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Full Name:_	
Section:_	

15-213/18-243, Spring 2011

Exam 1

Thursday, March 3, 2011 (v1)

Instructions: Assignment Project Exam Help

- section on the from t • Make sure that your e
- This exam is closed book, closed notes. You may not use any electr
- Write your answer in declarate party or ited the the country of the country of
- The exam has a maximum score of 100 points.
- The problems are of varying difficulty. The point value of each problem is indicated. Good luck!

1 (12):
2 (17):
3 (13):
4 (11):
5 (20):
6 (12):
7 (15):
TOTAL (100):

Problem 1. (12 points):

Multiple choice.

Write the correct answer for each question in the following table:

1	2	3	4	5	6	7	8	9	10
11	12								

- 1. Consider an int *a and an int n. If the value of %ecx is a and the value of %edx is n, which of the following assembly snippets best corresponds to the C statement return a[n]?
 - (a) ret (%ecx, %edx, 4)
 - (b) leal (%ecx, %edx, 4), %eax
 - rat ssignment Project Exam Help
 - 'd) mov (%ecx, ret https://eduassistpro.github.io/
- 2. Which of the following 8 bit floating point numbers (1 sign, 3 expo
 - (a) 1 000 1111 Add WeChat edu_assist_pro
 - (b) 0 111 1111
 - (c) 0 100 0000
 - (d) 1 111 0000
- 3. %rsp is 0xdeadbeefdeadd0d0. What is the value in %rsp after the following instruction executes?

pushq %rbx

- (a) 0xdeadbeefdeadd0d4
- (b) 0xdeadbeefdeadd0d8
- (c) 0xdeadbeefdeadd0cc
- (d) 0xdeadbeefdeadd0c8
- 4. How many lines does a direct-mapped cache have in a set?
 - (a) 0
 - (b) 1
 - (c) 2
 - (d) 4

5.	On an x86_64 Linux system, which of these takes up the most bytes in memory?
	(a) char a[7]
	(b) short b[3]
	(c) int *c
	(d) float d
6.	Two-dimensional arrays are stored in order, to help with cache performance.
	(a) column-major
	(b) row-major
	(c) diagonal-major
	(d) Art-major
7.	Which register has begunnent when an account Examinated in Phitecture?
	(a) edi
	(b) esi https://eduassistpro.github.io/
	(c) eax
	(d) None of the above
8.	What is the C equivalent of mov Ox10 (*rax, *rcx du_assist_pro
	(a) $rdx = rax + rcx + 4 + 10$
	(b) * (rax + rcx + 4 + 10) = rdx
	(c) $rdx = *(rax + rcx*4 + 0x10)$
	(d) $rdx = *(rax + rcx + 4 + 0x10)$
9.	What is the C equivalent of leal 0x10 (%rax, %rcx, 4), %rdx
	(a) $rdx = 10 + rax + rcx + 4$
	(b) $rdx = 0x10 + rax + rcx*4$
	(c) $rdx = *(0x10 + rax + rcx*4)$
	(d) $*(0x10 + rax + rcx + 4) = rdx$
10.	What is the C equivalent of mov %rax, %rcx
	(a) $rcx = rax$
	(b) $rax = rcx$
	(c) rax = *rcx
	(d) rcx = *rax

- 11. In x86 (IA32) an application's stack grows from
 - (a) High memory addresses to low memory addresses
 - (b) Low memory addresses to high memory addresses
 - (c) Both towards higher and lower addresses depending on the action
 - (d) Stacks are a fixed size and do not grow.
- 12. True or False: In x86_64 the %rbp register can be used as a general purpose register.
 - True
 - False

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Problem 2. (17 points):

Bits.

A. Convert the following from decimal to 8-bit two's complement.

```
67 = -35 =
```

B. Please solve the following are datalab-style puzzle. Please write brief and clear comments. You may use large constants. eg. instead of saying (1 << 16), you may use 0x10000.

```
* reverseBytes - reverse bytes

* Example: reverseBytes (0x12345678) = 0x78563412

* ASSIGNMENT Project Exam Help

*/
int reverseBy

{
    https://eduassistpro.github.io/

    Add WeChat edu_assist_pro
```

}

C. Assume x and y are of type int. For each expression below, give values for x and y which make the expression false, or write "none" if the expression is always true.

```
((x ^ y) < 0)</li>
((~(x | (~x + 1)) >> 31) & 0x1) == !x
(x ^ (x>>31)) - (x>>31) > 0
((x >> 31) + 1) >= 0
(!x | !!y) == 1
```

Problem 3. (13 points):

Floats.

Consider a 6-bit floating point data type with 3 exponent bits and 3 fraction bits (there is no sign bit, so the data type can only represent positive numbers). Assume that this data type uses the conventions presented in class, including representations on NaN, infinity, and denormalized values.

- A. What is the bias?
- B. What is the largest value, other than infinity, that can be represented?

C. What is the small grande, ther than Project Exam Help

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D. Fill in the following ta tion of infinity, and if it is too small to represent, use the representati in decimal.

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Bits	Value	Bits	Value
011 000	1		5
	17	111 010	
110 001			3/32
	9 1/2		8 1/2

Problem 4. (11 points):

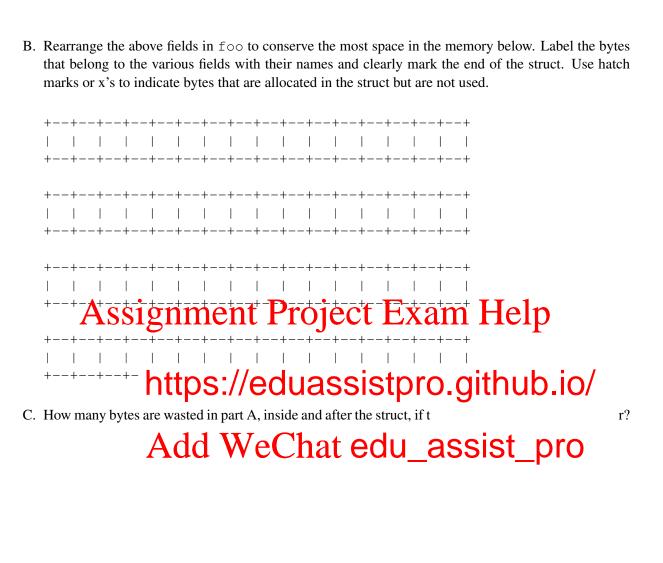
Structs.

Consider the following struct:

```
typedef struct
{
    char a[3];
    short b[3];
    double c;
    long double d;
    int* e;
    int f;
} JBOB;
```

Assignment Project Exam Help

A. Show how the struct a belong to the various ttps://eduassistpro.github.io/dicate bytes that are allocat



D. How many bytes are wasted in part B, inside and after the struct, if the next memory value is a pointer?

Problem 5. (20 points):

int lolwut(char *s)

Assembly/C translation. Given the x86 assembly dump, please fill in the blank lines for the function in the provided C code:

```
int i, n;
   n = 0;
   for (i = 0; ____; i++)
      if(_
          return -1;
           ssignment Project Exam Help
                https://eduassistpro.github.io/
080483a4 <lolwut>:
80483a4: 55
80483a5: 89 e5
                           push
80483a7: 53
                                 That edu_assist_pro
80483a8: 8b 5d 08
80483ab: 0f b6 0b Add
                          /Wrest
80483ae: ba 00 00 00 00
                                 $0x0, %edx
                           mov
        84 c9
80483b3:
                           test
                                 %cl,%cl
80483b5:
         74 31
                           jе
                                 80483e8 <lolwut+0x44>
80483b7: 8d 41 d0
                          lea
                                 -48(%ecx),%eax
80483ba: ba 00 00 00 00
                          mov
                                 $0x0, %edx
80483bf: 3c 09
                                $0x9,%al
                           cmp
80483c1: 76 0c
                           jbe 80483cf < lolwut + 0x2b >
                           jmp 80483e3 <lolwut+0x3f>
80483c3: eb 1e
80483c5: 83 c3 01
                          add $0x1, %ebx
80483c8: 8d 41 d0
                                 -48 (%ecx), %eax
                          lea
                          cmp $0x9,%al
80483cb: 3c 09
80483cd: 77 14
                                80483e3 <lolwut+0x3f>
                          ja
80483cf: 8d 14 92
                          lea (%edx, %edx, 4), %edx
80483d2: Of be c1
                          movsbl %cl, %eax
80483d5: 8d 54 50 d0
                          lea -48 (%eax, %edx, 2), %edx
        0f b6 4b 01
80483d9:
                          movzbl 0x1(%ebx),%ecx
         84 c9
80483dd:
                          test %cl,%cl
                                 80483c5 <lolwut+0x21>
80483df: 75 e4
                          jne
                          jmp 80483e8 <lolwut+0x44>
80483e1: eb 05
                                -1, %edx
80483e3: ba ff ff ff
                          mov
80483e8: 89 d0
                           mov
                                %edx, %eax
80483ea: 5b
                                 %ebx
                           pop
80483eb: 5d
                                 %ebp
                           pop
80483ec: c3
                           ret
```

- A. At address 0x080483a7 we see the instruction push %ebx. Name two things that happen as a result of executing that instruction, and explain why the instruction is necessary.
- B. Assume that immediately after executing the instruction at address 0x080483a7 (push %ebx), the value of %esp is 0xffff0000. If that is the case, at which address would one find the argument s?

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Problem 6. (12 points):

Stacks.

Given the following function prototypes, and initial lines of IA32 assembly for each function, fill in the stack frame diagram with

- any arguments to the function foo
- the return address
- Any registers stored on the stack by the asm fragment (register names not values)
- The location on the stack pointed to by %esp and %ebp after the exection of the sub instruction.

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```
int foo(int a, int b, int c, int d);
push %ebp
mov %esp,%ebp
push %ebx
sub $0x10,$esp
```

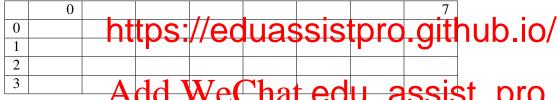
Problem 7. (15 points):

The Hit or Miss Question

Given a 32-bit Linux system that has a 2-way associative cache of size 128 bytes with 32 bytes per block. Long longs are 8 bytes. For all parts, assume that table starts at address 0x0.

```
int i;
int j;
long long table[4][8];
for (j = 0; j < 8; j++) {
  for (i = 0; i < 4; i++) {
    table[i][j] = i + j;
}
```

element's access will be a hit or a miss. Indicate hits with a 'H' and misses with a 'M'



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```
int i;
int j;
int table[4][8];
for (j = 0; j < 8; j++) {
   for (i = 0; i < 4; i++) {
     table[i][j] = i + j;
   }
}</pre>
```

B. This problem refers to code sample above. In the table below write down in each space whether that element's access will be a hit or a miss. Indicate hits with a 'H' and misses with a 'M'

	0	1	2	3	4	5	6	7	
0									
1									
2	Δς	cior	ıme	nt F	roje	oct]	Fya	m F	l elp
3	1 10	3181		116 1	10)				LOIP

What is the miss rate of t

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C. One code sample performs better than the other. Why is this?