

# CS III: Midterm exam

## October 7, 2002

Attempt all the questions. Programs may be written in **Pascal**, **C** or **C++**. Each question is worth 25 points.

1. Consider the following function in **C**:

```
int f(int a, int b)
{ int c;
  for(c=1; a > 1 ; a --)
    c = c * b;
  return c;}
```

- (a) What does  $f(a, b)$  compute?
  - (b) Approximately how long does  $f(a, b)$  take to compute its result as a function of the input size (in the worst case)?
2. (a) Describe an algorithm to compute the result of  $f(a, b)$  in polynomial time (as a function of the input size) without using pre-defined functions like *log*.
- (b) Write a program implementing this algorithm.
3. A *queue* of integers is a list of integers with two operations. These are described below.
- (a) A function *top* which returns the first number in the queue and removes this from the queue.
  - (b) A function *add* that adds a given integer to the end of the queue.

Write a program to implement these as arrays. Namely, write programs for the functions:

`int top(int q[], int ll)` \*l  
and  
`void add(int q[], int ll, int n)` \*l

where `q[]` is an array of integers containing the list and `l` is its length.

4. Use a self-referential data structure (a *double linked list*) in place of arrays to implement a queue (i.e., to implement the functions *top* and *add*). Give both the *struct* statement used and the functions *top* and *add*.