

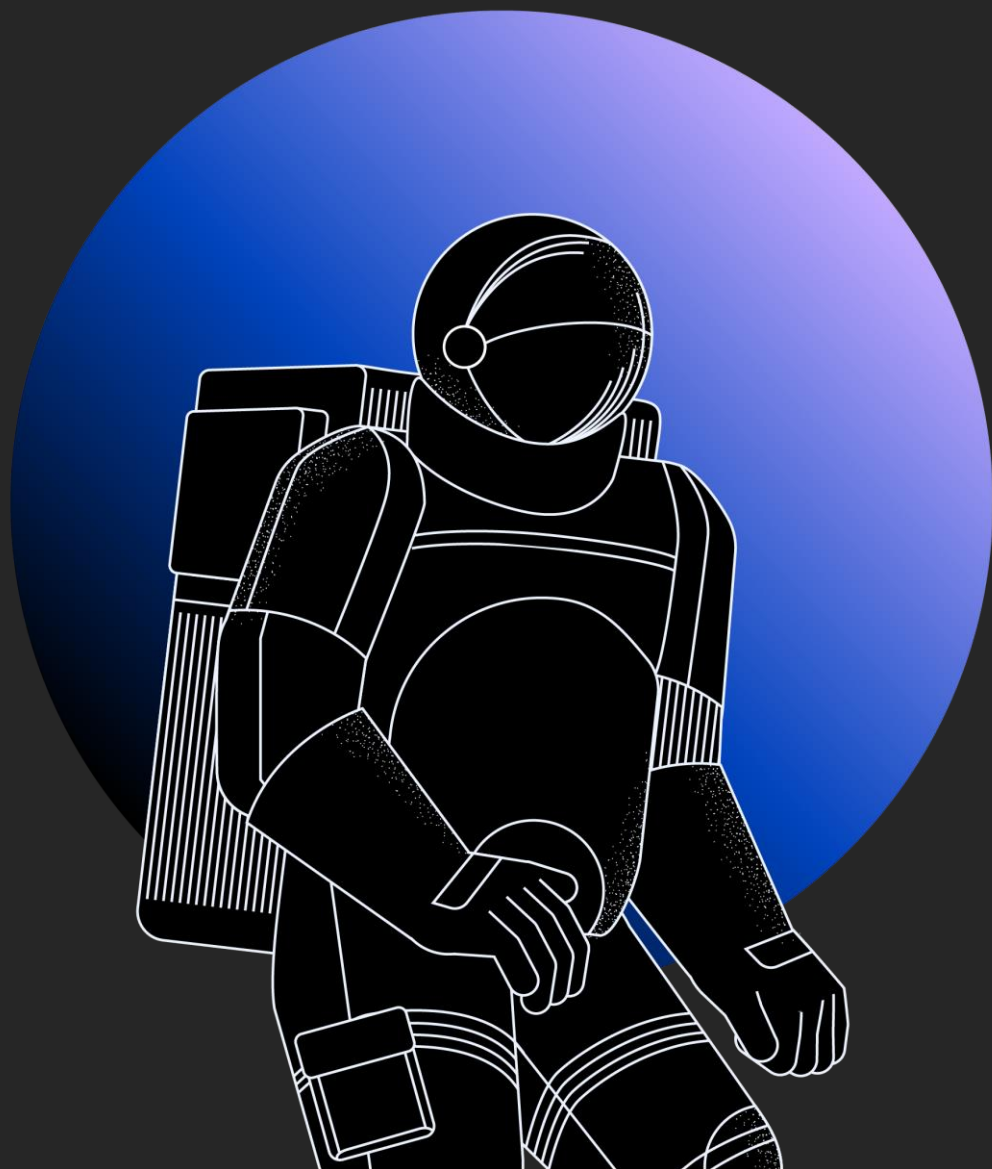
Lab Guide

IBM Decision Manger Open Edition

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Hands-on Guide

DMN Beyond the Basics



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1 Introduction

In this guide we go beyond basics to build real-world DMN.

The following topics are presented:

- **Data Types**
- **Applying patterns for large projects**
- **Hit Policies**
- **Advanced DMN**


By the end, you will be able to apply the techniques presented in these topics to your projects.

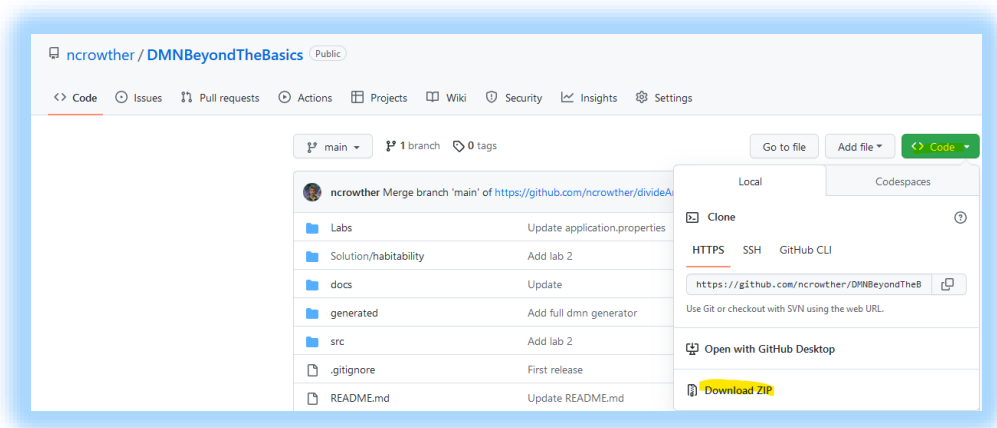
2 Prerequisites

For this lab you need **Kie Sandbox** with *Kie Sandbox Extended Services* running. If you have not already done so, download and install the *Kie Sandbox Extended Services*.

You will also need a local copy of the following Git repo:

<https://github.com/ncrowther/DMNBeyondTheBasics>


Click on the link and then click the **Code**  button and *Download ZIP*:

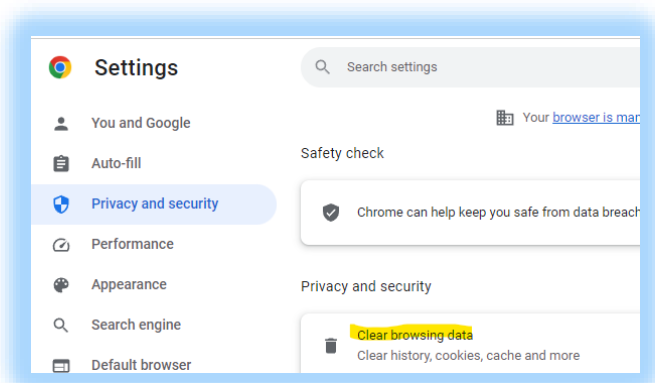


Unpack the zip to a local directory and note the location.

Important

If the Kie Sandbox stops working its likely a problem with the browser cache and you will need to clear it.

In Chrome, click  then select *Settings*. Select *Privacy and security* and press *Clear browsing data*:



If you lose your work, each lab has a completed DMN so that you can load the completed lab to see it working.

Additional Documentation

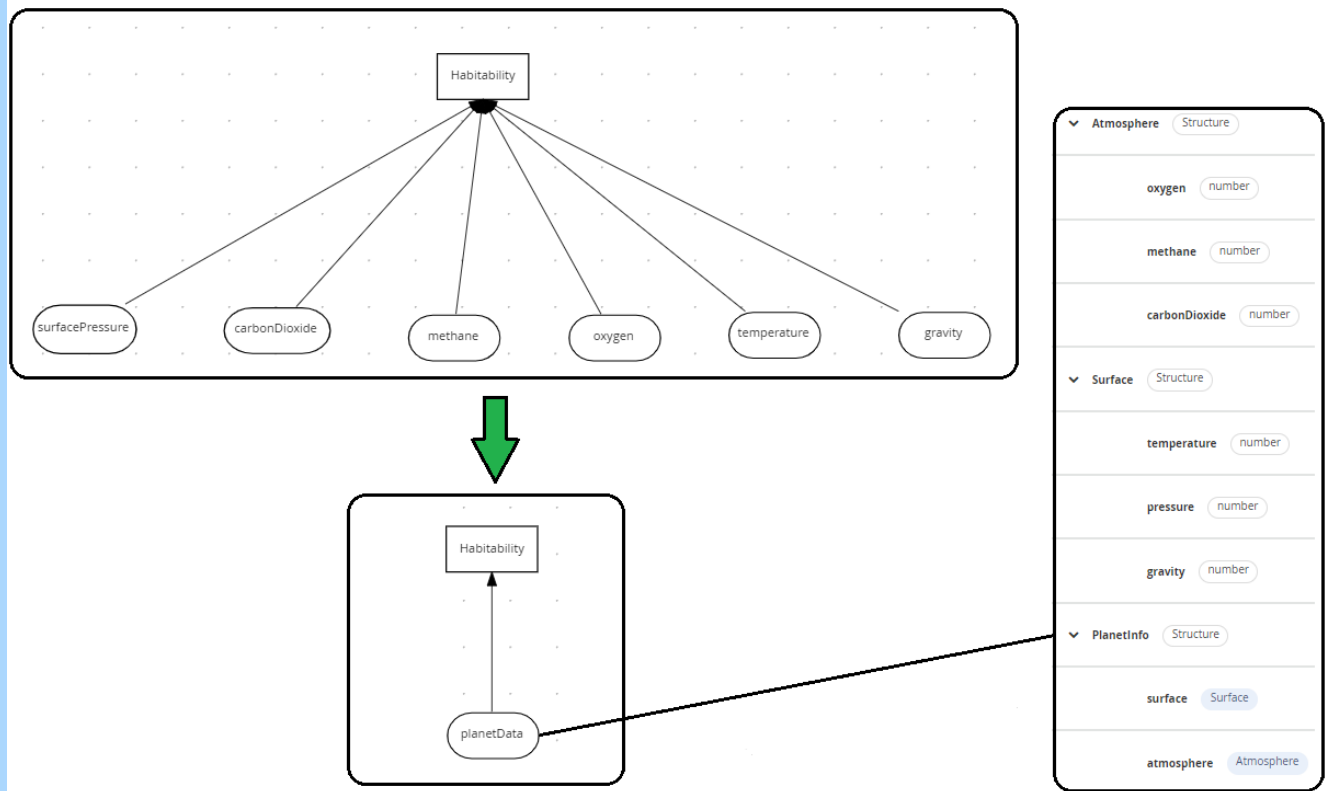
Additional documentation on DMN is found here:

https://access.redhat.com/documentation/en-us/red_hat_decision_manager/7.8/html/designing_a_decision_service_using_dmn_models

Lab 1 - Data Types

Introduction

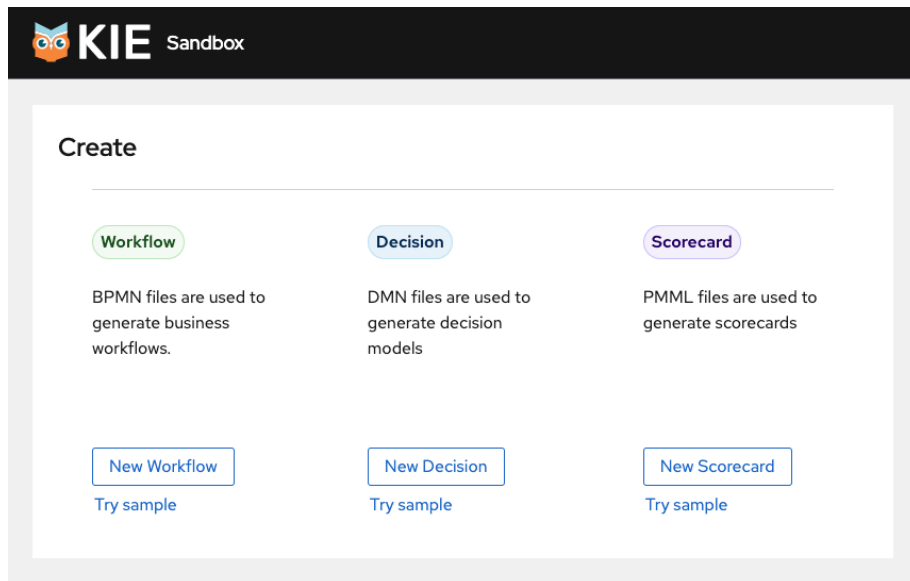
In this lab you will simplify DMN by using data structures. See below:

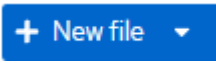


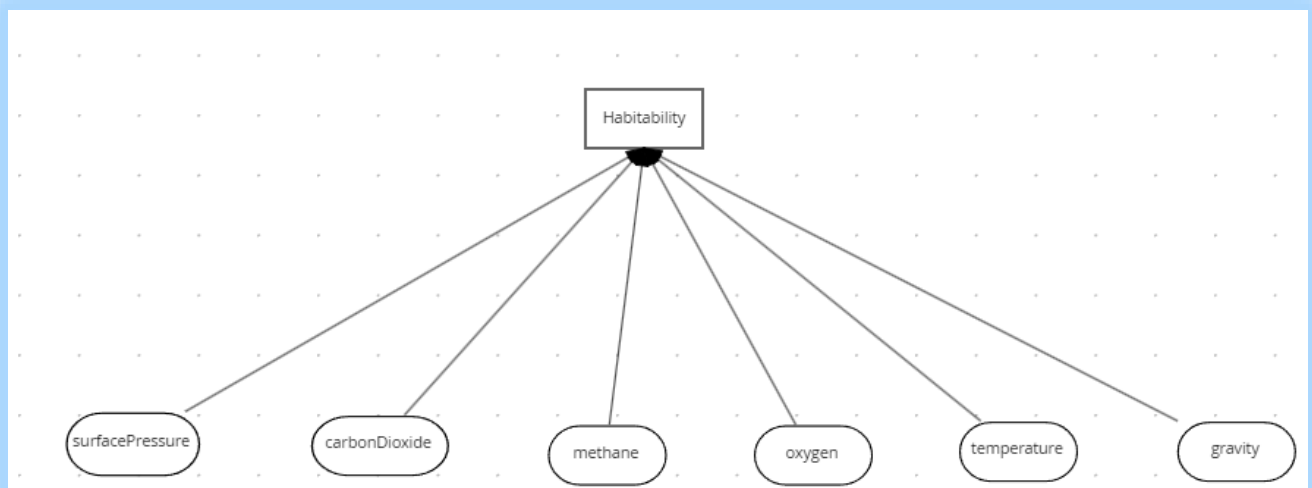
Applying a Data Model to Unstructured Data

Instructions

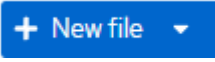
1. In browsers Chrome or Safari open the web site <https://sandbox.kie.org/>



2. Click on **New Decision**.
3. An empty canvas opens. Click *New file*  and then *Upload...*
4. From the downloaded zip contents, Select file: labs\lab01\HabitabilityStart.dmn
5. You should see this:

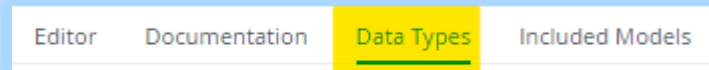


The inputs are simple data types and there are lots of them! This is an antipattern. We will apply a data type to make it more readable.

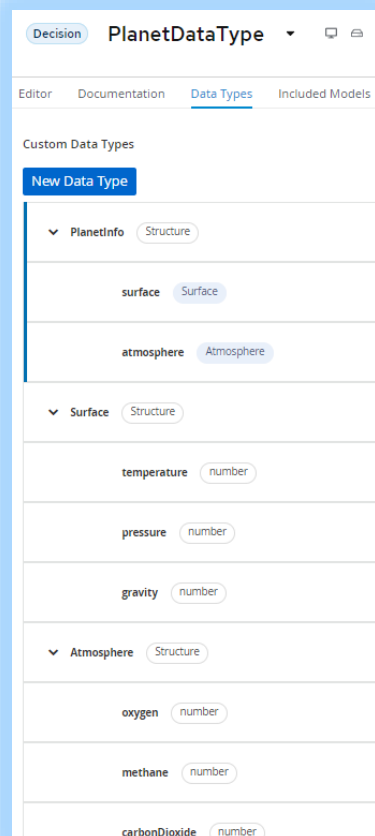
6. Click *New file*  and then Upload...

7. Select the file: *lab01/PlanetDataType.dmn*

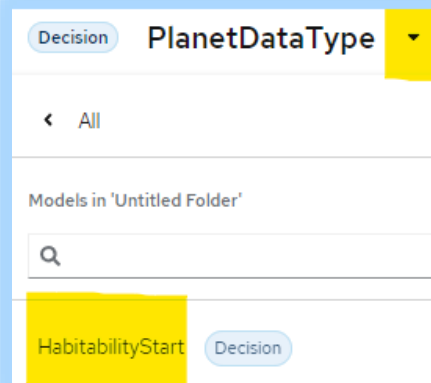
8. Click on the *Data Types* tab:



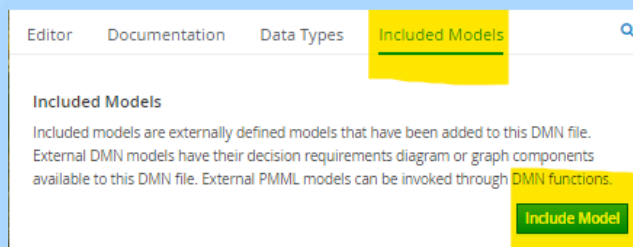
9. You should see the structure below. This data structure contains all attributes from the original diagram. It is structured into sub classes of *surface* and *atmosphere*.



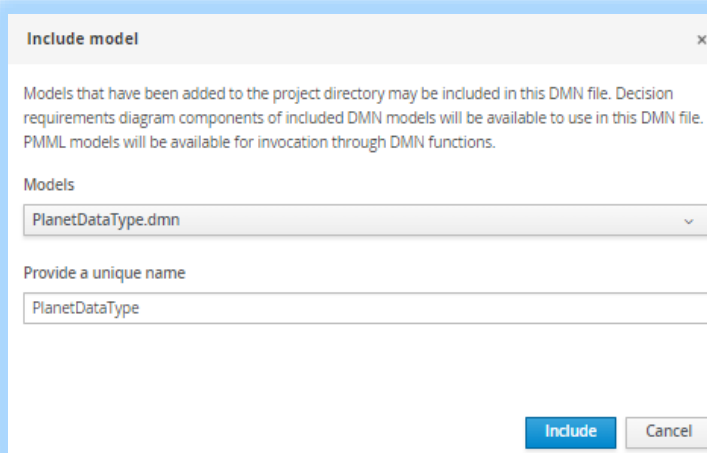
10. Go back to *HabitabilityStart* by clicking the drop-down arrow next to *PlanetDataType*:



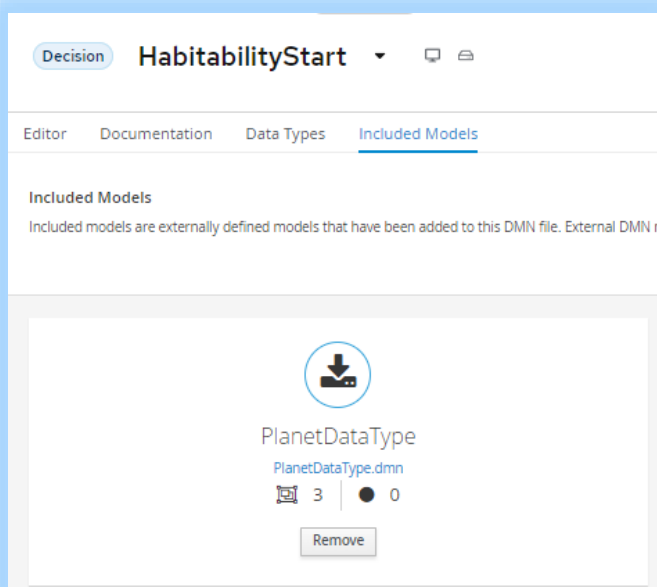
11. Within *HabitabilityStart*, Select **Included Models** tab, and then click **Include Model**



12. Add the *PlanetDataType* model and give it the same name of *PlanetDataType*:

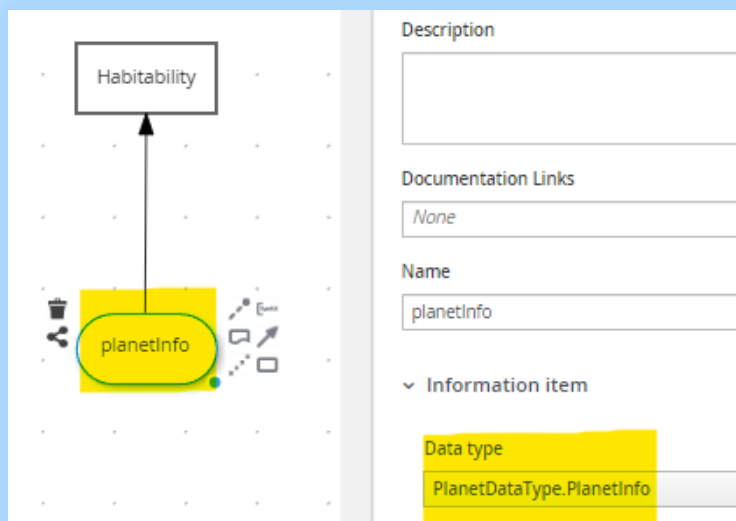


13. Click *Include*. You should see the model has been imported:

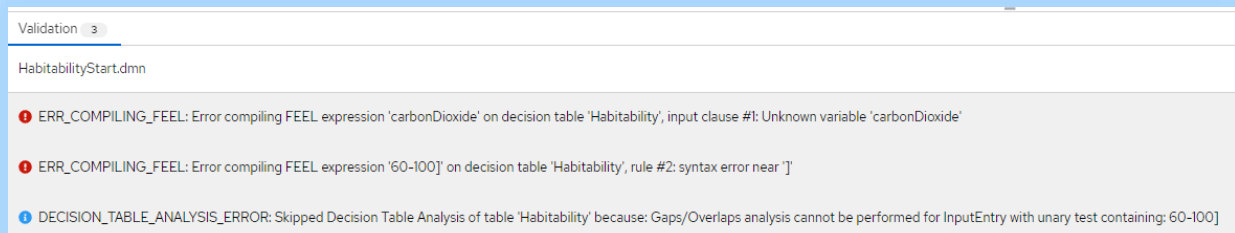


14. Switch to the **Editor** tab.

15. Back in the DMN Diagram, delete all the inputs and replace with one input called *PlanetInfo* assigning it a type of *PlanetDataType.PlanetInfo*:



16. Click in the Problems button at the bottom right¹. You should see errors:



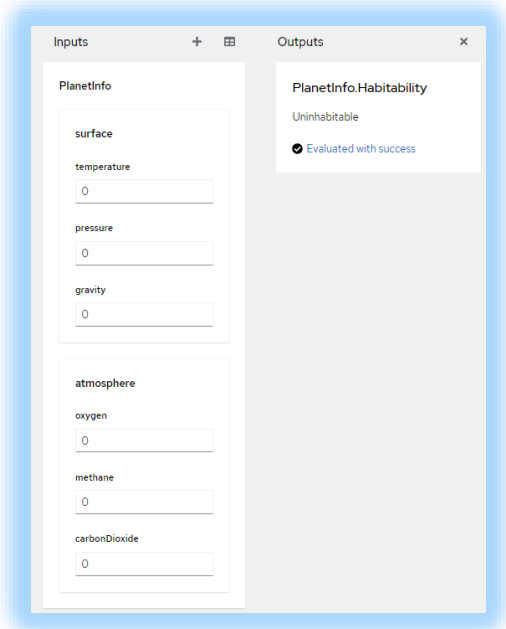
17. The *Habitality* decision table is still referencing the primitive inputs. We need to fix this. Edit the table so that *planetInfo* is referenced instead of the primitives. See below:

F	planetInfo.atmosphere.carbonDioxide (number)	planetInfo.surface.gravity (number)	planetInfo.atmosphere.methane (number)	planetInfo.atmosphere.oxygen (number)	planetInfo.surface.pressure (number)	planetInfo.surface.temperature (number)	Habitality (string)
1	<10	[0..2]	<10	[20..60]	[0.5..2]	[0..30]	"Habitable"
2	<10	[0..2]	<10	[60-100]	-	[30-50]	"Barely Habitable"
3	-	-	-	-	-	-	"Uninhabitable"

¹ You will need *Kie Sandbox Extended Services* installed. Hit the *Run* button and follow the instructions.

18. All errors should be clear, and two warnings are left. We will review the warnings in a later lab. Test the model by pressing *Run*. If you have not installed the *Kie Server Extended Services*, now is the time to do so.

19. Enter zero values for all attributes and the expected result is *Uninhabitable* :



The screenshot shows a web application interface with two main panels: 'Inputs' and 'Outputs'. The 'Inputs' panel is titled 'PlanetInfo' and contains two sections: 'surface' and 'atmosphere'. The 'surface' section has three input fields for 'temperature', 'pressure', and 'gravity', each with the value '0'. The 'atmosphere' section has three input fields for 'oxygen', 'methane', and 'carbonDioxide', each with the value '0'. The 'Outputs' panel is titled 'PlanetInfo.Habitability' and shows the result 'Uninhabitable' with a status indicator 'Evaluated with success'.

20. Test with other values and check the results against the decision table.

Conclusion

In this lab we refactored a decision with many inputs into a decision with one input associated to a data structure. Moving primitives to data structures simplifies DMN.

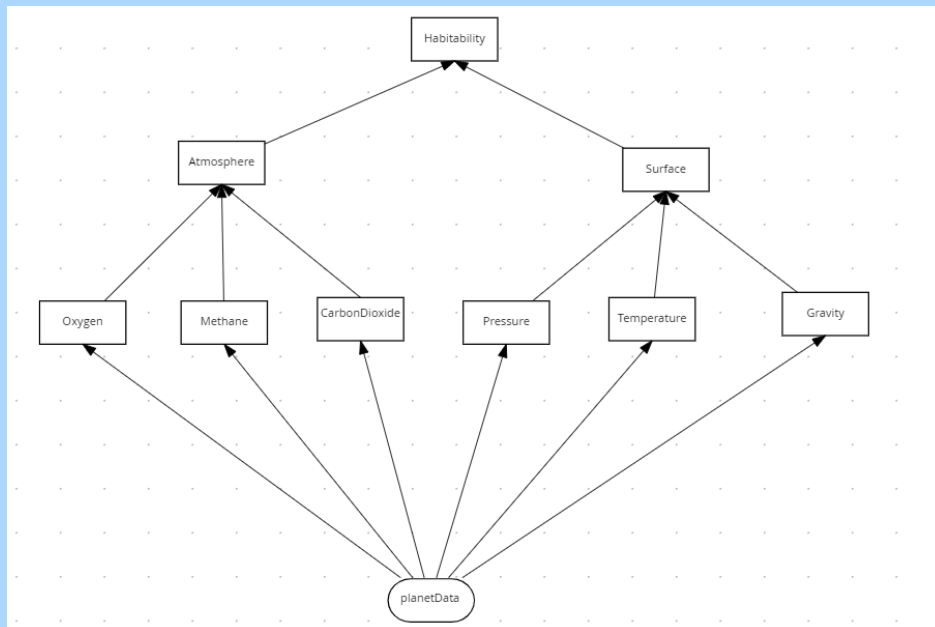
Lab 2 – The Divide and Conquer Pattern

Introduction

The decision table in the previous lab will not scale. If all rule combinations were entered the table would be huge. To reduce the size and complexity we can divide and conquer into smaller parts.

To do this, we create a decision table for each planet attribute and reduce outputs to enumerated values: *Optimal*, *Bearable* or *Deadly*. Then we apply these outputs in a decision further up in the model. Using this pattern, we split a wide table into several smaller tables.

The tables are linked in the DMN diagram shown below:

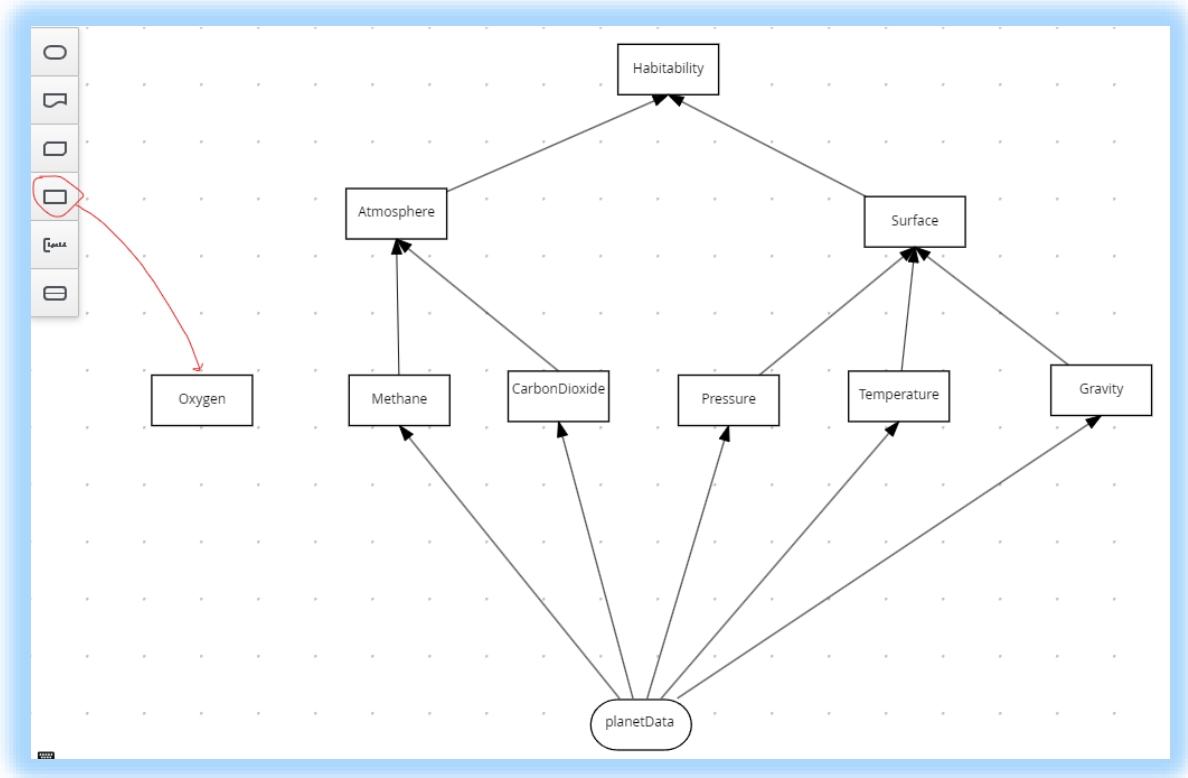



The **habitability** table has the same behavior as the original design, with the benefit that it is easier to maintain. Each attribute has its own table making it easier to focus on the decisions for each attribute.

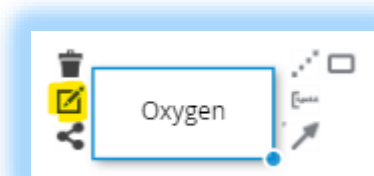
Instructions

1. In browsers Chrome or Safari open the web site <https://sandbox.kie.org/>
2. Click on **New Decision**.
3. An empty canvas opens. Click *New file*  and then *Upload...*

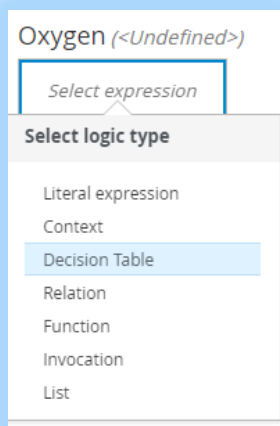
4. Select the file: *lab02/HabitabilityStart.dmn*
5. The model is nearly complete but is missing the *oxygen* attribute. Create a new Decision node and call it *Oxygen*.



6. Select the decision and then click the *edit*  button:



7. Select the logic type as *Decision Table*:



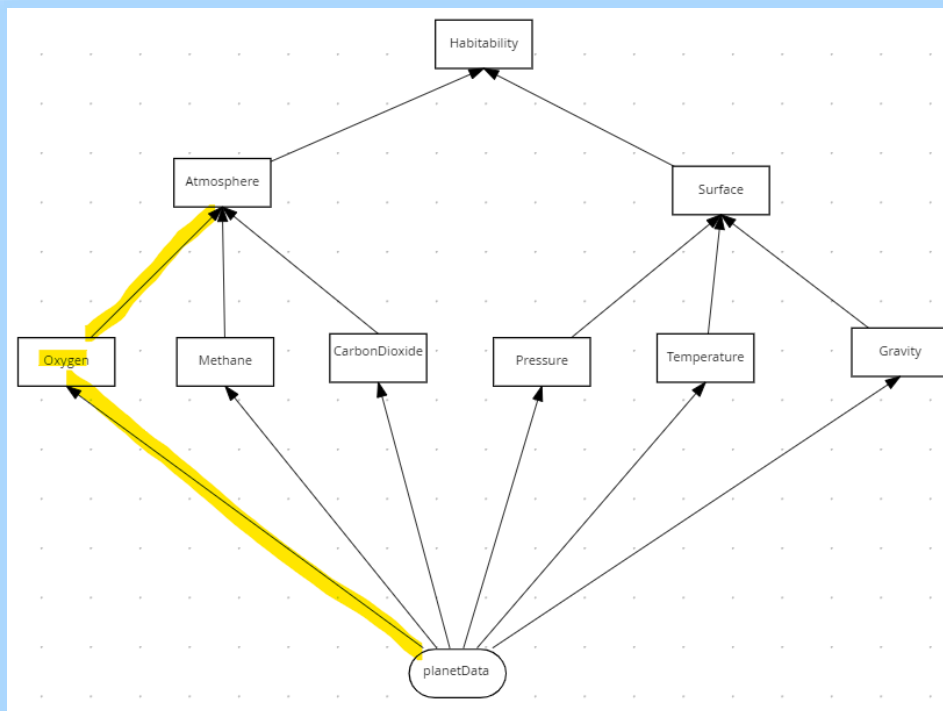
8. Create the table below

Oxygen (Decision Table)		
F	planetData.atmosphere.oxygen (number)	Oxygen (string)
1	[16..49]	"Optimal"
2	[5..15]	"Bearable"
3	-	"Deadly"

9. Verify the following:

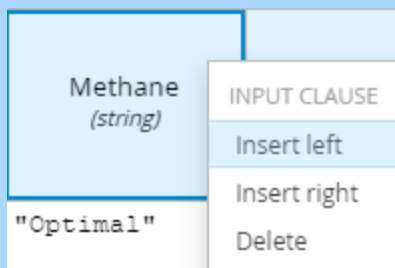
- `planetData.atmosphere.oxygen` is the condition variable. Case is important.
- Numeric ranges `[16..49]` and `[5..15]` are the conditions.
- Enumerated values are in quotes.
- The Hit policy is First (F)

10. Now plug the *Oxygen* Decision node to the diagram. You should have the following connections:

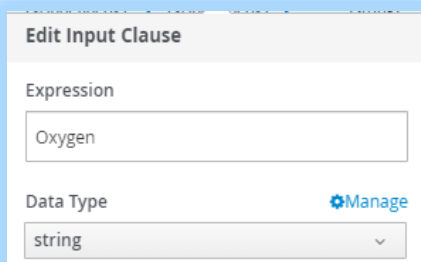


11. Edit the Atmosphere table so that it handles the Oxygen decision.

12. Right-click on the *Methane* column to add a new column to the left:



13. For the new column, set the Expression as *Oxygen* (case important) and the Data type as *string*.



14. Add four enumerated values (in quotes) as shown below:

Atmosphere (Decision Table)

F	Oxygen (string)	Methane (string)	CarbonDioxide (string)	Atmosphere (number)	annotation-1
1	"Optimal"	"Optimal"	"Optimal"	"Optimal"	
2	"Bearable"	"Bearable"	"Optimal"	"Bearable"	
3	"Bearable"	"Optimal"	"Optimal"	"Bearable"	
4	"Optimal"	"Bearable"	"Optimal"	"Bearable"	
5	-	-	-	"Deadly"	

15. Now look at the root decision node, *Habitability*. It combines the decisions in the lower tables to make the final decision on planet habitability:

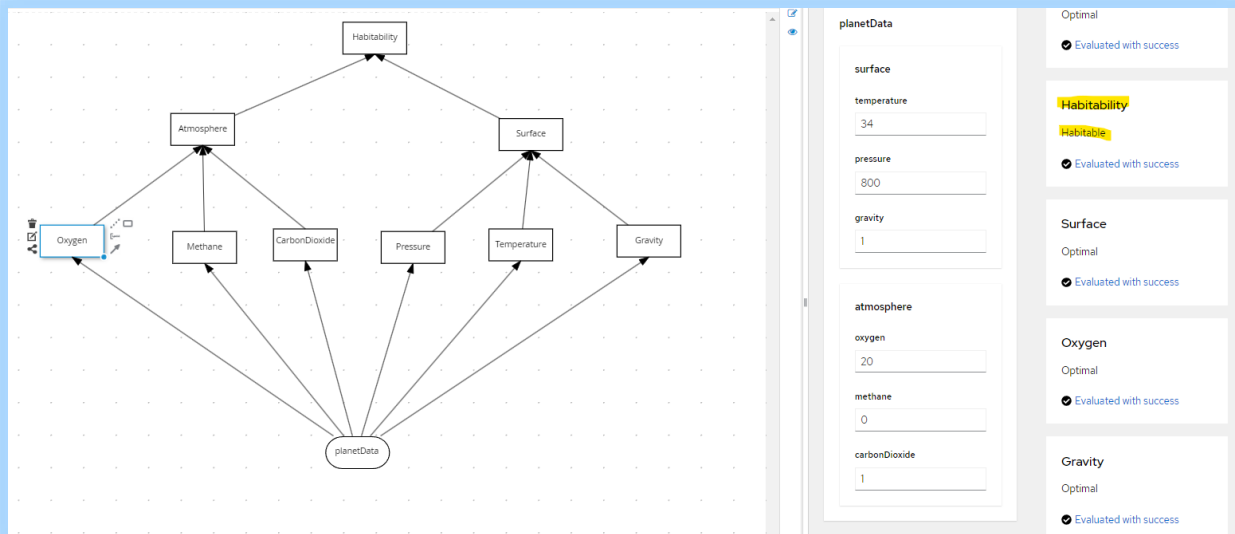
Habitability (Decision Table)

F	Atmosphere (string)	Surface (string)	Habitability (string)	annotation-1
1	"Optimal"	"Optimal"	"Habitable"	
2	"Bearable"	"Bearable"	"Bearly Habitable"	
3	"Bearable"	"Optimal"	"Bearly Habitable"	
4	"Optimal"	"Bearable"	"Bearly Habitable"	
5	-	-	"Deadly"	

16. We have now implemented the Divide and Conquer pattern by splitting up one wide decision table into several smaller ones. Let's test the service.

17. Press the *Run* button

18. Enter values for the inputs until Habitability is *Habitable*. You will need to examine each decision table to find the optimal value for each variable before this decision is reached.



Conclusion

In this lab we refactored the Habitability rules into separate decision services that build up the overall decision. Separating a single decision table helps manage complex decisions with many inputs.

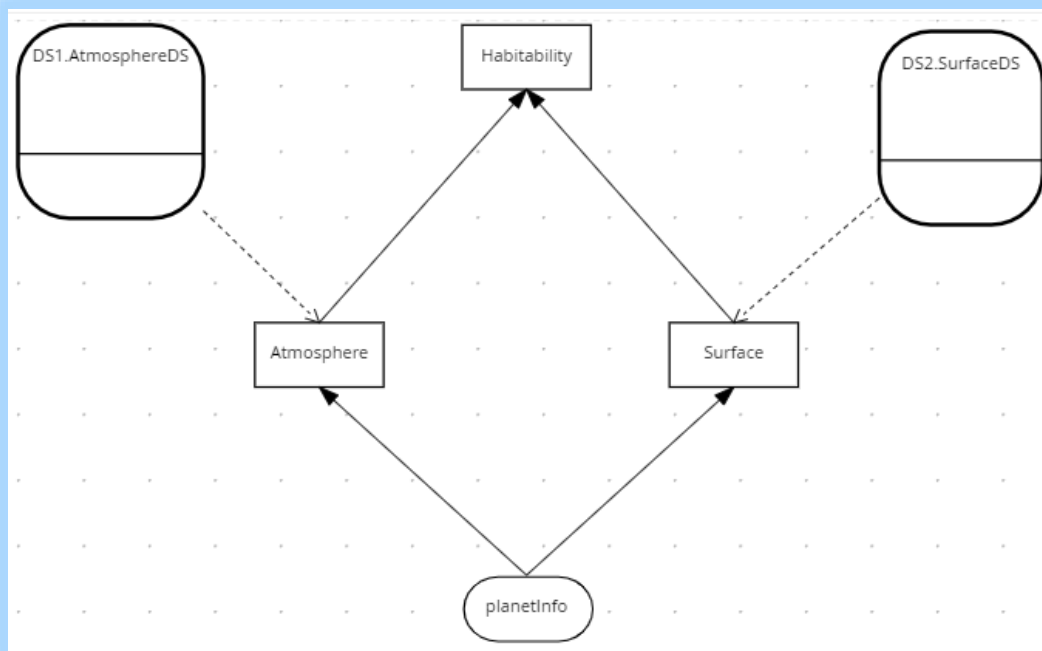
Lab 3 – The Tiered Service Pattern

Introduction

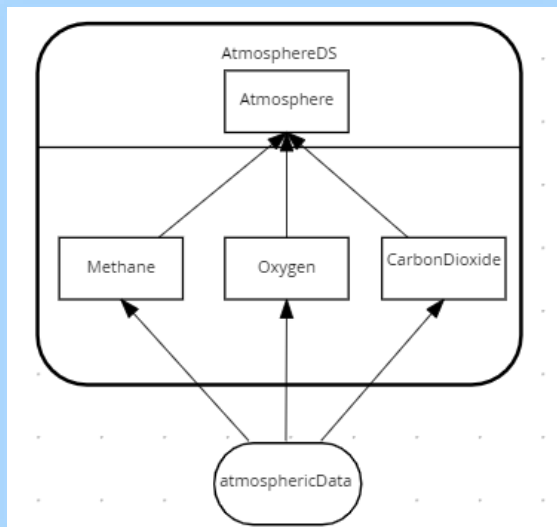
The DMN defined in the previous lab was confined to a single file. This is a problem because:

- The DMN cannot be edited simultaneously by several people
- The DMN cannot be reused in other decisions.

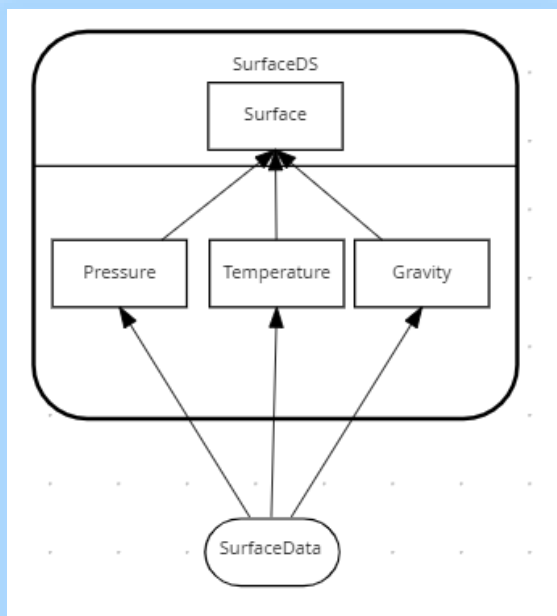
To improve, move the second-tier decisions into decision services and then invoke these decisions from the top tier. See below, where the second-tier decision services are *AtmosphereDS* and *SurfaceDS*:



The two second tier decision services are *AtmosphereDS* and *SurfaceDS*:



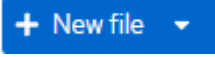
Atmosphere Decision Service

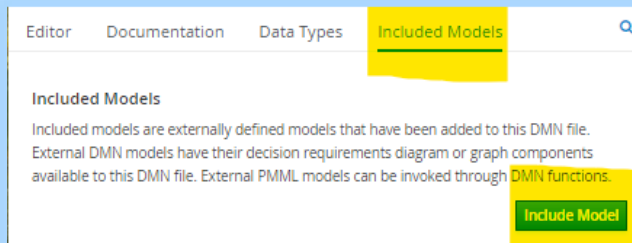


Surface Decision Service

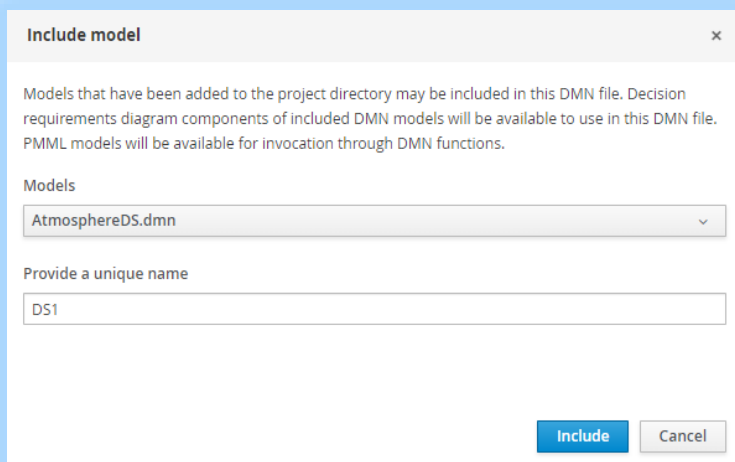
In the Habitability example we have only two tiers – but in practice the pattern could be applied to multiple tiers, with second tier decision services calling third tier services, and so on. The number of tiers depends on project complexity.

Instructions

1. In browsers Chrome or Safari open the web site <https://sandbox.kie.org/>
 2. Click on **New Decision**.
 3. An empty canvas opens. Click *New file*  and then *Upload...*
 4. Select file: *lab03/SurfaceDS.dmn*
 5. Repeat steps 3 and 4 for a further two files:
lab03/AtomosphereDS.dmn
lab03/HabitabilityStart.dmn
21. Within *HabitabilityStart*, Select **Included Models** tab, and then click **Include Model**



22. Add the *AtomosphereDS.dmn* and give it the name of *DS1*:



23. Click *Include*.
24. Click *Include Model* again and import *SurfaceDS.dmn*. Give it a name of *DS2*:

Include model ✕

Models that have been added to the project directory may be included in this DMN file. Decision requirements diagram components of included DMN models will be available to use in this DMN file. PMML models will be available for invocation through DMN functions.

Models

SurfaceDS.dmn

Provide a unique name

DS2

Include **Cancel**



25. You should see both decision services have been imported:

Decision **HabitabilityStart** ▼ 🖨 📁

Editor Documentation Data Types Included Models

Included Models

Included models are externally defined models that have been added to this DMN file. External DMN models have their decision requirements diagram or graph components available to use in this DMN file.

 <p>DS1</p> <p>AtmosphereDS.dmn</p> <p>3 0</p> <p>Remove</p>	 <p>DS2</p> <p>SurfaceDS.dmn</p> <p>0 0</p> <p>Remove</p>
--	--

26. Select the *Editor* tab.


27. Select the Decision Navigator button on the far right .


28. Set the filter *Decision Service*. You should see the following:

Decision Components 16

Decision service

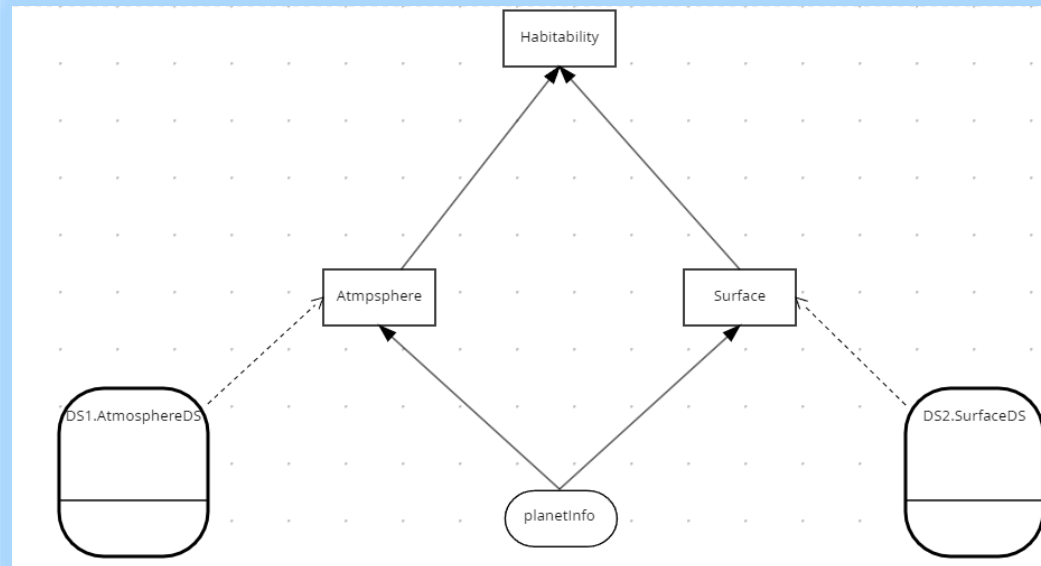
Enter text

 **DS1.AtmosphereDS**
AtmosphereDS.dmn

 **DS2.SurfaceDS**
SurfaceDS.dmn

29. Drag and drop *DS1.AtmosphereDS* and *DS2.SurfaceDS* to the diagram

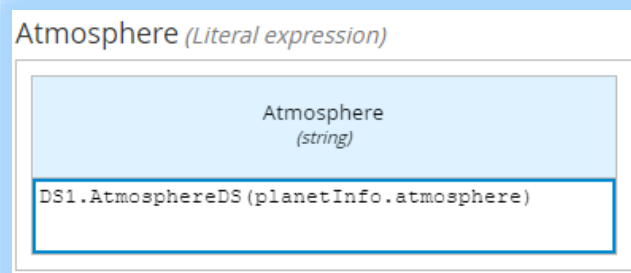
30. Using the arrow connector, connect *DS1.AtmosphereDS* to *Atmosphere* and *DS2.SurfaceDS* to *Surface*. You should now see the following:



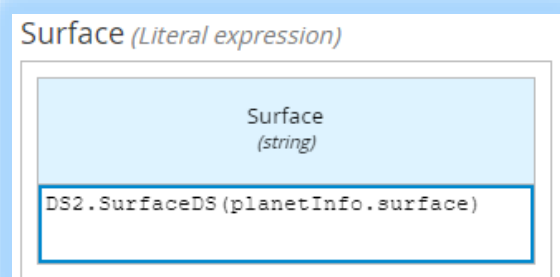
31. Edit the Atmosphere Decision Node. Create a Literal Expression and the FEEL expression:

```
DS1.AtmosphereDS (planetInfo.atmosphere)
```

32. Set the return type of *Atmosphere* to *string*. You should see this.



33. Edit *Surface* Decision. You should see it has been predefined to call the *DS2.SurfaceDS* decision service:



34. Press the *Run* button

35. Enter zero values for all inputs and the expected result is *Deadly*. If there are execution errors talk to your instructor.

Conclusion

In this lab we refactored the Habitability rules to call separate decision services. Separating a single decision into multiple services helps scale your DMN projects.

Lab 4 – The Index Pattern

Introduction

The Divide and Conquer Pattern does not work with many rules and few conditions. Use the Index Pattern for this. An example is SWIFT interchange rules. A simplified SWIFT message is:

BIC – A Bank Identifier Code

Receiving Branch – The bank branch

Message type – The type of payment

Route – The route the message is sent

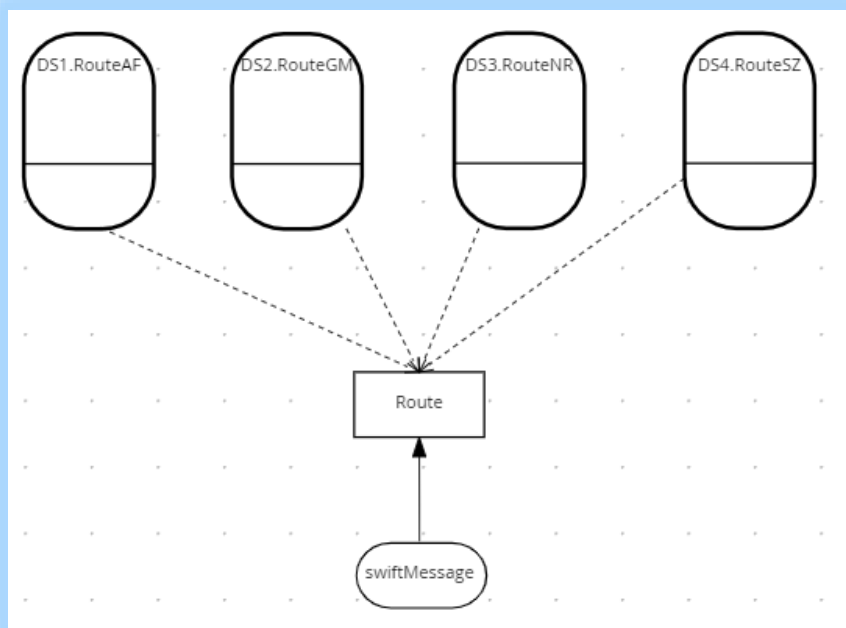
The rules below decide where to route a SWIFT message within the banking network:

Route (Decision Table)

U	SwiftMessage.bic (string)	SwiftMessage.branch (string)	SwiftMessage.messageType (string)	Route (string)	annotation-1
1	"AAA"	"001"	"202"	"X"	
2	"BBB"	"001"	"201"	"Y"	
3	"CCC"	"002"	"203"	"Z"	

There could be thousands of rules based on just three attributes *Bic*, *Branch* and *Message Type*.

In DMN this we could model this decision using the Index pattern:



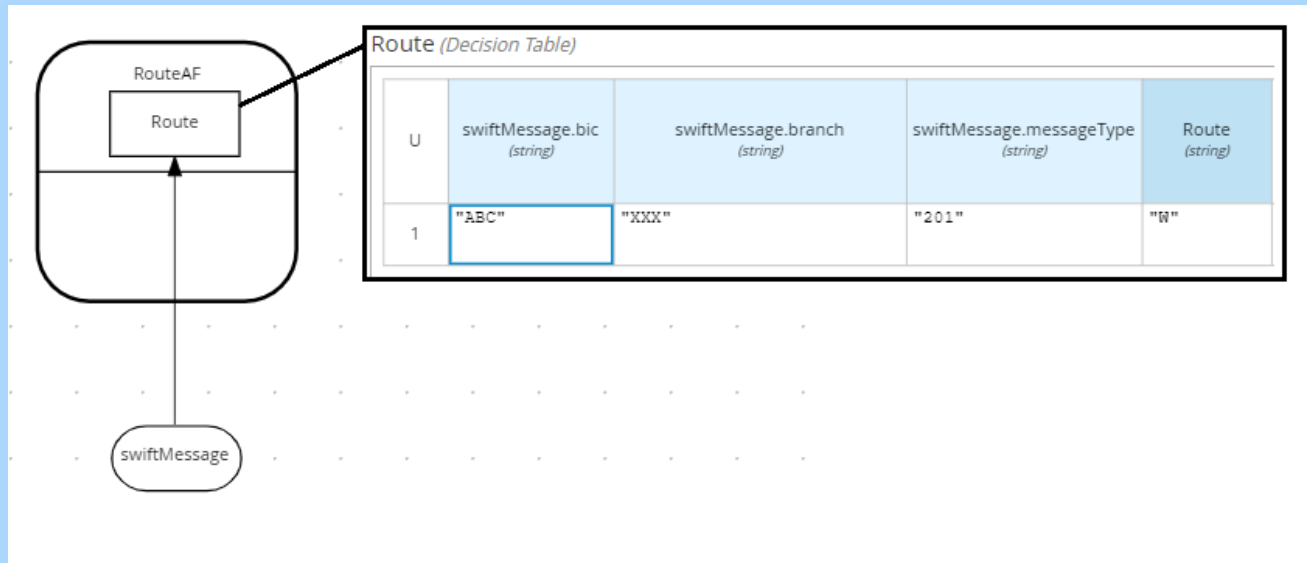
The index logic is in the *Route* decision. It routes the message to an indexed decision service based on the first letter of the BIC. This splits the table into four smaller tables, each alphabetically indexed. There could be further indexing within each of these decision services to split the decision table further

Here is the logic for the *Route* decision:

Route (Context)

#		Route (string)
1	A-F (boolean)	<code>matches (swiftMessage.bic, "[A-F] [A-Z]*")</code>
2	G-M (boolean)	<code>matches (swiftMessage.bic, "[G-M] [A-Z]*")</code>
3	N-R (boolean)	<code>matches (swiftMessage.bic, "[N-R] [A-Z]*")</code>
4	S-Z (boolean)	<code>matches (swiftMessage.bic, "[S-Z] [A-Z]*")</code>
5	resultA-F (string)	<code>if A-F then (DS1.RouteAF(swiftMessage)) else ""</code>
6	resultG-M (string)	<code>if G-M then (DS2.RouteGM(swiftMessage)) else ""</code>
7	resultN-R (string)	<code>if N-R then (DS3.RouteNR(swiftMessage)) else ""</code>
8	resultS-Z (string)	<code>if S-Z then (DS4.RouteSZ(swiftMessage)) else ""</code>
	<result>	<code>string join ([resultA-F, resultG-M, resultN-R, resultS-Z])</code>

The indexed decision service handles each part of its allocated alphabet range. The service handling BICs starting A-F is shown below.



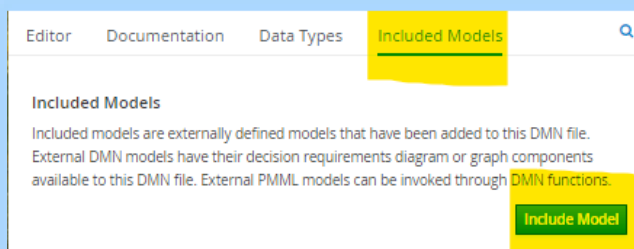
The decision services handling BICs G-M, N-R and S-Z follow the same pattern.

Instructions

1. In browsers Chrome or Safari open the web site <https://sandbox.kie.org/>
2. Click on **New Decision**.
3. An empty canvas opens. Click *New file*  and then *Upload...*
4. Perform a multiple select on the Lab04 files:

lab04/SwiftDataStructure.dmn
lab04/RouteAF.dmn
lab04/RouteGM.dmn
lab04/RouteNR.dmn
lab04/RouteSZ.dmn
lab04/SwiftRoutingRules.dmn

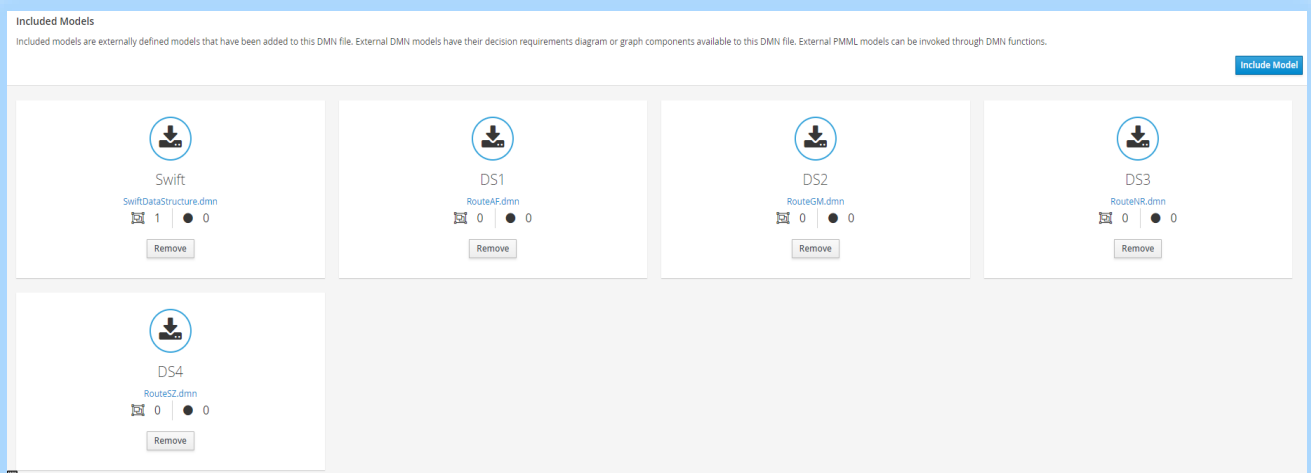
5. Within *SwiftRoutingRulesStart*, select **Included Models** tab, and then click **Include Model**



6. Include the following DMN Files as models:

DMN File	Name
SwiftDataStructure.dmn	Swift
RouteAF.dmn	DS1
RouteGM.dmn	DS2
RouteNR.dmn	DS3
RouteSZ.dmn	DS4

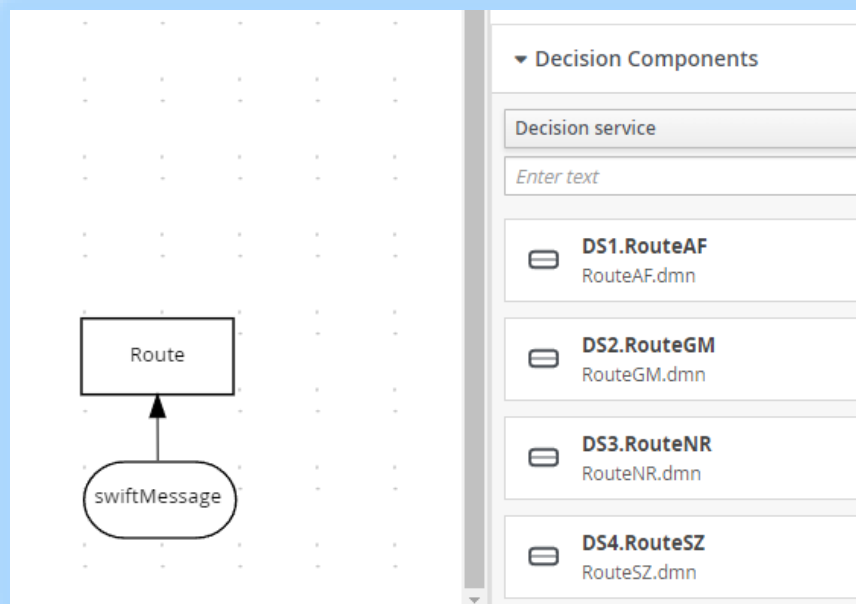
7. Once you have done this, you should see the following models included:



8. Select the *Editor* tab.

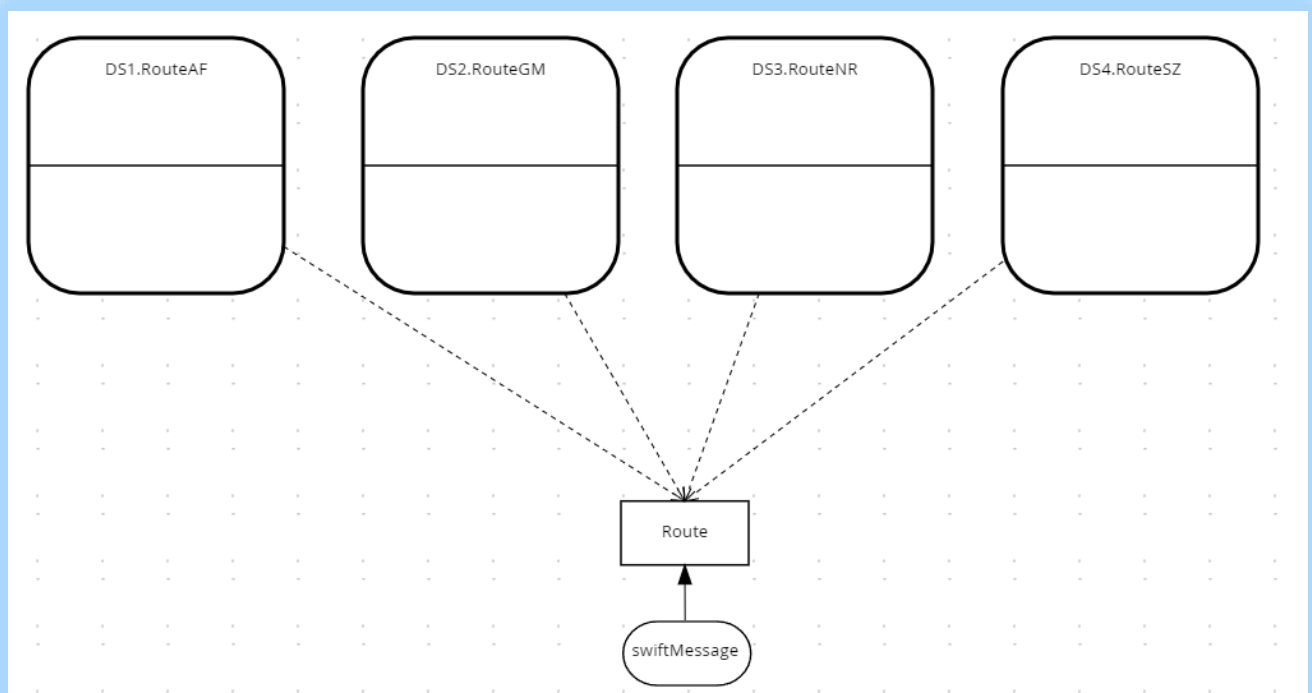
9. Select the Decision Navigator button on the far right .

10. Filter by Decision Service. You should see the following:



11. Drag and drop all four decision services to the diagram

12. Using the arrow connector, connect *the decision services to Route*. You should see the following:



13. Test the decision service by pressing *Run*.

14. Enter the following values:

Inputs

swiftMessage

messageType

branch

bic

Outputs

Route

☒ Evaluated with success

The output should be W. The Route decision determined the BIC started with 'A' and routed it to RouteAF. This decision service determines that a Swift message of ABC/XXX/201 is routed to W.

15. Verify this by selecting the RouteAF decision service and viewing the decision table.

Route (Decision Table)				
U	swiftMessage.bic (string)	swiftMessage.branch (string)	swiftMessage.messageType (string)	Route (string)
1	"ABC"	"XXX"	"201"	"W"

16. Now test the following Swift messages:

Swift Message	Route
GBC/XXX/201	X
NBC/XXX/201	Y
SBC/XXX/201	Z

You should see that each message is routed to a different decision service. If there are execution errors, talk to your instructor.

17. Now add a new message: **ZBC/XXX/201** with route **Z1**. Where would you put this rule?

Conclusion

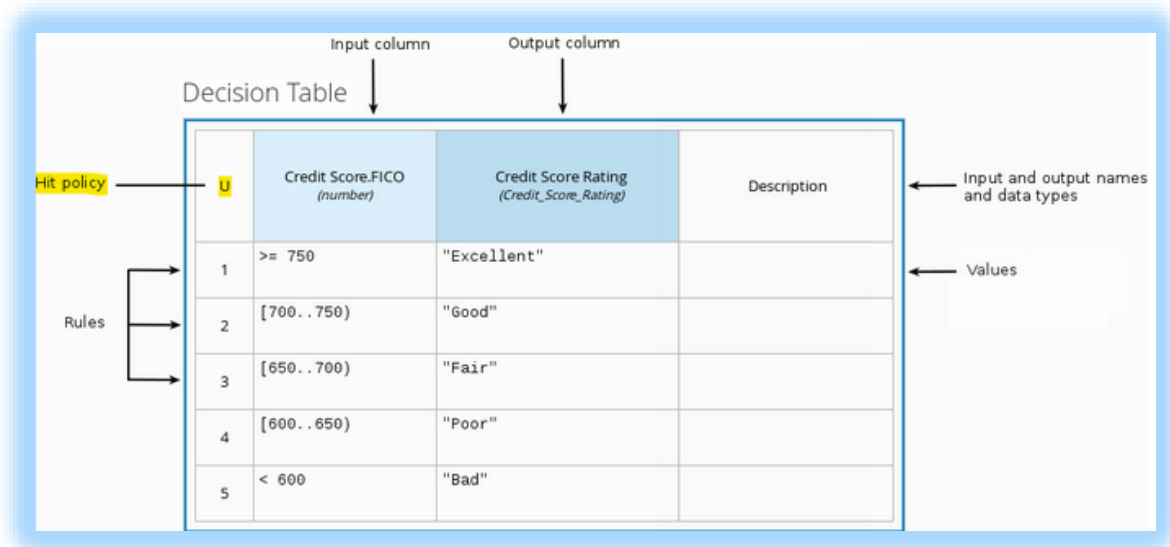
In this lab we split a tall narrow decision table into more manageable chunks using the Index Pattern.

Lab 5 - Hit Policies

Introduction

Decision tables do not always behave the same way. Some tables count outcomes, some are go / no go decisions and others require precise reasoning. Different hit policies lead to different results and require different ways of thinking about the decision table.

In DMN the hit policy is specified in the top left of the decision table. See below:



It is important to select the appropriate hit policy *before* adding rows to your decision table. The common policies are:

Hit Policy	Description	When to use
Unique (U)	Permits only one rule to match. Any overlap raises an error.	For detailed reasoning. Ensures your rules cover all cases and are complete
Any (A)	Permits only one rule to match. But allows overlaps.	As above but less strict enforcement of overlaps
First (F)	Rules are evaluated from top to bottom. Rules may overlap, but only the first match counts.	For concise decision tables where a simple go / no go decision is needed rather than complete reasoning.
Collect (C)	Aggregates values in an arbitrary list.	For multiple row matches. String aggregator: <ul style="list-style-type: none">• <None> - matching instances returned as list• Count – Matching instances counted Number aggregator: <ul style="list-style-type: none">• SUM – matching instances added• Count – matching instances counted• Min – minimum value

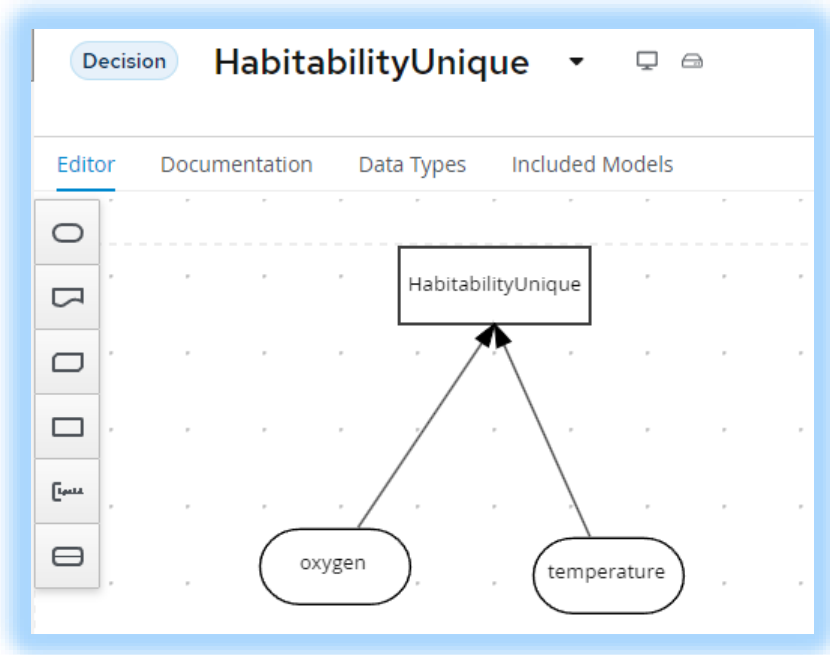
		<ul style="list-style-type: none">• Max – maximum value
--	--	---


Additional hit policies not covered in this lab. **Priority** which behaves like **Any**, and **Rule Order** and **Output Order** which behave like **Collect**.

Instructions

Unique Policy

1. In browsers Chrome or Safari open the web site <https://sandbox.kie.org/>
2. Click on **New Decision**.
3. An empty canvas opens. Click *New file*  and then *Upload...*
4. Select the file: *lab05/HabitabilityUnique.dmn*. You should see this:



5. Edit the *HabitabilityUnique* decision by clicking it and selecting Edit .
6. Delete the first row by right clicking row 1 and select *Delete*.
7. After deleting the first row you should see this:

HabitabilityUnique (Decision Table)

U	oxygen (number)	temperature (number)	HabitabilityUnique (string)	Description
1	<20	[0..50]	"Habitable temperature but too little Oxygen"	
2	>60	[0..50]	"Habitable temperature but too much Oxygen"	
3	[20..60]	>50	"Sufficient oxygen but too hot"	
4	[20..60]	<0	"Sufficient oxygen but too cold"	
5	<20	>50	"Not habitable - insufficient oxygen and too hot"	
6	<20	<0	"Not habitable - insufficient oxygen and too cold"	
7	>60	>50	"Not habitable - Too much oxygen and too hot"	
8	>60	<0	"Not habitable - Too much oxygen and too cold"	

Problems 1

8. Click in the **Problems** button in the bottom right. There is a gap warning:

DECISION_TABLE_GAP: Gap detected: [[20 .. 60], [0 .. 50]]

9. The gap created from the deleted row has been detected.

10. Fix this error by hitting **Ctrl-Z** to undo the change. The deleted row should reappear, and the analysis warning should disappear. You should see:

Validation 1

DECISION_TABLE_ANALYSIS_EMPTY: Decision Table Analysis of table 'HabitabilityUnique' finished with no messages to be reported.

11. Test by pressing **Run**. Enter Oxygen 20 and Temperature 25:

Inputs

oxygen

20

temperature

25

Outputs

HabitabilityUnique

Habitable - sufficient oxygen and temperature

Evaluated with success



12. The decision correctly evaluates to "*Habitable - sufficient oxygen and temperature*".

Conclusion

The *Unique* policy reasons over every possible input. This is useful for decisions requiring traceability. For example, an applicant may want to know the decision behind their rejected mortgage application. A second advantage of the Unique policy is that you can order rows in any order to get the same result.


The disadvantage of the Unique policy is that it can force the table to be more verbose than it needs to be.

Any Policy






1. In browsers Chrome or Safari open the web site <https://sandbox.kie.org/>
2. Click on **New Decision**.
3. An empty canvas opens. Click *New file*  and then *Upload...*
4. Select the file: lab05/*HabitabilityAny.dmn*
5. Edit the *HabitabilityAny* decision by clicking it and selecting Edit .
6. You should see this:

HabitabilityAny (Decision Table)

U	oxygen (number)	temperature (number)	HabitabilityAny (Habitability)
1	[20..60]	[0..50]	"Habitable"
2	<20	-	"Uninhabitable"
3	>60	-	"Uninhabitable"
4	-	>50	"Uninhabitable"
5	-	<0	"Uninhabitable"

7. Click in the  **Problems** button in the bottom right. There are several gap warnings:

Validation 5

 DECISION_TABLE_HITPOLICY_RECOMMENDER: Overlapping rules have the same output value, so the HitPolicy for decision table 'HabitabilityAny' should be ANY
 DECISION_TABLE_OVERLAP_HITPOLICY_UNIQUE: Overlap detected: Overlap values: [<20, <0] for rules: [2, 5]. UNIQUE hit policy decision tables can only have one matching rule.
 DECISION_TABLE_OVERLAP_HITPOLICY_UNIQUE: Overlap detected: Overlap values: [<20, >50] for rules: [2, 4]. UNIQUE hit policy decision tables can only have one matching rule.
 DECISION_TABLE_OVERLAP_HITPOLICY_UNIQUE: Overlap detected: Overlap values: [>60, <0] for rules: [3, 5]. UNIQUE hit policy decision tables can only have one matching rule.
 DECISION_TABLE_OVERLAP_HITPOLICY_UNIQUE: Overlap detected: Overlap values: [>60, >50] for rules: [3, 4]. UNIQUE hit policy decision tables can only have one matching rule.

8. These errors are due to the Hit policy being **Unique** and there are overlapping rows. Fix these errors by changing the Hit Policy to **Any**. You should see the policy symbol change to **A** and all errors disappear:

HabitabilityAny (Decision Table)

oxygen	temperature	HabitabilityAny (Habitability)	Description
habitable	-	habitable	
unhabitable	-	unhabitable	
-	>50	unhabitable	
4	-	>50	"Uninhabitable"

Validation 1 Execution 1

DECISION_TABLE_ANALYSIS_EMPTY: Decision Table Analysis of table 'HabitabilityAny' finished with no messages to be reported.

9. Test by pressing *Run*. Enter Oxygen 20 and Temperature 60:

Inputs	Outputs
<p>oxygen</p> <input type="text" value="20"/> <p>temperature</p> <input type="text" value="60"/>	<p>HabitabilityAny</p> <p>Uninhabitable</p> <p>✓ Evaluated with success</p>



10. This tests row 4 of the decision table.

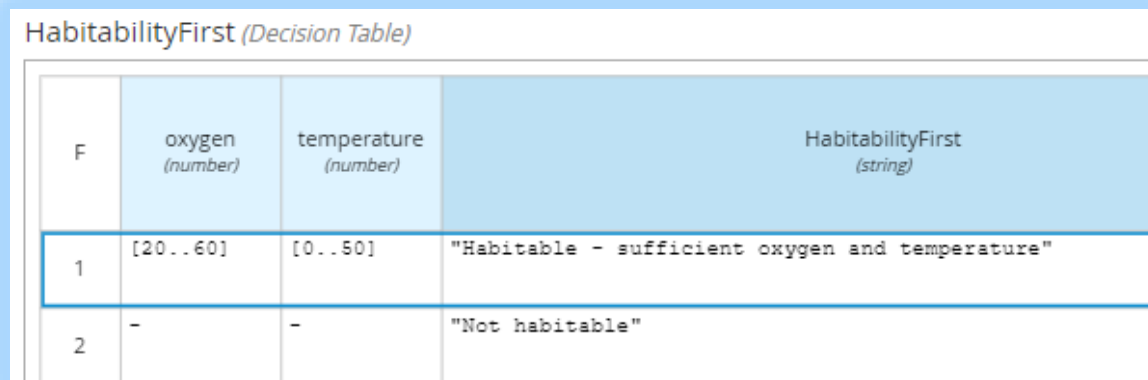
Conclusion

The advantage of the **Any** policy is you can create overlapping rules using “don’t care” (-) values to make it more compact.

This advantage is also a disadvantage of imprecision; row 4 is hit whether oxygen is *habitable* or *uninhabitable*. This may be a problem if you need to know the exact reason as to why this planet is uninhabitable.

First Policy

11. In browsers Chrome or Safari open the web site <https://sandbox.kie.org/>
12. Click on **New Decision**.
13. An empty canvas opens. Click *New file*  and then *Upload...*
14. Select the file: lab05/*HabitabilityFirst.dmn*
15. Edit the *HabitabilityFirst* decision by clicking it and selecting Edit 
16. You should see this:



The screenshot shows a decision table titled "HabitabilityFirst (Decision Table)". It has four columns: "F", "oxygen (number)", "temperature (number)", and "HabitabilityFirst (string)". There are two rows of data. Row 1 has values "1", "[20..60]", "[0..50]", and "Habitable - sufficient oxygen and temperature". Row 2 has values "2", "-", "-", and "Not habitable".



F	oxygen (number)	temperature (number)	HabitabilityFirst (string)
1	[20..60]	[0..50]	"Habitable - sufficient oxygen and temperature"
2	-	-	"Not habitable"

Test the decision by pressing *run*. Enter Oxygen 20 and Temperature 25 to check that row 1 fires.


Conclusion

Using the **First** hit policy you get the same result as the *Unique* and *Any* Policies, but with fewer rows. There are just two rows, one for a habitable planet, and another for an uninhabitable planet. The advantage is conciseness, but there are disadvantages. The first is that order matters – you cannot move row 2 to row 1. The **First** policy also has similar problems as the **Any** policy in that the decision has no detailed reasoning. Finally, the policy is the least strict, allowing overlaps and missing rows which could cause problems at run time.

String Collection policy

1. In browsers Chrome or Safari open the web site <https://sandbox.kie.org/>
2. Click on **New Decision**.
3. An empty canvas opens. Click *New file*  and then *Upload...*
4. Select the file: lab05/*HabitabilityStringCollect.dmn*
5. Edit the *HabitabilityCollect* decision by clicking it and selecting Edit 
6. You should see this:

HabitabilityCollect (Decision Table)

	oxygen (number)	temperature (number)	HabitabilityCollect (string)
1	[20..60]	[0..50]	"Habitable - sufficient oxygen and temperature"
2	<20	-	"Too little Oxygen"
3	>60	-	"Too much Oxygen"
4	-	>50	"Too hot"
5	-	<0	"Too cold"

7. Test the decision by pressing *run*. Enter Oxygen 0 and Temperature -1. This time two rows are fired: row 2 and row 5. Both outputs are passed out of the decision as a list. Row 2 is passed as position 0 and row 5 as position 1 in the list.

Inputs

oxygen

0

temperature

-1

Outputs


HabitabilityCollect

0

Too little Oxygen

1

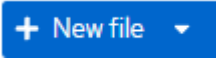

Too cold

 Evaluated with success

Conclusion

The Collection policy combines rows to make amalgamated decisions. This is useful when you require multiple rows in a decision table to be fired.

Numeric Collection policy

1. In browsers Chrome or Safari open the web site <https://sandbox.kie.org/>
2. Click on **New Decision**.
3. An empty canvas opens. Click *New file*  and then *Upload...*
4. Select the file: *lab05/HabitabilityNumericCollect.dmn*
8. Edit the *HabitabilityNumeric* decision by clicking it and selecting Edit 
9. You should see this:

Edit Hit Policy			Included Models
Hit Policy COLLECT			re using the stable version of the Boxed Expression editor. Do
Builtin Aggregator SUM			
	(number)	(number)	HabitabilityNumeric (number)
1	[20..60]	-	10
2	<20	-	-5
3	>60	-	-5
4	-	>50	-5
5	-	<0	-5

10. In the top left of the table, select the hit policy. Click the C+ symbol. This symbol expands to show the Hit Policy *Collect SUM*:
11. The *Collect SUM* hit Policy collects all the rows satisfying the input conditions and sums them together. Let's test this. Press *Run*. Enter Oxygen 20 and Temperature 51:

Inputs

+

⌘

Outputs

×

oxygen

20

temperature

51

HabitabilityNumeric

5

✓ Evaluated with success

The *collect sum hit policy* collects rows 1 and 4 and then adds them together resulting in 5. See workings highlighted below:

C+	oxygen (number)	temperature (number)	HabitabilityNumeric (number)
1	[20..60]	-	10
2	<20	-	-5
3	>60	-	-5
4	-	>50	-5
5	-	<0	-5

Now run the test with following Hit Policies:

Symbol	Hit Policy / Aggregator	Result	Comment
C#	Collect/Count	2	Counts the hits
C<	Collect/Min	-5	Returns the lowest value
C>	Collect/Max	10	Returns the highest value

See the test results change for each aggregator. What are the applications for each aggregator?

Conclusion

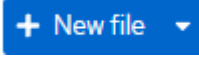
In this lab we looked at hit policies. The choice of hit policy depends on whether you need simple *go/no go* decisions, or comprehensive reasoning.

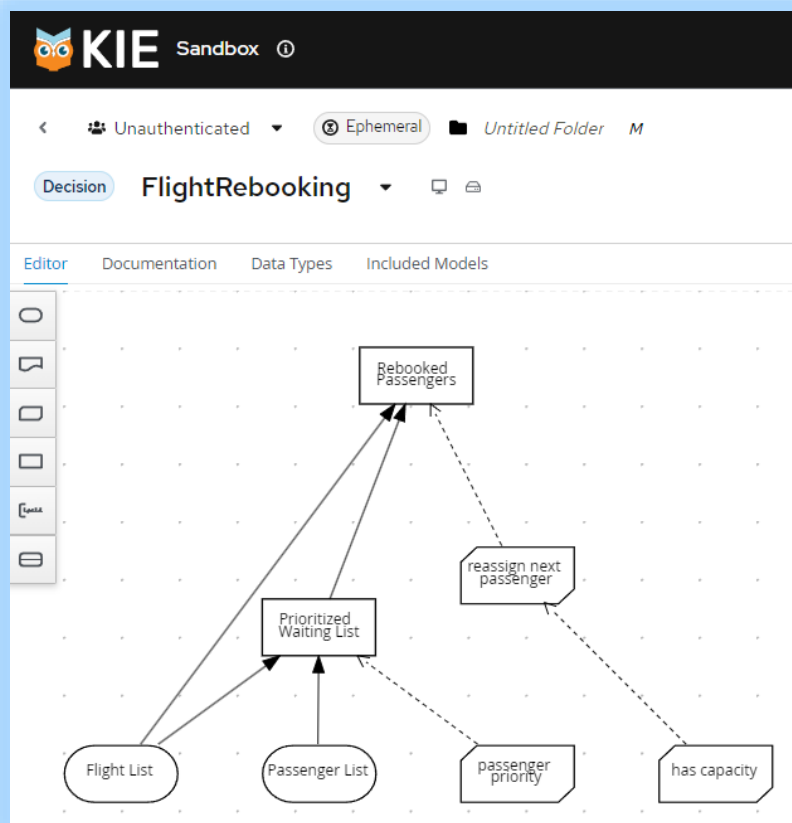
Lab 6 - Advanced DMN

Introduction

Decision Requirements Diagrams and Decision Tables are something business users can understand. The problem is that it is difficult to do anything useful with these, except provide requirements to developers. The real power of DMN comes with FEEL (Friendly Enough Expression Language). In this lab we will explore an advanced DMN example that uses FEEL to reschedule flights.

Instructions

1. In browsers Chrome or Safari open the web site <https://sandbox.kie.org/>
2. Click on **New Decision**.
3. An empty canvas opens. Click *New file*  and then *Upload...*
4. Select the file: `Labs\Lab06\src\main\resources\Lab06\FlightBooking.dmn`
5. You should see the following:




A Quick Tour of the Flight Rebooking Service

We will briefly examine the main components of the Flight Rebooking service.

Click on the *data types* tab. You should see:


- **tFlightTable** – This will list of flights with status of *cancelled* or *scheduled*
- **tPassengerTable** - A list of passengers with status of *gold*, *silver* or *bronze*

12. Back in the DMN diagram, edit the *passenger priority* by clicking it and selecting Edit 

13. You should see this:

passenger priority (Function)				
F	passenger priority (boolean)			
	(Passenger1, Passenger2)			
	U	Passenger1.Status (string)	Passenger2.Status (string)	<result> (<Undefined>)
	1	"gold"	"gold"	true
	2	"gold"	"silver", "bronze"	true
	3	"silver"	"silver"	true
	4	"silver"	"bronze"	true
	5	"bronze"	"bronze"	true

You will notice that it looks different to a standard decision table. It is a *Business Knowledge Model* which is a function invoked from a Decision. It takes parameters *Passenger1* and *Passenger2*.

14. Back in the DMN diagram, edit the *Prioritized Waiting List* by clicking it and select Edit 

15. You should see this:

Prioritized Waiting List (Context)

#	Prioritized Waiting List (tPassengerTable)	
1	Cancelled Flights (tFlightNumberList)	Flight List[Status = "cancelled"].Flight Number
2	Waiting List (tPassengerTable)	Passenger List[list contains(Cancelled Flights, Flight Number)]
	<result>	sort(Waiting List, passenger priority)

Note the highlighted *sort* function, which takes a list of waiting passengers and the *passenger priority function* described above. The *sort* function is a built in FEEL function and is shown below:

sort(list, precedes)

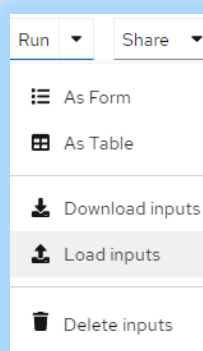
Returns a list of the same elements but ordered according to the sorting function.

Parameter	Type
list	list
precedes	function

Full details found here <https://kiegroup.github.io/dmn-feel-handbook/#sort-functions>

Test the Service

16. Load and run the provided test scenario. Click *Run*->*Load Inputs*



17. Open `/Labs/Lab06/src/test/resources/FlightRebooking.json`

18. Press *Run*

19. The service will run using the test data. You should see the data in the *Inputs* panel and the empty results in the *Outputs* panel:

Inputs

Flight List

Flight Number

BA001

From

LHR

To

NYC

Departure

2023-03-23

hh:mm

Arrival

2023-03-23

hh:mm

Capacity

100

Status

scheduled

Outputs

Prioritized Waiting List

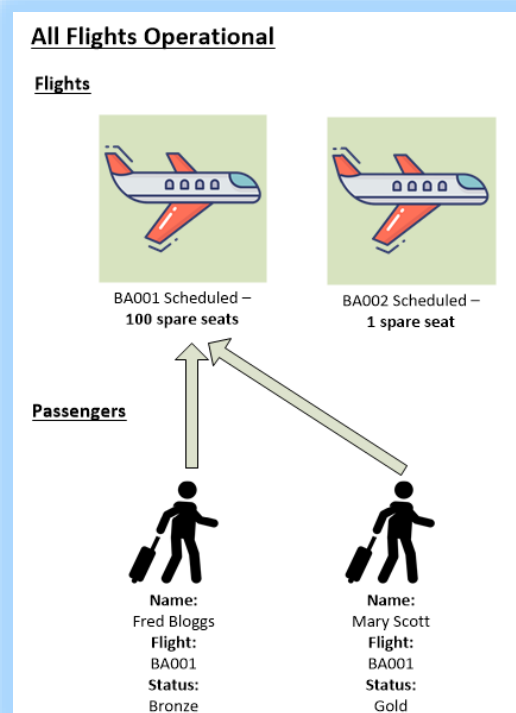
Evaluated with success

Rebooked Passengers

(null)

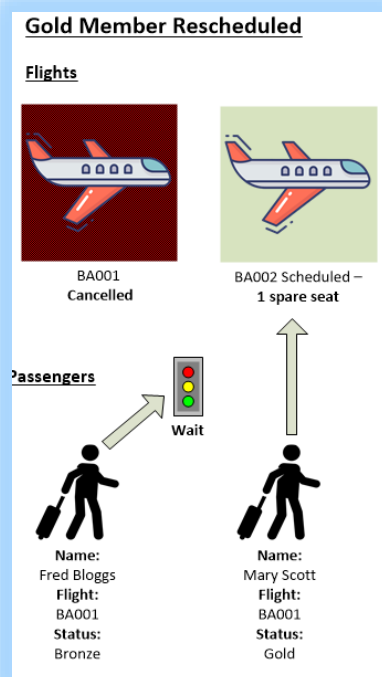
Evaluated with success

20. This is correct. The output contains no waiting list or rebooked passengers as all flights are operational. This is represented below:



Flight Number	
BA001	
From	
LHR	
To	
NYC	
Departure	
2023-03-23	hh:mm
Arrival	
2023-03-23	hh:mm
Capacity	
100	
Status	
cancelled	

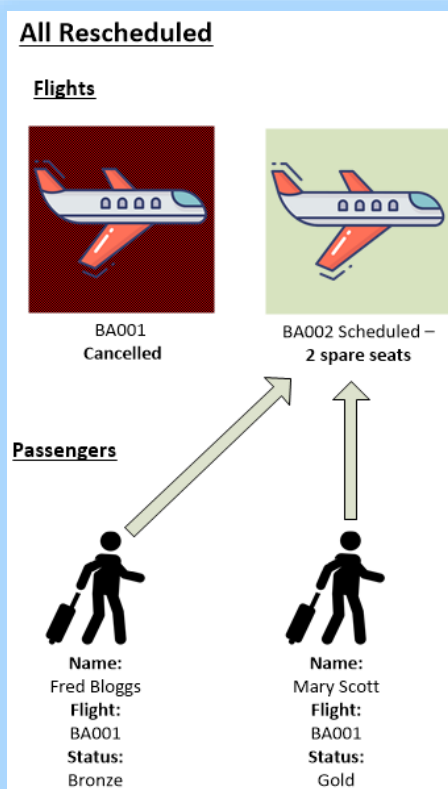
22. The results change so show gold member *Mary Scott* is rebooked onto flight *BA002*, and *bronze* member *Fred Bloggs* must wait:



23. In the *Flight List*, change the spare seat capacity on flight *BA002* to 2:

Flight Number	
BA002	
From	
LHR	
To	
NYC	
Departure	
2023-03-24	hh:mm
Arrival	
2023-03-24	hh:mm
Capacity	
2	
Status	
scheduled	

24. Now both Mary and Fred are scheduled to fly on *BA002*:



Extend the diagram

25. Extend the diagram so that it handles air miles as well as Gold/Silver/Bronze status. Select and then edit *passenger priority*.

26. Add a new column in the table. Right-click the *Passenger2.Status* column and then select *Insert right* to insert a decision column to the right.

U	Passenger1.Status (string)	Passenger2.Status (string)	<result> (<Undefined>)
1	"gold"	"gold"	

27. Rename the column *Passenger1.Miles* and select data type *number*:

passenger priority (Function)				
F				
U	Passenger1.Status (string)	Passenger2.Status (string)	Passenger1.Miles (number)	<result> (<Undefined>)
1	"gold"	"gold"	-	true

28. Add logic so that if passengers have the same status, they are prioritized on air miles:

F	passenger priority (boolean)			
	(Passenger1, Passenger2)			
U	Passenger1.Status (string)	Passenger2.Status (string)	Passenger1.Miles (number)	<result> (<Undefined>)
1	"gold"	"gold"	>= Passenger2.Miles	true
2	"gold"	"silver", "bronze"	-	true
3	"silver"	"silver"	>= Passenger2.Miles	true
4	"silver"	"bronze"	-	true
5	"bronze"	"bronze"	>= Passenger2.Miles	true

Test New Business Logic

29. Add another passenger. Click on the *Plus* symbol next to *Passenger List* in the *Inputs* Panel, then scroll to the bottom of the list to find the new entry. **Tip:** You may need to drag out the test panel to see the *Plus* symbol.

Passenger List



30. Scroll to the bottom of *Passenger List* to find the newly created entry. Add passenger *John Smith* with the following data:

Name

John Smith

Status

bronze

Miles

1000

Flight Number

BA001

31. John has *Bronze* status the same as *Fred Bloggs*, but John has more air miles, so using the new logic, he will have priority. Verify that *Fred Bloggs* is put on hold and *John Smith* is rescheduled to flight BA002

Gold and Air Mile Rescheduled

Flights



BA001
Cancelled



BA002 Scheduled –
2 spare seat

Passengers



Wait

Name:
Fred Bloggs
Flight:
BA001
Status:
Bronze
AirMiles:
0



Name:
John Smith
Flight:
BA001
Status:
Bronze
AirMiles:
1000



Name:
Mary Scott
Flight:
BA001
Status:
Gold

3 Conclusion

In this lab we went beyond the basics of DMN to give techniques for building real world DMN projects.