



Enhancing Instructors' Capability to Assess Open-Response using Natural Language Processing and Learning Analytics

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- **Education:**
 - PhD in Computer Science - UFPE, Brazil
 - Postdoc in University of Edinburgh, Scotland
- **Research Topics:**
 - Natural Language Processing
 - Learning Analytics
- **Research group:**
 - <https://aiboxlab.github.io/>
 - <https://www.nees.ufal.br/>
- **Google scholar:**
 - https://scholar.google.com.br/citations?user=kfo_AdcAAAAJ&hl=pt-BR&oi=a0

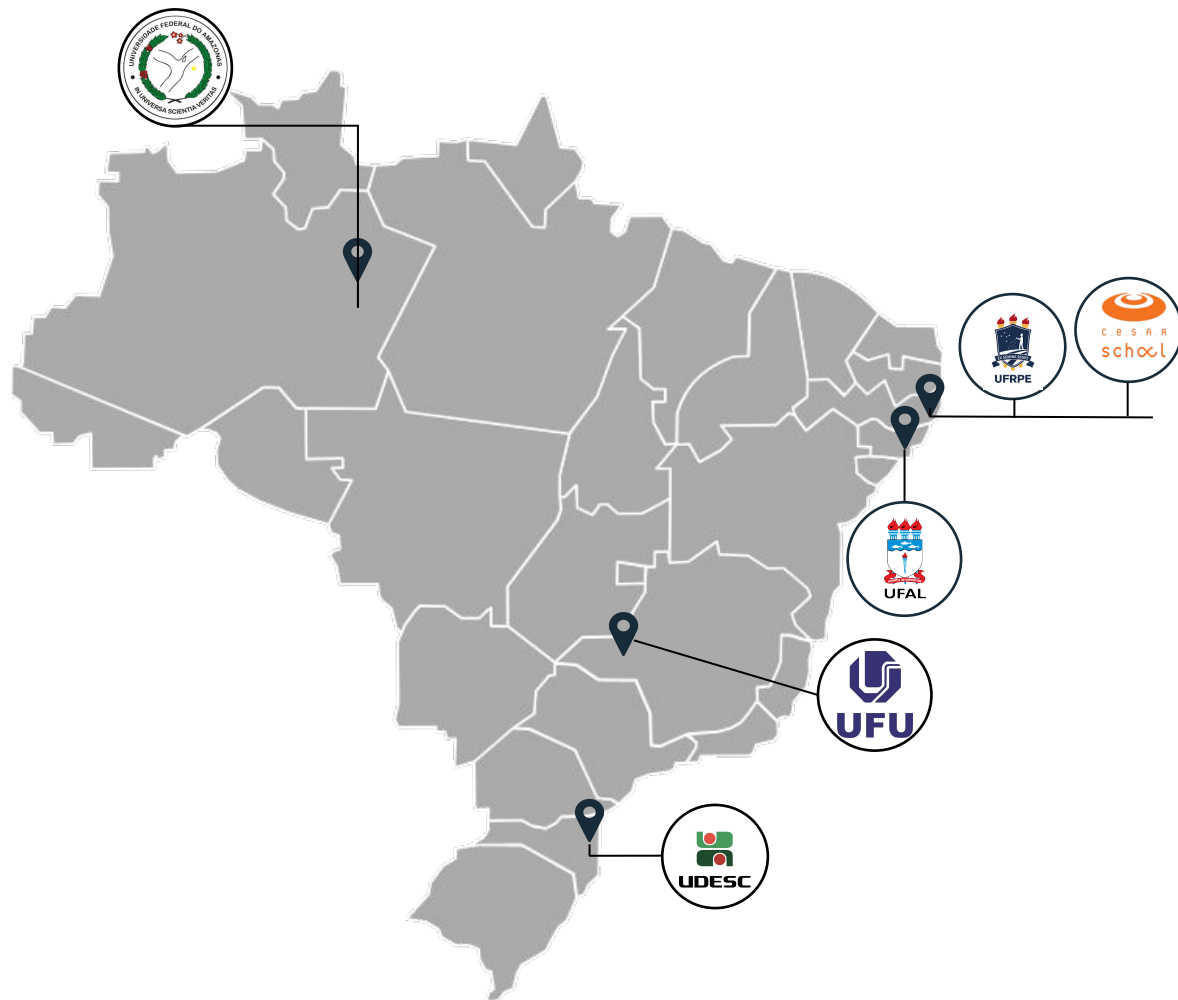


Pernambuco











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Context and motivation

How to improve the **feedback** given by teachers, to make it **quality**, **personalized** and **scalable**?



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Talking to students and Instructors

“ This (only getting a grade for the activity) is not a correction, it's just a list of responses. Correction is about commenting. ”

“ It's a lot of work to deliver all the feedback, especially with very large classes. ”

“ Receiving feedback comments is much better because we can see what we went wrong and improve in the future ”

“ Can't correct 120 contextualized tests ”



TUTORIA

We are a platform that assists teachers in correcting activities and directs this process towards the creation of complete feedback for the entire class.





My Assessments

You are correcting the activity 1.



Student 1

1. What is a programming language? 1

A programming language is a collection of grammar rules for giving instructions to computer or computing devices in order to achieve task.

Create extra tags for this question 2

Correct ▾

Tags

Correct Error

Programming language ✕

3

You can write a feedback message below

Perform achieve task ✕

Feedback

Score for this question 4

Save



Proposal

LA and NLP to support **instructors** in
assessing **open-ended responses** using
tag recommendation algorithms



Proposal - Clow LA cycle

(1) learners producing (2) data, which are processed into (3) metrics, thereby informing (4) interventions or actions



Proposal

(1) learners producing (2) data, which are processed into (3) metrics, thereby informing (4) interventions or actions

(1) the student answer open-ended questions, which (2) are assessed by the instructor in the platform, thereby (3) the system generates tag recommendations for the following student answer, (4) that can be accepted or not by the instructor



Proposal

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Proposal

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Proposal

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Student 1

1

Question 1

Student Answer

Type of comment

Correct Errors

Student 1

2

Question 1

Student Answer

Type of comment

Correct Errors

YELLOW TAG X

Feedback message about yellow tag

GREEN TAG X

Feedback message about green tag

Student 2

3

Question 1

Student Answer

Type of comment

Correct Errors

BLUE TAG X

Feedback message about blue tag

Student 2

4

Question 1

Student Answer

Type of comment

Correct Errors

BLUE TAG X

Feedback message about blue tag

GREEN TAG X

Feedback message about green tag

Minha Correção

Você está corrigindo a atividade **Atividade de informática básica**



Rafael Ferreira

2. O que são dispositivos de entrada e de saída?

Dispositivos de entrada são equipamentos de hardware responsáveis por receber sinais externos e capturar para o computador. Esses sinais podem ser imagem, áudio ou até mesmo os cliques de do mouse ou teclado.

Criar marcadores extras



Marcadores da questão

Erro

Acerto

Acerto parcial

Dispositivos de entrada são equipamentos de hardware responsáveis

Última edição: hoje às 08:39



Comentários gerais



Minha Correção

Você está corrigindo a atividade **Atividade de informática básica**

EN Estudante não cadastrado

2. O que são dispositivos de entrada e de saída?

Dispositivos de entrada são os que entram no computadores, os de saída são os que saem.

Criar marcadores extras ▼

Marcadores da questão

Erro Acerto Acerto parcial

Nenhum marcador cadastrado.

Comentários gerais ? ▼

Method



Dataset

- Fully-online undergraduate course
- Basic Informatics
- 47 students
- 5 open-ended questions

Table 1: Distribution of tags per question.

Question	Responses	Unique tags	Total number of tags	Potential recommendation
Q1	33	4	35	132
Q2	33	4	42	132
Q3	47	10	98	470
Q4	47	3	63	141
Q5	47	4	37	188
Total	207	25	275	1063



Text Processing and Feature Extraction

- Term Frequency-Inverse Document Frequency (TF-IDF)
- Bidirectional Encoder Representations from Transformers (BERT)



Similarity Measures

- Levenshtein
- Partial ratio
- Token Sort Ratio
- Partial Token Sort Ratio
- Token Set Ratio
- Partial Token Set Ratio
- Fuzzy Search
- Edit Distance
- Rapidfuzz
- Similarity based on n-gram
- BERT + cosine similarity



Results

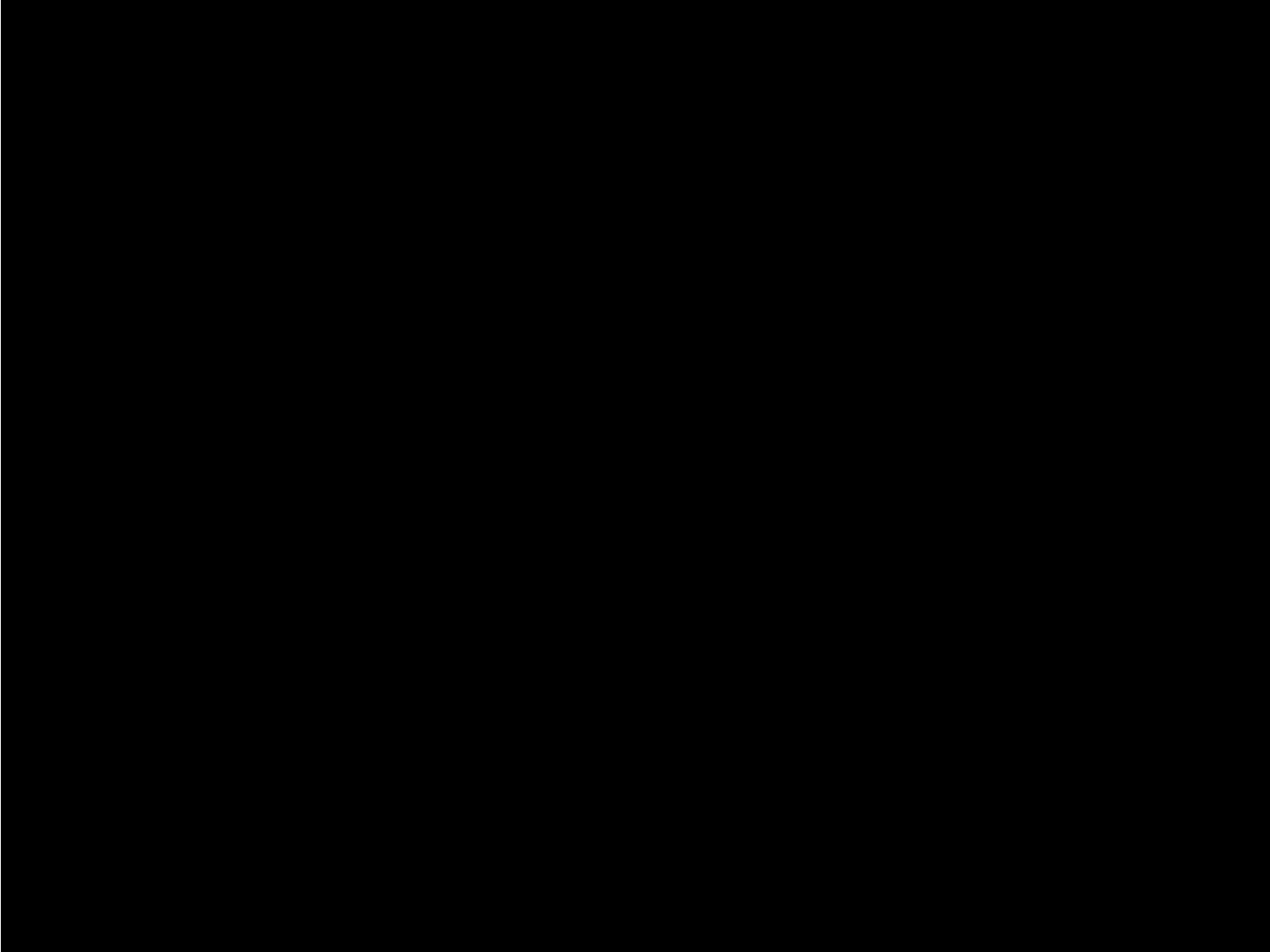


Results

Table 2: Results of each similarity algorithm in the tag recommendation task.

#	Similarity algorithm	Precision	Recall	F1-Score	Mean Time	Median Time
1	Levenshtein	0.80	0.01	0.01	00.02	00.03
2	Partial Ratio	0.98	0.32	0.48	00.06	00.29
3	Token Sort Ratio	0.94	0.02	0.03	00.05	00.07
4	Token Set Ratio	0.97	0.43	0.59	00.05	00.06
5	Partial Token Set Ratio	0.91	0.88	0.89	00.08	00.20
6	Partial Token Sort Ratio	0.96	0.25	0.39	00.07	00.25
7	Fuzzy Search	0.90	0.42	0.57	01.22	26.95
8	Edit Distance	0.93	0.62	0.74	01.03	01.04
9	Rapidfuzz	0.93	0.60	0.72	00.86	00.87
10	TFIDF 1-gram	0.90	0.74	0.81	05.10	05.10
11	TFIDF 2-gram	0.98	0.06	0.10	04.84	04.83
12	TFIDF 3-gram	0.98	0.02	0.03	04.78	04.75
13	TFIDF 4-gram	0.96	0.01	0.02	04.71	04.62
14	TFIDF n-gram	0.94	0.19	0.31	05.27	05.39
15	BERT	0.89	0.79	0.83	93.28	107.86





Tutoria in Practises

- System Usability Scale (SUS)

Average for good usability: 68

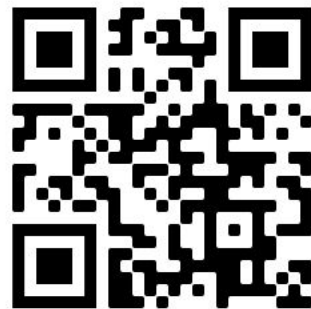
GENERAL AVERAGE OF TUTORIA: 73

The screenshot displays the Tutoria web application interface. The top navigation bar includes the logo 'TUTORIA' and links for 'Início', 'Configurações', 'Ajuda', 'Suporte', and 'Minha conta'. The main content area shows a quiz question: '3. Qual a diferença de hardware e software?'. Below the question, a text box explains that hardware consists of physical components (mouse, keyboard, hard disk, processor, etc.) and software consists of logical components (programs, operating system, files, data, etc.). To the right of the question, there is a 'Progresso de Correção' section with a circular progress indicator. On the far right, a video feed shows a man with long hair and a beard, wearing a green shirt, with the name 'RUAN VASCONCELOS BEZERRA CARVALHO' displayed below him. The bottom of the interface features 'Voltar' and 'Avançar' buttons.

Ensure **inclusive and equitable** quality education **for all?**



Questions?



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