Information Ordering

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Outline

1. Introduction
2. Algorithms
3. Coherence Metrics

A Simple Artifact Description

Towards the end of the archaic period, coins were used for transactions. This particular coin, which comes from that period, is a silver stater from Croton, a Greek Colony in South Italy.
On both the obverse and the reverse side there is a tripod (vessel standing on three legs), Apollo's sacred symbol.
Dates from between 530-510 BC.

(All examples from Karamanis & Manurung, 2002)

Extracted Facts

- use-coins(archaic-period)
- creation-period(ex5, archaic-period)
- madeof(ex5, silver)
- name(ex5, stater)
- origin(ex5, croton)
- concept-description(croton)
- exhibit-depicts((ex5, sides), tripod)
- concept-description(tripod)
- symbol(tripod, apollo)
- dated(ex5, 530-510bc)

. . . and Back.

Natural Language Generation

(1) Towards the end of the archaic period, coins were used for transactions. (2) This coin comes from the archaic period. (3) It is made of . . .

Information Ordering as a Search Task

The Simple Algorithm

Given a list of entity sets f_0,

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3. keep f_n for which M is maximal

A Simple Coherence Metric: NOCB

Count all utterances that refer to at least one entity from the utterance that precedes it.

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. . . formalized

$$nocb(U_0, \ldots, U_n) := |\{x : 0 < x \leq n \wedge Cf(U_{x-1}) \cap Cf(U_x) \neq \emptyset\}|$$

NOCB Example

Example

(0) Towards the end of the archaic period, coins were used for transactions.

NOCB Example

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NOCB Example

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NOCB Example

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(0) Towards the end of the archaic period, coins were used for transactions. (1) This coin comes from the archaic period. (2) It is made of silver. (3) It is called a stater.

NOCB Example

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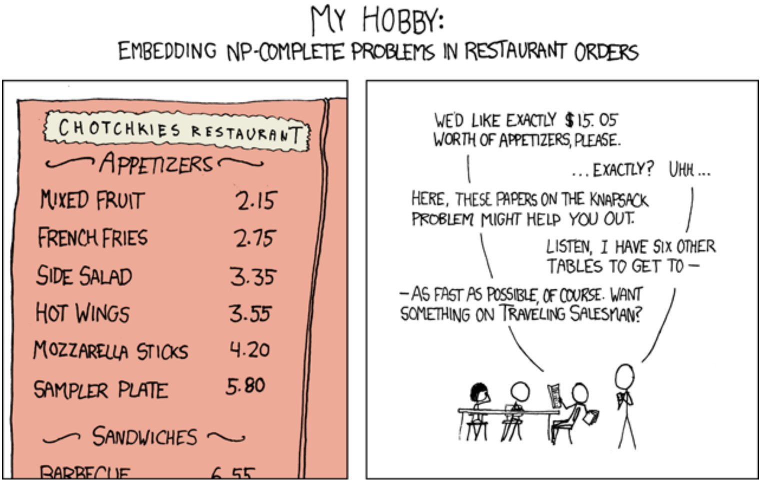
$$nocb(U_0, \dots, U_7) = 6$$

The ordering is suboptimal!

Complexity Considerations



Taken from `http://xkcd.com/287/`

Complexity Considerations

$O(n!)$ complexity

10 entity sets mean $10! = 3,628,800$ possible orderings. 20 sets can be arranged in 2,432,902,008,176,640,000 different orderings.

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The Task

Find an algorithm which frees us from having to look at all possible orderings to find at least one *good* ordering.

Evolutionary Search

Basic Idea

Evolutionary Algorithms (EA) try to find (near-)optimal solutions based on selection and gradual random improvement of *individuals* and stop when

- the population converges or
- a specified number of iterations is reached.

Evolutionary Search Algorithm

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n = 0
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    mutating good orderings
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    mutating good orderings
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  n += 1
until P converges or n > max_generations
```

EA Results

Karamanis & Manurung, 2002:

Text name	size	Target	Mean	Max
stater	10	7	6.482	8.0
tetradrachm	10	8	7.602	9.0
drachma	11	9	8.384	10.0
kouros	18	13	14.022	17.0
amphora	20	17	15.328	19.0
hydria	23	20	16.783	20.8 (!)

Experiment Setup

4000 generations, 50 individuals, elitist ratio of 0.2, only Crossover, 10 repetitions.

Finding a Better Coherence Metric

Comparing Coherence Metrics

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The Classification Rate

Given a sequence of entity sets B and a metric M, the *classification rate* υ is defined as

$$\upsilon(M, B) = \mathit{Better}(M) + \frac{\mathit{Equal}(M)}{2}$$

$\mathit{Better}(M)$ and $\mathit{Equal}(M)$ are the percentages of orderings that are, according to M, better than or equal to B.

Coherence Metrics

M.NOCB

$\forall n > 0 \;\; Cf_{n-1} \cap Cf_n \neq \emptyset$

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$\forall n > 0 \; CP_{n-1} = CB_n$

CP_n: The referent of the first NP in an utterance.

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Combination of M.NOCB, M.CHEAP, $\forall n \; CB_n = CP_n$ (salience) and $\forall n > 0 \; CB_n = CB_{n-1}$ (coherence)

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M.BFP

CONTINUE > RETAIN > SMOOTH-SHIFT

CP_n: The referent of the first NP in an utterance.

Results

Comparing Two Metrics M_a, M_b

Take n B

- for each B_i, compute $\upsilon(M_a, B_i)$ and $\upsilon(M_b, B_i)$
- the metric with the lower score is better for this utterance

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M.NOCB is

Competitor	better	equal	worse
M.CHEAP	18	0	2
M.KP	16	2	2
M.BFP	12	5	3

$n = 20$

(Results from Karamanis, Poesio et al., 2004)

Final Remarks

Information Ordering with Local Coherence

- the desired order of information in a text can be modelled with notions from Centering Theory
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Problems with Local Coherence

Orderings found using local coherence metrics might still be incoherent to a human reader.

References

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Thank You!

Questions?