Midterm Review

- Practice material from the Winter 2014 midterm.
- Will cover some (but not all) of the questions.
- Midterm content: Everything up to / including modules.

Short Answer

List three advantages of modularization, and briefly explain:

- Re-usability: Build programs faster, and build large programs more easily.
- Maintainability: Makes debugging and changing a program easier.
- Abstraction: No need to know / understand all parts to use them. Allows changing internals without breaking things.
Clicker Question
For positive integers, the C modulo operator (%) behaves the same as the Racket quotient function.

A True.
B False.
C Which one is quotient again?

The modulo operator behaves the same as the remainder function.

Clicker Question
Every C module must have a main function.

A True.
B False.
C True, but only on Tuesdays.
**Clicker Question**

Every C module must have a main function.

- **A** True.
- **B** False.
- **C** True, but only on Tuesdays.

A module does not require a main function. (Example: The stack module from the last assignment).

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**Short Answer**

Racket uses *dynamic typing*. What kind of typing does C use? Give one advantage of the typing C uses. Provide a brief Racket example that demonstrates dynamic typing that isn’t possible in C:

- C uses static typing.
- Advantage: Built-in contract, can detect type errors at compile-time, fast (no run-time type checking).
- Example (there are many):
  
  (define dyntype (if (>= x 0) x “invalid”))
Clicker Question

In C, (a != 0) && (b/a == 2) will produce an error if a is 0.

A True.
B False.
C Impossible to know without trying it.

Because && is used, the first condition will short circuit the evaluation, preventing b/a from being executed.

Short Answer

Briefly explain the purpose of requires and effects function documentation in C.
Short Answer

Briefly explain the purpose of requires and effects function documentation in C:

• Requires: Identifies conditions that must be true when calling the function (e.g. restrictions on parameters).

• Effect: Identifies what a function prints, reads, or mutates.

Clicker Question

```
printf("hello!\n") is a C expression with a value of 7.
A True.
B False.
C The only “expressions” in C are my cries of pain when I’m forced to code in it.
```

The return value of `printf` is the number of characters printed.
Short Answer

Write the declaration for a C function `add` that takes two ints, `x` and `y`, and returns an int `x+y`:

- No actual addition required!
- `int add(int x, int y);`

Clicker Question

In the following C code, the assignment operator appears only once:

`bool nisfive = (n == 5);`

A True.
B False.
C This has to be harder than it looks but I'm not seeing the trick.
Clicker Question

In the following C code, the assignment operator appears only once:

```c
bool nisfive = (n == 5);
```

A True.
B *False.
C *This has to be harder than it looks but I'm not seeing the trick.

The code above uses = for initialization, NOT assignment. They are very slightly different (e.g. some struct-related notation can only be used during initialization, and not assignment).

Coding Question

Write the C function `pyramid(int n)`; that prints a pyramid of numbers with n lines. You may assume n is an odd integer in the range [3-99]. Use the printf formatter “%3d” to print out each integer.

`pyramid(7)` prints the following:

```
1
2 3
3 4 5
4 5 6 7
3 4 5
2 3
1
```

Coding Question

General approach:

- Need nested for loops / while loops.
- One set of loops to count from row 1 to n/2 + 1, one set to count back down from row n/2 to 1.
Coding Question

```c
void pyramid(int n) {
    for (int i=1; i<=n/2+1; ++i) {
        for (int j=i; j<=2*i-1; ++j) {
            printf("%3d",j);
        }
        printf("\n");
    }
    for (int i=n/2; i>0; --i) {
        for (int j=i; j<=2*i-1; ++j) {
            printf("%3d",j);
        }
        printf("\n");
    }
}
```

Stack Trace

Draw the call stack immediately after “In exchange: ” is printed. For pointers, draw an arrow to the variable they point at.

```c
void exchange(int * pa, int * pb) {
    int temp;
    temp = * pa;
    * pa = * pb;
    * pb = temp;
    printf("In exchange: ");
    printf("a = %d, b = %d\n", * pa, * pb);
}
```

```c
int main(void) {
    int a, b;
    a = 5;
    b = 7;
    printf("In main: ");
    printf("a = %d, b = %d\n", a, b);
    exchange(&a, &b);
    printf("a = %d, b = %d\n", a, b);
}
```
Stack Trace

exchange:
  pa: [arrow pointing to a]
  pb: [arrow pointing to b]
  temp: 5
  return addr: main : 16

=========

main:
  a: 7
  b: 5
  return addr: OS

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