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An Ontology-based Approach for Conformance Checking of Decision Mining Rules

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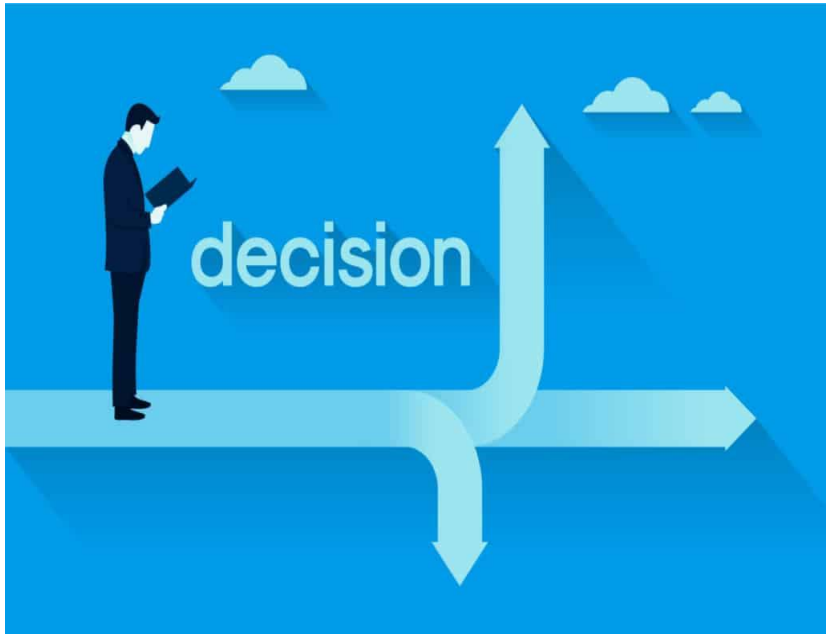
Outline

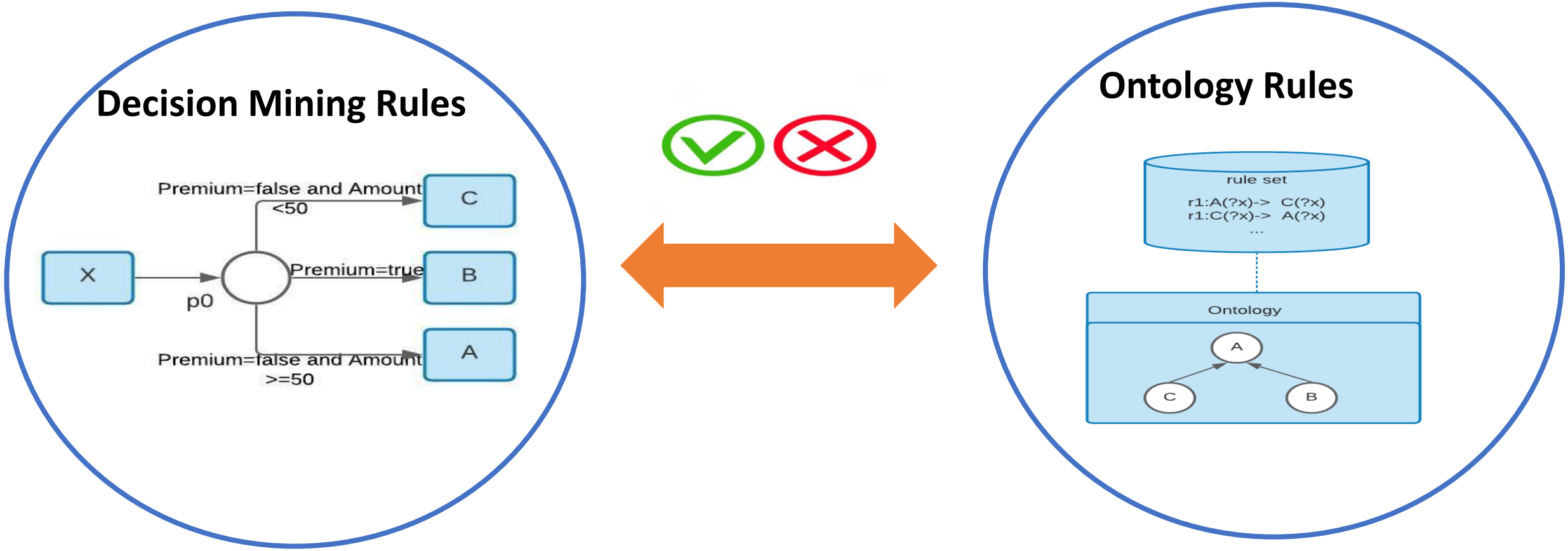
Introduction

- Making the right **decisions** is one of the most important capabilities of an organization.
- **Decision mining** field allows :
  - identifying decision points
  - analyzing rules for each choice depending on the available attributes in the business process.



- Scientific communities try to explore the decision support in organizations by emerging approaches on different **decision ontologies**.

Introduction: Research Objective



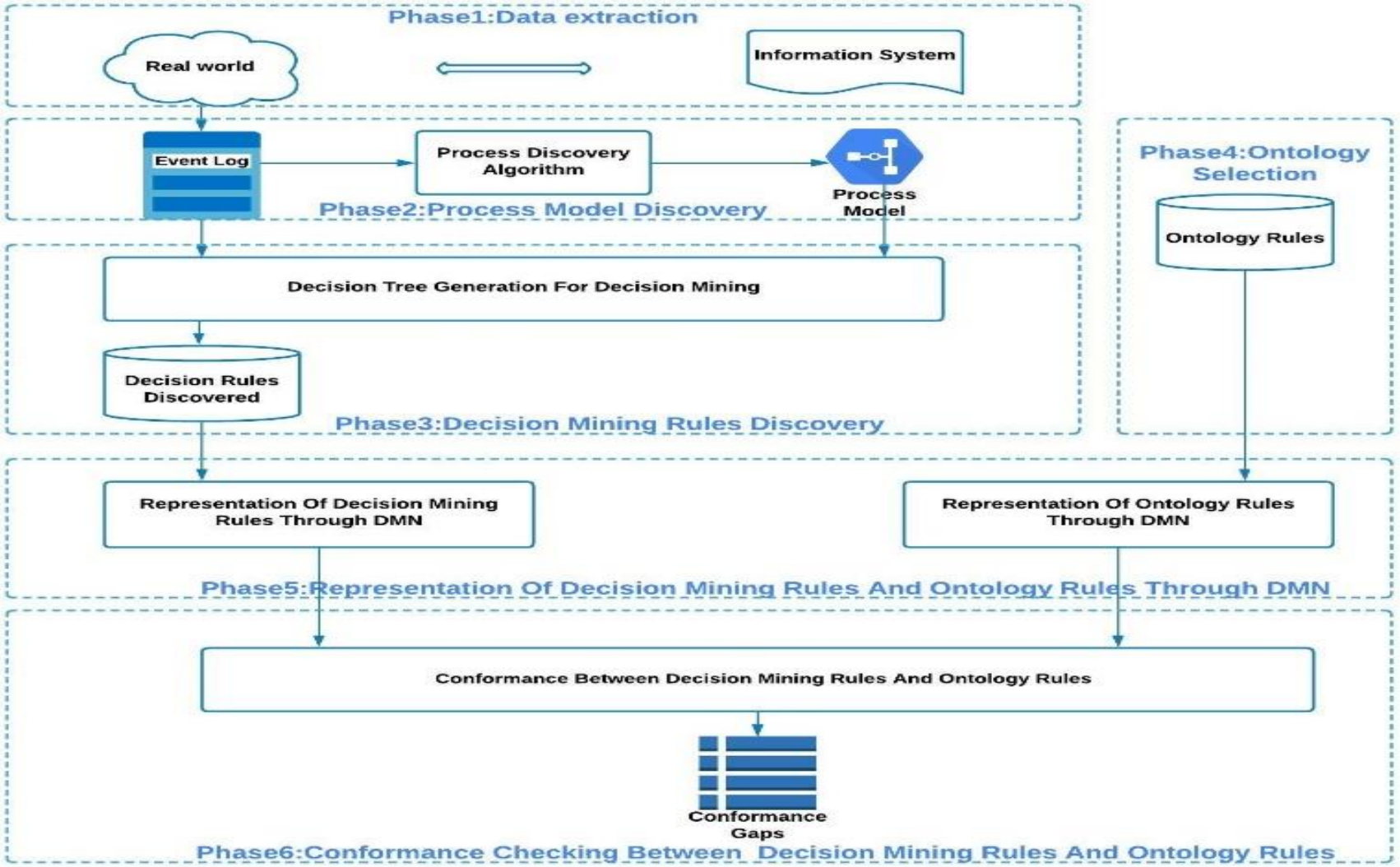
Introduction: Research Objective

- How to extract pertinent decision rules from event logs?
- How to check the validity of the extracted rules?
- How to compare the decision mining rules with the ontologies rules?

Related work

Author	Business process modeling		Consideration of DMN	Consideration of ontology	Comparison between decision mining rules &ontology rules
	BPMN	Petri net			
A. Rozinatet al.2006		√			
F. Mannhardtet al. 2015		√			
F. Mannhardtet al. 2016		√			
J. De Smedtet al.2016	√	√	√		
E. Bazhenovaet al.2019	√		√		
E. Kornyshovaet al.2010				√	
J. Camposet al.2018	√		√	√	
Our approach	√	√	√	√	√

Proposed Approach :**O**ntology-based approach for **C**onformance **C**hecking of **D**ecision mining rules: (**O2CD)**



Approach Application :Context of our experimentation

- Healthcare process for the management of COVID-19 patient.
- Department: the infectious diseases department of Farhat Hached in Sousse in Tunisia.
- Period: March 1, 2020 to May 31, 2020.

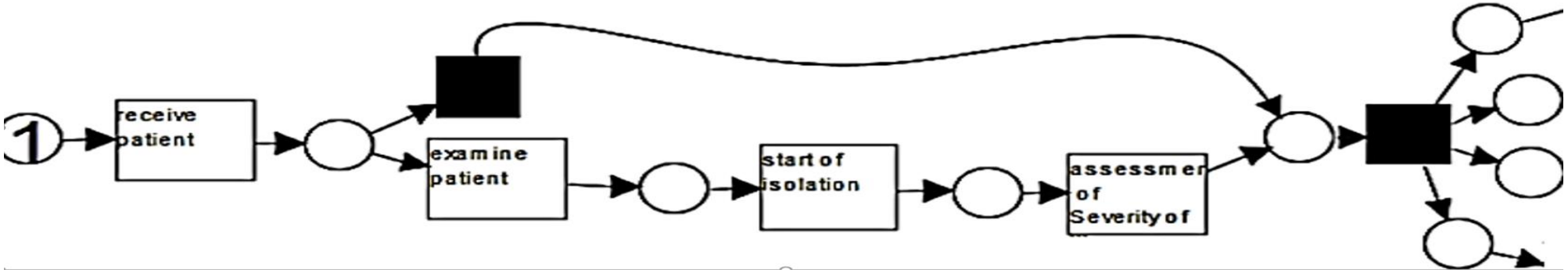
Approach Application: Data extraction

- Acquire an **event log** of the process from EHR (Electronic Health Record) information system.
- Event log was converted into CSV extension and filtered.
- **1024 events** were recorded involving 18 distinct activities, and 24 data attributes.

patient_ID	task	start_date	end_date	entry_modes	fever	engelure	headache	muscle_or	congestion	skin_rash	ageusia
50n	receive patier	21/04/2020 08:00	21/04/2020 08:10	emergency	1	0	0	0	0	0	0
50n	examine patie	21/04/2020 08:30	21/04/2020 08:40	emergency							
50n	start of isolati	21/04/2020 09:10	21/04/2020 09:30	emergency							
50n	assessment o	21/04/2020 09:40	21/04/2020 09:45	emergency							
50n	doing PCR tes	21/04/2020 10:45	21/04/2020 10:55	emergency							
50n	preparing for	21/04/2020 12:19	21/04/2020 12:40	emergency							
50n	decide diagnc	21/04/2020 13:40	21/04/2020 14:00	emergency							

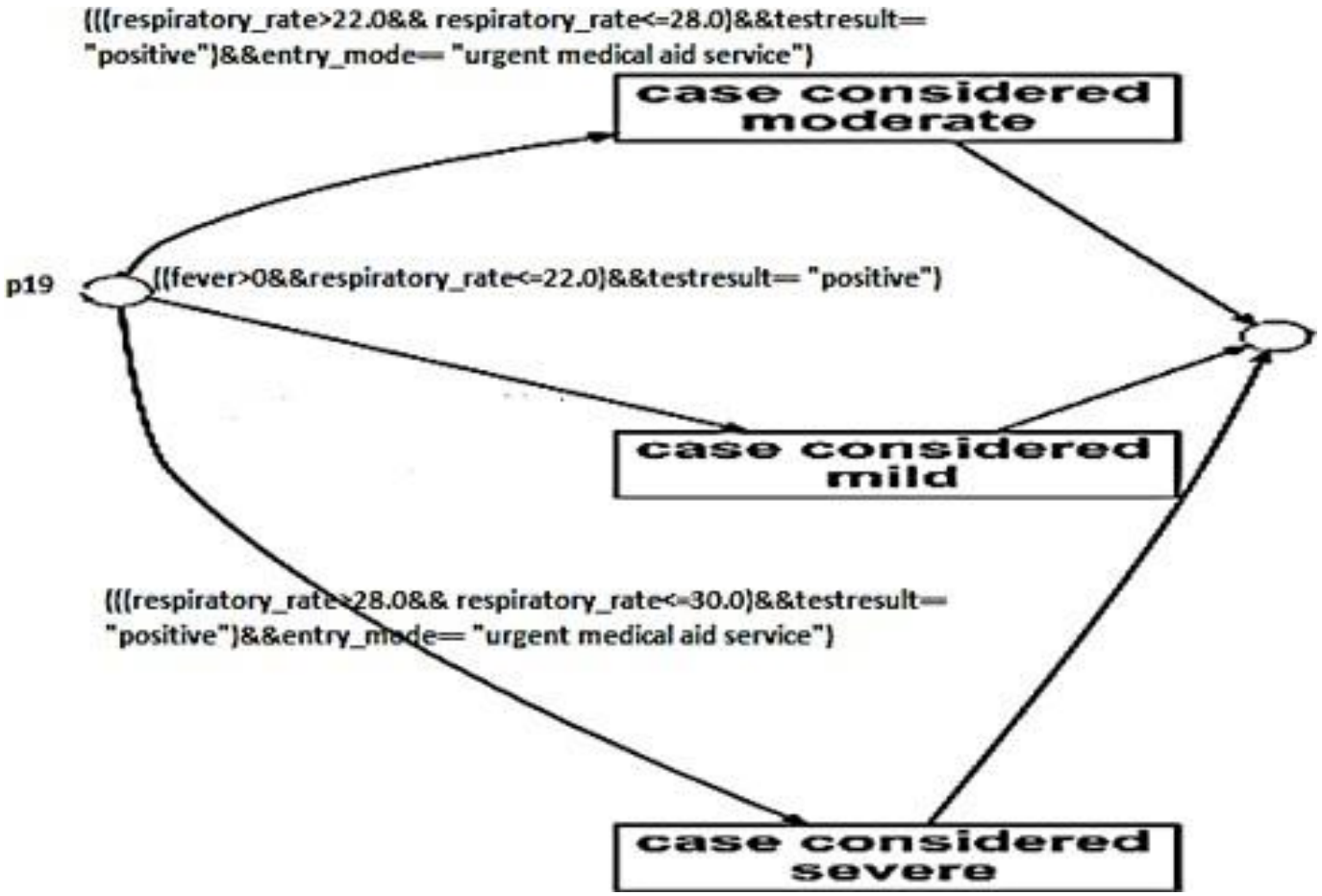
Approach Application: Process Model Discovery phase

- BP mined from the event log was discovered.
- Management of COVID-19 patients process: initiates with the reception of the patient and ends with her/his discharge or choosing a COVID-19 procedure.
- Main tasks: examine the patient, evaluate the degree of emergency, doing PCR, preparing for hospital stay, deciding the appropriate diagnostic protocol and the clinical examination, and evaluate the patient's status.



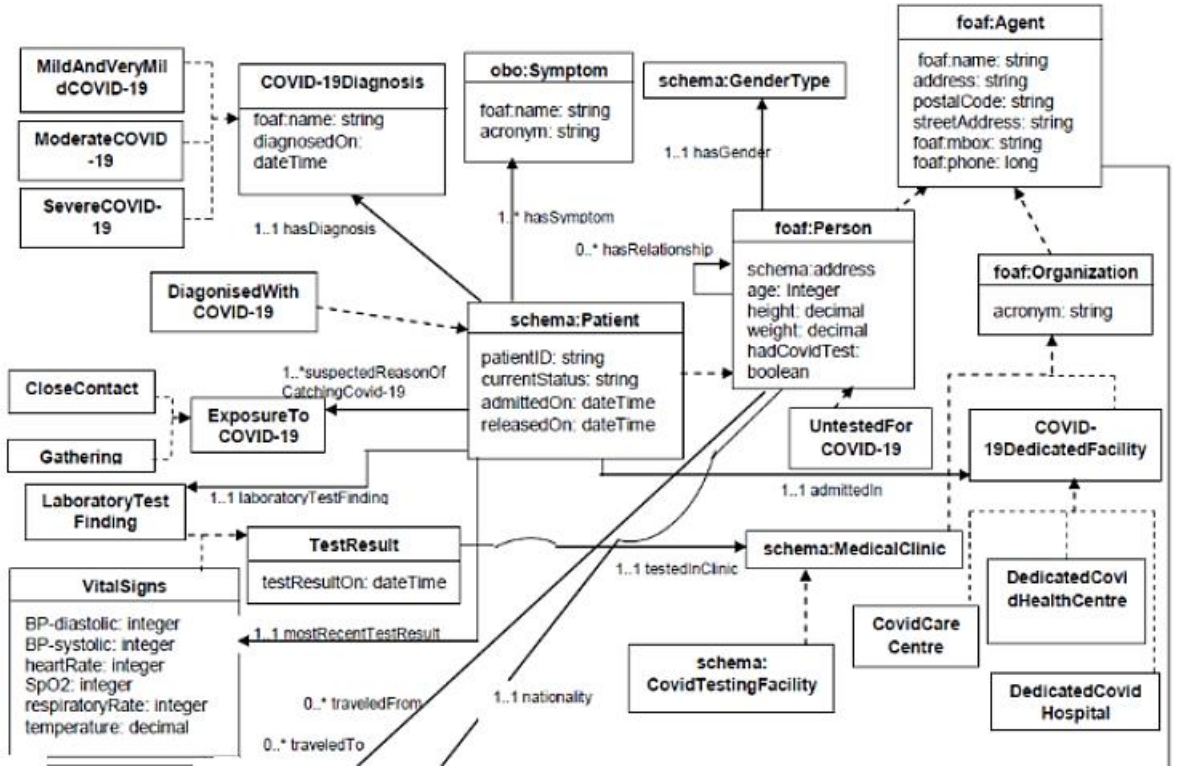
Approach Application: Decision Mining Rules Discovery

Discovering the rules on the Petri net model :



Approach Application: Ontology selection phase

- Select **the most appropriate ontology** in the context of COVID-19 pandemic.
- The inference rules were written in the Semantic Web Rule Language (**SWRL**).

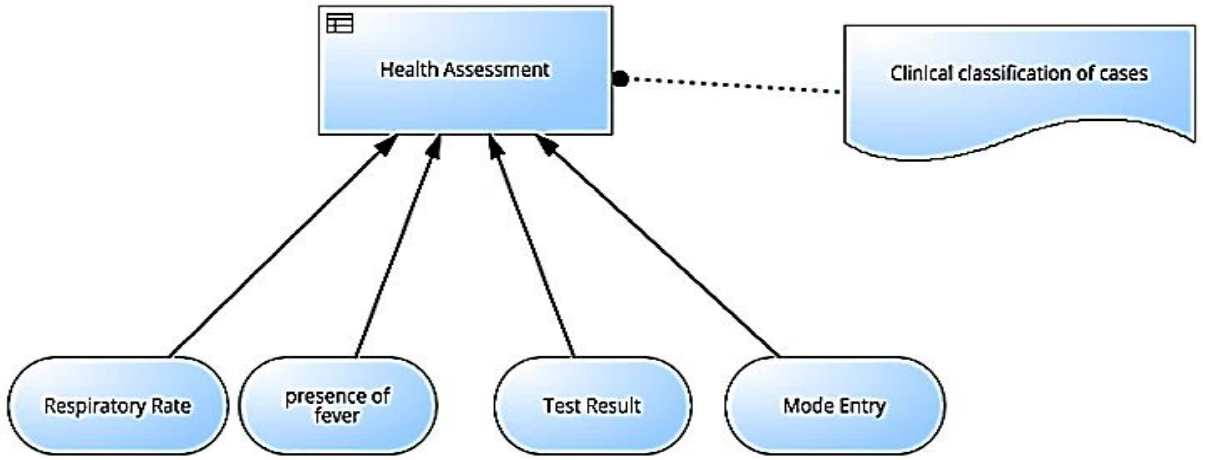


COvi**D**-19 **O**ntology for cases and patient information (**CODO**)[1]

[1]B. Dutta and M. DeBellis, "CODO: An Ontology for Collection and Analysis of Covid-19 Data," no. November, pp. 76–85, 2020, doi: 10.5220/0010112500760085.

Approach Application: Representation of Decision Mining rules and ontology rules through DMN

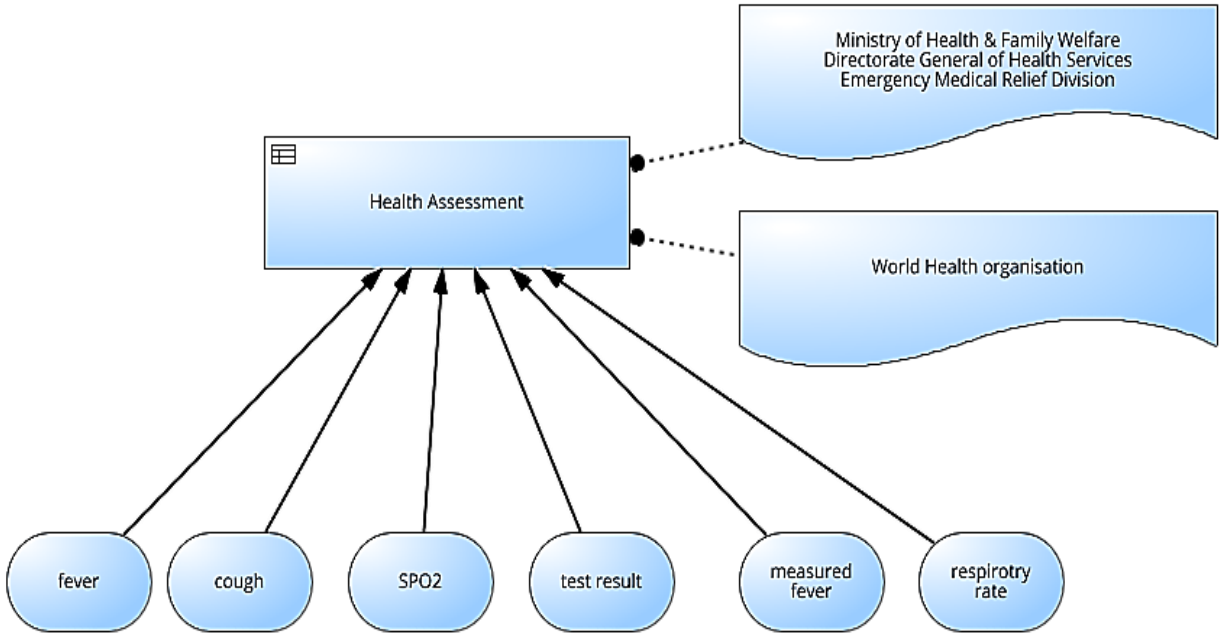
- Presenting how the decisions discovered in process models can be expressed into the corresponding elements of the DMN model.
- DMN defines two levels: decision requirements diagram (DRD) level and decision logic level (DL).



	Inputs								Outputs
F	Respiratory Rate		Fever		Test Result		Mode Entry		case type
	Number		*{has symptom fever}*		*{positive}*		*{SAMU}*		*Text*
1	≤	22	=	has symptom...	=	positive		-	"mild "
2	⊂	[22..28]		-	=	positive	=	SAMU	"moderate "
3	>	28		-	=	positive	=	SAMU	"severe "

Approach Application: Representation of Decision Mining rules and ontology rules through DMN

- **Expressing the ontology rules through DMN elements.**



	Inputs												Outputs
F	fever		cough		SpO2		measured fever		respirotry rate		test result		case type
	{has symptom fever}		*{has symptom cough}*		*Number*		*Number*		*Number*		*{positve}*		*Text*
1		-		-	⊂	[90..94]		-	⊂	[15..30]	=	positve	"moderate"
2		-		-		-		-	≥	30	=	positve	"severe"
3		-		-	<	90		-	≥	30	=	positve	"severe"
4	=	has symptom...		-		-		-		-	=	positve	"mild"
5	=	has symptom...	=	has symptom...		-	≥	38		-	=	positve	"mild"

Approach Application: Conformance checking between decision mining rules and ontology rules

decision tables

CaseId	Respiratory F	Measured Fe	Test Resı	Fever	Cough	SPO2	Result
1	19	38,2	positive	has symptom f	has symptom	100	mild
2	30	37	positive	has symptom f	has symptom	100	severe
3	20	38	positive	has symptom f	has symptom	96	mild
4	16	39,6	positive	has symptom f	has symptom	98	mild
5	16	39,2	positive	has symptom f	has symptom	98	mild
6	19	38,2	positive	has symptom f	has symptom	93	moderate
7	18	38,1	positive	has symptom f	has symptom	98	mild
8	24	37,1	positive	has symptom f	has symptom	92	moderate
9	28	37	positive			92	moderate
10	24	37,3	positive	has symptom f	has symptom	98	mild
11	24	37	positive	has symptom f	has symptom	99	mild
12	30	36,5	positive			100	severe
13	24	37	positive			94	moderate
14	16	38,3	positive	has symptom f	has symptom	99	mild
15	24	37	positive			94	moderate
16	24	37	positive			94	moderate
17	28	37	positive			92	moderate

ontology rules

Name	CaseId	Respiratory	Test Result	Fever	Mode Entry	result
testCases	1	19	positive	has symptom	fever	mild
testCases	2	30	positive	has symptom	SAMU	severe
testCases	3	20	positive	has symptom	SAMU	mild
testCases	4	16	positive	has symptom	SAMU	mild
testCases	5	16	positive	has symptom	SAMU	mild
testCases	6	19	positive	has symptom	SAMU	mild
testCases	7	18	positive	has symptom	SAMU	mild
testCases	8	24	positive	has symptom	SAMU	moderate
testCases	9	28	positive			moderate
testCases	10	24	positive	has symptom	SAMU	moderate
testCases	11	24	positive	has symptom	SAMU	moderate
testCases	12	30	positive		SAMU	severe
testCases	13	24	positive		SAMU	moderate
testCases	14	16	positive	has symptom	fever	mild
testCases	15	24	positive		SAMU	moderate
testCases	16	24	positive		SAMU	moderate
testCases	17	28	positive		SAMU	moderate

DM rules

True	Conformance
True	Conformance
True	Conformance
True	Conformance
True	Conformance
False	Please check the patient status
True	Conformance
True	Conformance
True	Conformance
False	Please check the patient status
False	Please check the patient status
True	Conformance
True	Conformance
True	Conformance
True	Conformance
True	Conformance
True	Conformance

The formula returns :

- true if the results are exactly the same.
- False if there are any differences.

Conclusion and Future work

- **Approach:** Proposal of an ontology-based approach for conformance checking of DM rules using ontologies.
- **Method :**

  Identification of decision rules in the control flow of process models and the derivation of corresponding DMN models.

  Selection of an ontology and the derivation of corresponding DMN models.

  Checking similarity between ontology rules and decision mining rules.
- **Approach application:** In the COVID-19 crisis unit of the Farhat Hached University Hospital Center**.**

Conclusion and Future work

Future work :

- Create an automatic tool for extracting the divergent cases when comparing DM rules and ontology rules.
- Rely on similarity metrics specifically dedicated to semantic similarity.

Thank you for your attention!