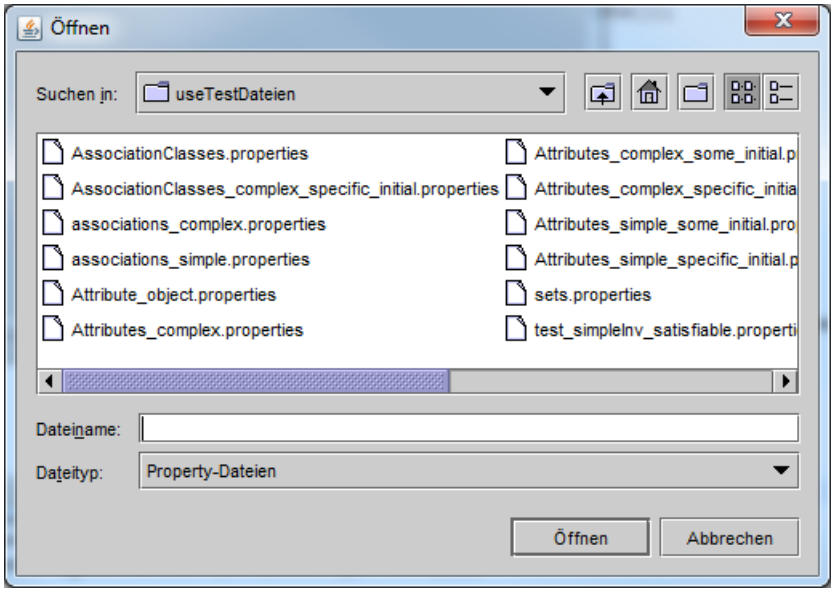
A short guide to the USE Model Validator

Usage through the GUI

1. The plug-in can be started by either using the toolbar button in USE or by selecting the menu item “Plugins/Validation/Kodkod”.

2. If a valid USE model was previously opened, the following file open dialog is shown.



This dialog can be used to open .properties files that configure the search space. A previously constructed system state can be used as an input (as a partial solution) to the model finding process (see Commands).

3. If the model finder can find a valid solution, the corresponding system state is automatically constructed and can be displayed in a new object diagram.

Commands

The model finder can be configured using commands on the USE shell. Using commands, the whole functionality of the model finder is available. These commands are described next.

- *kodkod –modelReset*

  Description:

  Resets the internal configuration of the transformed model.

- *kodkod –validate [<config-file>]*

  Parameter:

  - *config-file* (optional)
    Path to a configuration file (*.properties).

  Description:

  If the parameter *config-file* is provided, the model validator uses the provided settings during the search process. This is identical to the usage through the GUI.

  Without a configuration file the model validator uses default values for the configuration. A property file containing these values is generated using the name of the loaded USE file and the suffix *.properties*.

  The used defaults are as follows:

  - Exactly one object per class
  - Exactly one link per association
  - All attribute values must be defined
  - String: 1 <= x <= 5
  - Real: -2 <= x <= 2 (Step 0.5)
  - Integer: -10 <= x <= 10
  - All invariants are activated

  If no solution could be found using the default values all invariants are deactivated and a second model finding run is started.

- *kodkod –scrolling [<config-file>|next|previous|show(<n>)]*

  Parameter:

  - *config-file*
    Path to a configuration file (*.properties).
  - *next*
    Search next solution
  - *previous*
    Return to previous solution
  - *show(n)*
    Shows the n-th solution

  Description:

  The scrolling command allows searching for more than one solution. To the first call of the scrolling command a configuration file needs to be provided. Afterwards, one can scroll through the solutions by providing the argument *next*. The following solutions

have at least minor differences to the previous found ones. Returning to a solution can be done by invoking the commands *previous* or *show(n)*. The command *previous* returns to the solution found before, whereas *show(n)* returns the n-th solution.

Keep in mind, that this mechanism adds the already found solutions as forbidden to the search configuration. Therefore, at some time there are no more solutions.

- *kodkod –scrollingAll [<config-file>|next|previous|show(<n>)]*

  Parameter:

  - *config-file*
    Path to a configuration file (*.properties).
  - *next*
    Search next solution
  - *previous*
    Return to previous solution
  - *show(n)*
    Shows the n-th solution

  Description:

  Like *kodkod –scrolling*, but all possible solutions are calculated at once and are stored in memory.

- *kodkod –invIndep [<invName>]*

  Parameter:

  - *invName* (optional)
    Name of an invariant to check independence for.
    Syntax is `className::invariantName`

  Description:

  Checks the independence of a single invariant, if an invariant name is provided as an argument. If no name of an invariant is given, all invariants are checked step by step.

- *kodkod –config [satsolver := <name>; bitwidht:=<value>; automaticDiagramExtraction:=[on|off]; save]*

  Parameter:

  - *satsolver := name*
    Configures the SAT-solver to use.
  - *bitwidth := value (1 <= value <= 32)*
    Configures the bit-width.
  - *automaticDiagramExtraction := on|off*
  - *ADE := on|off*
    De-/Activates the extraction of a present system state as a partial solution provided to the model validator.
  - *save*
    Saves the current settings.

  All arguments can be mixed as required. They are separated by a semicolon (;).

  Description:

  Using this command the model validator can be configured as described next.

SAT-solvers supported by Kodkod are the following (these names can be used as the value for *name* of the parameter *satsolver*):

- DefaultSAT4J
- LightSAT4J
- MiniSat
- MiniSatProver
- ZChaffMincost
- CryptoMiniSat
- Lingeling

DefaultSAT4J and LightSAT4J can be used in any environment. Currently, MiniSat und MiniSatProver are contained in the Kodkod distribution for 32-Bit environments. They can only be used, if the Java virtual machine is also running as a 32-Bit version.

The parameter automaticDiagramExtraction or in short ADE is used to configure if the model validator respects a currently present system state or if it ignores it. Using the value *on*, a previously set-up system state is used as a partial solution to the model finding process. The model validator tries to complete the solution by adding new elements.

- *kodkod ? [enable|disable|enabled|<ocl-expression>]*

  Parameter:

  - enable
    Enables the query mechanism
  - disable
    Disables the query mechanism
  - enabled
    Shows the current state of the query mechanism
  - ocl-expression
    An OCL expression that is evaluated against the relational model used by the validator.

  Description:

  This command allows formulating queries against the relational solution. To do so, the query mechanism must be enabled before the validator searches for a solution. Because additional relations are required for the query functionality the runtime performance might be slower. After enabling and searching for a solution, an OCL expression provided to this command is translated into relation logic and evaluated against the relational solution. The expressions can only contain elements that were created by the validator. Manually added elements are not supported, because they are not present in the relational solution.

- *gen load <filename>*

  Parameter:

  - *filename*
    Path to a file containing additional invariants.

  Description:

  Loads additional invariants from the file provided by *filename*.

- *gen unload <invName>*

  Parameter:

  - *invName* (optional)
    Invariant name using the syntax: *classname::invariantname*

  Description:

  Unloads all separately loaded invariants or a single invariant if a name was provided.

Configuration using a property file

The following settings can be made for the different elements.

Basic types

- *String = Set{'ada'}*
  Defines concrete string values that need to be present inside of a solution.
- *String_min = 1*
  Minimum number of present string values. Concrete values override this setting.
- *String_max = 2*
  Maximum number of string values. Concrete values override this setting.
- *Integer = Set{1,2}*
  Concrete values oft he type integer that need tob e present in the solution.
- *Integer_min = -10*
  Lower bound for integer values.
- *Integer_max = 10*
  Upper bound for integer values.
- *Real = Set{15.5}*
  Concrete real values that need to be present in the solution.
- *Real_min = -2*
  Lower bounds for real values.
- *Real_max = 2*
  Upper bounds for real values.
- *Real_step = 0.5*
  Step size for the interval values of real.

Classes

- *classname = Set{ada,bob}*
  Concrete instance names for the objects of a class that need to be present in the solution.
- *classname_min = 2*
  Minimum number of instances for the class. Concrete object names override this setting.
- *classname_max = 4*
  Maximum number of instances for the class. Concrete object names override this setting.

Attributes

- *classname_attributename = Set{'Main Road', '5th Eve'}*
  Possible values for the attribute.
- *classname_attributename _min = 1*
  Minimum number of defined values for the attribute considering all instances of the class. The Value -1 forces defined attributes for all instances of the class. This setting overrides the setting *classname_attributename_max* = -1 (see below).
- *classname_attributename _max = 3*
  Maximum number of defined values for this attribute for all instances of the class. The value -1 does not constrain this number (default).
- *classname_attributename _minSize = 1*
  Minimum number of containing elements for collection based attributes.
- *classname_attributename _maxSize = 3*
  Maximum number of containing elements for collection based attributes. The value -1 does not constrain this number (default).

Associations

- *associationname = Set{(ada,bob),(cyd,dan)}*
  Concrete links that need to be present in the solution.
- *associationname _min = 2*
  Minimum number of links for the assciation. Concrete links override this setting.
- *associationname _max = 6*
  Maximum number of links for the association. Concrete links override this setting. The value -1 does not constraint the maximum number (default).

Association classes

- *associationclassname_ac = Set{b1}*
  Concrete names of instances that need to be present in the solution.
- *associationclassname _attributename = Set{}*
  see attributes
- *associationclassname _attributename _min = 1*
  see attributes
- *associationclassname _attributename _max = 3*
  see attributes
- *associationclassname* = Set{(b1,bsag,hvv)}
  Concrete links of accociation class that need to be present in the solution.
- *associationclassname _min = 1*
  Minimum number of link objects for this association class in the solution. Concrete links override this setting.
- *associationclassname _max = 1*
  Maximum number of link objects for this association class. Concrete links override this setting. The value -1 does not constrain the maximum number (default).

Invariants

- *classname_invariantname = active|inactive|negate*
  De-/activates or negates the invariant with the given name.

Miscellaneous

- *aggregationcyclefreeness = on|off*
  If set to on, no cycles are allowed inside of aggregations and compositions. Otherwise, cycles are allowed.
- forbiddensharing = *on|off*
  If off, objects participating in a composition can be member of more than one composition. Otherwise this is forbidden (Default = on).