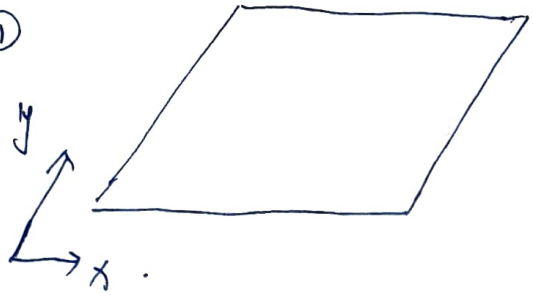
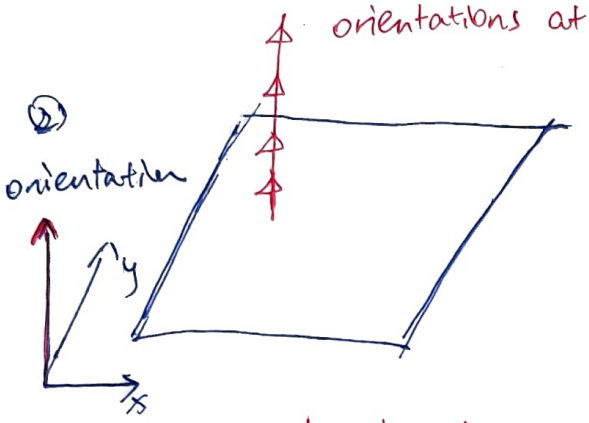
Week 5: Recurrent Models

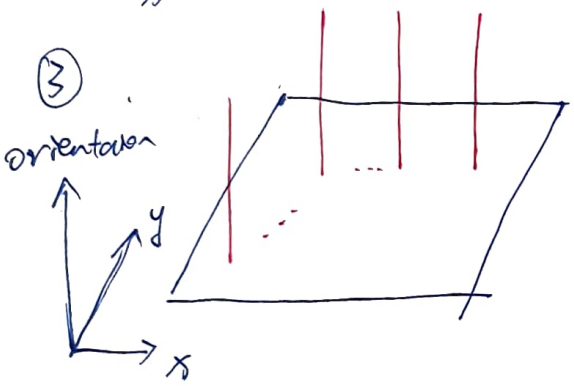
① 

visual field.

② 

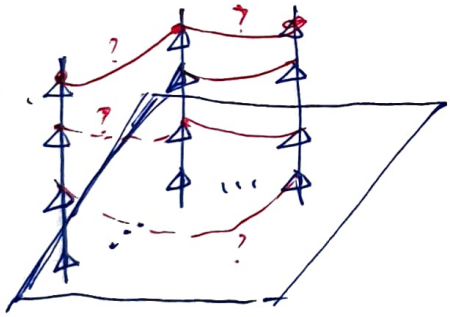
orientations at some single position on the visual field.

orientation column.

③ 

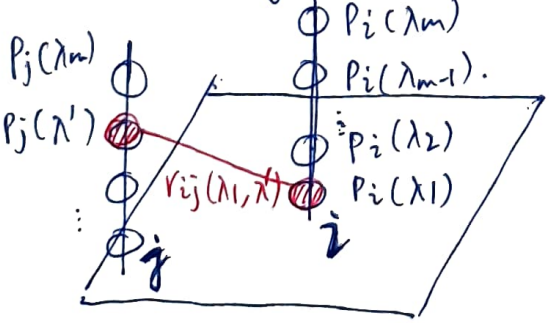
orientation columns (∀ positions on the visual field)

orientation columns.

④ 

connections between neurons across the columns.

↓ algebraic model:



Recurrent computation in cortical columns:

$$P_i^{t+1}(\lambda) \leftarrow \Pi_{\mathbb{R}}\left[P_i^t(\lambda) + \int S_i^t(\lambda)\right]$$

The Big Picture

The Model of Curve Detection (2 stages).

Stage 1 : Trace Inference + orientation selection.

Step 1.1 Initial local measurement (at simple cell receptive field)

- each endstopped neuron → orientation.
  ↳ curvature.

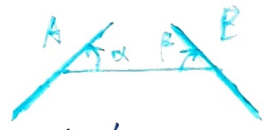
- 2 operators : ① normal operator : categorization.
  (selects the proper contrast cross section to define a +ve/-ve contrast line/edge).

② tagent operator : continuity
(ensures local C^1 continuity of the curve).

- Step 1.1 : 至 local linear approximation of the curve in the direction of the normal & the direction of the tangent.

Step 1.2. Establish consistency between the local measurements.
(from 1.1)

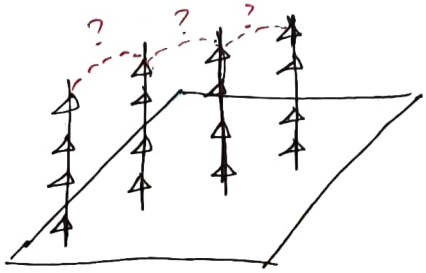
- given : ① co-circularity constraints.



(λ and λ are co circular. $\lambda \asymp \lambda'$
$\Leftrightarrow$ ∃ a circle to which both λ and λ' are tangent)

② a curve as a stimulus.

- to find : connections between endstopped neurons in nearby orientation hypercolumns.
  i.e. where are the long-range horizontal connections?



Stage 2 : Curve Synthesis

Motivation : recovering the global curve by computing a covering of te

Step 2.1 : Construct the potential distribution from the discrete tangent field

the same as the association field ?

Step 2.2 : Spline dynamics

Higher level of abstraction :

Discrete : orientations (from end stopped cells) .

Continuous : - a measure of activity ~~of~~ associated with the discrete object (response to stimuli at each endstopped cell)

- a measure of ~~out~~ consistency across discrete objects

↓

analogous to the TSP problem .

The model : Polymatrix game with n players .

(The columnar machine) ↓

Nash equilibrium always exists .