LAB 2

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COSC 3319 SECTION 1  
MEETING DAYS: MWF

GRADING OPTION: A/B/C/D

Lab 2 Multiple Stacks in Restricted Space

L0= 17 M= 63 n = 3 stacks AvailableSpace: 63-17 = 46

Base[1] = Top [1] = floor((1 – 1) / 3 \* 46) + 17

Base[2] = Top [2] = floor((2– 1) / 3 \* 46) + 17

Base[3] = Top [3] = floor((3 – 1) / 3 \* 46) + 17

Base[4] = Top [4] = floor((4 – 1) / 3 \* 46) + 17

Before Insertion:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 0 | 1 | 0 | 1 | 17 | 1 | 0 | 1 | 0 |
| 2 | 0 | 2 | 0 | 2 | 32 | 2 | 0 | 2 | 0 |
| 3 | 0 | 3 | 0 | 3 | 47 | 3 | 0 | 3 | 0 |
| 4 | 0 | 4 | 0 | 4 | 63 | 4 | 0 | 4 | 0 |

Insertion

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|  | I1 15 | I1 35 | I1 17 | I1 86 | I1 74 | I1 97 | I1 45 | I1 9 | I1 37 |
| 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| I1 49 | I1 56 | I1 15 | I1 63 | I1 74 | I1 37 | I2 122 | I2 148 | I2 176 | I2 986 |
| 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 |
| I2 1496 | I2 289 | I2 222 |  |  |  |  |  |  |  |
| 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
|  | I3 386 | I3 3452 | I3 322 | I3 134 |  |  |  |  |  |
| 57 | 58 | 59 | 60 | 61 | 62 | 63 |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

After Insertion:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 0 | 1 | 16 | 1 | 17 | 1 | 17 | 1 | 33 |
| 2 | 0 | 2 | 7 | 2 | 32 | 2 | 32 | 2 | 39 |
| 3 | 0 | 3 | 4 | 3 | 47 | 3 | 47 | 3 | 51 |
| 4 | 0 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

>Overflow at I1 97 (**1st OVERFLOW**)

**AvailableSpace = 46 - (33-17) - (39-32) - (51-47) = 19**

G (J4)= null

G (J3) = 33 - 17 (Growth = 16)

G (J2) = 39 - 32 (Growth = 7)

G (J1) = 51-47 (Growth = 4)

ReA2: If AvailSpace < (MinSpace - 1) **(WE HAVE SPACE)**

ReA3:

**GrowthAllocate := 1 – EqualAllocate**

**EqualAllocate = .3 (30%)**

**GrowthAllocate = .7 (70%)**

**Alpha := (.3)\*19/3 = 1.9**

ReA4:  
**Beta := (.7)\*19/27 = .49259**

ReA5:

Sigma := 0 ; J = 2

T= 0 + 1.9 + Growth[1] \* .49259 = 0 + 1.9 + 16 \* .49259 = 9.78144

**NewBase[2] := 17 + (33-17) + (9-0) = 42**

Sigma = Tau = 9.78144

T= 9.78144 + 1.9 + 7 \* .49259 = 15.12813

**NewBase[3] := 42 + (39-32) + (15-9) = 55**

ReA6:

Top[K] := Top[K] - 1;

Perform Algorithm MoveStack;

Top[K] := Top[K] + 1;

ReA6: (Move Up)

MoveStack Algorithm

J = 3; 55 > 47 ; Delta = 55-47 = 8

L = 48 StackSpace[48+8] := StackSpace[48]

L = 49 StackSpace[49+8] := StackSpace[49]

L = 50 StackSpace[50+8] := StackSpace[50]

L = 51 StackSpace[51+8] := StackSpace[51]

Base[3] := NewBase[3] = 55

Top[3] := 51 + 8 = 59

J = 2; 42 > 33 ; Delta = 42-32 = 10

L = 33 StackSpace[33+10] := StackSpace[33]

L = 34 StackSpace[34+10] := StackSpace[34]

L = 35 StackSpace[35+10] := StackSpace[35]

L = 36 StackSpace[36+10] := StackSpace[36]

L = 37 StackSpace[37+10] := StackSpace[37]

L = 38 StackSpace[38+10] := StackSpace[38]

L = 39 StackSpace[39+10] := StackSpace[39]

Base[2] := NewBase[2] = 42

Top[2] := 39 + 10 = 49

Insert item causing the overflow at location Top[K];

For J in 1..N Loop //get ready for next potential overflow.

OldTop[J] := Top[J];

End Loop;

Before Move:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 33 | 1 | 0 | 1 | 17 | 1 | 17 | 1 | 33 |
| 2 | 39 | 2 | 0 | 2 | 42 | 2 | 32 | 2 | 39 |
| 3 | 51 | 3 | 0 | 3 | 55 | 3 | 47 | 3 | 51 |
| 4 | 63 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

Move:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|  | I1 15 | I1 35 | I1 17 | I1 86 | I1 74 | I1 97 | I1 45 | I1 9 | I1 37 |
| 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| I1 49 | I1 56 | I1 15 | I1 63 | I1 74 | I1 37 | I1 97 |  |  |  |
| 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 |
|  |  |  |  |  |  | I2 122 | I2 148 | I2 176 | I2 986 |
| 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
| I2 1496 | I2 289 | I2 222 |  |  |  |  |  |  | I3 386 |
| 57 | 58 | 59 | 60 | 61 | 62 | 63 |  |  |  |
| I3 3452 | I3 322 | I3 134 |  |  |  |  |  |  |  |

After Move:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 33 | 1 | 0 | 1 | 17 | 1 | 17 | 1 | 33 |
| 2 | 39 | 2 | 0 | 2 | 42 | 2 | 42 | 2 | 48 |
| 3 | 51 | 3 | 0 | 3 | 55 | 3 | 55 | 3 | 59 |
| 4 | 63 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

K = 1 = J

For K in 1..7 Loop

If Top[K] = Base[K] then

report underflow;

Else

Y := StackSpace[ Top[K] ]; {Remove top item in stack and assign to Y.}

Top[K] := Top[K] - 1;

End If;

End Loop;

K = 2 = J

For K in 1..4 Loop

If Top[K] = Base[K] then

report underflow;

Else

Y := StackSpace[ Top[K] ]; {Remove top item in stack and assign to Y.}

Top[K] := Top[K] - 1;

End If;

End Loop;

Before Deletion/Insertion:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 33 | 1 | 0 | 1 | 17 | 1 | 17 | 1 | 33 |
| 2 | 39 | 2 | 0 | 2 | 42 | 2 | 42 | 2 | 48 |
| 3 | 51 | 3 | 0 | 3 | 55 | 3 | 55 | 3 | 59 |
| 4 | 63 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

Deletion / Insertion:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|  | I1 15 | I1 35 | I1 17 | I1 86 | I1 74 | I1 97 | I1 45 | I1 9 | I1 37 |
| 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|  |  |  |  |  |  |  |  |  |  |
| 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 |
|  |  |  |  |  |  | I2 122 | I2 148 | I2 176 |  |
| 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
|  |  |  |  |  |  |  |  |  | I3 386 |
| 57 | 58 | 59 | 60 | 61 | 62 | 63 |  |  |  |
| I3 3452 | I3 322 | I3 134 | I3 457 | I3 671 | I3 497 | I3 412 |  |  |  |

After Deletion/Insertion:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 33 | 1 | -7 | 1 | 17 | 1 | 17 | 1 | 26 |
| 2 | 48 | 2 | -3 | 2 | 42 | 2 | 42 | 2 | 45 |
| 3 | 59 | 3 | 5 | 3 | 55 | 3 | 55 | 3 | 64 |
| 4 | 63 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

**>Overflow at I3 402 (2nd OVERFLOW)**

**AvailableSpace = 47 - (64-55) - (26-17) - (45-42) = 25**

G (J4)= null

G (J3) = 64 - 59 (Growth = 5)

G (J2) = 45 – 49 (Growth = 0)

G (J1) = 26 – 33 (Growth = 0)

ReA2: **Availspace: 25 < (17-1) `We have space`**

ReA3:

**Growthallocate = .7; EqualAllocate = .3**

**Alpha = .3 \* (25 / 3) := 2.5**

ReA4: **Beta := .7 \* (2 / 5) := 3.5**

ReA5:

J = 2; Sigma = 0

T = 0 + 2.5 + ( 0 \* 3.5) = 2.5

**NewBase[2] := 17 + (26-17) + 2 = 28**

J = 3; Sigma = 2.5

T = 2.5 + 2.5+ ( 0 \* 3.5) = 5

**NewBase[3] := 28 + (45-42) + 5 - 2 = 34**

Top[K] := Top[K] - 1;

Perform Algorithm MoveStack;

Top[K] := Top[K] + 1;

ReA6: (Move Down)

MoveStack Algorithm

J = 2; 28 < 42 ; Delta = 28 – 42 = -14

L = 43 StackSpace[43-14] := StackSpace[43]

L = 44 StackSpace[44-14] := StackSpace[44]

L = 45 StackSpace[45-14] := StackSpace[45]

Base[2] := NewBase[2] = 28

Top[2] := 45-14 = 31

J = 3; 34 < 55 ; Delta = 34-55 = -21

L = 56 StackSpace[56-21] := StackSpace[56]

L = 57 StackSpace[57-21] := StackSpace[57]

L = 58 StackSpace[58-21] := StackSpace[58]

L = 59 StackSpace[59-21] := StackSpace[59]

L = 60 StackSpace[60-21] := StackSpace[60]

L = 61 StackSpace[61-21] := StackSpace[61]

L = 62 StackSpace[62-21] := StackSpace[62]

L = 63 StackSpace[63-21] := StackSpace[63]

L = 64 StackSpace[64-21] := StackSpace[64]

Base[3] := NewBase[3] = 34

Top[2] := 64-21 = 43

For J in 1..N Loop //get ready for next potential overflow.

OldTop[J] := Top[J];

End Loop;

Before Move:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 26 | 1 | 0 | 1 | 17 | 1 | 17 | 1 | 26 |
| 2 | 48 | 2 | 0 | 2 | 28 | 2 | 42 | 2 | 45 |
| 3 | 59 | 3 | 0 | 3 | 34 | 3 | 55 | 3 | 64 |
| 4 | 63 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

Move:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|  | I1 15 | I1 35 | I1 17 | I1 86 | I1 74 | I1 97 | I1 45 | I1 9 | I1 37 |
| 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|  |  | I2 122 | I2 148 | I2 176 |  |  |  | I3 386 | I3 3452 |
| 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 |
| I3 322 | I3 134 | I3 457 | I3 671 | I3 497 | I3 412 | I3 402 |  |  |  |
| 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
|  |  |  |  |  |  |  |  |  |  |
| 57 | 58 | 59 | 60 | 61 | 62 | 63 |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

Insert item causing the overflow at location Top[K];

After Move:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 26 | 1 | 0 | 1 | 17 | 1 | 17 | 1 | 26 |
| 2 | 48 | 2 | 0 | 2 | 28 | 2 | 28 | 2 | 31 |
| 3 | 59 | 3 | 0 | 3 | 34 | 3 | 34 | 3 | 43 |
| 4 | 63 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

Insert item causing the overflow at location Top[K];

Insertion:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|  | I1 15 | I1 35 | I1 17 | I1 86 | I1 74 | I1 97 | I1 45 | I1 9 | I1 37 |
| 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| I1 678 | I1 783 | I2 122 | I2 148 | I2 176 |  |  |  |  | I3 386 |
| 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 |
| I3 3452 | I3 322 | I3 134 | I3 457 | I3 671 | I3 497 | I3 412 | I3 402 | I3 412 | I3 588 |
| 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
| I3 444 | I3 477 | I3 896 |  |  |  |  |  |  |  |
| 57 | 58 | 59 | 60 | 61 | 62 | 63 |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

After Insertion:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 28 | 1 | 3 | 1 | 17 | 1 | 17 | 1 | 29 |
| 2 | 48 | 2 | 0 | 2 | 28 | 2 | 28 | 2 | 31 |
| 3 | 59 | 3 | 5 | 3 | 34 | 3 | 34 | 3 | 49 |
| 4 | 63 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

**>Overflow at I1 578 (3rd OVERFLOW)**

**AvailableSpace = 46 - (29-17) - (31-28) - (48-34) = 17**

G (J4)= null

G (J3) = 48-43 (Growth = 5)

G (J2) = 31-31 (Growth = 0)

G (J1) = 29-26 (Growth = 3)

ReA2: 18 < 16 ‘We have space’

**ReA3: GrowthAllocate := .7 ; EqualAllocate := .3**

**Alpha := .3 \* 17 / 3 = 1.7**

**ReA4: Beta := .7 \* 17 / 8 = 1.4875**

ReA5:

J = 2; Sigma = 0

T = 0 + 1.7 + ( 3 \* 1.4875) = 6.1625

**NewBase[2] := 17 + (29-17) + 6 = 35**

J = 3; Sigma = 5.666

T = 5.666 + 1.7 + ( 0 \* 1.322) = 7.366

**NewBase[3] := 34 + (31-28) + 7 - 5 = 39**

ReA6: (Move Up)

J = 3; 39 > 34 ; Delta = 39-34 = 5

L = 35 StackSpace[35+5] := StackSpace[35]

L = 36 StackSpace[36+5] := StackSpace[36]

L = 37 StackSpace[37+5] := StackSpace[37]

L = 38 StackSpace[38+5] := StackSpace[38]

L = 39 StackSpace[39+5] := StackSpace[39]

L = 40 StackSpace[40+5] := StackSpace[40]

L = 41 StackSpace[41+5] := StackSpace[41]

L = 42 StackSpace[42+5] := StackSpace[42]

L = 43 StackSpace[43+5] := StackSpace[43]

L = 44 StackSpace[44+5] := StackSpace[44]

L = 45 StackSpace[45+5] := StackSpace[45]

L = 46 StackSpace[46+5] := StackSpace[46]

L = 47 StackSpace[47+5] := StackSpace[47]

L = 48 StackSpace[48+5] := StackSpace[48]

Base[3] := NewBase[3] = 39

Top[3] := 48+5 = 53

J = 2; 34 > 28 ; Delta = 35-28 = 7

L = 29 StackSpace[29+7] := StackSpace[29]

L = 30 StackSpace[30+7] := StackSpace[30]

L = 31 StackSpace[31+7] := StackSpace[31]

Base[2] := NewBase[2] = 35

Top[2] := 31 + 7 = 38

For J in 1..N Loop //get ready for next potential overflow.

OldTop[J] := Top[J];

End Loop;

Before Move:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 29 | 1 | 0 | 1 | 17 | 1 | 17 | 1 | 29 |
| 2 | 31 | 2 | 0 | 2 | 35 | 2 | 28 | 2 | 31 |
| 3 | 49 | 3 | 0 | 3 | 39 | 3 | 34 | 3 | 49 |
| 4 | 63 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

Move:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|  | I1 15 | I1 35 | I1 17 | I1 86 | I1 74 | I1 97 | I1 45 | I1 9 | I1 37 |
| 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| I1 678 | I1 783 | I1 578 |  |  |  |  |  |  | I2 122 |
| 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 |
| I2 148 | I2 176 |  | I3 386 | I3 3452 | I3 322 | I3 134 | I3 457 | I3 671 | I3 497 |
| 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
| I3 412 | I3 402 | I3 412 | I3 588 | I3 444 | I3 477 | I3 896 |  |  |  |
| 57 | 58 | 59 | 60 | 61 | 62 | 63 |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

After Move:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 29 | 1 | 0 | 1 | 17 | 1 | 17 | 1 | 29 |
| 2 | 31 | 2 | 0 | 2 | 35 | 2 | 35 | 2 | 38 |
| 3 | 49 | 3 | 0 | 3 | 39 | 3 | 39 | 3 | 53 |
| 4 | 63 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

Insert item causing the overflow at location Top[K];

Before Insertion:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 29 | 1 | 0 | 1 | 17 | 1 | 17 | 1 | 29 |
| 2 | 31 | 2 | 0 | 2 | 35 | 2 | 35 | 2 | 38 |
| 3 | 49 | 3 | 0 | 3 | 39 | 3 | 39 | 3 | 53 |
| 4 | 63 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

Next Insertion:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|  | I1 15 | I1 35 | I1 17 | I1 86 | I1 74 | I1 97 | I1 45 | I1 9 | I1 37 |
| 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| I1 678 | I1 783 | I1 578 | I1 510 | I1 555 | I1 777 | I1 888 | I1 999 | I1 111 | I2 122 |
| 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 |
| I2 148 | I2 176 |  | I3 386 | I3 3452 | I3 322 | I3 134 | I3 457 | I3 671 | I3 497 |
| 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
| I3 412 | I3 402 | I3 412 | I3 588 | I3 444 | I3 477 | I3 896 |  |  |  |
| 57 | 58 | 59 | 60 | 61 | 62 | 63 |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

After Insertion:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | OldTop |  | Growth |  | NewBase |  | Base |  | Top |
| 1 | 29 | 1 | 7 | 1 | 17 | 1 | 17 | 1 | 36 |
| 2 | 31 | 2 | 0 | 2 | 35 | 2 | 35 | 2 | 38 |
| 3 | 49 | 3 | 0 | 3 | 39 | 3 | 39 | 3 | 53 |
| 4 | 63 | 4 | 0 | 4 | 63 | 4 | 63 | 4 | 63 |

**>Overflow I1 554 (4th Overflow)**

Process Complete!