LEARNING TO SUMMARIZE & SUMMARIZING FOR LEARNING

SYMPOSIUM AROUND THE INAUGURAL ADDRESS
OF PETER SLOEP
HEERLEN, THE NETHERLANDS
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OUTLINE AND CREDITS

I. First Example: Apex 1 & how it works
II. Some in-between Literature
III. Second Example: Apex 2 & how it Works
IV. Third Example: Resum'Web
V. How do they all Work in Educational Settings?
VI. Brainstorming Session: How Discover New Applications?

- Collaborative Work with Benoît Lemaire, Sonia Mandin & Virginie Zampa

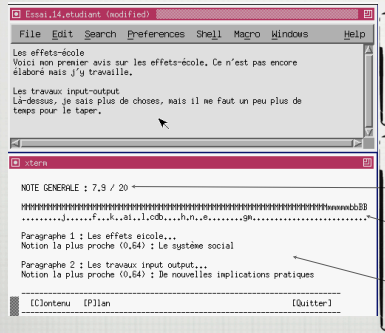
I. A FIRST EXAMPLE

PRESENTATION OF APEX 1,
A SYSTEM THAT HELPS REVISE COURSES

I. CONTEXT

- Students usually have to revise their courses...
  - a good way to do that is to summarize them...
  - ... but they seldom benefit from *content*-based assessments, cognitively demanding for the teacher
  - ... and current ICT only deliver assessment on shallow features
- Would ICT be an adequate way to *freely* allow students:
  - to write out course summaries for understanding course notions?
  - to be assessed on higher-level features?

I. FIRST EXAMPLE: *APEX 1*



Summary Pane: Written Course Summary

Feedback Pane:
Overall Grade
How well each topic is covered
Possible followed outline

I. HOW DOES *APEX 1* WORK?

- Beforehand
  - teacher processing : All the course is two-level tagged (topic/notions)
  - *Latent Semantic Analysis* processing : course + "general language" corpus compiled
- On-line and as many times as required
  - course summary semantically compared with each of the course notions

LATENT SEMANTIC ANALYSIS : A PRIMER 1/2 (LEMAIRE, 2005)

- LSA determines the statistical context in which each word occurs; semantically compares words; serves as semantic memory
  - two words are similar if they occur in ~~same~~ paragraphs
  - two paragraphs are similar if they contain ~~common~~ words
  - two words are similar if they occur in **similar** paragraphs
  - two paragraphs are similar if they contain **similar** words

LATENT SEMANTIC ANALYSIS: A PRIMER 2/2 (LEMAIRE 2005)

- Given a corpus processed beforehand
  - splited in paragraphs
  - words are projected in a *n*-dimension space so that
    - words can be compared to each other by computing the cosine of their corresponding vectors
    - paragraphs can be compared to each other by computing the cosine of the sum vector of the words they are composed of
- Requires huge corpora to acquire "common ground knowledge"
- Doesn't capture all features (negations, style, etc.)

WHAT'S LACKING?

- Involving the student in a more complete workflow
  - Revise courses also consists in reading them
- Focussing on processes rather than products
  - metacognitive judgements on course comprehension
  - model the summarization process
- Stop! More literature is needed!

II. SOME IN-BETWEEN LITERATURE REVIEW

EXISTING SYSTEMS; SUMMARIZING <-> LEARNING; METACOGNITIVE ACCOUNT

CURRENT FORMS OF TEXT ASSESSMENT

- Students already benefit from several computer-based ways of assessment
  - *very shallow*: text length, spelling, grammar, etc.
  - *mid-shallow*: readability
  - *multiple choice questions*: both plausible and inadequate??
- The semantic level is promising...

SEMANTIC ASSESSMENT LEVEL: SOME SYSTEMS

- *Intelligent Essay Assessor* (Foltz et al., 1999): LSA-based comparison with gold standard essays
- *Summary Street* (E. Kintsch et al., 2007): holistic grade, the score is this of the closest pre-graded essay (by a human)
- *Select-A-Kibitzer* (Wiemer-Hastings & Graesser, 2000): idem as previous, but with agents

IS SOMETHING MISSING?

- Prescriptive view of assessment: mostly depends on human judgment (comparison with pre-graded essays)
- Mostly feedback on products (e.g., number of words, cohesion, etc.) rather on processes. Necessity to have a closer look on activities
- Metacognition (how students judge themselves) seldom taken into account
- Notion of environment: students freely engaged in activity loops
  - *reading loop* (acquiring input, building knowledge)
  - *writing loop* (producing/reorganizing ideas)

LINKS BETWEEN SUMMARIZING–LEARNING

- Understanding necessary for summarizing
  - Text macrostructure recall similar to a summary of this text
- Summarizing fosters understanding (Bean & Steenwyk, 1984; Stevens, 1988)
  - strenghthen connections between source text ideas and knowledge
  - helps memorizing the source text content
  - helps monitoring comprehension (Thiede & Anderson, 2003)

THE PROCESS OF SUMMARIZING

- Two main interleaved processes, to be simulated
  - selection of the main (most important) ideas of the source text
  - macrorule application on some sentences of the source text (ST) to compose the summary (Sum) (W. Kintsch & van Dijk, 1978)
    - *copy*: a Sum sentence is very close to a ST one
    - *deletion*: a ST sentence is very far to all Sum ones 
    - *generalization*: a Sum sentence is close to several ST sentences
    - *construction*: a Sum sentence is not very close to all ST one, but pretty close to some 

A METACOGNITIVE ACCOUNT

- Metacognitive processes can be triggered by feedback. Student's...
  - awareness of strategies and goals
    - `I'll begin to read the text then I'll summarize it`
  - ability to assess their own understanding
    - `I think I grasped the notion X`
  - ability to compare their assessment to that of the computer
    - `you said you understood X but obviously you didn't`
    - `you said notion X is important but you deleted it`

III. SECOND EXAMPLE: *APEX 2*

AN ILE THAT HELPS EXPLORING & LEARNING CONTENT

III. *APEX 2*

- An Interactive Learning Environment
- 2 loops: Reading & Writing in which the student is freely engaged
- Written in PHP 5 with C routines, on top of LSA
- **Demo**

WHAT'S LACKING YET?

- Assessment on products rather than processes
- Relying on a cognitive model of summarizing/reading

IV. THIRD APPLICATION: *RESUM'WEB*

A TUTOR THAT HELPS SUMMARIZING

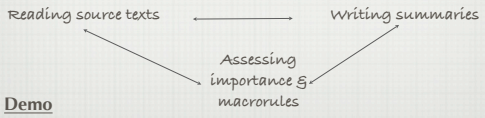
DEVELOPED AS PART OF THE PHD THESIS OF SONIA MANDIN

RESUM'WEB: HOW IT (VERY BRIEFLY) WORKS

- Main sentences identification process
  - an important sentence of a text is highly semantically connected with other sentences of this text (LSA comparison)
- Macrorule identification process
  - each sentence of the summary is semantically compared with all the source text sentences
  - 3 similarity thresholds empirically determined (too far, adequately close, too close)
  - macrorules determined accordingly (see slide # 15)

RESUM'WEB ARCHITECTURE

- A set of resources: courses on summarization
- A set of texts to be summarized
- A 2,5 (0,5: assessment activity) loops involvement



- **Demo**

V. DOES THIS STUFF WORK ANYMORE?

ASSESSMENT IN EDUCATIONAL SETTINGS

APEX 1 TEST IN CONTEXT

- 21 real-settings exam essays processed by *Apex 1*
- Pretty high correlation (r = .59) teacher *vs.* *Apex 1* grades
- *Apex 2* currently under tests (project)

RESUM'WEB: RESULTS IN CONTEXT (MANDIN, IN PREP)

- 32 Highschool students are given 10 texts to summary (1 per session)
  - 18 with the help of the "full" *Resum'Web*
  - 14 in a control group, with main ideas identification but without macrorule (self-)assessment (placebo task)
- Focus on progress for summaries 1, 5 and 10 (human assessment)
  - macrorules used
  - overall grades

EFFECT OF *RESUM'WEB* ON STUDENT'S ACTIVITY

Frequency of "off-the-subject" and constructions were equal
Summary grades by teachers were equal

FURTHER RESEARCH PROJECTS

- Focus on
  - adding a chatting loop (interact with peers, discuss, argument)
  - scrutinizing differences on summarizing narrative vs. expositive texts
  - integrating more specific ways of modelling understanding (e.g., using the Construction-Integration model, Kintsch 1988; Lemaire et al., 2006)
  - modelling students' ZPD (Zampa & Lemaire, 2002)

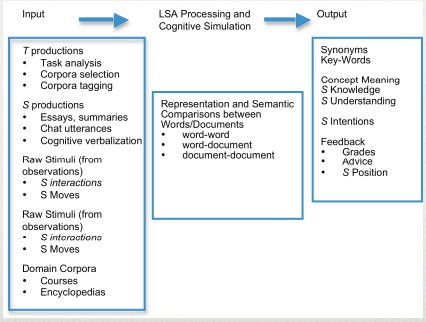
VI. BRAINSTORMING ZONE

WHAT TO DO NEXT? HOW TO DISCOVER NEW APPLICATIONS?

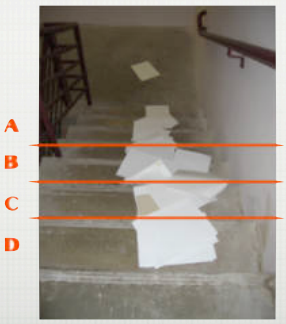
OVERVIEW OF THE EDUCATIONAL USES OF LSA

- *Text selection and production*: plagiarism detection, semantic-based text search, keyword selection
- *Essay assessment*: text readability, essay grading, outline analysis, macrorule analysis
- *Understanding assessment*: metaphor comprehension, matching texts to readers wrt. pre-knowledge, simulation of understanding, learner positioning wrt. knowledge
- *Self-regulation processes assessment*: self-regulated learning analysis, self-regulative vs. system assessment comparison, intentions uncovering

HOW TO FIND NEW LSA APPLICATIONS



THANKS FOR YOUR ATTENTION!



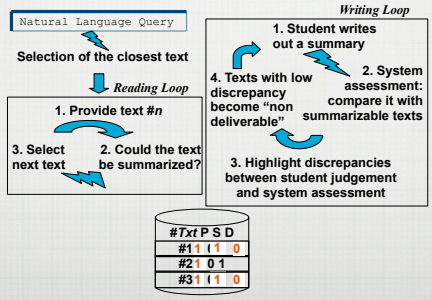
Source: http://upslinks.net/humor/grading.htm

SOME REFERENCES

- *Apex 1*: Lemaire, B. & Dessus, P. (2001). A system to assess the semantic content of student essays. *Journal of Educational Computing Research, 24*(3), 305-320.
- *Apex 2*: Dessus, P. & Lemaire, B. (2002). Using production to assess learning: an ILE that fosters Self-Regulated Learning. In S. A. Cerri, G. Gouardères, & F. Paraguaçu (Eds.), *Intelligent Tutoring Systems (ITS 2002)* (pp. 772-781). Berlin: Springer.
- *Resum'Web*: Lemaire, B., Mandin, S., Dessus, P. & Denhière, G. (2005). Computational cognitive models of summarization assessment skills. In B. G. Bara, L. Barsalou & M. Bucciarelli (Eds.), *Proceedings of the 27th Annual Conference of the Cognitive Science Society (CogSci' 2005) (pp. 1266-1271). Mahwah: Erlbaum*

- All available on: http://webu2.upmf-grenoble.fr/sciedu/pdessus/

APPENDIX 1: HOW DOES *APEX 2* WORK?



APPENDIX 2: HOW TO FIND NEW COGNITIVE TOOLS

- Interactively specify (after Popper, 1998; Dessus, 2004, 2006)
  - what are the objects at hand or metaphors used (world 1)
  - what are the knowledge artifacts used (world 3)
  - what are the simulated cognitive processes (world 2)

1. *World 1 Objects*	2. *World 3 Artefacts*	3. *Simulating or Assisting World 2*
Paper sheet Pupil desk School Environment…	Tabular form Check-list Course content…	Course design Classroom management Assessment…