Soft Eng 3M04
Mid-Term II 2002

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Name: ______________________________

Student No.: ______________________________

- This midterm contains 9 questions on 3 double-sided pages (including this one).
- This midterm will be marked out of 50. There are 55 total marks available.
- Answer the question in the space provided.
- Make sure that your name is on all sheets.
- Do not separate the pages.
- Make sure that you do not get stuck on one question; use your time wisely.

1. Over the alphabet $\Gamma = \{d, e, f\}$, give the BNF grammar which defines the language which contains the set of all strings that must either

   (a) start with 'feed'

   (b) contain the substring 'deff'.

   Important note: this is NOT an exclusive or, meaning that 'feedeff' would be a string in this language. *[5]*

2. The type $`a \rightarrow `b \rightarrow `c$ has 2 interpretations. Using words, describe both. *[4]*

3. List the 2 items that execution-based testing can identify, and the 1 item it cannot. *[3]*

4. Define 'module'. *[2]*

5. What are the 4 purposes of an MID ? *[4]*

6. Is javadoc a Litterate Programming tool ? (true or false) ? *[1]*

7. Given the declaration

$$\text{val s : ‘b seq}$$

[Stars indicate increasing difficulty]

(a) Write an expression that states that all the elements of s are different. *[2]*

(b) * Write an expression that states that s contains 3 elements that are the same. *[2]*

(c) ** Write an expression that states that s is a sequence of integers, all of which are prime, sorted in increasing order. (You are allowed to use the predicate `isprime :  int -> bool`). *[2]*

8. Simulate the following MIS. The simulation table is on the next page. *[20]*

MIS

Used External Functions: NONE

Used External Data Types: ‘a

Exported Constants: Max:int

Exported Functions:

Name	Input Types	Output Types	Exceptions
A1	‘a		e1, e2
A2		‘a	e3, e1
A3			e1, e3
A4		bool	e1
A5			

State Variables:

s : ’a seq

t : bool := false

Transition Functions:

```
A1(n:’a)
    Exception:   $\neg t \Rightarrow e1$
                 $|s| \geq \text{Max} \Rightarrow e2$
    Transition:  $s := s \,\|\, n$
‘a A2()
    Exception:   $\neg t \Rightarrow e1$
                 $|s| = 0 \Rightarrow e3$
    Output:      s[0]
A3()
    Exception:   $\neg t \Rightarrow e1$
                 $|s| = 0 \Rightarrow e3$
    Transition:  $s := s[1..|s| - 1]$
bool A4()
    Exception:   $\neg t \Rightarrow e1$
    Output:      $|s| = 0$
A5()
    Transition:  $s :=<>$
                 $t :=$ true
```

MID

Constants: Max := 3

Variables:

’a d[0..Max]

int num := -1

Exported Functions:

```
A1(n:’a)
    if num < 0 then ERROR(e1)
    else if num > Max then ERROR(e2)
    else $w[num] := n; num := num + 1$
‘a A2()
    if num=0 then ERROR(e3)
    else if num < 0 then ERROR(e1)
    else RETURN(d[0])
A3()
    if num=0 then ERROR(e3)
    else if num < 0 then ERROR(e1)
    else { num := num - 1;
    if num > 1 then d[0..num-1] := d[1..num] }
A4()
    if num=0 then ERROR(e3)
    else if num < 0 then ERROR(e1)
    else RETURN(num=0)
A5()
    num := 0
```

Abstraction Function

$$(t = (num \geq 0) \wedge$$

$$|s| = num \wedge (\forall i \in \mathbb{N} \cap [0..num - 1].s[i] = d[i])$$

Give the value of all state variables, output and/or exception after each call in the following calling sequence for the MIS and MID on the previous page. Assume that ‘a=int.

	state	output	exceptions
A2()			
A5()			
A4()			
A1(2)			
A1(3)			
A2()			
A1(4)			
A3()			
A1(2)			
A1(2)			
A1(2)			
A2()			
A3()			
A4()			
A2()			

9. Using the abstraction function on the previous page, verify its correctness for all states in the following table, for the following sequence of calls. Assume you are starting from an uninitialized state. *[10]*

A5()	
A1(-5)	
A1(7)	