Vizualizacija sestave izdelka, podprta z vdelavo jezikovnega modela

Visualization of the BOM Tree Supported by LLM Embeddings

Projektni seminar – uvodna predstavitev

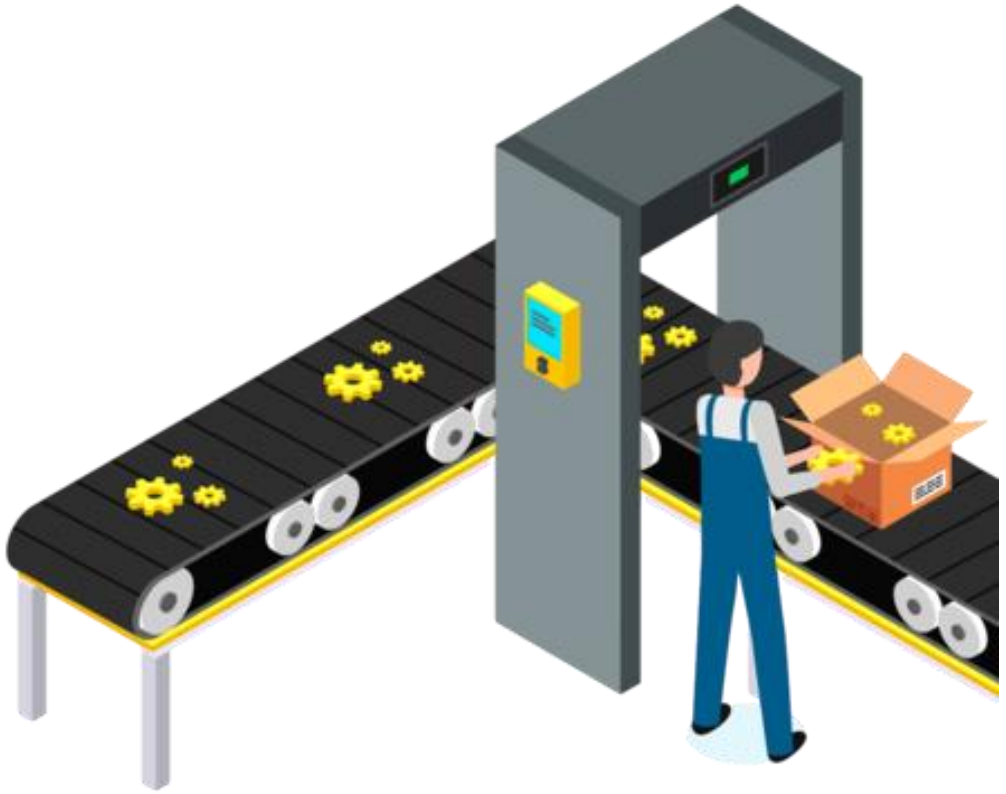
Andrej Erjavec

Mentor: doc. dr. Aleksandar Tošić

Introduction

- Industries rely on Bill of Material trees (BOMs)
  - Product configuration visualization
  - Production planning
  - Support PLM
  - Design comparison
  - Quality control and traceability

- **Task: BOM visualization for an automotive industry company**



Problem description

- Automotive company
- Large BOMs stored in JSON format
  - Products, operations and raw materials
  - Metadata and operation parameters
- A lot of parameter data
- Effective visualization of structure and data
- Easy information retrieval

We want to find operation parameters. There can be multiple 1000 parameters per product.


```
{
  "value": 26.1871,
  "parameterName": "T kosa [°C]",
  "limitLow": -100,
  "limitHigh": 100,
  "parameterDescription": "Temperatura kosa",
  "machineId": "12006354700",
  "unit": "°C",
  "scope": "PRODUCT",
  "dataType": "DOUBLE"
},
```


Figure 1: example of parameter representation in JSON format

How the data is generated

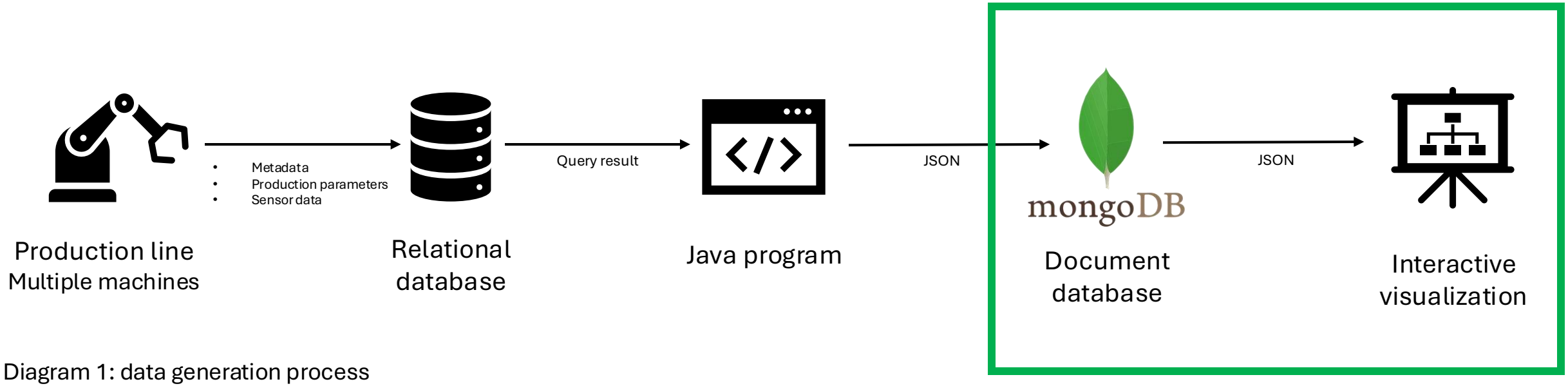


Diagram 1: data generation process

Requirements

- Easy to understand visualization
  - BOM structure and data
- Only important information visible
- Other data visible on demand
- Intuitive UI, easy to navigate
- Quick information retrieval
- Integration with Ignition SCADA software [1]

Workflow

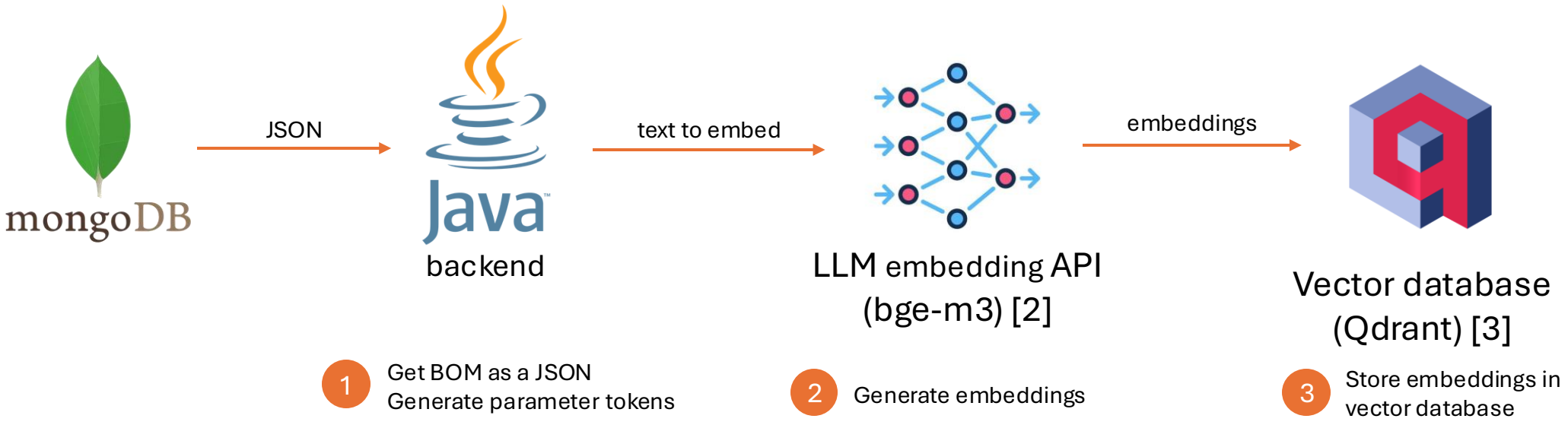


Diagram 2: process of BOM convertion to JSON and technologies used

Workflow (cont.)

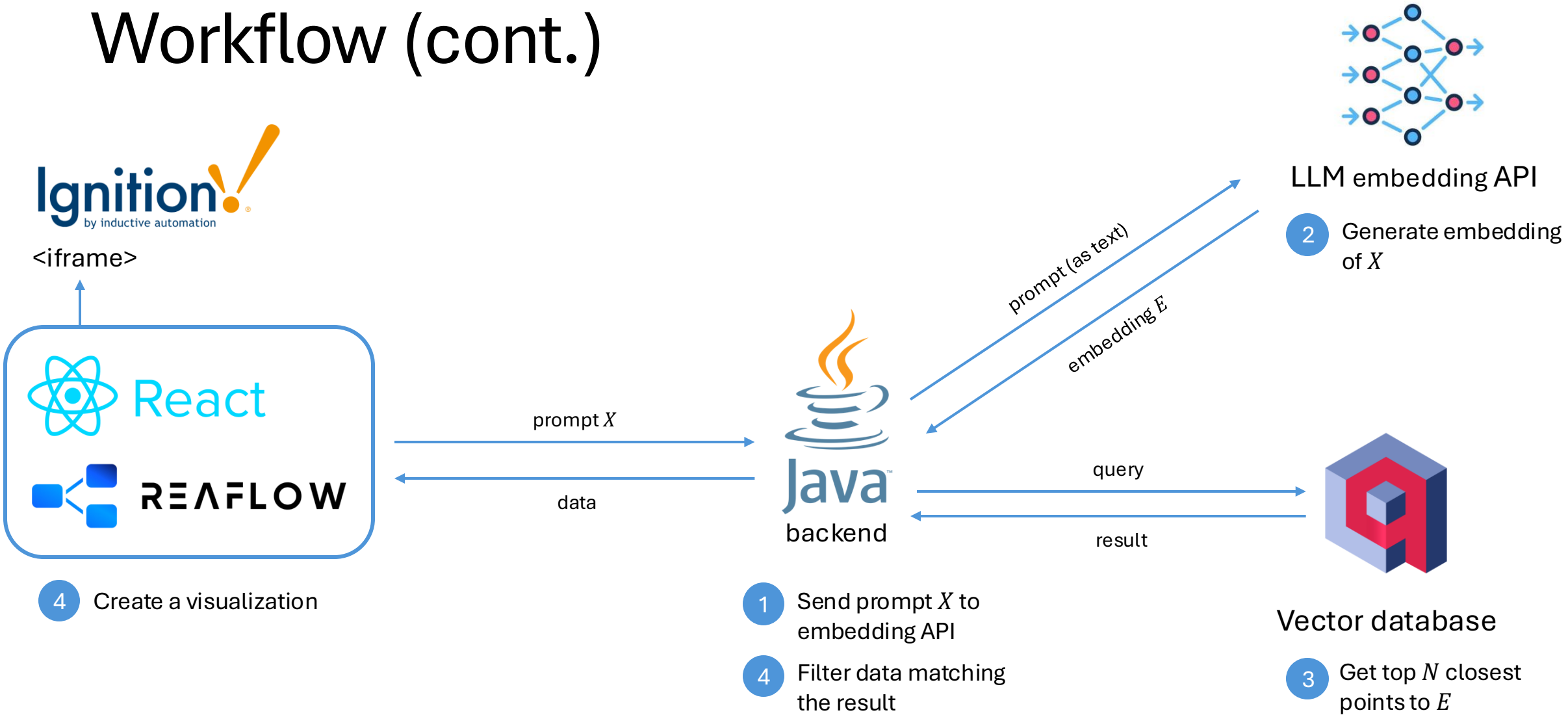


Diagram 3: process of information retrievel and technologies used

Embedding structure

```
{
  "productName": ”...",
  "operationName": ”...",
  "parameterName": ”...",
  "parameterDescription": ”...",
  "context": ”..."
}
```

Proposed visualization technique

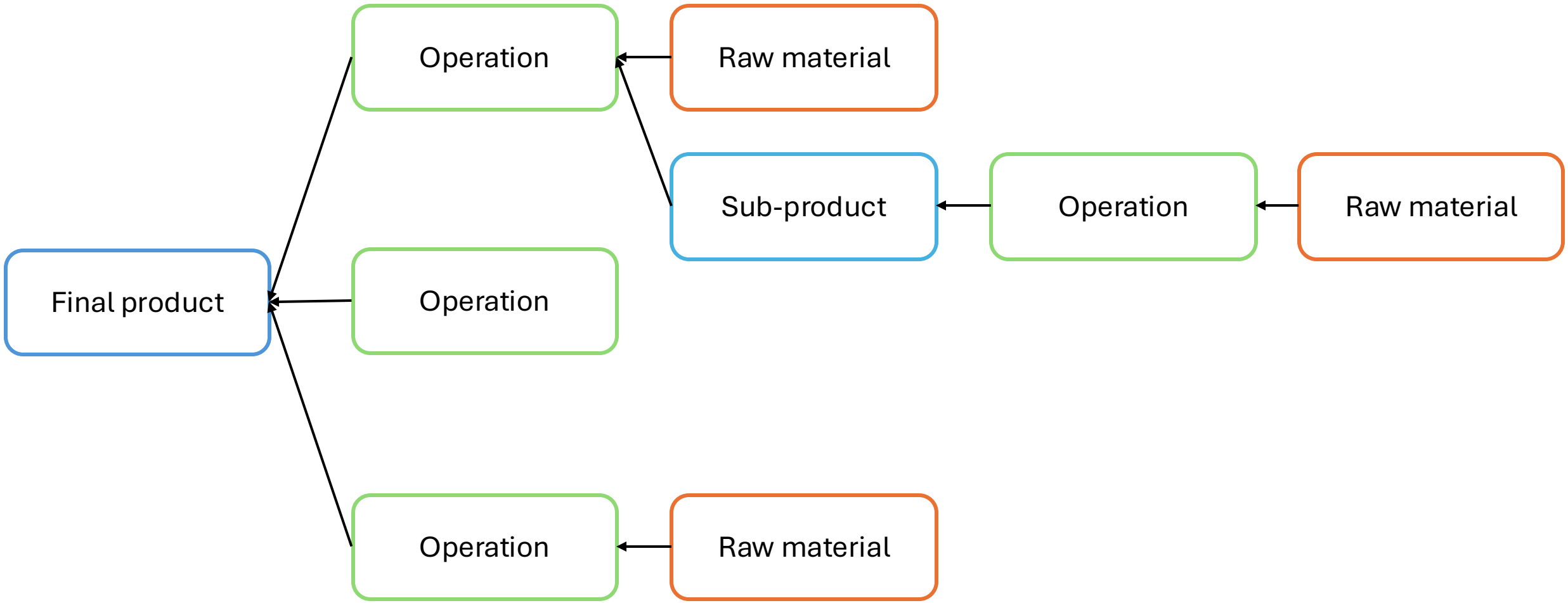


Diagram 4: BOM tree visualization schema

Usability testing

- 2 proposed versions of application
    1. Whole tree is displayed
    2. LLM-supported information retrieval

- Testers: experienced users (engineers), unexperienced users
- Task: find a specified parameter
- Measure time, clicks and mouse movement

Timeline

Week	Progress
1	testing different libraries for graph visualization
2	formatting for Reaflow on frontend
3	designed custom nodes
4-5	node collapsing
6-7	backend for interaction with embedder and vector DB
8-9	search and displaying query results on frontend
10-11	framework for user testing

Further work:

- Add mouse clicks and mouse tracking to user testing
- Deployment on FAMNIT servers
- Plan and prepare for user testing

References

[1] SCADA Software (https://inductiveautomation.com/scada-software/)

[2] bge-m3 (https://huggingface.co/BAAI/bge-m3)

[3] Qdrant(https://qdrant.tech/)

Reaflow (https://reaflow.dev/)

Thank you!

Questions?