

Recombination or Crossover

1 Binary valued recombination

1.1 One-point Crossover

Parent1: 1110 1100 | 1101 0110
 Parent2: yyzy zyyz | yzyy zzyy

Offspring1: 1110 1100 yzyy zzyy
 Offspring2: yyzy zyyz 1101 0110

1.2 Two-point Crossover

Parent1: 1110 | 1100 1101 | 0110
 Parent2: yyzy | zyyz yzyy | zzyy

Offspring1: yyzy 1100 1101 zzyy
 Offspring2: 1110 zyyz yzyy 0110

1.3 Uniform Crossover

Cover Mask: 1010 1010
 Parent1: 1010 1011
 Offspring1: 1111 1110
 Parent2: 0101 0100

2 Permutation-Based recombination

2.1 Partially matched crossover (PMX)

Parent1: AB|CDE|FGH
 Parent2: GF|HBA|CDE

Offspring1: --|H--|--C
 Offspring2: --|C--|H--

Offspring1: -D|HB-|--C
 Offspring2: --|CD-|HB-

Offspring1: ED|HBA|--C
 Offspring2: --|CDE|HBA

Offspring1: ED|HBA|FGC
 Offspring2: GF|CDE|HBA

2.2 Order Crossover (OX)

Parent1: AB|CDE|FGH
 Parent2: GF|HBA|CDE

PMX

Offspring1: ED|HBA|FGC

Offspring2: GF|CDE|HBA

Offspring1: --|HBA|FG-

Offspring2: GF|CDE|---

SHIFT

Offspring1: BA|---|FGH

Offspring2: DE|---|GFC

Offspring1: BA| CDE |FGH

Offspring2: DE| HBA |GFC

2.3 Cycle crossover (CX)

Parent1: 123456789

Parent2: 412876935

Offspring1: 1-----

Offspring2: 4-----

Offspring1: 1--4-----

Offspring2: 4--8-----

Offspring1: 1--4---8-

Offspring2: 4--8---3-

Offspring1: 1-34---8-

Offspring2: 4-28---3-

Offspring1: 1234---8-

Offspring2: 4128---3-

Offspring1: 1234---8-

Offspring2: 4128---3-

Offspring1: 123476985

Offspring2: 412856739

Parent1: ABCDEFGH

Parent2: GFHBACDE

Offspring1: A-----

Offspring2: G-----

Offspring1: A----G-

Offspring2: G----D-

Offspring1: A--D--G-

Offspring2: G--B--D-

Offspring1: AB-D--G-

Offspring2: GF-B--D-

Offspring1: AB-D-FG-
Offspring2: GF-B-CD-

Offspring1: ABCD-FG-
Offspring2: GFHB-CD-

Offspring1: ABCDEFGH
Offspring2: GFHBACDE

3 Real valued recombination

3.1 Discrete recombination

individual1	15	67	98	12	43
individual2	127	6	108	16	44
sample1	2	2	1	2	1
sample2	1	2	1	1	1
offspring1	127	6	98	16	43
offspring2	15	6	98	12	43

3.2 Intermediate recombination

offspring = parent 1 + α (parent 2 - parent 1)

individual1	15	67	98	12	43
individual2	127	6	108	16	44
sample1	0.5	1.1	-0.1	0.3	-0.2
sample2	0.1	0.4	0.7	1.2	0.9
offspring1	71.0	-0.1	97.0	13.2	42.8
offspring2	26.2	42.6	105.0	16.8	43.9

3.3 Line recombination

offspring = parent 1 + α (parent 2 - parent 1)

individual1	15	67	98	12	43
individual2	127	6	108	16	44
sample1	0.5				
sample2	0.1				
offspring1	71.0	36.5	103.0	14.0	43.5
offspring2	26.2	60.9	99.0	43.4	43.1