

# Functional Concepts in Frames and Functional Concepts as Frames

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# outline

- 1 Functional Concepts**
  - Research Unit on Functional Concepts and Frames
  - Concept Types
- 2 Frames**
  - Definition of Frames
  - Interpretation of Relational Concepts
  - Attributes in Frames
- 3 Conclusion**

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# Forscherguppe Funktionalbegriffe und Frames

**FFF** is a research unit with

- speaker: Prof. Dr. Löbner
- begin: august, 2005
- location: Düsseldorf (and Frankfurt)
- 9 projects from:
  - General Linguistics
  - Computational Linguistics
  - Romance Linguistics
  - Philosophy
  - Medicine History
  - Cognition Science



# classifying concepts

person, pope, house, verb, sun, Mary, wood,  
brother, mother, meaning, distance, spouse,  
argument, entrance

# classifying concepts: arity

arity:1	person, pope, house, verb, sun, Mary, wood
arity:>1	brother, mother, meaning, distance, spouse, argument, entrance

# classifying concepts: uniqueness of reference

	no unique reference	unique reference
arity:1	person, house, verb, wood	Mary, pope, sun
arity:>1	brother, argument, entrance	mother, meaning, distance, spouse



# concept types

	no unique reference	unique reference	
arity:1	person, house, verb, wood	Mary, pope, sun	
arity:>1	brother, argument, entrance	mother, meaning, distance, spouse	<b>relational</b>

# concept types

	no unique reference	unique reference	
arity:1	person, house, verb, wood	Mary, pope, sun	
arity:>1	brother, argument, entrance	mother, meaning, distance, spouse	<b>relational</b>
		<b>identificational</b>	

# 4 concept types (Löbner)

	no unique reference	unique reference	
arity:1	<b>SC:</b> sortal concept	<b>IC:</b> individual concept	
arity:>1	<b>RC:</b> (proper) relational concept	<b>FC:</b> functional concept	<b>relational</b>

**identificational**

## 4 concept types: linguistic realization

<p><b>SC: sortal concept</b></p> <p>INDEFINITE</p> <p>person, house, verb, wood</p>	<p><b>IC: individual concept</b></p> <p>DEFINITE</p> <p>Mary, pope, sun</p>
<p><b>RC: (proper) relational concept</b></p> <p>INDEFINITE + POSSESSIVE</p> <p>brother, argument, entrance</p>	<p><b>FC: functional concept</b></p> <p>DEFINITE + POSSESSIVE</p> <p>mother, meaning, distance, spouse</p>

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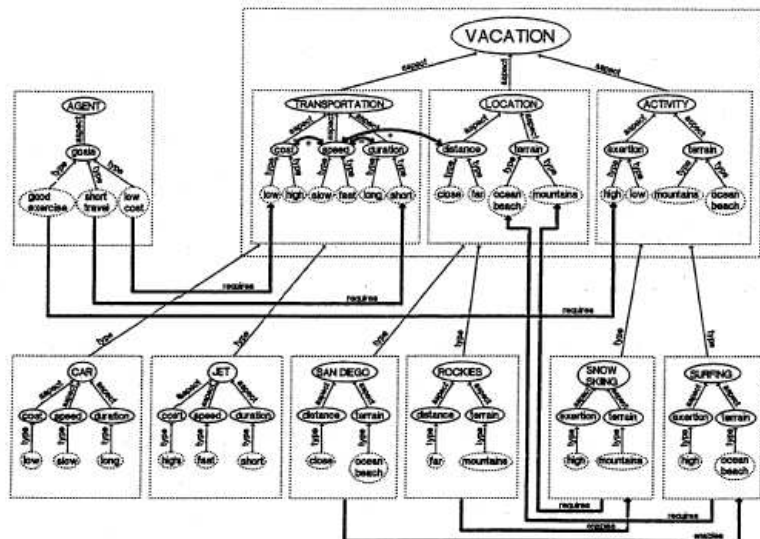
# Barsalou's frames

## Barsalou (1992) *Frames, Concepts, and Conceptual Fields*

- Frames provide the fundamental representation of knowledge in human cognition.
- At their core, frames contain **attribute-value sets**.
- Frames further contain a variety of relations.
  - **Structural invariants** in a frame capture relations in the world that tend to be relatively constant between attributes.
  - **Constraints** capture systematic patterns of variability between attribute values.

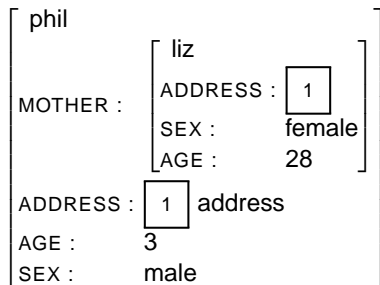
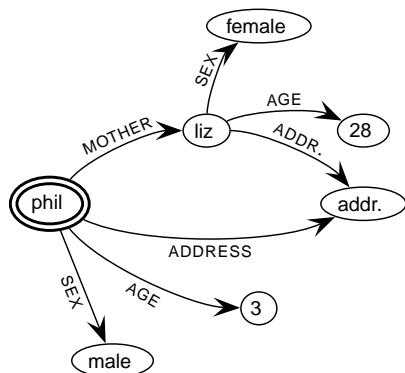
## Definition of Frames

## Barsalou's vacation frame



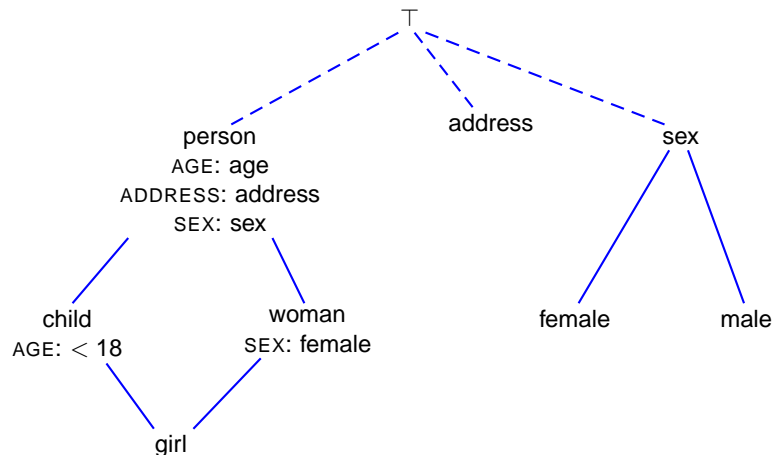


# typed feature structures

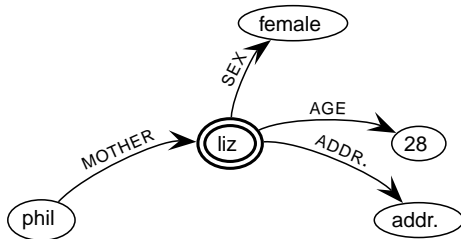


Typed feature structures model sortal and individual concepts!

# types can be organized in type signatures



# frames as extended typed feature structures



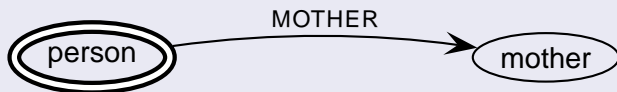
## Definition (Frame)

Frames are connected, directed graphs with

- one central / referential node
- nodes labeled with types
- edges labeled with attributes
- no node with two equally labeled outgoing edges
- (one root node)

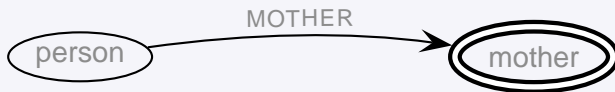
## example

## frame 'person' (with attribute 'mother')



$$\lambda x : \text{person}(x) \wedge (\exists y : \text{mother}(y) \wedge \text{MOTHER}(x) = y)$$

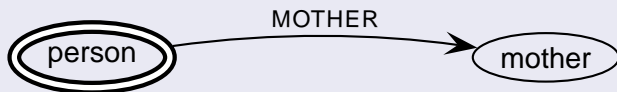
## frame 'mother'



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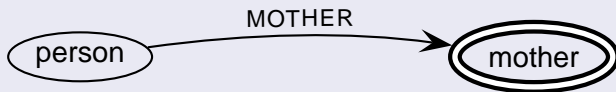
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$$\lambda y : \text{mother}(y) \wedge (\exists x : \text{person}(x) \wedge \text{MOTHER}(x) = y)$$

# attributes in frames

## Barsalou, 1992

“I define an attribute as a **concept** that describes an aspect of at least some category member.”

“Values are subordinate concepts of an attribute.”

## Guarino, 1992: *Concepts, attributes and arbitrary relations*

“We define attributes as **concepts** having an associate relational interpretation, allowing them to act as conceptual components as well as concepts on their own.”

# denotational and relational interpretation

## denotational interpretation

A relational concept denotes a set of entities:

$$\delta : \mathcal{R} \rightarrow 2^{\mathcal{U}}$$

$$\delta(\text{son}) = \{s \mid s \text{ is a son of somebody}\}$$

## relational interpretation

A relational concept has also a relational interpretation:

$$\rho : \mathcal{R} \rightarrow 2^{\mathcal{U} \times \mathcal{U}}$$

$$\rho(\text{son}) = \{(p, s) \mid s \text{ is a son of } p\}$$

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## Consistency Postulate (Guarino, 1992)

Any value of an relationally interpreted relational concept is also an instance of the denotation of that concept.

If  $(p, s) \in \rho(\text{son})$ , then  $s \in \delta(\text{son})$ .

## Consequences

- relationally interpreted relational concept: relation with
  - 1. argument: possessor argument
  - 2. argument: referring argument
- relational interpretation of a functional concept:  
function: possessor  $\rightarrow$  referent

If  $(c, m_1), (c, m_2) \in \rho(\text{mother})$ , then  $m_1 = m_2$ .

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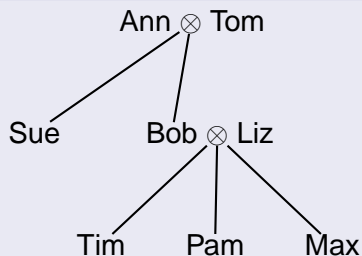
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## example

## example family



## 'son' denotational

$$\delta(\text{son}) = \{\text{Max}, \text{Tim}, \text{Bob}\}$$

## 'son' relational ('son of')

$$\text{Ann} \curvearrowright \text{Bob}$$

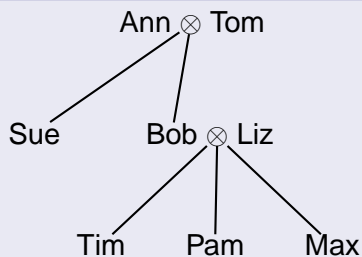
$$\text{Tom} \curvearrowright \text{Bob}$$

$$\text{Bob} \curvearrowright \text{Max}, \text{Bob} \curvearrowright \text{Tim}$$

$$\text{Liz} \curvearrowright \text{Max}, \text{Liz} \curvearrowright \text{Tim}$$

## example

## example family



## 'mother' denotational

$$\delta(\text{mother}) = \{\text{Ann}, \text{Liz}\}$$

## 'mother' relational ('mother of')

Sue  $\curvearrowright$  Ann

Bob  $\curvearrowright$  Ann

Tim  $\curvearrowright$  Liz

Pam  $\curvearrowright$  Liz

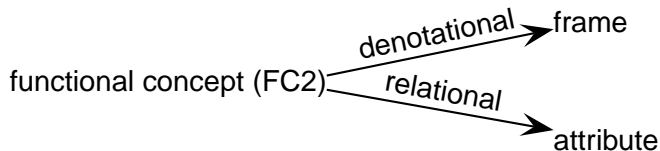
Max  $\curvearrowright$  Liz

# attributes in frames

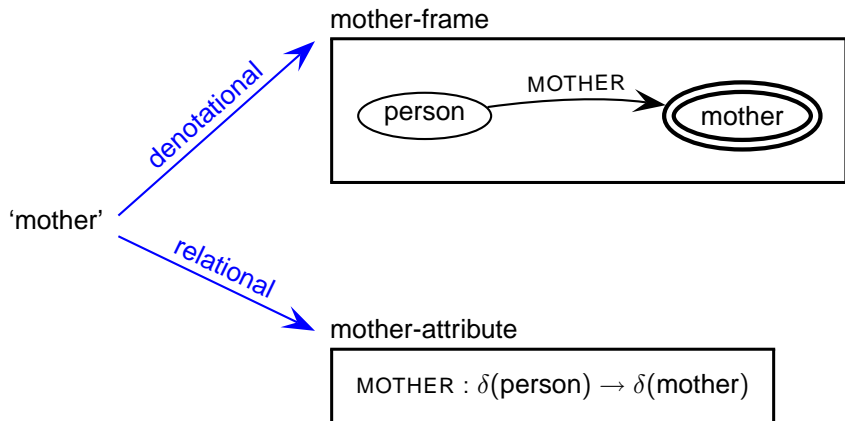
## FFF-thesis:

Attributes in frames are relationally interpreted functional concepts!

- attributes are not frames themselves
- attributes are unstructured
- each attribute has an associated frame
- the possible values of an attribute are subconcepts of the denotationally interpreted functional concept



# attributes in frames



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# conclusion

## concluding remarks

- Frames can be seen as slightly extended feature structures.
- Sortal and individual concepts can be analyzed by typed feature structures.
- Functional concepts can be analyzed by (functional) frames.
- Attributes in frames are relationally interpreted functional concepts.



# how to proceed?

## a fragmentary todo list

- How do frames of relational concepts look like?
- How to benefit practically of our frames? How to compute with them?
- How to define type signatures for frames (redefinition)?
- How to deal with scale-valued attributes and how to implement constraints on them?

...

## further information

Conference on  
**Concept Types and Frames**  
**in Language, Cognition, and Science**  
Düsseldorf, August 20-22, 2007

organized by

**FFF**

Forscherguppe

“Funktionalbegriffe und Frames”

[www.phil-fak.uni-duesseldorf.de/FFF](http://www.phil-fak.uni-duesseldorf.de/FFF)



# literature

- Barsalou (1992)** Frames, Concepts, and Conceptual Fields. In Lehrer and Kittay (eds.): Frames, Fields, and Contrasts.
- Guarino (1992)** Concepts, attributes and arbitrary relations — some linguistic and ontological criteria for structuring knowledge bases. Data Knowl. Eng. 8, 249-261
- Löbner (2005)** FFF — Forschergruppe “Funktionalbegriffe und Frames”, DFG-Antrag.
- Löbner (2005)** Funktionalbegriffe und Frames — Interdisziplinäre Grundlagenforschung zu Sprache, Kognition und Wissenschaft. Erschienen im Jahrbuch der Heinrich-Heine-Universität Düsseldorf.

## origin of the pictures

- picture frames (titlepage):  
<http://www.frames-by-the-case.com>(07/10/2006)
- German ID card:  
<http://de.wikipedia.org/wiki/Personalausweis>  
(07/10/2006)
- Barsalou's vacation frame: Barsalou 1992, p. 38