Kieran Finnegan

GA RBG Programming Assignment

Task 1:

Code:

```
;-------------------------------------------------------------------
;Task 1

;; Global constant to signify the number of letters in one RBG-string
( setf *limit* 25 )

;; A method to generate either R B G
( defun RBG()
  ( nth ( random 3 ) '( R B G ) )
)

;; A method to generate a string of length 25 with R B G
( defun RBG-string ()
  ( rbg-list *limit* )
)


( defun rbg-list ( num )
  ( cond
    ( ( = num 0 )
          nil
        )
        ( t
          ( append ( cons ( rbg ) ( rbg-list ( - num 1 ) ) ) )
        )
  )
)
```

Demo:

```
CL-USER> *limit*
25
CL-USER> ( rbg )
G
CL-USER> ( rbg )
G
```

```
CL-USER> ( rbg )
G
CL-USER> ( rbg )
R
CL-USER> ( list ( rbg ) ( rbg ) ( rbg ) ( rbg ) ( rbg ) )
(G G B G R)
CL-USER> ( list (rbg) (rbg) (rbg) (rbg) ( rbg) )
(R G R R B)
CL-USER> ( rbg-string )
(B B G B G B R R R G R G B G R B R G R G R R B B G)
CL-USER> ( rbg-string )
(G R R B R G B R R R R G R G B B B G B G R R G G G)
CL-USER> ( rbg-string )
(R B G G G R G G B B R B G G B B G G R B G B R R R)
CL-USER> ( rbg-string )
(R B R B G R G B G R G G B R R B G G B B G B G B R)
CL-USER>
```

Task 2:

Code:

```
;---------------------------------------------------------------------
; Task 2

( defmethod mutation ( ( rbg-str list ) &aux position symbol )
  ( setf position ( random ( length rbg-str ) ) )
  ( setf symbol ( others '( r b g ) ( nth position rbg-str ) ) )
  ( change rbg-str ( pick symbol ) position )
)

( defun others ( li l )
  ( remove l li )
)

( defun change ( str symbol position )
  ( setf ( nth position str ) symbol )
  str
)

( defun pick ( list )
  ( select ( random ( length list ) ) list )
)

(defun select (i l)
  ( cond
    ( ( = i 0 )
      ( car l )
          )
    ( t
      ( select ( - i 1 ) ( cdr l ) )
          )
  )
)
```

Demo:

```
CL-USER> ( load "rbg.lsp" )
```

```
T
CL-USER> ( setf colors '( r b g r ) )
(R B G R)
CL-USER> ( mutation colors )
(R B B R)
CL-USER> ( mutation colors )
(G B B R)
CL-USER> ( setf s '( rb g g b r ) )
(RB G G B R)
CL-USER> ( setf s ( mutation s ) )
(RB R G B R)
CL-USER> ( setf s '( r b g g b r ) )
(R B G G B R)
CL-USER> ( setf s ( mutation s ) )
(R B G B B R)
CL-USER> ( setf s ( mutation s ) )
(R B G B B B)
CL-USER> ( setf s ( mutation s ) )
(R B B B B B)
CL-USER> ( setf s ( mutation  s ) )
(G B B B B B)
CL-USER> ( setf x ( rbg-string ) )
(R B G B B G G R B R R B B G G B B R R G R B R B G)
CL-USER> ( setf x ( mutation x ) )
(R B G B B G R R B R R B B G G B B R R G R B R B G)
CL-USER> ( setf x ( mutation x ) )
(R B G B B G R R B R R B B R G B B R R G R B R B G)
CL-USER>
```

Task3 :

Code:

```
;---------------------------------------------------------------------
; Task 3

( defmethod crossover ( ( m list ) ( f list ) &aux pos)
  ( setf pos ( + 1 ( random ( length m ) ) ) )
  ( append ( first-n m pos ) ( rest-n f pos ) )
)

(defmethod first-n (m2 pos &aux lis)
    (loop for i from 0 to (- pos 1) do
      (setf lis (snoc (nth i m2) lis))
    )
    lis
  )

  (defmethod rest-n (f2 pos &aux lis)
    (loop for i from pos to (- (length f2) 1) do
      (setf lis (snoc (nth i f2) lis))
    )
    lis
  )

( defun snoc ( i l )
  ( cond
    ( ( null l )
      ( list i )
    )
    ( t
       ( cons ( car l ) ( snoc i ( cdr l ) ) )
    )
  )
)
```

Demo:

```
CL-USER> ( setf m '( a b c d e f g ) )
(A B C D E F G)
```

CL-USER> (setf f '(t u v w x y z))
(T U V W X Y Z)
CL-USER> (crossover m f)
(A B C D E F Z)
CL-USER> (crossover m f)
(A U V W X Y Z)
CL-USER> (crossover m f)
(A B V W X Y Z)
CL-USER> (crossover m f)
(A U V W X Y Z)
CL-USER> m
(A B C D E F G)
CL-USER> f
(T U V W X Y Z)
CL-USER> (setf m (rbg-string))
(R G B R R G R R B B R G G R R G G R B R R R R B R)
CL-USER> (setf f (rbg-string))
(G R R G G R B B G R R B R R R B R R G R B R R B B)
CL-USER> (crossover m f)
(R G B R R G R R B B R G G R R B R R G R B R R B B)
CL-USER> (crossover m f)
(R G B R R G R R B B R G G R R B R R G R B R R B B)
CL-USER> (crossover m f)
(R G B R R G R R B B R G G R R G G R B R R R R B B)
CL-USER> m
(R G B R R G R R B B R G G R R G G R B R R R R B R)
CL-USER> f
(G R R G G R B B G R R B R R R B R R G R B R R B B)

Task 4:

Code:

```
;---------------------------------------------------------------------------
; Task 4

( defmethod mutation-demo (&aux s m)
  ( setf s ( rbg-string ) )
  ( dotimes ( i 10 )
    ( format t "s = ~A~%" s )
    ( setf m ( mutation s ) )
    ( format t "m = ~A~%~%" m )
  )
)

( defmethod crossover-demo (&aux m f x)
  ( setf m ( rbg-string ) )
  ( setf f ( rbg-string ) )
  ( dotimes ( i 10 )
    ( format t "m = ~A~%" m )
    ( setf x ( crossover m f ) )
    ( format t "x = ~A~%" x )
    ( format t "f = ~A~%~%" f )
  )
)
```

Demo:

```
CL-USER> ( mutation-demo )
s = (R R R B R R G R R R B R R R B G B B G R B B B B R)
m = (R R R B R R G R R R B R R R B G B R G R B B B B R)

s = (R R R B R R G R R R B R R R B G B R G R B B B B R)
m = (R R R B R R G R R R B R R R B G B R G R B G B B R)

s = (R R R B R R G R R R B R R R B G B R G R B G B B R)
m = (R R R B B R G R R R B R R R B G B R G R B G B B R)

s = (R R R B B R G R R R B R R R B G B R G R B G B B R)
m = (B R R B B R G R R R B R R R B G B R G R B G B B R)
```

s = (B R R B B R G R R R B R R R B G B R G R B G B B R)
m = (B G R B B R G R R R B R R R B G B R G R B G B B R)

s = (B G R B B R G R R R B R R R B G B R G R B G B B R)
m = (B R R B B R G R R R B R R R B G B R G R B G B B R)

s = (B R R B B R G R R R B R R R B G B R G R B G B B R)
m = (R R R B B R G R R R B R R R B G B R G R B G B B R)

s = (R R R B B R G R R R B R R R B G B R G R B G B B R)
m = (R R B B B R G R R R B R R R B G B R G R B G B B R)

s = (R R B B B R G R R R B R R R B G B R G R B G B B R)
m = (R G B B B R G R R R B R R R B G B R G R B G B B R)

s = (R G B B B R G R R R B R R R B G B R G R B G B B R)
m = (R G B B B R G R R R B G R R B G B R G R B G B B R)

NIL
CL-USER> (crossover-demo)
m = (G R R G G G R G B B B B G B B B B R G R R R R B B)
x = (G R R G G G B B R G R R G B G G G G G G G B R G R)
f = (B B R G R R B B R G R R G B G G G G G G G B R G R)

m = (G R R G G G R G B B B B G B B B B R G R R R R B B)
x = (G R R G G G R G B B B B G B B B B R G R R R R B R)
f = (B B R G R R B B R G R R G B G G G G G G G B R G R)

m = (G R R G G G R G B B B B G B B B B R G R R R R B B)
x = (G R R G G G R G B B B B G B B B B R G R G B R G R)
f = (B B R G R R B B R G R R G B G G G G G G G B R G R)

m = (G R R G G G R G B B B B G B B B B R G R R R R B B)
x = (G R R G G G R G B B B B G B B B B G G G G G B R G R)
f = (B B R G R R B B R G R R G B G G G G G G G B R G R)

m = (G R R G G G R G B B B B G B B B B R G R R R R B B)
x = (G R R G G G R G B B B B G B B B B G G G G G B R G R)
f = (B B R G R R B B R G R R G B G G G G G G G B R G R)

m = (G R R G G G R G B B B B G B B B B R G R R R R B B)
x = (G R R G R R B B R G R R G B G G G G G G G B R G R)
f = (B B R G R R B B R G R R G B G G G G G G G B R G R)

m = (G R R G G G R G B B B B G B B B B R G R R R R B B)
x = (G R R G G G R G B B R R G B G G G G G G G B R G R)
f = (B B R G R R B B R G R R G B G G G G G G G B R G R)

m = (G R R G G G R G B B B B G B B B B R G R R R R B B)
x = (G R R G G G R G B B B B G B B G G G G G G B R G R)
f = (B B R G R R B B R G R R G B G G G G G G G B R G R)

m = (G R R G G G R G B B B B G B B B B R G R R R R B B)
x = (G R R G G G R G B B B B G B B B G G G G G B R G R)
f = (B B R G R R B B R G R R G B G G G G G G G B R G R)

m = (G R R G G G R G B B B B G B B B B R G R R R R B B)
x = (G R R G G G R G B B B B G B G G G G G G G B R G R)
f = (B B R G R R B B R G R R G B G G G G G G G B R G R)

NIL

Task 5:

Code:

```
;---------------------------------------------------------------------------
; Task 5

( defun fitness-r ( list )
  ( count 'r list )
)

( defun fitness-b ( list )
  ( count 'b list )
)

( defun fitness-g ( list )
  ( count 'g list )
)

( defmethod fitness-demo (&aux x fitness)
  ( setf x (rbg-string) )
  ( format t "x = ~A~%" x )
  ( format t "Directly applying the fitness metrics ...~%" )
  ( format t "fitness-r = ~A~%" ( fitness-r x ) )
  ( format t "fitness-b = ~A~%" ( fitness-b x ) )
  ( format t "fitness-g = ~A~%" ( fitness-g x ) )
  ( format t "Indirectly applying the fitness metrics ...~%" )
  ( setf fitness #'fitness-r )
  ( format t "fitness-r = ~A~%" ( funcall fitness x ) )
  ( setf fitness #'fitness-g )
  ( format t "fitness-g = ~A~%" ( funcall fitness x ) )
  ( setf fitness #'fitness-b )
  ( format t "fitness-b = ~A~%" ( funcall fitness x ) )
)
```

Demo:

```
CL-USER> ( load "rbg.lsp" )
T
CL-USER> ( setf test ( rbg-string ) )
(G G R R R B G R R B B R R B G R B G B G R R R R G)
CL-USER> ( fitness-r test )
```

```
12
CL-USER> ( load "rbg.lsp" )
T
CL-USER> ( setf x ( rbg-string ) )
(B B R B B R G G R G R B G B B R B G B B B G R G R)
CL-USER> ( fitness-r x )
7
CL-USER> ( fitness-b x )
11
CL-USER> ( fitness-g x )
7
CL-USER> ( setf fitness #'fitness-r )
#<FUNCTION FITNESS-R>
CL-USER> ( funcall fitness x )
7
CL-USER> ( setf fitness #'fitness-b )
#<FUNCTION FITNESS-B>
CL-USER> ( funcall fitness x )
11
CL-USER> ( setf fitness #'fitness-g )
#<FUNCTION FITNESS-G>
CL-USER> ( funcall fitness x )
7
CL-USER> ( fitness-demo )
x = (G B R B R R R B G G B R G G B G B B B G G R B B G)
Directly applying the fitness metrics ...
fitness-r = 6
fitness-b = 10
fitness-g = 9
Indirectly applying the fitness metrics ...
fitness-r = 6
fitness-g = 9
fitness-b = 10
NIL
CL-USER>
```

Task 6:

Code:

```
;---------------------------------------------------------------------------
; Task 6

( defclass individual ()
  (
    ( rbg-string :accessor individual-rbg-string :initarg :rbg-string )
    ( fitness :accessor individual-fitness :initarg :fitness )
    ( number :accessor individual-number :initarg :number )
  )
)

( defmethod random-individual (&aux rbg)
  ( setf rbg ( rbg-string ) )
  ( make-instance 'individual
    :rbg-string rbg
    :fitness ( funcall *fitness* rbg )
    :number 0
  )
)

( defmethod new-individual ( ( nr number ) ( notes list ) )
  ( make-instance 'individual
    :rbg-string notes
    :fitness ( funcall *fitness* notes )
    :number nr
  )
)

( defmethod display ( ( i individual ) )
  ( display-nnl i ) ( terpri )
)

( defmethod display-nnl ( ( i individual ) )
  ( prin1 ( individual-number i ) )
  ( princ ( filler ( individual-number i ) ) )
  ( prin1 ( individual-rbg-string i ) )
  ( princ " " )
  ( prin1 ( individual-fitness i ) )
```

```
  ( princ ( filler ( individual-fitness i ) ) )
)

( defmethod filler ( ( n number ) )
  ( cond
    ( ( < n 10 ) " " )
    ( ( < n 100 ) " " )
    ( ( < n 1000 ) " " )
    ( ( < n 10000 ) " " )
    ( ( < n 100000 ) " " )
  )
)

( defmethod fitness-b ( ( i individual ) )
  ( fitness-b ( individual-rbg-string i ) )
)

( defmethod fitness-r ( ( i individual ) )
  ( fitness-r ( individual-rbg-string i ) )
)

( defmethod fitness-g ( ( i individual ) )
  ( fitness-g ( individual-rbg-string i ) )
)

( defmethod individual-demo (&aux i0 i1 i2 i3 one two three)
  ( setf *fitness* #'fitness-r )
  ( setf i0 ( random-individual ) )
  ( display i0 )
  ( setf one ( rbg-string ) )
  ( setf i1 ( new-individual 1 one ) )
  ( display i1 )
  ( setf two ( rbg-string ) )
  ( setf i2 ( new-individual 2 two ) )
  ( display i2 )
  ( setf three ( rbg-string ) )
  ( setf i3 ( new-individual 3 three ) )
  ( display i3 )
  ( format t "Fitness of i0 = ~A~%" ( funcall *fitness* i0 ) )
  ( format t "Fitness of i1 = ~A~%" ( funcall *fitness* i1 ) )
```

```
  ( format t "Fitness of i2 = ~A~%" ( funcall *fitness* i2 ) )
  ( format t "Fitness of i3 = ~A~%" ( funcall *fitness* i3 ) )
  nil
)
```

Demo:

```
CL-USER> ( setf rbg ( rbg-string ) )
; in: SETF RBG
;     (SETF RBG (RBG-STRING))
;
; caught WARNING:
;   undefined variable: COMMON-LISP-USER::RBG
;
; compilation unit finished
;   Undefined variable:
;     RBG
;   caught 1 WARNING condition
(R G R R B B B G B G B R R R G R G B G R B R G R G)
CL-USER> rbg
(R G R R B B B G B G B R R R G R G B G R B R G R G)
CL-USER> ( setf *fitness* #'fitness-b )
; in: SETF *FITNESS*
;     (SETF *FITNESS* #'FITNESS-B)
;
; caught WARNING:
;   undefined variable: COMMON-LISP-USER::*FITNESS*
;
; compilation unit finished
;   Undefined variable:
;     *FITNESS*
;   caught 1 WARNING condition
#<STANDARD-GENERIC-FUNCTION COMMON-LISP-USER::FITNESS-B (2)>
CL-USER> ( setf rbg-i ( new-individual 1 rbg ) )
; in: SETF RBG-I
;     (NEW-INDIVIDUAL 1 RBG)
;
; caught WARNING:
```

```
;   undefined variable: COMMON-LISP-USER::RBG

;     (SETF RBG-I (NEW-INDIVIDUAL 1 RBG))
;
; caught WARNING:
;   undefined variable: COMMON-LISP-USER::RBG-I
;
; compilation unit finished
;   Undefined variables:
;     RBG RBG-I
;   caught 2 WARNING conditions
#<INDIVIDUAL {1002455F23}>
CL-USER> ( individual-number rbg-i )
1
CL-USER> ( individual-rbg-string rbg-i )
(R G R R B B B G B G B R R R G R G B G R B R G R G)
CL-USER> ( display rbg-i )
1 (R G R R B B B G B G B R R R G R G B G R B R G R G) 7
NIL
CL-USER> ( funcall *fitness* rbg )
7
CL-USER> ( setf r ( random-individual ) )
; in: SETF R
;     (SETF R (RANDOM-INDIVIDUAL))
;
; caught WARNING:
;   undefined variable: COMMON-LISP-USER::R
;
; compilation unit finished
;   Undefined variable:
;     R
;   caught 1 WARNING condition
#<INDIVIDUAL {10026EE223}>
CL-USER> ( display r )
0 (R R B B G G R R B R G B R R R R G R G B B B G B G) 8
NIL
CL-USER> ( setf r ( random-individual ) )
; in: SETF R
;     (SETF R (RANDOM-INDIVIDUAL))
;
```

```
; caught WARNING:
;   undefined variable: COMMON-LISP-USER::R
;
; compilation unit finished
;   Undefined variable:
;     R
;   caught 1 WARNING condition
#<INDIVIDUAL {100275A733}>
CL-USER> ( display r )
0 (R R G G G R B G G G R G G B B R B G G B B G G R B) 7
NIL
CL-USER> ( setf r ( random-individual ) )
; in: SETF R
;     (SETF R (RANDOM-INDIVIDUAL))
;
; caught WARNING:
;   undefined variable: COMMON-LISP-USER::R
;
; compilation unit finished
;   Undefined variable:
;     R
;   caught 1 WARNING condition
#<INDIVIDUAL {10027B5BE3}>
CL-USER> ( display r )
0 (G B R R R R B R B G R G B G R G G B R R B G G B B) 8
NIL
CL-USER> ( individual-demo )
0 (G B G B R B R B R R G B R R G R R B B R G G R R G) 11
1 (G R B R R R R B R G R R G G R B B G R R B R R R B) 14
2 (R R G R B R R B B R G G R R R B R R G R R R B R R) 16
3 (R B G B B G R B B B B R R B R B B B R R R R B B B R) 10
Fitness of i0 = 11
Fitness of i1 = 14
Fitness of i2 = 16
Fitness of i3 = 10
NIL
```

Task 7:

Code:

```
;---------------------------------------------------------------------------
; Task 7

( defconstant *population-size* 100 )
( defconstant *selection-size* 8 )
( setf *fitness* #'fitness-b )

( defclass population ()
  (
    ( individuals :accessor population-individuals :initarg :individuals )
    ( generation :accessor population-generation :initform 0 )
  )
)

( defmethod size ( ( p population ) )
  ( length ( population-individuals p ) )
)

( defmethod display ( ( p population ) )
  ( terpri ) ( terpri )
  ( princ "Generation " )
  ( prin1 ( population-generation p ) )
  ( princ " population ..." )
  ( terpri ) ( terpri )
  ( dolist ( i ( population-individuals p ) )
    ( display i )
  )
  ( terpri )
)

( defmethod initial-population ( &aux individuals )
  ( setf individuals () )
  ( dotimes ( i *population-size* )
    ( push ( new-individual ( + i 1 ) ( rbg-string ) ) individuals )
  )
  ( make-instance 'population :individuals ( reverse individuals ) )
)
```

```
( defmethod average ( ( p population ) &aux ( sum 0 ) )
  ( loop for i in ( population-indiviuals p ) do
    ( setf sum ( + ( funcall *fitness* i ) sum ) )
  )
  ( float ( / sum ( size p ) ) )
)

( setf *select-demo* nil )

( defmethod select-individual ( ( p population ) &aux i candidates rn )
  ( setf candidates ( select-individuals p ) )
  ( setf mfi ( most-fit-individual candidates ) )
  ( if *select-demo* ( select-demo-helper candidates mfi) )
  mfi
)

( defmethod select-individuals ( ( p population ) &aux individuals candidates rn )
  ( setf individuals ( population-individuals p ) )
  ( setf candidates () )
  ( dotimes ( i *selection-size* )
    ( setf rn ( random *population-size* ) )
    ( push ( nth rn individuals ) candidates )
  )
  candidates
)

( defmethod most-fit-individual ( ( l list ) &aux max-value max-individual )
  ( setf max-value 0 )
  ( setf max-individual nil )
  ( loop for i in l do
    ( if ( < max-vaule ( funcall *fitness* i ) )
           ( setf max-individual i max-value ( funcall * fitness* i ) )
         )
  )
  max-individual
)

( defmethod select-demo-helper ( ( l list ) ( i individual ) )
  ( princ "the sample of individuals ..." ) ( terpri )
```

```
  ( mapcar #'display l )
  ( terpri )
  ( princ "the most fit of the sample ... " ) ( terpri )
  ( display i )
  ( terpri )
  nil
)

( defmethod population-demo (&aux p)
  ( setf p ( initial-population ) )
  ( display p )
  ( format t "Average fitness = ~A~%~%" ( average p ) )
  ( setf *select-demo* t )
  ( format t "Sampling ...~%~%" )
  ( select-individual p ) ( terpri)
  ( format t "Sampling ...~%~%" )
  ( select-individual p ) ( terpri)
  ( format t "Sampling ...~%~%" )
  ( select-individual p ) ( terpri)
)
```

Demo:

```
CL-USER> ( setf p (initial-population ) )
; in: SETF P
;     (SETF P (INITIAL-POPULATION))
;
; caught WARNING:
;   undefined variable: COMMON-LISP-USER::P
;
; compilation unit finished
;   Undefined variable:
;     P
;   caught 1 WARNING condition
#<POPULATION {100232FB23}>
CL-USER> ( display p )


Generation 0 population ...
```

1 (G B B R B B G B G B B G G B B B G G B R R B B B G) 14
2 (B R B G G B R B R B G G G G B B G G G R R G R R G) 7
3 (B G R R G R B R R B R B R B G B R G G B G G G B B) 9
4 (G B B R B G G R R B R B G R R G G R B G R R R B G) 7
5 (B B G R R G B R R G B R B R R G G G G B G B R R B) 8
6 (B G B B G B G G R R B G R G G G R G G G R B G B G B) 8
7 (G B R B R R G B R B G R B B B B R G B R R R B R B) 11
8 (R G G B R R G B G G R B G G G G G G G R G G B G R) 4
9 (B B R B G B B G B G R B B G G R G G R R G B R B B) 11
10 (R B G R R R R G G G G B G R G G B G R B G R G B G) 5
11 (B B G G G G R B R R G G G R G B B R R B R G B R G) 7
12 (B R B R R G B G R G G R G R G G R R B R R R R R B) 5
13 (R G G G B R R G G B G R G G R R G B B B G B R B B) 8
14 (R G G B B G B G R B B R R R B B B B G B B R G R G) 11
15 (G G G G R G B G G G G G G G B R R R G B G R B B G B) 6
16 (G R B B R B B G R G G R R G R R G G G G G R R G G) 4
17 (B G G G R G G B G B R B R B G R R B G G B R G R B) 8
18 (R G G B B G G B R G G G G B G B G G B G R R B G G) 7
19 (B B G R R G G G G G R G B G R R G B G B R B R R B) 7
20 (G R G G G G G B R G G R G B R G R G R B R G R R G) 3
21 (R B G G R G R B G G R G G B G B R G R R B R R B R) 6
22 (R G R B G R R B B B G R G B G G R G G G B G B R R) 7
23 (R B R R R R R B B G R B B B G R G G R B B R R B R) 9
24 (R R G R B B R G G G G G G G R B B G G R B B G G G) 6
25 (R B G B R R R G B B G R B G G G B R R B B B G B G) 10
26 (R B R R G R R R G G G B B G R B B R G R R G G B R) 6
27 (G R G R R G B B G R G R R G G R R R R G G R B R B) 4
28 (R B G G G B G R G G R B B G G G B B B R G B G R B) 9
29 (G R B R G G B R B G R G B R R G G G B B G G R G B) 7
30 (R G G R B B G R B R B B G B B G B G G R B G B B G G) 11
31 (G R R R G R R B G B B B B R G G B G G B G R B G G) 8
32 (B R B G R B R B B R G B B R B B G R G G R R R R B) 10
33 (B G B R B R G B G R G G G G B G B R B B B R B B G) 11
34 (B B G G G B R R G G R G B B R G G G G B R G B R G) 7
35 (R R R G G R R G B R R G B G B B G G R B B R R B G) 7
36 (G B G G G B G B R R R R R R B G B R G R R G G B R) 6
37 (G R R R G G G B R R G B G B R B G B B R G B R R G) 7
38 (G G R G G G R B R R B G B R G R R B G B B R G R B) 7
39 (B G B B G R R G G R G G G B B G B B B G B G R G G) 9
40 (R G G B R G R G R G B R B B B G B B R G B R R R G) 8

41 (R B R B G B B G G R B B R G B B R B B R G R B B B) 13
42 (R B G R G R R R B B R B G B B B G R B B R R R R R) 9
43 (B G G R G B B R R B R G R G B R R B R B G G R G G) 7
44 (G R R G G R R B R B B G R R B G G B B G B G R G B) 8
45 (G R B R G G B B R R R R R G R R B G R R R R G R R) 4
46 (B B R R R B G B G R G G B R B B R G R B G G R G G) 8
47 (B G B R G R B B G R B R R G B G R R B G R B B R R) 9
48 (R R R R B R G G G G R G R G G G R B B G B B G G G) 5
49 (R R B G G G G G G G G G R G B R R B G B B B R R R) 6
50 (G R B R B G G G G R B B B G R G B G R B B R R R G) 8
51 (G B R G R G G B B B R G B B R B G G R G R B R R G) 8
52 (B R G B G G G G G R G R B R B B R R R G G B B G R) 7
53 (R R B B B G B G G G R B B R G B B R G G G B R R B) 10
54 (G R G G G G G B G G R R R B R B B G B G B B R B B) 9
55 (R B G R B B R R B R R G R G R R G G B G G B R B B) 8
56 (R B B R R R B B G B R G B R B G G R B B G G R G R) 9
57 (G G G G B R G R R R R B R R B R B B R B R B B B R) 9
58 (R G R R G B B G B B R G R G B G R B B R G R B B B) 10
59 (G R R R R R B G B R G G G G R B G B R B R B G B B) 8
60 (R R B R B R B R R G G R B B B G B G G G G G B B G) 9
61 (R R G G G B R R B B R R B B B R G R B B R R B R R) 9
62 (R R B B B G G G B G R G B G G G G G G B G B R R G R) 7
63 (B G G B R G R B G R R R R B R B B B R R G B G R G) 8
64 (G R B B G R G G B G R G R B B R R G B G B G R B R) 8
65 (B R G R G R B G G G R B B B R R G G B G R B R B G) 8
66 (G R B B G B B B B B B B R R G G G R G G G R B R R R) 10
67 (B R B G B G B R R G R G G R G B G G G G G G G G R R) 5
68 (R G G G R B R G B G R B B B B B B G R G R G R B G) 9
69 (G B B R G G G R G B B G G R G R G B G B B B R G R) 8
70 (R B G G B B R B R G B G G R R G R R R G B B G R B) 8
71 (B G G B G R G G G R B B R G R R R G G B R R G G R G) 5
72 (B G B G G B R G R R G G R R R G B G R R G B B G G) 6
73 (B G G G G G R R B G B R B G B G R R B G G B G R B R) 8
74 (B B B B G R B G G B R G R R R B G R B B G G G R G) 9
75 (B R G R R R B B R G R R B R R G B G B B R B G G R) 8
76 (B B G R R B G G G R R G G G R B R B B B R R R R B R) 8
77 (G B G B G B G G G G G B G R R B B G R B R B G R G R) 8
78 (G B R B R G G B R R R G G R B G B R B R R B R B B) 9
79 (G B R B G G G B B G G G G B R R R R B R B G R G G G R) 7
80 (R G R G R R G B G G G G R R B R R B R R B B G B B) 7

```
81 (B G G R R R B B G G R R B G G G G R B R B G B G R) 7
82 (G B G R R B R R R B R G G G B G G B R G R G R G G) 5
83 (G B R B R B G B B G G R R G B R G G B R G G G B R) 8
84 (B R G B B R G G B G G G G R R B G B B R G B R B G) 9
85 (B R R G G R B B G B B G R B G B R G B G G G B G G) 9
86 (G G R B B G G R B G B G B B G B B B B R G G R R G) 10
87 (R G B R G B G B G B B G R R B G R B R R G G B B B) 10
88 (G R B R B B B R G R R G R G B G R G B R B B R R B) 9
89 (G B R R R R B B B R B G G B G B G G G G R R B B R) 9
90 (R G R B R R R B R R R R G R G B G R B R R R G R R) 4
91 (G R B B G G G B R G R G B B G R R R B B G B B G B) 10
92 (G R R G G R R G R G G B G R B G G R G B G R G B B) 5
93 (R B G R G B B R B G B G R R G G R B B R B B R R G) 9
94 (B R R G B B R R B R G B B R B G G G R B B B B R R) 11
95 (B B G G R B B G R G G G R G R B B B G G R R B G B) 9
96 (R B R G B G R G R G B R B R R R G B R G R B B G R) 7
97 (G R B B R R B G G B B R B R G B G G R G R B G B G) 9
98 (R G G R G G G G B R B B B G B R B R R R G R B R G G) 7
99 (G B G B G R G R R G R G B R B R R R G R G R R G R) 4
100 (B G R R B G B R R B G R G B B R B G B R G B G G B) 10

NIL
CL-USER> ( average p )
7.85
CL-USER> ( select-individual p )
#<INDIVIDUAL {1002298353}>
CL-USER> ( display ( select-individual p ) )
7 (G B R B R R G B R B G R B B B B R G B R R R B R B) 11
NIL
CL-USER> ( display ( select-individual p ) )
91 (G R B B G G G B R G R G B B G R R R B B G B B G B) 10
NIL
CL-USER> ( display ( select-individual p ) )
25 (R B G B R R R G B B G R B G G G B R R B B B G B G) 10
NIL
CL-USER> ( setf *select-demo* t )
; in: SETF *SELECT-DEMO*
;     (SETF *SELECT-DEMO* T)
;
; caught WARNING:
```

```
;   undefined variable: COMMON-LISP-USER::*SELECT-DEMO*
;
; compilation unit finished
;   Undefined variable:
;     *SELECT-DEMO*
;   caught 1 WARNING condition
T
CL-USER> ( display ( select-individual p ) )
the sample of individuals ...
50 (G R B R B G G G G R B B B G R G B G R B B R R R G) 8
75 (B R G R R R B B R G R R B R R G B G B B R B G G R) 8
78 (G B R B R G G B R R R G G R B G B R B R R B R B B) 9
42 (R B G R G R R R B B R B G B B B G R B B R R R R R) 9
7 (G B R B R R G B R B G R B B B B R G B R R R B R B) 11
46 (B B R R R B G B G R G G B R B B R G R B G G R G G) 8
27 (G R G R R G B B G R G R R G G R R R R G G R B R B) 4
47 (B G B R G R B B G R B R R G B G R R B G R B B R R) 9

the most fit of the sample ...
7 (G B R B R R G B R B G R B B B B R G B R R R B R B) 11

7 (G B R B R R G B R B G R B B B B R G B R R R B R B) 11
NIL
CL-USER> ( display ( select-individual p ) )
the sample of individuals ...
58 (R G R R G B B G B B R G R G B G R B B R G R B B B) 10
7 (G B R B R R G B R B G R B B B B R G B R R R B R B) 11
76 (B B G R R B G G G R R G G G R B R B B B R R R R B R) 8
64 (G R B B G R G G B G R G R B B R R G B G B G R B R) 8
50 (G R B R B G G G G R B B B G R G B G R B B R R R G) 8
61 (R R G G G B R R B B R R B B B R G R B B R R B R R) 9
57 (G G G G B R G R R R R B R R B R B B R B R B B B R) 9
100 (B G R R B G B R R B G R G B B R B G B R G B G G B) 10

the most fit of the sample ...
7 (G B R B R R G B R B G R B B B B R G B R R R B R B) 11

7 (G B R B R R G B R B G R B B B B R G B R R R B R B) 11
NIL
CL-USER> ( display ( select-individual p ) )
```

```
the sample of individuals ...
79 (G B R B G G B B G G G B R R R R B R B G R G G G R) 7
98 (R G G R G G G B R B B B G B R B R R R G R B R G G) 7
26 (R B R R G R R R G G G B B G R B B R G R R G G B R) 6
53 (R R B B B G B G G G R B B R G B B R G G G B R R B) 10
87 (R G B R G B G B G B B G R R B G R B R R G G B B B) 10
59 (G R R R R R B G B R G G G G R B G B R B R B G B B) 8
5 (B B G R R G B R R G B R B R R G G G G B G B R R B) 8
32 (B R B G R B R B B B R G B B R B B G R G G R R R R B) 10

the most fit of the sample ...
53 (R R B B B G B G G G R B B R G B B R G G G B R R B) 10

53 (R R B B B G B G G G R B B R G B B R G G G B R R B) 10
NIL
CL-USER> ( display ( select-individual p ) )
the sample of individuals ...
14 (R G G B B G B G R B B R R R B B B B G B B R G R G) 11
26 (R B R R G R R R G G G B B G R B B R G R R G G B R) 6
97 (G R B B R R B G G B B R B R G B G G R G R B G B G) 9
29 (G R B R G G B R B G R G B R R G G G B B G G R G B) 7
71 (B G G B G R G G R B B R G R R R G G B R R G G R G) 5
55 (R B G R B B R R B R R G R G R R G G B G G B R B B) 8
33 (B G B R B R G B G R G G G G B G B R B B B R B B G) 11
3 (B G R R G R B R R B R B R B G B R G G B G G G B B) 9

the most fit of the sample ...
14 (R G G B B G B G R B B R R R B B B B G B B R G R G) 11

14 (R G G B B G B G R B B R R R B B B B G B B R G R G) 11
NIL
CL-USER>

CL-USER> ( population-demo )


Generation 0 population ...

1 (R R B B B B B B G B R G R R R G R G R R G G R R B) 8
2 (B B R G R G G B B R R R G B R B B B G R R B R B G) 10
```

3 (B B R G B B G G B R R G G R R G G R B R R B R G R) 7
4 (B B R R G G R G B R B B B B B R B G G R B G B B G) 12
5 (G R B B R B R G R B R B B R G R B G R G G R G G R) 7
6 (R B R R B B B R B B R G R R B R R B G R R B R B G) 10
7 (G G B G R B R R B R R B R B R R B B G B R R R B B) 10
8 (R R R R R B R B G R R B G G B B R G G G R R G R B) 6
9 (B R B B B R B R B G B B R G R G G G B B G B B B B) 14
10 (R B B R G R R R G B G R R R G G G B R R R R G R G) 4
11 (G R B R G B R G B R B R B G B R B B B G R B B R B) 12
12 (R B G B B B R B R B B G B R R B B B R B R R R R G) 12
13 (R B B B G R B B B R R B B R B G B G G B G G B G R) 12
14 (R B G B B B R G B R G B R B R B B B R B G G R R R) 11
15 (R B R G G B G G G R R B R B B G B G G G B R B B R) 9
16 (B B B G G B G G G R G G B R B B G G B R G B R R G R) 9
17 (R R R B G R G B G G B R G R R B B R R R G G B B R) 7
18 (B R R R B G B B R B B B R R R B B G R B G R B B B) 13
19 (R R G B G R R R G G G B R R R G R R R R R B B R R) 4
20 (G R G B R R B R G B G G B B B G R B G B B B R G R) 10
21 (R R R R B G R R R B R G R G G G B B R R B G B R R) 6
22 (G B B R B G R G G R G G G R R G B G R B R B G G B) 7
23 (R B R G G B R R G R R B G R R B G G G G B R B R G) 6
24 (G B B R R G R G G R G R B B G R B G G B G G G B G R) 7
25 (B B G G G B G R B R B R B R R B G R G B G G G G R R) 8
26 (G G R B G R G R R R G B B R B G R B B R G R R B B) 8
27 (G R G R G R G G G B B G B B B G R B B B R G R G R) 8
28 (B B R R R B B G R R G B B R R B B G B G R G G G R) 9
29 (B R B G R B B B R G B R R R B R B R G G G G R R G R) 7
30 (B R B G G R R B R R R R R G B B B B R G G B R G R) 8
31 (G B R B G R G R R G G R G G G G R B R B B R R R G) 5
32 (G B R B G B B B G R R R R B G B B R G B B B R B G R) 11
33 (G G G B B G G B G G G B G G B R B R R G G R R B B) 8
34 (R G R B B G G B R R B B B R B R B B R G B R R G B) 11
35 (G R R G R B B B G B R B R G R G B R G G B R G R G) 7
36 (R B B B R B R B B R B R R B G R B G B G B R R B B) 13
37 (G G R G B R B B B B R R G B B R B R R G R G R B G) 9
38 (R G G B G G G R R B R G G R R R R G R R B B G B B B) 7
39 (B G B G B B R B G B R G G B B R R R R R G B R B B) 11
40 (G B B R R B G R R G R R R G R B B R R R R R G R R) 5
41 (G R R G G G B B B R B G R B G G B R B R G G B B G) 9
42 (B G G B R B G G R R R B B B G R B R G R G R R R B) 8

43 (G G B B G G R R B R G B G B B B G R G B G B R B B) 11
44 (G B R B G B R G R G R B R G G B B G G R G G G G R) 6
45 (G G G R R B B R B B B R B B R R R R B B B G R R B) 11
46 (G B G G G R G R G B R B G G G B B B B B G R R R B) 9
47 (B B G B B R B R B B R R G B B G R B G B B R G B R) 13
48 (B R G G B G R R G B G R G G B G B G R R R B R G G) 6
49 (G B G G G G G R G G G R G G B R G B R G B G B G G) 5
50 (R G G B G B R B B B R B G G G R B G G G G R B G B) 9
51 (G R G B R B G G B R R B R R B B G R B G B B B R R) 10
52 (G B B G B R G G R G R G R R R B B G G G B G R R G) 6
53 (R B G G B R G R R B B B G R R R G B B R R G B G R) 8
54 (B B G R G G R R G B G G G B G R R R G R G B G B B) 7
55 (B B R B G G R R B B R B R G B G B G R B B R R B G) 11
56 (R R R G R B G B G R R R B R B B B G G B G B B B B) 11
57 (B G G B B G G R R G R G R R B G B R G B G G B B R) 8
58 (G B G G R R B B G G B R B G B R R G R B R G B G R) 8
59 (R G R B B R G G B G B G R G R R G B R G B R G B G) 7
60 (G R R G G B R R G G B B B R G R B B R G R G R G G) 6
61 (G G R G R R R B B B G G G B G G G R G R B R G B G) 6
62 (G G G G R B G B B B B G B R G G B B B R G R B R B) 11
63 (R G G R G R B G R R R R B B G R R R B B R B G R R) 6
64 (R B G B G B G B R R G R R G G G B R R B R G B B B) 9
65 (R G G G B B R B R B G G G R G B R R R G R B B B R) 8
66 (B G G B G B G B B R R B G G R G R R R R R G G B G) 7
67 (G G G B G B B B R G R R B B G R G B G G B G B G R) 9
68 (G G R G R B B R B R B G B R B B R B G R G B R B B) 11
69 (R B R B R R G G G B G R G B G R G B R G G B B R G) 7
70 (R G R B R B G B R R G G G R R R G G B R R G R G G) 4
71 (G B B R B B R R R R R B G G G G R G R B B R R G B) 8
72 (B G R G R G R R B R G R R R R B R B R G R B R R B) 6
73 (G G R R B R B R R B R B G R R B R G B G B R R B R) 8
74 (R G G R B G R G G G R R B B B B G B G R G R R G B) 7
75 (B R G G B R G G G R R G B R R B R R B R G R R B G G) 6
76 (R B B R R G R B G G G B B G B G B G R G G G B R R) 8
77 (G G R G G B G B R R R G G B R R B B G R G G R G B) 6
78 (G B B G G B R B R B R R R R R G G R R G B G R G R) 6
79 (G G R B G B B R G B R B B R G G B R G R R R G B R) 8
80 (G B B B R B G R R B G B G G B B R G B G B G G R G) 10
81 (G R B R G R R R B B G G B R B G G G R R B G B B B) 9
82 (R G R R B R R R G G R B R B G B G B B G B R G G R) 7

83 (B G R B G G G B R R G B B B G R G B B R R G B R G) 9
84 (R R G B G B G B B B B R B R G R R R G G R G R G B) 8
85 (B G R R R B R R R G R B R B R R G G B G B G G B B) 8
86 (B B B R G R G B R R G B G R B G R B G B G G R G R) 8
87 (B G R G B R G B G G B B R G R G R G R G R R B B B) 8
88 (G G B R B B G B R G R G G G B R B G R G B B G R B) 9
89 (B R G G G R B G G B G G G B R R B B B R R R G B B) 9
90 (B B G R G G G R R B G R B B R R G R G B B R B B G) 9
91 (R G R B R B G R B R B R G G G G R R B B B G B B R) 9
92 (G R G G B R R B B R B B G B G R B G G R R R B R B) 9
93 (B R R R G R G B B G B R B G B B R G G R R R G G R) 7
94 (G G R G R G G G G B B R G B R R B G B B R B B R R G) 8
95 (R R B G G R R R R B G B R G R B B R R G G R G B B) 7
96 (G R G R G R R G G B B R G G B G R G R G G G R R R R) 3
97 (R G B B R G G B G R R B G R B B G R B G G B R R R) 8
98 (R B G B G R R G R B R R G G B B G G G G B G R G G) 6
99 (R R R G R B B R G G G R B B G G G G R G G G R B R) 5
100 (R B B G R G B G B G G G G R R B G B B B R G G B B) 10

Average fitness = 8.24

Sampling ...

the sample of individuals ...
49 (G B G G G G G R G G G R G G B R G B R G B G B G G) 5
3 (B B R G B B G G B R R G G R R G G R B R R B R G R) 7
5 (G R B B R B R G R B R B B R G R B G R G G R G G R) 7
62 (G G G G R B G B B B B G B R G G B B B R G R B R B) 11
52 (G B B G B R G G R G R G R R R B B G G G B G R R G) 6
97 (R G B B R G G B G R R B G R B B G R B G G B R R R) 8
15 (R B R G G B G G G R R B R B B G B G G G B R B B R) 9
99 (R R R G R B B R G G G R B B G G G G R G G G R B R) 5

the most fit of the sample ...
62 (G G G G R B G B B B B G B R G G B B B R G R B R B) 11

Sampling ...

the sample of individuals ...

29 (B R B G R B B R G B R R R B R B R G G G G R R G R) 7
1 (R R B B B B B B G B R G R R R G R G R R G G R R B) 8
99 (R R R G R B B R G G G R B B G G G G R G G G R B R) 5
6 (R B R R B B B R B B R G R R B R R B G R R B R B G) 10
74 (R G G R B G R G G G R R B B B B G B G R G R R G B) 7
10 (R B B R G R R R G B G R R R G G G B R R R R G R G) 4
53 (R B G G B R G R R B B B G R R R G B B R R G B G R) 8
44 (G B R B G B R G R G R B R G G B B G G R G G G G R) 6

the most fit of the sample ...
6 (R B R R B B B R B B R G R R B R R B G R R B R B G) 10

Sampling ...

the sample of individuals ...
89 (B R G G G R B G G B G G G B R R B B B R R R G B B) 9
20 (G R G B R R B R G B G G B B B G R B G B B B R G R) 10
43 (G G B B G G R R B R G B G B B B G R G B G B R B B) 11
46 (G B G G G R G R G B R B G G G B B B B B G R R R B) 9
76 (R B B R R G R B G G G B B G B G B G R G G G B R R) 8
51 (G R G B R B G G B R R B R R B B G R B G B B B R R) 10
96 (G R G R G R R G G B B R G G B G R G R G G G R R R) 3
83 (B G R B G G G B R R G B B B G R G B B R R G B R G) 9

the most fit of the sample ...
43 (G G B B G G R R B R G B G B B B G R G B G B R B B) 11

NIL
CL-USER>

Task 8:

Code:

```
;---------------------------------------------------------------------------
; Task 8

( defmethod mutate ( ( i individual ) &aux mutation )
  ( setf mutation ( mutation ( individual-rbg-string i ) ) )
  ( make-instance 'individual
    :number ( individual-number i )
    :rbg-string mutation
    :fitness ( funcall *fitness* mutation )
  )
)

( defconstant *pc-m* 50 )

( defmethod maybe-mutate ( ( i individual ) )
  ( if ( <= ( + 1 ( random 100 ) ) *pc-m* )
    ( mutate i )
    i
  )
)

( defmethod mutate-demo ()
  ( setf i ( random-individual ) )
  ( display i )
  ( dotimes ( x 20 )
    ( setf i ( mutate i ) )
    ( display i )
  )
)


( defmethod maybe-mutate-demo ()
  ( setf i ( random-individual ) )
  ( display i )
  ( dotimes ( x 20 )
    ( setf n ( maybe-mutate i ) )
    ( display-nnl n )
    ( if ( not ( equal n i ) ) ( princ " *" ) )
```

```
    ( terpri )
    ( setf i n )
  )
)
```

Demo:

```
CL-USER> ( setf i ( random-individual ) )
; in: SETF I
;     (SETF I (RANDOM-INDIVIDUAL))
;
; caught WARNING:
;   undefined variable: COMMON-LISP-USER::I
;
; compilation unit finished
;   Undefined variable:
;     I
;   caught 1 WARNING condition
#<INDIVIDUAL {1004BF7C63}>
CL-USER> ( display i )
0 (B B B G G G B G R R G R G B B R G B G G B R B B B) 11
NIL
CL-USER> ( display ( mutate i ) )
0 (B B B G G G B G R R G R G G B R G B G G B R B B B) 10
NIL
CL-USER> ( display i )
0 (B B B G G G B G R R G R G G B R G B G G B R B B B) 11
NIL
CL-USER> ( display ( mutate i ) )
0 (B B B G B G B G R R G R G G B R G B G G B R B B B) 11
NIL
CL-USER> ( display i )
0 (B B B G B G B G R R G R G G B R G B G G B R B B B) 11
NIL
CL-USER> ( display ( maybe-mutate i ) )
0 (B B B G B G B G R R G R G G B R G B G G G R B B B) 10
NIL
CL-USER> ( display ( maybe-mutate i ) )
0 (B B B G B G B G R R G R G G B R G B G G G R B B B) 11
NIL
```

```
CL-USER> ( display ( maybe-mutate i ) )
0 (B B B G B G B G R R G R G G B R G B G G G R B B B) 11
NIL
CL-USER> ( display ( maybe-mutate i ) )
0 (B B B G B G B G R R G R G G B R G B G G G R B B B) 11
NIL
CL-USER> ( display ( maybe-mutate i ) )
0 (B B B G B G B G R R G R G G B R G B G G G R B B B) 11
NIL
CL-USER> ( display ( maybe-mutate i ) )
0 (R B B G B G B G R R G R G G B R G B G G G R B B B) 9
NIL
CL-USER>

CL-USER> ( mutate-demo )
0 (R G G G G G G G R B B B G G R R G R G G R R R R B) 4
0 (R G G G G G G B R B B B B G G R R G R G G R R R R B) 5
0 (R G G G G G G B R B B B B G G R R G R G G R B R R B) 6
0 (R G G G G G R B R B B B B G G R R G R G G R B R R B) 6
0 (R G G G G B R B R B B B B G G R R G R G G R B R R B) 7
0 (R G B G G B R B R B B B B G G R R G R G G R B R R B) 8
0 (R G B G G B R B R B B G B G G R R G R G G R B R R B) 7
0 (R G G G G B R B R B G B G G R R G R G G R B R R B) 6
0 (R B G G G B R B R B G B G G R R G R G G R B R R B) 7
0 (R B G G G B R B R B G B G G B R G R G G R B R R B) 8
0 (R B G G G B R B R B G B R G B R G R G G R B R R B) 8
0 (R B G G G B R B R B G B R G G R G R G G R B R R B) 7
0 (R B R G G B R B R B G B R G G R G R G G R B R R B) 7
0 (R R R G G B R B R B G B R G G R G R G G R B R R B) 6
0 (R R R G G B R B R B G B R G R R G R G G R B R R B) 6
0 (R R R G R B R B R B G B R G R R G R G G R B R R B) 6
0 (R R R G R B R B R B G B R G R R B R G G R B R R B) 7
0 (R R R G R B R B R B G B R G R R B R G G R G R R B) 6
0 (R R R G R B R B B B G B R G R R B R G G R G R R B) 7
0 (R R R G R B R B B B G B R G R R B R G G R G R B B) 8
0 (R R R G R B R B G B G B R G R R B R G G R G R B B) 7
NIL
CL-USER> ( maybe-mutate-demo )
0 (R G B B G G B B G G B B G B R G B B R G G B G B B) 12
0 (R G B B G G B B G G B B G B R G B B R G G B G B B) 12
```

0 (R G B B G G B B G G B B G B R G B B R G G B G B B) 12
0 (R G B B G G B B G G B B G B R G B B R G G B G B B) 12
0 (R G B B G G B B G G B B G B R G B B R G G B G B B) 12
0 (R G B B G G B B G G B B G B R G B B R G G B G B B) 12
0 (R G B B G G B B G G B B G B R G B B R G G B G B B) 12
0 (R G B B G G B B G G B B G B R G B B R G G B G B R) 11 *
0 (R G B B G G B B G G B B G B B G B B R G G B G B R) 12 *
0 (R G B B G G B B G G B B G B B G B B R G G B G B R) 12
0 (R G G B G G B B G G B B G B B G B B R G G B G B R) 11 *
0 (R G G B G G B B G G B B G B B G B B R G G B G B R) 11
0 (R G G B G G B B G G B B G B B G B B R G G B G B R) 11
0 (R G G R G G B B G G B B G B B G B B R G G B G B R) 10 *
0 (R G G R G G B B G G B B G B B G B B R G G B G B R) 10
0 (R G B R G G B B G G B B G B B G B B R G G B G B R) 11 *
0 (R G B R G G B B G G B B G B B G B B R G G B G B B) 12 *
0 (R G B R G G B B G G B B G B B G B B R G G B G B B) 12
0 (R G B R G G B B G G B B G B B G B B R G G B G R B) 11 *
0 (R G B R G G B B G G B B G B B G B B R G G B G R B) 11
0 (R G B R G G B B G G B B G B B G B B R G G B G R B) 11
NIL

Task 9:

Code:

```
;---------------------------------------------------------------------------
; Task 9

( setf *copy-demo* nil )
( defconstant *pc-c* 40 )

( defmethod perform-copies ( ( cp population ) ( np population))
  ( dotimes ( i ( nr-copies ) )
    ( perform-one-copy cp np )
  )
)

( defmethod nr-copies ()
  ( * ( / *pc-c* 100 ) *population-size* )
)
( defmethod perform-one-copy ( ( cp population ) ( np population ) &aux x m mm new-i )
  ( setf m ( select-individual cp ) )
  ( if *copy-demo* ( format t "Selected individual = ~%" ) )
  ( if *copy-demo* ( display m ) )
  ( setf mm ( maybe-mutate m ) )
  ( if *copy-demo* ( format t "Possibly muted individual = ~&" ) )
  ( if *copy-demo* ( display mm ) )
  ( setf ( individual-number mm ) ( + 1 ( size np ) ) )
  ( if *copy-demo* ( format t "Renumbered individual = ~&" ) )
  ( if *copy-demo* ( display mm ) )
  ( setf new-i ( new-individual ( + 1 ( size np ) ) ( individual-rbg-string mm ) ) )
  ( setf
    ( population-individuals np )
    ( append ( population-individuals np ) ( list new-i ) )
  )
  nil
)

( defmethod empty-population ( ( cp population ) &aux np )
  ( setf np ( make-instance 'population ) )
  ( setf ( population-individuals np ) () )
  ( setf ( population-generation np ) ( + 1 ( population-generation cp ) ) )
  np
```

```
)

( defmethod perform-copies-demo ( &aux cp np )
  ( setf cp ( initial-population ) )
  ( setf np ( empty-population cp ) )
  ( format t "------------------------------------------------------------------------" )
  ( display np )
  ( format t "~%~%------------------------------------------------------------------------" )
  ( setf *select-demo* t )
  ( setf *copy-demo* t )
  ( dotimes ( i 10 )
    ( perform-one-copy cp np )
    ( format t "------------------------------------------------------------------------" )
    ( display np )
    ( format t "~%~%------------------------------------------------------------------------ " )
  )
  ( setf *select-demo* nil )
  ( setf *copy-demo* nil )
  nil
)
```

Demo:

```
CL-USER> ( perform-copies-demo )
------------------------------------------------------------------------

Generation 1 population ...




------------------------------------------------------------------------the sample of individuals ...
40 (G G G B G B R R R R B R G R R G G R G G R G G R R) 3
66 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
11 (B G B R B G G B G G R G R R R G R B R B B G B R R) 8
40 (G G G B G B R R R R B R G R R G G R G G R G G R R) 3
91 (G B B R B R G B R R R B B R G B R G R R B G G B R) 9
1 (R R R G R B G R B G R R B G B G B R G G B B G B B) 9
18 (B R G B R B R G B B G R R B R G G B G R G B B R R) 9
93 (G B G G B R R R G R B B B G G R R B G B G G B G R) 8
```

the most fit of the sample ...
66 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11

Selected individual =
66 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
Possibly muted individual =
66 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
Renumbered individual =
1 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11

Generation 1 population ...

1 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11

---------- the sample of individuals ...
5 (R G B G G R R B R B B R G B G G G R G B G G G G B) 7
14 (B B B R R R G B R R G G G G G G B R R B G G B R B) 8
62 (R G G B G G R B B B R G G R R G R B B G B B B R G) 9
46 (R B R G G R G R B R R R B B G R B R R B B G R R G) 7
29 (R R R G R R B B G G R G R G G R R R B G G G G G G) 3
38 (R B B R R R R B B G B G G R B R R B B G R G R B R) 9
19 (G G R R B B G G B G R R G B B B R R R B B R G R R) 8
40 (G G G B G B R R R R B R G R R G G R G G G R G G R R) 3

the most fit of the sample ...
62 (R G G B G G R B B B R G G R R G R B B G B B B R G) 9

Selected individual =
62 (R G G B G G R B B B R G G R R G R B B G B B B R G) 9
Possibly muted individual =
62 (R G G B G G R B B B R G G R R G R B B G B R B R G) 8
Renumbered individual =
2 (R G G B G G R B B B R G G R R G R B B G B R B R G) 8

Generation 1 population ...

1 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
2 (R G G B G G R B B B R G G R R G R B B G B R B R G) 8

---------- the sample of individuals ...
50 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11
5 (R G B G G R R B R B B R G B G G G R G B G G G G B) 7
55 (B R G R R B B R R G B R R B R G B R B G R G R G B) 8
56 (R G R R R G R B G B R G B G B R B G B B R B B G R) 9
99 (B G R B G R G R B B B G G G B R R B R B R G B G B) 10
55 (B R G R R B B R R G B R R B R G B R B G R G R G B) 8
2 (G R G B R B G G B R R B G B B R G G G B B B G B R) 10
30 (G R B G R B R B G B R G R B G B B G B R G G G B R) 9

the most fit of the sample ...
50 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11

Selected individual =
50 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11
Possibly muted individual =
50 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11
Renumbered individual =
3 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11

Generation 1 population ...

1 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
2 (R G G B G G R B B B R G G R R G R B B G B R B R G) 8
3 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11

---------- the sample of individuals ...
95 (B B B B G B R B B B G G G B R R R G G G G R B B B) 12
52 (R R B R G G B R B R B B B R B B G B G R R G B R G) 10
85 (R R G B R B G B G B G B G G B G R G B B R G G G B) 9
56 (R G R R R G R B G B R G B G B R B G B B R B B G R) 9
84 (R R B B B R G G B B G B G B G G R G R B B B R B B) 12

65 (B B G G B G B B G G G B R G R R R R G B B G G R R) 8
88 (G R B R R B G R B G B R B G R R R B G R B R R B B) 9
11 (B G B R B G G B G G R G R R R G R B R B B G B R R) 8

the most fit of the sample ...
95 (B B B B G B R B B B G G G B R R R G G G G R B B B) 12

Selected individual =
95 (B B B B G B R B B B G G G B R R R G G G G R B B B) 12
Possibly muted individual =
95 (B B R B G B R B B B G G G B R R R G G G G R B B B) 11
Renumbered individual =
4 (B B R B G B R B B B G G G B R R R G G G G R B B B) 11

Generation 1 population ...

1 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
2 (R G G B G G R B B B R G G R R G R B B G B R B R G) 8
3 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11
4 (B B R B G B R B B B G G G B R R R G G G G R B B B) 11

---------- the sample of individuals ...
94 (G G G B G G B G R G G B R R B B G R R G R B B R G) 7
4 (B R G G B R R B R R R B R G G R R B R G R G R B R) 6
12 (B R R B B B B G G B R G R G R G B G B B B G G G G) 10
59 (R G B B R R R G R B G G G R R B R G B R G B G R B) 7
59 (R G B B R R R G R B G G G R R B R G B R G B G R B) 7
15 (G G B R G R B G R B G B G B G B G B G B R G R B R) 9
24 (G G G R B R R B B B B B B B G B R G R B G B R R B) 12
39 (B R B R R B B G R G R G B G G B G G B G R G B R B) 9

the most fit of the sample ...
24 (G G G R B R R B B B B B B B G B R G R B G B R R B) 12

Selected individual =
24 (G G G R B R R B B B B B B B G B R G R B G B R R B) 12
Possibly muted individual =

24 (R G G R B R R B B B B B B B G B R G R B G B R R B) 12
Renumbered individual =
5 (R G G R B R R B B B B B B B G B R G R B G B R R B) 12

Generation 1 population ...

1 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
2 (R G G B G G R B B B R G G R R G R B B G B R B R G) 8
3 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11
4 (B B R B G B R B B B G G G B R R R G G G G R B B B) 11
5 (R G G R B R R B B B B B B B G B R G R B G B R R B) 12

---------- the sample of individuals ...
63 (G R B G B B B R G B G G B B G B R R G R R R G R B) 9
69 (G G R G G G G R G B G G R R R B R B G G R R B B R) 5
76 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10
65 (B B G G B G B B G G G B R G R R R R G B B G G R R) 8
78 (R B R B R R B B G B G G G B R R R R R R B B B B R) 10
63 (G R B G B B B R G B G G B B G B R R G R R R G R B) 9
89 (G R G G B B B G R B R B R R G B G R R R G R R G G) 6
52 (R R B R G G B R B R B B B R B B G B G R R G B R G) 10

the most fit of the sample ...
76 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10

Selected individual =
76 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10
Possibly muted individual =
76 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10
Renumbered individual =
6 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10

Generation 1 population ...

1 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
2 (R G G B G G R B B B R G G R R G R B B G B R B R G) 8

3 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11
4 (B B R B G B R B B B G G G B R R R G G G G R B B B) 11
5 (R G G R B R R B B B B B B B G B R G R B G B R R B) 12
6 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10

---------- the sample of individuals ...
26 (B R B G B R B B B R B G R B B B G R B G B R B R G) 13
55 (B R G R R B B R R G B R R B R G B R B G R G R G B) 8
92 (R B R B R G R R R B R B G G G R G R R G G B R G B) 6
54 (G B R G B B G R G R R G B B G R R R B R R R B G G) 7
45 (G G G B B B G R G G G G B R B B B G R B R G B R R) 9
80 (G B R G G R R R B B R G B R R G R B G B G G B R B) 8
14 (B B B R R R G B R R G G G G G G B R R B G G B R B) 8
46 (R B R G G R G R B R R R B B G R B R R B B G R R G) 7

the most fit of the sample ...
26 (B R B G B R B B B R B G R B B B G R B G B R B R G) 13

Selected individual =
26 (B R B G B R B B B R B G R B B B G R B G B R B R G) 13
Possibly muted individual =
26 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13
Renumbered individual =
7 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13

Generation 1 population ...

1 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
2 (R G G B G G R B B B R G G R R G R B B G B R B R G) 8
3 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11
4 (B B R B G B R B B B G G G B R R R G G G G R B B B) 11
5 (R G G R B R R B B B B B B B G B R G R B G B R R B) 12
6 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10
7 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13

---------- the sample of individuals ...
40 (G G G B G B R R R R B R G R R G G R G G R G G R R) 3
71 (G B R B B G G R R G B B R G B G R B G G G B R G G) 8
78 (R B R B R R B B G B G G G B R R R R R R B B B B R) 10
21 (R R G B G B R R G R R G R G G B G G R R R R G G G) 3
20 (B B B B R R R R G B G G R G R G G G R R G R R B G) 6
17 (B R B B R G B B B G R B R R R R G B G R R B R R R) 9
99 (B G R B G R G R B B B G G G B R R B R B R G B G B) 10
82 (R G B R G R G R G B G B R G R R B B B R G G B G B) 8

the most fit of the sample ...
78 (R B R B R R B B G B G G G B R R R R R R B B B B R) 10

Selected individual =
78 (R B R B R R B B G B G G G B R R R R R R B B B B R) 10
Possibly muted individual =
78 (R B R B R R B B G B G G G B R R R R R R G B B B R) 9
Renumbered individual =
8 (R B R B R R B B G B G G G B R R R R R R G B B B R) 9

Generation 1 population ...

1 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
2 (R G G B G G R B B B R G G R R G R B B G B R B R G) 8
3 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11
4 (B B R B G B R B B B G G G B R R R G G G G R B B B) 11
5 (R G G R B R R B B B B B B G B R G R B G B R R B) 12
6 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10
7 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13
8 (R B R B R R B B G B G G G B R R R R R R G B B B R) 9

---------- the sample of individuals ...
86 (B R R G R G B R G B R B G R B G G B G G B B R B G) 9
9 (B G G G G R R G B R B G G B G R G R B B R G B R G) 7
90 (R B G B G R B R B R R R R R B G B R G R B G G R B) 8
30 (G R B G R B R B G B R G R B G B B G B R G G G B R) 9
9 (B G G G G R R G B R B G G B G R G R B B R G B R G) 7

26 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13
46 (R B R G G R G R B R R R B B G R B R R B B G R R G) 7
92 (R B R B R G R R R B R B G G G R G R R G G B R G B) 6

the most fit of the sample ...
26 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13

Selected individual =
26 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13
Possibly muted individual =
26 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13
Renumbered individual =
9 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13

Generation 1 population ...

1 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
2 (R G G B G G R B B B R G G R R G R B B G B R B R G) 8
3 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11
4 (B B R B G B R B B B G G G B R R R G G G G R B B B) 11
5 (R G G R B R R B B B B B B G B R G R B G B R R B) 12
6 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10
7 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13
8 (R B R B R R B B G B G G G B R R R R R R G B B B R) 9
9 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13

---------- the sample of individuals ...
6 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10
80 (G B R G G R R R B B R G B R R G R B G B G G B R B) 8
83 (G B R B R B R R R G G R R B R G B G B B G G G B R) 8
93 (G B G G B R R R G R B B B G G R R B G B G G B G R) 8
23 (B R B G B B G R G B G G B B B R R R G B R B R R R) 10
83 (G B R B R B R R R G G R R B R G B G B B G G G B R) 8
93 (G B G G B R R R G R B B B G G R R B G B G G B G R) 8
21 (R R G B G B R R G R R G R G G B G G R R R R G G G) 3

the most fit of the sample ...

6 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10

Selected individual =
6 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10
Possibly muted individual =
6 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10
Renumbered individual =
10 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10

Generation 1 population ...

1 (B G G B G R B G B R R R B B R B G B B B G R R G B) 11
2 (R G G B G G R B B B R G G R R G R B B G B R B R G) 8
3 (G R R R B G R B R B B B B G B R B R G R B B R R B) 11
4 (B B R B G B R B B B G G G B R R R G G G G R B B B) 11
5 (R G G R B R R B B B B B B B G B R G R B G B R R B) 12
6 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10
7 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13
8 (R B R B R R B B G B G G G B R R R R R R G B B B R) 9
9 (B R B G B R B B B R B G R B B B G R B G B G B R G) 13
10 (B B R B G R R B B B R R R G B G R R R G B B G R B) 10

NIL

Task 10:

Code:

```
;---------------------------------------------------------------------------
; Task 10

( setf *crossover-demo* nil )
( defconstant *pc-x* 60 )

( defmethod perform-crossovers ( ( cp population ) ( np population ) )
  ( dotimes ( i ( nr-crossovers ) )
    ( perform-one-crossover cp np )
  )
)

( defmethod nr-crossovers ()
  ( * ( / *pc-x* 100 ) *population-size* )
)

( defmethod perform-one-crossover ( ( cp population ) ( np population ) )
  ( let ( x m mm mother father new-i )
    ( setf mother ( select-individual cp ) )
    ( setf father ( select-individual cp ) )
    ( if *crossover-demo* ( format t "Select mother = ~%" ) )
    ( if *crossover-demo* ( display mother ) )
    ( if *crossover-demo* ( format t "Select father = ~&" ) )
    ( if *crossover-demo* ( display father ) )
    ( setf m ( crossover mother father ) )
    ( if *crossover-demo* ( format t "The crossover = ~&" ) )
    ( if *crossover-demo* ( display m ) )
    ( setf mm ( maybe-mutate m ) )
    ( if *crossover-demo* ( format t "The possibly mutated individual = ~&" ) )
    ( if *crossover-demo* ( display mm ) )
    ( setf ( individual-number mm ) ( + ( size np ) ) )
    ( if *crossover-demo* ( format t "The renumberd individual = ~&" ) )
    ( if *crossover-demo* ( display mm ) )
    ( setf new-i ( new-individual ( + 1 ( size np ) ) ( individual-rbg-string mm ) ) )
    ( setf ( population-individuals np )
           ( append ( population-individuals np )
           ( list new-i ) )
          )
```

```
  )
  nil
)

( defmethod crossover ( ( mother individual ) ( father individual ) &aux mi fi x i )
  ( setf mi (individual-rbg-string mother ) )
  ( setf fi (individual-rbg-string father ) )
  ( setf x ( crossover mi fi ) )
  ( setf i ( new-individual 0 x ) )
  i
)


( defmethod perform-crossovers-demo ( &aux cp np )
  ( setf cp ( initial-population ) )
  ( setf np ( empty-population cp ) )
  ( format t "------------------------------------------------------------------------" )
  ( display np )
  ( format t "~%~%------------------------------------------------------------------------" )
  ( setf *select-demo* t )
  ( setf *crossover-demo* t )
  ( dotimes ( i 10 )
    ( perform-one-crossover cp np )
    ( format t "------------------------------------------------------------------------" )
    ( display np )
    ( format t "~%~%------------------------------------------------------------------------" )
  )
  ( setf *select-demo* nil )
  ( setf *crossover-demo* nil )
  nil
)
```

Demo:

```
CL-USER> ( perform-crossovers-demo )
------------------------------------------------------------------------

Generation 1 population ...
```

----------the sample of individuals ...
56 (B R G B R B G R R B G B G G R G R G G B R G B R R) 7
36 (B G G R R R R R B B G R R R B R R B R G B G R R G) 6
88 (B G B B R B R B G B R R G B G B G G G B G G R B B) 11
55 (R B G G R R R G B B B G R G G G G R B G B G G G B) 7
63 (R G R B B R R G G B G R R R B R B G B R R R B G G) 7
87 (R R G G R R G B B B B B G R B B R B R R B B R R G) 10
81 (G R R G B R B R B G R B R R R B B G G G B B B B G) 10
10 (G G G G B B R B G G R B R B G B G R G G G B G R R) 7

the most fit of the sample ...
88 (B G B B R B R B G B R R G B G B G G G B G G R B B) 11

the sample of individuals ...
13 (G B G R R G B B B G R B G G R R R G R G G G R R R) 5
30 (G R B R G G G R R G R G G G R B B R B G G B G R B R G) 6
33 (B B R G G G R R G G G R G B B B G R G B G G G G G) 6
46 (B R R G G G R B R G R B B R G R G B G R B G G R B) 7
10 (G G G G B B R B G G R B R B G B G R G G G B G R R) 7
51 (R R G B G G B B G G B R B R R B R G R R G R R R B) 7
8 (B G B R R B B R R R G G G G B B B G R G B R R B G) 9
4 (B G G B R R R G G B G G R B B B R B B R B G B G B) 11

the most fit of the sample ...
4 (B G G B R R R G G B G G R B B B R B B R B G B G B) 11

Select mother =
88 (B G B B R B R B G B R R G B G B G G G B G G R B B) 11
Select father =
4 (B G G B R R R G G B G G R B B B R B B R B G B G B) 11
The crossover =
0 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13
The possibly mutated individual =
0 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13
The renumberd individual =
0 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13

Generation 1 population ...

1 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13

----------the sample of individuals ...
39 (G G R G G G R B B R G R G G G R R G B R B B G R B)
27 (B R R G G R B G R G B B R B G B G G B B B G B B G)
30 (G R B R G G G R R G R G G G R B B R B G G B G R B R G)
33 (B B R G G G R R G G G R G B B B G R G B G G G G G)
71 (G R B G B B B R B G R G R R B G R G G G G R B B B G R)
26 (G B B G G G B G G G G B R R G R G G B R R G B B G)
33 (B B R G G G R R G G G R G B B B G R G B G G G G G)
35 (B G G G R B B R R B R B R B B G R R R G B G B B R)

the most fit of the sample ...
27 (B R R G G R B G R G B B R B G B G G B B B G B B G)

the sample of individuals ...
99 (R G B G G G G R B G R R G R R G R G B R B B R G B)
87 (R R G G R R G B B B B B G R B B R B R R B B R R G)
60 (B G G R R R B B B G G B G G R B R R G G G G G B B)
31 (R B R R R G G B G R B B G R B G B G B G G G G G R)
77 (G B G R R G B G G B G B B B R G B G B B G B R B B)
39 (G G R G G G R B B R G R G G G R R G B R B B G R B)
51 (R R G B G G B B G G B R B R R B R G R R G R R R B)
61 (G G G G G G B B G G G R B B R B G R G R B B G R R)

the most fit of the sample ...
77 (G B G R R G B G G B G B B B R G B G B B G B R B B)

Select mother =
27 (B R R G G R B G R G B B R B G B G G B B B G B B G)
Select father =
77 (G B G R R G B G G B G B B B R G B G B B G B R B B)
The crossover =
0 (B R R G G R B G R B G B B B R G B G B B G B R B B)
The possibly mutated individual =
0 (B R R G G R B R R B G B B B R G B G B B G B R B B)
The renumberd individual =

1 (B R R G G R B R R B G B B B R G B G B B G B R B B) 12

Generation 1 population ...

1 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13
2 (B R R G G R B R R B G B B B R G B G B B G B R B B) 12

---the sample of individuals ...
84 (G B B G B B R G G B G G G R B R R G G G G G G R R) 6
15 (B B B G B B G R G G B G B R G G B G R R G R B G R) 9
91 (R G R R R B B G B R B B G G R G R R R G G G B B G) 7
38 (G B B B R R G R B G R B R B R B R G R B B R R R G) 9
92 (B B B G R R B R R G G R B R B B G G R R G B R R G) 8
53 (B R G G B G B B R R R B B B R G G R G R B R B G G) 9
65 (G G B R G B R B B G R B G G G G R B G G R R G G B) 7
45 (B R B R B R R R B R R R B B R B B R B R R R G B B) 11

the most fit of the sample ...
45 (B R B R B R R R B R R R B B R B B R B R R R G B B) 11

the sample of individuals ...
69 (R G B B R R G R R B G B G B B G G R B B R R B G R) 9
90 (G G B G B G G G R R G R R B B B R R R B G G R G R G) 6
96 (B R G B G B B B B G G B G B R R B B G R B G G B B B) 13
94 (R R G G R B B G R G R R R R B B R G B B G B R B G) 8
13 (G B G R R G B B B G R B G G R R R G R G G G R R R) 5
89 (G B B B B R G G B R G B G B B B G G R B B B B G B) 14
87 (R R G G R R G B B B B B G R B B R B R R B B R R G) 10
47 (R G G R G R B B G G G B R B G B G G R R R G G B B) 7

the most fit of the sample ...
89 (G B B B B R G G B R G B G B B B G G R B B B B G B) 14

Select mother =
45 (B R B R B R R R B R R R B B R B B R B R R R G B B) 11
Select father =
89 (G B B B B R G G B R G B G B B B G G R B B B B G B) 14

The crossover =
0 (B R B R B R R R B R R R B B R B B R R B B B B G B) 13
The possibly mutated individual =
0 (B R B R B R R R B R R R B B R B B R R B B B B G B) 13
The renumberd individual =
2 (B R B R B R R R B R R R B B R B B R R B B B B G B) 13

Generation 1 population ...

1 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13
2 (B R R G G R B R R B G B B B R G B G B B G B R B B) 12
3 (B R B R B R R R B R R R B B R B B R R B B B B G B) 13

----------the sample of individuals ...
74 (G B R G G G B R R R B B B R G R B R G B B B B B B) 12
65 (G G B R G B R B B G R B G G G G R B G G R R G G B) 7
89 (G B B B B R G G B R G B G B B B G G R B B B B G B) 14
74 (G B R G G G B R R R B B B R G R B R G B B B B B B) 12
51 (R R G B G G B B G G B R B R R B R G R R G R R R B) 7
71 (G R B G B B R B G R G R R B G R G G G R B B B G R) 8
11 (G G G R G R B R G R R R R G R B B R B R R R G B G) 5
20 (G G B R G R R R G R B G B G R R G B B G G G B B G) 7

the most fit of the sample ...
89 (G B B B B R G G B R G B G B B B G G R B B B B G B) 14

the sample of individuals ...
64 (B R B R R B R B G G B B G G G R B R R G B G G G R) 8
22 (G G G R R B B B B B B G B G G R G R G G B B R B B) 11
36 (B G G R R R R R B B G R R R B R R B R G B G R R G) 6
81 (G R R G B R B R B G R B R R R B B G G G B B B B G) 10
59 (R G R R G G G G R G R G B B B B B B B R G B G B R) 9
40 (B R B R R B G G R B G G G B G G B R R R G B B B R) 9
81 (G R R G B R B R B G R B R R R B B G G G B B B B G) 10
53 (B R G G B G B B R R R B B B R G G R G R B R B G G) 9

the most fit of the sample ...

22 (G G G R R B B B B B B G B G G R G R G G B B R B B) 11

Select mother =
89 (G B B B B R G G B R G B G B B B G G R B B B B G B) 14
Select father =
22 (G G G R R B B B B B B G B G G R G R G G B B R B B) 11
The crossover =
0 (G B B B B B B B B B B G B G G R G R G G B B R B B) 15
The possibly mutated individual =
0 (G B B R B B B B B B B G B G G R G R G G B B R B B) 14
The renumberd individual =
3 (G B B R B B B B B B B G B G G R G R G G B B R B B) 14

Generation 1 population ...

1 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13
2 (B R R G G R B R R B G B B B R G B G B B G B R B B) 12
3 (B R B R B R R R R B R R R B B R B B R R B B B B G B) 13
4 (G B B R B B B B B B B G B G G R G R G G B B R B B) 14

---the sample of individuals ...
67 (R R R R R G G B B G G G B B B B R B B R R G B B G) 10
5 (R G R G R B G B B B B R G B G G R B B R B R R G G) 9
15 (B B B G B B G R G G B G B R G G B G R R G R B G R) 9
62 (G G B G B R R R R G R B B G B B B B G R B G B G R) 10
20 (G G B R G R R R G R B G B G R R G B B G G G B B G) 7
80 (G G R B G B B B B R B R G R G G R B B R B B R R B) 11
65 (G G B R G B R B B G R B G G G G R B G G R R G G B) 7
93 (B R R R B R B B R R B G G G B G B G R B G B G R R) 9

the most fit of the sample ...
80 (G G R B G B B B B R B R G R G G R B B R B B R R B) 11

the sample of individuals ...
71 (G R B G B B R B G R G R R B G R G G G R B B B G R) 8
57 (R R G B B B G R G B G G G R R B B R B R R R G G R) 7
50 (R R R G R B B B R G B B G G G R G G B R B G G B R) 8

1 (B R G R B R G B R R R G R G R R R B R B R G B R G) 6
3 (G G R R B R R B G B G R R B R G R B G B R B B R G) 8
75 (R G R B R G G R B R B B B R G G G R R B R R B G G) 7
47 (R G G R G R B B G G G B R B G B G G R R R G G B B) 7
77 (G B G R R G B G G B G B B B R G B G B B G B R B B) 12

the most fit of the sample ...
77 (G B G R R G B G G B G B B B R G B G B B G B R B B) 12

Select mother =
80 (G G R B G B B B B R B R G R G G R B B R B B R R B) 11
Select father =
77 (G B G R R G B G G B G B B B R G B G B B G B R B B) 12
The crossover =
0 (G G R B G B B B B R B R G R G G R B B R B B R R B) 11
The possibly mutated individual =
0 (G G R B G B B B B R B R G R G G R B B B B B R R B) 12
The renumberd individual =
4 (G G R B G B B B B R B R G R G G R B B B B B R R B) 12

Generation 1 population ...

1 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13
2 (B R R G G R B R R B G B B B R G B G B B G B R B B) 12
3 (B R B R B R R R B R R R B B R B B R R B B B B G B) 13
4 (G B B R B B B B B B B G B G G R G R G G B B R B B) 14
5 (G G R B G B B B B R B R G R G G R B B B B B R R B) 12

---the sample of individuals ...
67 (R R R R R G G B B G G G B B B B R B B R R G B B G) 10
18 (R G R G B R B G G R B G B B G B B R G G G G B B G) 9
55 (R B G G R R R G B B B G R G G G G R B G B G G G B) 7
91 (R G R R R B B G B R B B G G R G R R R G G G B B G) 7
74 (G B R G G G B R R R B B B R G R B R G B B B B B B) 12
18 (R G R G B R B G G R B G B B G B B R G G G G B B G) 9
90 (G G B G B G G R R G R R B B B R R R B G G R G R G) 6
68 (B G R G G B R R R R B R B B R G G G R R G G G R G) 5

the most fit of the sample ...
74 (G B R G G G B R R R B B B R G R B R G B B B B B B) 12

the sample of individuals ...
66 (R R B R B B B G B R R B B G G G R R R G G G G R B) 8
52 (B B G R R B R R G G B R B B G B B R G G B B B R R) 11
54 (B B B B G G R G B B G R R G B R G R R B R G R B B) 10
44 (B R R B R G R R G G R R G G B R R G R R R G R B B) 5
50 (R R R G R B B B R G B B G G G R G G B R B G G B R) 8
68 (B G R G G B R R R R B R B B R G G G R R G G G R G) 5
91 (R G R R R B B G B R B B G G R G R R R G G G B B G) 7
53 (B R G G B G B B R R R B B B R G G R G R B R B G G) 9

the most fit of the sample ...
52 (B B G R R B R R G G B R B B G B B R G G B B B R R) 11

Select mother =
74 (G B R G G G B R R R B B B R G R B R G B B B B B B) 12
Select father =
52 (B B G R R B R R G G B R B B G B B R G G B B B R R) 11
The crossover =
0 (G B R G G G B R R R B B B R G R B R G B B B B B R) 11
The possibly mutated individual =
0 (G B R G B G B R R R B B B R G R B R G B B B B B R) 12
The renumberd individual =
5 (G B R G B G B R R R B B B R G R B R G B B B B B R) 12

Generation 1 population ...

1 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13
2 (B R R G G R B R R B G B B B R G B G B B G B R B B) 12
3 (B R B R B R R R R B R R R B B R B B R R B B B B G B) 13
4 (G B B R B B B B B B B G B G G R G R G G B B R B B) 14
5 (G G R B G B B B B R B R G R G G G R B B B B B R R B) 12
6 (G B R G B G B R R R B B B R G R B R G B B B B B R) 12

----------the sample of individuals ...
12 (G R R R B B R R R R B G G B R R R B G G R G G R R) 5
39 (G G R G G G R B B R G R G G G R R G B R B B G R B) 6
63 (R G R B B R R G G B G R R R B R B G B R R R B G G) 7
25 (R B G G G G G B R G R R R R G R G R G G G R R G B) 3
59 (R G R R G G G G R G R G B B B B B B B R G B G B R) 9
50 (R R R G R B B B R G B B G G G R G G B R B G G B R) 8
78 (B B B R R B B R R B G G B R B B R B G G R G B B B) 13
76 (R R B G B B B B G G R G G G R B B B G R B B B B B) 13

the most fit of the sample ...
78 (B B B R R B B R R B G G B R B B R B G G R G B B B) 13

the sample of individuals ...
56 (B R G B R B G R R B G B G G R G R G G B R G B R R) 7
4 (B G G B R R R G G B G G R B B B R B B R B G B G B) 11
61 (G G G G G G B B G G G R B B R B G R G R B B G R R) 7
6 (B G B G B B B R B R G B R B B R G R B R B R G B R) 12
77 (G B G R R G B G G B G B B B R G B G B B G B R B B) 12
41 (G G B R R B R B R G G R R R B G B G G R G B B B G) 8
40 (B R B R R B G G R B G G G B G G B R R R G B B B R) 9
91 (R G R R R B B G B R B B G G R G R R R G G G B B G) 7

the most fit of the sample ...
6 (B G B G B B B R B R G B R B B R G R B R B R G B R) 12

Select mother =
78 (B B B R R B B R R B G G B R B B R B G G R G B B B) 13
Select father =
6 (B G B G B B B R B R G B R B B R G R B R B R G B R) 12
The crossover =
0 (B B B R R B B R R B G G B R B R G R B R B R G B R) 11
The possibly mutated individual =
0 (B B B R R B B R R B G G B R B R G R B R B R G B R) 11
The renumberd individual =
6 (B B B R R B B R R B G G B R B R G R B R B R G B R) 11

Generation 1 population ...

1 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13
2 (B R R G G R B R R B G B B B R G B G B B G B R B B) 12
3 (B R B R B R R R B R R R B B R B B R R B B B B G B) 13
4 (G B B R B B B B B B B G B G G R G R G G B B R B B) 14
5 (G G R B G B B B B R B R G R G G R B B B B B R R B) 12
6 (G B R G B G B R R R B B B R G R B R G B B B B B R) 12
7 (B B B R R B B R R B G G B R B R G R B R B R G B R) 11

----------the sample of individuals ...
4 (B G G B R R R G G B G G R B B B R B B R B G B G B) 11
29 (R G G B G B B R G G B R R G B G B B G G B R B B R) 10
3 (G G R R B R R B G B G R R B R G R B G B R B B R G) 8
8 (B G B R R B B R R R G G G G B B B G R G B R R B G) 9
16 (B B B R R B G G R R B R B R B B R G B B B R R G G) 11
5 (R G R G R B G B B B B R G B G G R B B R B R R G G) 9
21 (R R G B G B G B R B R B B G R G G B B R G B B G R) 10
45 (B R B R B R R R B R R R B B R B B R B R R R G B B) 11

the most fit of the sample ...
4 (B G G B R R R G G B G G R B B B R B B R B G B G B) 11

the sample of individuals ...
46 (B R R G G G R B R G R B B R G R G B G R B G G R B) 7
93 (B R R R B R B B R R B G G G B G B G R B G B G R R) 9
8 (B G B R R B B R R R G G G G B B B G R G B R R B G) 9
29 (R G G B G B B R G G B R R G B G B B G G B R B B R) 10
16 (B B B R R B G G R R B R B R B B R G B B B R R G G) 11
1 (B R G R B R G B R R R G R G R R R B R B R G B R G) 6
13 (G B G R R G B B B G R B G G R R R G R G G G R R R) 5
10 (G G G G B B R B G G R B R B G B G R G G G B G R R) 7

the most fit of the sample ...
16 (B B B R R B G G R R B R B R B B R G B B B R R G G) 11

Select mother =
4 (B G G B R R R G G B G G R B B B R B B R B G B G B) 11
Select father =
16 (B B B R R B G G R R B R B R B B R G B B B R R G G) 11

The crossover =
0 (B G G B R R R G G B G G R R B B R G B B B R R G G) 8
The possibly mutated individual =
0 (B G G B R R R G G B B G R R B B R G B B B R R G G) 9
The renumberd individual =
7 (B G G B R R R G G B B G R R B B R G B B B R R G G) 9

Generation 1 population ...

1 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13
2 (B R R G G R B R R B G B B B R G B G B B G B R B B) 12
3 (B R B R B R R R R B R R R B B R B B B R R B B B B G B) 13
4 (G B B R B B B B B B B G B G G R G R G G B B R B B) 14
5 (G G R B G B B B B R B R G R G G R B B B B B R R B) 12
6 (G B R G B G B R R R B B B R G R B R G B B B B B R) 12
7 (B B B R R B B R R B G G B R B R G R B R B R G B R) 11
8 (B G G B R R R G G B B G R R B B R G B B B R R G G) 9

---the sample of individuals ...
14 (G B B G G G R G B G R G B G R G G G G R G B G R G) 5
29 (R G G B G B B R G G B R R G B G B B G G B R B B R) 10
39 (G G R G G G R B B R G R G G G R R G B R B B G R B) 6
95 (B B R B G R R R B G B R G R R R R G R B B G R B R) 8
80 (G G R B G B B B B R B R G R G G R B B R B B R R B) 11
76 (R R B G B B B B G G R G G G R B B B G R B B B B B) 13
60 (B G G R R R B B B G G B G G R B R R G G G G G B B) 8
96 (B R G B G B B B B G G B G B R R B B G R B G G B B B) 13

the most fit of the sample ...
76 (R R B G B B B B B G G R G G G R B B B G R B B B B B) 13

the sample of individuals ...
74 (G B R G G G B R R R B B B R G R B R G B B B B B B) 12
39 (G G R G G G R B B R G R G G G R R G B R B B G R B) 6
32 (B R R G R B R R G B B B B R G G B B G G G G G G G) 8
37 (B R R R R G R R R R B R B G R R B R R B R R G G G) 5
3 (G G R R B R R B G B G R R B R G R B G B R B B R G) 8

65 (G G B R G B R B B G R B G G G G R B G G R R G G B) 7
90 (G G B G B G G R R G R R B B B R R R B G G R G R G) 6
16 (B B B R R B G G R R B R B R B B R G B B B R R G G) 11

the most fit of the sample ...
74 (G B R G G G B R R R B B B R G R B R G B B B B B B) 12

Select mother =
76 (R R B G B B B B G G R G G G R B B B G R B B B B B) 13
Select father =
74 (G B R G G G B R R R B B B R G R B R G B B B B B B) 12
The crossover =
0 (R R B G B B B B G G R G G G R B B B G R B B B B B) 13
The possibly mutated individual =
0 (R R B G B B B B G G R G G G R B B B G R B B B B B) 13
The renumberd individual =
8 (R R B G B B B B G G R G G G R B B B G R B B B B B) 13

Generation 1 population ...

1 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13
2 (B R R G G R B R R B G B B B R G B G B B G B R B B) 12
3 (B R B R B R R R R B R R R B B R B B R R B B B B G B) 13
4 (G B B R B B B B B B B G B G G R G R G G B B R B B) 14
5 (G G R B G B B B B R B R G R G G R B B B B B R R B) 12
6 (G B R G B G B R R R B B B R G R B R G B B B B B R) 12
7 (B B B R R B B R R B G G B R B R G R B R B R G B R) 11
8 (B G G B R R R G G B B G R R B B R G B B B R R G G) 9
9 (R R B G B B B B G G R G G G R B B B G R B B B B B) 13

---the sample of individuals ...
96 (B R G B G B B B G G B G B R R B B G R B G G B B B) 13
72 (B R R G R R G B G B R B B G B B B G R R R B B R G) 10
57 (R R G B B B G R G B G G G R R B B R B R R R G G R) 7
96 (B R G B G B B B G G B G B R R B B G R B G G B B B) 13
58 (R B G R R B R B R G B B R G R B R R B R G G R G R) 7
44 (B R R B R G R R G G R R G G B R R G R R R G R B B) 5

71 (G R B G B B R B G R G R R B G R G G G R B B B G R) 8
71 (G R B G B B R B G R G R R B G R G G G R B B B G R) 8

the most fit of the sample ...
96 (B R G B G B B B G G B G B R R B B G R B G G B B B) 13

the sample of individuals ...
43 (G R G R G G R R R G G R R R B R B G R G G G R B R) 3
45 (B R B R B R R R B R R R B B R B B R B R R R G B B) 11
100 (G B R B G B R B R B B R B R G B G B R G R R B B R) 11
73 (R R R B R G R R R R R B R B B R R B G B R B R B G) 8
18 (R G R G B R B G G R B G B B G B B R G G G G B B G) 9
27 (B R R G G R B G R G B B R B G B G G B B B G B B G) 11
4 (B G G B R R R G G B G G R B B B R B B R B G B G B) 11
65 (G G B R G B R B B G R B G G G G R B G G R R G G B) 7

the most fit of the sample ...
45 (B R B R B R R R B R R R B B R B B R B R R R G B B) 11

Select mother =
96 (B R G B G B B B G G B G B R R B B G R B G G B B B) 13
Select father =
45 (B R B R B R R R B R R R B B R B B R B R R R G B B) 11
The crossover =
0 (B R G R B R R R B R R R B B R B B R B R R R G B B) 10
The possibly mutated individual =
0 (B R G R B R R R B R R R B B R B B R B R R R G B B) 10
The renumberd individual =
9 (B R G R B R R R B R R R B B R B B R B R R R G B B) 10

Generation 1 population ...

1 (B G B B R B R B G B R R G B G B R B B R B G B G B) 13
2 (B R R G G R B R R B G B B B R G B G B B G B R B B) 12
3 (B R B R B R R R R B R R R B B R B B R R B B B B G B) 13
4 (G B B R B B B B B B B G B G G R G R G G B B R B B) 14
5 (G G R B G B B B B R B R G R G G R B B B B B R R B) 12
6 (G B R G B G B R R R B B B R G R B R G B B B B B R) 12
7 (B B B R R B B R R B G G B R B R G R B R B R G B R) 11

8 (B G G B R R R G G B B G R R B B R G B B B R R G G) 9
9 (R R B G B B B B G G R G G G R B B B G R B B B B B) 13
10 (B R G R B R R R B R R R B B R B B R B R R R G B B) 10

NIL

Task 11:

Code:

```
;---------------------------------------------------------------------------
; Task 11

;; THE NEXT GENERATION METHOD FOR THE GA
( defmethod next-generation ( ( cp population ) &aux np )
  ( setf np ( empty-population cp ) )
  ( perform-copies cp np )
  ( perform-crossovers cp np )
  np
)
;; THE GA!
( defconstant *nr-generations* 25 )

( defmethod ga ( &aux p )
  ( format t "THE WORLD IS BLUE ~%~%" )
  ( setf *fitness* #'fitness-b )
  ( setf p ( initial-population ) )
  ( terpri )
  ( summarize p )
  ( dotimes ( i *nr-generations* )
    ( setf p ( next-generation p ) )
    ( check-average p )
  )
  ( terpri )
  ( summarize p )
  ( format t "THE WORLD IS RED ~%~%" )
  ( setf *fitness* #'fitness-r )
  ( dotimes ( i *nr-generations* )
    ( setf p ( next-generation p ) )
    ( check-average p )
  )
  ( terpri )
  ( summarize p )
  ( format t "THE WORLD IS GREEN ~%~%" )
  ( setf *fitness* #'fitness-g )
  ( dotimes ( i *nr-generations* )
    ( setf p ( next-generation p ) )
    ( check-average p )
```

```
  )
  ( terpri )
  ( summarize p )
)

;; METHODS TO PROVIDE INFORMATION ON "PROGRESS"
( defmethod summarize ( ( p population ) )
  ( display p )
  ( check-average p )
  ( terpri )
)

( defmethod check-average ( ( p population ) )
  ( format t "average fitness of populatioon ~A = ~A~%"
    ( population-generation p )
    ( average p )
  )
)
```

Demo:

```
CL-USER> ( ga )
THE WORLD IS BLUE



Generation 0 population ...

1 (R R R R G R R G G G B B R R B B B R G G G G B G R) 6
2 (R R G B G B B G B G R R G R R G G B B B G R G R B) 8
3 (B B G G B B R R G B R G R B G G B G G R G R G B B) 9
4 (B B R G R B R G G B R G B R R R G G G G G R R B R) 6
5 (B R G G G R R R R G R B R B B G R G R B R R B G B) 7
6 (B R R B R R B G B R R G R G R G G B R G G G G R R) 5
7 (B B B R B B G B G G R B G G B R G B G R R G B R R) 10
8 (G G R R R B R R G G R B G G R R B B B G B G B G R) 7
9 (R B R R B B G R B R R G B R B R G B R G R G R G G) 7
10 (B B B G B G G G B B B G G G G R B R R B G B B R B R) 12
11 (R G R B G G R R G G R G R R B G B B G G R G R R G) 4
```

12 (R R G B B R B R G R G B G G G B R G G B B R G R B) 8
13 (B R B B G G R B B R B R R R R G R G G B R G R G) 7
14 (B R G G B G B G R B G G R R G B R B R R B B G B G) 9
15 (B R G B B B G G G R B R R R R G G R B G B B B R R) 9
16 (B R G R G G G R R B R G R R G B B B R G B B G B B B) 10
17 (G G R B G R R G B G R R B B R G B G G B R G B B B) 9
18 (G G R G G G B R B G G R B B R B G B B B G G G B R) 9
19 (B G G G G B R R G B R B R B G G B R G B G R B R G) 8
20 (R R G G G G G R G B G G B R R B G B G B R G R R G) 5
21 (B B G G R B B B G G G G R B G B R G B G R R G B B) 10
22 (B G G R G G B R B B R G R B G R R G R G G R B R B) 7
23 (B R G B G G B G B B R B G R G R G G G G R R G B B) 8
24 (G B R R R G G R R B G B B G G R R B G R B R R R R) 6
25 (G R B B R B R B R B B R R R R R R B G B G R R R G) 8
26 (B G G G B B B R R B R G G G B B B G G G G G B R G) 9
27 (R G R R B R B B G B G G B B R R B R R G B G R G R) 8
28 (G G G B G G R R R B R R R G G R R G B B G R G R B) 5
29 (B G G R G G G R B R G B R R R R G G G B B B B R B R) 8
30 (G G G B R R B G G G B B B B R R G B R G B R B G G) 9
31 (B B G G B R R B R G R G B B R B R R R R R G B G R) 8
32 (R G G B G G R R R B G R B G G G R B B G G G R R G B B) 7
33 (B B R R G B G R G G R G R G G B G R R B R G B B B) 8
34 (G R B G G R G G G B R R G R B G B G G G B B B G G G) 7
35 (R B R R G R B R R R R R B G R B R R B G G G G G G B) 6
36 (R G B B R B R B R R R R B B B R R G B R G B G B G) 10
37 (B B G B R R B B B G B R B R B B R G B G B G B G G) 13
38 (G B B B B G R B G R B G R G R B B G G G G G G G R R) 8
39 (B G R R G R G R R B R B B B G R R R G B B R R G B) 8
40 (B R G G B R B G G G G B R B G G B B G R B G G B B) 10
41 (B G G B B B R G R R R R R B G B B R B G B G R G B) 10
42 (G R B R R G B R G G G G B G B B B R B G G R B G B) 9
43 (B R R R R B B G G R B R B B R R B G R G G R B B B) 10
44 (R R R R R B G B G G G R G R G G G B G R G R R B G) 4
45 (G R R B B R B G R B B G R G G R B R R B B B R R R) 9
46 (B B G B B R R B G B B B R R R R G B B G R R B R B) 12
47 (R B G R R G B R B R B G R R B B B R G B G R B B B) 11
48 (R G B R G B G G B B B B R R R B B G G B G B B R B) 12
49 (B R B R B B R B B G R B B G R R R R B G R B B G G) 11
50 (G R G B R G R B R G B B G B G R G G R B B R G G G) 7
51 (G G G R R G G R R R G B B G G R R G B R G B R R B) 5

52 (B R B B G G B R B R B R G R G B R R B G R R G G G) 8
53 (R R R B R G B G R R R R R B B G G G B R R B G G G) 6
54 (G G R R R B G B G R R R G B R G G R G G G G B B R) 5
55 (B G R G R G B B R G B G B B R B B R G R R B R G G) 9
56 (B B R B R B B B G G G B R R R B R B R R R B R B R) 11
57 (B R G B B G G G B G G G B R B B G B G G B B R R B) 11
58 (B G R R G G G R B G R B G G G G B B R R G B R G B) 7
59 (B R B G G B R B B G R B B R B R R R G G G B R G R) 9
60 (B B G G R B G G G R B B G R R R B R R R R R R R G) 6
61 (G B B R R B G G G G B B R B R B G G R R G R B G R) 8
62 (B G R R R R B B R G G B B G G B G R G R G R G R G) 6
63 (G R B B R B R G B R G B R B G R R B B R G R G B R) 9
64 (G G B B B R R R R R R R G R G G B B B G R G G R B) 7
65 (G R R R G R B G G R G G B R R B R B B G R R G R R) 5
66 (R B R G R G B R R R G G B R R R B R B R G G G R R) 5
67 (B B G R G R R B B R G G G R G R R R R R G B R R R) 5
68 (G B B R R B B B B B G G B B G B B R B B B R G R G) 14
69 (R R G R G R G B R G R R G R B B G R B B B R B G G) 7
70 (B B G G R R G R B G R R R G R B R R G G G B R G R) 5
71 (R G R R G B R G G B B B R B R G B B R G R B R R R) 8
72 (R B R R B B R G B G B G G G B G R R G G G R G B R) 7
73 (R R B R B B B R R R B R B B B B B R G B B G R G R) 12
74 (G B R G B B R R G G G G B B B G R B R B R B R G B) 10
75 (B B G R G B B G R B B B R G B G G B R R G R R G G) 9
76 (R R R B G B B G B G B B G R G G B B G G G B G G R) 9
77 (B B B R G G R R G R G G G G G R R R B G B G R B G) 6
78 (G R B B B G B R R G G B G B B B B B B R G R G G G) 11
79 (R B R G B G G G B G G B B R R R R R G G R G R B R) 6
80 (B R R B G G B G B R R R G R G R G R G R G R B G R) 5
81 (R R B B R B R R G B G B G G B R G R B B B R G B R) 10
82 (B B B R R B G B G G B G R G G G R G G B R G R G R) 7
83 (G G R B G G R G R G G G R R R R B B R R G G G R G) 3
84 (B G G B R R B G R G B B B R G B G G G G B R R R R) 8
85 (R B G B R G R G B R G G R G G B R R G R B G G R B) 6
86 (B B R R R G B R R R R B G G B R R G R R B B B R R) 8
87 (B B G R G G R G G R R G B G B B B B G G G G R R B) 8
88 (G B G B R B G B B B G R G G B R R G B G G B R B G) 10
89 (G R G R R R G G B R G G B B G G R R G B R G R B R) 5
90 (R B G B B B B G G B B R R G B R B G R R B G B R G) 11
91 (B G R B B R R G G B R B G B B B R G R G B R G R B) 10

92 (R G G R R R G R R G G B R B G G B R R B G R R B R) 5
93 (B G R R B R B G B G R R B R B B R G G R R R B B B) 10
94 (B G B G G B B G G B B G R R R R G G G G B B G R G) 8
95 (B G B G B R R B G B G R B R G B B R R G G G R B R) 9
96 (G G B B R G G R G G G G B R B B G B B R B G G R B) 9
97 (R R R G B G R B G B R R B B G B B R R G B G B G B) 10
98 (B G R R G R R G B B G G B G R B G G B B R B B G G) 9
99 (R G B B B B G G G B G B R B B B B G R G R R R B G) 11
100 (G B R G G R G R R R B B B B R R B B R G B G B R B) 10

average fitness of populatioon 0 = 8.11

average fitness of populatioon 1 = 11.01
average fitness of populatioon 2 = 13.4
average fitness of populatioon 3 = 14.74
average fitness of populatioon 4 = 15.83
average fitness of populatioon 5 = 16.99
average fitness of populatioon 6 = 18.16
average fitness of populatioon 7 = 19.01
average fitness of populatioon 8 = 19.91
average fitness of populatioon 9 = 20.52
average fitness of populatioon 10 = 20.91
average fitness of populatioon 11 = 21.04
average fitness of populatioon 12 = 21.24
average fitness of populatioon 13 = 21.78
average fitness of populatioon 14 = 21.91
average fitness of populatioon 15 = 22.11
average fitness of populatioon 16 = 22.75
average fitness of populatioon 17 = 22.85
average fitness of populatioon 18 = 22.68
average fitness of populatioon 19 = 22.85
average fitness of populatioon 20 = 23.09
average fitness of populatioon 21 = 23.49
average fitness of populatioon 22 = 24.0
average fitness of populatioon 23 = 23.96
average fitness of populatioon 24 = 23.99
average fitness of populatioon 25 = 24.04

Generation 25 population ...

1 (B B B B B B B B B B B B B B B B B B B R B B B B) 24
2 (B B B B B B B B B B B B B B B B B B B B B B B R B) 25
3 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
4 (B B B B B B B B B B B B B B B B B B G B B B B B) 25
5 (B B B R B B B B B B G B B B B B B B B B B B B B) 25
6 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
7 (B B B B B B B B B B B B B B B B B B G B B B B B) 25
8 (B B B B B B B B B B B B B B B B B B B B B B B R B) 24
9 (B B B R B B B B B B B B B B B B B B B B B B B B B) 24
10 (B B B B B B B B B B B B B B B B B R B B B B B B) 24
11 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
12 (B B G B B B B B B B B B B R B B B B B B B B B B) 23
13 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
14 (B B B R B B B B B B G B B B B B B B B B B B B B) 25
15 (B B R B B B B B B B B B B B B B B B B B B B B B) 25
16 (B B R B B B B B B B B B B B B B B B B B B B B B) 24
17 (B B B R B B B B B B G B B B B B B B B B B B B B) 25
18 (B B B B B B B R B B B B B B B B B B B B B B B B) 24
19 (B B B R B B B B B B B B B B B B B B B B B B B B) 25
20 (B B B B B B B B B B B B B B B B B B B B B B B B) 25
21 (B B B B B B B B B B B B B R B B B B B B B B B) 24
22 (B B B R B B B B B B B B B B B B B B B B B B B B) 25
23 (B B B R B B B B B B B B B B B B B B B B B B B B) 25
24 (B B B R B B B B B B B B B B B B B G B B B B B) 23
25 (B B B B B B B B B B G B B B B B B B B B B B B) 25
26 (B B B B B B B B B B B B B B B B B B B B B B B B) 25
27 (B B B B B B R B B B B B B B B B B B B B B B B B) 24
28 (B B B B B G B B B B B B B B B B B B B B B B B B) 24
29 (B B B B B B B B B B G B B B B B B B B B B B B B) 24
30 (B B B R B B B B B B B B B B B B B B B B B B B B) 24
31 (B B B B B B B B B B B B B B B B B B G B B B B B) 24
32 (B B B B B B B B B B B G B B B B B B B B B B B B) 24
33 (B B B B B B B B B B G B B B B B B B B B B B B B) 24
34 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
35 (B B B R B B B B B B G B B B B B B B B B B B B B) 24
36 (B B B B B B B B B B B B R B B B B B B B B B B B) 24
37 (B B B R B B B B B B G B B B B B B B B B B B B B) 23
38 (B B B R B B B B B B B B B B B B B B B B B B B B) 24

39 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
40 (B B B B B B B B B B B B B B B B B G B B B B B) 24
41 (B B B G B B B B B B B B B B B B B B B B B B B B B) 24
42 (B B B B B B B B B B B B G B B B B B B B B B B B B) 24
43 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
44 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
45 (B B B B B B G B B B B B B B B B B B B B B B B B B) 24
46 (B B B B B B B B B B B R B B B B B B B B B B B B B) 24
47 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
48 (B B B B B G B B B B B B B B B B B B B B B B B B B) 24
49 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
50 (B B B R B B G B B B B B B B B B B B B B B B B B G) 22
51 (B B B B B B B B B B B B B B B B B G B B B B B B B) 24
52 (B B B B B B B B B B B B B B B B B B B G B B B B) 24
53 (B B B B B B B B B B B B B G B B B B B B B B B) 24
54 (B B B B B B B B B B B B B B B B B B B B B B B R B) 24
55 (B B B B B R B B B B B B B B B B B B B B B B B B B) 24
56 (B B B B B B B R B B B B B B B B B B B B B B B B) 24
57 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
58 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
59 (B B B B B B B B B R B B B B B B B B B B B B B B) 24
60 (B B B B B G B B B B B B B B B B B B B B B B B B B) 24
61 (B B B B B B B B B B B B B R B B B B B B B B B) 24
62 (B B B B B B B B B B B B R B B B B B B B B B B) 24
63 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
64 (B B B B B B R B B B B B B B B B B B B B B B B B) 24
65 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
66 (B B B B B B B B B B B B B B B B B B B B B B B G B) 24
67 (B B B B B B B B B B B G B B B B B B G B B B B) 23
68 (B B B B G B B B B B B B G B B B B B B B B B B B) 23
69 (R B B B B B B B B B B B R B B B B B B B B B B B) 23
70 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
71 (B B B B B B B G B B B B B B B B B B B B B B B B) 24
72 (B B B B G B B B B B B R B B B B B B B B B B B B) 23
73 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
74 (B B B R B B B B B B B B B B B B B B B R B B B B) 23
75 (B B B B B B B B B G B B B B B B B B B B B B B) 24
76 (R B B B B B B B B B B B B B B B B B B B B B B B B) 24
77 (B B B B B B B B B B B B B B B R B B B B B R B) 23
78 (B B B B B B R B B B B B B B B B B B B B B B G B) 23

79 (B B B B B B B B B B B B B B B B B B B B B B B R B) 24
80 (B B B B B R B B B B B B B B B B B B B B B B B B B) 24
81 (B B B B B G B B B B B B B B B B B B B B B B B B B) 24
82 (B B B B B B B G B B B B B B B B B B B B B B B B B) 24
83 (B B G B B B B B B B B B B B B B B B B B B B B B B) 24
84 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
85 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
86 (B B B B B B B B B B B B B B B B B B B G B B B B B) 24
87 (B B B B B B B B B R B B B B B B B B B B B B B B B) 24
88 (B B B B B B B B B B B B B R B B B B B B B B B B B) 24
89 (B B B B B B B B B B B B B B B B B B B R B B B B B) 24
90 (B B B R B B B B R B B B B B B B B B B B B B B B B) 23
91 (B B G B B B B R B B B B B B B B B B B B B B B B B) 23
92 (B B B B B B B B B B B B R B B B B B B B B B B B B) 24
93 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
94 (B B B B B B B B B B B B B B B B B B B R B B B B B) 24
95 (B B B B B B B B B B B G B B B B B B B B B B B B B) 24
96 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
97 (B B B B B B B B B B B B B B B B B B B B B B B B B) 25
98 (B B R B B B B B B B B B B B B B B B B B B B B G B B) 23
99 (B B R B B B B B B B B B B B B B B B B B B B B B B) 24
100 (B B B B B B B B B B B B B B B R B B B B B B B B) 24

average fitness of populatioon 25 = 24.04

THE WORLD IS RED

average fitness of populatioon 26 = 2.0
average fitness of populatioon 27 = 4.23
average fitness of populatioon 28 = 6.7
average fitness of populatioon 29 = 9.43
average fitness of populatioon 30 = 11.11
average fitness of populatioon 31 = 13.28
average fitness of populatioon 32 = 14.55
average fitness of populatioon 33 = 15.86
average fitness of populatioon 34 = 16.67
average fitness of populatioon 35 = 17.92
average fitness of populatioon 36 = 18.54
average fitness of populatioon 37 = 19.17
average fitness of populatioon 38 = 19.75

average fitness of populatioon 39 = 20.24
average fitness of populatioon 40 = 20.93
average fitness of populatioon 41 = 21.18
average fitness of populatioon 42 = 21.65
average fitness of populatioon 43 = 21.63
average fitness of populatioon 44 = 21.91
average fitness of populatioon 45 = 22.0
average fitness of populatioon 46 = 22.41
average fitness of populatioon 47 = 22.43
average fitness of populatioon 48 = 22.55
average fitness of populatioon 49 = 22.74
average fitness of populatioon 50 = 22.86

Generation 50 population ...

1 (R R R R R R R R R R R B R R R G R R R R R R R R) 23
2 (R R R R R R R R R R G R R R R R R G R R R R R R) 23
3 (R R R R R R R R R R R B R R R R R R R R R R R B) 23
4 (R R R R R R R R R R R R R R R R G R R G R G R) 23
5 (R B R R R R R R R R R G R R R R R R R R R R R R) 23
6 (R R R R R R R R R R R G R G R R R R R R R R R R) 23
7 (R R R R R R R R R R R B R R R R R R R R R R R R) 24
8 (R R R R R R B R R R B R R R R R R R G R R R R R R) 22
9 (R R R R R R R R R R R B R R R R R R R R R R R R) 24
10 (R R R R R R R B R R R R R R R R R R G G R R R R) 22
11 (B R R R R R R B R B R R R R R R R R R R R R R R) 23
12 (R R R R R R R R R R R G R G R R R R R R R R R R) 23
13 (R R R R R R R R R R R G R G R R R R R R R R R R) 23
14 (R R R R R R R R R R R G R R R G R R R R R R R R) 23
15 (R R G R R R R R R R R R R R R R R G R R R R R R) 23
16 (R R R R R R R R R R R R R R R R R R R R R R G R) 24
17 (R R R R R R R R R R R G R R R G R R R R R R R R) 23
18 (R R R R G R R R R R R R R R R R R R B R R R G R) 22
19 (R R R R R R R R R R R B R R R R R R R R R R R R) 24
20 (R R R R R R R R R R R R R R R R R R R R R R G R) 24
21 (G R R R R R R R R R R B R R R R R R R R R R R R) 23
22 (R R R R G R R R R R B R R R R R R R R R R R R R) 23
23 (R R R R R R R R R R R G R G R R R R R R R R R R) 23

24 (R R R R R G R R R R R G R R R R R R G R R R R R) 22
25 (R R R R G R R R R R R R R B R R R R R R R G R) 22
26 (R R R R R R R R R R R R B R R R R R R R R R R R) 24
27 (R R R R R R R R R R R R R R R R R G R R G R G R) 22
28 (B R R R R R R B R B R R R R R R R R R R R R R R) 22
29 (R R R R R R R R R R R G R R R G R R R R R R B R) 22
30 (R R R R R R R R R B R R R R R R G R R G R R R R R) 22
31 (R R R R G R R R R R R R R R R R R R R G R R R R R) 23
32 (R R R R G R R R R R R G R R R R R R R G R R R R R) 22
33 (R R R R R R R B R R R R B R R R R R R R R R R R R) 23
34 (R R R R R R R R R R R G R R R G R R R R R R R R R) 23
35 (R R R R R R R R R R R R R R R R R G G G R R R R R) 22
36 (R R R R R R R R R R R R R R R R R R R R R R R G R) 24
37 (R R R R G R R R R R R R R R R R R R R G R R R R R) 23
38 (R R R R G R R R R R B R R R R R R R R R B R R R R R) 22
39 (R R R R R R R R R R R R R R R R R R R R R R R G R) 24
40 (R R R R R R R R R R R B R R R G R R R R R R R R R) 23
41 (R R R R R R R R R G R B R R R R R R R R R R R R B) 22
42 (R B R R G R R R R R R R R R R R R R R G R R R R R R) 22
43 (R R G R R R R B R R R G G R R R R R R R R R R R R) 21
44 (R R R R R R R R R R R R R R R R R B R R R R R G R) 23
45 (R R R B R R R R R R R R R R R R R R R G R R R R R R) 23
46 (R R R R R R R R R R R R R R R R R G R R R R R R R) 24
47 (R R R R R R R R R G R R R B R R R R R G R R R R R) 22
48 (R R R R G R R R R R R R R R R R R R R G R R R R R R) 23
49 (R R R R R R R R G R R R B R R R R R R G R R R R R) 22
50 (R R R R R R R R R R R R B R R R R R R R R R R R R) 24
51 (R R R G G R R R R R R R R R R R R R R G R R R R R) 22
52 (R R R R R R R R R R R R G R G R R R R R R R R R G) 22
53 (R R R R R R R R R R R R B R R R R R R R R R R R R) 24
54 (B R R R R R R R R R R R R R R R R R R G R R R R R R) 23
55 (R R R R R R R R R R R B R R R R R R G R R R R R) 23
56 (R R R R R R R R R R R R R R R R R R R R R R R G R) 24
57 (R R R R G R R R R R R R B R R R R R R R R R R R R) 23
58 (R R G R R R R R R B R R R R R R R R R G R R R R R) 22
59 (R R R R R R R R R R B R R R R R R R R R R R R G R) 23
60 (R R R R R R R R R R R R R R R R R R R G R R R R R R) 24
61 (R R R R R R G R R R B R R R G R R R R R R R R R R) 22
62 (R R R R R R R R G R R R B R R R R R R R R R R R R) 23
63 (R R R R R R R R G R R R B R R R R R R R R R R R R) 23

64 (R R R R R R R R R R R B R R R R R R R R R R R) 24
65 (R B R G R R R R R R R G R R R R R R R R R R R) 22
66 (R R R R G R R R R R R R B R R G R R R R R R R) 22
67 (R R R R R R R R R R R B R R R R R R R R R R R) 24
68 (R B R R R R R R R R R R R R R R R R R R G R) 23
69 (R R R R R R R R R R R G B R R R R R R R R R R) 23
70 (R R R R R R R R R R R G R R R G B R R R R R R) 22
71 (R R R R R R R B R R B R R R R R R R G R R R R R) 22
72 (B R R R R R R R R R R R R R R R R R R R R G R) 23
73 (R R R R B R R R R R R R R R R R R G R B R R R) 22
74 (R R R R R R R R R R B R R R R R G R R R R R R R) 23
75 (R R R R R R R R R R R B R R R G R G R R R R R) 22
76 (R R R R R R R R R R B R R R G R R R R R R R R) 23
77 (R R R R G R R R R R R R R R R R R R R R R R R) 24
78 (R R R R R B R R R R R R B R R R G R R R R R R) 22
79 (R R R R R R R R R R B R R R R R R R R R R R R) 24
80 (R R R R R R R R R R G R R R R R R R G R R R R R) 23
81 (R R G R R R R R R R R R R R R R R R R R R R G R) 23
82 (R R R R R R R R R B R R B R R R R R R R R R R) 23
83 (R R R R R R R R R R R G R R R G R R R R R R R) 23
84 (R R R R R R R R R R R R R R R G R R R R R R R) 24
85 (R R R R R R R B R R R R B R R R R R R R R R R) 23
86 (R R R R R R R R R B R R R R R R R R G R R R R R) 23
87 (R R R R R R R R R R R B R R R R G R R R R R R) 23
88 (R R R R R R R R R R R B R R R R R R R R R R R) 24
89 (R R R R R R R R G R R R B R R R R R R R R R R) 23
90 (R R R R R R R R R R G R R R R R R R G R R R R R) 23
91 (R R R R G R R R R R R R R R R R R R G R R B R R) 22
92 (R R R R R R R R R R R B R R R R R R R R R R R) 24
93 (R R R R R R R R R R R R R R R R R R G R R R R R) 24
94 (R R R R R G R R R R R R B R R R R R R R R R R) 23
95 (G R R R R R R R R R R R R R R R R R G R R R R R) 23
96 (R R R R G R R R R R R R R R R R R R G G R R R R R) 22
97 (R R R R R R R R R R R B R R R R R R R R R R B) 23
98 (R R R R R B G R R R R R B R R R R R R R R R R) 22
99 (R R R R R R R R R R B R R R R G R R R R R R G R) 22
100 (R B R R R R R R R R R R R R R R R R R R R R G R) 23

average fitness of populatioon 50 = 22.86

THE WORLD IS GREEN

average fitness of populatioon 51 = 3.19
average fitness of populatioon 52 = 5.71
average fitness of populatioon 53 = 9.08
average fitness of populatioon 54 = 10.56
average fitness of populatioon 55 = 11.95
average fitness of populatioon 56 = 13.43
average fitness of populatioon 57 = 15.04
average fitness of populatioon 58 = 15.84
average fitness of populatioon 59 = 16.37
average fitness of populatioon 60 = 17.26
average fitness of populatioon 61 = 17.94
average fitness of populatioon 62 = 18.29
average fitness of populatioon 63 = 19.16
average fitness of populatioon 64 = 19.78
average fitness of populatioon 65 = 20.97
average fitness of populatioon 66 = 21.33
average fitness of populatioon 67 = 21.66
average fitness of populatioon 68 = 22.38
average fitness of populatioon 69 = 22.58
average fitness of populatioon 70 = 22.66
average fitness of populatioon 71 = 23.14
average fitness of populatioon 72 = 23.13
average fitness of populatioon 73 = 23.13
average fitness of populatioon 74 = 23.23
average fitness of populatioon 75 = 23.07

Generation 75 population ...

1 (G G G G R G G G G G R G G G G G G G G G G G G G) 23
2 (G G G G G G G G G R G G G G G G G G B G G G G G) 24
3 (G G G G G G G G G G B G G G G G G G R G G G G G) 24
4 (G G G G G G G G G G G G G G G G G G B G G G G B G) 23
5 (G G G G G B G G G G G G G G G G G G G G G R G G) 23
6 (G G G G G G G R G G R R G G G G G G G G G G G G) 23
7 (G G G G G G G G G G R G G B G G G G G G G G G G) 23
8 (G G G G G G G G G G R G G G G G G G B G G G G G) 23

9 (G G G G G B G G G G R G G G G G G G G G G G G G) 23
10 (G G G G G G G G G R G G G G G G G G G G G R G) 23
11 (G G G G R G G G G G G B G G G G G G G G G G G G) 23
12 (G G G G G R G G G G R G G G G G G G G B G G G G) 22
13 (G G G G G G G G G G R G G B G G G G G G G G G G) 23
14 (G G G G G G G G G G R G G G G G G G G G G G G G) 24
15 (G G G G G G G G G G R G G G G G G G G B G G G G G) 24
16 (G G G G G G G G G G R G G G G G G G G G G G G G) 24
17 (G G G G G G G G G G R G G G G G G G G G G G G G) 24
18 (G G G G G G G G G G R G G G G G G G G G G G G G) 24
19 (G G G G G G G G G G G G G G G G G G G G G B B G G) 23
20 (G G G G G G G G G G R G G G G G G G G G G G R G G) 23
21 (G G G G G G G G G G G G G G G G G G G B G G G G G G) 24
22 (G G B G G G G G G G G G B G G G G G G G G G G G G) 24
23 (G G G G G G G G G G R G G G G G G G G G G G G G) 24
24 (G G G G G G G G G B G G G G G G G G B G G G G G G) 23
25 (G G G G G G G G G G R G G G G G G G G B G G G G G) 23
26 (G G G G G G G G G G B G G G B G G G G G G G G G) 23
27 (G G G G G G G G G G R G G G G G G G G G G G G G) 24
28 (G G G G G G G G G G R G G G G G G G G B G G G) 23
29 (G G G G G G G R G G R R G G G G G G G G G G G G) 22
30 (G G G G G G G G G G G G G G G G G G G G G B G G) 24
31 (G G G G G G B G G G G G G G G G G G G G G G G G) 24
32 (G G B G G G G G G G G G B G G G G G G G G G G G) 24
33 (G G B G G G G G G G G G B G G G G G G G G G G G) 23
34 (G G G G G G G G G G R G G G G G G G G G G G G G) 24
35 (G G G G G G G R B G G G G G G G G G G G G B G G) 22
36 (G G G G G G G G G G B G G G G G G G R G G G G G) 24
37 (G G G G G G B G G G G G G G G G G G G G G G G G) 24
38 (G G G G G G G G G G R G G G G G G G G G G G G G) 24
39 (G R G G G G G G G G R G G G G G G G G G G G G G) 23
40 (G G G G G G G G G G B G G G G G G G R G G G G G) 23
41 (G G B G G G G G G G R G G G G G R G G G G G G G) 22
42 (G G G G G G G G G G R G G G G B G G G G G G G G) 23
43 (G G G G G G G G G G R G G G G G G G G G G G G G) 24
44 (G G G G G G G G G G R G G G G G G R G G G G B G G) 22
45 (G B G G G G G G G G R G G G G G G G G G G G G G) 23
46 (G G G G G G G G G G G G G G G G G G G B G G G G G G) 24
47 (G G G G G G G G G G G B G G G B G G G R G G G G G) 22
48 (G G G G G G G G G G R G G G G G G G G R G G G G G) 23

49 (G G G G G G G G G G R G G G G G G G B G G G R B G) 21
50 (G G G G G G G G G G R G G G G G G G G G G G G G G) 24
51 (G G G G G G G G G G R G G G G G G G G G G G G G R) 23
52 (G G G G G G G G G G R G G G G B G G G G G G G G G) 23
53 (G G G G G G G G G G R G G G R G G G G G G G G G R) 22
54 (G G G G G G B G G G G G G G G G G G G G G B G G G) 23
55 (G G G R G G G B G G G G R G G G G G G G G G G R G G) 21
56 (G G G G G G G G G G R G G G G G G G B G G G G G G) 23
57 (G G G G R G G G G G R G G G G G G G G G G G G G G) 23
58 (G G G G G G B G G G G G G G G G G G G G G G G G G) 24
59 (G G G G G G G R G G R G G G G G G G G G G G G G G) 23
60 (B G R G G G G G G G G B G G G G G G G G G G G G G) 22
61 (G G R G G G G G G G G B G G G G G G G G G G G G G) 23
62 (G G G G G B G G G G G G G G G G G G G G G G R G G) 23
63 (G G G G G G G G G G R G G G G G G G G G G G R G G) 23
64 (G G G G G G G G G G G G G G G G G G G B G G B G G G) 23
65 (G G G G R R G G G G G G G G G G G G G G G G G G G) 23
66 (G G G G G G G G G G R G G G G G G G G G G G G G G) 24
67 (G G G G G G B G G G G B G G G G G G G R G G G G G G) 22
68 (G G G G G G G R G G R G G G G G G G G G G G G G G) 23
69 (G G G G R G G G G G G G G G G G G G G B G G G G G) 23
70 (G R G G G G G G G G R G G G G G G G G G G G G G G) 23
71 (G G G G R G G G G G G G G G G G G G G B G G G G G) 23
72 (G G G G B G G G G G R G G G G G G G B G G G G G G) 22
73 (G G G G G G G G G G R G G G G G G G G G G R G G G) 23
74 (G G G G R G G G G G G G G G B G G G G G G G G G G) 23
75 (G G G G G G G G B G R G G G G G G G G G G G G G G) 23
76 (G G G G G G G G G G R G G G G G G G G G G G G G G) 24
77 (G G G G G G G G G G R G G G G G G G G G G G G G G) 24
78 (G G G G G G G G G G R G G G G G G G G G G G R G G) 23
79 (G G G G G G G G G G R G G G G G R G G G G G G G G) 23
80 (G G G G R G G G G G R G G G G G G G G G G G G G G) 23
81 (G G G G B G G G G G G G G G G G G G B G G G G G G) 23
82 (G G G G G G G G G G R G G G G G G G G G G G G G G) 24
83 (G G G G R G G G G G G G G G G G G G G G G G R G G) 23
84 (G G G G G G B G G G G G G G G G G G G G G G R G G) 23
85 (G G G G G G G G G G G G G G G G G G G G G G R G G) 24
86 (G G G G G G G G G R G G G G G G R G B G G G G B G) 21
87 (G G G G G G G G G G R G G G G G G G G G G G B G G) 23
88 (G G G G G G G G G G R G G G G G G G G G G G G G G) 24

89 (G G G G G G G G G G R G G G G R G G G G G G G G G) 23
90 (G G G G R G G G G G G G G G G G G G G G G R G G) 23
91 (G G G G G G G B G G R G G G G G G G G G G G G G G) 23
92 (G G R G G G G G G G G B G G G G G G G G G G G G G) 23
93 (G G G G G G B G G G G G G G G G G G G G G B G G) 23
94 (G G G G G B G G G G R G G G G G G G G G G G G G G) 23
95 (G G G G G G G G G G R G G G B B G G G G G G G G G) 22
96 (G G G G R G G G R G G G G G G G G G G G G G G G G) 23
97 (G G G G B G G G G G R G G G G G G G G G G G G G G) 23
98 (G G G G G G G G G G R G G G G G G G G G G G G G G) 24
99 (G G G G G G G G G G G G G G G G G G G G G B G G G) 24
100 (G G G G G G G G G G R G G G G G G G G G G G G G G) 24

average fitness of populatioon 75 = 23.07

NIL