Practice Quiz 0

CS50 — Fall 2011

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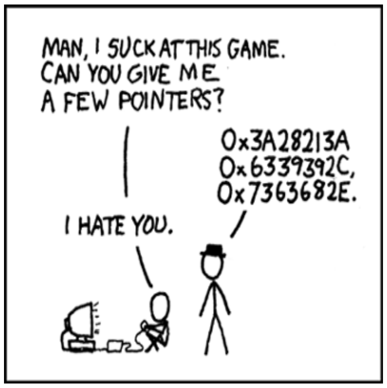
Below are several questions that are of the sort you will find on the quiz. While this is by no means a comprehensive review of all topics, it will help you study for the quiz. *Of course, you should also attend section, and study the course materials.*

1. Explain why some people might find the following image funny[1]:



2. Consider the following segment of code:

```
#include <stdio.h>

int main(int argc, char *argv[]) {
   char *myWord = "fish";
   char *myOtherWord = "mouse";
   int myInt = 12345678;
   double myDouble = 3.1415926535;
   printf("%d\n", sizeof(myWord));
   printf("%d\n", sizeof(myWord[1]));
   printf("%d\n", sizeof(myOtherWord));
   printf("%d\n", sizeof(myInt));
   printf("%d\n", sizeof(myDouble));
   printf("%d\n", sizeof(sizeof(myDouble)));
}
```

What will the output of this program be, if compiled on a 64-bit machine?

[1]Courtesy of *http://xkcd.com/138/*

3. Calculate in binary:

```
  01011101
+ 01101011
----------
```

   Convert your answer to decimal.

4. The ASCII value of `p` is 112. A character takes up 1 byte (8 bits) of space in memory. Give the binary representation of `p` in memory.

5. Describe the difference between a `while` loop and a `do-while` loop. Give an example of an instance where a `while` loop would be more useful and another where a `do-while` loop would be more useful and explain why.

6. Write a `for` loop that calculates the sum of the numbers 1 through 10 and stores the result in an integer variable `sum`. Then convert it to a `while` loop.

7. We would like to write the function `mult_binomials()`, which takes two binomials of degree 1 (each represented as a one-dimensional array of 2 `int`s), and outputs a polynomial of degree 2, represented as a one-dimensional of 3 `int`s, which is their product. For example, we would represent:

   $4x + 7$ as `int binomial[2] = {4, 7};`
   $2x + 0$ as `int binomial[2] = {2, 0};`
   5 as `int binomial[2] = {0, 5};`
   $3x^2 + 7x + 5$ as `int product[3] = {3, 7, 5};`

   ...et cetera. Fill in the values for `product[0]` (the x^2 term), `product[1]` (the x term), and `product[2]` (the constant term):

```
int *mult_binomials(int A[2], int B[2]) {

   int *product = (int *) malloc(3 * sizeof(int));

   product[0] = ________________________;
   product[1] = ________________________;
   product[2] = ________________________;

   return product;
}
```

8. Why is it okay that the return type of the function in Question 7 is `int *` instead of an `int` array? Is there a difference? Why or why not?

9. What is the major pointer error being made in Question 7?

10. What does the line

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

   do in a program? Name one function that is declared in `stdio.h`.

11. How would you declare some "container" of a type called `student` containing all of the following information:

    - A string (without using CS50's `string` type) for a student's last name,
    - An integer to represent that student's ID number,
    - A double-precision floating point number to represent their GPA, and
    - A character (A, B, C, D) to represent their class year (freshman, sophomore, junior, senior).

12. Given that we have one of these "containers" described in Question 11 called `student1`, instantiate `student1` for John Harvard, a junior whose ID number is 1636 and who has a 3.78 GPA.

Questions 13-15. Assume that the definition of a `student` is in the file `definition.h`

13. How would you statically create an array of 100 `student`s in your program?

14. It can be wasteful to statically declare this array. Now we have a program `make_students` that allows the user to input the number of student records they want to create. Fill in the line of code that **dynamically** allocates space for these `student`s:

```
#include <stdio.h>
#include <cs50.h>
#include "definition.h"

int main(int argc, char *argv[]) {
   printf("How many records do you want? ");
   int records = GetInt();

   ---------------------------------------------;

   return 0;
}
```

15. Convert the program in Question 14 into one that instead is run using `./make_student <number>`. That is, the user inputs on the command line how many records to create. You may assume that `<number>` will consist only of numeric characters. Make sure to do all error checking.

16. Say that at the top of our program we have the following two lines of code:

```
#include <time.h>
#include "clock.h"
```

    Why is `time.h` in angle brackets and `clock.h` in quotes? What does this say about the locations of the header files `time.h` and `clock.h`?

17. If we used the following function in our code somewhere, why could we run the risk of a major error?

```
void divide_and_remainder(int x, int y) {
   int q = x/y;
   int r = x%y;

   printf("%d divided by %d is: %d with a remainder of %d\n", x, y, q, r);
   return;
}
```

18. How many times will "`hello, world`" print to the screen when the following code is executed?

```
for(i = 0; i < 10; i++)
   for(j = 3; j < 303; j += 3)
       printf("hello, world\n");
```

19. David has written a program that takes a student's quiz score and assigns a letter grade to it. The code in the `giveGrade()` function looks like this:

```
char giveGrade(int quizScore) {
   int newScore = (quizScore/10) * 10; // Question 20
   char letterGrade;

   switch(newScore) {
      case 100: case 90:
         letterGrade = 'A';
      case 80:
         letterGrade = 'B';
      case 70:
         letterGrade = 'C';
      case 60:
         letterGrade = 'D';
         break;
      default:
         letterGrade = 'F';
   }

   return letterGrade;
}
```

Explain why everyone in the class is really upset about their grade.

20. Why is the line marked `Question 20` in the code above not equivalent to `quizScore`? After all, in general, $\frac{n}{10} * 10 = n$.

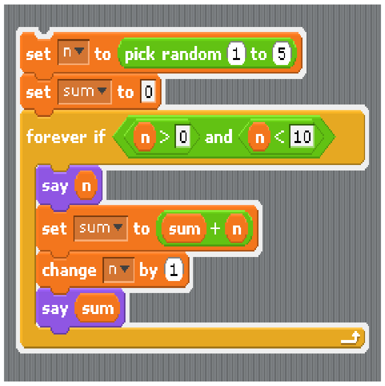
21. Explain what the following `for` loop does and how it accomplishes it:

```
for (c = 'A'; c <= 'Z'; c++)
{
  printf("%c", c);
}
```

22. What does the following function calculate:

```
int secret(int x, int y) {
   if(y == 0)
      return 1;
   else
      return x * secret(x, y-1);
}
```

23. Convert the below set of Scratch blocks into its C equivalent:



```
set n to pick random 1 to 5
set sum to 0
forever if n > 0 and n < 10
    say n
    set sum to sum + n
    change n by 1
    say sum
```

24. Sort the following "classes" of functions in the order of generally fastest to generally slowest: *logarithmic, exponential, factorial, constant, polynomial, linear.*

25. Write a function `div_by_n()` which takes two arguments, `k` and `n`, and returns `true` if `k` is divisible by `n`, and `false` otherwise.

26. Write the few lines of C code that would print out the multiplication table from 1 to 10 in the following format.

```
1    2    3    4    5    ....  10
2    4    6    8    10   ....  20
....
10   20   30   40   50   ....  100
```

27. Write a function `letter_appears()` which takes two arguments, `word` (a string) and `c`, (a character) and returns the position in `word` that `c` first appears, or 0 if `c` never appears in `word`.

28. What is the worst-case runtime of the function in Question 27?

29. Write a function called `swap()` that takes two arguments as integers, and swaps their values locally without returning anything. If this function is called from `main()` as:

```
...
swap(a,b);
...
```

where `a` and `b` are integers declared in `main()`, what will happen to the values of `a` and `b`? What is one solution to this problem?

30. If `main()` calls the function `domath()`, and `domath()` calls the function `pow()`, what function will be on the **top** of the stack right before `pow()` returns: `main()`, `domath()`, or `pow()`?

31. Give at least two reasons why `#define` statements are useful.

32. What does `strlen(a)` return if `a =` "`hello, world!`"? How many bytes does it take to store that string?

33. Write the lines of code that loop through a string, `s`, and print each character out on a line by itself. For example, if `s = "hello"`, then your program should print:

```
h
e
l
l
o
```

34. If a program, `commandline`, is executed as follows from the prompt:

```
> ./commandline pick apple cheese
```

what will be contained in the memory location designated by `argv[1][1]`?

35. Write code that will print out the contents of the following array:

```
int numbers[5][3] = { {1, 2, 3}, {4, 5, 6}, {7, 8, 9}, {10, 11, 12}, {13, 14, 15} };
```

(a) In the order: `1 2 3 4 5 6 7 8 9 10 11 12 13 14 15`

(b) In the order: `1 4 7 10 13 2 5 8 11 14 3 6 9 12 15`

36. Write a function that will compare two strings. Why can't you just compare strings using `==`?

37. What does this program do?

```
#include <stdio.h>
int main(int argc, char* argv[]) {
  printf("%d ", argc);
  if (argc) main(argc - 1, argv);
  else printf("\n");
  return 0;
}
```

38. Imagine I execute the following lines of code:

```
string input = GetString();
string input_copy = input;
input_copy[0] = 'X';
```

Why is it that, if I look at `input[0]`, it is also 'X', even though our line of code modified `input_copy`?

39. What is the printout of this program? `k`, `pk`, `ppk`, `&k`, `&pk`, or `&ppk`?

```
#include <stdio.h>
int main() {
    int k = 3;
    int *pk;
    int **ppk;

    pk = &k;
    ppk = &pk;

    printf("%x", (*(&(*(*ppk)))));
}
```

40. From what part of memory is memory obtained from `malloc()` allocated?

41. Why do we have a pointer type `void *` if we cannot dereference any pointers of that type?

42. What is the difference between a `float` and a `double`?

43. Fill in the following table regarding the values of variables and pointers. You may assume that the following declarations are made, and that `a` is stored at memory address $0x4$ (which is decimal 4), `b` is stored at memory address $0x8$ (decimal 8), and `c` is stored at memory address $0xC$ (decimal 12). You may assume that each row, everything begins anew. That is, you don't need to carry the values of the variables from row to row.

```
int a = 3, b = 5, c = 6;
int *pa = &a, *pb = &b, *pc = &c;
```

Code	a	b	c	pa	pb	pc
`b = a + c;`						
`a /= c;`						
`*pc = *pa * a;`						
`pb = *pb;`						
`*pc *= *pb;`						
`a = *pb * *pc;`						
`pc = &*pa;`						

44. What do we call it if we do not `free` all `malloc`ed memory? What is another major error that we can make involving the use of `free`?

45. Predict the error that will occur when you try to compile the following program:

```
#define SIX 6
void main(int argc, char **argv) {
   printf("%d", SIX++);
   return;
}
```

46. What is the value of each variable when these lines of code are executed, knowing that "false" is numerically 0 and "true" is numerically 1?

```
int i = 1, m = 1, n = 2;
i = --m || n++;
```

47. Assume we have some program `threeargs` which we run from the command line as `./threeargs ready set go`. What is printed if this is the only content of its `main()`? (Hint: Consider the relationship between pointers and arrays)

```
printf("%c", **++argv);
```

48. In the Game of Fifteen (in this case, restrict yourself only to the Game of Eight), we provided you with the files **3x3.txt** and **4x4.txt**. Let's walk through a hypothetical scenario for a moment. Imagine that, each time you play the game, a second program runs along with it, `capture_moves`. What this program does is, every time you type in a tile number to move, and that tile number is legal, it records it in a text file. When the game is complete, we close the text file, which is saved as **mymoves.txt**. Then, much like 3x3.txt and 4x4.txt, you can run mymoves.txt to recreate the moves that you made in that game. Provided below is some skeleton code for `capture_moves`. Help us fill in the blanks to get this pro- gram up and running! Imagine that the function `convertToCharacter()` takes an integer in the range $\{1, \ldots, 8\}$ and outputs the respective characters in the range $\{'1', \ldots, '8'\}$. For simplicity, you may assume that this program has access to the function `won()`, from the Game of Fifteen, as well as access to the variable `tile`.

```
#include <string.h>
#include <stdio.h>
int main(int argc, char *argv[]) {
   ___(1)___ *textFile = ___(2)___("mymoves.txt", "w");

   if(textFile != ___(3)___) {
      while(!won()) {
         fputc(convertToCharacter(tile), ___(4)___);
         fputc('\n', ___(4)___);
      }
   } else
      return ___(5)___;

   fclose(___(6)___);
   return 0;
}
```

49.
```
1  void main(void) {
2     int m = GetInt();
3
4     if(m) {
5        for(int i = 0; i <= m; i++) {
6           if(i = 13)
7              break;
8           if(i % 2) {
9              char *s = "i is odd here\n";
10             printf("%d: %s", i, s);
11          }
12          else {
13             s = "i is even here\n";
14             printf("%d: %s", i, s);
15          }
16       }
17       printf("I was only able to count to %d!\n", i);
18    }
19    return 0;
20 }
```

The above code (whose lines have been numbered for the sake of discussion) will not compile. When `make` is run, on which lines does the compiler say there's a problem, and why? (You may assume we have properly `#include`'d cs50.h and stdio.h.)

50. **Challenge question.** Explain what is happening in this program:

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

void baz(char *qux, int bar);

int main(int argc, char *argv[]) {
    if(argc != 2)
        return 1;
    baz(argv[1], strlen(argv[1]));
}

void baz(char *qux, int bar) {
    char foo1[bar+1];
    strcpy(foo1, qux);
    char foo2[bar+1], *xyzzy1, *xyzzy2;

    xyzzy1 = foo1 + bar - 1;
    xyzzy2 = foo2;

    while(xyzzy1 >= foo1)
        *xyzzy2++ = *xyzzy1--;

    *xyzzy2 = '\0';
    printf("%s %s\n", foo1, foo2);

    return;
}
```