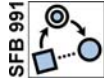


Frames 3.0 – Are all human concepts frames?

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Collaborative Research Centre 991
„The structure of representations in language, cognition, and science“
Heinrich Heine University Duesseldorf

Chungnam National University Daejeon, May 30, 2016



1. The Frame Hypothesis
2. Examples from everyday life
3. Towards a definition of ‘frame’
4. Applications in linguistics
5. Challenges

1. Frame Hypothesis 2. Examples 3. Definition 4. Linguistics **3**

1. The Frame Hypothesis

Frame – a notion from psychology and artificial intelligence

Knowledge unit for a complex condition
involving several components with defined relationships.

Lawrence W. Barsalou (1992): Frame Hypothesis

Frames constitute the universal format of concepts in human cognition.

Concepts – Any mental representations of individual objects, categories, events, properties, states, etc. etc. Arbitrary knowledge units in the cognitive system.

1. Frame Hypothesis **2. Examples** 3. Definition 4. Linguistics **4**

2. Examples of descriptions in frame format from everyday life

2.1 Passport

2. Examples of descriptions in frame format from everyday life

2.1 Passport

Description grid of the passport bearer

1. Name
2. Given names
3. Nationality
4. Date of birth
5. Sex
6. Place of birth
10. Signature of bearer
11. Residence
12. Height
13. Color of eyes

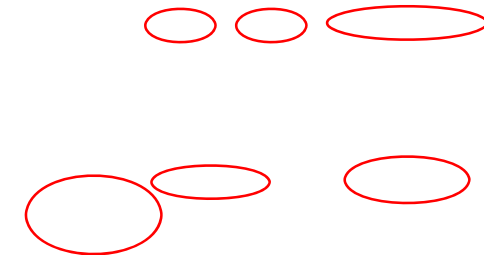
[without number and designation:] *Photograph of the face*

2. Examples of descriptions in frame format from everyday life

2.1 Passport

Description grid of the passport itself

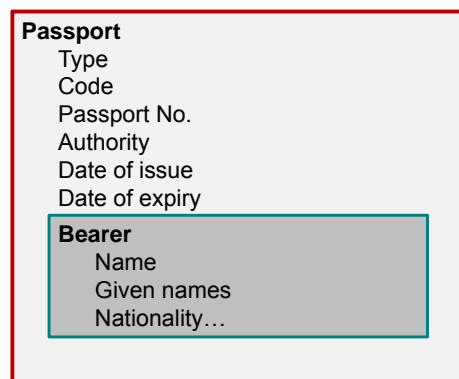
- Code
- Passport No.
- Authority
- Date of issue
- Date of expiry



2. Examples of descriptions in frame format from everyday life

2.1 Passport

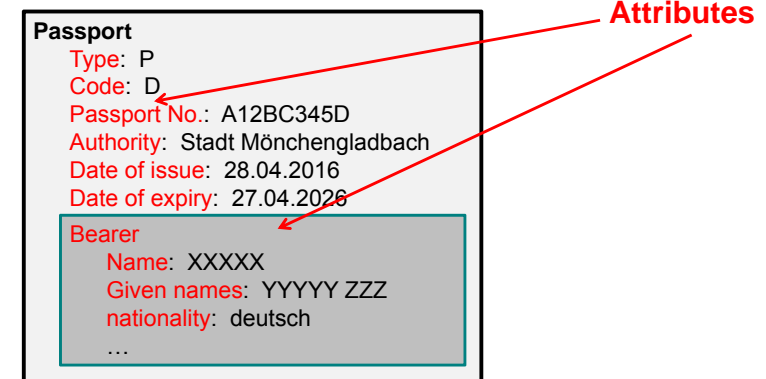
Frame embedding



2. Examples of descriptions in frame format from everyday life

2.1 Passport

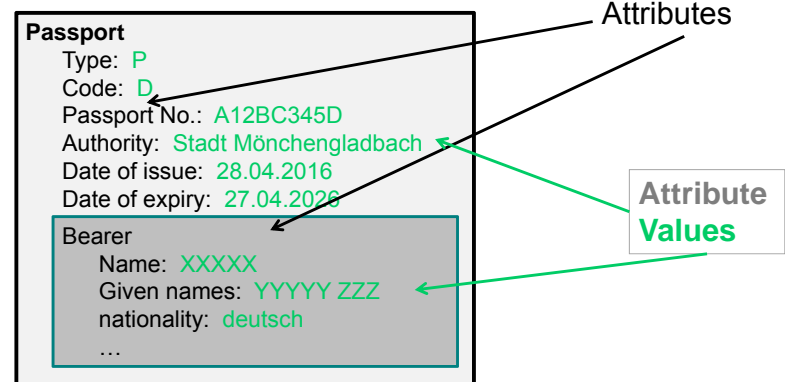
Frame embedding



2. Examples of descriptions in frame format from everyday life

2.1 Passport

Frame embedding



2. Examples of descriptions in frame format from everyday life

2.2 Library catalogue entry

Title: Cognitive psychology : an overview for cognitive scientists

Author: Barsalou, Lawrence W.

Subjects: Cognitive psychology; introduction

Similar titles: FBsprv200; psyf300

Related titles: Cognitive science series : Tutorial essays in cognitive science

Publisher: Hillsdale, NJ [u.a.] : Erlbaum

Creation date: 1992

Format: XI, 410 S. : graph. Darst.

Identifier: ISBN 0-8058-0691-1 ; ISBN 0-89859-966-0

Holdings: Zentralbibl. / Lesesaal 3. Etage : psyf300.b282

Verbundbibliothek Geisteswissenschaften : sprv200.b282

Source: DUE 01 aleph

(source: <http://katalog.ulb.hhu.de/>)

2. Examples of descriptions in frame format from everyday life

2.3 Scientific objects: elementary particles

Particle	Mass (GeV/c ²)	Spin	Charge	Interaction mediated
Photon	0	1	0	Electromagnetism
Z⁰-Boson	91.2	1	0	Weak interaction
W⁺-Boson	80.4	1	1	
W⁻-Boson			-1	
Gluon	0	1	0	Strong interaction
(Graviton)	0	2	0	Gravitation

(Sources: https://de.wikipedia.org/wiki/Schwache_Wechselwirkung
https://en.wikipedia.org/wiki/List_of_particles)

3. Towards a definition of 'frame'

3.1 Attributes and their values

Description / Representation of an object by assigning attributes and their values.

The specification of the values can be more or less precise; often just a range of possible values is specified. Values need not be describable in words.

Attribute

Bearer.NAME
 Bearer.DATE OF BIRTH
 Bearer.SIGNATURE
 Bearer.[FACE]
 Bearer.HEIGHT

Type of value

a linguistic expression that is admissible as a name
a date of a day
a written shape
a photographic picture of a human face
a measure of body height

Passport.TYPE
 Passport.CODE
 Passport.PASSPORT-NO.
 Passport.DATE OF EXPIRY

one out of five possible passport types (abstract)
a country code (letter sequence)
normed sequence of letters and numbers
a date of a day later than the date of issue

3. Towards a definition of 'frame'

3.1 Attributes and their values

Kind of attribute	Person	Guitar	Book
For parts	FACE	NECK	PREFACE
For correlates	PLACE OF BIRTH	OWNER	AUTHOR
For properties	SEX	TYPE	PRICE
For related actions and events	BIRTH	PURPOSE	PRINTING

Attributes have a **domain** and a **range of possible values**,

e.g. COLOR: domain = visible objects
range of values = the color space

3. Towards a definition of 'frame'

3.2 Structural conditions on Barsalou-Frames

Recursivity

The values of attributes can themselves carry attributes with values, and so on

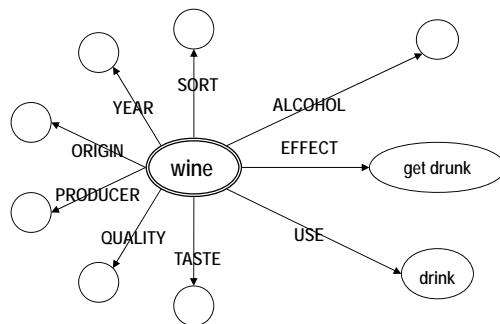
Objects, attributes and values are often represented by network.

The represented object and attribute values are nodes (vertices) connected by arcs that represent the attributes.

- Every node can carry an attribute only once.
 - An attribute links a node to exactly one value node.
 - The network of nodes and attribute arcs must be connected (coherent).
- The attributes in the network represent **functional**.

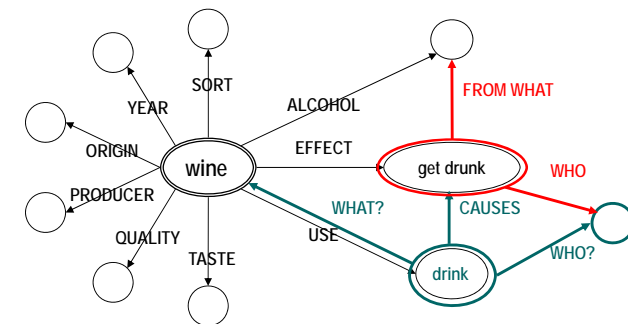
3. Towards a definition of 'frame'

3.3 A Barsalou frame für wine



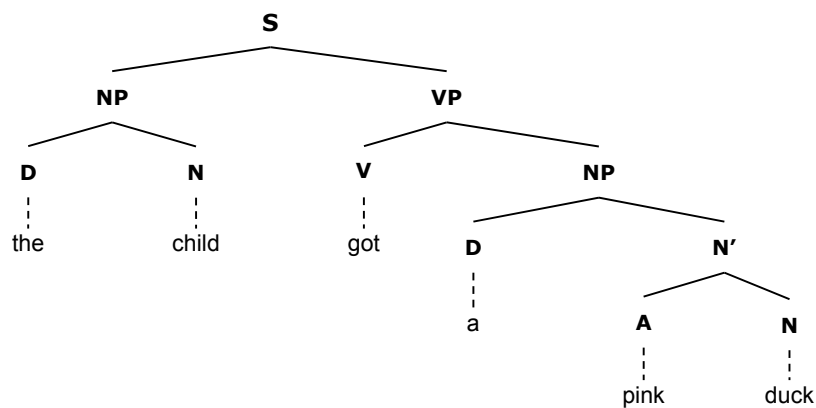
3. Towards a definition of 'frame'

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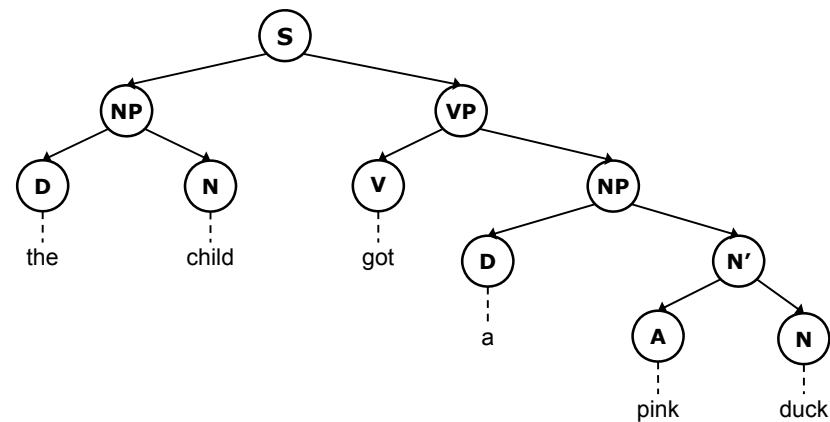
4. Applications in linguistics

4.1 Syntax: Syntactic trees can be read as frame representations



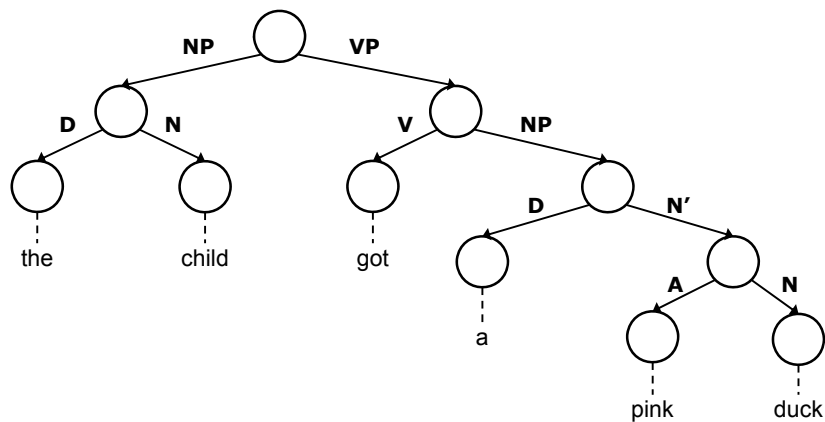
4. Applications in linguistics

4.1 Syntax: Syntactic trees can be read as frame representations



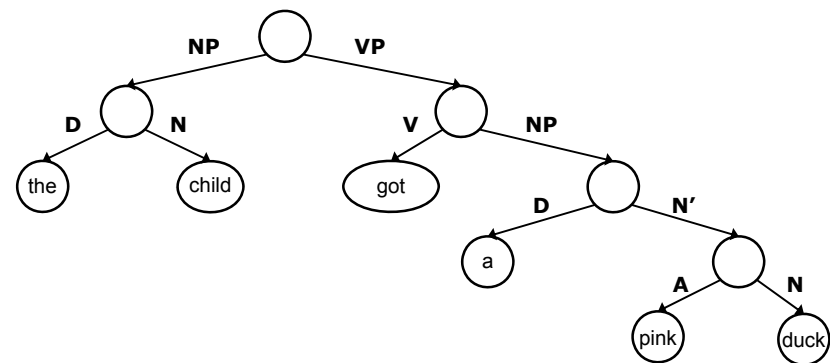
4. Applications in linguistics

4.1 Syntax: Syntactic trees can be read as frame representations



4. Applications in linguistics

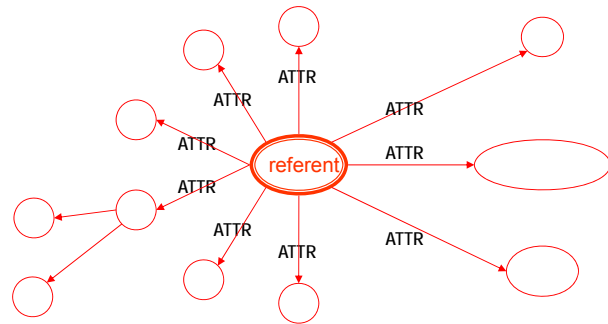
4.1 Syntax: Syntactic trees can be read as frame representations



4. Applications in linguistics

4.2 Semantics (1): different types of concepts

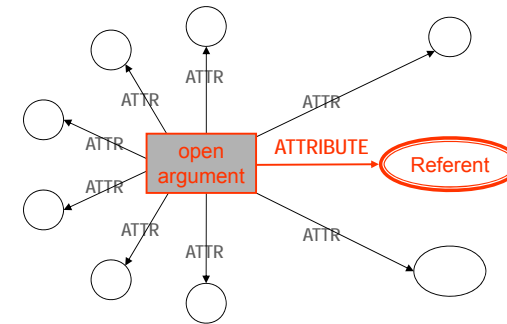
Sortal noun: central node for the referent with a fan of attributes



4. Applications in linguistics

4.2 Semantics (1): different types of concepts

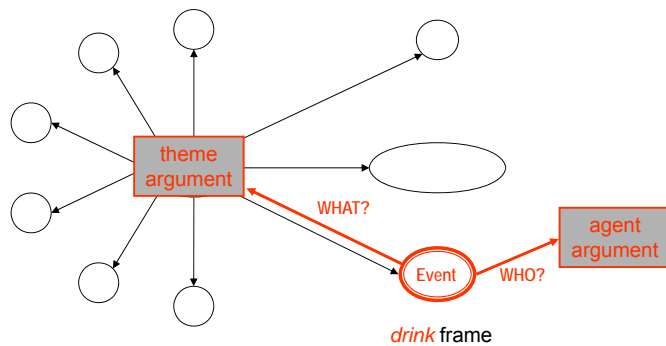
Functional noun: Attribute concept – argument node, referent node



4. Applications in linguistics

4.2 Semantics (1): different types of concepts

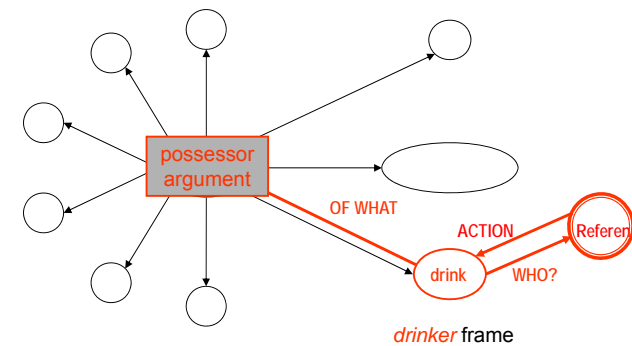
Verb: Case frame – node for the event referent, arguments of the verb as attributes



4. Applications in linguistics

4.2 Semantics (1): different types of concepts

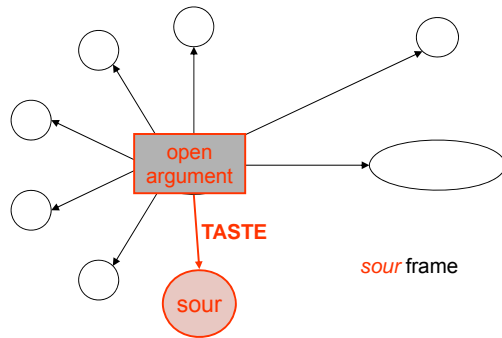
Relational noun: nodes for referent and possessor argument



4. Applications in linguistics

4.2 Semantics (1): different types of concepts

Adjective: no referent node, 1 argument node



4. Applications in linguistics

4.3 Semantics (2): Composition

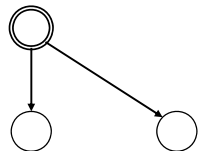


4. Applications in linguistics

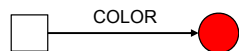
4.3 Semantics (2): Composition

(1) *red pencil*

>pencil< : sortal concept



>red< : adjective concept

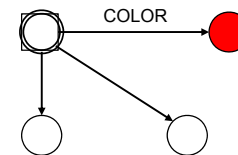


4. Applications in linguistics

4.3 Semantics (2): Composition

(1) *red pencil*

Unification 1

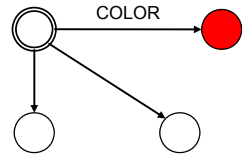


4. Applications in linguistics

4.3 Semantics (2): Composition

(1) *red pencil*

Unification 1

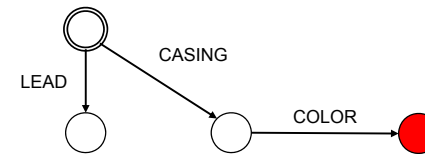


4. Applications in linguistics

4.3 Semantics (2): Composition

(1) *red pencil*

Unification 2

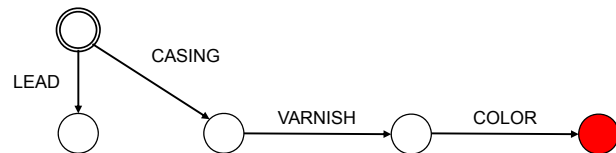


4. Applications in linguistics

4.3 Semantics (2): Composition

(1) *red pencil*

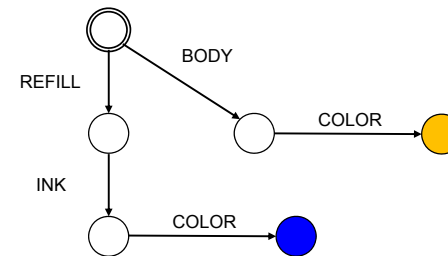
Unification 3



4. Applications in linguistics

4.3 Semantics (2): Composition

(2) *yellow ballpen / blue ballpen*



4. Applications in linguistics

4.3 Semantics (3): Composition and decomposition

Modeling lexical meaning (“decomposition”):
nouns, verbs, adjectives

- composition as compounding of frames
- more fine-grained analysis of composition:
detailed modeling of the interaction of meanings/concepts
- modeling conceptual meaning shifts:
metonymy, mass-count shifts, and others
- modeling semantic processes of word formation
(e.g. derivation of nouns from verbs, noun-noun compounds)

5. Challenges

- Can all types of concepts be modeled as a network of attributes and values?
- How to model temporal, spatial, and causal relations in verb concepts, scripts, narrations etc.?
- Can arbitrary conceptual relations be analyzed in terms of functional attributes?
- If all concept formation is in terms of attributes – What are admissible / cognitively plausible attributes to be used in frame analysis?
- How can frame contents be empirically assessed?

6. History

Frames 1.0

Bundles of attributes and values (‘slots and fillers’), often not recursively organized. Primarily sortal nouns and verbs.

- Fillmore, C.J. (1982). Frame Semantics. In Linguistic Society of Korea (Ed.), *Linguistics in the Morning Calm*. Hanshin. Seoul. 111–138.
- Minsky, Marvin (1975): A Framework for Representing Knowledge. In Patrick H. Winston (ed.): *The Psychology of Computer Vision*. McGraw-Hill. New York. 211–277.

Sequential models of complex sequences of events:

- Schank, Roger C. / Robert P. Abelson (1977): *Scripts, Plans, Goals and Understanding: An Inquiry into Human Knowledge Structures*. Lawrence Erlbaum. Hillsdale, NJ.

6. History

Frames 2.0

Barsalou. Recursive structure. Functional attributes. Different types of concepts. Constraints as additional conceptual conditions. Empirical underpinning.

- Barsalou, Lawrence W. (1992a), Frames, concepts, and conceptual fields, in A. Lehrer and E. F. Kittay (eds.), *Frames, fields, and contrasts: New essays in semantic and lexical organization*. Lawrence Erlbaum. Hillsdale, NJ. 21–74.
- Barsalou, Lawrence W. (1992b), *Cognitive psychology. An overview for cognitive scientists*. Lawrence Erlbaum Associates. Hillsdale, NJ .

6. History

Frames 3.0

Current developments in the Duesseldorf research community: development of a formal frame theory. Applications in linguistics, philosophy, science. Psychological and neurological research.

- Petersen, Wiebke (2007). Representation of concepts as frames, in Skilters, J.& Toccafondi, F.& Stemberger, G. (eds.). *Complex cognition and qualitative science. The Baltic Inter-national Yearbook of Cognition, Logic and Communication*, University of Latvia. Riga. Vol. 2. 151-170.
- Löbner, Sebastian (2013). *Understanding Semantics, 2nd edition*. New York, London: Routledge. Chapter 12: Frames. (Elementary introduction).

Visit the CRC homepage for more publications and ongoing work:

<http://www.sfb991.uni-duesseldorf.de/>

Thank you very much for your attention!