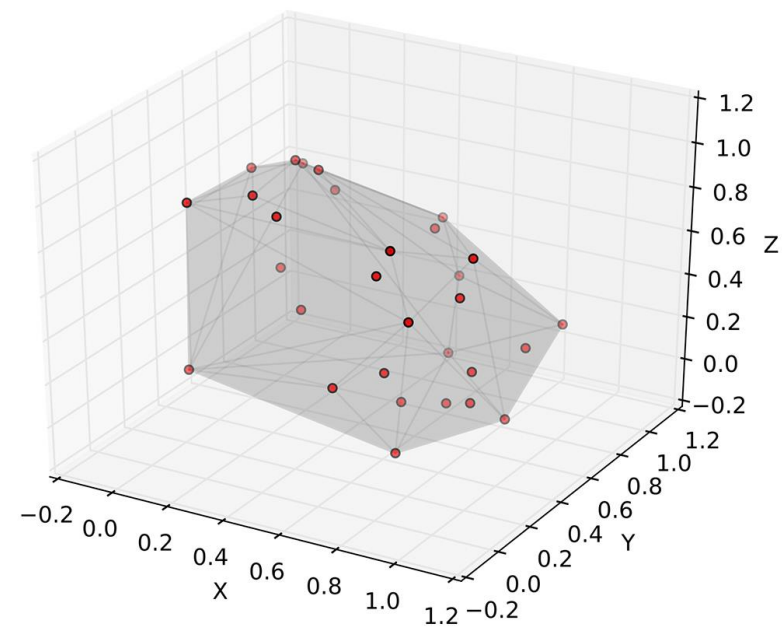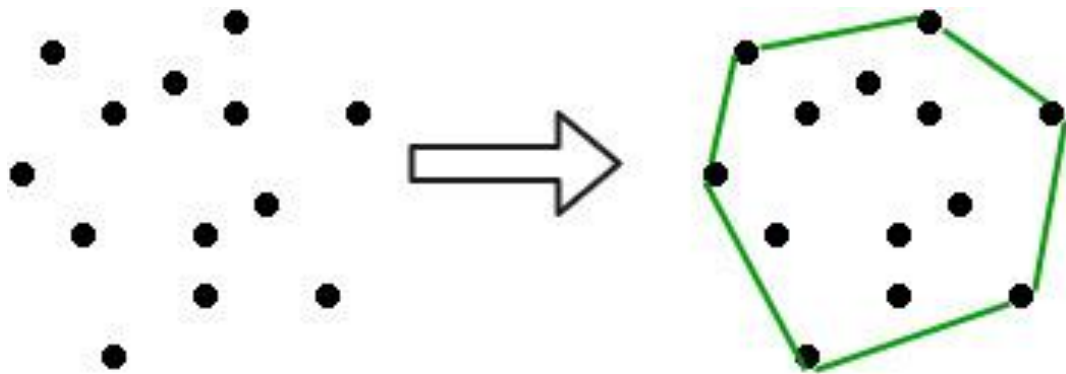# Pointer Network

6기 B반 김현우
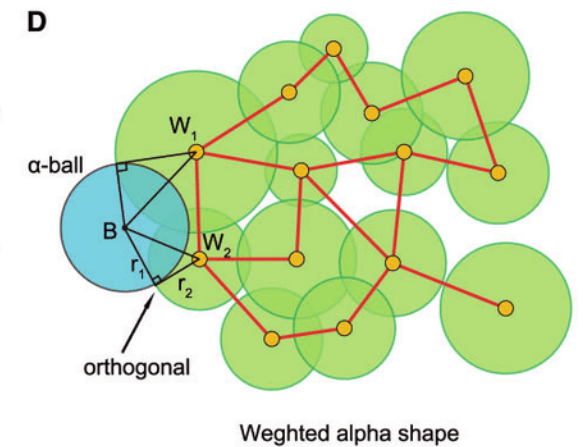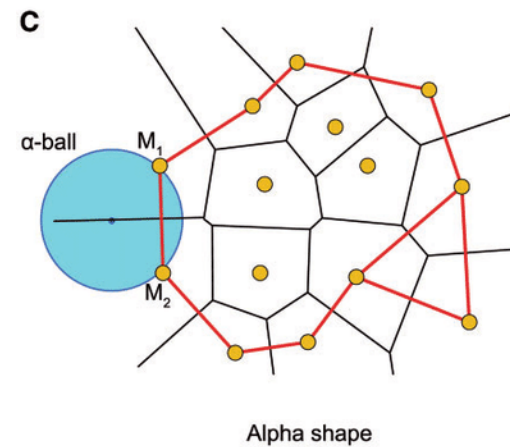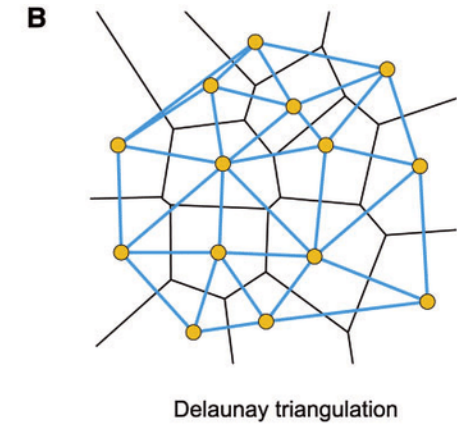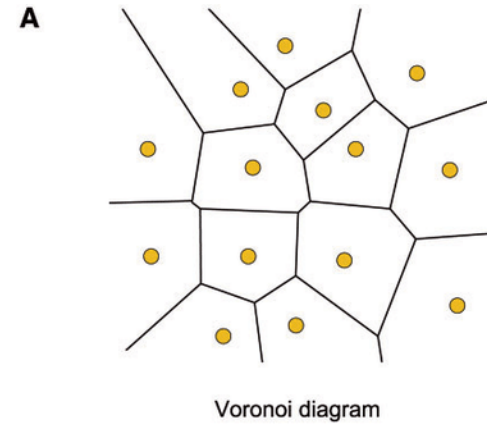
Combinational Optimization

- Mathematical optimization which consists of finding an optimal solution from a discrete set of objects

- Mostly NP-Hard Problems, which means hard to solve
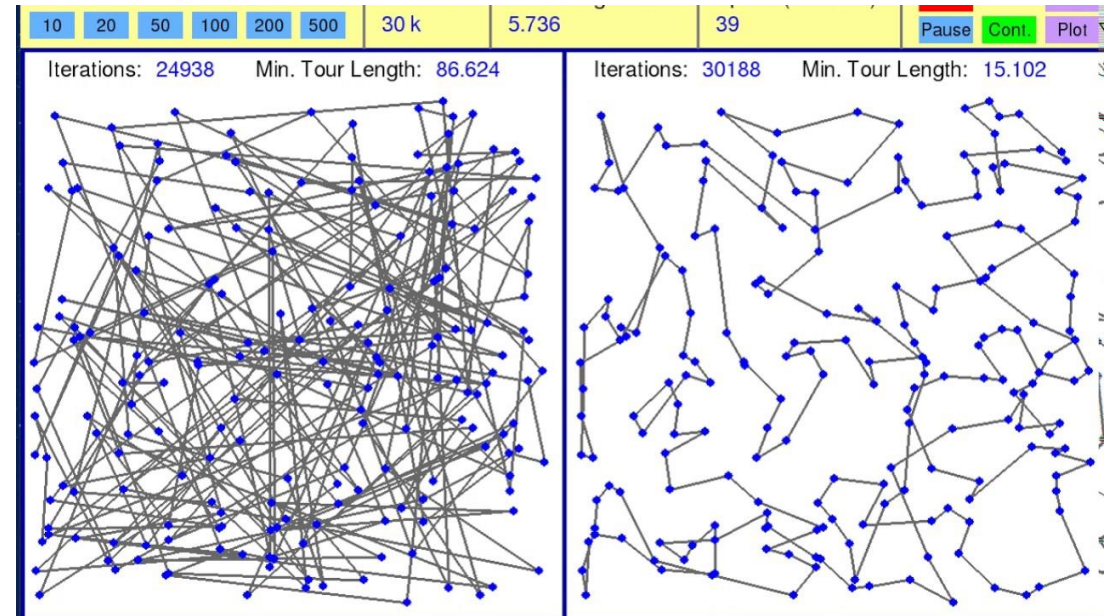
- TSP, Convex hull, Delaunay triangulation, MST, Knapsack Problem, etc.

Convex hull

Delaunay triangulation

A — Voronoi diagram

B — Delaunay triangulation

C — Alpha shape
α-ball
M_1
M_2

D — Weghted alpha shape
α-ball
W_1
W_2
B
r_1
r_2
orthogonal
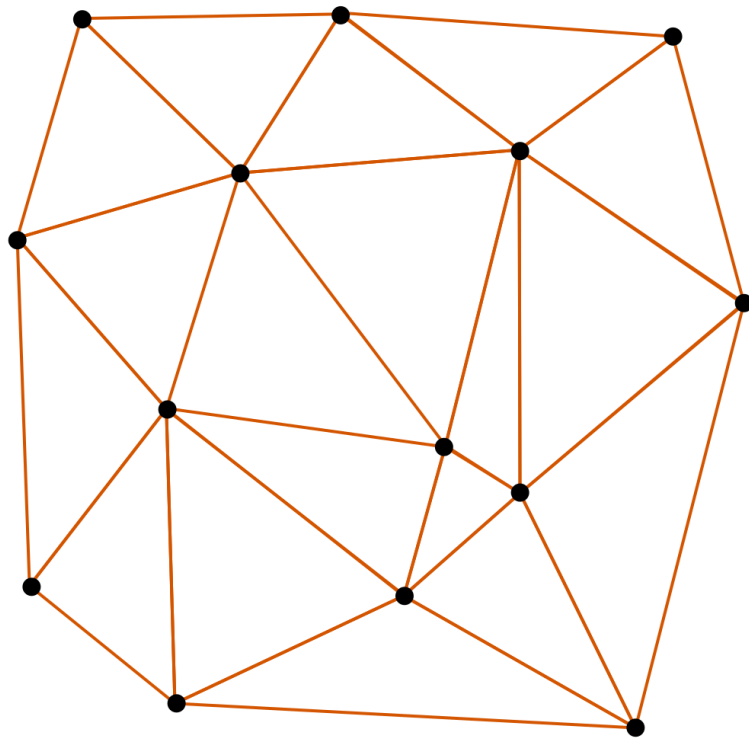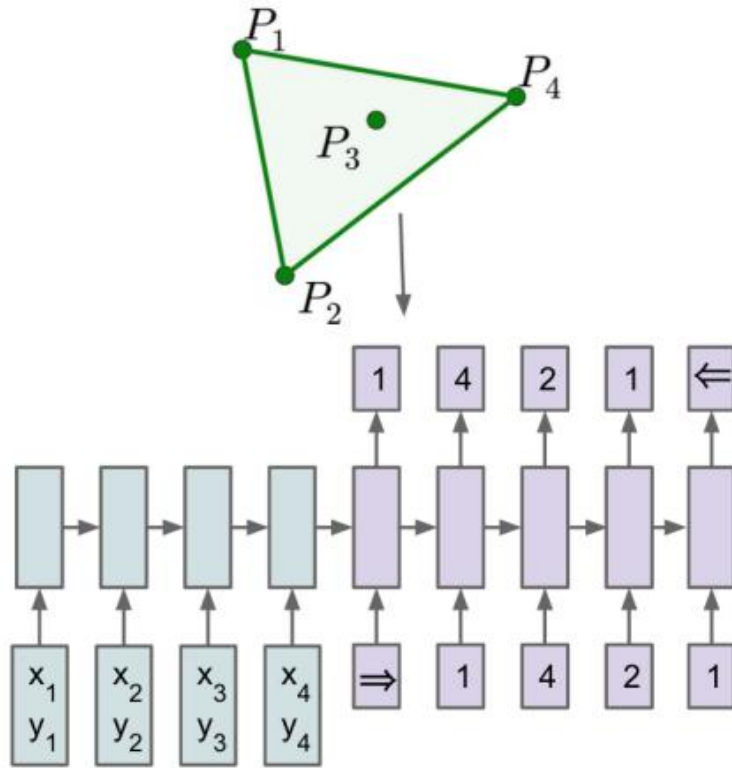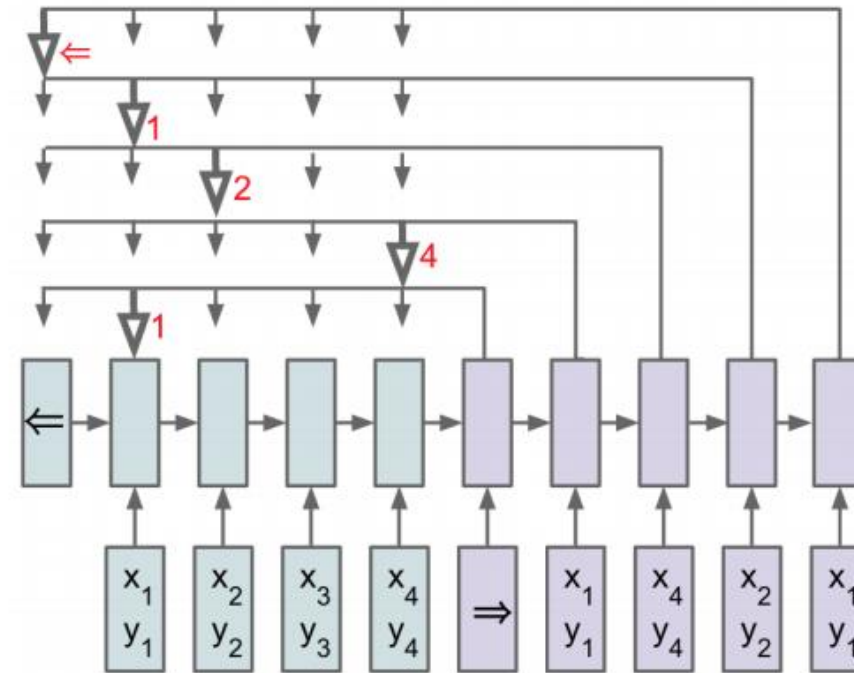
Traveling Salesman Problem (TSP)
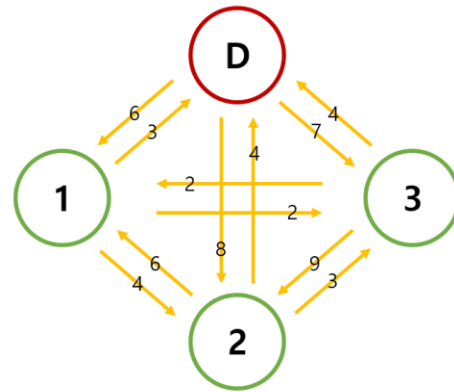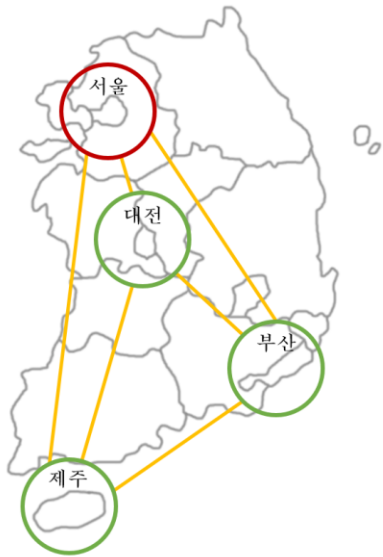
Pointer Network Architecture

(a) Sequence-to-Sequence

(b) Ptr-Net

Empirical Result : Convex hull

METHOD	TRAINED n	n	ACCURACY	AREA
LSTM [1]	50	50	1.9%	FAIL
+ATTENTION [5]	50	50	38.9%	99.7%
PTR-NET	50	50	72.6%	99.9%
LSTM [1]	5	5	87.7%	99.6%
PTR-NET	5-50	5	92.0%	99.6%
LSTM [1]	10	10	29.9%	FAIL
PTR-NET	5-50	10	87.0%	99.8%
PTR-NET	5-50	50	69.6%	99.9%
PTR-NET	5-50	100	50.3%	99.9%
PTR-NET	5-50	200	22.1%	99.9%
PTR-NET	5-50	500	1.3%	99.2%
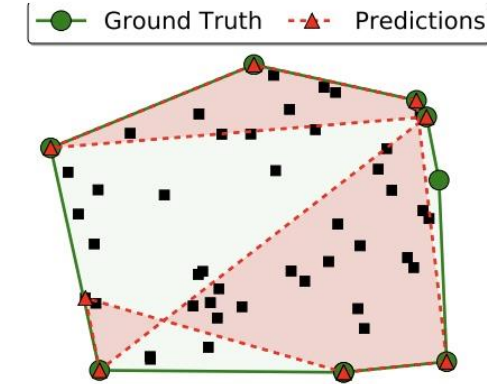
(a) LSTM, m=50, n=50
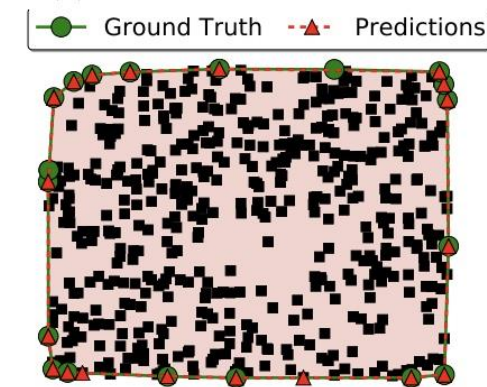
(d) Ptr-Net, m=5-50, n=500

Empirical Result : DT, TSP

n	OPTIMAL	A1	A2	A3	PTR-NET
5	2.12	2.18	2.12	2.12	2.12
10	2.87	3.07	2.87	2.87	2.88
50 (A1 TRAINED)	N/A	6.46	5.84	5.79	6.42
50 (A3 TRAINED)	N/A	6.46	5.84	5.79	6.09
5 (5-20 TRAINED)	2.12	2.18	2.12	2.12	2.12
10 (5-20 TRAINED)	2.87	3.07	2.87	2.87	2.87
20 (5-20 TRAINED)	3.83	4.24	3.86	3.85	3.88
25 (5-20 TRAINED)	N/A	4.71	4.27	4.24	4.30
30 (5-20 TRAINED)	N/A	5.11	4.63	4.60	4.72
40 (5-20 TRAINED)	N/A	5.82	5.27	5.23	5.91
50 (5-20 TRAINED)	N/A	6.46	5.84	5.79	7.66
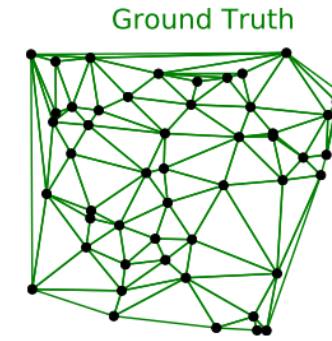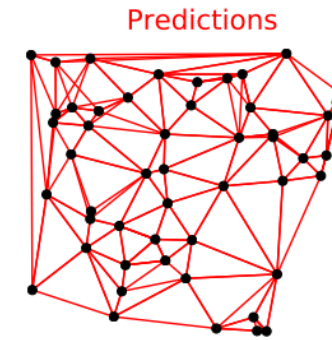
Ground Truth

(b) Truth, n=50

Ground Truth: tour length is 3.518

(c) Truth, n=20
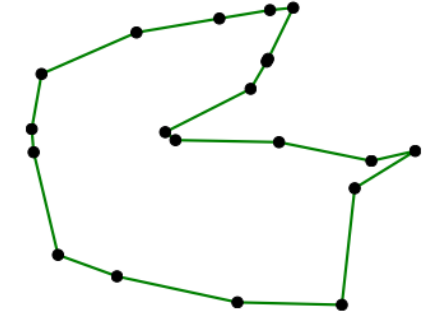
Predictions

(e) Ptr-Net , m=50, n=50

Predictions: tour length is 3.523
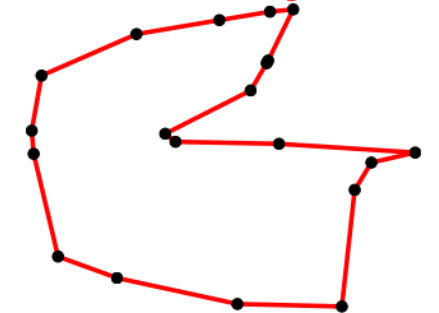
(f) Ptr-Net , m=5-20, n=20

Further Reading

- https://arxiv.org/abs/1911.04936 : Pointer Network using RL
- https://arxiv.org/abs/1410.5401 : Neural Turing Machine

References

- https://arxiv.org/abs/1506.03134
- https://pasus.tistory.com/292
- https://ropiens.tistory.com/57