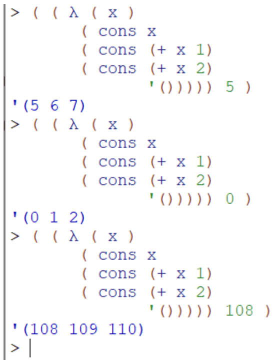
Nathaniel Wolf
Racket Programming Assignment #3: Lambda and Basic Lisp
2/28/2022
CSC 344

Learning Abstract

The purpose of this assignment was to become more adept at racket programming. These assignments feature a mixture of introduction to lambda functions, classical Lisp list processing, and recursive functions.

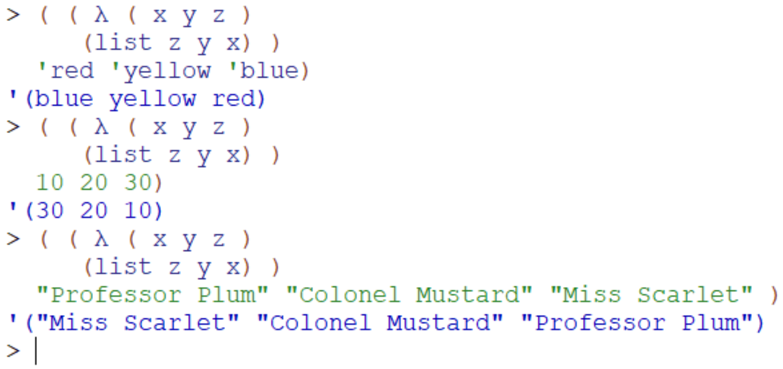
Nathaniel Wolf
Racket Programming Assignment #3: Lambda and Basic Lisp
2/28/2022
CSC 344

Part 1.A



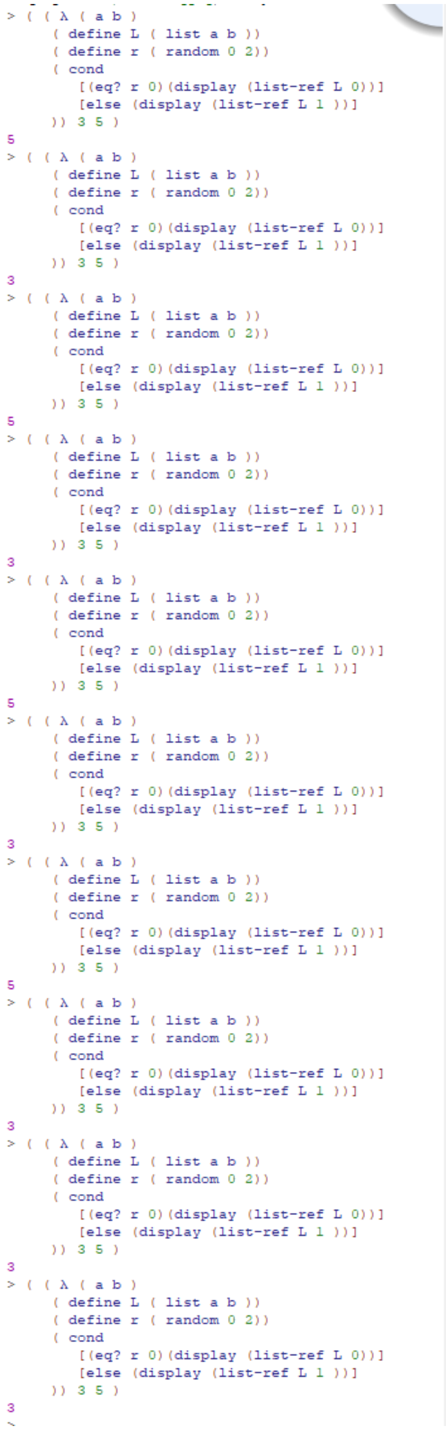
```
> ( ( λ ( x )
       ( cons x
       ( cons (+ x 1)
       ( cons (+ x 2)
              '()))))) 5 )
'(5 6 7)
> ( ( λ ( x )
       ( cons x
       ( cons (+ x 1)
       ( cons (+ x 2)
              '()))))) 0 )
'(0 1 2)
> ( ( λ ( x )
       ( cons x
       ( cons (+ x 1)
       ( cons (+ x 2)
              '()))))) 108 )
'(108 109 110)
> 
```

Part 1.B

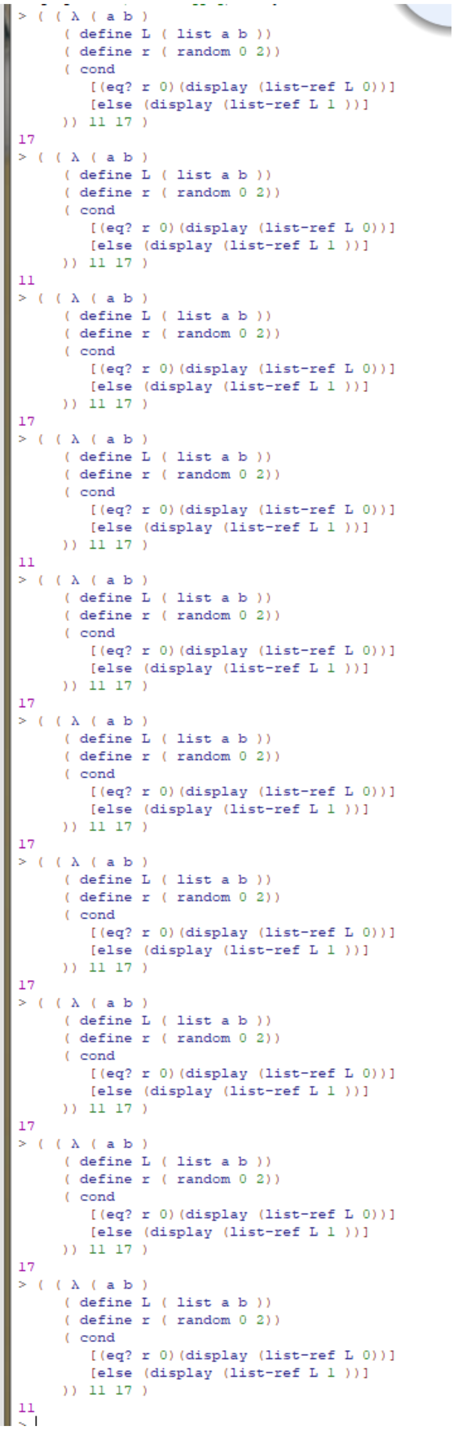


```
> ( ( λ ( x y z )
      (list z y x) )
  'red 'yellow 'blue)
'(blue yellow red)
> ( ( λ ( x y z )
      (list z y x) )
  10 20 30)
'(30 20 10)
> ( ( λ ( x y z )
      (list z y x) )
  "Professor Plum" "Colonel Mustard" "Miss Scarlet" )
'("Miss Scarlet" "Colonel Mustard" "Professor Plum")
> 
```

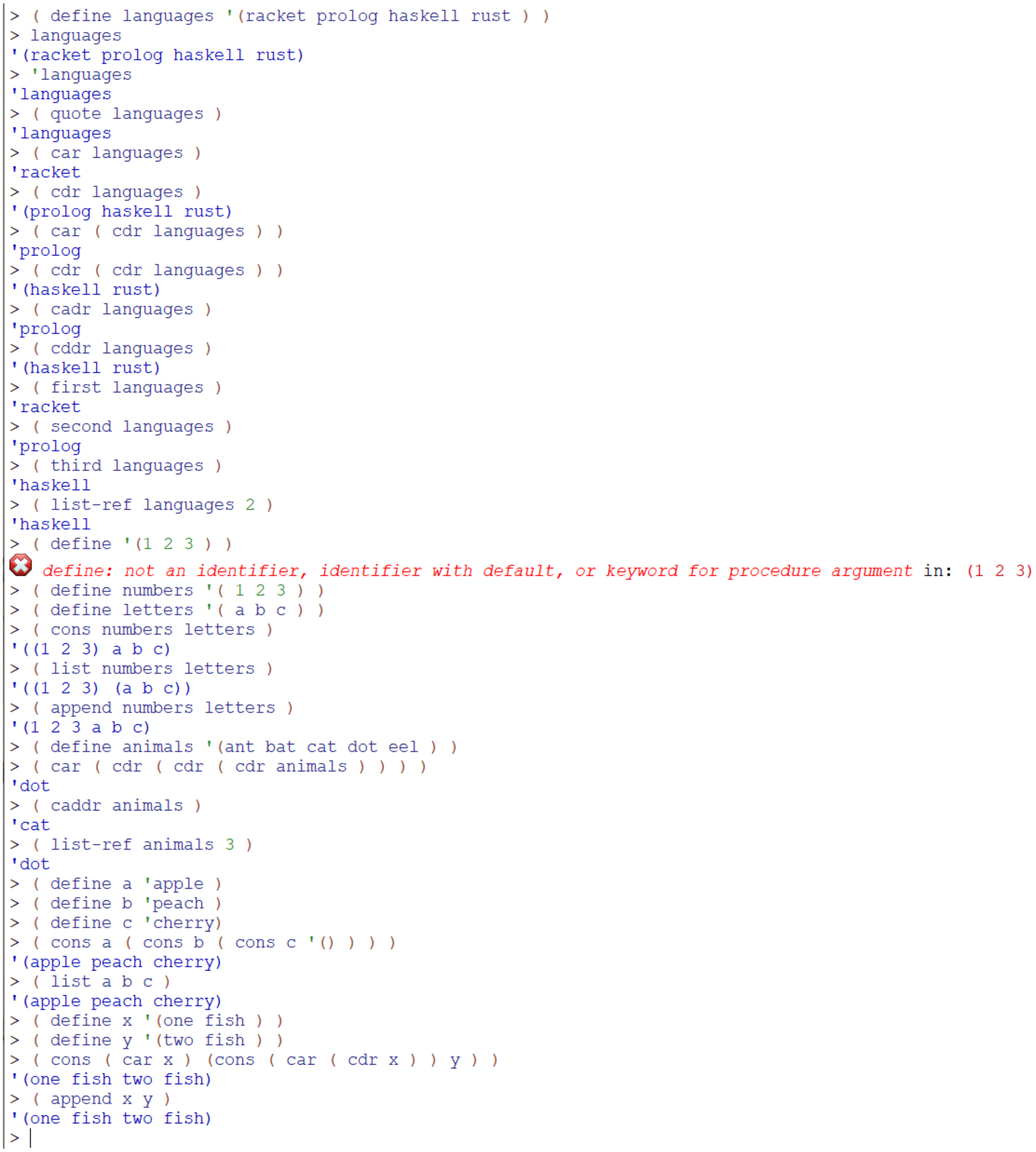
1.C



```
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 3 5 )
5
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 3 5 )
3
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 3 5 )
5
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 3 5 )
3
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 3 5 )
5
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 3 5 )
3
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 3 5 )
5
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 3 5 )
3
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 3 5 )
3
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 3 5 )
3
>
```

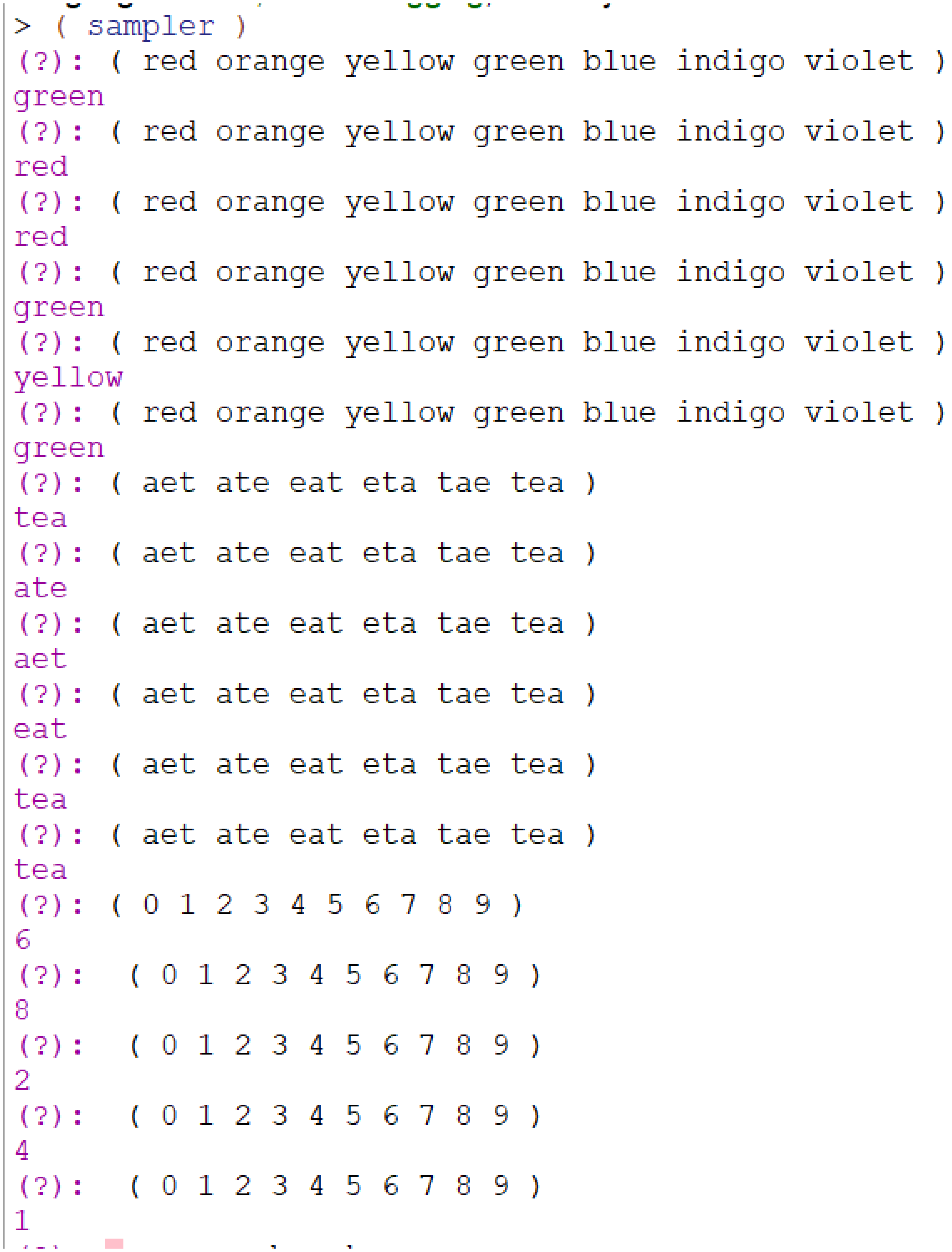


```
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 11 17 )
17
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 11 17 )
11
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 11 17 )
17
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 11 17 )
11
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 11 17 )
17
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 11 17 )
17
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 11 17 )
17
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 11 17 )
17
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 11 17 )
17
> ( ( λ ( a b )
     ( define L ( list a b ))
     ( define r ( random 0 2))
     ( cond
        [(eq? r 0)(display (list-ref L 0))]
        [else (display (list-ref L 1 ))]
     )) 11 17 )
11
>
```



```
> ( define languages '(racket prolog haskell rust ) )
> languages
'(racket prolog haskell rust)
> 'languages
'languages
> ( quote languages )
'languages
> ( car languages )
'racket
> ( cdr languages )
'(prolog haskell rust)
> ( car ( cdr languages ) )
'prolog
> ( cdr ( cdr languages ) )
'(haskell rust)
> ( cadr languages )
'prolog
> ( cddr languages )
'(haskell rust)
> ( first languages )
'racket
> ( second languages )
'prolog
> ( third languages )
'haskell
> ( list-ref languages 2 )
'haskell
> ( define '(1 2 3 ) )
 define: not an identifier, identifier with default, or keyword for procedure argument in: (1 2 3)
> ( define numbers '( 1 2 3 ) )
> ( define letters '( a b c ) )
> ( cons numbers letters )
'((1 2 3) a b c)
> ( list numbers letters )
'((1 2 3) (a b c))
> ( append numbers letters )
'(1 2 3 a b c)
> ( define animals '(ant bat cat dot eel ) )
> ( car ( cdr ( cdr ( cdr animals ) ) ) )
'dot
> ( caddr animals )
'cat
> ( list-ref animals 3 )
'dot
> ( define a 'apple )
> ( define b 'peach )
> ( define c 'cherry)
> ( cons a ( cons b ( cons c '() ) ) )
'(apple peach cherry)
> ( list a b c )
'(apple peach cherry)
> ( define x '(one fish ) )
> ( define y '(two fish ) )
> ( cons ( car x ) (cons ( car ( cdr x ) ) y ) )
'(one fish two fish)
> ( append x y )
'(one fish two fish)
> 
```

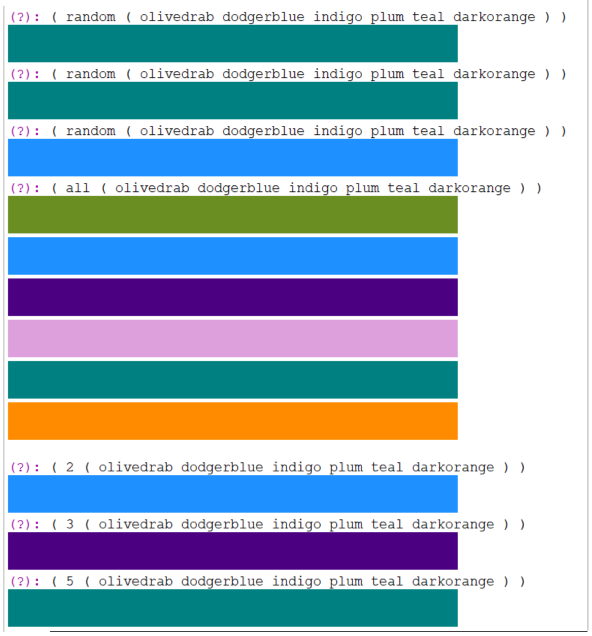
Part 3.A



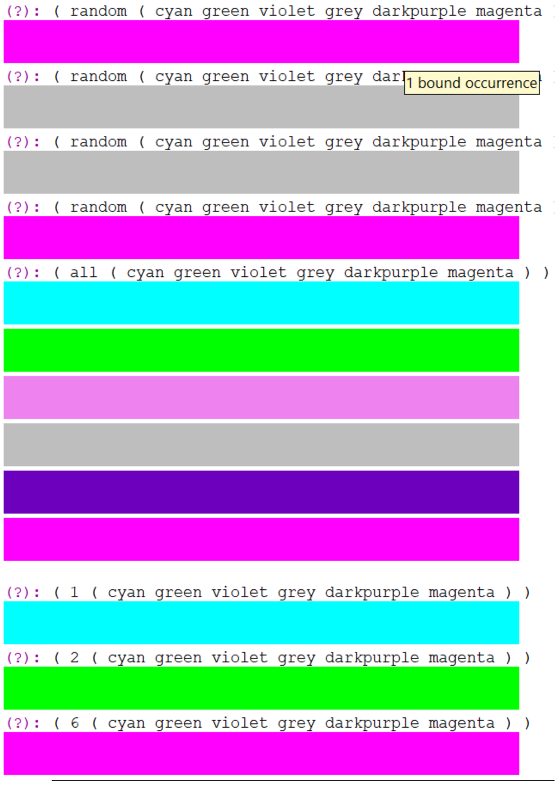
```
> ( sampler )
(?): ( red orange yellow green blue indigo violet )
green
(?): ( red orange yellow green blue indigo violet )
red
(?): ( red orange yellow green blue indigo violet )
red
(?): ( red orange yellow green blue indigo violet )
green
(?): ( red orange yellow green blue indigo violet )
yellow
(?): ( red orange yellow green blue indigo violet )
green
(?): ( aet ate eat eta tae tea )
tea
(?): ( aet ate eat eta tae tea )
ate
(?): ( aet ate eat eta tae tea )
aet
(?): ( aet ate eat eta tae tea )
eat
(?): ( aet ate eat eta tae tea )
tea
(?): ( aet ate eat eta tae tea )
tea
(?): ( 0 1 2 3 4 5 6 7 8 9 )
6
(?):  ( 0 1 2 3 4 5 6 7 8 9 )
8
(?):  ( 0 1 2 3 4 5 6 7 8 9 )
2
(?):  ( 0 1 2 3 4 5 6 7 8 9 )
4
(?):  ( 0 1 2 3 4 5 6 7 8 9 )
1
```

Nathaniel Wolf
Racket Programming Assignment #3: Lambda and Basic Lisp
2/28/2022
CSC 344

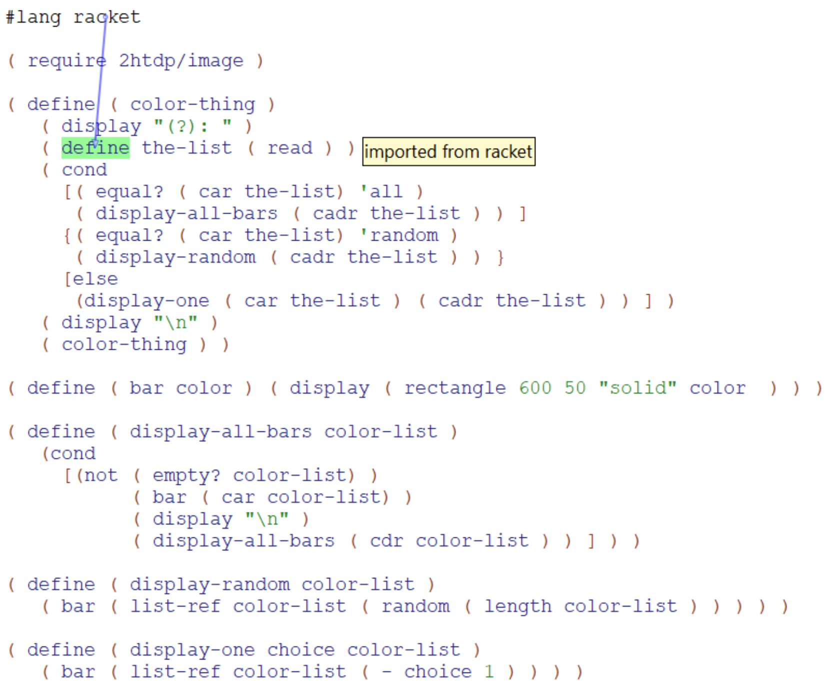
Part 3.B



```
(?): ( random ( olivedrab dodgerblue indigo plum teal darkorange ) )
(?): ( random ( olivedrab dodgerblue indigo plum teal darkorange ) )
(?): ( random ( olivedrab dodgerblue indigo plum teal darkorange ) )
(?): ( all ( olivedrab dodgerblue indigo plum teal darkorange ) )
(?): ( 2 ( olivedrab dodgerblue indigo plum teal darkorange ) )
(?): ( 3 ( olivedrab dodgerblue indigo plum teal darkorange ) )
(?): ( 5 ( olivedrab dodgerblue indigo plum teal darkorange ) )
```

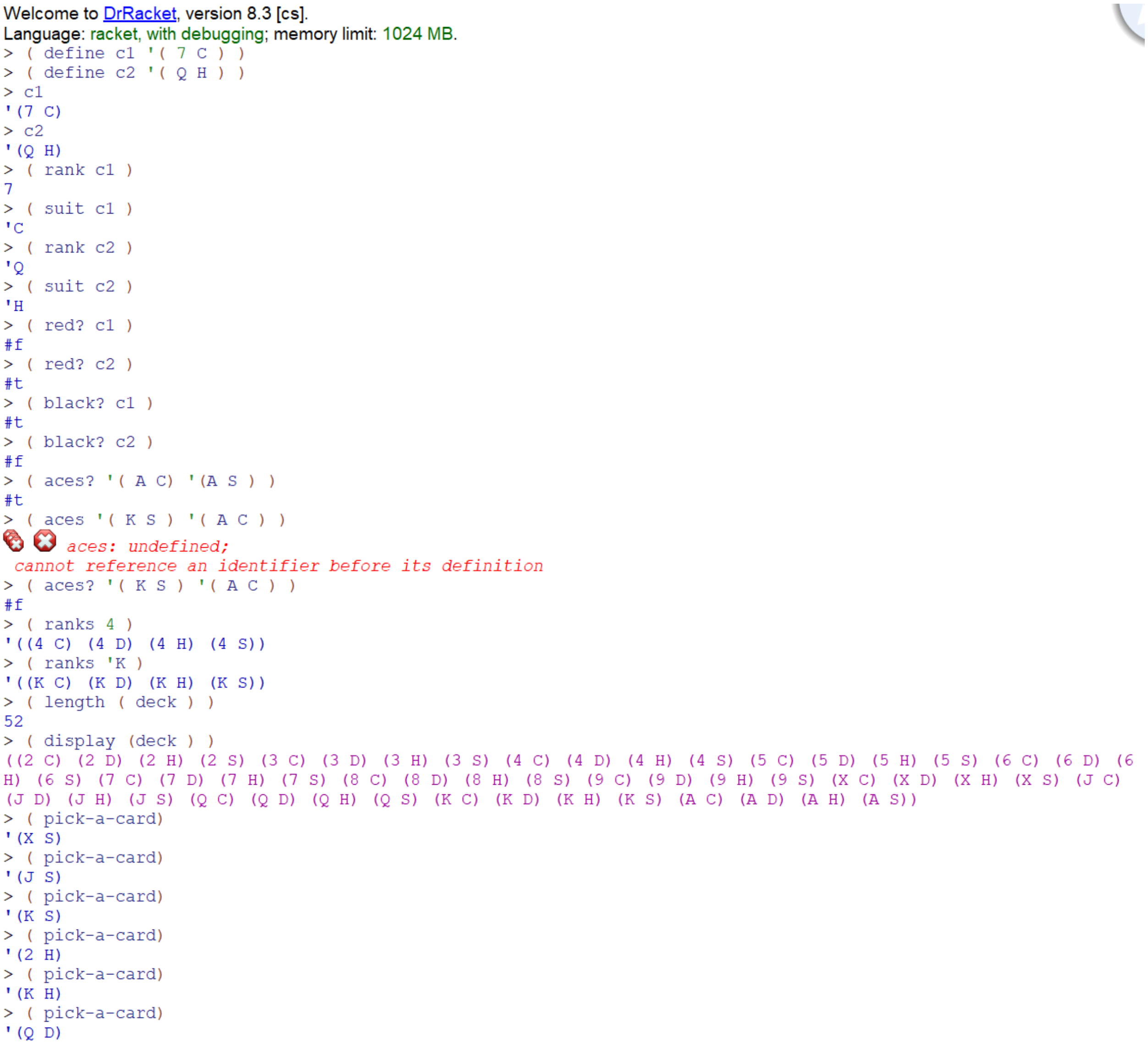


```
(?): ( random ( cyan green violet grey darkpurple magenta
(?): ( random ( cyan green violet grey dar
(?): ( random ( cyan green violet grey darkpurple magenta
(?): ( random ( cyan green violet grey darkpurple magenta
(?): ( all ( cyan green violet grey darkpurple magenta ) )
(?): ( 1 ( cyan green violet grey darkpurple magenta ) )
(?): ( 2 ( cyan green violet grey darkpurple magenta ) )
(?): ( 6 ( cyan green violet grey darkpurple magenta ) )
```



```
#lang racket

( require 2htdp/image )

( define ( color-thing )
   ( display "(?): " )
   ( define the-list ( read ) )
   ( cond
     [( equal? ( car the-list) 'all )
      ( display-all-bars ( cadr the-list ) ) ]
     {( equal? ( car the-list) 'random )
      ( display-random ( cadr the-list ) ) }
     [else
      (display-one ( car the-list ) ( cadr the-list ) ) ] )
   ( display "\n" )
   ( color-thing ) )

( define ( bar color ) ( display ( rectangle 600 50 "solid" color  ) ) )

( define ( display-all-bars color-list )
   (cond
     [(not ( empty? color-list) )
           ( bar ( car color-list) )
           ( display "\n" )
           ( display-all-bars ( cdr color-list ) ) ] ) )

( define ( display-random color-list )
   ( bar ( list-ref color-list ( random ( length color-list ) ) ) ) )

( define ( display-one choice color-list )
   ( bar ( list-ref color-list ( - choice 1 ) ) ) )
```

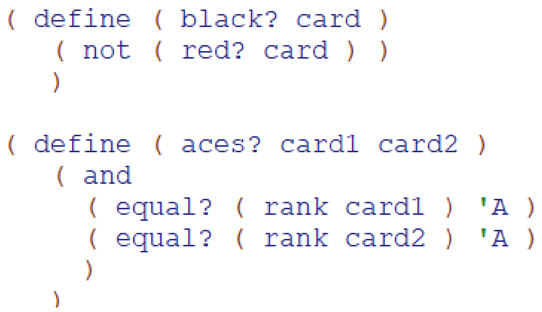
Part 4.A



```
Welcome to DrRacket, version 8.3 [cs].
Language: racket, with debugging; memory limit: 1024 MB.
> ( define c1 '( 7 C ) )
> ( define c2 '( Q H ) )
> c1
'(7 C)
> c2
'(Q H)
> ( rank c1 )
7
> ( suit c1 )
'C
> ( rank c2 )
'Q
> ( suit c2 )
'H
> ( red? c1 )
#f
> ( red? c2 )
#t
> ( black? c1 )
#t
> ( black? c2 )
#f
> ( aces? '( A C) '(A S ) )
#t
> ( aces '( K S ) '( A C ) )
 aces: undefined;
 cannot reference an identifier before its definition
> ( aces? '( K S ) '( A C ) )
#f
> ( ranks 4 )
'((4 C) (4 D) (4 H) (4 S))
> ( ranks 'K )
'((K C) (K D) (K H) (K S))
> ( length ( deck ) )
52
> ( display (deck ) )
((2 C) (2 D) (2 H) (2 S) (3 C) (3 D) (3 H) (3 S) (4 C) (4 D) (4 H) (4 S) (5 C) (5 D) (5 H) (5 S) (6 C) (6 D) (6
H) (6 S) (7 C) (7 D) (7 H) (7 S) (8 C) (8 D) (8 H) (8 S) (9 C) (9 D) (9 H) (9 S) (X C) (X D) (X H) (X S) (J C)
(J D) (J H) (J S) (Q C) (Q D) (Q H) (Q S) (K C) (K D) (K H) (K S) (A C) (A D) (A H) (A S))
> ( pick-a-card)
'(X S)
> ( pick-a-card)
'(J S)
> ( pick-a-card)
'(K S)
> ( pick-a-card)
'(2 H)
> ( pick-a-card)
'(K H)
> ( pick-a-card)
'(Q D)
```

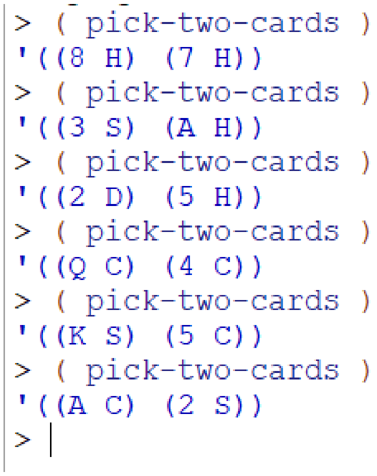
Nathaniel Wolf
Racket Programming Assignment #3: Lambda and Basic Lisp
2/28/2022
CSC 344

```
#lang racket

( require racket/trace )

( define ( ranks rank )
   ( list
     ( list rank 'C )
     ( list rank 'D )
     ( list rank 'H )
     ( list rank 'S )
     )
   )

( define ( deck )
   ( append
     ( ranks 2 )
     ( ranks 3 )
     ( ranks 4 )
     ( ranks 5 )
     ( ranks 6 )
     ( ranks 7 )
     ( ranks 8 )
     ( ranks 9 )
     ( ranks 'X )
     ( ranks 'J )
     ( ranks 'Q )
     ( ranks 'K )
     ( ranks 'A )
     )
   )

( define ( pick-a-card )
   ( define cards ( deck ) )
   ( list-ref cards ( random ( length cards ) ) )
   )

( define ( show card )
   ( display ( rank card ) )
   ( display ( suit card ) )
   )

( define ( rank card )
   ( car card )
   )

( define ( suit card )
   ( cadr card )
   )

( define ( red? card )
   ( or
     ( equal? ( suit card ) 'D )
     ( equal? ( suit card ) 'H )
     )
   )
```

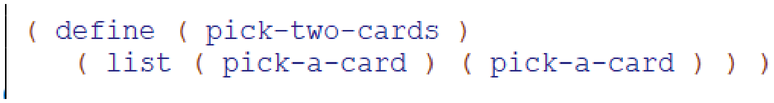


```
( define ( black? card )
   ( not ( red? card ) )
   )

( define ( aces? card1 card2 )
   ( and
     ( equal? ( rank card1 ) 'A )
     ( equal? ( rank card2 ) 'A )
     )
   )
```

Part 4.B

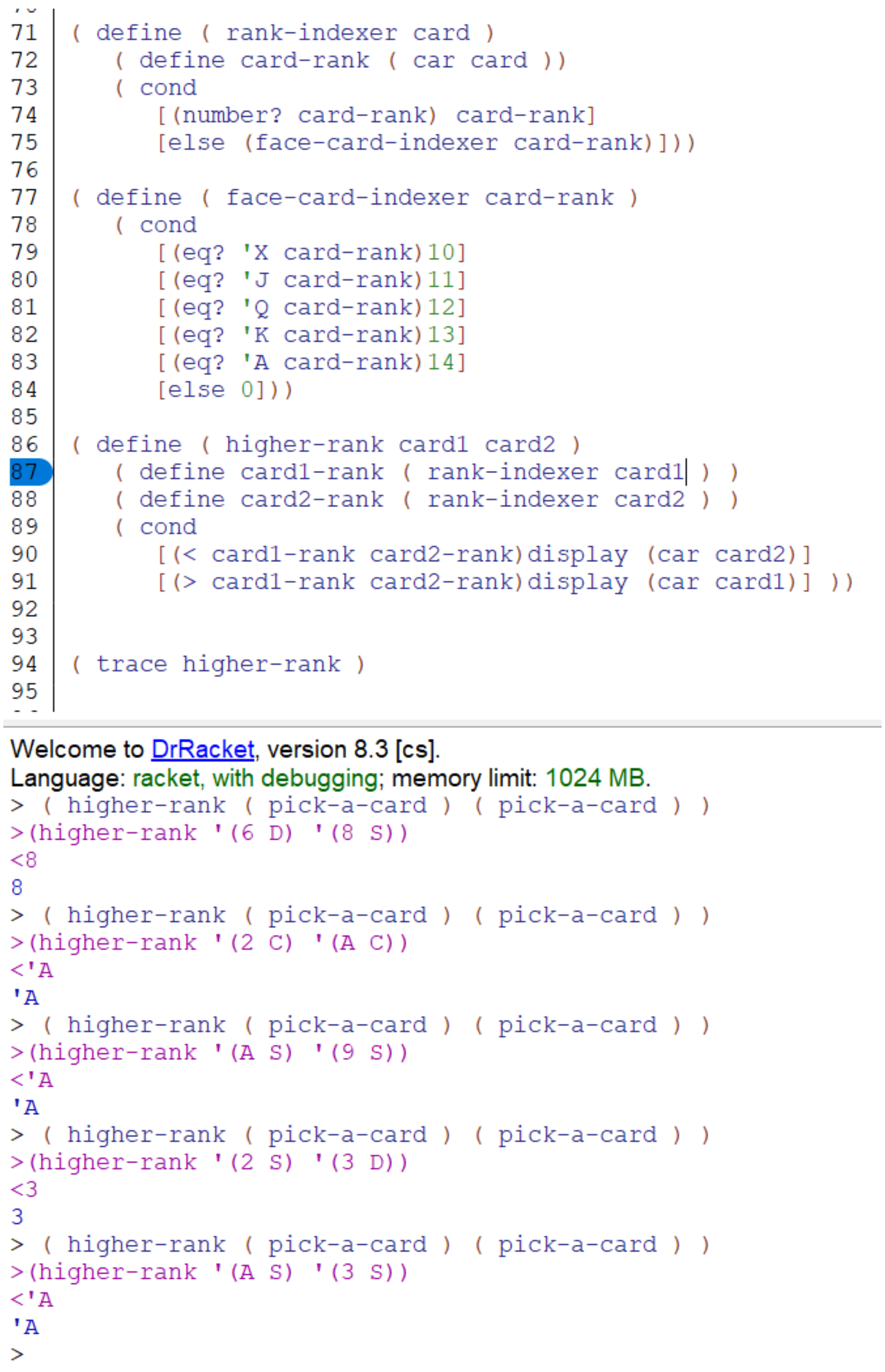


```
> ( pick-two-cards )
'((8 H) (7 H))
> ( pick-two-cards )
'((3 S) (A H))
> ( pick-two-cards )
'((2 D) (5 H))
> ( pick-two-cards )
'((Q C) (4 C))
> ( pick-two-cards )
'((K S) (5 C))
> ( pick-two-cards )
'((A C) (2 S))
>
```



```
( define ( pick-two-cards )
   ( list ( pick-a-card ) ( pick-a-card ) ) )
```

Part 4.B cont

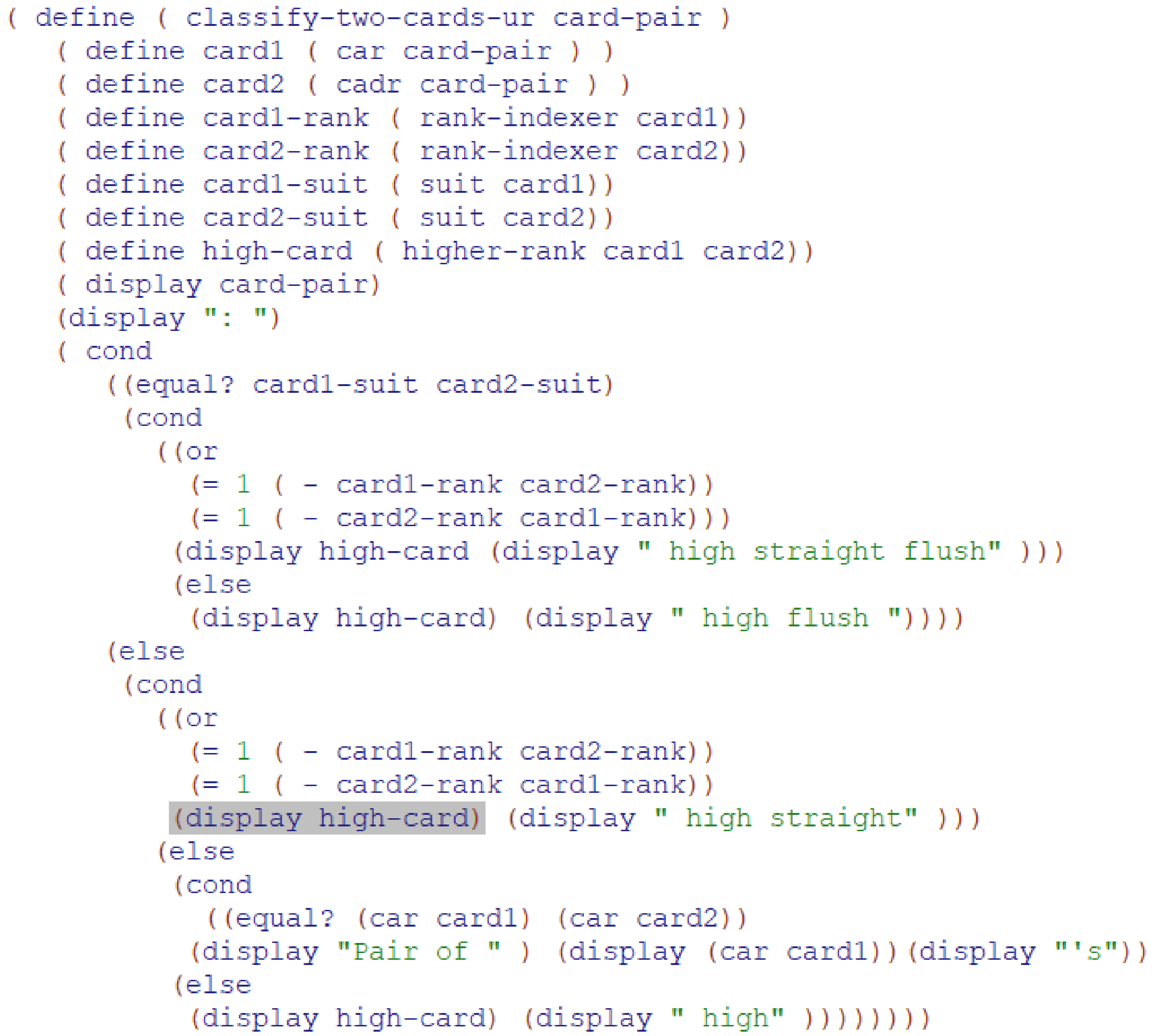


```
( define ( rank-indexer card )
   ( define card-rank ( car card ))
   ( cond
      [(number? card-rank) card-rank]
      [else (face-card-indexer card-rank)]))

( define ( face-card-indexer card-rank )
   ( cond
      [(eq? 'X card-rank)10]
      [(eq? 'J card-rank)11]
      [(eq? 'Q card-rank)12]
      [(eq? 'K card-rank)13]
      [(eq? 'A card-rank)14]
      [else 0]))

( define ( higher-rank card1 card2 )
   ( define card1-rank ( rank-indexer card1 ) )
   ( define card2-rank ( rank-indexer card2 ) )
   ( cond
      [(< card1-rank card2-rank)display (car card2)]
      [(> card1-rank card2-rank)display (car card1)] ))


( trace higher-rank )
```

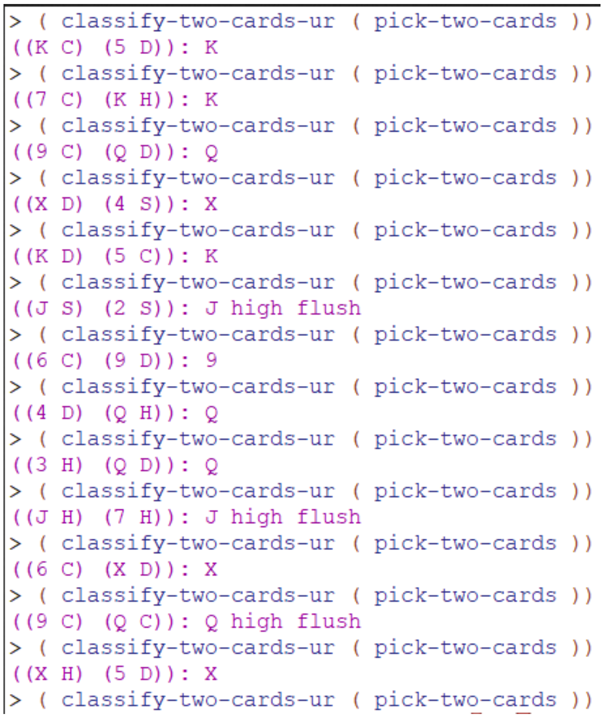
```
Welcome to DrRacket, version 8.3 [cs].
Language: racket, with debugging; memory limit: 1024 MB.
> ( higher-rank ( pick-a-card ) ( pick-a-card ) )
>(higher-rank '(6 D) '(8 S))
<8
8
> ( higher-rank ( pick-a-card ) ( pick-a-card ) )
>(higher-rank '(2 C) '(A C))
<'A
'A
> ( higher-rank ( pick-a-card ) ( pick-a-card ) )
>(higher-rank '(A S) '(9 S))
<'A
'A
> ( higher-rank ( pick-a-card ) ( pick-a-card ) )
>(higher-rank '(2 S) '(3 D))
<3
3
> ( higher-rank ( pick-a-card ) ( pick-a-card ) )
>(higher-rank '(A S) '(3 S))
<'A
'A
>
```

Part 4.B cont

Nathaniel Wolf
Racket Programming Assignment #3: Lambda and Basic Lisp
2/28/2022
CSC 344



```
( define ( classify-two-cards-ur card-pair )
   ( define card1 ( car card-pair ) )
   ( define card2 ( cadr card-pair ) )
   ( define card1-rank ( rank-indexer card1))
   ( define card2-rank ( rank-indexer card2))
   ( define card1-suit ( suit card1))
   ( define card2-suit ( suit card2))
   ( define high-card ( higher-rank card1 card2))
   ( display card-pair)
   (display ": ")
   ( cond
      ((equal? card1-suit card2-suit)
       (cond
         ((or
           (= 1 ( - card1-rank card2-rank))
           (= 1 ( - card2-rank card1-rank)))
          (display high-card (display " high straight flush" )))
          (else
           (display high-card) (display " high flush "))))
      (else
       (cond
         ((or
           (= 1 ( - card1-rank card2-rank))
           (= 1 ( - card2-rank card1-rank))
          (display high-card) (display " high straight" )))
         (else
          (cond
            ((equal? (car card1) (car card2))
           (display "Pair of " ) (display (car card1))(display "'s"))
          (else
           (display high-card) (display " high" ))))))))
```



```
> ( classify-two-cards-ur ( pick-two-cards ))
((K C) (5 D)): K
> ( classify-two-cards-ur ( pick-two-cards ))
((7 C) (K H)): K
> ( classify-two-cards-ur ( pick-two-cards ))
((9 C) (Q D)): Q
> ( classify-two-cards-ur ( pick-two-cards ))
((X D) (4 S)): X
> ( classify-two-cards-ur ( pick-two-cards ))
((K D) (5 C)): K
> ( classify-two-cards-ur ( pick-two-cards ))
((J S) (2 S)): J high flush
> ( classify-two-cards-ur ( pick-two-cards ))
((6 C) (9 D)): 9
> ( classify-two-cards-ur ( pick-two-cards ))
((4 D) (Q H)): Q
> ( classify-two-cards-ur ( pick-two-cards ))
((3 H) (Q D)): Q
> ( classify-two-cards-ur ( pick-two-cards ))
((J H) (7 H)): J high flush
> ( classify-two-cards-ur ( pick-two-cards ))
((6 C) (X D)): X
> ( classify-two-cards-ur ( pick-two-cards ))
((9 C) (Q C)): Q high flush
> ( classify-two-cards-ur ( pick-two-cards ))
((X H) (5 D)): X
> ( classify-two-cards-ur ( pick-two-cards ))
```