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Evolutionary Computation Homework #2

1. Discuss why generational GAs and ES form opposites regarding where the fitness information influences the search.

in generational GA, fitness information influences parent selection

in ES, fitness information influences survivor selection

2. Given a population of μ individuals, which are bit-strings of length L. Let the frequency of allele 1 be 0.3 at position i, that is, 30% of all individuals contains a 1, and 70% a 0 at the ith position on the chromosome. How does this allele frequency change after performing k crossover operations with one-point crossover? How does it change if uniform crossover is performed?

crossover does not change the allele frequency of the population

3. Evolution strategies with fixed step-sizes for n-dimensional sphere model.

(1+1)-ES	σ=0.01	σ=0.1	σ=1
Run#1	830	55992	10000000
Run#2	880	93490	10000000
Run#3	847	110263	10000000
Run#4	790	346680	10000000
Run#5	793	139087	10000000
Run#6	852	64082	10000000
Run#7	808	82369	10000000
Run#8	782	22920	10000000
Run#9	850	247028	10000000
Run#10	786	75191	10000000

(1,1)-ES	σ=0.01	σ=0.1	σ=1
Run#1	10000000	10000000	10000000
Run#2	10000000	10000000	10000000
Run#3	10000000	10000000	10000000
Run#4	10000000	10000000	10000000
Run#5	10000000	10000000	10000000
Run#6	10000000	10000000	10000000
Run#7	10000000	10000000	10000000
Run#8	10000000	10000000	10000000
Run#9	10000000	10000000	10000000
Run#10	10000000	10000000	10000000

4. Compare the results of 3. Discuss the difference between (1,1)-ES and (1+1)-ES.

after creating 1 offspring and calculating its fitness, the best one are chosen, either from offspring only, called (1,1) selection, or from union of parent and offspring, called (1+1) selection.

the results of (1,1) selection are close to the real optimum, but those of (1+1) selection are not. since the population size is only one, (1,1) selection may not generate a move in the direction of better solutions.

5. Evolution strategies with n step-sizes for n-dimensional sphere model.

(1+1)-ES	σ=0.01	σ=0.1	σ=1
Run#1	3418	3189	2144
Run#2	3776	3658	3250
Run#3	3855	3647	3777
Run#4	3511	3309	3378
Run#5	3967	3257	2672
Run#6	3776	3402	2584

(1,1)-ES	σ=0.01	σ=0.1	σ=1
Run#1	10000000	10000000	10000000
Run#2	10000000	10000000	10000000
Run#3	10000000	10000000	10000000
Run#4	10000000	10000000	10000000
Run#5	10000000	10000000	10000000
Run#6	10000000	10000000	10000000

Run#7	3771	3570	3196
Run#8	3814	3191	2799
Run#9	3280	3253	3326
Run#10	3906	3202	2779

Run#7	10000000	10000000	10000000
Run#8	10000000	10000000	10000000
Run#9	10000000	10000000	10000000
Run#10	10000000	10000000	10000000

6. Compare the results of 3 and 5. Discuss what you think about the self-adaptation.

the performance of evolution strategies with *n* step-sizes is highly dependent on the overall learning rate. it can generate good solutions in real-time if overall learning rate is suitable, otherwise it may be worse than the one with fixed step-size.

the above results are generated with overall learning rate -0.1451.

7. Evolution strategies with 1/5-rule for *n*-dimensional sphere model.

(1+1)-ES	σ=0.01	σ=0.1	σ=1
Run#1	858	119311	10000000
Run#2	872	50802	10000000
Run#3	853	20229	10000000
Run#4	876	334193	10000000
Run#5	790	165692	10000000
Run#6	816	60497	10000000
Run#7	864	93776	10000000
Run#8	883	182613	10000000
Run#9	836	77983	10000000
Run#10	855	117129	10000000

(1,1)-ES	σ=0.01	σ=0.1	σ=1
Run#1	10000000	10000000	10000000
Run#2	10000000	10000000	10000000
Run#3	10000000	10000000	10000000
Run#4	10000000	10000000	10000000
Run#5	10000000	10000000	10000000
Run#6	10000000	10000000	10000000
Run#7	10000000	10000000	10000000
Run#8	10000000	10000000	10000000
Run#9	10000000	10000000	10000000
Run#10	10000000	10000000	10000000

8. Compare the results of 3, 5 and 7. Discuss what you think about the 1/5-rule for the self-adaptation of strategic parameters.

1/5-rule is a easy version of self-adaption.

in this experiment, its performance in term of the number of generation is more or less the same as evolution strategies with fixed step-sizes, but it takes much more time.