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CSC 344 Programming Languages

Assignment 5: RLP and HoFs

Abstract: This assignment introduces us to RLP and HoFs in Racket Programming language. In this assignment I was able to gain a basic understanding of these concepts as this project opened my eyes and helped me appreciate the power of RLP and HoFs as well as helped me improve my problem solving/programming skills.

Task 1A Code and Demo:



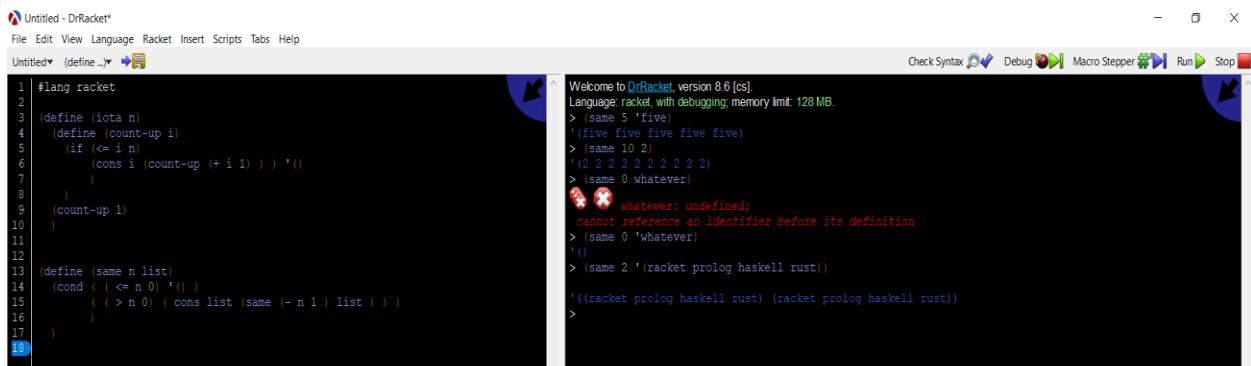
The screenshot shows the DrRacket IDE with a file named 'Untitled - DrRacket*.rkt'. The code in the editor is as follows:

```
1 #lang racket
2
3 (define (iota n)
4   (define (count-up i)
5     (if (<= i n)
6       (cons i (count-up (+ i 1))) '())
7     )
8   )
9   (count-up 1)
10 )
```

The right-hand pane shows the REPL output:

```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging, memory limit: 128 MB.
> (iota 10)
'(1 2 3 4 5 6 7 8 9 10)
> (iota 1)
'(1)
> (iota 12)
'(1 2 3 4 5 6 7 8 9 10 11 12)
```

Task 1B Code and Demo:



The screenshot shows the DrRacket IDE with a file named 'Untitled - DrRacket*.rkt'. The code in the editor is as follows:

```
1 #lang racket
2
3 (define (iota n)
4   (define (count-up i)
5     (if (<= i n)
6       (cons i (count-up (+ i 1))) '())
7     )
8   )
9   (count-up 1)
10 )
11
12 (define (same n list)
13   (cond ((<= n 0) '())
14         ((> n 0) (cons list (same (- n 1) list))))
15 )
```

The right-hand pane shows the REPL output:

```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging, memory limit: 128 MB.
> (same 5 'five)
'(five five five five five)
> (same 10 2)
'(2 2 2 2 2 2 2 2 2 2)
> (same 0 whatever)
'()
> (same 2 '(racket prolog haskell rust))
'((racket prolog haskell rust) (racket prolog haskell rust))
```

Task 1C Code and Demo:

The screenshot shows the DrRacket IDE with a file named 'Untitled - DrRacket'. The left pane contains Racket code defining several functions: `iota`, `count-up`, `same`, and `alternator`. The right pane shows the REPL output, which includes a welcome message and several interactive commands and their results, such as `(alternator 7 '(black white))` returning `'(black white black white black white black)`.

```
#lang racket

(define (iota n)
  (define (count-up i)
    (if (<= i n)
        (cons i (count-up (+ i 1))) '()))
  (count-up 1))

(define (same n list)
  (cond ((<= n 0) '())
        ((> n 0) (cons list (same (- n 1) list)))))

(define (alternator i objList)
  (cond ((<= i 0) '())
        ((> i 0) (cons (car objList)
                        (alternator (- i 1)
                                   (append (cdr objList) (list (car objList))))))))

Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging, memory limit: 128 MB.
> (alternator 7 '(black white))
'(black white black white black white black)
> (alternator 12 '(red yellow blue))
'(red yellow blue red yellow blue red yellow blue)
> (alternator 9 '(1 2 3 4))
'(1 2 3 4 1 2 3 4 1)
> (alternator 12 '(x y))
'(x y x y x y x y x y x y)
> |
```

Task 1D Code and Demo:

This screenshot shows the DrRacket IDE with a file named 'Untitled - DrRacket'. The left pane contains Racket code defining `iota`, `count-up`, `same`, `alternator`, and a new function `sequence`. The right pane shows the REPL output, including the welcome message and several commands like `(sequence 5 20)` returning `'(20 40 60 80 100)`.

```
#lang racket

(define (iota n)
  (define (count-up i)
    (if (<= i n)
        (cons i (count-up (+ i 1))) '()))
  (count-up 1))

(define (same n list)
  (cond ((<= n 0) '())
        ((> n 0) (cons list (same (- n 1) list)))))

(define (alternator i objList)
  (cond ((<= i 0) '())
        ((> i 0) (cons (car objList)
                        (alternator (- i 1)
                                   (append (cdr objList) (list (car objList))))))))

(define (sequence num seq)
  (cond ((<= num 0) '())
        (else (map (lambda (x) (* x seq)) (iota num))))))

Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging, memory limit: 128 MB.
> (sequence 5 20)
'(20 40 60 80 100)
> (sequence 10 7)
'(7 14 21 28 35 42 49 56 63 70)
> (sequence 8 50)
'(50 100 150 200 250 300 350 400)
> |
```

Task 2 Counting and Task 2A Code and Demo:

The screenshot shows the DrRacket IDE with two panes. The left pane contains Racket code for Task 2B, and the right pane shows the interactive console output.

```
#lang racket

(count-up 1)

(define (same n list)
  (cond ((<= n 0) '())
        ((> n 0) (cons list (same (- n 1) list)))))

(define (alternator i objList)
  (cond ((<= i 0) '())
        ((> i 0) (cons (car objList)
                        (alternator (- i 1)
                                   (append (cdr objList) (list (car objList)))))))

(define (sequence num seq)
  (cond ((<= num 0) '())
        (else (map (lambda (x) (* x seq)) (iota num)))))

(define (a-count list)
  (cond ((empty? list) '())
        (else (append (iota (car list)) (a-count (cdr list))))))
```

The right pane shows the following output:

```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging, memory limit: 128 MB.
> (a-count '(1 2 3))
'(1 1 2 1 2 3)
> (a-count '(4 3 2 1))
'(1 2 3 4 1 2 3 1 2 1)
> (a-count '(1 1 2 2 3 3 2 2 1 1))
'(1 1 1 2 1 2 1 2 2 3 1 2 3 1 2 2 1 1)
> |
```

Task 2B Code and Demo:

The screenshot shows the DrRacket IDE with two panes. The left pane contains Racket code for Task 2C, and the right pane shows the interactive console output.

```
#lang racket

(define (alternator i objList)
  (cond ((<= i 0) '())
        ((> i 0) (cons (car objList)
                        (alternator (- i 1)
                                   (append (cdr objList) (list (car objList)))))))

(define (sequence num seq)
  (cond ((<= num 0) '())
        (else (map (lambda (x) (* x seq)) (iota num)))))

(define (a-count list)
  (cond ((empty? list) '())
        (else (append (iota (car list)) (a-count (cdr list))))))

(define (r-count list)
  (cond ((empty? list) '())
        (else (append (same (car list) (car list)) (r-count (cdr list))))))
```

The right pane shows the following output:

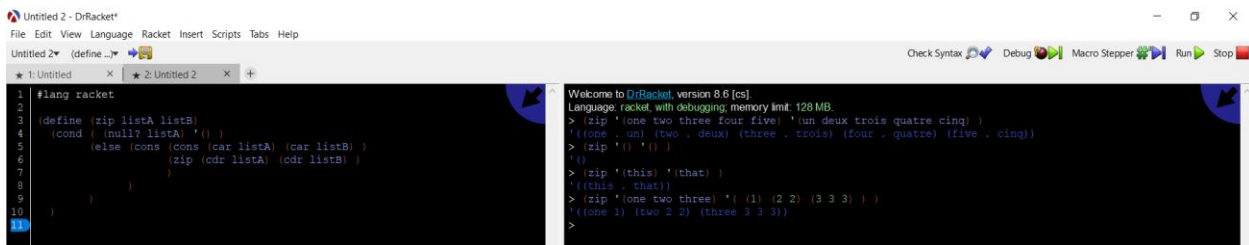
```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging, memory limit: 128 MB.
> (r-count '(1 2 3))
'(1 2 2 3 3 3)
> (r-count '(4 3 2 1))
'(4 4 4 4 3 3 3 2 2 1)
> (r-count '(1 1 2 2 3 3 2 2 1 1))
'(1 1 2 2 2 2 3 3 3 3 3 2 2 2 2 1 1)
> |
```

Task 2C Demo:



```
Welcome to DrRacket, version 8.6 [cs]
Language: racket, with debugging, memory limit: 128 MB.
> (a-count '(1 2 3) )
'(1 1 2 1 2 3)
> (r-count '(1 2 3) )
'(1 2 2 3 3 3)
> (r-count (a-count '(1 2 3) ) )
'(1 1 2 2 1 2 2 3 3 3)
> (a-count (r-count '(1 2 3) ) )
'(1 1 2 1 2 1 2 3 1 2 3 1 2 3)
> (a-count '(2 2 5 3) )
'(1 2 1 2 1 2 3 4 5 1 2 3)
> (r-count '(2 2 5 3) )
'(2 2 2 2 5 5 5 5 5 3 3 3)
> (r-count (a-count '(2 2 5 3) ) )
'(1 2 2 1 2 2 1 2 2 3 3 3 4 4 4 4 5 5 5 5 1 2 2 3 3 3)
> (a-count (r-count '(2 2 5 3) ) )
'(1 2 1 2 1 2 1 2 1 2 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 1 2 3 1 2 3)
> |
```

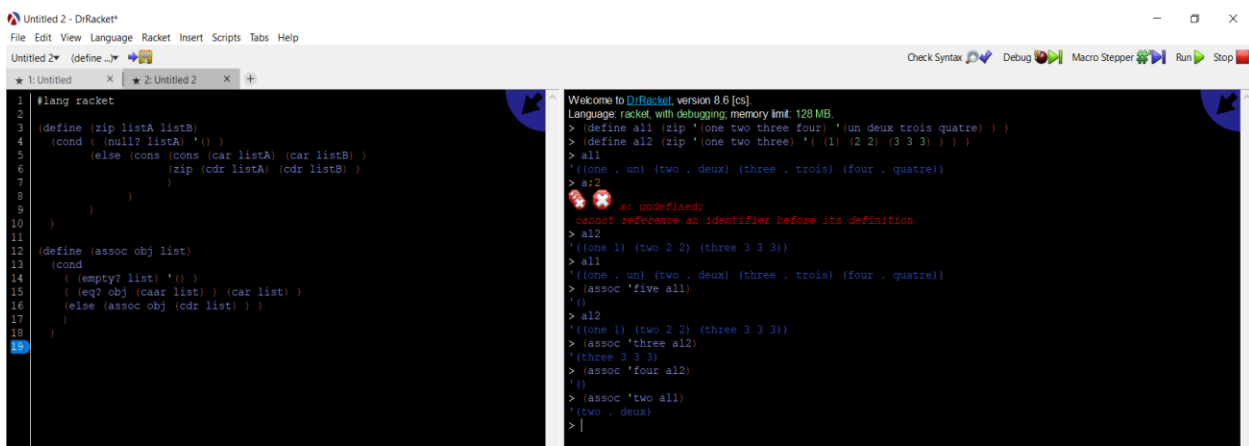
Task 3 Association List and Task 3A Code and Demo:



```
#lang racket
(define (zip listA listB)
  (cond (null? listA) '()
        (else (cons (cons (car listA) (car listB))
                      (zip (cdr listA) (cdr listB)))))
  )
)

Welcome to DrRacket, version 8.6 [cs]
Language: racket, with debugging, memory limit: 128 MB.
> (zip '(one two three four five) '(un deux trois quatre cinq) )
'((one . un) (two . deux) (three . trois) (four . quatre) (five . cinq))
> (zip '() '())
'()
> (zip '(this) '(that) )
'((this . that))
> (zip '(one two three) '(1) (2 2) (3 3 3) )
'((one 1) (two 2 2) (three 3 3 3))
> |
```

Task 3B Code and Demo:



```
#lang racket
(define (assoc obj list)
  (cond (empty? list) '()
        (eq? obj (car list)) (car list)
        (else (assoc obj (cdr list)))))
  )
)

Welcome to DrRacket, version 8.6 [cs]
Language: racket, with debugging, memory limit: 128 MB.
> (define all (zip '(one two three four) '(un deux trois quatre) ))
> (define al2 (zip '(one two three) '(1) (2 2) (3 3 3) ))
> all
'((one . un) (two . deux) (three . trois) (four . quatre))
> a/2
a: undefined;
cannot reference an identifier before its definition
> al2
'((one 1) (two 2 2) (three 3 3 3))
> all
'((one . un) (two . deux) (three . trois) (four . quatre))
> (assoc 'five all)
'()
> al2
'((one 1) (two 2 2) (three 3 3 3))
> (assoc 'three al2)
'(three 3 3 3)
> (assoc 'four al2)
'()
> (assoc 'two all)
'(two . deux)
> |
```

Task 3C Code and Demo:

The screenshot shows the DrRacket IDE with a file named "Untitled 2 - DrRacket". The editor contains Racket code for Task 4. The code defines several functions: `zip`, `assoc`, `scale-zip-CM`, `scale-zip-short-AM`, `scale-zip-short-low-AM`, `scale-zip-short-low-blues-Dm`, and `scale-zip-whole-tone-C`. The code is as follows:

```
#lang racket

(define (zip listA listB)
  (cond ((null? listA) '())
        (else (cons (cons (car listA) (car listB))
                      (zip (cdr listA) (cdr listB))))))

(define (assoc obj list)
  (cond ((empty? list) '())
        ((eq? obj (caar list)) (car list))
        (else (assoc obj (cdr list)))))

(define scale-zip-CM
  (zip (iota 7) '("C" "D" "E" "F" "G" "A" "B")))

(define scale-zip-short-AM
  (zip (iota 7) '("A/2" "B/2" "C/2" "D/2" "E/2" "F/2" "G/2")))

(define scale-zip-short-low-AM
  (zip (iota 7) '("A,/2" "B,/2" "C,/2" "D,/2" "E,/2" "F,/2" "G,/2")))

(define scale-zip-short-low-blues-Dm
  (zip (iota 7) '("D,/2" "E,/2" "F,/2" "G,/2" "A,/2" "B,/2" "C,/2")))

(define scale-zip-whole-tone-C
  (zip (iota 7) '("C" "D" "E" "F" "G" "A" "B")))

Determine language from source
```

The right pane shows the Welcome to DrRacket, version 8.6 [cs] message and the Racket language. The console output shows the results of the code execution:

```
Welcome to DrRacket, version 8.6 [cs]
Language: racket, with debugging, memory limit: 128 MB.
> scale-zip-CM
'(("C" (2 . "D") (3 . "E") (4 . "F") (5 . "G") (6 . "A") (7 . "B")))
> scale-zip-short-AM
'(("A/2" (2 . "B/2") (3 . "C/2") (4 . "D/2") (5 . "E/2") (6 . "F/2") (7 . "G/2")))
> scale-zip-short-low-AM
'(("A,/2" (2 . "B,/2") (3 . "C,/2") (4 . "D,/2") (5 . "E,/2") (6 . "F,/2") (7 . "G,/2")))
> scale-zip-short-low-blues-Dm
'(("D,/2" (2 . "E,/2") (3 . "F,/2") (4 . "G,/2") (5 . "A,/2") (6 . "B,/2") (7 . "C,/2")))
> scale-zip-whole-tone-C
'(("C" (2 . "D") (3 . "E") (4 . "F") (5 . "G") (6 . "A") (7 . "B")))
>
```

Task 4 Numbers to Notes to ABC and Task 4A Code and Demo:

The screenshot shows the DrRacket IDE with a file named "Task 3.rkt - DrRacket". The editor contains Racket code for Task 4B and C. The code defines several functions: `zip`, `assoc`, `scale-zip-CM`, `scale-zip-short-AM`, `scale-zip-short-low-AM`, `scale-zip-short-low-blues-Dm`, `scale-zip-whole-tone-C`, and `nr-note`. The code is as follows:

```
#lang racket

(define (assoc obj list)
  (cond ((empty? list) '())
        ((eq? obj (caar list)) (car list))
        (else (assoc obj (cdr list)))))

(define scale-zip-CM
  (zip (iota 7) '("C" "D" "E" "F" "G" "A" "B")))

(define scale-zip-short-AM
  (zip (iota 7) '("A/2" "B/2" "C/2" "D/2" "E/2" "F/2" "G/2")))

(define scale-zip-short-low-AM
  (zip (iota 7) '("A,/2" "B,/2" "C,/2" "D,/2" "E,/2" "F,/2" "G,/2")))

(define scale-zip-short-low-blues-Dm
  (zip (iota 7) '("D,/2" "E,/2" "F,/2" "G,/2" "A,/2" "B,/2" "C,/2")))

(define scale-zip-whole-tone-C
  (zip (iota 7) '("C" "D" "E" "F" "G" "A" "B")))

(define (nr-note smallint assoc-list)
  (cond ((= (length assoc-list) 0) '())
        ((= (car (car assoc-list)) smallint)
         (cdr (car assoc-list)))
        (else (nr-note smallint (cdr assoc-list)))))

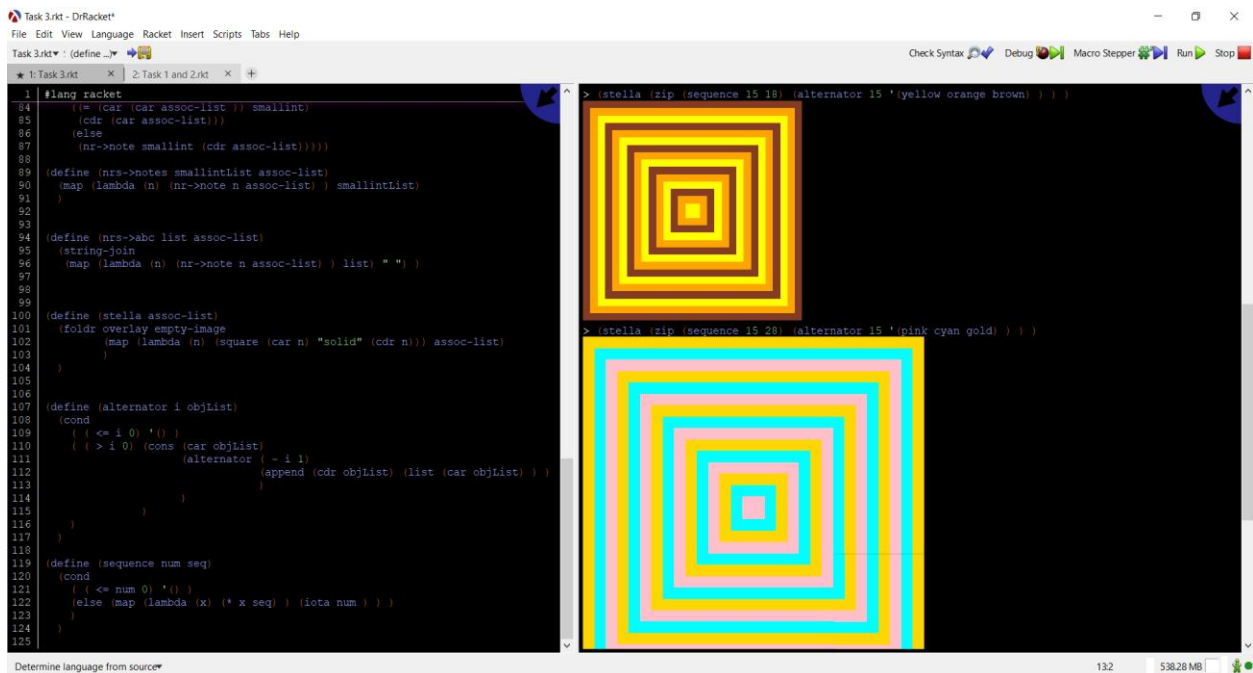
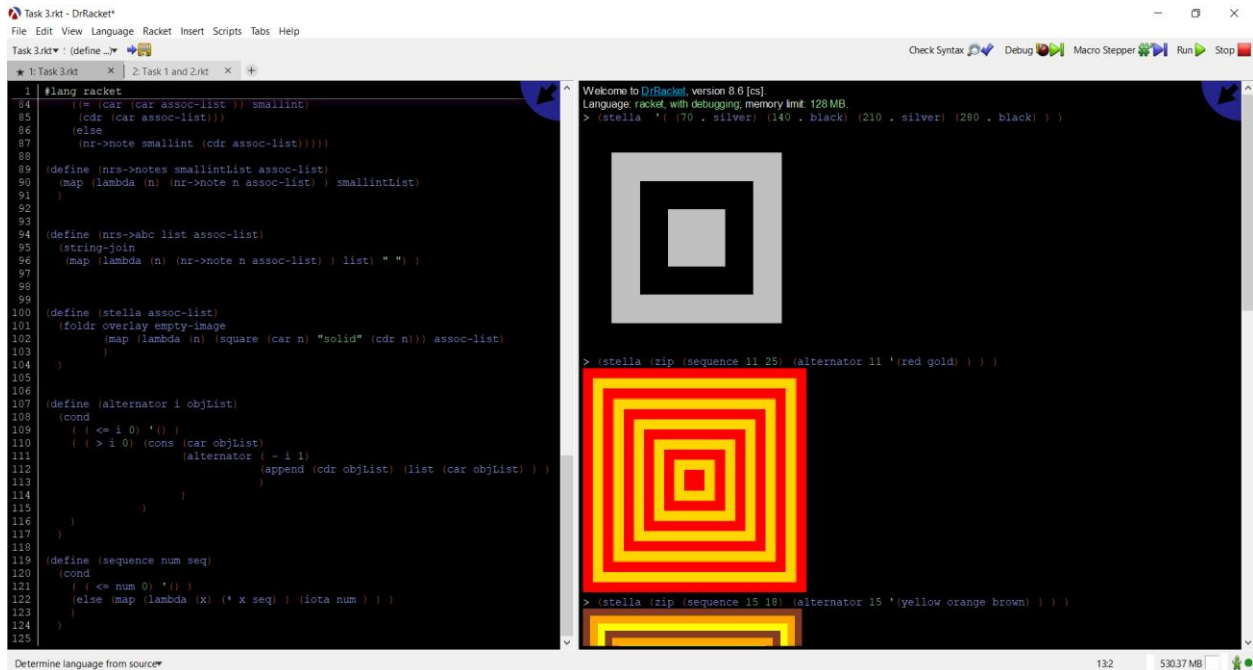
Determine language from source
```

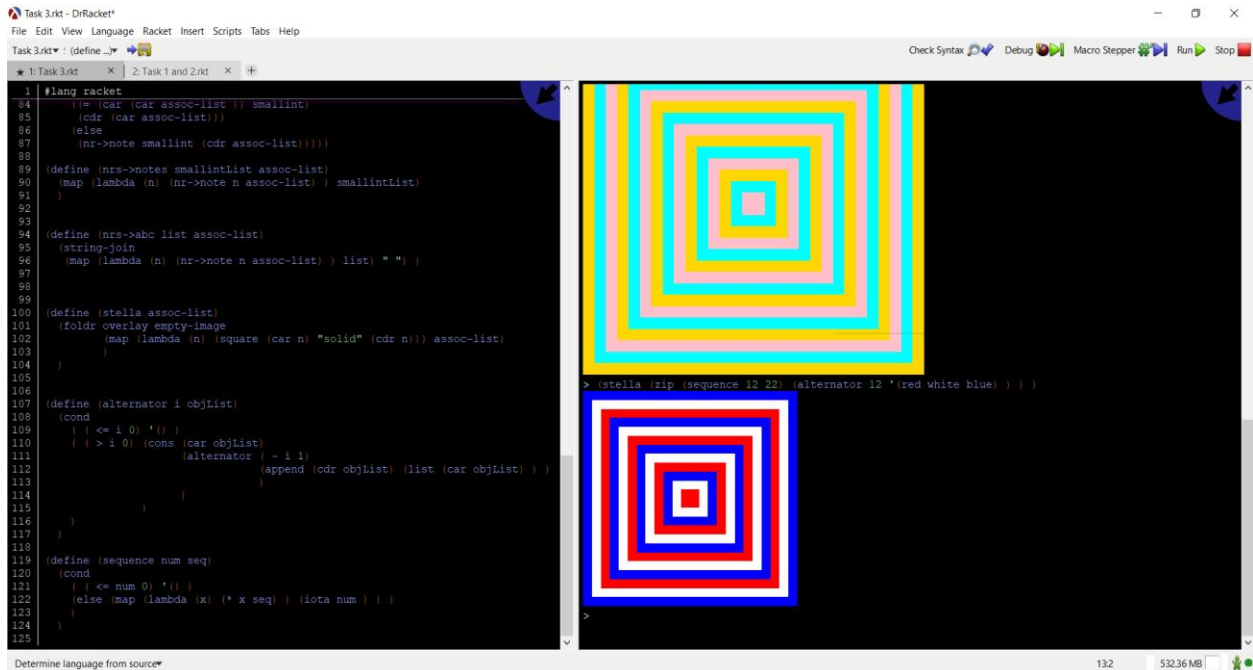
The right pane shows the Welcome to DrRacket, version 8.6 [cs] message and the Racket language. The console output shows the results of the code execution:

```
Welcome to DrRacket, version 8.6 [cs]
Language: racket, with debugging, memory limit: 128 MB.
> (nr-note 1 scale-zip-CM)
"C"
> (nr-note 1 scale-zip-short-AM)
"A/2"
> (nr-note 1 scale-zip-short-low-AM)
"A,/2"
> (nr-note 3 scale-zip-CM)
"E"
> (nr-note 4 scale-zip-short-AM)
"D/2"
> (nr-note 5 scale-zip-short-low-AM)
"D,/2"
> (nr-note 1 scale-zip-short-low-blues-Dm)
"D,/2"
> (nr-note 1 scale-zip-whole-tone-C)
"C"
> (nr-note 4 scale-zip-short-low-blues-Dm)
"A,/2"
> (nr-note 4 scale-zip-whole-tone-C)
"A"
>
```

Task 4B and C Code and Demo:

```
Task 3.rkt - DrRacket
File Edit View Language Racket Insert Scripts Tabs Help
Task 3.rkt - (define ...)
1 #lang racket
2
3
4
5
6 (define scale-zip-CM
7   (zip (iota 7) '("C" "D" "E" "F" "G" "A" "B") )
8 )
9
10 (define scale-zip-short-AM
11   (zip (iota 7) '("A/2" "B/2" "C/2" "D/2" "E/2" "F/2" "G/2") )
12 )
13
14 (define scale-zip-short-low-AM
15   (zip (iota 7) '("A,/2" "B,/2" "C,/2" "D,/2" "E,/2" "F,/2" "G,/2") )
16 )
17
18 (define scale-zip-short-low-blues-Dm
19   (zip (iota 7) '("D,/2" "E,/2" "F,/2" "G,/2" "A,/2" "B,/2" "C,/2" "d,/2") )
20 )
21
22 (define scale-zip-whole-tone-C
23   (zip (iota 7) '("C" "D" "E" "F" "G" "A" "c") )
24 )
25
26 (define (nr->note smallint assoc-list)
27   (cond
28     [(= (length assoc-list) 0)
29      '()]
30     [(= (car (car assoc-list)) smallint)
31      (cdr (car assoc-list))]
32     [else
33      (nr->note smallint (cdr assoc-list))])
34 )
35
36 (define (nrs->notes smallintList assoc-list)
37   (map (lambda (n) (nr->note n assoc-list) ) smallintList)
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Task 6 Chromesthic Renderings TaskA Code and Demo:



Task 7 Grapheme to Color Synesthesia, Code and Demo:


```

1 #lang racket
138
139 (define AI (text "A" 36 "orange" ) )
140 (define BI (text "B" 36 "red" ) )
141 (define CI (text "C" 36 "blue" ) )
142 (define DI (text "D" 36 "green" ) )
143 (define EI (text "E" 36 "teal" ) )
144 (define FI (text "F" 36 "royal blue" ) )
145 (define GI (text "G" 36 "cyan" ) )
146 (define HI (text "H" 36 "aqua" ) )
147 (define II (text "I" 36 "teal" ) )
148 (define JI (text "J" 36 "navy" ) )
149 (define KI (text "K" 36 "indigo" ) )
150 (define LI (text "L" 36 "purple" ) )
151 (define MI (text "M" 36 "violet" ) )
152 (define NI (text "N" 36 "plum" ) )
153 (define OI (text "O" 36 "coral" ) )
154 (define PI (text "P" 36 "olive" ) )
155 (define QI (text "Q" 36 "silver" ) )
156 (define RI (text "R" 36 "khaki" ) )
157 (define SI (text "S" 36 "linen" ) )
158 (define TI (text "T" 36 "snow" ) )
159 (define UI (text "U" 36 "orchid" ) )
160 (define VI (text "V" 36 "gold" ) )
161 (define WI (text "W" 36 "wheat" ) )
162 (define XI (text "X" 36 "sienna" ) )
163 (define YI (text "Y" 36 "crimson" ) )
164
165 (define alphabet '(A B C D E F G H I J K L M N O P Q R S T U V W X Y ) )
166
167 (define alphabetic (list AI BI CI DI EI FI GI HI II JI KI LI MI NI OI PI QI RI SI ) )
168
169 (define a->i (zip alphabet alphabetic) )
170
171 (define (letter->image l)
172   (cdr (assoc l a->i) )
173 )
174
175 (define (gcs letters)
176   (foldr beside empty-image
177     (map (lambda (letter) (letter->image letter) ) ) letters) )
178 )

```

```

Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.

❗❗❗ oax: contract violation
  expected: pair?
  given: ()
> alphabet
'(A B C D E F G H I J K L M N O P Q R S T U V W X Y)
> alphabetic
(list A B C D E F G H I J K L M N O P Q R S T U V W X Y)
> (gcs '(C A B) )
❗❗❗ gcs: undefined;
  cannot reference an identifier before its definition
> |

```