Laboratory for Advanced Software Systems
University of Luxembourg

ᴇxᴄᴀʟɪʙᴜʀ Standard Libraries Documentation
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Contents

List of Figures

Listings

Chapter 1

Introduction

Chapter 2

General Description

Chapter 3

Additional Constraints

Appendix A

Undocumented Messir Specification Elements

A.1 Undocumented Primary Types

A.1.1 Undocumented Primary Datatype Types

- lu.uni.lassy.messir.libraries.calendar.dtDate

- lu.uni.lassy.messir.libraries.calendar.dtDateAndTime

- lu.uni.lassy.messir.libraries.calendar.dtDay

- lu.uni.lassy.messir.libraries.calendar.dtHour

- lu.uni.lassy.messir.libraries.math.dtInteger

- lu.uni.lassy.messir.libraries.calendar.dtMinute

- lu.uni.lassy.messir.libraries.calendar.dtMonth

- lu.uni.lassy.messir.libraries.math.dtReal

- lu.uni.lassy.messir.libraries.calendar.dtSecond

- lu.uni.lassy.messir.libraries.string.dtString

- lu.uni.lassy.messir.libraries.calendar.dtTime

- lu.uni.lassy.messir.libraries.calendar.dtYear

A.1.2 Undocumented Primary Primitive Types

- lu.uni.lassy.messir.libraries.primitives.ptBoolean

- lu.uni.lassy.messir.libraries.primitives.ptInteger

- lu.uni.lassy.messir.libraries.primitives.ptReal

- lu.uni.lassy.messir.libraries.primitives.ptString

A.2   Undocumented Operation Specifications

- lu.uni.lassy.messir.libraries.calendar.dtDate.close

- lu.uni.lassy.messir.libraries.calendar.dtDate.eq

- lu.uni.lassy.messir.libraries.calendar.dtDate.fromSecondsQty

- lu.uni.lassy.messir.libraries.calendar.dtDate.gt

- lu.uni.lassy.messir.libraries.calendar.dtDate.is

- lu.uni.lassy.messir.libraries.calendar.dtDate.isNow

- lu.uni.lassy.messir.libraries.calendar.dtDate.lt

- lu.uni.lassy.messir.libraries.calendar.dtDate.toSecondsQty

- lu.uni.lassy.messir.libraries.calendar.dtDateAndTime.close

- lu.uni.lassy.messir.libraries.calendar.dtDateAndTime.eq

- lu.uni.lassy.messir.libraries.calendar.dtDateAndTime.fromSecondsQty

- lu.uni.lassy.messir.libraries.calendar.dtDateAndTime.gt

- lu.uni.lassy.messir.libraries.calendar.dtDateAndTime.is

- lu.uni.lassy.messir.libraries.calendar.dtDateAndTime.isNow

- lu.uni.lassy.messir.libraries.calendar.dtDateAndTime.lt

- lu.uni.lassy.messir.libraries.calendar.dtDateAndTime.toSecondsQty

- lu.uni.lassy.messir.libraries.calendar.dtDay.close

- lu.uni.lassy.messir.libraries.calendar.dtDay.is

- lu.uni.lassy.messir.libraries.calendar.dtHour.close

- lu.uni.lassy.messir.libraries.calendar.dtHour.is

- lu.uni.lassy.messir.libraries.math.dtInteger.acos

- lu.uni.lassy.messir.libraries.math.dtInteger.add

- lu.uni.lassy.messir.libraries.math.dtInteger.asdtReal

- lu.uni.lassy.messir.libraries.math.dtInteger.asin

- lu.uni.lassy.messir.libraries.math.dtInteger.asptInteger

- lu.uni.lassy.messir.libraries.math.dtInteger.atan

- lu.uni.lassy.messir.libraries.math.dtInteger.close

- lu.uni.lassy.messir.libraries.math.dtInteger.cos

- lu.uni.lassy.messir.libraries.math.dtInteger.eq

- lu.uni.lassy.messir.libraries.math.dtInteger.frac

- lu.uni.lassy.messir.libraries.math.dtInteger.geq

- lu.uni.lassy.messir.libraries.math.dtInteger.gt

- lu.uni.lassy.messir.libraries.math.dtInteger.is

- lu.uni.lassy.messir.libraries.math.dtInteger.leq

- lu.uni.lassy.messir.libraries.math.dtInteger.lt

- lu.uni.lassy.messir.libraries.math.dtInteger.mod

- lu.uni.lassy.messir.libraries.math.dtInteger.msrabs

- lu.uni.lassy.messir.libraries.math.dtInteger.msrdiv

- lu.uni.lassy.messir.libraries.math.dtInteger.mul

- lu.uni.lassy.messir.libraries.math.dtInteger.neq

- lu.uni.lassy.messir.libraries.math.dtInteger.opp

- lu.uni.lassy.messir.libraries.math.dtInteger.power

- lu.uni.lassy.messir.libraries.math.dtInteger.sin

- lu.uni.lassy.messir.libraries.math.dtInteger.sqr

- lu.uni.lassy.messir.libraries.math.dtInteger.sqrt

- lu.uni.lassy.messir.libraries.math.dtInteger.sub

- lu.uni.lassy.messir.libraries.math.dtInteger.tan

- lu.uni.lassy.messir.libraries.math.dtInteger.toDeg

- lu.uni.lassy.messir.libraries.math.dtInteger.toRad

- lu.uni.lassy.messir.libraries.math.dtInteger.todtString

- lu.uni.lassy.messir.libraries.calendar.dtMinute.close

- lu.uni.lassy.messir.libraries.calendar.dtMinute.is

- lu.uni.lassy.messir.libraries.calendar.dtMonth.close

- lu.uni.lassy.messir.libraries.calendar.dtMonth.is

- lu.uni.lassy.messir.libraries.math.dtReal.acos

- lu.uni.lassy.messir.libraries.math.dtReal.add

- lu.uni.lassy.messir.libraries.math.dtReal.asdtInteger

- lu.uni.lassy.messir.libraries.math.dtReal.asin

- lu.uni.lassy.messir.libraries.math.dtReal.asptReal

- lu.uni.lassy.messir.libraries.math.dtReal.atan

- lu.uni.lassy.messir.libraries.math.dtReal.close

- lu.uni.lassy.messir.libraries.math.dtReal.cos

- lu.uni.lassy.messir.libraries.math.dtReal.eq

- lu.uni.lassy.messir.libraries.math.dtReal.frac

- lu.uni.lassy.messir.libraries.math.dtReal.geq

- lu.uni.lassy.messir.libraries.math.dtReal.gt

- lu.uni.lassy.messir.libraries.math.dtReal.is

- lu.uni.lassy.messir.libraries.math.dtReal.leq

- lu.uni.lassy.messir.libraries.math.dtReal.lt

- lu.uni.lassy.messir.libraries.math.dtReal.msrabs

- lu.uni.lassy.messir.libraries.math.dtReal.msrdiv

- lu.uni.lassy.messir.libraries.math.dtReal.msrround

- lu.uni.lassy.messir.libraries.math.dtReal.mul

- lu.uni.lassy.messir.libraries.math.dtReal.neq

- lu.uni.lassy.messir.libraries.math.dtReal.opp

- lu.uni.lassy.messir.libraries.math.dtReal.power

- lu.uni.lassy.messir.libraries.math.dtReal.sin

- lu.uni.lassy.messir.libraries.math.dtReal.sqr

- lu.uni.lassy.messir.libraries.math.dtReal.sqrt

- lu.uni.lassy.messir.libraries.math.dtReal.sub

- lu.uni.lassy.messir.libraries.math.dtReal.tan

- lu.uni.lassy.messir.libraries.math.dtReal.toDeg

- lu.uni.lassy.messir.libraries.math.dtReal.toRad

- lu.uni.lassy.messir.libraries.math.dtReal.todtString

- lu.uni.lassy.messir.libraries.calendar.dtSecond.close

- lu.uni.lassy.messir.libraries.calendar.dtSecond.is

- lu.uni.lassy.messir.libraries.string.dtString.close

- lu.uni.lassy.messir.libraries.string.dtString.dtStringConcat

- lu.uni.lassy.messir.libraries.string.dtString.eq

- lu.uni.lassy.messir.libraries.string.dtString.geq

- lu.uni.lassy.messir.libraries.string.dtString.gt

- lu.uni.lassy.messir.libraries.string.dtString.is

- lu.uni.lassy.messir.libraries.string.dtString.length

- lu.uni.lassy.messir.libraries.string.dtString.leq

- lu.uni.lassy.messir.libraries.string.dtString.lt

- lu.uni.lassy.messir.libraries.string.dtString.neq

- lu.uni.lassy.messir.libraries.string.dtString.subdtString

- lu.uni.lassy.messir.libraries.string.dtString.toLower

- lu.uni.lassy.messir.libraries.string.dtString.toUpper

- lu.uni.lassy.messir.libraries.string.dtString.toptString

- lu.uni.lassy.messir.libraries.calendar.dtTime.close

- lu.uni.lassy.messir.libraries.calendar.dtTime.eq

- lu.uni.lassy.messir.libraries.calendar.dtTime.fromSecondsQty

- lu.uni.lassy.messir.libraries.calendar.dtTime.gt

- lu.uni.lassy.messir.libraries.calendar.dtTime.is

- lu.uni.lassy.messir.libraries.calendar.dtTime.isNow

- lu.uni.lassy.messir.libraries.calendar.dtTime.lt

- lu.uni.lassy.messir.libraries.calendar.dtTime.toSecondsQty

- lu.uni.lassy.messir.libraries.calendar.dtYear.close

- lu.uni.lassy.messir.libraries.calendar.dtYear.is

- lu.uni.lassy.messir.libraries.primitives.ptBoolean.close

- lu.uni.lassy.messir.libraries.primitives.ptBoolean.eq

- lu.uni.lassy.messir.libraries.primitives.ptBoolean.is

- lu.uni.lassy.messir.libraries.primitives.ptBoolean.msrand

- lu.uni.lassy.messir.libraries.primitives.ptBoolean.msrnot

- lu.uni.lassy.messir.libraries.primitives.ptBoolean.msror

- lu.uni.lassy.messir.libraries.primitives.ptBoolean.msrxor

- lu.uni.lassy.messir.libraries.primitives.ptBoolean.neq

- lu.uni.lassy.messir.libraries.primitives.ptInteger.acos

- lu.uni.lassy.messir.libraries.primitives.ptInteger.add

- lu.uni.lassy.messir.libraries.primitives.ptInteger.asin

- lu.uni.lassy.messir.libraries.primitives.ptInteger.asptReal

- lu.uni.lassy.messir.libraries.primitives.ptInteger.atan

- lu.uni.lassy.messir.libraries.primitives.ptInteger.close

- lu.uni.lassy.messir.libraries.primitives.ptInteger.cos

- lu.uni.lassy.messir.libraries.primitives.ptInteger.eq

- lu.uni.lassy.messir.libraries.primitives.ptInteger.frac

- lu.uni.lassy.messir.libraries.primitives.ptInteger.geq

- lu.uni.lassy.messir.libraries.primitives.ptInteger.gt

- lu.uni.lassy.messir.libraries.primitives.ptInteger.is

- lu.uni.lassy.messir.libraries.primitives.ptInteger.leq

- lu.uni.lassy.messir.libraries.primitives.ptInteger.lt

- lu.uni.lassy.messir.libraries.primitives.ptInteger.mod

- lu.uni.lassy.messir.libraries.primitives.ptInteger.msrabs

- lu.uni.lassy.messir.libraries.primitives.ptInteger.msrdiv

- lu.uni.lassy.messir.libraries.primitives.ptInteger.mul

- lu.uni.lassy.messir.libraries.primitives.ptInteger.neq

- lu.uni.lassy.messir.libraries.primitives.ptInteger.opp

- lu.uni.lassy.messir.libraries.primitives.ptInteger.power

- lu.uni.lassy.messir.libraries.primitives.ptInteger.sin

- lu.uni.lassy.messir.libraries.primitives.ptInteger.sqr

- lu.uni.lassy.messir.libraries.primitives.ptInteger.sqrt

- lu.uni.lassy.messir.libraries.primitives.ptInteger.sub

- lu.uni.lassy.messir.libraries.primitives.ptInteger.tan

- lu.uni.lassy.messir.libraries.primitives.ptInteger.toDeg

- lu.uni.lassy.messir.libraries.primitives.ptInteger.toRad

- lu.uni.lassy.messir.libraries.primitives.ptInteger.toptString

- lu.uni.lassy.messir.libraries.primitives.ptReal.acos

- lu.uni.lassy.messir.libraries.primitives.ptReal.add

- lu.uni.lassy.messir.libraries.primitives.ptReal.asin

- lu.uni.lassy.messir.libraries.primitives.ptReal.asptInteger

- lu.uni.lassy.messir.libraries.primitives.ptReal.atan

- lu.uni.lassy.messir.libraries.primitives.ptReal.close

- lu.uni.lassy.messir.libraries.primitives.ptReal.cos

- lu.uni.lassy.messir.libraries.primitives.ptReal.eq

- lu.uni.lassy.messir.libraries.primitives.ptReal.frac

- lu.uni.lassy.messir.libraries.primitives.ptReal.geq

- lu.uni.lassy.messir.libraries.primitives.ptReal.gt

- lu.uni.lassy.messir.libraries.primitives.ptReal.is

- lu.uni.lassy.messir.libraries.primitives.ptReal.leq

- lu.uni.lassy.messir.libraries.primitives.ptReal.lt

- lu.uni.lassy.messir.libraries.primitives.ptReal.msrabs

- lu.uni.lassy.messir.libraries.primitives.ptReal.msrdiv

- lu.uni.lassy.messir.libraries.primitives.ptReal.msrround

- lu.uni.lassy.messir.libraries.primitives.ptReal.mul

- lu.uni.lassy.messir.libraries.primitives.ptReal.neq

- lu.uni.lassy.messir.libraries.primitives.ptReal.opp

- lu.uni.lassy.messir.libraries.primitives.ptReal.power

- lu.uni.lassy.messir.libraries.primitives.ptReal.sin

- lu.uni.lassy.messir.libraries.primitives.ptReal.sqr

- lu.uni.lassy.messir.libraries.primitives.ptReal.sqrt

- lu.uni.lassy.messir.libraries.primitives.ptReal.sub

- lu.uni.lassy.messir.libraries.primitives.ptReal.tan

- lu.uni.lassy.messir.libraries.primitives.ptReal.toDeg

- lu.uni.lassy.messir.libraries.primitives.ptReal.toRad

- lu.uni.lassy.messir.libraries.primitives.ptReal.toptString

- lu.uni.lassy.messir.libraries.primitives.ptString.close

- lu.uni.lassy.messir.libraries.primitives.ptString.eq

- lu.uni.lassy.messir.libraries.primitives.ptString.geq

- lu.uni.lassy.messir.libraries.primitives.ptString.gt

- lu.uni.lassy.messir.libraries.primitives.ptString.is

- lu.uni.lassy.messir.libraries.primitives.ptString.length

- lu.uni.lassy.messir.libraries.primitives.ptString.leq

- lu.uni.lassy.messir.libraries.primitives.ptString.lt

- lu.uni.lassy.messir.libraries.primitives.ptString.neq

- lu.uni.lassy.messir.libraries.primitives.ptString.ptStringConcat

- lu.uni.lassy.messir.libraries.primitives.ptString.subptString

- lu.uni.lassy.messir.libraries.primitives.ptString.toLower

- lu.uni.lassy.messir.libraries.primitives.ptString.toUpper

Appendix B

Messir Specification Files Listing

B.1 File ./src-gen/messir-spec/.views.msr

```
1 //
2 //DON'T TOUCH THIS FILE !!!
3 //
4 package uuid7d4b15133efc45b9b0f503fbb2d93068 {
5  Concept Model {}
6 }
```

Listing B.1: Messir Spec. file .views.msr.

B.2 File ./src-gen/messir-spec/library/calendar.msr

```
1 /*
2 * Copyright University of Luxembourg
3 *
4 * This file is part of EXCALIBUR.
5 * EXCALIBUR is free software: you can redistribute it and/or modify
6 * it under the terms of the GNU General Public License as published by
7 * the Free Software Foundation, version 3 of the License.
8 *
9 * EXCALIBUR is distributed in the hope that it will be useful,
10 * but WITHOUT ANY WARRANTY; without even the implied warranty of
11 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
12 * GNU General Public License for more details.
13 *
14 * You should have received a copy of the GNU General Public License
15 * along with EXCALIBUR in the COPYING.txt file.
16 * If not, see <http://www.gnu.org/licenses/>.
17 *
18 * Last Modification:
19 *
20 * @author nicolas.guelfi
21 * @date Mon May 06 18:10:54 CEST 2013
22 */
23
24 package lu.uni.lassy.messir.libraries.calendar{
25
26 import lu.uni.lassy.messir.libraries.primitives
27 import lu.uni.lassy.messir.libraries.math
28
29  Concept Model {
30
31   Primary Types {
32
33    datatype dtHour extends dtInteger {
34     operation is():ptBoolean
35     external operation close() : ptBoolean
36    }
```

21

```
37    datatype dtMinute extends dtInteger {
38     operation is():ptBoolean
39     external operation close() : ptBoolean
40    }
41    datatype dtSecond extends dtInteger {
42     operation is():ptBoolean
43     external operation close() : ptBoolean
44    }
45
46    datatype dtTime {
47     attribute hour:dtHour
48     attribute minute: dtMinute
49     attribute second: dtSecond
50
51     operation is():ptBoolean
52     external operation close() : ptBoolean
53
54     // Logical Operations
55     operation lt(AdtTime:dtTime):ptBoolean
56     operation gt(AdtTime:dtTime):ptBoolean
57     operation eq(AdtTime:dtTime):ptBoolean
58     external operation isNow():ptBoolean
59
60     // Conversion Operations
61     operation toSecondsQty():dtInteger
62     operation fromSecondsQty(AdtInteger:dtInteger):ptBoolean
63    }
64
65    datatype dtYear extends dtInteger {
66     operation is():ptBoolean
67     external operation close() : ptBoolean
68    }
69    datatype dtMonth extends dtInteger {
70     operation is():ptBoolean
71     external operation close() : ptBoolean
72    }
73    datatype dtDay extends dtInteger {
74     operation is():ptBoolean
75     external operation close() : ptBoolean
76    }
77
78    datatype dtDate {
79     attribute year:dtYear
80     attribute month: dtMonth
81     attribute day: dtDay
82
83     operation is():ptBoolean
84     external operation close() : ptBoolean
85
86     // Logical Operations
87     operation lt(AdtDate:dtDate):ptBoolean
88     operation gt(AdtDate:dtDate):ptBoolean
89     operation eq(AdtDate:dtDate):ptBoolean
90     external operation isNow():ptBoolean
91
92     // Conversion Operations
93     operation toSecondsQty():dtInteger
94     operation fromSecondsQty(AdtInteger:dtInteger):ptBoolean
95
96    }
97    datatype dtDateAndTime {
98     attribute date:dtDate
99     attribute time: dtTime
100
101     operation is():ptBoolean
102     external operation close() : ptBoolean
103
104     operation lt(AdtDateAndTime:dtDateAndTime):ptBoolean
105     operation gt(AdtDateAndTime:dtDateAndTime):ptBoolean
106     operation eq(AdtDateAndTime:dtDateAndTime):ptBoolean
```

```
107      external operation isNow():ptBoolean
108
109      // Conversion Operations
110      operation toSecondsQty():dtInteger
111      operation fromSecondsQty(AdtInteger:dtInteger):ptBoolean
112    }
113  }
114 }
115 }
```

Listing B.2: Messir Spec. file calendar.msr.

B.3   File ./src-gen/messir-spec/library/math.msr

```
1  /*
2  * Copyright University of Luxembourg
3  *
4  * This file is part of EXCALIBUR.
5  * EXCALIBUR is free software: you can redistribute it and/or modify
6  * it under the terms of the GNU General Public License as published by
7  * the Free Software Foundation, version 3 of the License.
8  *
9  * EXCALIBUR is distributed in the hope that it will be useful,
10 * but WITHOUT ANY WARRANTY; without even the implied warranty of
11 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
12 * GNU General Public License for more details.
13 *
14 * You should have received a copy of the GNU General Public License
15 * along with EXCALIBUR in the COPYING.txt file.
16 * If not, see <http://www.gnu.org/licenses/>.
17 *
18 * Last Modification:
19 *
20 * @author nicolas.guelfi
21 * @date Mon May 06 18:10:54 CEST 2013
22 */
23
24 package lu.uni.lassy.messir.libraries.math{
25
26 import lu.uni.lassy.messir.libraries.primitives
27 import lu.uni.lassy.messir.libraries.string
28
29  Concept Model {
30
31   Primary Types {
32
33    datatype dtInteger{
34     attribute value:ptInteger
35     // Type checking Operation
36     operation is():ptBoolean
37     external operation close() : ptBoolean
38
39     // Arithmetic Operations
40     operation add(AdtInteger:dtInteger): dtInteger
41     operation sub(AdtInteger:dtInteger): dtInteger
42     operation mul(AdtInteger:dtInteger): dtInteger
43     operation frac(AdtInteger:dtInteger): dtReal
44     operation msrdiv(AdtInteger:dtInteger): dtInteger
45     operation power(AExp:dtInteger): dtInteger
46     operation mod(AdtInteger:dtInteger): dtInteger
47
48     operation sqrt(): dtReal
49     operation msrabs(): dtInteger
50     operation opp(): dtInteger
51     operation sqr(): dtInteger
52
53     // Logical Operations
54     operation eq(AdtInteger:dtInteger): ptBoolean
55     operation neq(AdtInteger:dtInteger): ptBoolean
```

```
56      operation geq(AdtInteger:dtInteger): ptBoolean
57      operation leq(AdtInteger:dtInteger): ptBoolean
58      operation lt(AdtInteger:dtInteger): ptBoolean
59      operation gt(AdtInteger:dtInteger): ptBoolean
60
61      // Trigonometric Operations
62      // default is radian
63      operation cos(): dtReal
64      operation acos(): dtReal
65      operation tan(): dtReal
66      operation atan(): dtReal
67      operation sin(): dtReal
68      operation asin(): dtReal
69      operation toDeg(): dtReal
70      operation toRad(): dtReal
71
72      // Conversion Operations
73      operation asdtReal():dtReal
74      operation todtString():dtString
75      operation asptInteger():ptInteger
76      }
77
78    datatype dtReal {
79      attribute value:ptReal
80
81      // Type checking Operation
82      operation is():ptBoolean
83      external operation close() : ptBoolean
84
85      // Arithmetic Operations
86      operation add(AdtReal:dtReal): dtReal
87      operation sub(AdtReal:dtReal): dtReal
88      operation mul(AdtReal:dtReal): dtReal
89      operation frac(AdtReal:dtReal) : dtReal
90      operation msrdiv(AdtReal:dtReal): dtInteger
91      operation power(AdtReal:dtReal): dtReal
92
93      operation msrround() : dtInteger
94      operation sqrt(): dtReal
95      operation msrabs(): dtReal
96      operation opp(): dtReal
97      operation sqr(): dtReal
98
99      // Logical Operations
100     operation eq(AdtReal:dtReal): ptBoolean
101     operation neq(AdtReal:dtReal): ptBoolean
102     operation geq(AdtReal:dtReal): ptBoolean
103     operation leq(AdtReal:dtReal): ptBoolean
104     operation lt(AdtReal:dtReal): ptBoolean
105     operation gt(AdtReal:dtReal): ptBoolean
106
107     // Trigonometric Operations
108     // default is radian
109     operation cos(): dtReal
110     operation acos(): dtReal
111     operation tan(): dtReal
112     operation atan(): dtReal
113     operation sin(): dtReal
114     operation asin(): dtReal
115     operation toDeg(): dtReal
116     operation toRad(): dtReal
117
118     // Conversion Operations
119     operation asdtInteger():dtInteger
120      operation todtString() : dtString
121     operation asptReal():ptReal
122    }
123   }
124 }
```

125 }

Listing B.3: Messir Spec. file math.msr.

B.4   File ./src-gen/messir-spec/library/primitives.msr

```
1 /*
2 * Copyright University of Luxembourg
3 *
4 * This file is part of EXCALIBUR.
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6 * it under the terms of the GNU General Public License as published by
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8 *
9 * EXCALIBUR is distributed in the hope that it will be useful,
10 * but WITHOUT ANY WARRANTY; without even the implied warranty of
11 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
12 * GNU General Public License for more details.
13 *
14 * You should have received a copy of the GNU General Public License
15 * along with EXCALIBUR in the COPYING.txt file.
16 * If not, see <http://www.gnu.org/licenses/>.
17 *
18 * Last Modification:
19 *
20 * @author nicolas.guelfi
21 * @date Mon May 06 18:10:54 CEST 2013
22 */
23
24 package lu.uni.lassy.messir.libraries.primitives{
25  Concept Model {
26   Primary Types {
27
28  primitive ptBoolean {
29    external operation is() : ptBoolean
30    external operation close() : ptBoolean
31
32    external operation msrnot() : ptBoolean
33    external operation msror(AptBoolean:ptBoolean) : ptBoolean
34    external operation msrxor(AptBoolean:ptBoolean) : ptBoolean
35    external operation msrand(AptBoolean:ptBoolean) : ptBoolean
36    external operation eq(AptBoolean:ptBoolean) : ptBoolean
37    external operation neq(AptBoolean:ptBoolean) : ptBoolean
38    }
39
40  primitive ptInteger {
41
42    operation is() : ptBoolean
43    external operation close() : ptBoolean
44
45    // Arithmetic Operations
46    external operation add(AptInteger:ptInteger) : ptInteger
47    external operation sub(AptInteger:ptInteger) : ptInteger
48    external operation mul(AptInteger:ptInteger) : ptInteger
49    external operation frac(AptInteger:ptInteger) : ptReal
50    external operation msrdiv(AptInteger:ptInteger) : ptInteger
51    external operation power(AptInteger:ptInteger) : ptInteger
52    external operation mod(AptInteger:ptInteger) : ptInteger
53
54    external operation sqrt() : ptReal
55    external operation msrabs() : ptInteger
56    external operation opp() : ptInteger
57    external operation sqr() : ptInteger
58
59    // Logical Operations
60    external operation eq(AptInteger:ptInteger) : ptBoolean
61    external operation neq(AptInteger:ptInteger) : ptBoolean
62    external operation geq(AptInteger:ptInteger) : ptBoolean
63    external operation leq(AptInteger:ptInteger) : ptBoolean
```

```
 64     external operation lt(AptInteger:ptInteger) : ptBoolean
 65     external operation gt(AptInteger:ptInteger) : ptBoolean
 66
 67     // Trigonometric Operations
 68     // default is radian
 69     external operation cos(): ptReal
 70     external operation acos(): ptReal
 71     external operation tan(): ptReal
 72     external operation atan(): ptReal
 73     external operation sin(): ptReal
 74     external operation asin(): ptReal
 75     external operation toDeg(): ptReal
 76     external operation toRad(): ptReal
 77
 78     // Conversion Operations
 79     external operation asptReal() : ptReal
 80     external operation toptString() : ptString
 81 }
 82
 83  primitive ptReal {
 84
 85     operation is() : ptBoolean
 86     external operation close() : ptBoolean
 87
 88     // Arithmetic Operations
 89     external operation add(AptReal:ptReal) : ptReal
 90     external operation sub(AptReal:ptReal) : ptReal
 91     external operation mul(AptReal:ptReal) : ptReal
 92     external operation frac(AptReal:ptReal) : ptReal
 93     external operation msrdiv(AptReal:ptReal) : ptInteger
 94     external operation power(AptReal:ptReal) : ptReal
 95
 96     external operation msrround() : ptInteger
 97     external operation sqrt() : ptReal
 98     external operation msrabs() : ptReal
 99     external operation opp() : ptReal
100     external operation sqr() : ptReal
101
102     // Logical Operations
103     external operation eq(AptReal:ptReal) : ptBoolean
104     external operation neq(AptReal:ptReal) : ptBoolean
105     external operation geq(AptReal:ptReal) : ptBoolean
106     external operation leq(AptReal:ptReal) : ptBoolean
107     external operation lt(AptReal:ptReal) : ptBoolean
108     external operation gt(AptReal:ptReal) : ptBoolean
109
110     // Trigonometric Operations
111     // default is radian
112     external operation cos(): ptReal
113     external operation acos(): ptReal
114     external operation tan(): ptReal
115     external operation atan(): ptReal
116     external operation sin(): ptReal
117     external operation asin(): ptReal
118     external operation toDeg(): ptReal
119     external operation toRad(): ptReal
120
121     // Conversion Operations
122     external operation asptInteger() : ptInteger
123     external operation toptString() : ptString
124 }
125
126 primitive ptString {
127
128     external operation is() : ptBoolean
129     external operation close() : ptBoolean
130
131     external operation length() : ptInteger
132     external operation ptStringConcat(AptString:ptString) : ptString
133     external operation subptString(
```

```
134             StartIndex:ptInteger,
135             EndIndex:ptInteger
136             ) : ptString
137    external operation toLower():ptString
138    external operation toUpper():ptString
139    external operation eq(AptString:ptString):ptBoolean
140    external operation neq(AptString:ptString):ptBoolean
141    external operation geq(AptString:ptString) : ptBoolean
142    external operation leq(AptString:ptString) : ptBoolean
143    external operation lt(AptString:ptString) : ptBoolean
144    external operation gt(AptString:ptString) : ptBoolean
145    }
146 }
147 }
148 }
```

Listing B.4: Messir Spec. file primitives.msr.

B.5   File ./src-gen/messir-spec/library/string.msr

```
1 /*
2 * Copyright University of Luxembourg
3 *
4 * This file is part of EXCALIBUR.
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6 * it under the terms of the GNU General Public License as published by
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9 * EXCALIBUR is distributed in the hope that it will be useful,
10 * but WITHOUT ANY WARRANTY; without even the implied warranty of
11 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
12 * GNU General Public License for more details.
13 *
14 * You should have received a copy of the GNU General Public License
15 * along with EXCALIBUR in the COPYING.txt file.
16 * If not, see <http://www.gnu.org/licenses/>.
17 *
18 * Last Modification:
19 *
20 * @author nicolas.guelfi
21 * @date Mon May 06 18:10:54 CEST 2013
22 */
23
24 package lu.uni.lassy.messir.libraries.string{
25
26 import lu.uni.lassy.messir.libraries.primitives
27 import lu.uni.lassy.messir.libraries.math
28
29  Concept Model {
30
31   Primary Types {
32
33    datatype dtString {
34     attribute value:ptString
35
36     // Type checking Operation
37     operation is():ptBoolean
38     external operation close() : ptBoolean
39
40     operation length() : dtInteger
41     operation dtStringConcat(AdtString:dtString) : dtString
42     operation subdtString(StartIndex:dtInteger,
43                EndIndex:dtInteger
44                  ) : dtString
45
46     operation toLower():dtString
47     operation toUpper():dtString
48
49     operation eq(AdtString:dtString):ptBoolean
```

```
50      operation neq(AdtString:dtString):ptBoolean
51      operation geq(AdtString:dtString) : ptBoolean
52      operation leq(AdtString:dtString) : ptBoolean
53      operation lt(AdtString:dtString) : ptBoolean
54      operation gt(AdtString:dtString) : ptBoolean
55
56      // Conversion Operations
57      operation toptString():ptString
58      }
59   }
60  }
61 }
```

Listing B.5: Messir Spec. file string.msr.