QUEEN MARY, UNIVERSITY OF LONDON
DCS/128 ALGORITHMS AND DATA STRUCTURES

Class Test Friday 14th March 2003 15.05-16.35

Please fill in your Examination Number here: .....

Student Number here: .....

All answers to this test should be written on the test sheet, but you may use spare paper for rough working, or the space on the back page if you cannot fit your answers into the space provided. Answer as many of the questions as you can.

1) a) Write in the space below a Java static method which takes as its argument an array of integers and two integers and changes the array destructively so that all occurrences of the first integers are changed to the second. For example, if the argument array is:

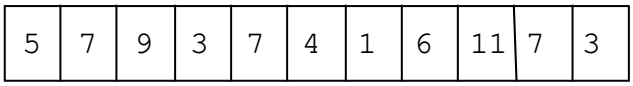
5	7	9	3	7	4	1	6	11	7	3

and the integer arguments are `7` and `8`, the array will be changed to:

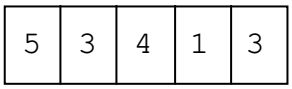
5	8	9	3	8	4	1	6	11	8	3

b) In the space below, write a Java static method which performs the same operation as that for part a), but constructively rather than destructively.

c) Write a Java static method which takes an array and an integer and returns an array consisting of all those elements of the original array less than the integer in the order in which they occurred in the original array. For example, if the array is



and the integer is `6`, the array that is returned is:

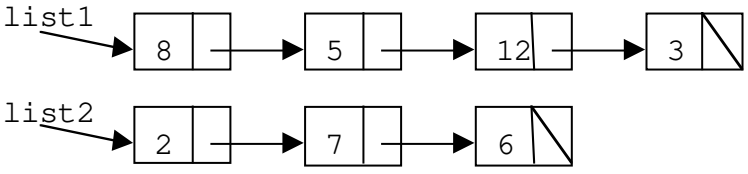


2) Assume we have the following definition of Java class `Cell`:

```
class Cell
{
 int first;
 Cell next;

 Cell(int f, Cell n)
 {
  first=f;
  next=n;
 }
}
```

Assume also we have variables `list1`, `list2` and `ptr` of type `Cell`. For each part below, assume the situation starts as in the following cells and pointers diagram, and sketch the cells and pointers diagram that would result from executing the code fragment given.



a)
```
list2.next.next = list1.next;
```

b)
```
for(ptr=list1; ptr.next!=null; ptr=ptr.next) {}
ptr.next=list2.next;
list1.next.first = 10;
```

c)
```
list2 = list2.next;
for(ptr=list1; ptr!=null; ptr=ptr.next)
   ptr.first = ptr.first+list2.first;
```

3) In this question, assume the same `Cell` class as used in question 2)

a) Write a static method which takes a linked list of integers and an integer `n` as arguments and multiplies all the integers in the linked list by `n` (performing the operation destructively):

b) Write a static method which performs the same operation as in part a), but does it constructively, that is returns a new list representing the change without changing the arguments list.

4) In the space given, write brief explanations of the following terms with reference to programming algorithms and data structures.

a) Aliasing

b) Tail recursion

c) $O(N^2)$

d) Axioms

5) a) In the space below, describe informally how the selection sort algorithm works:

b) In the space below, describe informally how you would delete a number from a linked list of numbers destructively, i.e. changing the linked list to give the deletion.

Use the space below if you need any additional space to answer any of the questions.