Toolbox

4 MATLAB®

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MATLAB® Toolbox

- converts
- stores
- views

SBML models in MATLAB® environment

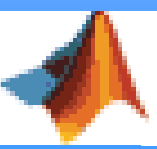
Converting SBML Models into MATLAB

Link to libsbml

Build a MATLAB executable

TranslateSBML

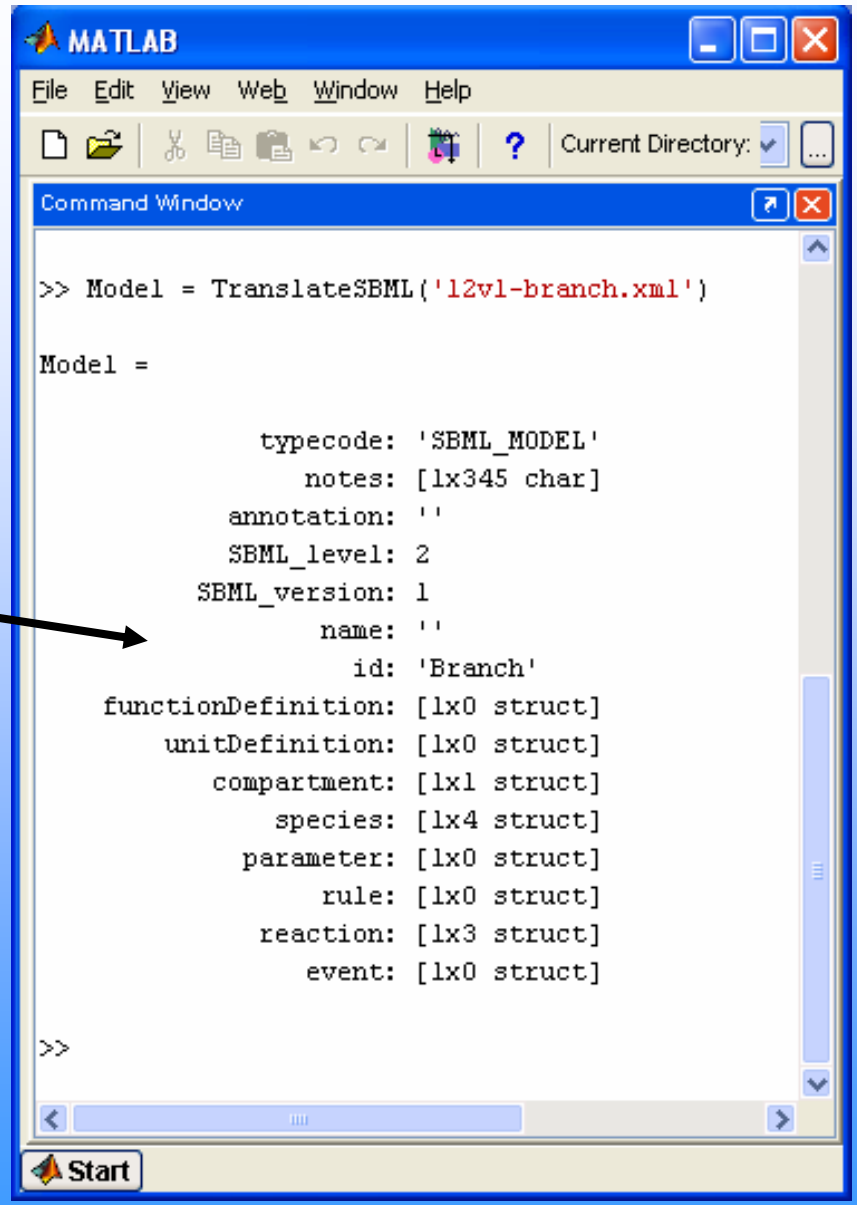
(.dll in Windows)

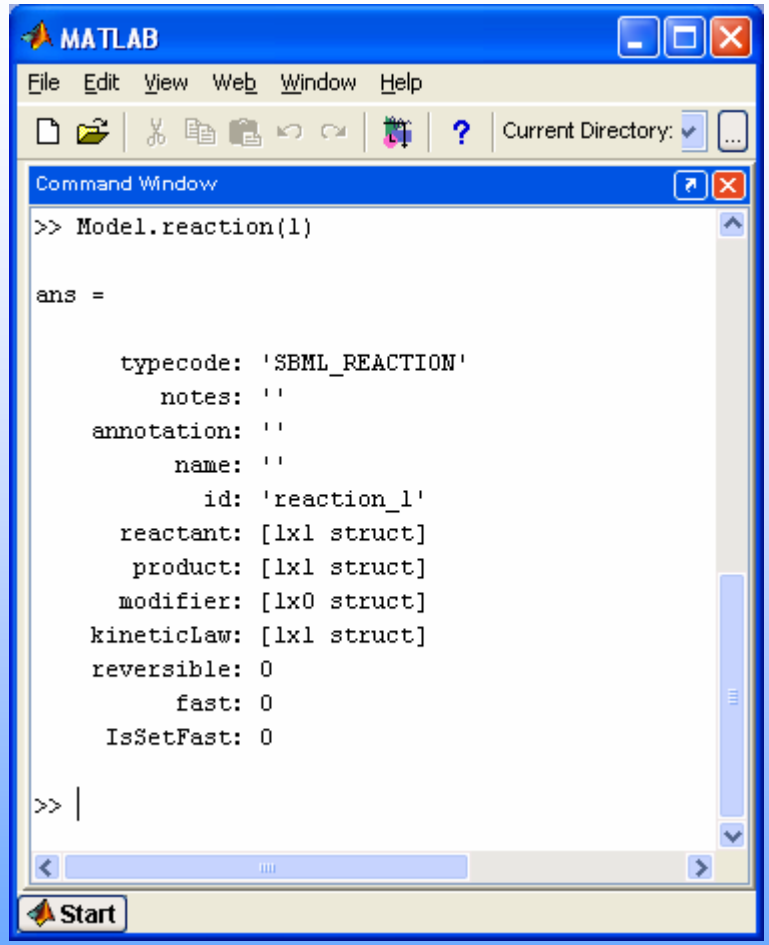


Model = TranslateSBML('filename')

Matlab Structure

that replicates the C structures used by libsbml





MATLAB

Reaction
id : SId name : string {use="optional"} reactant : SpeciesReference[0..*] product : SpeciesReference[0..*] modifier : ModifierSpeciesReference[0..*] kineticLaw : KineticLaw {minOccurs="0"} reversible : boolean {use="optional" default="true"} fast : boolean {use="optional"}

UML

```
typedef struct
{
  SBASE_FIELDS;
  char          *id;
  char          *name;
  ListOf_t      *reactant;
  ListOf_t      *product;
  ListOf_t      *modifier;
  KineticLaw_t *kineticLaw;
  int           reversible;
  int           fast;

  struct
  {
    unsigned int fast:1;
  }
  isSet;

} Reaction_t;
```

C structure

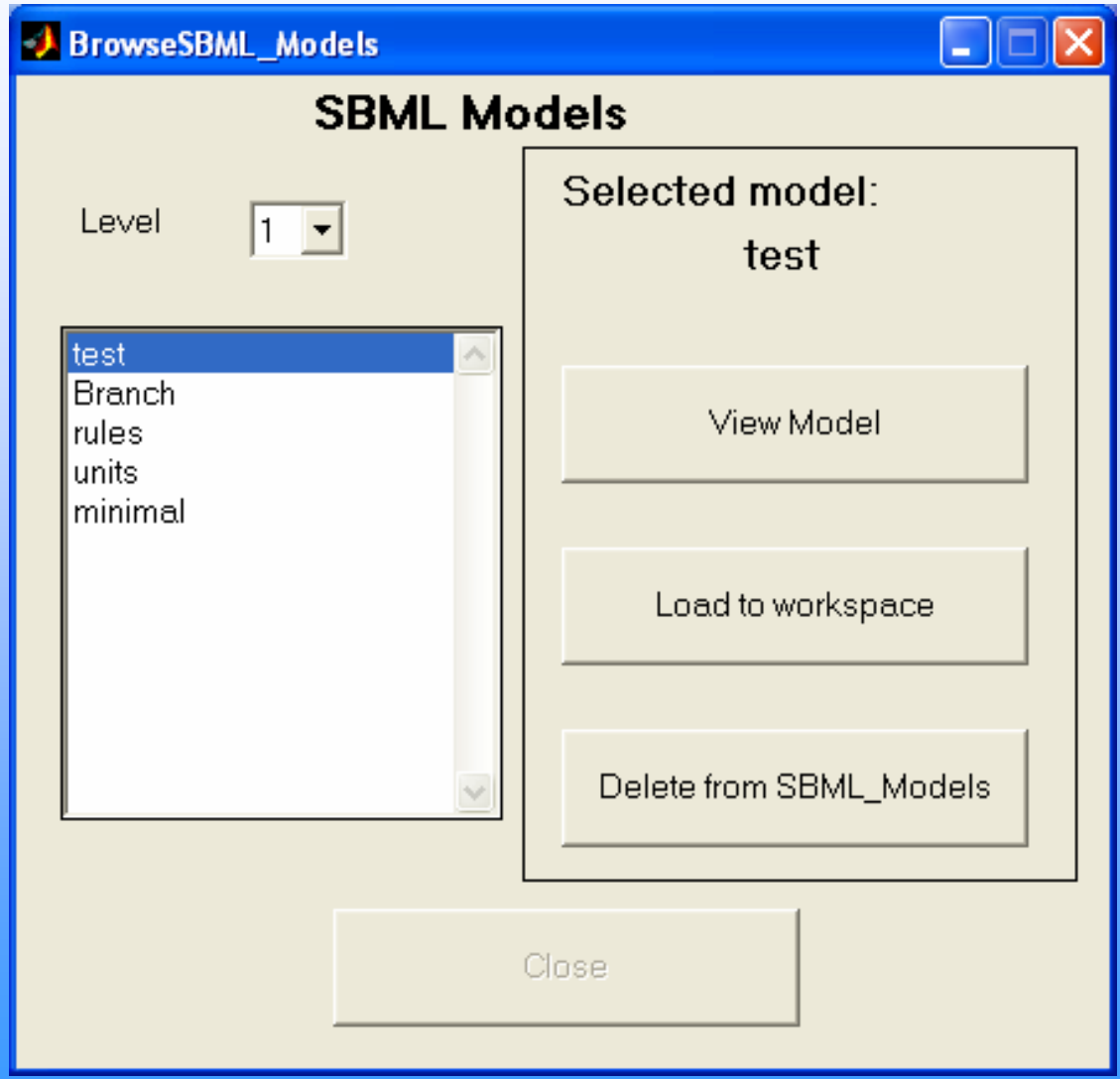
Storing SBML Models in MATLAB

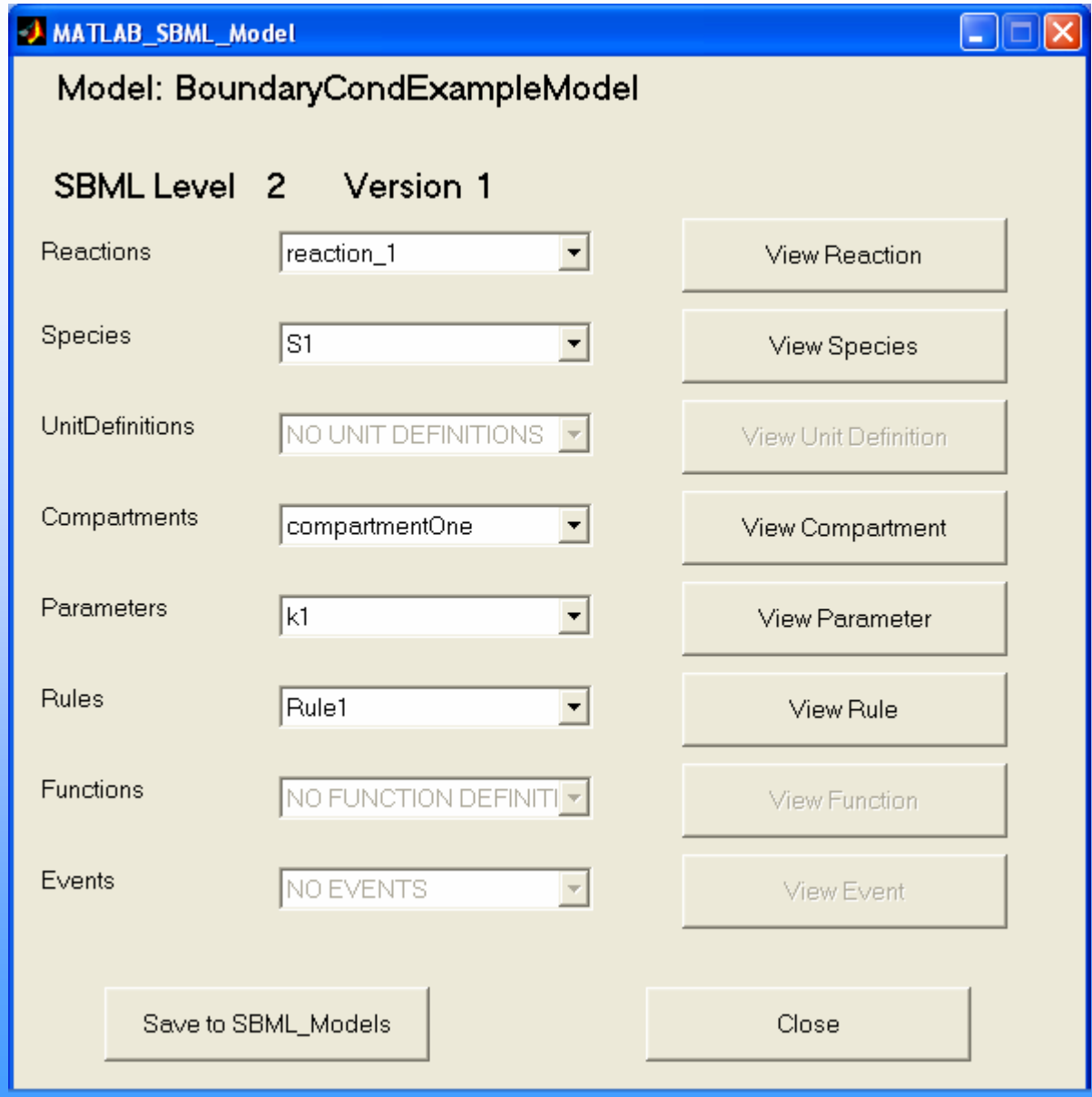
Functions (MATLAB .m scripts)

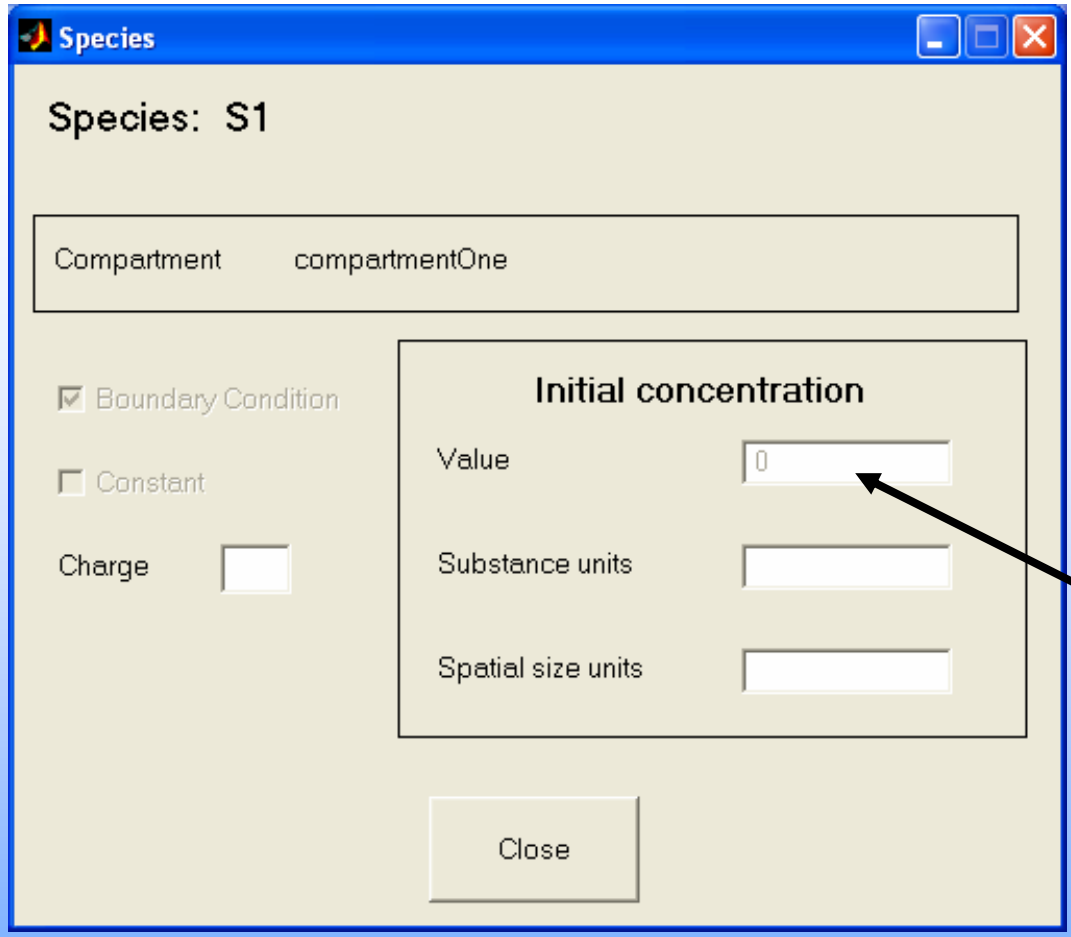
- save to
- load from
- delete from
- list models in

a MATLAB data file (.mat)

or use the viewing options




MATLAB_SBML_Model
Model: BoundaryCondExampleModel
SBML Level 2 Version 1
Reactions
reaction_1
View Reaction
Species
S1
View Species
UnitDefinitions
NO UNIT DEFINITIONS
View Unit Definition
Compartments
compartmentOne
View Compartment
Parameters
k1
View Parameter
Rules
Rule1
View Rule
Functions
NO FUNCTION DEFINITI
View Function
Events
NO EVENTS
View Event
Save to SBML_Models
Close



Edit boxes are disabled at present

Matlab applications

- Stability and robustness
- Model (in)validation
- Parameter value determination

- Data fitting
- Data interpolation ???

Control and Dynamical Systems

CALTECH

MATLAB Toolbox

- solving sum of squares problems

Lyapunov stability

- determines whether an equilibrium point is stable

If x = 0 is equilibrium for $\dot{x} = f(x)$

If can find a function V(x) such that

V(0) = 0

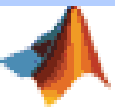
V(x) >0

$$\frac{\partial V}{\partial x}\dot{x} \leq 0$$

Then x = 0 is stable

- can be done with SOSTools

$$\dot{x} = \begin{bmatrix} -x_1^3 + x_2 \\ -x_1 - x_2 \end{bmatrix}$$

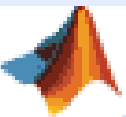


```
syms x1 x2
V = findlyap([-x1^3+x2; -x1-x2], [x1;x2], 2)
```

```
V =

1.2964*x1^2+.21232e-4*x1*x2+1.2966*x2^2
```

- bridge gap between an SBML model and SOSTools



```
stable = IsStableEquilibrium(SBMLModel)
```

```
stable =

     1
```

```
stable =

     0
```