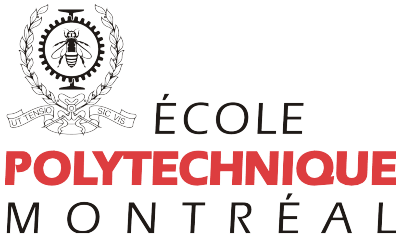
A preprocessing system to include imaginative animations according to text in educational applications.



Plan

The GITAN Project

Grammar for Interpretation of Text and ANimations

Proposing a universal model to manage transition from a textual content to a graphical animated representation.

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Proposing a universal model to manage transition from a textual content to a graphical animated representation.

A long-term project

Began at the end of 2009. First prototype planned at the end of 2010.

Case studied in this communication

A system dedicated to build a language learning software application.

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Difficult aspect of this work.

Open text input with restricted bag of words. Any word combination is allowed. Each semantically valid sentence must be displayed.

Application principles

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Targeted Learning software for Text to Animation

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- A bag of words is proposed to a student

- $\{prince, transforms, into, the, castle, in, his, toad, himself, a\}$

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- The learning software displays an animation representing the targeted sentence.

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Targeted Learning software for Text to Animation

- A bag of words is proposed to a student
- The learning software displays an animation representing the targeted sentence.
- The student composes his sentence and the software display an animation representing this sentence.

- $\{prince, transforms, into, the, castle, in, his, toad, himself, a\}$
- *The prince transforms himself into a toad*

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The student can compare the animation resulting of his own words combination.

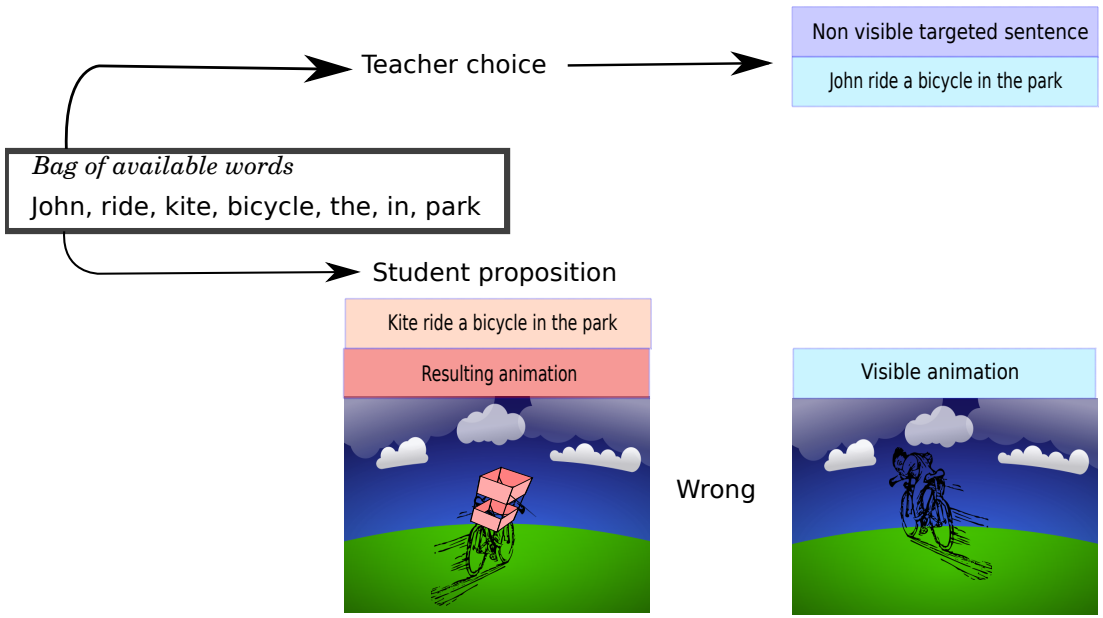

Figure: Synaptic representation of proposed application

A system dedicated to build a language learning software application.

Application may meet situations where the animation does not respect physical laws and common sense.

Example

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- A bag of words, including the 10 following terms: {**Jack, rides, with, bicycle, park, the, kite, runs, in, his**}.

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- A bag of words, including the 10 following terms: {**Jack, rides, with, bicycle, park, the, kite, runs, in, his**}.
- *Jack rides his bicycle in the park. The kite runs in the park.*

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Example

- A bag of words, including the 10 following terms: {**Jack, rides, with, bicycle, park, the, kite, runs, in, his**}.
- *Jack rides his bicycle in the park. The kite runs in the park.*
- Can also be *The bicycle rides Jack. The kite rides the bicycle.*

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Semantic cases

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Semantic cases

- **Position case**: *The kite rides the bicycle*. Can be represented by a graphic engine.

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- **Position case**: *The kite rides the bicycle*. Can be represented by a graphic engine.
- **Action case**: *The chair eats the cat. The chair eats on the cat*.

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Semantic cases

- **Position case**: *The kite rides the bicycle*. Can be represented by a graphic engine.
- **Action case**: *The chair eats the cat. The chair eats on the cat*.
- **Transformation case**: *The prince transforms himself into a toad*.

Theoretical view and previous work

Limitations of Text to Image systems: theoretical view

- Tversky : "correspondences between mental and graphical representations *suggest cognitive correspondences between mental spaces and real ones*" *Tversky (2002)*.
- Johnson-Laird : consider that there is some mental representation that *cannot be visualized* (*Johnson-Laird (1998)*, page 442)
- Adorni: cognitive transformation should be relevant to a computer AI problem *Adorni 1984* .

Limitations of Text to Image systems: theoretical view

In pictural arts, the correspondences for mental representations permitted by imagination, are obtained by a cognitive transformation of physical law, natural spaces and transgression of common sense to adapt an animation or a static image to the mental representation.

Limitations of Text to Image systems: existing systems

Some samples of existing applications and their limitations

[1] 18 characters, 67 behaviors, and 31 backgrounds

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- Confucius : an ontology of eventive verbs is used to constrain the representation to commonsense. In *Ma 2006* page 109.

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Proposed System

A intermediate way to solve the problem of open semantic content representation.

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- Enumerating all the syntacticaly valid sentences that may potentially be produced for a given bag of words
- Clustering of those sentences into groups according to their meaning similarity
- Pre-producing an unique animation for each cluster of sentences.

Architecture.

A bag of words

cat, eats, on, the, chair, in, his

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Modules

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- Sentence generator (SG)

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- Sentence generator (SG)
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- Sentence generator (SG)
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- Clustering algorithm (CA)

Architecture.

Sentence generator (SG)

Built with a limited set of flexible generative grammar rules implemented in Prolog. Rules cover verbal phrases, noun phrases and prepositional phrases and allow the generation of sentences from a bag of words.

$vp(Features, BagIn, BagOut) --> lex(v, Features, BagIn, Bag1), np(, Bag1, Bag2), pp(Bag2, BagOut)$

Architecture.

Language Model Filter (LMF)

A Language model (LM) is trained from a corpus which domain is related to the targeted application. Each candidate sentence proposed by the *Sentence Generator* is filtered by using an estimation of its probability, regarding LM.

Probability $P(w_1, \ldots, w_n)$ to observe a sentence composed of words $w_1 \ldots . w_n$ in the modeled corpus is estimated by the product of probabilities of the individual appearance of words contained in sequence $P(w_{1,n}) \approx P(w_1)P(w_2) \ldots P(w_n)$. A bi-gram model is used to select sentences.

Architecture.

Clustering algorithm (CA)

An analysis of a sentence trough chunking that identifies the constituents (noun phrases, verb phrases, etc.). Considering the list *l* of *n* sentences 1...*n* kept by LMF, we generate a function *f_similarity* for the first sentence *s*1 of *l*. All sentences are evaluated by function, and clustered if accepted. Process is iterated until the list of sentences is empty.

Example of resulting cluster:
[*Jack*/*NC*][*rides*/*VC*][*a bicycle*/*NC*], [*Jack*/*NC*][*runs*/*VC*][*the bicycle*/*NC*],
[*Jack*/*NC*][*rides*/*VC*][*the bicycle*/*NC*]

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- We count sentences generated in SG, kept in LMF, and how many clusters remain in CA.

Preliminary experimental results

Words	Generated sentences (SG)	Correct sentences (LMF)	Sentences clusters (CA)
6	25	23	7
10	460	280	20

Discussions:

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Preliminary results are sufficient to build an application prototype.

Next step: a test corpus generator

The system will be used as a component of text-to-animation application who automatically produces test sentences for evaluation purposes.

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- P is used to validate representation capacities of graphic engine regarding any C.

Conclusions

We presented an original component to support text to animation applications in the context of imaginative sentences.

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Conclusions

- An attempt to evaluate the capacities of a system to elaborate imaginative-like text to animation system.
- An intermediate solution to build application of Text to Image without semantic content restriction.
- A way to test capacities of Text to Image application for difficult semantic meaning of open text.

Questions.