

CSE2312 (Fall 2022)

Homework #6

Notes:

With this homework, we continue writing assembly functions for the RPi 3b/3b+/4b.

All numbers are in base-10 unless otherwise noted.

If part of a problem is not solvable, explain why in the answer area.

The target date to complete this homework set is November 22, 2022.

This homework set will not be graded, but please solve all of the problems to prepare for the quizzes and exams.

1. Write assembly functions that implement the following C functions:

- a. `float sumF32(const float x[], uint32_t count)`
// returns the sum of the elements in an array (x) containing count entries
- b. `double prodF64(const double x[], uint32_t count)`
// returns the product of the elements in an array (x) containing count entries
- c. `double dotpF64(const double x[], const double y[], uint32_t count)`
// returns the dot product of two arrays (x and y) containing count entries
- d. `float maxF32(const float x[], uint32_t count)`
// returns the maximum value in the array (x) containing count entries

2. For the following code, calculate the number of instruction cycles required to execute the following code, using the simplified pipeline timing rules in class, including the time to call this function with BL bro8 and the time to return from the function with BX LR. You can assume that the pipeline is full before the BL bro8 instruction is executed.

bro8:

MOV R1, R0

MOV R0, #0

MOV R2, #0x00000080

MOV R3, #0x00000001

bro8_loop:

TST R1, R2

ORRNE R0, R3

MOVS R2, R2, LSR #1

MOV R3, R3, LSL #1

BNE bro8_loop

BX LR

Clock cycles: _____

If the clock rate is 2 GHz, what is the execution time in nanoseconds? _____

3. Assume SP = 0x20001034 before the following instructions are executed:

Address	Instruction
10000000:	BL fn
	fn:
10001000:	MOV R0, #8192
10001004:	MOV R1, #0x10000000
10001008:	MOV R2, #0x7400
1000100C:	PUSH {R0, R1, R2, LR}
	loop:
10001010:	B loop

After this program enters the endless loop:

What is the value of the SP? _____

Assuming the processor uses little-endian convention, what is the value of the following memory locations (place X in the blank if there is not enough information):

Address	8-bit Data
0x2000103B	_____
0x2000103A	_____
0x20001039	_____
0x20001038	_____
0x20001037	_____
0x20001036	_____
0x20001035	_____
0x20001034	_____
0x20001033	_____
0x20001032	_____
0x20001031	_____
0x20001030	_____
0x2000102F	_____
0x2000102E	_____
0x2000102D	_____
0x2000102C	_____
0x2000102B	_____
0x2000102A	_____
0x20001029	_____
0x20001028	_____
0x20001027	_____
0x20001026	_____
0x20001025	_____
0x20001024	_____

4. Explain the concept of memory virtualization, including the concept of paging and fragmentation. Also explain the role of virtualization in memory protection between running processes (“programs”).

5. Explain the concept of cache, including the principle of locality. Explain how this can speed up memory accesses.