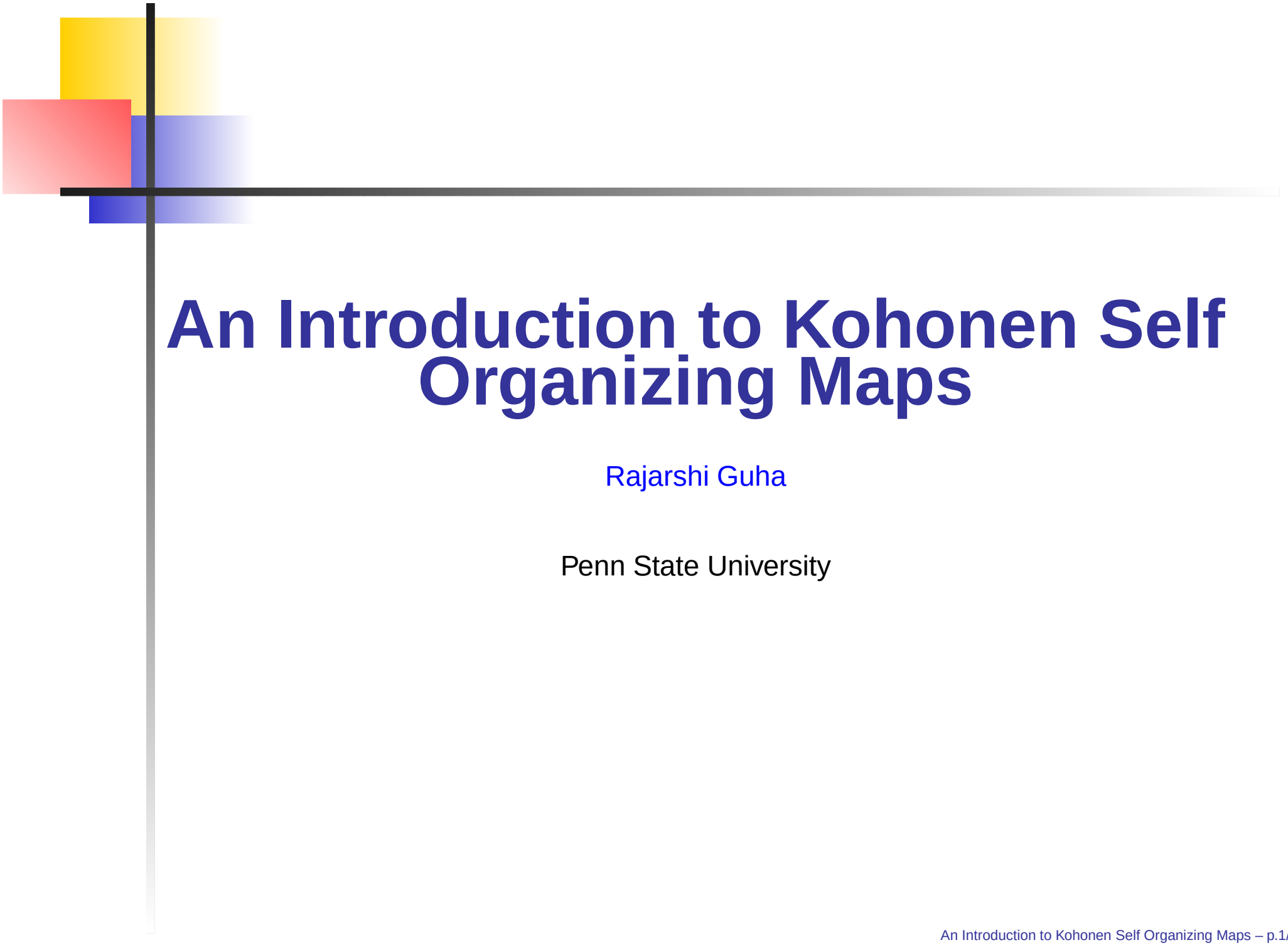

An Introduction to Kohonen Self Organizing Maps

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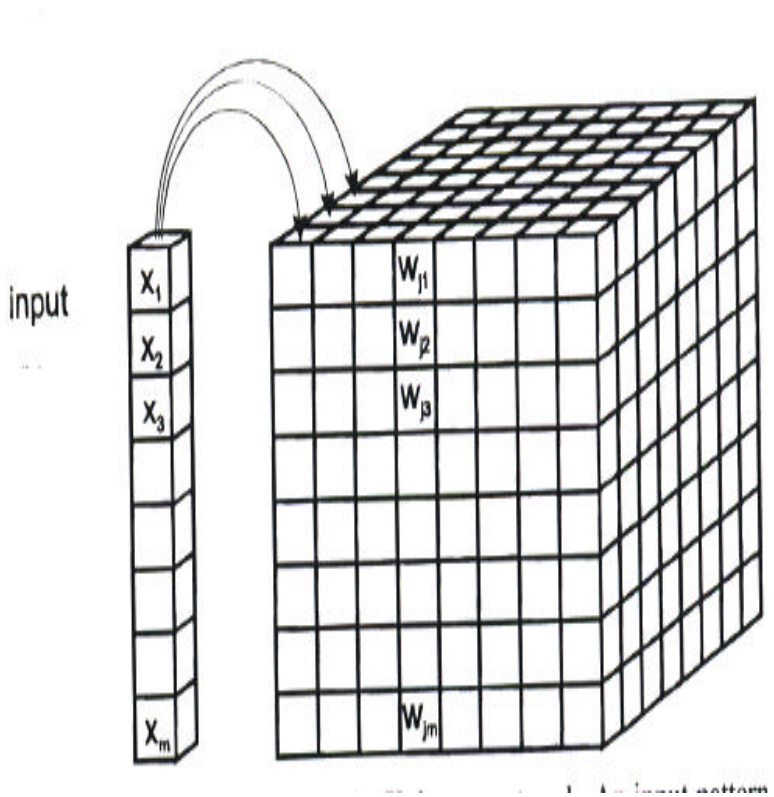
Kohonen Self Organizing Maps

- ***What are SOM's ?***
  - Competitive Learning ANN
  - Elastic net of points which is made to fit the input vector
- ***Mode of Functioning***
  - Each unit of the map recieves identical inputs
  - The units compete for selection
  - The selected neuron and surrounding neighbours get modified
  - Results in groups of units becoming

Kohonen Self Organizing Maps

- ***Utility***
  - Visualizing N dimensional data in 2D
  - Detecing similarity and degree's of similarity

Structure of the Map



- Square grid
- Each grid point is a vector containing the descriptor values
- The grid wraps round the edges
- The grid is initialized with random vectors

Training the Map

- Each descriptor vector in the training set is presented to all grid points.
- Select the closest matching grid point based on minimum Euclidean distance

$$d_{sj} = \sqrt{\sum_{i=1}^{m} (s_{si} - w_{ji})}$$

- Modify the selected grid point and its neighbours.
- Degree of modification reduces with each training iteration
- Once all the training vectors have been

Modification of Grid Points, aka Learning

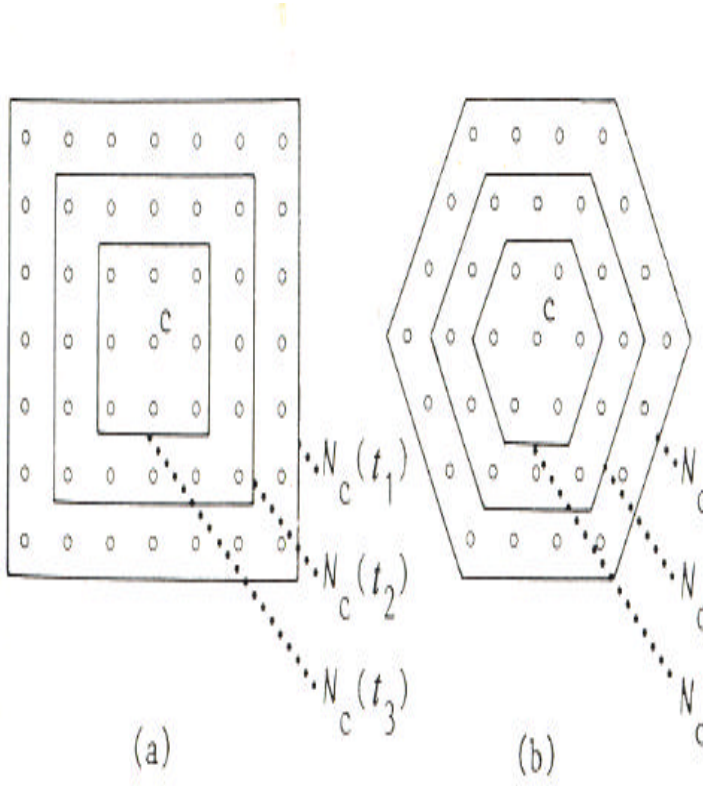
- Selected grid point and *topologically* close gridpoints are modified
- Leads to smoothing which leads to global ordering
- The general form of modification is

$$m_i(t+1) = m_i(t) + h_{ci}(t)[x(t) - m_i(t)]$$

- $h_{ci}(t)$ is termed as the neighborhood function
- As $t \to \infty, h_{ci}(t) \to 0$

The Neighborhood Function

The neighborhood function can be of various forms.



- Neighborhood Set
  - $h_{ci}(t) = \alpha(t)$ if $j \in N$

The Neighborhood Function

- Gaussian Neighborhood Function
  - $h_{ci}(t) = \alpha(t) \exp\left(-\frac{\|r_c - r_i\|^2}{2\sigma^2(t)}\right)$
  - σ is the width of the smoothening
  - Corresponds to the radius of the neighborhood set

The Learning Factor

$\alpha(t)$ is termed the learning factor. Some properties of the function are:

- $0 < \alpha < 1$
- Decreases monotonically with time
- When $\alpha = 0$, learning stops
- α can be varied in several ways
  - Constant decrement
  - Function of training iteration
  - Recursive - $\alpha_i(t+1) = \alpha_i(t)/(1 + h_{ci}\alpha_i(t))$

Classification

- Assign an arbitrary class to the first grid point
- For each grid point calculate distances to each nearest neighbor
- If the distance to a neighbor is less than a user specified threshold then the neighbor is in the same class as the grid point
- Finally, find the closest matching neuron in the training set for the initial grid point. Correspondingly modify class assignments of all the other grid points

More to Come

References

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[3] Kohonen, T. *Self Organizing Maps;* Springer Series in Information Sciences Springer: Espoo, Finland, 1994.