

CS 216 Exam 1 – Spring 2005

Name: _____ Lab Section: _____

Email Address: _____

This exam is **closed note, closed book**. You will have an hour and fifty minutes total to complete the exam. You may **NOT** use calculators.

It is an Honor Code violation to discuss this exam with ANYONE (**including other students who have already taken the exam**) until after 9:30pm Tuesday, Feb 22, 2005

Good Luck!!

	MAX	SCORE
TOTAL	97	

Write and sign **pledge** after taking the exam:

4) (3 points) Name 3 factors that are ignored by big-Oh notation.

5) (4 points) Fill in the blanks in the definition of big-Oh notation:

$T(N) = O(f(N))$ if:

there are positive constants c and n_0 such that: _____

when: _____

- 6) (10 points total) Describe the running time of the following pseudocode in Big-Oh notation in terms of the variable n . Assume all variables used have been declared. **Show your work for partial credit.**

```
int foo(int k) {
    int cost;
    for (int i = 0; i < k; ++i)
        cost = cost + (i * k);
    return cost;
}
```

a) `answ = foo(n);`

b) `int sum;`

```
for (int i = 0; i < n; ++i)
    if (n < 1000)
        cout << "cool!";
    else
        sum += foo(n);
```

c)

```
for (int i = 0; i < n * 1000; ++i) {
    sum = (sum * sum)/(n * i);
    for (int j = 0; j < i; ++j)
        cout << j * i;
}
```

d)

```
for (int i = 0; i < n + 100; ++i) {
    for (int j = 0; j < i * n; ++j)
        sum = sum + j;
    for (int k = 0; k < n + n + n; ++k)
        c[k] = c[k] + sum;
}
```

e)

```
for (int j = 4; j < n; j=j+2) {
    cin >> val;
    for (int i = 0; i < j; ++i) {
        cout << val + i * j;
        for (int k = 0; k < n; ++k)
            val++;
    }
}
```

7) (6 points total) What is the representation of each of the following in the indicated radix? Be sure to show your work.

a) 23_9 in decimal

b) 126_8 in hex

c) $1F_{18}$ in radix 10

8) (6 points total) Consider the positive binary integer represented in two's complement:

0010110110100101_2

a) Express this binary number in octal

b. Express this binary number in hexadecimal

c. Negate the number (i.e. give the two's complement representation of a negative version of the same number) Use the same number of bits.

9) For each operation below give: 1) How you would most efficiently **implement** the operation, 2) **Describe** the worst case scenario (e.g. “The worst case occurs when the value you are looking for is not in the list”), if all cases are the same then state: “no worst case”, and 3) What is the worst case **Big-Oh running time** of this scenario. *State any assumptions you make.*

a) (3 points) Push a value onto a stack implemented as an array.

b) (3 points) Dequeue a value from a queue implemented as a singly linked list with a dummy header node, where the head of the queue points to the dummy node.

c) (3 points) Delete the three largest values found in an unsorted doubly linked list.

10) (7 points) Assume we are using the 32-bit IEEE single precision floating point format as described in class and used in lab. The mantissa has 24 bits including the hidden bit. There is one sign bit and there are eight exponent bits. The exponent is stored in excess 127.

What decimal floating point number is represented by the following 32 bits? SHOW YOUR WORK!

0001 1100 0011 0000 0000 0000 0000 0000

a) Is this a positive or negative number?

b) What is the exponent (in base 10)?

c) What is the value of the mantissa (in base 10)

d) What is the total value?

Note: you may leave your answer in the form: $value_{10} * base^{exponent}$

Where you specify value, base and exponent.

11) (16 points) This question tests your understanding of stacks. You must implement a **stack** ADT in C++. The underlying representation of the stack should be a C++ **primitive array**. Your stack should store integers and should handle errors (printing an error message is fine).

You will be graded mostly on the correctness of the ideas of your solution rather than exact C++ syntax, but your solution should be clear. Correct C++ code is the best way to ensure we understand your solution. You may NOT use the STL in any way for this question. You should use the header file provided below.

You should implement all the functions with \rightarrow in front of them.

```
class Stack {
public:
→     Stack(); // constructor
→     void push(int value); // pushes value onto the stack.
→     int pop(); // returns and removes the value on
                // the top of the stack.
→     int top(); // returns the value on the top of
                // the stack without removing it.
→     bool isEmpty(); // returns true if the stack contains
                // no elements.
→     bool isFull(); // returns true if the stack is full
    const int max_size = 100; // max number of elements that
                // can be stored in the stack

private:
// Add more data members here if needed.

    int data[max_size];

};
```

[Extra space for previous problem]

12) (2 points) What is the worst case big-Oh running time of your **pop** method and why?

13) (2 points) What is the worst case big-Oh running time of your **push** method and why?

Questions 14 - 16 refer to these declarations:

```
class Node {
    public:
        string Value;
        Node *Next;
};
Node *Temp1;
Node Temp2;
Temp1 = new Node;
```

14) [2 points each] What is the **type** of each the following expressions? Please circle your answer below. Draw pictures if it helps.

a) Temp1.Next

[string] [pointer to string] [Node] [pointer to Node] [pointer to a pointer to a Node] [illegal]

b) (*Temp1).Value

[string] [pointer to string] [Node] [pointer to Node] [pointer to a pointer to a Node] [illegal]

c) *(Temp2.Next)

[string] [pointer to string] [Node] [pointer to Node] [pointer to a pointer to a Node] [illegal]

d) &Temp2

[string] [pointer to string] [Node] [pointer to Node] [pointer to a pointer to a Node] [illegal]

e) Temp1->Value

[string] [pointer to string] [Node] [pointer to Node] [pointer to a pointer to a Node] [illegal]

f) Temp2.Value

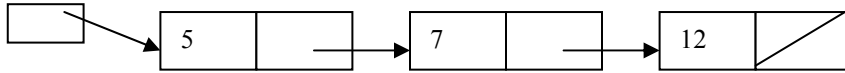
[string] [pointer to string] [Node] [pointer to Node] [pointer to a pointer to a Node] [illegal]

g) &Temp1

[string] [pointer to string] [Node] [pointer to Node] [pointer to a pointer to a Node] [illegal]

15) [4 points] Assuming that Temp1 points to a list of Nodes that looks like this:

Temp1

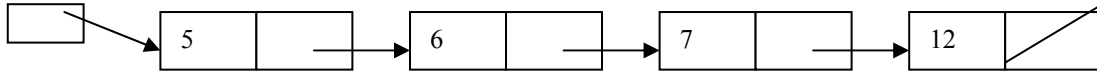


Write code that will insert a new Node containing the value 6 into the list after the Node containing 5 and before the Node containing 7. This new node should be allocated on the heap. After inserting the value 6 into the list, your list should appear as in 16) below. You do not need to write code that searches for the values 5 or 7. Please ask the instructor if you are unsure what is being asked for in this question. Feel free to declare more variables as needed.

```
Node *Temp1;  
// code deleted that builds the list as shown above  
... . . .  
// your code here:
```

16) [4 points] Assuming that Temp1 points to a list of Nodes that looks like this:

Temp1



Write code that will remove the Node containing the value 7 from the list and return its memory to the heap. After removing the node, your list should look like the picture shown below. You do not need to write code that searches for the value 7. Please ask the instructor if you are unsure what is being asked for in this question. Feel free to declare more variables as needed.

```
Node *Temp1;  
// code deleted that builds the list as shown above  
... . . .  
// your code here:
```

After:

Temp1

