MESTRADO INTEGRADO EM ENGENHARIA INFORMÁTICA

Revisão de Artigos: ANN e CBR

SISTEMAS DE REPRESENTAÇÃO DE CONHECIMENTO E RACIOCÍNIO

2015/2016

Abordagem

Revisão de Artigos

I. Qualidade da Informação versus Grau de Confiança

II. Representação do Conhecimento e Raciocínio

III. Redes Neuronais Artificiais

IV. Raciocínio Baseado em Casos

Revisão de Artigos

A Soft Computing Approach to Quality Evaluation of General Chemistry Learning in Higher Education

Margarida Figueiredo, José Neves e Henrique Vicente

ANN

An Artificial Intelligence Approach to Dyscalculia

Filipa Ferraz, José Neves, António Costa e Henrique Vicente

CBR

I. Qualidade da Informação vs. Grau de Confiança

QoI vs. DoC

Quality of Information *QoI*

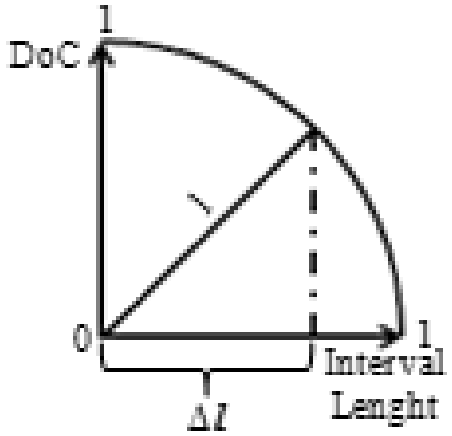
$$predicate_i((x_1, \cdots, x_n)) :: QoI$$

[0,1]

falso verdadeiro

$$QoI_i = {}^{1}/_{Card}$$

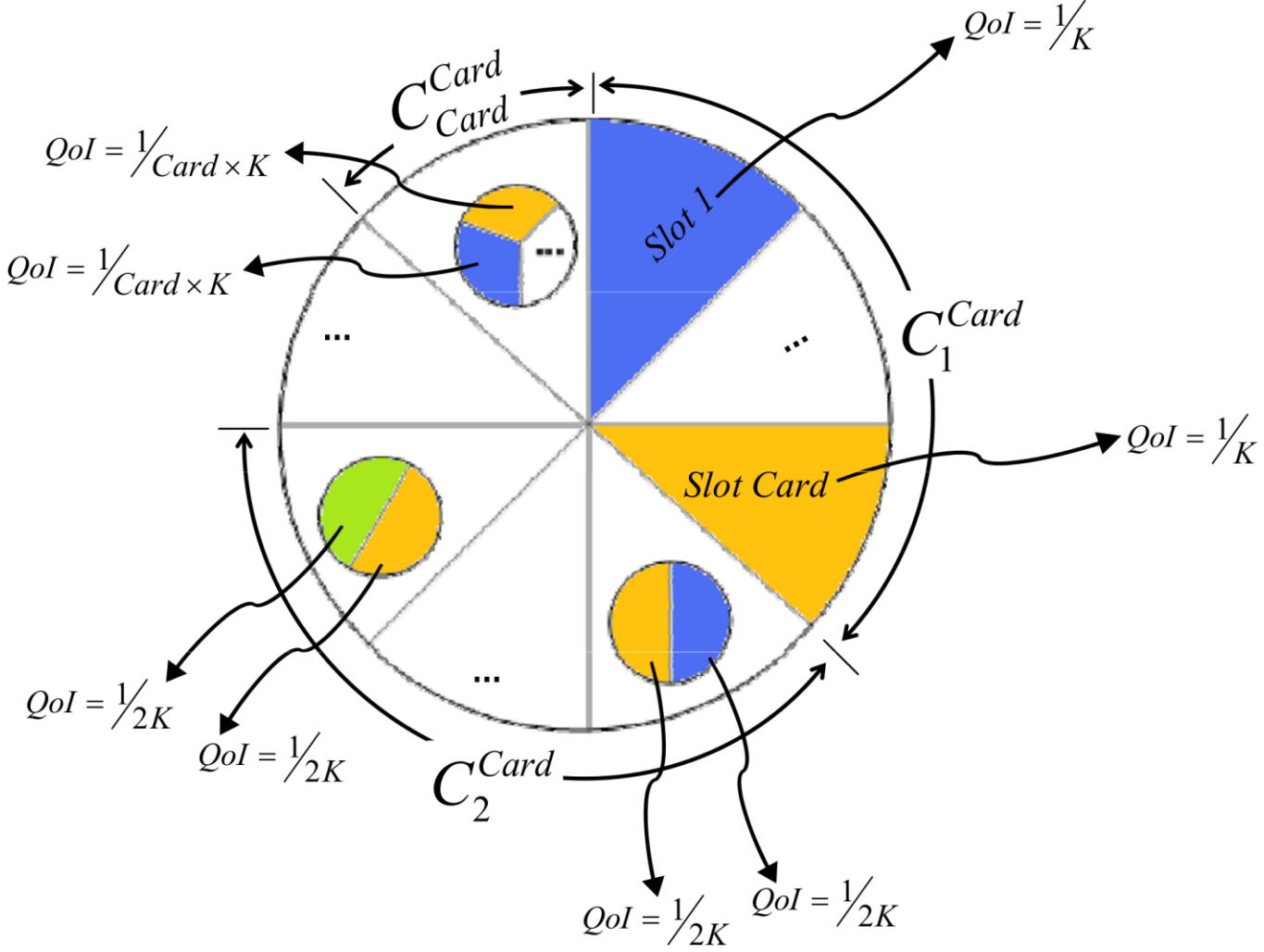
Degree of Confidence *DoC*



$$DoC = \sqrt{1 - \Delta l^2}$$

$$\downarrow$$

$$|0,1|$$



$$K = C_1^{Card} + C_2^{Card} + \cdots + C_{Card}^{Card}$$

II. Representação do Conhecimento e Raciocínio

Extensão do Programa em Lógica, Normalização, QoI, DoI

Extensão do Programa em Lógica (EPL)

$$\{$$

$$\neg f_1\left((QoI_{x_1}, DoC_{x_1}), (QoI_{y_1}, DoC_{y_1}), (QoI_{z_1}, DoC_{z_1})\right) \leftarrow not\left((QoI_{x_1}, DoC_{x_1}), (QoI_{y_1}, DoC_{y_1}), (QoI_{z_1}, DoC_{z_1})\right)$$

$$f_1 \underbrace{\left((QoI_{\perp}, DoC_{\perp}), (QoI_2, DoC_2), \left(QoI_{[1,\,1.75]}, DoC_{[1,1.75]}\right)\right)}_{attribute`s\ values} :: QoI :: DoC$$

$$\underbrace{[3,6] \qquad [0,3] \qquad [0.5,2]}_{attribute`s\ domains}$$

$$exception_{f_1}\left(\left(QoI_{[5,6]}, DoC_{[5,6]}\right), (QoI_{\perp}, DoC_{\perp}), (QoI_{0.8}, DoC_{0.8})\right) :: QoI :: DoC$$

$$exception_{f_1}\left((QoI_4, DoC_4), \left(QoI_{[0,2]}, DoC_{[0,2]}\right), (QoI_{\perp}, DoC_{\perp})\right) :: QoI :: DoC$$

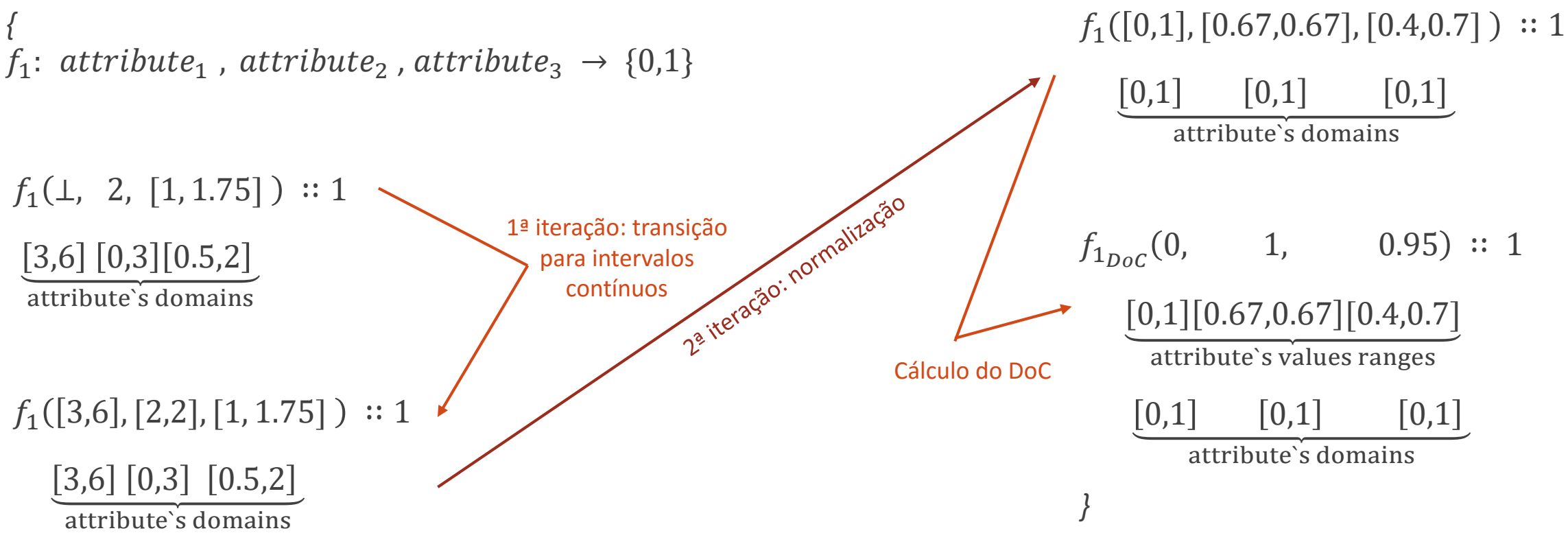
$$exception_{f_1}\left((QoI_{\perp}, DoC_{\perp}), (QoI_{1.5}, DoC_{1.5}), \left(QoI_{[1,2]}, DoC_{[1,2]}\right)\right) :: QoI :: DoC$$

$\}$ :: 1 (*once the universe of discourse is set in terms of the extension of only one predicate*)

TIPOS DE DADOS

⊥	desconhecido
[a,b]	intervalos
{baixo, médio, alto}	qualitativos
{2,5,9}	discretos

EPL, Normalização e DoC



III. Redes Neuronais Artificiais

ANN

A Soft Computing Approach to Quality Evaluation of General Chemistry Learning in Higher Education

Abstract

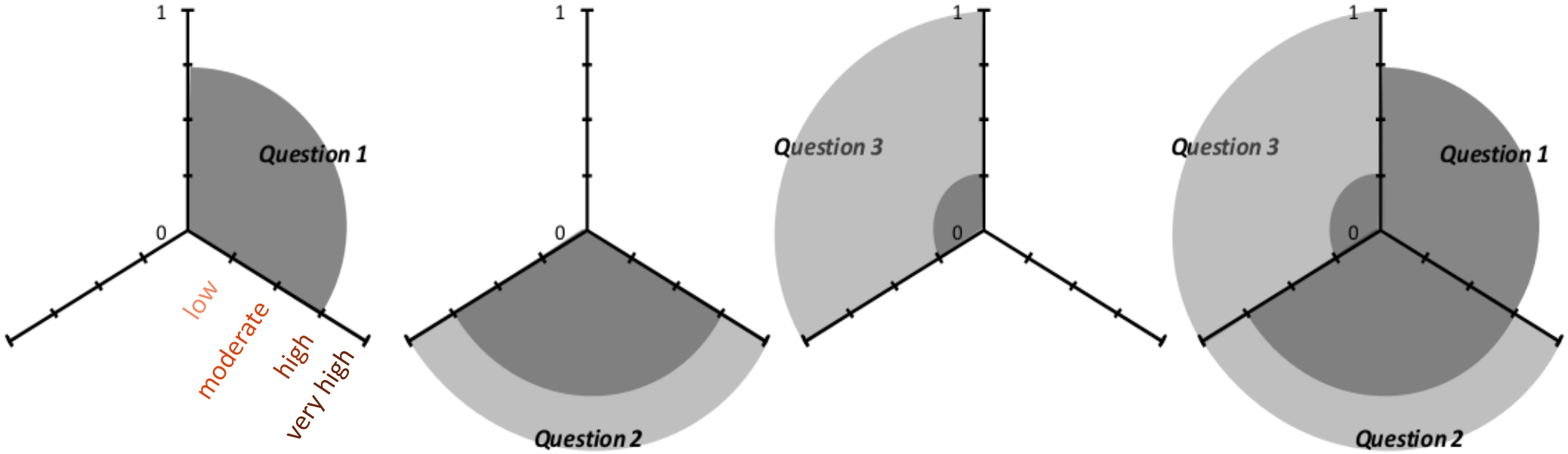
In contemporary societies higher education must shape individuals able to solve problems in a workable and simpler manner and, therefore, a multidisciplinary view of the problems, with insights in disciplines like psychology, mathematics or computer science becomes mandatory. Undeniably, the great challenge for teachers is to provide **a comprehensive training in General Chemistry with high standards of quality**, and aiming not only at the **promotion of the student's academic success**, but also at the **understanding of the competences/skills required to their future doings**. Thus, this work will be focused on **the development of an intelligent system to assess the Quality-of-General-Chemistry-Learning**, based on factors related with subject, teachers and students.

Keywords

General Chemistry · Higher Education · Logic Programming · Knowledge Representation and Reasoning · Artificial Neural Networks

Pré-processamento de Dados

low → $\frac{\pi \times 0.25^2}{3} = 0.02\pi$ *moderate* → $\frac{\pi \times 0.5^2}{3} = 0.08\pi$ *high* → $\frac{\pi \times 0.75^2}{3} = 0.19\pi$ *very high* → $\frac{\pi \times 1^2}{3} = 0.33\pi$

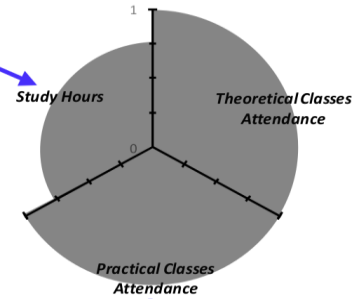


$A_{total} = 0.19\pi$ $A_{total} = |0.19\pi, 0.33\pi|$ $A_{total} = |0.02\pi, 0.33\pi|$ $A_{total} = |0.4\pi, 0.85\pi|$

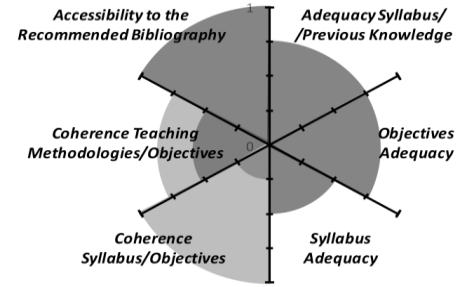
Subject Related Factors						
#	*Adequacy Syllabus/ /Previous Knowledge*	*Objectives Adequacy*	*Syllabus Adequacy*	*Coherence Syllabus/Objectives*	*Coherence Teaching Methodologies/Objectives*	*Accessibility to the Recommended Bibliography*
1	High	High	Moderate	⊥	High/Moderate	Very High
2	Low	Moderate	Moderate	Moderate	Moderate	High
…	…	…	…	…	…	…
127	Very High	Very High	High	High	Very High	Very High

Student Related Factors			
#	*Theoretical Classes Attendance*	*Practical Classes Attendance*	*Study Hours*
1	Very High	Very High	High
2	High	High	High
…	…	…	…
127	Very High	Very High	Very High

Case 1



Case 1

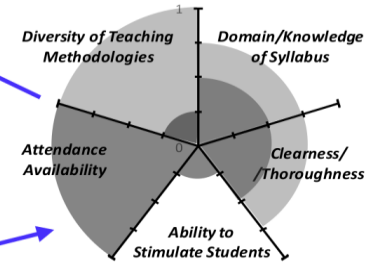


Case 1

Case 1

General Chemistry Learning Quality			
#	*Student Issues*	*Teacher Issues*	*Subject Issues*
1	0.85	[0.33, 0.64]	[0.48, 0.66]
2	0.56	0.31	0.27
…	…	…	…
127	1	[0.53, 1]	0.85

Case 1



Case 1

Teacher Related Factors					
#	*Domain/Knowledge of Syllabus*	*Clearness/Thoroughness*	*Ability to Stimulate Students*	*Attendance Availability*	*Diversity of Teaching Methodologies*
1	High/Moderate	High/Moderate	Low	Very High	⊥
2	Moderate	Moderate	Moderate	High	Moderate
…	…	…	…	…	…
127	Very High/High	Very High	⊥	Very High	⊥

Extensão do Programa em Lógica (EPL)

$$quality_{gcl}: Stud_{ent\ Issues}, Teacher_{Issues}, Subj_{ect\ Issues} \rightarrow \{0,1\}$$

General Chemistry Learning Quality

#	Student Issues	Teacher Issues	Subject Issues
1	0.85	[0.33, 0.64]	[0.48, 0.66]
2	0.56	0.31	0.27
...	...	...	...
127	1	[0.53, 1]	0.85
	[0, 1]	[0, 1]	[0, 1]

Caso Aleatório

$Stud_{ents\ Issues} = 0.71$
$Teacher_{Issues} = [0.25, 0.56]$
$Subj_{ect\ Issues} = \bot$

EPL, Normalização, QoI e DoC

$$\{$$

$$\neg\ quality_{gcl}\ \Big((QoI_{Stud}, DoC_{Stud}), (QoI_{Teacher}, DoC_{Teacher}), \big(QoI_{Subj}, DoC_{Subj}\big)\Big)$$

$$\leftarrow not\ quality_{gcl}\ \Big((QoI_{Stud}, DoC_{Stud}), (QoI_{Teacher}, DoC_{Teacher}), \big(QoI_{Subj}, DoC_{Subj}\big)\Big)$$

$$quality_{gcl}\ \underbrace{\big((1,1),\ (1,0.95),\ (0,1)\big)}_{\substack{attribute's\ quality\ of\ information \\ and\ respective\ confidence\ values}}\ ::1::0.65$$

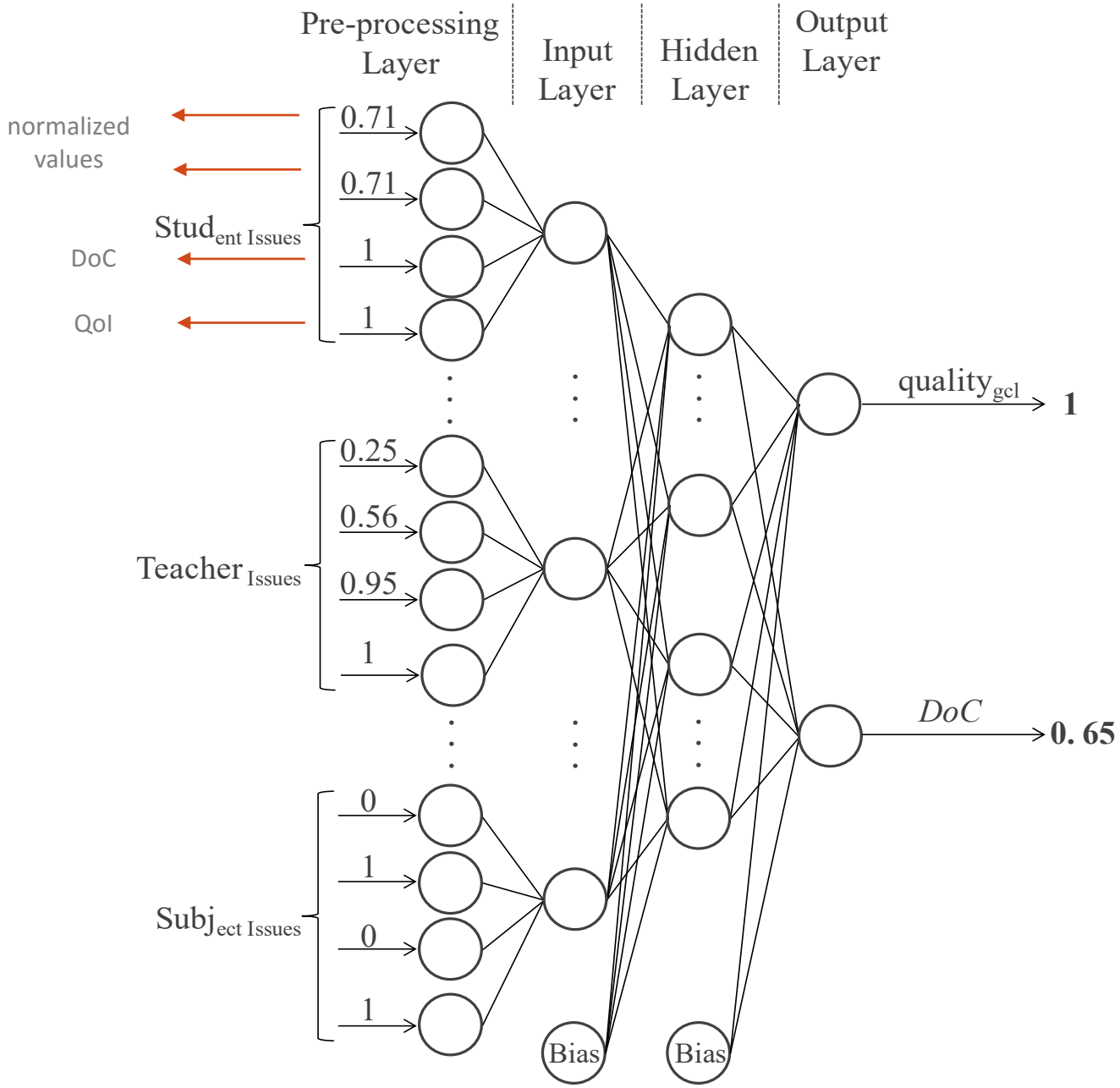
$$\underbrace{(1,\quad 0.95,\quad 0)}_{attibute's\ degree\ of\ confidence}$$

$$\underbrace{[0.71,\ \ 0.71]\ [0.25, 0.56]\ [0, 1]}_{attribute's\ values\ ranges}$$

$$\underbrace{[0,1]\qquad [0,1]\qquad [0,\ 1]}_{attribute's\ domains}$$

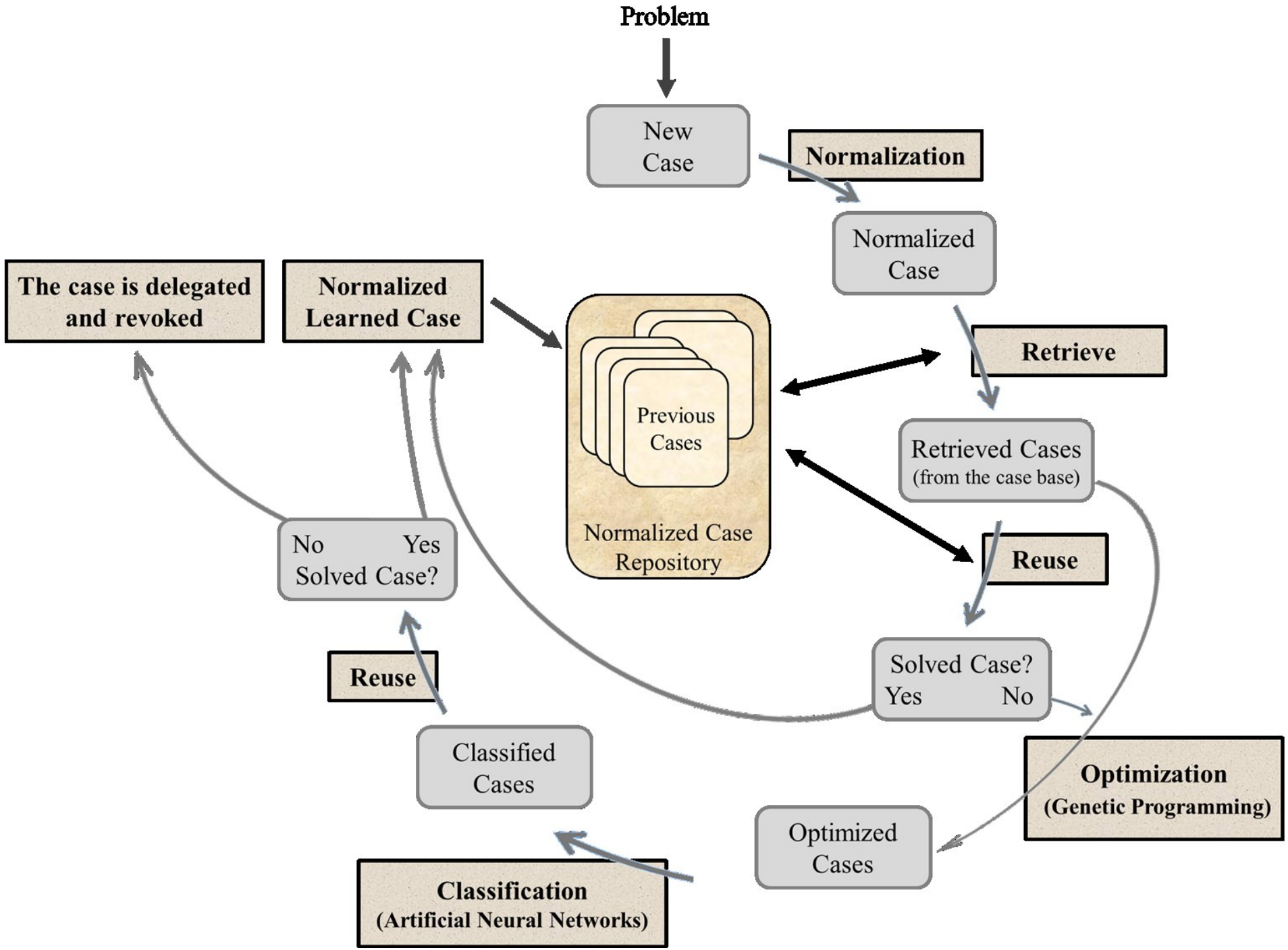
$$\}::1$$

Rede Neuronal Artificial do Caso Aleatório



IV. Raciocínio Baseado em Casos

CBR


Problem
New Case
Normalization
Normalized Case
Retrieve
Retrieved Cases (from the case base)
Reuse
Solved Case? Yes No
Optimization (Genetic Programming)
Optimized Cases
Classification (Artificial Neural Networks)
Classified Cases
Reuse
No Yes Solved Case?
The case is delegated and revoked
Normalized Learned Case
Previous Cases
Normalized Case Repository

An Artificial Intelligence Approach to Dyscalculia

Abstract

Dyscalculia stands for a brain-based condition that makes it hard to make sense of numbers and mathematical concepts. Some adolescents with dyscalculia cannot grasp basic number concepts. They work hard to learn and memorize basic number facts. They may know *what* to do in mathematical classes but do not understand *why* they are doing it. In other words, they miss the logic behind it. However, it may be worked out in order to decrease its degree of severity. For example, ***disMAT***, an *app* developed for *android* may help children to apply mathematical concepts, without much effort, that is turning in itself, a promising tool to **dyscalculia treatment**. Thus, this work focuses on the development of an *Intelligent System* to estimate **children evidences of dyscalculia**, based on data obtained on-the-fly with *disMAT*. The computational framework is built on top of a *Logic Programming* framework to *Knowledge Representation and Reasoning*, complemented with a *Case-Based* problem solving approach to computing, that allows for the handling of incomplete, unknown, or even contradictory information.

Keywords

Dyscalculia · Knowledge Representation and Reasoning · Logic Programming · Case-Based Reasoning · Similarity Analysis

Extensão do Programa em Lógica (EPL)

$$dys_{diag}: Age, L_{evels}C_{ompleted}, Min_{imum\ Score}, Ave_{rage\ Score}, Max_{imum\ Score},$$
$$L_{evel}1\ R_{esponse\ Time}, L_{evel}2\ R_{esponse\ Time}, L_{evel}3\ R_{esponse\ Time},$$
$$U_{nderstanding}D_{ifficulties}, D_{oing}D_{ifficulties} \rightarrow \{0,1\}$$

Dyscalculia Diagnosis

#	Age	Nº. of Levels Completed	Minimum Score	Average Score	Maximum Score	Level 1 Response Time	Level 2 Response Time	Level 3 Response Time	Understanding Difficulties	Doing Difficulties	Descriptions
1	6	0	0	5	10	[12,30]	⊥	[0,6]	2	2	Description 1
2	7	2	90	190	290	[12,21]	[0,11]	[6,16]	1	0	Description 2
...	...	...	...	...	...	...	...	...	...	...	...
148	6	⊥	0	60	120	[12,30]	[11,24]	[0,6]	⊥	1	Description 148
	[5,10]	[0,3]	[0,300]	[5,300]	[10,300]	[12,60]	[0,30]	[0,20]	[0,2]	[0,2]	

Caso Aleatório

Age = 8
Levels Completed = 2
Minimum Score = 20
Average Score = 120
Maximum Score = 220
Level 1 Response Time = [12, 20]
Level 2 Response Time = 15
Level 3 Response Time = 0
Understanding Difficulties = ⊥
Doing Difficulties = ⊥

EPL, Normalização, QoI e DoC

$$\{$$

$$\neg\, dys_{diag}\ \Big((QoI_{Age}, DoC_{Age}), \cdots, (QoI_{L1R}, DoC_{L1R}), \cdots, (QoI_{DD}, DoC_{DD})\Big)$$

$$\leftarrow not\ dys_{diag}\ \Big((QoI_{Age}, DoC_{Age}), \cdots, (QoI_{L1R}, DoC_{L1R}), \cdots, (QoI_{DD}, DoC_{DD})\Big)$$

$$dys_{diag}\ \underbrace{\big((1,1), \cdots, (1,0.99), \cdots, (1,0)\big)}_{\substack{attribute's\ quality\ of\ information \\ and\ respective\ confidence\ values}} :: 1 :: 0.80$$

$$\underbrace{(1, \quad \cdots \quad , 0.99, \quad \cdots \quad , 0)}_{attibute's\ degree\ of\ confidence}$$

$$\underbrace{[0.6, 0.6] \quad \cdots \quad [0, 0.17] \quad \cdots \quad [0, 1]}_{attribute's\ values\ ranges\ once\ normalized}$$

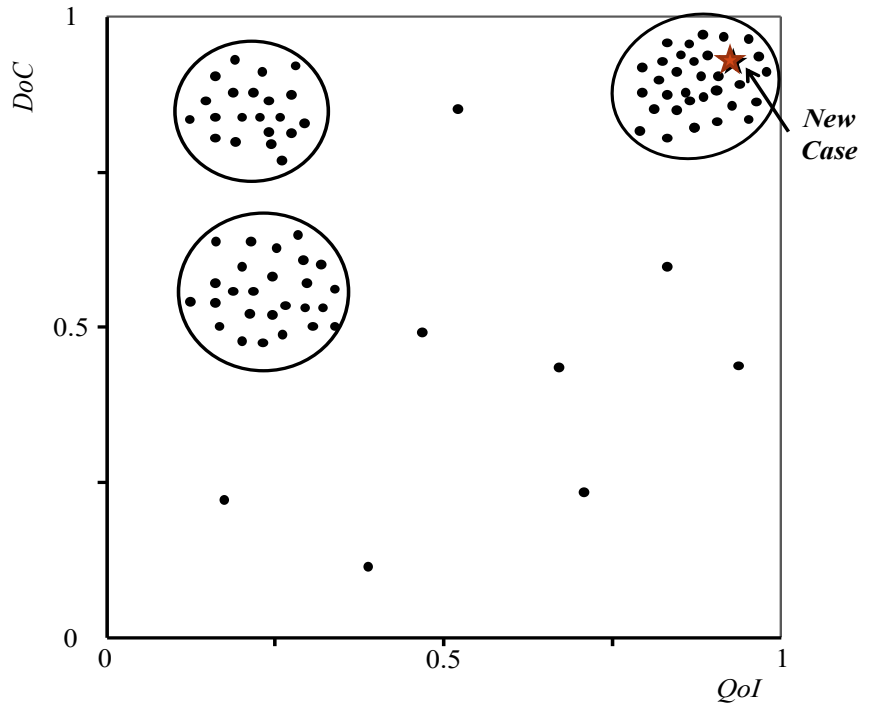
$$\underbrace{[0, 1] \quad \cdots \quad [0, 1] \quad \cdots \quad [0, 1]}_{attribute's\ domains\ once\ normalized}$$

$$\}\ ::\ 1$$

Processo CBR

Abordagem CBR

$$Case = \{< Raw_{data}, Normalized_{data}, Description_{data} >\}$$



$$\underbrace{dys_{diag_{new}}\big((1,1),(1,0),\cdots,(1,0.97),(1,0.89),\cdots,(1,1),(1,1)\big) \;::\; 1 \;::\; 0.88}_{new\ case}$$

Novo Caso

Age = 6

$L_{evels}C_{ompleted}$ = *7*

$Min_{imum\ Score}$ = 30

$Ave_{rage\ Score}$ = 150

$Max_{imum\ Score}$ = 240

$L_{evel\ 1}\ R_{esponse\ Time}$ = [12, 20]

$L_{evel\ 2}\ R_{esponse\ Time}$ = [11, 18]

$L_{evel\ 3}\ R_{esponse\ Time}$ = [6, 15]

$U_{nderstanding}\ D_{ifficulties}$ = *0*

$D_{oing}\ D_{ifficulties}$ = 0

Description = Description new

$$\underbrace{dys_{diag_{new}}\big((1,1),(1,0),\cdots,(1,0.97),(1,0.89),\cdots,(1,1),(1,1)\big) :: 1 :: 0.88}_{new\ case}$$

Novo caso

$$dys_{diag_1}\big((1,1),(1,0.98),\cdots,(1,1),(1,1),\cdots,(1,1),(1,0)\big) :: 1 :: 0.84$$
$$dys_{diag_2}\big((1,1),(1,1),\cdots,(1,0),(1,1),\cdots,(1,1),(1,0.95)\big) :: 1 :: 0.89$$
$$\vdots$$
$$\underbrace{dys_{diag_j}\big((1,1),(1,0.92),\cdots,(1,0),(1,0),\cdots,(1,1),(1,0)\big) :: 1 :: 0.72}_{normalized\ cases\ from\ retrieved\ cluster}$$

Cluster com os casos mais próximos do 'novo caso'

$$dys_{diag}{}^{DoC}_{new\to 1} = \frac{\|1-1\| + \|0-0.98\| + \|1-1\| + \cdots + \|1-0\|}{10} = 0.17$$

Dissimilaridade entre o 'novo caso' e o caso 1

$$similarity\left[dys_{diag}{}^{DoC}_{new\to 1}\right] = dys_{diag}{}^{QoI}_{new\to 1} - dys_{diag}{}^{DoC}_{new\to 1} = 1 - 0.17 = 0.83$$

Similaridade entre o 'novo caso' e o caso 1

$$global\ similarity\left[dys_{diag}{}^{QoI,DoC}_{new\to 1}\right] = \frac{1 + 0.83}{2} = 0.92$$

Similaridade global

Dúvidas?

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