

NAME :

The exam is closed book, no notes and no computer.

All your answers to the questions below must be submitted on paper.

Write your name on this sheet and submit it with your answers.

Please do not ask questions during the exam.

1. Describe the Abstract Data Type of a stack to store elements of any type.
In your description of the operations on the stack, specify all relevant preconditions and postconditions.
2. Consider the problem of finding the minimum value in an array of arrays of integers.
 - Write a C++ function `find_min` to compute the minimum value of `int A[n][n]`. In addition to `A`, the other input argument is `n`, of type `size_t`. The function returns an `int`, the smallest element in `A`.
 - The cost of this problem is the number of comparison operations. Count the number of comparisons for general `n` and use the big $O(\cdot)$ notation to express the cost. Justify your count, *writing complete sentences*, and the cost of this problem.
3. Consider two scenarios to process a number of strings:
 - (a) In each run of the program, the number of strings ranges between 10 and 20.
 - (b) The number of strings is unpredictable with each run of the program. Sometimes only a couple of strings are stored, while at other times, the number of strings equals several thousands.

Which data structure, vector or list, is best for which scenario?

Justify your choice of data structure and *write complete sentences* for your justification.

In your arguments, refer to the advantages and disadvantages of vectors and lists.

4. The code


```
class List
{
    struct Node
    {
        double data;
        Node *next; // pointer to the next node
        Node(const double& item, Node* ptr = NULL) :
            data(item), next(ptr) {}
    };
    Node *first; // pointer to the first node
    Node *last; // pointer to the last node
};
```

defines a linked list where `first` points to the first node and `last` points to the last node in the list. Consider the operation to append a number to the end of the list.

- (a) Draw a list of three elements and illustrate your drawing to show the steps in the append operation of a number to the end of the list.
 - (b) Write code for a function to append a number to the end of the list.
5. Evaluate the postfix expression `5 4 2 * - 1 + 2 /` using a stack.
Draw all intermediate stages of the stack. Write the corresponding infix expression.