

# Assignment #1

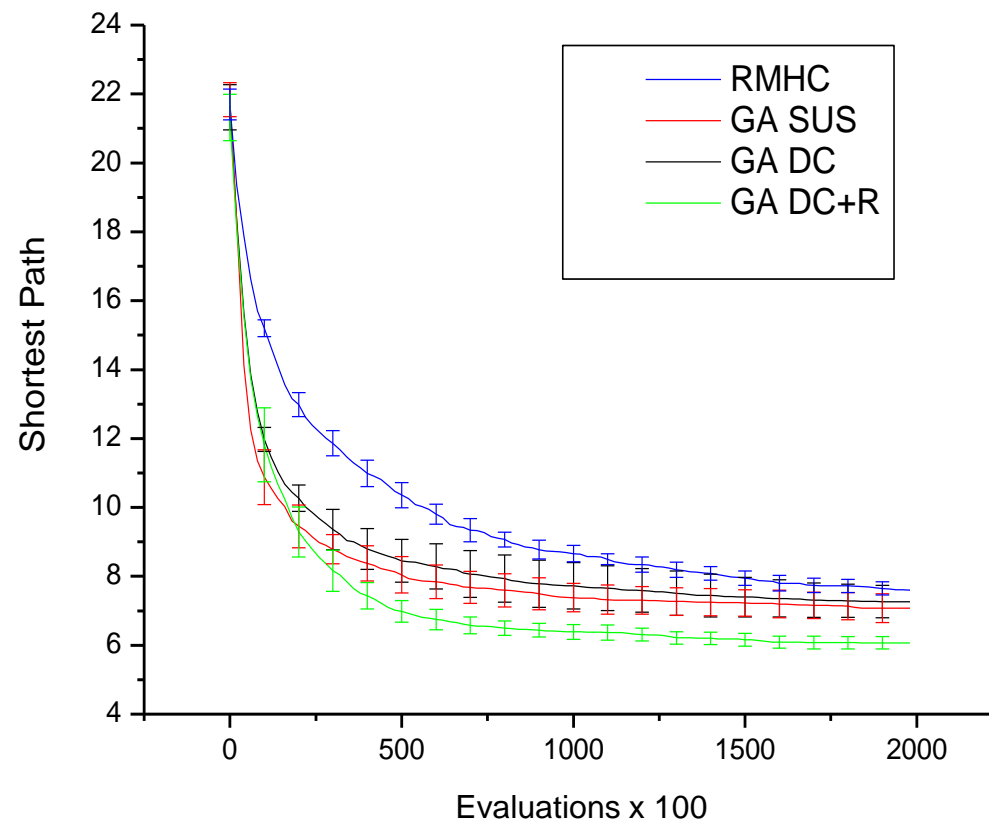
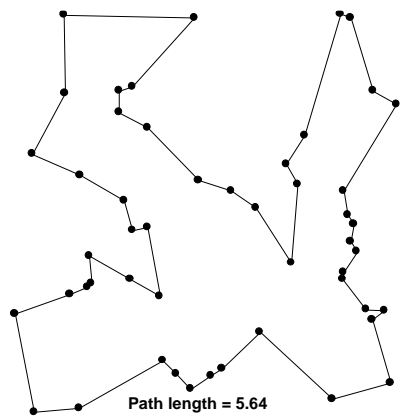
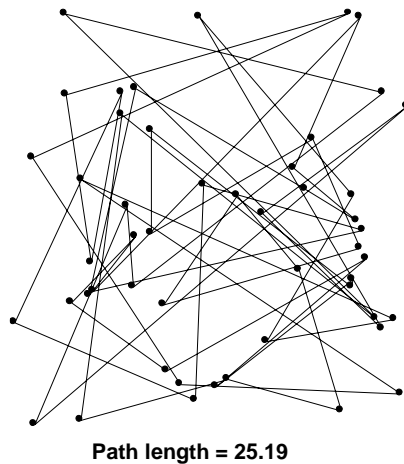
## TSP

MECS 4510

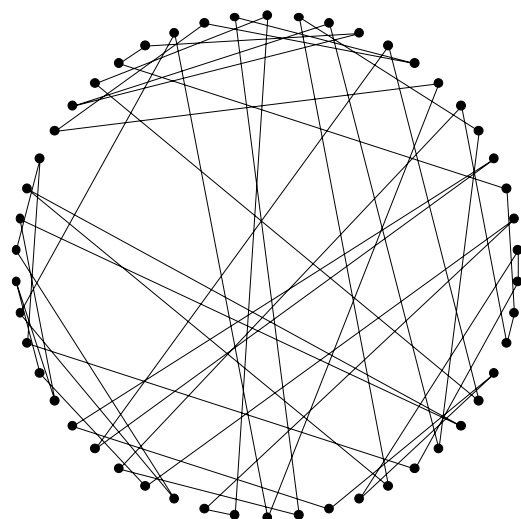
Evolutionary Computation

Hod Lipson

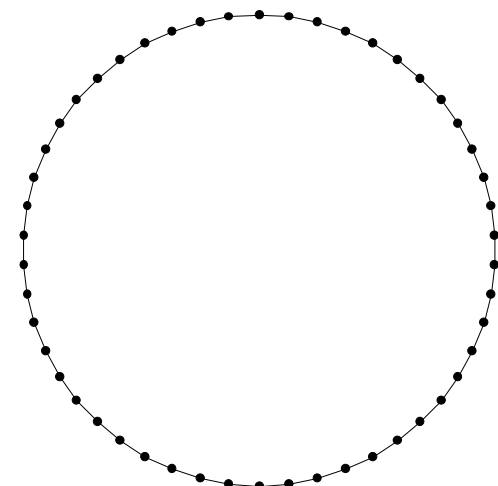
# TSP: Example 1



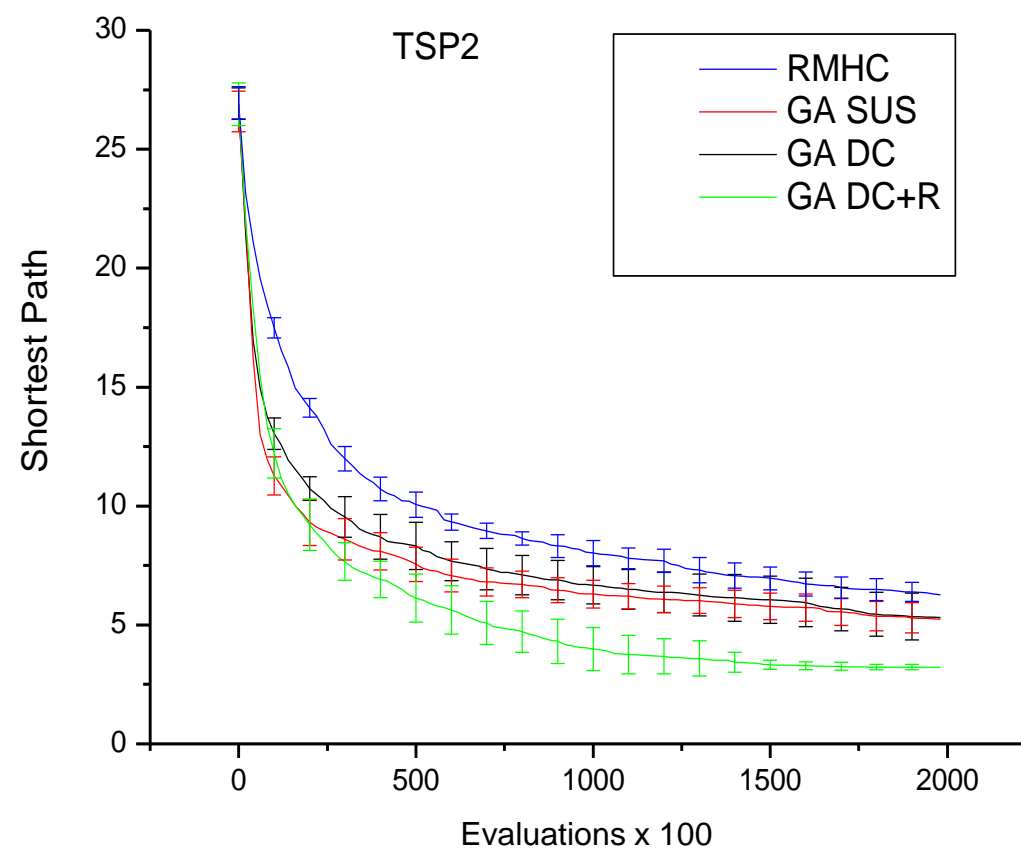
# TSP: Example 2



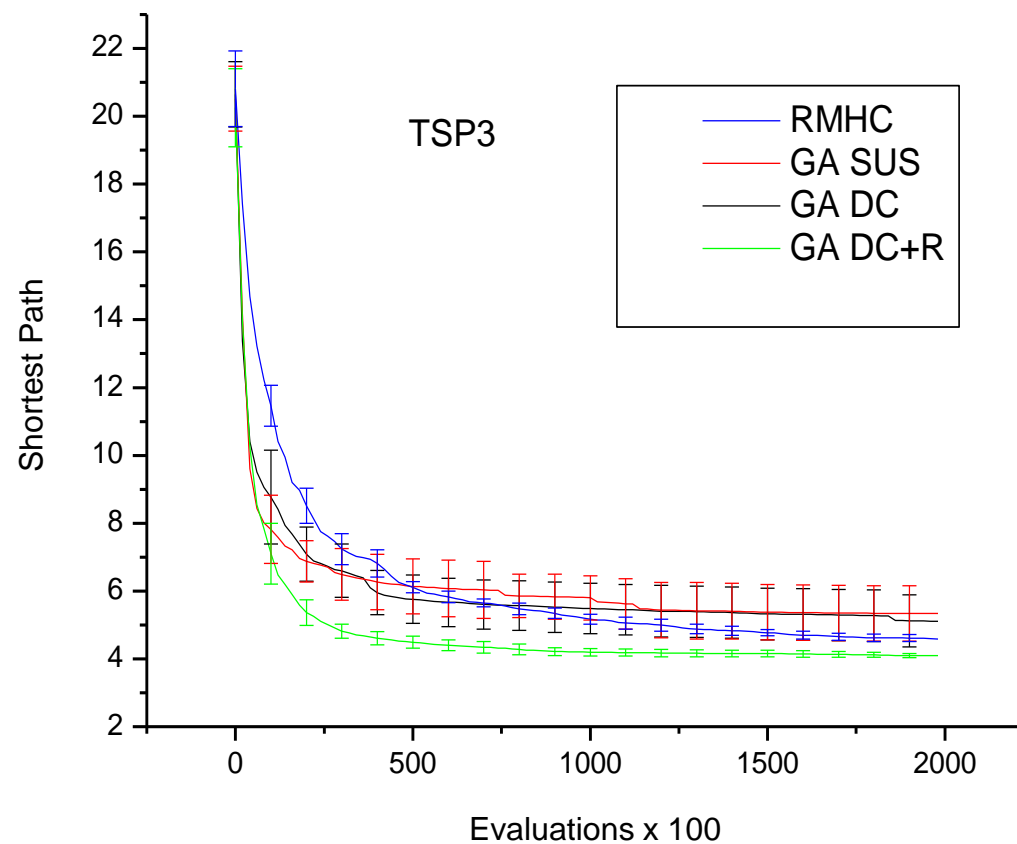
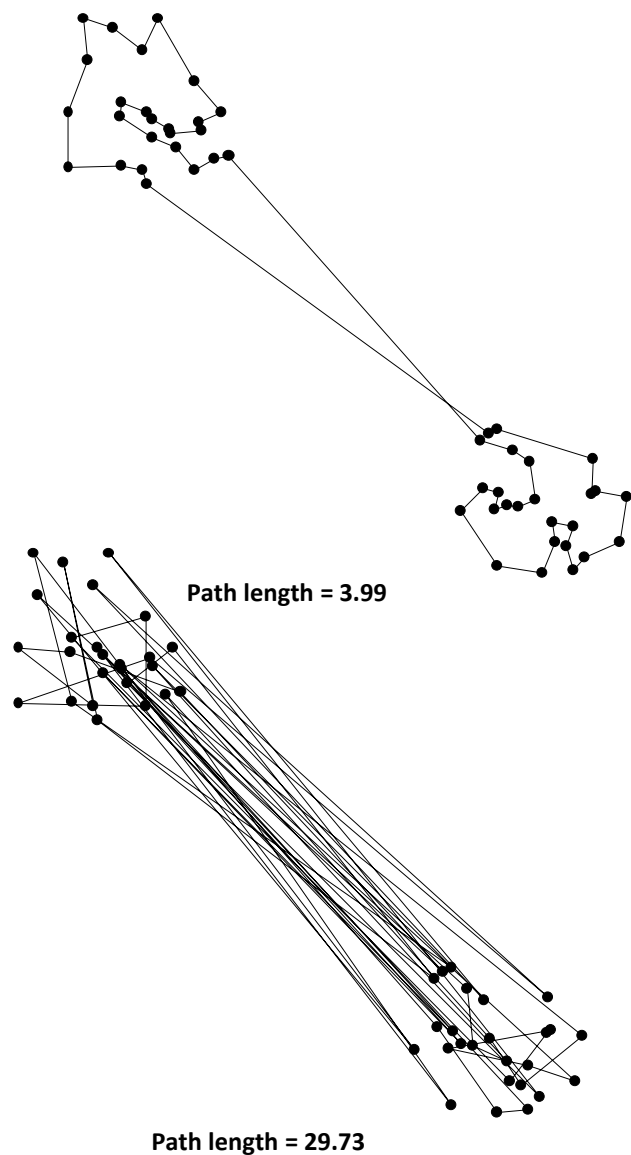
Path length = 29.65



Path length = 3.14

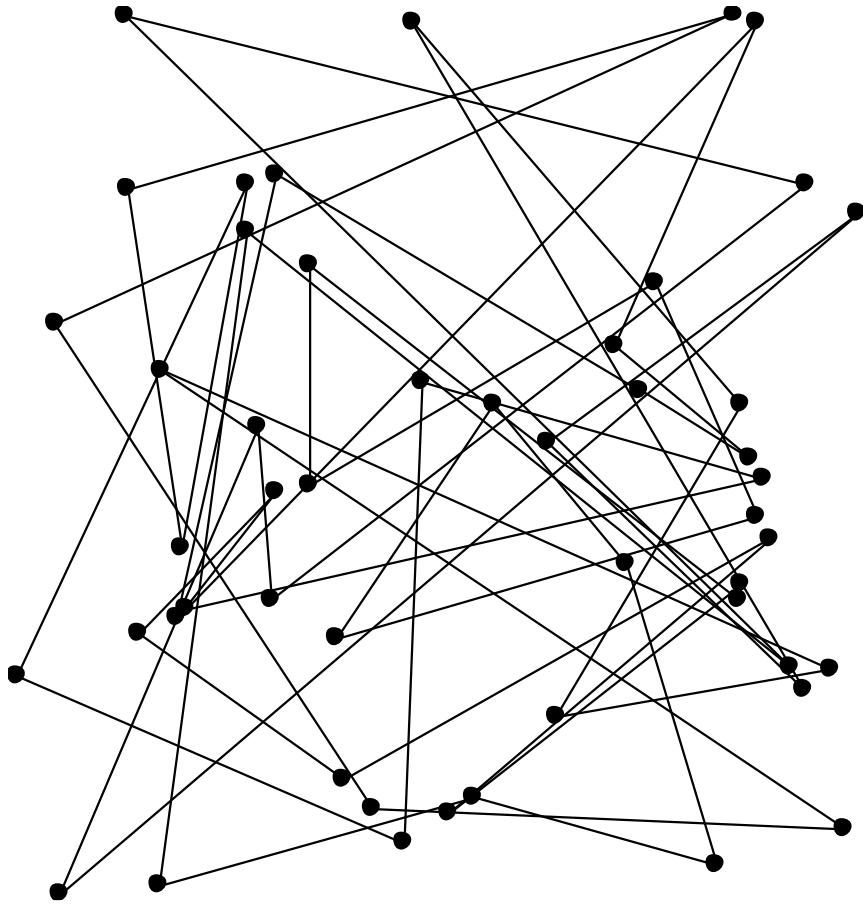


# TSP: Example 3

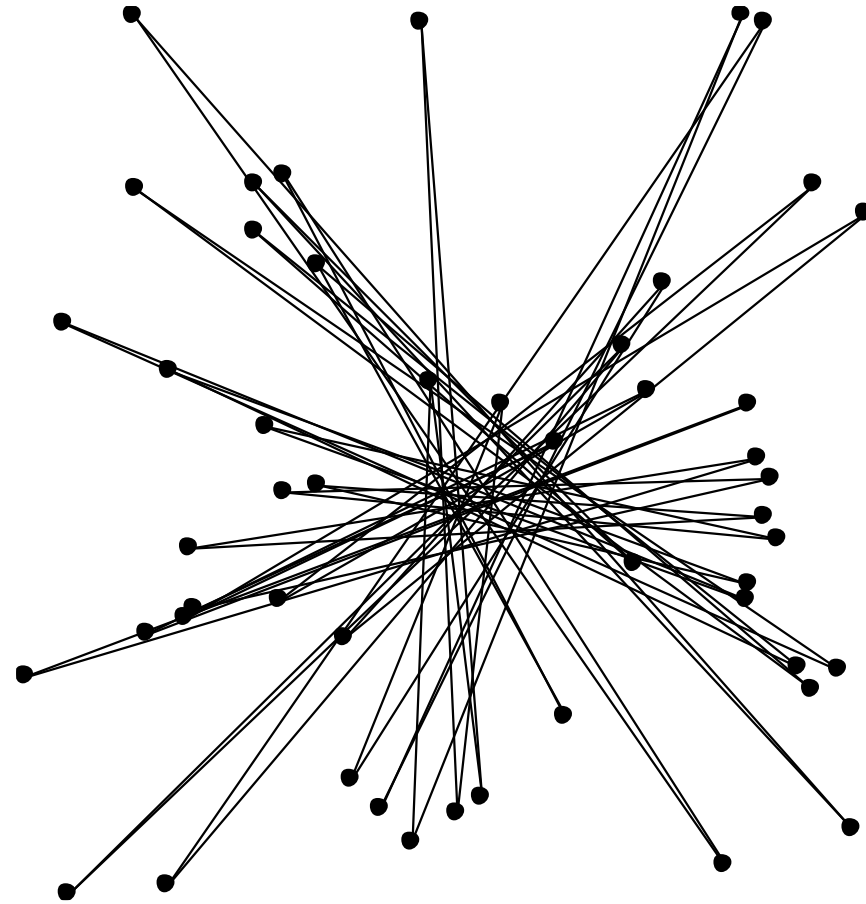


# Traveling Salesman Problem\*

\*With Frequent-Flyer Benefits



**Path Length 25.19**



**Path Length 36.97**



1. Cover page, with Your name, UNI, Course name and number, instructor, Date Submitted, Grace hours used and grace hours remaining.
2. Page 2: Results summary table with four figures (two per dataset)
  - a. Shortest path found (plot path and write total distance and # evals)
  - b. Longest path found (plot path and write total distance and # evals)
3. Methods (2 pages max)
  - a. A brief description of the representation, variation operators and selection process you used for your implementation.
  - b. Analysis of what worked and what didn't, and why
4. Performance plots: One page for each of the two test problems
  - a. Learning curves (fitness vs. evaluations) averaged on at least four runs, with error of the mean, for each approach tested
  - b. Baseline curves for comparison
  - c. Dot plot for the best method (sample points)
5. Appendix: Listing of all the code you wrote (do not include code you did not author yourself, for example external libraries or auto-generated code)
  - a. Use Courier font, size 8, single line spacing, highlight function declarations

## General

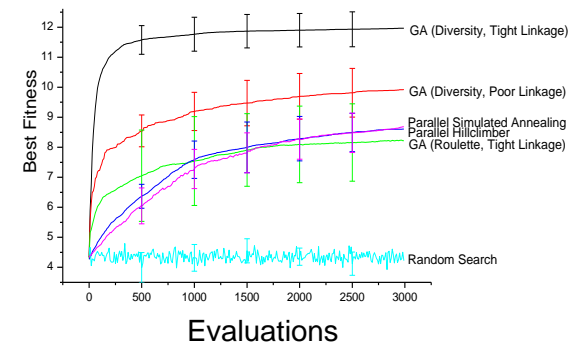
- 5 Points: Cover page includes all information
- 5 Points: Result table showing all information requested
- 5 Points: Dot plot for any one of the methods (not all required)
- 5 Points: Convergence plot for any one of some methods (not all)
- 5 Points: General quality of the report (grammar, layout)
- 5 Points: Code included (8pt courier single spacing)
- 5 Points: Theoretical shortest path for problem 2 using **Christofides' algorithm**

## Methods

- 5 Points description of representation used
- 5 Points description of random search
- 5 Points description of hill climber
- 5 Points description of EA variation and selection methods used
- 5 Points analysis of performance

## Performance plots

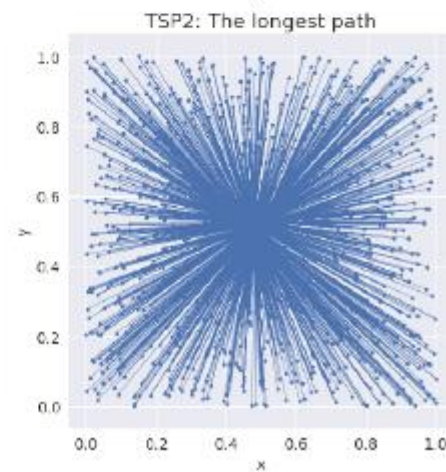
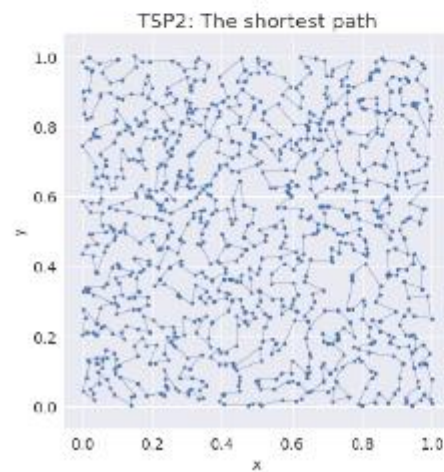
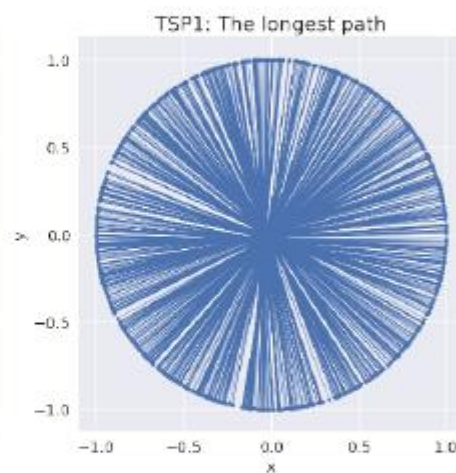
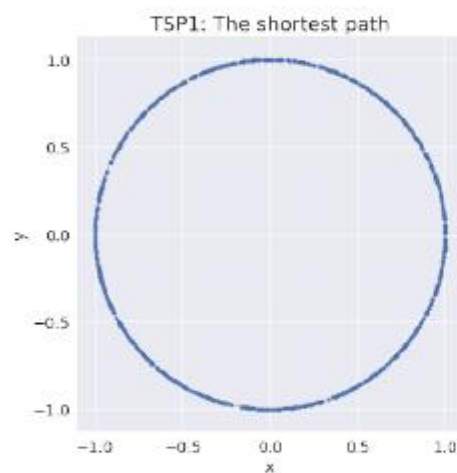
- 5 Points: Learning curve of random search, hill climber, EA, variation
- 5 Points: learning curves clearly labeled, have error bars, labeled axes
- 5 Points: Overall performance (Pareto layer of distance and evaluations)



## Results summary

Table 1: Results summary

		Evaluations	Length
TSP1	The shortest path	15,668,800	6.2836
	The longest path	3,540,300	1999.56
TSP2	The shortest path	15,113,100	26.308
	The longest path	5,140,000	764.767





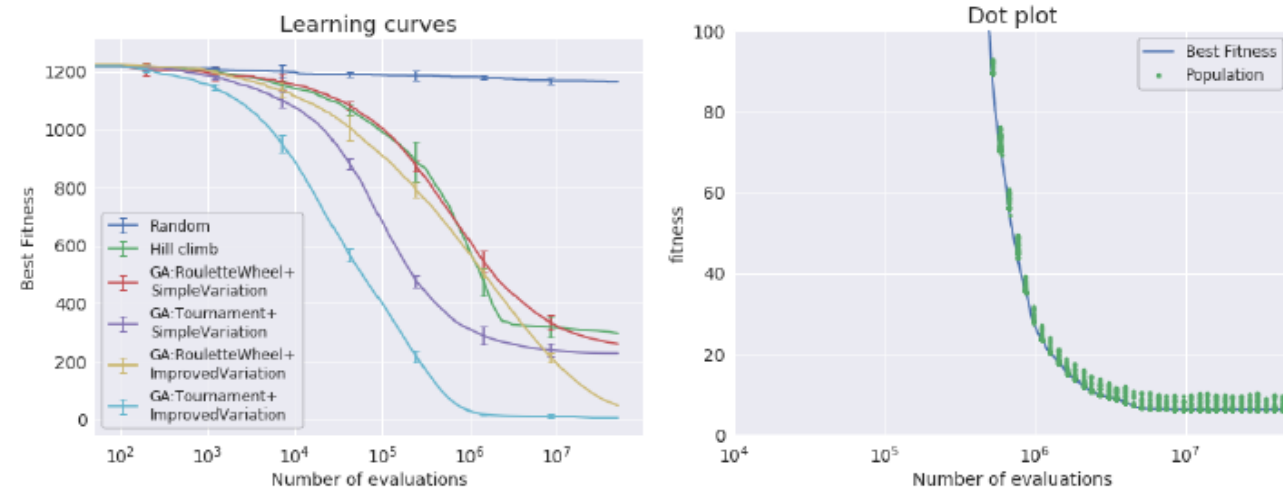


Figure 2: TSP1: The shortest path

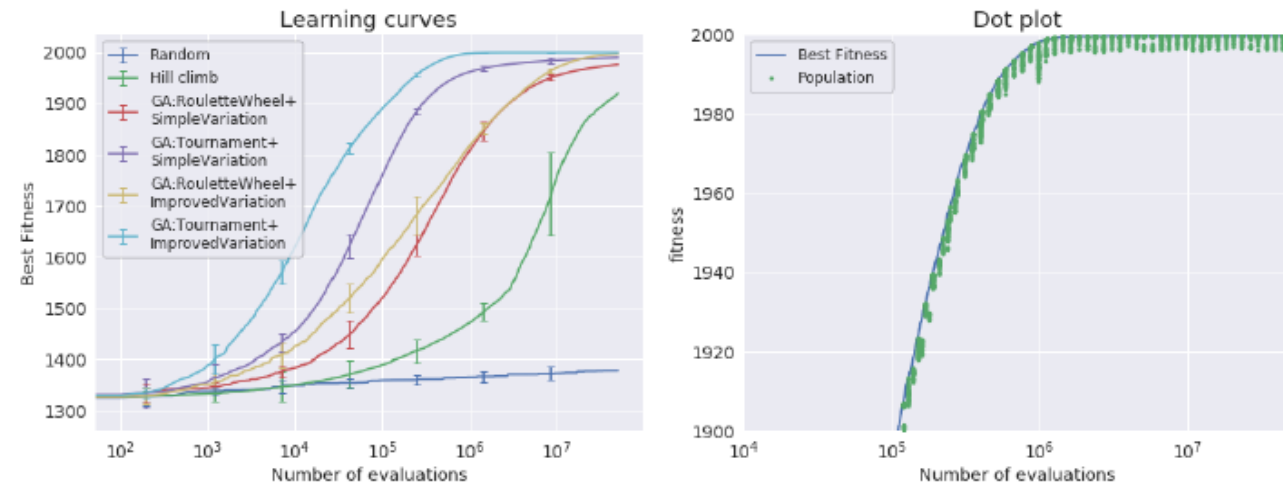
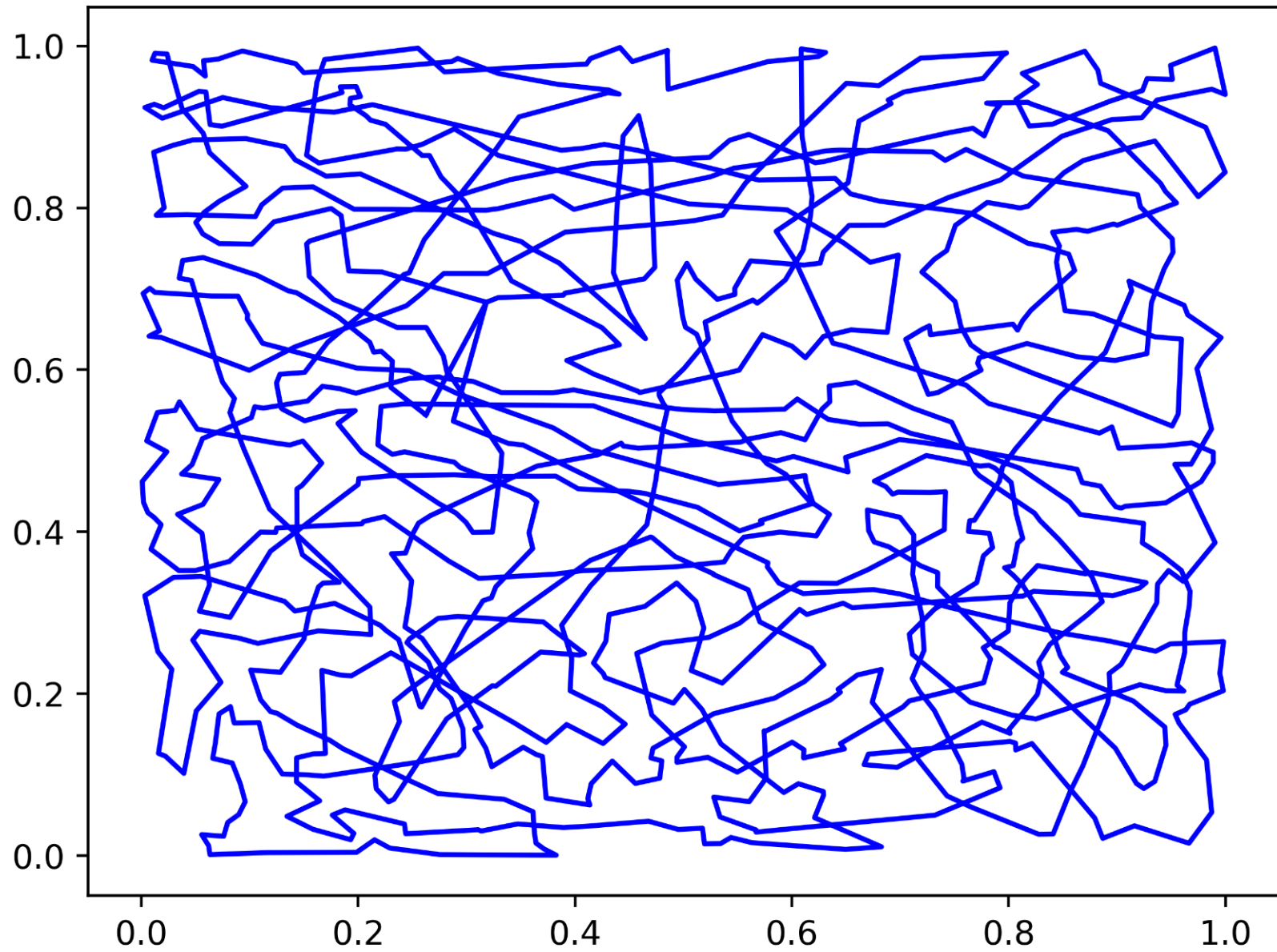
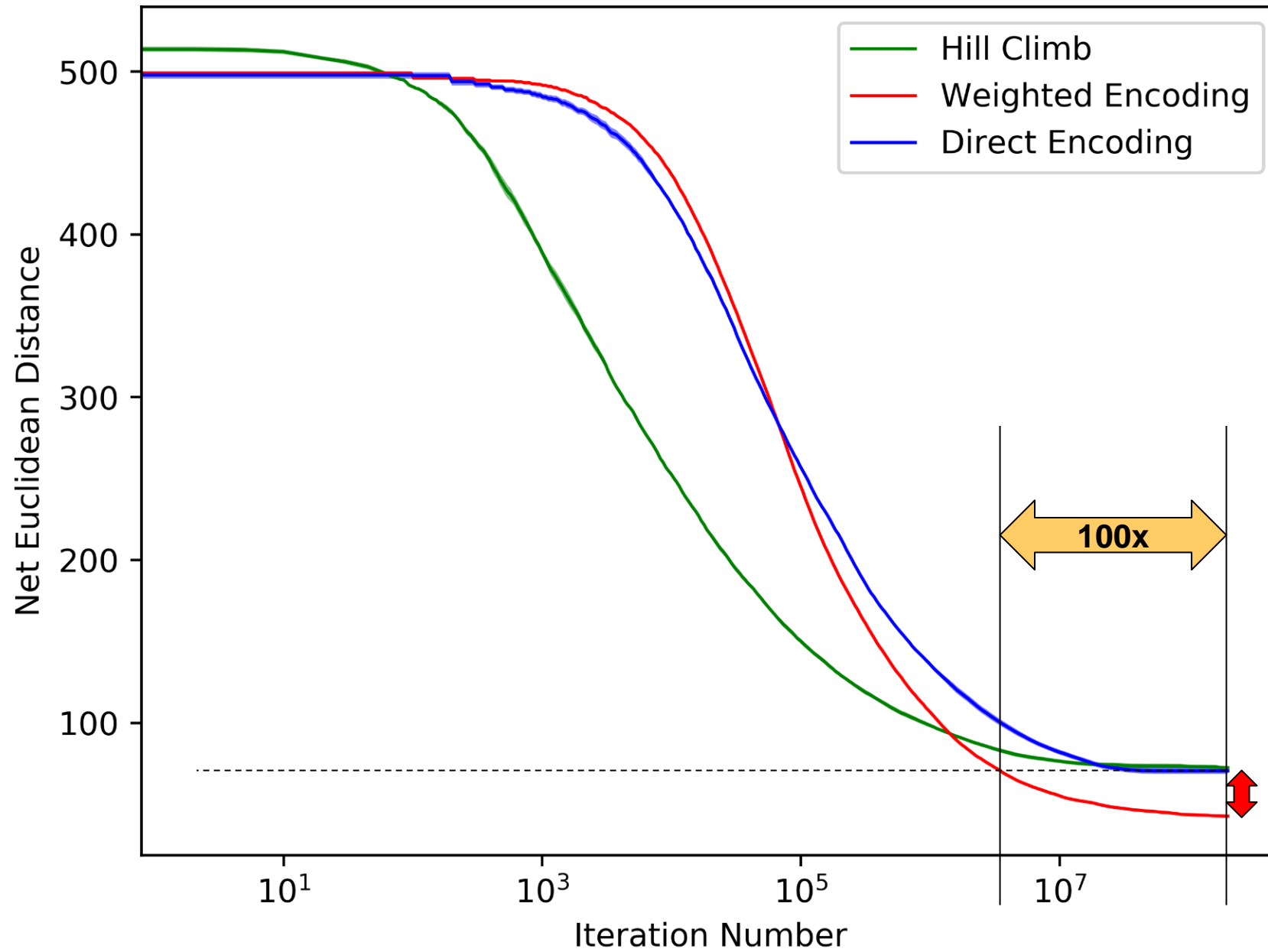


















Figure 3: TSP1: The longest path

TSP Solution: 36.61511195455606



## Training Efficiency



1.72 min	99.9%	21.00 ms		▼TSP.run() TSP
1.10 min	63.5%	1.00 ms		▶TSPSolution.__allocating_init(genome:map:) TSP
22.58 s	21.8%	2.00 ms		▶static TSPGenome.merge(mother:father:i:j:) TSP
5.25 s	5.0%	12.00 ms		▶specialized _arrayForceCast<A, B>(_:) TSP
5.13 s	4.9%	1.50 s		▶TSPSolution.distance() TSP ➡
1.60 s	1.5%	23.00 ms		▶Array.description.getter libswiftCore.dylib
799.00 ms	0.7%	0 s		▶_swift_release_dealloc libswiftCore.dylib
720.00 ms	0.6%	1.00 ms		▶static TSP.selectWeightedRandom(weights:sortedWeights:) TSP
365.00 ms	0.3%	0 s		▶specialized static BinaryFloatingPoint<>.random(in:) TSP
305.00 ms	0.2%	8.00 ms		▶TSPGenome.mutate() TSP
151.00 ms	0.1%	0 s		▶-[NSNumberFormatter numberFromString:] Foundation
136.00 ms	0.1%	136.00 ms		__swift_instantiateConcreteTypeFromMangledName TSP
95.00 ms	0.0%	95.00 ms		swift_release libswiftCore.dylib
77.00 ms	0.0%	0 s		▶specialized MutableCollection<>.sort(by:) TSP
64.00 ms	0.0%	64.00 ms		swift_retain libswiftCore.dylib
52.00 ms	0.0%	52.00 ms		DYLD-STUB:\$\$swift_dynamicCast TSP