MATHEMATICAL NEUROBIOLOGY

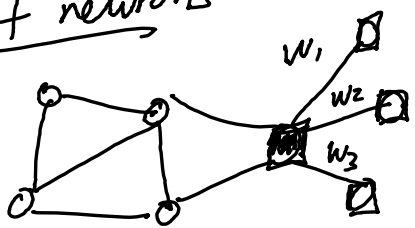
24 Feb 202

- models of nerve excitation
  - LIMIT cycles
  - fast-slow systems

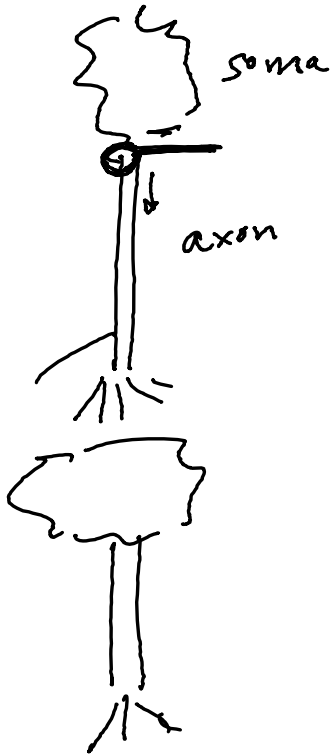
  Hodgkin-Huxley

- models of associational memory

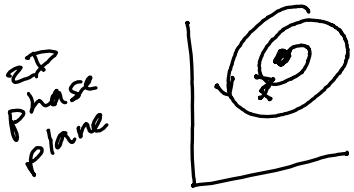
  network of neurons



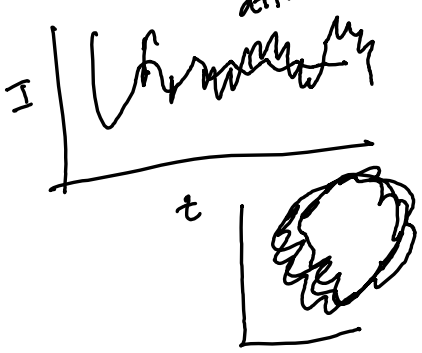
↳ encode memories as the attractors/stable states of the network



- LIMIT cycles +



point attractors



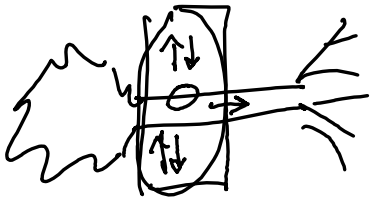
PERIODIC ORBIT

$t \to \infty$

[Poincaré-Bendixson (2D)]

- EPIDEMIC models ?? [deterministic autonomous]
  - stochastic: (prolong cycles around a weakly stable spiral)
  - seasonal forcing ($\beta(t)$)
  - WEIRD math
    Wang & Ruan 2004
    Cont removal of inf.
    LINEAR
    [Math Biosciences / J Disc Cont Dynam Sys]

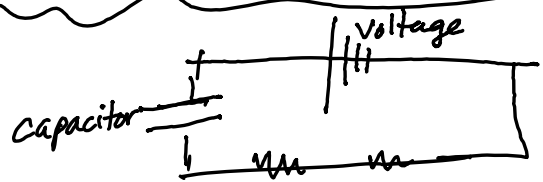
- ECOLOGICAL models ?



'electrochemical'

* NOT movement of electrons
  IONS Na^+, K^+, Cl^-
* NOT along axon.
  transverse axon
* active movement of ions -
  maintains resting potential
  ≈ -50 mV
  less Na^+
  more K^+
  less Cl^-
* voltage-controlled pores

① voltage increases
② Na^+ channels open : Na^+ ↗, V ↗
③ K^+ channels K^+ ↘ V ↘
④ Na^+ channels



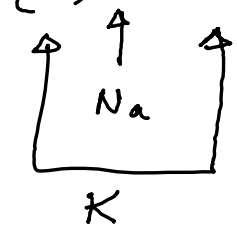
PARALLEL currents

conductance ($= \frac{1}{R}$)

$$\frac{dV}{dt} = -\frac{1}{C}\left(g_{Na}^{(v)}(V - V_{Na}) + g_K(V - V_K) + g_L(V - V_L)\right)$$

Capac.

$\{n, m, h\}$ LATENT variables $[0, 1]$



$$\frac{dn}{dt} = \alpha_n(v)(1-n) + \beta_n(v)\,n$$

{ exponential
{ logistic