THE AUSTRALIAN NATIONAL UNIVERSITY

Mid Semester Examination, April 2009

COMP2300 / COMP6300 (Introduction to Computer Systems)

Writing Period: 1 hour duration

Study Period: 0 minutes duration

Permitted Materials: One A4 page with notes on both sides. NO calculator permitted.

Questions are NOT equally weighted. This exam will contribute 20% (redeemable) to your final assessment.

The questions are followed by labelled, framed blank panels into which your answers are to be written. Additional answer panels are provided (at the end of the paper) should you wish to use more space for an answer than is provided in the associated labelled panels. If you use an additional panel, be sure to indicate clearly the question and part to which it refers to.

The marking scheme will put a high value on clarity so, as a general guide, it is better to give fewer answers in a clear manner than to outline a greater number in a sketchy, half-answered fashion. The Appendix contains a table with powers of 2 values in decimal.

Please write clearly - if we cannot read your writing you may lose marks!

Student	Number:		
Official use	e only: Q2 (17)	Total (30)	

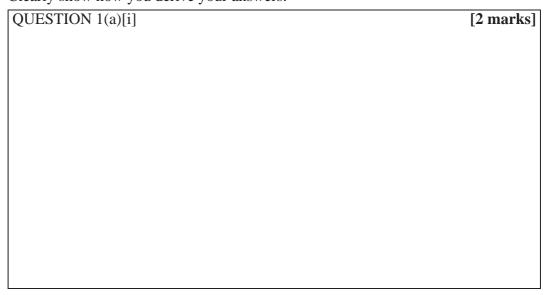
QUESTION 1 [13 marks]

(a) Assume memory addresses 0x02000411 to 0x02000415 contain the following 8-bit binary values:

Address	0x02000411	0x02000412	0x02000413	0x02000414	0x02000415
Binary value	0010 1011	1001 0011	1100 1010	0101 0111	0001 0110

Assume sizeof(x) and sizeof(y) are both 2, &x = 0x02000412 and &y = 0x02000414, and the data storage is *little endian*.

(i) What would be printed by the following C statement? printf("Values for x+y: %x %o\n", x+y, x+y); Clearly show how you derive your answers.



(ii) What would be printed by the following C statement? printf("Value for (x+y)/256: %d\n", (x+y)/256); Clearly show how you derive your answer.

QUESTION 1(a)[ii]	[1 mark]

Que	estion 1 (continued)
(b)	The IEEE single-precision floating-point standard is: 1 bit sign, 8 bits exponent with a bias of 127, and the remaining 23 bits are the mantissa (with an implicit leading bit). What floating point number is represented by the following 32-bit number (given in hexadecimal representation): 0x41B80000
	For full marks, your answer should be expressed as a single decimal number accurate to four decimal digits.
	QUESTION 1(b) [2 marks]
(c)	What would be the approximate value of the largest number expressible in IEEE single-precision floating-point (express your answer in terms of the nearest power of 2)? Suppose it was desired to represent numbers up to 256 times larger than this; how would you change the format to accommodate this? What tradeoff would be involved?
	QUESTION 1(c) [3 marks]

Student Number:

Question 1 (continued)

(d)	In the context of two's complement arithmetic, explain the term <i>sign extension</i> . Briefly describe one example in computer systems where sign extension is used.		
	QUESTION 1(d)	[2 marks]	
(e)	State one similarity and one difference between registers and	d main memory in a computer.	
	QUESTION 1(e)	[1 mark]	
(((((((((((((
(I)	State Moore's Law. Briefly describe its impact on compute years.		
	QUESTION 1(f)	[2 marks]	

QUESTION 2 [17 marks]

(a) Write C statements to declare an integer variable i initialized to 0, and a char pointer s initialized to the string "comp2300".

```
QUESTION 2(a) [1 mark]
```

(b) Consider the following C program foo.c

```
#include <stdio.h>
#include <stdlib.h>
int main(int argc, char *argv[]) {
   int a[256], i;
   int n = atoi(argv[1]);
   a[0] = 0;
   for (i=1; i<=n; i++) {
      a[i] = 2*a[i-1] + 1;
      printf("%3d", a[i]);
   }
   printf("\n");
   return 0;
}</pre>
```

Suppose the program was compiled and linked into an executable program called foo.

(i) Write the output produced by the command ./foo 4, clearly indicating spaces. *Hint:* in this case, the variable n will be assigned the value of 4.

QUESTION 2(b)[i]	[2 marks]

(ii) Suppose n represents an integer and $0 \le n < 256$. In terms of n, state what the command ./foo n produces.

QUESTION 2(b)[ii]	[1 mark]

Question 2 (continued)

(111)	Describe how you would re-code the program so that the array a was allocated from <i>heap memory</i> (give your answer in terms of changes to For full marks, include any appropriate code for the purpose of <i>defensioning</i> . What is the main advantage of changing the program in this fash	the C code). ive program-
	QUESTION 2(b)[iii]	[3 marks]
(iv)	State two reasons why, in general, dynamically allocated memory showhen the storage for that memory is no longer required.	ould be freed
	QUESTION 2(b)[iv]	[1 mark]

	Student Number:
Question 2 (continued)	

(c) Consider the following function definition.

```
int strcmp(const char *s1, const char *s2);
// the function compares the two strings s1 and s2.
// It returns -1, 0, or +1 if s1 is less than, equal,
// or greater than s2, respectively.
```

For example, strcmp("ab", "ac"), strcmp("ab", "ab") and strcmp("abc", "ab") return -1, 0 and +1, respectively. Write an implementation of strcmp(). Your code must not call any other function except strlen().

QUESTION 2(c)	[5 marks]

Question 2 (continued)

(d) Given the declaration char c, s[256];, consider the following C code to read the next character from input into c and the next string from input into s.

```
scanf("%c", &c);
scanf("%s", s);
```

State the reason why the C address-of operator & is not used in the second call.

```
QUESTION 2(d) [1 mark]
```

(e) Consider the declarations:

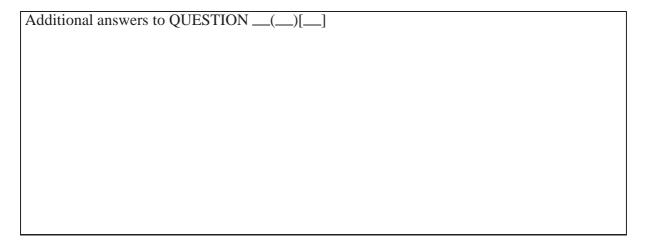
and suppose that t1 and t2 have been initialized to contain two different times recorded on a computer. Write C code to assign to tdiff the difference between the time represented in t2 and the time represented in t1 (expressed in seconds). Note: 10^6 microseconds = 1 second.

```
QUESTION 2(e) [1 mark]
```

Que	estion 2 (continued)	Student Number:
(f)	Briefly state the purpose of a function pr support separate compilation of libraries.	rototype ('header') and explain how these can
	QUESTION 2(f)	[2 marks]
Addi	itional answers to QUESTION()[]	
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	Student Number:
Additional answers to QUESTION()[]	
Additional answers to QUESTION()[]	



Appendix

х	2^x
-5	0.03125
-4	0.0625
-3	0.125
-2	0.25
-1	0.5
0	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256
9	512
10	1024
11	2048
12	4096
13	8192
14	16384
15	32768
16	65536

Table 1: Powers of 2 in decimal