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Evolving to learn: discovering interpretable plasticity rules for spiking networks

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Continuous adaptation allows survival in an ever-changing world. Adjustments in the synaptic coupling strength between neurons are essential for this capability, setting us apart from simpler, hard-wired organisms. How these adjustments come about is essential both for understanding biological information processing and for developing cognitively performant artificial systems.

We suggest an automated approach for discovering biophysically plausible plasticity rules based on the definition of task families, associated performance measures and biophysical constraints. This approach makes the relative weighting of guiding factors explicit, explores large search spaces, encourages diverse sets of hypotheses, and can discover domain-specific solutions. By evolving compact symbolic expressions we ensure the discovered plasticity rules are amenable to intuitive understanding. This is fundamental for successful communication and human-guided generalization, for example to different network architectures or task domains. We demonstrate the flexibility of our approach by discovering efficient plasticity rules in typical learning scenarios.

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