# Incrementality: Evidence for / against incrementality from psycholinguistic research and incremental algorithms in NLP.

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Universität des Saarlandes

– SS 2011 –

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# Introduction

**What are we going to discuss today?**

1. Introduction to Incremental Processing
2. Course Requirements
3. Giving a good talk
4. Topics
5. Organization: Time Slots

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# What does “Incrementality” mean?

- In parsing: word-by-word processing
  = always have to deal with word $w_n$ before dealing with word $w_{n+1}$
- Depending on granularity level you’re interested in, could also refer to syllable by syllable, sound by sound, sentence by sentence processing
- “Incremental Processing” is practically used in different ways:
  - input read in incrementally
  - incremental input processed partially
  - incrementaly input processed completely ← “strict incrementality”

This seminar is going to be mostly concerned with *strict incrementality*

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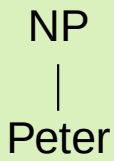
incremental parsing:



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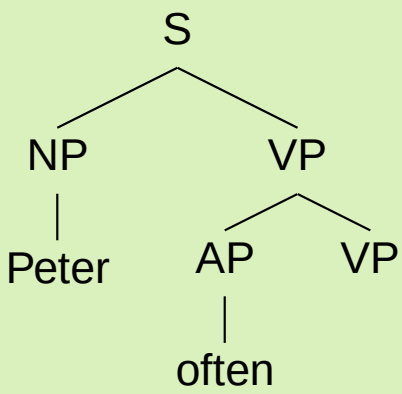


non-incremental parsing:


(two trees on a stack to be connected later)

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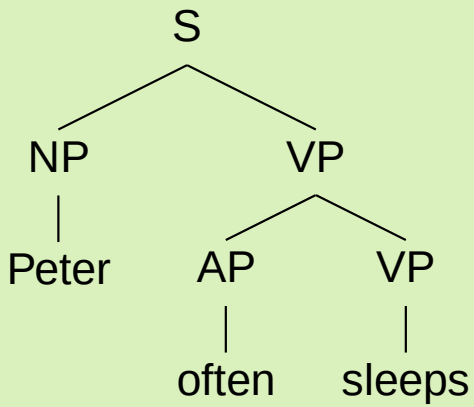

# Why should we care about incrementality?

- Psycholinguistic motivation:
  - Is human sentence processing is strictly incremental?
  - if yes: learn about cognition by building strictly incremental processing models
  - if yes: what advantages does it have that we can learn from for NLP?
- Motivation from language technology:
  - some applications are time-critical
  - response times can be much faster if we process incrementally
  - relevant for dialogue systems, speech-to-speech translation, human-robot interaction

# Different angles on incrementality in this course

- **Psycholinguistic Evidence** for different degrees of incrementality
  - Everybody agrees that words are perceived one after the other. :-)
  - Not everybody agrees that they are eagerly integrated into the context as soon as they are perceived.
- Examples from **Applications** that profit from Incrementality
  - Where can incremental processing improve an application?
  - Are there also disadvantages related to incrementality?
  - Is there an optimal degree of incrementality? What might it be?
- Let's have a look at current **incremental algorithms in NLP**
  - What's the state of the art? Are there many incremental algorithms to choose from?
  - What are the challenges in designing an incremental algorithm?
  - Are some linguistic formalisms more appropriate than others?

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# Requirements for this course

- Each student has to give **a presentation** based on 1-2 papers (70%).
- Each student has to fill in **a peer review form** for each presentation (15%).
- You have to **read one of the papers** in advance each week and prepare at least 2 thoughtful questions for each session and participate in the discussion (15%).
- If you registered for the seminar for 7 points, you need to write a **term paper** (12-15 pages) at the end of the semester.
- **Attendence**: You can miss ONE seminar without giving an explanation; if you miss more, you have to hand in a critical review for each paper that was presented when you were absent.

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# How to give a good talk

- Think of the worst / most boring talk or lecture you've ever had to sit through.
- Let's brain storm: Why was it so bad?
- And what makes good talks good?

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# How to prepare for your presentation

- Read your paper(s) well in advance (2-3 weeks before your presentation date)!
- in order to understand them well, you'll probably have to read them 3-4 times! Send me an email if there is something you don't understand.
- prepare your slides
- note: making *good* slides takes a lot of time!
- meet me one week before your presentation, send me your slides *before* the meeting
- train your presentation style in front of your flatmate / the mirror / ...
- you'll probably have to go through your presentation 3-10 times before you'll be able to give it well.

# Peer Review Forms

WHY peer review forms??? and how will it work?

You profit as a reviewer:

- goal: to make you more observant of other's talks
- learn more from presentations given by others
- all comments to the presenter will be ANONYMOUS

You profit as a presenter:

- **know what you're aiming for:** you can check beforehand whether you think your talk meets all the criteria in the review form
- **feedback:** you will get lots of *detailed* feedback on your talk which you otherwise don't usually have the chance to obtain

**Note on grading for review forms:** good grade = thoughtful comments, give *constructive* comments in addition to the box ticking and circling.

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# Psycholinguistics topics: PSY1

Evidence for / against strict incrementality (choose 2)

- Sturt, P. and Lombardo, V. (2005):
  *Processing coordinate structures: Incrementality and connectedness.*
- Aoshima, Yoshida and Phillips (2009):
  *Incremental Processing of Coreference and Binding in Japanese*
- Swets et al. (2008):
  *Underspecification of syntactic ambiguities: Evidence from self-paced reading*

# Psycholinguistics topics: PSY2

Incrementality and Prediction (choose 2:)

- Altman, Kamide and Haywood (2003):
  *The time-course of prediction in incremental sentence processing: Evidence from anticipatory eye-movements.*
- Van Berkum et al. (2005):
  *Anticipating upcoming words in discourse: Evidence from ERPs and reading times.*
- Staub and Clifton (2006):
  *Syntactic Prediction in Language Comprehension: Evidence From Either...or*

# Psycholinguistics topics: PSY3

Local Coherence Effects

- Tabor et al. (2004)
  *Effects of merely local syntactic coherence on sentence processing.*
- Gibson (2006)
  *The interaction of top-down and bottom-up statistics in the resolution of syntactic category ambiguity.*

# Psycholinguistics topics: PSY4

How about language production?

- Fernanda Ferreira (2000).
  *Syntax in Language Production: An Approach Using Tree-Adjoining Grammars*

# Psycholinguistics topics: PSY5

Arguments for incrementality from a linguistic view point

- Phillips (2002)
  *Linear Order and Constituency*

(strong linguistics background required)

# Applications topics: APP1

Dialogue systems / interactions with agents

- Skantze, G. and Hjalmarsson, A. (2010).
  *Towards Incremental Speech Generation in Dialogue Systems.*
- Skantze, G. and Schlangen, D. (2009)
  *Incremental dialogue processing in a micro-domain.*
- Schlangen, D. and Skantze, G. (2009)
  *A general, abstract model of incremental dialogue processing.*

# Applications topics: APP2

Machine translation

- Hassan, Sima'an, Way (2009)
  *A Syntactified Direct Translation Model with Linear-time Decoding*
- Hefny, Hassan, Bahgat (2011)
  *Incremental Combinatory Categorial Grammar and Its Derivations*

(Familiarity with CCG advantageous for this topic, or at least willingness to learn about the CCG grammar formalism)

# Applications topics: APP3

Trade-off between incrementality (speed) and accuracy:

- Baumann, Atterer, Schlangen (2009)
  *Assessing and Improving the Performance of Speech Recognition for Incremental Systems*
- Kato, Y. and Matsubara, S. and Inagaki, Y.(2004)
  *Stochastically evaluating the validity of partial parse trees in incremental parsing*

# Applications topics: APP4

Speech Recognition

- Schuler, Wu, Schwarz (2009)
  *A Framework for Fast Incremental Interpretation during Speech Decoding*

# NLP topics: NLP1

Incremental Parsing with a PCFG

- Brian Roark (2001)
  *Probabilistic top-down parsing and language modeling.*

# NLP topics: NLP2

Incremental Parsing with Dependency Grammars

- Nivre (2004)
  *Incrementality in Deterministic Dependency Parsing*
- Menzel (2009)
  *Towards radically incremental parsing of natural language.*

# NLP topics: NLP3

Incremental Parsing with Tree-Adjoining Grammars (choose 3a or 3b)

- 3a:
  - Libin Shen and Aravind Joshi (2005).
    *Incremental LTAG parsing*
  - Mazzei, Lombardo, Sturt (2007).
    *Dynamic TAG and Lexical Dependencies*
- 3b:
  - Demberg, Keller and Koller, (2011, under review)
    *Incremental, Predictive Parsing with Psycholinguistically Motivated Tree-Adjoining Grammar*
  - Demberg and Keller, (2008)
    *A Psycholinguistically Motivated Version of TAG*

# NLP topics: NLP4

Incremental Semantic Parsing

- Atterer and Schlangen (2009)
  *RUBISC - a Robust Unification-Based Incremental Semantic Chunker*
- Purver and Kempson (2004)
  *Incremental parsing, or incremental grammar?*

(the latter will require to learn about ”Dynamic Syntax”)

# NLP topics: NLP5

Incremental Parsing with Cascaded / Hierarchical HMMs

- Stephen Wu, Asaf Bachrach, Carlos Cardenas, William Schuler (2010)
  *Complexity Metrics in an Incremental Right-corner Parser.*
- Matthew Crocker and Thorsten Brants (2000)
  *Wide Coverage Probabilistic Sentence Processing.*

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# Organization: Topics and Time Slots

Please:

- Send me an email with your top 3 preferred topics **by MONDAY**.
- If you want to have a specific time slot, please also let me know in that email
- If you're particularly keen on a specific topic and / or time slot, please write me an explanation for why this is so important to you.

EMAIL ADDRESS: vera@coli.uni-saarland.de

Next week:

- finalize time table
- historic background to debate on incremental processing