# Pig Science - Breeding

Peter von Rohr

2023-03-15

# Program

| Datum | Day | Room | Time | Dozent | Topic |
|---|---|---|---|---|---|
| **22.02.23** | Wednesday | LFW B2 | 8:15 - 10 | SN | Introduction, Genetics |
| **01.03.23** | Wednesday | LFW B2 | 8:15 - 10 | SN | Genetics |
| **08.03.23** | Wednesday | LFW B2 | 8:15 - 10 | SN | Genetics |
| **15.03.23** | Wednesday | LFW B2 | 8:15 - 10 | PvR | Breeding |
| **22.03.23** | Wednesday | LFW B2 | 8:15 - 10 | SN/PvR | **Student presentations 1** |
| **29.03.23** | Wednesday | LFW B2 | 8:15 - 10 | SN/GB | **Student presentations 2** |
| **05.04.23** | Wednesday | LFW B2 | 8:15 - 10 | GB | Feeding & Meat Quality |
| **12.04.23** | **Easter break** | | | | |
| **19.04.23** | Wednesday | | | PVR | Breeding |
| **21.04.23** | **Friday** | **Excursion Agrovet Strickhof** | | | **Pig housing, constitution** |
| **26.04.23** | Wednesday | LFW B2 | 8:15 - 10 | PVR | Breeding |
| **03.05.23** | Wednesday | LFW B2 | 8:15 - 10 | GB | Feeding & Meat Quality |
| **10.05.23** | Wednesday | LFW B2 | 8:15 - 10 | GB | Feeding & Meat Quality |
| **17.05.23** | Wednesday | LFW B2 | 8:15 - 10 | CK | Sustainable pigs |
| **24.05.23** | Wednesday | **No lecture** | | | |
| **31.05.23** | Wednesday | LFW B2 | 8:15 - 10 | SN | **Exam** |

# Program - Breeding

| Week | Date | Topic |
|---|---|---|
| 1 | 2023/03/15 | Extension of Breeding Programs |
| 2 | 2023/04/19 | Genomic Selection in Pigs and other species |
| 3 | 2023/04/26 | Breeding Program via Aggregate Genotype |

# Information

- Lecturer: S. Neuenschwander, C. Kasper, G. Bee, P. von Rohr
- Date: Wednesday 8-10
- Mode: in person
- Room: LFW B2
- Moodle: https://moodle-app2.let.ethz.ch/course/view.php?id=19265
- Website: https://charlotte-ngs.github.io/psbss2023
- Questions: during the lecture and during the exercise hour or via e-mail
  - Peter von Rohr (peter.vonrohr at usys.ethz.ch)

# Course Objectives

The students

- understand the theoretical background and the practical application of the prediction of breeding values in a livestock breeding
- know how to interpret predicted breeding values.

$\rightarrow$ What is the meaning of a predicted aggregate genotype $-9$ index points

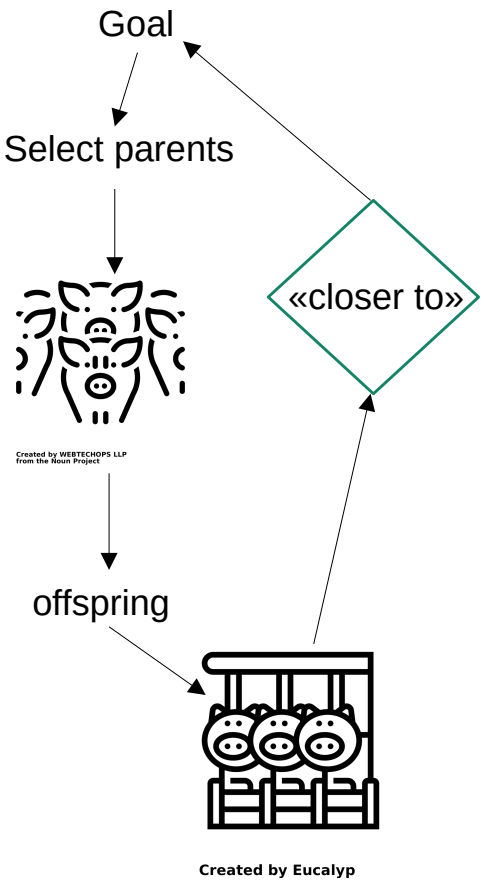
$\rightarrow$ What is the difference between production and breeding

# Further Reading

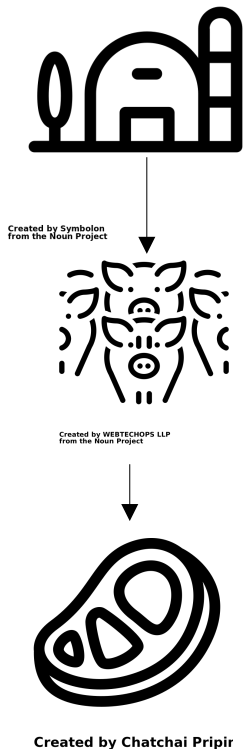
- Willam und Simianer: Tierzucht - Grundwissen Bachelor (Ulmer, UTB 3526 2011). This book gives an introduction into evolution, livestock production and breeding programs.
- Falconer and Mackay: Introduction to Quantitative Genetics (Longman). The de-facto standard in the area of quantitative genetics uses many examples from experimental research to illustrate the concepts of quantitative genetics.
- Mrode: Linear Models for the Prediction of Animal Breeding Values (CABI Publishing, 2005). The main focus is on prediction of breeding values using different models.

# Terminology

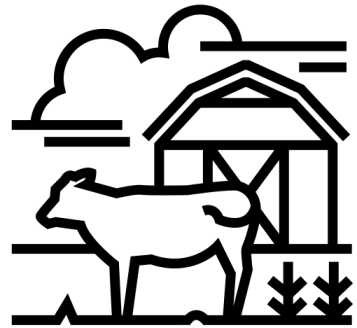
Breeding




Production




Husbandry



Created by Creative Mania from the Noun Project

**… and into many other products according to https://www.ted.com/talks/christien_meindertsma_how_pig_parts_make_the_world_turn**

# Scientific Definition

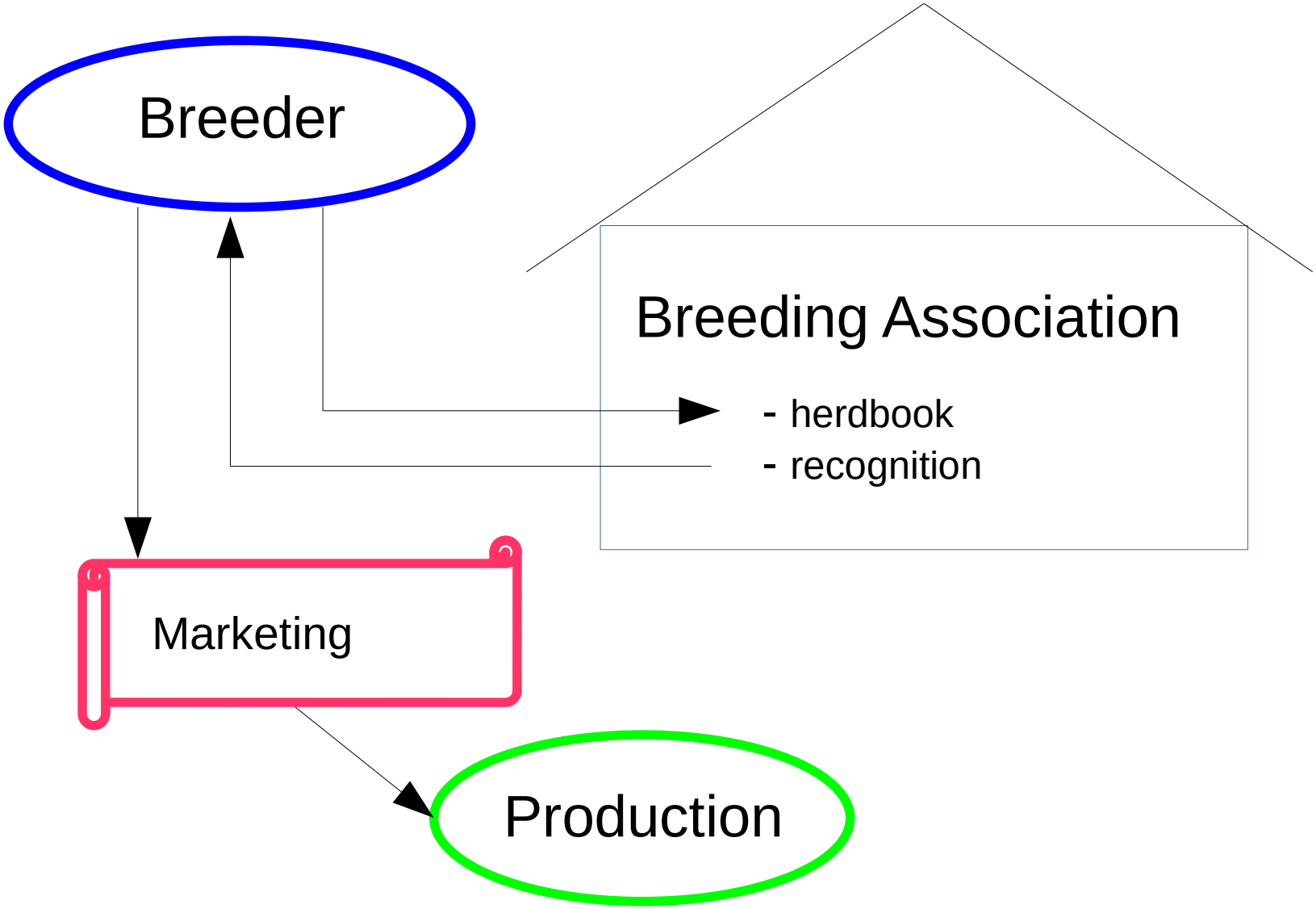
*"Selection and Mating of parents are used such that offspring generations are closer to a defined goal."*

- Distinction between
  - livestock breeding and production
  - cattle breeding and milk or beef production
  - pig breeding and pork production and
  - chicken breeding and egg producers

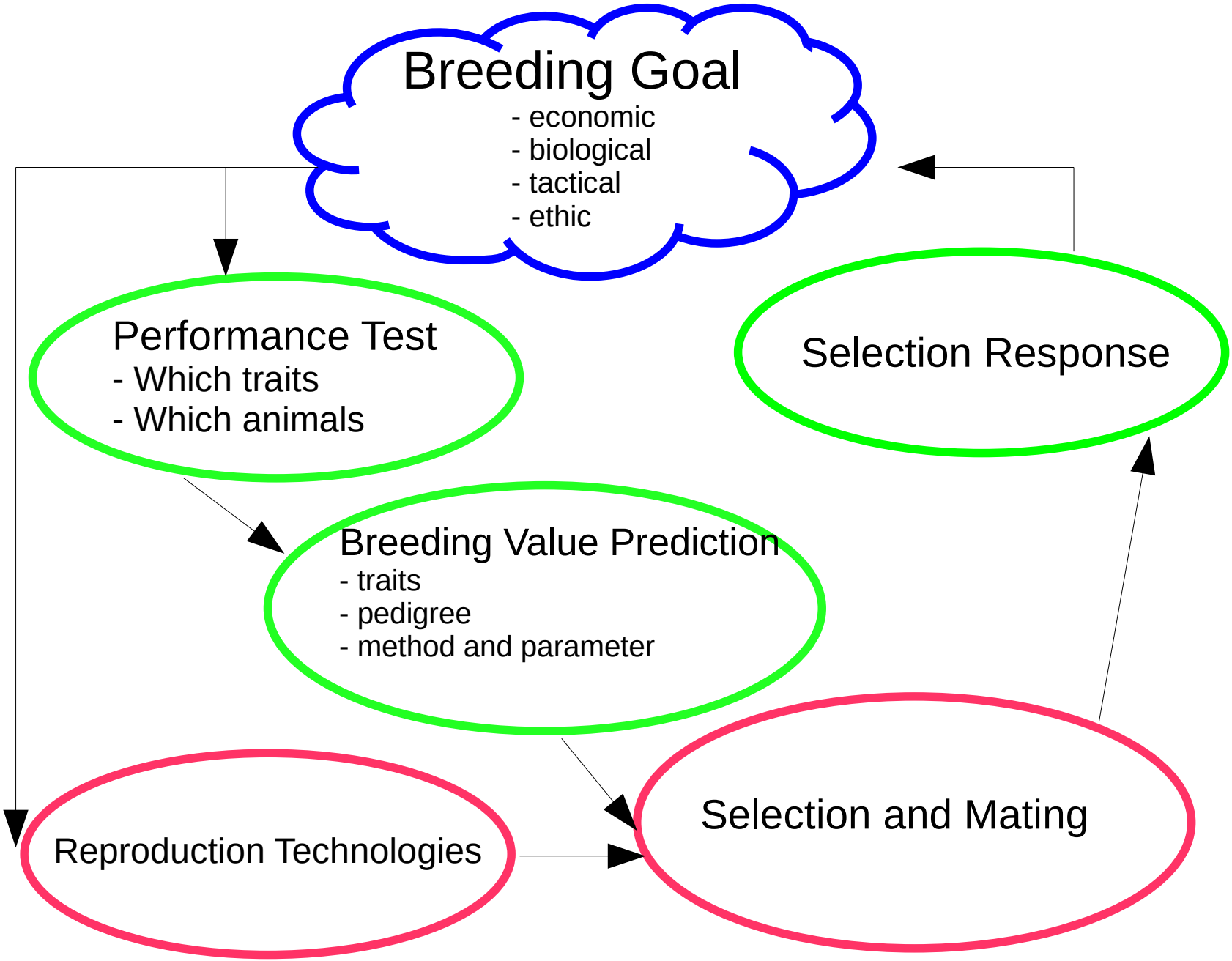
# History

- Formations of breeding organisation (BO)
- Tasks of BO: herdbooks and certification
- Crisis at beginning of $20^{th}$ century lead to federal regulations
- Developments of technologies
  - Reproduction
  - Molecular biology
  - Computer science

# Breeding Organisations



# Breeding Programs



# Parts of Breeding Program

- Applied prediction of breeding values is a part of the breeding program
- Design and planning of a breeding program requires to answer the questions
  - What goal do we want to achieve
  - What measures do we want to use to achieve the goal

# Types of Breeding Programs

Two types of breeding programs

1. Focus on **selection response**
   - countries with limited resources
   - big farms or big companies
2. Focus on clients and services
   - cattle and pig breeding of developed countries
   - economic interest of companies and farms

# Breeding Goals

Types of breeding goals

- economic
- biological
- tactical
- ethical

Breeding goals might be formulated in different ways

- **political**: description of idealized image of future animal. Often conflicting and not verifiable
- **scientific**: mathematical description of direction of desired change. Measurable via selection response

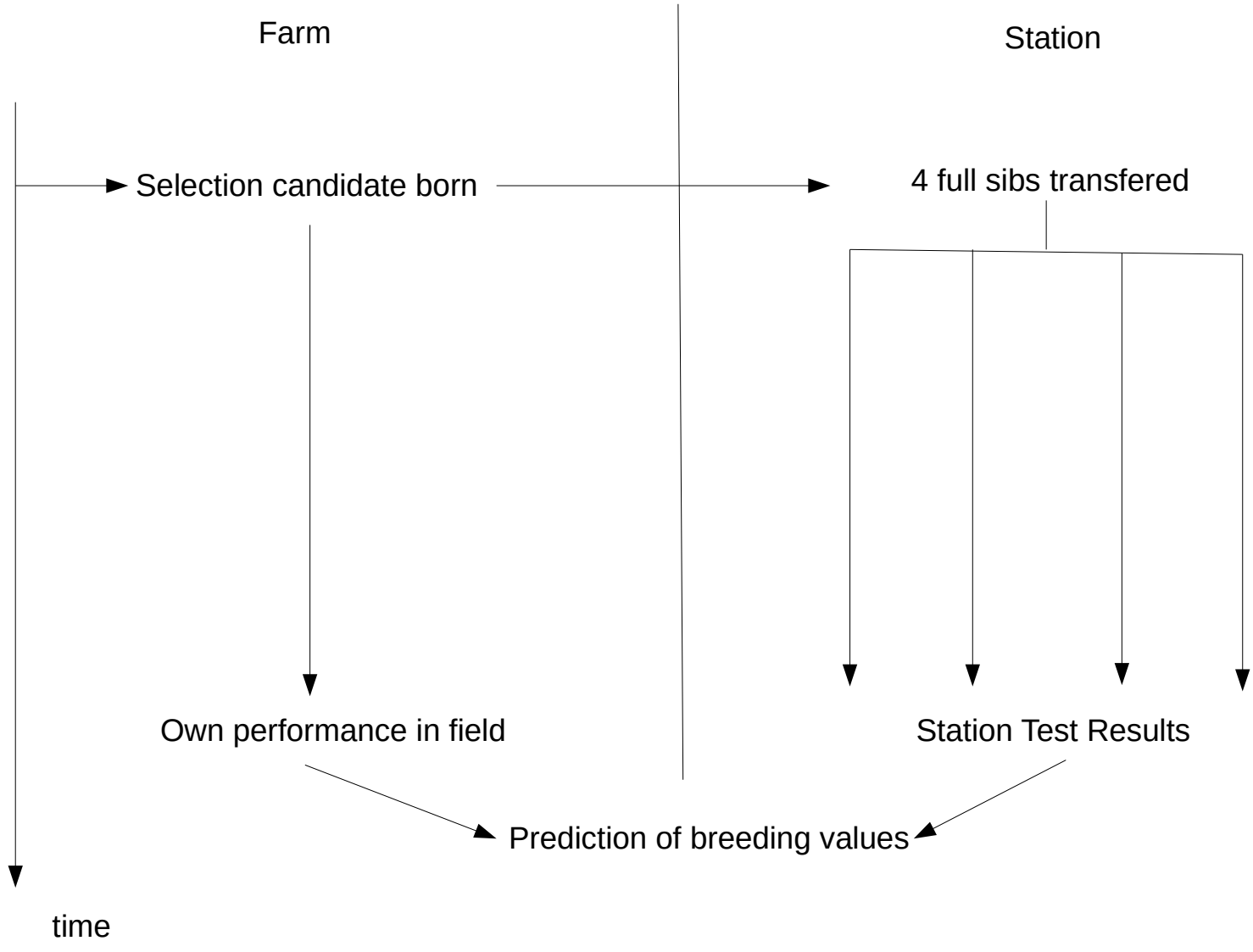
# Performance Testing

- Basic question: What trait is measured when for which animals
- Breeding should be based on data
- Quality of derived parameters (heritability, predicted breeding values) depend on accuracy of collected data
- Data collection used for performance testing often started for different reasons
  - milk sample testing: quality of product
  - station testing in pigs: correction of environment

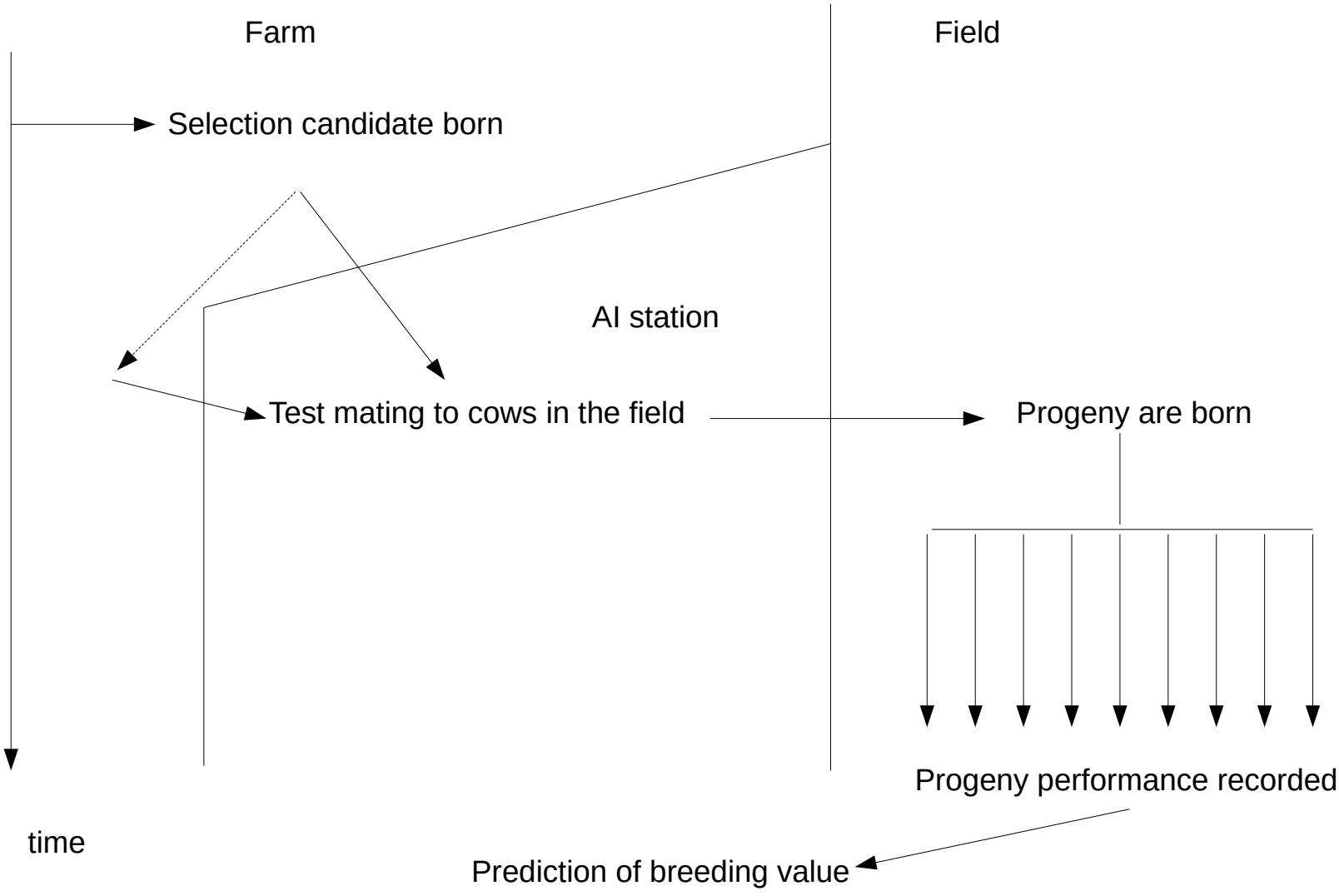
# Classification of Performance Tests

- Place
  - Station
  - Field
- Relationship between selection candidate and tested animal
  - own performance record
  - full-sib
  - progeny
- Traits
  - should have genetic variation
  - economic importance
  - measurable better than subjectively observed

# Examples: Pigs



# Examples: Cattle



# Prediction Of Breeding Values

- Done in most breeding programs
- Federal regulation
- Performance tests much more expensive
- Different intervals
  - cattle: three times per year
  - pigs: nightly or weekly

# Progress In Technologies

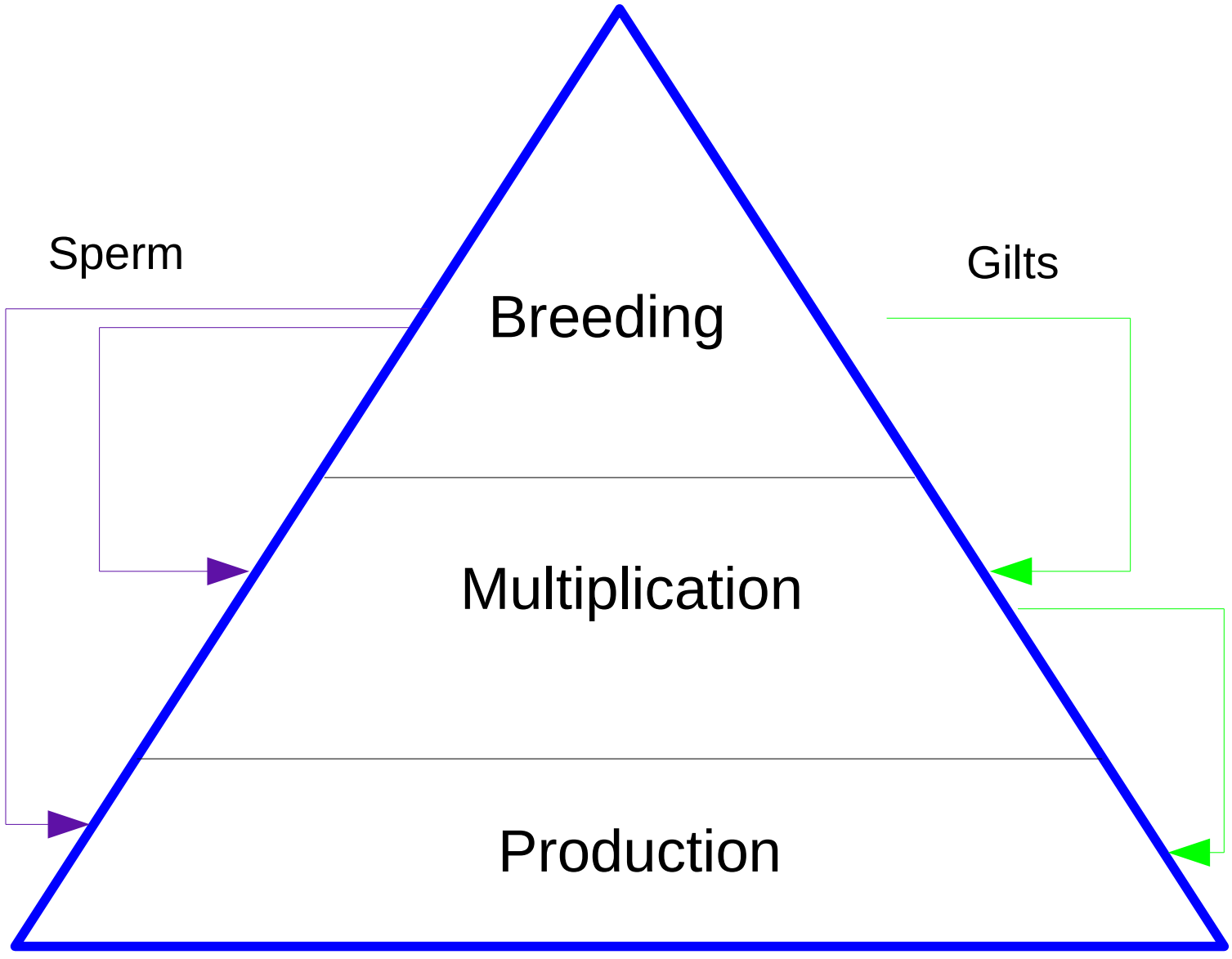
- Reproduction - AI
  - disease prevention
  - number of progeny per sire increased
  - better comparisons between herds
  - Future: more development on female side
- Molecular Biology
  - cheap and efficient large-scale genotyping
  - sequencing with more accuracy
- Computer Science
  - efficient evaluation of large amounts of data
  - big data technologies - continuous monitoring

# Differences Of BP Between Species

Breeding programs (BP) for different species have different structure

- **hierarchical**: pigs and chicken
- **flat**: cattle and horse

# Hierarchical Structure



# Monolithic Structure