



MARKSCHEME

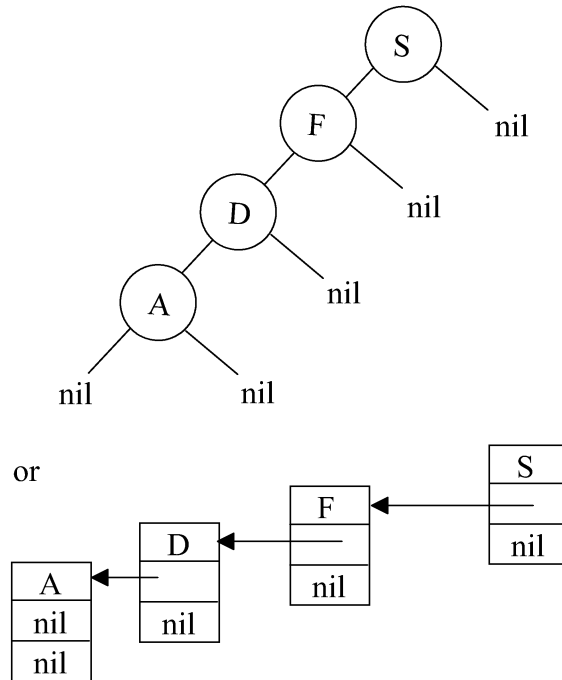
May 2001

COMPUTER SCIENCE

Higher Level

Paper 2

1. (a) Award [1 mark] for data in the tree in the correct order, and [1 mark] for indicating most of the nil links (this cannot be given if the first mark is not gained).



- (b) (i) One solution is:

```

procedure SEARCH
  declare SEARCHITEM character
  declare CURRENT pointer->NODE

  output 'Enter item to find'
  input SEARCHITEM

  CURRENT <- ROOT

  while (CURRENT # nil) and (CURRENT->DATA # SEARCHITEM) do
    if SEARCHITEM < CURRENT->DATA then
      CURRENT <- (CURRENT->LEFT)
    else
      CURRENT <- (CURRENT->RIGHT)
    endif
  endwhile

  if CURRENT = nil then
    output 'data not in tree'
  else
    output 'data node is',CURRENT->NUMBER
  endif
endprocedure SEARCH
    
```

Award marks as follows:

- **[1 mark]** for most of the variables declared
- **[1 mark]** for user input of data to find
- **[3 marks]** for correct loop (**[1 mark]** for any loop, **[1 mark]** for terminating when no data is found (*i.e.* nil) and **[1 mark]** for terminating when found)
- **[3 marks]** for correct branch (**[1 mark]** for correct **if** statement, **[1 mark]** for correct left branch, **[1 mark]** for similar attempt at right branch)
- **[1 mark]** for correct test and output of error message
- **[1 mark]** for correct output of node number (no comment statement is required)

(ii) *Award marks as follows:*

$O(\log n)$ **[1 mark]**

$O(n)$ **[1 mark]**

(Note: unless clearly labelled, do not give marks if values are in opposite order).

(c) (i) Award marks as follows:

output	STACK	CURRENT->NUMBER	CURRENT->DATA	Marks
	nil	1	Q	Given
Q	3T,nil			Given
		2	C	[1 mark]
C	4J, 3T,nil			[1 mark]
	3T,nil	4	J	[2 marks]
J				
	5M,3T,nil			[1 mark]
		6	E	[1 mark]
E				
	3T,nil	5	M	[2 marks]
M				
	nil	3	T	[1 mark]
T				
		nil	nil	

If the candidate's table gives composite results without interim steps (e.g. a push and pop in one step) do not penalise. For example the following table would get full marks:

output	STACK	CURRENT->NUMBER	CURRENT->DATA
	nil	1	Q
Q	3T,nil	2	C
C	4J, 3T,nil	4	J
J	5M,3T,nil	6	E
E	5M,3T,nil	5	M
M	3T,nil	3	T
T	nil	-	-

(ii) Award [1 mark] for the following answer:

Preorder

(iii) Solutions include:

```
procedure RECTRAVERSE (val CURRENT pointer -> NODE)
  output CURRENT -> DATA
  if CURRENT -> LEFT # nil then
    RECTRAVERSE (CURRENT -> LEFT)
  endif
  if CURRENT -> RIGHT # nil then
    RECTRAVERSE (CURRENT -> RIGHT)
  endif
endprocedure RECTRAVERSE
```

```
procedure RECTRAVERSE (val CURRENT pointer -> NODE)
  if CURRENT # nil then
    output CURRENT -> DATA
    RECTRAVERSE (CURRENT -> LEFT)
    RECTRAVERSE (CURRENT -> RIGHT)
  endif
endprocedure RECTRAVERSE
```

Award marks as follows:

- **[1 mark]** for a parameter deduced as **pointer** -> NODE
- **[1 mark]** for an correct initial **output** statement (accept **output** CURRENT)
- **[1 mark]** for testing correct nil condition (i.e. CURRENT->LEFT # nil (accept **if** LEFT#nil) or CURRENT if appropriate)
- **[2 marks]** for recursive call to left link (**[1 mark]** for any attempt at recursion and **[1 mark]** for correct parameter in recursion call)
- **[1 mark]** for a similar attempt at the right call.

2. (a) *Award marks as follows, up to [2 marks] max:*

- new supercomputers would have predicted bad storm [1 mark], whereas less powerful ones didn't [1 mark].
- newer computers will be able to process equations faster [1 mark], giving forecasts earlier [1 mark].
- new computers will be able to process more complex equations (*i.e.* more than 7 variables) [1 mark], giving more accurate predictions [1 mark].

(b) *Award [1 mark] for defining archive data, and [2 marks] for a clear description of its use ([1 mark] for a reasonable attempt), up to [3 marks] max.*

- Data kept after initial use / for long-term store / not required for on-line access [1 mark].
- Used for research / tracking history [1 mark] to test for patterns [1 mark].

(c) *Award [1 mark] for each valid point shown, up to [5 marks] max:*

- people base business / leisure decisions on weather
- much of the economy is dependent on weather
- so accuracy is important

Limitations:

- only as good as the formulae
- developed on past weather
- which is not consistent
- so formulae are always changing
- because the number of variables need to be increased / can't predict 'nature'

(d) *Award marks as follows:*

- (i) - Data collection site \Rightarrow National Weather Service [1 mark]
- (ii) - forecasting based on it [1 mark], so important for accuracy [1 mark]

- (e) *Award marks as below, up to [4 marks] max:*

Computers only work to set rules **[1 mark]** as determined by humans / based on past patterns **[1 mark]**.

Since weather is not human-controlled / ‘unpredictable’ **[1 mark]** it is not possible to totally predict / simulate it **[1 mark]**. Past weather patterns are not necessarily a good predictor of future weather **[1 mark]**.

- (f) *Award [2 marks] for a genuine fail-critical situation ([1 mark] for a fail-safe situation, or a fail-critical situation not clearly described), and [2 marks] for a clear description of how predictions can be improved ([1 mark] for a reasonable attempt), up to [4 marks] max.*

E.g. of fail-critical situations: Prediction of avalanches in skiing areas which could kill skiers if not forecast, storms at sea which could kill fisherpeople, sailors etc.

Better formulae / use of variables / more powerful computers **[1 mark]** improve forecasting **[1 mark]**.

Research could be concentrated upon such areas **[1 mark]** for example using archive data **[1 mark]**.

- (g) The METAR format **[1 mark]**. This is important so that everyone using the data can understand it **[1 mark]** and there are no misunderstandings / ‘mistakes’ **[1 mark]**.
- (h) *Award [1 mark] for a correct identification, and [2 marks] for a clear reason, for two reasons, giving a maximum of [6 marks].*

New media will take less space **[1 mark]**. As archive data continues to increase **[1 mark]**, it will keep space used to a minimum if more compact media is used **[1 mark]**.

Current media will become out-of-data / obsolete **[1 mark]**. New media is always being developed **[1 mark]** and if data is not changed with the new media, it may not be able to be read **[1 mark]**.

3. (a) *Award marks as follows:*

- (i) An array of set length is declared *[1 mark]*.
A variable is used for the end location *[1 mark]*.
- (ii) An array of set length is used *[1 mark]*.
A variable is required for start location and another for end location *[1 mark]*.
- (iii) Pointers are used *[1 mark]*.
A record / node is created (as required) *[1 mark]*.
Pointers to start / end are used *[1 mark]*.

(b) *Award marks as follows up to [4 marks] max:*

In a static array the head will always be in position 1/0 *[1 mark]*.
Additions are placed at the first free location *[1 mark]*.
Removing data ‘shuffling up’ all the data behind it *[1 mark]*.

In a circular array data is added at the location given by a variable *[1 mark]*.
As data is removed, the head variable (pointer) simply increases by one *[1 mark]*.
so much less data movement is required so it is faster *[1 mark]*.

Allow any of the marks to be gained by giving a clear diagram.

(c) *Award [2 marks] for one well-explained advantage of each method ([1 mark] for a partially correct/incomplete answer). ([4 marks] maximum.)*

Advantages of circular array over dynamic linked list:

dealing with array locations of an array is faster than pointer *[1 mark]* since new nodes do not need creating / direct access of memory locations is faster than pointer manipulation *[1 mark]*.

Array implementation cannot run out of memory *[1 mark]* since space is allocated at start of program *[1 mark]*. (Of course, queue may get full, but this is covered below).

Advantage of DLL over CA:

A node can be allocated as required (during the program) *[1 mark]*, thus size of queue is only restricted by size of available RAM *[1 mark]*.

4. (a) *Award marks as follows up to [2 marks] max:*

tracks above each other *[1 mark]* where data is stored *[1 mark]* to minimise head movement *[1 mark]*.

- (b) *Award marks as follows up to [2 marks] max:*

to compensate for speed difference *[1 mark]* between peripheral and processor *[1 mark]*.

- (c) *Award marks as follows, up to [3 marks] max:*

if there wasn't a second buffer, the head could not start reading as sector start passes under head because the buffer wouldn't be empty *[1 mark]*, part way through rotation the buffer would be empty *[1 mark]* so would have to wait (wasted time) until sector passed back under head *[1 mark]*. Switching to the second buffer stops this delay *[1 mark]* and so data transfer is faster *[1 mark]*.

(Do not award marks for answers like “one is used for reading, and one is used for writing” etc.)

- (d) *Award marks as follows, up to [6 marks] max:*

data transfer is slow compared to processor speed *[1 mark]*

if processor was ‘in charge’ of transfer, it could not do other tasks *[1 mark]*

this would slow down overall processing (e.g. user programs) *[1 mark]*

the DMA transfers data independent of processor *[1 mark]*

so processor can continue with other tasks *[1 mark]*

DMA receives data from the disk drive *[1 mark]*

and stores it directly into RAM *[1 mark]*

- (e) *Award marks as follows up to [2 marks] max:*

fully-indexed file has every record key in its index *[1 mark]*

partially-indexed file has data in sorted order *[1 mark]*

5. (a) *Award marks as follows, up to [3 marks] max:*

Design solution [1 mark] using top-down approach [1 mark] of the overall problem [1 mark] so that all the teams' parts are mapped / linked together [1 mark].

- (b) *Award marks as follows, up to [3 marks] max:*

(i) To test final code [1 mark] because results are independent of programming [1 mark] they are problem-based, not code-based [1 mark]. Not allow knowledge of program dictate test data [1 mark].

(ii) *Award [1 mark] for any feasible person, e.g.:*

Systems analyst / weather forecast manager
(Do not accept programmer)

- (c) *Award marks as follows, up to [2 marks] max for (i) and (ii), [4 marks] max for (iii):*

Disruption must be minimised during installation [1 mark] so that forecasting can continue [1 mark] because it is an important activity [1 mark].

The training must be done so that staff are confident in the new system [1 mark] before it is to be used on its own [1 mark] so that errors are not made [1 mark]

Parallel running could be used to compare results [1 mark], but since large systems / fast time is required, may not be feasible [1 mark] so probably a direct changeover would be used [1 mark] but if errors are found, there is no old system to revert to [1 mark]. A staggered changeover could be used [1 mark] where some tasks are carried out on the new system and others on the old [1 mark] until it is certain that it works [1 mark] then a new task is transferred until the new system is in full use [1 mark].
