Shallow Text Generation

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Application Systems for NLG Must be Developed Quickly and in a User-Oriented Way

- **Requirements placed by the application**
  - on the user: recognize and articulate needs
  - on the developer: make herself acquainted with the domain
  - on both: create and adapt a corpus of sample target texts
- **Requirements wrt the software**
  - Adaptability to new tasks and domains
  - Scalability (low costs of the next rule)
  - Modularisation (interpreter, data, knowledge, interfaces)

High efficiency of development is difficult to achieve with traditional approaches to language generation

Source: Stephan Busemann

Non-Trivial Generation Systems are Expensive to Adapt to New Domains and Tasks

- **Examples**
  - KPML (Bateman 1997), systemic grammars, development environment
  - FUF/Surge (Elhadad/Robin 1992), functional unification grammar, interpreter
- **Features**
  - large multi-lingual systems
  - detailed, monolingual semantic representations as input
  - broad coverage of linguistic phenomena (goal: the more, the better)
- **Effort for adaptation**
  - Rich interface to the input language of the system (logical form, SPL)
  - Generation of sentences reflecting the distinctions covered

The excellent scope of services of generic resources can often not easily be utilised in practice

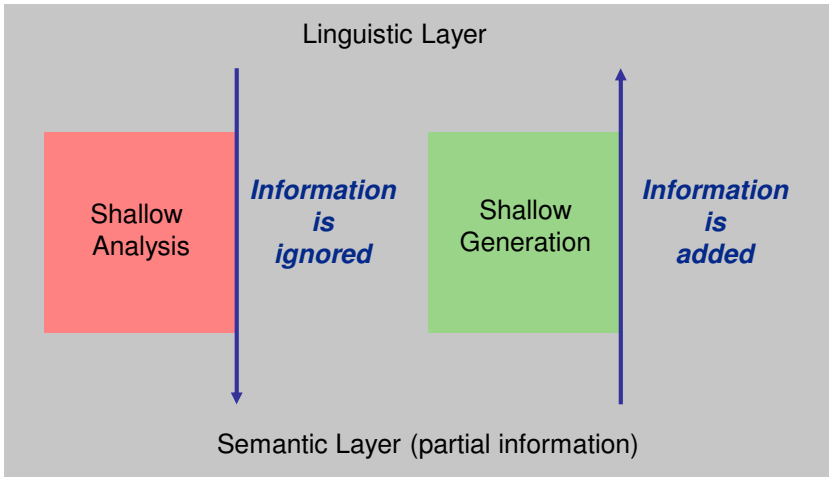
Deep* vs Shallow NLG

* This differs from the Chomskyan distinction between deep and surface structrure, which is sometimes used to characterize deep and surface generation

- **Deep generation**
  - knowledge-based: models of the domain, of the author and the addressees, of the language(s) involved
  - theoretically motivated: aiming at generic, re-usable technology
  - unresolved issue of general system architecture
- **Shallow generation**
  - opportunistic modelling of relevant aspects of the application
  - diverse depths of modelling, as required by the application
  - some methods can be viewed as „short cuts“ for unsolved questions of deep generation

Shallow generation can be defined in analogy to shallow analysis

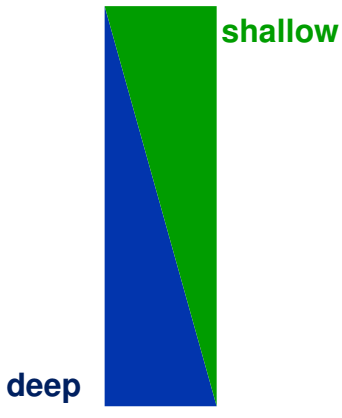
Shallow Processing Deals With Partial Information



Source: Stephan Busemann

There is a Smooth Transition Between Shallow and Deep Methods

- **Prefabricated texts**
- **„Fill in the slots“**
- **with flexible templates**
- **with aggregation**
- **with sentence planning**
- **with document planning**



Source: Stephan Busemann

Shallow Architectures Have a Simple Task Structure

"Deep" model with interaction (cf. Reiter/Dale 2000)

- Content Determination
  Discourse Planning
- Sentence Aggregation
  Lexicalisation
  Generation of Referring Expressions
- Surface Realisation

„Shallow" Model (Busemann/Horacek 1998)

- Content Determination
- Text Organisation (Aggregation)
- Mapping Onto Linguistic Structures

Overview

- **Motivation**
- **The TG/2 Shallow NLG framework**
- **Some major applications for shallow NLG**
- **Assessment and conclusions**

Input for Air Quality Report Generation

```
[(COOP threshold-passing)
 (TIME [(PRED season)
        (NAME [(SEASON summer)
               (YEAR 1999)])])
 (POLLUTANT o3)
 (SITE "Völklingen-City")
 (DURATION [(MINUTE 60)])
 (SOURCE [(LAW-NAME bimsch)
          (THRESHOLD-TYPE info-value)])
 (EXCEEDS [(STATUS yes)
           (TIMES 1)])]
```

In summer 1999 at the measuring station of Völklingen-City, the information value for ozone – 180 µg/m³ according to the German decree Bundesimmissions-schutzverordnung – was exceeded once during a period of 60 minutes.

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Im Sommer 1999 wurde der Informationswert für Ozon an der Messstation Völklingen-City während einer 60-minütigen Einwirkungsdauer (180 µg/m³ nach Bundesimmissionsschutzverordnung) einmal überschritten.

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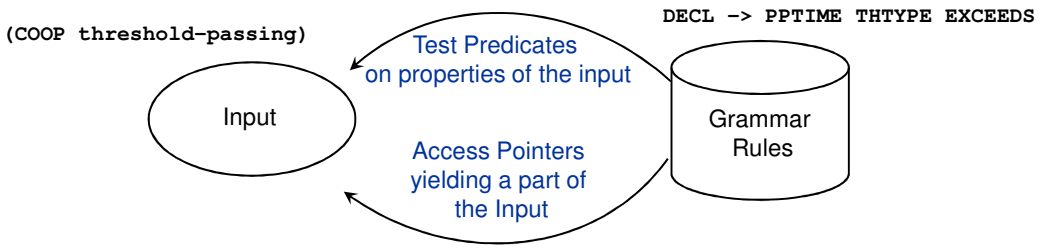
TG/2 Offers a Flexible Framework for NLG

- **TG/2 is a transparent production system**
- **TG/2 interprets a separately defined set of condition-action rules**
- **TG/2 maps pieces of input onto surface strings**

TG/2 keeps grammars largely independent from input representations



TG/2 Grammars Integrate Canned Texts, Templates and Context-free Rules

```
My category is DECL.
IF the slot COOP is 'threshold-passing
   AND the slot LAW-NAME is specified
THEN apply PPtime from slot TIME
     apply THTYPE from CURRENT-INPUT
     utter "("
     apply LAW from slot LAW-NAME
     utter ") "
     apply EXCEEDS from slot EXCEEDS
     utter "."
WHERE THTYPE AND EXCEEDS agree in GENDER
```

(Busemann 1996)

En été 1999
la valeur limite autorisée
(
selon le decret ...
)
a été dépassée une fois
.

```
My category is THTYPE.
IF there is no slot THRESHOLD-TYPE specified
THEN utter "la valeur limite autoris&e2e "
WHERE THTYPE has value 'fem for GENDER
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Source: Stephan Busemann

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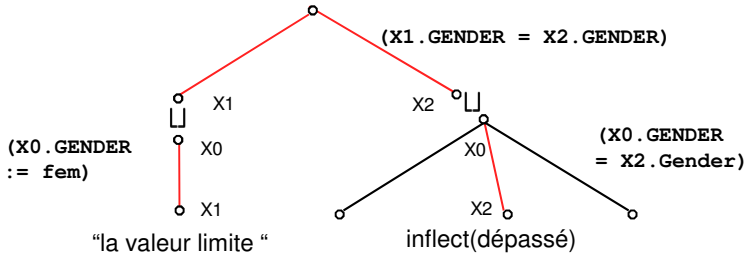
Source: Stephan Busemann

Language Technology I, WS 2014/2015, 16

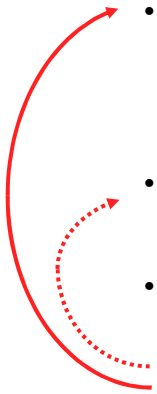
Constraints are Percolated Across the Derivation Tree

- Feature unification (⊔) at tree nodes
- Every tree of depth 1 is licensed by a grammar rule
- A feature can be assigned a value (:=)
- Two features can be constrained to have identical values (=)



The Interpreter is Based on the Context-Free Backbone of the Grammars

THREE-STEP EVALUATION CYCLE



- **Matching**
  - Identify all rules with the **current category**
  - For each of them perform its tests on the **input structure** (“IF” part)
  - Add those passing the tests to the conflict set
- **Conflict resolution**
  - Select an element of the conflict set (possibly by some preference mechanism)
- **Firing**
  - Evaluate the rule‘s constraints (if available, “WHERE” part)
  - For each element of the “THEN” part, read the new category and determine the new input structure by evaluating the associated access pointer

Overview

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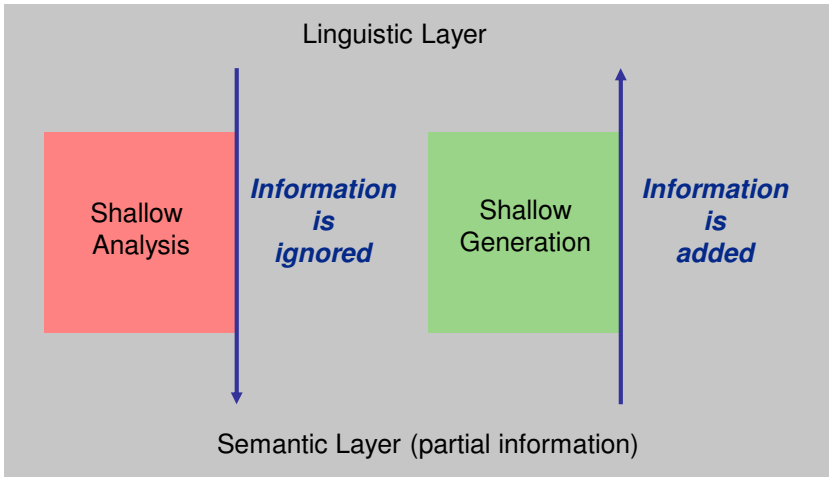
- **Some major applications for shallow NLG**
- **Assessment and conclusions**

Shallow Processing Deals With Partial Information



Some Major Applications with TG/2

Shallowness / Domain dependence of grammar

much

some

little

info added

TEMSIS – multilingual air quality reports (Busemann/Horacek 1998)
ImmoML – real estate announcements (German Telekom in 2007)
COMRIS – personalized recommendations in a conference scenario (Geldof 1999)

COSMA – appointment scheduling dialogue contributions (Busemann et al. 1994)

MUSI – syntactic realizer for medical scientific sentences (Lenci et al. 2002)

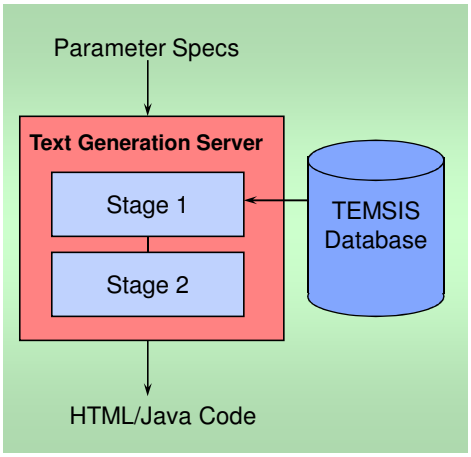
Depth / reusability of grammar

(Busemann 2005)

Text Generation in TEMSIS Occurs in Two Steps

GENERATION SYSTEM OVERVIEW

- **Parameter selection by the user**
  - language (D, E, F, P, C, J)
  - pollutant and measurement station
  - relevant period of time
- **Stage 1: Text schema construction**
  - querying the database
  - composition of report structure
  - elision of contextual redundancies
- **Stage 2: Linguistic realisation by TG/2**
  - selection of sentence patterns
  - wording, phrasing, grammar
- **HTML postprocessing**



The Texts Vary According to the User's Preferences

EXAMPLE

- **Parameters selected within the TEMSIS Navigator menus:**
  - French text about a German situation
  - ozone data, exceeding thresholds according to decree
  - measurements at Völklingen-City in summer 1997 (to be confirmed)

Vous avez choisi la station de mesure de Völklingen-City afin de consulter la pollution atmosphérique relevée en été 1997.

A la station de mesure de Völklingen-City, la valeur d'information pour l'ozone pour une exposition de 60 minutes (180 µg/m³ selon le decret allemand (Bundesimmissionsschutzverordnung)) a été dépassée une fois.

La valeur d'interdiction du trafic (240 µg/m³) a aussi été dépassée une fois.

En été 1996 la valeur d'information (180 µg/m³) n'a pas été dépassée .

The Reports Consist of Several Statements

SAMPLE SCHEMA FOR SUMMER OBSERVATION, THRESHOLD PASSING

- **Confirm pollutant, measurement station, and time interval**
- **Number the values exceeding the lowest threshold**
- **Number the values exceeding the next threshold**
- **Compare with values of preceeding year**
- **Repeat the core statement („Summary")**

A schema is instantiated on the basis of the input parameters and the retrieved data

Instantiating a Schema Leads to a Report Structure

TEXT ORGANISATION

- **Achieves text coherence by**
  - removing redundant information
  - inserting particles („also“)
  - simple techniques of aggregating information
- **Yields canned texts or intermediate content representations**
- **Intermediate representations are independent of particular languages**
  - TG/2 generates German, French, English, Portuguese, Chinese and Japanese text from them

Shallow generation can do without explicit knowledge representation and text planning

Source: Stephan Busemann

Non-Linguistic Input for Air Quality Report Generation in TEMSIS

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Multilingual Generation in TEMSIS

- **Grammar size about 100-120 rules**
- **Written with standard text editors (emacs)**
- **Six languages: German, French, English, Chinese, Japanese, Portuguese**
- **Grammar is the only language-specific part** (except for canned texts about pollutants etc. and error messages)
- **Adding a new language required little effort: 2-4 weeks, depending on skills** (incl. getting familiar with the system)

Generated Texts Are Not Invented

CORPUS-BASED GRAMMAR DEVELOPMENT (Ehud Reiter)

- **User provide examples for target texts - the more, the better**
  - Texts produced manually by domain experts
- **Initial analysis of user-generated corpus**
  - Identify the knowledge used by the authors
  - Clarify with users any underlying semantic and rhetoric relationships
  - Discuss with users how the texts can be improved
- **Analysis of the revised corpus**
  - Definition of linguistic coverage
  - Correlate surface chains and underlying relations
  - Test of revised corpus (Wizard of Oz) and iterate the whole process, if necessary
- **Generalisation from Corpus Samples to Prototypical Examples (Templates)**
  - Basis for shallow grammar development

Input and Grammars

- **Most NLG systems expect a specific, fixed kind of input**
  - Linguistic vs non-linguistic
  - Course-grained vs fine-grained semantic specifications
  - The TG/2 *framework* does not constrain input
- **TG/2 grammars usually are domain-dependent**
  - The TEMSIS input needs domain-dependent interpretation
  - Grammar development in TEMSIS was cheap (~120 rules, ~20 lexemes)
- **Deeper applications require a more generic approach**
  - MUSI input is language-specific
  - MUSI grammar to cover German sentence structures (DUDEN grammar)
  - Coverage requirements are considerably higher than with shallow NLG (> 900 rules, several thousand lexemes)
  - TG/2 grammar editor eGram to improve maintainability

Source: Stephan Busemann

MUSI: Language-Specific Input to TG/2

```
[(SENTENCE DECL)
 (VC [(VOICE PASSIV) (MOOD IND) (TENSE PRAESENS) (SBP S2)
      (STEM "verursach")])
 (DEEP-SUBJ [(TY GENERIC-NP)
             (NUMBER SG) (DET INDEF) (NR V2) (GENDER MAS)
             (STEM "antagonismus")
             (PP-ATR [(PREP MIT) (DET WITHOUT) (NUMBER SG) (GENDER NTR)
                      (STEM "Acetylcholin")
                      (LOCATIVE ...)])
             (ADJ [(STEM "kompetitiv")
                   (POS ADJECTIVE) (DEG POS)])])
 (DEEP-AKK-OBJ [(TY GENERIC-NP)
                (NUMBER PLUR) (DET DEF) (GENDER FEM)
                (STEM "wirkung")])]
```

Die Wirkungen werden durch einen kompetitiven Antagonismus mit Acetylcholin ... verursacht.

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Realization of German Sentences in MUSI

- **Size of hand-written grammar: about 950 rules**
- **Written with standard text editors (emacs), then dedicated editor eGram**
- **CFGs do not support encoding of word order variation etc.**
- **Metarule formalism within eGram (Rinck 2003)**
- **Size of derived grammar about 2.500 rules**
- **Processing slows down with huge conflict sets**
- **Take decisions on sentence structure and lexical choice outside of TG/2**

Performance loss on backtracking is low

Size of grammars and conflict sets can slow processing down

Source: Stephan Busemann

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TG/2 is a Single Pass Mapper

- **TG/2 is often combined with other NLG components**
  - TEMSIS: Text structuring depending on database content; TG/2 generating at paragraph level
  - MUSI: Lexicalization and syntactic choice, avoiding huge conflict sets in TG/2 (e.g. for all nouns); TG/2 operates as a sentence realizer
- **Limited usability for large NLG tasks**
  - Text coherence (text plan) and aggregation difficult to mimic jointly
  - Large conflict sets may require considerable computation time as the test predicates of all candidates must be checked
  - Large grammars are difficult to maintain and extend

Shallow Generation Has Pros and Cons

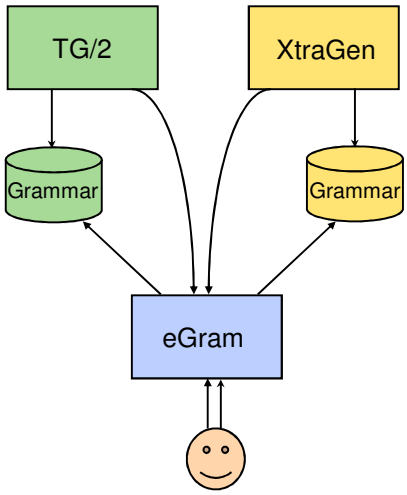
ASSESSMENT

Possible advantages	Possible drawbacks
• Low development effort • Reusable interpreter and subgrammars • Very fast processing • Easy introduction of additional languages • Easy extension with alternative formulations (through a preference mechanism in TG/2)	• Knowledge about domain is hidden in the grammar rules • Implicit dependencies • Scalability is inherently lower than with deep generators • Maintaining transparency of grammars can become a cost factor

Source: Stephan Busemann

Conclusions

- TG/2 is a framework that can implement shallow NLG tasks as well as deep realization
- Grammar writing for TG/2 and XtraGen is supported by eGram
- TG/2 has been licensed to more than 30 sites for commercial, educational and research purposes



Source: Stephan Busemann

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Note: a rather comprehensive bibliography of the field is available from http://www.fb10.uni-bremen.de/anglistik/langpro/bibliographies/

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