies that are being used today in chip design?

A model known as Google’s Tensor Processing Unit and has a custom application specific circuit or ASIC. It is made for AI like navigation or speech. Another technology is Microsoft’s Project Catapult. It uses gate arrays and uses Bing search to put algorithms onto hardware. Another example is Nervana made by Intel. It will have a super high bandwidth and it will focus on multipliers and memory. It can also help with computation and data management.

* What is Moore’s law and why is it relevant in this context?

Moore’s law is “that the number of transistors on a microchip doubles every two years, though the cost of the computers is halved.”

Companies can keep creating new chips and hardware, but there might come to a point where we don’t know what the next step in the physical technology to make it faster. Researchers would have to rely on the algorithms and computational power to make it faster. They have to figure out how to increase efficiency without compromising integrity.

[Moore's Law Definition (investopedia.com)](https://www.investopedia.com/terms/m/mooreslaw.asp)

* What are some of the challenges ? (Price, power consumption, design)

You want the chip to use a lot less power and do more. Finding the right balance can be difficult. I think there are many physical challenges because there is only so much you can put in a chip and researchers must think more about the inner workings of the chip and efficiency. They want to increase performance without changing the physical parts of the chips as much. Cost can decrease because these chips can work faster and improve performance if they do it right. Researchers just must create the right chip to do it correctly.

Once again the aim is to promote self learning and exploration. Provide references for your sources and come up with your own answer. Do not copy.paste information directly from other articles.

**Note:** Google Scholar is a free search engine for searching research and academic articles. You should definitely try using this to understand how scientific articles are written,

### Section C Programming Challenge (30 points)

1. (15 points) Write a python program to accept a number from a user. The program should print "even number" as an output if the number is even and print "odd number" as an output if the number is odd. If the number is negative, it should print "negative number".0 is considered even.

Hint: Use the modulus operator "%". Read online on what it does and how to use it. Part of the exercise is to learn to find information online. Do not copy code directly without understanding it.

1. (15 points) Write a python program to print the first 20 even numbers.

**Instructions: Upload the file with the screenshot on Blackboard with your firstname\_lastname.docx**

