

## Solution to Midterm #1

1. (a) i, ii, iii, iv

(b) i, iii, iv

2.

$\{ (\forall i \in 1..n-1. A[i] \leq A[i+1]) \wedge (\exists k \in 1..n-1. A[k] = A[k+1]) \}$

$j := 1;$   
while  $A[j] \neq A[j+1]$  do

$\{ (\forall i \in 1..j. A[i] < A[i+1]) \}$

$j := j+1;$   
end do

$\{ (\forall i \in 1..j. A[i] < A[i+1]) \wedge A[j] = A[j+1] \}$

3. (a) static scoping: 5 8 3 4 1 8

(b) dynamic scoping 7 11 3 11 1 3

4. (a) call-by-value: 4 5 1 3

(b) call-by-value-result: 4 5 4 3 or 4 5 5 3, depending on whether parameters are copied back left-to-right or right-to-left

(c) call-by-reference: 8 8 8 3

5.

$AR_1: SL = GL$

$AR_3: SL = AR_2$

$AR_5: SL = GL$

$DL = GL$

$DL = AR_2$

$DL = AR_4$

$AR_2: SL = GL$

$AR_4: SL = AR_2$

$DL = AR_1$

$DL = AR_3$