Neural Dynamics 2

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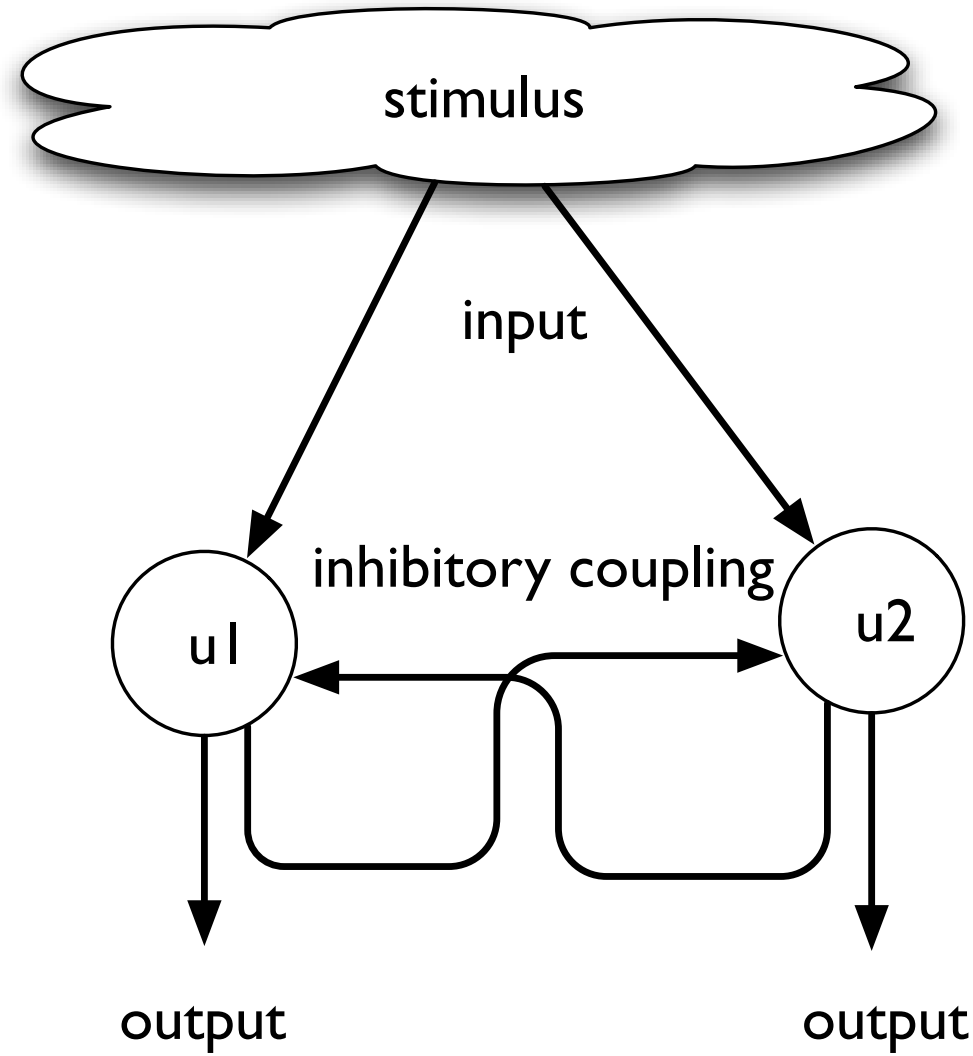
Neuronal dynamics with competition



$$\tau \dot{u}_1(t) = -u_1(t) + h - \sigma(u_2(t)) + S_1$$
$$\tau \dot{u}_2(t) = -u_2(t) + h - \sigma(u_1(t)) + S_2$$

Neuronal dynamics with competition

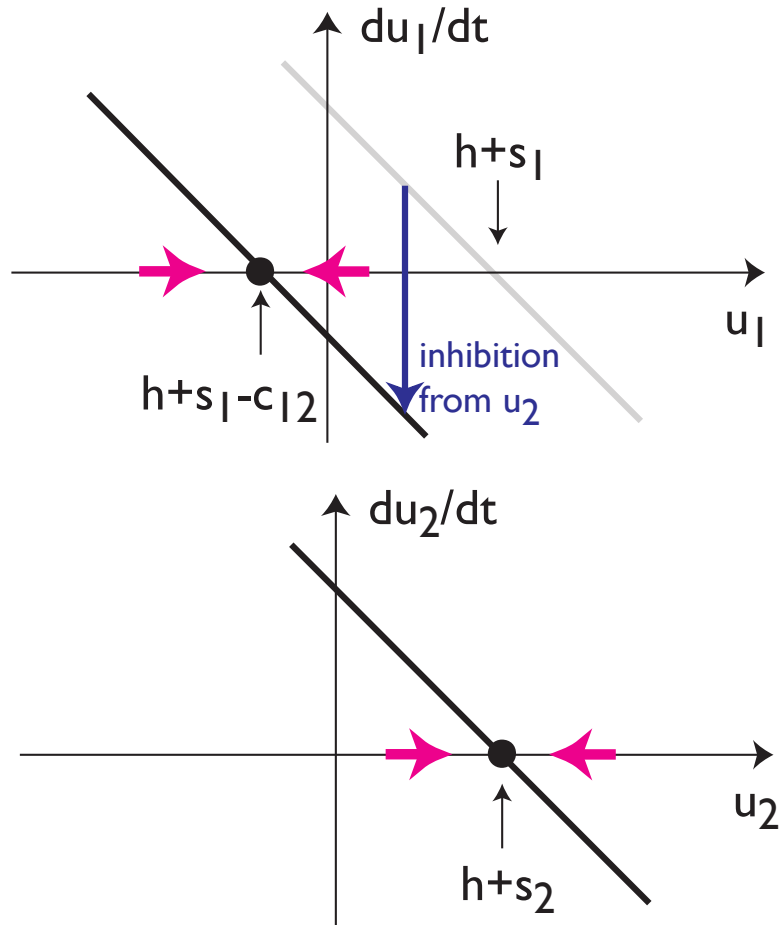
- the rate of change of activation at one site depends on the level of activation at the other site
- mutual inhibition

$$\tau \dot{u}_1(t) = -u_1(t) + h - \sigma(u_2(t)) + S_1$$
$$\tau \dot{u}_2(t) = -u_2(t) + h - \sigma(u_1(t)) + S_2$$

sigmoidal nonlinearity

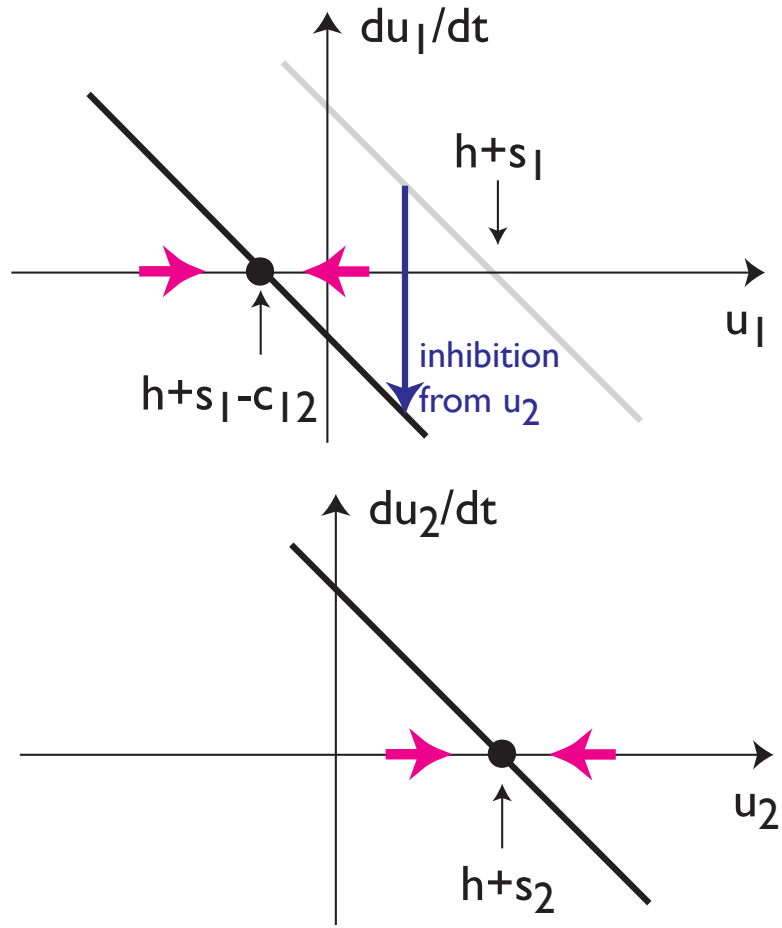
Neuronal dynamics with competition

- to visualize, assume that u_2 has been activated by input to positive level
- => then u_1 is suppressed



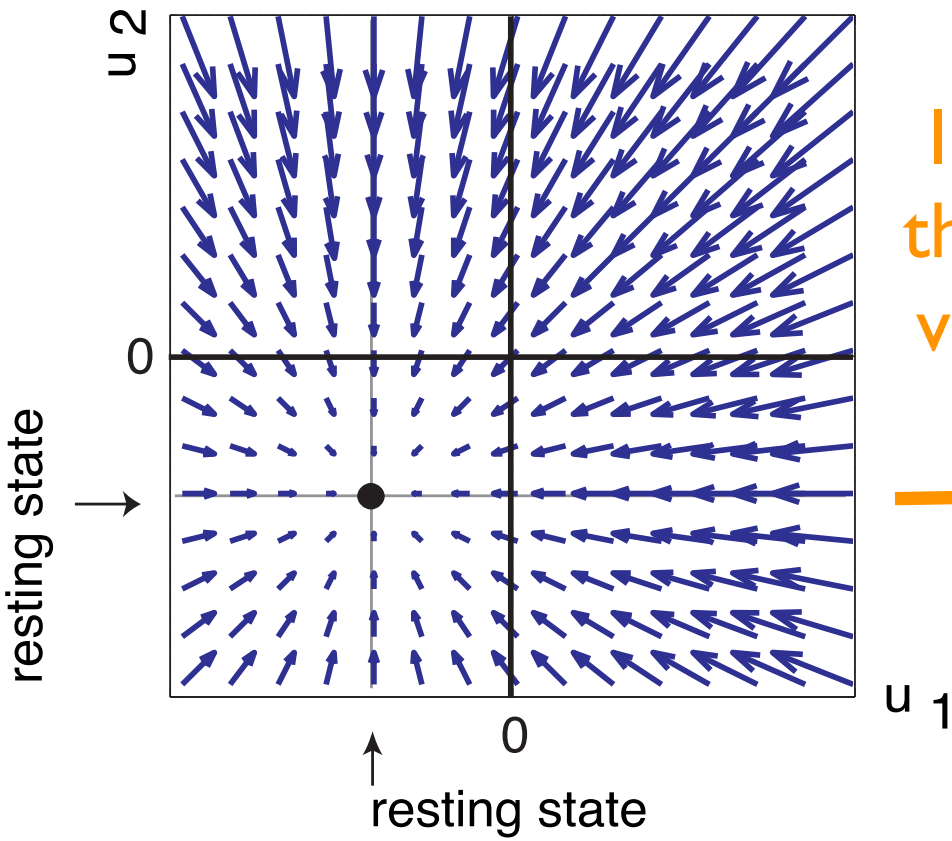
Neuronal dynamics with competition

- why would u_2 be positive before u_1 is? E.g., it grew faster than u_1 because its inputs are stronger/inputs match better
- => input advantage translates into time advantage which translates into competitive advantage

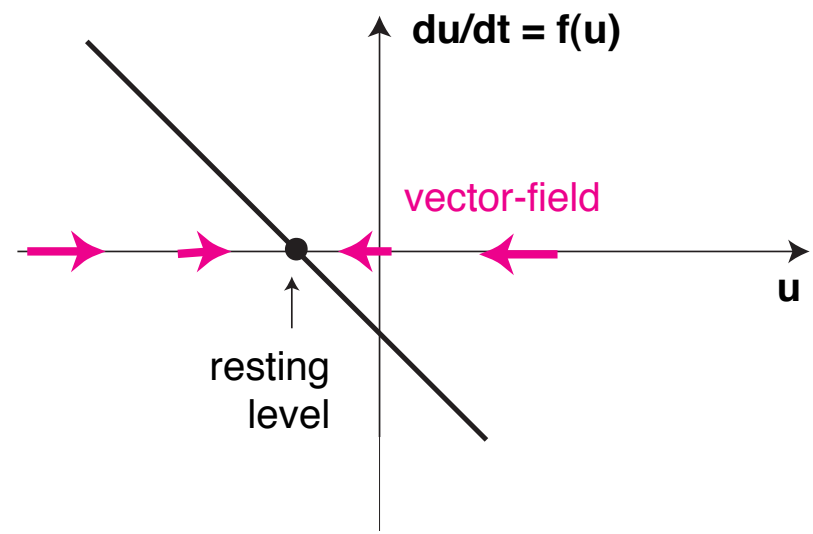


Neuronal dynamics with competition

vector-field in the absence of input

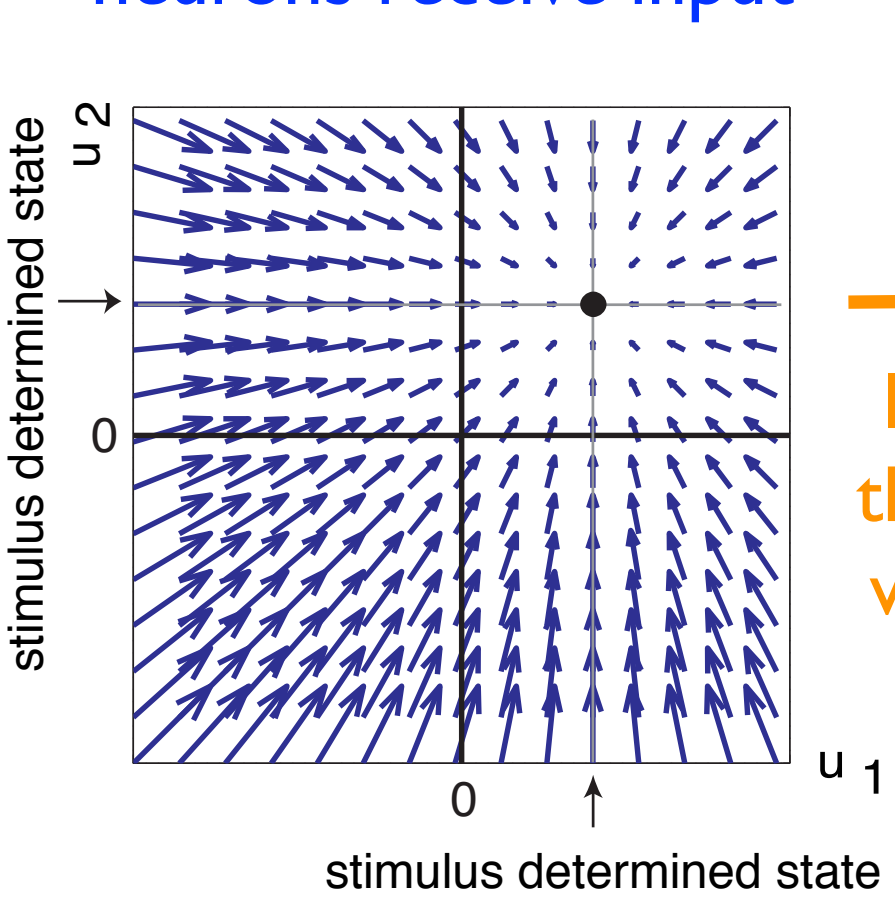


1D cut through vector-field

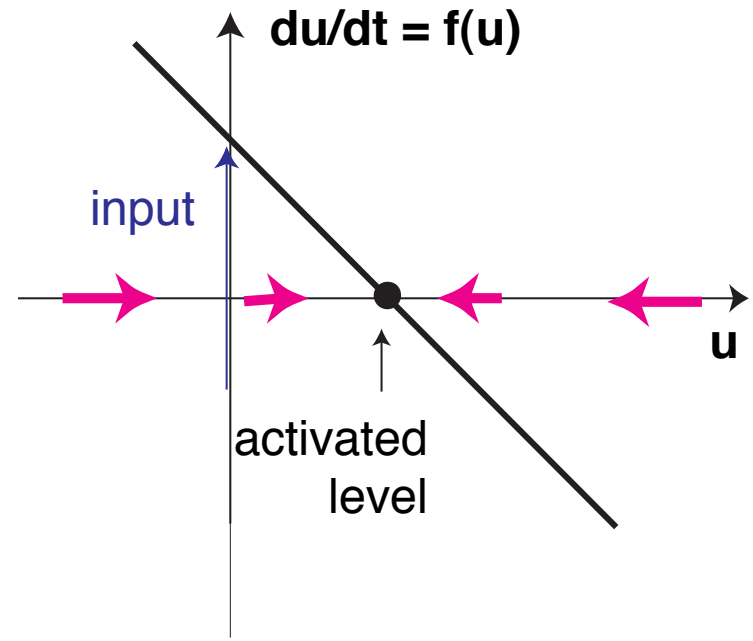


Neuronal dynamics with competition

vector-field (without interaction) when both neurons receive input



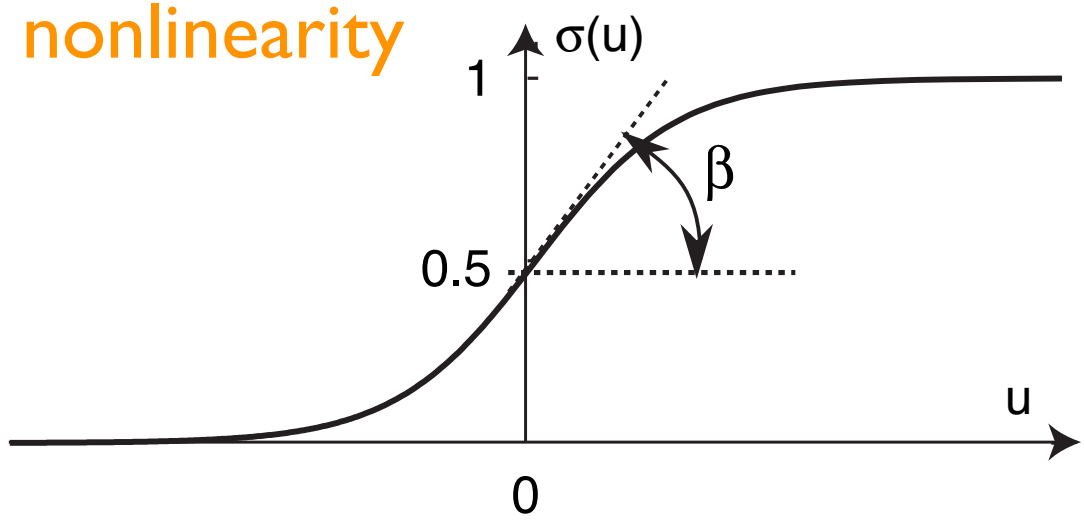
1D cut through vector-field



Neuronal dynamics with competition

- only activated neurons participate in interaction!

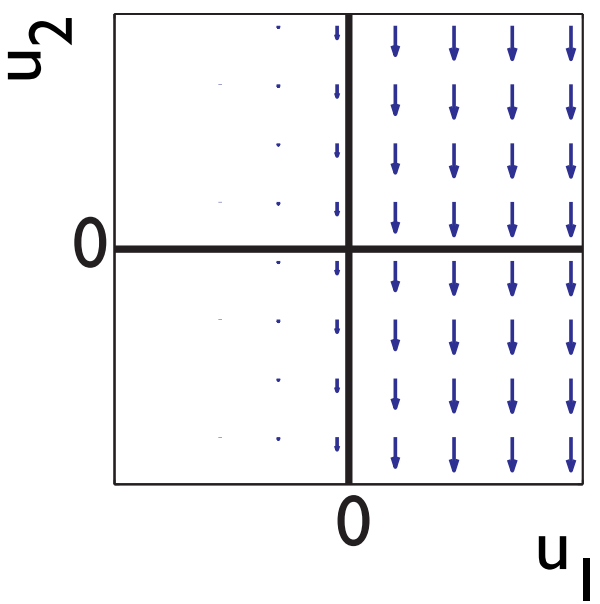
sigmoidal nonlinearity



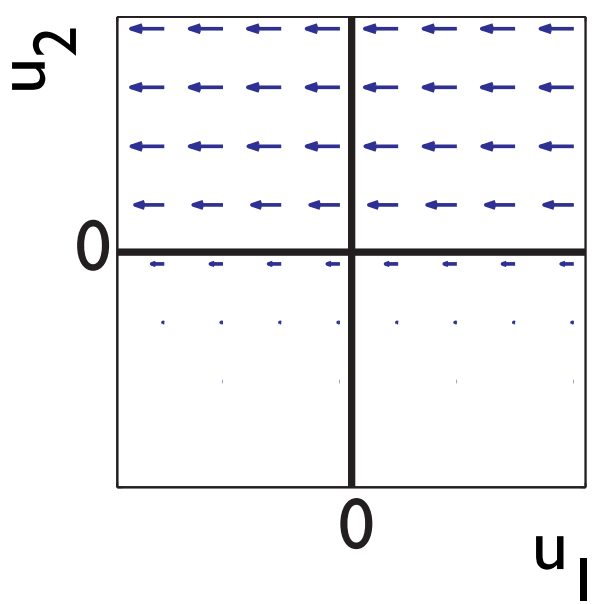
Neuronal dynamics with competition

- vector-field of mutual inhibition

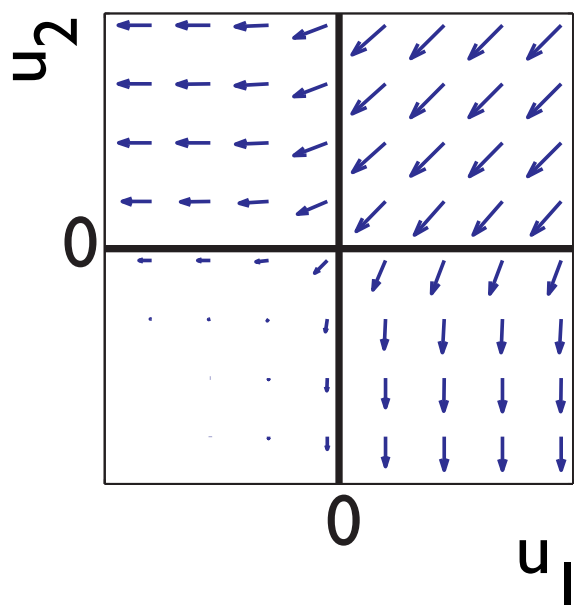
site 1 inhibits site 2



site 2 inhibits site 1

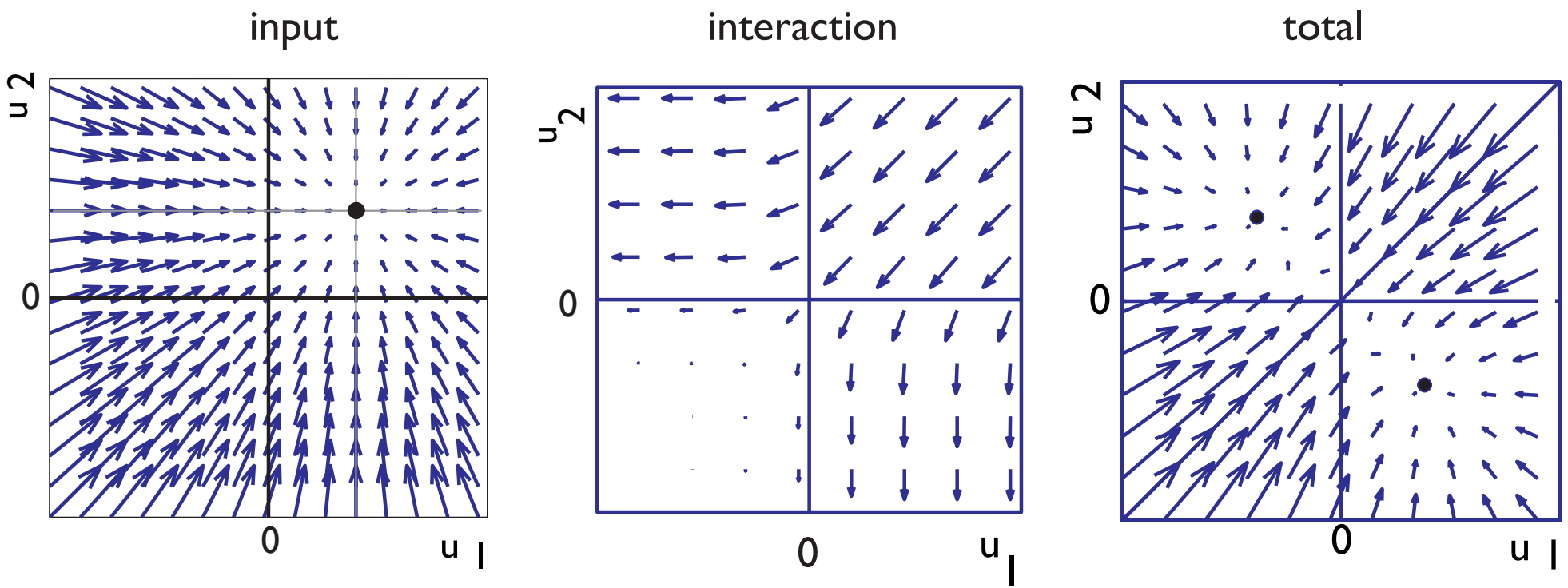


interaction combined



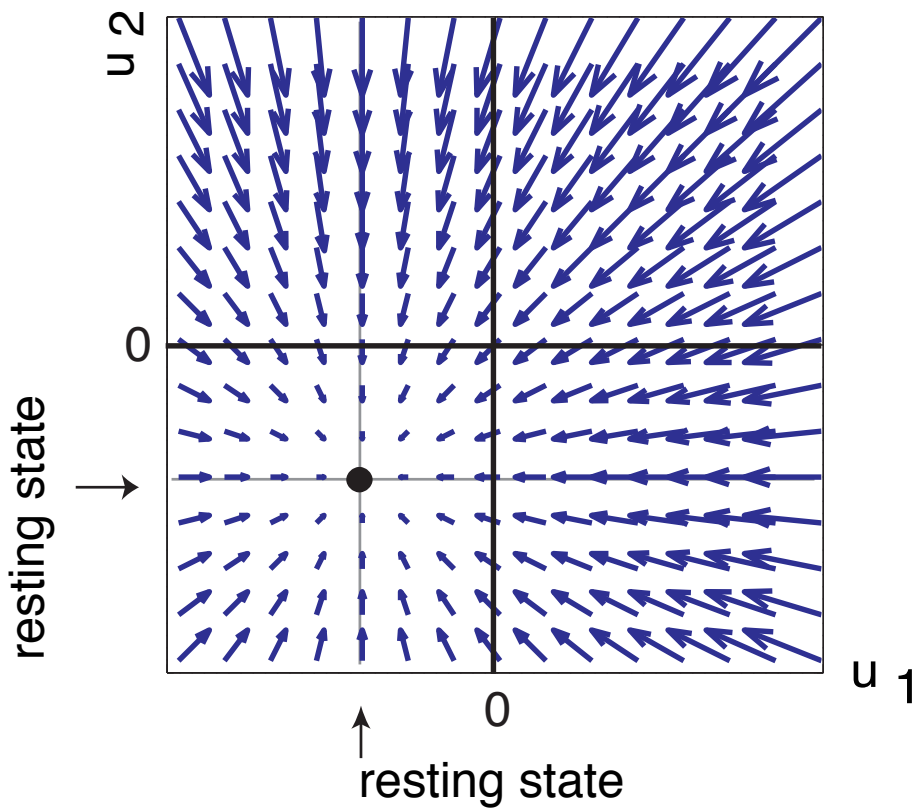
Neuronal dynamics with competition

vector-field with strong mutual inhibition: bistable

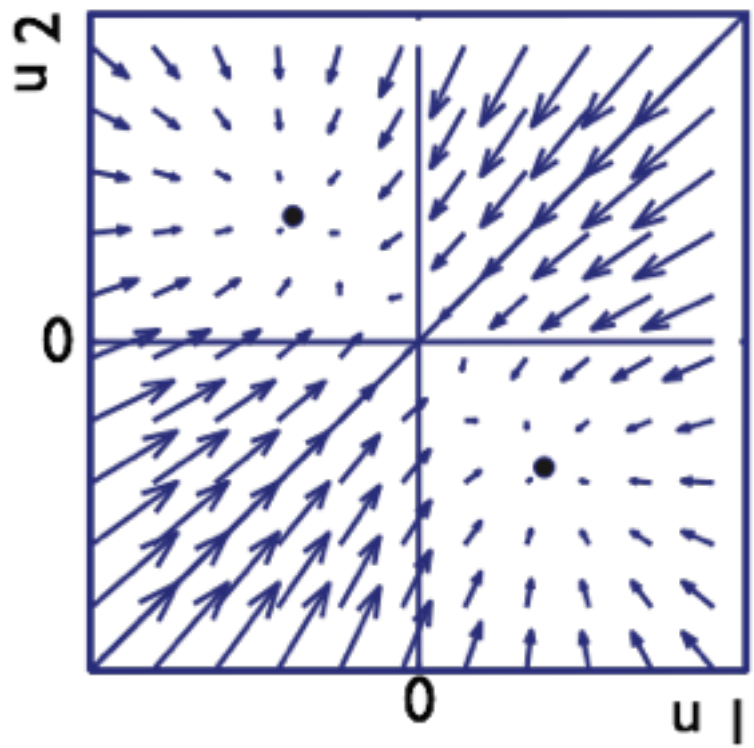


Neuronal dynamics with competition

before input is presented



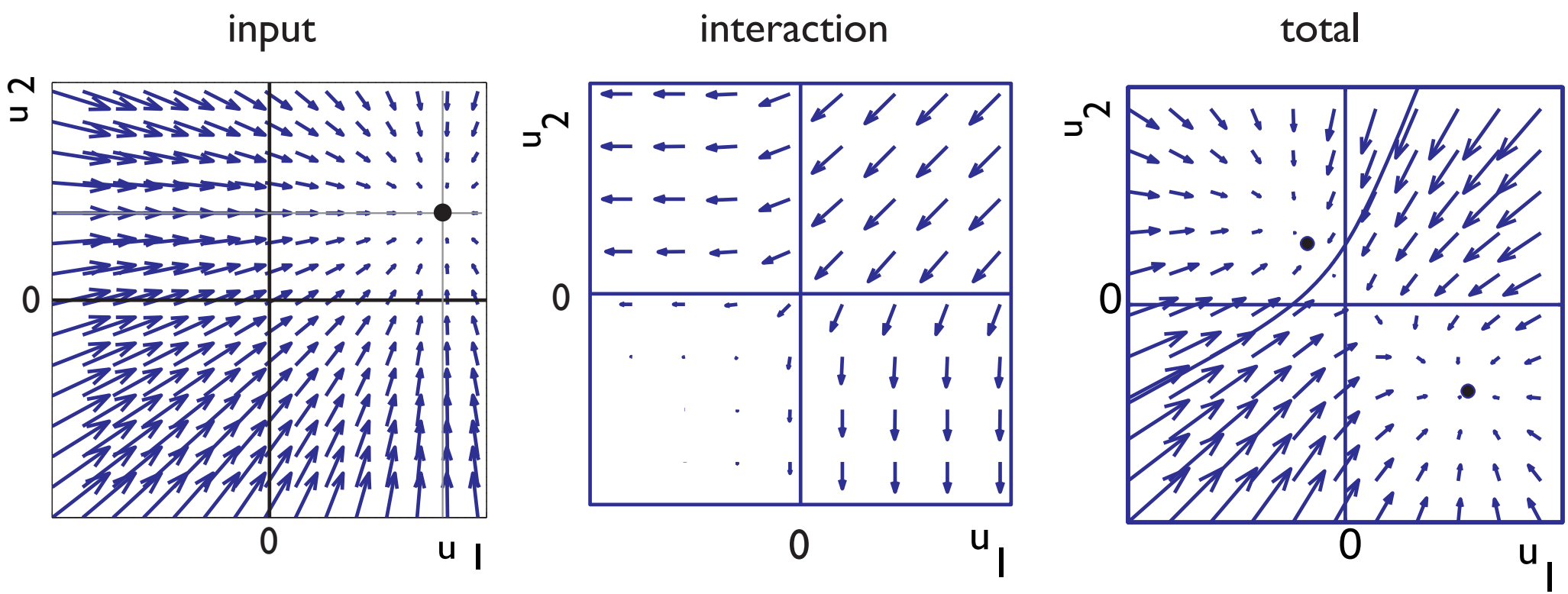
after input is presented



Neuronal dynamics with competition

=>biased competition

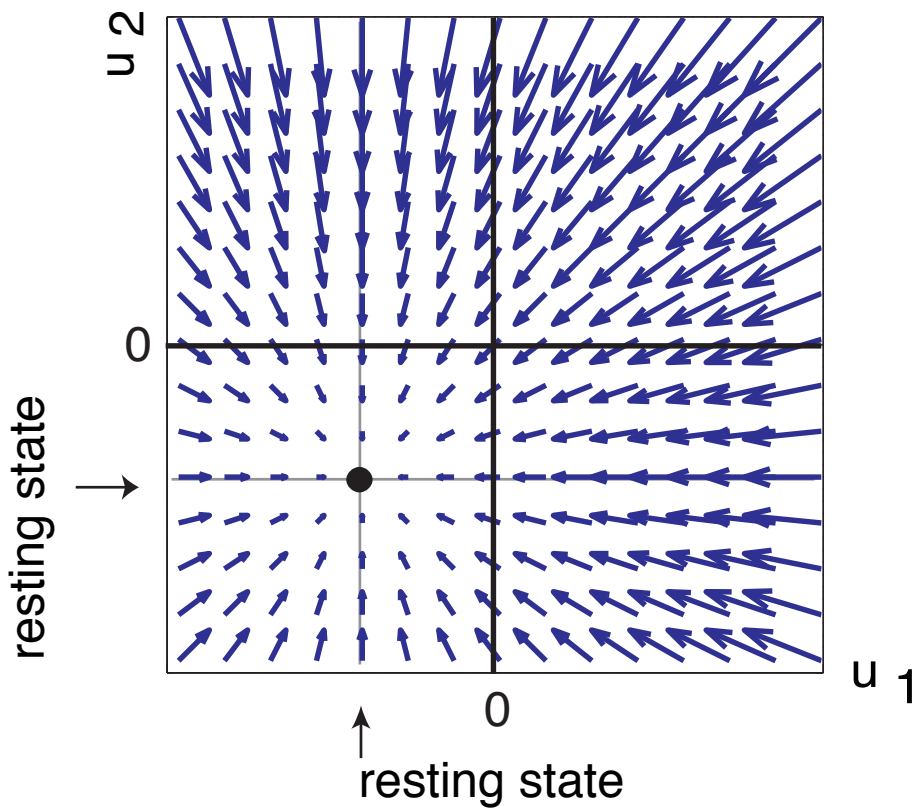
stronger input to site 1:
attractor with activated u_1 stronger,
attractor with activated u_2 weaker, may become unstable



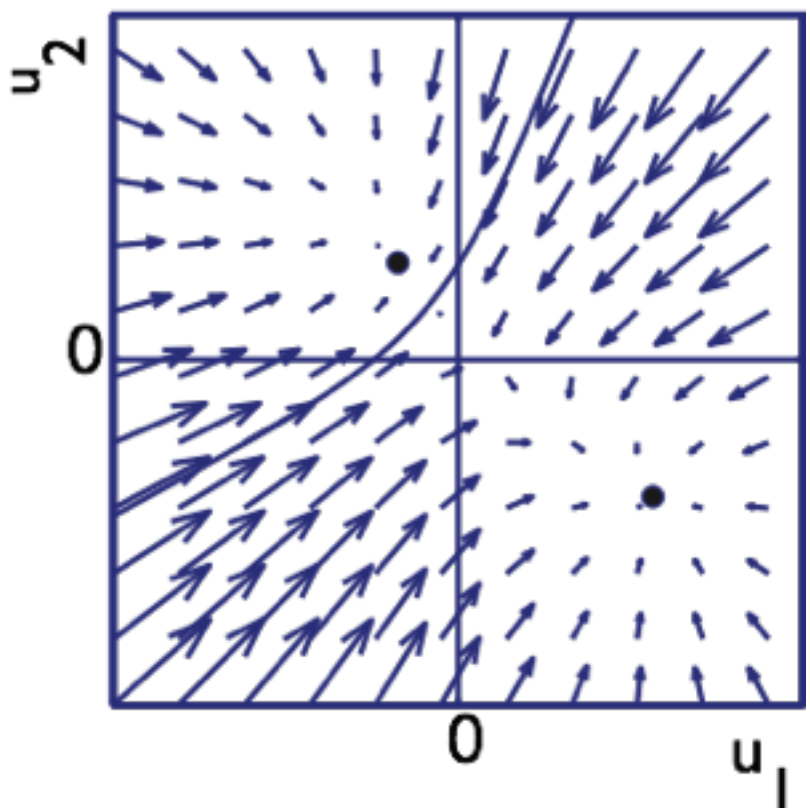
Neuronal dynamics with competition

=>biased competition

before input is presented



after input is presented



- => simulation

- where do activation variables come from?
- how do discrete activation variables reflect continuous behaviors?
- => DFT lecture