# LEAP: Lernende Erforschen Adaptive Phänomene

## Terminology

The ***Leap*** project uses agent-based modelling (ABM) to investigate the influence of four processes on *rheolectic search* (*RS*): *mutation*, *recombination*, *development* and *construction*.

We use the term ***rheolectic*** to refer to systems are adaptive in the following sense: (i) They possess both structure and dynamical flow; (ii) their structure determines their dynamical flow; (iii) flow determines the system's stability against stochastic structural perturbations.

***RS*** is a *rheolectic* process that achieves "success" by attaining metastable states that fulfil some success criterion such as minimising an objective function. Examples are genetic algorithms (GA), back-propagation learning and the dynamical stabilisation of an ecosystem.

***Mutation*** is stochastic perturbation of structures (e.g. genetic mutation, synaptic decay).

***Recombination*** merges two structures into one (e.g. genetic recombination, endosymbiosis).

***Development*** is the set of flows generated by a particular structure (e.g. ontogeny, feeding).

***Construction*** is the inertia of dynamical flows against change over time (e.g. a persisting house, dam, anthill, cellular or multicellular body, or tribe).

## Leap research group (LRG)

LRG will optimise the *mepi* (*maximally epistatic*) function, which Watson (2007) specifically designed to be as difficult as possible to optimise using native GAs. LRG will use *mepi* as a benchmark for comparing a sequence of RS models of increasing developmentality:

1. ***Native GA***: Uses only mutation and genetic recombination as a control model.
2. ***Developmental GA***: Uses mutation and recombination to constrain developmental search. This model seeks to verify Hinton and Nowlan's (1987) suggestion that developmental GAs are more successful with deceptive functions like *mepi*.
3. ***Developmental SEAM*** (Symbiogenic Evolutionary Adaptation Model): Recombination across developing individuals that encode their own role in participatory solutions.
4. ***RS***: Developmental SEAM across spatially situated agent neighbourhoods.

## Leap development group (LDG)

LDG will develop the infrastructure for the research. It will construct course materials based on past ABM courses to enable *fourth-semester novices* to understand and reproduce the work of LRG. This course will constitute a pedagogically sound introduction to ABM in Julia, incorporating themes of emergence, chaotic motion, complexity, adaptation and rheolecsis.

## Performative quality assessment

LDG and LRG are responsible for continually assessing the content and quality of each other's work, ensuring that all LRG and LDG code and course materials are pedagogically transparent, that LRG products motivate all LDG materials, and LDG materials explain all LRG products.

## References

Hinton, G.E. & Nowlan, S.J. (1987). How learning can guide evolution. *Complex Systems, 1*, 495–502.

Watson, R.A. (2007). *Compositional evolution*. MIT Press.