Datenbanken und Informationssysteme

Chair for Applied Computer Science IV
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On the Way of Bottom-Up Designing Textual Domain-Specific Modelling Languages

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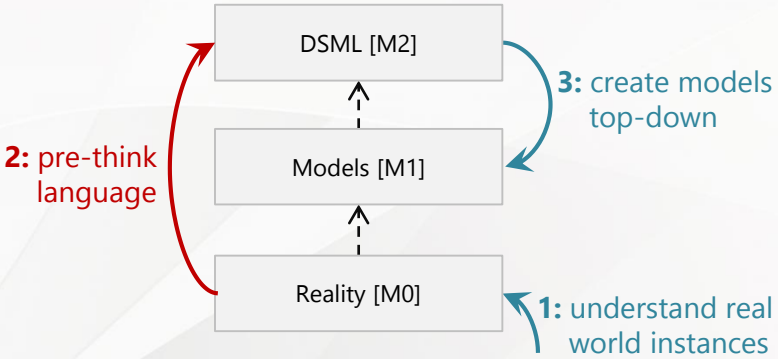
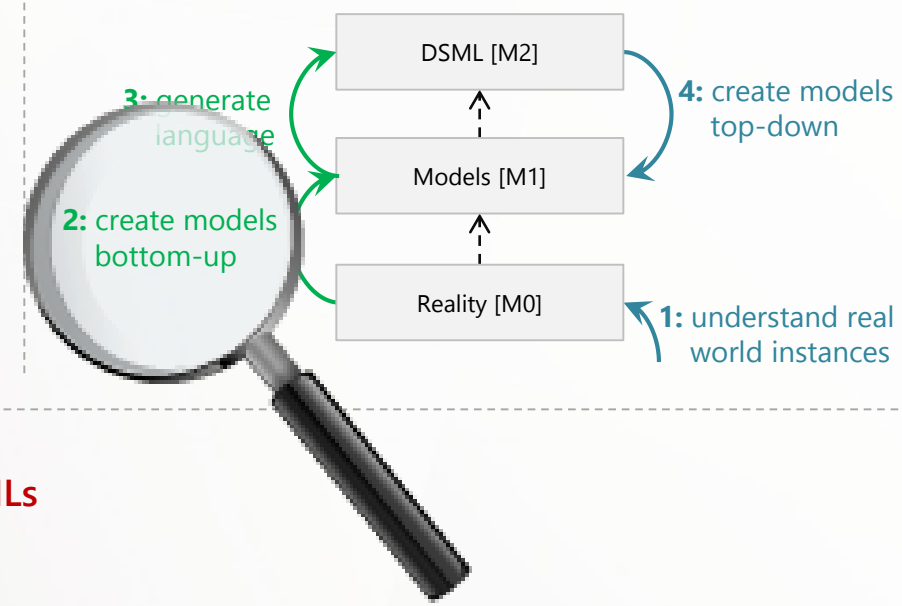
Motivation

- Designing a Domain-Specific Modelling Language (DSML) is a complex and time-consuming task, especially when restricting to the wide-spread **formal method**
- It requires to „pre-think" the language

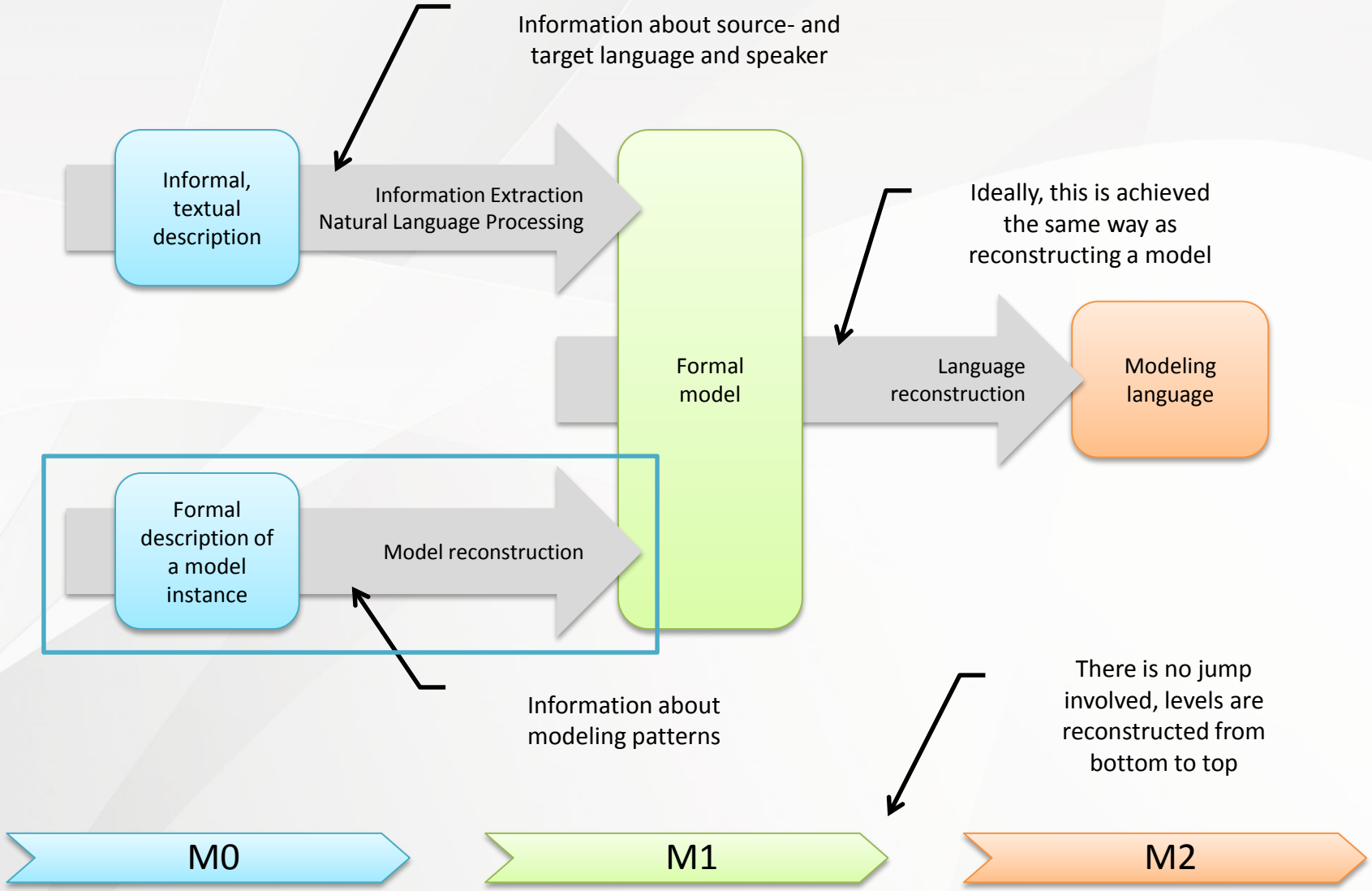


- An alternative approach has arisen which is often called "**bottom-up** (meta) **modelling**" or "by-demonstration approach"
- First models are sketched diagrams which are used to (semi)-automatically derive a DSML



- *Current solutions* **only** address **graphical DSMLs**
- ***Our focus***:
  Tool support for building **textual DSMLs** the **bottom-up** way

Larger Scope



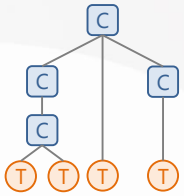
Example

- Simplified variant of Fowler's state machine
- Exemplary state machine

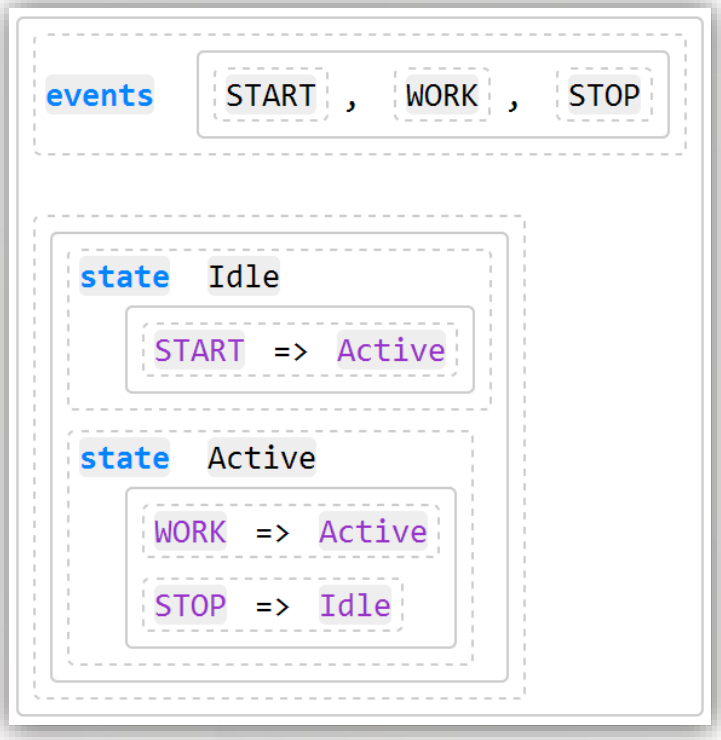
```
events   START , WORK , STOP

state  Idle
   START  =>  Active
state  Active
   WORK  =>  Active
   STOP  =>  Idle
```

- How to achieve this syntax highlighting?
  - Split text into tokens
  - Tag those tokens
- The text's hierarchical structure acts as basis for the later derived abstract syntax.
  How to identify such a structure?
- During sketching textual models it is expedient that the user directly sees the resulting hierarchical structure (concrete syntax tree, **CST**)



- Suggestion for an adequate structuring



Token identification

- The identification procedure is performed every time a token is modified.
  This modification occurs by simply entering free text.

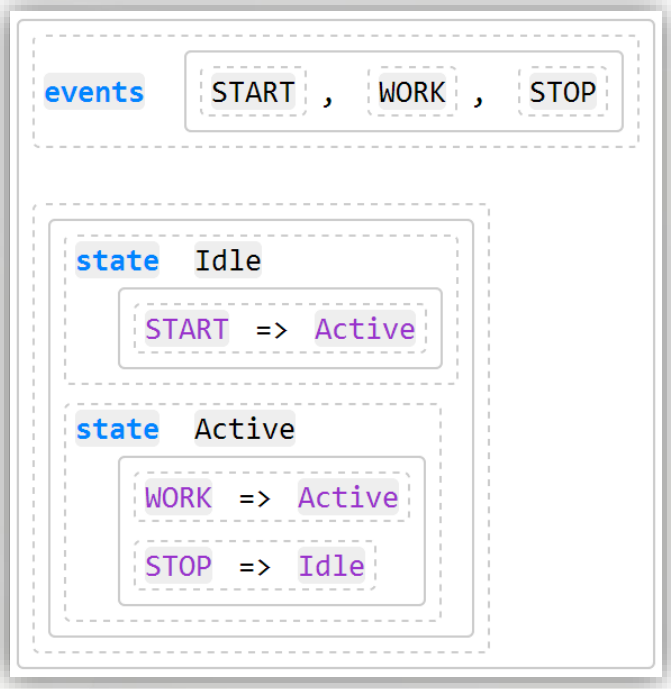
- Many DSMLs and also general purpose programming languages (GPLs) consist of various recurring **token types**
  - *Keyword*
  - *Identifier*
  - *Reference*
  - *String literal*
  - *Integer literal*
  - *Float literal*
  - *Comments*
  - *Delimiter*
    - Further subdivision is required
    - Special case: delimiters may directly affect the CST's structure

- Explicitly set a token's type using **shortcuts**

- Identification by means of **regular expressions**
  - Those regular expressions need to be determined beforehand
  - It is expedient to provide defaults

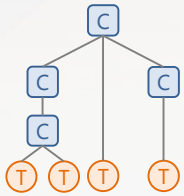
```
events  START , WORK , STOP

state  Idle
   START  =>  Active
state  Active
   WORK  =>  Active
   STOP  =>  Idle
```



Structure identification

- Containers as structuring nodes within the CST, Tokens as leaf nodes



- According to many DSMLs and GPLs, differentiation between following **container types**
  - *Statement*
  - *Block*
  - *Expression*

- **Example** with all container types

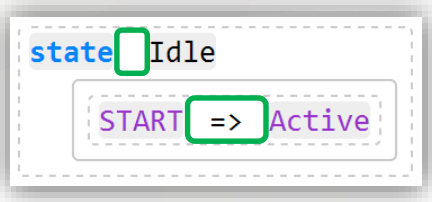
```
public int compute( int a, int b ){
    return a * 100 / b
}
```

- Container creation and rebuilding is triggered during the identification of certain tokens (primarily delimiters)

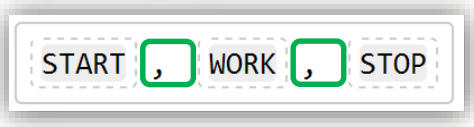
Structure identification cont.

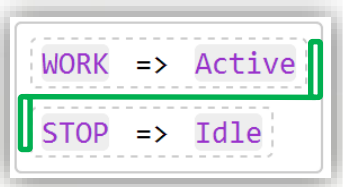
Categorization of **delimiters** according to their impact on the CST's structure

- *Token separator*
  - Default type of each delimiter
  - Separates *tokens* from each other (within a *statement*)
  - No impact on the CST



- *Statement separator*
  - Separates *statements* from each other
  - Inserted into the parent *block*
  - Successive tokens are wrapped by a new *statement*



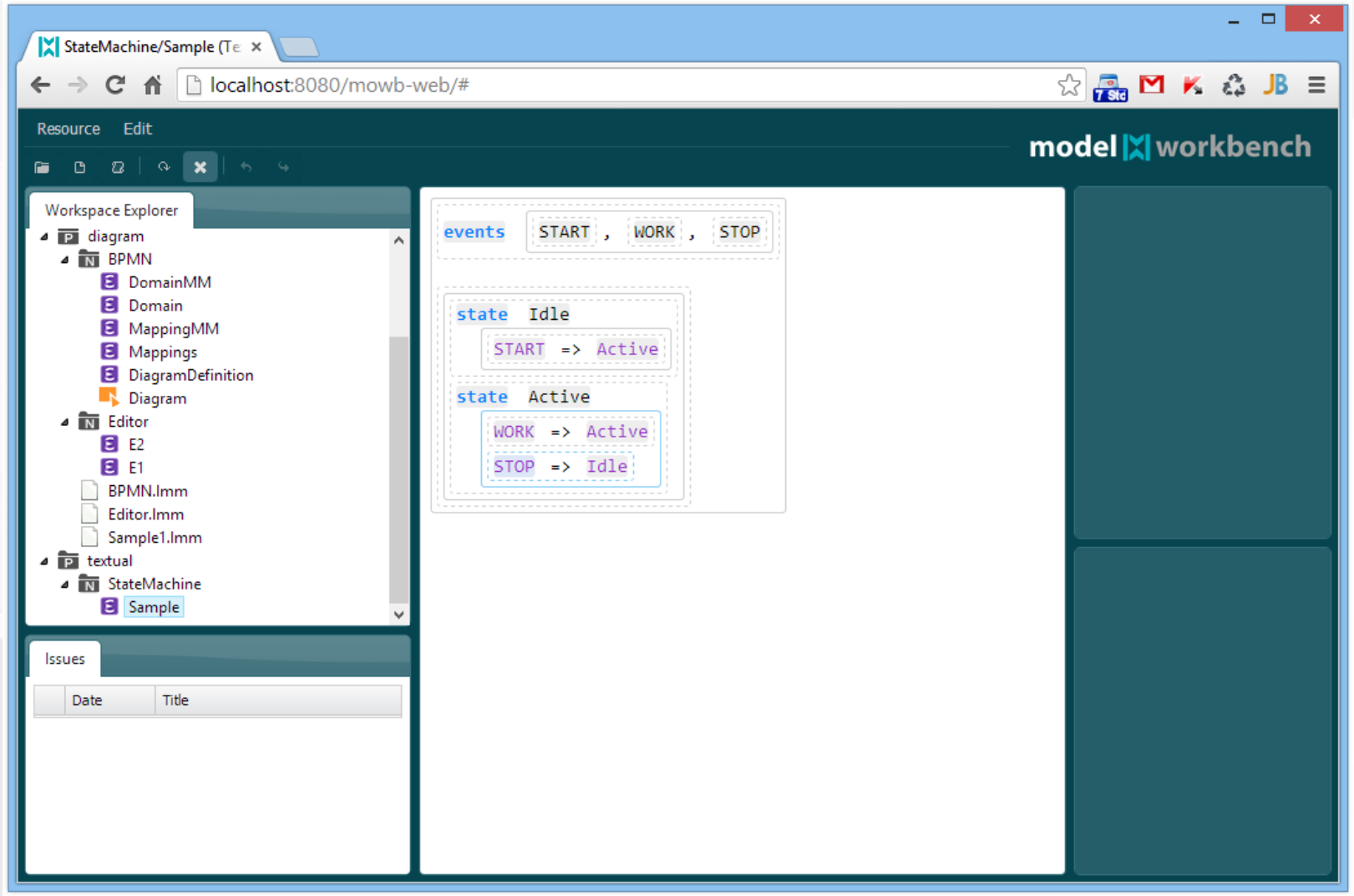


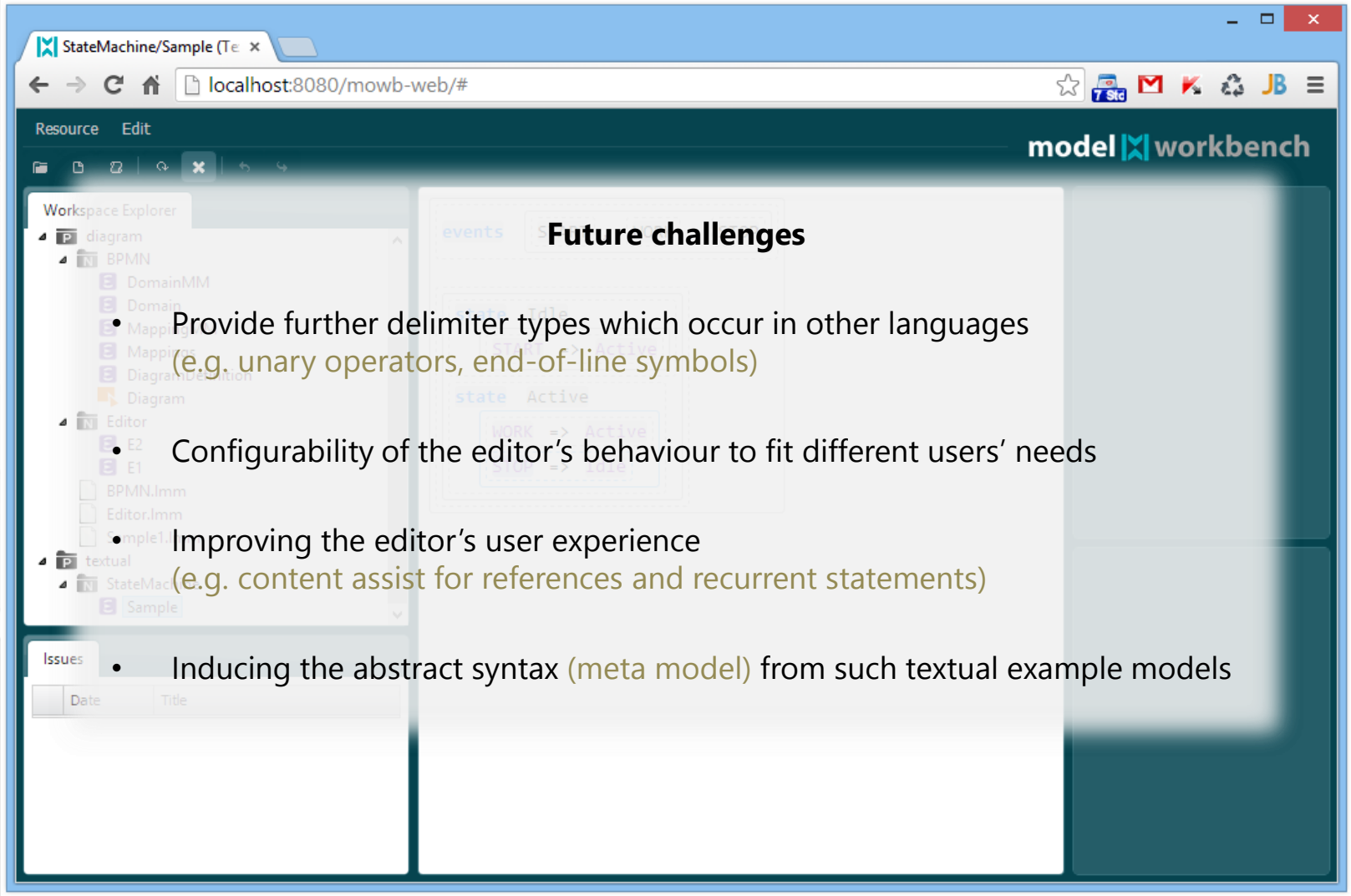
- *Opening brace*
  - Adds a successive *block* and creates a corresponding *closing brace*
  - Familiar feature of modern IDEs

- *Binary operator*
  - Wraps the previous *token* or *expression* and the inserted *operator token* with a new *expression*

Extensions are possible and even recommended!

model workbench – a Web-based modelling environment





Future challenges

- Provide further delimiter types which occur in other languages (e.g. unary operators, end-of-line symbols)
- Configurability of the editor's behaviour to fit different users' needs
- Improving the editor's user experience (e.g. content assist for references and recurrent statements)
- Inducing the abstract syntax (meta model) from such textual example models

Thank you for your attention