Children Philosophy Artificial Intelligence (AI) Teaching

Extended Logical Reasoning (ELR) integration with PROLOG for Natural Language Stories and Logic-Construction-Set (LCS) Application

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International Conference of Philosophy for Children
Responsibility for the Future: New Philosophical Foundations of Peace and Justice
November 7-10, 2019 in Graz/Austria

ACPC Austrian Center of Philosophy with Children and Youth
Institut für Kinder- und Jugendphilosophie

„Menschen, die miteinander arbeiten, addieren ihre Potenziale. Menschen, die füreinander arbeiten, multiplizieren ihre Potenziale“

Steffen Kirchner

FH-Prof. Mag. DI Dr. Bernhard Heiden, MBA

Professor for Production Engineering

FH-Prof. DI Dr. Roland Willmann

Professor for Industrial Management

FH-Prof. DI Dr. Erich Hartlieb

Degree programm leader Industrial Engineering Professor für Innovation- und Technologymanagement

Mag. Dr. Petra Hössl

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FH-Kärnten Wirtschaftsingenieurwesen Studiengang WING & IEM

FH-Prof. Dr. Joachim Werner

Professor for Business Administration

DI Dr. Josef Tuppinger

Senior Researcher

DI (FH), Mag. (FH) Michael Roth

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Mag. (FH) Thomas Saier

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Laboratory Engineer Smartlab

Joris Löschnig

Student Staff Member Smartlab

Monika Decleva, BSc

Scientific Employee

Tamara Penker

Administration

Alexandra Reithofer

Administration

Von der Idee zur erfolgreichen Marktumsetzung

InnovationsWerkstatt KÄRNTEN

Impuls → Analyse und Zieldefinition → Ideenentwicklung und -verdichtung → Konzept-entwicklung und Geschäftsmodell → Leistungs-entwicklung und Markttest → Umsetzung und Markteinführung

smart lab CARINTHIA

Prototyping & Industrie 4.0

- CNC
- LASER CUTTER
- SCHNEIDPLOTTER
- 3D-DRUCK / SCANNING
- ELEKTRONIK
- DESIGN / KONSTRUKTION

Konstruktion und Entwicklung → Prototypen-fertigung → Prototypen-validierung

Smartlab 1

Smartlab 2

Content

Introduction

Natural vs. Artificial Perception

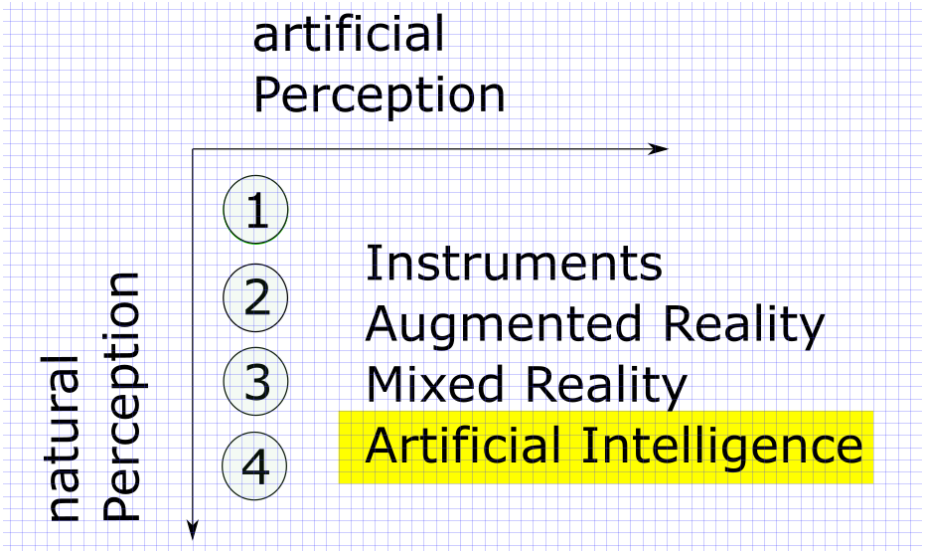


Figure 1: Dimensions of perception (1) Text (2) Picture (3) Video (4) Sensomotoric (Heiden and Oberlercher 2018) extended with Artificial Intelligence for logical reasoning

Figure 2: *

Generalized Montessori Principle 1

Generalized Montessori Principle

Take some disciplinary regularity e.g. laws of mathematics, physics or of any discipline and combine the core of the law in a material that contains the law available to different perception channels according to Figure 1 (on p. 8).

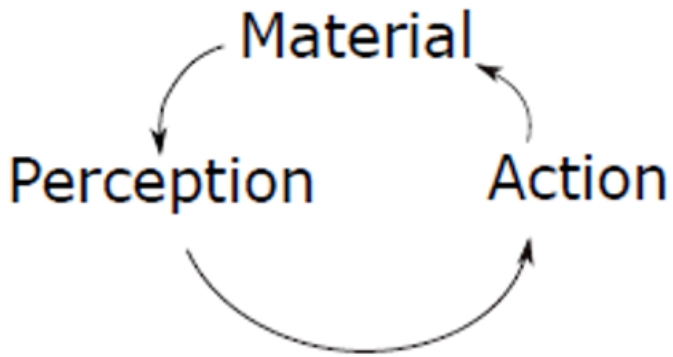


Figure 3: Biocybernetics feedback cycle

Generalized Montessori Principle 2 - Deduction

THEORETIC FRAMEWORK

(0) Framework of System Theory (Lunze 2008), Perception Theory, Montessori Pedagogic (Montessori 2007, Montessori 1967), 5^{th} Main Sentence of Thermodynamics (Heiden and Leitner 2018, Information Theory - *language*

perception channels

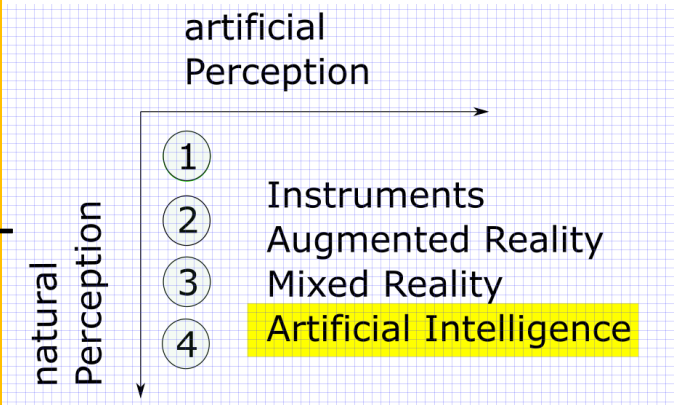
(1) Sensory perception channels *speak* with each other (translation)

(2) New rules can be observerd by practical implementation (using senses) - *conclude*

new learning material

(3) Compression of information by means of generalization rules → semantic density forming - *understand*

Generalized Montessori Principle



(compare Figure 1 o.p. 8)

What is Artificial Intelligence (AI) ?

1 Knowledge

2 Query

Part 1
Exercise Family Resemblances

The knowledge base According to the Exercise <Family resemblances> concerning the Pixie novel (Lipman 1981) in the handbook from Lipman and Sharp 1984, p. 39-40:

> "(1) Mr. John Jones is the son of Lucy and Walter Jones. (2) Mary Jones, the wife of John Jones, (3) is the daughter of Wendy and Henry Smith. (4) John and Mary Jones have three children: Edward, Suzy and Betsy."

Figure 4: Knowledge Base - Pixie novel from Lipman 1981, Lipman and Sharp 1984

Rules in Prolog

The rules That what is used as the rules in PROLOG are in the Pixie accompanying handbook from Lipman and Sharp 1984, p. 40 the resemblances:

"Now here are the resemblances:

1. (5a) John Jones has his mother's mouth, (5b) his father's nose, and (5c) his mother's eyes.
2. (6a) Mary Jones has her mother's chin, her (6b) mother's ears, and (6c) her father's mouth.
3. (7a) Edward Jones has Lucy Jones's nose, (7b) Henry Smith's mouth, and (7c) John Jones's ears.

Figure 5: Rules - a form of sentences or knowledge

Family - Diagram

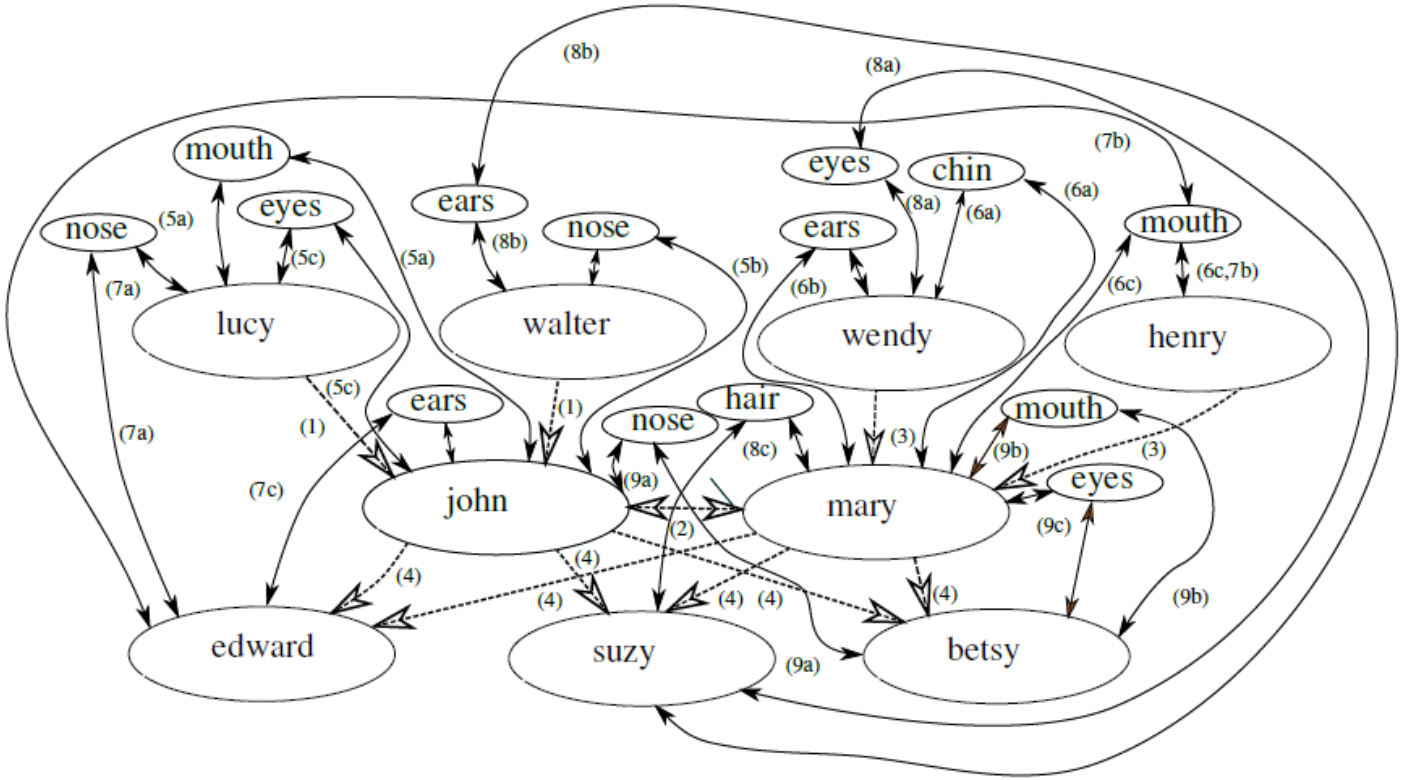


Figure 6: Pixie - Family Diagram

Queries in Prolog

The queries The queries, i.e. the questions to the database are the questions we ask about the story. In the example part this is according to Lipman and Sharp 1984, p. 40:

"Questions:

1. Which member of the family looks most like Henry Smith (other than Henry himself)?
2. Which member of the family looks most like Wendy Smith?
3. Which member of the family looks most like Lucy Jones?
4. Which member of the family looks most like Walter Jones?
5. Which member of the family looks most like John Jones?
6. Which member of the family looks most like Mary Jones?"

Figure 7: Rules - a form of sentences or knowledge

Part 2

Logic Constructions Set (LCS)

Logic Construction Set (LCS)

1. Logic Railway
2. Logic Tree
3. Logic City

Logic Railway I

Logic Railway The Logic Railway is shown in Fig. 2 for predicates P1-4.

Here also the translation is given for the PROLOG writing. On each railway-track a predicate is given, and two readings: That of the natural language, and that of PROLOG, which can be written directly to SWI-PROLOG. This is shown in Fig. 2 for the railway-tracks and in Fig. 3 for the SWI-PROLOG Editor, both for the predicates P1-4.

Figure 8: Logic Railway

Logic Railway II

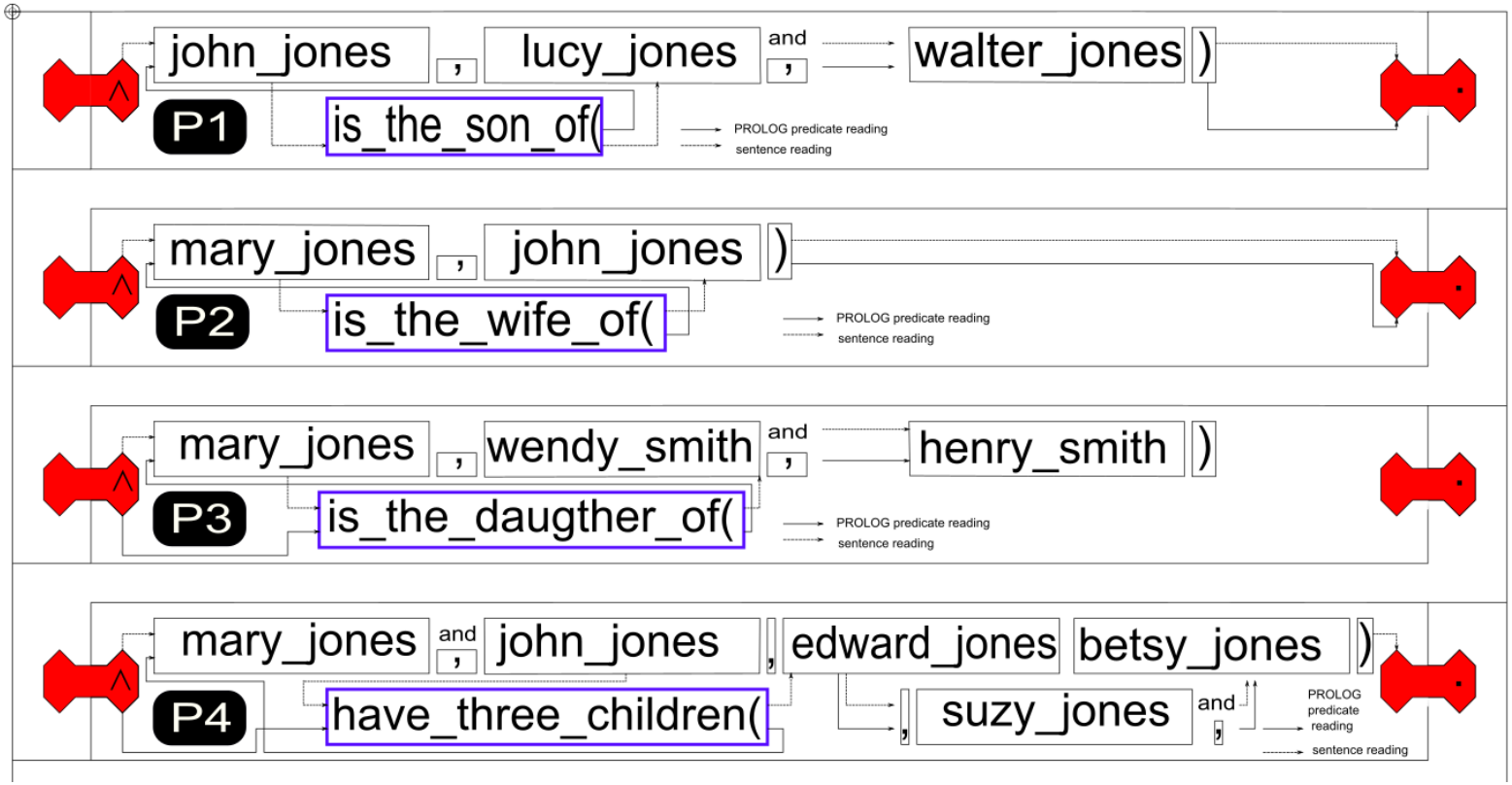


Figure 9: Fig.2 Logic Railway

Logic Railway III

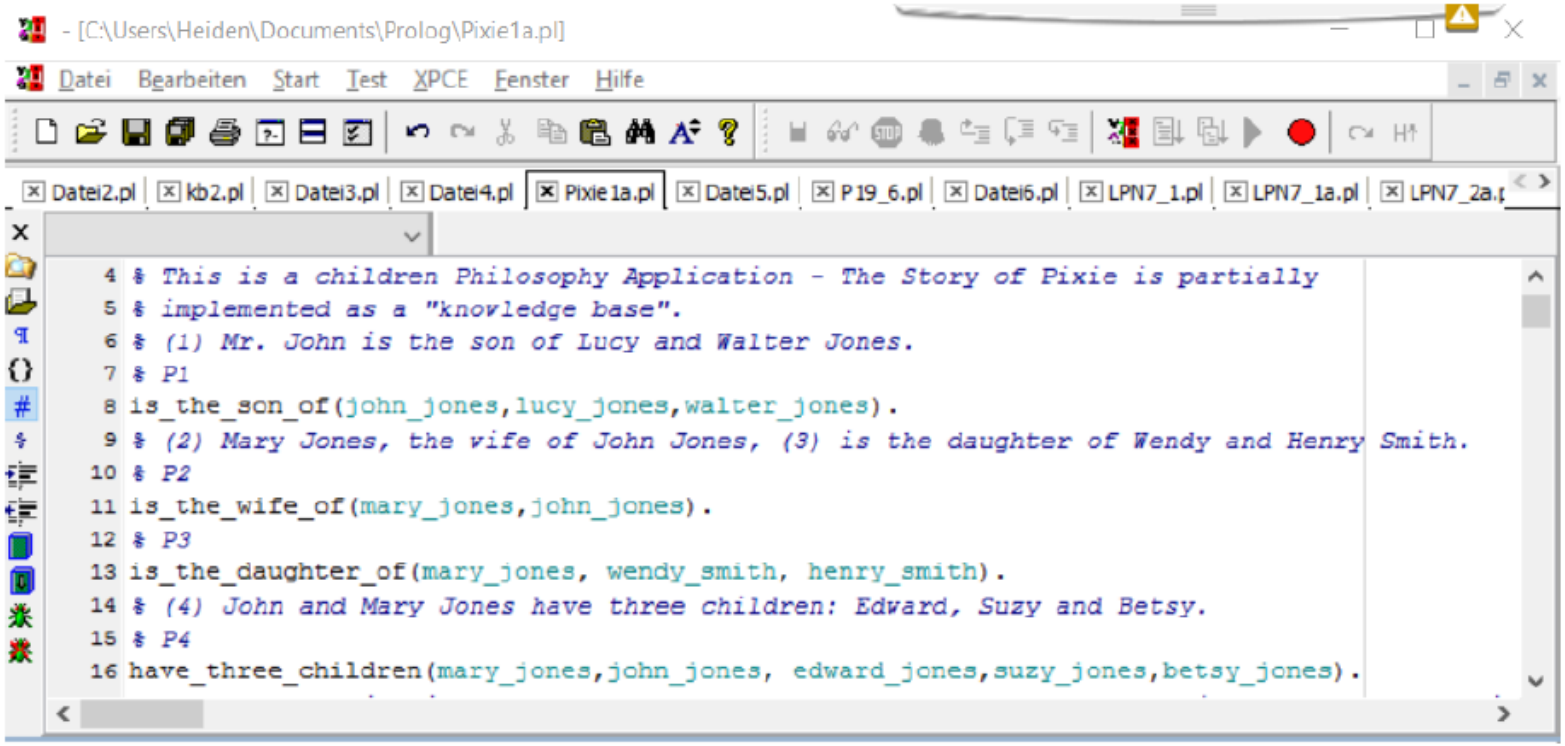


Figure 10: Fig.3 Logic Railway - SWI-Prolog Editor

Logic Tree

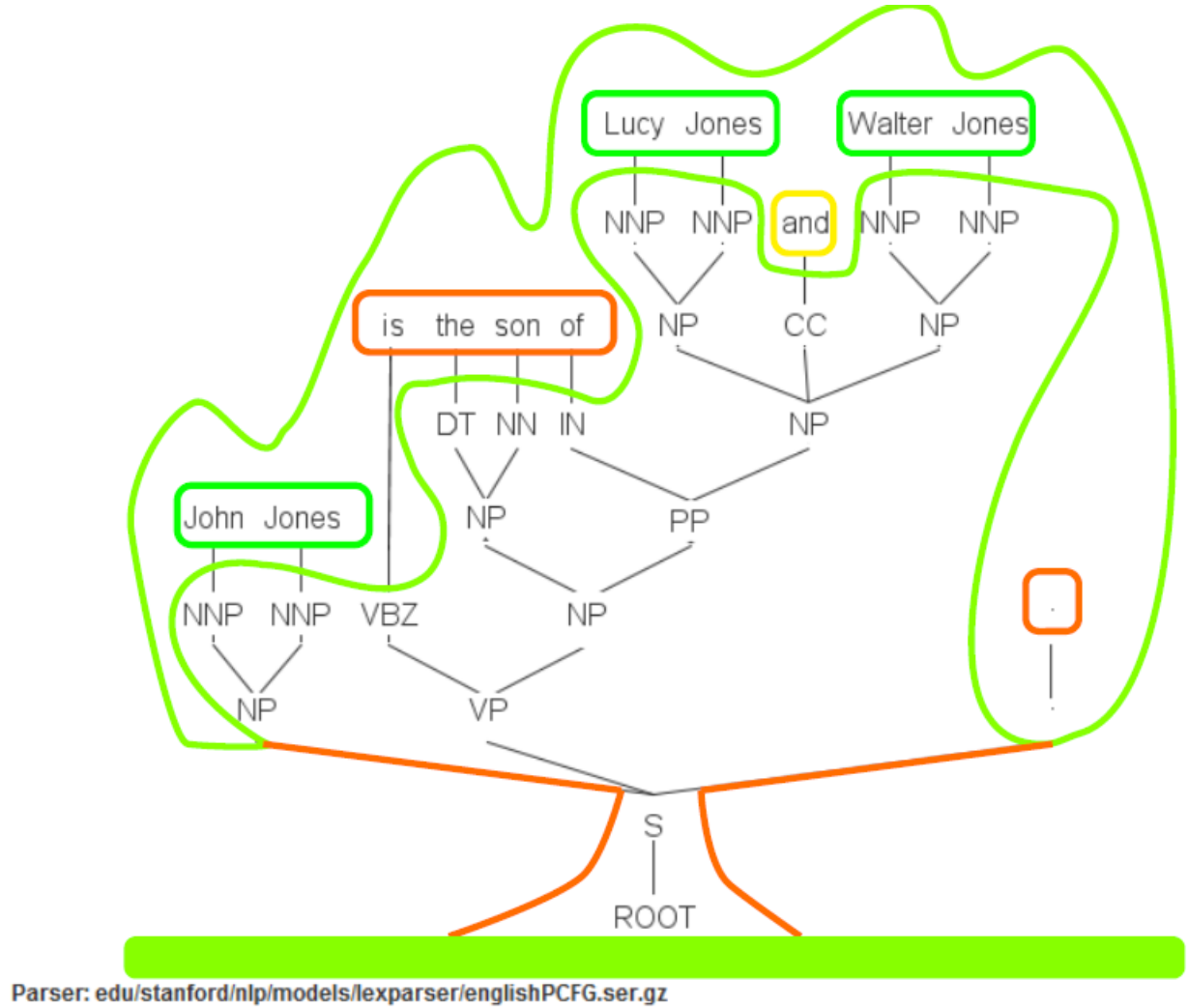


Figure 11: Logic Tree

Logic City

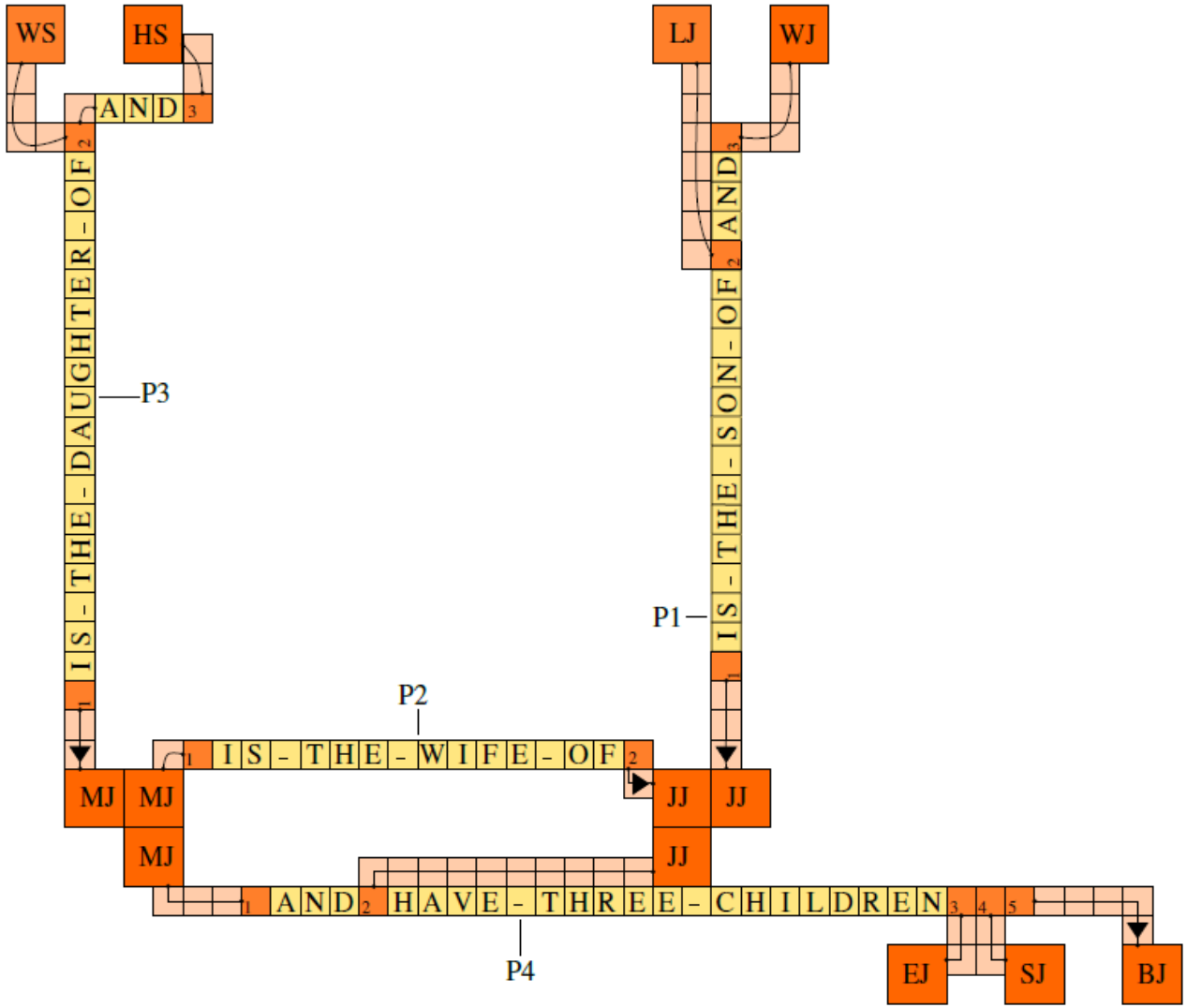


Figure 12: Logic City

Part 3
PROLOG Implementation

Prolog Terms

```
% P1
is_the_son_of(john_jones,lucy_jones,walter_jones).
% P2
is_the_wife_of(mary_jones,john_jones).
% P3
is_the_daughter_of(mary_jones, wendy_smith, henry_smith).
% P4
have_three_children(mary_jones,john_jones,edward_jones,
suzy_jones,betsy_jones).
```

Here it is of importance, that the PROLOG "atoms" or ground-terms, like the name "John Jones" are beginning with a lowercase letter. The logical variables, are beginning with an uppercase letter. The underscore _ denotes in a term for a variable, something like "that it does not matter what to fill in".

Figure 13: Prolog Terms

Latent Sentences

The latent sentences are the implicit premises, that have also to be formulated as sentences. These are as a part of all, for premises P5-30:

$$\%P5,P6 \qquad is\_the\_mother\_of(A\_mother,A\_child):-$$
$$is\_the\_son\_of(A\_child,A\_mother,\_).$$

The Rules

The rules Finally the rules are defined. These correspond to the resemblances in the example given above. They are similar to the latent premises, and constitute in our case "if then" sentences, denoted by the PROLOG operator ":-". In the following the rules for the sentences (5a-c) are given, according to Fig. 1 and the paragraph <The rules>:

```
%P25,%P26 (5a)
has_the_same_mouth_as(john_jones,His_mother) :-
        is_the_mother_of(john_jones,His_mother).
%P27,%P28 (5b)
has_the_same_nose_as(john_jones,His_father):-
        is_the_father_of(john_jones,His_father).
%P29,%P30 (5c)
has_the_same_eyes_as(john_jones,His_mother):-
        is_the_mother_of(john_jones,His_mother).
```

Figure 14: The Rules

Queries

The queries Finally the questions are asked according to the paragraph <The queries>. When we ask for example the question "Which member of the family looks most like Henry Smith (other than Henry himself)?" we first have to analyze the sentence and reformulate it as a predicate, that can be logically deduced by PROLOG. In this case, "member of family" and "looks most like" seem to be adequate predicates. As all the persons we defined are members of the family we leave out the first predicate. Then we look at the predicate "looks most like", this seems to be too difficult at first, as there is the question what means "most" logically. The word "most" seems to mean something with regard to the predicate itself. Therefore it is in nature something that is self-referential. So we divide the predicate by analysis into two predicates "most" and "looks like", and implement the last only. This is defined in PROLOG in the database e.g. for the property mouth with the rules:

```
%P62,P63
looks_like(A_person,Another_person,mouth):-
            has_the_same_mouth_as(A_person,Another_person).
```

Figure 15: Queries

Queries

Now we are prepared to ask the question to PROLOG. This is done as follows: First the database is loaded. This is done directly in SWI-PROLOG (OpenSource-Software 1987) or the SWI-PROLOG Editor (Röhner 2015) by

```
['Pixie1a'].
```

followed by an <ENTER>, when the database filename is "Pixie1a.pl". Now the query can by written into the query window, which begins with the signs:

```
?-
```

The question is now formulated, after definition of a set of latent predicates as a query by the following sentence-predicate:

```
looks_like(henry_smith,X,Y).
```

The answer of PROLOG is first:

```
X=mary_jones,
Y=mouth
```

after pressing <SPACE>

```
;
X=edward_jones,
Y=mouth
```

and after another pressing of <SPACE>

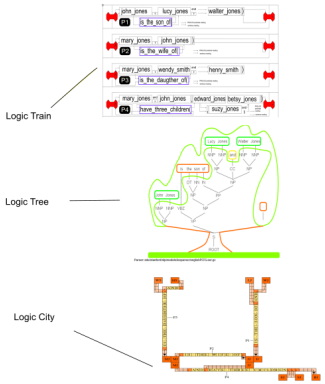
```
;
false.
```

Part 4

Summary and Outlook

Summary and Outlook I

- Introduction of a new Montessori Material according to the generalized Montessori Principle according to Heiden 2018 $\rightarrow$ Logik wird damit 'begreifbar'. (Locic can by 'handled' - i.e. operated by 'hands')
  - Logical Train
  - Logical Tree
  - Logical City



- Combination of Children Philosophy and Artificial Intelligence (AI)

Summary and Outlook II

- This is an application of a machine for extended logical reasoning to improve the ability of reasoning and to give the possibility to **interact** with logical machines and material playfully.
- $\rightarrow$ Hence it is an intrinsic socratic instrument of two sided communication or dialoguing in a human extended environment.

Thank you cordially for your attention!

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PS.: The presentation can later also be found at:

http://www.dr-heiden.com/Vortraege.htm

Literature I

Heiden, Bernhard and Ulrich Leitner (2018). "Additive Manufacturing – a system theoretic approach". In: *ICAT 2018, Maribor*. Ed. by Igor Drstvenšek. 10.-11. Oct. Ljubljana: Interesansa - zavod, pp. 136–139. ISBN: 978-961-288-789-6 (cit. on p. 10).

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Lipman, Matthew (1981). *Pixie*. Upper Montclair, N.J. 07043: Institute for The Advancement of Philosophy for Children, Montclair State College. 94 pp. ISBN: 0-916834-17-4. URL: https://sites.google.com/site/iapcsummerworkshop2016/iapc-curriculum (cit. on p. 13).

Literature II

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Lunze, Jan (2008). *Automatisierungstechnik*. 2nd ed. Oldenburg Verlag, München. ISBN: 978-3-486-58061-7 (cit. on p. 10).

Montessori, Maria (1967). *Grundgedanken der Montessori Pädagogik*. Ed. by Paul Oswald and Günter Schulz-Benesch. Herder, Freiburg, Basel, and Wien (cit. on p. 10).

— (2007). *Die Entdeckung des Kindes Taschenbuch*. Ed. by Paul Oswald and Günter Schulz-Benesch. Herder Verlag (cit. on p. 10).