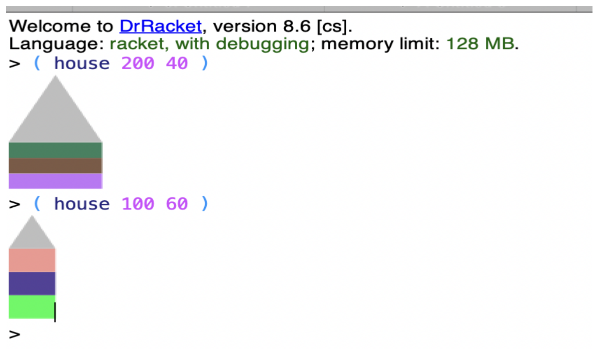
Racket Programming Assignment #2: Racket Functions and Recursion

Learning Abstract

This following assignment is another glimpse at the programming language known as Racket. This assignment shows seven different programs that involve the form of recursion. The first program involves making a three story house and tract by repeatedly placing rectangles on top of each other or beside each other. The second program involves rolling dice until meeting a specific requirement. The third program involves using numerical series. The fourth program involves making an array of dots. The fifth program involves layering the same shape on top of each other. The sixth program involves recursion by using itself twice. The last program involves repeating squares in order to make a shape.

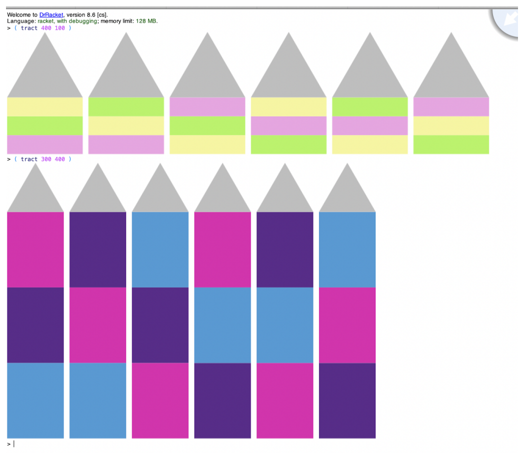
Task 1

House:



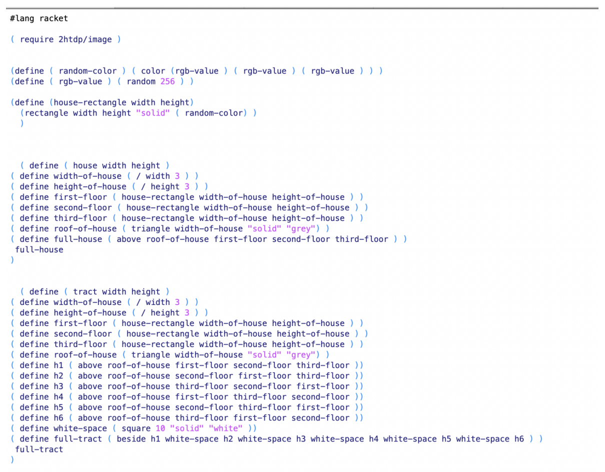
```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> ( house 200 40 )
> ( house 100 60 )
>
```

Tract:



```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> ( tract 400 100 )
> ( tract 300 400 )
>
```

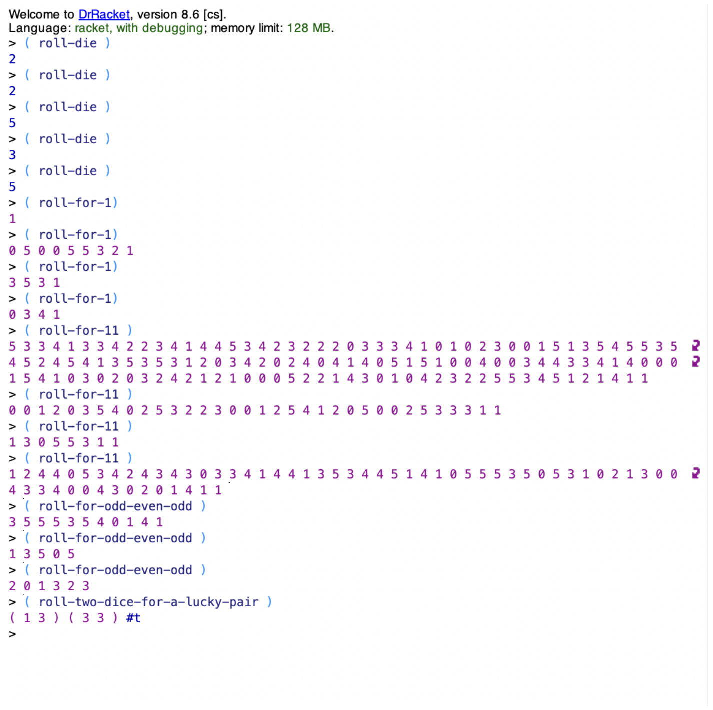
Code:



```
#lang racket

( require 2htdp/image )


(define ( random-color ) ( color (rgb-value ) ( rgb-value ) ( rgb-value ) ) )
(define ( rgb-value ) ( random 256 ) )

(define (house-rectangle width height)
  (rectangle width height "solid" ( random-color) )
  )



  ( define ( house width height )
( define width-of-house ( / width 3 ) )
( define height-of-house ( / height 3 ) )
( define first-floor ( house-rectangle width-of-house height-of-house ) )
( define second-floor ( house-rectangle width-of-house height-of-house ) )
( define third-floor ( house-rectangle width-of-house height-of-house ) )
( define roof-of-house ( triangle width-of-house "solid" "grey") )
( define full-house ( above roof-of-house first-floor second-floor third-floor ) )
 full-house
)


  ( define ( tract width height )
( define width-of-house ( / width 3 ) )
( define height-of-house ( / height 3 ) )
( define first-floor ( house-rectangle width-of-house height-of-house ) )
( define second-floor ( house-rectangle width-of-house height-of-house ) )
( define third-floor ( house-rectangle width-of-house height-of-house ) )
( define roof-of-house ( triangle width-of-house "solid" "grey") )
( define h1 ( above roof-of-house first-floor second-floor third-floor ))
( define h2 ( above roof-of-house second-floor first-floor third-floor ))
( define h3 ( above roof-of-house third-floor second-floor first-floor ))
( define h4 ( above roof-of-house first-floor third-floor second-floor ))
( define h5 ( above roof-of-house second-floor third-floor first-floor ))
( define h6 ( above roof-of-house third-floor first-floor second-floor ))
( define white-space ( square 10 "solid" "white" ))
( define full-tract ( beside h1 white-space h2 white-space h3 white-space h4 white-space h5 white-space h6 ) )
 full-tract
)
```

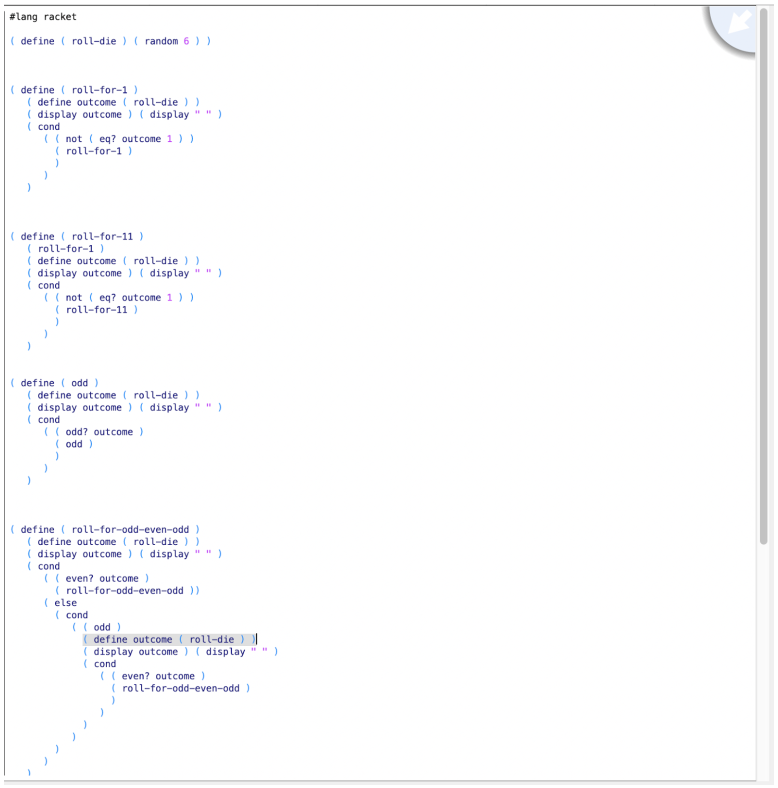
Task 2

Dice:



```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> ( roll-die )
2
> ( roll-die )
2
> ( roll-die )
5
> ( roll-die )
3
> ( roll-die )
5
> ( roll-for-1)
1
> ( roll-for-1)
0 5 0 0 5 5 3 2 1
> ( roll-for-1)
3 5 3 1
> ( roll-for-1)
0 3 4 1
> ( roll-for-11 )
5 3 3 4 1 3 3 4 2 2 3 4 1 4 4 5 3 4 2 3 2 2 2 0 3 3 3 4 1 0 1 0 2 3 0 0 1 5 1 3 5 4 5 5 3 5
4 5 2 4 5 4 1 3 5 3 5 3 1 2 0 3 4 2 0 2 4 0 4 1 4 0 5 1 5 1 0 0 4 0 0 3 4 4 3 3 4 1 4 0 0 0
1 5 4 1 0 3 0 2 0 3 2 4 2 1 2 1 0 0 0 5 2 2 1 4 3 0 1 0 4 2 3 2 2 5 5 3 4 5 1 2 1 4 1 1
> ( roll-for-11 )
0 0 1 2 0 3 5 4 0 2 5 3 2 2 3 0 0 1 2 5 4 1 2 0 5 0 0 2 5 3 3 3 1 1
> ( roll-for-11 )
1 3 0 5 5 3 1 1
> ( roll-for-11 )
1 2 4 4 0 5 3 4 2 4 3 4 3 0 3 3 4 1 4 4 1 3 5 3 4 4 5 1 4 1 0 5 5 5 3 5 0 5 3 1 0 2 1 3 0 0
4 3 3 4 0 0 4 3 0 2 0 1 4 1 1
> ( roll-for-odd-even-odd )
3 5 5 5 3 5 4 0 1 4 1
> ( roll-for-odd-even-odd )
1 3 5 0 5
> ( roll-for-odd-even-odd )
2 0 1 3 2 3
> ( roll-two-dice-for-a-lucky-pair )
( 1 3 ) ( 3 3 ) #t
>
```

Code:

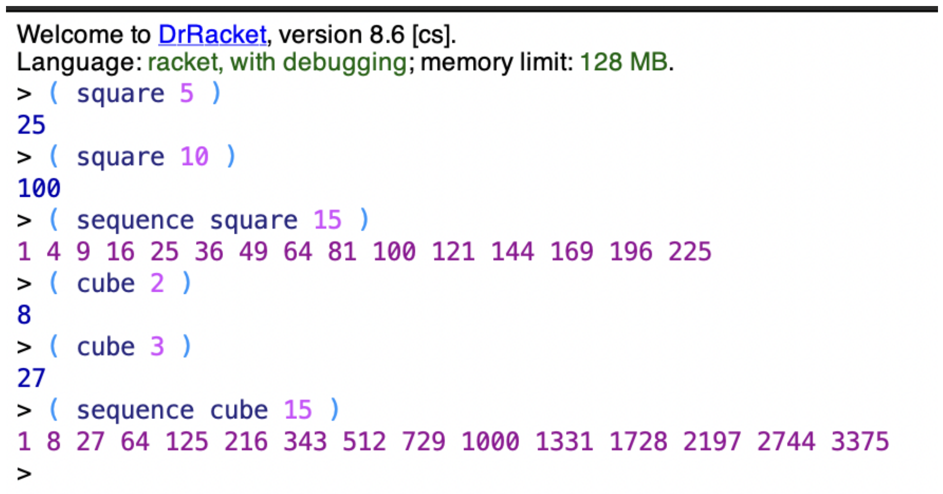


```
#lang racket

( define ( roll-die ) ( random 6 ) )



( define ( roll-for-1 )
   ( define outcome ( roll-die ) )
   ( display outcome ) ( display " " )
   ( cond
      ( ( not ( eq? outcome 1 ) )
        ( roll-for-1 )
        )
      )
   )



( define ( roll-for-11 )
   ( roll-for-1 )
   ( define outcome ( roll-die ) )
   ( display outcome ) ( display " " )
   ( cond
      ( ( not ( eq? outcome 1 ) )
        ( roll-for-11 )
        )
      )
   )


( define ( odd )
   ( define outcome ( roll-die ) )
   ( display outcome ) ( display " " )
   ( cond
      ( ( odd? outcome )
        ( odd )
        )
      )
   )



( define ( roll-for-odd-even-odd )
   ( define outcome ( roll-die ) )
   ( display outcome ) ( display " " )
   ( cond
      ( ( even? outcome )
        ( roll-for-odd-even-odd ))
      ( else
        ( cond
           ( ( odd )
             ( define outcome ( roll-die ) )
             ( display outcome ) ( display " " )
             ( cond
                ( ( even? outcome )
                  ( roll-for-odd-even-odd )
                  )
                )
             )
           )
        )
      )
   )
```

```
( define ( roll-two-dice-for-a-lucky-pair )
   ( define die-outcome ( roll-die ) )
   ( define die-outcome2 ( roll-die ) )
   ( display "( " ) ( display die-outcome ) ( display " " )
   ( display die-outcome2 ) ( display " ) " )
   ( cond
      ( ( eq? die-outcome die-outcome2 ) )
      ( else
        ( cond
           ( ( eq? ( + die-outcome die-outcome2 ) 5 ) )
           ( else
             ( cond
                ( ( eq? ( + die-outcome die-outcome2 ) 7 ) )
                ( else
                  ( cond
                   (( roll-two-dice-for-a-lucky-pair )))

                  ) ) )
             )
           )
        )
      )
   )
```

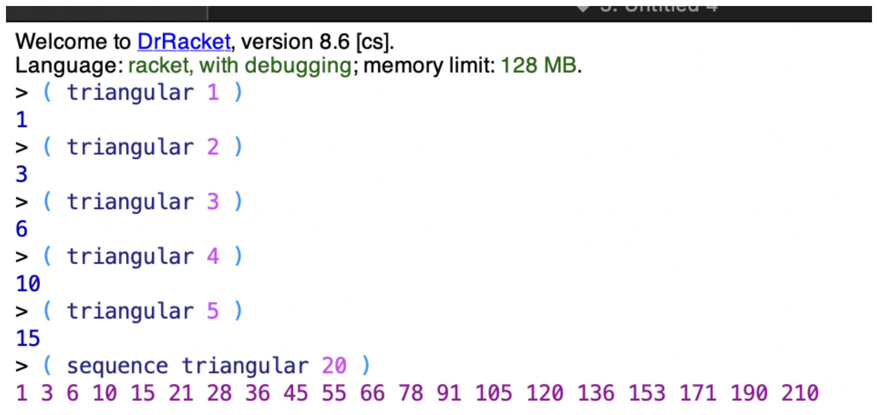
Task 3

Square Numbers:



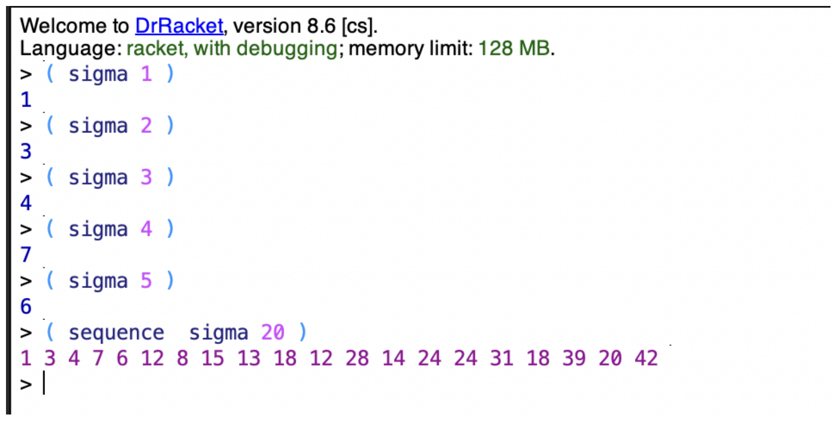
```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> ( square 5 )
25
> ( square 10 )
100
> ( sequence square 15 )
1 4 9 16 25 36 49 64 81 100 121 144 169 196 225
> ( cube 2 )
8
> ( cube 3 )
27
> ( sequence cube 15 )
1 8 27 64 125 216 343 512 729 1000 1331 1728 2197 2744 3375
>
```

Triangular Numbers:



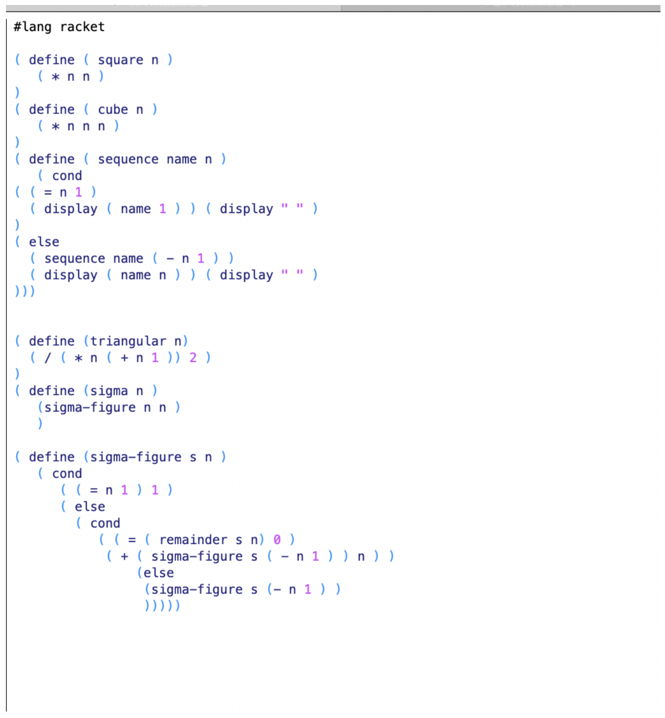
```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> ( triangular 1 )
1
> ( triangular 2 )
3
> ( triangular 3 )
6
> ( triangular 4 )
10
> ( triangular 5 )
15
> ( sequence triangular 20 )
1 3 6 10 15 21 28 36 45 55 66 78 91 105 120 136 153 171 190 210
```

Sigma Numbers:



```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> ( sigma 1 )
1
> ( sigma 2 )
3
> ( sigma 3 )
4
> ( sigma 4 )
7
> ( sigma 5 )
6
> ( sequence  sigma 20 )
1 3 4 7 6 12 8 15 13 18 12 28 14 24 24 31 18 39 20 42
> |
```

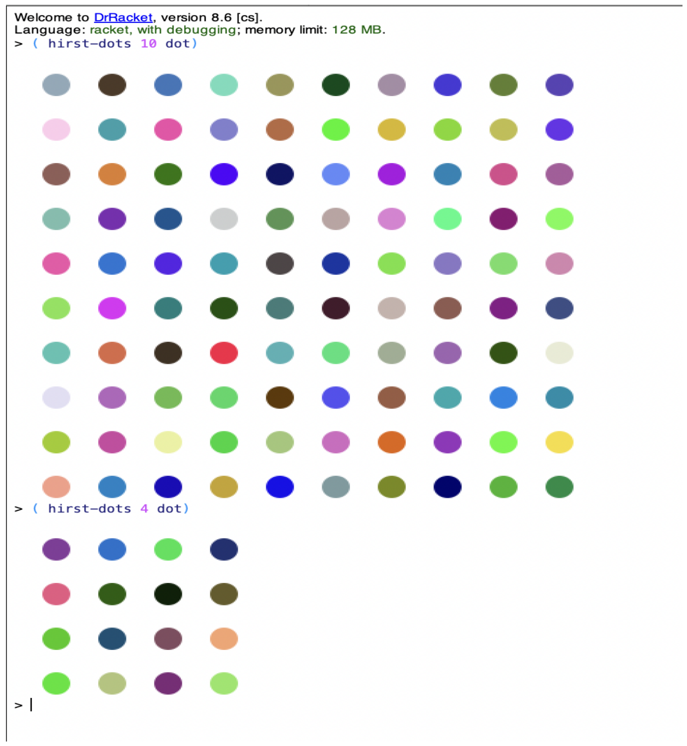
Code



```
#lang racket

( define ( square n )
   ( * n n )
)
( define ( cube n )
   ( * n n n )
)
( define ( sequence name n )
   ( cond
( ( = n 1 )
  ( display ( name 1 ) ) ( display " " )
)
( else
  ( sequence name ( - n 1 ) )
  ( display ( name n ) ) ( display " " )
)))


( define (triangular n)
  ( / ( * n ( + n 1 )) 2 )
)
( define (sigma n )
   (sigma-figure n n )
   )

( define (sigma-figure s n )
   ( cond
      ( ( = n 1 ) 1 )
      ( else
        ( cond
           ( ( = ( remainder s n) 0 )
            ( + ( sigma-figure s ( - n 1 ) ) n ) )
                (else
                 (sigma-figure s (- n 1 ) )
                 )))))
```

Task 4

Hirst Dot:



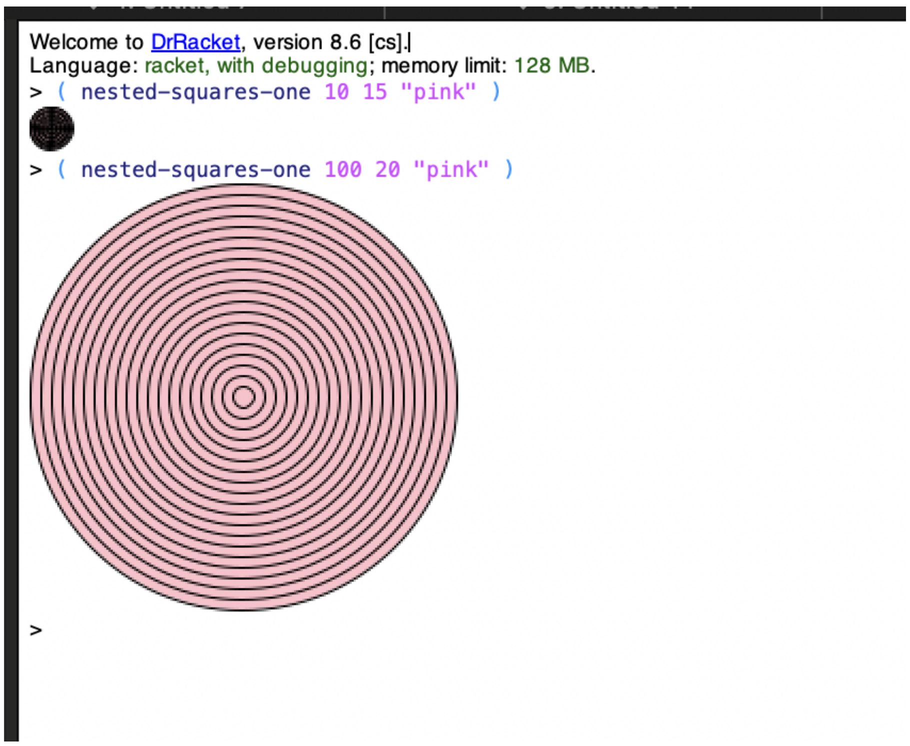
```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> ( hirst-dots 10 dot)
> ( hirst-dots 4 dot)
> |
```

Code:

```
#lang racket

( require 2htdp/image )

( define ( random-color )
   ( color( rgb-value ) ( rgb-value ) ( rgb-value ) )
   )

( define ( rgb-value ) (random 255 )

   )
( define space ( square 20 "solid" "white" ))

(define ( dot ) (circle 10 "solid" ( random-color)))


( define ( row-of-circles n dot )
   ( cond
(( = n 0) empty-image
) (( > n 0)
( beside ( row-of-circles ( - n 1 ) dot ) space  ( dot ) ) )
) )


( define ( rectangle-of-circles d c dot)
   ( cond
((= d 0)
 empty-image
)
((> d 0)
( above

( rectangle-of-circles ( - d 1 ) c dot ) space ( row-of-circles c dot) ) )
) )

( define ( hirst-dots n dot) ( rectangle-of-circles n n dot )
)
```

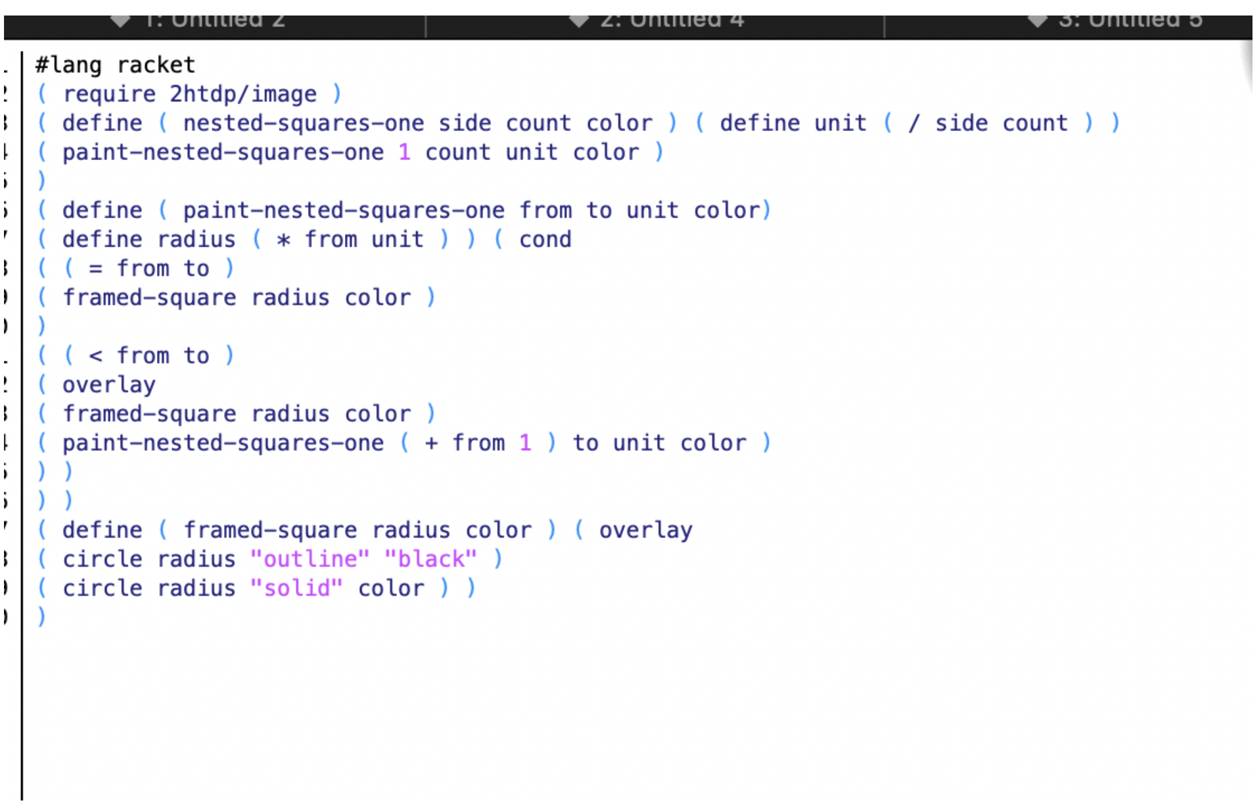
Task 5

Stella



```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> ( nested-squares-one 10 15 "pink" )

> ( nested-squares-one 100 20 "pink" )

>
```

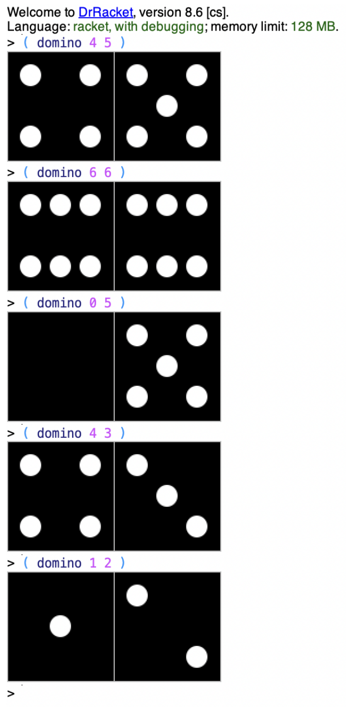
Code:



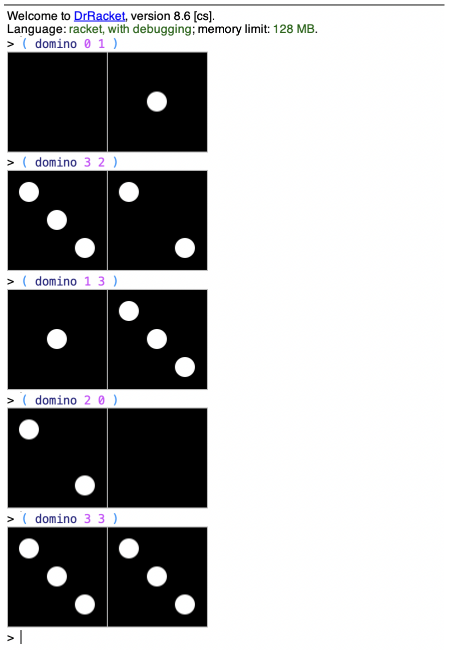
```
#lang racket
( require 2htdp/image )
( define ( nested-squares-one side count color ) ( define unit ( / side count ) )
( paint-nested-squares-one 1 count unit color )
)
( define ( paint-nested-squares-one from to unit color)
( define radius ( * from unit ) ) ( cond
( ( = from to )
( framed-square radius color )
)
( ( < from to )
( overlay
( framed-square radius color )
( paint-nested-squares-one ( + from 1 ) to unit color )
) )
) )
( define ( framed-square radius color ) ( overlay
( circle radius "outline" "black" )
( circle radius "solid" color ) )
)
```

Task 6

Domino:

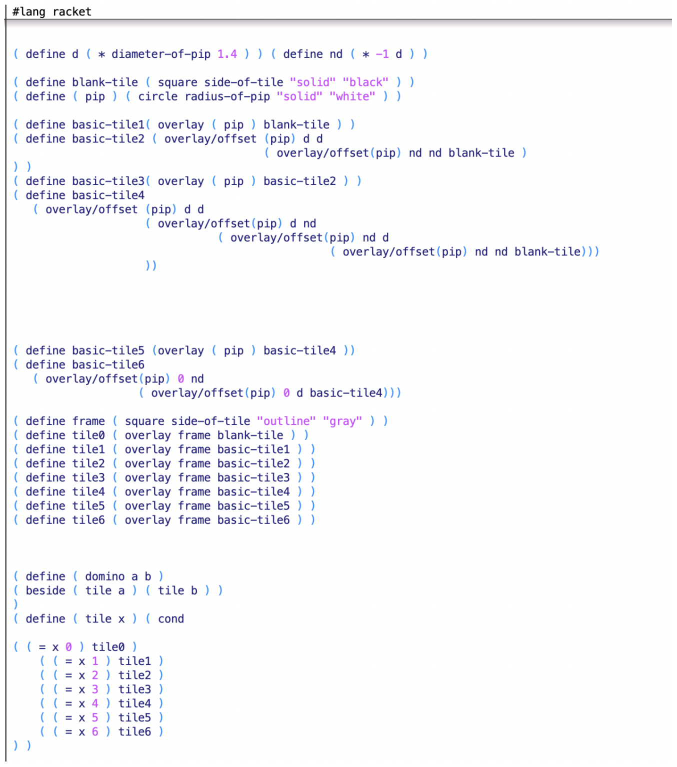


```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> ( domino 4 5 )
> ( domino 6 6 )
> ( domino 0 5 )
> ( domino 4 3 )
> ( domino 1 2 )
>
```



```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> ( domino 0 1 )
> ( domino 3 2 )
> ( domino 1 3 )
> ( domino 2 0 )
> ( domino 3 3 )
>
```

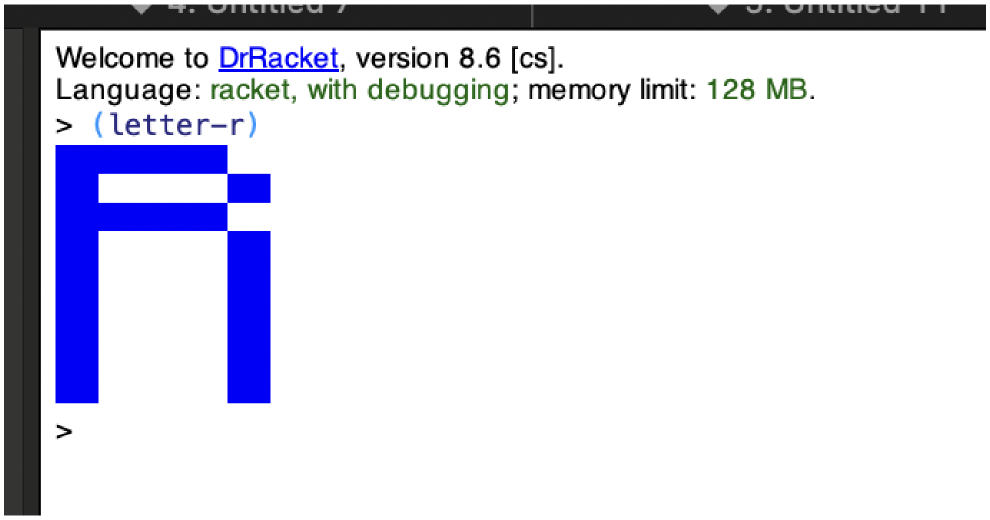
Code:



```racket
#lang racket

( define d ( * diameter-of-pip 1.4 ) ) ( define nd ( * -1 d ) )

( define blank-tile ( square side-of-tile "solid" "black" ) )
( define ( pip ) ( circle radius-of-pip "solid" "white" ) )

( define basic-tile1( overlay ( pip ) blank-tile ) )
( define basic-tile2 ( overlay/offset (pip) d d
                                       ( overlay/offset(pip) nd nd blank-tile )
) )
( define basic-tile3( overlay ( pip ) basic-tile2 ) )
( define basic-tile4
   ( overlay/offset (pip) d d
                     ( overlay/offset(pip) d nd
                                ( overlay/offset(pip) nd d
                                                 ( overlay/offset(pip) nd nd blank-tile)))
                     ))




( define basic-tile5 (overlay ( pip ) basic-tile4 ))
( define basic-tile6
   ( overlay/offset(pip) 0 nd
                    ( overlay/offset(pip) 0 d basic-tile4)))

( define frame ( square side-of-tile "outline" "gray" ) )
( define tile0 ( overlay frame blank-tile ) )
( define tile1 ( overlay frame basic-tile1 ) )
( define tile2 ( overlay frame basic-tile2 ) )
( define tile3 ( overlay frame basic-tile3 ) )
( define tile4 ( overlay frame basic-tile4 ) )
( define tile5 ( overlay frame basic-tile5 ) )
( define tile6 ( overlay frame basic-tile6 ) )



( define ( domino a b )
( beside ( tile a ) ( tile b ) )
)
( define ( tile x ) ( cond

( ( = x 0 ) tile0 )
    ( ( = x 1 ) tile1 )
    ( ( = x 2 ) tile2 )
    ( ( = x 3 ) tile3 )
    ( ( = x 4 ) tile4 )
    ( ( = x 5 ) tile5 )
    ( ( = x 6 ) tile6 )
) )
```

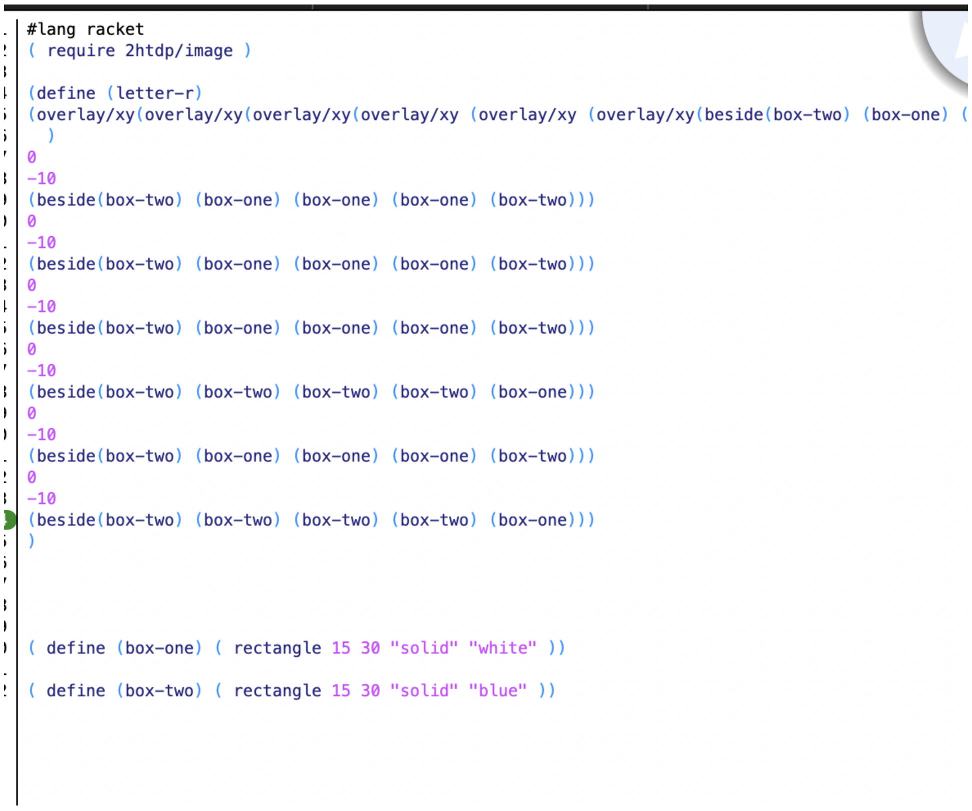
Task 7

Creation:



```
Welcome to DrRacket, version 8.6 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> (letter-r)

>
```

Code:



```
#lang racket
( require 2htdp/image )

(define (letter-r)
(overlay/xy(overlay/xy(overlay/xy(overlay/xy (overlay/xy (overlay/xy(beside(box-two) (box-one) (
  )
0
-10
(beside(box-two) (box-one) (box-one) (box-one) (box-two)))
0
-10
(beside(box-two) (box-one) (box-one) (box-one) (box-two)))
0
-10
(beside(box-two) (box-one) (box-one) (box-one) (box-two)))
0
-10
(beside(box-two) (box-two) (box-two) (box-two) (box-one)))
0
-10
(beside(box-two) (box-one) (box-one) (box-one) (box-two)))
0
-10
(beside(box-two) (box-two) (box-two) (box-two) (box-one)))
)




( define (box-one) ( rectangle 15 30 "solid" "white" ))

( define (box-two) ( rectangle 15 30 "solid" "blue" ))
```