Processing and Comparing of Eye-tracking Data Using Machine Learning

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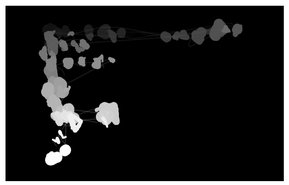
What do we get?

- An efficient abstraction of eye-tracking data using unsupervised learning
- Possibility to compare, cluster and categorize user sessions

How do we get it?

- By training Restricted Boltzmann Machine (RBM), with a visual representation of user session fragments in form of heat maps capturing:
  - *spatial information* (pixel coordinates)
  - *time information* (pixel intensity)



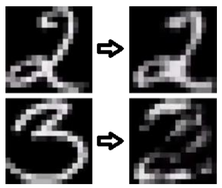
What is Restricted Boltzmann Machine?

- Neural network with following architecture:

- Generative model based on energy

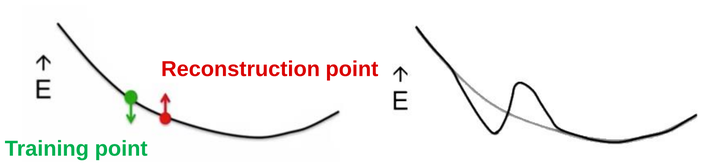
Why generative?

- Because it generates what it “believes” in



Why energy based?

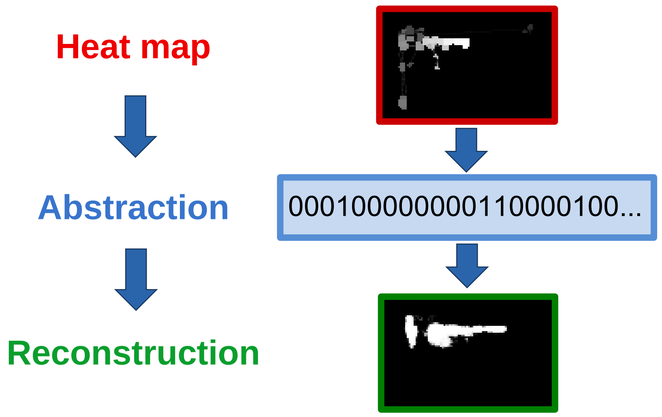
- Because every configuration of neuron activities has its energy based on current weights of neuron connections



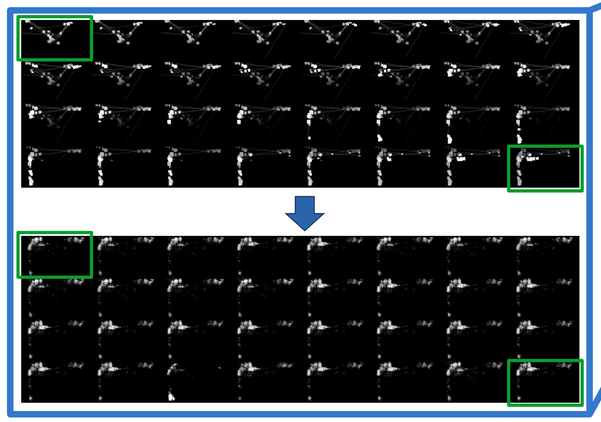
Main principle of RBM training: Decreasing energy for training point and increasing energy for current reconstruction of training point.

What do we do after training?

We create abstractions and reconstructions of every user session converted into sequence of our heat maps.



Why RBM and not something simpler? Isn’t it only clustering of similar images?

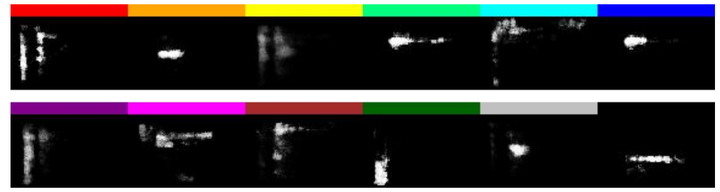


On this detailed image of samples and their reconstructions for specific pattern we clearly see that RBM is finding patterns in the context of all data we have.

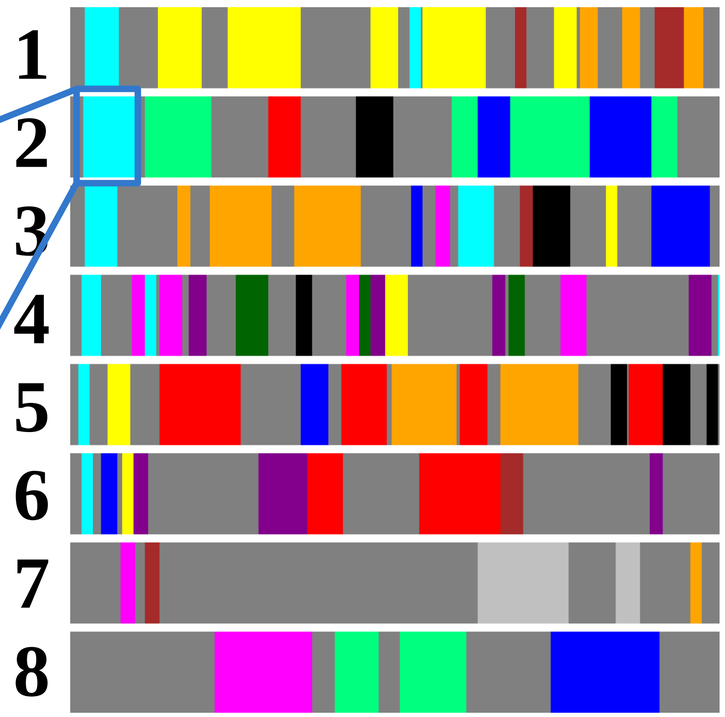
First and last sample are very different, yet they were evaluated to be part of the same pattern.

Results – The visualization

- We cluster user session abstractions (sparse binary vectors) based on their mutual Hamming distance in order to get patterns of activities.
- We assume that the most frequent patterns will be interesting enough to give us information about user behavior in the context of other sessions from different users.



Color legend of 12 most common abstract patterns in our experiment.



Visualization of 12 most common abstract patterns in our experiment with eight participants. Horizontal axis corresponds to time.