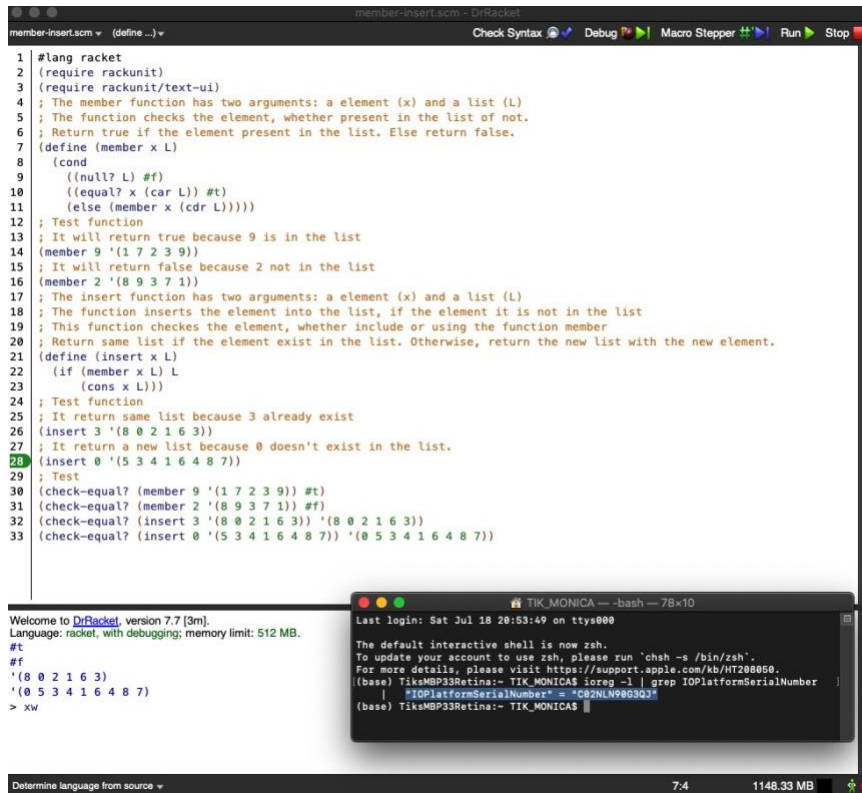


Lab 1

1.



```
1 #lang racket
2 (require rackunit)
3 (require rackunit/text-ui)
4 ; The member function has two arguments: a element (x) and a list (L)
5 ; The function checks the element, whether present in the list or not.
6 ; Return true if the element present in the list. Else return false.
7 (define (member x L)
8   (cond
9     ((null? L) #f)
10    ((equal? x (car L)) #t)
11    (else (member x (cdr L)))))
12 ; Test function
13 ; It will return true because 9 is in the list
14 (member 9 '(1 7 2 3 9))
15 ; It will return false because 2 not in the list
16 (member 2 '(8 9 3 7 1))
17 ; The insert function has two arguments: a element (x) and a list (L)
18 ; The function inserts the element into the list, if the element it is not in the list
19 ; This function checks the element, whether include or using the function member
20 ; Return same list if the element exist in the list. Otherwise, return the new list with the new element.
21 (define (insert x L)
22   (if (member x L) L
23       (cons x L)))
24 ; Test function
25 ; It return same list because 3 already exist
26 (insert 3 '(8 0 2 1 6 3))
27 ; It return a new list because 0 doesn't exist in the list.
28 (insert 0 '(5 3 4 1 6 4 8 7))
29 ; Test
30 (check-equal? (member 9 '(1 7 2 3 9)) #t)
31 (check-equal? (member 2 '(8 9 3 7 1)) #f)
32 (check-equal? (insert 3 '(8 0 2 1 6 3)) '(8 0 2 1 6 3))
33 (check-equal? (insert 0 '(5 3 4 1 6 4 8 7)) '(0 5 3 4 1 6 4 8 7))
```

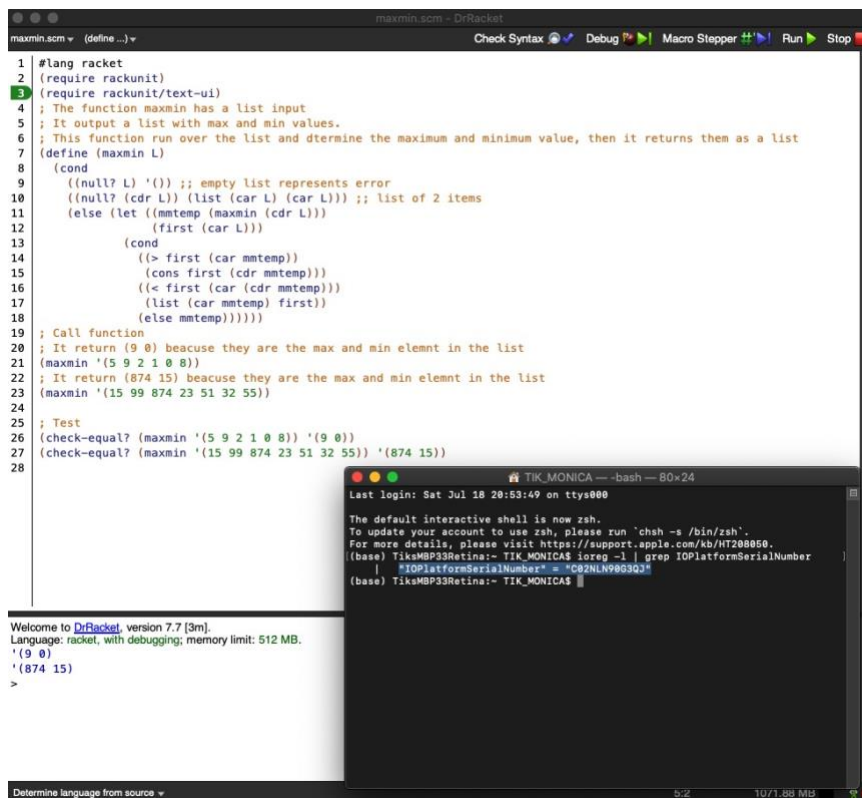
Welcome to **DrRacket**, version 7.7 [3m].
Language: racket, with debugging; memory limit: 512 MB.

```
#t
'(8 0 2 1 6 3)
'(0 5 3 4 1 6 4 8 7)
> xw
```

TIK_MONICA --- -bash --- 78x10
Last login: Sat Jul 18 20:53:49 on tty000
The default interactive shell is now zsh.
To update your account to use zsh, please run 'chsh -s /bin/zsh'.
For more details, please visit <https://support.apple.com/kb/HT208069>.
(base) TiksMBP33Retina:~ TIK_MONICA\$ ioreg -l | grep IOPlatformSerialNumber
| IOPlatformSerialNumber = "C02N1N98G3Q3"
(base) TiksMBP33Retina:~ TIK_MONICA\$

Determine language from source v 7:4 1148.33 MB

i.



```
1 #lang racket
2 (require rackunit)
3 (require rackunit/text-ui)
4 ; The function maxmin has a list input
5 ; It output a list with max and min values.
6 ; This function run over the list and determine the maximum and minimum value, then it returns them as a list
7 (define (maxmin L)
8   (cond
9     ((null? L) '()) ; empty list represents error
10    ((null? (cdr L)) (list (car L) (car L))) ; list of 2 items
11    (else (let ((mtemp (maxmin (cdr L))))
12            (first (car L))
13            (cond
14              ((> (first (car mtemp))
15                 (cons first (cdr mtemp)))
16               ((< (first (car (cdr mtemp)))
17                  (list (car mtemp) first))
18               (else mtemp))))))
19 ; Call function
20 ; It return (9 0) because they are the max and min elemnt in the list
21 (maxmin '(5 9 2 1 0 8))
22 ; It return (874 15) because they are the max and min elemnt in the list
23 (maxmin '(15 99 874 23 51 32 55))
24 ; Test
25 (check-equal? (maxmin '(5 9 2 1 0 8)) '(9 0))
26 (check-equal? (maxmin '(15 99 874 23 51 32 55)) '(874 15))
27
```

Welcome to **DrRacket**, version 7.7 [3m].
Language: racket, with debugging; memory limit: 512 MB.

```
'(9 0)
'(874 15)
>
```

TIK_MONICA --- -bash --- 80x24
Last login: Sat Jul 18 20:53:49 on tty000
The default interactive shell is now zsh.
To update your account to use zsh, please run 'chsh -s /bin/zsh'.
For more details, please visit <https://support.apple.com/kb/HT208069>.
(base) TiksMBP33Retina:~ TIK_MONICA\$ ioreg -l | grep IOPlatformSerialNumber
| IOPlatformSerialNumber = "C02N1N98G3Q3"
(base) TiksMBP33Retina:~ TIK_MONICA\$

Determine language from source v 5:2 1071.88 MB

ii.

```

msort.scm - DrRacket
msort.scm (define ...)
Check Syntax Debug Macro Stepper Run Stop

1 #lang racket
2 (require rackunit)
3 (require rackunit/text-ui)
4 ; The function merge takes two lists: fst and snd
5 ; It merges two list in sorted order
6 ; If first list is null, return second list. If second list is null, return first list.
7 ; Otherwise, iterate call function split to sort the list
8 ; If the first element in fst list is less than the first element in snd list,
9 ; the output merge list will start with fst's element.
10 ; Otherwise the output merge list will start with snd's element.
11 (define (merge fst snd)
12   (cond
13     ((null? fst) snd)
14     ((null? snd) fst)
15     (else
      (let ((x (car fst)) (y (car snd)))
        (if (< x y) (cons x (merge (cdr fst) snd))
            (cons y (merge fst (cdr snd)))))))
16 ; Test
17 ; It return fst list because snd list has no element
18 (merge '(1 2 3) '())
19 ; It return snd list because fst list has no element
20 (merge '() '(4 5 6))
21 ; The output merge list begin with fst's element because the first element in fst is less than snd's element
22 (merge '(1 2 9) '(4 7 6))
23 ; The output merge list begin with snd's element because the first element in snd is less than fst element
24 (merge '(99 33 11) '(22 44 66))
25 ; Test
26 (check-equal? (merge '(1 2 3) '()) '(1 2 3))
27 (check-equal? (merge '() '(4 5 6)) '(4 5 6))
28 (check-equal? (merge '(1 2 9) '(4 7 6)) '(1 2 4 7 6 9))
29 (check-equal? (merge '(99 33 11) '(22 44 66)) '(22 44 66 99 33 11))
30 ; The function split take a list: list
31 ; It splits into two sub lists
32 ; If list is null, return a list of list
33 ; If list is null, return a list of list
34
35 '(1 2 3)
36 '(4 5 6)
37 '(1 2 4 7 6 9)
38 '(22 44 66 99 33 11)
39
Determine language from source
msort.scm - DrRacket
Check Syntax Debug Macro Stepper Run Stop

```

iii.

```

1 #lang racket
34
35 ; The function split take a list: list
36 ; It splits into two sub lists
37 ; If list is null, return a list of list. Return second element of the list, if list is not null.
38 ; Otherwise, iterative the function split and take out the second element of the list.
39 (define (split lis)
40   (cond
41     ((null? lis) (cons '() '()))
42     ((null? (cdr lis)) (cons (list (car lis)) '()))
43     (else
      (let ((a (car lis)) (b (car (cdr lis))) (c (split (cdr (cdr lis)))))
        (cons (cons a (car c)) (cons b (cdr c))))))
44 ; Test
45 ; It returns null list within a list because lis is null list
46 (split '())
47 ; It splits 73 out because it is the second element in lis
48 (split '(35 73))
49 ; It splits 35 out because it is the second element in lis
50 (split '(73 35))
51 ; It splits 2 4 6 8 out because they are the second element in lis
52 (split '(1 2 3 4 5 6 7 8 9))
53 ; It splits 2 out because it is the second element in lis
54 (split '(1 2 3))
55 ; It splits 11 66 out because they are the second element in lis
56 (split '(22 11 33 66))
57 ; Test
58 (check-equal? (split '()) '())
59 (check-equal? (split '(35 73)) '((35) 73))
60 (check-equal? (split '(73 35)) '((73) 35))
61 (check-equal? (split '(1 2 3 4 5 6 7 8 9)) '((1 3 5 7 9) 2 4 6 8))
62 (check-equal? (split '(1 2 3)) '((1 3) 2))
63 (check-equal? (split '(22 11 33 66)) '((22 33) 11 66))
64 ; The function msort takes a
65
66 '()
67 '((35) 73)
68 '((73) 35)
69 '((1 3 5 7 9) 2 4 6 8)
70 '((1 3) 2)
71 '((22 33) 11 66)
Determine language from source
msort.scm - DrRacket
Check Syntax Debug Macro Stepper Run Stop

```

*(Continue)

```
msort.scm - DrRacket
msort.scm (define ...)
1 #lang racket
64 (check-equal? (split '(1 2 3 4 5 6 7 8 9)) '({(1 3 5 7 9) 2 4 6 8}))
65 (check-equal? (split '(1 2 3)) '({(1 3) 2}))
66 (check-equal? (split '(22 11 33 66)) '({(22 33) 11 66}))
67
68 ; The function msort takes a list: lis
69 ; It takes the list and sorted in order
70 ; Return null list, if list is empty. Return list, if the list has only one element.
71 ; Otherwise, it splits list into sublists and sort the list. Then merge two splitted sorted lists.
72 (define (msort lis)
73   (cond
74     ((null? lis) '())
75     ((null? (cdr lis)) lis)
76     (else
      (let* ((c (split lis)) (fst (car c)) (snd (cdr c)))
        (merge (msort fst) (msort snd))))))
77
78 ; Test
79
80 ; The function return a list in sorted order
81 (msort '(0 5 8 3 9 5 0 199 245 662 124))
82 (msort '(-8 3 7532 -9 -2 857 95))
83 (msort '(9 8 2 7 1 5 0 -1 -3 -6 -8))
84
85 ; Test
86 (check-equal? (msort '(0 5 8 3 9 5 0 199 245 662 124)) '(0 0 3 5 5 8 9 124 199 245 662))
87 (check-equal? (msort '(-8 3 7532 -9 -2 857 95)) '(-9 -8 -2 3 95 857 7532))
88 (check-equal? (msort '(9 8 2 7 1 5 0 -1 -3 -6 -8)) '(-8 -6 -3 -1 0 1 2 5 7 8 9))
89
' (0 0 3 5 5 8 9 124 199 245 662)
' (-9 -8 -2 3 95 857 7532)
' (-8 -6 -3 -1 0 1 2 5 7 8 9)
Determine language from source v 9:10-10:22 1315.71 MB
```

2.

```
lab1_q2.rkt - DrRacket
lab1_q2.rkt (define ...)
1 #lang racket
2 (require rackunit)
3 (require rackunit/text-ui)
4 ; Part 2, i
5 ; tail-fact is a tail recursive function
6 ; The function fact take one element: n
7 ; return 1 if n is zero. Otherwise iterative call function fact
8 (define (tail-fact n [acc 1])
9   (cond
10    [(= n 0) 1]
11    [(= n 1) acc]
12    [else (tail-fact (- n 1) (* n acc))])
13 )
14 (display "Factorial Tail Recursive\n")
15 (tail-fact 0)
16 (tail-fact 1)
17 (tail-fact 2)
18 (tail-fact 5)
19 (check-equal? (tail-fact 0) 1)
20 (check-equal? (tail-fact 1) 1)
21 (check-equal? (tail-fact 2) 2)
22 (check-equal? (tail-fact 5) 120)
23
24 ; fact is a non-tail recursive function
25 (define (fact n)
26   (if (= n 0)
27       1
28       (* n (fact (- n 1)))))
29 ; Print function
30 (display "Factorial Non Tail Recursive\n")
31 (fact 0)
32 (fact 1)
33 (fact 2)
34 (fact 5)
35 (check-equal? (fact 0) 1)
36 (check-equal? (fact 1) 1)
37 (check-equal? (fact 2) 2)
38 (check-equal? (fact 5) 120)
39
Language: racket, with debugging; memory limit: 512 MB.
Factorial Tail Recursive
1
1
2
120
Factorial Non Tail Recursive
1
1
2
120
Determine language from source v 2:55 927.19 MB
```

i.

lab1_q2.rkt - DrRacket

Check Syntax Debug Macro Stepper Run Stop

```
1 #lang racket
40 ; Part 2, ii
41 ; non-expt is a non-tail recursive function
42 ; The function power take one element: n
43 ; Return 1 if n equals 1. Otherwise iterative call the function with n - 1
44 ; and add each step multiple 2.
45 (define (power n)
46   (*
47     (cond
48       ((= n 1) 1)
49       (else (power (- n 1)))
50     )
51     2
52   ))
53
54 ; Call the function
55 (display "Exponential Non Tail Recursive\n")
56 (power 10)
57 (power 5)
58
59 ; expt is a tail recursive function
60 ; The function expt take one element: n
61 ; Return 1 if n is zero. Otherwise 2call the function with n - 1
62 (define (expt n)
63   (if (= n 0)
64       1
65       (* 2 (expt (- n 1)))
66   ))
67 ; Print function
68 (display "Exponential Tail Recursive\n")
69 (expt 0)
70 (expt 1)
71 (expt 2)
72 (expt 10)
73 (check-equal? (expt 0) 1)
74 (check-equal? (expt 1) 2)
75 (check-equal? (expt 2) 4)
76 (check-equal? (expt 10) 1024)
77
```

Exponential Non Tail Recursive
1024
32
Exponential Tail Recursive
1
2
4
1024
compose
2
4

Determine language from source 2:55 929.96 MB

TIK_MONICA — -bash — 80x24

Last login: Sat Jul 18 20:53:49 on ttys000

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit <https://support.apple.com/kb/HT208850>.
((base) TiksMBP33Retina:~ TIK_MONICA\$ ioreg -l | grep IOPlatformSerialNumber
| "IOPlatformSerialNumber" = "C02N1N90G3QJ"
(base) TiksMBP33Retina:~ TIK_MONICA\$

ii.

lab1_q2.rkt - DrRacket

Check Syntax Debug Macro Stepper Run Stop

```
1 #lang racket
77
78 ; Part 2, iii
79 ; The function compose takes 3 elements: g f x
80 ; It used the expt and fact function to construc 2^n!
81 (define (compose g f x) (g (f x)))
82 (display "compose\n")
83 (compose expt fact 1)
84 (compose expt fact 2)
85 (compose expt fact 3)
86 (check-equal? (compose expt fact 1) 2)
87 (check-equal? (compose expt fact 2) 4)
88 (check-equal? (compose expt fact 3) 64)
89
90
91
92
93
```

compose
2
4
64
>

Determine language from source 18:1-19:1 1109.84 MB

TIK_MONICA — -bash — 78x13

Last login: Mon Jul 20 01:09:56 on ttys000

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit <https://support.apple.com/kb/HT208850>.
((base) TiksMBP33Retina:~ TIK_MONICA\$ ioreg -l | grep IOPlatformSerialNumber
| "IOPlatformSerialNumber" = "C02N1N90G3QJ"
(base) TiksMBP33Retina:~ TIK_MONICA\$

iii.

3. Part 3, i

The screenshot shows the DrRacket IDE with a file named 'lab1_q3.rkt'. The code defines a 'range' function and includes test cases. A terminal window is open in the foreground, displaying system messages and the output of a command to find the IOPlatformSerialNumber.

```

1 #lang racket
2 ; The function range has three elements: start, step, and stop.
3 ; It returns the list of integers that is equal to start:step:stop
4 ; Return empty list if start is less than end.
5 ; Otherwise, add the first element.
6 ; Call the function if the start less than end
7 (define (range r)
8   (append
9     (cond
10      ((> (list-ref r 0) (list-ref r 2)) '())
11      (else (list (list-ref r 0)))
12    )
13     (if (< (list-ref r 0) (list-ref r 2))
14       (range (list (+ (list-ref r 0) (list-ref r 1)) (list-ref r 1) (list-ref r 2))) '())
15     )
16   )
17 ;call the function
18 (range '(0 2 7))
19 (range '(2 2 0))
20 (range '(1 2 3))
21
22 ; Test Cases
23 (check-equal? (range '(0 2 7))
24               '(0 2 4 6))
25 (check-equal? (range '(2 2 0))
26               '())
27 (check-equal? (range '(1 2 3))
28               '(1 3))
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

```

Terminal output:

```

Last login: Sat Jul 18 20:53:49 on ttys000
The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
(base) TiksMBP33Retina:~ TIK_MONICA$ ioreg -l | grep IOPlatformSerialNumber
| "IOPlatformSerialNumber" = "C02NLN90G3QJ"
(base) TiksMBP33Retina:~ TIK_MONICA$

```

Below the code editor, the DrRacket welcome message is visible:

```

Welcome to DrRacket, version 7.7 [3m].
Language: racket, with debugging; memory limit: 512 MB.
'()
'(1 3)
>

```

The status bar at the bottom shows 'Determine language from source', '6:2', and '309.41 MB'.

i.

ii. Part 3, ii (Unable to complete)

lab_q4.rkt - DrRacket

lab_q4.rkt (define ...) 1: lab1/member-insert.scm 2: lab_q4.rkt 3: Downloads/member-insert.scm

```
1 #lang racket
2 ; Part 4
3 ; The function B take two elements n and k
4 ; Return 0 if n <= 0, k >= 0, or n >= k.
5 ; Return 1 if k equal to zero or k equal to n.
6 ; Otherwise, recursively calls the function B.
7 (require rackunit)
8 (require rackunit/text-ui)
9 (define (B n k)
10   (if (and (>= n 0) (>= k 0) (>= n k))
11       (if (or (= k 0) (= k n))
12           1
13           (+ (B (- n 1) (- k 1))
14              (B (- n 1) k)))
15       0))
16 ; Return 0 because n less than k
17 (B 1 2)
18 ; Return 1 because k equal to 0
19 (B 8 0)
20 ; Return 1 because n equal to k
21 (B 5 5)
22 ; The element n and k pass two if conditionals
23 (B 7 3)
24 ; The element n and k pass two if conditionals
25 (B 6 2)
26
27 (check-equal? (B 1 2) 0)
28 (check-equal? (B 8 0) 1)
29 (check-equal? (B 5 5) 1)
30 (check-equal? (B 7 3) 35)
31 (check-equal? (B 6 2) 15)
```

Welcome to [DrRacket](#), version 7.7 [3m].
Language: racket, with debugging; memory limit: 512 MB.

0
1
1
35
15
>

TIK_MONICA -- -bash -- 78x13

Last login: Mon Jul 20 01:09:56 on ttys000

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit <https://support.apple.com/kb/HT208050>.

((base) TiksMBP33Retina:~ TIK_MONICA\$ ioreg -l | grep IOPlatformSerialNumber
| "IOPlatformSerialNumber" = "C02N1N90G3QJ"
(base) TiksMBP33Retina:~ TIK_MONICA\$

4. Determine language from source 2:8 967.36 MB