



CONNECTING FEEDS TO ANIMAL RATIOS

Chris VanKerkhove

- HOW DO WE FORMULATE SPECIALIZED RATIONS FOR DIFFERENT GROUPS OF ANIMALS?
- HOW DO WE SIMULTANEOUSLY GROW AND STORE CROPS WHILE INCLUDING THESE FEEDS IN THE ANIMAL RATIONS?
- HOW ARE WE EFFECTIVELY AND EFFICIENTLY RELAYING INFORMATION FROM ONE MODULE TO ANOTHER?



Class Feed

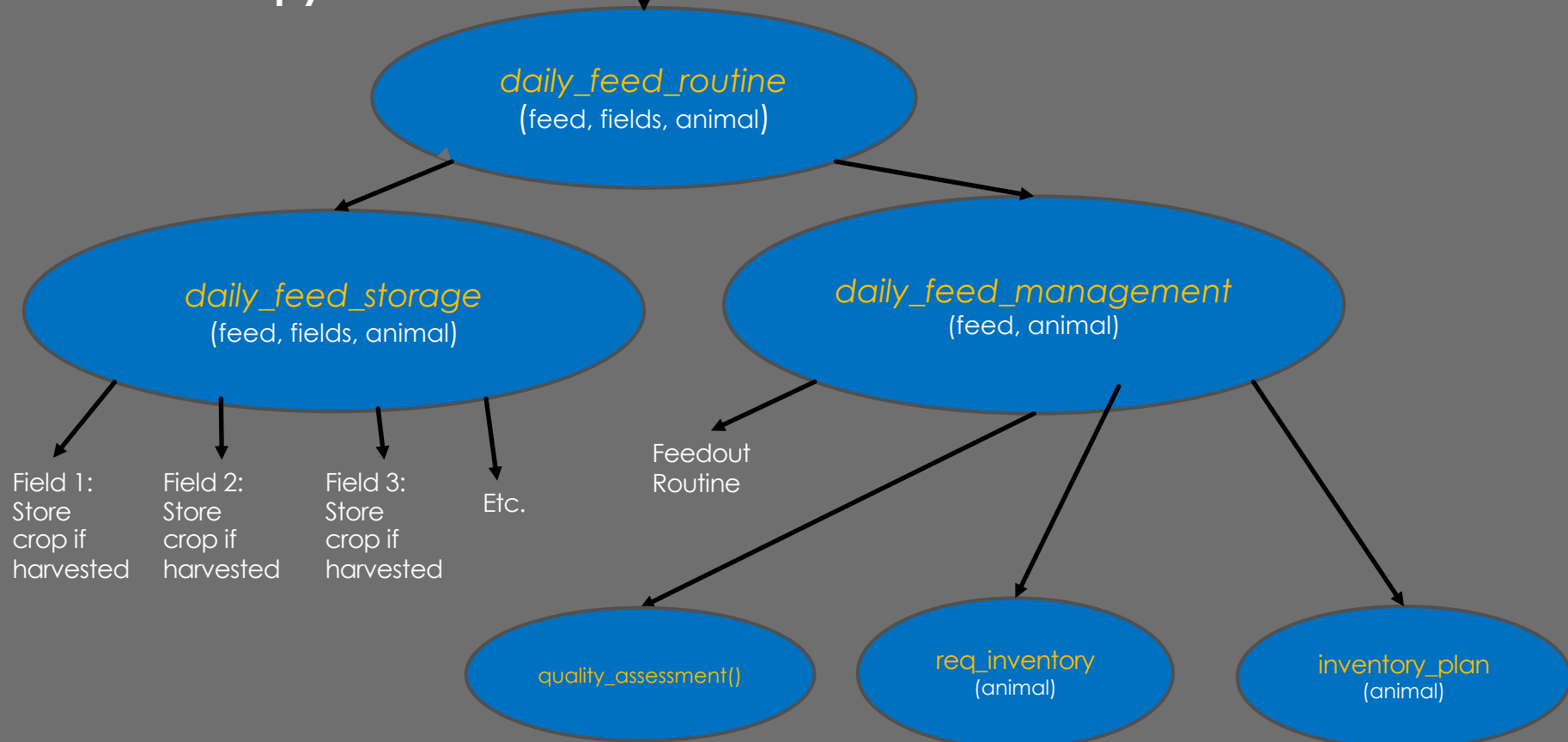


Class Animal

FEED MODULE DEVELOPMENT

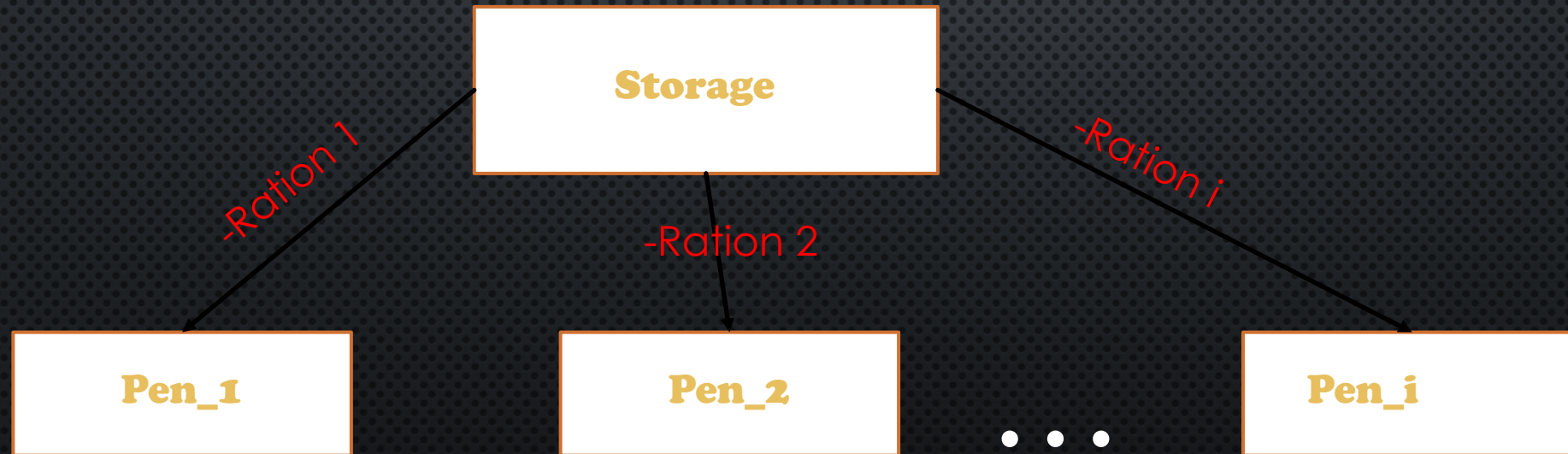
Simulation_engine.py

Feed.py



FEED STORAGE REDUCTION

- WHEN A CROP IS STORED, FEED STORAGE LOSSES FOR A YEAR ARE ACCOUNTED FOR AND REDUCED
(PROVIDED BY KEVIN PAINKE-BUISSE OF THE DFRC 2019)
- AT THE END OF A RATION INTERVAL, WE REDUCE THE FEED AVAILABLE IN STORAGE BASED ON THE RATION



FEED MANAGEMENT

3 STEP PROCESS FOR **EACH** SILO OF A NEWLY HARVESTED CROP:

1. quality_assessment()

- Checks if forage is a feed split by maturity
- Quality assessed on
 - **NDF %**
 - **DM %**

2. req_inventory()

- Calculates required inventory for all animals based on:
 - **Body Weight**
 - **Inclusion %**

3. Inventory_plan()

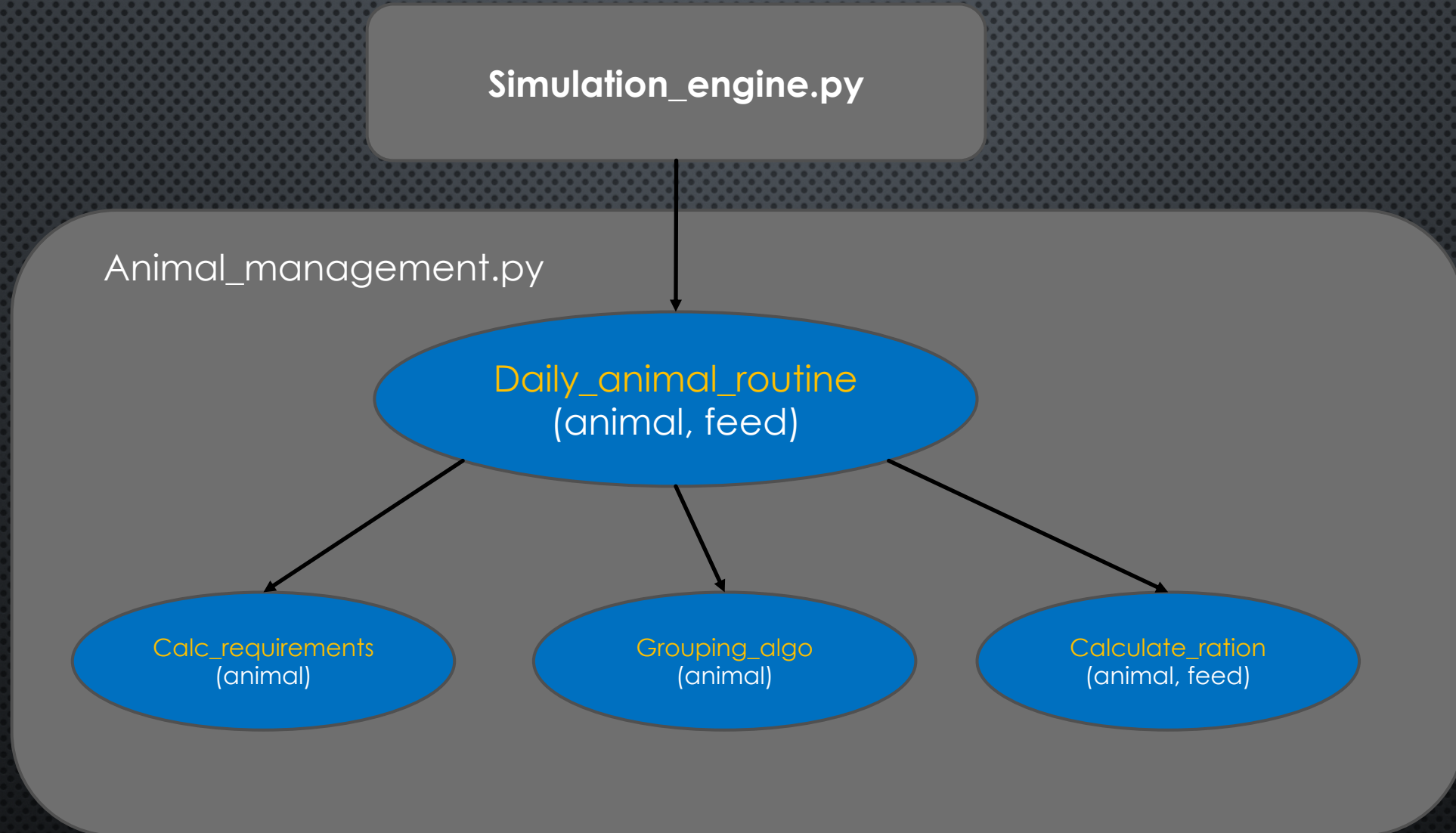
- Based on quality of req inventory of forage computes DMI
- DMI: (daily max intake per animal)

FEED → RATION CONNECTION

- FEED INFORMATION COMPRESSED INTO AVAILABLE_FEEDS DICTIONARY AND PASSED TO RATION DRIVER
- CONTAINS NUTRIENT INFORMATION OF ALL FEEDS USED IN THE RATION FORMULATION

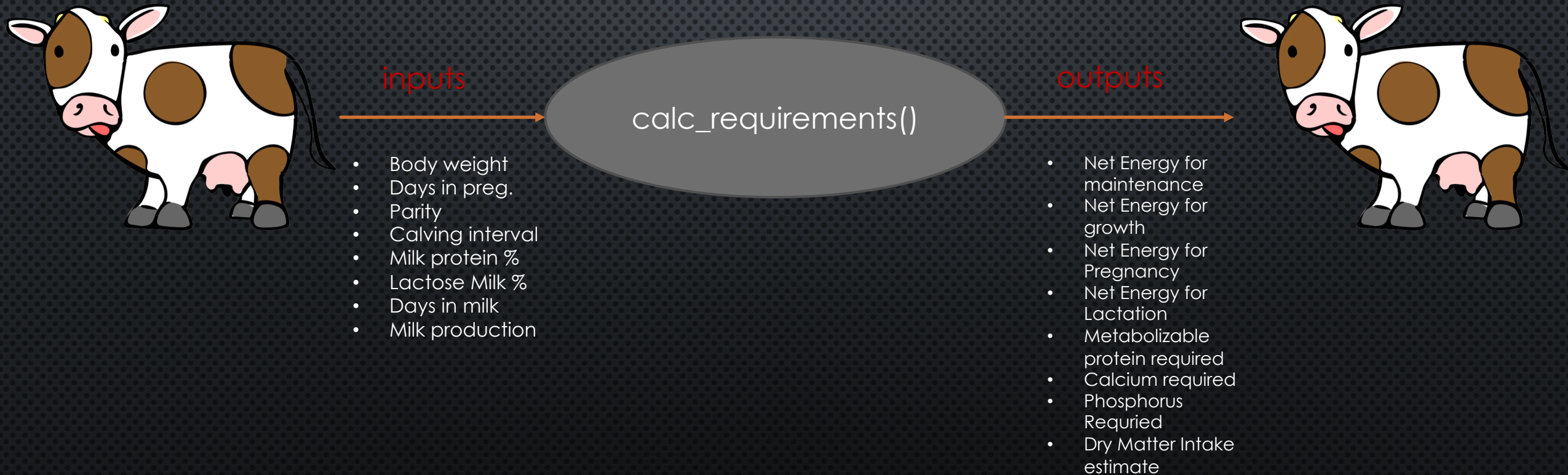


ANIMAL MODULE DEVELOPMENTS



REQUIREMENTS CALCULATIONS

- `CALC_REQUIREMENTS()`
 - REQUIREMENTS ARE CALCULATED FOR EACH COW ON AN INDIVIDUAL BASIS
 - INPUT VALUES AN INDIVIDUAL COW'S ATTRIBUTES
 - REQUIREMENT VALUES ARE ASSIGNED TO EACH COW OBJECT



LACTATING COW GROUPING

- TWO DIET SCENARIOS
 - 1 PEN FOR LACTATING COWS
 - MULTIPLE PENS FOR LACTATING COWS
- IF MULTIPLE PENS, COWS GROUPED ACCORDING TO SIMILAR NUTRIENT REQUIREMENTS

COW GROUPING ALGORITHM COURTESY OF JORGE BARRIENTOS

(BARRIENTOS, 2020. JDS. 103: 3774-3785)



Lactating Cow Grouping Algorithm

200 Stalls

[0,20) Percentile

300 Stalls

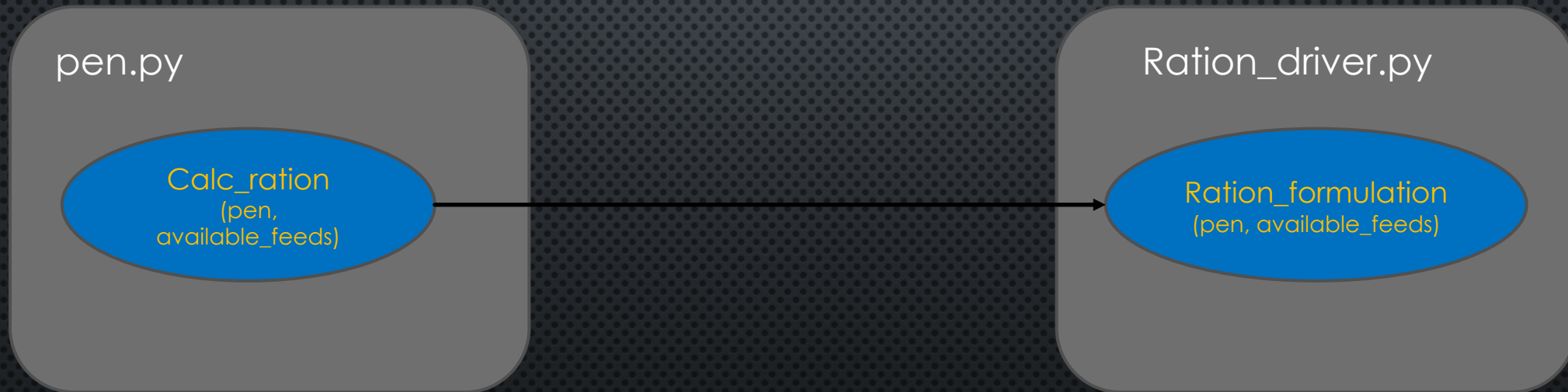
[20,50) Percentile

500 Stalls

[50,100] Percentile

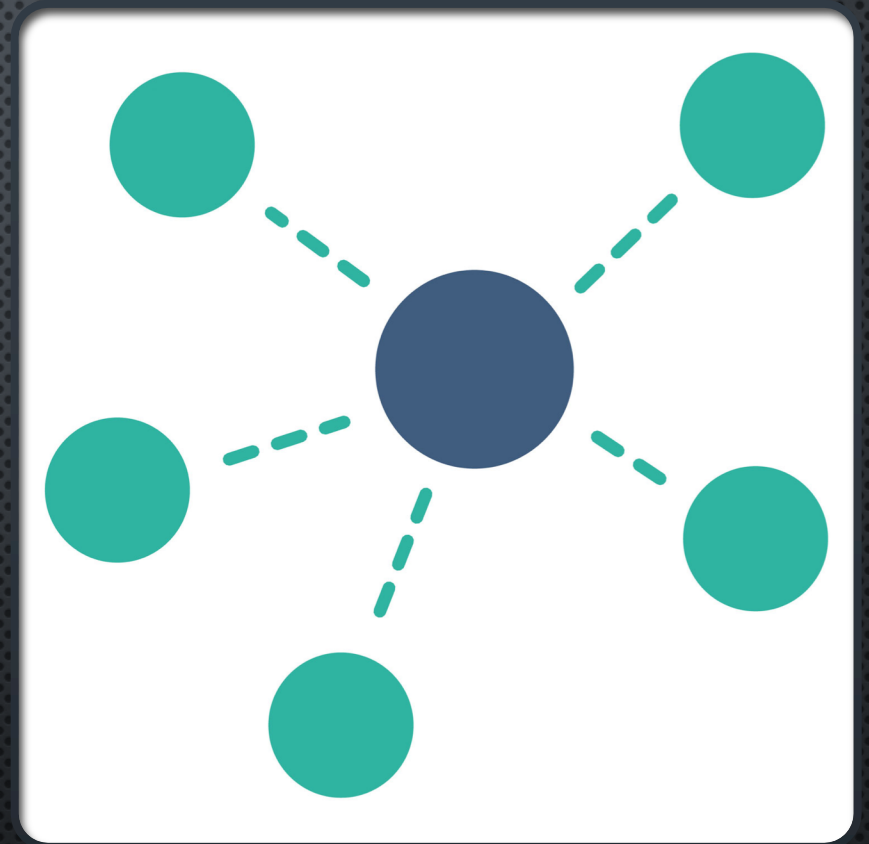
ANIMAL → RATION CONNECTION

- WE FORMULATE A UNIQUE DIET FOR EACH PEN
- INFORMATION PASSED INTO RATION DRIVER THROUGH PEN



RATION DRIVER

- THE CENTER OF RATION FORMULATION RELATED OPERATIONS
- RESTRUCTURES ANIMAL AND FEED INPUT DATA FOR THE NON-LINEAR PROGRAM OPTIMIZATION



feed.py

Class Feed

```
self.available_feeds
```

Data restructure

ration_driver.py

Class AvailableFeeds

pen.py

Class Pen

Data restructure

Class Requirements

NON-LINEAR PROGRAM

- WITH THE RESTRUCTURED DATA, WE CAN NOW PASS IT TO THE NLP FILE
- THIS FILE IS A SPECILAZED NON-LINEAR PROGRAM MINIMIZATION FOR COW RATION FORMULATION

Ration_driver.py

**Class
AvailableFeeds**

**Class
Requirements**

Non-linear
Program

Class Pen

self.ration