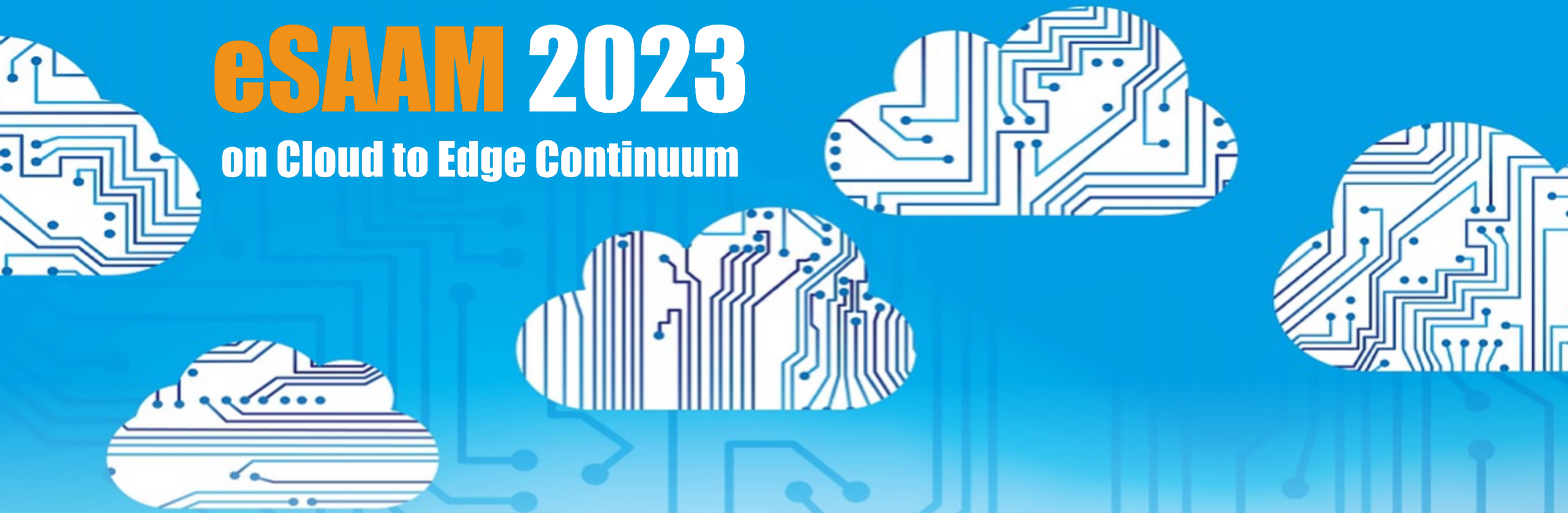


# Federated Learning Simulation Engine

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Oct. 17, 2023

Ludwigsburg, Germany

# Structure



- What is federated learning (FL)?
- How does FL work?
- Why FL?
- Proposed simulation tool
- Conclusions

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# What is FL?

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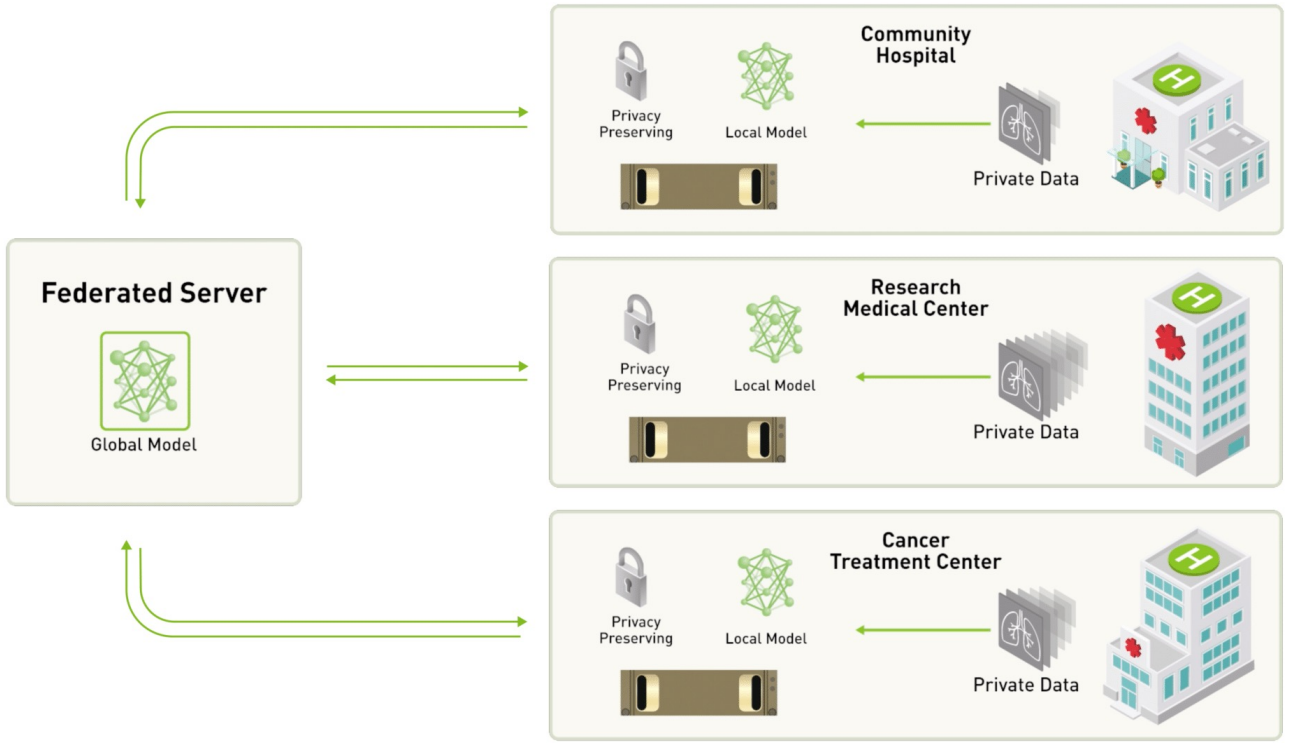
# Slide #1.1



- **Is a learning algorithm that allows to train models on decentralized data.**
- **Allows to train models without the exchange of private data.**
- **Involves two different entities:**
  - Central node stores the global model and acts as aggregator.
  - Data nodes store local copies of the global model: local learners.




Nvidia blog: What is federated learning?

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# How does FL work?

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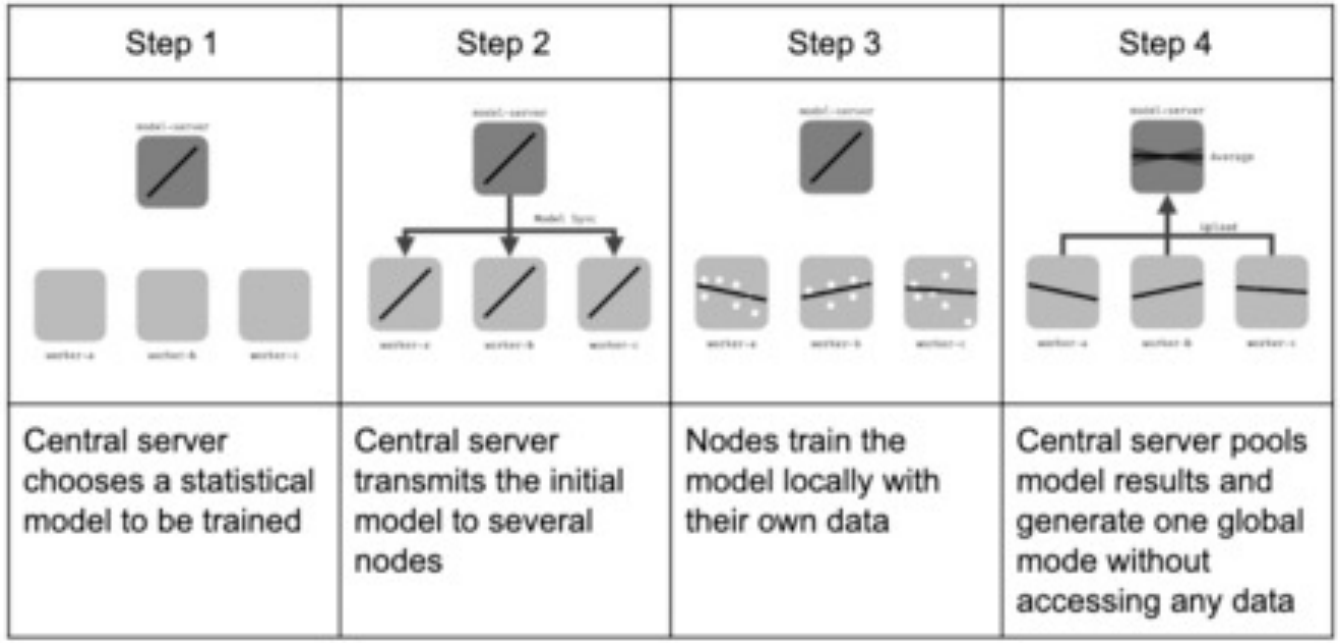
# Slide #2.1



- **Runs iteratively such that:**

1. The local learners get trained on local data.
2. The aggregator combines the updates received from all data nodes and broadcasts a new version of the global model.




Wikipedia: Federated learning

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# Why FL?

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# Slide #3.1

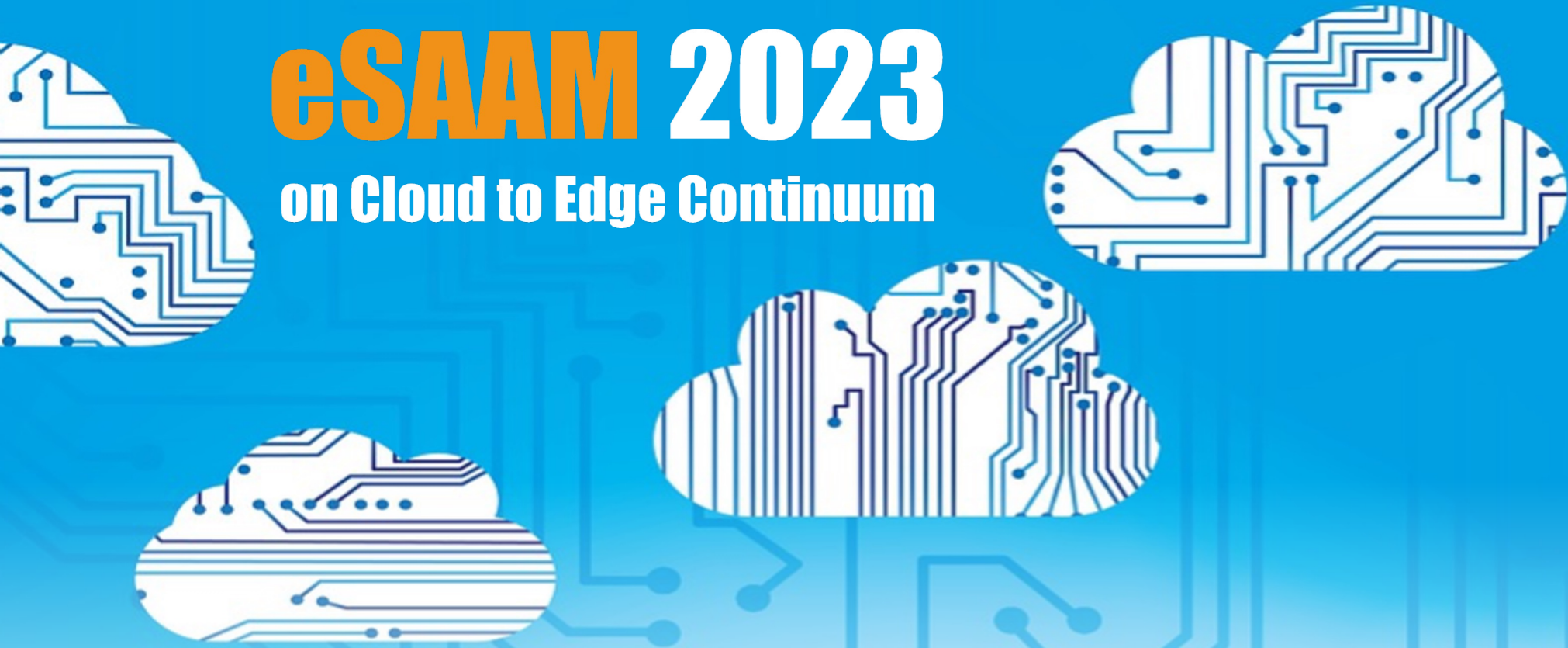


- Complies with data protection regulations regarding sensitive data.
- Supports novel approaches → Deep Learning.
- Can leverage on further privacy mechanisms. E.g. SMPC and DP

# Slide #3.2



- Complies with data protection regulations regarding sensitive data.
- Supports novel approaches → Deep Learning.
- Can leverage on further privacy mechanisms. E.g. SMPC and DP
- **But it comes with a cost:**
  - Leap in complexity w.r.t. traditional ML.
  - In general, humble hardware resources in data nodes. E.g. phones.
  - Unpredictable behaviour in production scenarios.

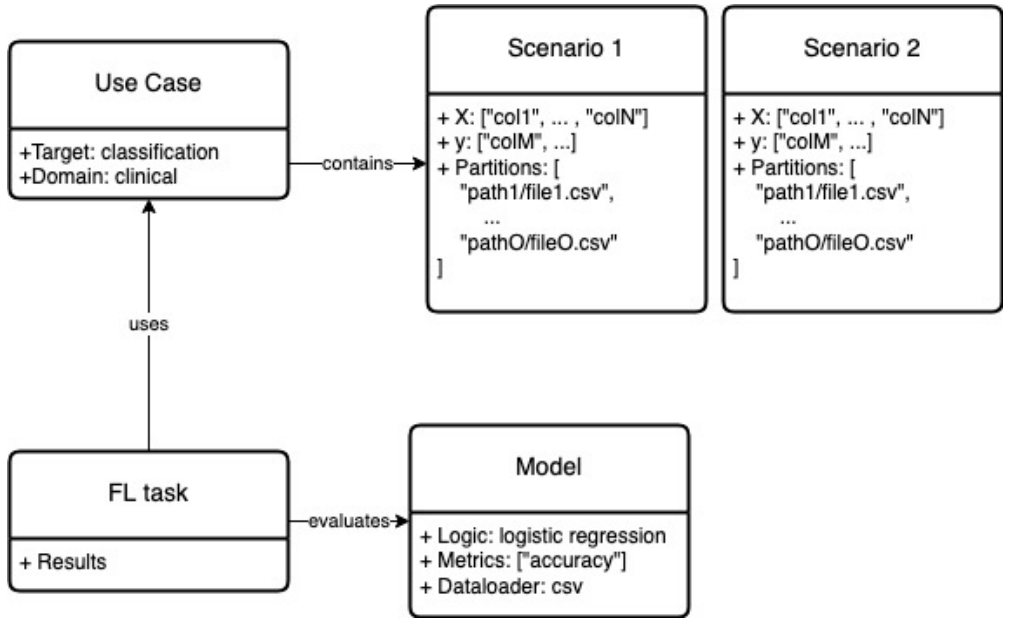


# Proposed simulation tool

# Slide #4.1



- **Features:**
  - Allows for the definition of use cases
  - These use cases can be defined by the end user
  - They consist of a set of scenarios
  - A model can be simulated over meaningful data for a specific task
  - FLOps → level 2 of maturity. Automatic training and evaluation + automatic verification of the models

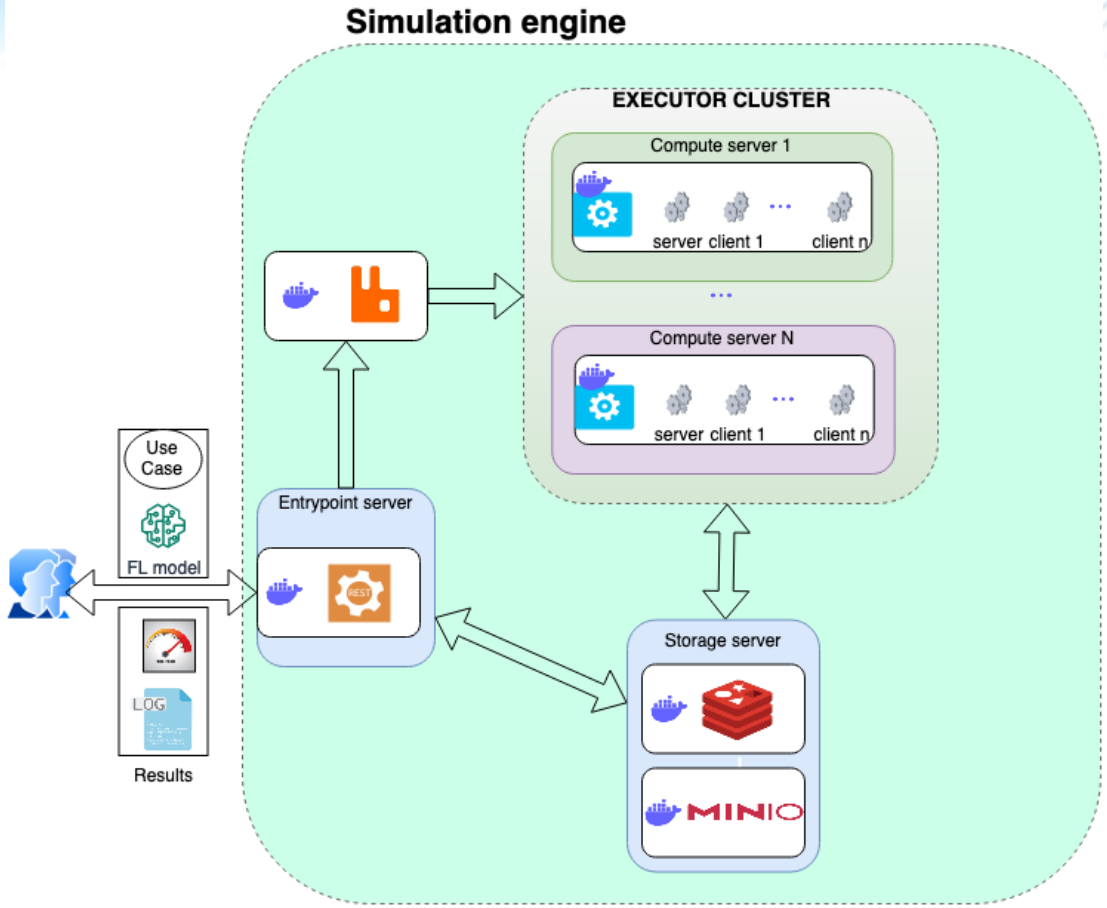



ER diagram

# Slide #4.2



- **Benefits:**
  - Validate that a FL model runs error free prior to production scenario
  - Optimizes resources usage in the production environment
  - Gives a sense of the performance of the FL model over use cases
  - Runs on a multicontainer setup




Architecture diagram

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# Conclusion

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# Slide #5.1



- Offers a tool that can be used both standalone or embedded within a larger architecture, it can be deployed anywhere and allows for concurrent, scalable, and highly available V&V assessment support for FL models
- Supports AI practitioners in the process of integrating FL driven model designs and to grasp model performance prior to production scenarios, allowing for a boost in trustworthiness towards ethical AI

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