

Quiz 0 Solutions

Answers other than the below may be possible.

A Little Bit of Everything.

0. Binary numbers represent values using only 0s and 1s. Whereas decimal numbers have a “1s’ place,” a “10s’ place,” a “100s’ place,” and so forth, binary numbers have a “1s’ place,” a “2s’ place,” a “4s’ place,” and so forth. Accordingly, each digit in a binary number represents 0 times some power of two or 1 times some power of two. And, so, 100 in binary does, in fact, represent the number we know as four:

$$\begin{array}{r} 4s \ 2s \ 1s \\ 100 = 1 \times 4 + 0 \times 2 + 0 \times 1 = 4 \end{array}$$

1.

$$\begin{array}{r} 1 \ 11 \\ 00100100 \\ + 00101111 \\ \hline 01010011 \end{array}$$

2. Even though you can represent 4,294,967,296 different values with 32 bits, you can only represent $-2,147,483,648$ through $2,147,483,647$ (assuming a two’s-complement system) if half of those values are to be negative (as is the case for an `int`). Because we also need to represent zero somehow, only $2,147,483,647$ patterns of bits remain for positive values.
3. None of David’s students ever receives an A, B, or C because all students deserving of such grades are instead awarded Ds. Because students deserving As, Bs, or Cs have averages greater than or equal to 70, line 2 of this program always evaluates to true for such students. And so they are awarded a D, as per line 3. Lines 4 through 9 are not even executed for such students.

The computer considers a 60 to be a failing grade because the program awards Ds to all students having averages greater than 60—not equal to 60—as per line 2.

To redress these issues, the program can be re-written as follows.

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

This program also correctly recognizes a 90 as an A, an 80 as a B, and a 70 as a C.

4. To compile a program is to translate human-readable source code into machine-readable object code, patterns of 0s and 1s that a computer's CPU interprets as instructions and data.
5. Given an uppercase char between 'A' and 'Z', this function returns its lowercase equivalent; given any other char, the function returns that same char. Because a char is just an ASCII number underneath the hood, with 'A' mapped to 65, and 'B' mapped to 66, on upwards, the effect of subtracting 'A' from *c* is to map 'A' through 'Z' to 0 through 25, thereby indicating which of 26 letters is to be converted to uppercase. The effect of adding thereafter 'a' (or 97) to that value is to re-map 0 through 25 to 'a' through 'z', which yields our lowercase equivalent.
6. A multi-threaded program can essentially perform multiple tasks at once. More precisely, it gives the illusion of performing multiple tasks at once by splitting its functionality into multiple parts (threads) and relying on the operating system to switch rapidly back and forth among them. Microsoft Word, for instance, is able to check your spelling (underlining misspelled words in red) while you type because it is multi-threaded. Similarly are Scratch projects with multiple sprites effectively multi-threaded.
7. 1151

Multiple Choice.

8. a, b, c, or d
9. d
10. d
11. c
12. b
13. d
14. d
15. a, b, c, or d

Let's C You Do These.

```
16. bool
    even(int n)
    {
        if (n % 2 == 0)
            return TRUE;
        else
            return FALSE;
    }
```

Aspiring hackers might like the below.

```
bool
even(int n)
{
    return (n % 2 == 0);
}
```

17. correct

```
18. int
    strlen(string s)
    {
        int i, n = 0;
        for (i = 0; s[i] != '\0'; i++)
            n++;
        return n;
    }
```

Aspiring hackers might like the below.

```
int
strlen(string s)
{
    int n;
    for (n = 0; s[n]; n++);
    return n;
}
```

19. One advantage is that you could determine the length of a string immediately, without iterating over the entire string. One disadvantage is that a string could be no more than 255 chars long, as a byte can only store 256 different values.

Mock Interview.

- i. See <http://www.techinterview.org/puzzles/TheRopeBridge.html>.
- ii. See <http://www.techinterview.org/puzzles/YarrMaties.html>.