An Application of Traveling Salesman Problem Using the Improved Genetic Algorithm on Android Google Maps

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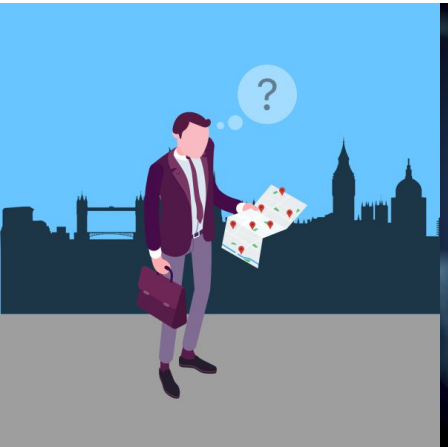
TSP
Traveling Salesman Problem

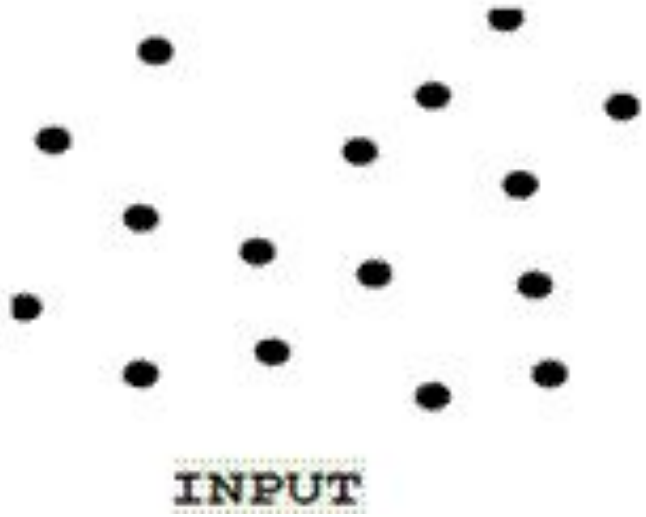
GA
Genetic Algorithm

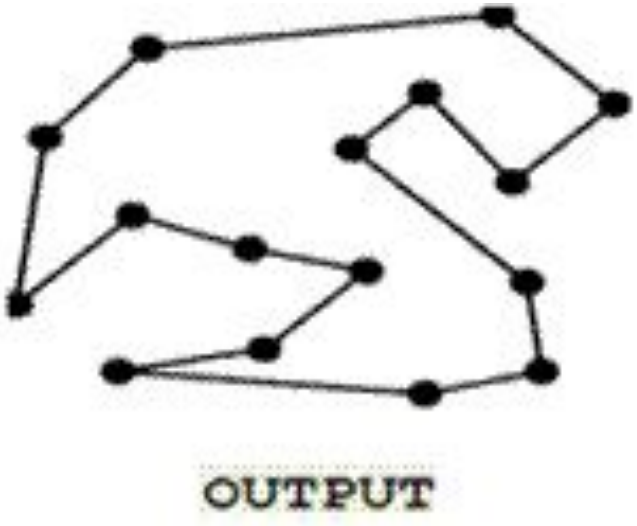
Android Google Maps

Improved Genetic Algorithm



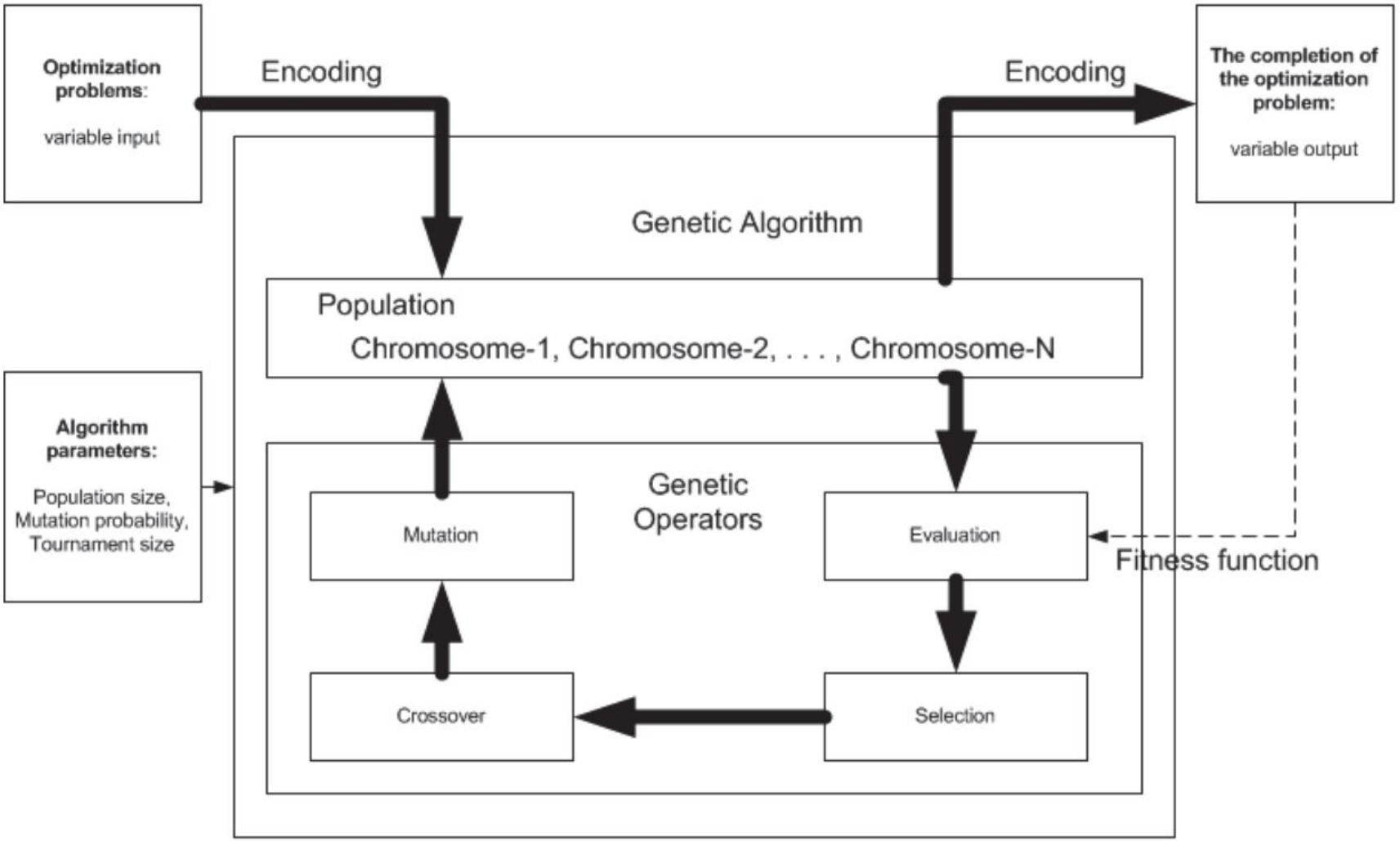
TSP
Travelling Salesman Problem





GA : Genetic Algorithm

The overall structure of Genetic Algorithm



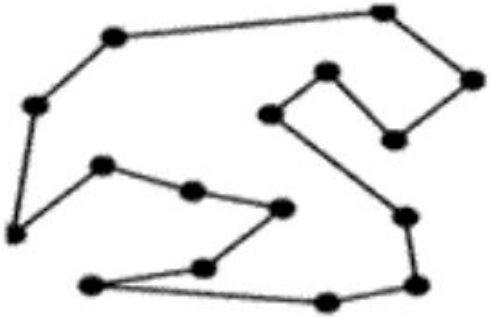
Genetic Algorithm

1. Representation
2. Initialization
3. Evaluation
4. Selection
5. Crossover
6. Mutation
7. Termination condition

GA	1	2	3	4	5	6	7

1. Representation
Path 1-2-3-4-5

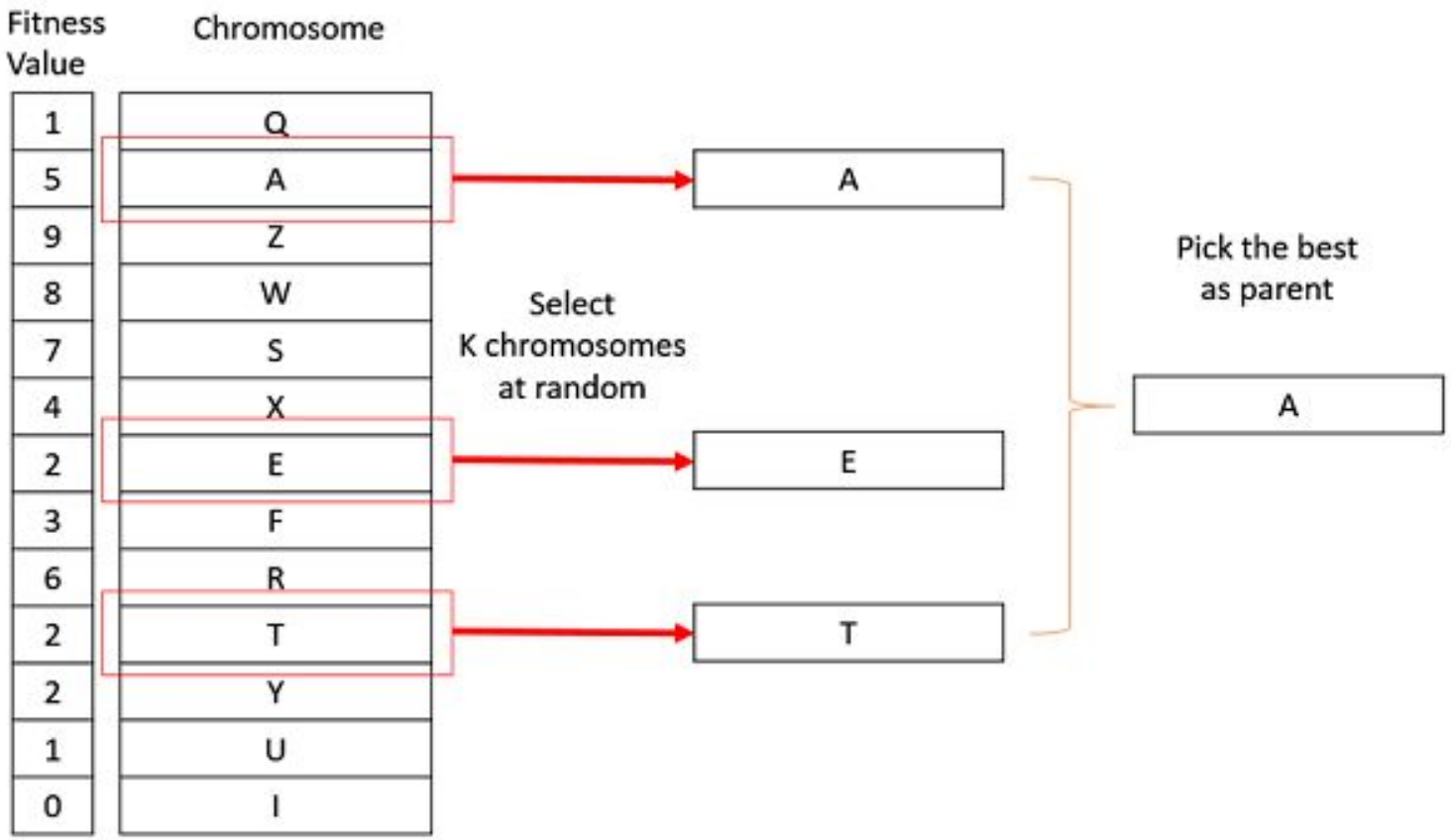
2. Initialization
random selection



3. Evaluation
shortest path

4. Selection

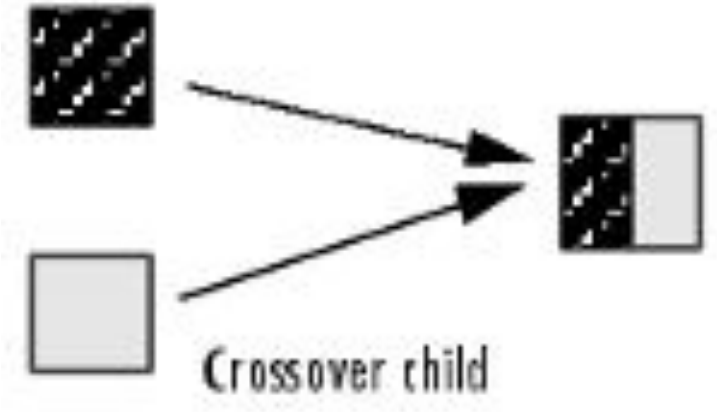
Tournament selection + elite selection



4. Selection :

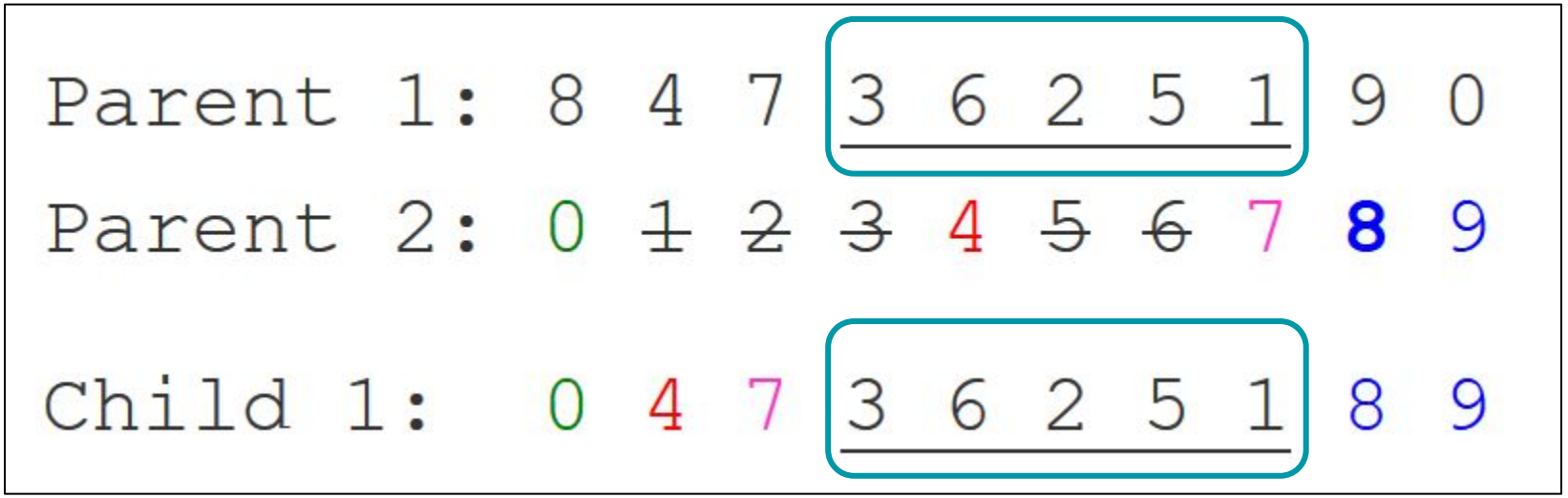
Tournament selection +

elite selection



5. Crossover

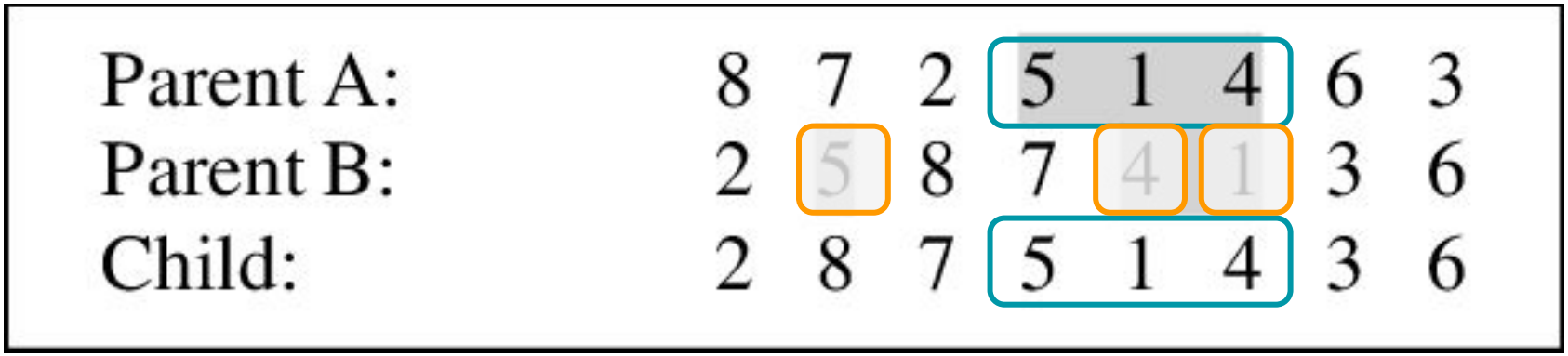
order crossover (OX)



GA	1	2	3	4	5	6	7

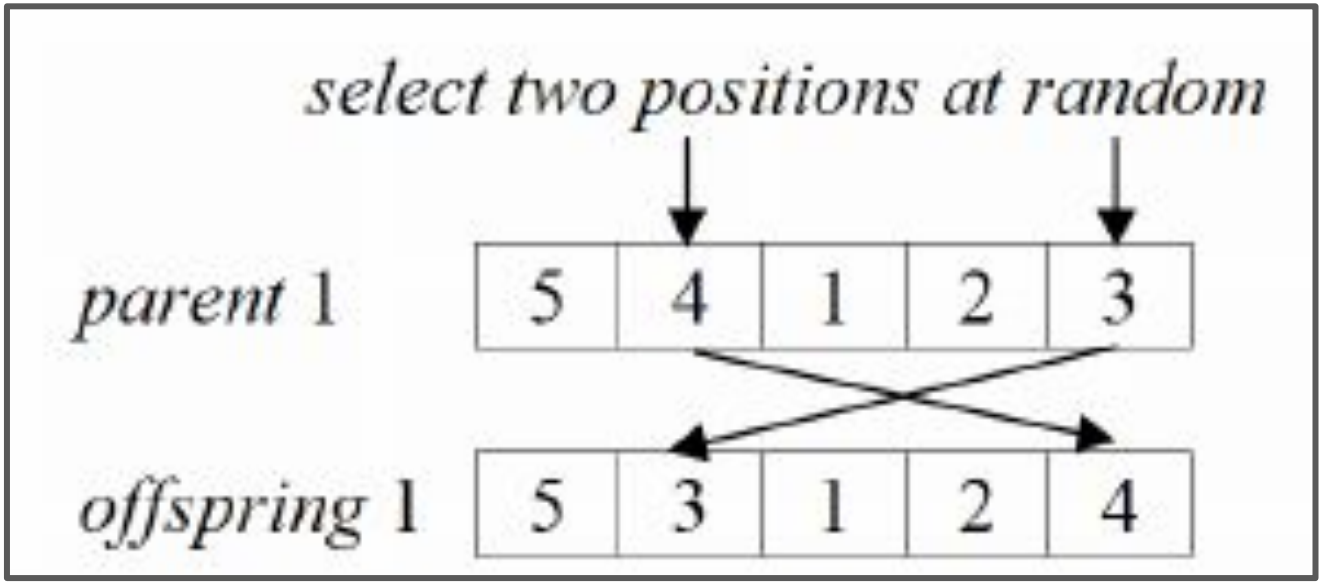
5. Crossover

order crossover (OX)



6. Mutation

exchange mutation -> randomly two genes



7. Termination condition

maximum time period

Genetic
Algorithm

vs.

Hybrid
Genetic
Algorithm

Hybrid
Genetic
Algorithm

=

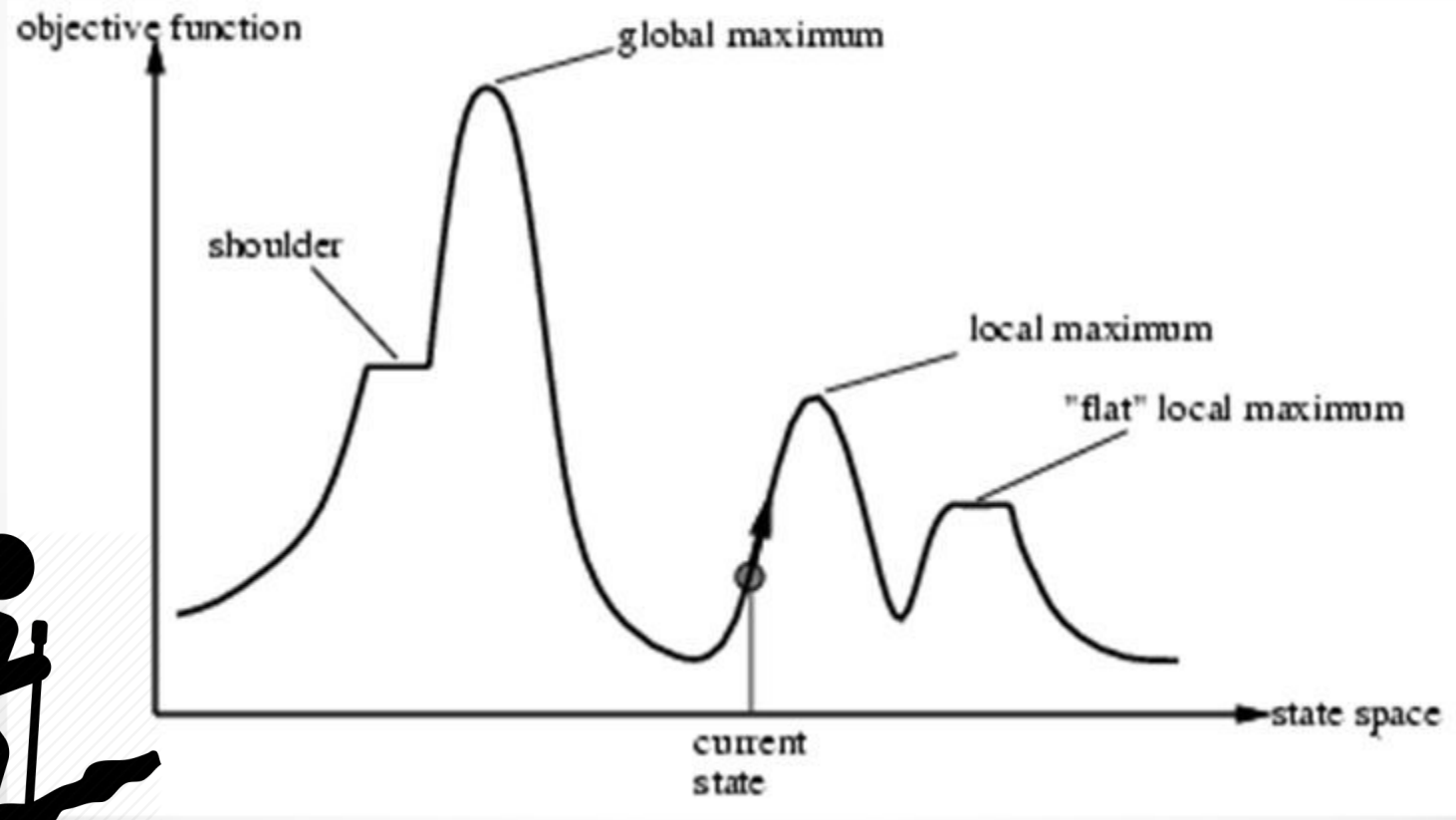
Genetic
Algorithm

+

Hill climbing

Hill-climbing search

- Problem: depending on initial state, can get stuck in local maxima.



Hill climbing in HGA

Procedure: Iterative hill climbing method
Begin
Select best individual v_c from current GA population according to fitness function;
Generate as many individuals as the population size in the v_c neighborhood randomly;
Select the individual v_n with the best fitness value from newly generated individuals;
If fitness(v_c) < fitness(v_n) **then**
$v_c \rightarrow v_n$
Else If fitness(v_c) ≥ fitness(v_n) **then**
$v_c \rightarrow v_c$
end
End

Hill climbing in HGA

1. Choose the best Vc
   current pop from fitness fn.

2. Generate Vn from Vc
   Randomly, total num. = pop.size

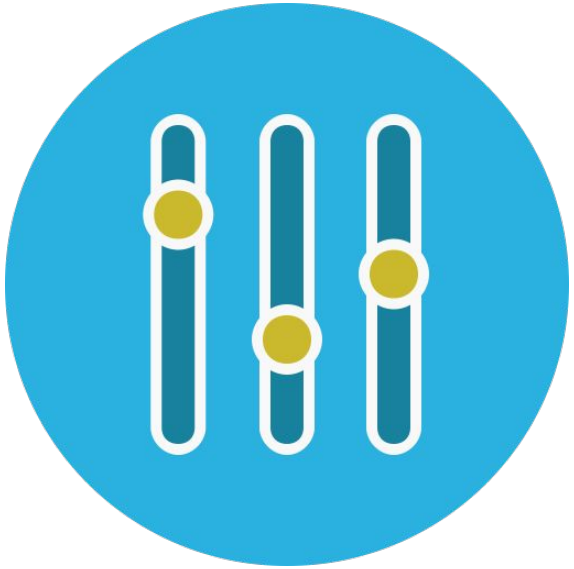
3. Choose the best Vn

4. Compare between Vc & Vn
   IF Vn better ,THEN Vc = Vn

Hybrid Genetic Algorithm

Procedure: Hybrid Genetic Algorithm
Begin
Step1: Initial population:
Encode the problem using path representation and generate initial population
Step2: Evaluation:
Evaluate the current population using the fitness function
Step3: Genetic operators:
Selection: Select two parents for crossover using tournament selection
Crossover: Crossover two chromosomes selected using order crossover
Mutation: Mutate the offspring using exchange mutation
Step4: Local Search:
Using hill climbing method to search a new best individual
Step5: Termination condition:
The termination conditions have been set to a time frame of 60 seconds. If this termination condition are reach and stop looping.
End

EXPERIMENTS



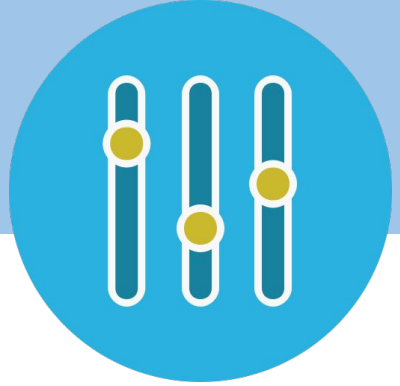
Find
Parameter
in HGA

Compare
Result Between
GA & HGA

EXPERIMENTS
Hardware & Software

smartphone android
Quad-core 1.3 GHz Cortex-A7,
1 GB RAM,
Android OS v4.4.2 (Kitkat)

The application developed by
Android Developer Tool (ADT)
Java prog. language.



Parameter in HGA

1. Mutation Probability (pm)
2. Termination Condition
3. Population Size

Parameter in HGA

Dataset TSPLIB
library of sample instances for the TSP

3 sample data ,
each 20 times

No	Coordinate X	Coordinate Y
1	*288*	*149*
2	*288*	*129*
3	*270*	*133*
4	*256*	*141*
5	*256*	*157*

Parameter in HGA
Mutation Probability

TABLE 1. Results over different instances using different mutation probabilities

instance		*pm*=0.01	*pm*=0.03	*pm*=0.05
burma14	best	3668	3650	3210
	avg	4016.2	3743.8	3642.6
	time	0.040	0.054	0.064
ulysses22	best	8530	9233	8386
	avg	9575.8	9701.6	9415.2
	time	0.187	0.215	0.179
bays29	best	14786	13650	12377
	avg	15021	14508.2	14116.2
	time	0.466	0.518	0.412

Parameter in HGA
Termination Condition

TABLE 2. The result of the termination condition

instance	n		s=20	s=40	s=60
burma14	14	best	3087	3087	3087
		avg	3087	3087	3087
ulysses22	22	best	7579	7530	7530
		avg	7681	7626	7603
bays29	29	best	9542	9213	9105
		avg	10272	9741	9488

Parameter in HGA
Population Size

TABLE 3. The result of the population size

instance	n	pop size	best	avg
burma14	14	14	3087	3087
		28	3087	3087
		42	3087	3087
ulysses22	22	22	7530	7590
		44	7530	7601
		66	7530	7592
bays29	29	29	9105	9468
		58	9203	9582
		87	9203	9653

Population Size = n

Parameter in HGA

Dataset TSPLIB
library of sample instances for the TSP

1. Mutation Probability 5%
2. Termination Condition 60s
3. Population Size n cities

Compare Result Between GA & HGA

Genetic
Algorithm

Hybrid
Genetic
Algorithm

GOOGLE MAPS ANDROID

Google Maps API

Latitude and Longitude
distance between cities

Database

SQLite
Relational database
Matrix of distance

Test DataSet

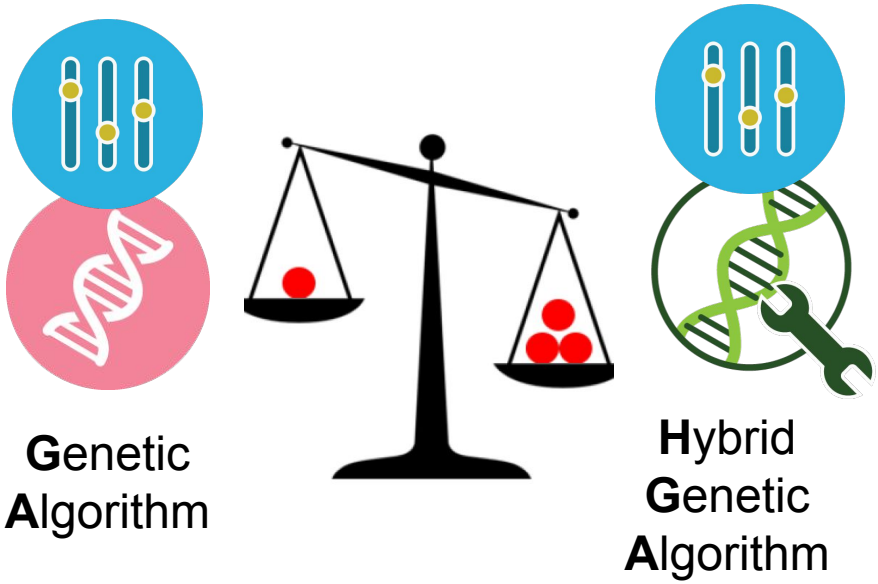
Test DataSet

TABLE 4. The several cities in Central Java, Indonesia

No.	City	Latitude	Longitude
1	Pati	-6.753899	111.042784
2	Purwodadi	-7.083219	110.913327
3	Demak	-6.894602	110.638154
4	Temanggung	-7.316753	110.178341
5	Magelang	-7.476794	110.218917
6	Sragen	-7.427645	111.023387
7	Rembang	-6.705611	111.348445
8	Wonosobo	-7.358785	109.902953
9	Kendal	-6.920633	110.20483
10	Batang	-6.906720	109.732468
11	Banjarnegera	-7.399196	109.688866
12	Semarang	-6.990155	110.422515
13	Purwokerto	-7.427879	109.242443
14	Blora	-6.970731	111.421695
15	Kudus	-6.808916	110.842946
16	Jepara	-6.590626	110.667318
17	Kebumen	-7.669664	109.651954
18	Sukoharjo	-7.683752	110.846919
19	Slawi	-6.974607	109.139532
20	Wonogiri	-7.813768	110.926073

Test DataSet

population size 5, 8, 12, 16, and 20 -> 5 Cases
Simulation 10 times for each



Result

TABLE 5. The result of the experiments

No	Data	Number of cities	Distance (meters)					
			GA			HGA		
			Best	Worst	Average	Best	Worst	Average
1	Case1	5	333390	333390	333390	333390	333390	333390
2	Case2	8	518053	595128	533484.6	518053	518053	518053
3	Case3	12	667143	872809	750450.6	622172	719781	679885.6
4	Case4	16	999926	1107099	1060378.4	823899	977451	906274
5	Case5	20	1175422	1314313	1260734.8	1001333	1289746	1185912.8

More cities More Complex problem
-> HGA even better than GA

Result

	Avg Distant			
	GA	HGA	GA %	HGA %
Case1 : 5 cities	333390	333390	100	100
Case2 : 8 cities	533484.6	518053	100	97
Case3 : 12 cities	750450.6	679885.6	100	91
Case4 : 16 cities	1060378.4	906274	100	85
Case5 : 20 cities	1260734.8	1185912.8	100	94

In 5 tests (100%) show that HGA is better than GA

Thank You