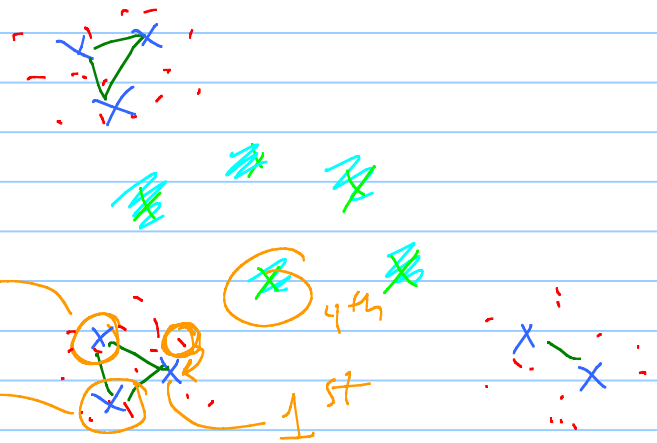
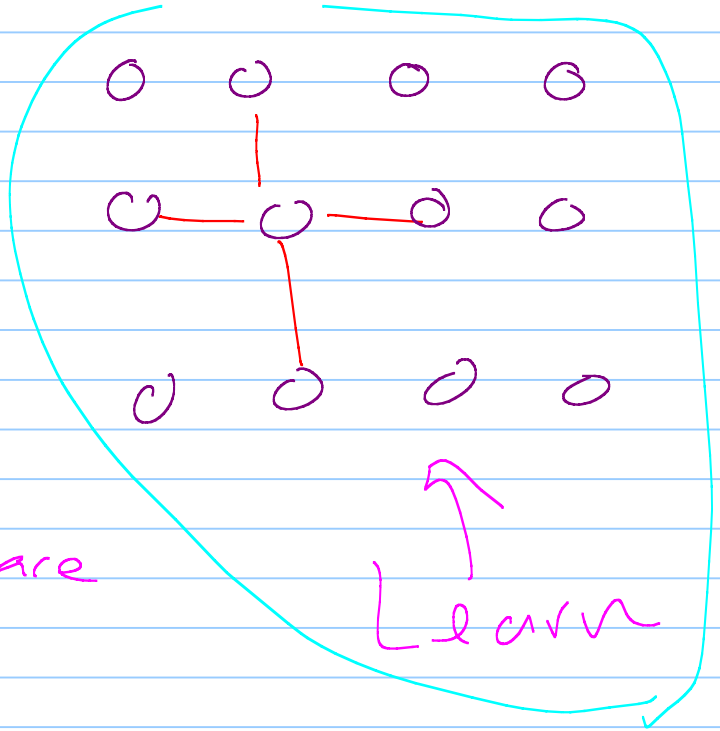
Neural gas

Note Title 3/31/2020

* fixed typ structure in SOM
* what if we could learn the connections?

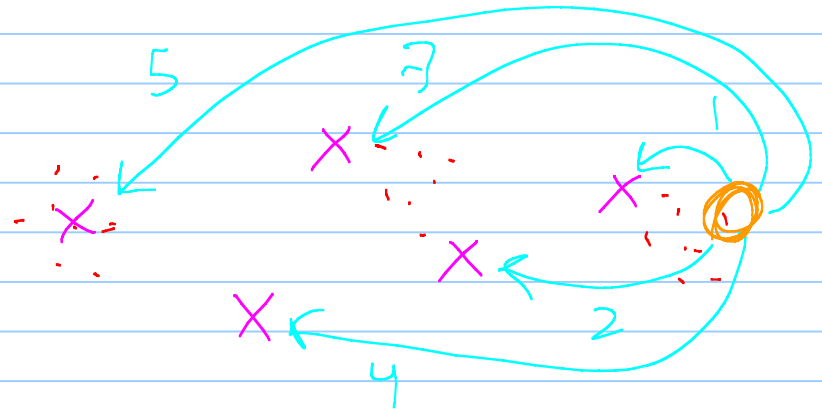




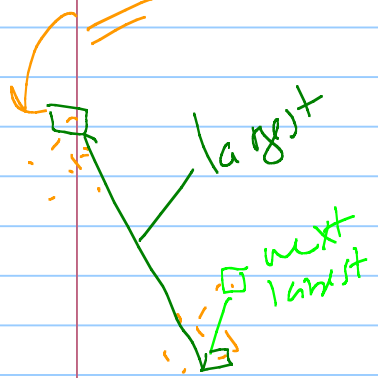
* data as "line" in feature space
* abstract their connections

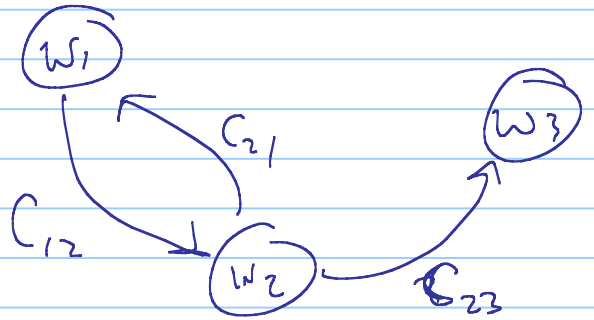
* Manifold of data, e.g. submanifold $M \subseteq \mathbb{R}^N$
  - sampled data !!!
    - discrete set of points

* Neural gas
  - winner-takes-most
  - vs
  - soft $\Rightarrow$ winner-takes-all



(0) Init $\vec{w}_i \in \mathbb{R}^N$ and set C_{ij} to "zero"





Graph

$G = (V, E)$

V: N units

E: connection $\{0, 1\}$

(1) Select a sample, ν, from manifold M

random

ν: samples

M: data set

(2) For each unit i, determine the number k_i neural units j with

all neurons closer than w_i : $\|v - w_j\| < \|v - w_i\|$ ith neuron

by, e.g., determining the sequence $(i_0, i_1, \ldots, i_{N-1})$ s.t.

$$\|v - w_{i_0}\| < \|v - w_{i_1}\| < \ldots < \|v - w_{i_{N-1}}\|$$

i_0: closest neuron to v; i_1: next closest; ...; i_{N-1}: just closer than w_i

(3) Adaptation (update) step

$$w_i^{new} = w_i^{old} + \epsilon \cdot e^{-k_i/\lambda} (v - w_i^{old})$$

yes! diff eq :-)

k_i: how many neurons are closer than it

λ: user defined

delta

$\epsilon \in [0, 1]$: small extent of modification

smaller

④ What's the graph?

If $C_{i_0 i_1} = 0$, set $C_{i_0 i_1} = 1$ ← make this connection

and $t_{i_0 i_1} = 0$ ← counter

closest

next closest

→ through time, when $t_{i_0 i_1}$ gets "BIG" break connection

If $C_{i_0 i_1} = 1$, set $t_{i_0 i_1} = 0$ ← reset

⑤ Increase all of our counters

$t_{i_0 j} = t_{i_0 j} + 1 \quad \forall j$ with $C_{i_0 j} = 1$

⑥ Remove "old" connections

✓ Set $C_{i_0 j} = 0 \quad \forall j$ s.t. $C_{i_0 j} = 1$

$t_{i_0 j} > \boxed{T}$ — user defined

⑦ Go back to step 1