CISS245: Advanced Programming
Test t01

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Instructions

- This is a closed-book, no-discussion, no-calculator, no-browsing-on-the-web no-compiler/no-MIPS-simulator test.
- Cheating is a serious academic offense. If caught you will receive an immediate score of -100%.
- If a question asks for a program output and the program or code fragment contains an error, write `ERROR` as output. When writing output, whitespace is significant.
- If a question asks for the computation of a value and the program or code fragment contains an error, write `ERROR` as value.
- When you're asked to write a C++ statement, don't forget that it must end with a semicolon.
- Bubblesort refers to the bubblesort algorithm in our notes where values are sorted in ascending order.

Honor Statement

I, Brysen Landis, attest to the fact that the submitted work is my own and is not the result of plagiarism. Furthermore, I have not aided another student in the act of plagiarism.

Question	Points
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Question	Points
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TOTAL	

Q1. Complete the following program. You can only add to the given code. You cannot delete or change what is given below.

Answer:

```
#include <iostream>

void swap(int * p, int * q)
{
    int t;
    t = *q;
    *q = *p;
    *p = t;
}


int main()
{
    int x = 0;
    int y = 1;

    swap(x, y);

    std::cout << x << ' ' << y << '\n'; // expected output: 1 0

    return 0;
}
```

Q2. Complete the following program. You can only add to the given code. You cannot delete or change what is given below.

The function `reverse(x, x_len)` reverses the values in the integer array `x` from index `0` up to index `x_len - 1`. For instance suppose the user enters `2 3 5 7 -9999`, then the values `2, 3, 5, 7` are placed in `x` and `x_len` is set to 4. After calling `reverse(x, x_len)`, the first four value in `x` becomes `7, 5, 3, 2`.

Answer:

```
#include <iostream>

void reverse(int x[], int x_len)
{
       int l = 0;
       int r = x_len - 1;

       while (l < r)
       {
         x[l] = x[r];
         ++l;
         --r;
       }

       return;
}


int main()
{
    int x[1024];
    int x_len;

    x_len = 0;
    for (int i = 0; i < 1024; ++i)
    {
        int t;
        std::cin >> t;
        if (t == -9999)
        {
            break;
        }
        x[x_len] = t;
        ++x_len;
    }

    reverse(x, x_len);
    // x from index 0 to x_len - 1 is now reverse.
```

```
    return 0;
}
```

Q3. What is the output of this program?

```
int x = 10;
int y = 20;
int * p = &x;
int * q = &y;
*p = *p * *q;
*q = 42;
std::cout << x << ' ' << y << '\n';
std::cout << *p << ' ' << *q << '\n';
```

Answer:

```
200 42
200 42
```

Q4. Rewrite the following code fragment by doing the following: Do a simple addition program using the following skeleton. You MUST follow the given instructions.

Answer:

```
int x = 0, y = 0;
int * p = &x;
int * q = &y;

std::cin >> *p;
std::cin >> *q;

std::cout << x + y << '\n';
```

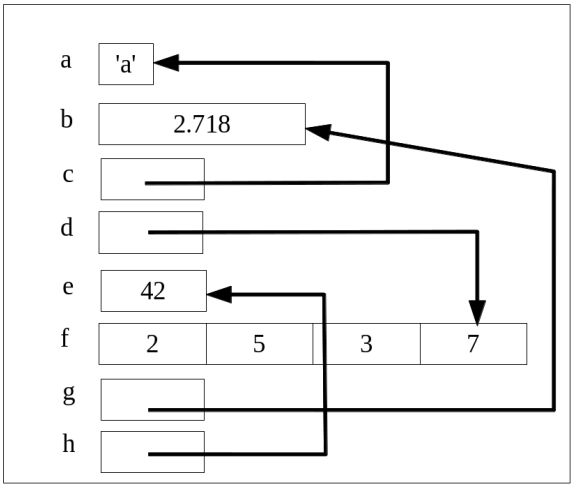
Q5. What is the output of this code fragment?

```
int i = 1;
int j = 2;
int k = 3;
int * p = &i;
int * q = &j;
int * r = &k;
p = q;
q = r;
std::cout << *p << ' ' << *q << ' ' << *r << '\n';
```

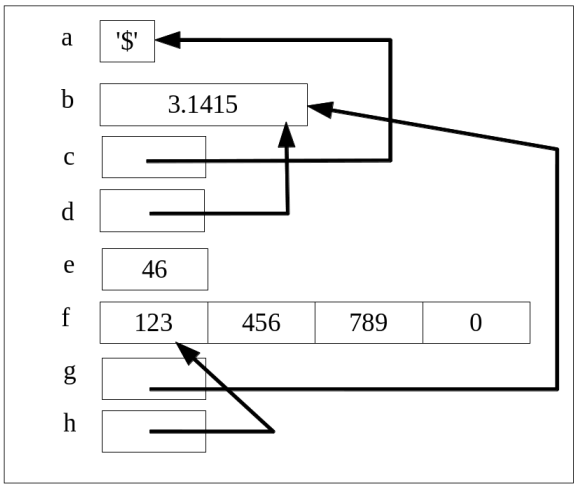
Answer:

```
2 3 3
```

Q6. You were brainstorming with your team in one of the company's meeting rooms. Your boss popped in to say hi on his way to get coffee and he noticed the following diagram on the whiteboard. Someone was tracing a piece of code on the whiteboard:



On his way back, your boss glanced at the whiteboard and saw this:



You noticed he was shaking his head as he walked away. Why?

Answer:

```
The values within the variables a, b, e, f are changing.
(I'm honestly very confused with this one.)
```

Q7. The following program does compile and does run. But it has a memory leak. Fix it so that there is no memory leak.

Answer:

```
#include <iostream>

int sum(int n)
{
    int s = 0;
    int * i = new int;
    for (*i = 0; *i <= n; ++(*i))
    {
        s += *i;
    }
    delete i;
    return s;
}

int main()
{
    std::cout << sum(10) << '\n';
    return 0;
}
```

Q8. The following program get two integer values from the user and then prints the sum. Do NOT use integer or double variables – you can only use pointers. In fact I have already declared all the variables you need, i.e., two pointer variables. You must allocate and deallocate memory correctly.

Answer:

```
#include <iostream>

int main()
{
    int * p;
    int * q;

    *p = new int;
    *q = new int;

    std::cin >> *p;
    std::cin >> *q;

    std::cout << *(p) + *(q) << '\n';

    delete q;
    delete p;


    return 0;
}
```

Q9. Complete this code segment.

Answer:

```
int x[] = {1, 5, 3, 7, 9, 4, 2, 6, 8, 0};
int max;

int * start = &x[0];
int * end = &x[10];
int * p;
int * pmax = &max;
// Complete the following to compute the maximum value in the array x
// from *start to *(end - 1) and store it in variable max.
// Your code must work for different array values in x.
// You also cannot use the name x or max.
// You must use a loop (of course).
// You can only use integer pointer variables start, end, p, pmax

for (*start; *start < *(end - 1); ++start)
{
  if (*start < *(start + 1))
  {
    *pmax = *(start + 1)
  }
}

// At this point the maximum value of *start,...,*(end - 1) is stored in
// variable max.
std::cout << max << '\n';
```

Q10. The following have a function that attempts to perform memory allocation and memory deallocation, but they are done incorrectly:

```
void mynew(int * p)
{
    p = new int;
}

void mydelete(int * p)
{
    delete p;
    p = NULL;
}

int main()
{
    int * p;
    mynew(p);
    *p = 42;
    mydelete(p);
    if (p != NULL) std::cout << "ERROR\n";

    return 0;
}
```

Fix the above problem below.

Answer:

```
void mynew(int *p)
{
  *p = new int;
}

void mydelete(int *p)
{
  *p = NULL;
}

int main()
{
    int * p;
    mynew(p);
    *p = 42;
    mydelete(p);
    return 0;
}
```

Q11. Complete the following by writing a struct and making any corrections.
Answer:

```
#include <iostream>

// define the struct here
struct Student
{
  int student_id;
  int dob_year;
  int dob_month;
  int dob_day;
  int height;
  int weight;
};


void input(Student * x)
{
    std::cin >> x->student_id; // get an integer value from user for x's
                               // student id
    std::cin >> x->dob_year;   // get an integer value from user for x's year
                               // of date of birth
    std::cin >> x->dob_month;  // get an integer value from user for x's month
                               // of date of birth
    std::cin >> x->dob_day;    // get an integer value from user for x's day
                               // of date of birth
    std::cin >> x->height;     // get a double value from user for x's height
    std::cin >> x->weight;     // get a double value frin user for x's weight
}


void print(Student & x)
{
  std::cout << x->student_id << ','
            << x->dob_year << ','
            << x->dob_month << ','
            << x->dob_day << ','
            << x->height << ','
            << x->weight << '\n';
}


int main()
{
    Student john;
    input(john);
    println(john); // print all values of john separated by ',' and print '\n'
    return 0;
}
```

Q12. You are writing a tic-tac-toe game. The following code is in your `main()`:

```
#include <iostream>
#include "TTT.h"

int main()
{
    TTT board;

    while (1)
    {
        print(board);
        int row, col;
        get_input(board, row, col);
        make_move(board, row, col);
        if (game_ended(board))
        {
            break;
        }
    }
    print_result(board);

    return 0;
}
```

Complete the header file (with the struct definition and the function prototypes – no function body definitions). The struct and function prototypes must be minimal (i.e., no useless member variables, no unnecessary parameters, reference parameters must be constant whenever possible).

Answer:

```
#ifndef TTT_H
#define TTT_H

struct TTT
{
  int board[9];
  int row;
  int col;
};

void print(const int &board[]);
int get_input(const int &board[], int, int);
int make_move(int &board[], int, int);
const int game_ended(const int &board);
void print_result(print());
```

```
#endif
```

Q13. What is the output? Or is there an error?

```
#include <iostream>

int h(int * p)
{
    return *p;
}

int * g(int * p)
{
    return p;
}

int * f(int * p)
{
    return (p != NULL ? g(p) : NULL);
}

int main()
{
    int i = 5;
    std::cout << *f(&i) + h(&i) << std::endl;
    return 0;
}
```

Answer:

```
ERROR
```

Q14. Complete the following program. Make sure there is no memory leak.

Answer:

```
#include <iostream>

int f(int n)
{
    int * p;

    // Allocate an integer array of size n to p. (Of course the array
    // is in the heap.)

    p = new int[n];

    // Fill the array that p points to with values 1, 2, 3, ..., n.

    for (p; p < n; ++i)
    {
      std::cin >> x[*p];
    }

    // Go over the values in the array that p points to and
    // (1) if a value is odd, replace that value by the square root of the
    //     value, or
    // (2) if a value x is even, replace that value x by x + 1.
    // This is one pass.
    // Repeat this until every value in the array is <= 42.
    // Return the number of passes you have to run over the array

    int ret; // number of passes

    return ret;
}

int main()
{
    int n;
    std::cin >> n;
    std::cout << f(n) << '\n';
    return 0;
}
```

Q15. Complete the following function that performs the binary search. You need NOT use recursion.

Answer:

```
// Performs binary search on *start, *(start+1), ..., *(end - 1) for the
// value of target and return the pointer where target is found.
// If target is not found, NULL is returned.
int * binarysearch(int * start, int * end, int target)
{
  int mid = (end - start) / 2;
  while (start < end)
  {
    if (mid == target)
    {
      return mid;
    }
    else if (mid > target)
    {
      mid = mid - 1;
    }
    else
    {
      return NULL:
    }
  }

}
```

Q16. Complete the program below. Here are two test cases.

Test 1

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

Test 2

```
10 9 8
5 6 7
5 6 7
10 9 8
```

Answer:

```
#include <iostream>

void swap(int ** p, int ** q))
{
    int t = **q;
    **q = **p;
    **p = t;
    return;
}

int main()
{
    int * p = new int[3];
    int * q = new int[3];
    for (int i = 0; i < 3; ++i)
    {
        std::cin >> p[i];
    }
    for (int i = 0; i < 3; ++i)
    {
        std::cin >> q[i];
    }

    swap(&p, &q);
    for (int i = 0; i < 3; ++i)
    {
        std::cout << p[i] << ' ';
    }
    std::cout << '\n';
    for (int i = 0; i < 3; ++i)
    {
        std::cin << q[i] << ' ';
    }
    std::cout << '\n';
```

```
    delete [] p;
    delete [] q;
    return 0;
}
```

Instructions

In the file `thispreamble.tex` look for

```
\renewcommand\AUTHOR{}
```

and enter your email address:

```
\renewcommand\AUTHOR{jdoe5@cougars.ccis.edu}
```

(This is not really necessary since alex will change that for you when you execute `make`.) In your bash shell, execute "`make`" to recompile `main.pdf`. Execute "`make v`" to view `main.pdf`.

Enter your answers in `main.tex`. In the bash shell, execute "`make`" to recompile `main.pdf`. Execute "`make v`" to view `main.pdf`.

For each question, you'll see boxes for you to fill. For small boxes, if you see

```
1 + 1 = \answerbox{}.
```

you do this:

```
1 + 1 = \answerbox{2}.
```

`answerbox` will also appear in "true/false" and "multiple-choice" questions.

For longer answers that need typewriter font, if you see

```
Write a C++ statement that declares an integer variable name x.
\begin{answercode}
\end{answercode}
```

you do this:

```
Write a C++ statement that declares an integer variable name x.
\begin{answercode}
int x;
\end{answercode}
```

`answercode` will appear in questions asking for code, algorithm, and program output. In this case, indentation and spacing is significant. For program output, I do look at spaces and newlines.

For long answers (not in typewriter font) if you see

```
What is the color of the sky?
\begin{answerlong}
\end{answerlong}
```

you can write

```
What is the color of the sky?
\begin{answerlong}
The color of the sky is blue.
\end{answerlong}
```

A question that begins with "T or F or M" requires you to identify whether it is true or false, or meaningless. "Meaningless" means something's wrong with the question and it is not well-defined. Something like "$1 + 2 = 4$" is either true or false (of course it's false). Something like "$1+_2 = 4$?" does not make sense.

When writing results of computations, make sure it's simplified. For instance write 2 instead of $1 + 1$.

Higher level classes.

For students beyond 245: You can put LaTeX commands in `answerlong`.

More examples of meaningless statements: Questions such as "Is $42 = 1+_2$ true or false?" or "Is $42 = \{2\}^{\{3\}}$ true or false?" does not make sense. "Is $P(42) = \{42\}$ true or false?" is meaningless because $P(X)$ is only defined if X is a set. For "Is $1 + 2 + 3$ true or false?", "$1 + 2 + 3$" is well–defined but as a "numerical expression", not as a "proposition", i.e., it cannot be true or false. Therefore "Is $1 + 2 + 3$ true or false?" is also not a well-defined question.

More examples of simplification: When you write down sets, if the answer is $\{1\}$, do not write $\{1, 1\}$. And when the values can be ordered, write the elements of the set in ascending order. When writing polynomials, begin with the highest degree term.

When writing a counterexample, always write the simplest.