## 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 Vole machines consists of 2 parts, the op(operation) code, and the operand field and has a length of 16 bits. The op code has a length of 4 bits and is the part of the instruction that tells what to do e.g. add, jump fetch etc., and the operand has a length of 12 bits and tells the processor where exactly to perform the action from the op code. All the instructions can be found in Appendix C of the class book and are in hexadecimal. The 2 load instruction Op codes are 0x1 and 0x2. This is then followed by which register will be loaded, and the last byte gives either a memory cell address, or a bit pattern to be loaded into that register.

For example, 0x142C would load register 4 with the bit pattern found in the 2C memory cell.

0x2A13 would load register A with 13.

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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.
* How are chips developed for deep learning different from traditional processors?
* What are some of the emerging technologies that are being used today in chip design?
* What is Moore’s law and why is it relevant in this context?
* What are some of the challenges ? (Price, power consumption, design)

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,

Three key points from the Making Chips smarter article were:

1: New research is being conducted to develop new chip designs that could revolutionize AI and machine learning.

2: Improvements in GPUS, FPGA’s (field programmable gate arrays, TPUs (tensor processing units) and other chip systems and architectures could significantly improve the performance and energy efficiency needed to build AI.

3: New models such as Googles TPU, Microsoft’s Project Catapult, which uses FPGAs, and Bings search engine are currently experimenting with new technologies aimed at advancing AI and machine learning.

Chips developed for deep learning use multiple processors, each with specialized functions. These AI chips are much faster and more efficient than normal CPUs.

http://www.differencebetween.net/technology/difference-between-ai-processor-and-normal-processor/

According to Oxford Dictionary, Moore’s Law is “the principle that the speed and capability of computers can be expected to double every two years, as a result of increases in the number of transistors a microchip can contain”. It is relevant to this context because the massive increases in processing speed, combined with low-cost chips will enable machine intelligence to evolve at a rate that could possible exceed this, which would be unprecedented.

<https://siliconangle.com/2021/04/10/new-era-innovation-moores-law-not-dead-ai-ready-explode/>

Some challenges that AI faces are it requires a lot of power to use. There are also certain scenarios when right now, humans could perform better than an AI service. For example, recognizing whether a picture was a dog or not is simple for a human to do, although what is occurring in the human brain is insanely complex, likewise, an AI program has a much harder time when posed with the same problem. Another challenge that could arise is an AI system could become biased. This could happen if the data the system is trained on is biased.

https://www.upgrad.com/blog/top-challenges-in-artificial-intelligence/

### 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.

https://colab.research.google.com/drive/1NZ2AWUclAd9HDv6bS3Qb8j\_nCwVIsnDo?usp=sharing

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

https://colab.research.google.com/drive/15Zx3R2zKfYp12XRXbQJJyChKdZtfItoT?usp=sharing

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