When and Why Development Is Needed

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Contribution

- Maximization of the overhang of balanced blocks stacks
- Studying the effect of the representation choice
- Ontogenic representation is the most appropriate

Experimental setup

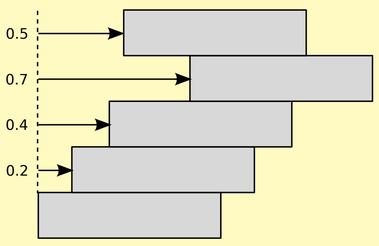
For each representation

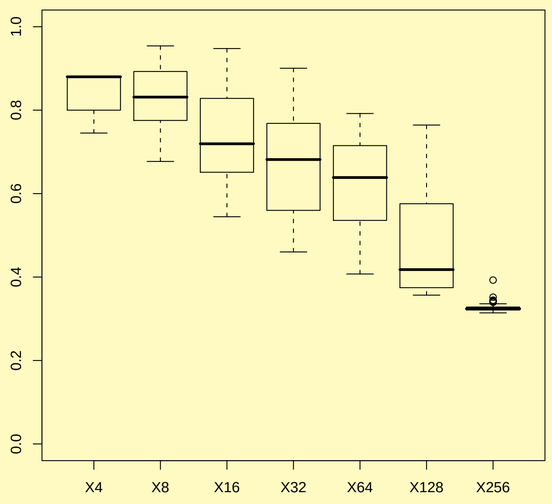
- Purely parametric optimization, CMA-ES, with all its default settings
- 100 CMA-ES, for stacks 4, 8, 16, 32, 64, 128, 256 blocks
- 0 is the worst possible overhang, 1 is the best possible.
- A non balanced stack got the worst possible fitness

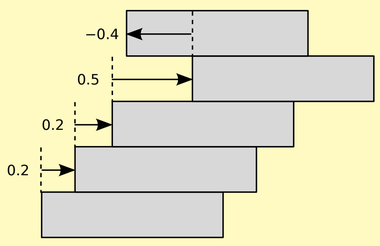
We are looking the statistical repartition of the fitness, as a function of the number of blocks

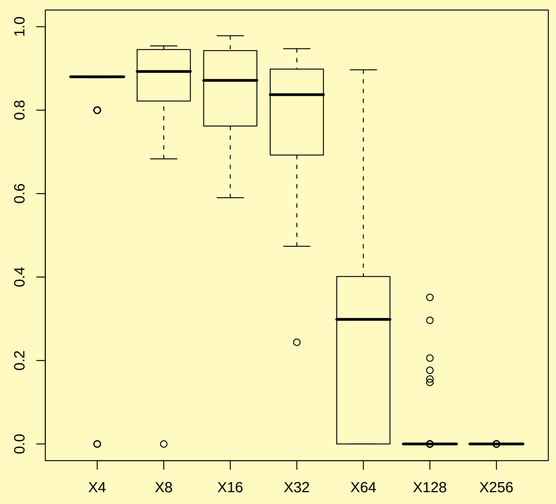
Direct representations (N blocks = $N-1$ parameters)

Encode the positions of each block separately, either relatively to the bottom block (left), or relatively to the block bellow (right).



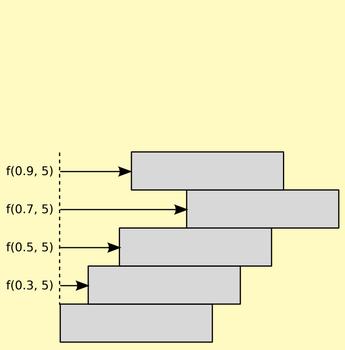


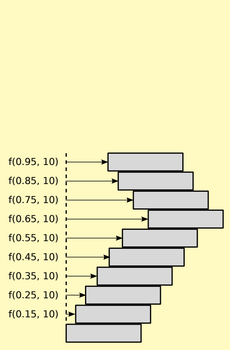


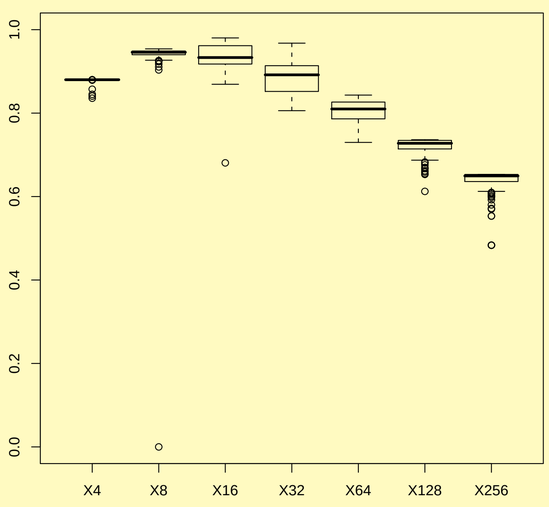


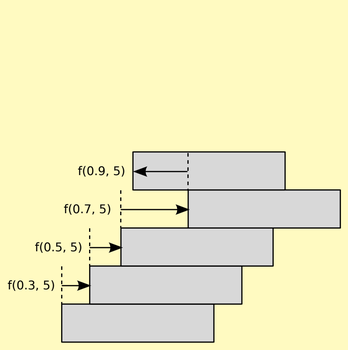
Generative representations (N blocks = 32 parameters)

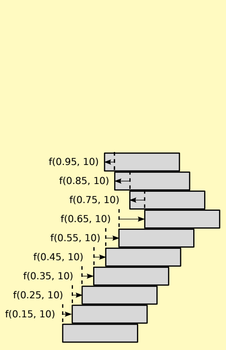
Encode the positions of each block as a function F of it height. F is a 3 layers Perceptron, with 8 hidden units. F inputs are the normalized height in $[0,1]$ and the number of blocks. F outputs position either relatively to the bottom block (left), or relatively to the block bellow (right).

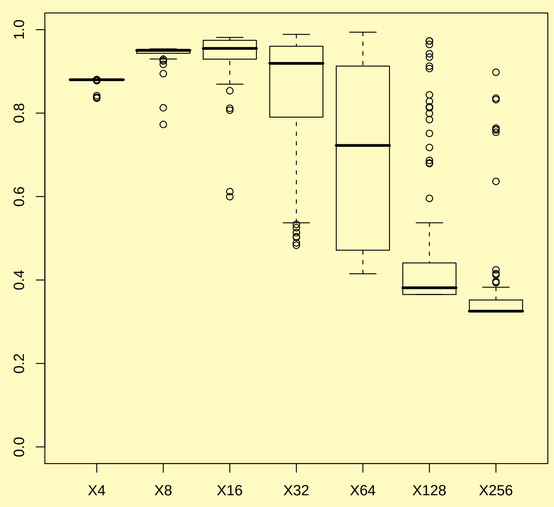






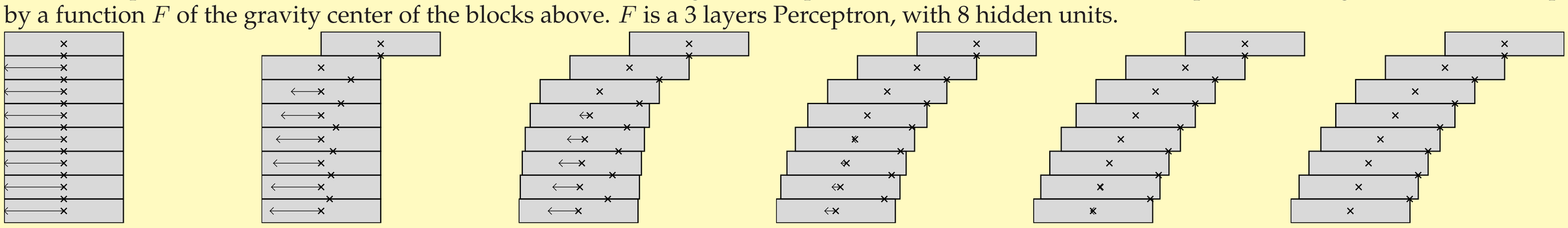


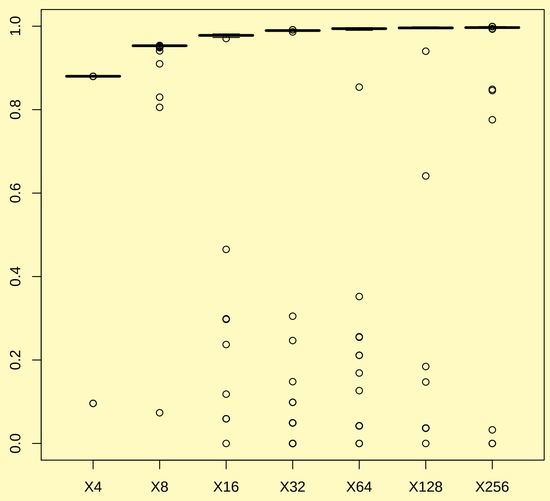




Ontogenic representation (N blocks = 24 parameters)

Encode the positions of each block as the result of iterative changes on the positions of the blocks. The iterated position change of a block is computed by a function F of the gravity center of the blocks above. F is a 3 layers Perceptron, with 8 hidden units.





Increasing numbers of blocks drive does no result in lower fitness. One reason is that the genotype size is independent from the size of the phenotype. Moreover, random perturbations acts on the building process, not on the blocks stack itself. Thus, similar genotypes feature similar phenotypes with similar physical behavior. This representation is a *scalable* representation for blocks stacks.