1. **Inhibition**

   - Controls activity (bidirectional excitation).
   - Competition -> selection (Darwin!).

2. **Types of Inhibition**

   - Anticipates excitation
   - Reacts to excitation

3. **Critical Parameters**

   - Inhib conductance into hidden units \(g_{\text{bar}_i.\text{hidden}}\)
   - Inhib conductance into inhib units \(g_{\text{bar}_i.\text{inhib}}\)
   - Strength of feedforward weights to inhib \(\text{scale.ff}\)
   - Strength of feedback weights to inhib \(\text{scale.fb}\)

4. **Approximating Inhibitory Interneurons**

   - Computationally expensive to simulate inhibitory interneurons:
     - Extra units and connections.
     - Slower rate constants \((dt)\) required to avoid oscillations (many cycles of updating to process inputs).

   Thus, we approximate inhibition by only activating \(k\) units.
   Approximates set point behavior.

   k-Winners-Take-All (kWTA): Compute \(g_i\) such that \(k\) units are above threshold, rest below.
kWTA Idea

kWTA: Simple

\[ V_m = \frac{g_i \bar{g} E_g + g_l \bar{g} E_l + g_i \bar{g} E_l}{g_i \bar{g} + g_l \bar{g} + g_i \bar{g} + g_l \bar{g}} \] (1)

\[ g_i = \frac{g_i \bar{g} (E - \Theta) + g_l \bar{g} (E_l - \Theta)}{\Theta - E_i} \] (2)

\[ g_i = g_i^\Theta (k + 1) + q(g_i^\Theta (k) - g_i^\Theta (k + 1)) \] (3)

kWTA: Average-Based

\[ \langle g_i^\Theta \rangle_k = \frac{1}{k} \sum_{i=1}^{k} g_i^\Theta (i) \] (4)

\[ \langle g_i^\Theta \rangle_{n-k} = \frac{1}{n-k} \sum_{i=k}^{n} g_i^\Theta (i) \] (5)

\[ g_i = \langle g_i^\Theta \rangle_{n-k} + q(\langle g_i^\Theta \rangle_k - \langle g_i^\Theta \rangle_{n-k}) \] (6)

Simulations

1. kWTA approximates set point behavior.

2. Allows for faster updating.