CowBase - A Library for Dairy Farm Data Handling and Curation in Python

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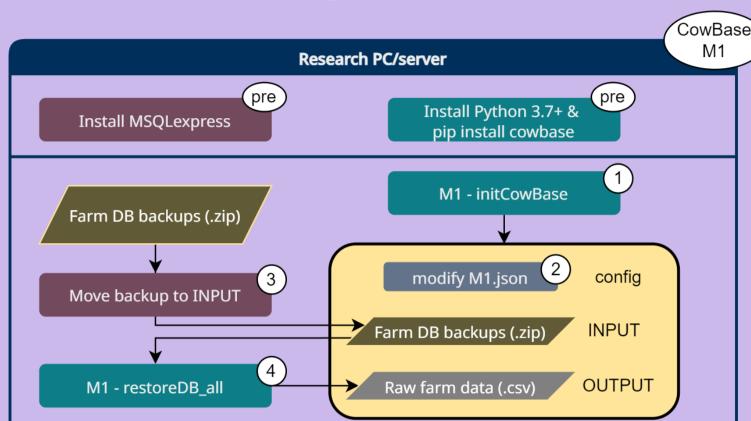
Introduction

More high-frequency and cow-specific data become available with the increased implementation of Automatic Milking Systems (AMS) and sensor technology on dairy farms. Collecting, processing, and analyzing these on-farm sensor data are required for intensive production and health monitoring. Often, with significant differences between data availability and standardization, a time-consuming and error-prone pre-processing makes data and software sharing difficult. Therefore, we present CowBase, an opensource Python software package that streamlines and standardizes data management for dairy farms with AMS.

<u>Objectives</u>

- (A) Extracting data extraction of raw data from the on-farm AMS database or a backup thereof
- (B) Data pre-processing and storage application of standardization and creation of a standardized CowBase database
- (C) Application for data analysis a collection of functions, including a class to handle the data connection with the database and previously published functions/models

A. Extracting data



- CowBase works with both DeLaval and Lely AMS
- A JSON dictionary allows to specify tables & columns for extraction
- Extracted raw data is saved and can be accessed

Fig. 2: Overview of module 1 – data extraction from AMS database backups

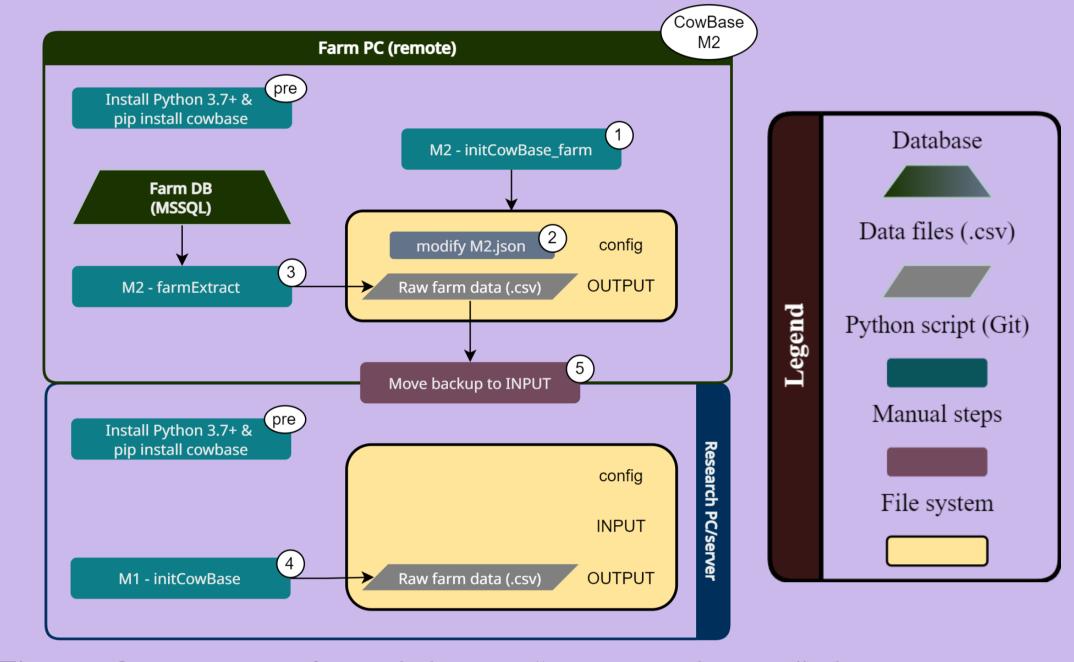


Fig. 3: Overview of module 2 – "semi-real-time" data extraction

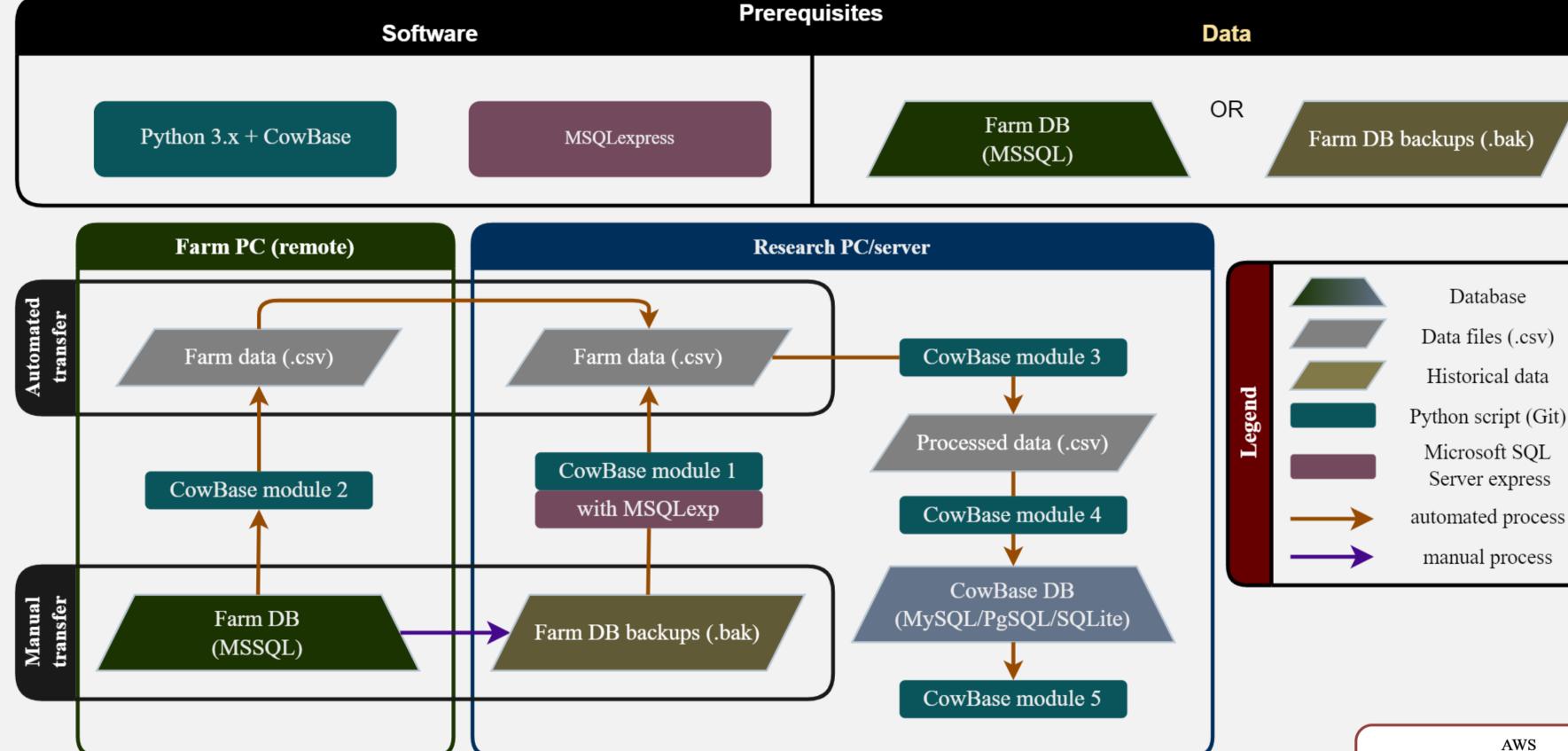
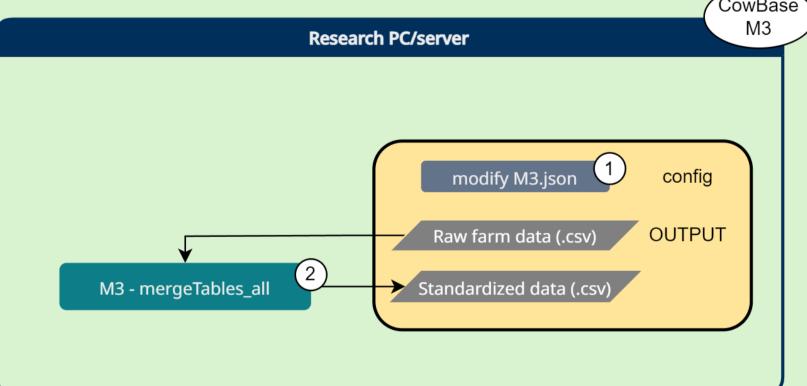


Fig. 1: Prerequisites and workflow for using CowBase. Modules 1 and 2 are used to extract data, and modules 3 and 4 are used for pre-processing and data storage. Module 5 offers a set of general functions that can be used for data analysis.

aws id pkey, serial, bigint aws oid aws oid **AWS Weights** farm id pkey, serial, bigint aws id 1 fkey, serial, bigint fkey, serial, bigint aws id 2 fkey, serial, bigint aws id 3 fkey, serial, bigint aws id 4 farm id Weather pkey, serial, bigint weather id fkey, serial, bigint farm id farm id - datetime

B. Data pre-processing and storage



 On-farm manually entered animal and lactation metadata is corrected using information derived from the milking data

Fig. 4: Overview of module 3 – data pre-processing and standardization

- CowBase supports server-based (MySQL, PostgreSQL) and file-based (SQLite) database instances
- ER-diagram of CowBase is shown in **Fig. 6**

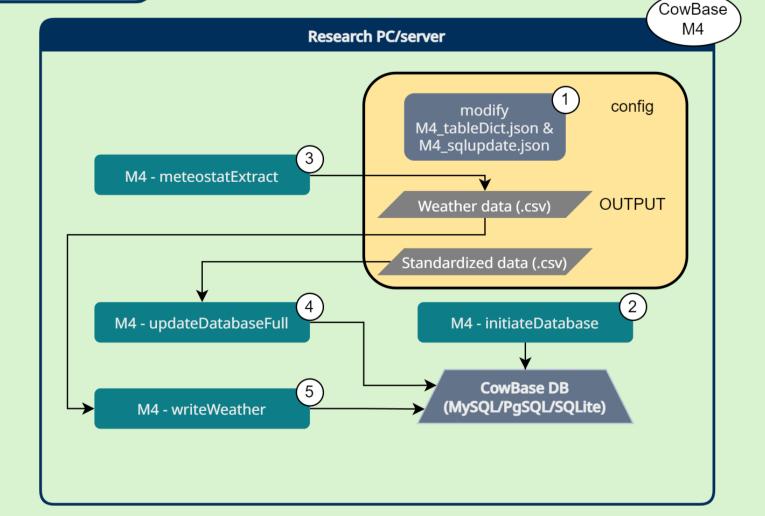


Fig. 5: Overview of module 4 – generating the CowBase database

farm id pkey, serial, bigin farmname milking id pkey, serial, bigint farmname fkey, serial, bigint fkey, serial, bigint Animal fkey, serial, bigint animal id milking oid fkey, serial, bigint farm id animal oid farm id - animal oid pkey, serial, bigint Lactation fkey, serial, bigint pkey, serial, bigint lactation id fkey, serial, bigint farm id fkey, serial, bigint lactation id fkey, serial, bigint animal id lactation oid farm id - bcs oid farm id - lactation oid Activity Milking system pkey, serial, bigint activity id milking system id fkey, serial, bigint farm id fkey, serial, bigint fkey, serial, bigint milking system oid lactation id fkey, serial, bigint farm id - milking system oid activity oid farm id - activity oid Cleaning cleaning id pkey, serial, bigint herdnavigator id farm id fkey, serial, bigint fkey, serial, bigint cleaning oid fkey, serial, bigint milking system id - cleaning oid herdnavigator oid farm id - herdnavigator oid Lactation corrected pkey, serial, bigint lactation id farm id fkey, serial, bigint >0pkey, serial, bigint insemination id animal id fkey, serial, bigint farm id - animal id fkey, serial, bigint lactation id insemination oid Changelog farm id - insemination oid changelog id pkey, serial, bigint fkey, serial, bigint

Fig. 6: Entity-relationship diagram of the CowBase database

C. Application for data analysis

Module 5: Data retrieval and analysis functions

- Connection function to query data from CowBase database in Python
- Previously developed models/functions:
 - "dailyMY"
 - "itw", "pert", "qreg"

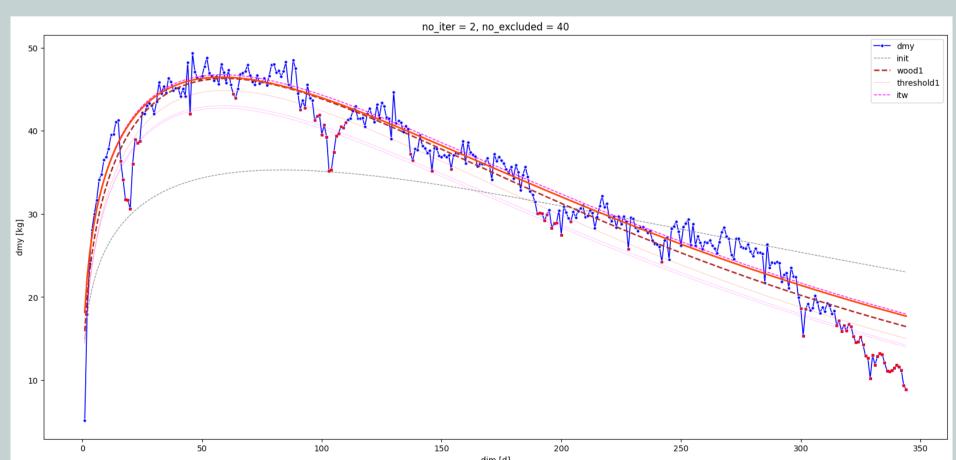


Fig. 7: Iterative wood model – "itw" - (Adriaens et al. 2021) applied to daily milk yield data

Summary

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- CowBase allows for fast and efficient data mining and standardization
- The well-structured CowBase database allows for easy and fast data retrieval and assures high reproducibility of research results
- With standardization applied, sharing data and collaborating in research **projects** is strongly supported
- Tested and validated on **70 European farms** with data dating back to 2005



https://gitlab.kuleuven.be/livestock-technology/cowbase or

pip install cowbase

