CPSC-240.09 Extra Credit Assignment
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The objective of this extra-credit report is to research and report on a specific processor architecture. I will provide a list of various possible processors to choose from and you can select a process to report on from the list. If there is a specific processor that you would like to research and report on that is not in the list, please let me know and we can discuss if it meets the criteria that I have in mind.

Due on or before May 13th at 11:58pm.

This assignment can be worth up to 10% of your grade, which effectively can boost you up one grade level. Unfortunately, getting the full 10% is NOT guaranteed – you need to do some work. (Hey! I took the time to write up this assignment, didn't I?) You are, however, practically guaranteed to get some portion of the 10% if you TRY!

Your resulting report should be at least 2 pages of single line, 11-font text of at least 1000 words. You will want to add some helpful graphics and charts, which should make your report close to 3 pages and maybe more in order to get your information across. A short code example is not part of the 1000 words of the report and, as mentioned below, is required.

Topics important to your report

In your report you want to describe the architecture of the processor that you are reporting on. Such things as number and sizes of registers, busses, any interesting characteristics of the instruction set such as multiprocessing and/or virtualization features, is the architecture Harvard or Von Neumann (or Harvard modified), if the processor supports floating point data/instructions, if it implements a micro-coded architecture (none on my list do), code density (for example the thumb-2 architecture), or any other feature or characteristic. Do they processors have instructions that use the stack, like a PUSH, POP, CALL, or RETURN instruction? Are there other characteristics of their stack architecture?

You must include a short snippet of code demonstrating a for-loop similar to the one on the midterm exam! I believe this is a good example to show how some of the instructions of the processor can be used in a common coding problem. You do not necessarily have to get the assembly code syntax correct, but you do need to get the name and operands of the instructions as close to correct as you can.

Processor list to select from. This list can be confusing because most of them are microcontrollers that have a processor at its heart with many different peripherals attached to it. **We are only interested in the processor and its architecture.** So, for example, the STM32F103 has an ARM Cortext-M3 processor at its core, so we are only interested in the ARM Cortext-M3 processor. I have included links to information about the processors below.

There is an amazing amount of info out on the web for all of these processors. Unfortunately, there is so much it can be confusing. I've got some starter links, but you might have to do some additional googling on your own. For example, you might want to google for some sample/example code for your processor of choice.

1. Texas Instruments MSP430 (MSP430 processor)
2. ST-Micro STM32F103 (ARM Cortext-M3 processor)

3. Z/80 processor
4. ESP8266 (Tensilica L106 processor)
5. MIPS32 processor

Texas Instruments MSP430

The MSP430 is a microcontroller that contains a core processor with several different sizes of flash memory (for program storage) and static memory (for data storage) and various types of peripherals. The MSP430 is a modern embedded processor that you will find in alarm controllers, pool controllers, small medical devices (like blood pressure monitors or blood sugar or oxygen saturation meters), etc.

There are quite a few different variations of MSP430 chips but in your report you should focus on the processor core and its characteristics. The processor core is a 16-bit processor

This link: https://www.ti.com/lit/ug/slau144j/slau144j.pdf is the User's Guide to a subset of some of the MSP430 microcontrollers, but the first four chapters are useful in understanding the MSP430 processor.

http://www.ti.com/sc/data/msp/databook/chp8.pdf This is a nice short overview of the MSP430 architecture (19 pages).

ST-Micro STM32F103

As mentioned above, this processor has an ARM Cortex-M3 processor. This is a modern embedded processor that you will find in alarm controllers, pool controllers, small medical devices (like blood pressure monitors or blood sugar or oxygen saturation meters), etc. There is a whole family of STM32 processors, but we are only interested in the ARM Cortex-M3 processor which these microcontrollers use as their processor. There is only very little information about the ARM Cortex-M3 on Wikipedia, but it might be worth checking out first (There is a whole series of Cortex-M processors, the M3 is somewhere in the middle.) Here are some links worth checking out:

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0337h/DDI0337H_cortex_m3_r2p0_trm.pdf This is the Technical Reference. Start with Chapter 3, which has a "programmer's view" of the processor. Section 3.3 has a brief summary of the instruction set (Thumb-2). Figure 3-3 shows the registers.

http://hermes.wings.cs.wisc.edu/files/Thumb-2SupplementReferenceManual.pdf This is the complete Thumb-2 instruction set. As such, it is pretty hefty. Do some google searches for examples of Thumb-2 sample code.

Z/80 processor

This is an old processor that is still be manufactured today; however, it is not really being used in too many new designs. Remember the Game Boy? I loved my Game Boy and my Tetris game. Well, the Z/80 is the processor inside the Game Boy!

The z/80 is an 8-bit processor and is somewhat based on the first Intel x86 processor (the 8088).

http://www.z80.info/ This webpage has lots of information about the z/80.

ESP8266 and the Tensilica Xtensa L106 32-bit RISC processor

I have several dozen different types of boards with ESP8266 chips on them that I have been playing with in my spare time. The core processor in the ESP8266 is the Tensilica Xtensa L106 processor (too many names!) and is designed by a company call Tensilica, which is now part of Cadence Design Systems in Silicon Valley.

I think this chip is pretty amazing because it has lots of peripherals, such as a wifi radio. The Arduino community has adopted it and supports it through the Arduino IDE and libraries.

https://0x04.net/~mwk/doc/xtensa.pdf This document has the instruction set architecture for the L106

https://www.espressif.com/en/products/hardware/esp8266ex/resources This is a webpage for the ESP8266. Since you need to focus on the processor, this webpage will probably distract you. So, don't look at it!

https://www.esp8266.com/ This is a forum for the ESP8266. This will also distract you.

MIPS32 Processor

You are kind of on your own on this one. But, do some google searches and you will find some documentation on the MIPS32 architecture. One thing to note about MIPS is that it executes instructions out-of-order! So, there's a half a page worth of information to write about right there!