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Question 1 Homework 1

Part a) A memory is byte addressable and has a 17-bit address. All the addresses are valid. What is the total size of the memory?

$$2^{17} = 2^{10} \cdot 2^7 = 128 \text{ KB}$$

Part b) A memory is byte addressable and has a total size of 18,432 Bytes (18 KB). What is the smallest address size that can be used for this memory.

$$10 \text{ bit} \Rightarrow 1 \text{ KB}$$

$$11 \text{ bit} \Rightarrow 2 \text{ KB}$$

$$12 \text{ bit} \Rightarrow 4 \text{ KB}$$

$$13 \text{ bit} \Rightarrow 8 \text{ KB}$$

$$14 \text{ bit} \Rightarrow 16 \text{ KB}$$

$$15 \text{ bit} \Rightarrow 32 \text{ KB} \leftarrow$$

15 bit will be the smallest address size that can be used.

* Must be larger than total size *

Homework 1

Question 2

- A) A computer maintains memory alignment. At what address can we store a byte variable? What about a 16-bit variable?

For
8-bit data

Aligned @
multiples of 1

16-bit data

multiples of 2

32-bit data

multiples of 4

- B) A computer maintains memory alignment. Show how the variables below are stored in memory if they have to be stored in the order they are declared (x, f, y, g, z) starting at address 500.

```
unsigned char x;    // 8-bit
short int f;        // 16-bit
unsigned char y;
short int g;
unsigned char z;
```

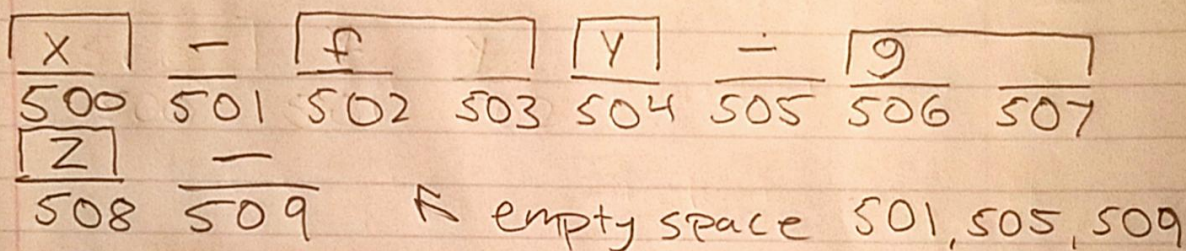
- C) Repeat above knowing that the memory should be aligned but the variables can be stored in any order

Work for Band C on Next page

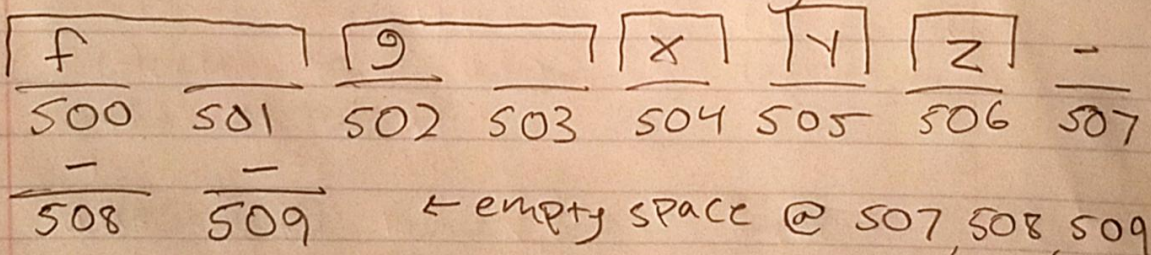
Question 2

B) unsigned char x; // 8-bit
 short int f; // 16-bit
 unsigned char y;
 short int g;
 unsigned char z;

Stored starting at 500



C) Variables stored in any order



Homework 1

Question 3

A) Explain the Big Endian and the Little Endian configurations

Big Endian: Most significant Byte at the Lowest address

Little Endian: Most significant at the highest address.

0x12EF

B) Big
12 EF
500 501

Little
EF 12
500 501

→ Show how the data (0x12EF) is stored at address 500 in the two configurations

C) Which configuration is used in the MSP430?

MSP 430 use Little Endian

Homework 1

Question 4

A) A microcontroller's memory map allocates the FLASH code space to the address range $[0x0400]$ to $[0x0BFF]$, what code size in Bytes will be supported by this microcontroller?

$$\begin{array}{r} 0000 \ 0100 \ 0000 \ 0000 \quad 2^{10} = 1024 \\ + 0000 \ 1011 \ 1111 \ 1111 \quad = 3071 \\ \hline 2^{11} + 2^9 + 2^8 \end{array}$$

$$\begin{array}{r} 3071 \\ - 1024 \\ \hline 2047 \end{array} \Leftarrow 2048 \text{ total memory Locations}$$

Each Location can store 2 Bytes of Data

$$\begin{aligned} \text{Code size} &= 2048 \times 2 \text{ Bytes} \\ &= 4096 \text{ Bytes or } 4 \text{ KB} \end{aligned}$$

B) The Vector table contains memory addresses (A vector is a memory address). In certain MSP430 device, the Vector table is in the range $[0xFFC0]$ to $[0xFFFF]$. The memory address is 16-bit. How many Vectors does this table support?

$$\begin{array}{r} 1111 \ 1111 \ 1100 \ 0000 \quad 65472 \quad 65535 \\ 1111 \ 1111 \ 1111 \ 1111 \quad 65535 \quad - 65472 \\ \hline \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad 63 \end{array}$$

$$63 + 1 = 64 \text{ Vectors}$$

HW1

Question 5.

A) Two clock technologies used in microcontrollers are the crystal oscillator and the RC oscillator.

For each of them, comment on:

	<u>XT (crystal)</u>	<u>RC oscillator</u>
Startup speed.	up to 10^5 dead cycles to stabilize	10 cycles or less to stabilize
<u>Accuracy</u>	Parts per million XT is more Accurate	low accuracy are sensitive to EMI, vibrations and noise
<u>Stability with temp and Voltage Variations</u>	more stable they have lower Voltage Variations	Poor temp stability and Voltage Variation
Price	They have low cost crystals but the cost to performance of a more expensive XT will have better performance	Low cost but have performance issues and are susceptible to Noise

Hw 1

Question 6

A) Why does embedded programming use extensions to C?

In C, the embedded programs will be executed by the embedded processors, and provide portability
" @ operator "

B) Downside of extensions regarding code probability?

- extensions are compiled extensions

C) what is an intrinsic function?

- tell the compiler which function to use. " hints for the compiler."

D) In MSP 430, interrupts are enabled/disabled by writing to the bit called GIE in the status register (SR: R2) why do we use:

- enable - interrupts();
- disable - interrupts();

- An interrupt launches an Interrupt service routine.

Benefits:

- CPU doesn't have to poll the event
- Enables Fast response to Interrupts

E.g. Overflow.

Hw1

Question 7

A) How many bits is an int (integer) in the C language?

16-bits or 32 bits

B) why does embedded programming use data types like (uint-8t, int-8t, uint-16t, int-16t)
- So that we can select the size or type of integer we need to store a certain amount of Bits

C) unsigned Int Counter from 0 to 45,000 to create a small delay. If we double the delay, can they simply change the Value to 90,000?

No, the counter speed depends upon the workload of the CPU and resource Availability.

D) If the code contains a delay loop and we notice no delay is being created at runtime. What should we suspect during debugging?

- Check if loop is being satisfied.
- Check initial value of loop variable.
- Check for break or exit statement.

H w l

Questions 8 and 9

I typed these two Questions
out since there was a lot
of writing.

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