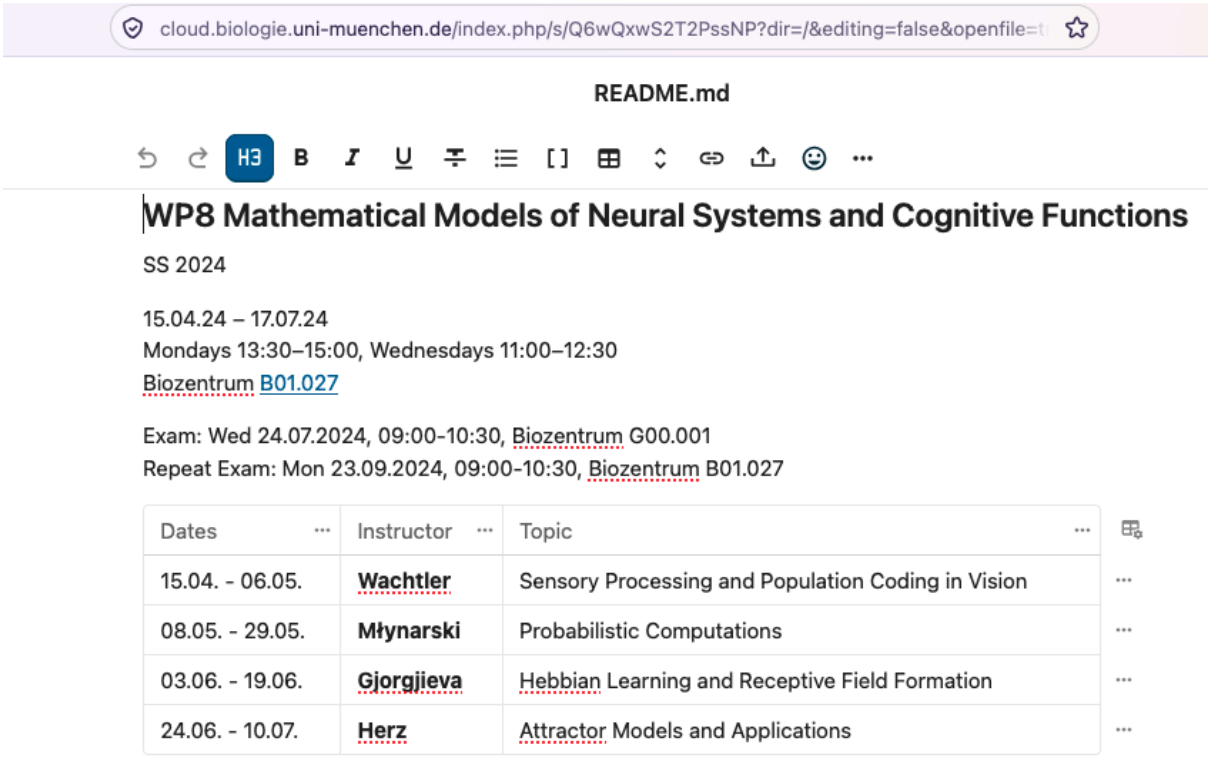
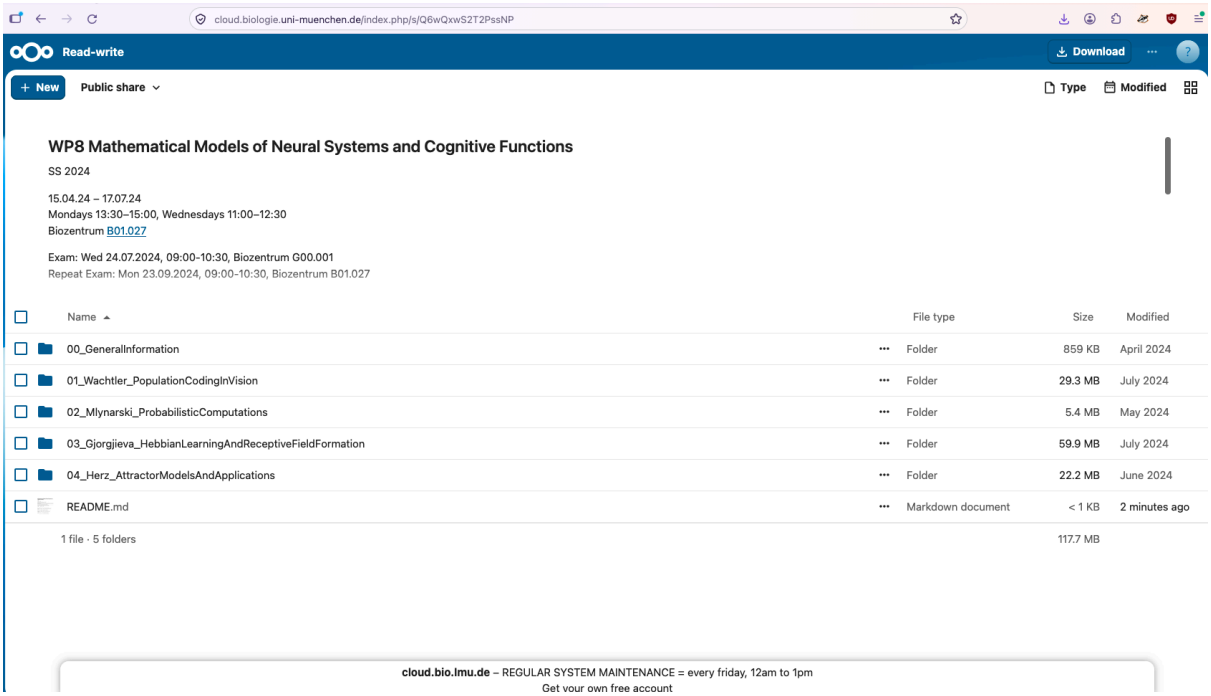
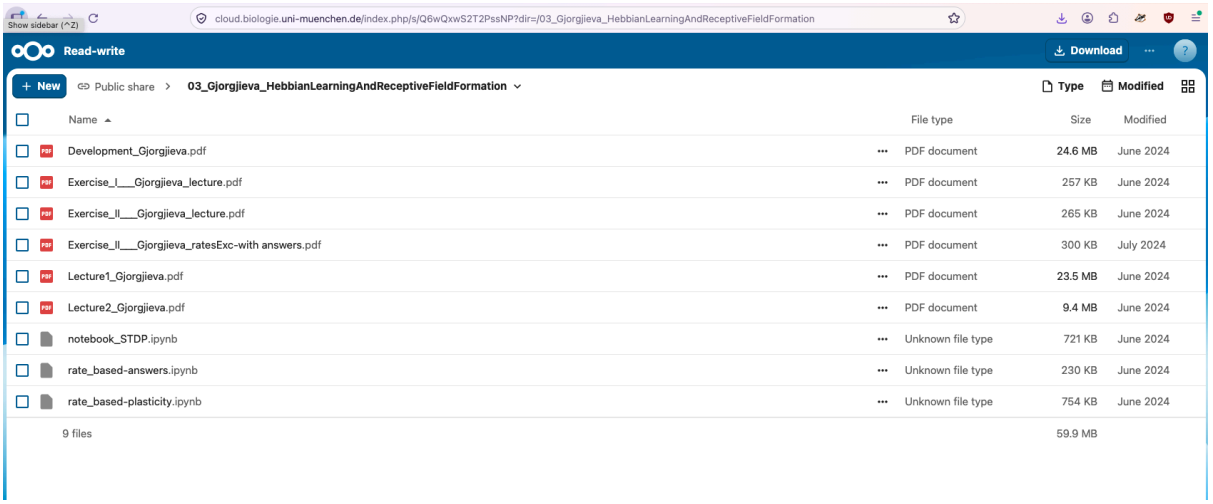
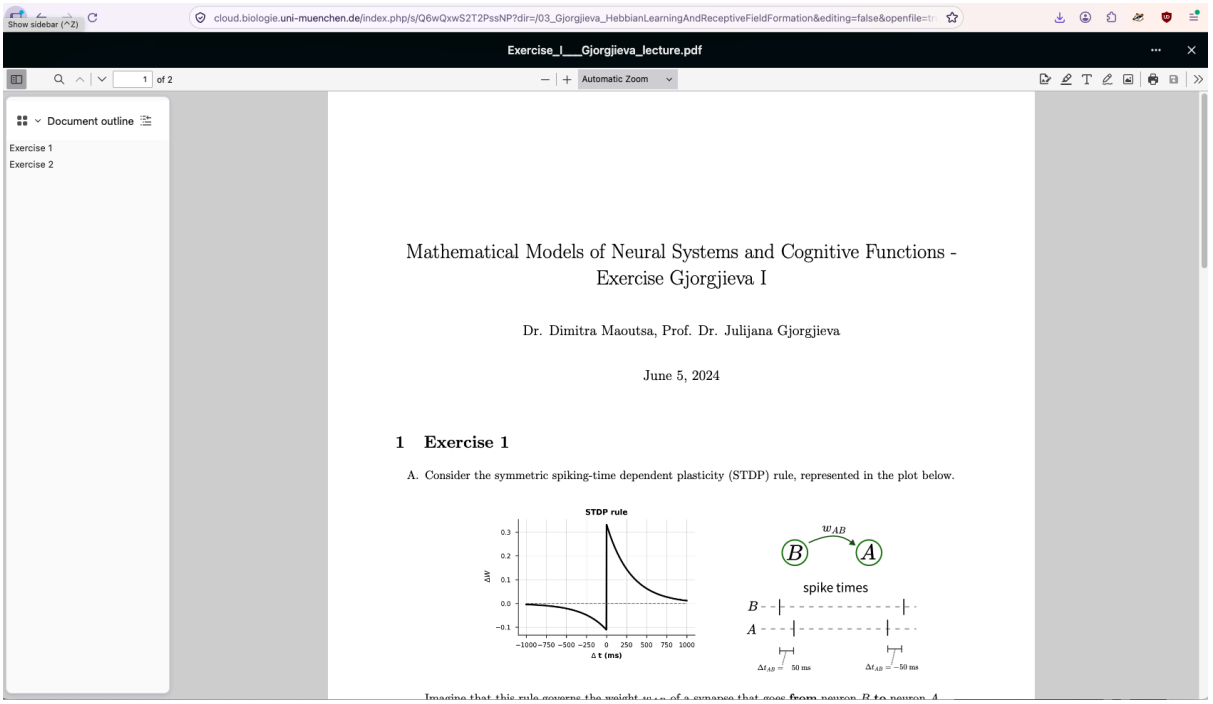

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15.04.24 – 17.07.24
Mondays 13:30–15:00, Wednesdays 11:00–12:30
Biozentrum B01.027
Exam: Wed 24.07.2024, 09:00-10:30, Biozentrum G00.001
Repeat Exam: Mon 23.09.2024, 09:00-10:30, Biozentrum B01.027
Dates
Instructor
Topic
15.04. - 06.05.
Wachtler
Sensory Processing and Population Coding in Vision
08.05. - 29.05.
Młynarski
Probabilistic Computations
03.06. - 19.06.
Gjorgjieva
Hebbian Learning and Receptive Field Formation
24.06. - 10.07.
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Document outline
Exercise 1
Exercise 2
Mathematical Models of Neural Systems and Cognitive Functions - Exercise Gjorgjieva I
Dr. Dimitra Maoutsa, Prof. Dr. Julijana Gjorgjieva
June 5, 2024
1 Exercise 1
A. Consider the symmetric spiking-time dependent plasticity (STDP) rule, represented in the plot below.
STDP rule
spike times

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Document outline

Exercise 1

Mathematical Models of Neural Systems and Cognitive Functions - Exercise Gjorgjieva II

Dr. Dimitra Maoutsa, Prof. Dr. Julijana Gjorgjieva

June 12, 2024

1 Exercise 1

Consider two presynaptic neurons connected to a single postsynaptic neuron (panel **A**). Their rates are r_1, r_2 and r_{post}. Neurons 1 and 2 project excitatory connections to the postsynaptic neuron, which also receives an external current h.

- Assuming linear interactions and stable rates, express the steady-state r_{post} (no need to write a differential equation, just the expression for the rate) as a function of the presynaptic rates, the synaptic weights, and the input current.

Now consider a Hebbian rate-based plasticity rule, where the synaptic change is proportional to the product of the pre- and post-synaptic rates $\Delta w = \alpha\, r_{\text{pre}}\, r_{\text{post}}$. Assume that α is very small, so that the changes in synaptic weights have negligible influences on the neuronal dynamics for the duration of the experiment.

- Assuming both synaptic weights are plastic, write the equation for the change in the weights Δw_1 and for

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Exercise_II___Gjorgjieva_ratesExc-with answers.pdf

1 of 4 — Automatic Zoom

Document outline

Exercise 1

Mathematical Models of Neural Systems and Cognitive Functions - Exercise Gjorgjieva II

Dr. Dimitra Maoutsa, Prof. Dr. Julijana Gjorgjieva

June 12, 2024

1 Exercise 1

Consider two presynaptic neurons connected to a single postsynaptic neuron (panel **A**). Their rates are r_1, r_2 and r_{post}. Neurons 1 and 2 project excitatory connections to the postsynaptic neuron, which also receives an external current h.

- Assuming linear interactions and stable rates, express the steady-state r_{post} (no need to write a differential equation, just the expression for the rate) as a function of the presynaptic rates, the synaptic weights, and the input current.

Answer. $r_{post} = \sum_{i=1}^{2} w_i\, r_i + h^{\text{input}}$, where w_i denotes the weight from neuron i to the post-synaptic neuron, and h^{input} the input current.

Now consider a Hebbian rate-based plasticity rule, where the synaptic change is proportional to the product of