

Summary of *A tutorial on the free-energy framework for modelling perception and learning* by Rafal Bogacz

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Introduction

- Predictive coding model of Rao and Ballard.
- Free-energy model of Friston.

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1. Prior predictions are compared to stimuli and the model parameters are updated considering prediction errors, features corresponding to receptive fields in the the primary sensory cortex are learned.
2. Weight stimuli by their noise, learn features using their covariance, implement attentional modulation changing the variance of attended features.

- Predictive coding model of Rao and Ballard.
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- Hebbian learning.

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1. Prior predictions are compared to stimuli and the model parameters are updated considering prediction errors, features corresponding to receptive fields in the the primary sensory cortex are learned.
2. Weight stimuli by their noise, learn features using their covariance, implement attentional modulation changing the variance of attended features.
3. Synaptic strenght is changed proportionally to activities of pre-synaptic and post-synaptic neurons.

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Introduction

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- Predictive coding model of Rao and Ballard.
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- Hebbian learning.
- Free energy minimization.

1. Prior predictions are compared to stimuli and the model parameters are updated considering prediction errors, features corresponding to receptive fields in the the primary sensory cortex are learned.
2. Weight stimuli by their noise, learn features using their covariance, implement attentional modulation changing the variance of attended features.
3. Synaptic strenght is changed proportionally to activities of pre-synaptic and post-synaptic neurons.
4. Minimization of free energy can be seen as the base of many theories of perception.

- Predictive coding model of Rao and Ballard.
- Free-energy model of Friston.
- Hebbian learning.
- Free energy minimization.

Working hypotheses

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- Working hypotheses

1. The state of a neuron is determined only by the synaptic weight and the state of its input neurons.

- Local computation.

Working hypotheses

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- Working hypotheses

- Local computation.
- Local plasticity.

1. The state of a neuron is determined only by the synaptic weight and the state of its input neurons.
2. Synaptic plasticity depends only on the activities of pre-synaptic and post-synaptic neurons.

- Local computation.
- Local plasticity.

Working hypotheses

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└ Introduction

- Working hypotheses

- Local computation.
- Local plasticity.
- Basic neuronal computation.

1. The state of a neuron is determined only by the synaptic weight and the state of its input neurons.
2. Synaptic plasticity depends only on the activities of pre-synaptic and post-synaptic neurons.
3. The state of a neuron is the result of the application of a monotonic function to the linear combination of states and synaptic weights of input neurons.

- Local computation.
- Local plasticity.
- Basic neuronal computation.

Single variable model

- Feature is a scalar variable $v \in \Omega_v$.
- Stimulus is a scalar variable $u \in \Omega_u$.

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- Single variable model

- └ Single variable model

1. The model describes the inference of a single variable from a single sensory input.

- Feature is a scalar variable $v \in \Omega_v$.
- Stimulus is a scalar variable $u \in \Omega_u$.

Exact solution of the inference problem

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- Single variable model

- Exact solution of the inference problem

Approximated solution of the inference problem



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└ Single variable model

└ Approximated solution of the inference problem



Neural implementation

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└ Single variable model

└ Neural implementation

Learning model parameters

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- Single variable model

- Learning model parameters

Learning relation between variable and stimulus



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└ Single variable model

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Free energy framework

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 - └ Single variable model
 - └ Free energy framework

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- └ Multiple variables model
 - └ Multiple variables model

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- Multiple variables model

- Multiple variables model

Learning parameters

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- └ Multiple variables model
 - └ Learning parameters

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 - Multiple variables model
 - Learning parameters

- Learning parameters

Hierarchical structure implementation

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- Multiple variables model

└ Hierarchical structure implementation

Recover local plasticity

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- Multiple variables model

- Recover local plasticity

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Conclusion

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