UNIVERSITÄT KOBLENZ · LANDAU

IWVI

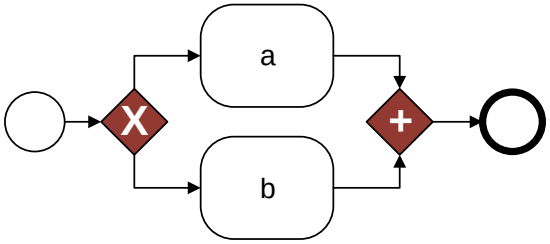
BUSINESS PROCESS MANAGEMENT

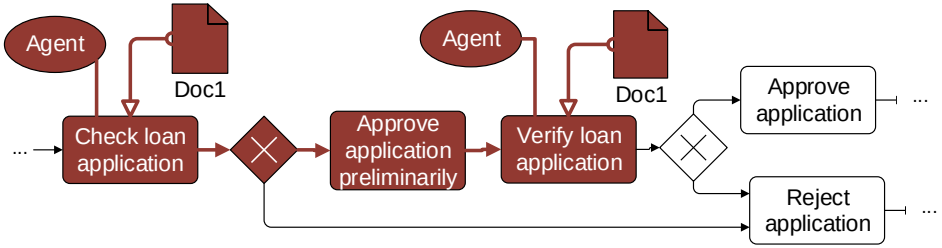
MODEL QUERY II:
THE GENERIC MODEL QUERY LANGUAGE (GRAPH MATCHING)

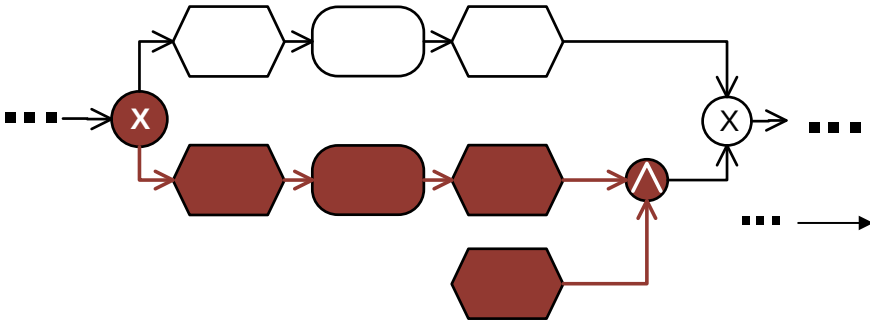
AGENDA

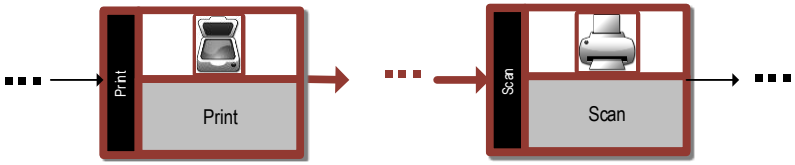
- Requirements of Model Query Languages
- The Generic Model Query Language (GMQL)
- Example Queries
- Live Demo

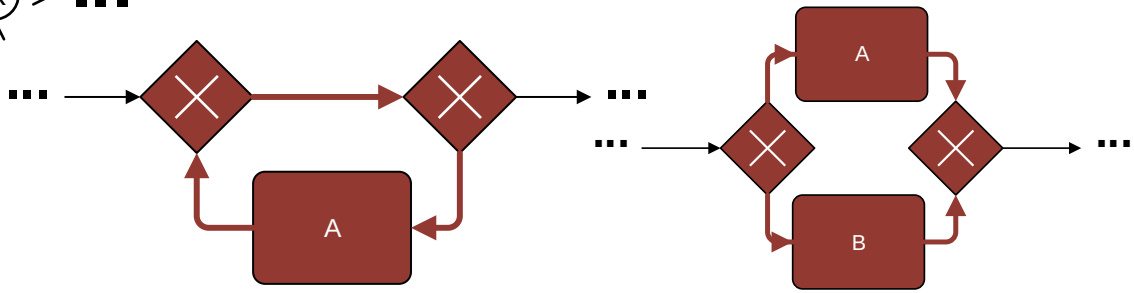
RECAP: TYPICAL STRUCTURES

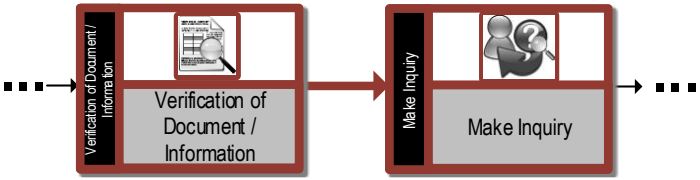


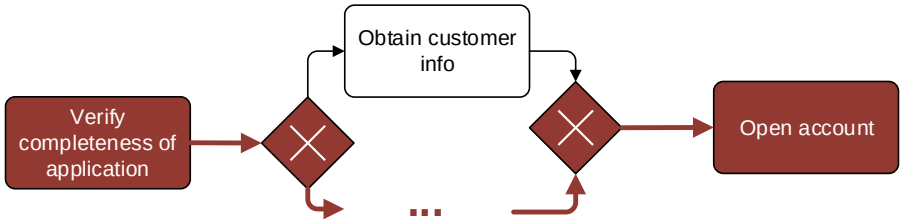






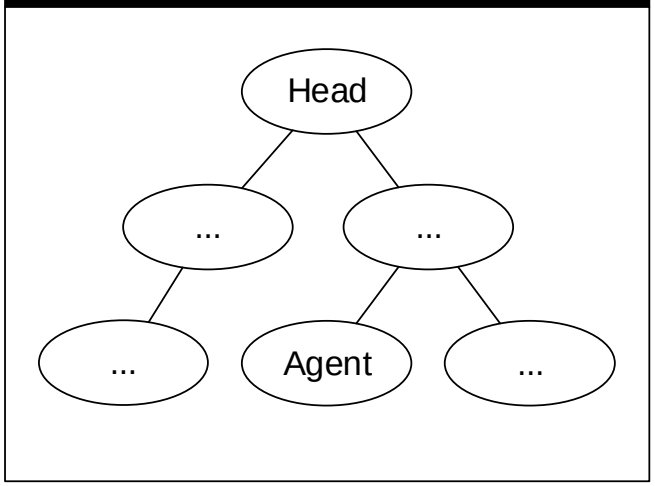




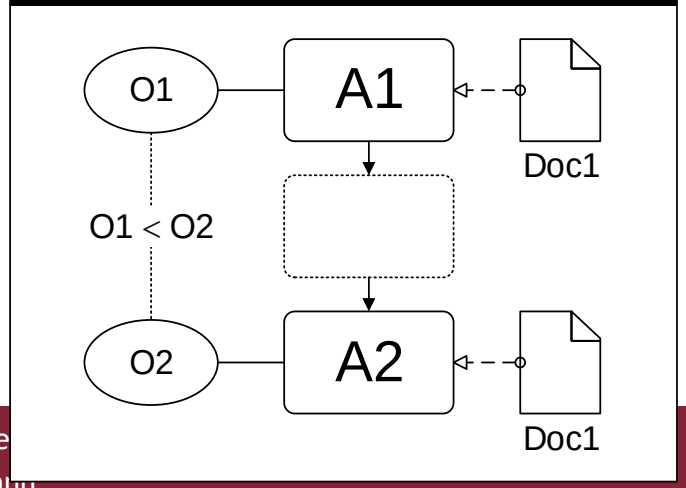


EXAMPLE: COMPLIANCE CHECKING

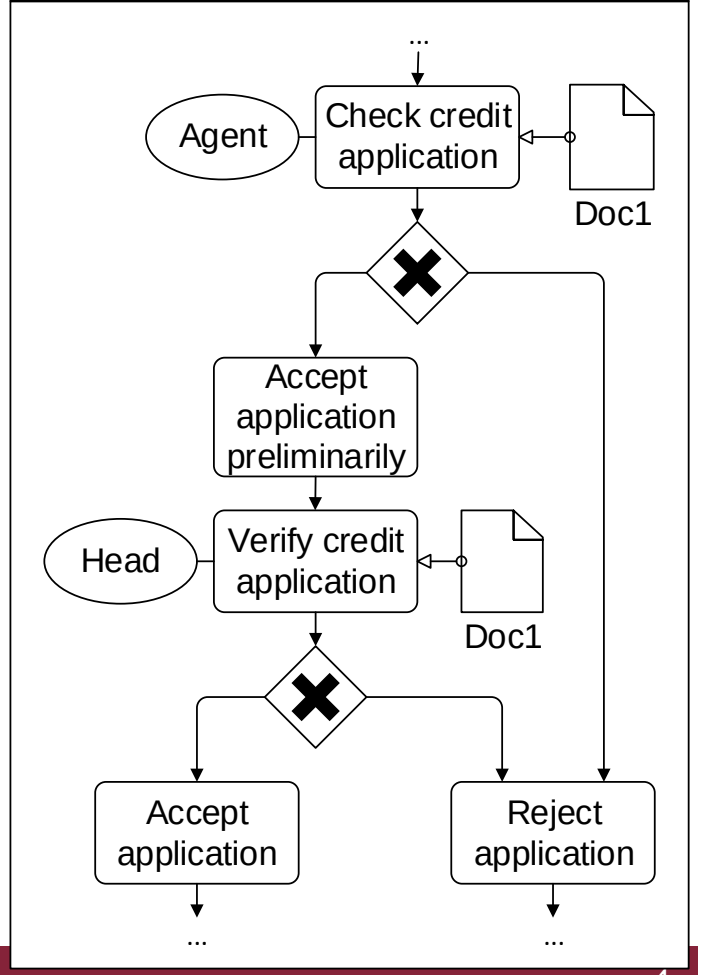
Organizational chart



Compliance rule *separation of duties*



Process model



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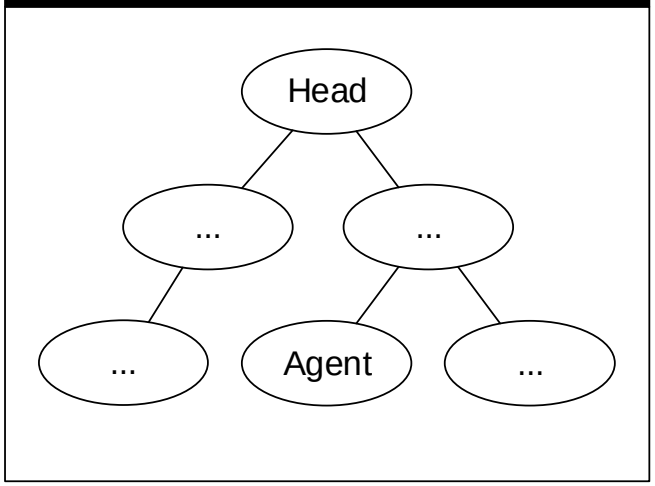

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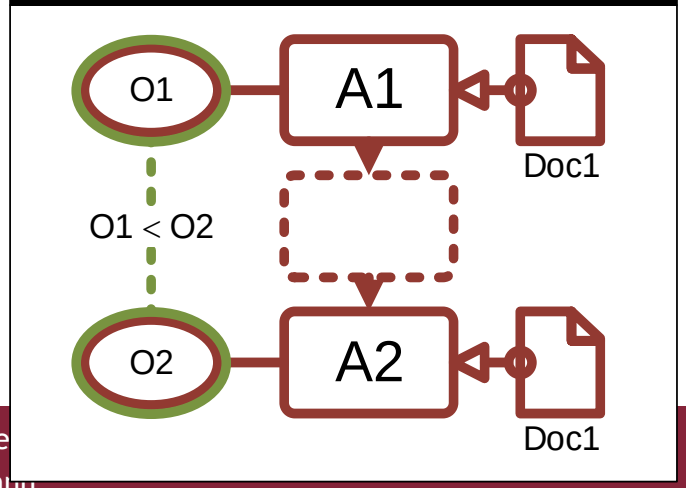
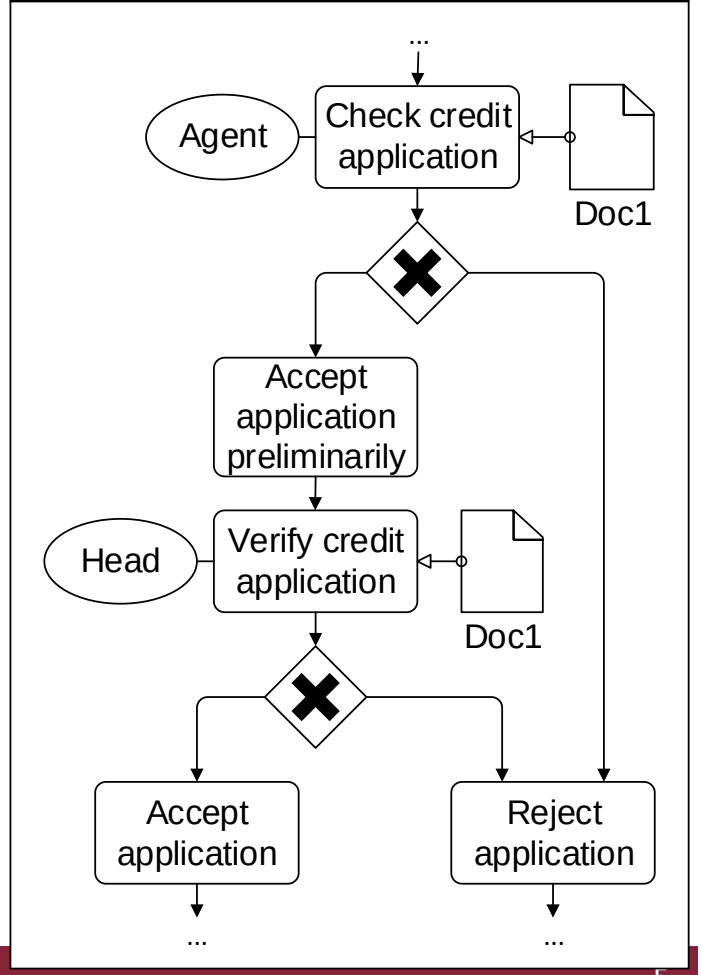


Process model



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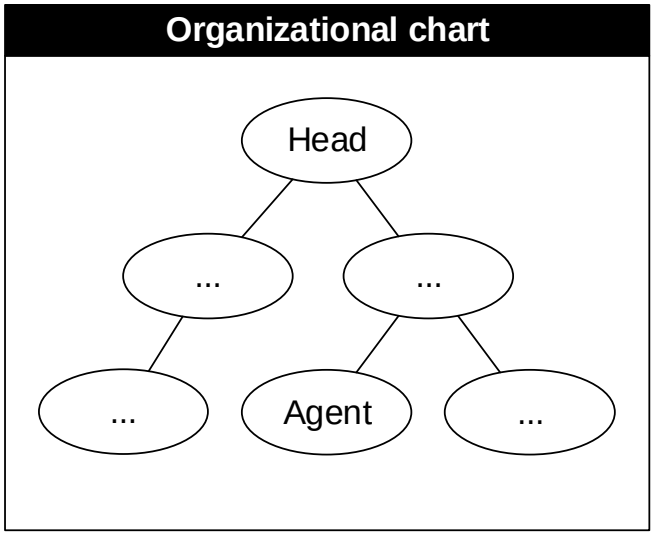
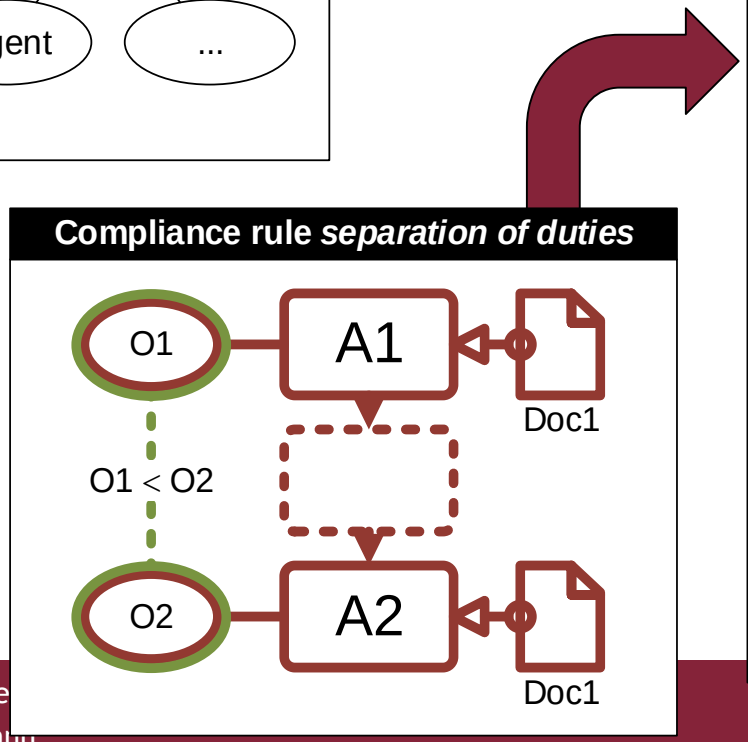
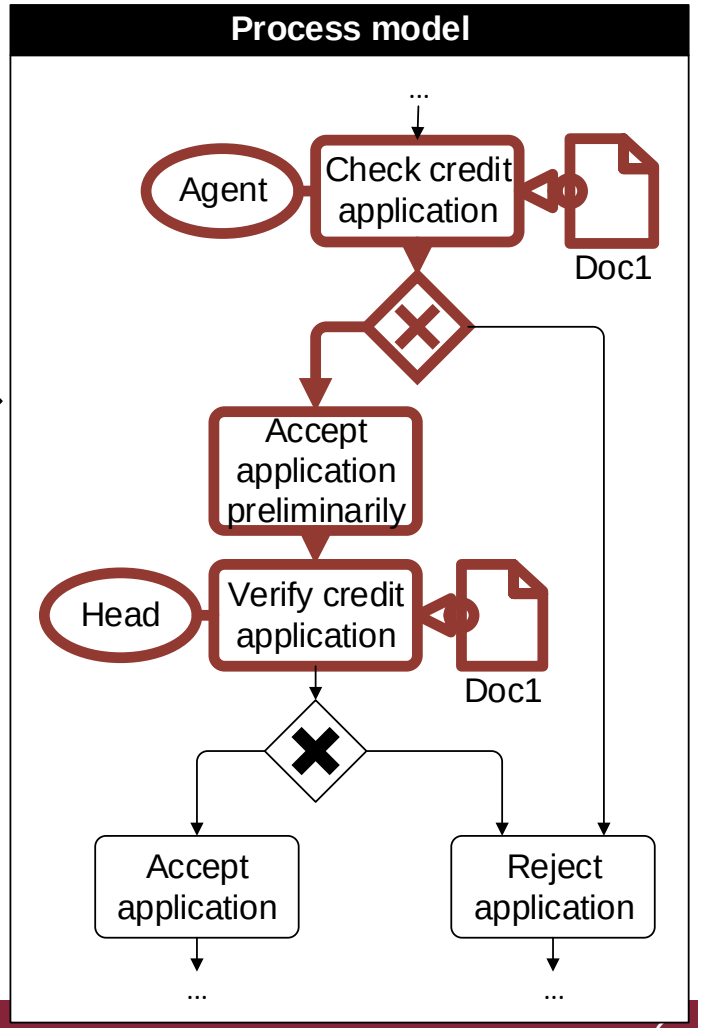
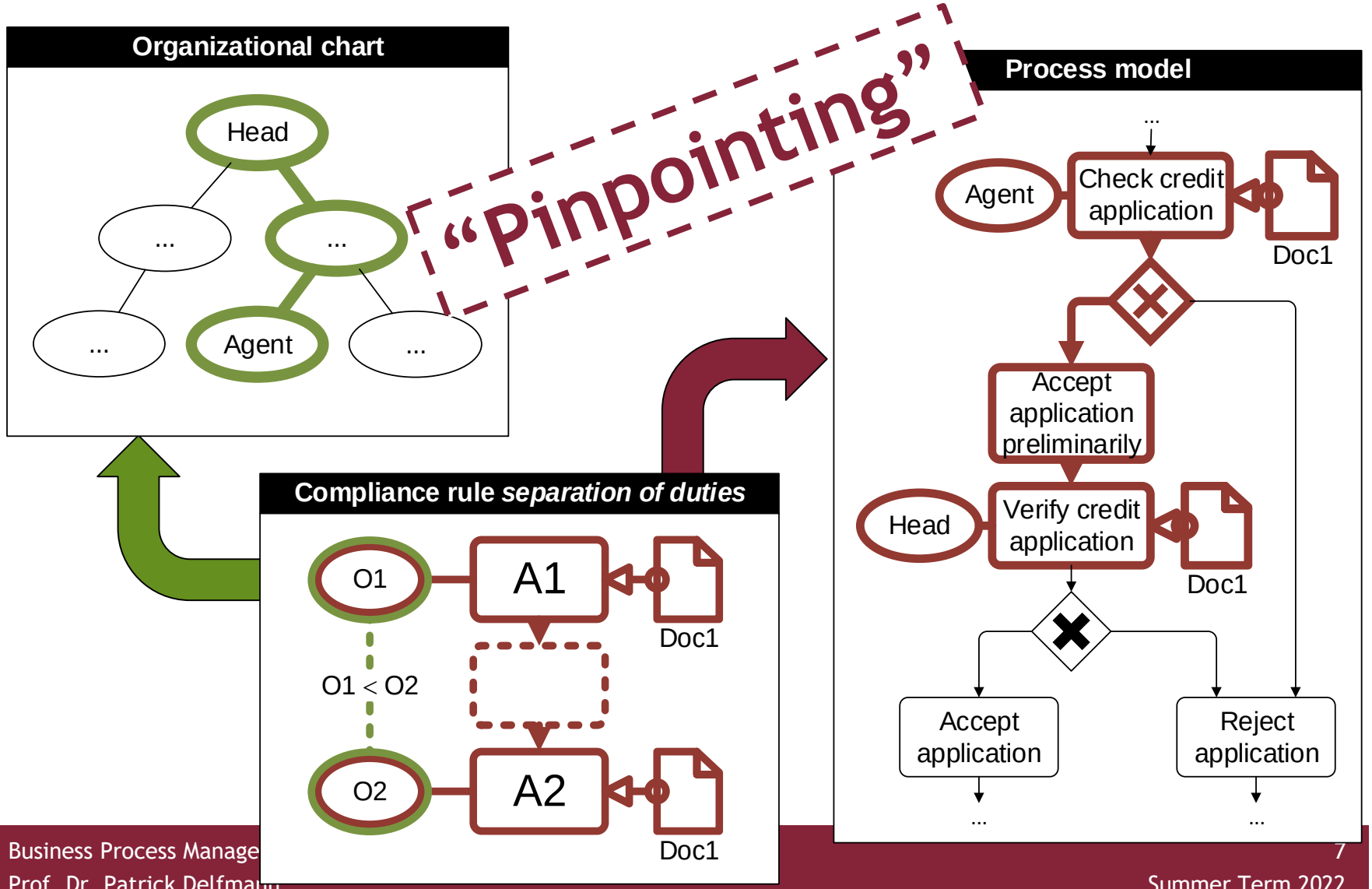






EXAMPLE: COMPLIANCE CHECKING



AGENDA

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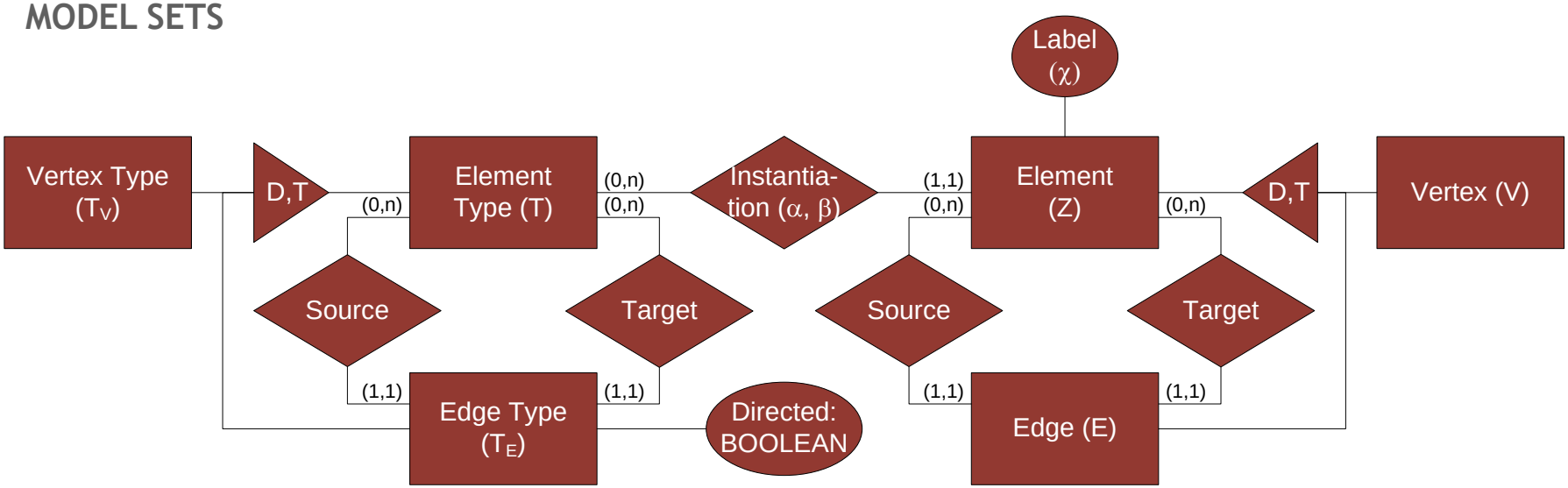
THE GENERIC MODEL QUERY LANGUAGE

BASIC IDEA

- Recognize any model as two basic sets
  - Set V of model vertices
  - Set E of model edges
- Provide set-altering functions and operators that perform operations on these basic sets
- Nest functions and operators to assemble a query

GMQL

MODEL SETS



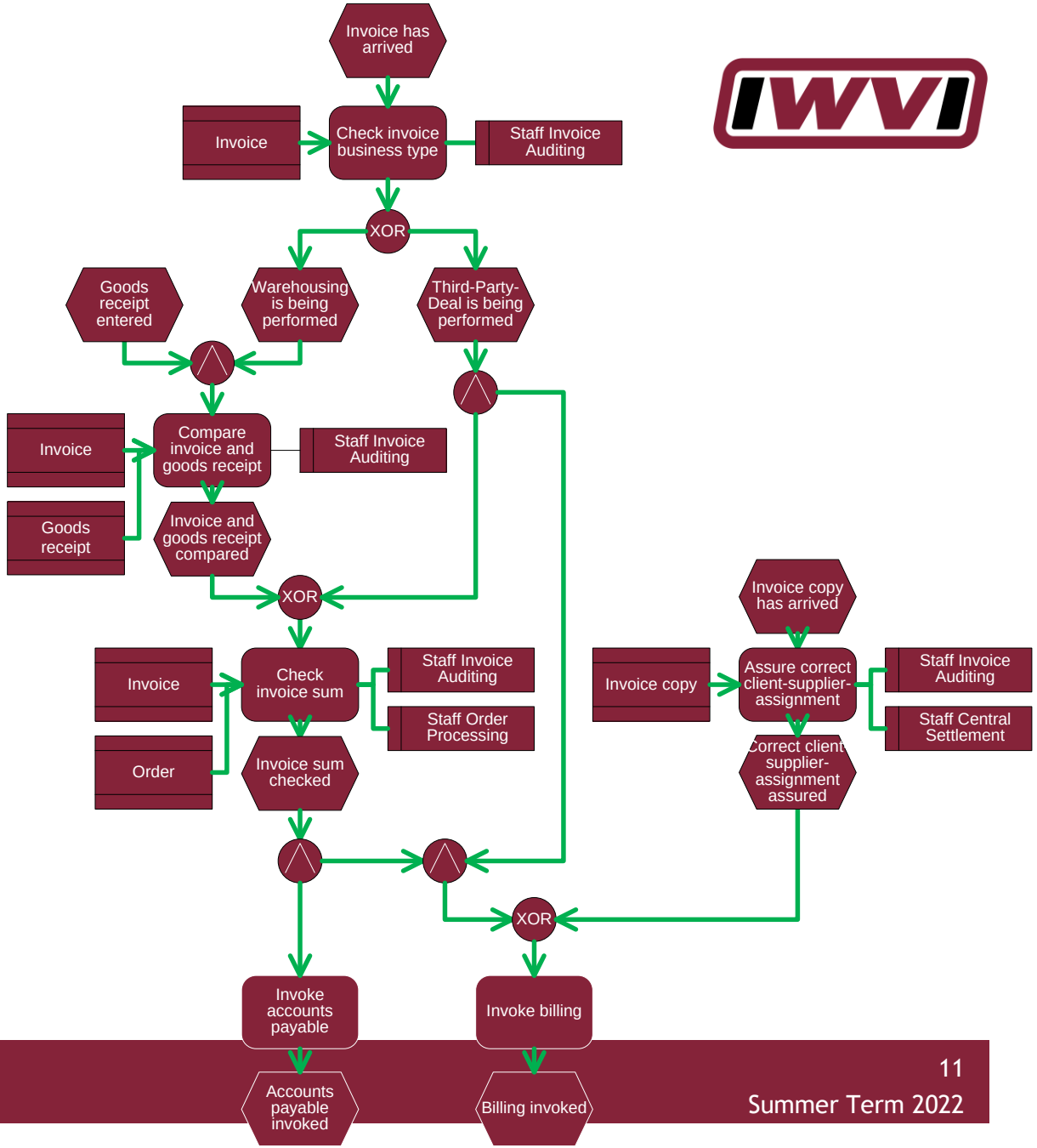
- Z: set of all elements available; $z \in Z$ is a particular element.
- V: set of all vertices available; $V \subseteq Z$; $v \in V$ is a particular vertex.
- E: set of all edges available; $E \subseteq Z$; $e \in E$ is a particular edge.
- T: set of all element types available; $t \in T$ is a particular element type.
- T_V: set of all vertex types available; $T_V \subseteq T$; $t_V \in T_V$ is a particular vertex type.
- T_E: set of all edge types available; $T_E \subseteq T$; $t_E \in T_E$ is a particular edge type.

GMQL

MODEL SETS EXAMPLES

- V
- E
- $Z=V \cup E$

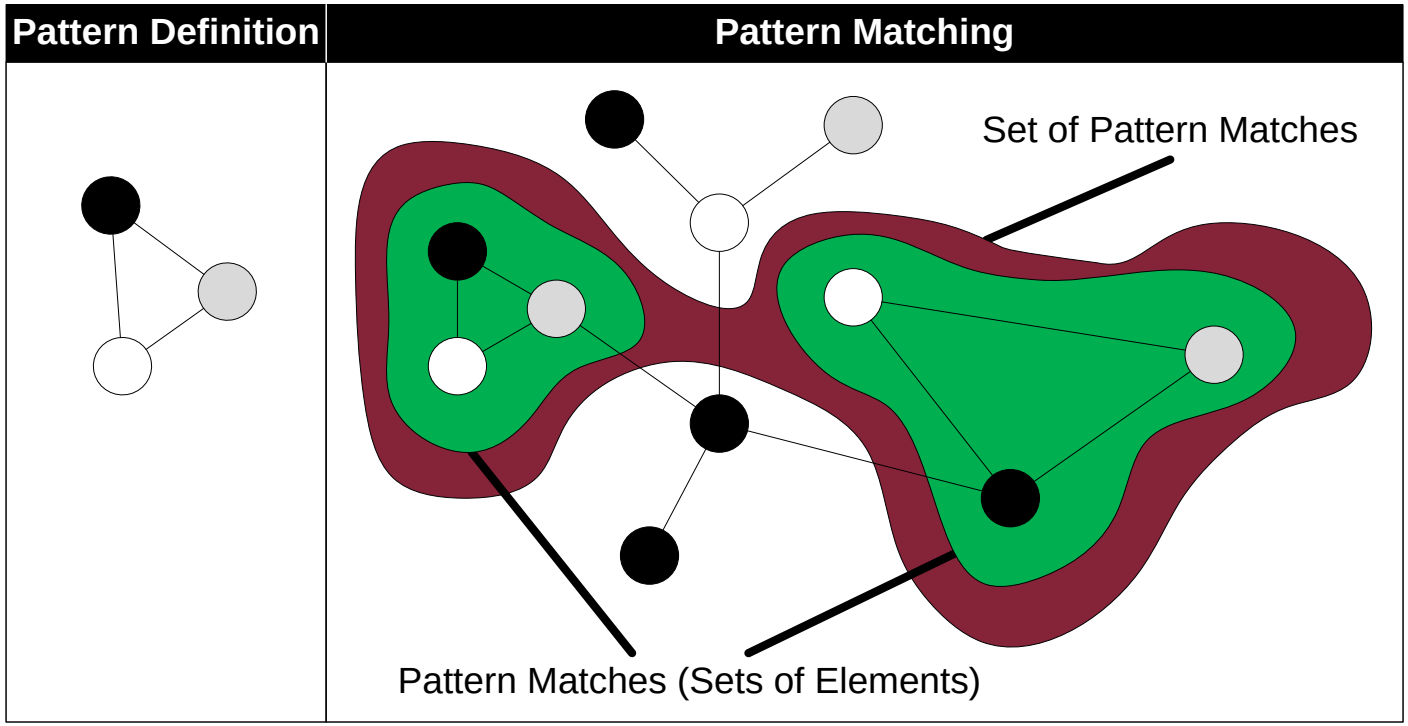
- T_V={event, function, xor, …}
- T_E={e_f, f_e, x_e, …}
- $T=T_V \cup T_E$



GMQL

QUERY PROCESS: PATTERN MATCHING

- The pattern matching process returns a set of sets which is a subset of the Power Set of Z: $P(Z)$



GMQL

SOME MORE SETS AND NUMBERS

- X_k: any set of elements with $X_k \subseteq Z$
- x_l: a distinct element with $x_l \in Z$
- Y_V: any set of vertices with $y_V \in Y_V \subseteq V$.
- Y_E: any set of edges with $y_E \in Y_E \subseteq E$.
- n_x: a natural number $n_x \in N$

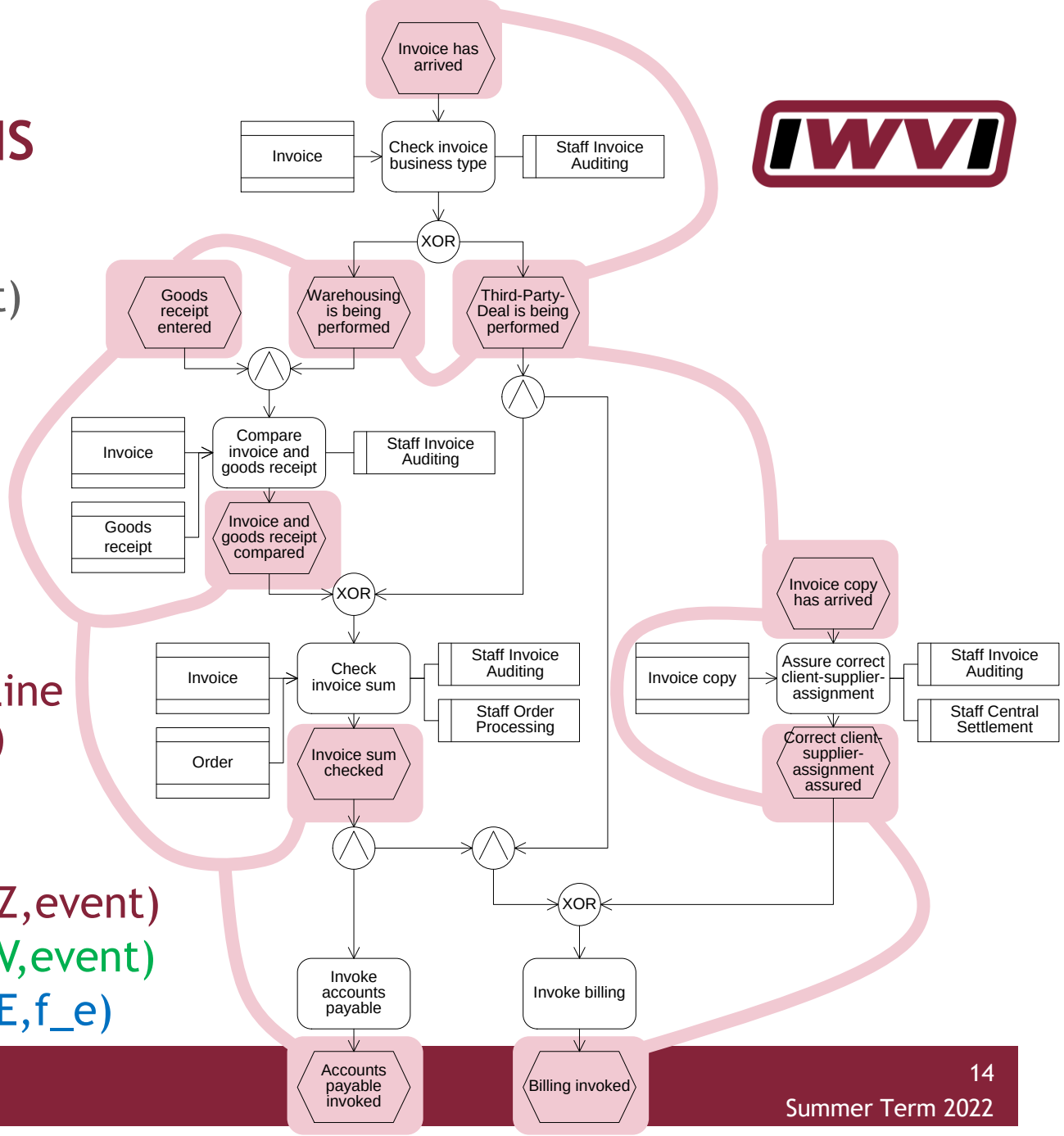
GMQL FUNCTIONS

EOT

- ElementsOfType(X,t)
  Returns a set containing all elements of *X* that belong to the given type

- Result: One simple set! (see single outline in the visulaization)

- Examples
  - ElementsOfType(Z,event)
  - ElementsOfType(V,event)
  - ElementsOfType(E,f_e)



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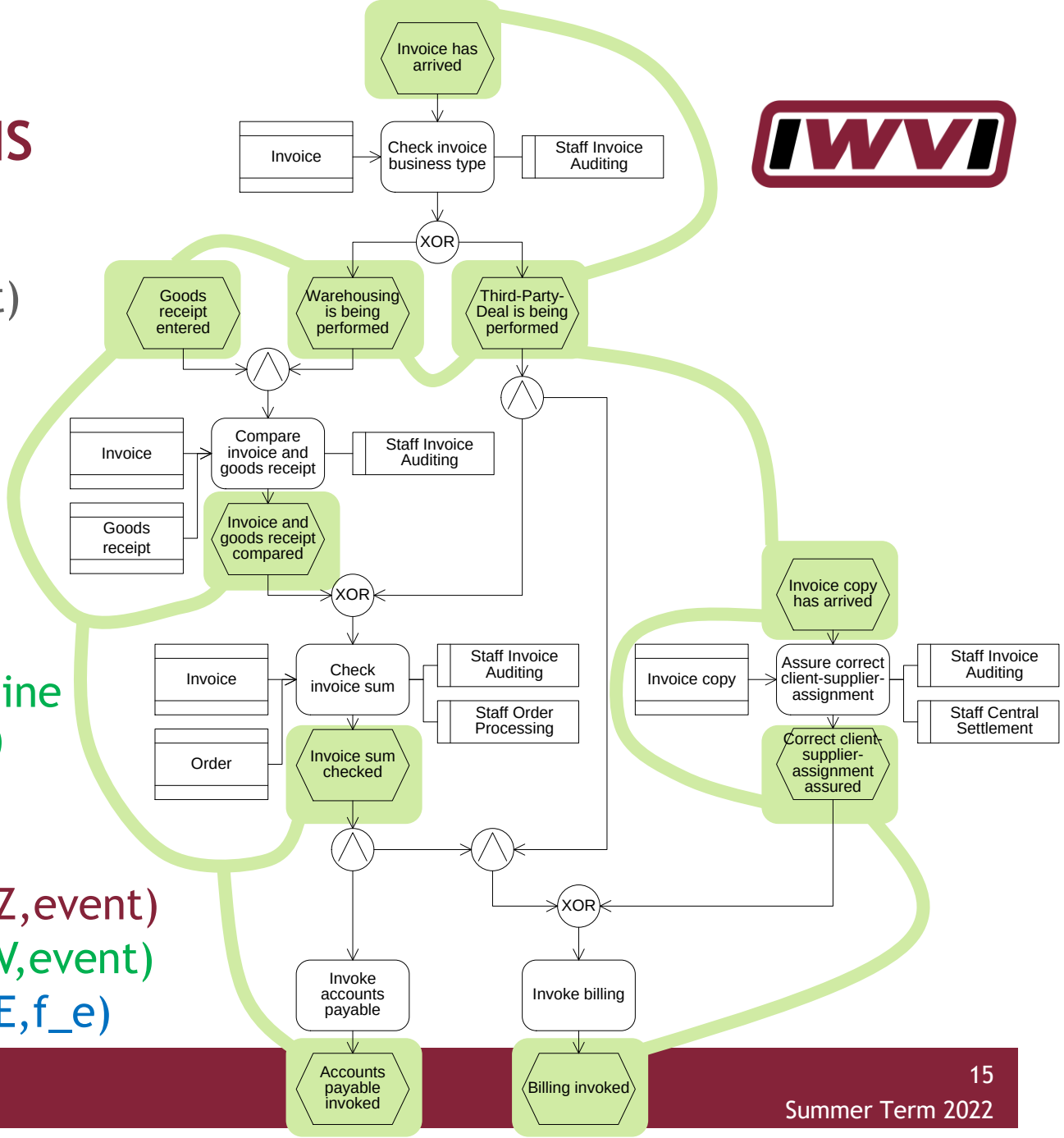

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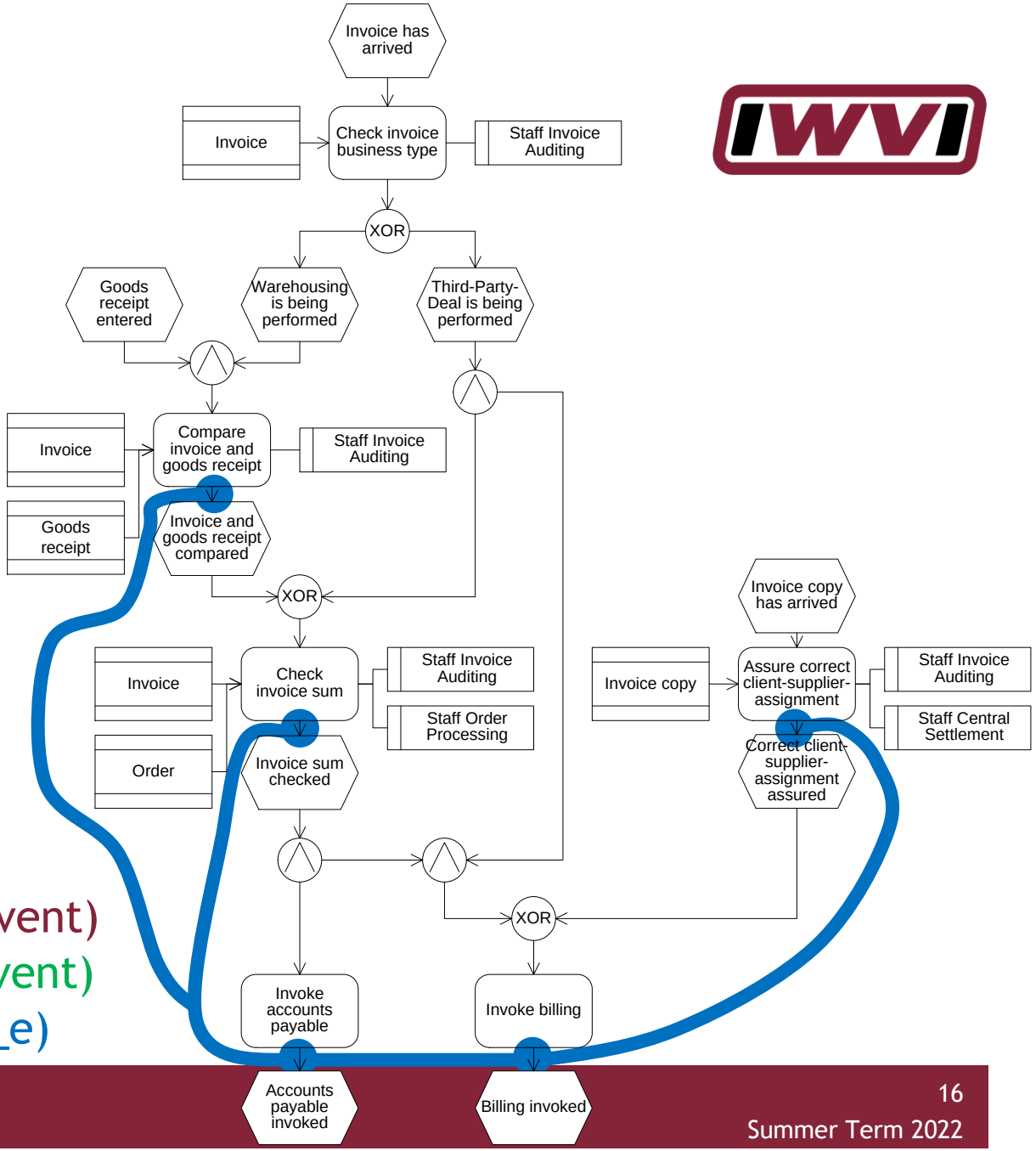
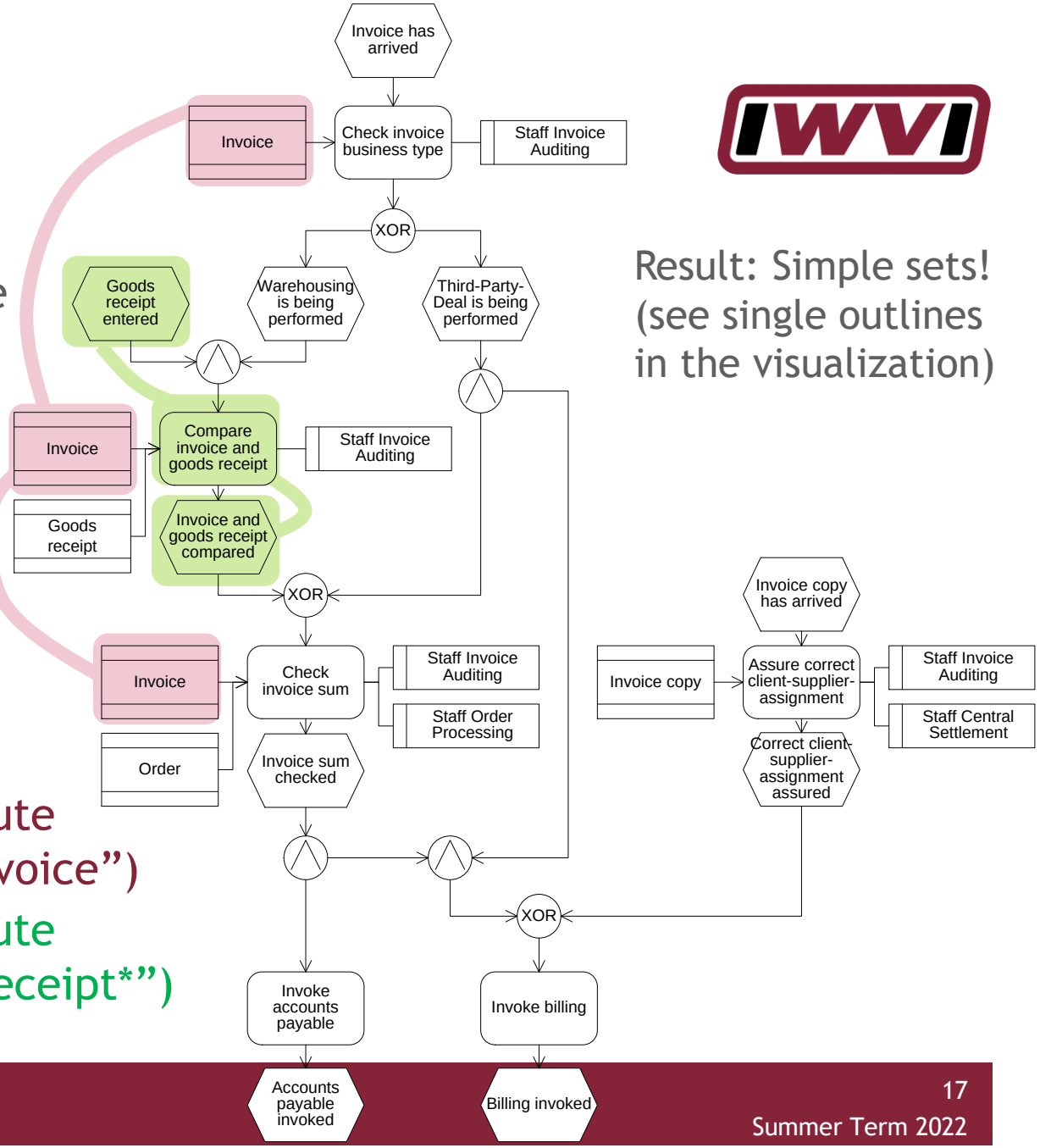


GMQL FUNCTIONS

EWAOV

- ElementsWithAttribute OfValue(X,t_V,u)
  Returns a set containing all elements of *X* having an attribute of type t_V that carries the value u

- Examples
  - ElementsWithAttribute OfValue (V,label,"Invoice")
  - ElementsWithAttribute OfValue (V,label,"*receipt*")



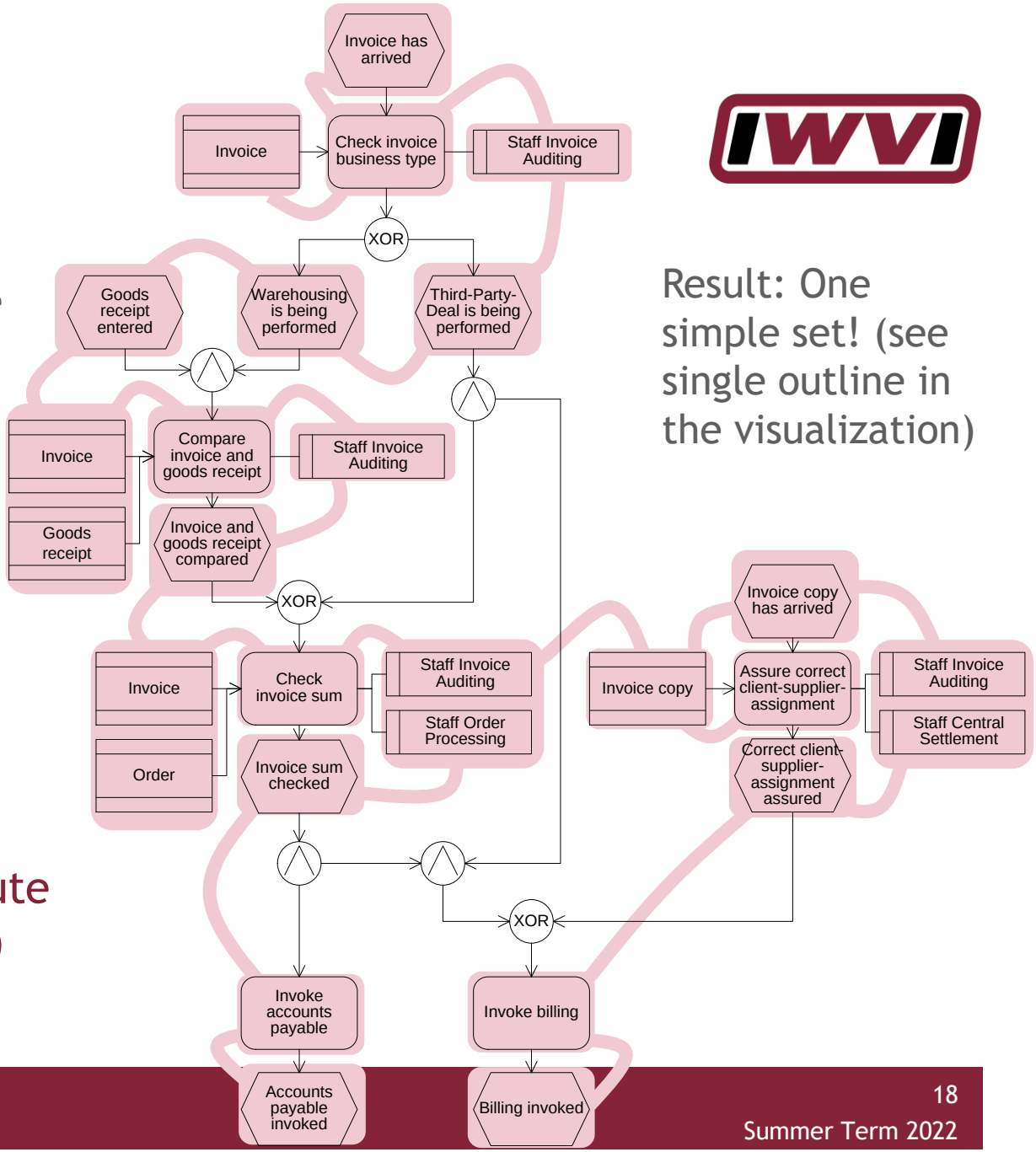
Result: Simple sets! (see single outlines in the visualization)

GMQL FUNCTIONS

EWAODT

- ElementsWithAttributeOfDataType(X,u)
  Returns a set containing all elements of *X* having an attribute that is of datatype u

- Example
  - ElementsWithAttributeOfDataType(V,string)



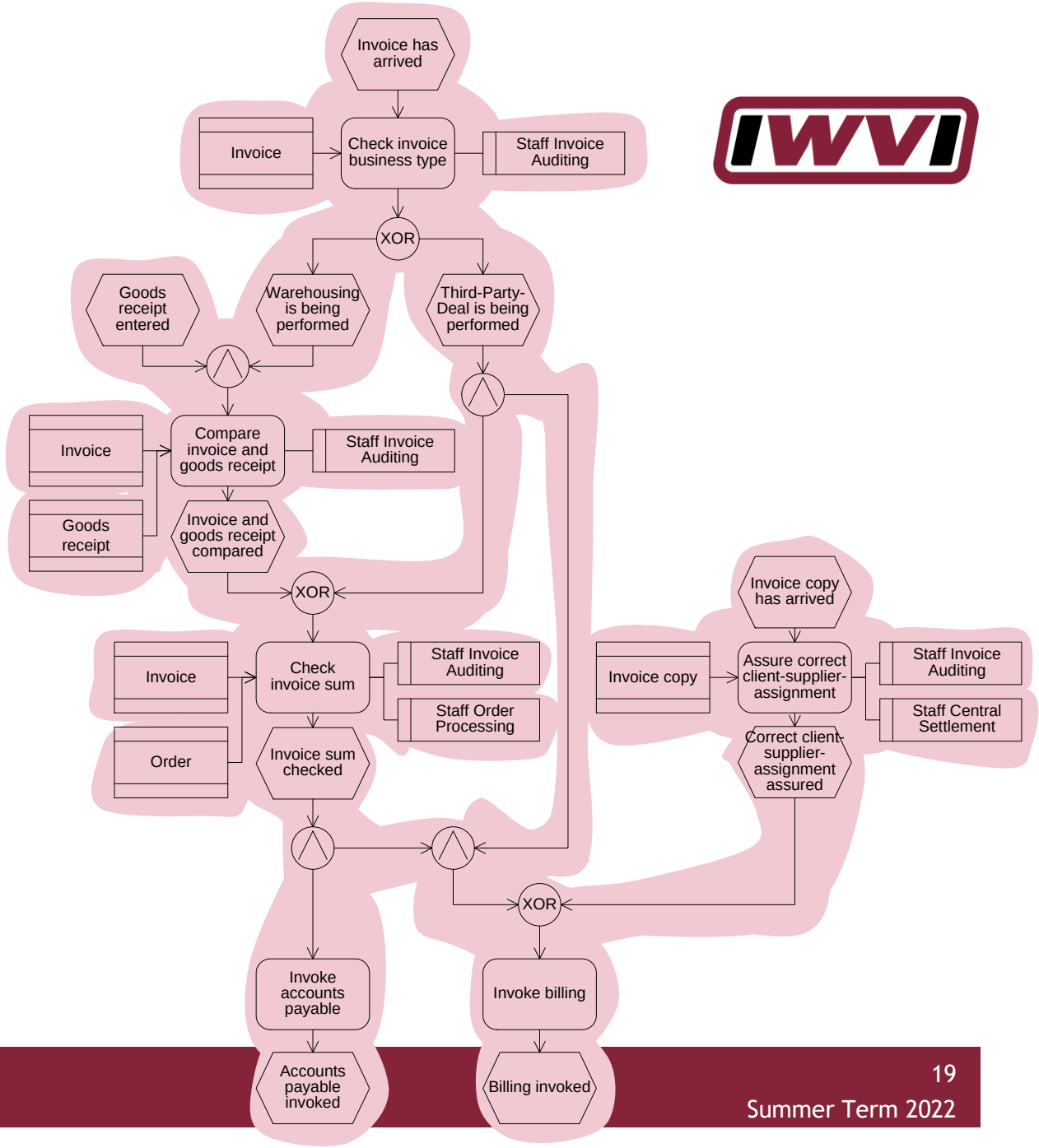
Result: One simple set! (see single outline in the visualization)

GMQL FUNCTIONS

EWR

- ElementsWith Relations(X, Y_E)
  Returns a set of sets. Each inner set contains an element of *X* and all its edges of Y_E.

- Examples
  - ElementsWith Relations(V,E)



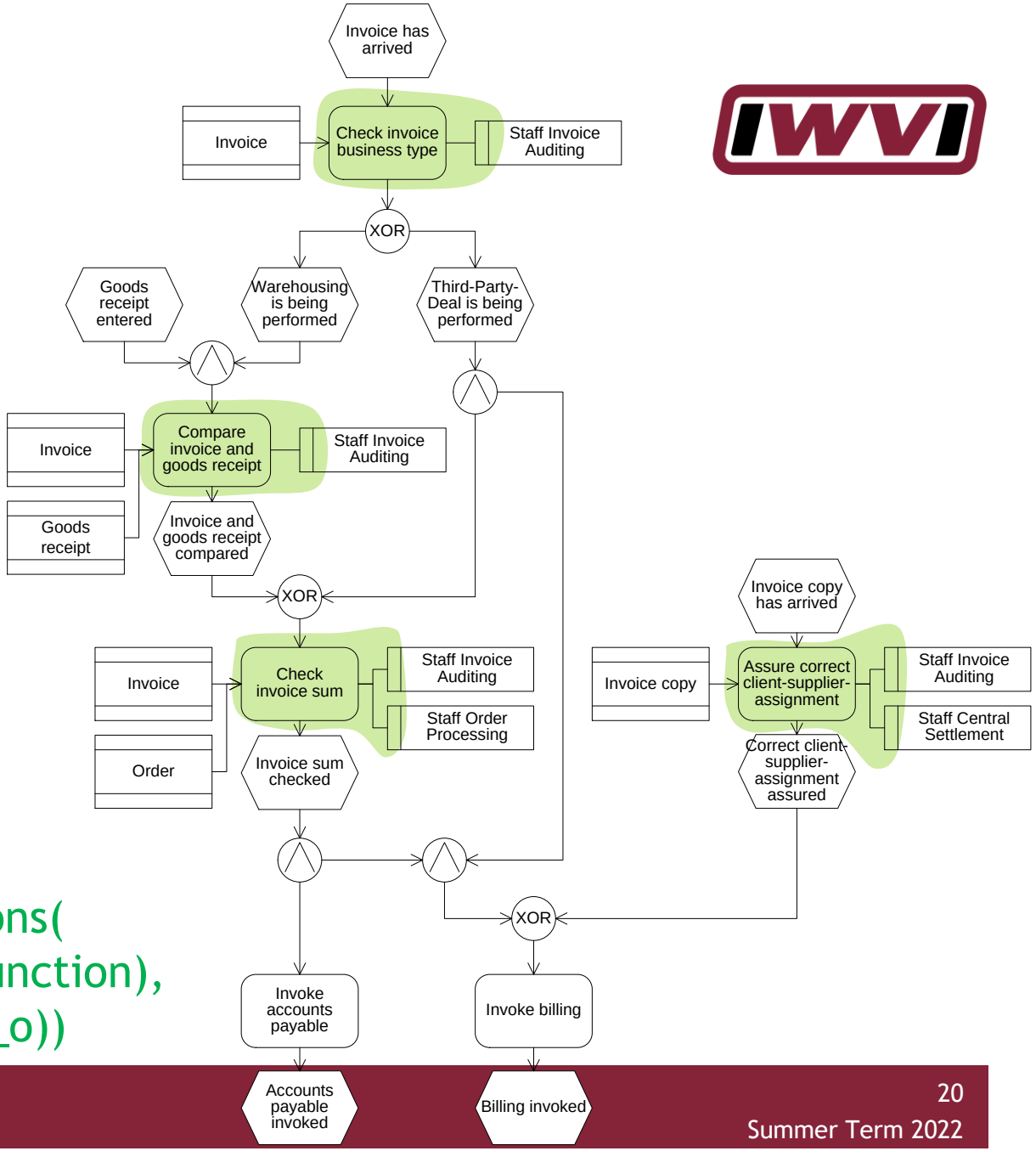
GMQL FUNCTIONS

EWR

- ElementsWithRelations(X,Y_E)
  Returns a set of sets. Each inner set contains an element of *X* and all its edges of Y_E.

- Examples

  - ElementsWithRelations(ElementsOfType(V,function), ElementsOfType(E,f_o))

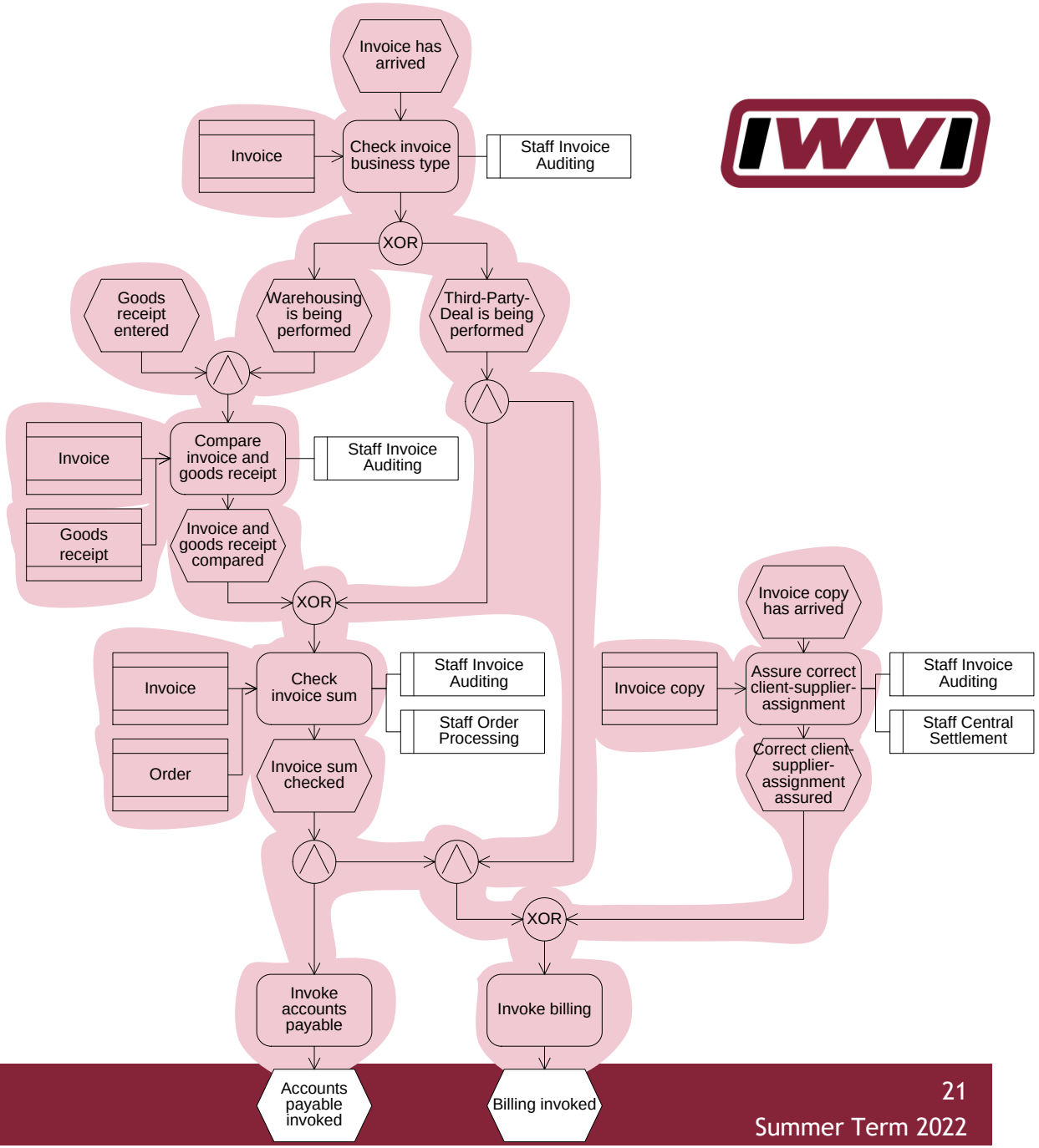


GMQL FUNCTIONS

EWSR

- *ElementsWithSuccRelations(X,Y_E)* Returns a set of sets. Each inner set contains an element of *X* an its outgoing edges of Y_E.

- Examples
  - ElementsWithSuccRelations(V,E)



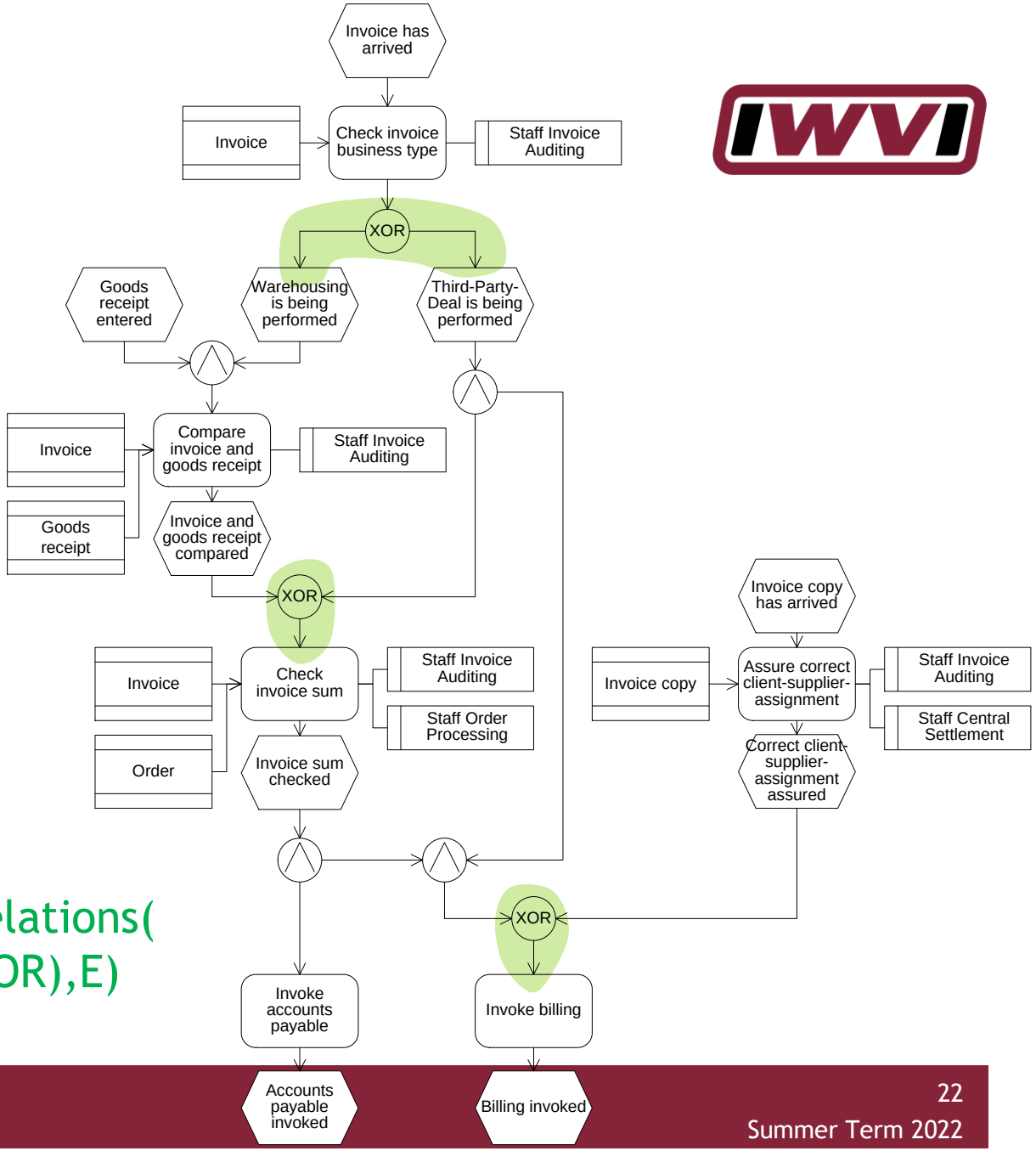
GMQL FUNCTIONS

EWSR

- *ElementsWithSuccRelations(X,Y_E)* Returns a set of sets. Each inner set contains an element of *X* an its outgoing edges of Y_E.

- Examples

  - ElementsWithSuccRelations(ElementsOfType(V,XOR),E)

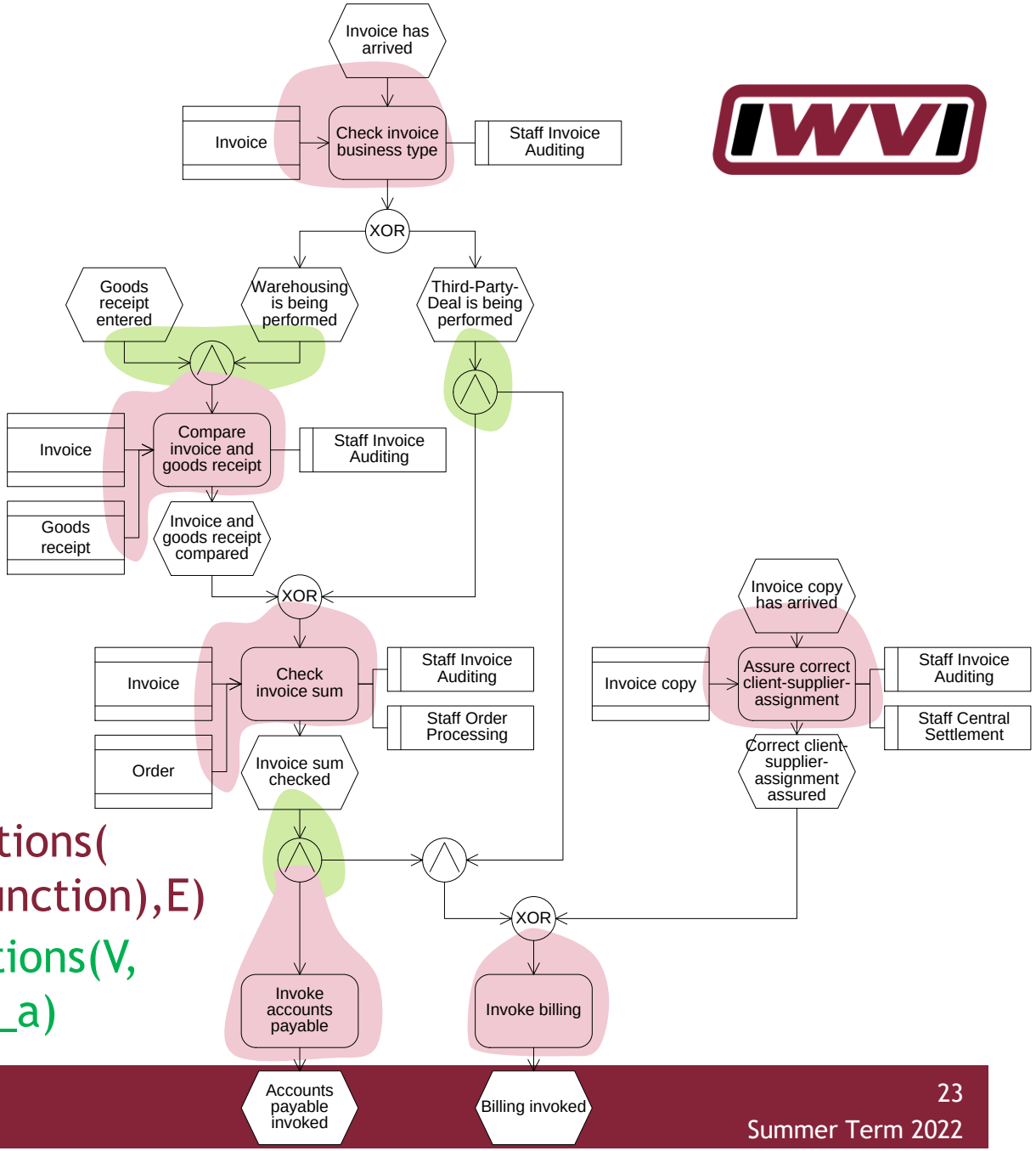


GMQL FUNCTIONS

EWPR

- ElementsWithPredRelations(X,Y_E)
  Returns a set of sets. Each inner set contains an element of X and its incoming edges of Y_E.

- Examples
  - ElementsOfPredRelations(ElementsOfType(V,function),E)
  - ElementsofPredRelations(V, ElementsOfType(E,e_a)

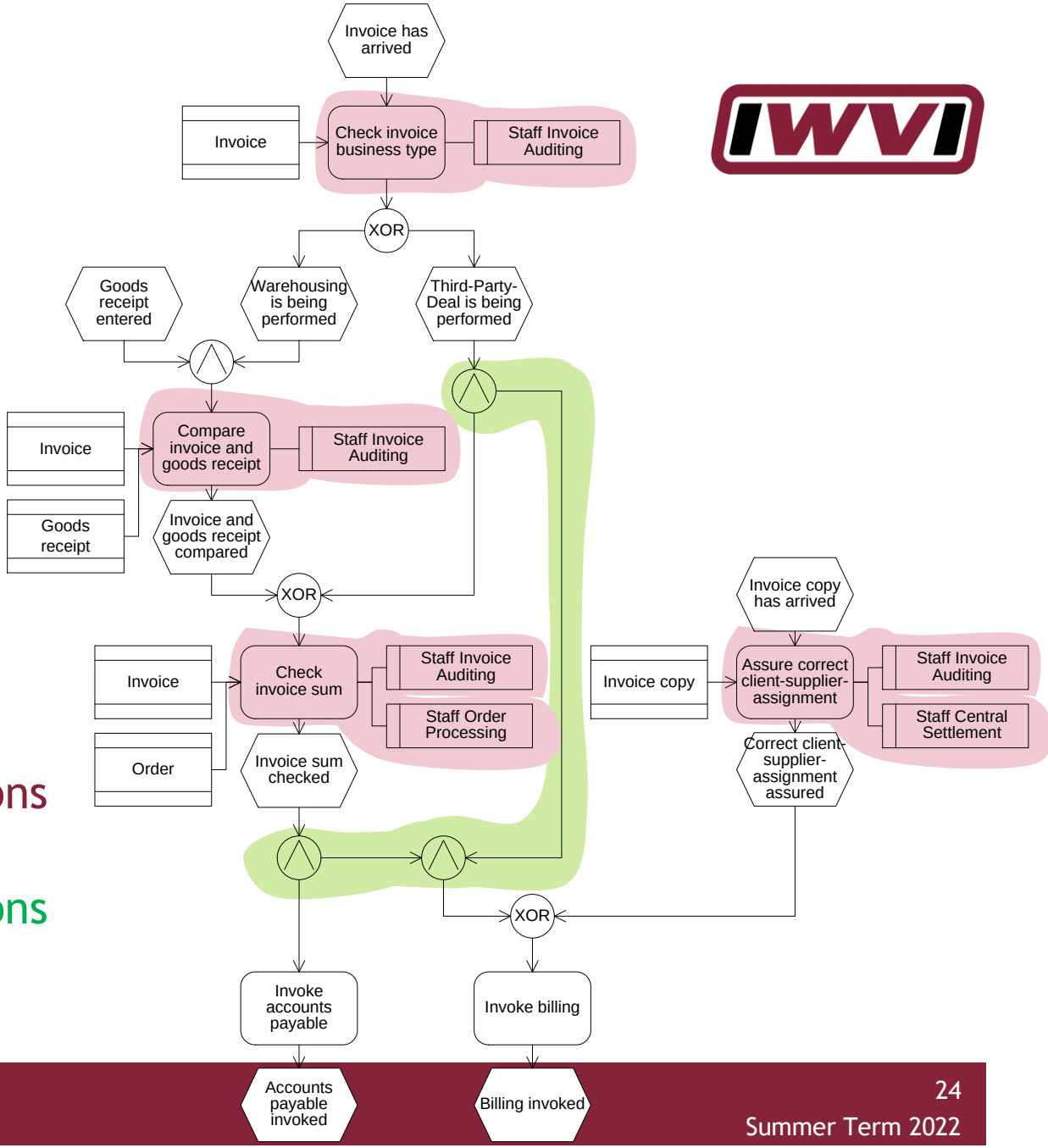


GMQL FUNCTIONS

EWROT

- ElementsWithRelations OfType(X,Y_E,t_E)
  Returns a set of sets. Each inner set contains an element of X and its edges of Y_E that are of type t_E.

- Examples
  - ElementsWithRelations OfType(V,E,f_o)
  - ElementsWithRelations OfType(V,E,a_a)

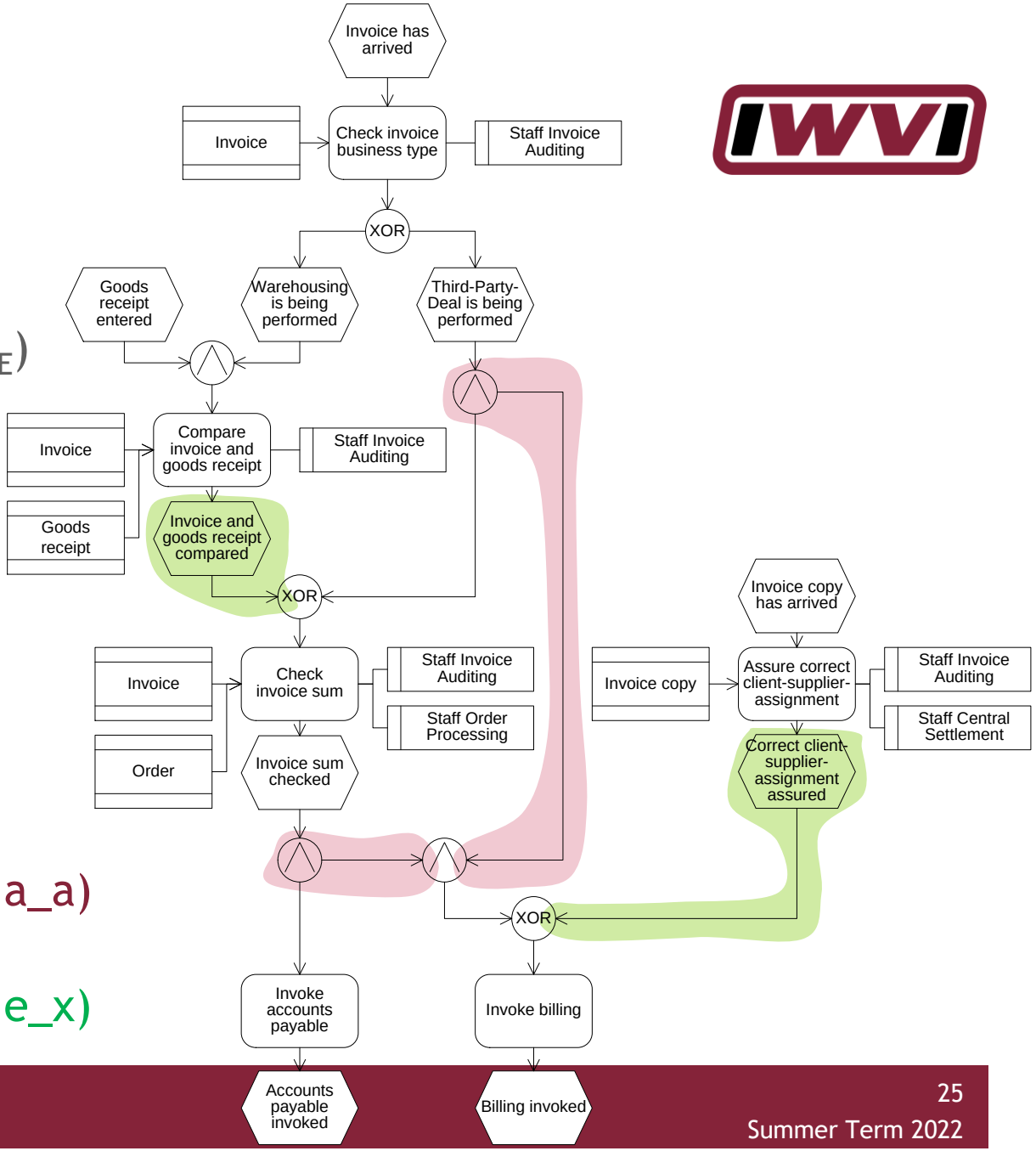


GMQL FUNCTIONS

EWSROT

- ElementsWithSucc RelationsOfType(X,Y_E,t_E)
  Returns a set of sets. Each inner set contains an element of *X* and its outgoing edges of Y_E that are of type t_E.

- Examples
  - ElementsWithSucc RelationsOfType(V,E,a_a)
  - ElementsWithSucc RelationsOfType(V,E,e_x)

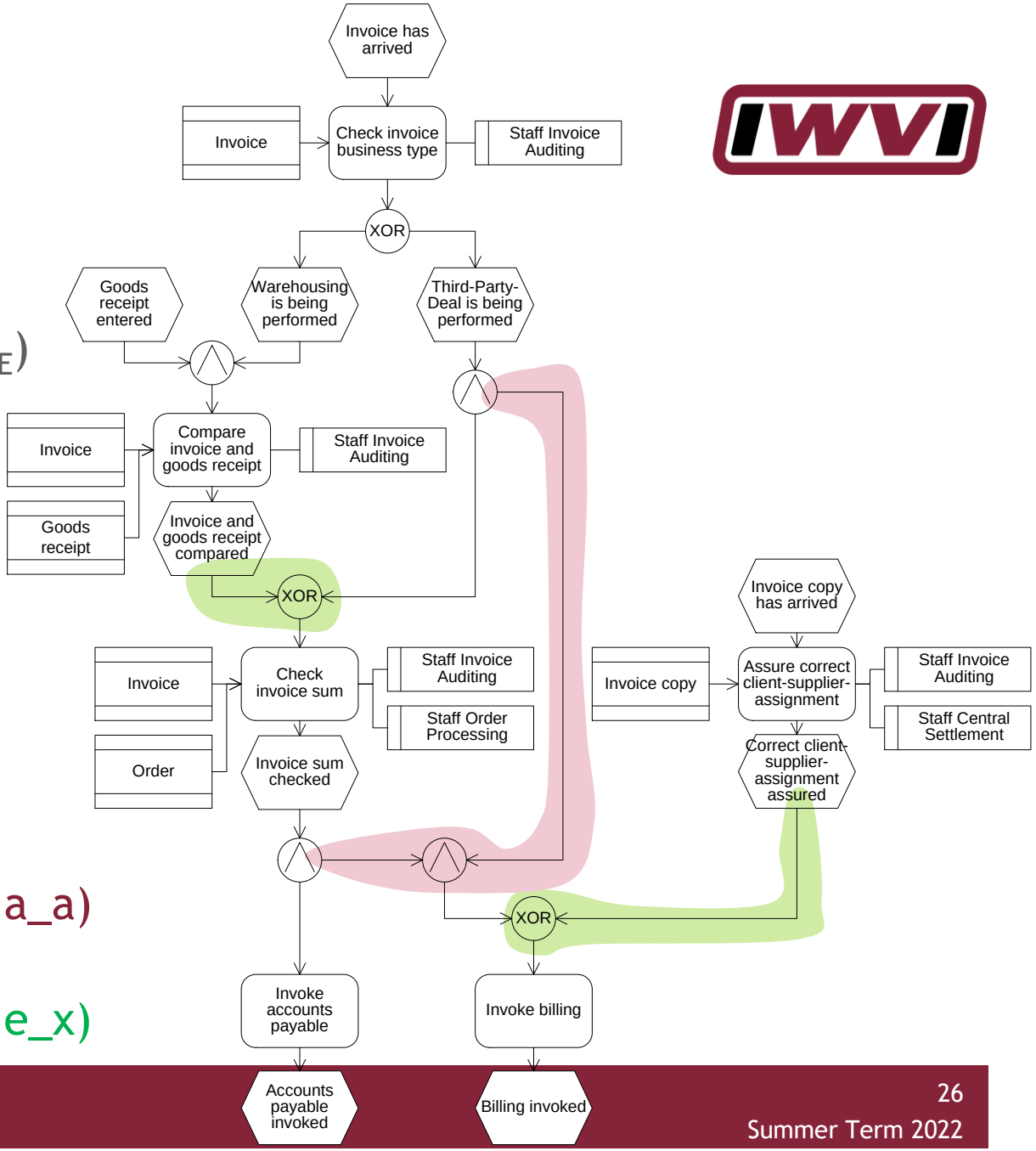


GMQL FUNCTIONS

EWPROT

- ElementsWithPred RelationsOfType(X,Y_E,t_E)
  Returns a set of sets. Each inner set contains an element of *X* and its ingoing edges of Y_E that are of type t_E.

- Examples
  - ElementsWithPred RelationsOfType(V,E,a_a)
  - ElementsWithPred RelationsOfType(V,E,e_x)

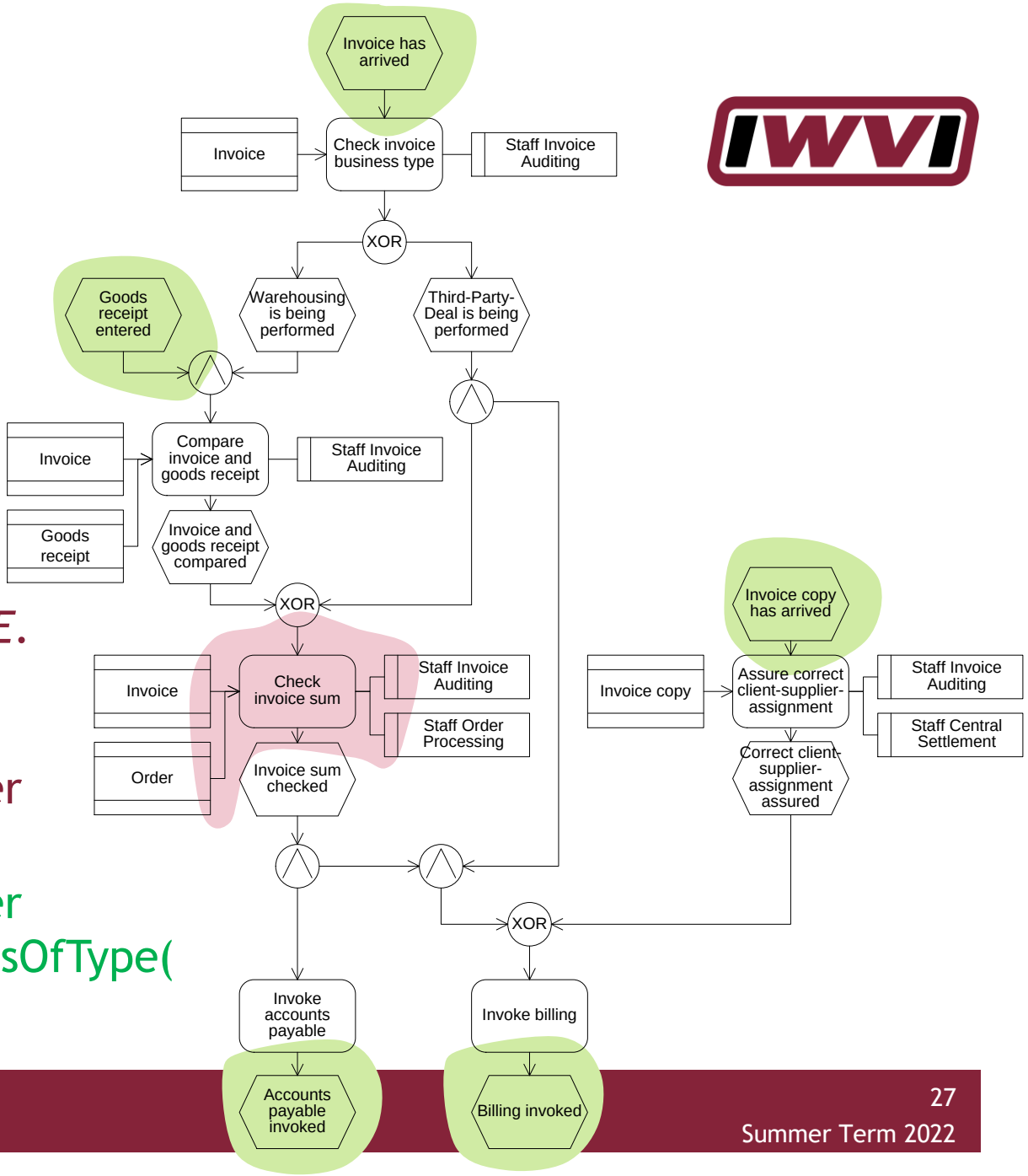


GMQL FUNCTIONS

EWNOR

- ElementsWithNumberOfRelations(X,n_x)
  Returns a set of sets. Each inner set contains an element of *X* and its edges, if it is related to n_x edges of *E*.

- Examples
  - ElementsWithNumberOfRelations(V,6)
  - ElementsWithNumberOfRelations(ElementsOfType(V,event),1)

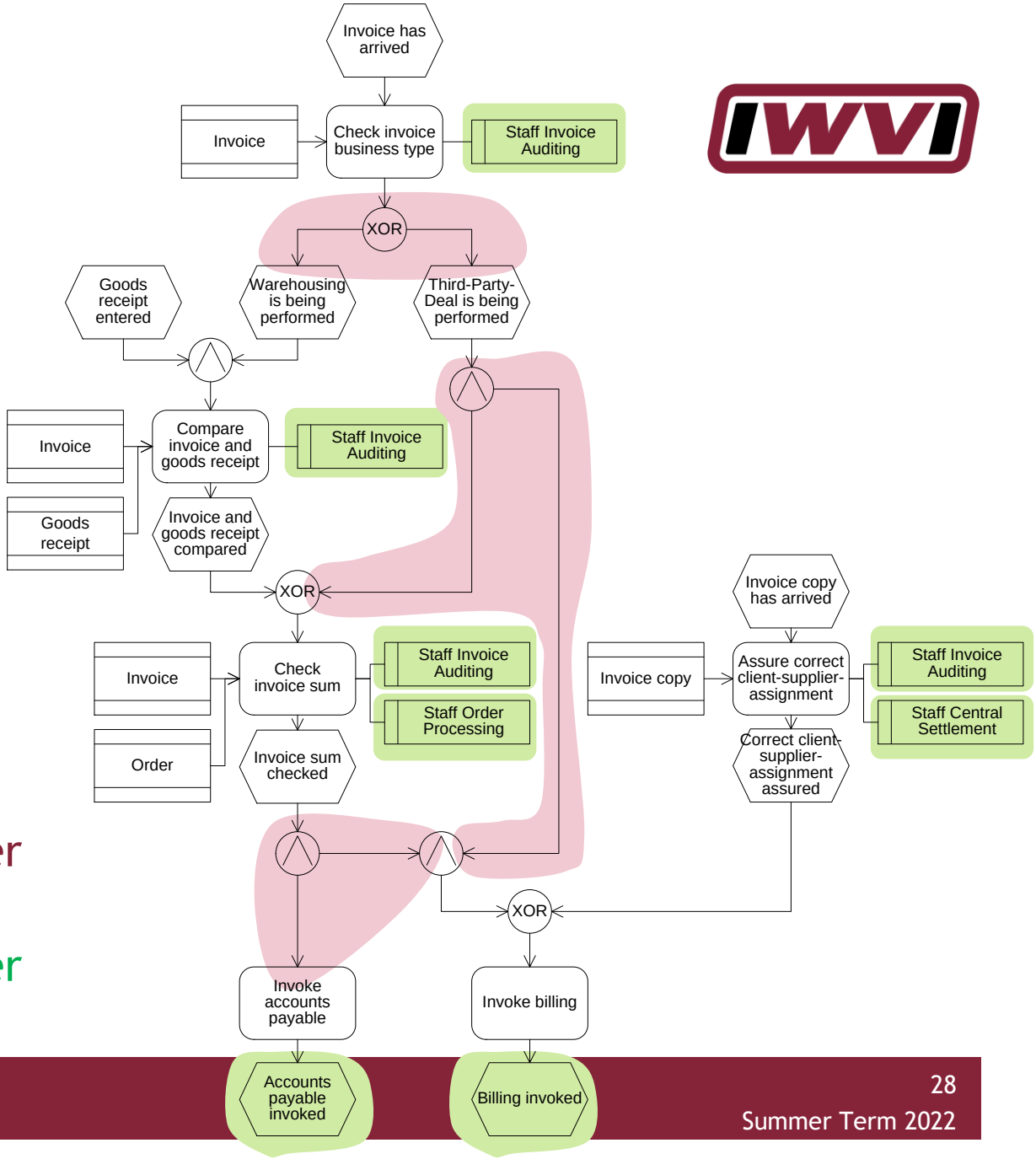


GMQL FUNCTIONS

EWNOSR

- ElementsWithNumberOfSuccRelations(X,n_x) Returns a set of sets. Each inner set contains an element of *X* and its edges, if it is related to n_x outgoing edges of *E*.

- Examples
  - ElementsWithNumberOfSuccRelations(V,2)
  - ElementsWithNumberOfSuccRelations(V,0)

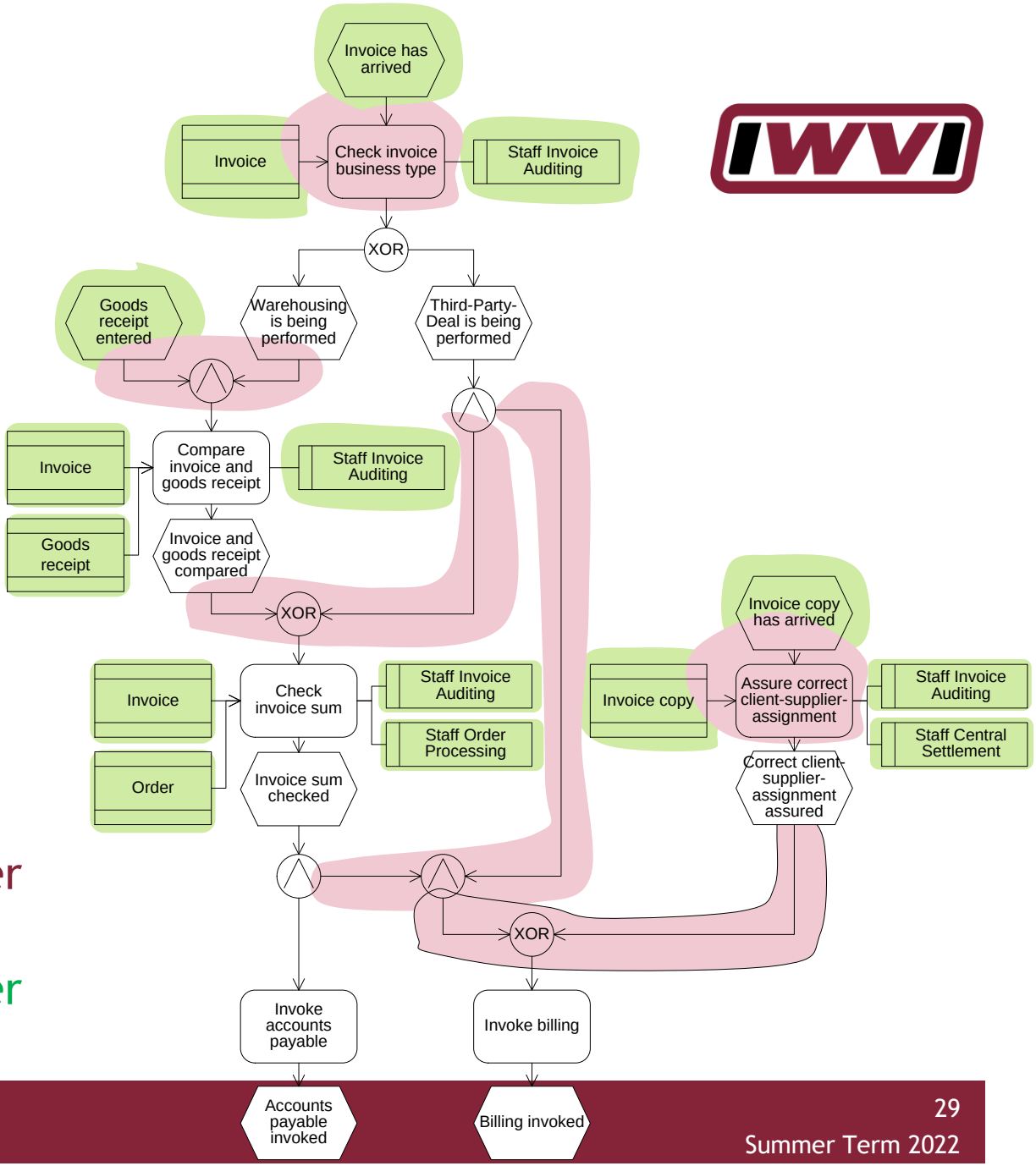


GMQL FUNCTIONS

EWNOPR

- ElementsWithNumberOfPredRelations(X,n_x) Returns a set of sets. Each inner set contains an element of *X* and its edges, if it is related to n_x incoming edges of *E*.

- Examples
  - ElementsWithNumberOfPredRelations(V,2)
  - ElementsWithNumberOfPredRelations(V,0)

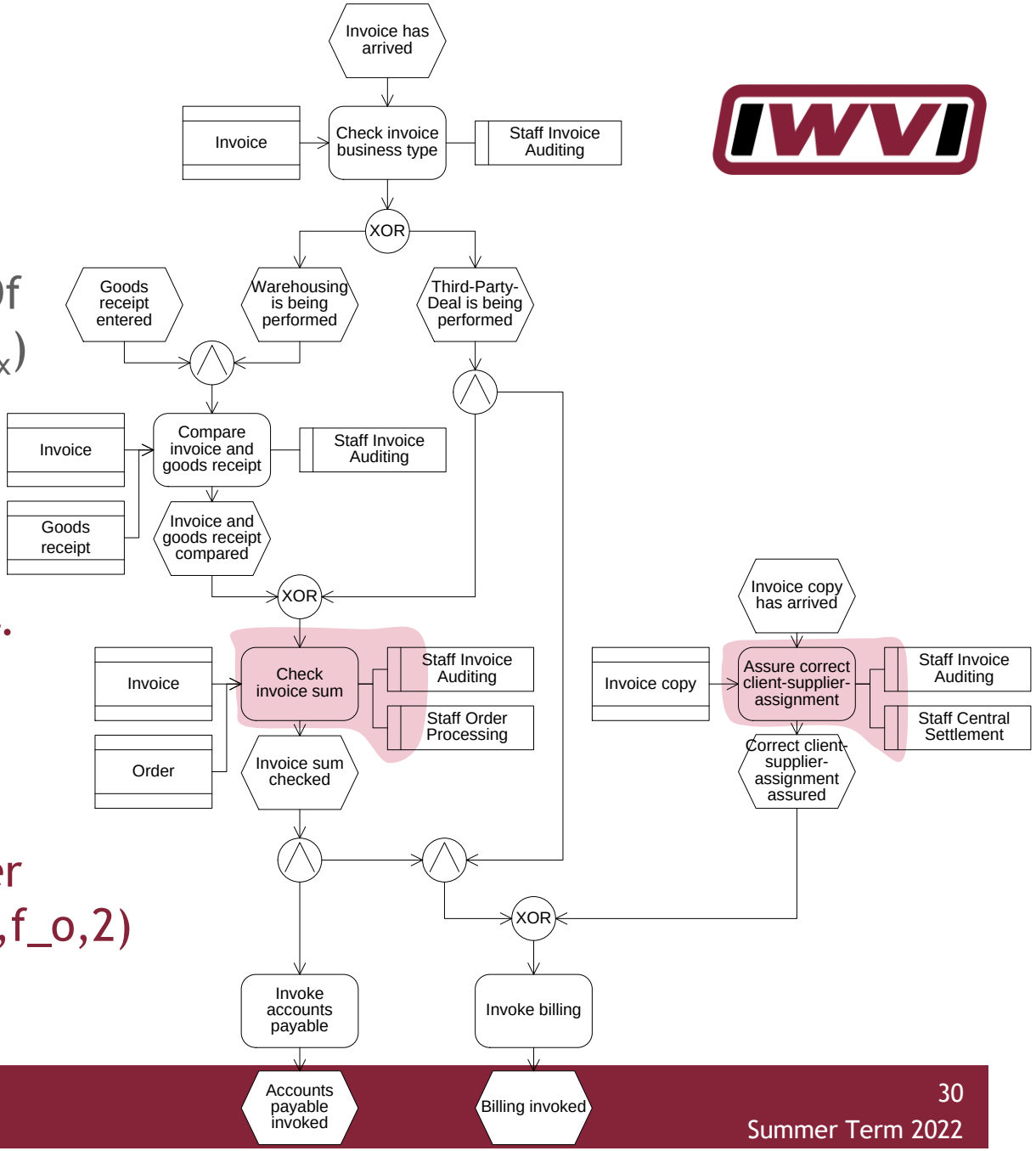


GMQL FUNCTIONS

EWNOROT

- ElementsWithNumberOf RelationsOfType(X,t_E,n_x)
  Returns a set of sets. Each inner set contains an element of *X* and its n_x edges of *E* that are of type t_E.

- Example
  - ElementsWithNumber OfRelationsOfType(V,f_o,2)

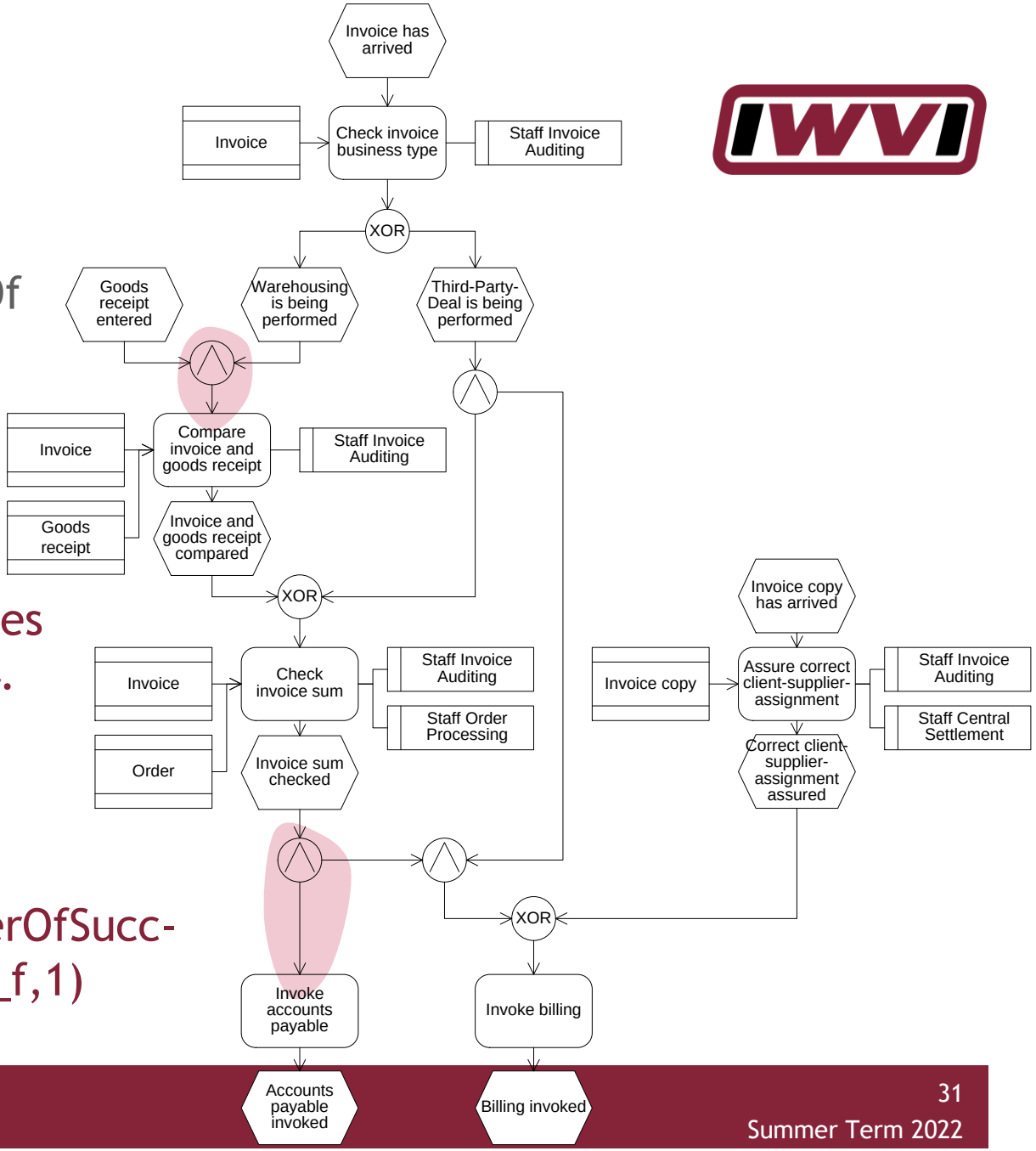


GMQL FUNCTIONS

EWNOSROT

- ElementsWithNumberOf SuccRelations OfType(X,t_E,n_x)
  Returns a set of sets. Each inner set contains an element of *X* and its n_x outgoing edges of *E* that are of type t_E.

- Example
  - ElementsWithNumberOfSucc-RelationsOfType(V,a_f,1)



GMQL FUNCTIONS

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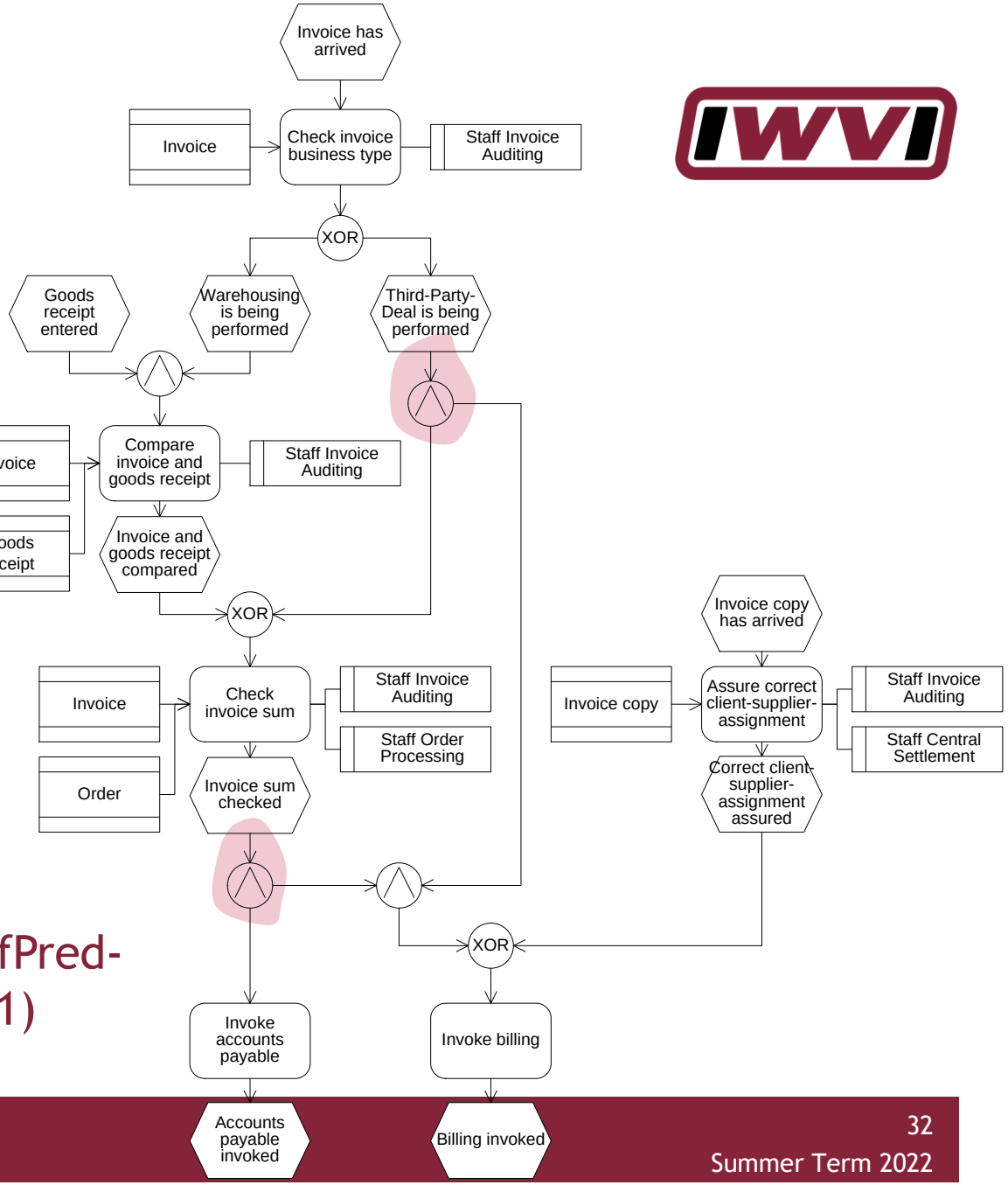
- Example
  - ElementsWithNumberOfPred-RelationsOfType(V,e_a,1)



VARIABLES

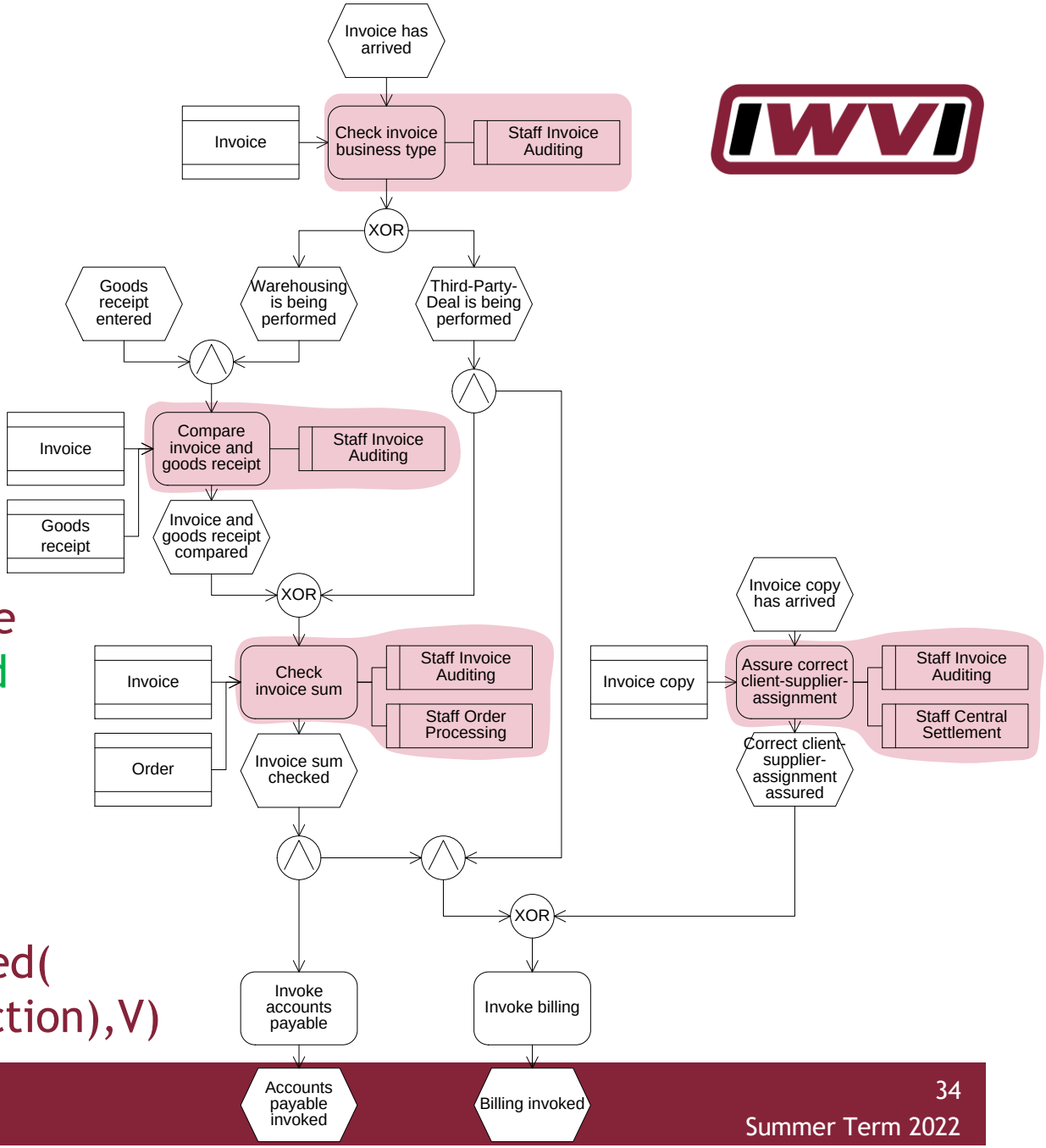
- All functions that take non-set parameters as input also accept variables for these parameters
- Variables can thus replace a number, type, attribute, value, or data type parameter
- Variables can be combined to equations (see examples below)

GMQL FUNCTIONS

EDR

- ElementsDirectly Related(X_1,X_2)
  Returns a set of sets. Each inner set contains an element of X_1, its adjacent elements of X_2, and the connecting, undirected edges of E.

- Example
  ElementsDirectlyRelated(ElementsOfType(V,function),V)

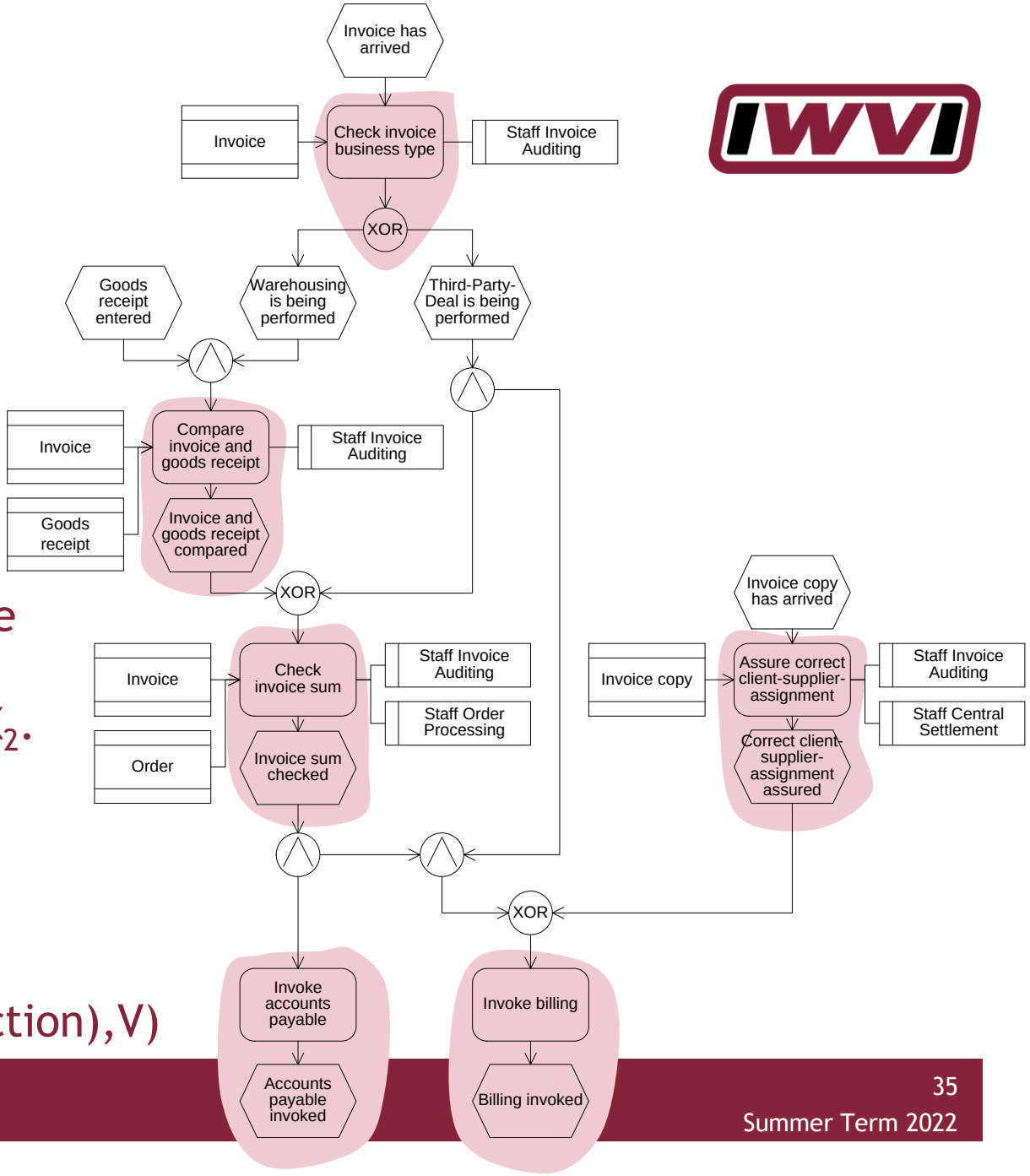


GMQL FUNCTIONS

AS

- Adjacent Successors(X_1,X_2)
  Returns a set of sets. Each inner set contains an element of X_1, its adjacent elements of X_2, and the connecting, directed edges of E from X_1 to X_2.

- Example
  AdjacentSuccessors(ElementsOfType(V,function),V)

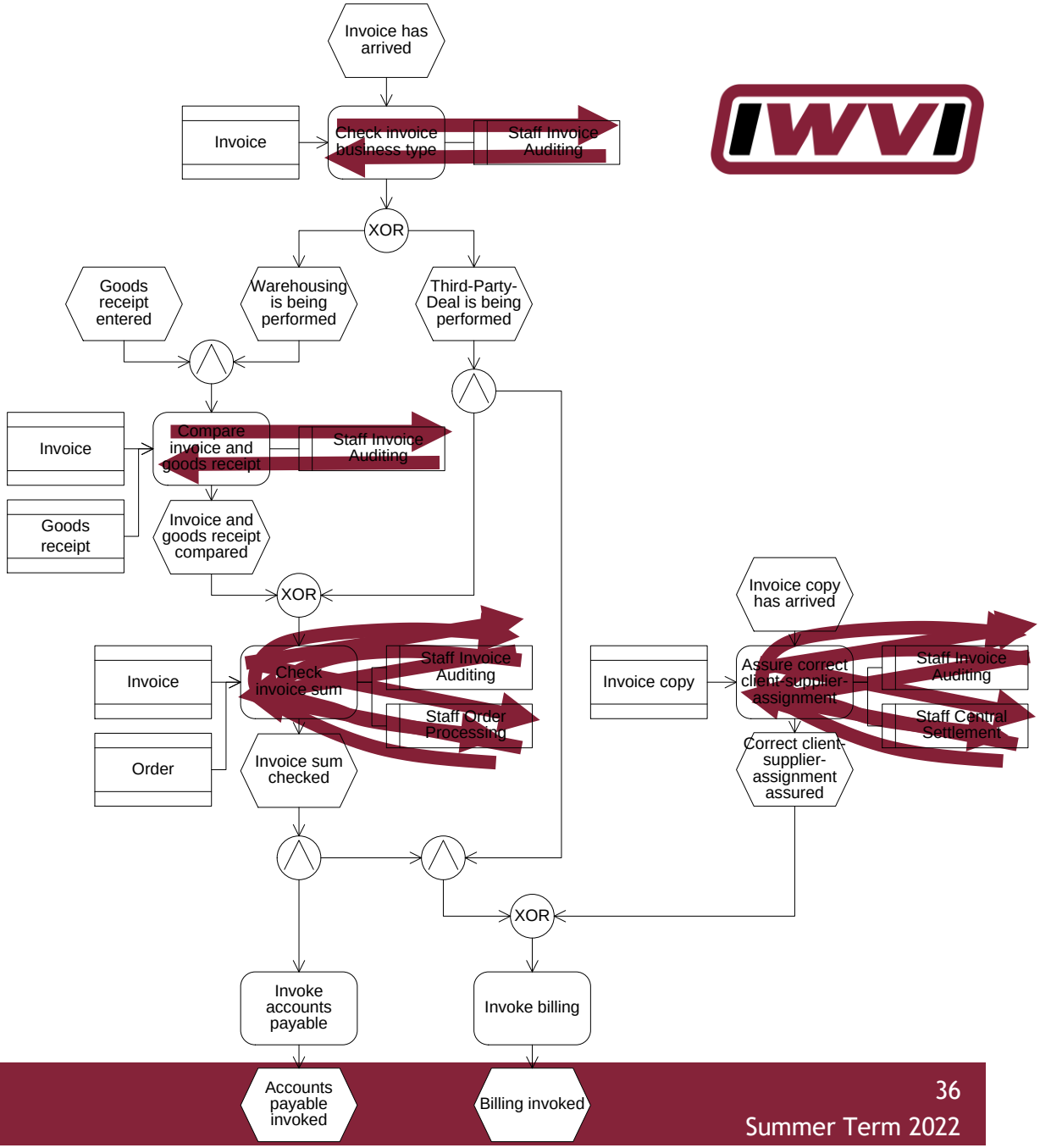


GMQL FUNCTIONS

P

- Paths(X_1,X_n)
  Returns a set of sets. Each inner set contains an undirected sequence, which leads from one element of X_1 to one element of X_n.

- Examples
  - Paths(V,V)

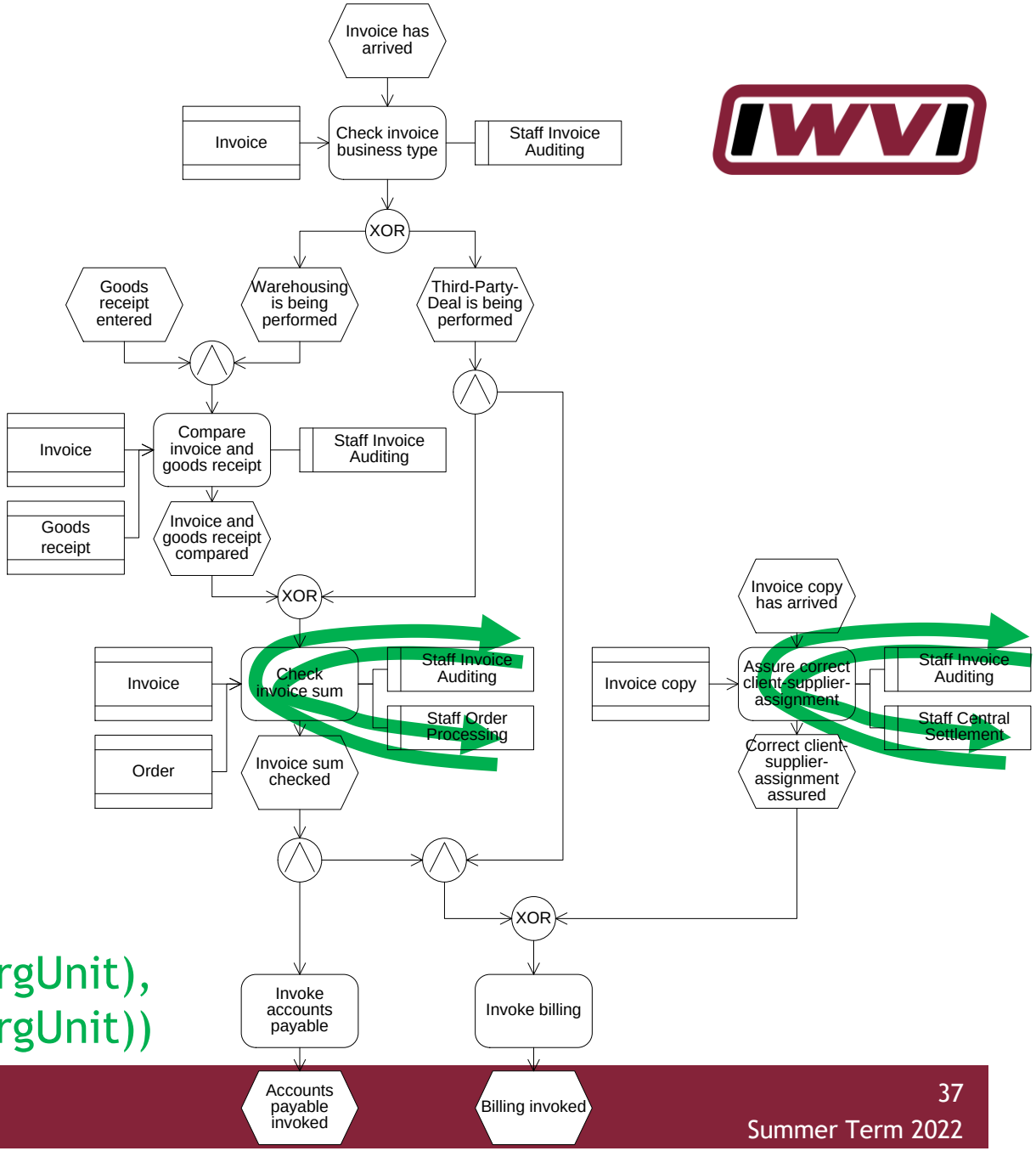


GMQL FUNCTIONS

P

- Paths(X_1,X_n)
  Returns a set of sets. Each inner set contains an undirected sequence, which leads from one element of X_1 to one element of X_n.

- Examples
  - Paths(ElementsOfType(V,OrgUnit), ElementsOfType(V,OrgUnit))

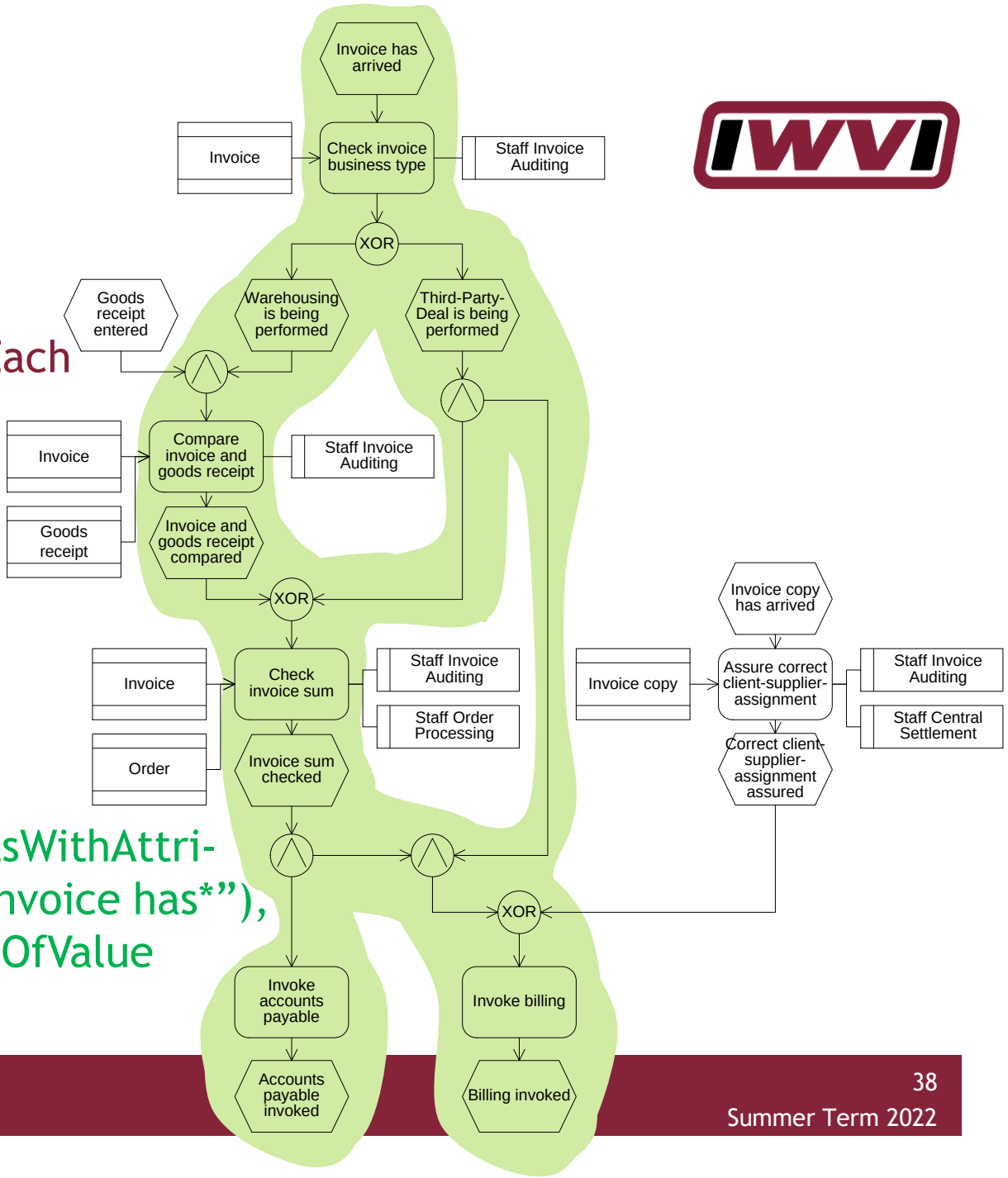


GMQL FUNCTIONS

DP

- DirectedPaths(X_1,X_n)
  Returns a set of sets. Each inner set contains a directed sequence of the same direction, which leads from one element of X_1 to one element of X_n.

- Example
  DirectedPaths(ElementsWithAttri-buteOfValue(V,label,"Invoice has*"), ElementsWithAttributeOfValue (V,label,"*invoked"))

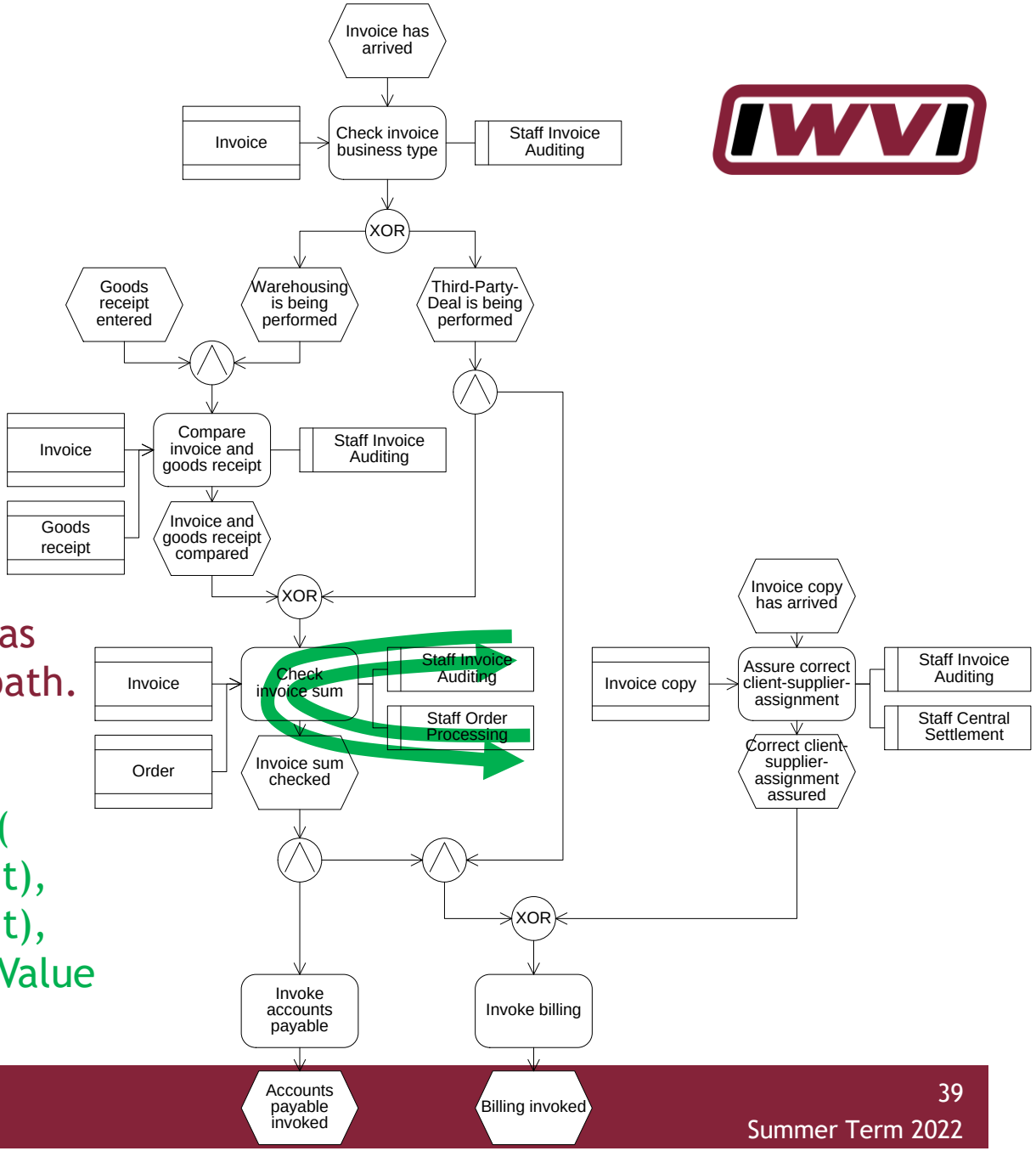


GMQL FUNCTIONS

PCE

- PathsContaining Elements(X_1,X_n,X_c)
  Returns a set of sets. Each inner set contains one undirected path from one element of X_1 to one element of X_n. At least one element of X_c has to be contained on that path.

- Example
  PathsContainingElements(ElementsOfType(V,OrgUnit), ElementsOfType(V,OrgUnit), ElementsWithAttributeOfValue (V,label,"*invoice*"))

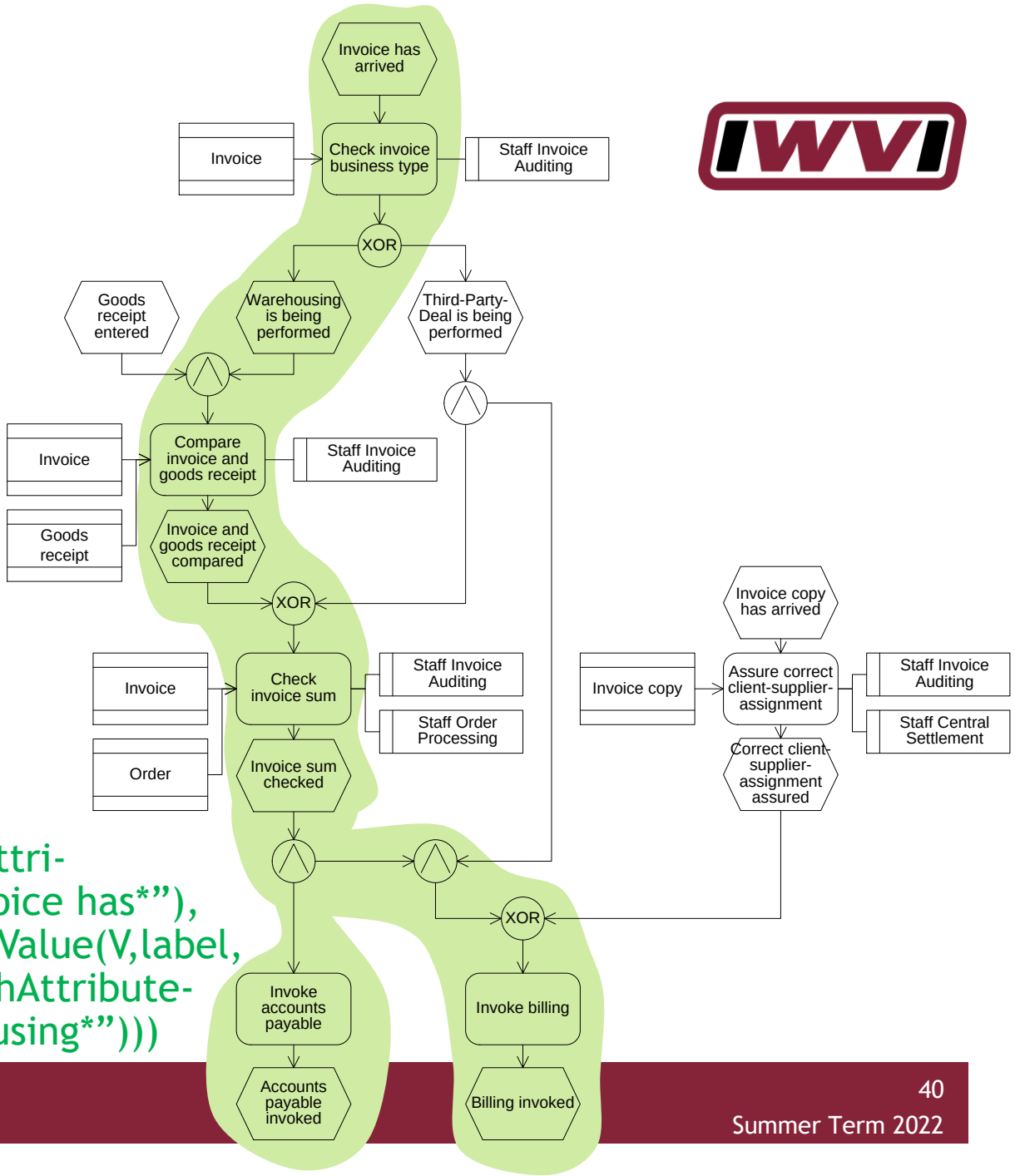


GMQL FUNCTIONS

DPCE

- DirectedPathsContaining Elements(X_1,X_n,X_c)
  Returns a set of sets. Each inner set contains one directed path from one element of X_1 to one element of X_n. At least one element of X_c has to be contained on that path.

- Example
  DirectedPathsContaining-Elements(ElementsWithAttri-buteOfValue(V,label,"Invoice has*"), ElementsWithAttributeOfValue(V,label, "*invoked"),ElementsWithAttribute-OfValue(V,label,"Warehousing*")))

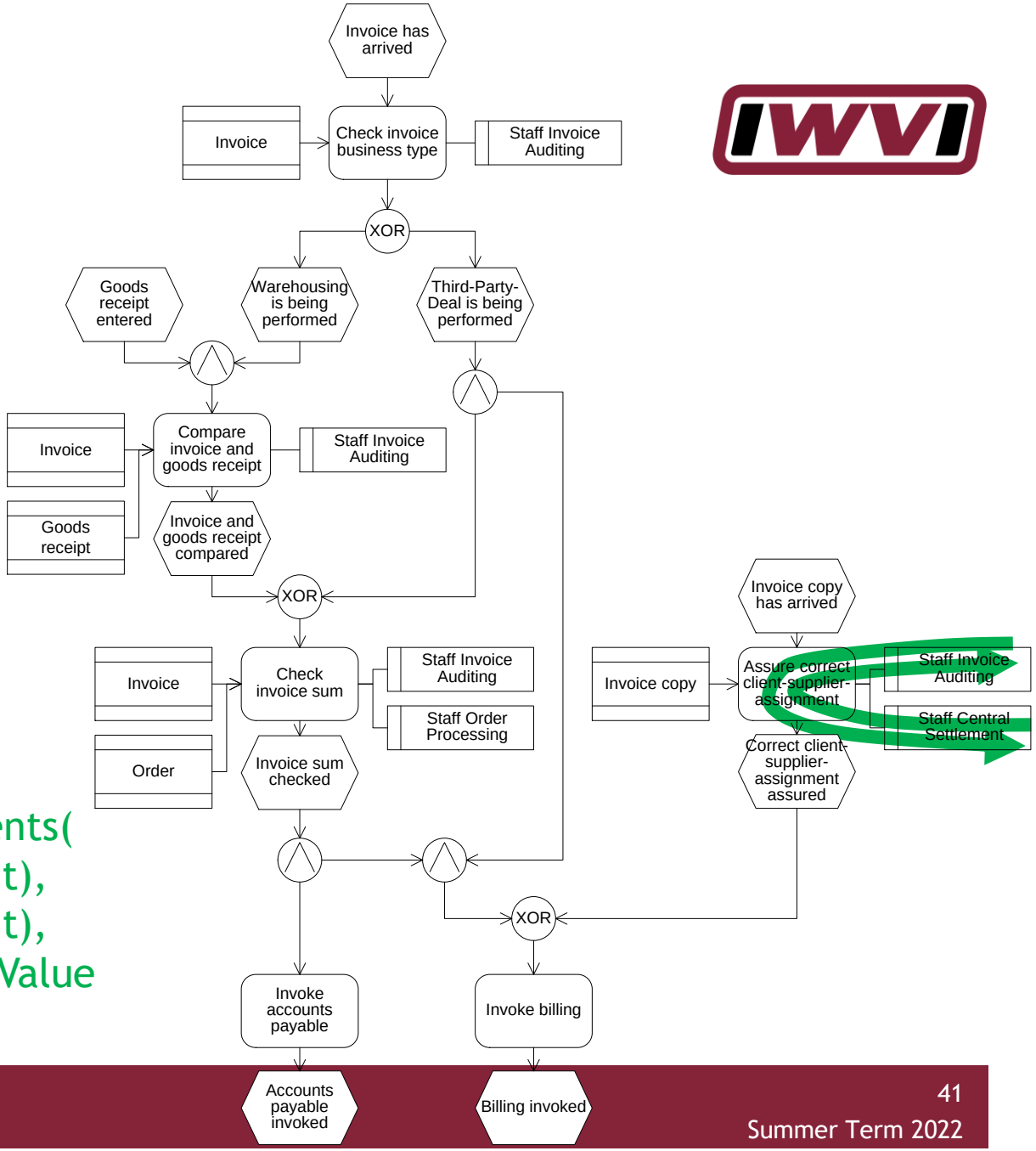


GMQL FUNCTIONS

PNCE

- PathsNotContaining Elements(X_1,X_n,X_c)
  Returns a set of sets. Each inner set contains one undirected path from one element of X_1 to one element of X_n. No element of X_c may be contained on that path.

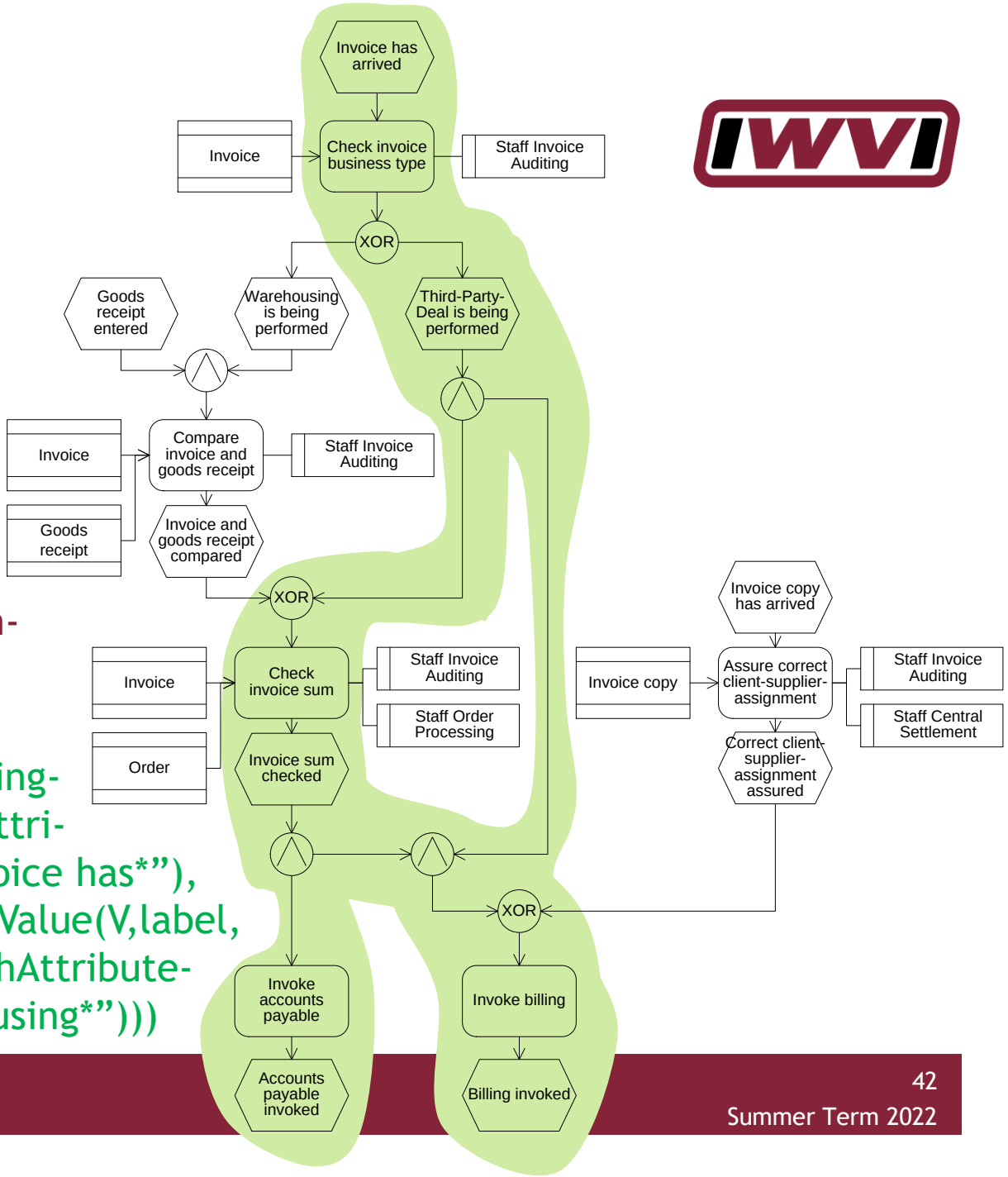
- Example
  PathsNotContainingElements(ElementsOfType(V,OrgUnit), ElementsOfType(V,OrgUnit), ElementsWithAttributeOfValue(V,label,"*invoice*"))



GMQL FUNCTIONS

DPNCE

- DirectedPathsNotCon-tainingElements(X_1,X_n,X_c) Returns a set of sets. Each inner set contains one directed path from one element of X_1 to one element of X_n. No element of X_c may be con-tained on that path.
- Example DirectedPathsNotContaining-Elements(ElementsWithAttri-buteOfValue(V,label,"Invoice has*"), ElementsWithAttributeOfValue(V,label, "*invoked"),ElementsWithAttribute-OfValue(V,label,"Warehousing*")))



GMQL FUNCTIONS

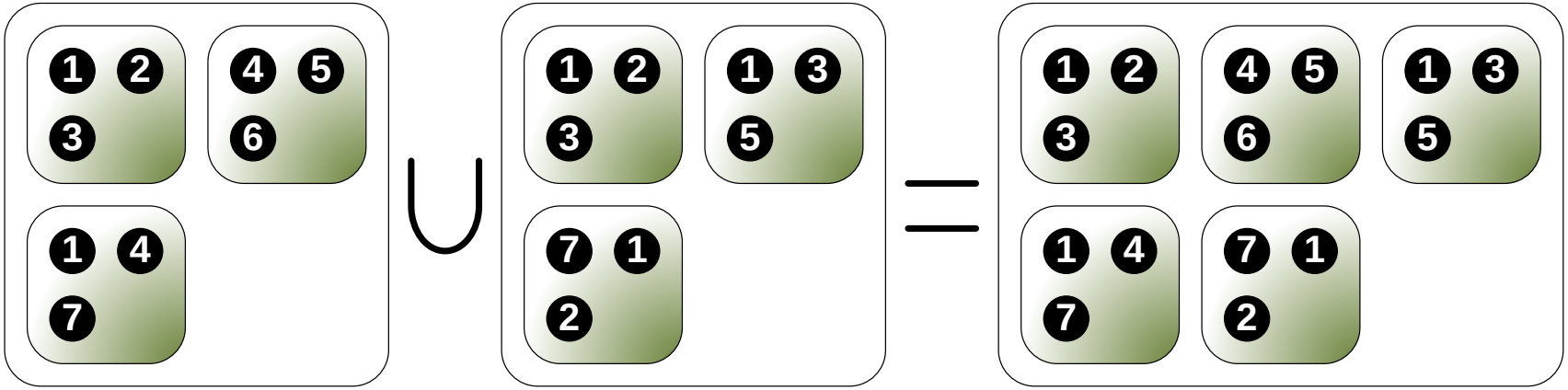
L, DL, LCE, DLCE, LNCE, DLNCE

- The following Loop functions actually do almost the same as their Path function counterparts, however, they are searching for paths that start and end in the same element (which is always out of X)
  - Loops(X)
  - DirectedLoops(X)
  - LoopsContainingElements(X,X_c)
  - DirectedLoopsContainingElements(X,X_c)
  - LoopsNotContainingElements(X,X_c)
  - DirectedLoopsNotContainingElements(X,X_c)

COMBINATION OF FUNCTION RESULTS

GMQL SET OPERATORS

- The common UNION operator
- Takes either two simple sets or two sets of sets as input

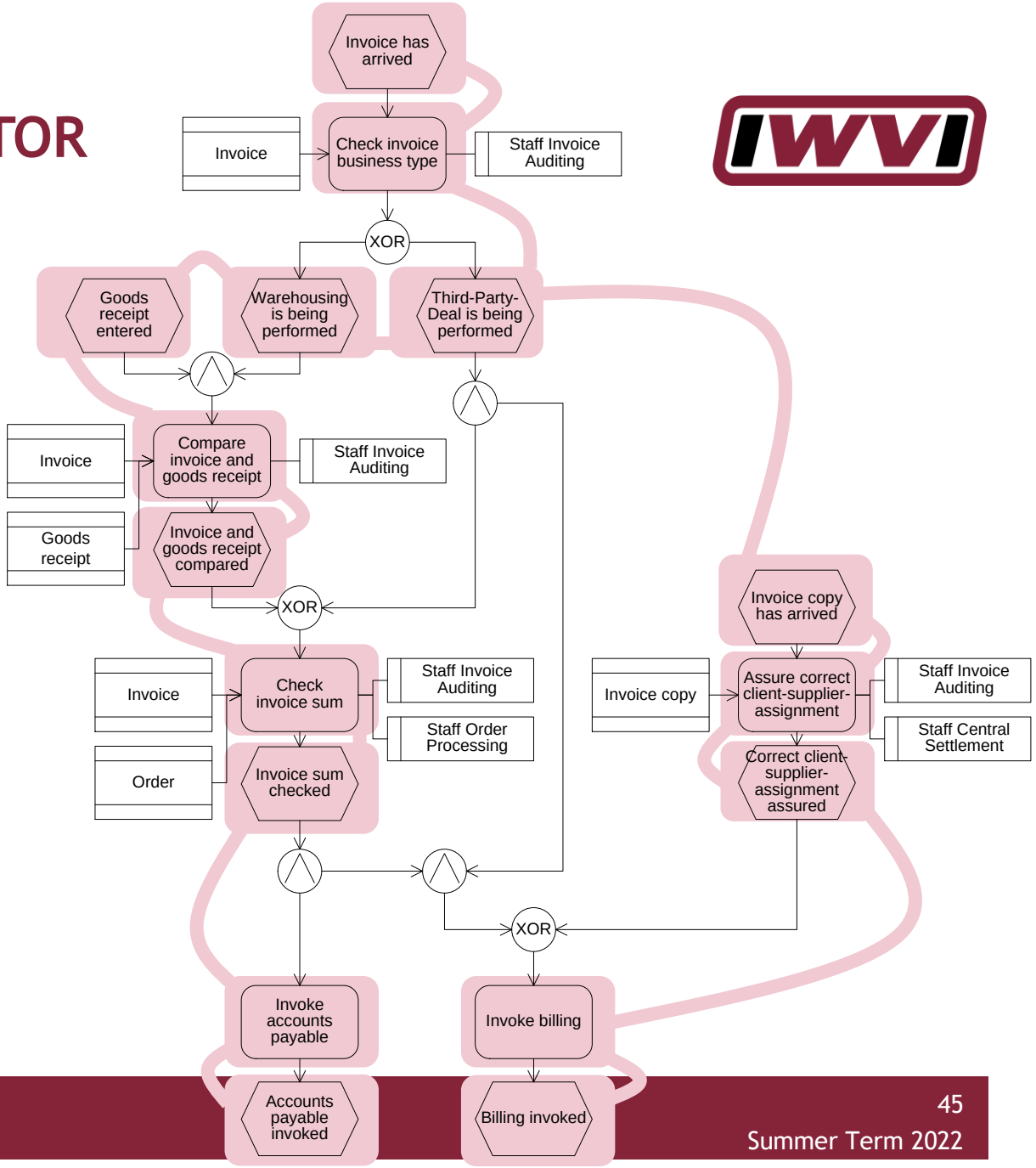


THE UNION OPERATOR

EXAMPLES

- UNION(ElementsOfType(V,function), ElementsOfType(V,event))

- Result: One simple set! (see single outline in the visulaization)

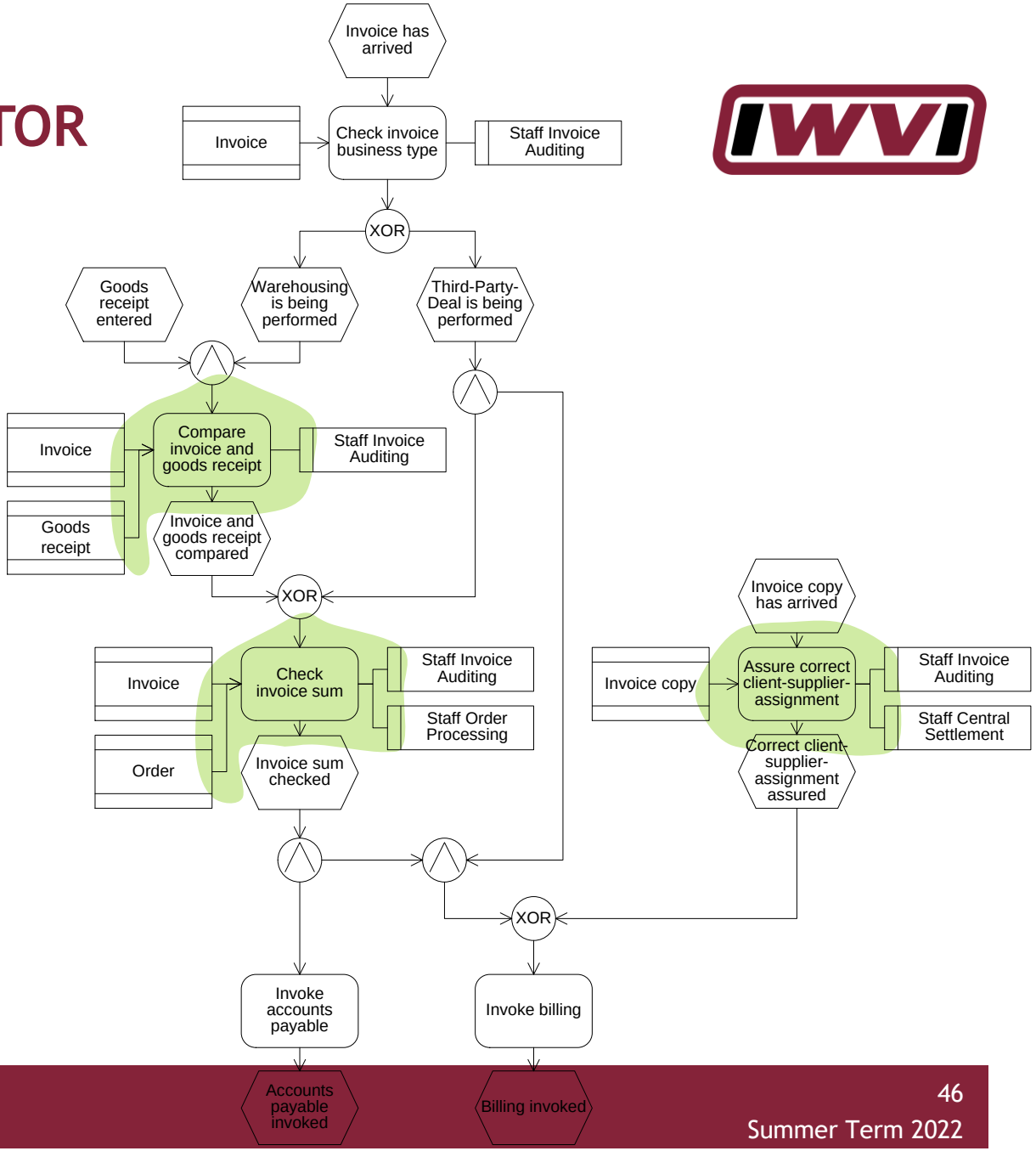


THE UNION OPERATOR

EXAMPLES

- UNION(ElementsWith-NumberOf-Relations(V,5), ElementsWith-NumberOf-Relations(v,6))

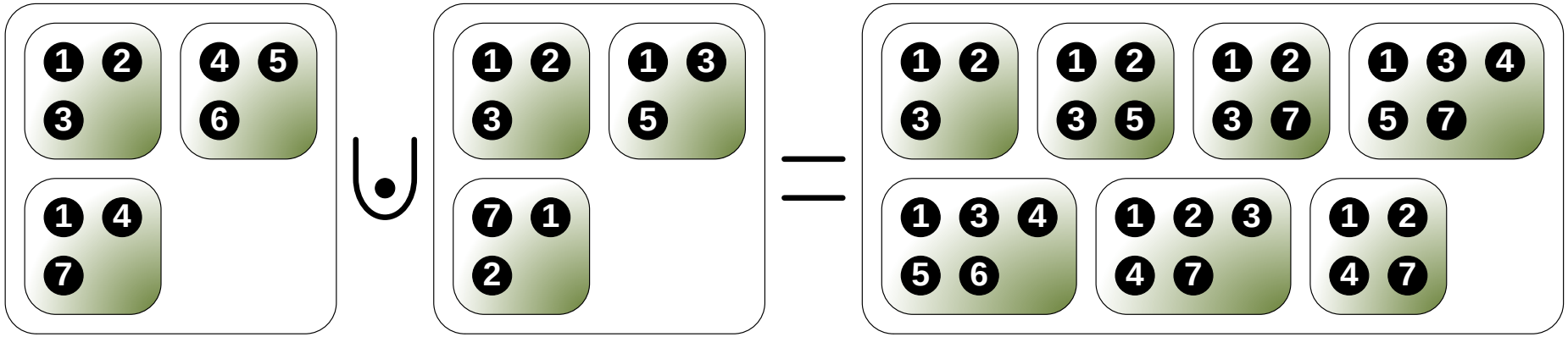
- Result: A set of sets!



COMBINATION OF FUNCTION RESULTS

GMQL SET OPERATORS

- The JOIN operator performs a UNION on two inner sets that have at least one element in common
- Only works on two sets of sets as inputs



THE JOIN OPERATOR

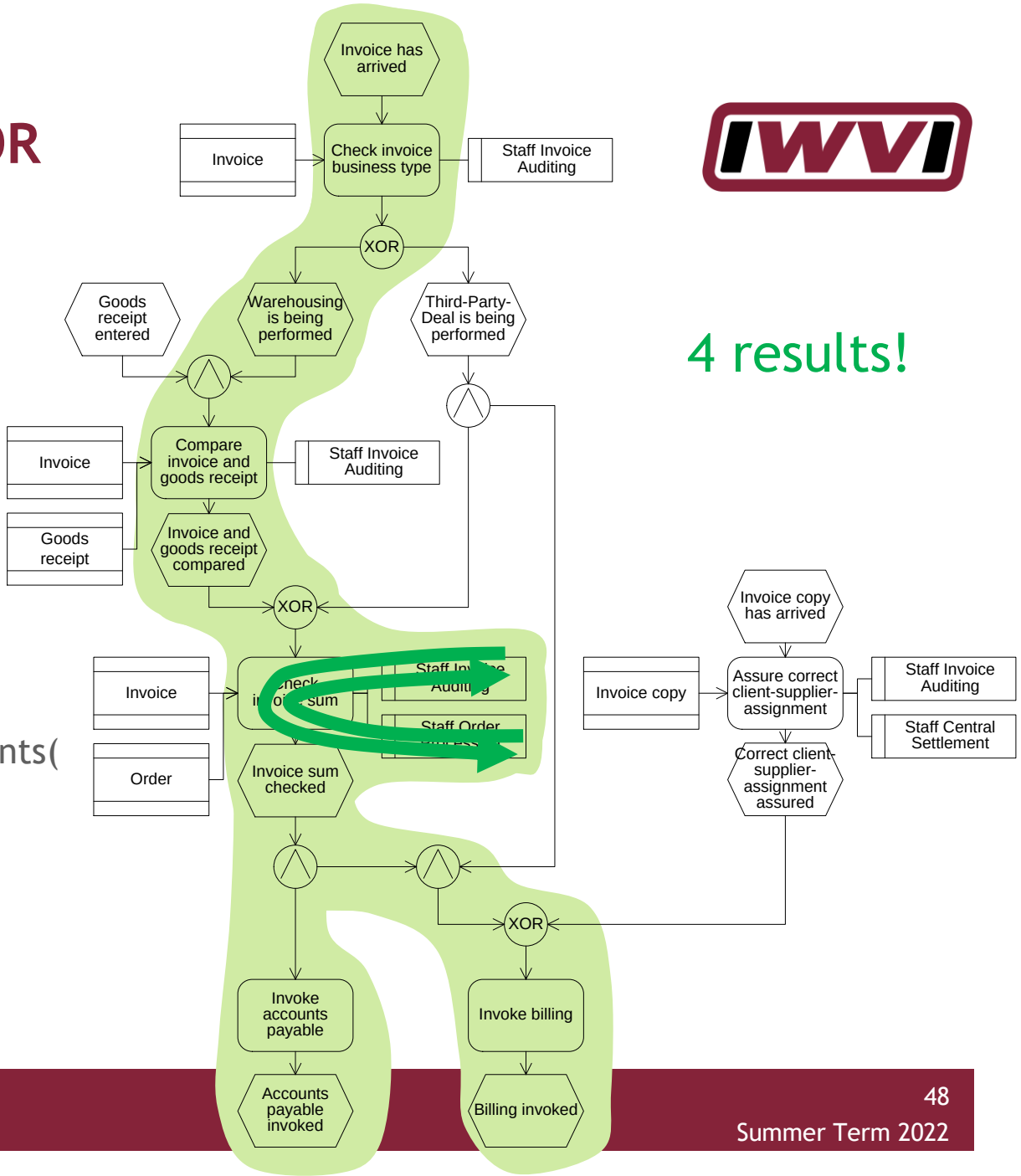
EXAMPLE

- Result: A set of sets!

- JOIN(

  Paths(
  ElementsOfType(V,OrgUnit),
  ElementsOfType(V,OrgUnit)),

  DirectedPathsContainingElements(
  ElementsWithAttributeOfValue
  (V,label,"Invoice has*"),
  ElementsWithAttributeOfValue
  (V,label, "*invoked"),
  ElementsWithAttributeOfValue
  (V,label,"Warehousing*")))

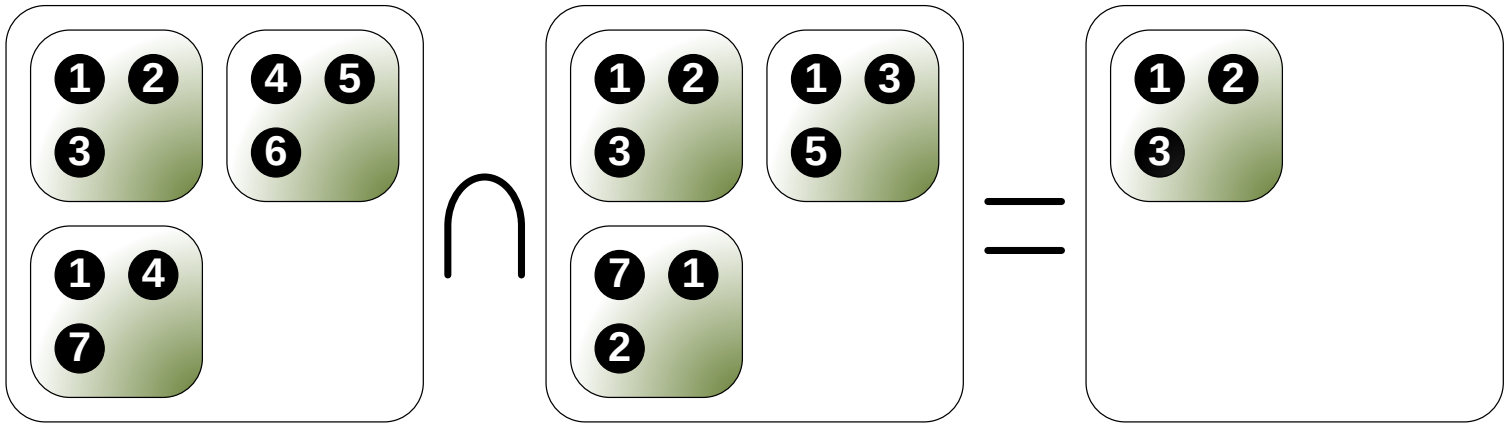


4 results!

COMBINATION OF FUNCTION RESULTS

GMQL SET OPERATORS

- The common INTERSECTION operator
- Takes either two simple sets or two sets of sets as input

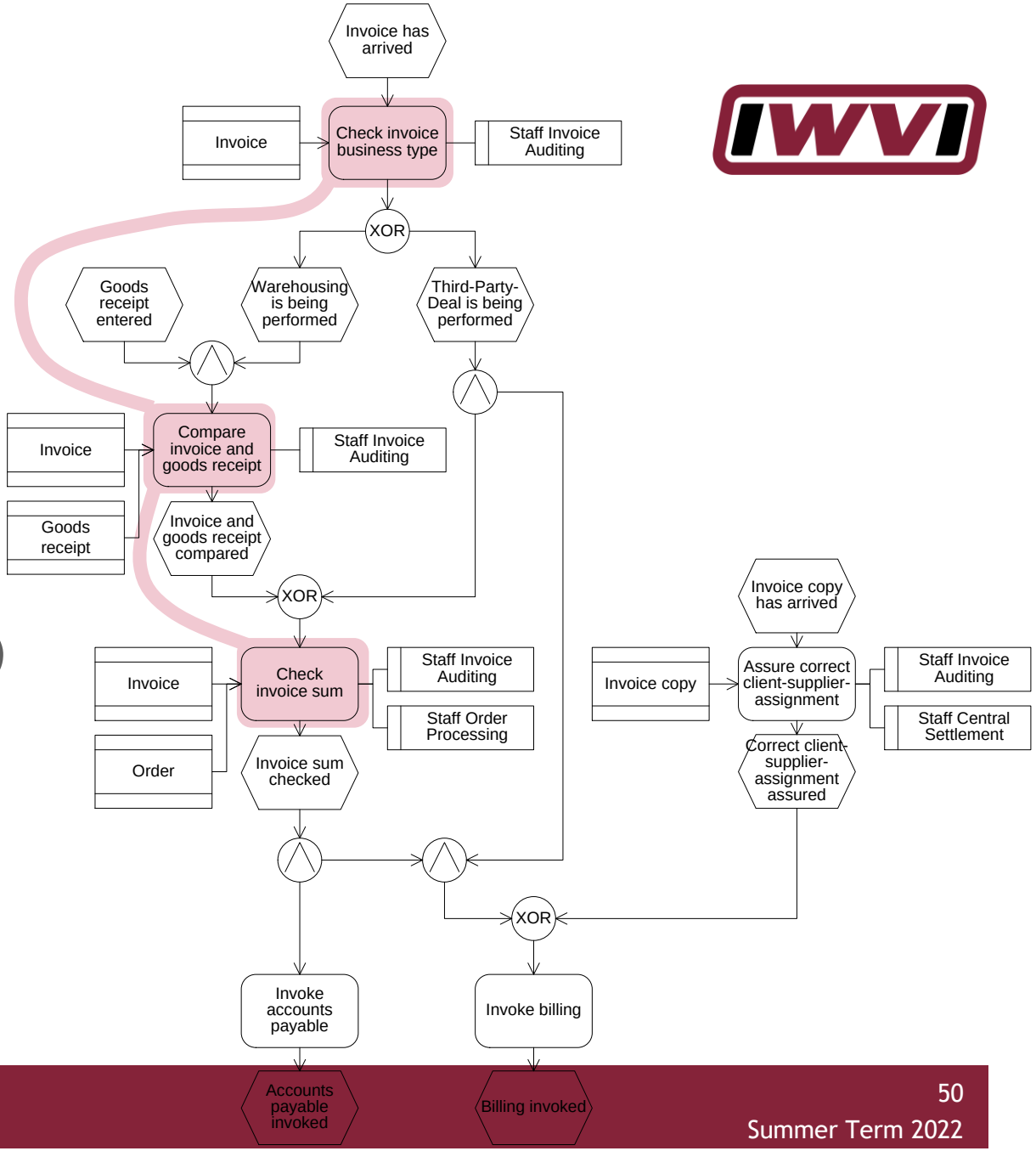


THE INTERSECTION OPERATOR

EXAMPLES

- Intersection(ElementsOfType (V,function), ElementsWith-AttributeOfValue (V,label,“*invoice*“))

- Result: One simple set! (see single outline in the visulaization)



THE INTERSECTION OPERATOR

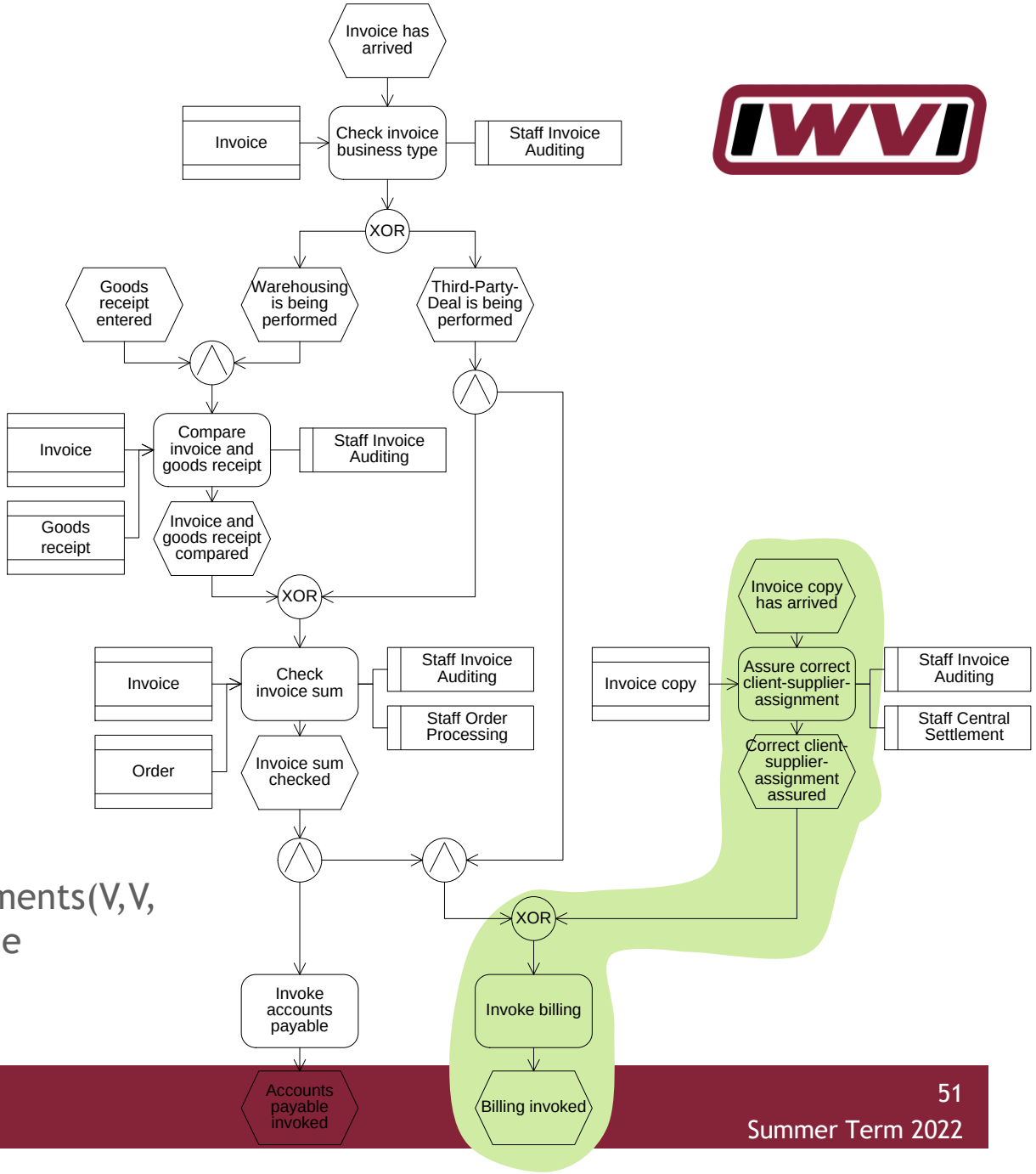
EXAMPLES

- Result: A set of sets!

- Intersection(

  DirectedPaths(
  ElementsOfType(V,event),
  ElementsOfType(V,event)),

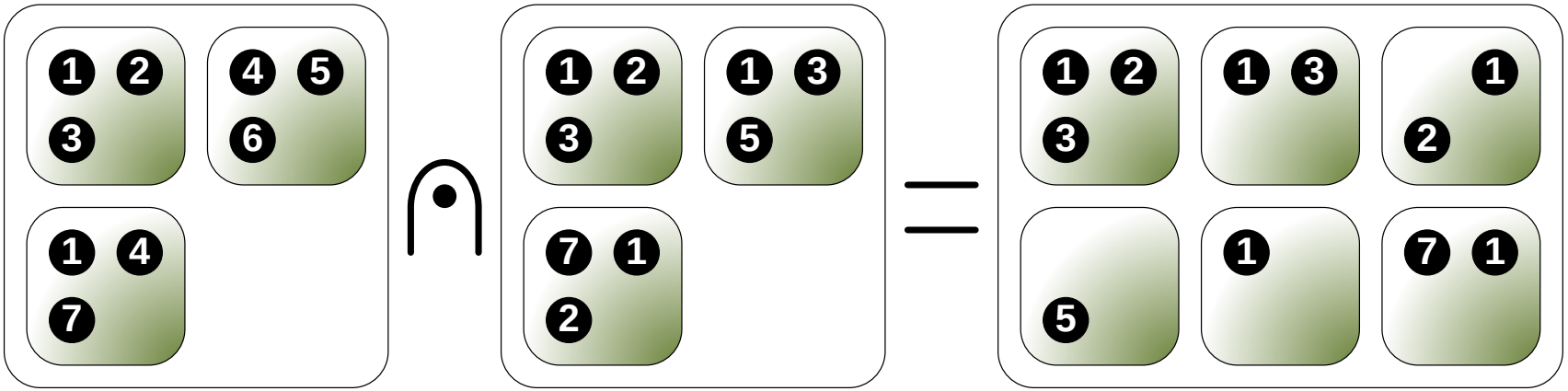
  DirectedPathsContainingElements(V,V,
  ElementsWithArributeOfValue
  (V,label,”*supplier*”))



COMBINATION OF FUNCTION RESULTS

SET OPERATORS

- The INNERINTERSECTION operator performs an intersection on each combination of two inner sets
- If one of the two arguments is a single set, it is handled as a set of sets with each inner set containing one element only (see example on the next slides)



THE INNERINTERSECTION OPERATOR

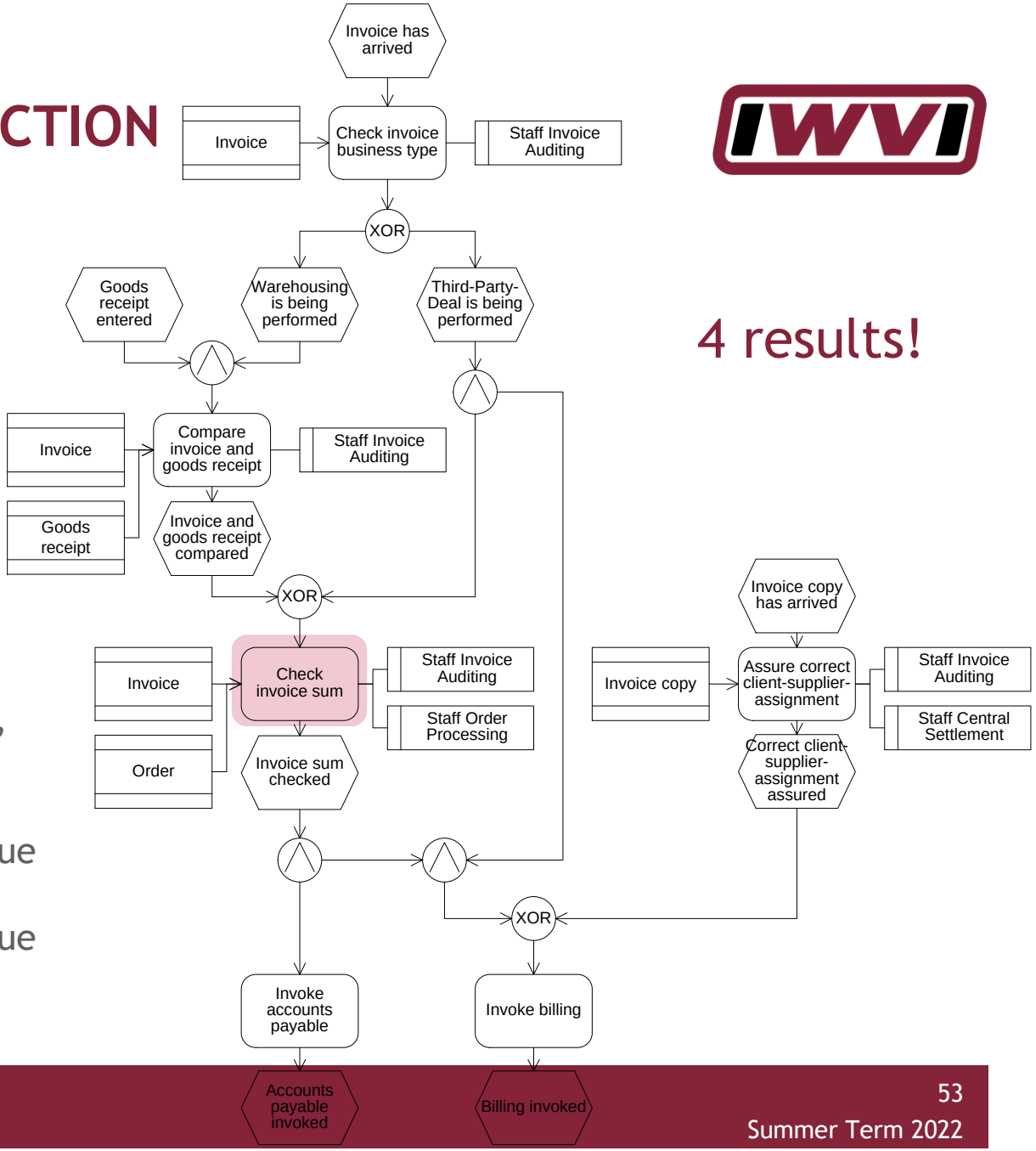
EXAMPLES

- Result: A set of sets!

- InnerIntersection(

  Paths(
  ElementsOfType(V,OrgUnit),
  ElementsOfType(V,OrgUnit)),

  DirectedPaths(
  ElementsWithAttributeOfValue
  (V,label,”Invoice has*”),
  ElementsWithAttributeOfValue
  (V,label, ”*invoked”)))



4 results!

THE INNERINTERSECTION OPERATOR

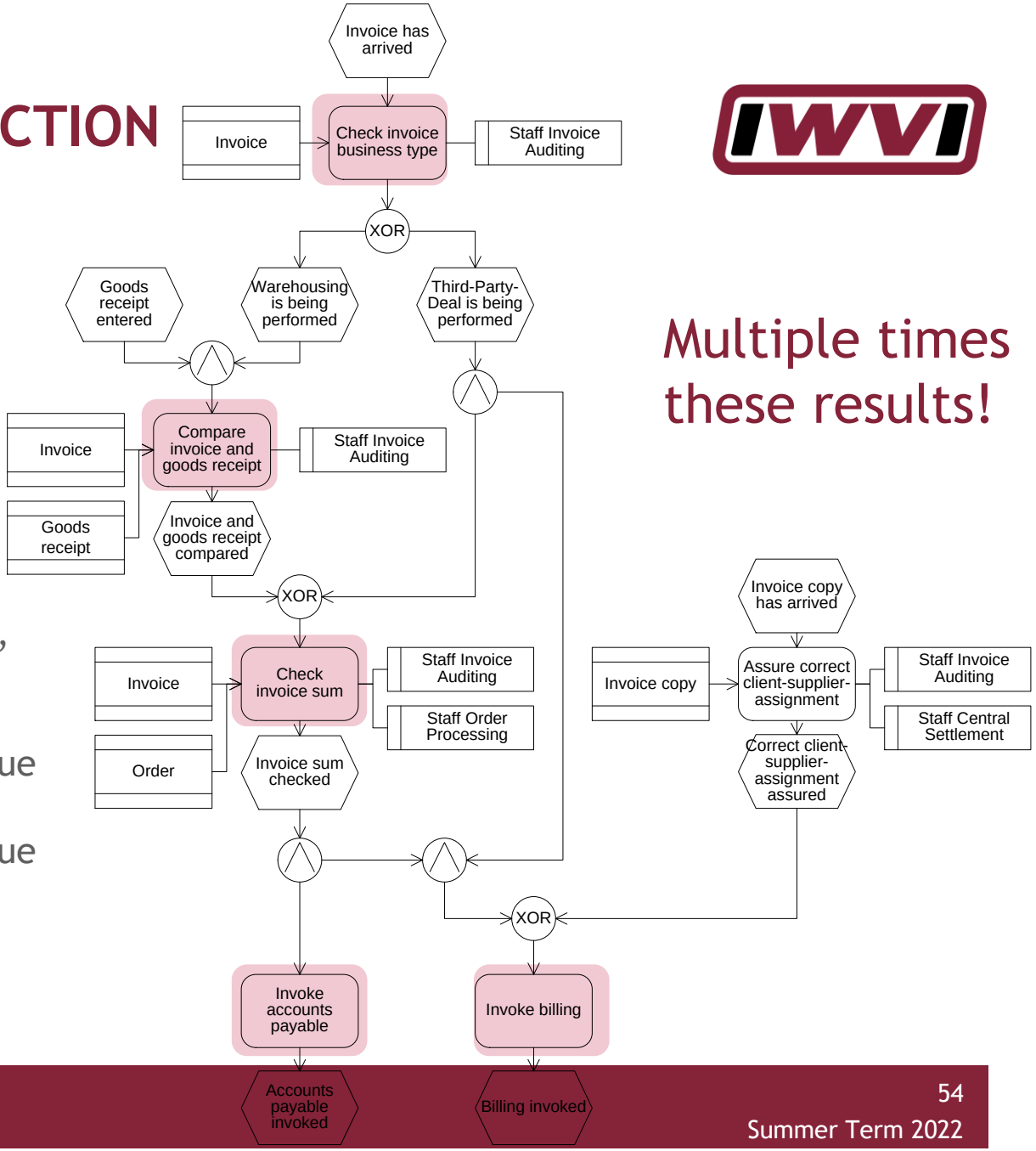
EXAMPLES

- Result: Also a set of sets!

- InnerIntersection(

  ElementsOfType(V,Function),

  DirectedPaths(
  ElementsWithAttributeOfValue
  (V,label,"Invoice has*"),
  ElementsWithAttributeOfValue
  (V,label, "*invoked")))

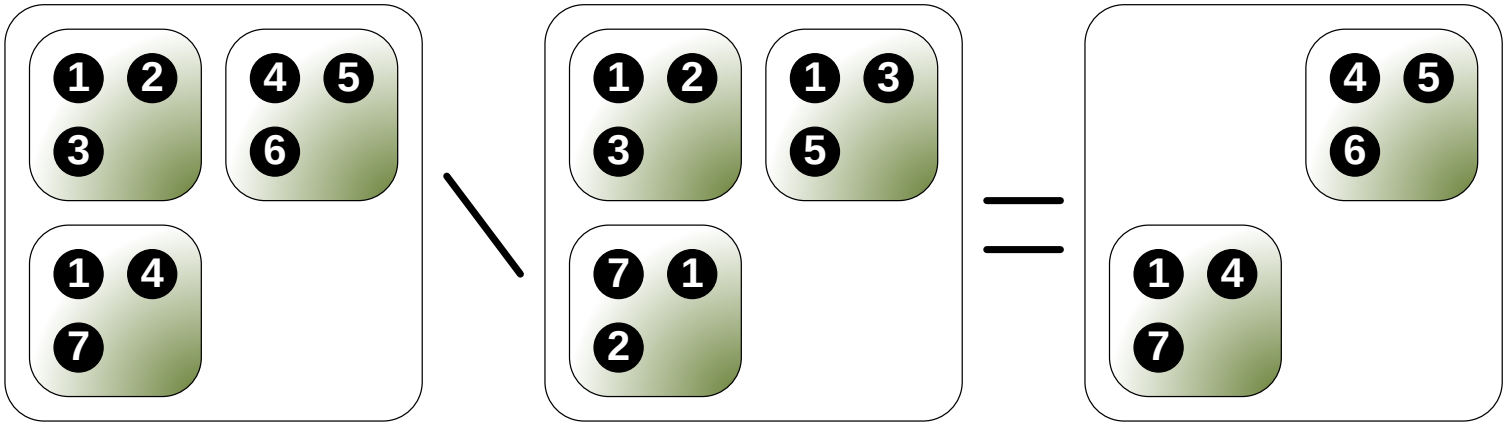


Multiple times these results!

COMBINATION OF FUNCTION RESULTS

SET OPERATORS

- The common COMPLEMENT operator
- Takes either two simple sets or two sets of sets as input

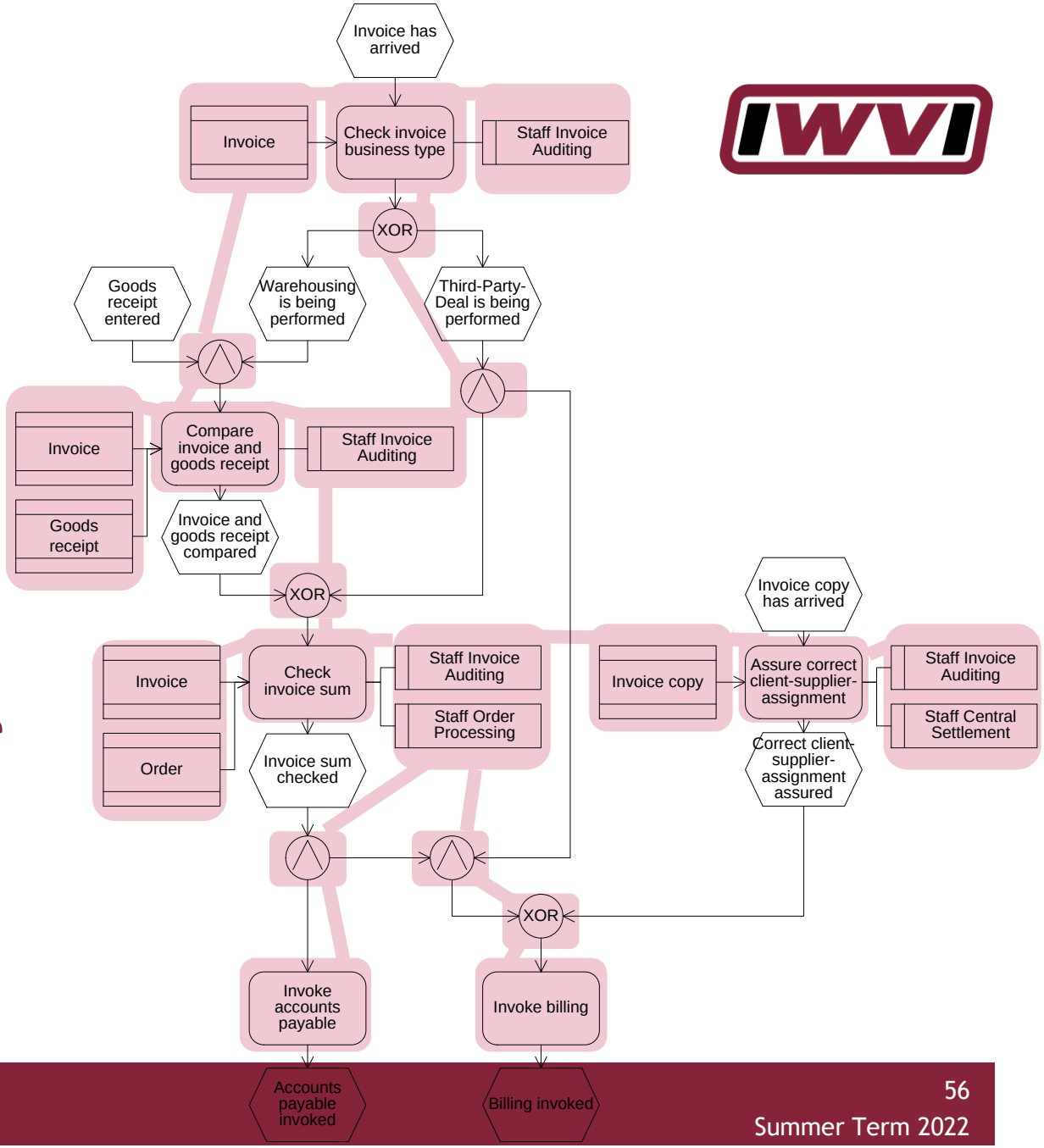


THE COMPLEMENT OPERATOR

EXAMPLES

- Complement(V, ElementsOfType (V,event))

- Result: One simple set! (see single outline in the visulaization)



THE COMPLEMENT OPERATOR

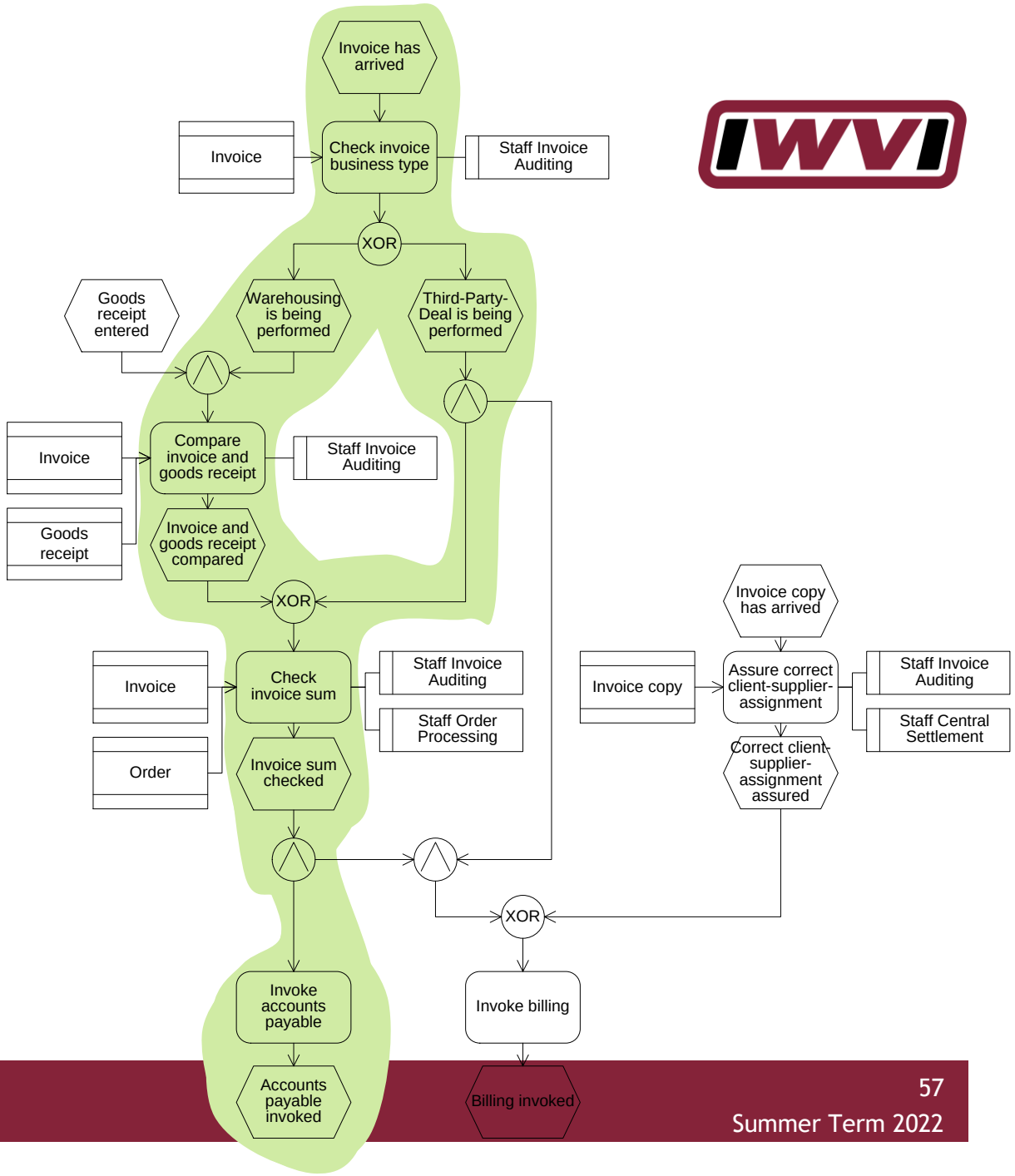
EXAMPLES

- Complement(

  DirectedPaths(Elements-WithAttributeOfValue (V,label,”Invoice has*”), ElementsWithAttributeOf-Value(V,label,”*invoked”)),

  DirectedPaths(Elements-WithAttributeOfValue (V,label,”Invoice has*”), ElementsWithAttributeOf-Value(V,label,”Billing*”)))

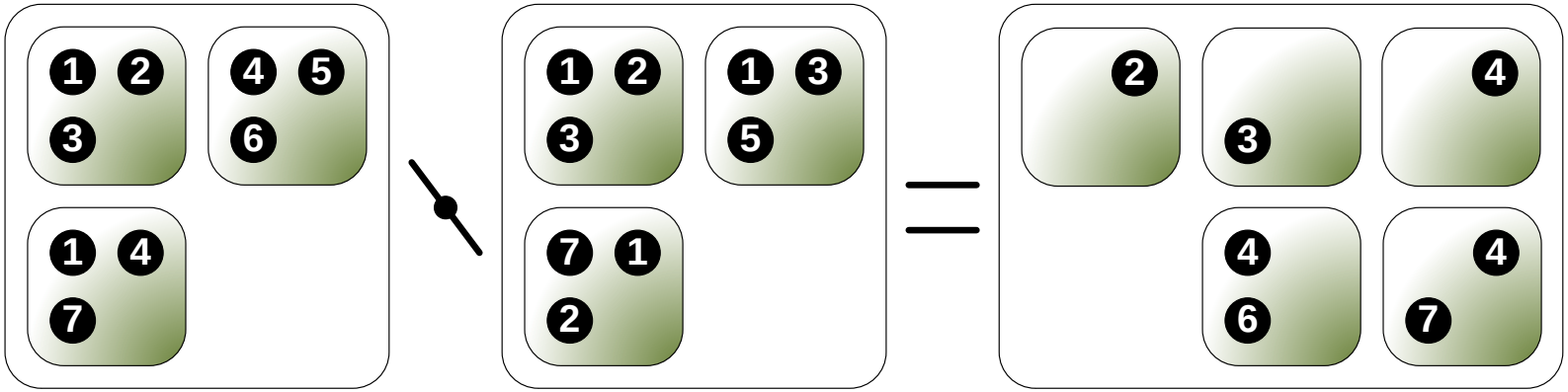
- Result: A set of sets!



COMBINATION OF FUNCTION RESULTS

SET OPERATORS

- The INNERCOMPLEMENT operator performs a subtraction on each inner set pairs having at least one element in common
- If one of the two arguments is a single set, it is handled as a set of sets with each inner set containing one element only



THE INNERCOMPLEMENT OPERATOR

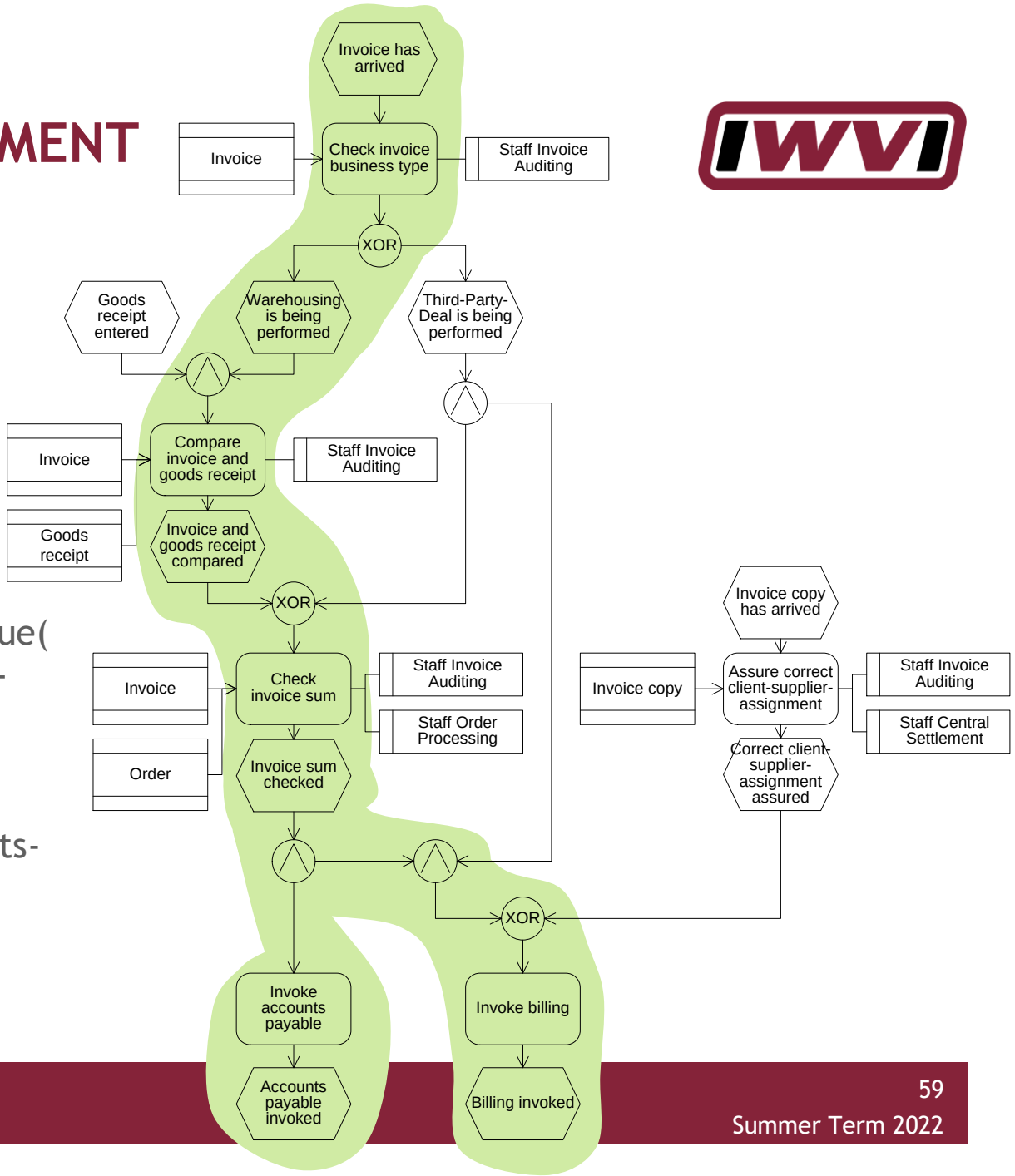
EXAMPLE

- InnerComplement(

  DirectedPathsContaining-Elements(ElementsWith-AttributeOfValue (V,label,”Invoice has*”), ElementsWithAttributeOfValue(V,label,*invoked”),Elements-WithAttributeOfValue (V,label,”Warehousing*”))),

  Adjacent Successors(Elements-WithAttributeOfValue (V,label,”Invoke*”),V)))

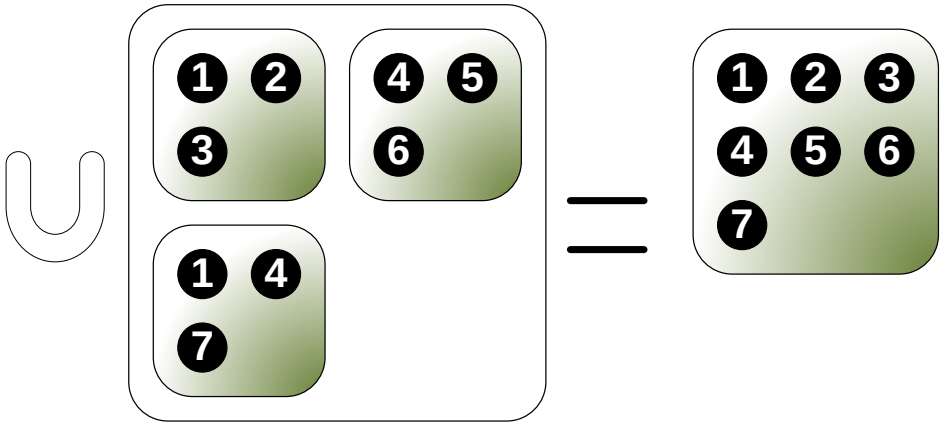
- Result: A set of sets!



COMBINATION OF FUNCTION RESULTS

SET OPERATORS

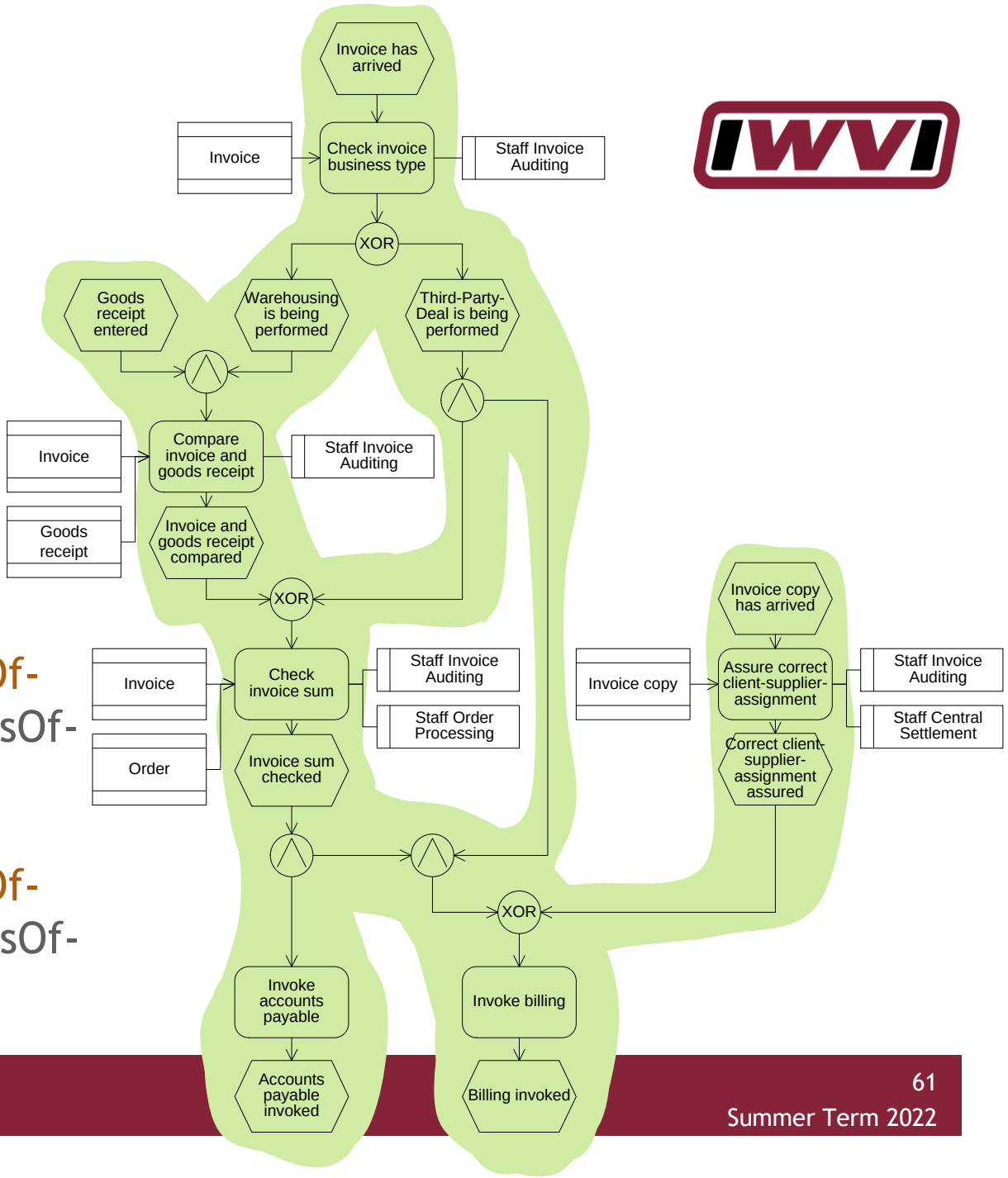
- The SELFUNION operator turns a set of sets into a simple set while performing a union



THE SELFUNION OPERATOR

EXAMPLE

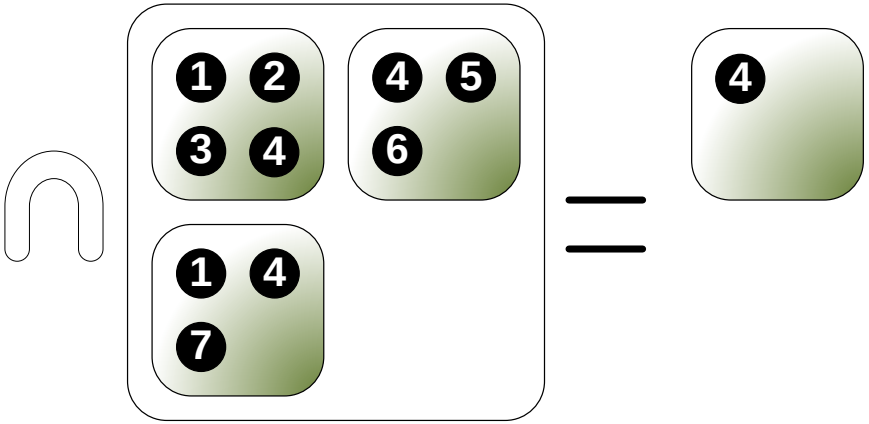
- DirectedPaths(SelfUnion(ElementsWithNumberOf-PredRelations(ElementsOf-Type(V,event),0)), SelfUnion(ElementsWithNumberOf-SuccRelations(ElementsOf-Type(V,event),0)))



GMQL

SET OPERATORS

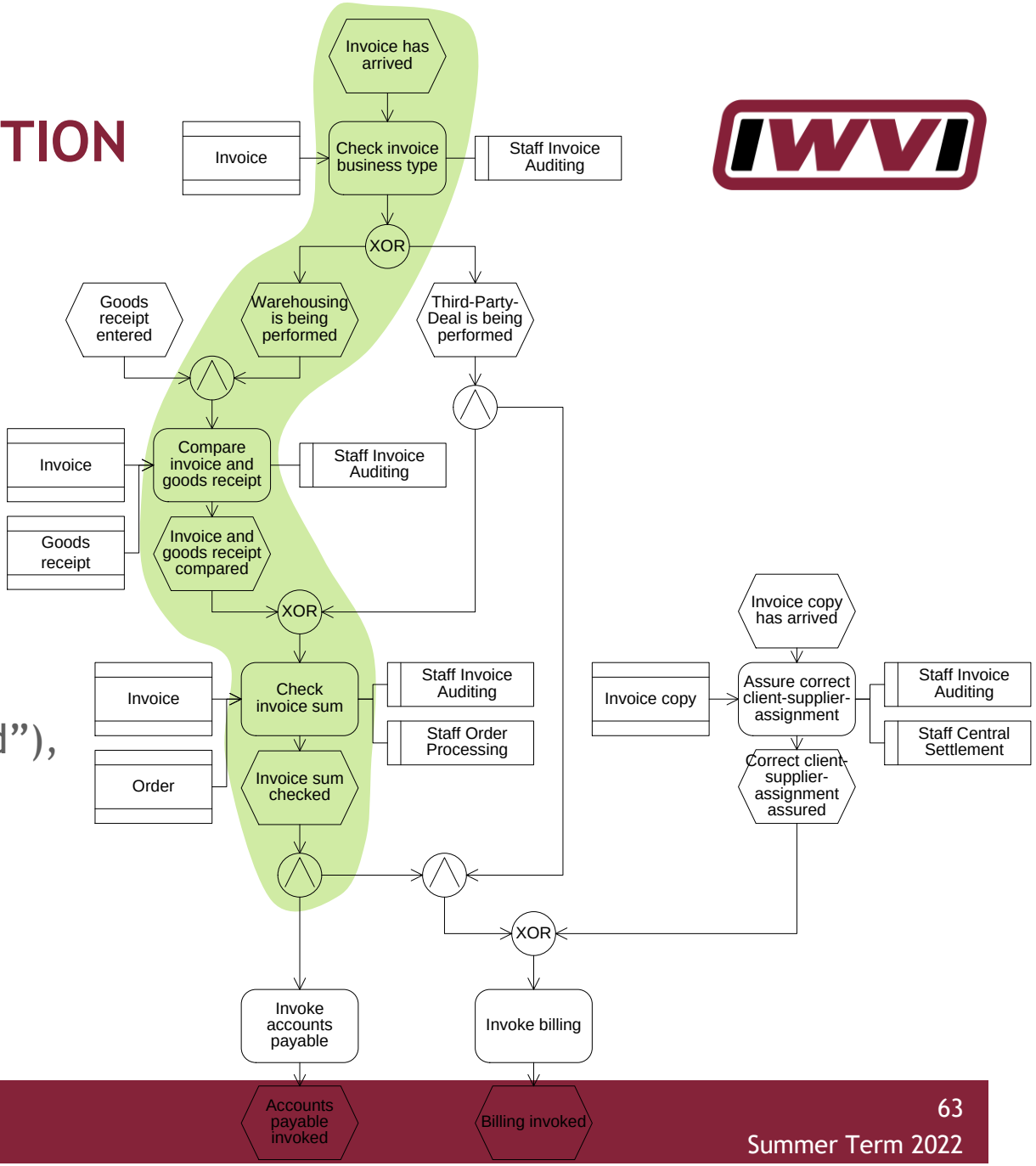
- The SELFINTERSECTION operator turns a set of sets into a simple set while performing an intersection



THE SELFINTERSECTION OPERATOR

EXAMPLE

- SelfIntersection(DirectedPaths-ContainingElements(ElementsWith-AttributeOfValue (V,label,”Invoice has*”), ElementsWithAttribute-OfValue(V,label,”*invoked”), ElementsWithAttribute-OfValue(V,label, ”Warehousing*”))))



GMQL SYNTAX

```
queryExpression = subQueryExpression
    {“,” equationExpression};

subQueryExpression = (functionExpression |
    operatorExpression | setExpression);
```

GMQL SYNTAX

```
functionExpression = functionIdentifier "("
                subQueryExpression
            [","  (parameterExpression |
                subQueryExpression)]
            [","  (parameterExpression |
                subQueryExpression)]")";
```

GMQL SYNTAX

```
functionIdentifier = (“ElementsOfType” | “ElementsWithAttributeOfValue”
    | “ElementsWithAttributeOfDatatype” | “ElementsWithRelations” |
       “ElementsWithSuccRelations” | “ElementsWithPredRelations”
  |“ElementsWithRelationsOfType” | “ElementsWithSuccRelationsOfType” |
 “ElementsWithPredRelationsOfType” | “ElementsWithNumberOfRelations” |
                “ElementsWithNumberOfSuccRelations” |
                “ElementsWithNumberOfPredRelations” |
               “ElementsWithNumberOfRelationsOfType” |
             “ElementsWithNumberOfSuccRelationsOfType” |
“ElementsWithNumberOfPredRelationsOfType” | “ElementsDirecltyRelated” |
     “AdjacentSuccessors” | “Paths” | “DirectedPaths” | “Loops” |
         “DirectedLoops” | “ShortestPaths” | “LongestPaths” |
          “ShortestDirectedPaths” | “LongestDirectedPaths” |
    “PathsContainingElements” | “DirectedPathsContainingElements” |
 “PathsNotContainingElements” | “DirectedPathsNotContainingElements” |
    “LoopsContainingElements” | “DirectedLoopsContainingElements” |
 “LoopsNotContainingElements” | “DirectedLoopsNotContainingElements”);
```

GMQL SYNTAX

```
parameterExpression = (Integer | ElementType
| AttributeDataType |
AttributeValue | Variable);

ElementType = String;

AttributeDataType = (“INTEGER” | “STRING” |
“BOOLEAN” | “ENUM” | “DOUBLE”);

AttributeValue = String;
```

GMQL SYNTAX

```
operatorExpression = operatorIdentifier "("
subQueryExpression
[“,” subQueryExpression] “)”;

operatorIdentifier = (“UNION” |
“INTERSECTION” | “COMPLEMENT” | “JOIN” |
“INNERINTERSECTION” | “INNERCOMPLEMENT” |
“SELFUNION” | “SELFINTERSECTION”);

setExpression = (“V” | “E” | “Z”);
```

GMQL SYNTAX

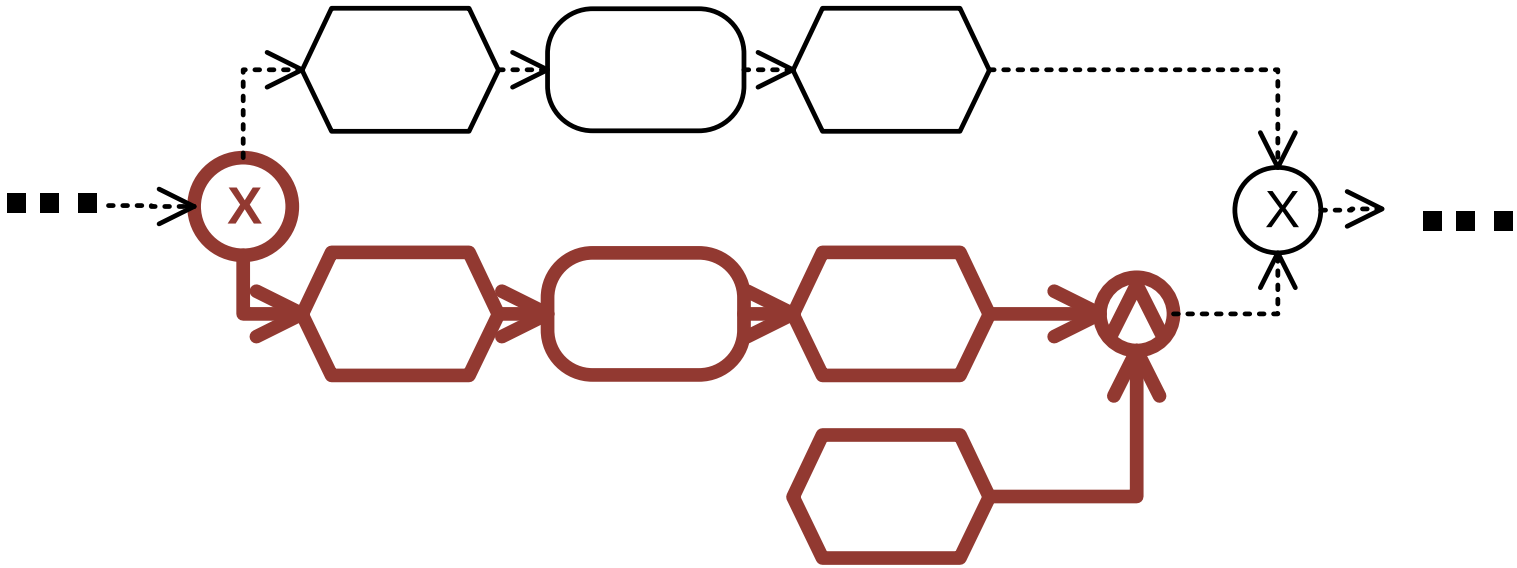
```
Variable = "("("A" | "B" | "C" | "D" | "E" |
  "F" | "G" | "H" | "I" | "J" | "K" | "L" |
  "M" | "N" | "O" | "P" | "Q" | "R" | "S" |
  "T" | "U" | "V" | "W" | "X" | "Y" | "Z")+
                "," ("Integer" |
    "ElementType" | "AttributeDataType" |
            "AttributeValue")")";

equationExpression = Variable ("=" | "!=" |
    "<" |  ">" | "<=" | ">=") Variable;
```

AGENDA

- Requirements of Model Query Languages
- The Generic Model Query Language (GMQL)
- Example Queries
- Live Demo

EXAMPLE QUERIES

AND MIGHT NOT GET CONTROL FROM XOR (CF. MENDLING 2007)



EXAMPLE QUERIES

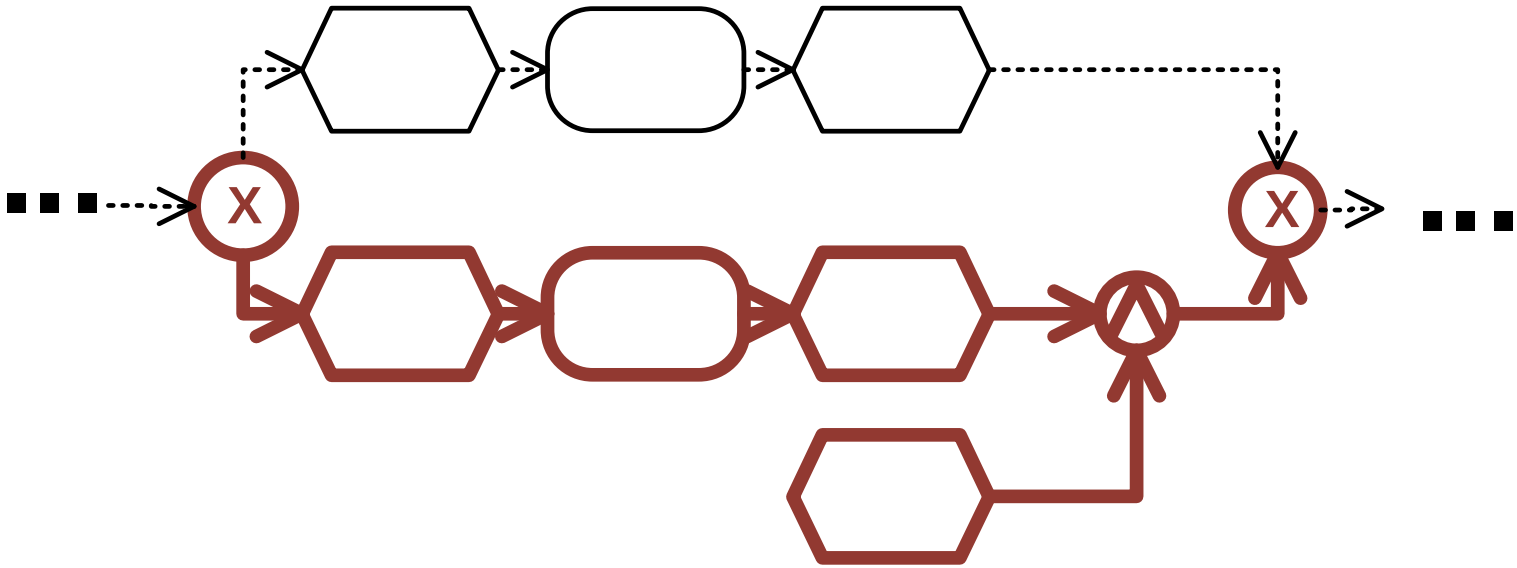
AND MIGHT NOT GET CONTROL FROM XOR (CF. MENDLING 2007)

```
DirectedPaths(
    COMPLEMENT(
        ElementsOfType(V,XOR),
        UNION(
            SELFUNION(INNERINTERSECTION(
                ElementsOfType(V,XOR),
                ElementsWithNumberOfSuccRelations(ElementsOfType(V,XOR),1))),
            SELFUNION(ElementsWithNumberOfSuccRelations(ElementsOfType(V,XOR),0))
        )
    ),
    SELFUNION(INNERINTERSECTION(
        ElementsOfType(V,AND),
        AdjacentSuccessors(
            SELFUNION(ElementsWithNumberOfPredRelations(ElementsOfType(V,Event),0)),
            ElementsOfType(V,AND)
        )
    ))
)
```

EXAMPLE QUERIES

AND MIGHT NOT GET CONTROL FROM XOR (CF. MENDLING 2007)

- “Extended version” of the pattern



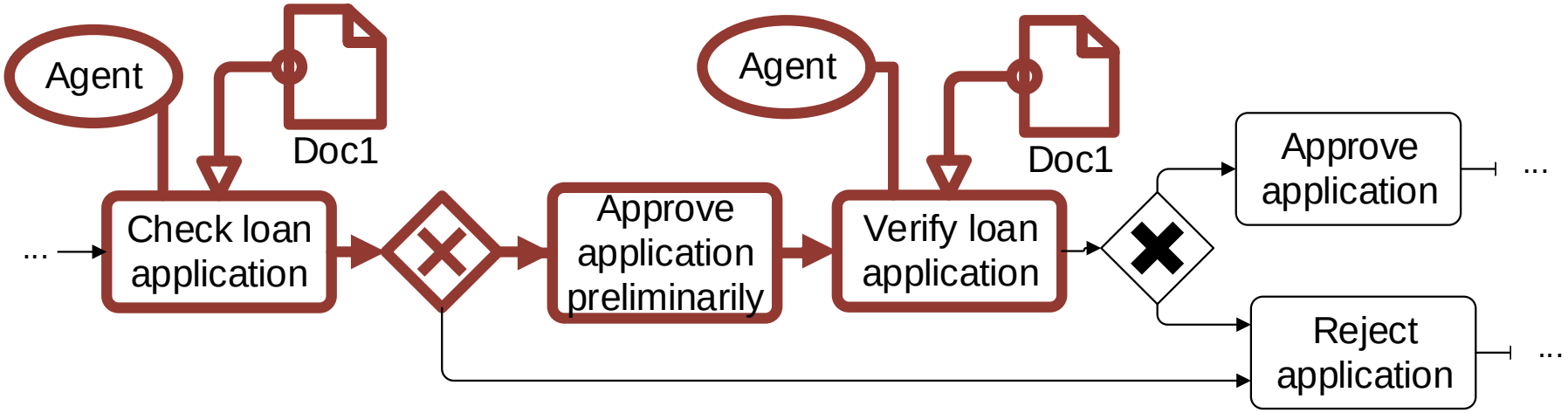
EXAMPLE QUERIES

AND MIGHT NOT GET CONTROL FROM XOR (CF. MENDLING 2007)

```
DirectedPathsContainingElements(
    COMPLEMENT(
        ElementsOfType(V,XOR),
        UNION(
            SELFUNION(INNERINTERSECTION(
                ElementsOfType(V,XOR),
                ElementsWithNumberOfSuccRelations(ElementsOfType(V,XOR),1))),
            SELFUNION(ElementsWithNumberOfSuccRelations(ElementsOfType(V,XOR),0))
        )
    ),
    COMPLEMENT(
        ElementsOfType(V,XOR),
        UNION(
            SELFUNION(INNERINTERSECTION(
                ElementsOfType(V,XOR),
                ElementsWithNumberOfPredRelations(ElementsOfType(V,XOR),1))),
            SELFUNION(ElementsWithNumberOfPredRelations(ElementsOfType(V,XOR),0))
        )
    ),
    SELFUNION(INNERINTERSECTION(
        ElementsOfType(V,AND),
        AdjacentSuccessors(
            SELFUNION(ElementsWithNumberOfPredRelations(ElementsOfType(V,Event),0)),
            ElementsOfType(V,AND)
        )
    ))
)
```

EXAMPLE QUERIES

SEPARATION OF DUTIES (CF. KNORR AND STORMER 2001)



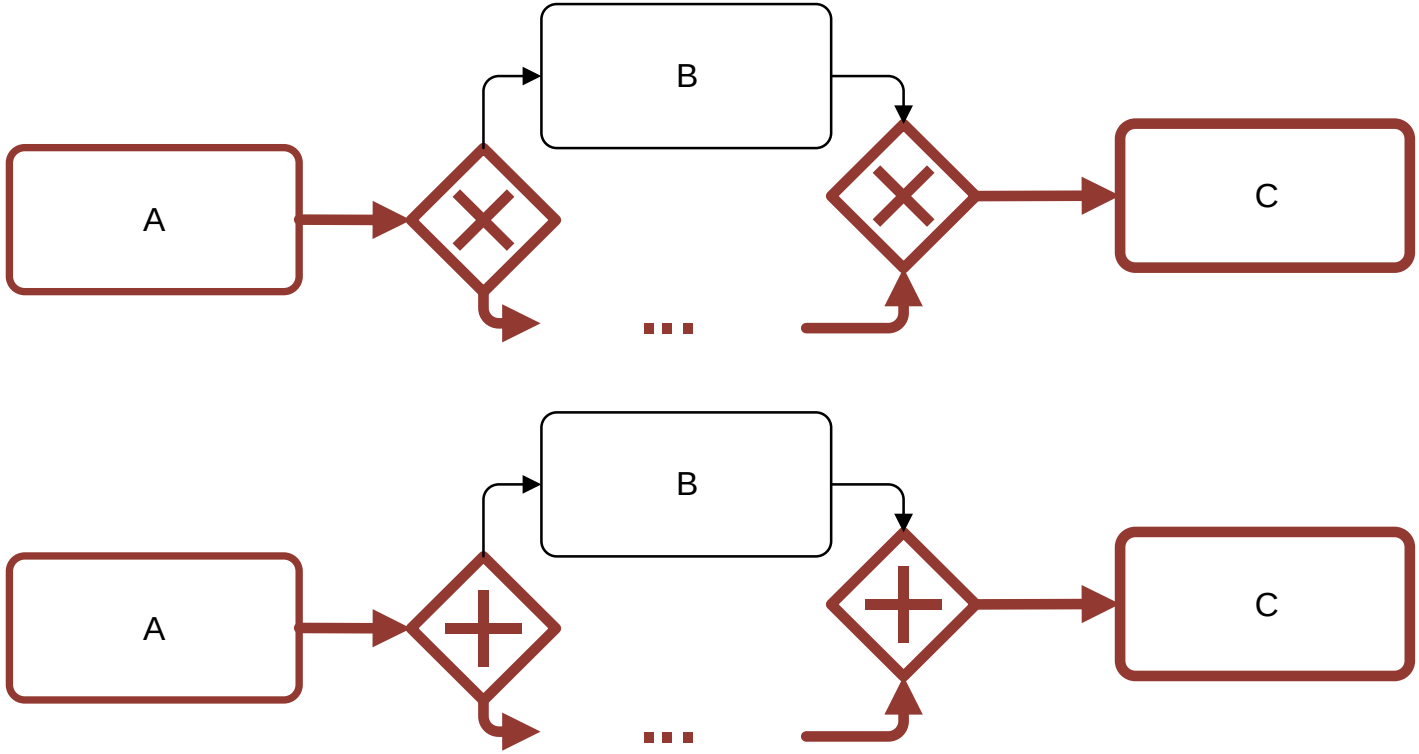
EXAMPLE QUERIES

SEPARATION OF DUTIES (CF. KNORR AND STORMER 2001)

```
DirectedPaths(
  SELFUNION(INNERINTERSECTION(
    AdjacentSuccessors(
        ElementsWithAttributeOfValue(ElementsOfType(V, Document), Label, (A,AttributeValue)),
        ElementsOfType(V, Activity)),
    ElementsDirectlyRelated(
        ElementsWithAttributeOfValue(ElementsOfType(V, OrgaUnit), Label, (C,AttributeValue)),
        ElementsOfType(V, Activity)))),
  SELFUNION(INNERINTERSECTION(
    AdjacentSuccessors(
        ElementsWithAttributeOfValue(ElementsOfType(V, Document), Label, (B,AttributeValue)),
        ElementsOfType(V, Activity)),
    ElementsDirectlyRelated(
        ElementsWithAttributeOfValue(ElementsOfType(V, OrgaUnit), Label, (D,AttributeValue)),
        ElementsOfType(V, Activity))))
),

(A,AttributeValue)=(B,AttributeValue), (C,AttributeValue)=(D,AttribteValue)
```

EXAMPLE QUERIES

PREDECESSOR / SUCCESSOR RULE (CF. AWAD ET AL. 2008)



EXAMPLE QUERIES

PREDECESSOR / SUCCESSOR RULE (CF. AWAD ET AL. 2008)

```
COMPLEMENT(
  DirectedPathsNotContainingElements(
      ElementsWithAttributeOfValue(ElementsOfType(V,Activity), Label,„A“),
      ElementsWithAttributeOfValue(ElementsOfType(V,Activity), Label,“C“),
      ElementsWithAttributeOfValue (ElementsOfType(V,Activity), Label,“B“)),
  DirectedPathsContainingElements(
      ElementsWithAttributeOfValue(ElementsOfType(V,Activity), Label,“A“),
      ElementsWithAttributeOfValue (ElementsOfType(V,Activity), Label,“C“),
      INNERINTERSECTION(
         AdjacentSuccessors(
            ElementsOfType(V,AND),
            ElementsWithAttributeOfValue(ElementsOfType(V,Activity), Label,“B“)),
         ElementsOfType(V,AND))
))
```

Even more sophisticated: intersect the „AND“ with a path starting with „AND“, leading to „B“ and not containing any connector

AGENDA

- Requirements of Model Query Languages
- The Generic Model Query Language (GMQL)
- Example Queries
- Live Demo

[εm]

Navigation | Modelling | Language | Perspective Editor | Administration | Shape Management | Plug-in Manager

Undo Redo

Edit

Current Language: EPC

Current Diagram Type: Standard

Information

Language Definition

- Object Types
- Roles
- Relationship Types
- Refinements
- Object Type Import
- Diagram Types
- Authorization
- Structural Model Patterns

Structural Model Patterns

Save Pattern | Cancel

Sets

- O Objects
- E Elements
- R Relations
- I Type-Entity-Relation
- T Target-Relation
- S Source-Relation
- Variable

Operators

- Union
- Join
- Intersect
- InnerIntersect
- Minus
- InnerMinus

Functions

- ElementsWithInRelations
- ElementsWithInRelationsOfType
- ElementsWithNumberOfInRelations
- ElementsWithNumberOfInRelationsOfType
- ElementsWithNumberOfOutRelations
- ElementsWithNumberOfOutRelationsOfType
- ElementsWithNumberOfRelations
- ElementsWithNumberOfRelationsOfType
- ElementsWithOutRelations
- ElementsWithOutRelationsOfType
- ElementsWithRelations
- ElementsWithRelationsOfType

Pattern

- Intersect
  - DirectedPathsNotContainingElements
    - ElementsOfTypeFast
      - Event
    - ElementsOfTypeFast
      - Function
    - Union
      - ElementsOfTypeFast
        - Event
      - ElementsOfTypeFast
        - Function
  - DirectedPathsContainingElements
    - ElementsOfTypeFast
      - Event
    - ElementsOfTypeFast
      - Function
    - Minus
      - Union
        - ElementsOfTypeFast
          - OR
        - ElementsOfTypeFast
          - XOR
      - InnerIntersect
        - O
        - Union

Values

Select or enter value:

Event

Documentation

Save and close | Cancel

[εm] 0 Connection

[εm]

Navigation | Modeling | Language Editor | Perspective Editor | Administration | Shape Management | Plug-in Manager

Edit
Save
Close Model
Model

Select | Connect
Undo | Redo
Modeling

Zoom in | Zoom out
Width | Page
75%
View

Show shapes | Print | Grid
Layout | Connection points | Page setup
Export
Modeling Environment

Pattern: Decision split after event in path of arbitrary length
Model selection: Invoice Auditing (Standard)
Matches: 1 / 2
New search in: Model Selection
Pattern Matching

Invoice Auditing

Invoice has arrived
Determine invoice business type
Staff invoice auditing
Goods receipt entered
Business type is warehousing
Business type is 3rd-party-deal
Compare invoice and goods receipt
Staff invoice auditing
Invoice and goods receipt compared
Invoice copy has arrived
Check invoice sum
Staff invoice auditing
Staff order processing
Check assignment of client and supplier
Staff invoice auditing
Staff central settlement
Invoice sum checked
Assignment of client and supplier checked
Transmit invoice to accounts payable
Staff invoice auditing
Transmit invoice to billing
Staff invoice auditing
Invoice transmitted to accounts payable
Invoice transmitted to billing

[em] Structural Pattern Matching

[εm]
Pattern selection

Suche:

Complete paths — Sprache: EPC
Decision split after event in path of arbitrary length — Sprache: EPC
Connector loops — Sprache: EPC
Join-and-split connectors — Sprache: EPC

Search | Cancel

[εm] 0 Connection

REFERENCES

- GMQL
  Delfmann, P.; Steinhorst, M.; Dietrich, H.-A.; Becker, J.: *The generic model query language GMQL – Conceptual specification, implementation, and runtime evaluation.* Information Systems 47 (2015) 1, pp. 129-177.

- Related Model Query Languages
  See related work section in the above article!

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BUSINESS PROCESS MANAGEMENT

MODEL QUERY II:
THE GENERIC MODEL QUERY LANGUAGE (GRAPH MATCHING)

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