Lecture 6b: Formal methods in HCI

To read: Alan Dix (2003) Upside-Down $\forall$s and Algorithms - Computational Formalisms and Theory. Chapter 14 in J.M. Carroll (Ed.), *HCI Models, Theories, and Frameworks*. San Francisco: Morgan Kaufmann

Outline

- Motivation

- What does *formal* mean?

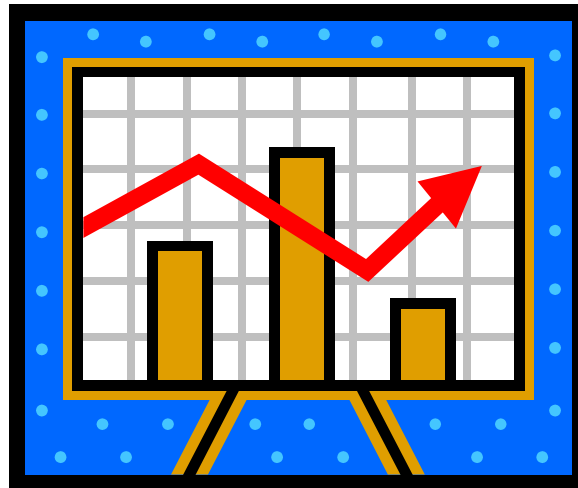- Tools

- Examples

Motivation

We want to

- analyse and understand

  – the computer as raw material

- communicate with stakeholders

- generate interfaces automatically

- see details clearly

Definition of formal

- To represent something in such a way that the representation can be analysed and manipulated regardless of its content or meaning

Why formalisms?

- they might be executable
- they might handle infinity ∞
- they abstract
- they force the designer to reflect upon design suggestions
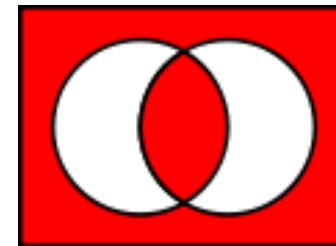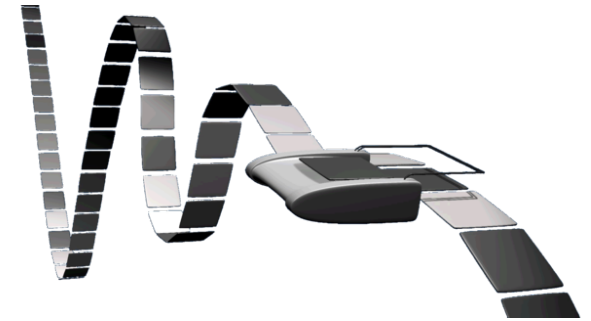
Formal vs. informal

Cons:

- demands special competence, considered difficult

- we can't catch everything formally

Pros:

- Powerful – compare, predict

- Supports early analysis

- The result (the system) is very formal!

Tools

- Mathematics, logics
- Computational theory
- Complexity theory
  - "Good enough"
- Notation
  - Diagrams
  - Formal grammars
  - Set theory
  - etc.

State transition diagrams

- Consist of possible states and transitions between states
- Suitable for modelling an interaction situation
- Often consist of explaining names and notations, but they do not affect formal processing
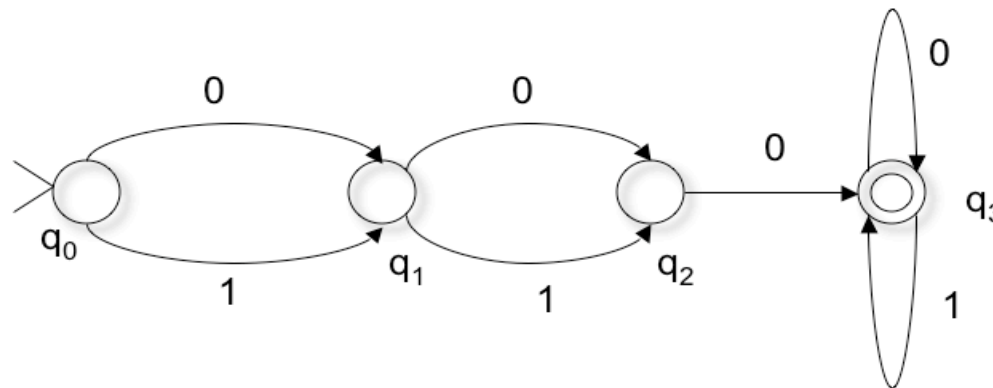
Why modelling?

- Useful– addresses the real problem
- Adequate level of detail
- Means for communication
- Complementary to code structure
- Easy to change
- Easy to determine if all paths have been tested
- Reliable, use standard code
- Maintenance, easy to trace errors

What is being formalized?

- **Dialogues**
- **States** in an interaction situation
- Keystrokes
- Movements, Fitts' law
- **Tasks**
- **Users**
  - Preferences
  - Characteristics
  - Interests
  - Social network
  - ...

Modeling the context

- Many different models
  - Key-value, Markup scheme, Graphical, Object oriented, Logic based
  - Taxonomies
  - UML
  - MOF
  - Ontology
    - Pointed as the **best** approach

Conferences

- CADUI - Computer-Aided Design of User Interfaces

- EHCI - Engineering for HCI

- TAMODIA - TAsk MOdels and DIAgrams for User Interface Design

SOFTWARE ENGINEERING

- CMNA - Formal Models of Natural Arguments

- IUI – Intelligent User Interfaces

ARTIFICIAL INTELLIGENCE
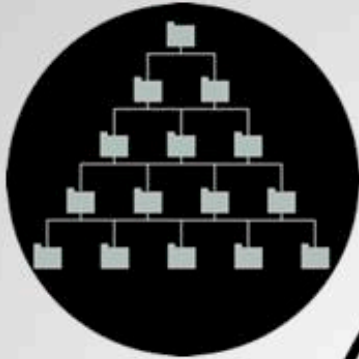
- Persuasive

- INTERACT

HCI / INTERACTION DESIGN

- CHI

Lecture 6c:

Formalisation for Personalisation Utilising the Semantic Web

Terminological knowledge

Factual knowledge

Frank Van Harmelen. 10 Years of Semantic Web: does it work in theory? Keynote at ISWC 2011.
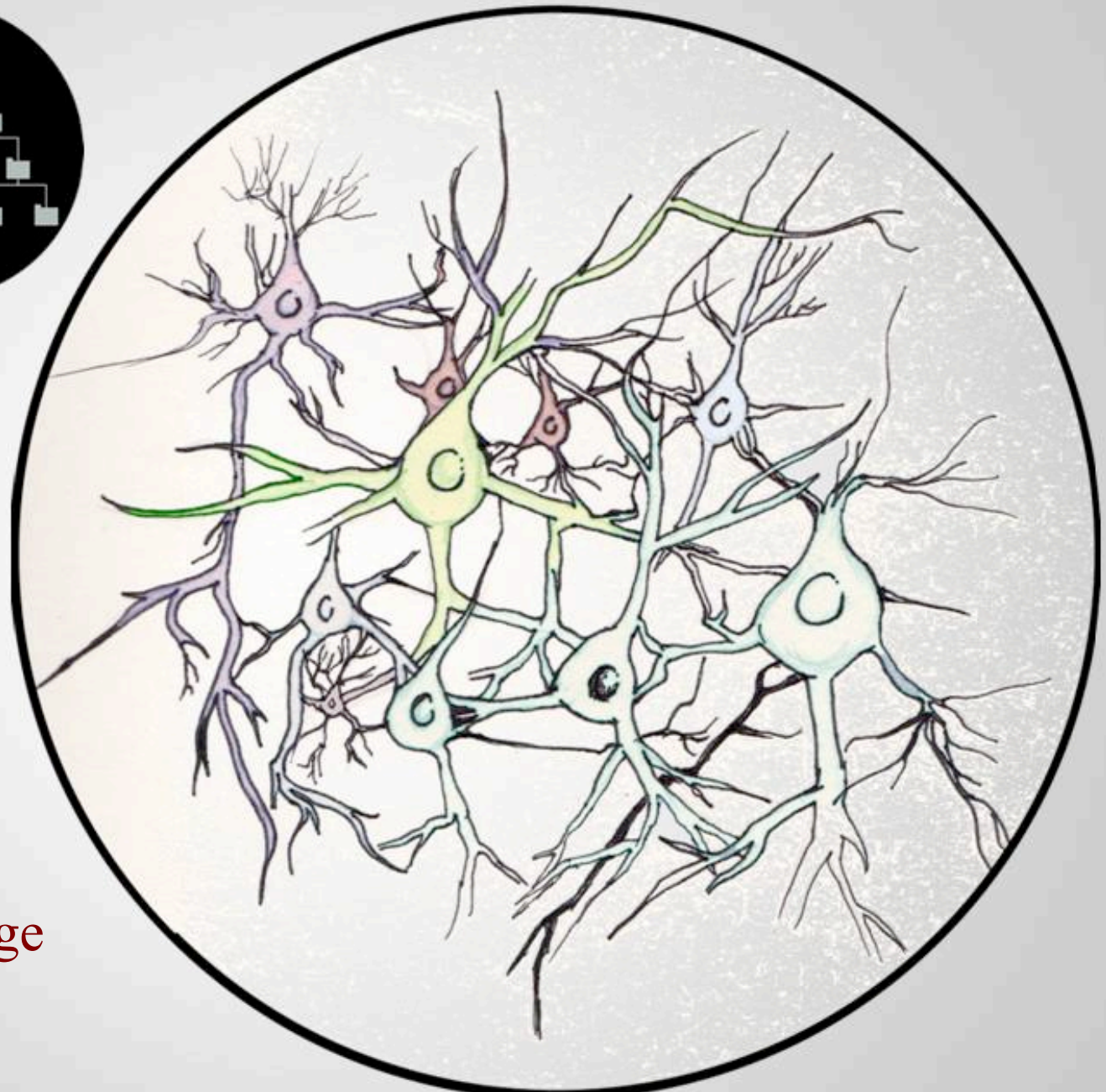
RDF(s): Resource description framework

(Tweety, hasColour, Yellow)

or as a directed labelled graph:

Tweety —hasColour→ Yellow

or in the following RDF/XML format:

```
<rdf:Description rdf:about=Tweety>
  <rdf:hasColour>
    <rdf:Description rdf:about=Yellow/>
  </rdf:hasColour>
</rdf:Description>
```

OWL: Web Ontology Language

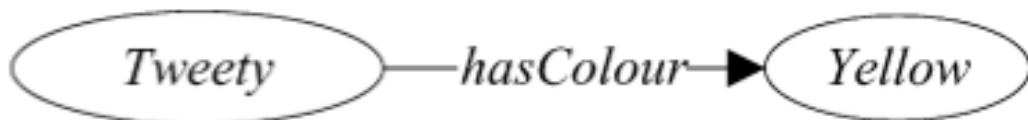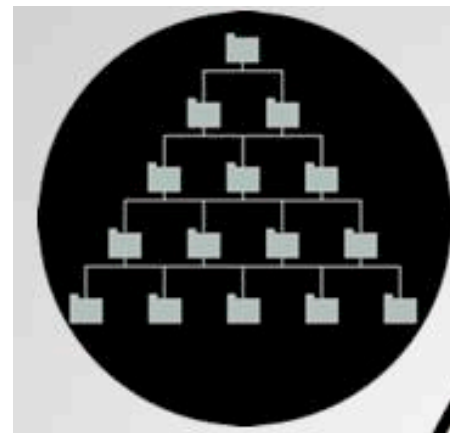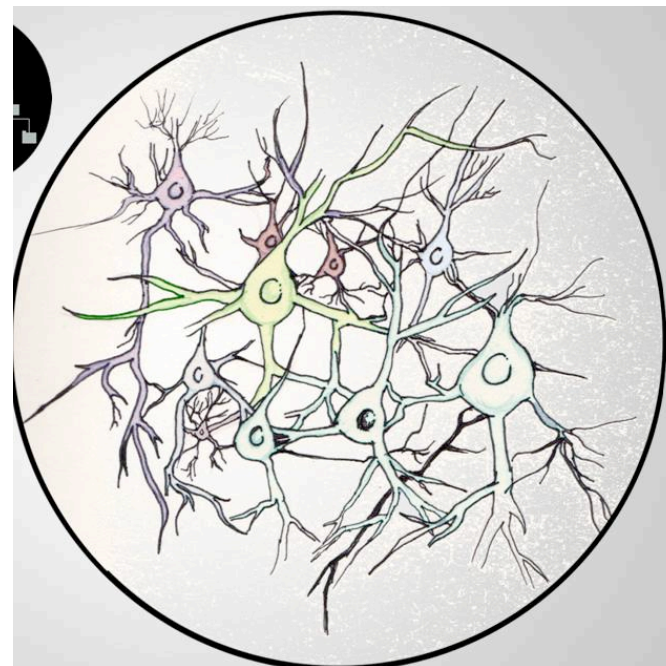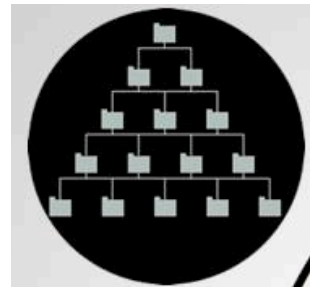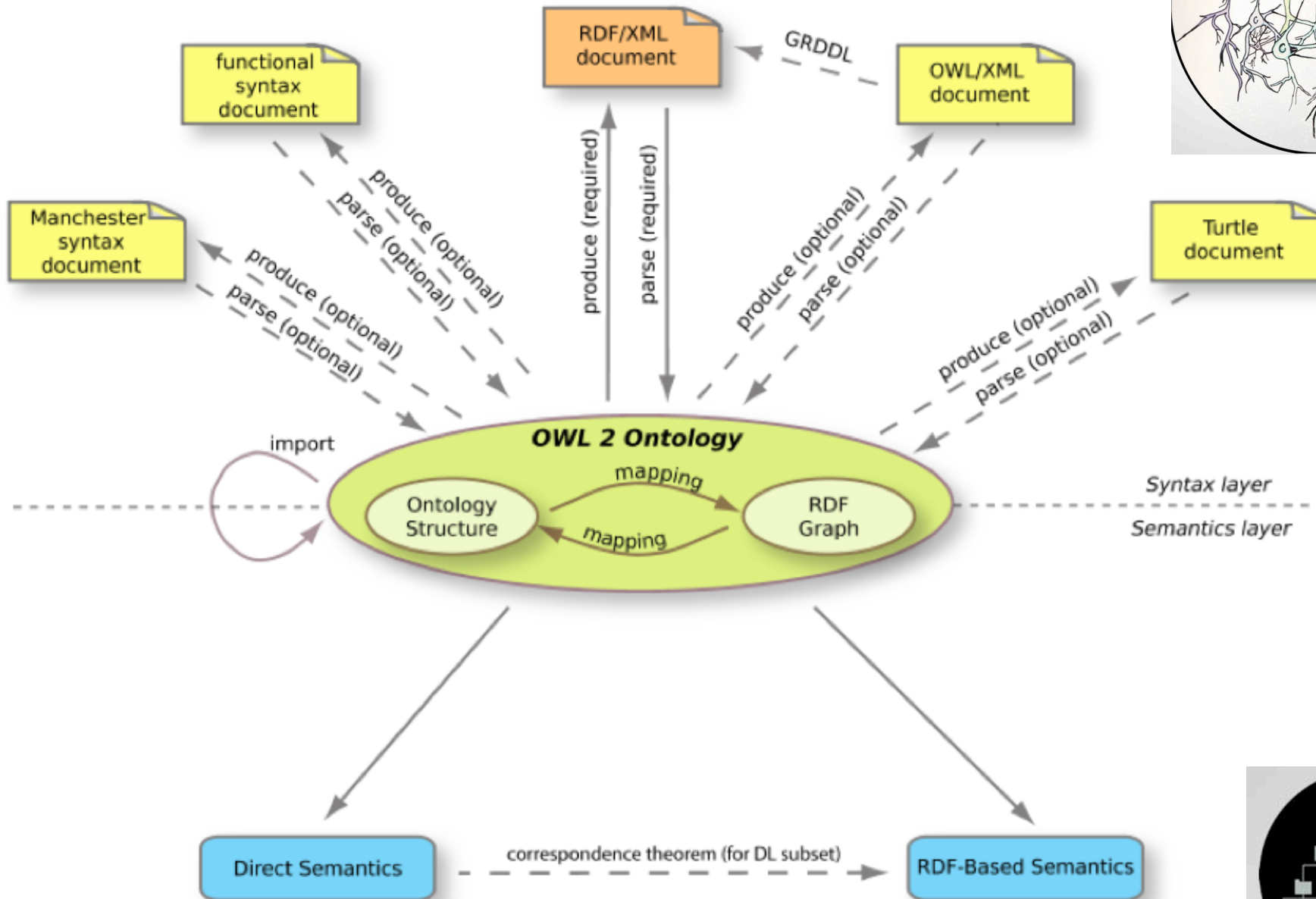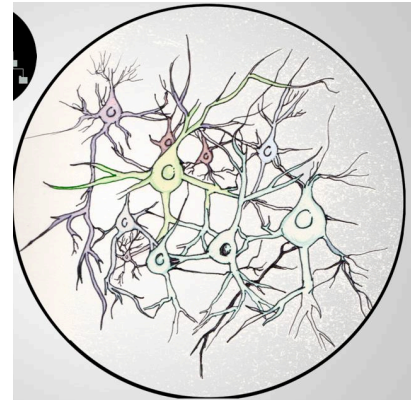

Figure 1. The Structure of OWL 2
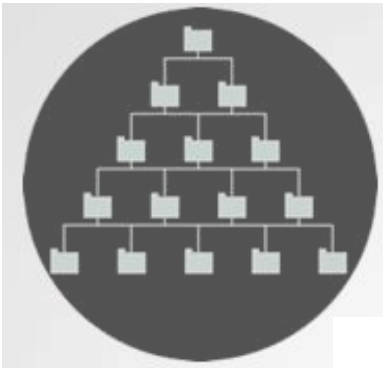
Terminology: Example 1

Example:
There are no single terminology which covers the range of evidence, or gives support for the whole dementia investigation process. Combinations are necessary.

We need:
ICF, DSM-IV, ICD-9, ICD-10, SNOMED CT, possibly UMLS as source for definitions.

Semantic Network
Semantic Types

Disease or Syndrome | Finding | Mental process

Knowledge base:
UMLS
Metathesaurus
Concepts

Patient MAP:
ICF Concepts

Cognitive Disorders
Alzheimer's Disease
Dementia of Alzheimer type
Dementia

Mental or behavioural dysfunctions
Aphasia
Memory Impairment
Impairment of Executive functions
Apraxia
...

B1_Mental functions
b167_Language
b144_Memory
B1641_Organisation and planning
B176_Mental function of sequencing complex movements

instances_of

instances_of

Instances

dementia
dementia of alzheimer type
Alzheimer's disease

aphasia
memory impairment
impairment of executive functions
apraxia
...

X_b167
X_b144   X_b1641
X_b176

diagnose
determine
cause
manifested_in
manifested_in

Body Svensson

Example 2:

Erriquez E and Grasso F. *Generation of Personalised Advisory Messages: an Ontology Based Approach*. 21th IEEE International Symposium on Computer-Based Medical Systems, Jyvaskyla, Finland, 19-21 June 2008, pp. 437-442, IEEE press.
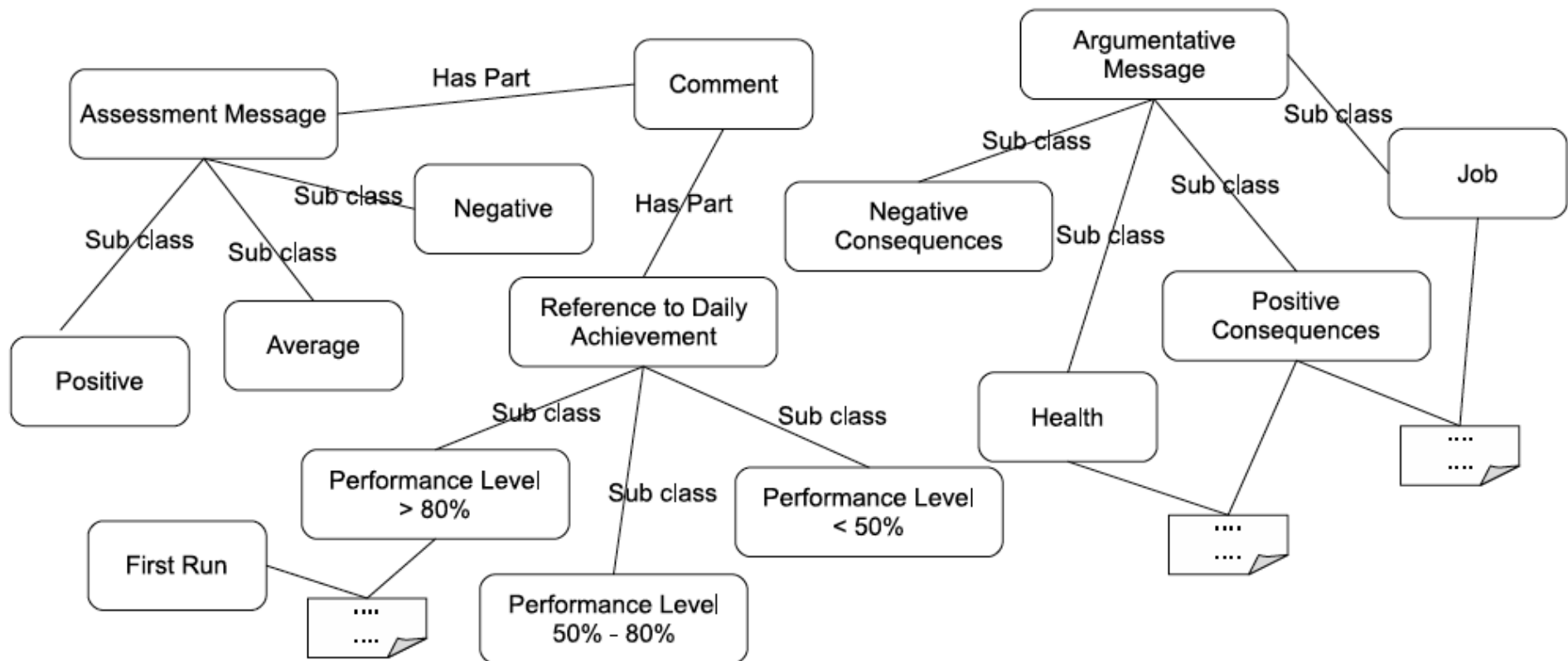
Figure 1. Discourse Ontology (extract)
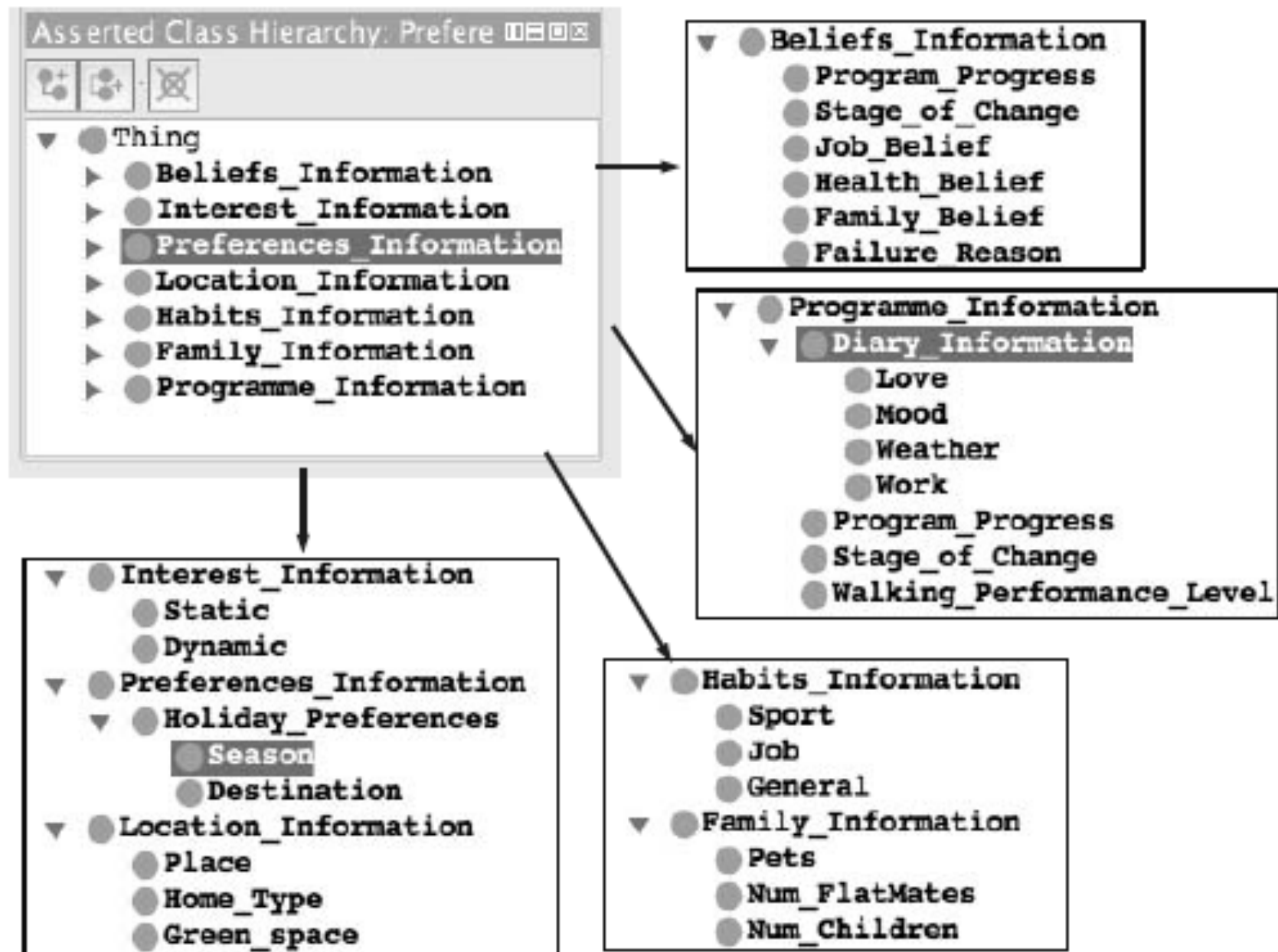
Figure 2. User Ontology (snapshots)
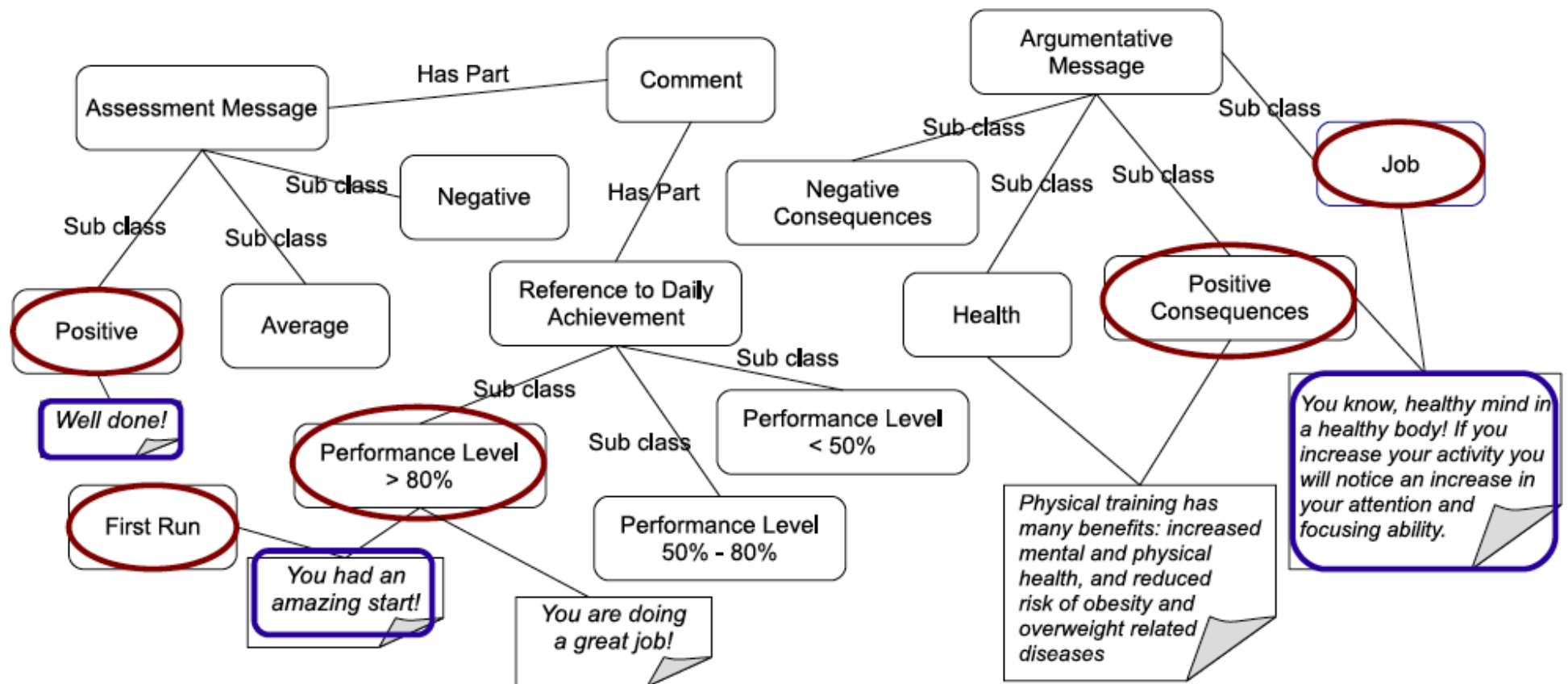
Figure 3. Message Composition

CRITICALLY MAKING THE INTERNET OF THINGS
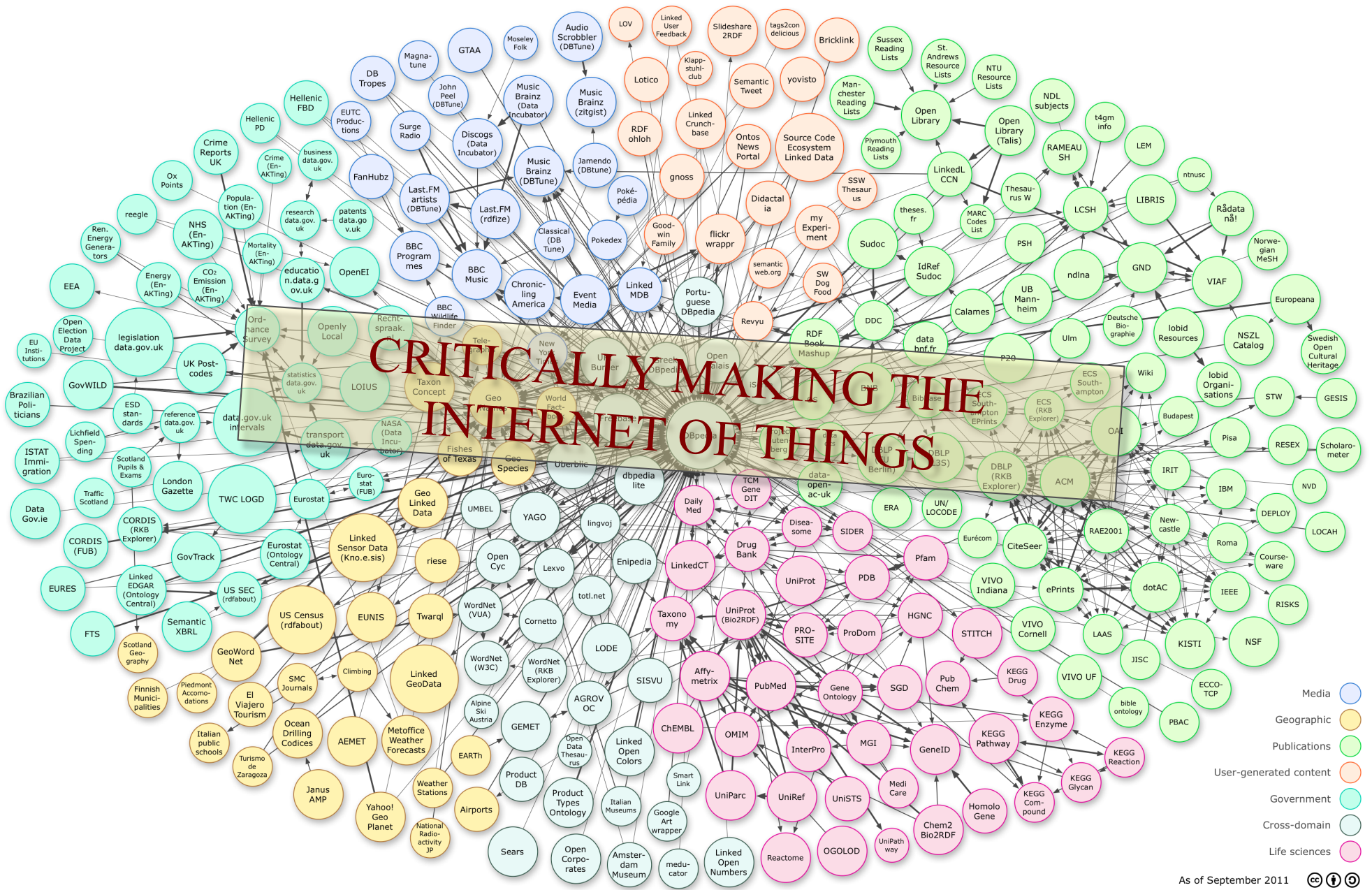
"Linking Open Data cloud diagram, by Richard Cyganiak and Anja Jentzsch. http://lod-cloud.net/"

As of September 2011

Media
Geographic
Publications
User-generated content
Government
Cross-domain
Life sciences

Lecture 6d:

Formal Argumentation for (Persuasive) dialogues

Dialogue types (Walton)

1. *Persuasion* - participants aim to resolve conflicts of opinion,

2. *Negotiation* - participants aim to agree on a method for collaboration that resolves their conflicting interests,

3. *Deliberation* - participants aim to jointly decide on a plan of action,

4. *Information seeking* - participants aim to share knowledge,

5. *Inquiry* - participants aim to jointly discover new knowledge.

Formal Argumentation

- Toulmin's model

(IF) DATA:
Harry was born in Bermuda

THEN

QUALIFIER:
Presumably

CLAIM:
Harry is a British subject

BECAUSE

WARRANT:
A man born in Bermuda will generally be a British subject

UNLESS

REBUTTAL:
Both his parents were aliens or he has become a naturalised American

ON ACCOUNT OF

BACKING:
The following statutes and legal provisions....
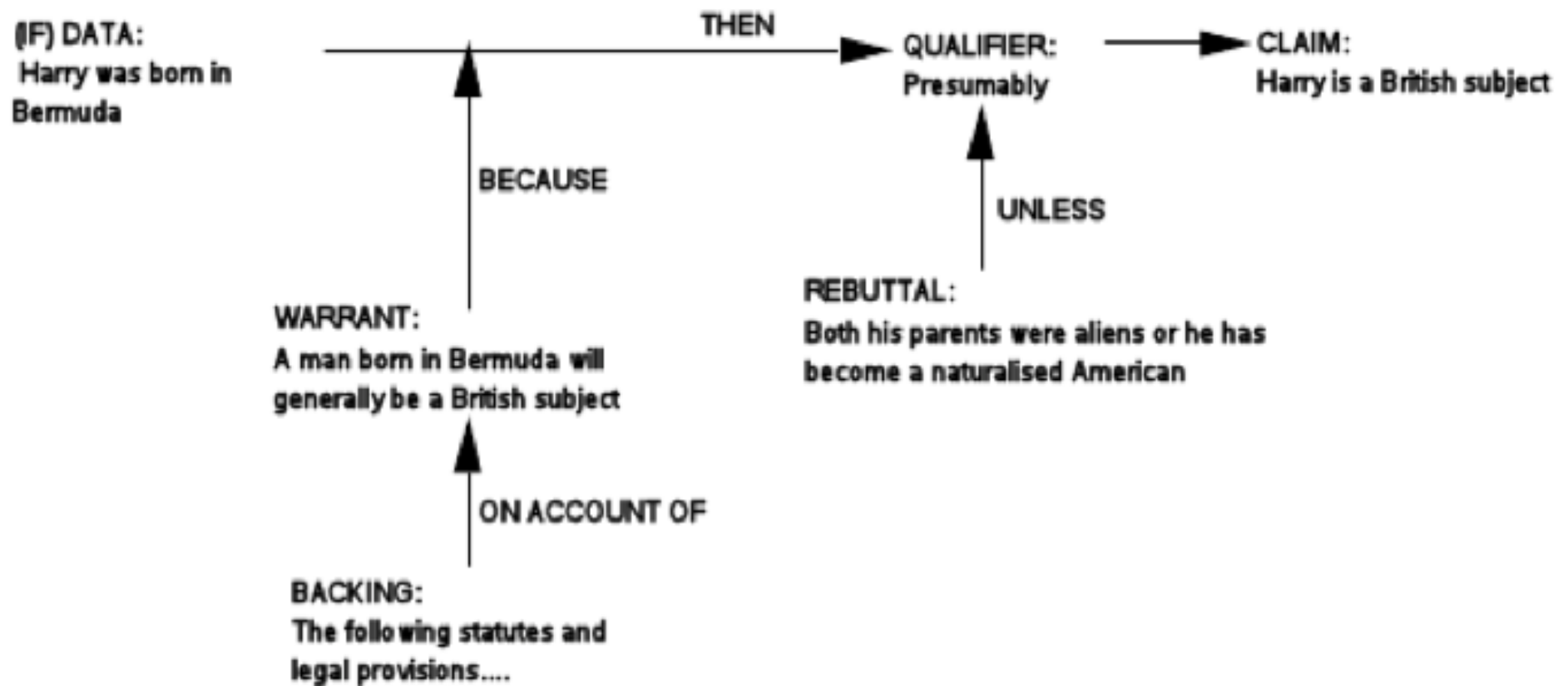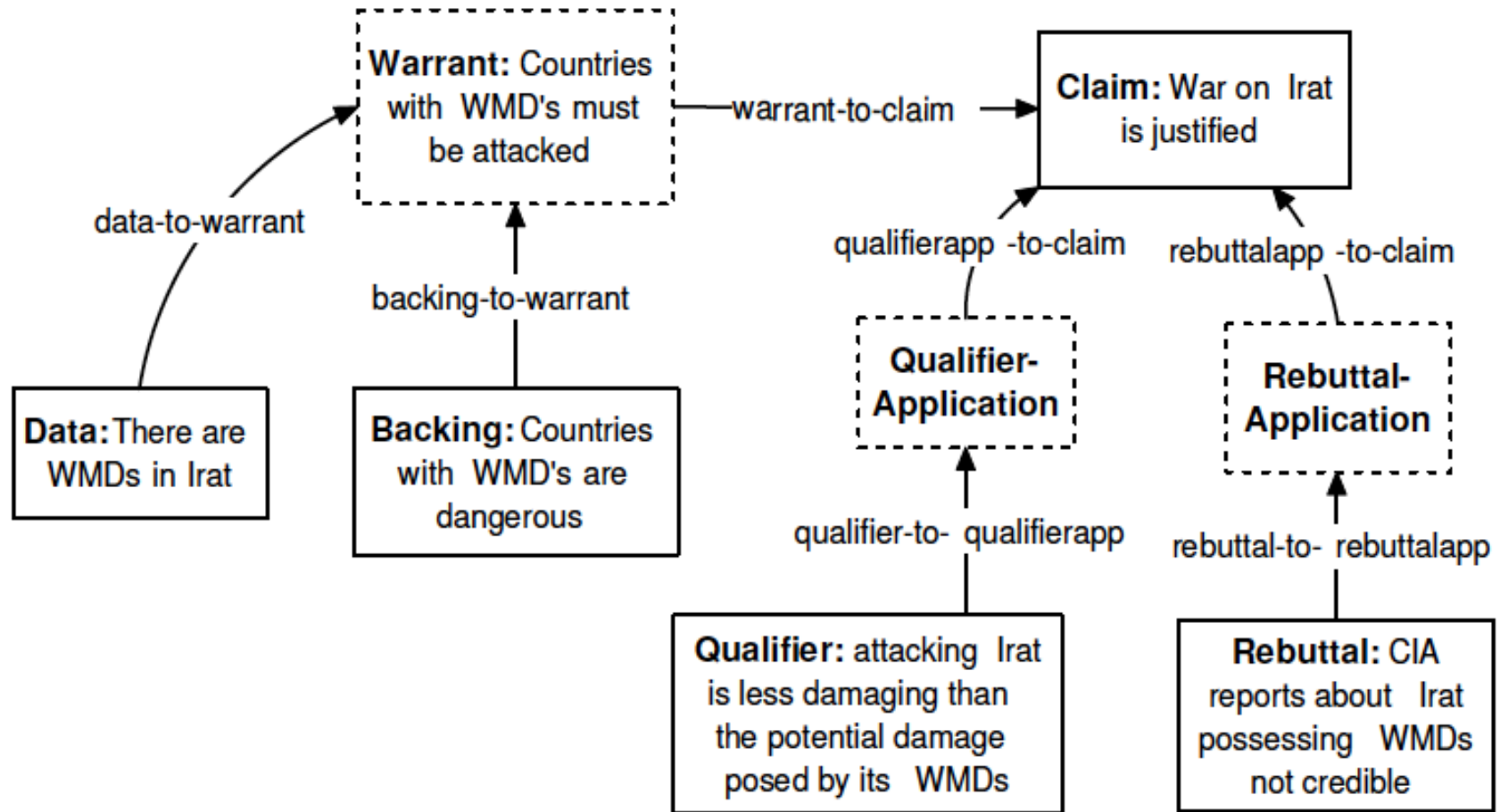
ARGUMENT EXAMPLE 1

Figure 13 RDF graph for a Toulmin argument claiming that war on Irat is justified

Formal Argumentation: Example

- Argument framework by Bench-Capón (2003)
- A value-based argumentation framework (VAF) is defined as VAF = <AR, attacks, V, val, P>
- where
  - AR = finite set of arguments
  - attacks = irreflexive binary relation on AR
  - V = a non-empty set of values (the set of all values related to arguments contained in AR)
  - val = function mapping from AR -> V
  - P = set of possible audiences

  - An argument A relates to a value v if accepting A promotes or defends v.
  - An argument A = (id, grounds, claim, value)
- SEMANTIC MODELS regulate interpretation

D

U

Defeated

Undefeated

Support vs. Attacks

Building more roads increases traffic congestion

If more roads were built then that would encourage people to take more trips by car

If people take more trips by car then traffic congestion will increase — support

Building more roads will encourage people to use less public transport and drive more often when commuting from A to B — supports

Building more roads will encourage people to take more joy rides — supports

People drive because they want to get from A to B, not because they want to take joy rides

People would want to take the same number of trips from A to B each week regardless of how many roads were built

If the same number of people are taking the same number of car trips per week on more roads, then traffic congestion will decrease — oppose

Argument Interchange Format
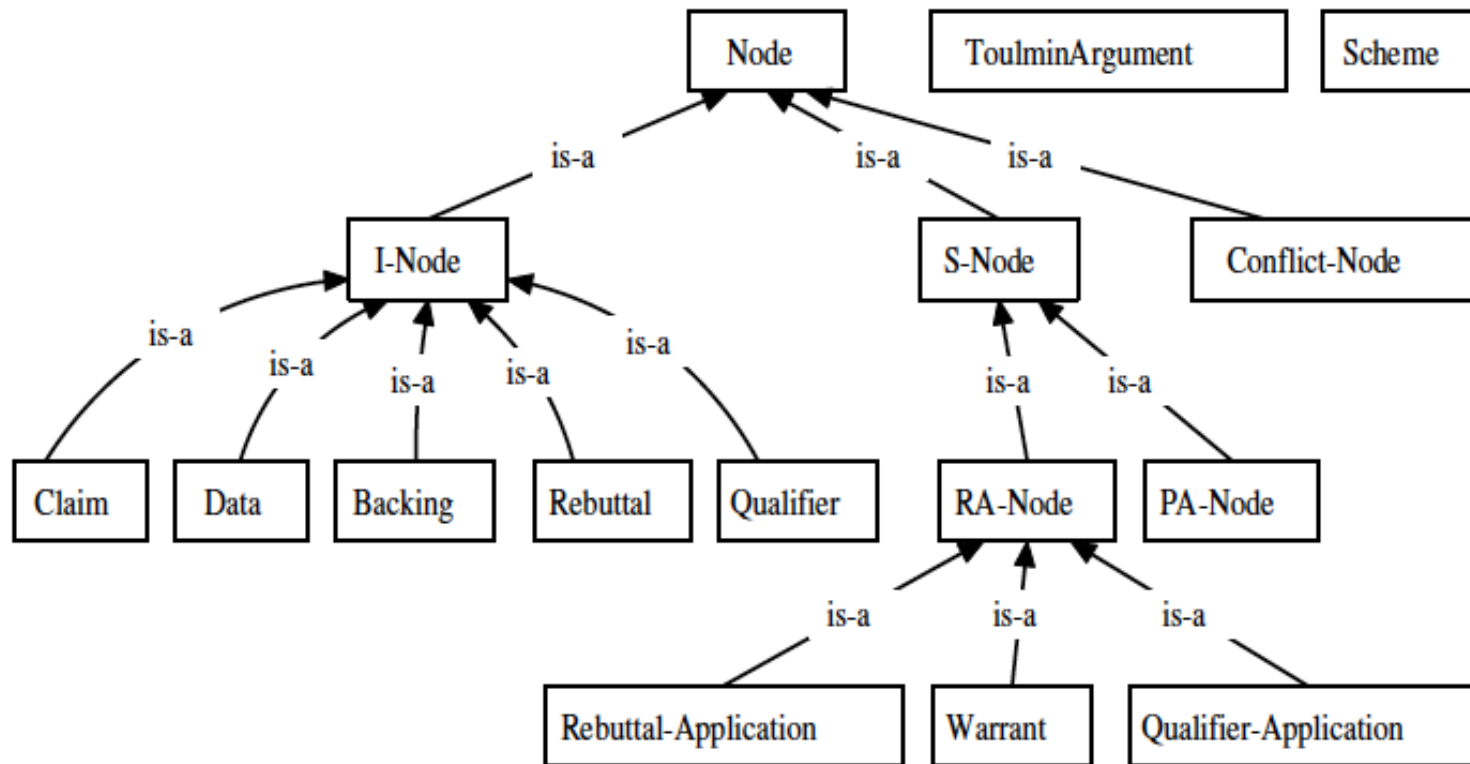
Figure 12 Toulmin argument class hierarchy in RDF Schema as an extension of the AIF ontology

ARGUMENT EXAMPLE 2:

GROUNDS: A SET OF FINDINGS, RULES THAT CONNECT THE FINDINGS WITH THE CLAIM
CLAIM: A STATE OF DEMENTIA IS PRESENT

Responding to Iran's nuclear ambitions

Expand UN Security Council sanctions *°

Military strike on Iranian nuclear facilities *

Stabilize Iraq

Pursue a diplomatic solution *

Support Iran's nuclear program *

Iran *°'

How should the international community respond? *°

Sabotage the Iranian nuclear program *

Convince Iran that a military strike is possible *

Do nothing *°

Implications if Iran intends to develop nuclear weapons? *'

Strengthen the Iranian opposition

Responding to Iran's nuclear ambitions *°

Edit Delete Bookmark Share

Add idea | Discuss | Move | Cross-link | Cite

debategraph

Debategraph

Argumentum /debates/

Healthcare is a human right

You: ○support ○oppose

Click **oppose** or **support** above to take a stand

| Top | New | Tracking | Related | 🗃 **0** vs **0** in **7** days (add to pot) | **240** arguments: **134** vs **106** |

search for.. | sort by relevance ▾ | any position ▾ | **search**

KevinConner 10-11   [Oppose]

What are "human rights"?The only rights we should be concerned about are the rights promised to us by our Constitution. We do NOT need a larger government.Let free market capitalism do it's job. The government having control over heal...

↓Expand & Comment   Permalink   📧**7**   ¢**100**

TonySpearman 10-29   [Oppose]

A "right" can not be refused. What I mean by this is a "right" is totally dependent on your own action. I have the "right" to free speech. My actions may result in my death but no one can stop me from doing it. If you are on a deserted island an...

↓Expand & Comment   Permalink   📧**9**   ¢**76**

NeilCitrin 10-10   [Support]

Since everyone has the right to life, liberty and the pursuit of happiness, that should not be circumscribed by the ability to pay the extreme fees charged by the fascists (I mean the insurance companies). The US is the only industrial nation that do...

↓Expand & Comment   Permalink   📧**40**   ¢**1**

ArjunVasan 09-04   [Oppose]

Today's Facebook meme of the day happens to be "No one should die because they cannot afford health care, and no one should go broke because they get sick." This is a bold statement, which sounds nice, but upon further review falls as flat as "Hope"...

↓Expand & Comment   Permalink   📧**59**

StewartRShields 09-08   [Oppose]

And now, a lesson on the greatness of America and the unrivaled-on-Earth wisdom of our founders... In recent days I have found myself engaged in debates over what are the powers of our federal government, specifically our

Sidebar

Explore

Arg /You

Arguers

Factions

Public Figures

Arg .Wiki

"While it can seem that omega-3s do everything but wash your windows, it's important to remember that they are essential nutrients", says Ms Tribole, author of The Ultimate Omega-3 Diet: Maximise the Power of Omega-3s to Supercharge Your Health, Battle Inflammation, and Keep Your Mind Sharp.

She says modern forms of food production are reducing the amount of omega-3 in our foods, "contributing to a global omega-3 fat deficiency in the diets of most people".

"For example, animals that graze on grass have higher omega-3 contents in their meat - and the longer they are out to pasture, the more omega-3s accumulate in their meat. But today the great majority of animals dine on [corn grain], which is devoid of omega-3s."

Grass-grazing cattle have more omega-3, says Evelyn Tribole

That is bad, she says, because "remarkable and consistent" scientific studies show us omega-3 is good for brain function, mood disorders, heart health and more. And she dismisses the claim that this is just a fad.

"Yes, food and nutrition seem to run in fashionable trends, with followers and believers. In this case, however, there is a lot of good evidence for the benefits of omega-3s."
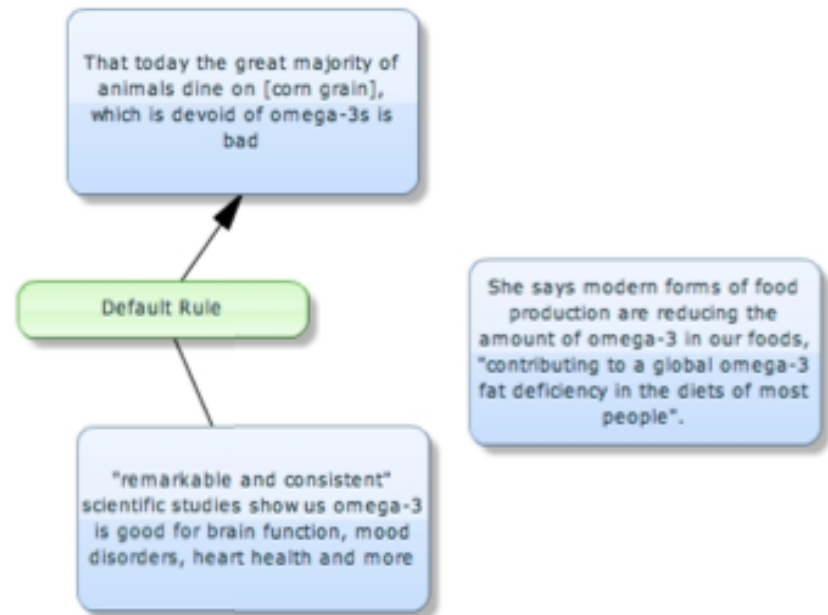
But others are sceptical.

Dr Lee Hooper, lead author of one of the most thorough studies on the apparent benefits of omega-3, published in the British Medical Journal in 2006, urges people not to get "carried away".

File   Tools   Options

OVA

Zoom
50   100   150   200

Show Participants

That today the great majority of animals dine on [corn grain], which is devoid of omega-3s is bad

Default Rule

She says modern forms of food production are reducing the amount of omega-3 in our foods, "contributing to a global omega-3 fat deficiency in the diets of most people".

"remarkable and consistent" scientific studies show us omega-3 is good for brain function, mood disorders, heart health and more

Find: vour   Next   Previous   Highlight all   ☐ Match case   Reached end of page, continued from top

Done

S3Fox

(1) Congratulations to [**name**] who submitted S_1 suggestions and [**name**] who submitted S_2 suggestions. Your family still needs to provide **X** suggestions if you want to meet your goal. There are still **Y** days before the end of the study. Nice work!

(2) Your family has provided a total of **Q** suggestions so far. The most recent contributions include: [**name**] with D_1 suggestions, [**name**] with D_2, and [**name**] with D_4. This is excellent, we encourage you to continue.

(3) As of today, [**name**] provided S_1 suggestions, while [**name**] and [**name**] already provided S_3 suggestions. Congratulations to [**name**] with S_4 suggestions submitted. As a family, you need to propose **X** more suggestions. Well done![1]
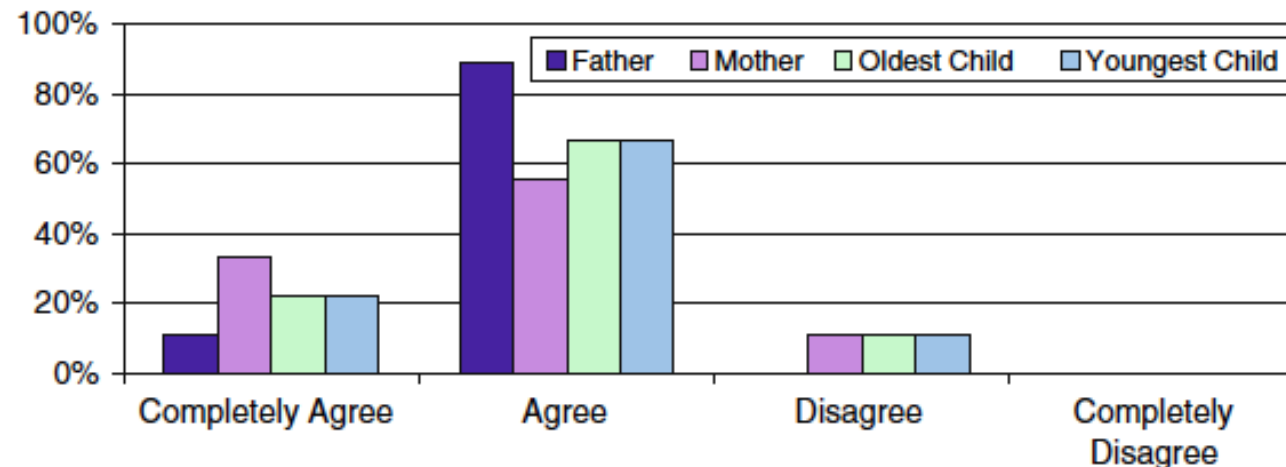
Fig. 7 Family members' responses to the statement: the feedback was motivating

Lifestyle ideas

See the help page on how to use the scroller.
  Colours: Edward   Ann   Pat   Tom
Select an entry:

«« « 50 51 **52** 53 54 » »»

»Entry by Edward : 16 Mar 2009, 20:12

My lifestyle as it is now:
i had few full strength beer after work with friends

What could I change or do differently:
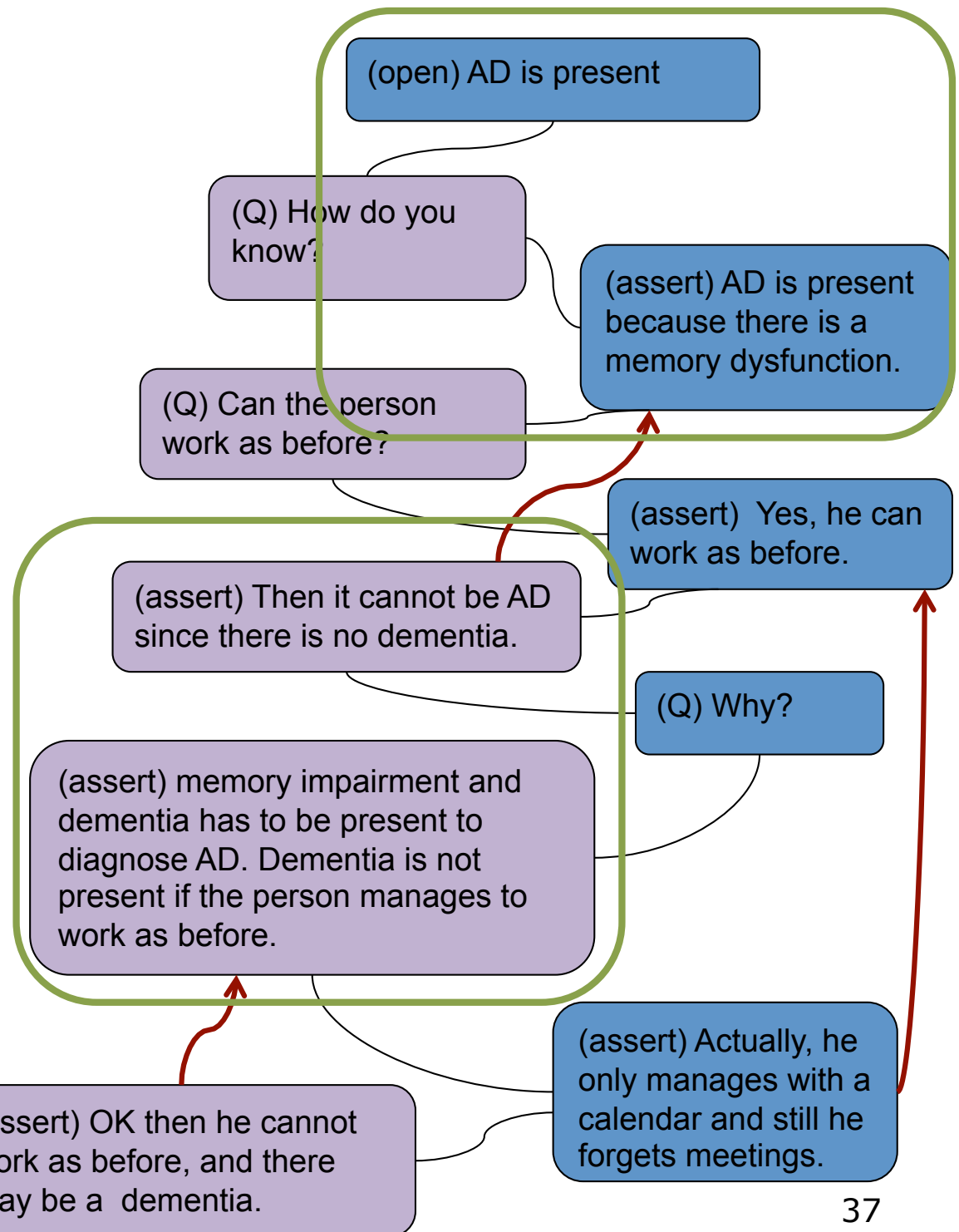cut down the amount of alcohol, switch to light beer is a better choice. By drinking light beer, you can cut your alcohol intake by about 50%.

Why these changes would result in a healthier lifestyle:
Beer, like other alcoholic drinks, is high in calories and it contains no nutrients or vitamins. so drink less is a good start for a healthier lifestyle

. 2   Example of lifestyle idea entry

Example

- Moves: *open, assert, ask, close*
- Rules: Both actors need to make a close move for the dialogue to end, they take turn in the dialogue, and are collaborative
- Dialogue type: Inquiry (build new knowledge)
- Actors: doctor, system agent
- Topic: Alzheimer's disease (AD) is present

argument   *attack*

(open) AD is present

(Q) How do you know?

(assert) AD is present because there is a memory dysfunction.

(Q) Can the person work as before?

(assert) Yes, he can work as before.

(assert) Then it cannot be AD since there is no dementia.

(Q) Why?

(assert) memory impairment and dementia has to be present to diagnose AD. Dementia is not present if the person manages to work as before.

(assert) OK then he cannot work as before, and there may be a dementia.

(assert) Actually, he only manages with a calendar and still he forgets meetings.

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37

TODO:

- Formal method for representing dialogues:
  - 1) choose topic
  - 2) choose two actors
  - 3) choose type of dialogue
  - 4) specify the generic pieces (moves, arguments, values)
  - 5) specify rules (who wins? when are moves allowed?)
  - 6) put into a graphical example