Computer Science 50: Introduction to Computer Science I
Harvard College
Fall 2007

Quiz 0

out of 40 points

Print your name on the line below.

Do not turn this page over until told by the staff to do so.

This quiz is "closed-book." However, you may utilize during the quiz one two-sided page (8.5" × 11") of notes, typed or written, and a pen or pencil, but nothing else.

Scrap paper is included at this document's end.
Unless otherwise noted, assume that any code herein is in C.

Please circle your section leader's name.

Abe Passaglia

Andrew Berry

Andrew Granoff

Anjuli Kannan

Charlotte Eccles

Chris Stevens

David Haley

David Ramos
formerly Samir Paul

Diana MacLean

Doug Lloyd

Emily Parfit

Josh Schwartz
formerly Jesse Rader

Katie Fifer

Kelly Heffner

Kristen Lovin

Mike Tucker

Paul Govereau

Rafael Garcia
formerly Thomas Carriero

Roy Shi

Samir Paul

Thomas Carriero

Tova Wiener

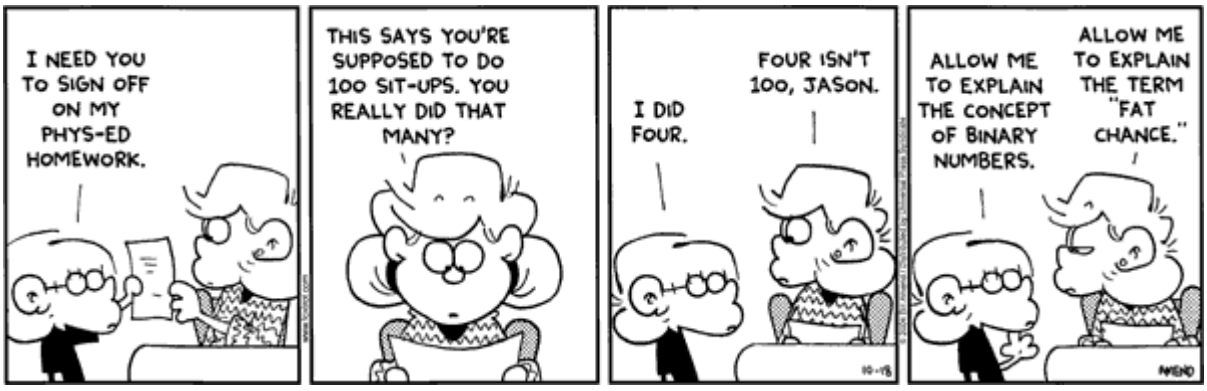
Yao Yu

for staff use only

final score out of 40

A Little Bit of Everything.

0. (2 points.) Recall the comic strip below from Week 0.



Why is this strip funny (to some people)? In other words, explain in a few sentences how binary numbers work by explaining why 100 does, in fact, represent the value we know as four.

1. (2 points.) Perform the following calculation *in binary*. Be show to show your work (*i.e.*, any 1s carried).

```
  00100100
+ 00101111
----------
```

for staff use only
points off on this page
–

2. (2 points.) 2^{32} is 4,294,967,296 and, yet, the largest non-negative value that you can represent with a 32-bit `int` is 2,147,483,647 (*i.e.*, $2^{31} - 1$). In a sentence or more, why?

3. (4 points.) Consider the following "program," given in pseudocode, used by David's computer to award final grades.

```
1.  for each student
2.      if student's average > 60
3.          award student a D
4.      else if student's average > 70
5.          award student a C
6.      else if student's average > 80
7.          award student a B
8.      else if student's average > 90
9.          award student an A
10.     else
11.         award student an E
```

Sadly, David can't figure out why none of his students ever earns an A, B, or C in his class. Granted, he could try teaching better. But still.

Moreover, David doesn't understand why his computer considers a 60 to be a failing grade, as opposed to a D.

David also doesn't understand why Harvard doesn't call a failing grade an F, as opposed to an E, but that's not the point of this problem.

In a sentence or more, explain why David's computer never awards an A, B, or C and why the computer considers a 60 to be a failing grade. Then explain how to fix the "program" above so that his students start earning the grades they deserve. Feel free to refer to line numbers in the program above and/or to write changes on the program itself.

for staff use only
points off on this page
–

4. (2 points.) In a sentence or more, what does it mean to compile source code (*i.e.*, what happens when you run `gcc`)?

5. (2 points.) Consider the function below.

```
char
mystery(char c)
{
    if (c >= 'A' && c <= 'Z')
        return (c - 'A' + 'a');
    else
        return c;
}
```

In a sentence or more, explain what this mysterious function does and why it works.

6. (2 points.) What does it mean if a program is multi-threaded?

for staff use only
points off on this page
–

7. (4 points.) Consider the program below.

```
#include <stdio.h>

int foo(int x);

int x;

int
main(int argc, char * argv[])
{
    x = 1;
    printf("%d", x);
    foo(x);
    printf("%d", x);
}

int
foo(int x)
{
    printf("%d", x);
    x += 4;
    printf("%d", x);
    return x;
}
```

If compiled and executed, exactly what does this program print?

for staff use only

points off on this page

–

Multiple Choice.

For each of the following questions or statements, circle the letter (a, b, c, or d) of the one response that best answers the question or completes the statement; you need not explain your answers.

8. (0 points.) Or fher gb qevax lbhe
   a. binygvar!
   b. Crcfv!
   c. ebhaqgvar!
   d. hochwertige Ergänzungsnahrung für jeden Tag!

9. (1 point.) Consider the code below; a question appears within.

```
int
main(int argc, char * argv[])
{
    /* Which of the statements below, if inserted in place of
       this comment, would print the number of arguments typed
       after this program's name at the command line? */
}
```

   a. `printf("%d\n", argc);`
   b. `printf("%d\n", argv - 1);`
   c. `printf("%d\n", strlen(argc));`
   d. `printf("%d\n", argc - 1);`

10. (1 point.) If Alice wishes to send Bob an encrypted message using PGP, she should encrypt her message with
    a. her private key.
    b. her public key.
    c. Bob's private key.
    d. Bob's public key.

11. (1 point.) Consider the code below.

```
int i, j;
for (i = 0; i < 5; i++)
    for (j = i; j < 5; j++)
        printf("*");
```

    How many asterisks does this code print in total?

    a. 5
    b. 10
    c. 15
    d. 25

for staff use only
points off on this page
–

12. (1 point.) Which of the following is *not* a keyword in C?

    a. `while`
    b. `loop`
    c. `for`
    d. `if`

13. (1 point.) Consider the two segments of code below, one at left, one at right, in which `x` is an `int` initialized to some value.

```
/* first segment */
while (x > 0)
{
    x--;
}
printf("x = %d\n", x);
```

```
/* second segment */
do
{
    x--;
}
while (x > 0);
printf("x = %d\n", x);
```

    Under which of the following conditions will the two segments differ in output?

    I. `x` is `0` just before each segment executes
    II. `x` is greater than `0` just before each segment executes
    III. `x` is less than `0` just before each segment executes

    a. I only
    b. III only
    c. I and II
    d. I and III

14. (1 point.) Assuming a 26-letter alphabet, how many *n*-letter keywords are possible when using Vigenère's cipher?

    a. 26
    b. n
    c. n^{26}
    d. 26^{n}

15. (4 points.) So how many free points do you need at this point?

    a. 1
    b. 2
    c. 3
    d. 4

for staff use only

points off on this page

–

Let's C You Do These.

16. (2 points.) In the space below, write a function named `even`, the return type of which is `bool`, that accepts as its sole parameter an `int` called `n`; the function must return `TRUE` if `n` is even or `FALSE` if `n` is odd.

17. (2 points.) Consider the following code.

```
#include <stdio.h>
#include <string.h>

int
main(int argc, char * argv[])
{
    int i;

    if (argc != 2)
        return 1;

    for (i = strlen(argv[1]) - 1; i >= 0; i--)
        printf("%c", argv[1][i]);

    return 0;
}
```

Suppose that this code is compiled into a binary called `a.out` that is then executed at a command line as follows.

```
a.out tcerroc
```

Exactly what would be printed?

for staff use only
points off on this page
–

18. (4 points.) Recall that `strlen` is a function declared in `string.h` that takes as its sole parameter a `string` (well, technically a `char *`) and returns an `int` equal to the length of that `string`. Suppose, though, that nobody ever got around to implementing this function, and so you must yourself. Do so in the space down below, without, to be clear, calling `string.h`'s version of `strlen`. You must declare your version's parameter as a `string`, but you may name that parameter whatever you wish.

    Don't forget that a `string` is essentially an array of `char`s, the last of which is `'\0'`, a special character that explicitly demarks the `string`'s end. That character, however, is not counted as part of a `string`'s length. In other words, the length of, say, `"foo"` is not 4 but 3. For simplicity, you may assume that your version of `strlen` will always be passed a `string` whose length is at least 1 and at most $2^{31} - 2$; it will never be passed just `NULL`.

19. (2 points.) Because a `char` is just an 8-bit value, it's also fair to say that a `string` is just an array of bytes, the last of whose values is 0. Suppose, though, that a `string` were instead implemented as an array of bytes with the array's first byte storing the `string`'s length and subsequent bytes storing the `string`'s `char`s, without any trailing marker.

    In a sentence or more, argue one advantage and one disadvantage of this alternative representation.

20. That's it for Quiz 0! Only riddles and scrap paper ahead!

for staff use only
points off on this page
–

Mock Interview.

Love 'em or hate 'em, riddles are quite common these days in interviews with consulting firms, hedge funds, tech companies, and the like. If and only if you have time to spare, below are a couple of challenges. Best to tackle them only once you've double-checked your answers to real questions!

This is just for fun; this is not extra credit.

i. (0 points.) Four people need to cross a rickety rope bridge to get back to their camp at night. Unfortunately, they only have one flashlight and it only has enough light left for seventeen minutes. The bridge is too dangerous to cross without a flashlight, and it's only strong enough to support two people at any given time. Each of the campers walks at a different speed. One can cross the bridge in 1 minute, another in 2 minutes, the third in 5 minutes, and the slowpoke takes 10 minutes to cross.

   Tell these campers how they can make it across in 17 minutes.

Mock Interview, Continued.

Again, this is just for fun; this is not extra credit.

ii. (0 points.) Five pirates discover a chest full of 100 gold coins. The pirates are ranked by their years of service, Pirate #5 having five years of service, Pirate #4 four years, and so on down to Pirate #1 with only one year of deck scrubbing under his belt. To divide up the loot, they agree on the following:

> The most senior pirate will propose a distribution of the booty. All pirates will then vote, including the most senior pirate, and if at least 50% of the pirates on board accept the proposal, the gold is divided as proposed. If not, the most senior pirate is forced to walk the plank and sink to Davy Jones' locker. Then the process starts over with the next most senior pirate until a plan is approved.

These pirates are not your ordinary swashbucklers. Besides their democratic leanings, they are also perfectly rational and know exactly how the others will vote in every situation. Emotions play no part in their decisions. Their preference is first to remain alive, and next to get as much gold as possible and finally, if given a choice between otherwise equal outcomes, to have fewer pirates on the boat.

Suppose that you're the most senior pirate (#5). Propose a distribution of coins that keeps you alive, that maximizes your gold, and that will be accepted.

Scrap Paper.

Nothing on this page will be examined by the staff unless otherwise directed in the space provided for some question.

Scrap Paper.

Nothing on this page will be examined by the staff unless otherwise directed in the space provided for some question.