CIFO 3/5/2025

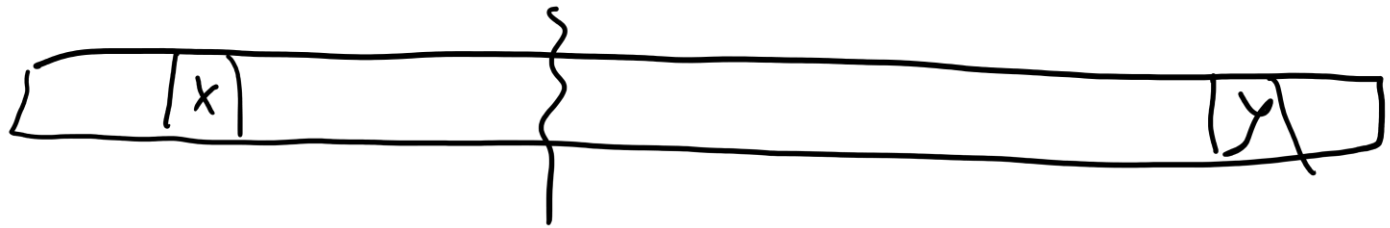
IN THE PREVIOUS CLASS:

- PSEUDO-CODE OF GAs
- THEOREM OF ASYMPTOTIC CONVERGENCE OF GAs
- BUILDING BLOCKS HYPOTHESIS

DRAWBACKS OF STANDARD GAs

1. PREMATURE CONVERGENCE (LOSS OF DIVERSITY)

2. "POSITION" PROBLEM OF CROSSOVER



3. UNICITY OF FITNESS

PREMATURE CONVERGENCE

MEASURES OF DIVERSITY OF POPULATIONS

	PHENOTYPIC	GENOTYPIC
ENTROPY		
VARIANCE		

ENTROPY

$$H(P) = -\sum_{j=1}^{N} F_j \log(F_j)$$

PHENOTYPIC ENTROPY

- N NUMBER OF DIFFERENT FITNESS VALUES IN P
- F_j PROPORTION OF INDIVS IN P HAVING A SPECIFIC FITNESS

GENOTYPIC ENTROPY

- N NUMBER OF DIFFERENT STRUCTURES IN P
- F_j PROPORTION OF INDIVS IN P HAVING A SPECIFIC STRUCTURE

VARIANCE

$$V(P) = \frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2$$

PHENOTYPIC VARIANCE

n NUMB. OF INDIVS IN THE POP.

x_i FITNESS OF INDIV. i

$\bar{x}$ AVERAGE POP. FITNESS

ORIGIN → "ANY" INDIVIDUAL

GENOTYPIC VARIANCE

n NUMB OF INDIVS IN THE POP.

x_i DISTANCE OF INDIV. i FROM AN INDIV. (ORIGIN)

$\bar{x}$ AVERAGE DISTANCE TO ORIGIN OF ALL INDIVS IN P.

METHODS TO COUNTERACT PREMATURE CONVERGENCE

- FITNESS SHARING
- RESTRICTED MATING

FITNESS SHARING

FOR EACH INDIV. IN P i :

- CALCULATE ALL DISTANCES FROM i TO ALL OTHER INDIVS IN P
- NORMALIZE ALL THESE DISTANCES INTO $[0,1]$
- "INVERT" THESE NORMALIZED DISTANCES (TYPICALLY $1-d$)
- CALCULATE THE SHARING COEFFICIENT OF i $S(i)$ (SUM OF ALL THIS INVERTED DISTANCES)
- $$f_S(i) = \frac{f(i)}{S(i)}$$

EXAMPLE

$P = \{ i_1, i_2, i_3, i_4 \}$

$i_1 = 00000 \quad f(i_1) = 10$
$i_2 = 00001 \quad f(i_2) = 8$
$i_3 = 10000 \quad f(i_3) = 7$
$i_4 = 11111 \quad f(i_4) = 2$

MAXIMIZATION

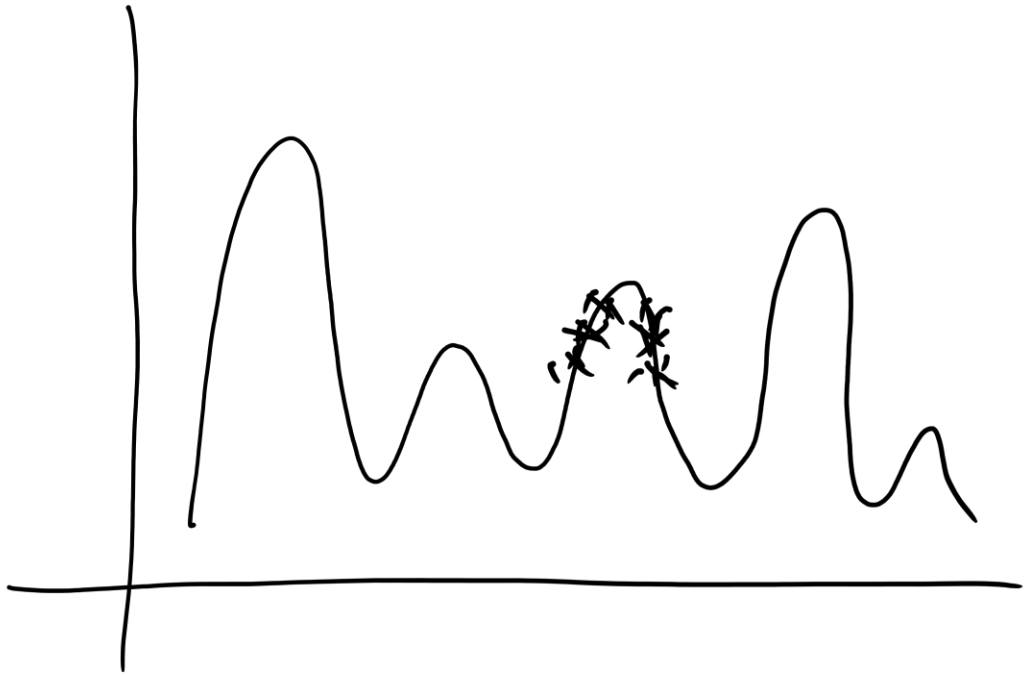
- HAMMING DISTANCE
- NORMALIZE → DIVIDE BY THE TOT. NUMB. OF CHAR.

FOR CALCULATING THE NEW FITNES OF i_4 :

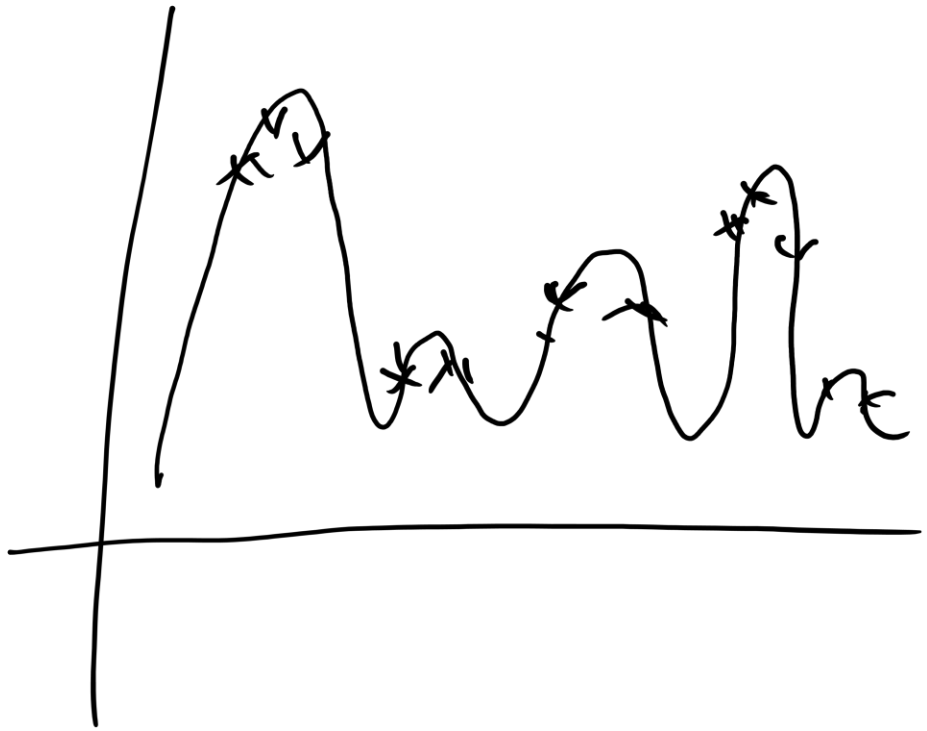
$d(i_1, i_4) = 5 \longrightarrow d_N = 1 \longrightarrow S(i_1, i_4) = 0$
$d(i_2, i_4) = 4 \longrightarrow d_N = \frac{4}{5} \longrightarrow S(i_2, i_4) = \frac{1}{5}$
$d(i_3, i_4) = 4 \longrightarrow d_N = \frac{4}{5} \longrightarrow S(i_3, i_4) = \frac{1}{5}$

$S(i_4) = \frac{1}{5} + \frac{1}{5} + 0 = \frac{2}{5}$

$f_k(i_1) = \frac{2}{2/5} = \frac{10}{2} = 5$



NO SHARING



SHARING

IMPLICIT SPECIATION
OF THE POPULATION

RESTRICTED MATING

⟨TEMPLATE⟩: ⟨FUNCTIONAL PART⟩

a. *10* : 1010

b. *01* : 1101

c. *00* : 0000

1. BI-DIRECTIONAL MATCH

2. UNI-DIRECTIONAL MATCH

3. BEST PARTIAL MATCH