



# AlphaSim

software for  
simulating plant and  
animal breeding  
programs

[www.alphagenes.roslin.ed.ac.uk](http://www.alphagenes.roslin.ed.ac.uk)

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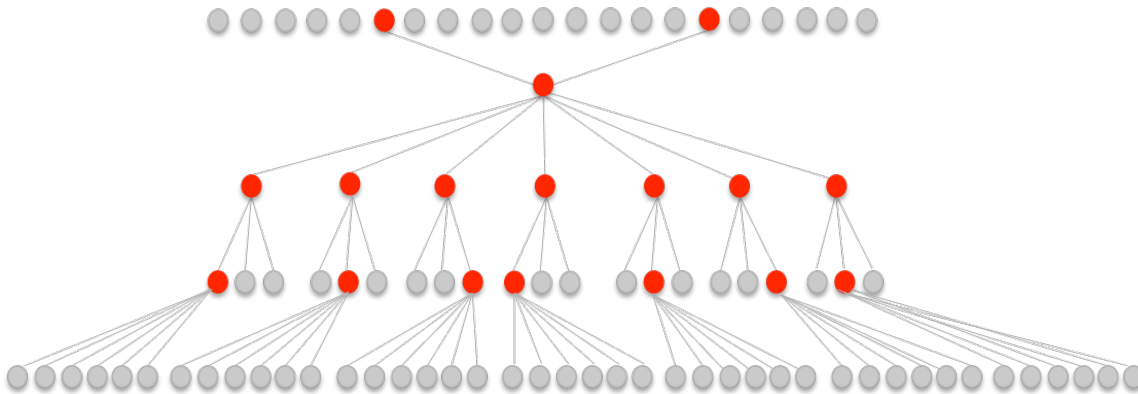
## (1) Simulate haplotype sequences\* and initial pedigree

1	1	0	0	1	0	0	1	0	1	0	0	0	0	0	1	0	1	1	0
0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1
0	0	0	0	0	0	0	1	0	1	1	1	0	0	1	0	0	1	0	1
0	1	1	0	0	1	0	0	1	1	0	1	1	0	0	1	0	0	1	1
0	0	1	1	1	0	0	1	0	1	0	0	1	1	1	0	0	1	0	1

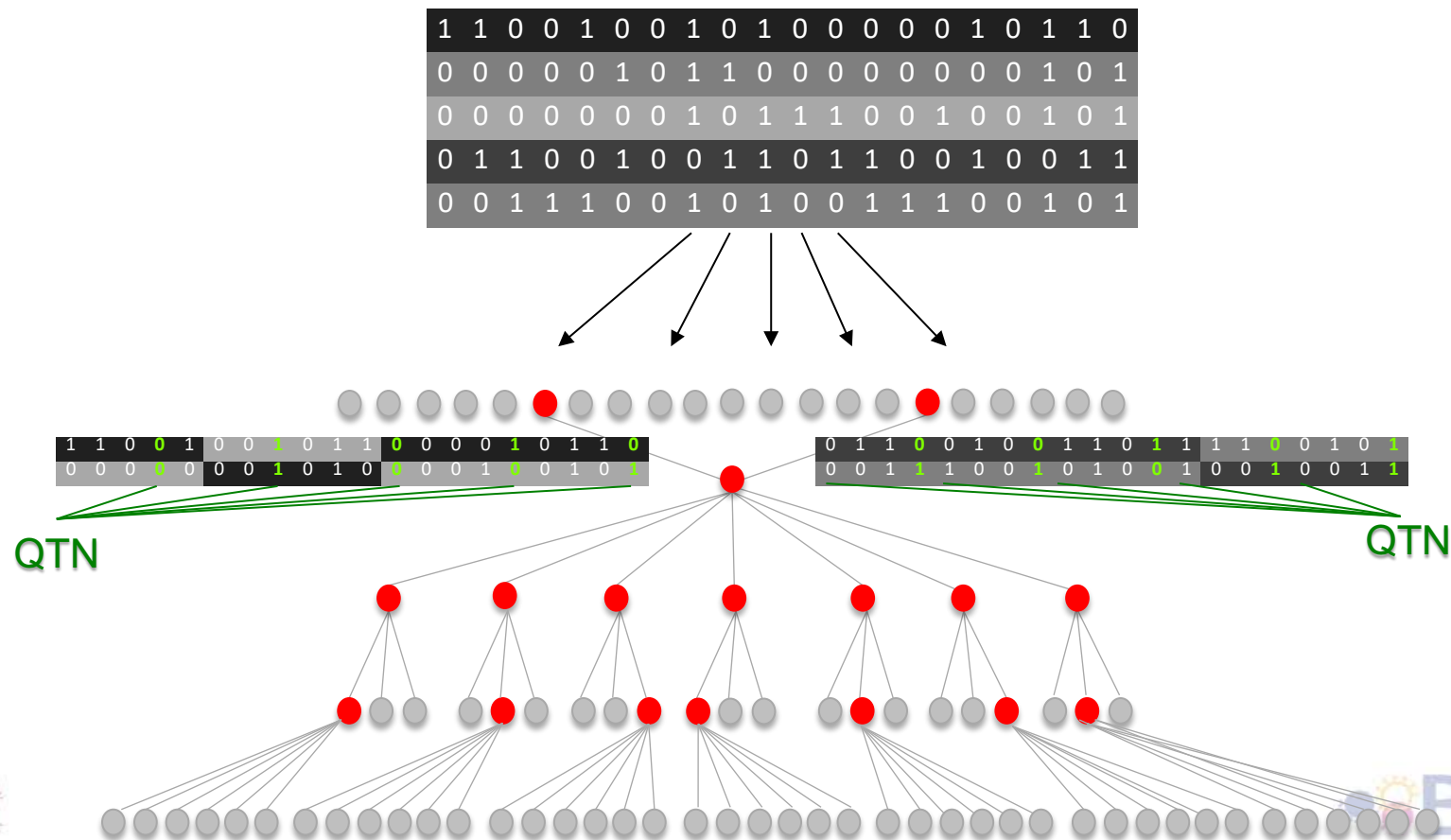
Model **haplotype structure** given a specific population history

Haplotypes can be:

- Externally supplied by user
- Internally simulated
  - Wheat
  - Maize
  - Cattle
  - Poultry
  - Swine
  - Rabbit



## (2) Sample haplotypes for base generation Select marker and casual loci



## (3) Simulate allele substitution effects for causal loci

Additive effects

$$a_k = \text{RandDev} \sqrt{\frac{\sigma_a^2}{n_{QTN}}} +$$

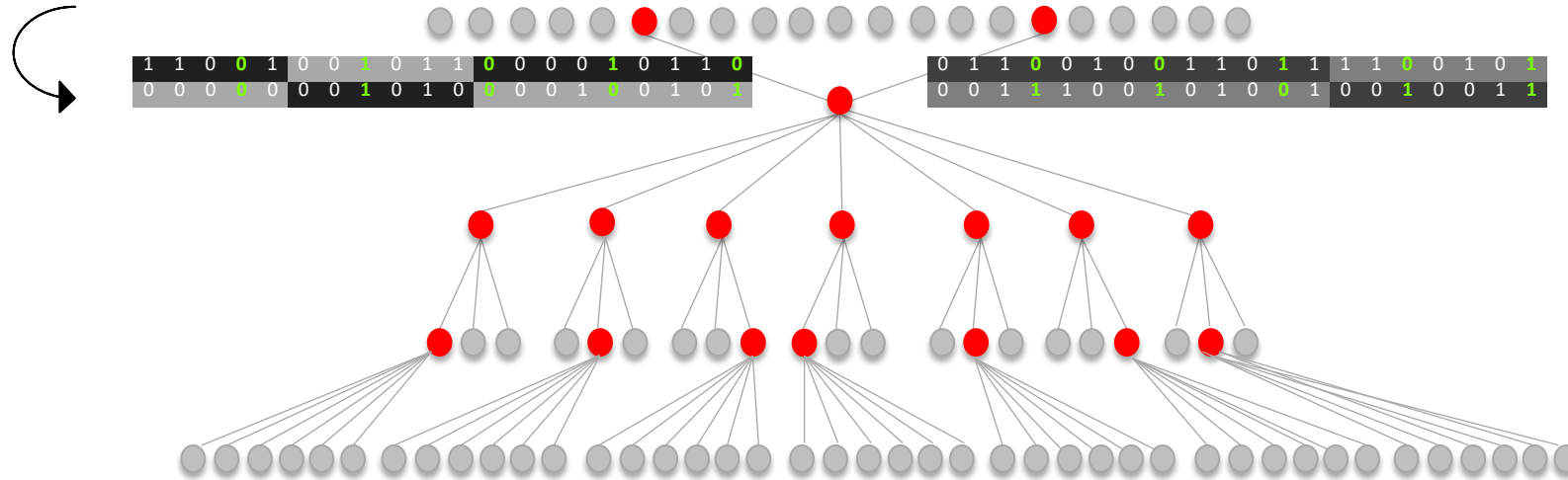
Dominance effects

$$\delta_k = m_\delta + \text{RandDev} \sqrt{\sigma_\delta^2}$$
$$d_k = \delta_k |a_k|$$

Allele substitution effects

$$\alpha_k = a_k + d_k (q_{0k} - p_{0k})$$

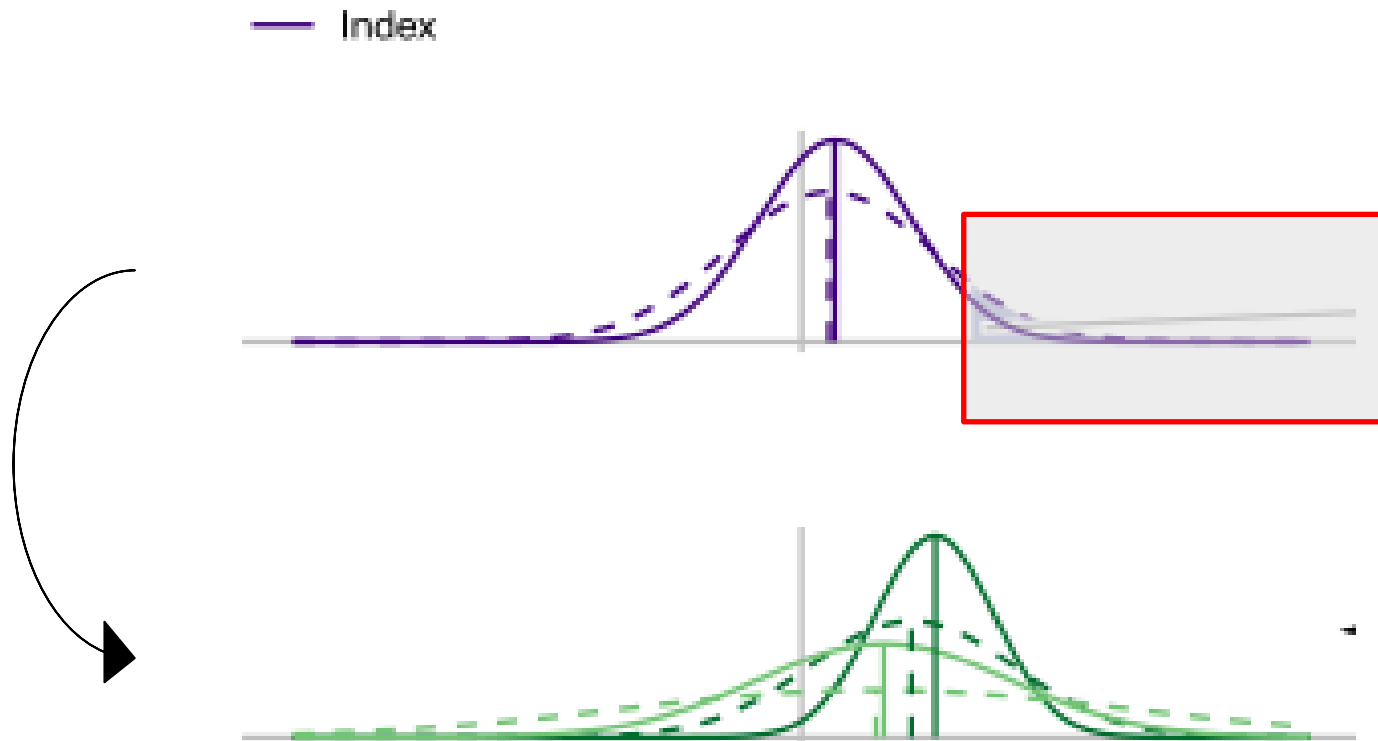
## (4) Drop base haplotypes to the first generation



## (5) Generate breeding values and phenotypes

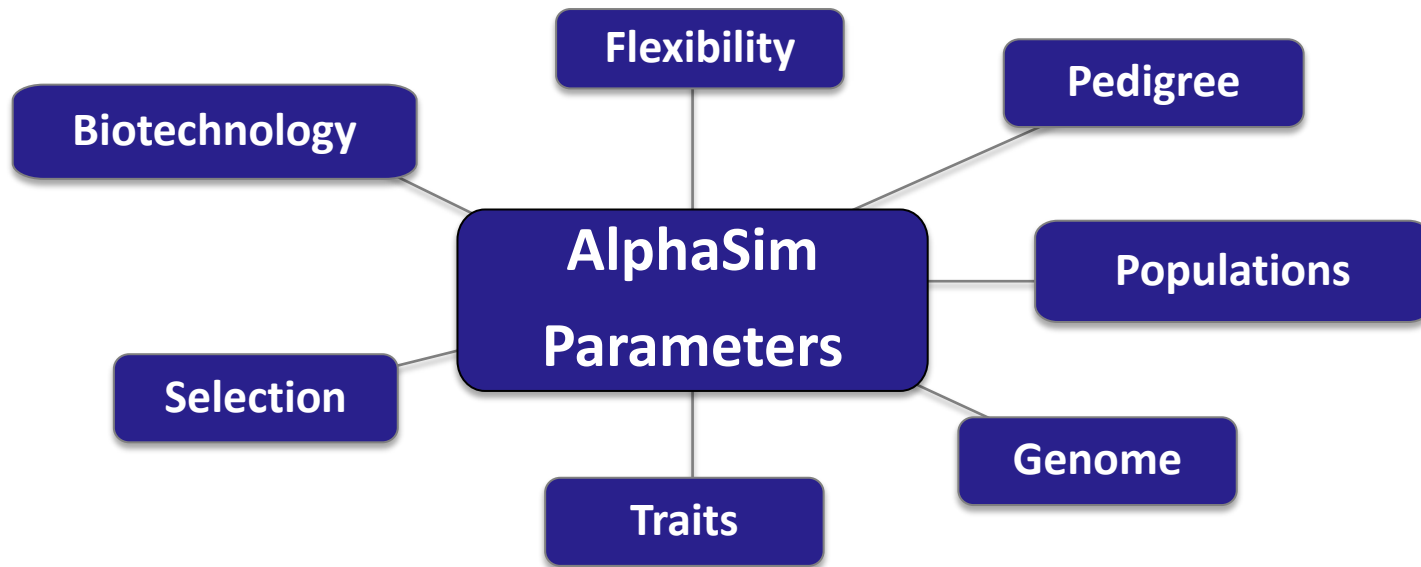


**(6) Select parents of next generation, generate gametes and drop haplotypes to next generation**

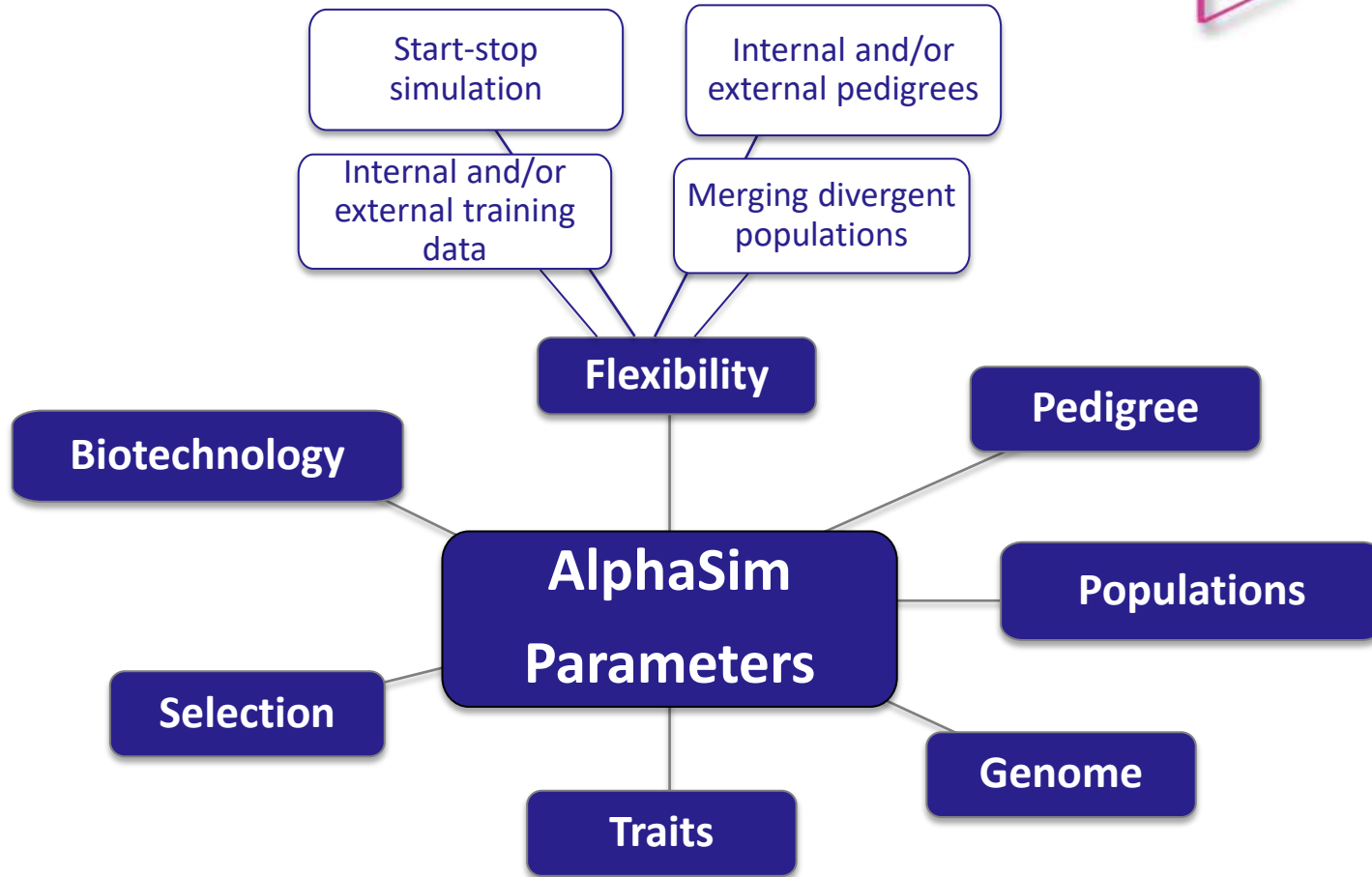


**(7) Repeat!**

# AlphaSim: Parameters

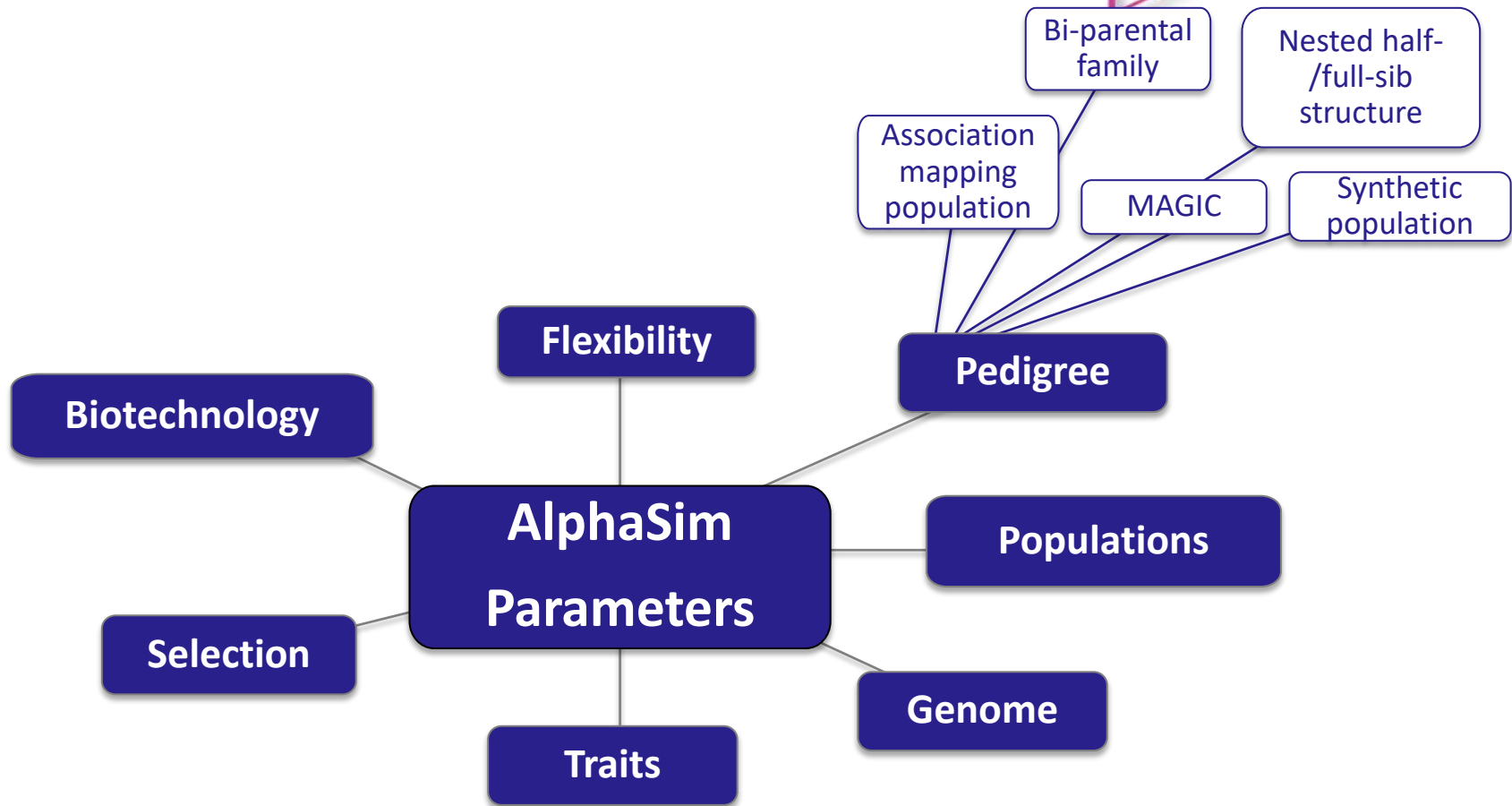


# AlphaSim: Parameters

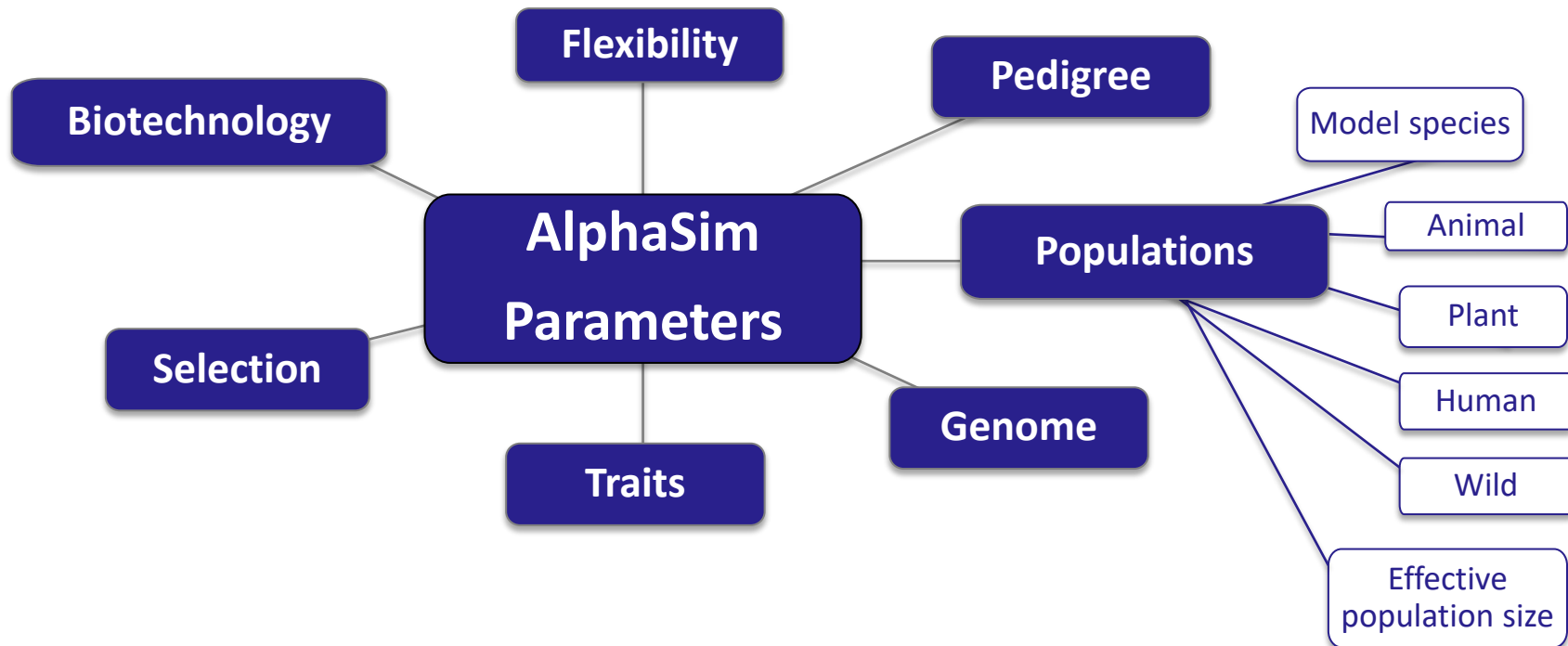




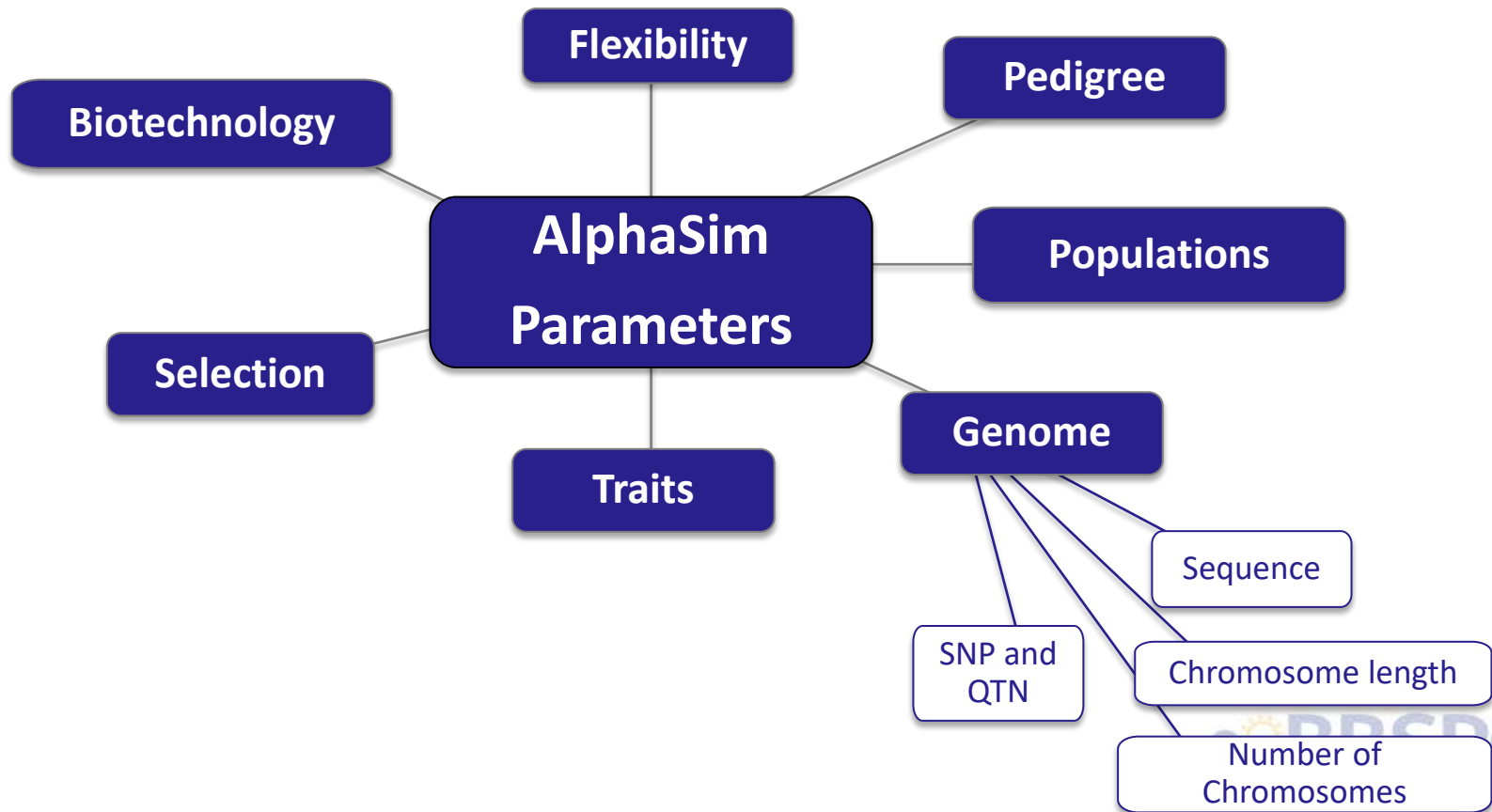
# AlphaSim: Parameters



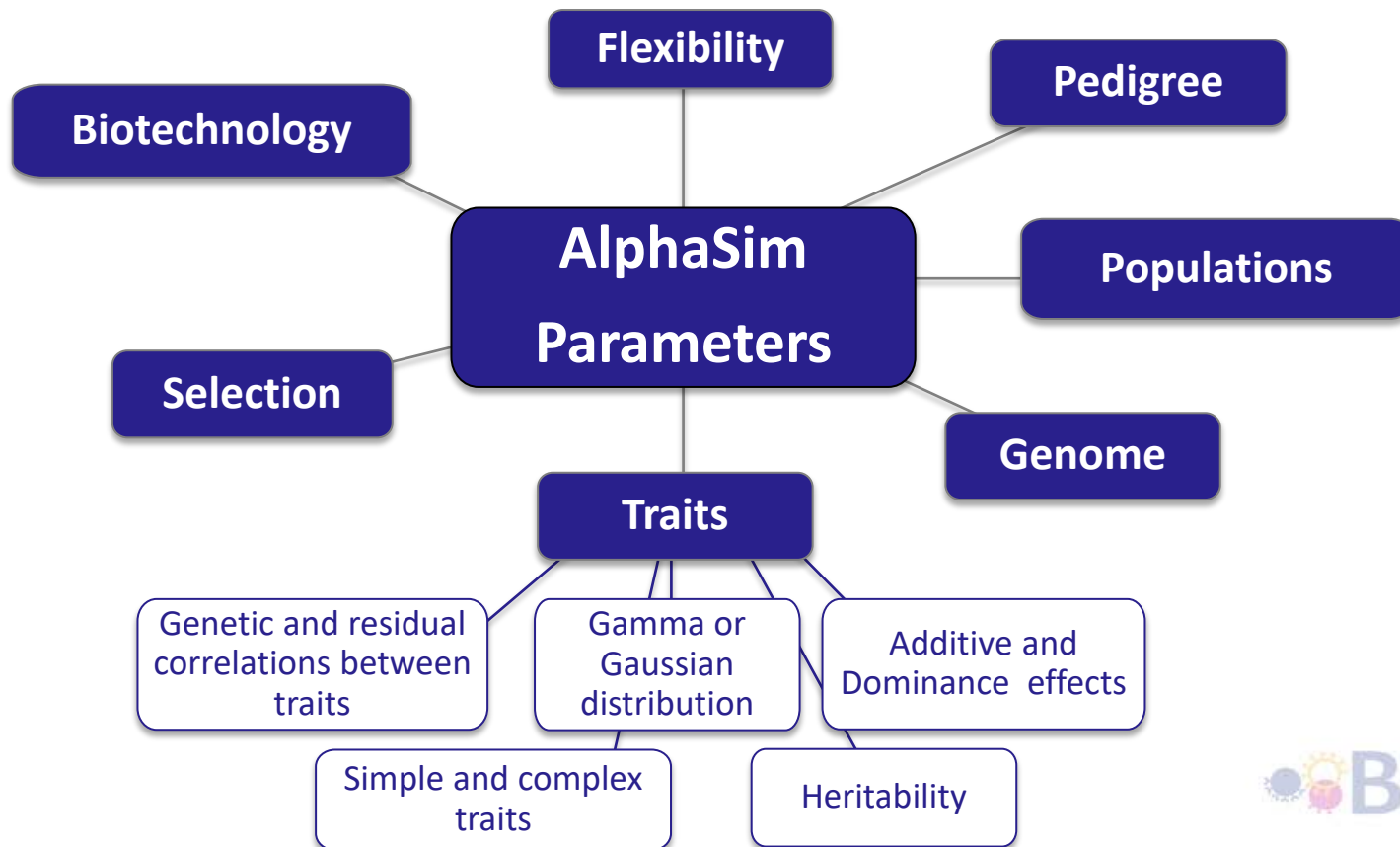
# AlphaSim: Parameters



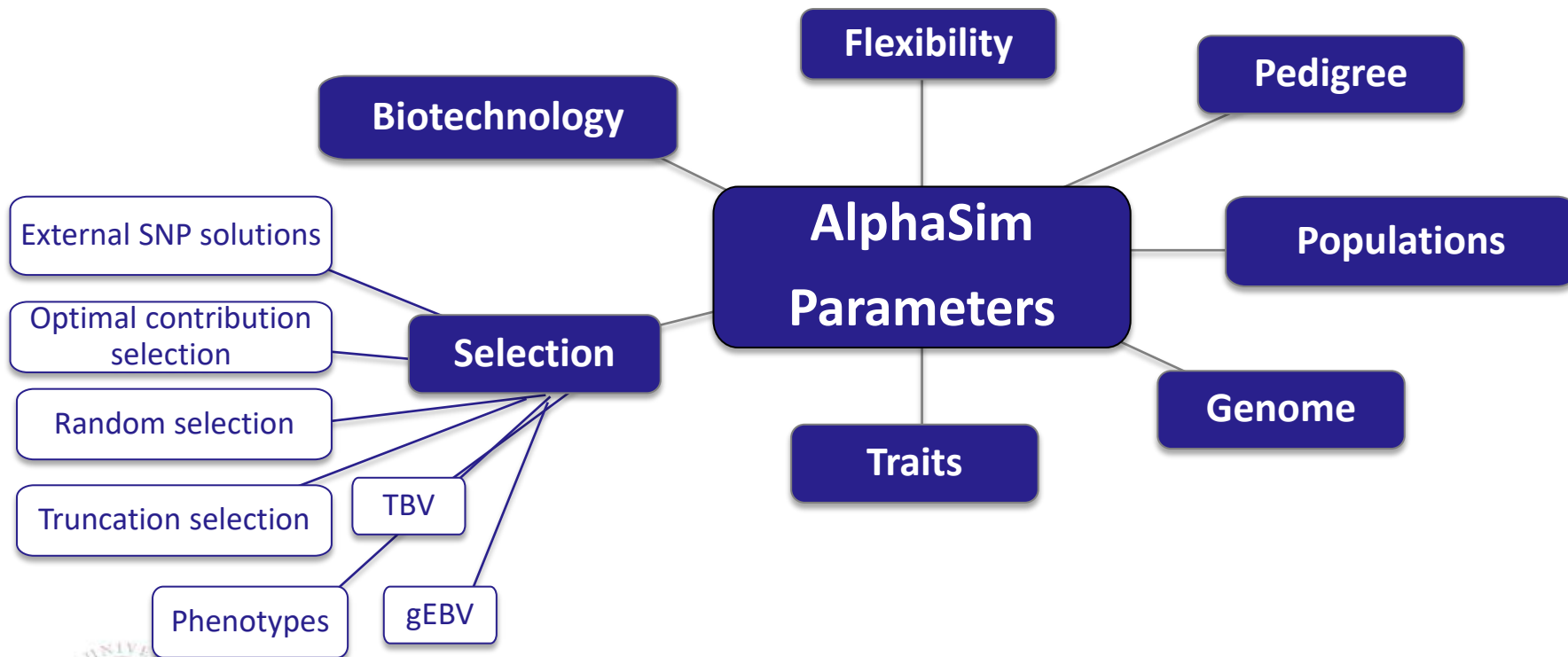
# AlphaSim: Parameters



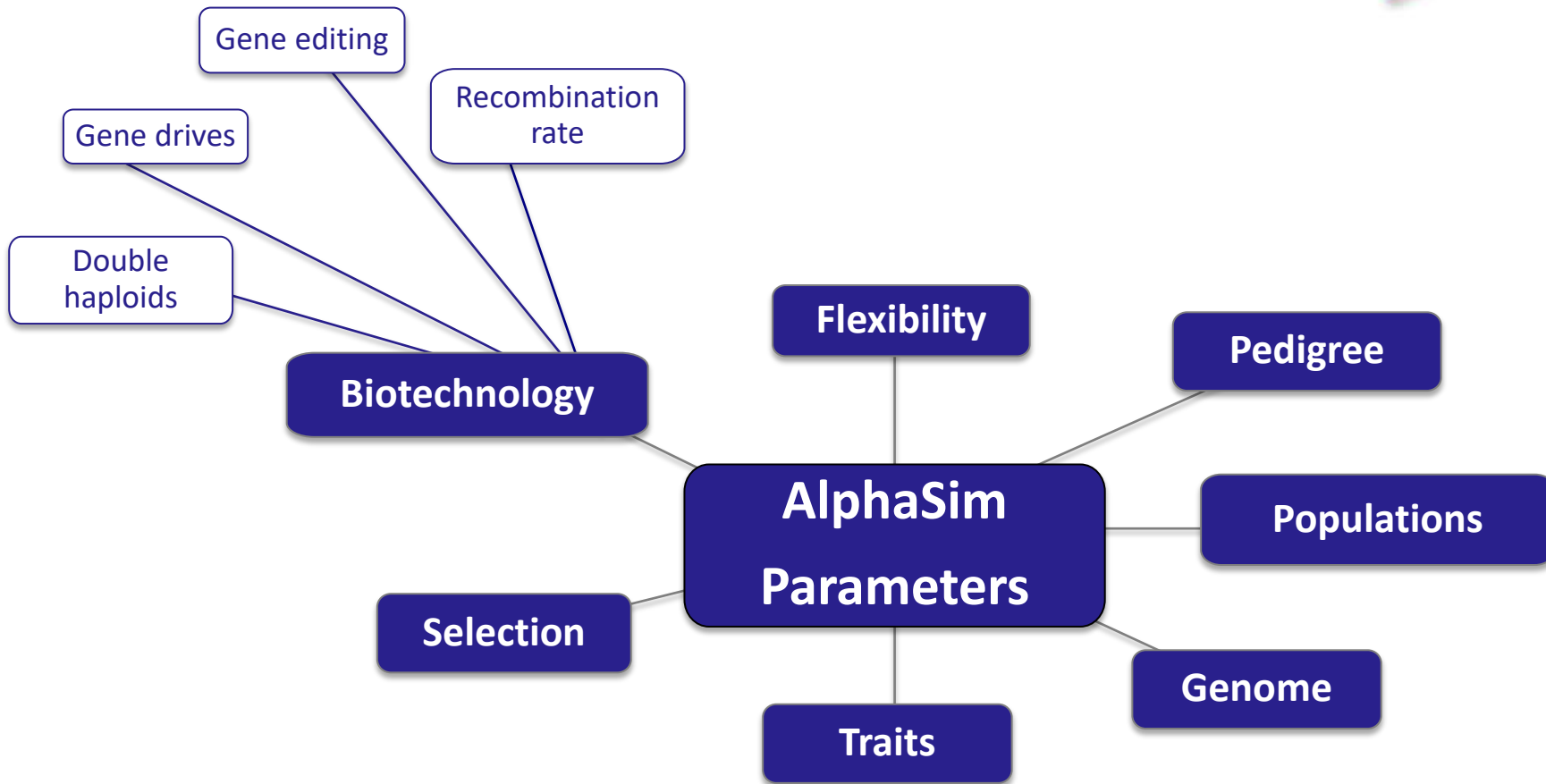
# AlphaSim: Parameters



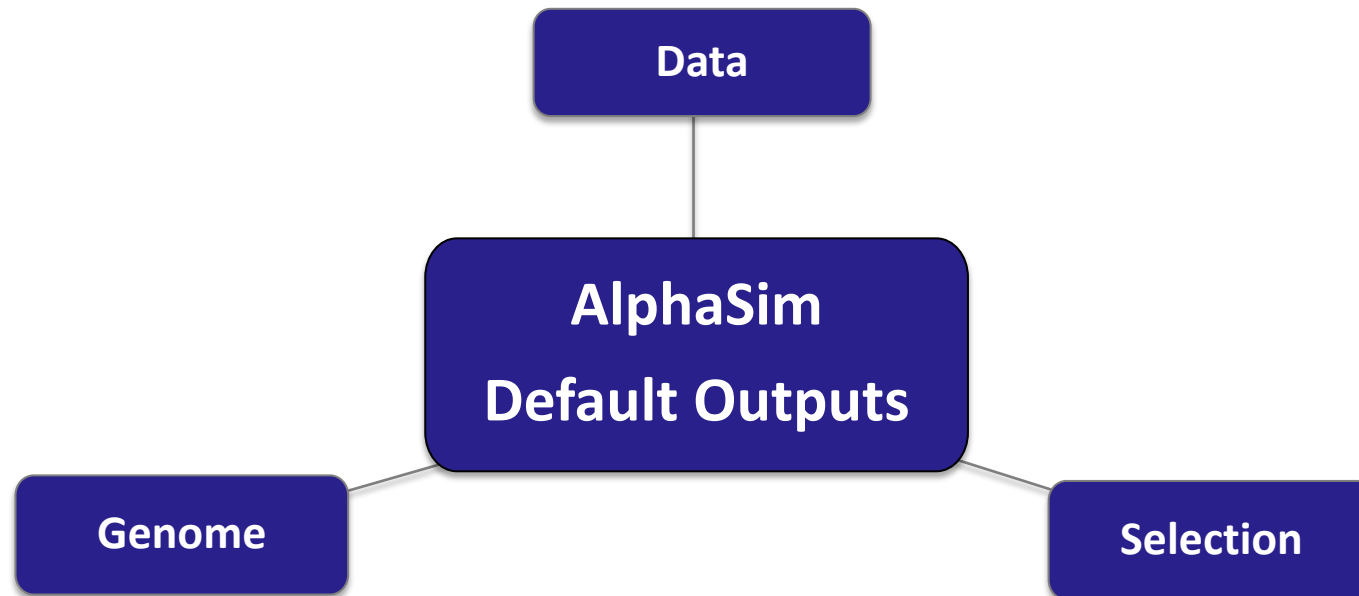
# AlphaSim: Parameters



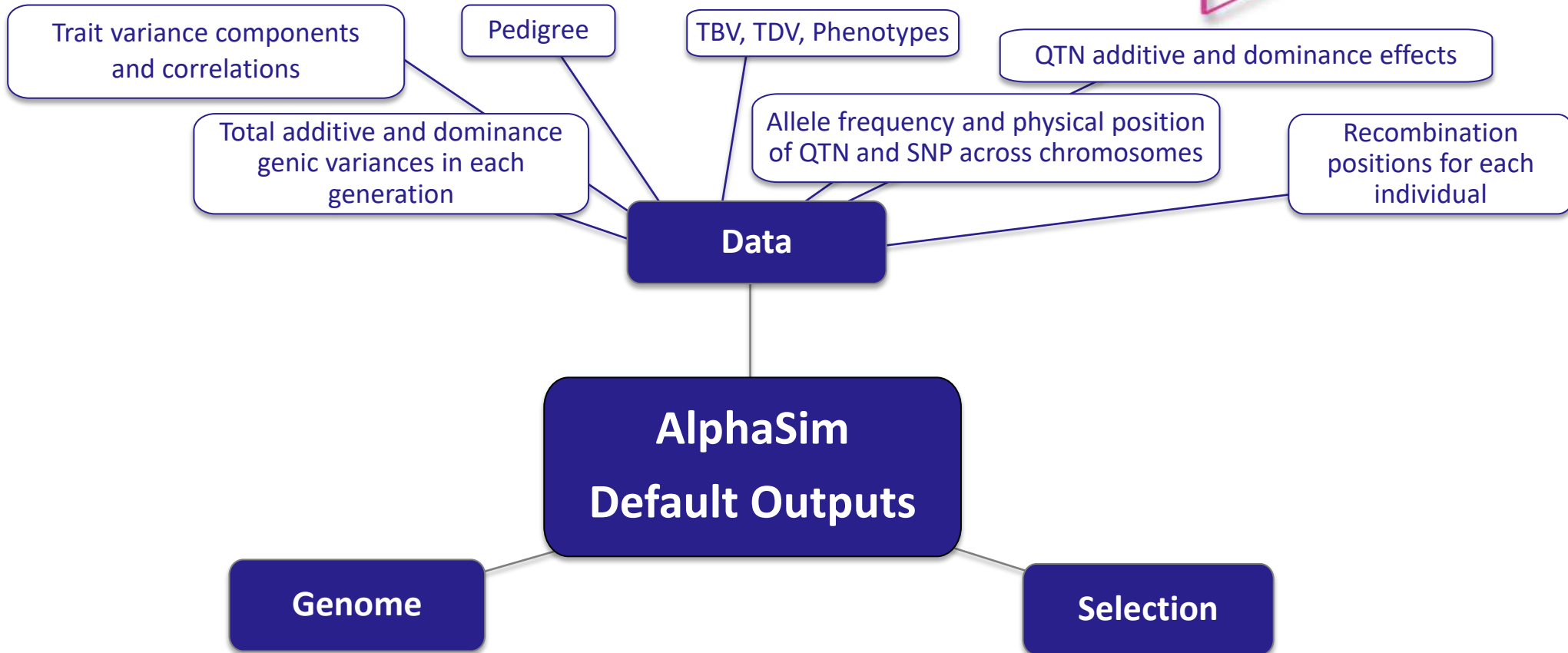
# AlphaSim: Parameters



# AlphaSim: Output

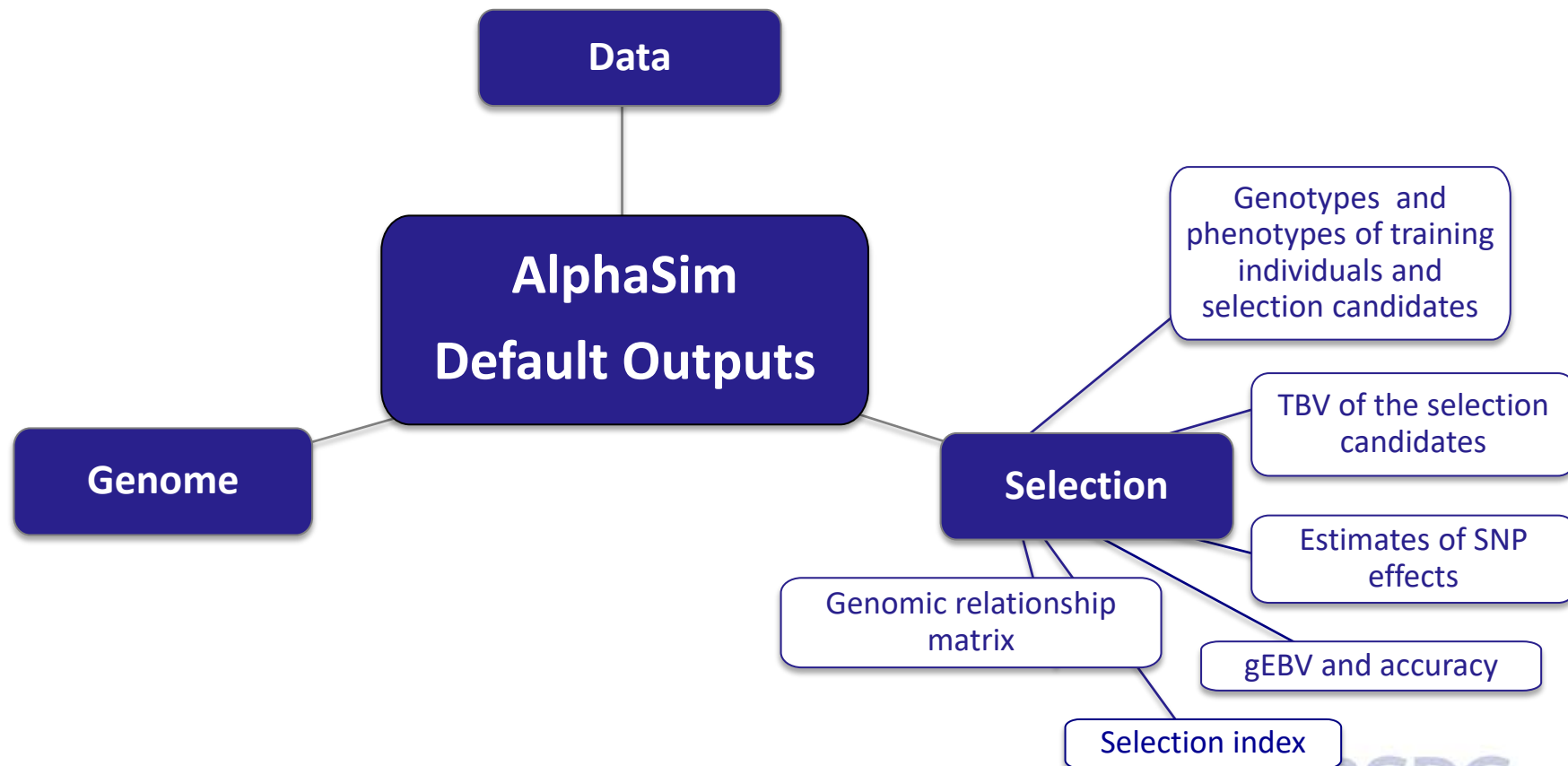


# AlphaSim: Output

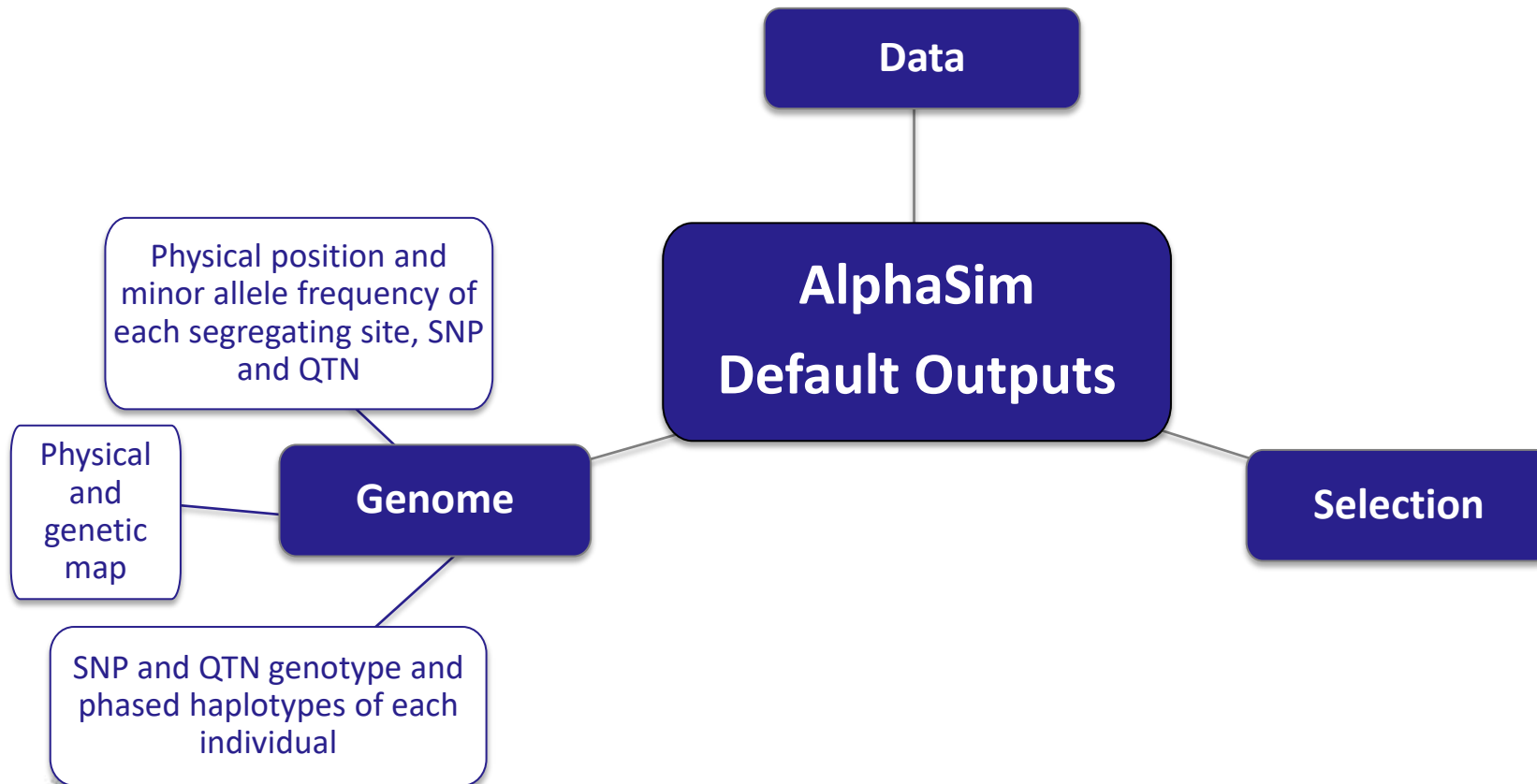




# AlphaSim: Output



# AlphaSim: Output



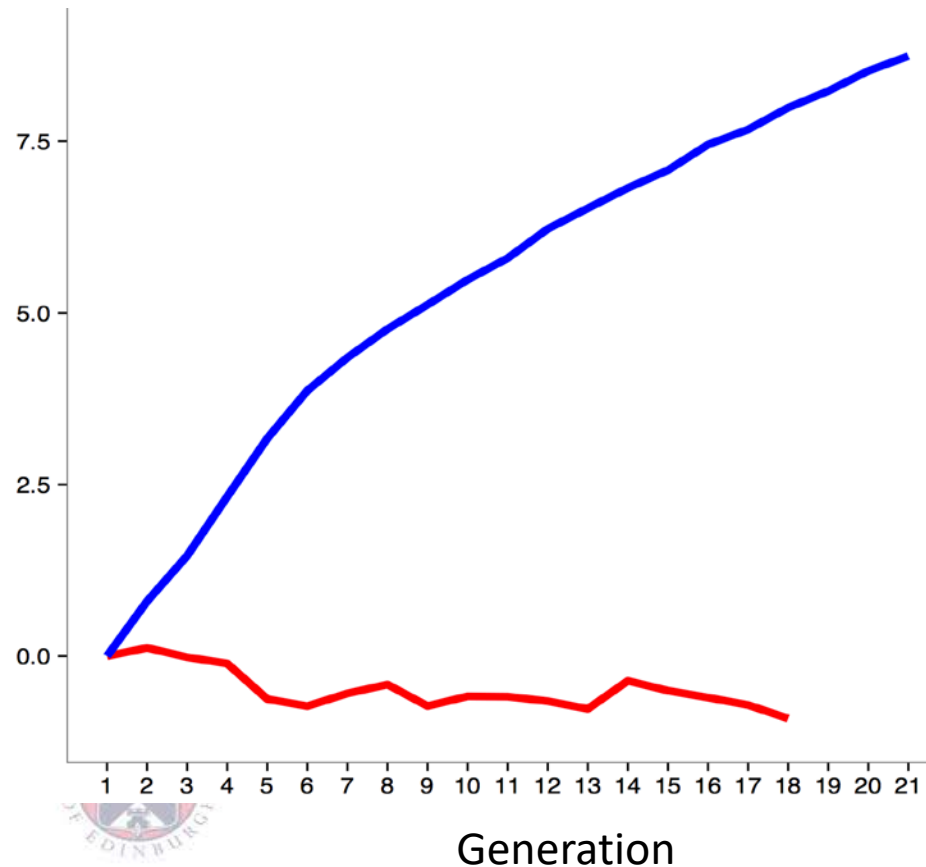
# AlphaSim: Examples



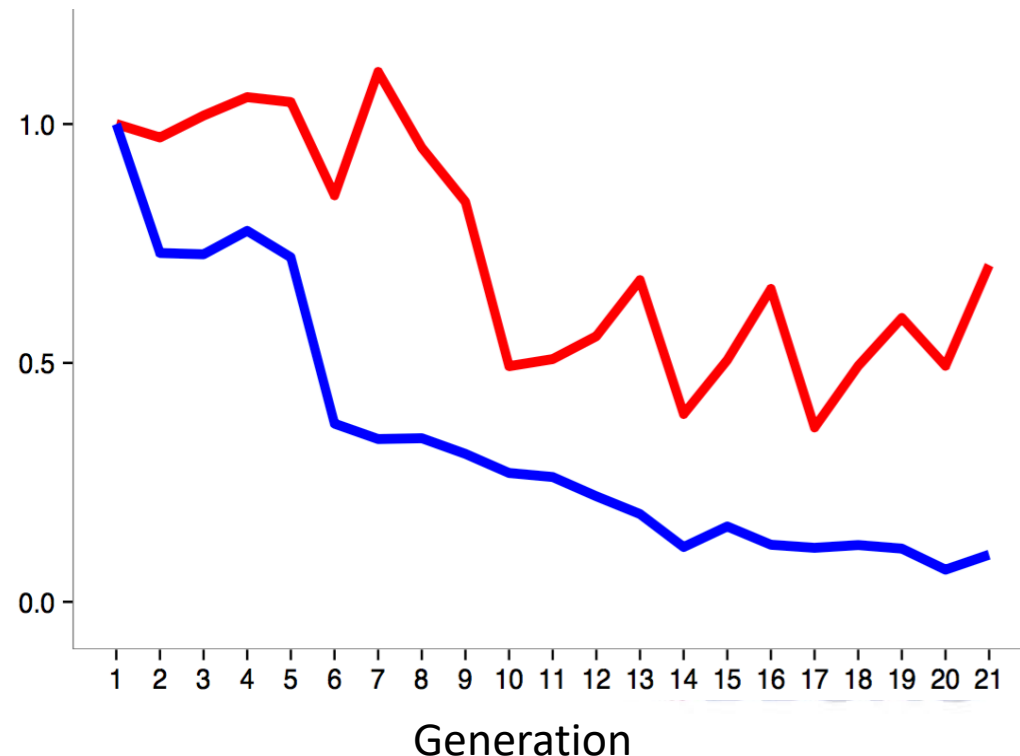
## (1) Random Mating vs Genetic Selection

— Random mating — Genetic Selection

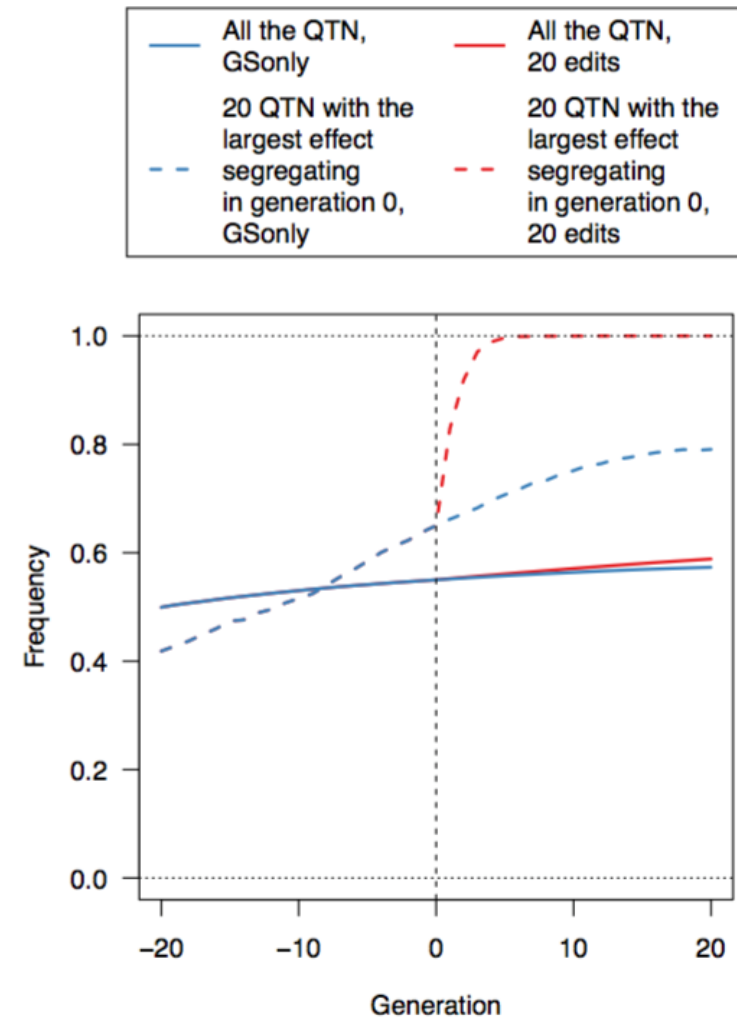
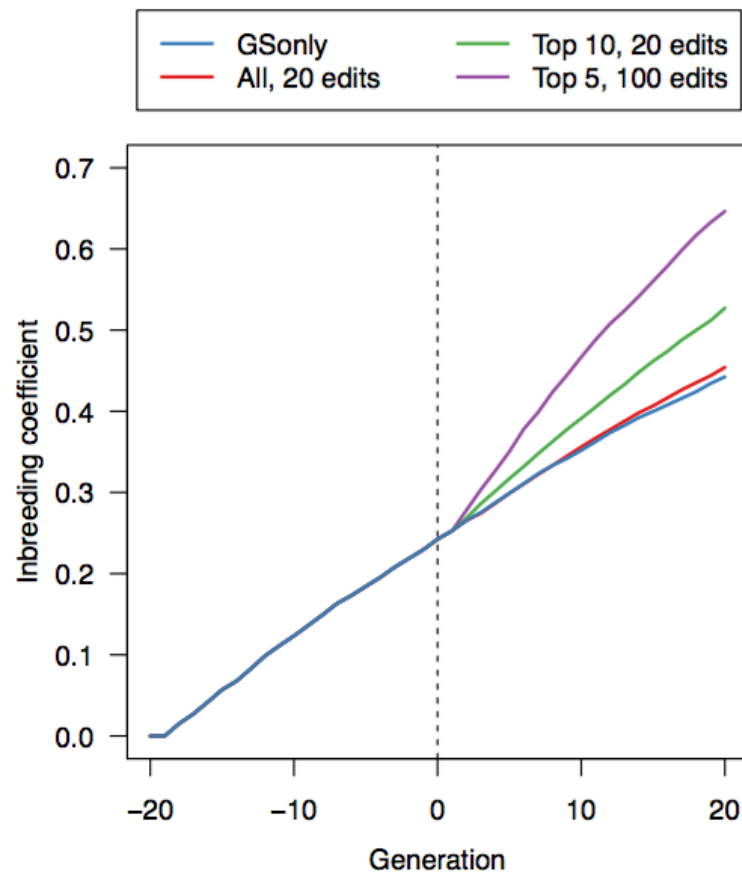
Response to Selection



Genetic Variance

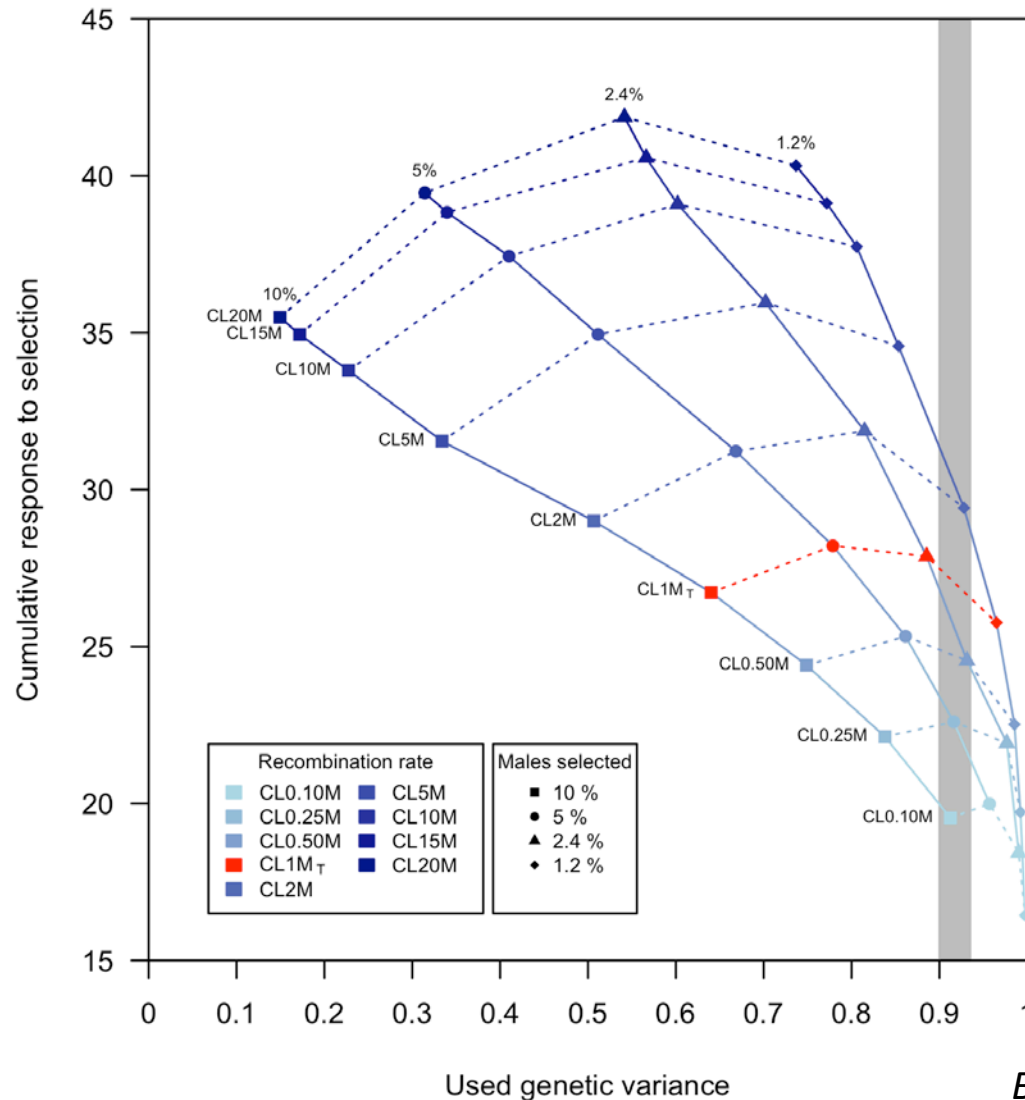


## (2) Genome editing in animal breeding



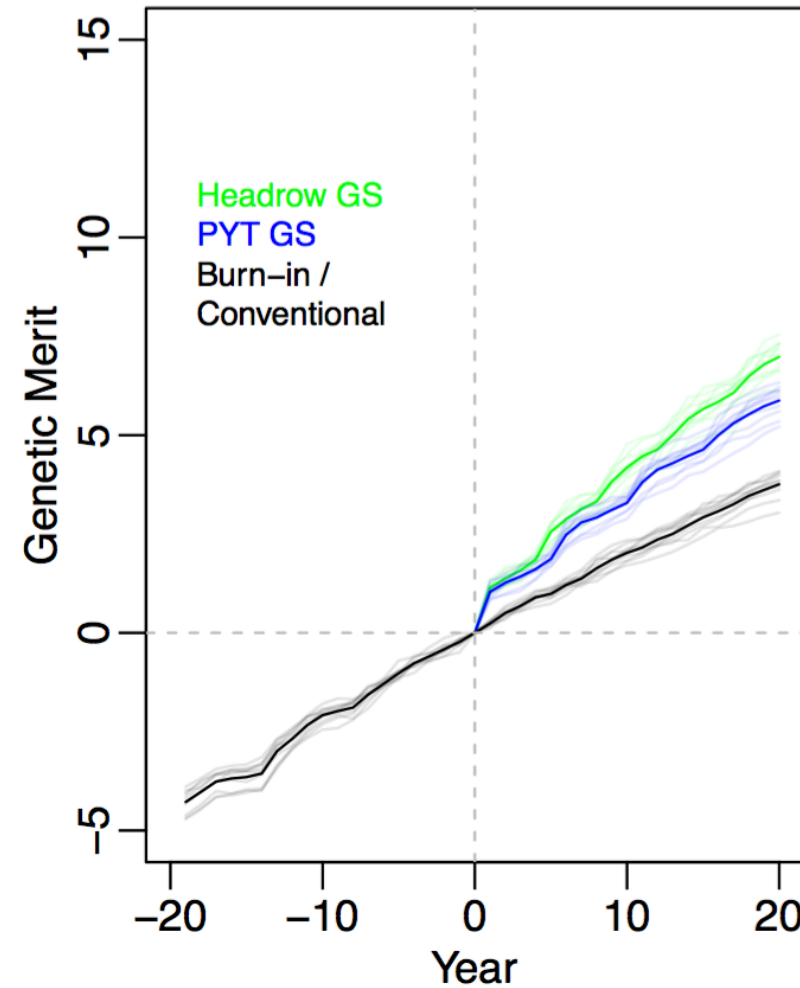
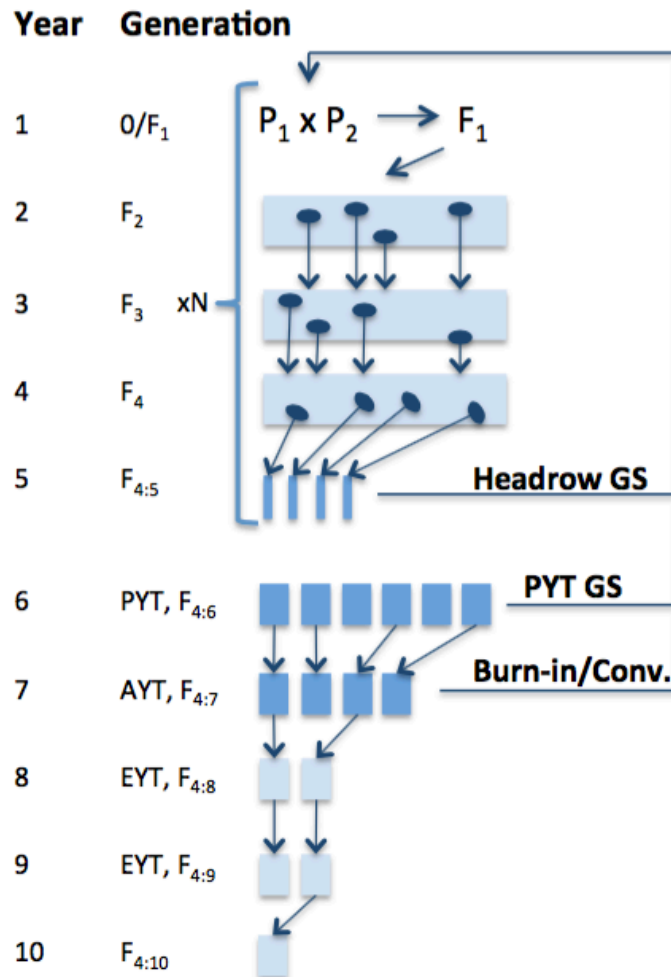
# AlphaSim: Examples

## (3) Selecting for recombination in animal breeding



# AlphaSim: Examples

## (4) Introducing genomic selection in wheat



# AlphaSim: AlphaSuite



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## AlphaSim

### General description

AlphaSim is a software package for simulating sequence, genotypic, phenotypic, and pedigree data in a wide range of population types (e.g., animal breeding, plant breeding, human genetics, natural populations). In developing AlphaSim major emphasis was placed on flexibility, computational efficiency, and ease of use. Populations can have almost any pedigree structure, almost any type of selection, a wide range of genotyping platforms, and multiple traits with a wide range of alternatives for genetic architecture. Additionally, AlphaSim also includes features for genome editing, manipulating the recombination rate and its genetic architecture, performing optimal contribution selection, and other "tricks".

Any questions? go to [AlphaSim Forum](#) and join the discussion.

### Download

#### 1. User Manual

Click [here](#) to see the html version.

#### 2. Binaries for Linux, Mac and Windows

The AlphaSim1.05 folders contains:

- 7 programs (AlphaSim, MaCS, alphaformatter, AlphaBayes, AlphaBayesP, AlphaAGH and AlphaMate),
- 1 pdf (AlphaSim User Manual),
- 1 parameter file (AlphaSimSpec.txt),
- 1 Excel document (MaCS\_parameters.xlsx).

Running AlphaSim requires *AlphaSimSpec.txt*, *MaCS*<sup>2</sup> (Chen et al. 2009), and *alphaformatter*. MaCS and alphaformatter are called from within AlphaSim if the program is started from the first generation. In contrast, *AlphaBayes*, *AlphaAGH* and *AlphaMate* are called only when specific options are activated. Further details are given in the user manual.

In addition, we supply a Microsoft Excel sheet (MaCS\_parameters.xlsx), which can be used to compute the values of the parameters included in the RunMacs.sh file, as well as six exemplary RunMacs.sh files for different species (cattle, rabbit, maize and wheat). Further details are given in the user manual.

#### 3. Exercises for Linux and Mac

Basic examples to run AlphaSim1.05 in Linux and OSX. Run simulations for plant and animal breeding program using a bash script named RunMe.sh.

The examples are divided in (i) Basic simulations, (ii) Plant breeding simulations, and (iii) Animal breeding simulations.

All the steps to run AlphaSim1.05 are explained in the document [Notes.pdf](#)

<sup>2</sup> We thank Gary Chen for allowing us to redistribute his MaCS and msformatter executables alongside our AlphaSim executables.

[www.alphagenes.roslin.ed.ac.uk/alphasuite/alphasim/](http://www.alphagenes.roslin.ed.ac.uk/alphasuite/alphasim/)



# AlphaSim

GRAPHICAL USER INTERFACE

**Build New  
Simulation**



# Acknowledgements



## Funding Bodies

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Adriana Somavilla



## Industrial Partners



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**Thank you!**