CERN openlab

Evolutionary Optimization of LHCb software compilation

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LHCb

Large Hadron Collider beauty

- LHCb data acquisition system processes currently 1 MHz of data in software
- This will be increased to 30 MHz - hardware level trigger will be removed

Figure 0: LHCb logo

Motivation

- After increase: software performance becomes paramount towards real-time reconstruction
- The whole reconstruction software needs a speed up
- **How to improve a large code in ONE summer?**

Solution

How to get there?

- Compiler's optimization flags
- Evolutionary algorithms!

Evolutionary algorithms: an overview

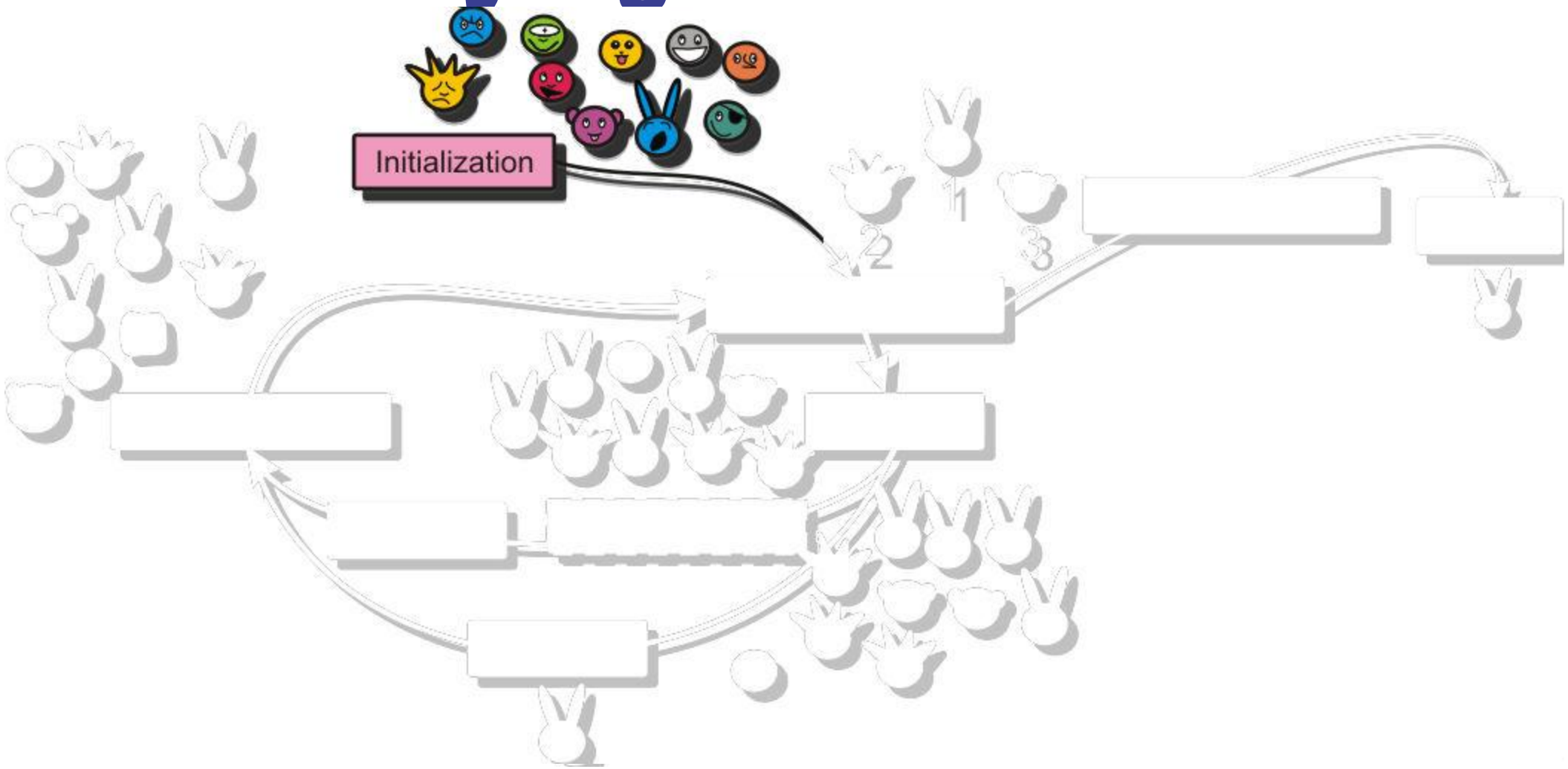
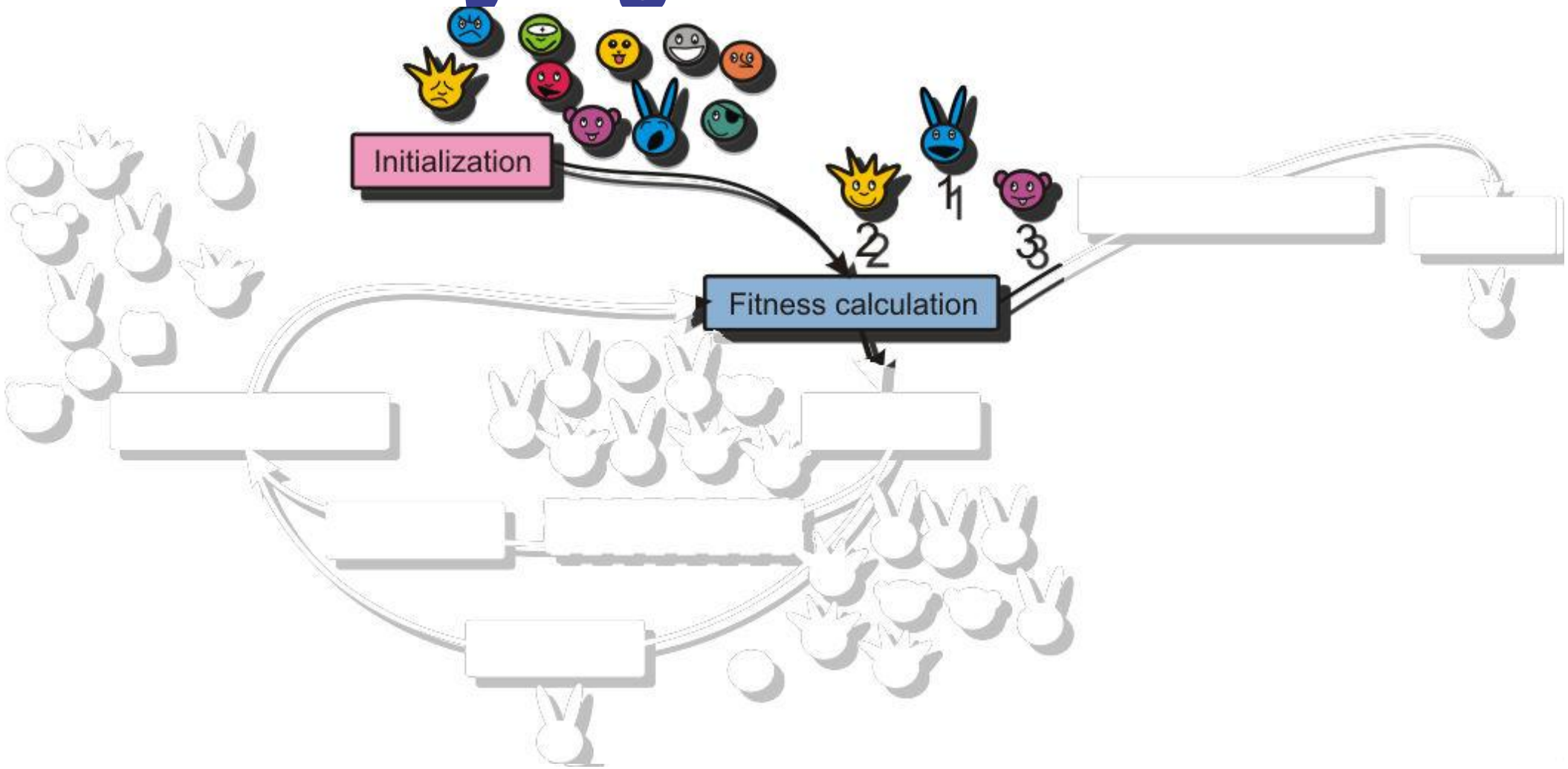


Figure 1 - How works evolutionary algorithm

Evolutionary algorithms: an overview



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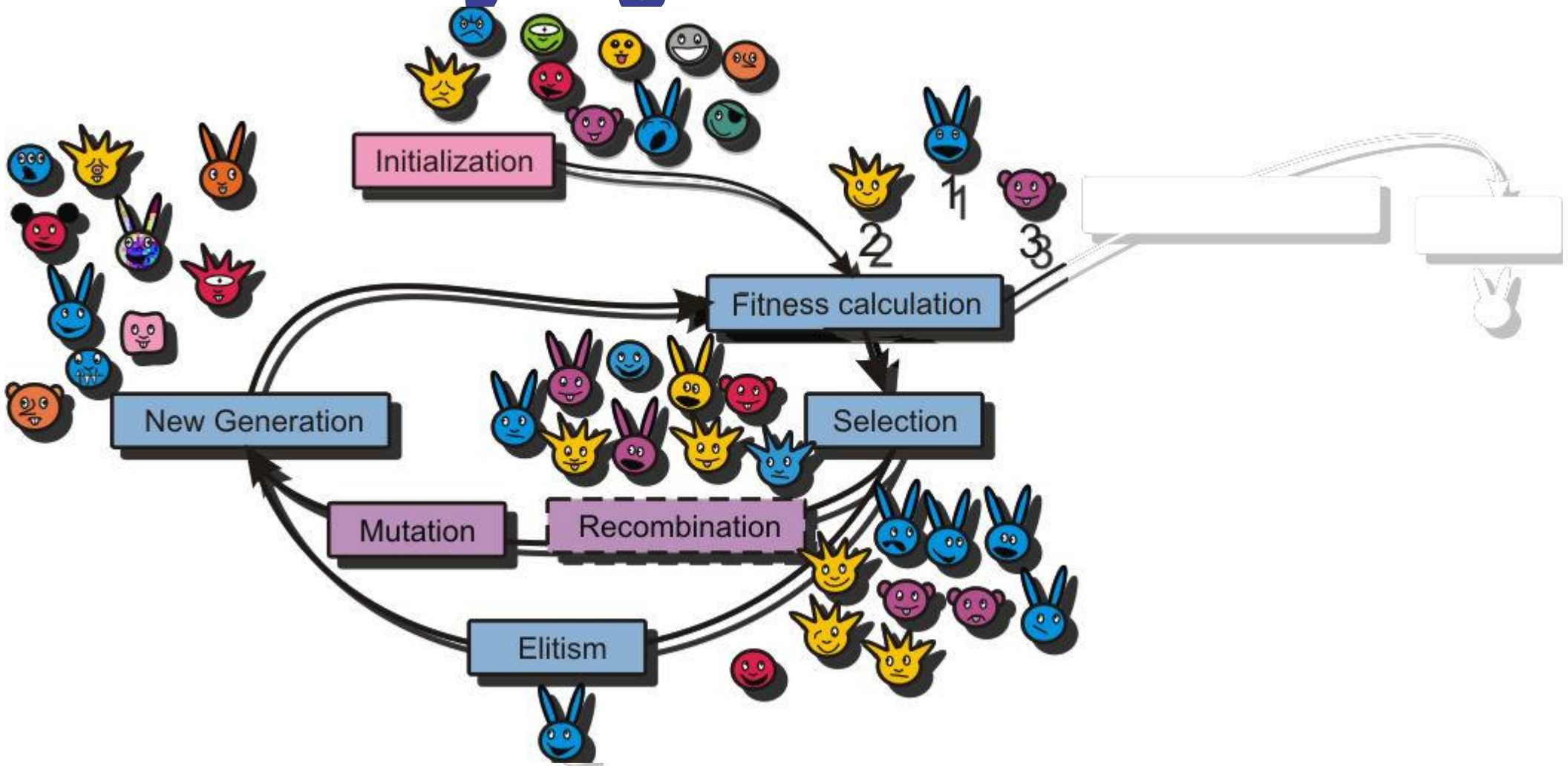

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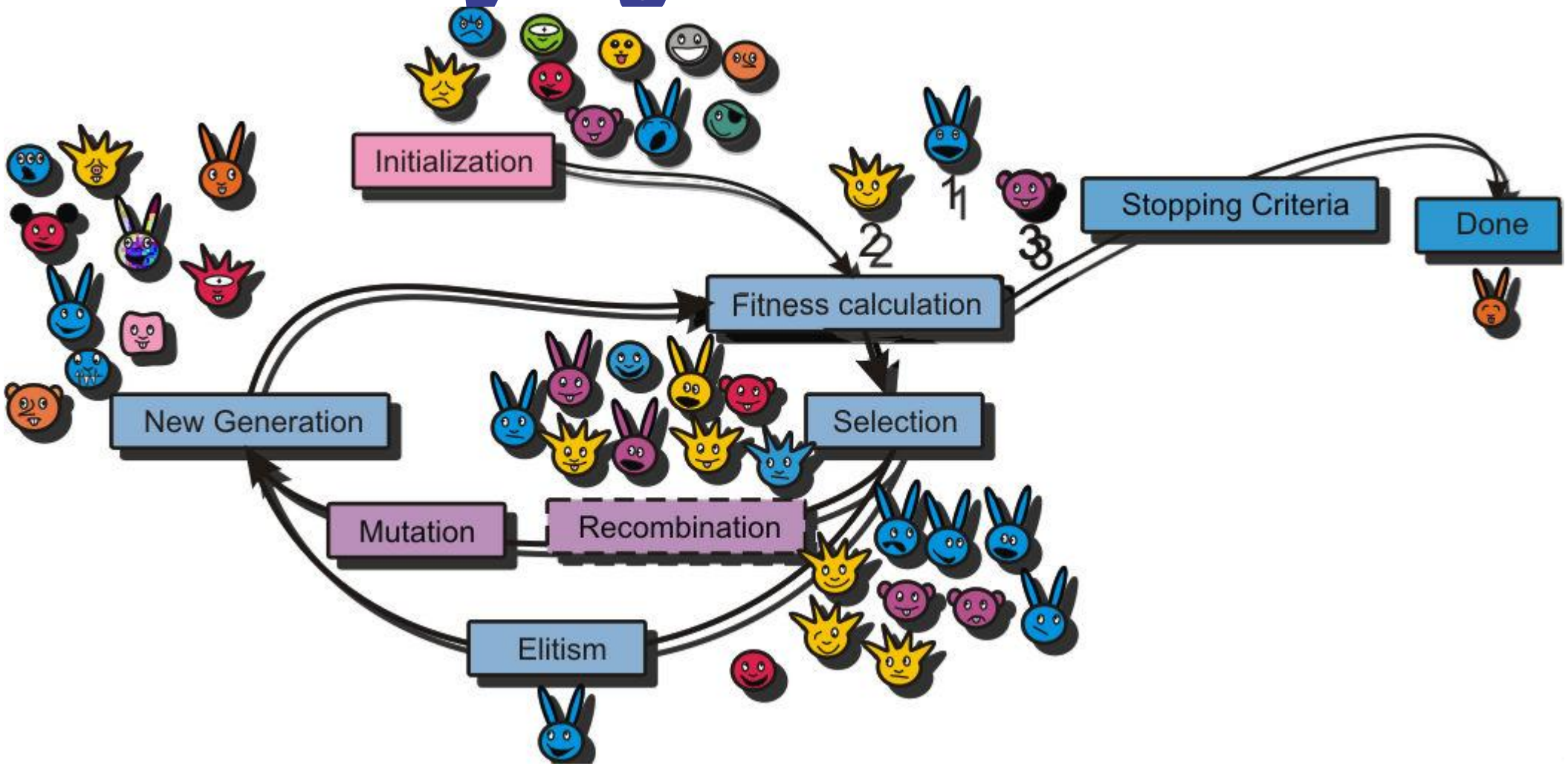


Figure 1 - How works evolutionary algorithm

Implementation: frameworks

DISTRIBUTED EVOLUTIONARY ALGORITHMS IN PYTHON

Results

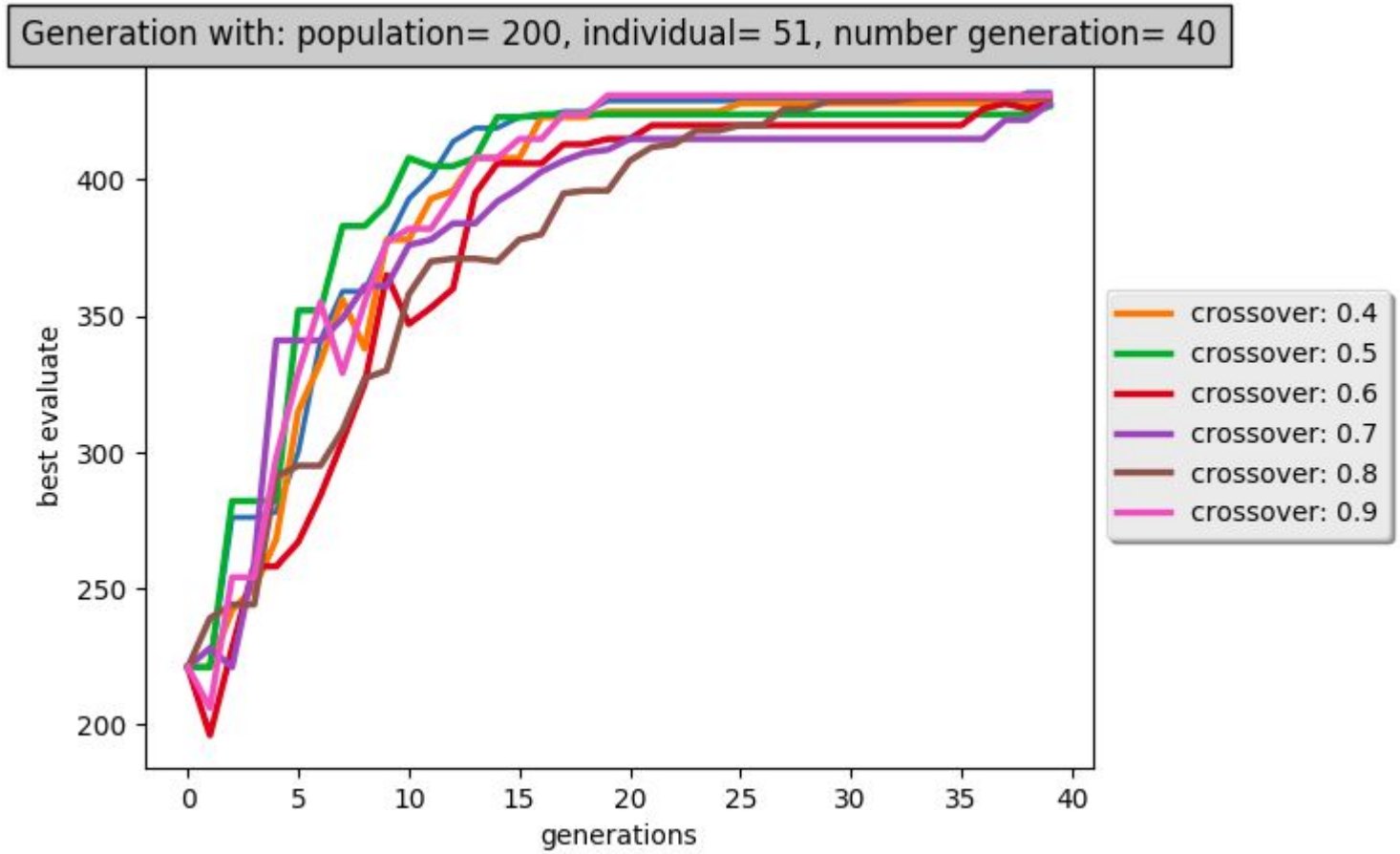
What we get until now

- Set of compilation flags defined
- Implemented a small framework and generic tests working well
- Implemented evaluation function that compiles and runs the code to the optimized

What we get until now

Results of
optimizing generic test function

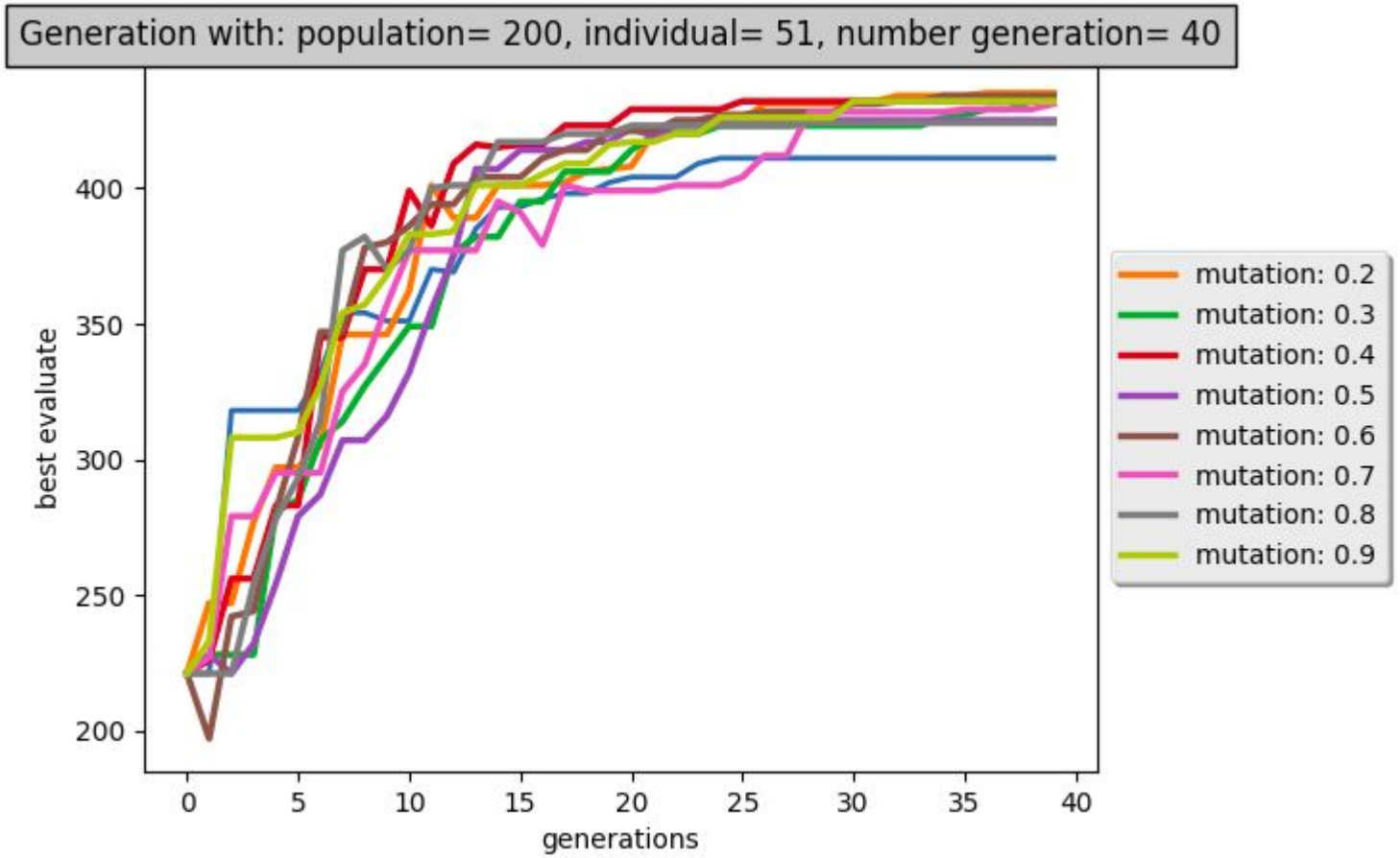
Testing crossover rate



What we get until now

Results of
optimizing generic test function

Testing mutation rate



Conclusions & Future work

- We are in the right way!
  - Tests using generic data working well
  - Good basis
- Testing the actual evaluating function in progress
- Adjust the parameters for the LHCb code
  - Crossover rate
  - Mutation rate
  - etc.

Thank you

Questions?

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References

(1) LHCb logo: http://cds.cern.ch/record/1260132
(2) Evolutionary algorithms overview: http://physiol.gu.se/maberg/figures/EAalgorithmPedagogical.png
(3) DEAP logo: http://deap.readthedocs.io/en/master/_images/deap_long.png
(4) Python logo: https://www.python.org/static/opengraph-icon-200x200.png
(5) Background: https://cds.cern.ch/record/1463546