# MindEngine

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# Contents

# Chapter 1

# Todo List

**Member RuleBased::IdType**

Use identifier with strings may decrease performance with large systems due to string-matching operations. Will change this to integer or unsigned integer as soon as I find a way to match identifier with human-readable strings.

**Member RuleBased::NumberDatumMatch< T >::matchesNode (DataNode *node, BindingList &bindings)**

Need adding bindings mechanism here

**Member RuleBased::Rule::action ()=0**

Examine the performance and reusability of using a method. If it is hard to expand, find a way to use a struct/class instead.

# Chapter 2

# Namespace Index

## 2.1 Namespace List

Here is a list of all documented namespaces with brief descriptions:

# Chapter 3

# Hierarchical Index

## 3.1 Class Hierarchy

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## 4.1 Class List

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# Chapter 5

# Namespace Documentation

## 5.1 RuleBased Namespace Reference

Contains classes to represent Rule-based system's database, which stores knowledge available to the AI agent as well as the implementation of rules and the mechanism to match the rules and the data in the database.

### Classes

- class DataGroup

  *Represents a non-leaf node, which contains children. Its children can be any DataNode object: either another Data↩ Group, or a Datum only.*
- struct DataGroupMatch

  *Matches a group of data in the database. This is done by building a match data structure that mirrors the data structure that is being searched for in the database.*
- class DataNode

  *Base class of each node in the database tree. Since every node needs an identifier, but non-leaf nodes contain their children, while leaf nodes store values.*
- struct DataNodeMatch

  *A struct derived from Match, it is responsible for matching a single DataNode in the database.*
- class Datum

  *A Datum consists of an identifier and and value. In Database's tree structure, a leaf node is a Datum.*
- class IdCheck

  *Provides methods to check the IDs.*
- struct Match

  *Provides the mechanism to match the data item from the rule with any item inside the database.*
- struct NumberDatumMatch

  *A struct provides mechanism for matching two Datum whose values is number values (int, float,...).*
- class Rule

  *Represent a rule in a Rule-based system. A rule has two components: an if clause is going to be used to match against the database and a function to perform any action required.*

### Typedefs

- typedef std::string IdType

  *Currently set the type of the ID of data nodes as string.*
- typedef std::map$<$ std::string, DataNode $*$ $>$ BindingList

  *The list of bound actions is simply a list of strings representing actions (for now). I use list of strings for output actions because 1/ the action should be freed from function signatures and 2/ the AI engine should only produce 'decisions', rather than carry out the actions - that is the job of the agent itself.*

### 5.1.1 Detailed Description

Contains classes to represent Rule-based system's database, which stores knowledge available to the AI agent as well as the implementation of rules and the mechanism to match the rules and the data in the database.

### 5.1.2 Typedef Documentation

#### 5.1.2.1 typedef std::map<std::string, DataNode*> RuleBased::BindingList

The list of bound actions is simply a list of strings representing actions (for now). I use list of strings for output actions because 1/ the action should be freed from function signatures and 2/ the AI engine should only produce 'decisions', rather than carry out the actions - that is the job of the agent itself.

**Note**

The output actions list would be used to carry out actions later by the agent. The approach here is to find appropriate methods on the script files to execute.

#### 5.1.2.2 typedef std::string RuleBased::IdType

Currently set the type of the ID of data nodes as string.

**Todo** Use identifier with strings may decrease performance with large systems due to string-matching operations. Will change this to integer or unsigned integer as soon as I find a way to match identifier with human-readable strings.

# Chapter 6

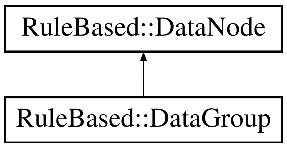
# Class Documentation

## 6.1 RuleBased::DataGroup Class Reference

Represents a non-leaf node, which contains children. Its children can be any DataNode object: either another DataGroup, or a Datum only.

```
#include <DataGroup.h>
```

Inheritance diagram for RuleBased::DataGroup:



### Public Member Functions

- DataGroup ()

  *DataGroup default constructor.*
- DataGroup (const std::string &identifier, DataNode ∗rightSibling, DataNode ∗leftMostChild)

  *DataGroup constructor.*
- virtual ∼DataGroup ()

  *∼DataGroup destructor.*
- DataNode ∗ getLeftMostChild () const

  *Data nodes are put into a left-most child, right sibling tree. This function returns the pointer to the left most child of this node.*
- bool isGroup ()

  *Allows user to check whether this node is a DataGroup or not.*

### Additional Inherited Members

### 6.1.1 Detailed Description

Represents a non-leaf node, which contains children. Its children can be any DataNode object: either another DataGroup, or a Datum only.

**See also**

DataNode
Datum

### 6.1.2 Constructor & Destructor Documentation

#### 6.1.2.1 RuleBased::DataGroup::DataGroup ( const std::string & *identifier*, DataNode ∗ *rightSibling*, DataNode ∗ *leftMostChild* )

DataGroup constructor.

**Parameters**

| | |
|---|---|
| *identifier* | a string parameter. |
| *rightSibling* | a DataNode pointer representing this node's right sibling in tree. |
| *leftMostChild* | a DataNode pointer representing this node's left most child in tree. |

### 6.1.3 Member Function Documentation

#### 6.1.3.1 DataNode ∗ RuleBased::DataGroup::getLeftMostChild ( ) const

Data nodes are put into a left-most child, right sibling tree. This function returns the pointer to the left most child of this node.

**Returns**

The left most child of this data group node.

#### 6.1.3.2 bool RuleBased::DataGroup::isGroup ( )

Allows user to check whether this node is a DataGroup or not.

**Returns**

true if this node is a DataGroup, otherwise returns false.

The documentation for this class was generated from the following files:

- Engine/Database/DataGroup.h
- Engine/Database/DataGroup.cpp

## 6.2 RuleBased::DataGroupMatch Struct Reference

Matches a group of data in the database. This is done by building a match data structure that mirrors the data structure that is being searched for in the database.

```
#include <DataGroupMatch.h>
```

### Public Member Functions

- virtual bool matchesNode (DataNode ∗node, BindingList &bindings)

  *Tries to match the given data node from the database against the criteria. Method used: a recursive matching algorithm that travels down the given node, trying to match it against the structure of this match and its children.*

### Public Attributes

- IdType identifier

  *The identifier to match.*
- DataNodeMatch ∗ leftMostChild

  *The first sub-match in this group.*

### 6.2.1 Detailed Description

Matches a group of data in the database. This is done by building a match data structure that mirrors the data structure that is being searched for in the database.

### 6.2.2 Member Function Documentation

#### 6.2.2.1 bool RuleBased::DataGroupMatch::matchesNode ( DataNode ∗ *node,* BindingList & *bindings* ) `[virtual]`

Tries to match the given data node from the database against the criteria. Method used: a recursive matching algorithm that travels down the given node, trying to match it against the structure of this match and its children.

**Parameters**

| | |
|---|---|
| *node* | The database node to match on. |
| *bindings* | When part of the if clause matches a wild card, it is added to the bindings. This parameter is both input and output parameter. |

**Returns**

true if matches, otherwise return false.

The documentation for this struct was generated from the following files:

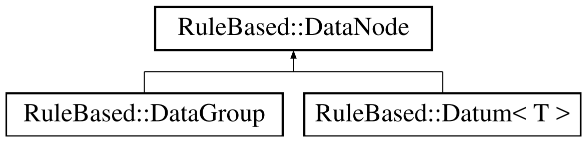
- Engine/Rules/DataGroupMatch.h
- Engine/Rules/DataGroupMatch.cpp

## 6.3 RuleBased::DataNode Class Reference

Base class of each node in the database tree. Since every node needs an identifier, but non-leaf nodes contain their children, while leaf nodes store values.

```
#include <DataNode.h>
```

Inheritance diagram for RuleBased::DataNode:



## Public Member Functions

- DataNode ()

  *DataNode default constructor.*
- DataNode (const IdType &identifier, DataNode ∗rightSibling)

  *DataNode constructor with parameters.*
- virtual ∼DataNode ()

  *∼DataNode destructor.*
- IdType getIdentifier () const

  *The data nodes have unique identifiers.*
- DataNode ∗ getRightSibling () const

  *Data nodes are put into a left-most child, right sibling tree. This function is used to get the sibling next to current node.*
- virtual bool isGroup () const

  *Allows user to check whether this node is a DataGroup or not.*
- virtual bool isDatum () const

  *Allows user to check whether this node is a Datum or not.*

## Protected Attributes

- IdType identifier

  *Each item of data should be identified to know what the value means.*
- DataNode ∗ rightSibling

  *The right sibling node of this node, or NULL if this node is the right most child.*

### 6.3.1 Detailed Description

Base class of each node in the database tree. Since every node needs an identifier, but non-leaf nodes contain their children, while leaf nodes store values.

**See also**

DataGroup
Datum

### 6.3.2 Constructor & Destructor Documentation

#### 6.3.2.1 RuleBased::DataNode::DataNode ( const IdType & *identifier,* DataNode ∗ *rightSibling* )

DataNode constructor with parameters.

**Parameters**

| | |
|---|---|
| *identifier* | an ID parameter. |
| *rightSibling* | a DataNode pointer representing this node's right sibling in tree. structure |

## 6.3.3 Member Function Documentation

### 6.3.3.1 IdType RuleBased::DataNode::getIdentifier ( ) const

The data nodes have unique identifiers.

**Returns**

The identifier of this node.

### 6.3.3.2 DataNode * RuleBased::DataNode::getRightSibling ( ) const

Data nodes are put into a left-most child, right sibling tree. This function is used to get the sibling next to current node.

**Returns**

The right sibling node of this node, or NULL if this node is the right most child.

### 6.3.3.3 bool RuleBased::DataNode::isDatum ( ) const [virtual]

Allows user to check whether this node is a Datum or not.

**Returns**

true if this node is a Datum, otherwise returns false.

### 6.3.3.4 bool RuleBased::DataNode::isGroup ( ) const [virtual]

Allows user to check whether this node is a DataGroup or not.

**Returns**

true if this node is a DataGroup, otherwise returns false.

The documentation for this class was generated from the following files:

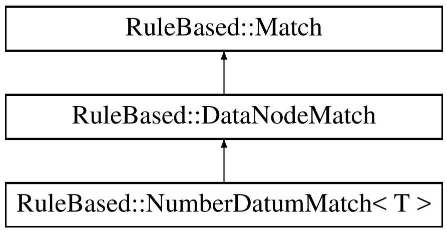
- Engine/Database/DataNode.h
- Engine/Database/DataNode.cpp

## 6.4 RuleBased::DataNodeMatch Struct Reference

A struct derived from Match, it is responsible for matching a single DataNode in the database.

`#include <DataNodeMatch.h>`

Inheritance diagram for RuleBased::DataNodeMatch:



### Public Member Functions

- virtual bool matches (DataNode ∗database, BindingList &bindings)

  *Matches the given database by checking each element in the database against the matchesNode method.*
- bool matchesChildren (DataGroup ∗group, BindingList &bindings)

  *Matches all the children of the given group to see if any of them pass the matchesNode test. This is used in the implementation of the matches method to iterate through items in the database.*
- virtual bool matchesNode (DataNode ∗node, BindingList &bindings)=0

  *Matches the data node from the database against the criteria in this match.*

### Public Attributes

- DataNodeMatch ∗ rightSibling

  *The right sibling of this node in match tree.*

### 6.4.1 Detailed Description

A struct derived from Match, it is responsible for matching a single DataNode in the database.

Conceptually, the match class could match the whole database in a single operation: it is only ever fed the whole database, so it can do with that what it likes. However in practical, the vast majority of matching requirements involve trying to find a single item in the database. This struct's match method iterates through the items in the database, and calls matchesNode on each one. Matches items can be implemented in sub-classes to check if the item fulfils the mtach criteria.

Data node matches are arranged into tree, just like how data nodes are.

**See also**

Match

### 6.4.2 Member Function Documentation

#### 6.4.2.1 bool RuleBased::DataNodeMatch::matches ( DataNode ∗ *database,* BindingList & *bindings* ) `[virtual]`

Matches the given database by checking each element in the database against the matchesNode method.

**Parameters**

| | |
|---|---|
| *database* | The database node to match on. |
| *bindings* | When part of the if clause matches a wild card, it is added to the bindings. This parameter is both input and output parameter. |

**Returns**

true if matches, else returns false.

#### 6.4.2.2 bool RuleBased::DataNodeMatch::matchesChildren ( **DataGroup** ∗ *group,* **BindingList** & *bindings* )

Matches all the children of the given group to see if any of them pass the matchesNode test. This is used in the implementation of the matches method to iterate through items in the database.

**Parameters**

| | |
|---|---|
| *group* | The group to match on. |
| *bindings* | When part of the if clause matches a wild card, it is added to the bindings. This parameter is both input and output parameter. |

**Returns**

true if matches, else return false.

#### 6.4.2.3 virtual bool RuleBased::DataNodeMatch::matchesNode ( **DataNode** ∗ *node,* **BindingList** & *bindings* ) `[pure virtual]`

Matches the data node from the database against the criteria in this match.

**Parameters**

| | |
|---|---|
| *node* | The database node to match on. |
| *bindings* | When part of the if clause matches a wild card, it is added to the bindings. This parameter is both input and output parameter. |

**Returns**

true if matches, else return false.

Implemented in RuleBased::NumberDatumMatch< T >.

The documentation for this struct was generated from the following files:

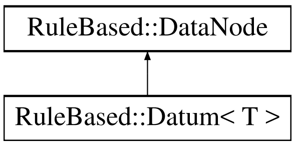
- Engine/Rules/DataNodeMatch.h
- Engine/Rules/DataNodeMatch.cpp

## 6.5 RuleBased::Datum< T > Class Template Reference

A Datum consists of an identifier and and value. In Database's tree structure, a leaf node is a Datum.

```
#include <Datum.h>
```

Inheritance diagram for RuleBased::Datum< T >:



### Public Member Functions

- Datum (T value)

  *Datum constructor.*
- Datum (const std::string &identifier, DataNode ∗rightSibling, T value)

  *Datum constructor.*
- virtual ∼Datum ()

  *∼Datum destructor*
- void setValue (T newValue)

  *To change the value of the Datum.*
- T getValue () const

  *To get the value of the Datum.*
- bool isDatum ()

  *Allows user to check whether this node is a Datum or not.*

### Additional Inherited Members

### 6.5.1 Detailed Description

**template<class T>**
**class RuleBased::Datum< T >**

A Datum consists of an identifier and and value. In Database's tree structure, a leaf node is a Datum.

**See also**

DataNode
DataGroup

### 6.5.2 Constructor & Destructor Documentation

#### 6.5.2.1 template<class T > RuleBased::Datum< T >::Datum ( T *value* )

Datum constructor.

**Parameters**

| | |
|---|---|
| *value* | the value that the Datum holds. |

#### 6.5.2.2 template<class T > RuleBased::Datum< T >::Datum ( const std::string & *identifier*, DataNode ∗ *rightSibling*, T *value* )

Datum constructor.

**Parameters**

| | |
|---|---|
| *identifier* | a string parameter. |
| *rightSibling* | a DataNode pointer representing this node's right sibling in tree. |
| *value* | the value that the Datum holds. |

### 6.5.3 Member Function Documentation

#### 6.5.3.1 template<class T > T RuleBased::Datum< T >::getValue ( ) const

To get the value of the Datum.

**Returns**

The value that the datum is currently holding.

#### 6.5.3.2 template<class T > bool RuleBased::Datum< T >::isDatum ( )

Allows user to check whether this node is a Datum or not.

**Returns**

true if this node is a Datum, otherwise returns false.

#### 6.5.3.3 template<class T > void RuleBased::Datum< T >::setValue ( T *newValue* )

To change the value of the Datum.

**Parameters**

| | |
|---|---|
| *newValue* | The new value that is going to be assigned to the Datum. |

The documentation for this class was generated from the following files:

- Engine/Database/Datum.h
- Engine/Database/Datum.cpp

## 6.6 RuleBased::IdCheck Class Reference

Provides methods to check the IDs.

```
#include <IdCheck.h>
```

### Static Public Member Functions

- static bool isWildcard (IdType identifier)

  *Check if the given database item's identifier is a wildcard or not.*

### 6.6.1 Detailed Description

Provides methods to check the IDs.

### 6.6.2 Member Function Documentation

#### 6.6.2.1 bool RuleBased::IdCheck::isWildcard ( IdType *identifier* ) [static]

Check if the given database item's identifier is a wildcard or not.

**See also**

IdType

**Returns**

True if it is a wildcard.

The documentation for this class was generated from the following files:

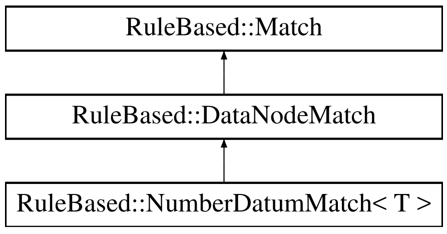
- Engine/Rules/IdCheck.h
- Engine/Rules/IdCheck.cpp

## 6.7 RuleBased::Match Struct Reference

Provides the mechanism to match the data item from the rule with any item inside the database.

```
#include <Match.h>
```

Inheritance diagram for RuleBased::Match:



### Public Member Functions

- virtual bool matches (const DataNode ∗database, void ∗bindings)=0

  *Check the match on the database.*

## 6.7.1 Detailed Description

Provides the mechanism to match the data item from the rule with any item inside the database.

## 6.7.2 Member Function Documentation

#### 6.7.2.1 virtual bool RuleBased::Match::matches ( const DataNode ∗ *database,* void ∗ *bindings* ) `[pure virtual]`

Check the match on the database.

**Parameters**

| | |
|---|---|
| *database* | The database to match on. |
| *bindings* | When part of the if clause matches a wild card, it is added to the bindings. This parameter is both input and output parameter. |

**Returns**

true if matches, else returns false.

The documentation for this struct was generated from the following file:

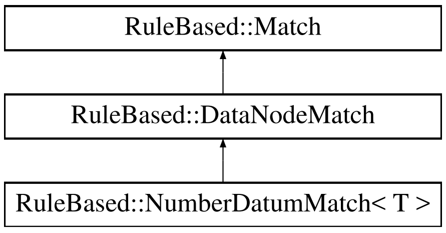
- Engine/Rules/Match.h

## 6.8 RuleBased::NumberDatumMatch< T > Struct Template Reference

A struct provides mechanism for matching two Datum whose values is number values (int, float,...).

`#include <NumberDatumMatch.h>`

Inheritance diagram for RuleBased::NumberDatumMatch< T >:



## Public Member Functions

- virtual bool matchesNode (DataNode ∗node, BindingList &bindings)

  *Matches the given database node.*
- NumberDatumMatch (IdType identifier, T min, T max)

  *Create a match object with the given identifier and range. This range-based approach allows you to match a range with more flexibility. For example, if you want to check the HP of the agent is lower than 80, you just create a matching range of [0, 79] (since both limits are inclusive).*

## Public Attributes

- T min

  *The minimum value of the matching range (inclusive).*
- T max

  *The maximum value of the matching range (inclusive).*
- IdType identifier

  *The identifier to match.*

### 6.8.1 Detailed Description

**template<typename T>**
**struct RuleBased::NumberDatumMatch< T >**

A struct provides mechanism for matching two Datum whose values is number values (int, float,...).

It uses the range-based approach, since every number values in game is limited in a specific range, for example: HP is from 0 to 100, ammo is from 0 to 50, and so on. That means, the comparision operators greater than, greater than or equal, equal, less than, less than or equal can be combined into a single match struct.

**Note**

This struct acts not only as the mechanism of matching two number Datum nodes, it also is the example of how to implement your own type of matching with other data structures.

**See also**

Match
DataNodeMatch

### 6.8.2 Constructor & Destructor Documentation

#### 6.8.2.1 template<typename T > RuleBased::NumberDatumMatch< T >::NumberDatumMatch ( IdType *identifier,* T *min,* T *max* )

Create a match object with the given identifier and range. This range-based approach allows you to match a range with more flexibility. For example, if you want to check the HP of the agent is lower than 80, you just create a matching range of [0, 79] (since both limits are inclusive).

**Note**

Remember to have max value greater than or equal to the min value.

### 6.8.3 Member Function Documentation

#### 6.8.3.1 template<typename T > bool RuleBased::NumberDatumMatch< T >::matchesNode ( DataNode ∗ *node,* BindingList & *bindings* ) [virtual]

Matches the given database node.

**Parameters**

| | |
|---|---|
| *node* | The database node to match on. |
| *bindings* | When part of the if clause matches a wild card, it is added to the bindings. This parameter is both input and output parameter. |

**Returns**

true if matches, else return false.

**Todo** Need adding bindings mechanism here

Implements RuleBased::DataNodeMatch.

The documentation for this struct was generated from the following files:

- Engine/Rules/NumberDatumMatch.h
- Engine/Rules/NumberDatumMatch.cpp

## 6.9 RuleBased::Rule Class Reference

Represent a rule in a Rule-based system. A rule has two components: an if clause is going to be used to match against the database and a function to perform any action required.

```
#include <Rule.h>
```

### Public Member Functions

- virtual void action ()=0

  *The action is going to be carried out when the rule matches.*

### Public Attributes

- Match ∗ ifClause

  *Consist of a set of data items, in a similar format to those in the database.*

### 6.9.1 Detailed Description

Represent a rule in a Rule-based system. A rule has two components: an if clause is going to be used to match against the database and a function to perform any action required.

### 6.9.2 Member Function Documentation

#### 6.9.2.1 virtual void RuleBased::Rule::action ( ) `[pure virtual]`

The action is going to be carried out when the rule matches.

**Todo** Examine the performance and reusability of using a method. If it is hard to expand, find a way to use a struct/class instead.

The documentation for this class was generated from the following file:

- Engine/Rules/Rule.h

# Index