On emergent linguistic characteristics in learner and translation corpora

Detmar Meurers
Universität Tübingen

Université Paris 7, UFR Études Interculturelles de Langues Appliquées (EILA)
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Overview

- Context: A sketch of our research perspective
- On linguistically analyzing learner language
  - Categories for interlanguage
    - Parts-of-speech as an example:
      – sources of evidence
      – nature of categories
    - Which level of analysis?
      – between robustness and representing variation
  - Target hypotheses and error annotation
    - Inter-annotator agreement and gold-standards
    - Comparative fallacy
  - Relevance of the task and learner modeling
- Emerging, data-driven units in translation corpora?
  - Automatically detecting variation in corpus annotation to detect annotation errors (DECCA)
  - Considering a related approach for translation corpora

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Context: A sketch of our research perspective

Analyzing learner language

- Intelligent Tutoring System TAGARELA for Portuguese (Amaral & Meurers 2008, 2009, 2011; Amaral et al. 2011)
- Automatic analysis of learner language (Meurers 2009)
- Linguistic analysis of NOCE corpus of English written by Spanish learners (Díaz-Negrillo, Meurers, Valera & Wunsch 2010)
- Word order errors (Metcalf & Meurers 2006b; Boyd & Meurers 2008)
- Content assessment of answers to reading comprehension questions (Bailey & Meurers 2008) → CoMiC (SFB 833 A4)
  - Longitudinal corpus collection using WELCOME (Meurers, Ott & Ziai 2010a) → KU/OSU collaboration
  - Dependency parsing of learner language (Ott & Ziai 2010)

Analyzing language for learners

- Visual input enhancement of authentic web pages for learners (WERTi, Meurers et al. 2010b)
- Language-aware search engine (Ott & Meurers 2010)

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Contact Points: CL & learner language analysis

- **Learner corpora**: representing, annotating, searching
  - can provide empirical evidence for SLA research
  - can provide insights into typical student needs in FLT

  annotation = off-line analysis
- **Writer's aid tools**: on-line analysis of learner language to provide immediate feedback *aimed at producing text*
- **Language testing**: off-line or on-line analysis to support or automate *assessment of learner abilities*
- **Intelligent Tutoring Systems**: on-line analysis
  - to provide immediate, individualized feedback, e.g.:
    - meta-linguistic feedback in a form-focused activity
    - incidental focus-on-form in a meaning-based activity
    - feedback on meaning (very rare in ITS)
  - to determine progression through pedagogical material

  aimed at supporting language acquisition.

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Data in SLA research

An example: Clahsen & Muysken (1986)

- They studied word order acquisition in German by native speakers of Romance languages.
- Stages of acquisition:
  1. S (Aux) V O
  2. (AdvP/PP) S (Aux) V O
  3. S V[+fin] O V[-fin]
  4. XP V[+fin] S O
  5. S V[+fin] (Adv) O
  6. *dass* S O V[+fin]

  Stage 2 example: *Früher* *ich kannte* *den Mann*
  earlier$_{AdvP}$ I$_S$ knew$_V$ [the man]$_O$

  Stage 4 example: *Früher* *kannte* *ich den Mann*
  earlier$_{AdvP}$ knew$_{V[+fin]}$ I$_S$ [the man]$_O$
- How is the data characterized?
  - lexical and syntactic categories and functions
  - some acquisition stages are well-formed, others ill-formed

Annotation: Error Annotation and Beyond

- SLA research essentially observes correlations of linguistic properties, whether erroneous or not.
- Yet, the annotation of learner corpora has focused on *errors* made by the learners (cf. Granger 2003; Díaz-Negrillo & Fernández-Domínguez 2006).
- Even where errors are the research focus, their correlation with other linguistic properties is relevant.
- A wide range of linguistic modeling useful for capturing
  - overuse/underuse of particular patterns
  - measures of language development
    - CAF (Wolfe-Quintero et al. 1998; Ortega 2003; Housen & Kuiken 2009; Lu 2010)
    - Criterial Features (Hawkins & Buttery 2009, 2010)

Annotation of Linguistic Properties

- Annotation schemes for native language corpora have been developed for a wide range of linguistic properties, including
  - part-of-speech and morphology
  - syntactic constituency or lexical dependency structures
  - semantics (word senses, coreference), discourse structure
- Each type of annotation typically requires an extensive manual annotation effort → gold standard corpora
- Automatic annotation tools learning from such gold standard annotation are becoming available, but
  - quality of automatic annotation drops significantly for text differing from the gold standard training material
- Interdisciplinary collaboration between SLA & CL crucial to adapt annotation schemes & methods to learner language
  - Surprisingly little research on this (Meunier 1998; de Haan 2000; de Mönnink 2000; van Rooy & Schäfer 2002, 2003).

Annotation Schemes and Annotation Quality

- An annotation scheme is only as good as the distinctions it reliably supports making based on available evidence.
  - E.g., particle vs. preposition dropped in Penn Treebank tagset since often not enough evidence available.
  - Note: More classes may be more reliable if they are more coherent (cf. CLAWS7 annotation, followed by mapping to CLAWS5 in BNC Tag Enhancement Project).
- How can high quality gold standards be obtained?
  - Keep only reliably and consistently identifiable distinctions, described in detailed manual, including appendix on hard cases (Voutilainen & Järvinen 1995; Sampson & Babarczy 2003)
  - Annotate corpus several times and independently, then test interannotator agreement (Brants & Skut 1998)
  - Detection of annotation errors through automatic analysis of comparable data recurring in the corpus → DECCA (Dickinson & Meurers 2003a,b, 2005b; Boyd et al. 2008)

Linguistically annotating learner language

Parts-of-speech as an example

- The NOCE learner corpus (Díaz-Negrillo 2007, 2009)
  - Short essays written by Spanish 1st and 2nd year students of English, annotated with editing and error tags
  - 998 texts, 337.332 tokens (149.256 types)

⇒ How about adding linguistic information?
(Díaz-Negrillo, Meurers, Valera & Wunsch 2010)

- Exploring automatic POS annotation
- What does it mean to POS-annotate learner language?

Automatic POS-Tagging of NOCE

- Used 3 POS taggers trained on WSJ newspaper text, using Penn Treebank tagset (TreeTagger, TnT, Stanford)
- Manually evaluated POS tags assigned by taggers to 10 texts by 10 different participants (1.850 words)
  - TreeTagger: 94.95%
  - TnT Tagger: 94.03%
  - Stanford Tagger: 88.11%

Aspects of a qualitative analysis

- We found lower performance for expressions which do not exist in English (cf. also de Haan 2000; van Rooy & Schäfer 2002).

(1) *I think that university teachs to people ...* [spelling]

(2) *They can't pay their studies and more over they have to pay a flat ...* [tokenization]

- But is tagging learner language really just a robustness issue, like adapting taggers to another domain?
- What does it mean to use POS tags developed for native language for the interlanguage of learners?
  - What research questions can such POS tags answer?

Three Sources of Evidence for POS analysis

Lemma/Lexical entry: *of* ⇒ preposition

(3) *drugs can be killer **of** many of ours.*

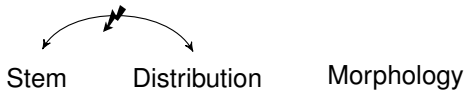
Morphology: *-ion* ⇒ noun

(4) *but it was a **revolution** in that period*

Distribution: det __ noun ⇒ adjective

(5) *In the **modern** life the people can communicate*

Case 1: Stem-Distribution mismatch



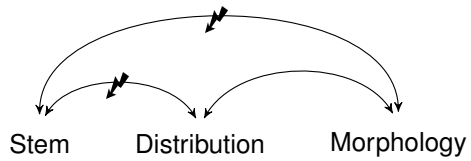
(6) […] *you can find a big **vary** of beautiful beaches* […]

Stem	Distribution	Morphology
verb	noun	?

(7) *RED helped him **during** he was in the prison.*

Stem	Distribution	Morphology
preposition	conjunction	?

Case 2: Stem-Distrib./Stem-Morph. mismatch



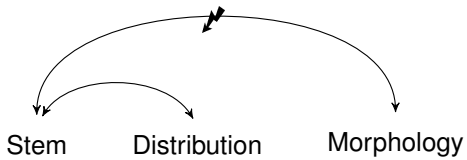
(8) […] *one of the favourite places to visit for many **foreigns**.*

Stem	Distribution	Morphology
adjective	noun	noun / verb 3rd sg

(9) […] *to be **choiced** for a job* […]

Stem	Distribution	Morphology
noun / adjective	verb	verb

Case 3: Stem-Morphology mismatch



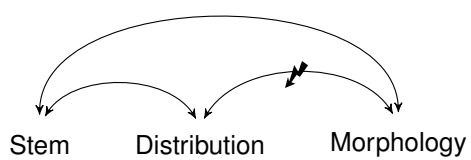
(10) […] *this film is one of the **bests** ever* […]

Stem	Distribution	Morphology
adjective (noun / verb)	adjective	noun / verb 3rd sg

(11) […] *television, radio are very **subjectives*** […]

Stem	Distribution	Morphology
adjective / noun	adjective	noun / verb 3rd sg

Case 4: Distribution-Morphology mismatch



(12) […] *for almost every **jobs** nowadays* […]

Stem	Distribution	Morphology
noun	noun sg	noun pl / verb 3rd sg

(13) […] *it has **grew** up a lot specially after 1996* […]

Stem	Distribution	Morphology
verb	verb past participle	verb past tense

Systematic POS for Learner Language

- A single, standard POS tag **fails to systematically identify properties of learner language**.
- Alternative: tripartite POS encoding of
  - distribution, stem, morphology
- Some errors in learner language are **epiphenomena of mismatches** in linguistic encoding.
  - → Identify such errors through linguistic annotation.
- The value of identifying such mismatches systematically is confirmed by recent SLA research (Zyzik & Azevedo 2009)
  - L2 learners have difficulty distinguishing between word classes among semantically related forms
  - Hypothesis: L2 learners have limited ability to interpret syntactic and morphological cues!

On the nature of categories for learner language

- Where do the categories abstracted to come from?
- Categories result from generalizations, which require a significant amount of comparable data to be made.
  - requires decision on what constitutes comparable data, which is difficult for a dynamic target such as interlanguage
- Robustness and the level of analysis:
  - In NLP, *robustness* is the ability to *ignore* variation in the realization of a category to be identified.
  - But variation in the realization of a category is an important characteristic of learner language.
    - → Design annotation schemes for learner language to encode minimal observations.
    - → Provide access to those on one level of annotation, with other annotation levels providing robust L2 abstractions.

On the nature of categories for learner language

Comparative fallacy

- "mistake of studying the systematic character of one language by comparing it to another" (Bley-Vroman 1983)
  - extended to include bias towards towards native language (Lakshmanan & Selinker 2001)
- Essentially trying to analyze a "non-canonical variety" using a "robust" version of the canonical grammar.
  - divergences from norm is annotated as errors
  - but: the research question is the issue here, not corpus error annotation as such (Tenfjord et al. 2006)
- Issue more general than language acquisition research:
  - Eurocentrism in field work, e.g., Gil (2001)
  - Variationist sociolinguistics

→ Importance of explicitly defining classes and when an instance is counted as one of the variants.

On the nature of categories for learner language

Aspects of syntactic modeling

- Just like POS categories, syntactic structure is motivated by different types of evidence.
- For analyzing learner language, one can separate:
  - overall topology of a sentence (Hirschmann et al. 2007)
  - chunks and chunk-internal word order (Abney 1997)
  - lexical dependencies
    - canonical, as interface to meaning (MacWhinney 2008; Rosén & Smedt 2010; Ott & Ziai 2010; Hirschmann et al. 2010)
    - non-canonical, separating evidence for morpho-syntactic and semantic relations (Dickinson & Ragheb 2009)

Error annotation

- Error annotation involves (implicitly or explicitly):
  a) Determining what the learner wanted to say (**target**).
  b) Identifying
     i. the **location** of the error, and
     ii. the **type** of the error corresponding to the difference between the learner sentence and the target hypothesis.
  c) **Annotating** the error in the corpus
- Each of these steps can present ambiguity:
  a) multiple possible target hypotheses
  b) i. different locations in which the error can be rooted
     ii. different types of errors a divergence can be attributed to
  c) different ways to mark an error location & type in corpus

Error annotation schemes: Desiderata

Inter-annotator agreement

- An annotation is only relevant and useful if it provides a uniform, reliable index to relevant classes of data.
- Traditionally every researcher develops their own error annotation scheme. (cf. Díaz-Negrillo & Fernández-Domínguez 2006)
- Alarmingly, no studies on which inter-annotator agreement can be reached for which distinctions in error annotation
- No freely available gold standard corpora, so
  - no reliable quantitative evaluation in research
  - no reliable training & evaluation of NLP for error analysis
- Promising progress for some subclasses (det, prep)
  (e.g., Lee & Seneff 2006; Tetreault & Chodorow 2008; De Felice 2008)
  - but it is important to establish a tool-independent, transparent definition of the markables to be annotated

Target hypotheses

- Fitzpatrick & Seegmiller (2004) report unsatisfactory levels of agreement in determining learner target forms.
  - Keeping the target hypothesis implicit results in error annotation which diverge even more unsatisfactorily.
- Anke Lüdeling has argued for making target hypotheses an explicit part of error annotation (Lüdeling et al. 2005; Hirschmann et al. 2007; Lüdeling 2008).
  - supports alternative targets (and corresponding error annotation), and
  - supports multiple levels of target hypotheses, differing in scope and operations allowed to obtain them
    - e.g., only replacement, omission, etc. to make sentence locally well-formed vs. taking context into account
- If target hypothesis is explicit, one can evaluate reliability of second step, from target hypothesis to error tag.

Difficulty of determining target hypotheses

- What are the target forms for the sentences taken from the Hiroshima English Learners' Corpus (Miura 1998)?

  (14) *I didn't know*
  (15) *I don't know his lives.*
  (16) *I know where he lives.*
  (17) *I know he lived*

  They are taken from a translation task, for the Japanese of

  (18) *I don't know where he lives.*

- How can one obtain a better handle on target hypotheses?
  - Focus on more advanced learners.
  - Take explicit task context into account.
  - Support targets other than fully explicit surface forms.
  - Take more learner strategies into account.
    - Learners often lift material from texts or use mastered chunks instead of trying to express appropriate meaning!

Constraining the search space of interpretation

Importance of activity and learner modeling

- All approaches to modeling learner language, such as
  - *mal*-rules, constraint relaxation, statistical modeling

  must model the space of **well-formed and ill-formed variation** that is possible given
  - a particular activity, and
  - a given learner.
- For example, without task and speaker context, how would you interpret the following?

(19) *I will not buy this record it is scratched*

(20) *My hovercraft is full of eels.*

Exemplifying interpretation in context

Monty Python: Hungarian Phrase Book sketch
http://purl.org/net/mp-sketch

Towards task-specific learner corpora

- Explicit task and learner models included as meta-information in a corpus can provide crucial constraining information for interpreting learner language.
  - E.g., it's easier to infer what a learner wanted to say if one knows the text they are answering questions about.
  - Related to taking strategic competence, task, and L1 into account in learner models of Intelligent Tutoring Systems (Amaral & Meurers 2008).
- Most current learner language corpora consist of essays, yet learners produce language in a wide range of contexts, naturalistic or instructed, e.g.,
  - email and chat messages
  - answering reading or listening comprehension questions
  - asking questions in information gap activities
- To obtain learner corpora which are interpretable and representative, we need language resulting from explicit tasks, in a variety of contexts, including longitudinal data.

Emerging Units in Translation Corpora

- What constitutes relevant linguistic units of analysis?
- How about units for analyzing translation corpora?
- Starting point: Variation *n*-gram error detection approach
  - part-of-speech annotation (Dickinson & Meurers 2003a)
  - syntactic annotation (Dickinson & Meurers 2003b; Boyd, Dickinson & Meurers 2007)
  - discontinuous syntactic annotation (Dickinson & Meurers 2005b)
  - dependency annotation (Boyd, Dickinson & Meurers 2008)
  - spoken language corpora (Dickinson & Meurers 2005a).
- Idea: Use the approach to study the variation in recurrent *n*-grams in translation corpora
- Work just started, so we here discuss issues arising in working out idea, as basis for feedback and discussion.

Variation Detection for POS Annotation

(Dickinson & Meurers 2003a)

- POS tagging reduces the set of lexically possible tags to the correct tag for a specific corpus occurrence.
  - A word occurring multiple times in a corpus can occur with more than one annotation.
- Variation: material occurs multiple times in corpus with different annotations
- Variation can result from
  - genuine ambiguity
  - inconsistent, erroneous tagging
- How can one find such variation and decide whether it's an ambiguity or error?

Classifying variation

- The key to classifying variation lies in the context:
  - The more similar the context of the occurrences, the more likely the variation is an error.
- A simple way of making "similarity of context" concrete is to say it consists of
  - words
  - which immediately surround the variation, and
  - require identity of contexts.

⇒ Extract all *n*-grams containing a token that is annotated differently in another occurrence of the *n*-gram in corpus.

- variation nucleus: recurring unit with different annotation
- variation *n*-gram: variation nucleus with identical context

Computing variation *n*-grams

- Example from WSJ: Variation 12-gram with *off*

(21) *to ward off a hostile takeover attempt by two European shipping concerns*

- once annotated as a preposition (IN), and
- once as a particle (RP).

- Note: Such a 12-gram contains two variation 11-grams:

(22) *to ward off a hostile takeover attempt by two Eur. shipping*
ward off a hostile takeover attempt by two Eur. shipping concerns

→ Calculate variation *n*-grams based on variation *n*–1-grams to obtain an algorithm efficient enough for large corpora.

- Essentially an instance of the a priori algorithm (Agrawal & Srikant 1994).

Computing variation *n*-grams

Algorithm

1. Calculate the set of variation unigrams in the corpus and store them.
2. Extend the *n*-grams by one word to either side. For each resulting $(n+1)$-gram
   - check whether it has another instance in the corpus and
   - store it in case there is a variation in the way the occurrences are tagged.
3. Repeat step 2 until we reach an *n* for which no variation *n*-grams are in corpus.

Running this algorithm on the Penn Treebank 3 version of the WSJ, retrieves variation *n*-grams up to length 224.

Applying the idea to translation corpora

- Idea: Use the same approach to identify translation variation *n*-grams in aligned corpora.
  - View translation as a form of annotation
- First step: Identify recurring units of any length.
- For example, we extracted recurrent n-grams from fr-en Europarl v6 (http://www.statmt.org/europarl)
  - over 47 million tokens (in French part)
  - recurrent n-grams found (length ≥ 2, recurrence ≥ 2):
    - longest: 621 tokens
    - total number: 18.181.667

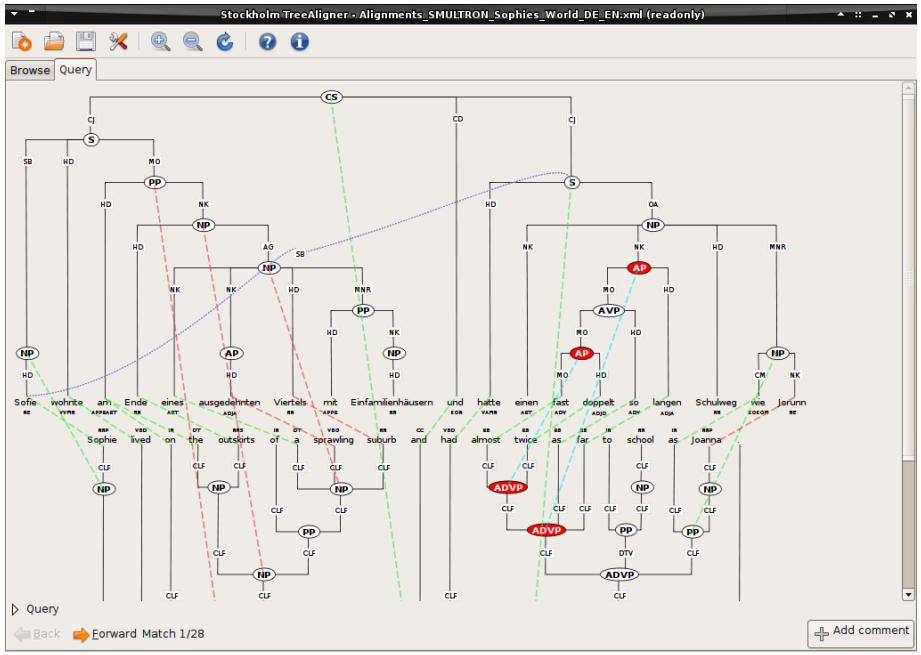
Which recurring units are relevant?

- Problem: Every n-gram contains two n-1 grams.
- For example:
  - *conclusion d'un protocole portant* (4, 5)
  - *d'un protocole portant adaptation* (4, 5)
  - *protocole portant adaptation des* (4, 5)
  - *portant adaptation des aspects* (4, 5)
- Flood of n-grams not interesting for unit identification.
- More interesting units are needed!
- Potential solution: Keep only those recurrent n-grams which cannot be further extended.
  - For every token in the corpus, record it only as part of the longest recurring n-gram type that it is apart of.

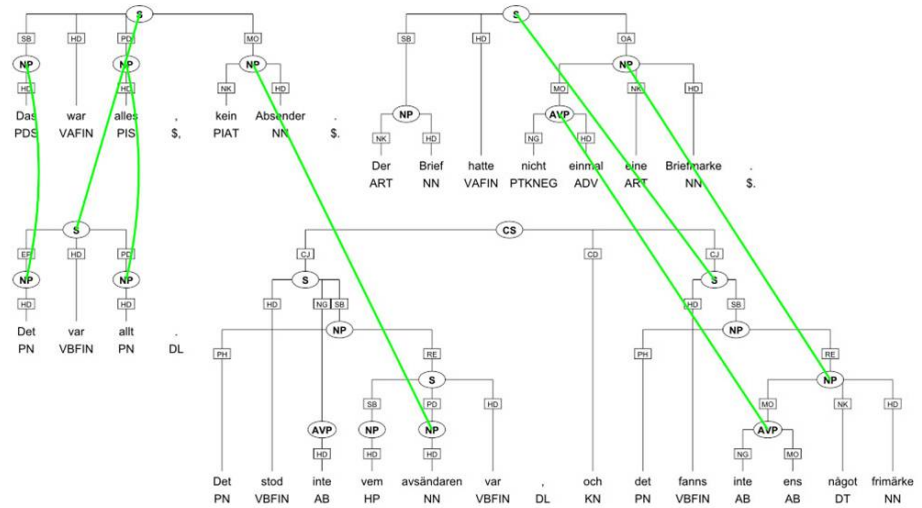
On identifying translation variation

- When viewing translation as annotation, we need to consider which units are aligned in the corpus.
- Europarl is sentence aligned, but we want to look at the translation of recurring n-grams, which can be smaller or bigger than sentences.
- What are useful ways to characterize variation in translation for a corpus which (only) is sentence aligned?
  a) Compare length of longest recurring unit in translation of corresponding sentence.
     - Problematic for sentences with multiple recurring n-grams
  b) Only consider recurring sentences (not any n-grams).
     - limits method to 4372 recurrent cases in Europarl-fr
     - many seem to arise through genre, not language:
       – *Le procès-verbal de la séance d'hier a été distribué. Y a-t-il des observations ?* (2, 44)
       – *La discussion commune est close. Le vote aura lieu à 17h30.* (2, 44)
  c) Alternative: Use a corpus with a richer correspondence → aligned treebanks, e.g., SMULTRON (Volk et al. 2010)

SMULTRON example



Domains beyond sentences: *m*-to-*n* tree alignment



Summary of automatic translation variation detection idea

- potentially fruitful to study variation in translation using variation-n-gram detection method
- requires synchronization of those units which can be detected as recurring & those which have been translated
- sketched some potential ideas which we intend to explore (studying statistical MT literature may well provide more)

Conclusion

- We motivated linguistic annotation to support effective querying for SLA patterns and discussed an approach to the POS analysis of learner language separating
  - lexical, morphological, and distributional information.

  Goal: Corpus annotation systematically characterizing language (native-like as well as learner innovations).
- Turning to error annotation, we argued for inter-annotator agreement as crucial for establishing which distinctions are replicable based on the available information.
- We explored the nature of target hypotheses and argued for explicit task and learner modeling to constrain the search space of interpretation.
- Turning to the question of emerging units, we sketched the use of the variation n-gram method for the identification of recurring units and variation in aligned corpora.

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