Enriching Models with Extra-Functional Information

Or: How to abuse modelling-languages for unintended purposes

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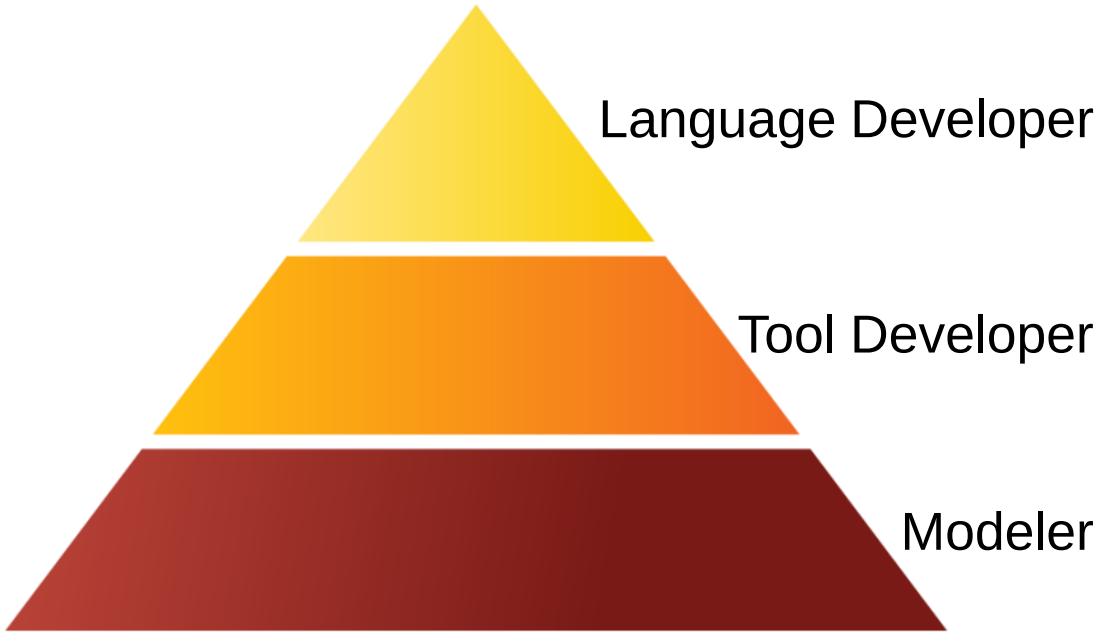
How This Talk Benefits YOU

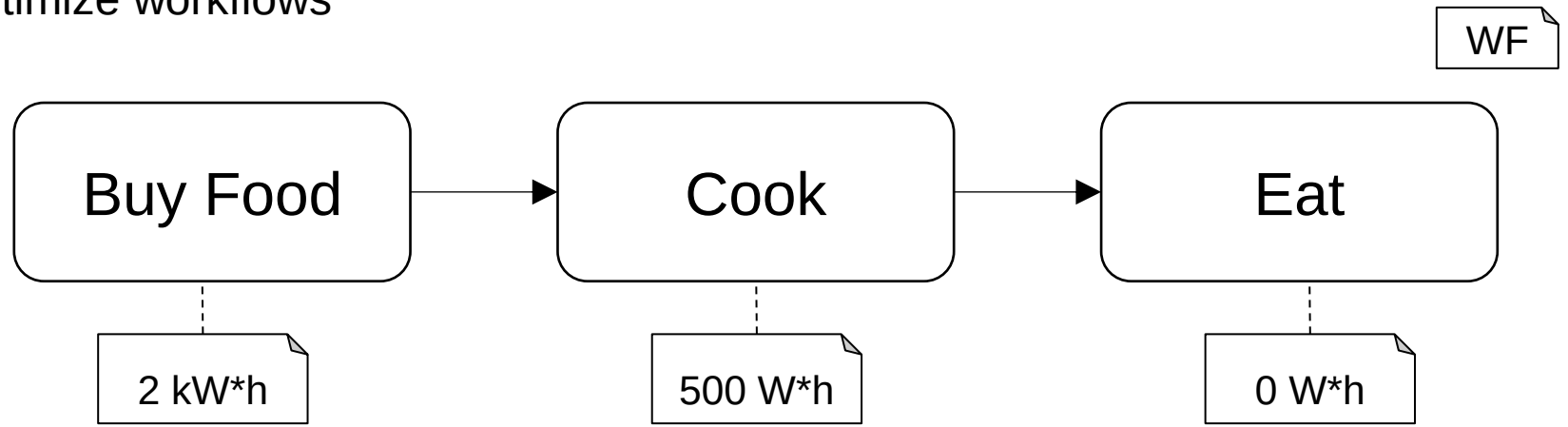


- Future-Proofing Languages
  - Longevity by accommodating unforeseen use-cases.
- Stable Language
  - Dependable foundation for long-term development
- Minimal Language
  - Easier maintenance and support
  - Reduces learning curve for new users
- Empowering Tool Developers
  - Vibrant ecosystem around language

⇨ Enable Tool-Developers to handle new use-cases

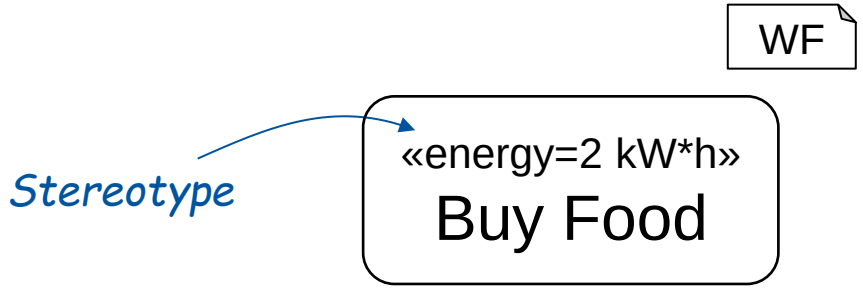
Running Example – Workflow with Sustainability Information

- Workflow-Language
  - Model tasks and dependency between tasks
  - Minimalistic demonstration
- Annotate tasks with energy consumption
- Analyse Workflows for total energy consumption
  - Idea: optimize workflows



Simple Way of Adding Information – Stereotypes

- What are stereotypes?
  - `<<energy="2 kW*h">>`

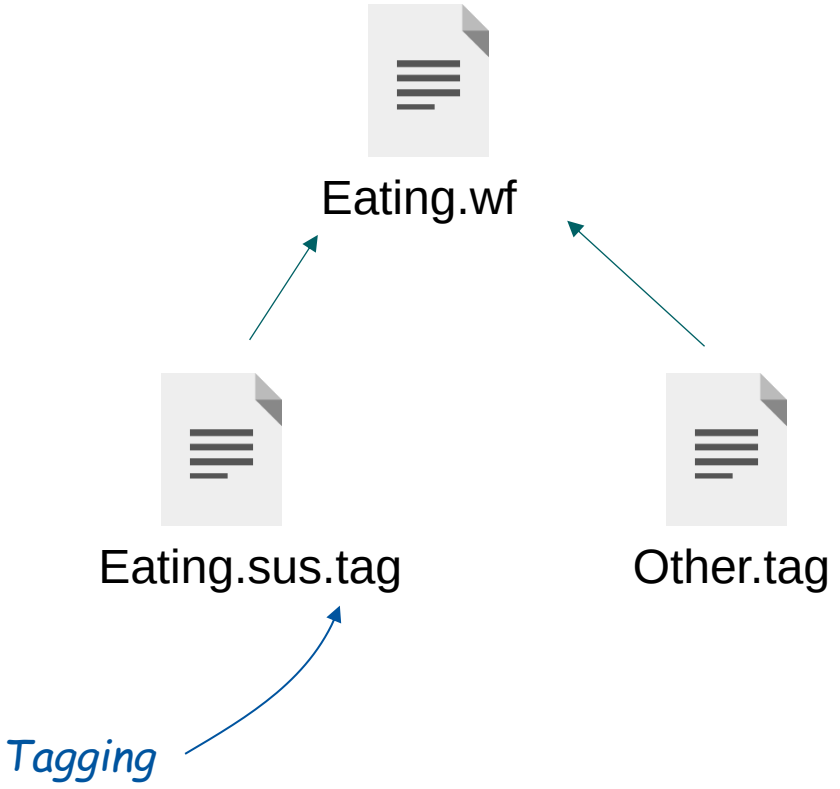


- Benefits :
  - Integration: Seamlessly information within the model itself.
  - Easy for Language Developer

- Downsides:
  - Spelling-Mistakes hard to detect
  - Must be present in modelling-language
  - Cluttered Models: Model overloaded with extraneous information

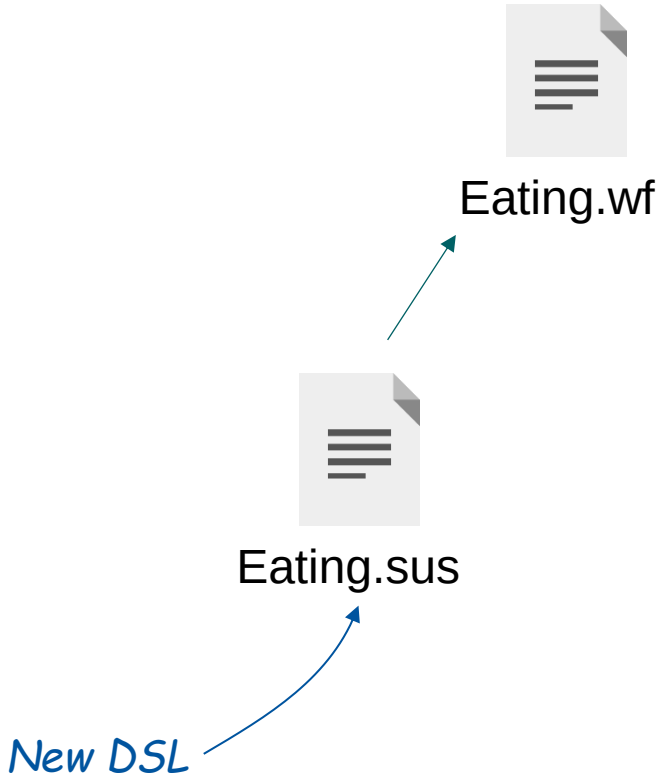
Declutter the Model – Tagging in Separate File

- What is Tagging?
  - A separate file that references elements of the original model.
  - Adds extra information without modifying the core model.
- Benefits:
  - Unchanged Core Language
  - Validation of Names
  - Separation of Concerns – separates model annotations.
  - Reusability: Independent of modelling-language
- Downsides:
  - Requires Reference Mechanism
  - Synchronization Effort
  - Readability



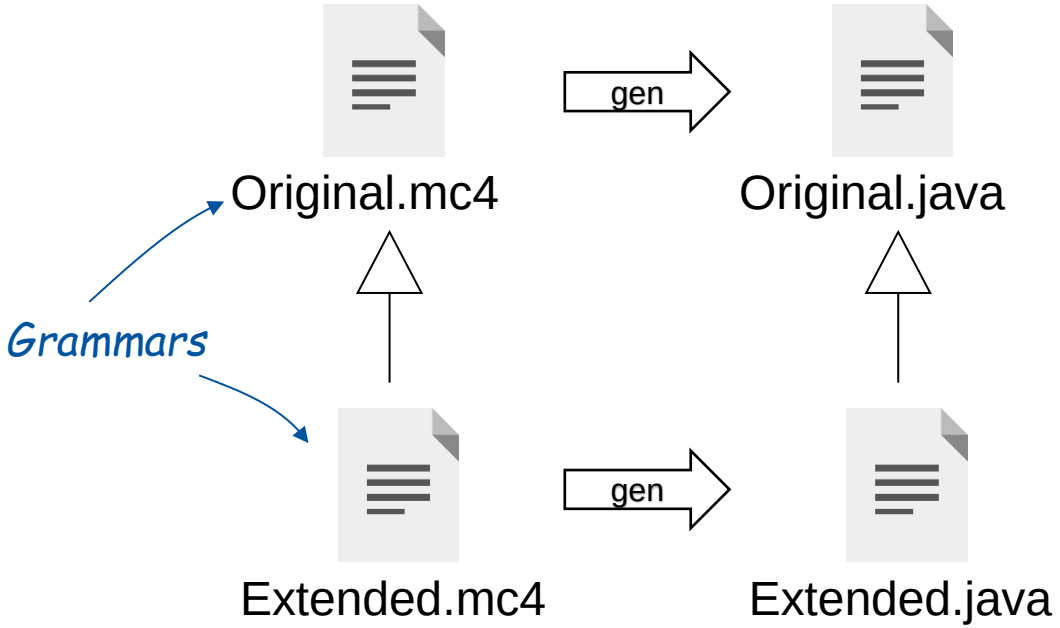
Create a New Domain-Specific-Language

- What is it?
  - A separate file that lies alongside the original model.
  - A new DSL tailored for the specific use-case.
- Benefits
  - Customization to use-case
  - High readability
- Downsides:
  - Higher initial effort than tagging
  - Requires reference mechanism
  - Synchronization Effort



Extend Original Language while Keeping Some Compatibility

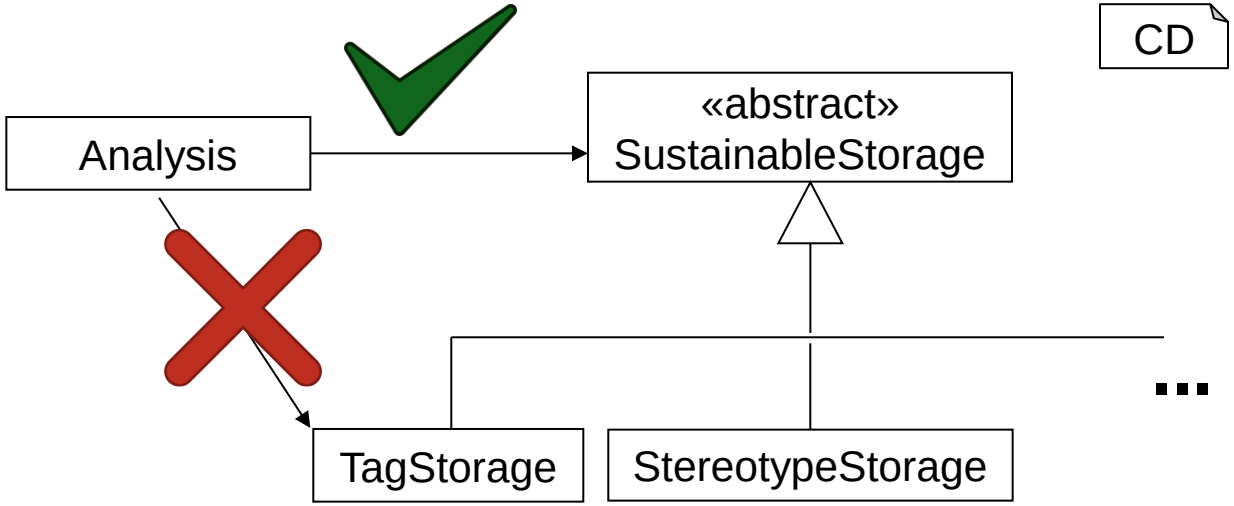
- What is it?
  - New information is embedded within the model.
  - The language is modified specifically for the use-case.
- Benefits:
  - Tool Compatibility: Inheritance of Java data structure allows reuse
  - Integration: Seamlessly information within the model itself.
- Downsides:
  - Cluttered Models: Model overloaded with extraneous information
  - Transformation to original model sometimes necessary
  - More effort & complexity



There are Many Good Ways – Abstract from It!

- For analysis, generators, or other tools, the location of additional information is irrelevant.

- Benefits:
  - Flexibility in approach selection
  - Consistent access method
  - Simplified maintenance
  - Easy interchangeability



With Great Power Comes Great Responsibility – Java Annotations

- What are Java Annotations?
  - Metadata added to Java code elements
  - Provide additional information to the compiler and runtime.
  - E.g. Spring, Hibernate, JUnit, Lombok
- Benefits:
  - Code Simplification: Reduce boilerplate code
  - Tool Integration
- Downsides:
  - Not realistic for many DSLs: Requires a powerful and flexible language
  - Hard to debug

Java

```
1  import lombok.*;
2
3  @Builder
4  public class Person {
5    private final String name;
6
7    @Getter(AccessLevel.PROTECTED)
8    private int age;
9
10   Person(String name, int age) {
11     this.name = name;
12     this.age = age;
13   }
14 }
```

Annotation -- Lombok

Conclusion – Experience

Personal Use-Cases:

- Stereotypes: Code-Generator configuration, State-Invariants for analysis
- Tagging: As internal data structure within tool
- Separate DSL: Effect analysis for SysML systems
- Extend DSL: MontiArc4Verification

Questions for you:

- Did you ever want to add additional information that the modelling-language didn’t support?
- How do you see the benefits / downsides?