

Computer Science Foundation Exam

December 17, 2004

Computer Science I

Section IA

No Calculators!

KEY

Name: _____

SSN: _____

Score:

/50

In this section of the exam, there are four (4) problems. You must do all of them.

The weight of each problem in this section is indicated with the problem.

Partial credit cannot be given unless all work is shown and is readable.

Be complete, yet concise, and above all be neat.

1. [15 points]

Consider a binary tree in which each node stores an integer value. Assume the struct `treeNode` shown below exists and that the root of the tree is referred to by pointer `p`. Construct a C function called `Q1` that will increase the value by 5, in each node of the tree that contains only a right child. Assume the initial call is: `Q1(p)`;

```
struct treeNode {
    int data;
    struct treeNode *left, *right;
}
```

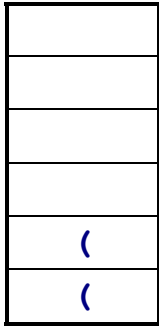
One possible solution is:

```
void Q1(struct tree_node *ptr)
{
    if (ptr !=NULL)
    {
        if ((ptr->left == NULL) && (ptr->right != NULL))
        {
            ptr->data += 5;
        }
        Q1(ptr->left);
        Q1(ptr->right);
    }
}
```

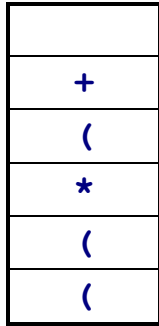
2. [15 pts – 9 pts for part(a), 6 pts for part (b)]

- (a) Using a stack, convert the following infix expression into an equivalent postfix expression. Show the contents of the stack at the indicated points (1, 2, 3, and 4) in the infix expression. Write the resulting postfix expression in the box.

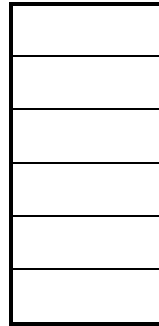
$$(((1 + 3) * (4 + 2)) / 2) + (5 * (2 + 3))$$



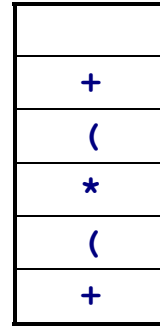
1



2



3

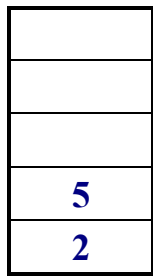


4

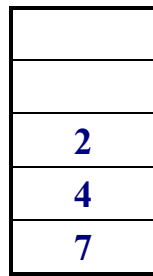
Final postfix expression: 1 3 + 4 2 + * 2 / 5 2 3 + * +

- (b) Given the postfix expression shown below, use a single stack to evaluate the expression. Show the contents of the evaluation stack at the reference points indicated in the expression (points 1 and 2) and the final value of the evaluated expression. Assume the values of the variables at the time of evaluation are: A = 2, B = 3, C = 6, D = 2, and E = 2

The postfix expression is: A 2 B + * C D / - 4 E * +



1



2

Final value of the expression is: 15

3. [10 pts – (a) 4 pts, (b) and (c) 3 pts each]

(a) Indicate the time complexity for each of the following operations in terms of Big-Oh notation, assuming that efficient implementations are used. Give the complexities in terms of n , assuming that the data structure involved holds n elements.

i) Worst case performance for a Bubble Sort. $O(n^2)$

ii) Worst case performance for a Merge Sort. $O(n \log n)$

iii) Best case for a Binary Sort. $O(1)$

iv) Worst case for inserting an element into a sorted linked list. $O(n)$

(b) What is the decimal equivalent to the binary number: 10011101

Show all work.

answer:

$$\begin{aligned} & \mathbf{157} \text{ since,} \\ & (1 \times 2^7) + (1 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (1 \times 2^0) \\ & = 128 + 16 + 8 + 4 + 1 \\ & = \mathbf{157} \end{aligned}$$

(c) What is the binary equivalent to the decimal number: 79

answer:

$$\begin{aligned} & \mathbf{1001111} \text{ since,} \\ & 79/2 = 39 \text{ remainder } 1 \text{ (LSB)} \\ & 39/2 = 19 \text{ remainder } 1 \\ & 19/2 = 9 \text{ remainder } 1 \\ & 9/2 = 4 \text{ remainder } 1 \\ & 4/2 = 2 \text{ remainder } 0 \\ & 2/2 = 1 \text{ remainder } 0 \\ & 1/2 = 0 \text{ remainder } 1 \text{ (MSB)} \\ & \text{reading from MSB to LSB (bottom to top) gives } \mathbf{1001111} \end{aligned}$$

4. [10 points]

Consider the circular array implementation of a queue named Q, in which the array is declared to have a size of 5. Trace the status of the queue by showing the elements in the queue and the position of the front and rear pointers after each of the operations shown below. Assume that the queue is initially empty.

1. enqueue(Q, 45);
2. enqueue(Q, 12);
3. enqueue(Q, 69);
4. enqueue(Q, 54);
5. x = dequeue(Q);
6. enqueue(Q, 98);
7. y = dequeue(Q);
8. enqueue(Q, y);
9. enqueue(Q, x);
10. x = dequeue(Q);

