TAGARELA: A web based intelligent workbook for Portuguese

Detmar Meurers and Ramon Ziai

based on joint research with
Luiz Amaral (UMass Amherst)

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TAGARELA: An Intelligent Tutoring System

- TAGARELA: Teaching Aid for Grammatical Awareness, Recognition and Enhancement of Linguistic Abilities (Amaral & Meurers 2005, 2006, 2007a,b, 2008, 2009; Amaral 2007; Ziai 2009)
- an intelligent web-based workbook for beginning learners of Portuguese
- designed to satisfy real-life FLT needs identified at OSU
- provide opportunities for students to practice their listening, reading, and writing skills
- offers individual feedback on learner input to system
- foster learner awareness of language forms and categories (Long 1991, 1996; Ellis 1994; Schmidt 1995; Lyster 1998; Lightbown & Spada 1999; Norris & Ortega 2000; Schulz 2002)

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System role, Activity types, Interface

- What role does the system play in teaching?
  → Self-guided activities accompanying teaching
- What type of activities are appropriate and useful for fostering awareness (and fit into the FLT approach)?
  → Activities ideally involve both form and meaning, such as listening/reading comprehension questions.
  - TAGARELA offers six types of activities:
    - listening comprehension
    - reading comprehension
    - picture description
    - fill-in-the-blank
    - rephrasing
    - vocabulary

    Similar to traditional workbook exercises, plus audio.
- What should the system interfaces look like?
  → Use L2 as far as possible (needs careful interface design).

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Providing Feedback

- TAGARELA provides on-the-spot feedback on
  - orthographic errors (non-words, spacing, capitalization, punctuation)
  - syntactic errors (nominal and verbal agreement)
  - semantic errors (missing or extra concepts, word choice)
- Providing feedback on meaning becomes crucial for activities such as reading and listening comprehension.

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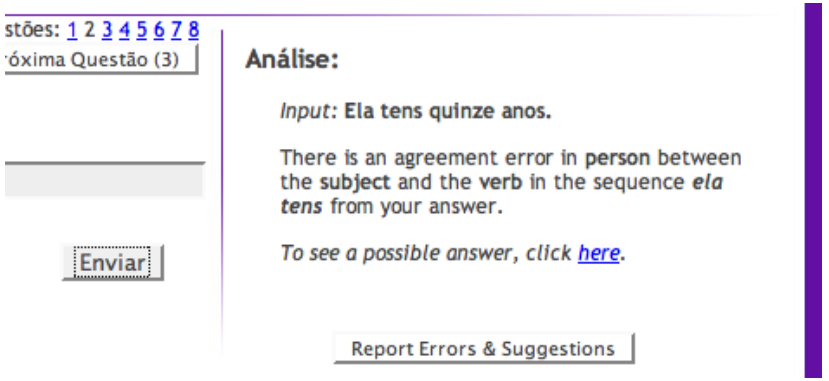
Feedback on Agreement



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Feedback on Word Choice

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Feedback on Wrong Word

Questões: 1 2 3 4
ma Questão (2)

e Beatriz

Análise:

Input: **Elas se chamam Ana e Maria.**

I think there is a problem with the proper noun you have chosen.

Are you sure you want to use **Maria** instead of **Beatriz**?

To see a possible answer, click here.

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Feedback on Missing Verb

Questões: 1 2 3 4 5
óxima Questão (4)

Enviar

Análise:

Input: **Qual o seu nome?**

Your answer is close, but there is a **verb** missing in your sentence.

To see a possible answer, click here.

Report Errors & Suggestions

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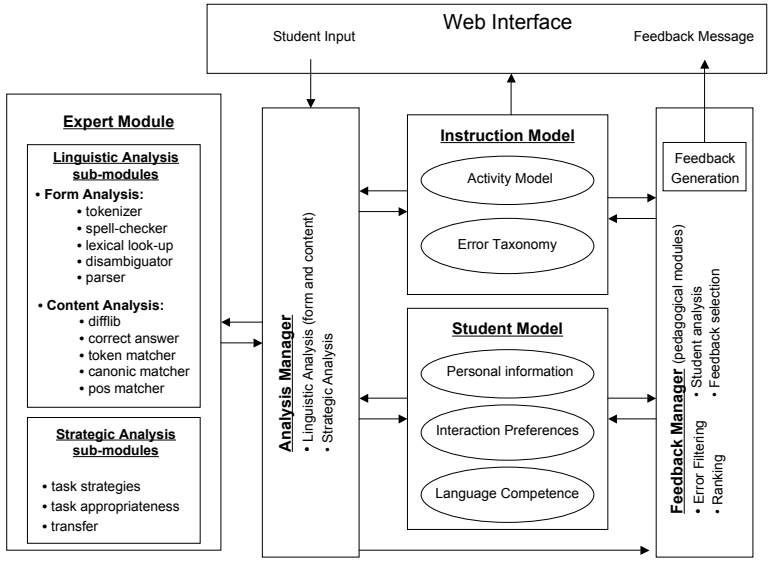
General Architecture of TAGARELA



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The three models

- The TAGARELA architecture includes
  - model of domain knowledge (linguistic knowledge)
  - learner model
  - instruction/activity model
- What is the point of learner and activity models?

⇒ Providing feedback involves
  - identifying linguistic properties of the learner input and
  - interpreting them in terms of likely (mis)conceptions of the learner
    - This interpretation goes beyond linguistic form as such.
    - It needs to model the learner's use of language for a specific task in a specific context.
      → (Amaral & Meurers 2007a)

NLP analysis modules in TAGARELA

- Form Analysis:
  - tokenizer: takes into account specifics of Portuguese (cliticization, contractions, abbreviations)
  - lexical/morphological lookup: returns multiple analyses based on CURUPIRA lexicon (Martins et al. 2006)
  - disambiguator: finite state disambiguation rules narrow down lexical information, in the spirit of Constraint Grammar (Karlsson et al. 1995; Bick 2000, 2004)
  - parser: bottom-up chart parser establishes relations to check agreement, case and global well-formedness
- Content Analysis:
  - shallow semantic matching strategies between student answer and target, cf. Content Assessment Module (Bailey & Meurers 2006, 2008)

Annotation-based processing

- Allow the analysis manager to flexibly employ NLP modules relevant to a particular activity.
- To support a flexible control structure, the data structures serving as input and as output for the analysis modules need to be uniform and explicit.
- NLP analysis = a process of enriching the learner input with annotations (parallel to XML-based corpus annotation)
- The same data structure, the learner input annotated with information, is accessed throughout.
  - Closely related idea: Common Analysis System (CAS, Götz & Suhre 2004) of the Unstructured Information Management Architecture (UIMA).
  - UIMA-based reimplementation of TAGARELA's NLP (Ziai 2009)
- In addition to the information obtained by analyzing the input, we need information about the activity.

General Characteristics of Activities

Activities can be characterized and differ in:

- task specification
  - e.g.: listen, read, write, comment, complete
- level
  - e.g.: basic, intermediate, advanced
- expected input
  - e.g.: word, phrase, sentence
- nature and availability of target responses and type of variation from target that is permitted
- required skills and abilities, e.g.:
  - strategies needed (e.g., scanning, summarizing, grouping)
  - amount of content manipulation required
  - required awareness of linguistic categories and rules
- pedagogical goals behind activity and feedback provided:
  - generally: improve the required skills and abilities

Where it matters for processing

- General claim: The NLP analysis and feedback generation depend on the specific activity (type).
- The information from the activity model has an impact on
  - **Property Identification**:
    - Which linguistic properties (incl. errors) of the learner input can actually be observed in a given activity?
  - **Property Selection**: Which of the observed properties to select as likely error cause (or other relevant aspect)?
    - Which of the identified properties is most likely to provide a reliable assessment?
    - Which of the identified errors should be the focus of the feedback given activity and its specific pedagogical goals?
  - **Feedback Strategy**: Which strategy does it choose? E.g.:
    - explicit feedback on form for FIBs
    - scaffolding for reading comprehension (i.e., encouraging the use of required strategies)

Property identification in TAGARELA

- In TAGARELA, different activity types require different linguistic information to analyze student's input:
  - FIB: spell-checking, lexical information
  - Rephrasing: as above + syntactic processing and basic content assessment (correct answer, token matcher)
  - Reading: as above + all content analysis modules
- Why not always run everything?
  - "Don't guess what you know."
  - The more we know about the linguistic properties, the types of variation, and the potential errors NLP needs to detect,
    - the more specific information we can diagnose
    - with higher reliability

TAGARELA meets real life language learners

- The system was used by beginning Portuguese students at The Ohio State University.
- Studying the system logs, we identified two aspects where feedback based on the linguistically correct analysis did not seem to be helpful for learners:
  - interpretation of tokens with accented characters
  - tokenization of compounds

Identifying tokens (I)

Regiões do Brasil

O Brasil está política e geograficamente dividido em cinco regiões. Os limites de cada região (Norte, Nordeste, Sudeste, Sul e Centro-Oeste) coincidem sempre com as fronteiras dos estados que as compõem.

A região Norte ocupa a maior parte do território brasileiro, com uma área que corresponde a 45,27% da área total do País. Formada por sete Estados, tem sua área quase totalmente dominada pela bacia do Rio Amazonas.

A região Nordeste pode ser considerada a mais heterogênea do País. Dividida em quatro grandes zonas - meio-norte, zona da mata, agreste e sertão -, ocupa 18,26% do território nacional e tem nove estados.

O Sudeste é formado por quatro Estados. Esta é a região de maior importância econômica do País, onde está concentrado também o maior índice populacional - 42,63% dos brasileiros.

Já o Sul, região mais fria do País, com ocorrências de geadas e neve, é a que apresenta menor área, ocupando 6,75% do território brasileiro e com apenas três Estados. Os rios que cortam sua área formam a bacia do Paraná em quase toda sua totalidade e são de grande importância para o País, principalmente pelo seu potencial hidrelétrico.

Finalmente, a região Centro-Oeste tem sua área dominada basicamente pelo Planalto Central Brasileiro e pode ser dividida em três porções: maciço goiano-mato-grossense, bacia de sedimentação do Paraná e as depressões. Ela é formada por quatro Estados e nela está a capital do Brasil.

Questões: 1 2 3 4 5 6 7
Próxima Questão (3)

Questão 2

Em que região fica o Rio Amazonas?

O Amazonas fica na região norte.

à á â ã é ê í ó ô õ ú ü ç
À Á Â Ã É Ê Í Ó Ô Õ Ú Ü Ç

Enviar

Análise:

Input: O Amazonas fica na região norte.

Excellent!

Identifying tokens (II)

Regiões do Brasil

O Brasil está política e geograficamente dividido em cinco regiões. Os limites de cada região (Norte, Nordeste, Sudeste, Sul e Centro-Oeste) coincidem sempre com as fronteiras dos estados que as compõem.

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à á ã ã é ê í ó ô õ ú ü ç
À Á Ã Ã É Ê Í Ó Ô Ô Ú Ü Ç

Enviar

Análise:

Input: O Amazonas fica no região norte.

There is an agreement error in **gender** between the **determiner** and the **noun** in the sequence ***o região norte*** from your answer.

To see a possible answer, click here.

Properties of Portuguese

Tokenization

- Certain Portuguese words are syntactically complex.
- Contraction: preposition + determiner/pronoun
  - *no* = *em* (in) + *o* (the)
  - *nela* = *em* (in) + *ela* (it)
  - *destes* = *de* (of) + *estes* (these)
  - *às* = *a* (to) + *as* (the)
- Encliticization:
  - *comprá-lo* = *comprar* (to buy) + *o* (it)
  - *compram-nas* = *compram* (buy) + *as* (them)
  - *comprei-a* = *comprei* (bought) + *a* (it)

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Mismatches in the identification of tokens

- Learner input: *O Amazonas fica no região norte.*
- System's interpretation: *no* = *em* + *o*
  - tokenized input: [em, o, região, norte]
  - syntactically analyzed: [$_{PP}$ em [$_{NP}$ o$_{masc}$, região$_{fem}$, norte]]
  - ⇒ Agreement error between *o* and *região*.
- Student's interpretation:
  - There is no *o região norte* in the sentence I wrote.
  - I used the 'preposition' *no*.
  - ⇒ So *no* seems to be the wrong preposition?

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Addressing the Identification of Tokens

- The system needs to connect the surface form provided by the student with the system analysis of this input.
- An annotation-based NLP architecture (→ UIMA) readily supports this with multiple parallel layers of annotation for the learner input.
- The tokenization mismatch can be addressed by representing both surface and deep tokenizations of the learner input, and the mapping between the two.
  - Refer to surface form when generating the feedback.

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Example Token Representation

```
Token
BEGIN        0
END          2
TOKENSTRING  'no'
CATEGORY     'prep'
LEXDEF       { LexiconInfo
               POS        'prep'
               CANONIC    'no'
               FREQUENCY  31
               SOURCE     'lexicon' }
DEEPFORM     { Token
               BEGIN        0
               END          2
               TOKENSTRING  'em'
               CATEGORY     'prep'
               LEXDEF       { LexiconInfo
                              POS     'prep'
                              SOURCE  'tokn' }
             , Token
               BEGIN        0
               END          2
               TOKENSTRING  'o'
               CATEGORY     'det'
               LEXDEF       { LexiconInfo
                              POS     'det'
                              SOURCE  'tokn'
                              GENDER  'm'
                              NUMBER  's' }
             }
```


Interpreting tokens: Accents (I)

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Interpreting tokens: Accents (II)

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Properties of Portuguese

Accents and their importance for lexical distinctions

- Accents in Portuguese encode important linguistic distinctions.
- Part-of-speech differences:
  - pronoun vs. verb
    - *esta* (this) – *está* (is)
  - conjunction vs. verb
    - *e* (and) – *é* (is)
  - verb vs. noun
    - *para* (stop) – *Pará* (state's name)
- Other differences:
  - gender
    - *avô* (grandfather) – *avó* (grandmother)
  - meaning
    - *coco* (coconut) – *cocô* (poop)

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Mismatches in the interpretation of accents

- Learner Input: *O vaso esta em cima de mesa.*
- System's interpretation:
  - The word *esta* in the learner input is a determiner.
  - There is no form of the verb (*estar*) in the answer.
  - ⇒ The student did not include the main verb.
- Student's interpretation:
  - I included *esta* as a form of the verb *estar*.
    - (The correct spelling is *está*.)
  - There is a verb in the sentence.
  - ⇒ The lack of an accent is a spelling error.

Addressing the Interpretation of Accents

- Learners perceive the unaccented and accented versions of a character as orthographically similar and in consequence confuse linguistically unrelated forms.
- The system needs to capture the confusability of accented with unaccented characters.
  - Treat accented and unaccented characters parallel to common L1-transfer phonological confusions.
    - *está* and *esta* are confused just like
    - *liver* and *river* are by Japanese learners of English

⇒ Develop a module that compares whether different (un)accentuated variants of input words are more likely.
  - Where this is the case, provide dedicated feedback alerting learner of this confusion.

Wrapping up: Token Identification & Interpretation

- Problems for an ITS can arise from mismatches between
  - the system's interpretation of the learner input
  - how the learner perceives and conceptualize the input
- Where such mismatches arise, the feedback produced by the system is inadequate.
- We discussed two such mismatches for Portuguese tokens in TAGARELA:
  - identification of tokens: contraction, encliticization
  - interpretation of tokens: accented characters
- We argued that these problems can be addressed
  - by treating accented and unaccented characters parallel to common L1-transfer phonological confusions.
  - using an annotation-based NLP processing architecture supporting a rich representation of the learner input, including surface and deep tokenizations.

Conclusion

- Integration of computational, linguistic, and FLT/SLA expertise opens up opportunities for ICALL research
- An ITS such as TAGARELA can address specific needs in real-life FLT:
  - provide opportunities for students to practice their listening, reading, and writing skills
  - provide individualized feedback to learner
  - foster learner awareness of language forms and categories
  - provide contextualized activities integrating meaning and form
- The explicit activity design in ITS opens up unique opportunities for the collection of learner language produced in a range of controlled but meaningful activities.
  - Explicit activity design (constraining the potential learner input) makes it possible to include target answers (i.e., a premeditated set of potential target hypotheses!)

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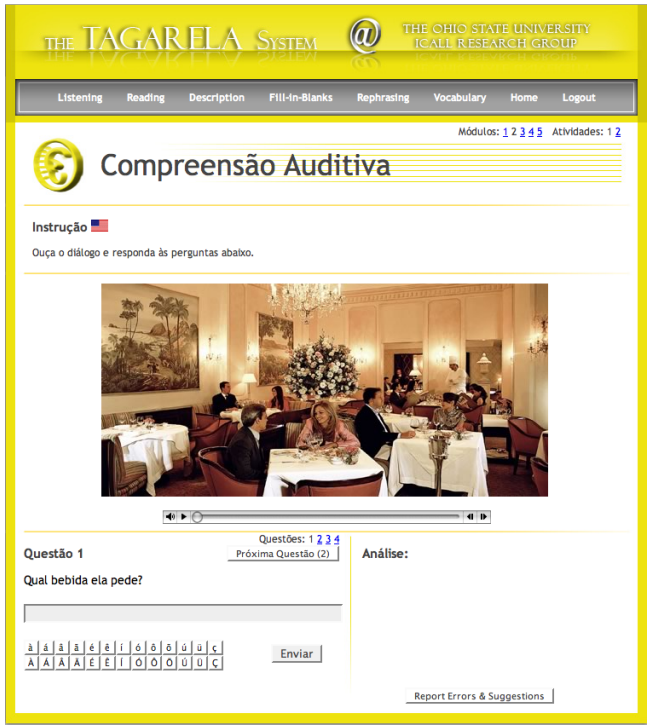

THE TAGARELA SYSTEM @ THE OHIO STATE UNIVERSITY ICALL RESEARCH GROUP

Listening | Reading | Description | Fill-in-Blanks | Rephrasing | Vocabulary | Home | Logout

Módulos: 1 2 3 4 5 Atividades: 1

Preencha as Lacunas

Instrução

Complete as lacunas com os verbos listados abaixo. Não repita o mesmo verbo mais de uma vez. Conjugue os verbos no pretérito perfeito do indicativo.

Questões: 1 2 3 4 5 6 7

Questão 1 Próxima Questão (2)

comprar - falar - mostrar

Semana passada eu _____ com meu vizinho que queria vender meu carro. Eu _____ o carro pra ele. Hoje de manhã ele _____ o carro.

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À Á Â Ã É Ê Í Ó Ô Õ Ú Ü Ç

Enviar

Análise:

Report Errors & Suggestions

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Reescreva

Instrução

Escreva uma frase comparando os dois elementos apresentados na tabela. Siga o exemplo abaixo.

ensolarada
cozinha 1: sol todo o dia
cozinha 2: sol só pela manhã

Resposta: *A cozinha 1 é mais ensolarada que a cozinha 2.*

Questões: 1 2 3 4 5 6 7 8

Questão 1 Próxima Questão (2)

caro
apartamento 1: R$150.000
apartamento 2: R$230.000

à á â ã é ê í ó ô õ ú ü ç
À Á Â Ã É Ê Í Ó Ô Õ Ú Ü Ç

Enviar

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Vocabulário

Instrução

Observe a figura e complete a descrição com as palavras que estão faltando.

Questões: 1 2 3 4 5 6 7 8 9

Questão 1 Próxima Questão (2)

No banheiro tem _____.

à á â ã é ê í ó ô õ ú ü ç
À Á Â Ã É Ê Í Ó Ô Õ Ú Ü Ç

Enviar

Análise:

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