Challenge March-2019
Offering Donated Organs for Transplant

Part 2 of a solution with DT5GL by Jack Jansonius – 12 august 2019

Problem description:

See the text on the website:
https://dmcommunity.org/challenge/challenge-march-2019/

In part 1 of the solution I have made a distinction between askable (and thus also queryable) variables and derivable variables; see the explanation on page 6 in the document. At this point the decision tables can be perfectly combined with any relational (or non-relational) database (4GL). All the variables (attributes and propositions) that are requested from the user by means of "askable_using" can be replaced by queries in SQL (and can be connected to any database via Python).

Part 2 is precisely the realisation of this idea: connecting the decision tables to a relational database; in this case: SQLite. However, by means of the pyodbc module of python, DT5GL can be connected to a range of ODBC-compliant databases, such as MySQL, SQL Server, Oracle, DB2, etc.

In my opinion, decision tables are a fifth-generation programming language (5GL) technique. The overview will then be very simple:

Retrievable variables: 4GL, derivable variables: 5GL.

The results in the derivable variables (in particular the goal variables) can then be restored to the database by means of 4GL.

Of course, you can also record the if-then rules in the decision tables in any 3GL (Java, PL/SQL), but then you get a cluttered nesting of if-then-else and case commands (without checking for completeness!).

The tools I used to connect DT5GL to SQLite:
1. Python 3.6.0, the smoothest 3GL nowadays
2. PyCharm 2019.1.3 (CE), a python development environment
3. Notepad++; a fine editor for both python code and decision tables.
4. SQLite 3.2.1; the 4GL used here
5. Dbeaver 6.0.5 (in addition to SQLite for creating an ER diagram).

Description of new constructions in DT5GL

The status of an organ is no longer requested from the user/tester of the service but retrieved from the database.

```
Attribute: H_Stat_inp
Askable_using: "What is the Status of the offered Heart in the block?"
```

is thus replaced by:

```
Attribute: H_Stat_inp
Obtain_value_from_database_view: organ_block.heart_status
```

Now it makes little sense to retrieve organs from the database that need not be used, for example because they have already been offered to an individual patient or transplantation centre. For this reason, only organs with status I_Available or status TC_Available are retrieved.

With this restriction, we immediately encounter an incompleteness[1] in the problem description of the challenge: in what order should available organs be picked up? Organs become available because they are newly added, but also become available because they have been refused by an individual patient or transplant centre. The priority in offering organs can easily be changed with the query; in the example I have used a sorting by placement date, or: first in, first out.

The question now is what value for the status of an organ should be retrieved from the database if there is no such organ at all! This was not taken into account in part 1 of the solution, but the retrieval of the organ status should be preceded by a proposition:

```
Proposition: 'Still organs to offer'
Obtain_instance_from_database_view: organ_block
```

The first question to be asked here is: is there still an organ in the database that can be offered to a patient or transplantation centre?

A very neat way to include this proposition in the decision tables is of course the first condition of the first 2 tables, but it can also be done in one place: as the first condition of the third table:

```
rTable 2: DUOBLOCK/fallback policy still applies.
If:                                          | 0| 1|
'Still organs to offer'                      | Y| N|
H_Stat_inp is NotAvailable                   | N| -|
H_Stat_inp is I-Accepted                     | N| -|
L_Stat_inp is NotAvailable                   | N| -|
L_Stat_inp is I-Accepted                     | N| -|
Then:
'DUOBLOCK/Fallback is (still) possible'      | X|  |
Action is No_Organs_To_Offer                 |  | X|
# .......
```

And this is because this is the first sub-table that is executed from both the first and second table.

[1] Where I refer to an incompleteness in the problem description, that is not, of course, intended to be a critique of the author of the challenge! On the contrary, my compliments (and thanks) for this excellent, very educational challenge to Dr. Bob Moore.

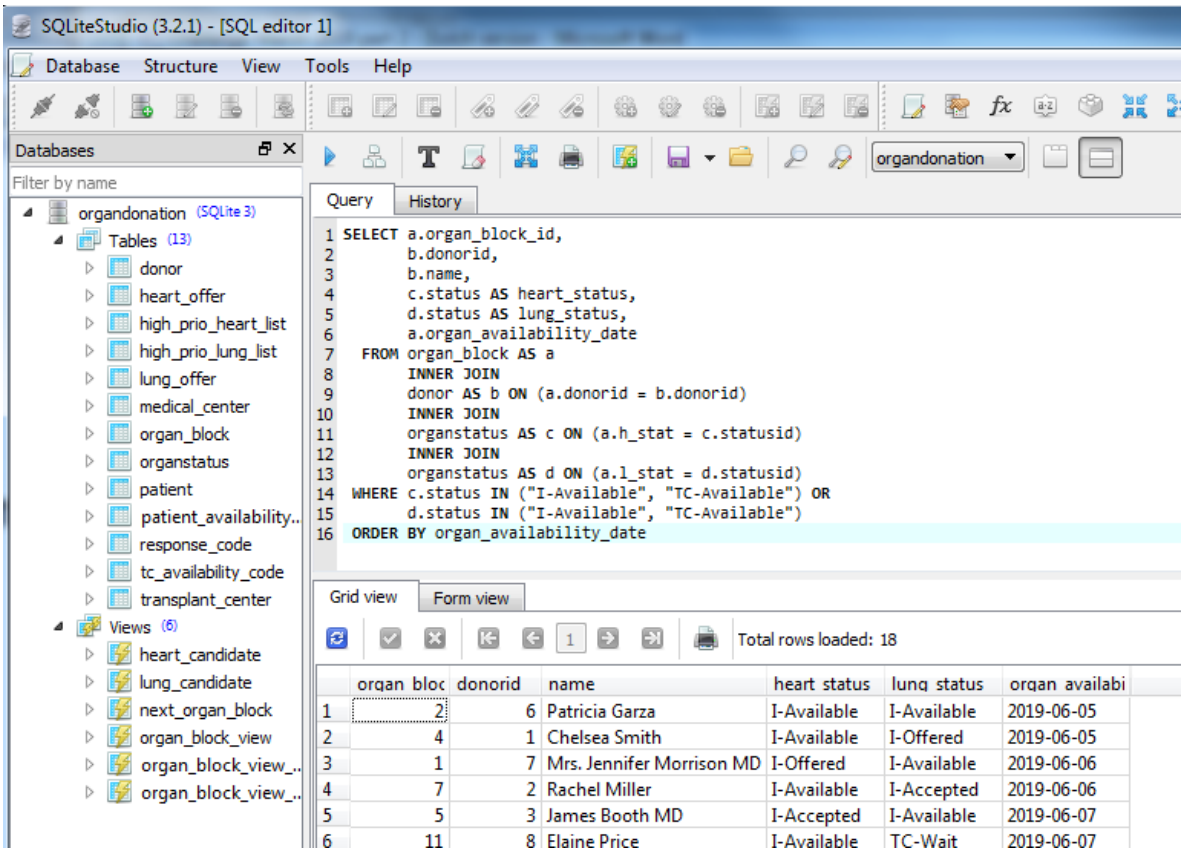
Both the attribute and the proposition refer to the database view organ_block and this is what it looks like in DT5GL:

```
Database_view: organ_block
With_attributes:
organ_block_id,donorid,name,heart_status,lung_status,organ_availability_date
Query:
SELECT a.organ_block_id,
       b.donorid,
       b.name,
       c.status AS heart_status,
       d.status AS lung_status,
       a.organ_availability_date
  FROM organ_block AS a
       INNER JOIN
       donor AS b ON (a.donorid = b.donorid)
       INNER JOIN
       organstatus AS c ON (a.h_stat = c.statusid)
       INNER JOIN
       organstatus AS d ON (a.l_stat = d.statusid)
 WHERE c.status IN ("I-Available", "TC-Available") OR
       d.status IN ("I-Available", "TC-Available")
 ORDER BY organ_availability_date
 LIMIT 1
End_Query
```

Of course, the query is only performed at the first reference.

A query can be developed and tested in SQLite and then copied into DT5GL; conversely, a query can also be copied from DT5GL into SQLite in order to predict how many organs will be processed and in what order.

It is important that the query in DT5GL will yield a maximum of 1 organ block; hence the LIMIT 1 at the end. If the query is copied to SQLite, then LIMIT 1 can be omitted to get an overview of all organs that will be picked up and processed in one run.



The proposition 'Still organs to offer' is True as long as the corresponding query in the database view yields an instance and becomes False if this is no longer the case; at that moment the goal variable Action will get the value No_Organs_To_Offer (according to the second rule/column in the third table). On this basis, all organs in the database with status I-Available and TC-Available can be supplied and processed:

```
GoalAttribute: Action
Repeat_until: No_Organs_To_Offer
```

As long as the goal variable Action does not lead to the value No_Organs_To_Offer, all values obtained for the (goal) propositions, (goal) attributes and database views will be erased and the reasoning mechanism will be set to work for the next organ after all print and sql commands have been executed for the realized goal value.

The first test run with this construction with 18 organs to be offered in the database (and thus 18 test cases at the same time) resulted in an interesting error in the test cases for part 1 of the solution. As a tester of the organ donation service, I agreed to the results of the test cases 2 and 3 too quickly: the conclusions were good, but not all the necessary actions were carried out! These kinds of errors are of course particularly evident when data have to be entered into the database using SQL statements.

The situation is simple: both the heart and the lungs in an organ block have status I-Available; another patient is available for the heart; not for the lungs. At that moment the heart has to be offered to this patient and the lungs become in a waiting state. This composite action, namely H->I and L->TC-Wait I had not recognized as a value for the goal attribute and therefore not in the decision tables derived. The reasoning mechanism came to the correct conclusions 'H_Stat is I-Offered' and 'L_Stat is TC-Wait', but based on this came to the single value 'H->I' for the goal variable Action, after which only the SQL instructions for this value were executed.

The solution is now obvious: in addition to the single actions H->I, L->I, H->TC-Wait and L->TC-Wait introduce 2 more composite actions for the goal variable, namely:
H->I; L->TC-Wait (so heart to next patient, lungs in waiting state)
L->I; H->TC-Wait (so heart in waiting state, lungs to next patient.)

In addition, decision table 5 must be adjusted for this:

```
Table 5: Assign heart and/or lungs to next patient, while the other comes in a wait
If:                                          | 0| 1| 2| 3| 4| 5|
H_Stat is I-Offered                          | Y| Y| Y| N| N| N|
L_Stat is I-Offered                          | Y| N| N| Y| Y| N|
H_Stat is TC-Wait                            | -| -| -| Y| N| -|
L_Stat is TC-Wait                            | -| Y| N| -| -| -|
Then:
Action is H->I;L->I                          | X|  |  |  |  |  |
Action is H->I                               |  |  | X|  |  |  |
Action is L->I                               |  |  |  |  | X|  |
Action is H->I;L->TC-Wait                    |  | X|  |  |  |  |
Action is L->I;H->TC-Wait                    |  |  |  | X|  |  |
# .......
```

So there was a composite action in Part 1 that I had recognised: H->I;L->I !

A disadvantage of composite actions is that they lead to a doubling of sql-code:
the SQL instructions for the composite action H->I;L->I are a combination of the SQL code for H->I and the SQL code for L->I. This duplication can in turn be avoided by invoking the SQL instructions for the individual actions successively from the composite actions, but this has not yet been realized in the tool.

Another objection to composite actions is that they must be explicitly derived in the decision tables (but in some cases this can also be seen as an advantage).

In addition to introducing composite actions, an alternative solution is possible, namely:
an adjustment of the reasoning mechanism; not stopping when 1 value for the goal variable is derived, but trying to derive all values for the goal variable.

In a nutshell: a multivalued goal attribute.

The reasoning mechanism no longer derives 1 value, for example H->I;L->I , but 2 values, namely H->I and L->I and executes the corresponding SQL instructions.

At that moment the composite goal values are no longer needed.

It is quite easy to make a goal attribute multivalued:

```
GoalAttribute: Action
Repeat_until: No_Organs_To_Offer
MultiValued
```

Omitting the indication "MultiValued" therefore implies Singlevalued (as a default).

However, the simple statement "Multivalued" goes wrong in one case: if the reasoning mechanism derives the action No_Organs_To_Offer! In that case you don't want other action values to be derived.

And so it becomes:

```
GoalAttribute: Action
Repeat_until: No_Organs_To_Offer
MultiValued_until: No_Organs_To_Offer
```

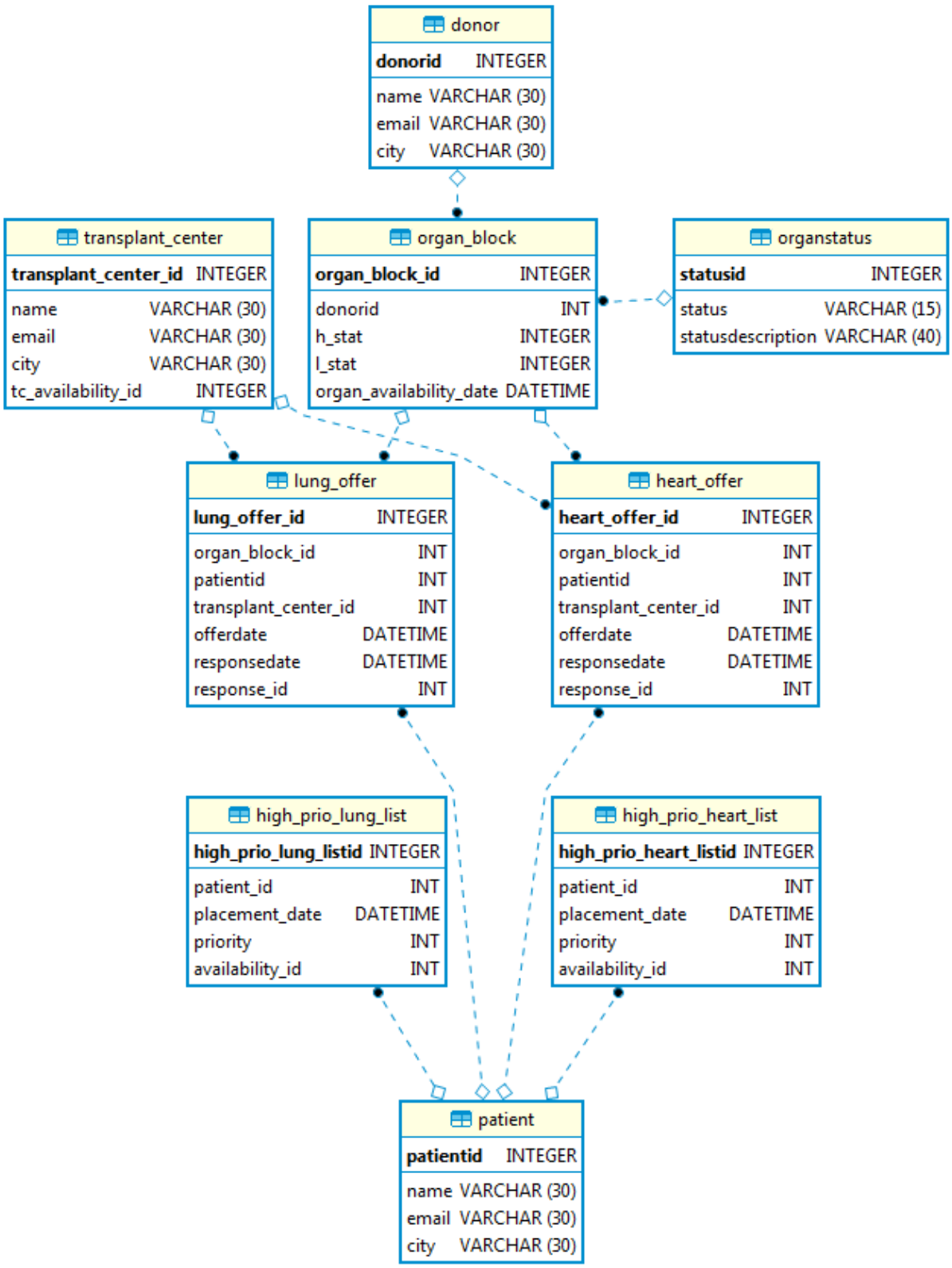
This will allow the composite actions H->I;L->I, H->I;L->TC-Wait and L->I;H->TC-Wait to be removed and will reduce the size of Table 5:

```
Table 5: Assign heart and/or lungs to next patient.
If:                                          | 0| 1| 2| 3|
H_Stat is I-Offered                          | Y| Y| N| N|
L_Stat is I-Offered                          | Y| N| Y| N|
Then:
Action is H->I                               | X| X|  |  |
Action is L->I                               | X|  | X|  |
# .......
```

In summary:
1. singlevalued goalattributes => composite goal values/actions
2. multivalued goalatttribues => simple goal values/actions.

The following paragraphs now contain:
1. The ER model used for this solution; made with DBeaver
2. A solution with a singelvalued goal attribute.
3. A solution with a multivalued goal attribute.
4. The initial situation in SQLite for a full test run (with 22 test cases).
5. The results of the test run with a singelvalued goalattribute.
6. The results of the test run with a multivalued goalattribute.

ER-model for the solution (with dbeaver)



Note: these entities obviously contain a lot more data in real life; kept as simple as possible here.

In addition, the following status tables are interesting:

Organstatus:

	statusid	status	statusdescription
1	1	I-Available	Available for individual patients.
2	2	I-Offered	Offered to an individual patient.
3	3	I-Accepted	Accepted by an individual patient.
4	4	TC-Wait	Fallback
5	5	TC-Available	Available for transplant centers.
6	6	TC-Offered	Offered to a transplant center.
7	7	TC-Accepted	Accepted by a transplant center.
8	8	NotAccepted	Not accepted by any individual patient
9	9	NotAvailable	Not available

Patient_availability_code:

	availability_id	availability_description
1	1	Available for an organ offer
2	2	Temporarily unavailable; an organ is currently being offered to the patient.
3	3	Temporarily unavailable; condition of the patient is currently insufficient
4	4	Definitely not available; patient has already accepted an organ.
5	5	Definitely not available; patient has passed away in the meantime

etc.

Tc_availability_code:

	tc_availability_id	tc_availability_description
1	1	Available for organ offer
2	2	Not available for organ offer

etc.

Implementation of the decision tables in DT5GL: singlevalued goalattribute.

```
Table 0: Assign the heart to an individual patient or a transplant center.
If:                                          | 0| 1| 2| 3| 4| 5| 6| 7| 8| 9|10|
'DUOBLOCK/Fallback is (still) possible'      | Y| Y| Y| Y| N| N| N| N| N| -| -|
H_Stat_inp is NotAvailable                   | -| -| -| -| Y| N| N| N| N| -| -|
H_Stat_inp is TC-Wait                        | Y| N| N| N| -| Y| N| N| N| -| -|
H_Stat_inp is I-Available                    | -| Y| Y| N| -| -| Y| Y| N| -| -|
'Another patient on Heart Prio List'         | -| Y| N| -| -| -| Y| N| -| -| -|
H_Stat_inp is TC-Available                   | -| -| -| -| -| -| -| -| -| Y| N|
Then:
H_Stat is I-Offered                          |  | X|  |  |  |  | X|  |  |  |  |
H_Stat is TC-Wait                            |  |  | X|  |  |  |  |  |  |  |  |
H_Stat is TC-Available                       |  |  |  |  |  | X|  | X|  | X|  |
# .......

Attribute: H_Stat_inp
Obtain_value_from_database_view: organ_block.heart_status

Proposition: 'Another patient on Heart Prio List'
Obtain_instance_from_database_view: high_prio_heart_list


Table 1: assign the lungs to an individual patient or a transplant center
If:                                          | 0| 1| 2| 3| 4| 5| 6| 7| 8| 9|10|
'DUOBLOCK/Fallback is (still) possible'      | Y| Y| Y| Y| N| N| N| N| N| -| -|
L_Stat_inp is NotAvailable                   | -| -| -| -| Y| N| N| N| N| -| -|
L_Stat_inp is TC-Wait                        | Y| N| N| N| -| Y| N| N| N| -| -|
L_Stat_inp is I-Available                    | -| Y| Y| N| -| -| Y| Y| N| -| -|
'Another patient on Lung Prio List'          | -| Y| N| -| -| -| Y| N| -| -| -|
L_Stat_inp is TC-Available                   | -| -| -| -| -| -| -| -| -| Y| N|
Then:
L_Stat is I-Offered                          |  | X|  |  |  |  | X|  |  |  |  |
L_Stat is TC-Wait                            |  |  | X|  |  |  |  |  |  |  |  |
L_Stat is TC-Available                       |  |  |  |  |  | X|  | X|  | X|  |
# .......

Attribute: L_Stat_inp
Obtain_value_from_database_view: organ_block.lung_status

Proposition: 'Another patient on Lung Prio List'
Obtain_instance_from_database_view: high_prio_lung_list

Proposition: 'Still organs to offer'
Obtain_instance_from_database_view: organ_block


rTable 2: DUOBLOCK/fallback policy still applies.
If:                                          | 0| 1|
'Still organs to offer'                      | Y| N|
H_Stat_inp is NotAvailable                   | N| -|
H_Stat_inp is I-Accepted                     | N| -|
L_Stat_inp is NotAvailable                   | N| -|
L_Stat_inp is I-Accepted                     | N| -|
Then:
'DUOBLOCK/Fallback is (still) possible'      | X|  |
Action is No_Organs_To_Offer                 |  | X|
# .......

# The Duoblock proposition indicates whether a fallback scenario is possible.
# DUOBLOCK is false when a Heart-Lung-block contains 1 organ only; the other organ
has status NotAvailable.
# DUOBLOCK becomes false when one of the organs is accepted by an individual
patient.
# DUOBLOCK is true as long as both organs are offered to individual patients.
```

rTable 3: Assign a heart-lung block to a transplant center for the first time (fallback-scenario)

If:	0	1	2
H_Stat is TC-Wait	Y	Y	N
L_Stat is TC-Wait	Y	-	Y
H_Stat_inp is TC-Wait	-	-	Y
L_Stat_inp is TC-Wait	-	Y	-
Then:			
'Heart-Lung Block to TC for the first time'	X	X	X

....

Table 4: Assign heart and/or lungs to a next transplantation center.

If:	0	1	2	3	4	5	6	7	8
'Heart-Lung Block to TC for the first time'	Y	Y	N	N	N	N	N	N	N
H_Stat is TC-Available	-	-	Y	Y	Y	Y	N	N	N
L_Stat is TC-Available	-	-	Y	Y	N	N	Y	Y	N
'Another Transplant Center on TC list'	Y	N	Y	N	Y	N	Y	N	-
Then:									
Action is HL->TC	X		X						
Action is HL_NotAccepted		X		X					
Action is H_NotAccepted						X			
Action is L_NotAccepted								X	
Action is H->TC					X				
Action is L->TC							X		

....

Proposition: 'Another Transplant Center on TC list'
Obtain_instance_from_database_view: transplant_center

Table 5: Assign heart and/or lungs to next patient, while the other comes in a wait state.

If:	0	1	2	3	4	5
H_Stat is I-Offered	Y	Y	Y	N	N	N
L_Stat is I-Offered	Y	N	N	Y	Y	N
H_Stat is TC-Wait	-	-	-	Y	N	-
L_Stat is TC-Wait	-	Y	N	-	-	-
Then:						
Action is H->I;L->I	X					
Action is H->I			X			
Action is L->I					X	
Action is H->I;L->TC-Wait		X				
Action is L->I;H->TC-Wait				X		

....

Table 6: Only the heart or the lungs come into a wait state (fallback scenario)

If:	0	1	2	3
H_Stat is TC-Wait	Y	Y	N	N
L_Stat is TC-Wait	Y	N	Y	N
Then:				
Action is H->TC-Wait		X		
Action is L->TC-Wait			X	

....

```
Database_view: organ_block
With_attributes:
organ_block_id,donorid,name,heart_status,lung_status,organ_availability_date
Query:
SELECT a.organ_block_id,
       b.donorid,
       b.name,
       c.status AS heart_status,
       d.status AS lung_status,
       a.organ_availability_date
  FROM organ_block AS a
       INNER JOIN
       donor AS b ON (a.donorid = b.donorid)
       INNER JOIN
       organstatus AS c ON (a.h_stat = c.statusid)
       INNER JOIN
       organstatus AS d ON (a.l_stat = d.statusid)
 WHERE c.status IN ("I-Available", "TC-Available") OR
       d.status IN ("I-Available", "TC-Available")
 ORDER BY organ_availability_date
 LIMIT 1
End_Query


Database_view: high_prio_heart_list
With_attributes:
high_prio_heart_listid, patient_id, placement_date, priority, availability_id
Query:
SELECT *
  FROM high_prio_heart_list
 WHERE availability_id = 1
 ORDER BY priority DESC,
          placement_date ASC
 LIMIT 1
End_Query


Database_view: high_prio_lung_list
With_attributes: high_prio_lung_listid, patient_id, placement_date, priority,
availability_id
Query:
SELECT *
  FROM high_prio_lung_list
 WHERE availability_id = 1
 ORDER BY priority DESC,
          placement_date ASC
 LIMIT 1
End_Query


Database_view: transplant_center
With_attributes: transplant_center_id, name, tc_availability_id
Query:
SELECT transplant_center_id,
       name,
       tc_availability_id
  FROM transplant_center
  WHERE  tc_availability_id = 1
  LIMIT 1
End_Query
```

```
GoalAttribute: Action
Repeat_until: No_Organs_To_Offer


Case: No_Organs_To_Offer
Print: "============================Result======================================="
Print: "No organs with status 1 (I-Available) or status 5 (TC-Available) to offer."
Print: "The offering service has been finished"
Print: "========================================================================="


Case: H->I;L->I
Print: "============================Result================================="
Print: "H->I;L->I"
Print: "Assign heart and lungs to the following patients on the prio lists"
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "The heart was offered to patient: %s." high_prio_heart_list.patient_id
Print: "The lungs have been offered to patient: %s." high_prio_lung_list.patient_id
Print: "================================================================="
>SQL:  "UPDATE organ_block SET h_stat = 2, l_stat = 2 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO heart_offer (organ_block_id, patientid, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          high_prio_heart_list.patient_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE high_prio_heart_list SET availability_id = 2 "
<SQL:  "WHERE patient_id = %s"   high_prio_heart_list.patient_id

>SQL:  "INSERT INTO lung_offer (organ_block_id, patientid, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          high_prio_lung_list.patient_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE high_prio_lung_list SET availability_id = 2 "
<SQL:  "WHERE patient_id = %s"   high_prio_lung_list.patient_id


Case: H->I
Print: "============================Result================================="
Print: "H->I"
Print: "Assign the heart to patient %s on the heart prio list"
high_prio_heart_list.patient_id
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "Status of the heart is now: %s." H_Stat
Print: "Status of the lungs remains: %s."  organ_block.lung_status
Print: "================================================================="
>SQL:  "UPDATE organ_block SET h_stat = 2 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO heart_offer (organ_block_id, patientid, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          high_prio_heart_list.patient_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE high_prio_heart_list SET availability_id = 2 "
<SQL:  "WHERE patient_id = %s"   high_prio_heart_list.patient_id
```

```
Case: L->I
Print: "============================Result=================================="
Print: "L->I"
Print: "Assign the lungs to patient %s on the lung prio list"
high_prio_lung_list.patient_id
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "Status of the heart remains: %s." organ_block.heart_status
Print: "Status of the lungs is now: %s." L_Stat
Print: "====================================================================="
>SQL:  "UPDATE organ_block SET l_stat = 2 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO lung_offer (organ_block_id, patientid, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          high_prio_lung_list.patient_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE high_prio_lung_list SET availability_id = 2 "
<SQL:  "WHERE patient_id = %s"   high_prio_lung_list.patient_id


Case: H->TC-Wait
Print: "============================Result=================================="
Print: "H->TC-Wait"
Print: "The heart is waiting now for a block-offer to a transplant center,"
Print: "while the lungs are still offered to individual patients on the prio list."
Print: "Status of the lungs remains: %s."  organ_block.lung_status
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "====================================================================="
>SQL:  "UPDATE organ_block SET h_stat = 4 "
<SQL:  "WHERE donorid = %s" organ_block.donorid


Case: L->TC-Wait
Print: "============================Result=================================="
Print: "L->TC-Wait"
Print: "The lungs are waiting now for a block-offer to a transplant center,"
Print: "while the heart is still offered to individual patients on the prio list."
Print: "Status of the heart remains: %s."  organ_block.heart_status
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "====================================================================="
>SQL:  "UPDATE organ_block SET l_stat = 4 "
<SQL:  "WHERE donorid = %s" organ_block.donorid


Case: H->I;L->TC-Wait
Print: "============================Result=================================="
Print: "H->I;L->TC-Wait"
Print: "The lungs are waiting now for a block-offer to a transplant center,"
Print: "while the heart has been offered to patient %s on the heart prio list"
high_prio_heart_list.patient_id
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "====================================================================="
>SQL:  "UPDATE organ_block SET h_stat = 2, l_stat = 4 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO heart_offer (organ_block_id, patientid, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          high_prio_heart_list.patient_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE high_prio_heart_list SET availability_id = 2 "
<SQL:  "WHERE patient_id = %s"   high_prio_heart_list.patient_id
```

```
Case: L->I;H->TC-Wait
Print: "============================Result============================="
Print: "L->I;H->TC-Wait"
Print: "The heart is waiting now for a block-offer to a transplant center,"
Print: "while the lungs have been offered to patient %s on the lung prio list"
high_prio_lung_list.patient_id
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "============================================================="
>SQL:  "UPDATE organ_block SET h_stat = 4, l_stat = 2 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO lung_offer (organ_block_id, patientid, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          high_prio_lung_list.patient_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE high_prio_lung_list SET availability_id = 2 "
<SQL:  "WHERE patient_id = %s"   high_prio_lung_list.patient_id



Case: HL->TC
Print: "============================Result==================================="
Print: "HL->TC"
Print: "Assign a heart and lung-block to a next transplant center"
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "Status of the heart is now: 6. (TC-Offered)."
Print: "Status of the lungs is now: 6. (TC-Offered)."
Print: "Transplant center %s is temporarily unavailable for following organ offers"
transplant_center.name
Print: "============================================================================"
>SQL:  "UPDATE organ_block SET h_stat = 6, l_stat = 6 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO heart_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          transplant_center.transplant_center_id
<SQL:  "%s) "          DateToday
>SQL:  "INSERT INTO lung_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          transplant_center.transplant_center_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE transplant_center SET tc_availability_id = 2 "
<SQL:  "WHERE transplant_center_id = %s"  transplant_center.transplant_center_id


Case: H->TC
Print: "============================Result==================================="
Print: "H->TC"
Print: "Assign the heart to a next transplant center"
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "Status of the heart is: 6. (TC-Offered)."
Print: "Status of the lungs remains: %s."  organ_block.lung_status
Print: "Transplant center %s is temporarily unavailable for following organ offers"
transplant_center.name
Print: "============================================================================"
>SQL:  "UPDATE organ_block SET h_stat = 6 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO heart_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          transplant_center.transplant_center_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE transplant_center SET tc_availability_id = 2 "
<SQL:  "WHERE transplant_center_id = %s"  transplant_center.transplant_center_id
```

```
Case: L->TC
Print: "============================Result=================================="
Print: "L->TC"
Print: "Assign the lungs to a next transplant center"
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "Status of the lungs is now: 6. (TC-Offered)."
Print: "Status of the heart remains: %s."  organ_block.heart_status
Print: "Transplant center %s is temporarily unavailable for following organ offers"
transplant_center.name
Print: "======================================================================="
>SQL:  "UPDATE organ_block SET l_stat = 6 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO lung_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          transplant_center.transplant_center_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE transplant_center SET tc_availability_id = 2 "
<SQL:  "WHERE transplant_center_id = %s"  transplant_center.transplant_center_id



Case: HL_NotAccepted
Print: "============================Result=================================="
Print: "Neither the heart nor the lungs have been accepted by patients or
transplantation centres."
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "======================================================================="
>SQL:  "UPDATE organ_block SET h_stat = 8, l_stat = 8 "
<SQL:  "WHERE donorid = %s" organ_block.donorid


Case: H_NotAccepted
Print: "============================Result=================================="
Print: "The heart is not accepted by patients or transplantation centers."
Print: "Status of the lungs remains: %s."  organ_block.lung_status
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "======================================================================="
>SQL:  "UPDATE organ_block SET h_stat = 8 "
<SQL:  "WHERE donorid = %s" organ_block.donorid


Case: L_NotAccepted
Print: "============================Result=================================="
Print: "The lungs have not been accepted by patients or transplant centers."
Print: "Status of the heart remains: %s."  organ_block.heart_status
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "======================================================================="
>SQL:  "UPDATE organ_block SET l_stat = 8 "
<SQL:  "WHERE donorid = %s" organ_block.donorid
```

Implementation of the decision tables in DT5GL: multivalued goalattribute.

```
Table 0: Assign the heart to an individual patient or a transplant center.
If:                                          | 0| 1| 2| 3| 4| 5| 6| 7| 8| 9|10|
'DUOBLOCK/Fallback is (still) possible'      | Y| Y| Y| Y| N| N| N| N| N| -| -|
H_Stat_inp is NotAvailable                   | -| -| -| -| Y| N| N| N| N| -| -|
H_Stat_inp is TC-Wait                        | Y| N| N| N| -| Y| N| N| N| -| -|
H_Stat_inp is I-Available                    | -| Y| Y| N| -| -| Y| Y| N| -| -|
'Another patient on Heart Prio List'         | -| Y| N| -| -| -| Y| N| -| -| -|
H_Stat_inp is TC-Available                   | -| -| -| -| -| -| -| -| -| Y| N|
Then:
H_Stat is I-Offered                          |  | X|  |  |  |  | X|  |  |  |  |
H_Stat is TC-Wait                            |  |  | X|  |  |  |  |  |  |  |  |
H_Stat is TC-Available                       |  |  |  |  |  | X|  | X|  | X|  |
# .......

Attribute: H_Stat_inp
Obtain_value_from_database_view: organ_block.heart_status

Proposition: 'Another patient on Heart Prio List'
Obtain_instance_from_database_view: high_prio_heart_list


Table 1: assign the lungs to an individual patient or a transplant center
If:                                          | 0| 1| 2| 3| 4| 5| 6| 7| 8| 9|10|
'DUOBLOCK/Fallback is (still) possible'      | Y| Y| Y| Y| N| N| N| N| N| -| -|
L_Stat_inp is NotAvailable                   | -| -| -| -| Y| N| N| N| N| -| -|
L_Stat_inp is TC-Wait                        | Y| N| N| N| -| Y| N| N| N| -| -|
L_Stat_inp is I-Available                    | -| Y| Y| N| -| -| Y| Y| N| -| -|
'Another patient on Lung Prio List'          | -| Y| N| -| -| -| Y| N| -| -| -|
L_Stat_inp is TC-Available                   | -| -| -| -| -| -| -| -| -| Y| N|
Then:
L_Stat is I-Offered                          |  | X|  |  |  |  | X|  |  |  |  |
L_Stat is TC-Wait                            |  |  | X|  |  |  |  |  |  |  |  |
L_Stat is TC-Available                       |  |  |  |  |  | X|  | X|  | X|  |
# .......


Attribute: L_Stat_inp
Obtain_value_from_database_view: organ_block.lung_status

Proposition: 'Another patient on Lung Prio List'
Obtain_instance_from_database_view: high_prio_lung_list

Proposition: 'Still organs to offer'
Obtain_instance_from_database_view: organ_block


rTable 2: DUOBLOCK/fallback policy still applies.
If:                                          | 0| 1|
'Still organs to offer'                      | Y| N|
H_Stat_inp is NotAvailable                   | N| -|
H_Stat_inp is I-Accepted                     | N| -|
L_Stat_inp is NotAvailable                   | N| -|
L_Stat_inp is I-Accepted                     | N| -|
Then:
'DUOBLOCK/Fallback is (still) possible'      | X|  |
Action is No_Organs_To_Offer                 |  | X|
# .......

# The Duoblock proposition indicates whether a fallback scenario is possible.
# DUOBLOCK is false when a Heart-Lung-block contains 1 organ only; the other organ
has status NotAvailable.
# DUOBLOCK becomes false when one of the organs is accepted by an individual
patient.
# DUOBLOCK is true as long as both organs are offered to individual patients.
```

rTable 3: Assign a heart-lung block to a transplant center for the first time (fallback-scenario)

If:	0	1	2
H_Stat is TC-Wait	Y	Y	N
L_Stat is TC-Wait	Y	-	Y
H_Stat_inp is TC-Wait	-	-	Y
L_Stat_inp is TC-Wait	-	Y	-
Then:			
'Heart-Lung Block to TC for the first time'	X	X	X

....

Proposition: 'Another Transplant Center on TC list'
Obtain_instance_from_database_view: transplant_center

Table 4: Assign heart and/or lungs to a next transplantation center.

If:	0	1	2	3	4	5	6	7	8
'Heart-Lung Block to TC for the first time'	Y	Y	N	N	N	N	N	N	N
H_Stat is TC-Available	-	-	Y	Y	Y	Y	N	N	N
L_Stat is TC-Available	-	-	Y	Y	N	N	Y	Y	N
'Another Transplant Center on TC list'	Y	N	Y	N	Y	N	Y	N	-
Then:									
Action is HL->TC	X		X						
Action is HL_NotAccepted		X		X					
Action is H_NotAccepted						X			
Action is L_NotAccepted								X	
Action is H->TC					X				
Action is L->TC							X		

....

Table 5: Assign heart and/or lungs to next patient.

If:	0	1	2	3
H_Stat is I-Offered	Y	Y	N	N
L_Stat is I-Offered	Y	N	Y	N
Then:				
Action is H->I	X	X		
Action is L->I	X		X	

....

Table 6: Only the heart or the lungs come into a wait state (fallback scenario)

If:	0	1	2	3	4
'Heart-Lung Block to TC for the first time'	Y	N	N	N	N
H_Stat is TC-Wait	-	Y	Y	N	N
L_Stat is TC-Wait	-	Y	N	Y	N
Then:					
Action is H->TC-Wait			X		
Action is L->TC-Wait				X	

....

```
Database_view: organ_block
With_attributes:
organ_block_id,donorid,name,heart_status,lung_status,organ_availability_date
Query:
SELECT a.organ_block_id,
       b.donorid,
       b.name,
       c.status AS heart_status,
       d.status AS lung_status,
       a.organ_availability_date
  FROM organ_block AS a
       INNER JOIN
       donor AS b ON (a.donorid = b.donorid)
       INNER JOIN
       organstatus AS c ON (a.h_stat = c.statusid)
       INNER JOIN
       organstatus AS d ON (a.l_stat = d.statusid)
 WHERE c.status IN ("I-Available", "TC-Available") OR
       d.status IN ("I-Available", "TC-Available")
 ORDER BY organ_availability_date
 LIMIT 1
End_Query


Database_view: high_prio_heart_list
With_attributes:
high_prio_heart_listid, patient_id, placement_date, priority, availability_id
Query:
SELECT *
  FROM high_prio_heart_list
 WHERE availability_id = 1
 ORDER BY priority DESC,
          placement_date ASC
 LIMIT 1
End_Query

Database_view: high_prio_lung_list
With_attributes: high_prio_lung_listid, patient_id, placement_date, priority,
availability_id
Query:
SELECT *
  FROM high_prio_lung_list
 WHERE availability_id = 1
 ORDER BY priority DESC,
          placement_date ASC
 LIMIT 1
End_Query

Database_view: transplant_center
With_attributes: transplant_center_id, name, tc_availability_id
Query:
SELECT transplant_center_id,
       name,
       tc_availability_id
  FROM transplant_center
  WHERE  tc_availability_id = 1
  LIMIT 1
End_Query
```

```
GoalAttribute: Action
Repeat_until: No_Organs_To_Offer
MultiValued_until: No_Organs_To_Offer


Case: No_Organs_To_Offer
Print: "============================Result======================================="
Print: "No organs with status 1 (I-Available) or status 5 (TC-Available) to offer."
Print: "The offering service has been finished"
Print: "========================================================================="


Case: H->I
Print: "============================Result================================="
Print: "H->I"
Print: "Assign the heart to patient %s on the heart prio list"
high_prio_heart_list.patient_id
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "========================================================================"
>SQL:  "UPDATE organ_block SET h_stat = 2 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO heart_offer (organ_block_id, patientid, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          high_prio_heart_list.patient_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE high_prio_heart_list SET availability_id = 2 "
<SQL:  "WHERE patient_id = %s"   high_prio_heart_list.patient_id


Case: L->I
Print: "============================Result================================="
Print: "L->I"
Print: "Assign the lungs to patient %s on the lung prio list"
high_prio_lung_list.patient_id
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "========================================================================"
>SQL:  "UPDATE organ_block SET l_stat = 2 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO lung_offer (organ_block_id, patientid, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          high_prio_lung_list.patient_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE high_prio_lung_list SET availability_id = 2 "
<SQL:  "WHERE patient_id = %s"   high_prio_lung_list.patient_id
```

```
Case: H->TC-Wait
Print: "============================Result=================================="
Print: "H->TC-Wait"
Print: "The heart is waiting now for a block-offer to a transplant center."
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "======================================================================="
>SQL:  "UPDATE organ_block SET h_stat = 4 "
<SQL:  "WHERE donorid = %s" organ_block.donorid


Case: L->TC-Wait
Print: "============================Result=================================="
Print: "L->TC-Wait"
Print: "The lungs are waiting now for a block-offer to a transplant center."
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "======================================================================="
>SQL:  "UPDATE organ_block SET l_stat = 4 "
<SQL:  "WHERE donorid = %s" organ_block.donorid


Case: HL->TC
Print: "============================Result=================================="
Print: "HL->TC"
Print: "Assign a heart and lung-block to a next transplant center"
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "Status of the heart is now: 6. (TC-Offered)."
Print: "Status of the lungs is now: 6. (TC-Offered)."
Print: "Transplant center %s is temporarily unavailable for following organ offers"
transplant_center.name
Print: "======================================================================="
>SQL:  "UPDATE organ_block SET h_stat = 6, l_stat = 6 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO heart_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          transplant_center.transplant_center_id
<SQL:  "%s) "          DateToday
>SQL:  "INSERT INTO lung_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          transplant_center.transplant_center_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE transplant_center SET tc_availability_id = 2 "
<SQL:  "WHERE transplant_center_id = %s"  transplant_center.transplant_center_id
```

```
Case: H->TC
Print: "============================Result=================================="
Print: "H->TC"
Print: "Assign the heart to a next transplant center"
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "Status of the heart is: 6. (TC-Offered)."
Print: "Status of the lungs remains: %s."  organ_block.lung_status
Print: "Transplant center %s is temporarily unavailable for following organ offers"
transplant_center.name
Print: "======================================================================="
>SQL:  "UPDATE organ_block SET h_stat = 6 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO heart_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          transplant_center.transplant_center_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE transplant_center SET tc_availability_id = 2 "
<SQL:  "WHERE transplant_center_id = %s"  transplant_center.transplant_center_id


Case: L->TC
Print: "============================Result=================================="
Print: "L->TC"
Print: "Assign the lungs to a next transplant center"
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "Status of the lungs is now: 6. (TC-Offered)."
Print: "Status of the heart remains: %s."  organ_block.heart_status
Print: "Transplant center %s is temporarily unavailable for following organ offers"
transplant_center.name
Print: "======================================================================="
>SQL:  "UPDATE organ_block SET l_stat = 6 "
<SQL:  "WHERE donorid = %s" organ_block.donorid

>SQL:  "INSERT INTO lung_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL:  "VALUES (%s, "  organ_block.organ_block_id
-SQL:  "%s, "          transplant_center.transplant_center_id
<SQL:  "%s) "          DateToday
>SQL:  "UPDATE transplant_center SET tc_availability_id = 2 "
<SQL:  "WHERE transplant_center_id = %s"  transplant_center.transplant_center_id
```

```
Case: HL_NotAccepted
Print: "============================Result=================================="
Print: "Neither the heart nor the lungs have been accepted by patients or
transplantation centres."
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "===================================================================="
>SQL:  "UPDATE organ_block SET h_stat = 8, l_stat = 8 "
<SQL:  "WHERE donorid = %s" organ_block.donorid


Case: H_NotAccepted
Print: "============================Result=================================="
Print: "The heart is not accepted by patients or transplantation centers."
Print: "Status of the lungs remains: %s."  organ_block.lung_status
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "===================================================================="
>SQL:  "UPDATE organ_block SET h_stat = 8 "
<SQL:  "WHERE donorid = %s" organ_block.donorid


Case: L_NotAccepted
Print: "============================Result=================================="
Print: "The lungs have not been accepted by patients or transplant centers."
Print: "Status of the heart remains: %s."  organ_block.heart_status
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "===================================================================="
>SQL:  "UPDATE organ_block SET l_stat = 8 "
<SQL:  "WHERE donorid = %s" organ_block.donorid
```

The initial situation in SQLite for a full test run (with 22 test cases).

In organ block:

Query | History

```
SELECT a.organ_block_id,
       b.donorid,
       b.name,
       c.status AS heart_status,
       d.status AS lung_status,
       a.organ_availability_date
  FROM organ_block AS a
       INNER JOIN
       donor AS b ON (a.donorid = b.donorid)
       INNER JOIN
       organstatus AS c ON (a.h_stat = c.statusid)
       INNER JOIN
       organstatus AS d ON (a.l_stat = d.statusid)
 WHERE c.status IN ("I-Available", "TC-Available") OR
       d.status IN ("I-Available", "TC-Available")
 ORDER BY organ_availability_date
```

Grid view | Form view

Total rows loaded: 22

	organ bloc	donorid	name	heart status	lung status	organ availability date
1	2	6	Patricia Garza	I-Available	I-Available	2019-06-05
2	4	1	Chelsea Smith	I-Available	I-Offered	2019-06-05
3	1	7	Mrs. Jennifer Morrison MD	I-Offered	I-Available	2019-06-06
4	7	2	Rachel Miller	I-Available	I-Accepted	2019-06-06
5	5	3	James Booth MD	I-Accepted	I-Available	2019-06-07
6	11	8	Elaine Price	I-Available	TC-Wait	2019-06-07
7	8	10	Krista Graves PhD	TC-Wait	I-Available	2019-06-08
8	10	19	Anthony Cooper	I-Available	NotAvailable	2019-06-08
9	6	4	Jacqueline Johnson DDS	NotAvailable	I-Available	2019-06-09
10	9	9	Jesus Watson	I-Available	I-Available	2019-06-10
11	3	5	Doris Harmon	I-Available	I-Available	2019-06-11
12	19	17	Laurie Pennington	I-Available	I-Available	2019-06-12
13	12	21	Deborah Clark	TC-Wait	I-Available	2019-06-21
14	13	11	Brandon Cannon	I-Available	TC-Wait	2019-07-30
15	14	12	Brian Reyes	TC-Available	TC-Available	2019-07-30
16	15	13	Tiffany Brandt	TC-Available	NotAvailable	2019-07-30
17	16	14	Ronald Potter	NotAvailable	TC-Available	2019-07-30
18	17	15	Tyler Garner	TC-Available	TC-Accepted	2019-08-01
19	18	16	Alyssa Mullen	TC-Accepted	TC-Available	2019-08-01
20	20	20	John Hale	I-Available	I-Available	2019-08-03
21	21	22	Caroline Jones	I-Available	I-Accepted	2019-08-04
22	22	23	Timothy Murphy	TC-Accepted	TC-Available	2019-08-05

Note: all names are generated with Python's Faker library.

7 candidates on the high prio heart list:

Query | History

```
SELECT *
  FROM high_prio_heart_list
 WHERE availability_id = 1
 ORDER BY priority DESC,
          placement_date ASC
```

Grid view | Form view

Total rows loaded: 7

	high_prio_heart_listid	patient_id	placement_date	priority	availability_id
1	18	16	2019-06-13	92	1
2	5	5	2019-06-08	90	1
3	11	13	2019-06-04	80	1
4	13	9	2019-05-31	75	1
5	3	3	2019-05-31	70	1
6	8	8	2019-06-01	70	1
7	14	10	2019-05-31	60	1

5 candidates on the high prio lung list:

Query | History

```
SELECT *
  FROM high_prio_lung_list
 WHERE availability_id = 1
 ORDER BY priority DESC,
          placement_date ASC
```

Grid view | Form view

Total rows loaded: 5

	high_prio_lung_listid	patient_id	placement_date	priority	availability_id
1	18	34	2019-05-31	92	1
2	7	23	2019-05-31	90	1
3	12	28	2019-06-08	90	1
4	4	40	2019-05-31	80	1
5	15	31	2019-06-01	70	1

and 8 available transplant centers:

	transplant_center_id	name	tc_availability_id
1	1	Medical Center West	1
2	2	Medical Center East	1
3	3	Medical Center North	1
4	4	Medical Center Alex Ryan	1
5	5	Medical Center Tyler Powell	1
6	6	Medical Center Leah Jenkins	1
7	7	Medical Center William Chandler	1
8	8	Medical Center Lisa Rose	1

The results of the test run with a singelvalued goalattribute.

```
File to read...: organstsv2.txt
All decision tables (except the rTables) are checked and ok.
Attribute: H_Stat_inp
Proposition: 'Another patient on Heart Prio List'
Proposition: 'Still organs to offer'
Attribute: L_Stat_inp
Proposition: 'Another patient on Lung Prio List'
Proposition: 'Another Transplant Center on TC list'
Database_view: organ_block
Database_view: high_prio_heart_list
Database_view: high_prio_lung_list
Database_view: transplant_center
GoalAttribute: Action


============================Result=================================
H->I;L->I
Assign heart and lungs to the following patients on the prio lists
This concerns organ block 2 from donor Patricia Garza.
The heart was offered to patient: 16.
The lungs have been offered to patient: 34.
===================================================================


============================Result=================================
H->I
Assign the heart to patient 5 on the heart prio list
This concerns organ block 4 from donor Chelsea Smith.
Status of the heart is now: I-Offered.
Status of the lungs remains: I-Offered.
===================================================================


============================Result=================================
L->I
Assign the lungs to patient 23 on the lung prio list
This concerns organ block 1 from donor Mrs. Jennifer Morrison MD.
Status of the heart remains: I-Offered.
Status of the lungs is now: I-Offered.
===================================================================


============================Result=================================
H->I
Assign the heart to patient 13 on the heart prio list
This concerns organ block 7 from donor Rachel Miller.
Status of the heart is now: I-Offered.
Status of the lungs remains: I-Accepted.
===================================================================


============================Result=================================
L->I
Assign the lungs to patient 28 on the lung prio list
This concerns organ block 5 from donor James Booth MD.
Status of the heart remains: I-Accepted.
Status of the lungs is now: I-Offered.
===================================================================
```

```
============================Result=====================================
H->I
Assign the heart to patient 9 on the heart prio list
This concerns organ block 11 from donor Elaine Price.
Status of the heart is now: I-Offered.
Status of the lungs remains: TC-Wait.
=======================================================================


============================Result=====================================
L->I
Assign the lungs to patient 40 on the lung prio list
This concerns organ block 8 from donor Krista Graves PhD.
Status of the heart remains: TC-Wait.
Status of the lungs is now: I-Offered.
=======================================================================


============================Result=====================================
H->I
Assign the heart to patient 3 on the heart prio list
This concerns organ block 10 from donor Anthony Cooper.
Status of the heart is now: I-Offered.
Status of the lungs remains: NotAvailable.
=======================================================================


============================Result=====================================
L->I
Assign the lungs to patient 31 on the lung prio list
This concerns organ block 6 from donor Jacqueline Johnson DDS.
Status of the heart remains: NotAvailable.
Status of the lungs is now: I-Offered.
=======================================================================


============================Result=============================
H->I;L->TC-Wait
The lungs are waiting now for a block-offer to a transplant center,
while the heart has been offered to patient 8 on the heart prio list
This concerns organ block 9 from donor Jesus Watson.
================================================================


============================Result=============================
H->I;L->TC-Wait
The lungs are waiting now for a block-offer to a transplant center,
while the heart has been offered to patient 10 on the heart prio list
This concerns organ block 3 from donor Doris Harmon.
================================================================


============================Result=====================================
HL->TC
Assign a heart and lung-block to a next transplant center
This concerns organ block 19 from donor Laurie Pennington.
Status of the heart is now: 6. (TC-Offered).
Status of the lungs is now: 6. (TC-Offered).
Transplant center Medical Center West is temporarily unavailable for following
organ offers
=======================================================================
```

==========Result==========
HL->TC
Assign a heart and lung-block to a next transplant center
This concerns organ block 12 from donor Deborah Clark.
Status of the heart is now: 6. (TC-Offered).
Status of the lungs is now: 6. (TC-Offered).
Transplant center Medical Center East is temporarily unavailable for following organ offers
==========

==========Result==========
HL->TC
Assign a heart and lung-block to a next transplant center
This concerns organ block 13 from donor Brandon Cannon.
Status of the heart is now: 6. (TC-Offered).
Status of the lungs is now: 6. (TC-Offered).
Transplant center Medical Center North is temporarily unavailable for following organ offers
==========

==========Result==========
HL->TC
Assign a heart and lung-block to a next transplant center
This concerns organ block 14 from donor Brian Reyes.
Status of the heart is now: 6. (TC-Offered).
Status of the lungs is now: 6. (TC-Offered).
Transplant center Medical Center Alex Ryan is temporarily unavailable for following organ offers
==========

==========Result==========
H->TC
Assign the heart to a next transplant center
This concerns organ block 15 from donor Tiffany Brandt.
Status of the heart is: 6. (TC-Offered).
Status of the lungs remains: NotAvailable.
Transplant center Medical Center Tyler Powell is temporarily unavailable for following organ offers
==========

==========Result==========
L->TC
Assign the lungs to a next transplant center
This concerns organ block 16 from donor Ronald Potter.
Status of the lungs is now: 6. (TC-Offered).
Status of the heart remains: NotAvailable.
Transplant center Medical Center Leah Jenkins is temporarily unavailable for following organ offers
==========

==========Result==========
H->TC
Assign the heart to a next transplant center
This concerns organ block 17 from donor Tyler Garner.
Status of the heart is: 6. (TC-Offered).
Status of the lungs remains: TC-Accepted.
Transplant center Medical Center William Chandler is temporarily unavailable for following organ offers
==========

```
============================Result=================================
L->TC
Assign the lungs to a next transplant center
This concerns organ block 18 from donor Alyssa Mullen.
Status of the lungs is now: 6. (TC-Offered).
Status of the heart remains: TC-Accepted.
Transplant center Medical Center Lisa Rose is temporarily unavailable for following
organ offers
====================================================================


============================Result=================================
Neither the heart nor the lungs have been accepted by patients or transplantation
centres.
This concerns organ block 20 from donor John Hale.
====================================================================


============================Result=================================
The heart is not accepted by patients or transplantation centers.
Status of the lungs remains: I-Accepted.
This concerns organ block 21 from donor Caroline Jones.
====================================================================


============================Result=================================
The lungs have not been accepted by patients or transplant centers.
Status of the heart remains: TC-Accepted.
This concerns organ block 22 from donor Timothy Murphy.
====================================================================


============================Result=========================================
No organs with status 1 (I-Available) or status 5 (TC-Available) to offer.
The offering service has been finished
===========================================================================

Process finished with exit code 0
```

New organ statuses:

	organ bloc	donorid	name	heart status	lung status	organ avai
1	2	6	Patricia Garza	I-Offered	I-Offered	2019-06-05
2	4	1	Chelsea Smith	I-Offered	I-Offered	2019-06-05
3	1	7	Mrs. Jennifer Morrison MD	I-Offered	I-Offered	2019-06-06
4	7	2	Rachel Miller	I-Offered	I-Accepted	2019-06-06
5	5	3	James Booth MD	I-Accepted	I-Offered	2019-06-07
6	11	8	Elaine Price	I-Offered	TC-Wait	2019-06-07
7	8	10	Krista Graves PhD	TC-Wait	I-Offered	2019-06-08
8	10	19	Anthony Cooper	I-Offered	NotAvailable	2019-06-08
9	6	4	Jacqueline Johnson DDS	NotAvailable	I-Offered	2019-06-09
10	9	9	Jesus Watson	I-Offered	TC-Wait	2019-06-10
11	3	5	Doris Harmon	I-Offered	TC-Wait	2019-06-11
12	19	17	Laurie Pennington	TC-Offered	TC-Offered	2019-06-12
13	12	21	Deborah Clark	TC-Offered	TC-Offered	2019-06-21
14	13	11	Brandon Cannon	TC-Offered	TC-Offered	2019-07-30
15	14	12	Brian Reyes	TC-Offered	TC-Offered	2019-07-30
16	15	13	Tiffany Brandt	TC-Offered	NotAvailable	2019-07-30
17	16	14	Ronald Potter	NotAvailable	TC-Offered	2019-07-30
18	17	15	Tyler Garner	TC-Offered	TC-Accepted	2019-08-01
19	18	16	Alyssa Mullen	TC-Accepted	TC-Offered	2019-08-01
20	20	20	John Hale	NotAccepted	NotAccepted	2019-08-03
21	21	22	Caroline Jones	NotAccepted	I-Accepted	2019-08-04
22	22	23	Timothy Murphy	TC-Accepted	NotAccepted	2019-08-05

Placed heart offers:

	heart_offer_id	organ_block_	patientid	transplant_	offerdate	responseda	response_i
1	1	2	16	NULL	2019-08-11 15:32:53.48	NULL	NULL
2	2	4	5	NULL	2019-08-11 15:32:53.51	NULL	NULL
3	3	7	13	NULL	2019-08-11 15:32:53.54	NULL	NULL
4	4	11	9	NULL	2019-08-11 15:32:53.57	NULL	NULL
5	5	10	3	NULL	2019-08-11 15:32:53.60	NULL	NULL
6	6	9	8	NULL	2019-08-11 15:32:53.64	NULL	NULL
7	7	3	10	NULL	2019-08-11 15:32:53.65	NULL	NULL
8	8	19	NULL	1	2019-08-11 15:32:53.68	NULL	NULL
9	9	12	NULL	2	2019-08-11 15:32:53.70	NULL	NULL
10	10	13	NULL	3	2019-08-11 15:32:53.72	NULL	NULL
11	11	14	NULL	4	2019-08-11 15:32:53.75	NULL	NULL
12	12	15	NULL	5	2019-08-11 15:32:53.77	NULL	NULL
13	13	17	NULL	7	2019-08-11 15:32:53.81	NULL	NULL

Placed lung offers:

	lung_offer_id	organ_bloc	patientid	transplant_	offerdate	responseda	response_i
1	1	2	34	NULL	2019-08-11 15:32:53.49	NULL	NULL
2	2	1	23	NULL	2019-08-11 15:32:53.52	NULL	NULL
3	3	5	28	NULL	2019-08-11 15:32:53.55	NULL	NULL
4	4	8	40	NULL	2019-08-11 15:32:53.59	NULL	NULL
5	5	6	31	NULL	2019-08-11 15:32:53.62	NULL	NULL
6	6	19	NULL	1	2019-08-11 15:32:53.68	NULL	NULL
7	7	12	NULL	2	2019-08-11 15:32:53.70	NULL	NULL
8	8	13	NULL	3	2019-08-11 15:32:53.73	NULL	NULL
9	9	14	NULL	4	2019-08-11 15:32:53.75	NULL	NULL
10	10	16	NULL	6	2019-08-11 15:32:53.79	NULL	NULL
11	11	18	NULL	8	2019-08-11 15:32:53.83	NULL	NULL

The results of the test run with a multivalued goalattribute.

```
File to read...: organstmv2.txt
All decision tables (except the rTables) are checked and ok.
Attribute: H_Stat_inp
Proposition: 'Another patient on Heart Prio List'
Proposition: 'Still organs to offer'
Attribute: L_Stat_inp
Proposition: 'Another patient on Lung Prio List'
Proposition: 'Another Transplant Center on TC list'
Database_view: organ_block
Database_view: high_prio_heart_list
Database_view: high_prio_lung_list
Database_view: transplant_center
GoalAttribute: Action



============================Result=================================
H->I
Assign the heart to patient 16 on the heart prio list
This concerns organ block 2 from donor Patricia Garza.
===================================================================
============================Result=================================
L->I
Assign the lungs to patient 34 on the lung prio list
This concerns organ block 2 from donor Patricia Garza.
===================================================================


============================Result=================================
H->I
Assign the heart to patient 5 on the heart prio list
This concerns organ block 4 from donor Chelsea Smith.
===================================================================


============================Result=================================
L->I
Assign the lungs to patient 23 on the lung prio list
This concerns organ block 1 from donor Mrs. Jennifer Morrison MD.
===================================================================


============================Result=================================
H->I
Assign the heart to patient 13 on the heart prio list
This concerns organ block 7 from donor Rachel Miller.
===================================================================


============================Result=================================
L->I
Assign the lungs to patient 28 on the lung prio list
This concerns organ block 5 from donor James Booth MD.
===================================================================


============================Result=================================
H->I
Assign the heart to patient 9 on the heart prio list
This concerns organ block 11 from donor Elaine Price.
===================================================================
```

```
============================Result=================================
L->I
Assign the lungs to patient 40 on the lung prio list
This concerns organ block 8 from donor Krista Graves PhD.
====================================================================


============================Result=================================
H->I
Assign the heart to patient 3 on the heart prio list
This concerns organ block 10 from donor Anthony Cooper.
====================================================================


============================Result=================================
L->I
Assign the lungs to patient 31 on the lung prio list
This concerns organ block 6 from donor Jacqueline Johnson DDS.
====================================================================


============================Result=================================
H->I
Assign the heart to patient 8 on the heart prio list
This concerns organ block 9 from donor Jesus Watson.
====================================================================
============================Result=================================
L->TC-Wait
The lungs are waiting now for a block-offer to a transplant center.
This concerns organ block 9 from donor Jesus Watson.
====================================================================


============================Result=================================
H->I
Assign the heart to patient 10 on the heart prio list
This concerns organ block 3 from donor Doris Harmon.
====================================================================
============================Result=================================
L->TC-Wait
The lungs are waiting now for a block-offer to a transplant center.
This concerns organ block 3 from donor Doris Harmon.
====================================================================


============================Result=================================
HL->TC
Assign a heart and lung-block to a next transplant center
This concerns organ block 19 from donor Laurie Pennington.
Status of the heart is now: 6. (TC-Offered).
Status of the lungs is now: 6. (TC-Offered).
Transplant center Medical Center West is temporarily unavailable for following
organ offers
====================================================================


============================Result=================================
HL->TC
Assign a heart and lung-block to a next transplant center
This concerns organ block 12 from donor Deborah Clark.
Status of the heart is now: 6. (TC-Offered).
Status of the lungs is now: 6. (TC-Offered).
Transplant center Medical Center East is temporarily unavailable for following
organ offers
====================================================================
```

==========Result==========
HL->TC
Assign a heart and lung-block to a next transplant center
This concerns organ block 13 from donor Brandon Cannon.
Status of the heart is now: 6. (TC-Offered).
Status of the lungs is now: 6. (TC-Offered).
Transplant center Medical Center North is temporarily unavailable for following organ offers
==========

==========Result==========
HL->TC
Assign a heart and lung-block to a next transplant center
This concerns organ block 14 from donor Brian Reyes.
Status of the heart is now: 6. (TC-Offered).
Status of the lungs is now: 6. (TC-Offered).
Transplant center Medical Center Alex Ryan is temporarily unavailable for following organ offers
==========

==========Result==========
H->TC
Assign the heart to a next transplant center
This concerns organ block 15 from donor Tiffany Brandt.
Status of the heart is: 6. (TC-Offered).
Status of the lungs remains: NotAvailable.
Transplant center Medical Center Tyler Powell is temporarily unavailable for following organ offers
==========

==========Result==========
L->TC
Assign the lungs to a next transplant center
This concerns organ block 16 from donor Ronald Potter.
Status of the lungs is now: 6. (TC-Offered).
Status of the heart remains: NotAvailable.
Transplant center Medical Center Leah Jenkins is temporarily unavailable for following organ offers
==========

==========Result==========
H->TC
Assign the heart to a next transplant center
This concerns organ block 17 from donor Tyler Garner.
Status of the heart is: 6. (TC-Offered).
Status of the lungs remains: TC-Accepted.
Transplant center Medical Center William Chandler is temporarily unavailable for following organ offers
==========

==========Result==========
L->TC
Assign the lungs to a next transplant center
This concerns organ block 18 from donor Alyssa Mullen.
Status of the lungs is now: 6. (TC-Offered).
Status of the heart remains: TC-Accepted.
Transplant center Medical Center Lisa Rose is temporarily unavailable for following organ offers
==========

```
============================Result=================================
Neither the heart nor the lungs have been accepted by patients or transplantation
centres.
This concerns organ block 20 from donor John Hale.
===================================================================


============================Result=================================
The heart is not accepted by patients or transplantation centers.
Status of the lungs remains: I-Accepted.
This concerns organ block 21 from donor Caroline Jones.
===================================================================


============================Result=================================
The lungs have not been accepted by patients or transplant centers.
Status of the heart remains: TC-Accepted.
This concerns organ block 22 from donor Timothy Murphy.
===================================================================


============================Result=========================================
No organs with status 1 (I-Available) or status 5 (TC-Available) to offer.
The offering service has been finished
========================================================================

Process finished with exit code 0
```

New organ statuses:

	organ bloc	donorid	name	heart status	lung status	organ avai
1	2	6	Patricia Garza	I-Offered	I-Offered	2019-06-05
2	4	1	Chelsea Smith	I-Offered	I-Offered	2019-06-05
3	1	7	Mrs. Jennifer Morrison MD	I-Offered	I-Offered	2019-06-06
4	7	2	Rachel Miller	I-Offered	I-Accepted	2019-06-06
5	5	3	James Booth MD	I-Accepted	I-Offered	2019-06-07
6	11	8	Elaine Price	I-Offered	TC-Wait	2019-06-07
7	8	10	Krista Graves PhD	TC-Wait	I-Offered	2019-06-08
8	10	19	Anthony Cooper	I-Offered	NotAvailable	2019-06-08
9	6	4	Jacqueline Johnson DDS	NotAvailable	I-Offered	2019-06-09
10	9	9	Jesus Watson	I-Offered	TC-Wait	2019-06-10
11	3	5	Doris Harmon	I-Offered	TC-Wait	2019-06-11
12	19	17	Laurie Pennington	TC-Offered	TC-Offered	2019-06-12
13	12	21	Deborah Clark	TC-Offered	TC-Offered	2019-06-21
14	13	11	Brandon Cannon	TC-Offered	TC-Offered	2019-07-30
15	14	12	Brian Reyes	TC-Offered	TC-Offered	2019-07-30
16	15	13	Tiffany Brandt	TC-Offered	NotAvailable	2019-07-30
17	16	14	Ronald Potter	NotAvailable	TC-Offered	2019-07-30
18	17	15	Tyler Garner	TC-Offered	TC-Accepted	2019-08-01
19	18	16	Alyssa Mullen	TC-Accepted	TC-Offered	2019-08-01
20	20	20	John Hale	NotAccepted	NotAccepted	2019-08-03
21	21	22	Caroline Jones	NotAccepted	I-Accepted	2019-08-04
22	22	23	Timothy Murphy	TC-Accepted	NotAccepted	2019-08-05

Placed heart offers:

	heart_offe	organ_bloc	patientid	transplant_	offerdate	responseda	response_i
1	1	2	16	NULL	2019-08-11 16:04:48.31	NULL	NULL
2	2	4	5	NULL	2019-08-11 16:04:48.36	NULL	NULL
3	3	7	13	NULL	2019-08-11 16:04:48.39	NULL	NULL
4	4	11	9	NULL	2019-08-11 16:04:48.45	NULL	NULL
5	5	10	3	NULL	2019-08-11 16:04:48.50	NULL	NULL
6	6	9	8	NULL	2019-08-11 16:04:48.54	NULL	NULL
7	7	3	10	NULL	2019-08-11 16:04:48.56	NULL	NULL
8	8	19	NULL	1	2019-08-11 16:04:48.58	NULL	NULL
9	9	12	NULL	2	2019-08-11 16:04:48.60	NULL	NULL
10	10	13	NULL	3	2019-08-11 16:04:48.62	NULL	NULL
11	11	14	NULL	4	2019-08-11 16:04:48.64	NULL	NULL
12	12	15	NULL	5	2019-08-11 16:04:48.66	NULL	NULL
13	13	17	NULL	7	2019-08-11 16:04:48.69	NULL	NULL

Placed lung offers:

	lung_offer_	organ_bloc	patientid	transplant_	offerdate	responseda	response_i
1	1	2	34	NULL	2019-08-11 16:04:48.33	NULL	NULL
2	2	1	23	NULL	2019-08-11 16:04:48.38	NULL	NULL
3	3	5	28	NULL	2019-08-11 16:04:48.43	NULL	NULL
4	4	8	40	NULL	2019-08-11 16:04:48.49	NULL	NULL
5	5	6	31	NULL	2019-08-11 16:04:48.52	NULL	NULL
6	6	19	NULL	1	2019-08-11 16:04:48.58	NULL	NULL
7	7	12	NULL	2	2019-08-11 16:04:48.60	NULL	NULL
8	8	13	NULL	3	2019-08-11 16:04:48.62	NULL	NULL
9	9	14	NULL	4	2019-08-11 16:04:48.64	NULL	NULL
10	10	16	NULL	6	2019-08-11 16:04:48.68	NULL	NULL
11	11	18	NULL	8	2019-08-11 16:04:48.71	NULL	NULL