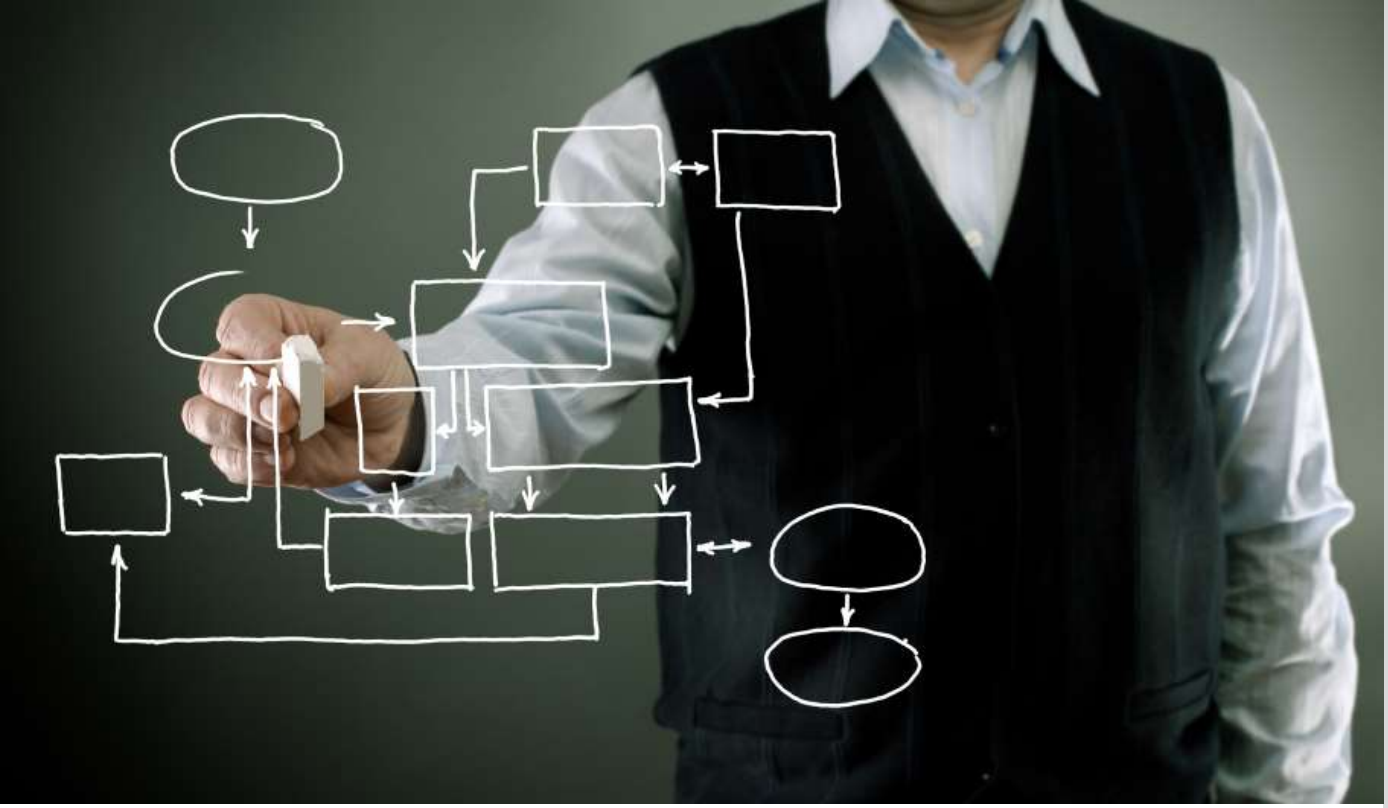

# Concept for a Technical Infrastructure for Management of Predictive Models in Industrial Applications


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**EuroCAST 2019**


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# Research goal

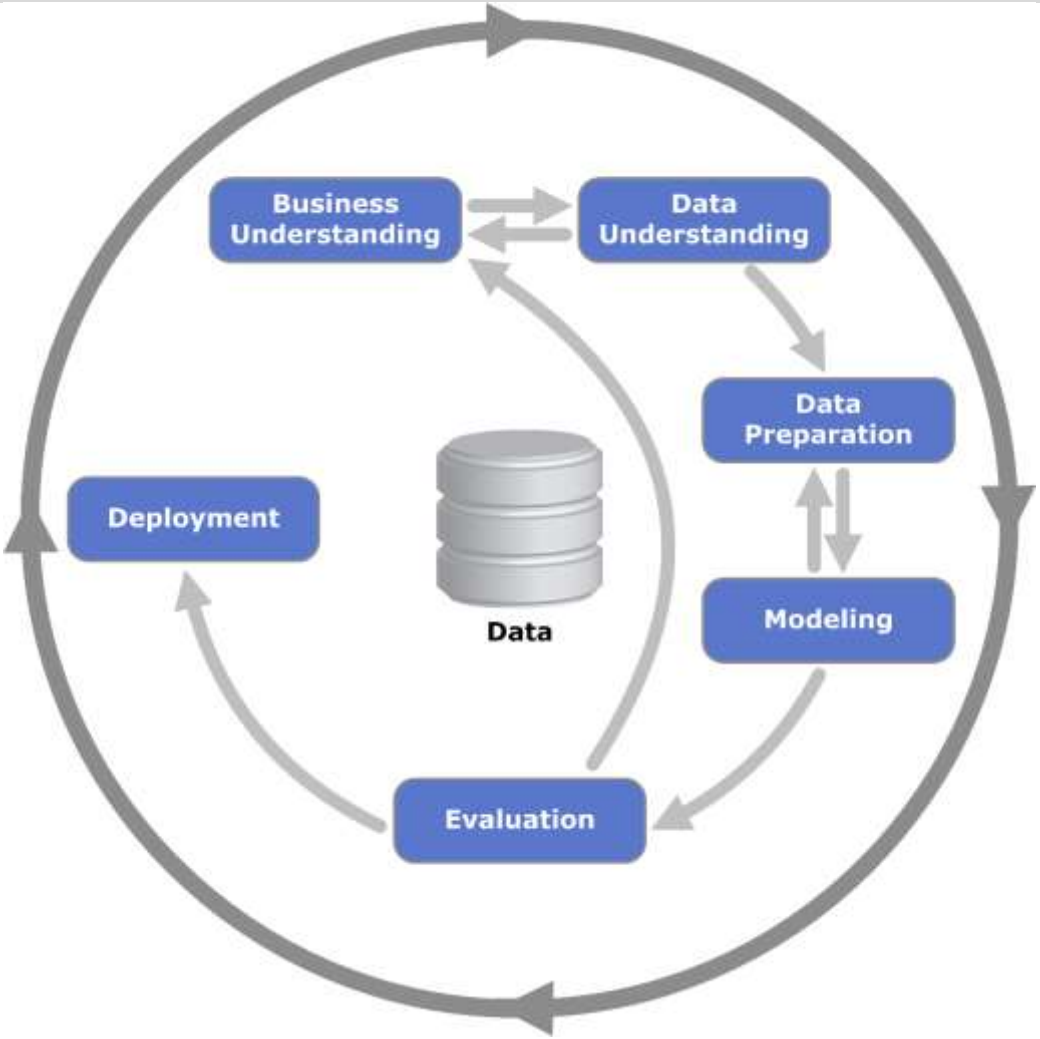
**Support machine learning lifecycle.**

**From data to deployed model.**

# Content overview

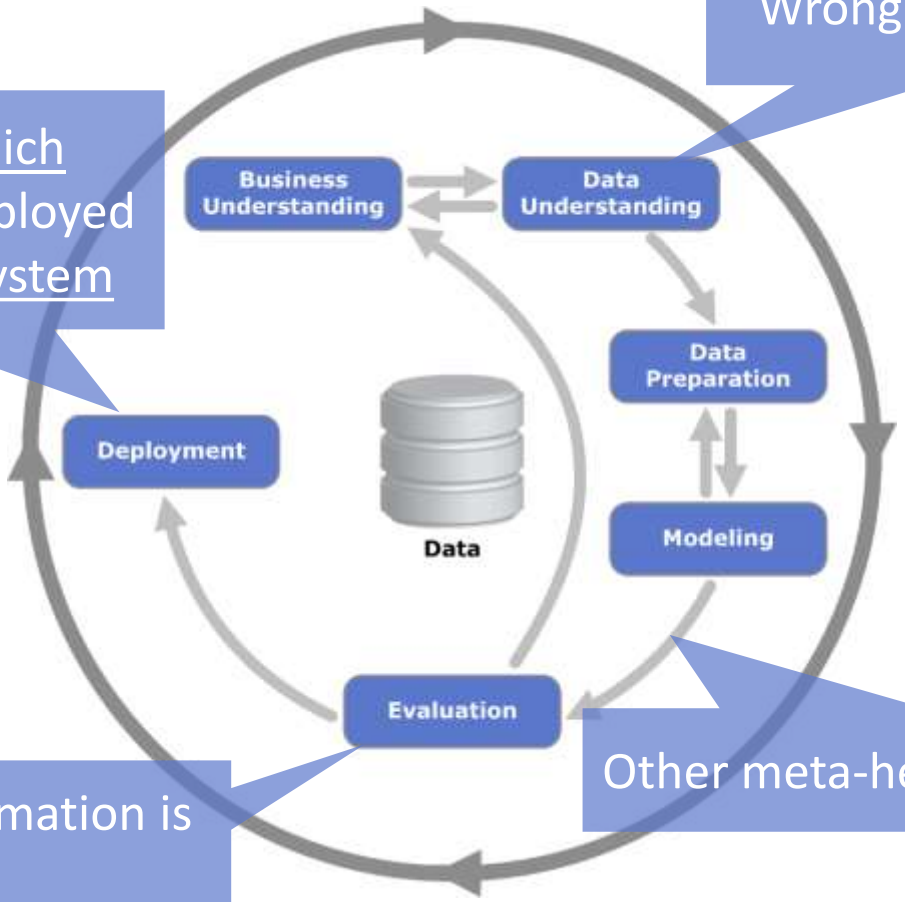
- A typical data based modeling workflow
- Challenges in data based modeling
- RQ: How can we manage models?
- State of art
- Our concept

# Typical machine learning workflow




[1] NCR, P. C., Clinton, J., NCR, R. K., Khabaza, T., Reinartz, T., Shearer, C., & Wirth, R. (1999). CRISP-DM 1.0.

# Problems and challenges



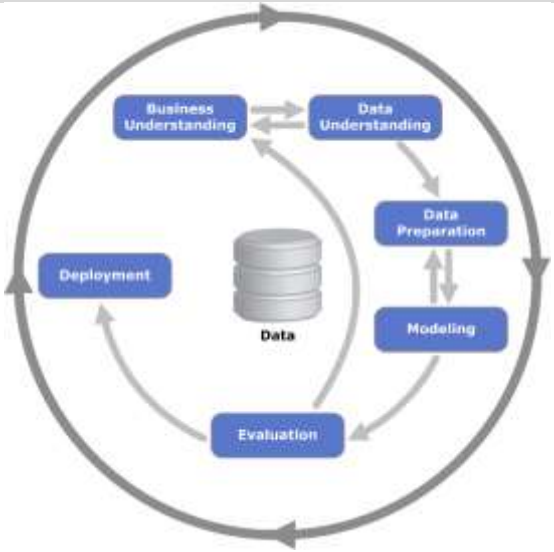

Wrong assumptions

Losing information which model version was deployed and on which target system

Other meta-heuristic works better

Other model's estimation is more robust

# Our vision




- **Ever increasing industrial applications for machine learning**
- **More machine learning models**
- **Model building and training phase is continuous**
  - Improve knowledge discovery in process
  - Through comparability of intermediate results

# RQs: How can we manage models?

- How can we aid **comparison of models** and see **which algorithm or configuration** yielded the best results?
- How can we **ensure reproducibility** of the ML pipeline, from data to deployed model in order to **increase transparency**?
- How can we **automatically and securely roll out improved models** to industrial systems and keep track of their production performance?
- How can we **aid researchers** in the machine learning workflow?

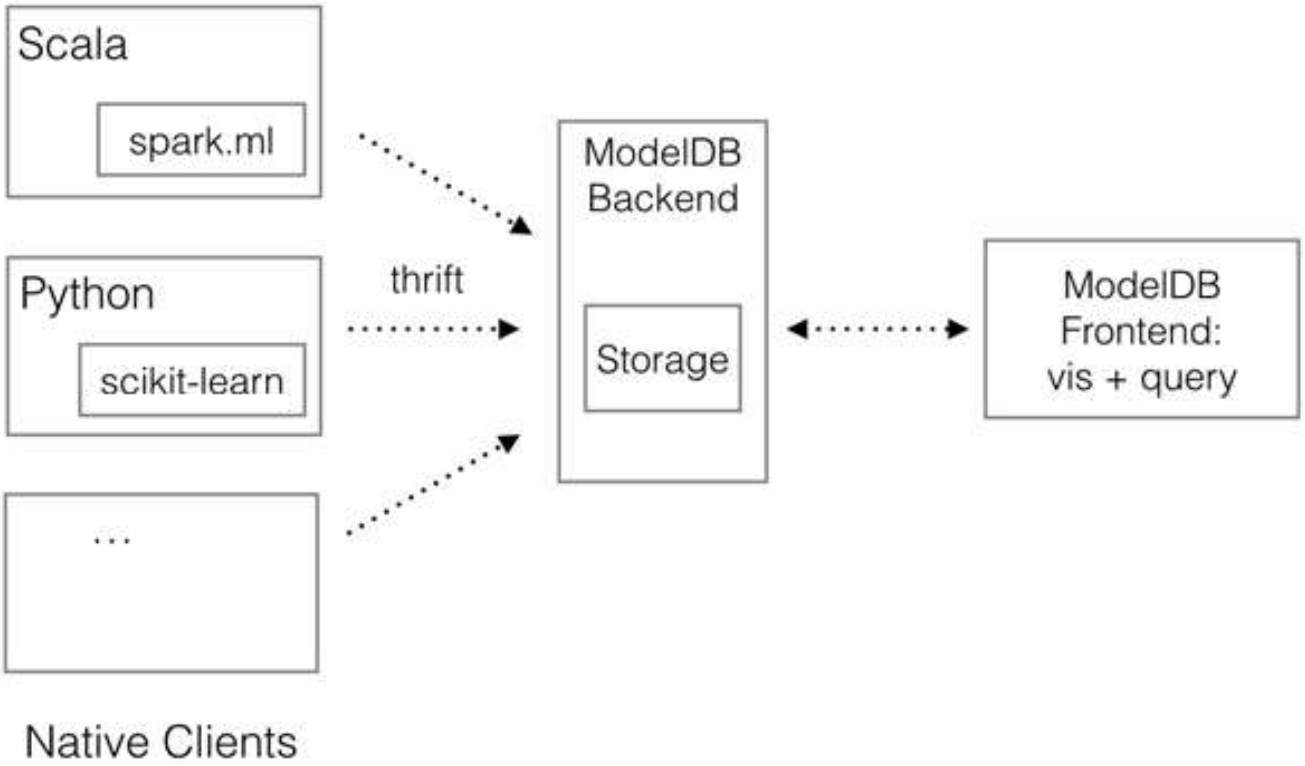
# State of art

- **Database integration**
  - MauveDB [2] – models as DB functions
  - Longview [3] – external models as DB functions (through API)
- **ML framework integration**
  - ModelDB [4] – ML pipeline instrumentation (spark.ml, scikit-learn)
- **Model deployment – prediction serving**
  - Clipper [5] – ML framework agnostic model serving in docker containers

[2] A. Deshpande and S. Madden. MauveDB: Supporting Model-based User Views in Database Systems. In SIGMOD, 2006.
[3] M. Akdere et al. The Case for Predictive Database Systems: Opportunities and Challenges. In CIDR, 2011.
[4] M. Vartak et al. MODELDB: A System for Machine Learning Model Management. In SIGMOD Workshop HILDA, 2016.
[5] D. Crankshaw et al. Clipper: A Low-Latency Online Prediction Serving System. In NSDI, 2017.

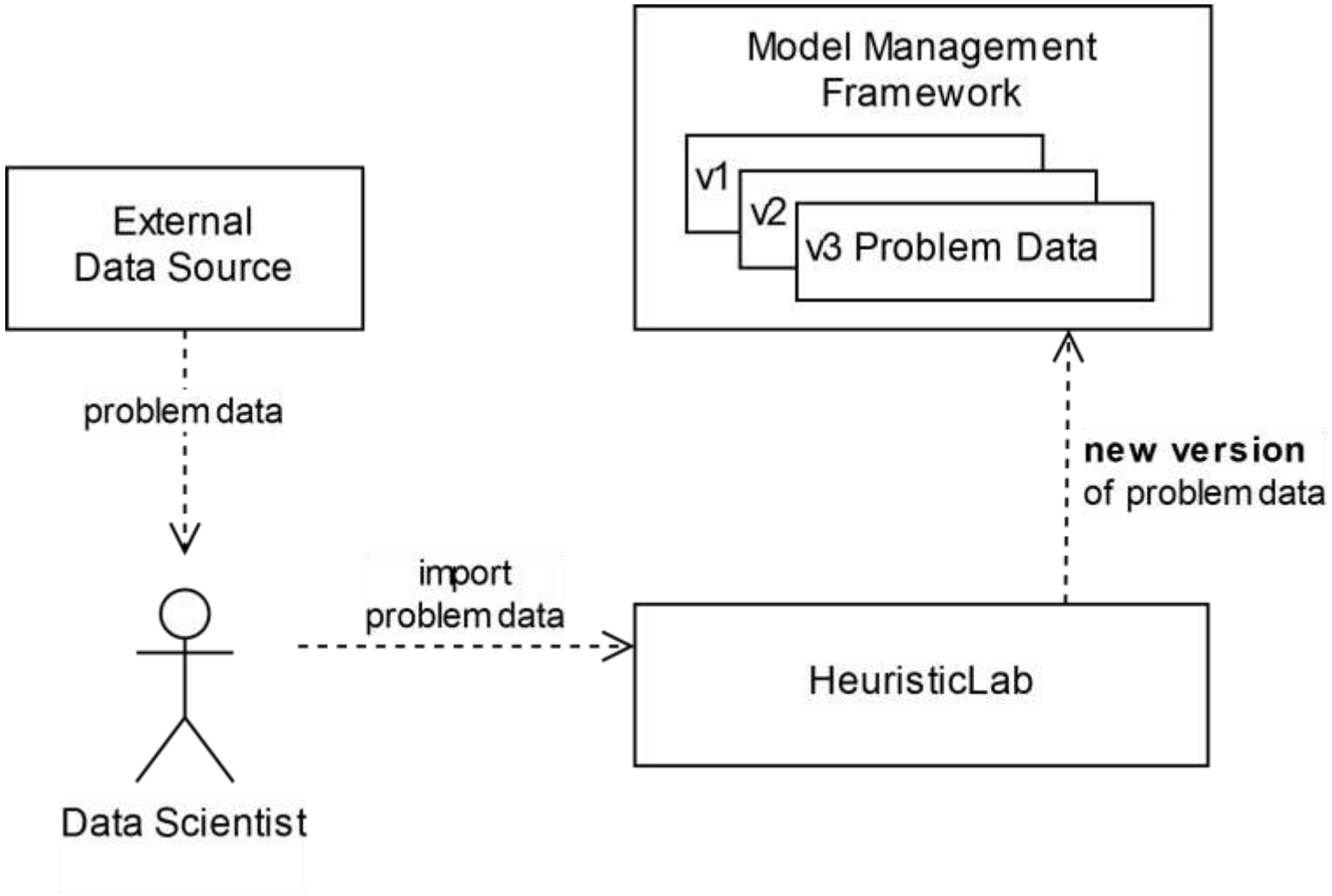
# State of art – ModelDB (MIT DB Group)

```
estimator.fit(data) --> estimator.fitSync(data)
transformer.transform(data) --> transformer.transformSync(data)
model.predict(data) --> model.predictSync(data)
```

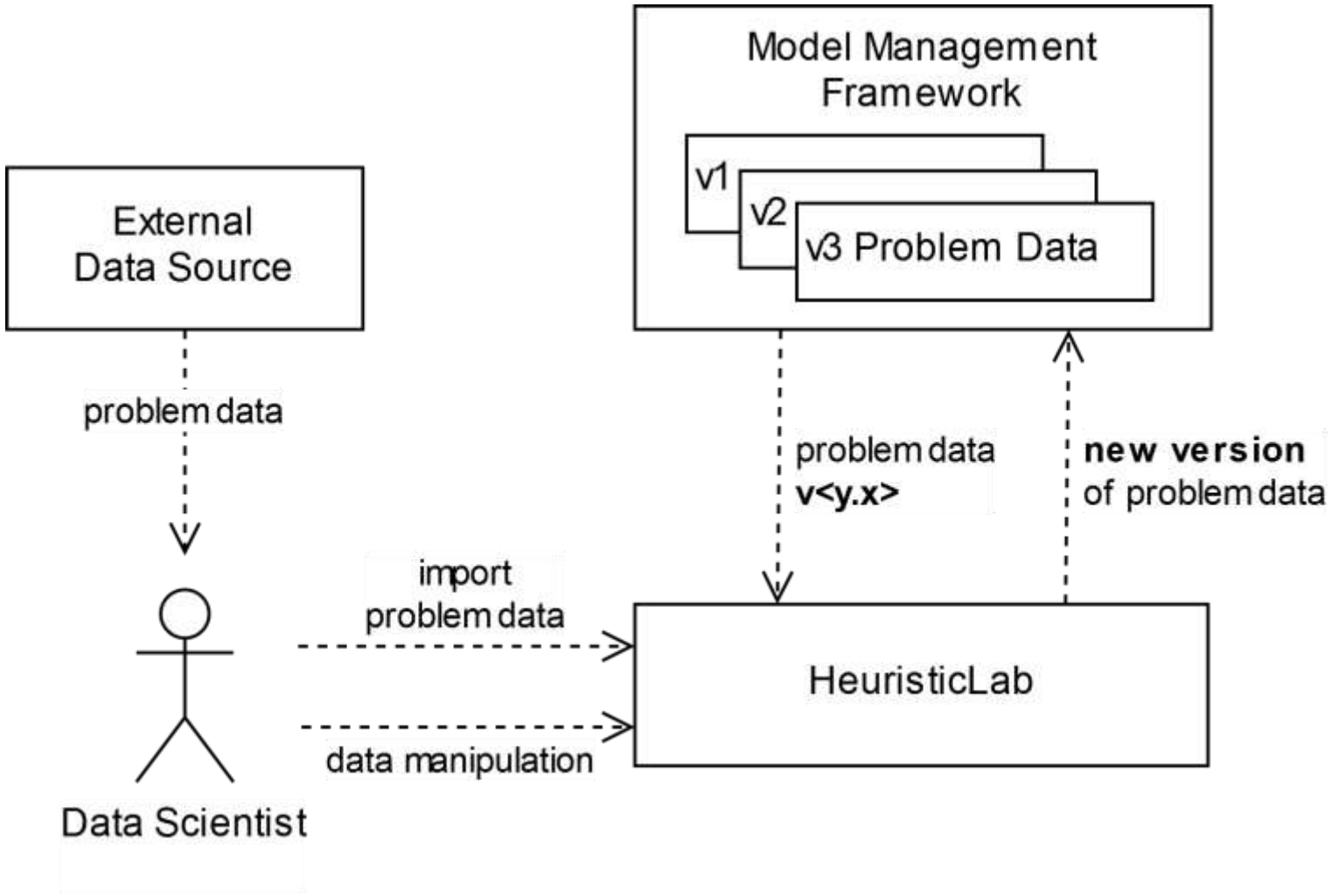



[4] M. Vartak et al. MODELDB: A System for Machine Learning Model Management. In SIGMOD Workshop HILDA, 2016.

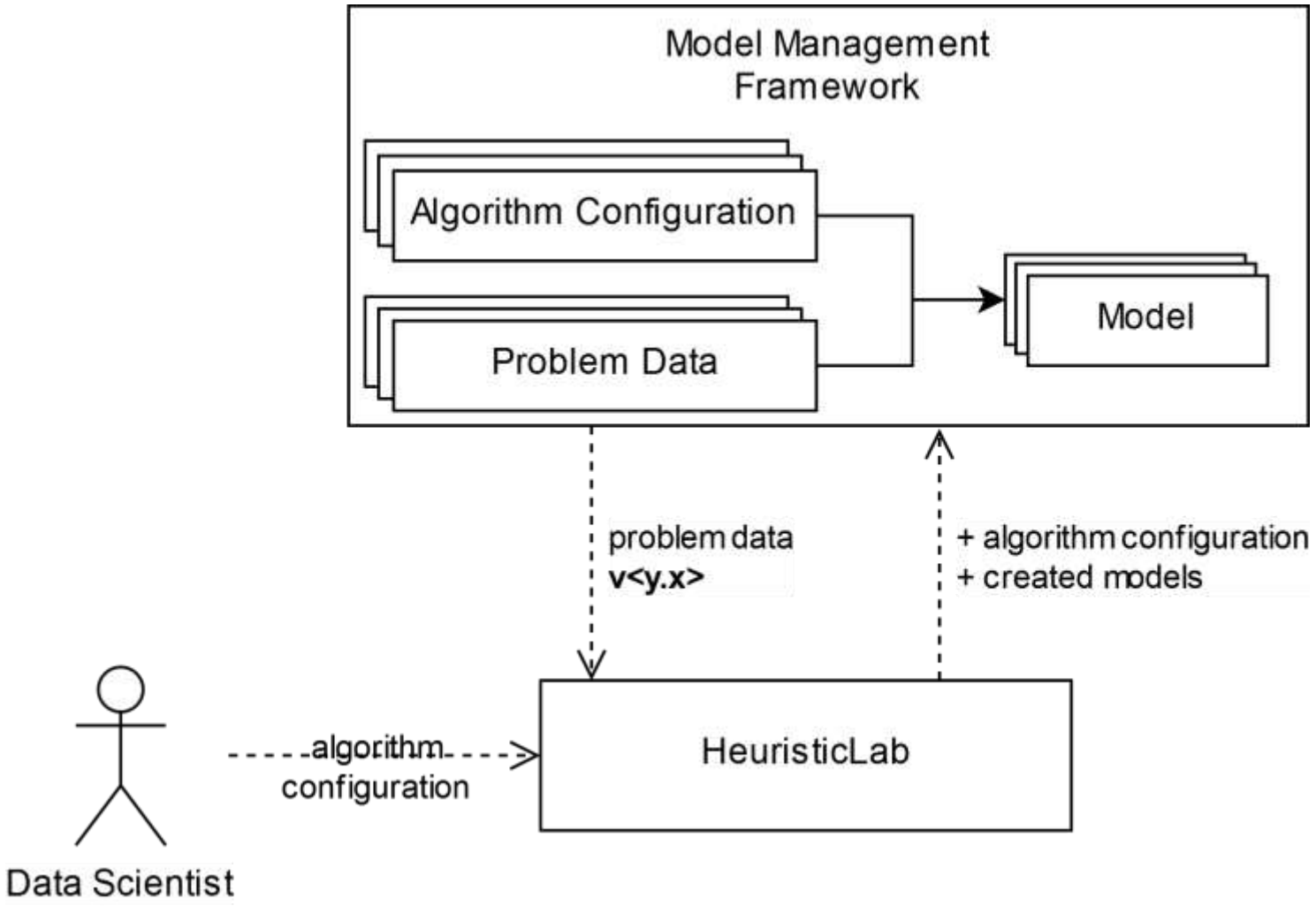
# Concept for data integration



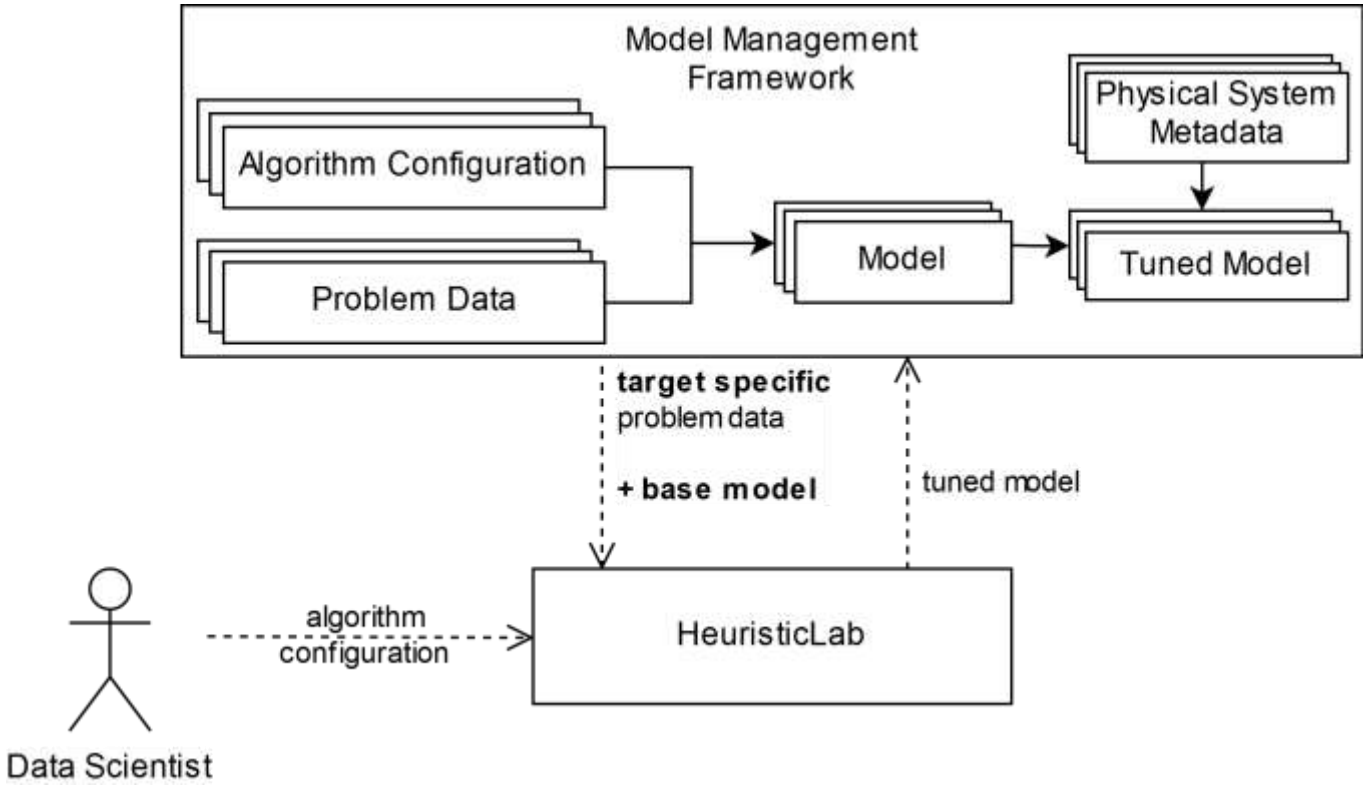
# Concept for data integration – data preprocessing



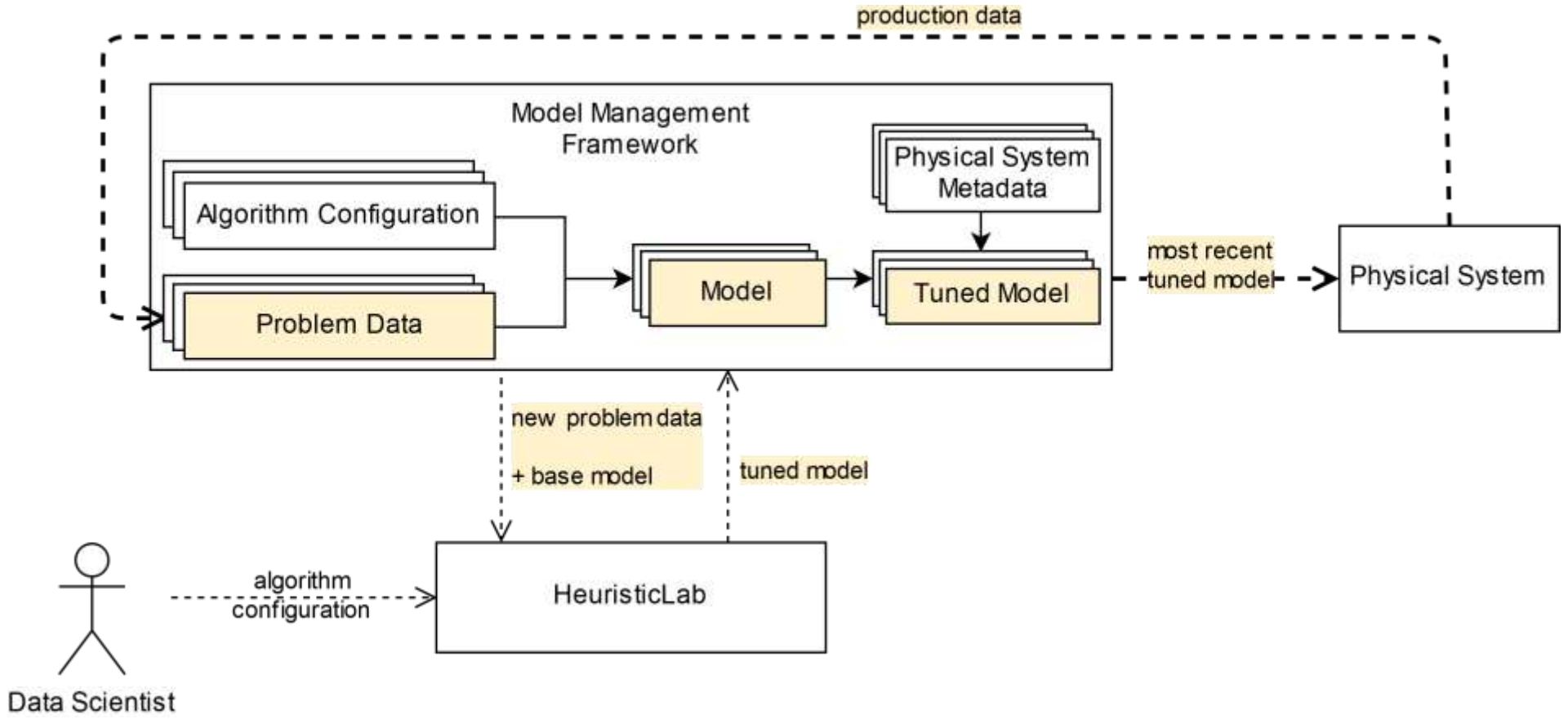
# Concept for model versioning



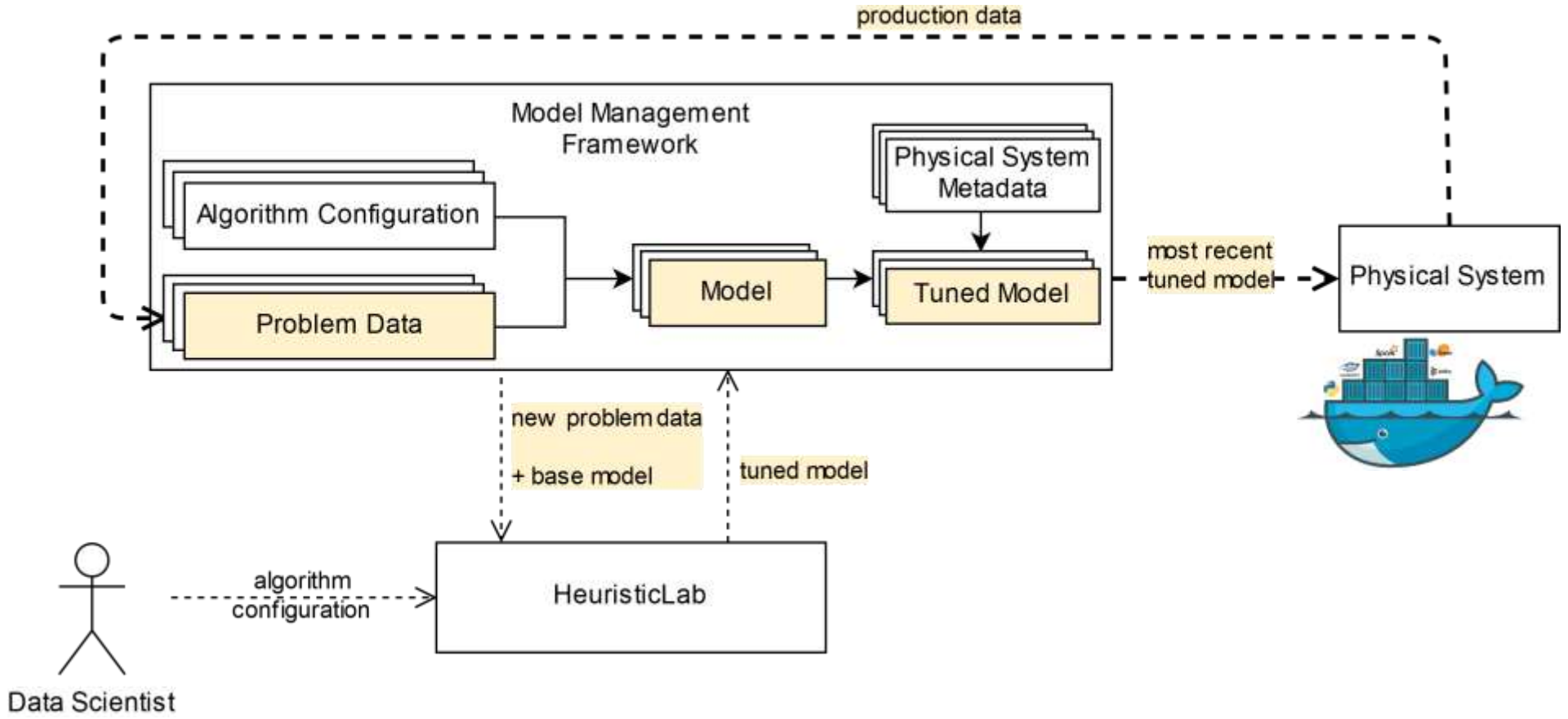
# Concept for tuning models for a target system



# Concept for deployment and target system feedback



# Concept for ensuring execute ability of deployed model




[5] D. Crankshaw et al. Clipper: A Low-Latency Online Prediction Serving System. In NSDI, 2017.

# Conclusion

- Fully integrated and connected machine learning lifecycle
- Versioned storage of data
- **Tracking deployed models and observing their performance**

# Discussion

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