CIS 2107
Computer Systems and Low-Level Programming
Spring 2013
Midterm

March 21, 2012

Name: 

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Instructions

The exam is closed book, closed notes. You may not use a calculator, cell phone, etc.

For each of the questions of this quiz, you can assume the following sizes for C data types:

<table>
<thead>
<tr>
<th>type</th>
<th>bytes</th>
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<tr>
<td>char</td>
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<tr>
<td>short</td>
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</tr>
<tr>
<td>int</td>
<td>4</td>
</tr>
<tr>
<td>long</td>
<td>8</td>
</tr>
<tr>
<td>float</td>
<td>4</td>
</tr>
<tr>
<td>double</td>
<td>8</td>
</tr>
<tr>
<td>void*</td>
<td>4</td>
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Some short answer questions

1. (1 point) In the unix shell, what’s the command to change from the current directory to the parent of your current directory?

2. (1 point) In the unix shell, what’s the command to create a directory called stuff and place it in your current directory?

3. (1 point) Now that you have the directory created in question 2), what’s the command to take a file called junk.txt, which is in your current directory, and put it into the new directory?

4. (1 point) We’ve described the storage hierarchy in modern computers as a type of pyramid. What two things are true the farther up the pyramid we go?

5. (1 point) What’s the program manipulates your program’s text before it gets fed to the compiler?

6. (1 point) What’s the program that translates assembly language into machine language (i.e. a binary)?

7. (1 point) What’s the program that combines binaries to form an executable?
8. Some conversions.
   (a) (1 point) 72 gbytes = ? kbytes
       (a) __________

   (b) (1 point) 2 hours = ? milliseconds
       (b) __________

   (c) (1 point) 112 gbits = ? tbits
       (c) __________

   (d) (1 point) 144 mbits = ? tbytes
       (d) __________

   (e) (1 point) 15 minutes = ? microseconds
       (e) __________

9. Convert 246_{10} to:
   (a) (2 points) base 2
       (b) (1 point) base 16

10. Using the approximation trick that we talked about in class, about how much are each of the following?
    (a) (1 point) 2^{41}
        (a) __________

    (b) (1 point) 2^{16}
        (b) __________

    (c) (1 point) 2^{29}
        (c) __________
11. (3 points) What is \(11011110011_2 + 10011010_2\) in base 2?

\[
\begin{array}{ccccccccccc}
1 & 1 & 0 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\
+ & 1 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 1 & 0 \\
\hline
\end{array}
\]

12. (3 points) What is \(DEDC5B_{16} + 61B_{16}\) in base 16?

\[
\begin{array}{ccccccc}
D & E & D & C & 5 & B \\
+ & 6 & 1 & B & & \ \\
\hline
\end{array}_{16}
\]

13. data representation. For these questions, please remember to answer in hex, not binary.

(a) (1 point) In hex, what is the smallest integer that can be represented by a 16-bit two’s complement int?

(a) 

(b) (1 point) In hex, what is the largest integer that can be represented by a 16-bit two’s complement int?

(b) 

(c) (1 point) In hex, what is the smallest integer that can be represented by a 16-bit unsigned int?

(c) 

(d) (1 point) In hex, what is the largest integer that can be represented by a 16-bit unsigned int?

(d) 

(e) (1 point) In hex, what is \(-1\) as a 16-bit two’s complement int?

(e) 

points: _______ 3 of 11  exam continues...
14. (6 points) **Some bit operations.** If we have `char x = 0x3D, y = 0xA7;`, what is the result of the following operations? Your answer must be in the form of exactly two hex digits\(^1\).

(a) \(x | y\)  
(b) \(x || y\)  
(c) \(x << 2\)  
(d) \(\neg x\)  
(e) \(\neg \neg x\)  
(f) \(x ^ y\)  
(g) \(x && 1\)

---

\(^1\)Ignore the possibility of promotion to 32-bit ints. Behave as though we’re living in the land of 8-bit arithmetic.
15. (4 points) What’s printed by the following code?

```c
int main(void) {
    char c;
    unsigned char uc;
    c = uc = 0x7F;
    c += 1;
    uc += 1;
    printf("%d\n", c);
    printf("%u\n", uc);
    return 0;
}
```

(h) -x

(i) !!x

(j) x<1

(k) x&y

(l) xˆyˆy
16. (5 points) If I have the following:

```c
int main(void)
{
    int a=10;
    int b=20;
    int c=30;
    int *p, *q;
    p=q=&a;
    b++;
    q-=4;
}
```

and memory is laid out like this:

```
q 1000
p 1004
c 1008
b 1012
a 1016
```

what do you see if you print:

(a) `a`

(b) `&a`

(c) `b`

(d) `&b`

(e) `p`

(f) `*p`

(g) `&p`

(h) `q`

(i) `*q`

(j) `&q`

points: ____ out of a possible 27
17. (5 points) How would $187.5625_{10}$ be stored in a C `float` variable?

18. (5 points) **Recognizing the value of a floating-point variable.** In this question, consider 6-bit floating-point numbers. What number is represented by the 0 10 000, where:

- 0 is the sign bit
- 10 is stored in the mantissa field
- 000 is stored in the exponent field
19. (10 points) Write a function called `bit_is_set()` which takes as arguments an `unsigned int x`, and an `int i`. The function checks to see if the ith bit of x is set and returns:

- 1 if the ith bit is set to 1
- 0 if the ith bit is set to 0
- -1 if i is an invalid index.

Indices start from the right: so right-most bit would be index 0. Do not assume anything about the size of integers.
20. (12 points) Write a function whose sole argument is a C string. The function removes all leading and trailing whitespace from the string. For example, if before your function is called, the string is “What a long exam”, after the function is called, the string is “What a long exam”. (Note: you’re modifying the original string. You’re not creating and returning a new string.) You may use any function in `<ctype.h>`, but do not use any functions in `<string.h>`. 
21. (12 points) Write a function which is passed an int start, and an int end. The function returns an array of int consisting of all of the integers from start to end inclusive. If start>=end or on error the function returns a NULL pointer. It is up to the caller to free any memory allocated by your function. Do not use the [ ] operator in the body of your function. For example, if start=5 and end=11, the function returns a pointer to \{5,6,7,8,9,10,11\}.
22. (12 points) Write a function which is passed the name of a file. The function prints everything read from the file, but capitalizes the first letter of every word. For example, if the text “this is a pretty LONG exam” is read, the program prints “This Is A Pretty LONG Exam”. You may assume that the text includes only letters and spaces (as defined by the `isspace()` function in `<ctype.h>`).