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

Quiz 2

Solutions

Answers other than the below may be possible.

Multiple Choice.

0. a, b, c, or d
1. a, b, c, or d

Trees and Tries.

2. For small inputs (*i.e.*, uncompressed files with few characters), Huffman might spit out more metadata (*e.g.*, characters' frequencies) than actual, compressed data!

3. This hash function is pretty fast, since it only examines the first character of its input. However, because many more English words start with, say, 'a' than with, say, 'q', this hash function will likely result in some very long chains and some very short chains, the implication of which is longer search times for words that start with more "popular" letters.

4. $O(k)$ or, if the lengths of English words are bounded by some constant (*e.g.*, 45, thanks to pneumonoultramicroscopicsilicovolcanoconiosis), $O(1)$.

Super Smash Bros.

5. This function fails to allocate (as with `malloc`) space into which to copy characters from `input`. Since `output` is not even initialized to some address, this function blindly copies `n` characters from `input` to some address that doesn't even "belong" to it! If those characters happen to overwrite some function's return address on the stack, this bug could empower an adversary to execute code of his or her own!

Some More Queries for You.

6. Either `id` or `username` could be used as a primary key, since, unlike `dorm` or even `name`, both are presumably unique, which a primary key must be.

7. `SELECT * FROM students WHERE dorm='Matthews'`

Doubly Linked Lists.

8.

```
typedef struct Node_t
{
    struct Node_t *prev;
    int n;
    struct Node_t *next;
}
Node;


typedef struct List_t
{
    Node *last;
    Node *first;
    int mySize;
}
List;
```

9.

```
bool
find(List *list, int n)
{
    if (list == NULL)
        return FALSE;

    Node *current = list->first;
    while (current != NULL)
    {
        if (current->n == n)
            return TRUE;
        else if (current->n > n)
            return FALSE;
        else
            current = current->next;
    }
    return FALSE;
}
```

Rapid Fire.

10. If `foo` is a member of some `struct` called `bar` to which `baz` is a pointer, the dot operator allows you to access `foo` by way of `bar.foo`, whereas the `->` operator allows you to access the same by way of `baz->foo`.

11. Source code is human-readable and not tied to a particular CPU (*i.e.*, the same source code can be compiled differently for different CPUs). Object code is machine-readable and very much tied to a particular CPU, inasmuch as its 0s and 1s represent instructions for a particular CPU.

12. A register is a tiny chunk (*e.g.*, 32 bits) of fast memory inside of a CPU designed to store data and addresses.

13. An associative array in PHP is an array whose indices are not necessarily numbers but generally strings instead.

14. GET transmits parameters via URLs whereas POST "hides," but still transmits, the same.

15. PHP handles memory management for a programmer, whereas C requires that a programmer manage his or her own memory (as via `malloc` and `free`).

16. Because C is not interpreted but instead compiled, a program written in C tends to be faster than an "equivalent" program written in PHP.

Fun with Tables.

17.

	O	**Ω**	**assumptions, if any**
insertion into an **unsorted singly linked list**	1	1	
insertion into a **sorted singly linked list**	*n*	1	
insertion into a **heap**	log *n*	1	heap is implemented with an array of size greater than *n*

18.

`x & y`	`00000000`
`x | y`	`00001111`
`x ^ y`	`00001111`
`~x`	`11110101`

~~Extra Credit.~~ **"Extra Credit."**

20. Oh, we can't spoil the frustration.

21. See `http://en.wikipedia.org/wiki/Quine_%28computing%29`.