PIC 10A 1C. Midterm 1 Review Problems. TA: Eric Kim. [Solutions] *(Updated: 2/9/2016 v2)*

1. Re-re-repeat

Write a program that asks the user for a single word, and checks to see if the input word is a "repetition". A word is a repetition if it starts and ends with the same subword. For instance, the following are considered repetition words: cancan, tutu, mama, papa, aa, abab, zaazaa.
To illustrate, here are some example expected outputs for your program:

```
Please enter a word: cancan
The word 'cancan' is a repetition!
Please enter a word: powder
The word 'powder' is not a repetition.
```

[Solution]

```
#include <iostream>
#include <string>
using namespace std;
int main() {
  string wd;
  cout << "Please enter a word: ";
  cin >> wd;
  size_t wdlen = wd.size();
  string w1 = wd.substr(0, wd.size()/2);
  string w2 = wd.substr((wd.size()/2));
  if (w1 == w2) {
    cout << "The word '" << wd << "' is a repetition!";
  } else {
    cout << "The word '" << wd << "' is not a repetition.";
  }
  return 0;
}
```

1. Be the Compiler

Determine the output of the following code snippets. If the code crashes, does not compile, or never finishes running, explain why. Assume that we have included: <iostream>, <string>, <cmath>, and are using the standard namespace. The first is done for you.

Code	**Output**
`cout << "Hello" << 42;`	Hello42
`cout << (3/2) + 1;`	2
`cout << 'hi ther' << 'e';`	CompileError: Should use

	double-quotes "hi ther"! String literal (double-quotes) vs single quotes (for single characters).
`cout << "What \"is\" 'is'.";`	What "is" 'is'
`cout << "\\a//a\\";`	\a//a\

`int a = 3;`
`if ( (a % 2) == 0) {`
`  cout << "Abra";`
`}else if(((a+1) <= 2)||((a*2) >= 6)){`
`  cout << "Kadabra";`
`} else {`
`  cout << "Alakazam";`
`}`
	Kadabra

`bool a = false;`
`if (a)`
`  cout << "meow";`
`  cout << "bark";`
	bark

`int i = 1;`
`while (i < 3) {`
`  i = i * 2;`
`}`
`cout << "i is: " << i;`
	i is: 4

`int n = 2; bool flag = true;`
`while ( (n % 2) == 0 ) {`
`  if (flag) {`
`  n = (2*n);`
`  flag = false;`
`  } else {`
`  n -= 2;`
`  flag = true;`
`  }`
`}`
`cout << "n is: " << n;`
	Infinite loops! n oscillates between 2 and 4, which are both even numbers.

3. The Prime Directive

A number is prime if it is only evenly divisible by itself and 1. For instance, 7 is prime because no other integer evenly divides it other than 7 and 1. On the other hand, 14 is not prime, because it is evenly divisible by 2 and 7. By definition, 1 is not a prime number. The first few prime numbers are: 2, 3, 5, 7, 11, 13, ...

Louis Reasoner wants to write a program that asks the user for a number, and checks to see if it is prime.

```
#include <iostream>
using namespace std;
int main() {
    int n;
    cout << "Enter a number: ";
    cin >> n;
    int i = 2;
    bool isprime = true;
    while (i < n) {
        if ((n % i) == 0) {
            isprime = false;
            i = i + 1;
        } else {
            i = i + 1;
        }
    }
    if (isprime)
        cout << n << " is prime!";
    else
        cout << n << " is NOT prime!";
    return 0;
}
```

Alyssa P. Hacker looks over his code, and comments that the code, while correct, can be made faster for cases where the number is not prime by making a small modification. What could Alyssa be referring to?

[Solution]

In the while loop, as soon as we detect that n is not prime, we should break out of the while loop immediately and output to the user. However, the current code will continue going through the while-loop rather needlessly. The change is simple: add a break statement after setting isprime to false:

```
...
while (i < n) {
  if ( (n % i) == 0 ) {
    isprime = false;
    break;    // Modification!
  } else {
    i = i + 1;
  }
}
```

. . .

4. De Morgan

Determine if each row is logically equivalent. Assume that a, b, and c are integers defined elsewhere. The first has been done for you.

`if ( !((a == 3) && (b == 5)) )`
`  cout << 1;`
`else`
`  cout << 2;`
	`if ( (a != 3) || (b != 5) )`
	`  cout << 1;`
	`else`
	`  cout << 2;`

`if ( (a > 3) && (b < 5) )`
`  cout << 1;`
`else`
`  cout << 2;`
	`if ( !((a <= 3) || (b >= 5)) )`
	`  cout << 1;`
	`else`
	`  cout << 2;`

`if ( a || b || c) {`
`  cout << 1;`
`else`
`  cout << 2;`
	`if ( !a && b && c)`
	`  cout << 1;`
	`else`
	`  cout << 2;`

`if ( (a<3) && ((b<1)||(c>5)) )`
`  cout << 1;`
`else`
`  cout << 2;`
	`if ( (a<3) && !((b>=1)&&(c<=5))`
	`)`
	`  cout << 1;`
	`else`
	`  cout << 2;`

Write Answers Here:

(a) Logically Equivalent

(b) Logically Equivalent

(c) Not Logically Equivalent

(d) Logically Equivalent

5. Compiling Your Thoughts

Briefly describe the input and output of each step of the C++ compilation process. The first step has been done for you (preprocessor).

Preprocessor Input: C++ source code. Output: "Expanded" source code, ie with #include and other preprocessor directives expanded out.
Compiler

Input: C++ source code, ie the output of the preprocessor. Output: Assembly code, in human-readable format (ie "mov $42, %rax");
Assembler Input: Assembly code, ie output of compiler. Output: Machine code. Not human-readable, ie binary code(01100100…). Resulting file is called an object file.
Linker Input: Object file(s). Output: Executable.

6. All Your Base

Complete the following table, converting to/from binary/decimal as needed. The first row has been completed for you.

Decimal (Base 10)	Binary (Base 2)
3	0011
1	0001
2	0010
11	1011
16	10000
20	10100