Introduction to **Wordnets**

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Reference:
Mustafa Jarrar: Lecture Notes on Conceptual Analyses
University of Birzeit, Palestine, 2015

Online Course

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Course Page: http://www.jarrar.info/courses/WordnetBasics.pdf

More Online Courses at: http://www.jarrar.info

Reading

Everything in these slides + everything I say

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Introduction to
Wordnets

In this lecture:

- □ Part 1: **What and why Thesauri**
- □ Part 2: What is WordNet
- □ Part 3: EuroWordnet
- □ Part 4: Global Wordnet

Why Lexical Semantic Resources?

The importance of lexical semantic resources (such as thesauri, wordnets, linguistic ontologies) is increasing in many application areas, such as:

- Word sense disambiguation,
- Multilingual big data
- Smarter Information search and retrieval
- Multilingual semantic web
- NLP tasks and applications (classification/ summarization/translation)
- Data integration
- among many others.

Thesaurus (مكنز) as a source of semantics

A **list of words classified as near-synonyms**;

or

it can be seen as pairs of terms connected through "*RelatedTo*" and/or a "*Broader/Narrow*" relations.

However, such relations are **semantically-poor** and imprecise relationships between words and not sufficient for most IT-based applications.

➔ **From thesaurus to wordnet**

Introduction to **Wordnets**

In this lecture:

- ❑ Part 1: What and why Thesaurus
- ❑ Part 2: **What is WordNet**
- ❑ Part 3: EuroWordnet
- ❑ Part 4: Global Wordnet

What is WordNet?

- In 1985 a group of **psychologists and linguists** at Princeton University started to develop a “**mental lexicon**”.
- You may also call it:“electronic dictionary”, “Mental dictionary”, English, “**semantic Network**”, hyperdimensional thesaurus, etc.
- Includes **most frequent words** (nouns, adjectives, adverbs, verbs).
- **Organized by meaning**: words in close proximity are semantically similar.
- Can be used by humans and machines.
- Human users and computers can browse WordNet and find words that are meaningfully related to their queries.
- **Available online**, for downloading! http://wordnet.princeton.edu

WordNet: **Synonymy**

- English words are grouped into sets of synonyms called a **Synset**.
- Each synset is given a unique **SynsetID**.
- Each synset *signify* that a **Concept** exist.
- Each synset is described by a **gloss** (examples of contexts).

03410635

{Furniture, Piece of furniture , Article of furniture}

Furnishings that make a room….

03018908

{Bureau, Dresser, Chest of Drawers,}

Furniture with drawers for keeping clothes

07955878

{Categorization, Classification}

A group of people or things arranged…

08283156

{Table, Tabular Array}

A set of data arranged in rows and columns

04615793

{work table}

A table designed…

06501650

{Contents, TableOfContents}

A list of divisions…

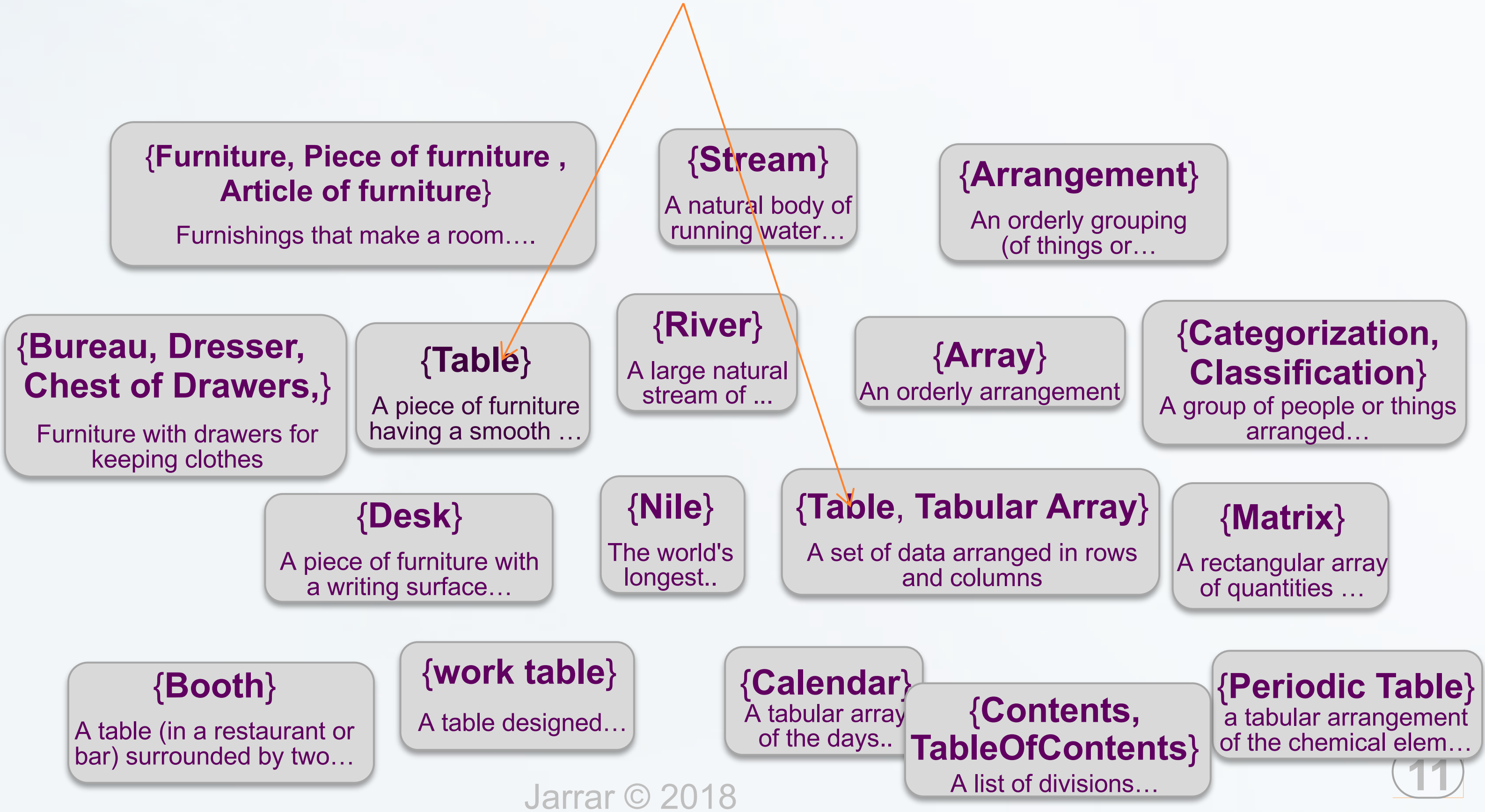
Exercise

List the different meanings of the words:

Table,   Array,   Matrix,   Bureau

WordNet: **Polysemy**

- Each word form-meaning pair is unique.
- A word that appears in *n* synsets is *n*-fold polysemous.
- For example: “Table” here is two-fold polysemous



{Furniture, Piece of furniture , Article of furniture}
Furnishings that make a room….

{Stream}
A natural body of running water…

{Arrangement}
An orderly grouping (of things or…

{Bureau, Dresser, Chest of Drawers,}
Furniture with drawers for keeping clothes

{Table}
A piece of furniture having a smooth …

{River}
A large natural stream of ...

{Array}
An orderly arrangement

{Categorization, Classification}
A group of people or things arranged…

{Desk}
A piece of furniture with a writing surface…

{Nile}
The world's longest..

{Table, Tabular Array}
A set of data arranged in rows and columns

{Matrix}
A rectangular array of quantities …

{Booth}
A table (in a restaurant or bar) surrounded by two…

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{Calendar}
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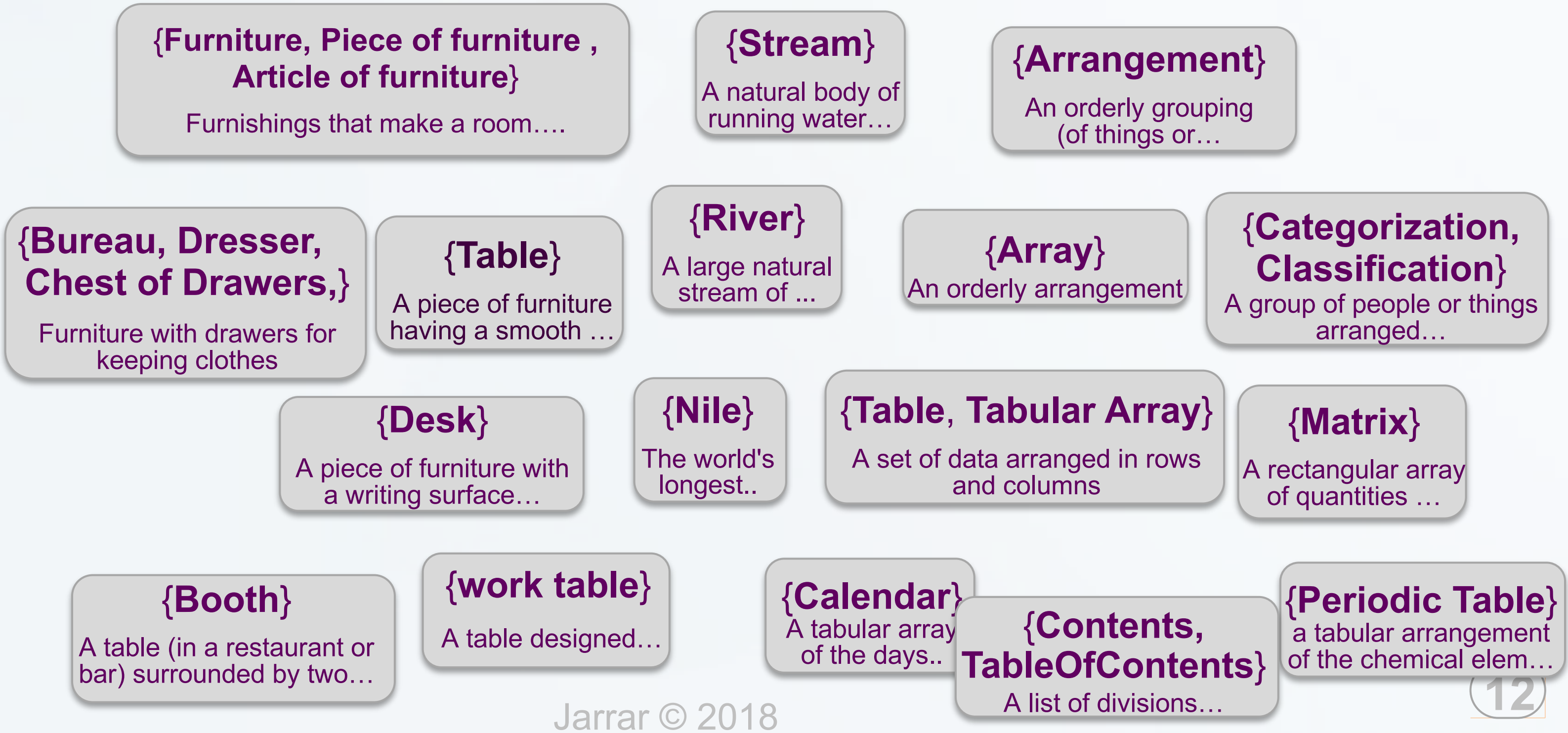
{Periodic Table}
a tabular arrangement of the chemical elem…

WordNet: **Glosses**

A short gloss is provided for each sysnet.

Glosses are **examples of contexts** for many word-sense pairs, telling us how words with specific senses are being used in context.



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WordNet: **Statistics**

155 287 word forms, groups into

117 659 synsets

	WordForms	Synsets
noun	117,798	82,115
verb	11,529	13,767
adjective	21,479	18,156
adverb	4,481	3,621
Total	**155,287**	**117,659**

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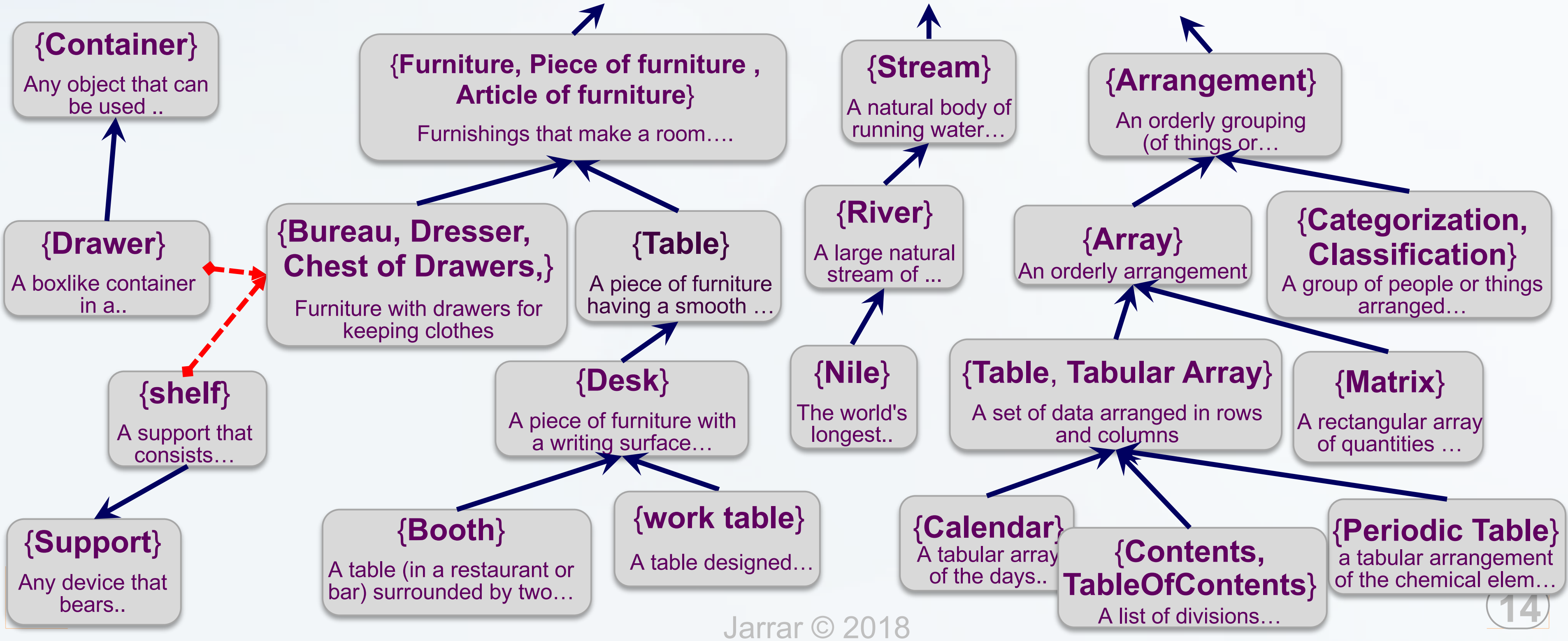
WordNet Semantic Relations

Synsets are interconnected with semantic relations, forming a large semantic network (graph).

Such Relations are:

- **Hyponymy**, also called “Is a” relation, or sub/superordinate.
- **Meronymy**, also called “part of” relation



{Container} Any object that can be used ..

{Furniture, Piece of furniture , Article of furniture} Furnishings that make a room….

{Stream} A natural body of running water…

{Arrangement} An orderly grouping (of things or…

{Drawer} A boxlike container in a..

{Bureau, Dresser, Chest of Drawers,} Furniture with drawers for keeping clothes

{Table} A piece of furniture having a smooth …

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{Array} An orderly arrangement

{Categorization, Classification} A group of people or things arranged…

{shelf} A support that consists…

{Desk} A piece of furniture with a writing surface…

{Nile} The world's longest..

{Table, Tabular Array} A set of data arranged in rows and columns

{Matrix} A rectangular array of quantities …

{Support} Any device that bears..

{Booth} A table (in a restaurant or bar) surrounded by two…

{work table} A table designed…

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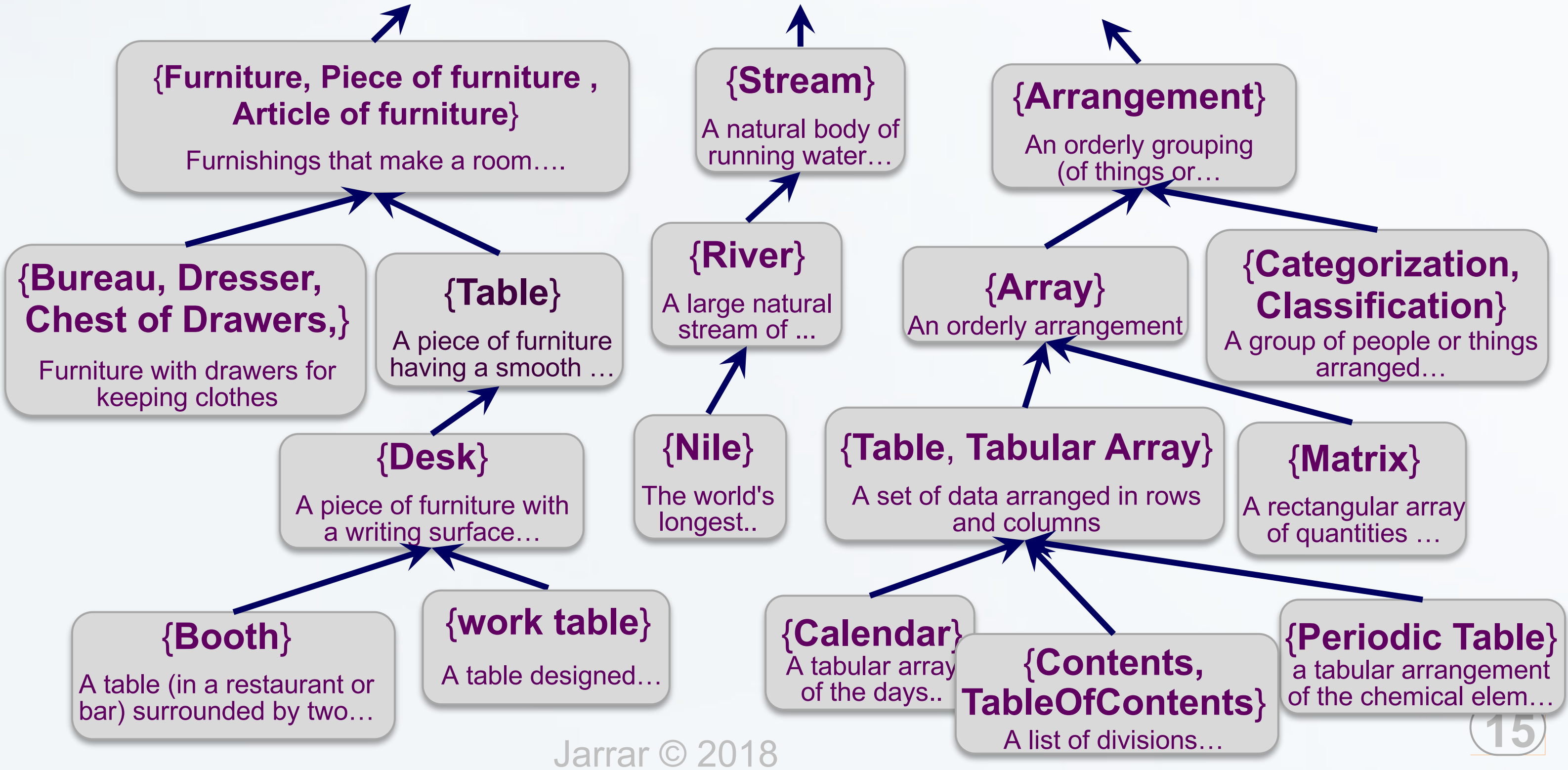
WordNet Relations: **Hyponymy**

- A synset {x, x′, . . .} is hyponym of the synset {y, y′, . . .} **if native English speakers accept sentences like x is a (kind of) y**. E. g., *Table/Tabular Array* is a kind of *Array*, *Array* is a kind of *Arrangement*,…
- Hyponymy is transitive and asymmetrical. So as Hyponymy generates a hierarchical semantic structure, a hyponym inherits all the features of the more generic concept and adds at least one feature that distinguishes it from its superordinate.



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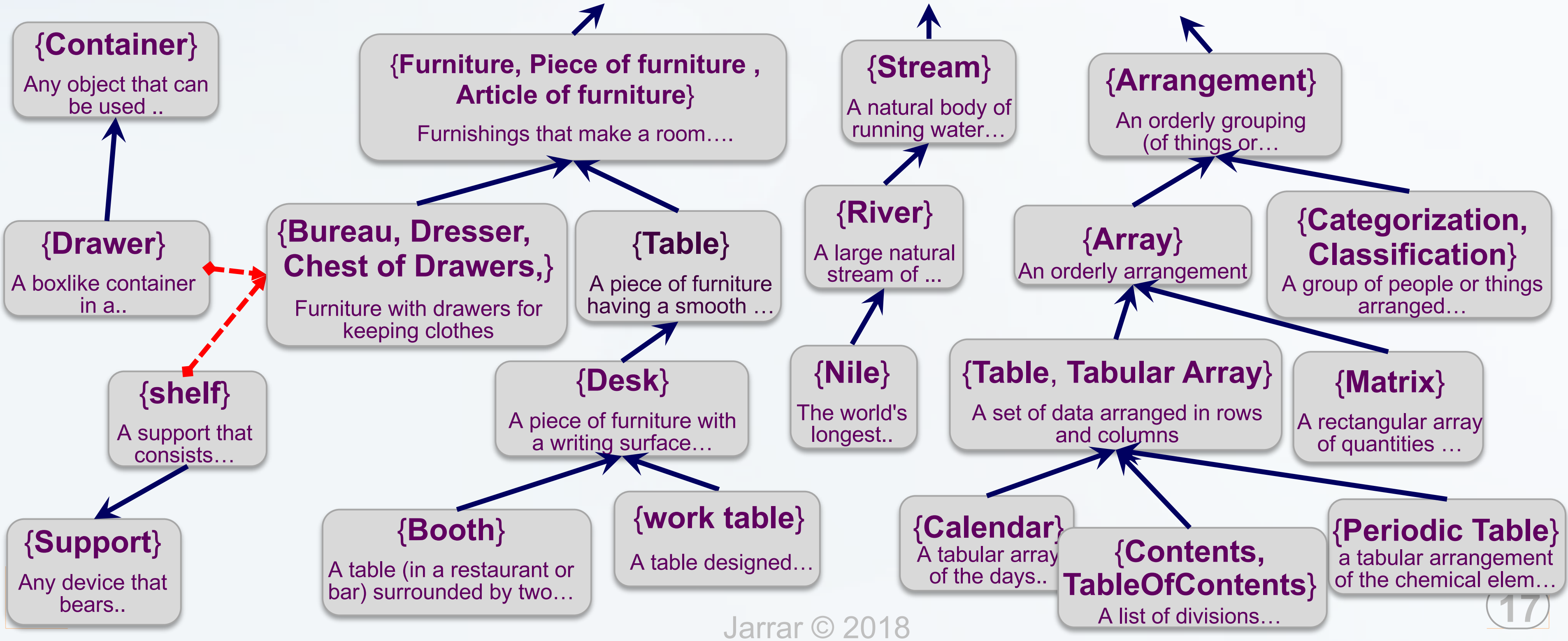
The WordNet hierarchy is about 16 levels

Top Level Nouns (25 unique beginners)

{act, action, activity}
{animal, fauna}
{artifact }
{attribute, property }
{body, corpus}
{cognition, knowledge}
{communication}
{event, happening}
{feeling, emotion}
{food}
{group, collection}
{location, place }
{motive}
{natural object }
{natural phenomenon }
{person, human being}
{plant, flora}
{possession}
{process}
{quantity, amount}
{relation }
{shape}
{state, condition}
{substance}
{time}

WordNet Relations: **Meronymy**

- A synset {x, x′, . . .} is meronym of the synset {y, y′, . . .} if native English speakers accept sentences like y has an x (as a part) or An x is a part of y. E. g., *Finger* is part of *Hand* , *Hand* is part of *Arm*, *Arm* is part of *Body*.
- Meronymy is transitive (with qualification) and asymmetrical relations, and forms a part hierarchy..
- Synsets may have multiple hypernyms



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Exercise

Find the hyponyms and meronyms of this synset

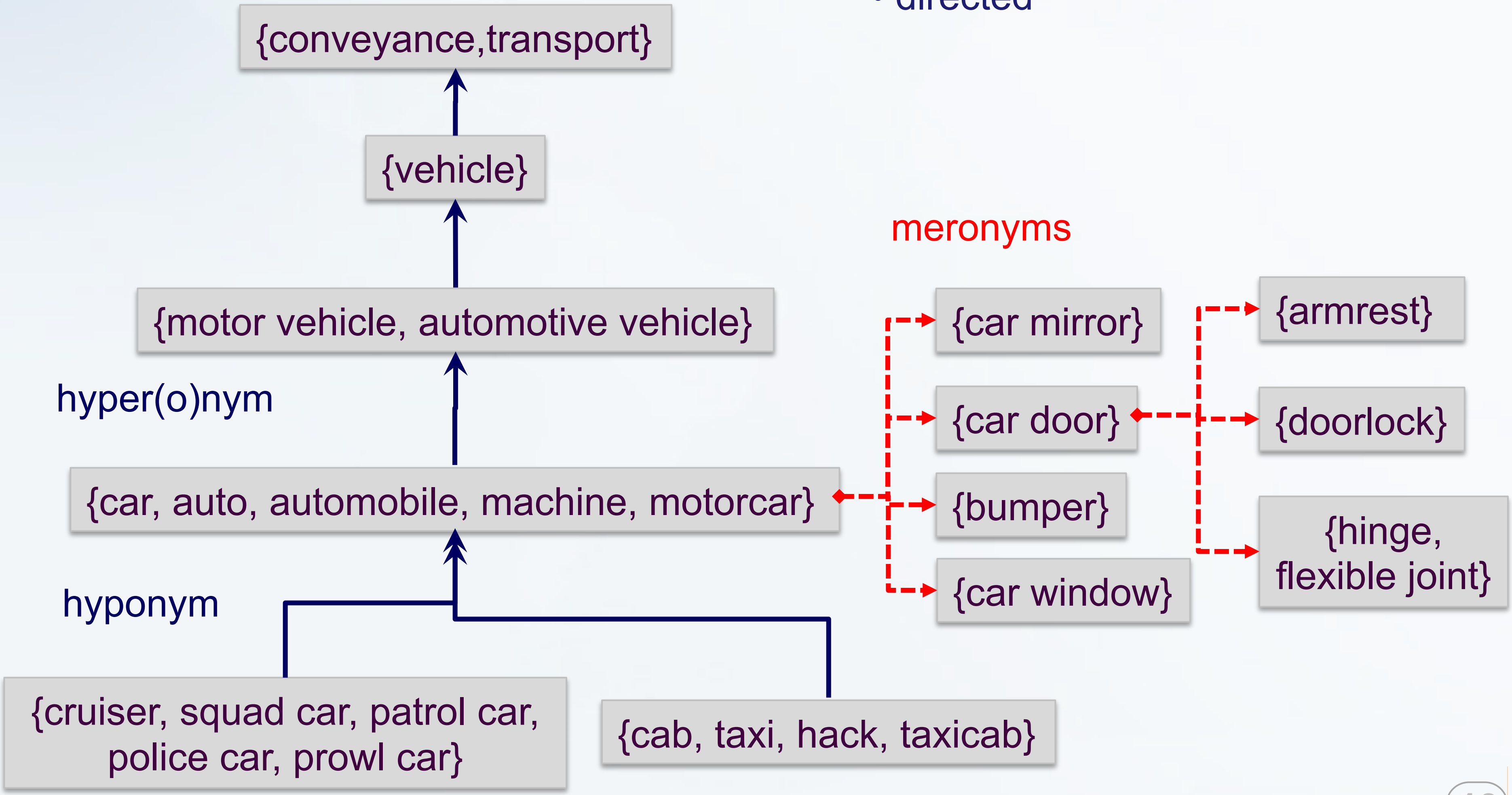
{car, auto, automobile, machine, motorcar}

WordNet Relations: **Another Example**

[Vossen]

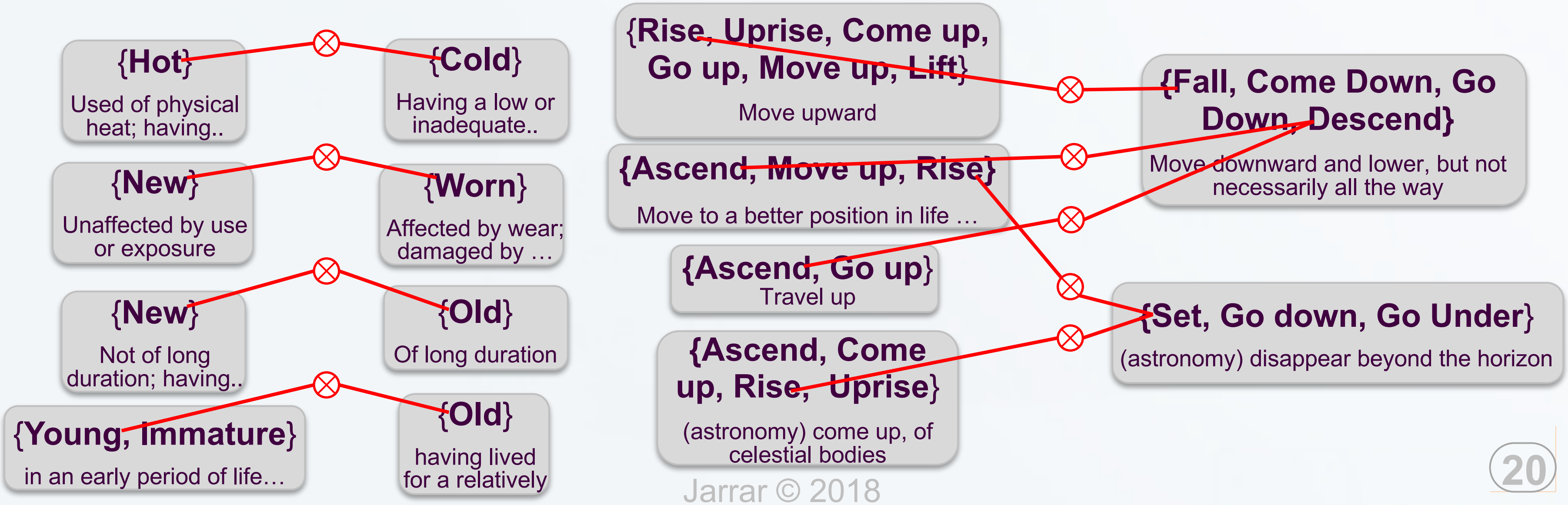
Hyponymy and meronymy relations are:

- transitive
- directed


{conveyance,transport}
{vehicle}
meronyms
{motor vehicle, automotive vehicle}
{armrest}
{car mirror}
hyper(o)nym
{car door}
{doorlock}
{car, auto, automobile, machine, motorcar}
{bumper}
{hinge, flexible joint}
hyponym
{car window}
{cruiser, squad car, patrol car, police car, prowl car}
{cab, taxi, hack, taxicab}

WordNet Relations: **Antonymy**

- The antonym of a word x is sometimes not-x, but not always. For example, *rich* and *poor* are antonyms, but to say that someone is not rich does not imply that they must be poor; many people consider themselves neither rich nor poor.
- Antonymy, which seems to be a simple symmetric relation, is actually quite complex, yet speakers of English have little difficulty recognizing antonyms when they see them. For example, the meanings {rise, ascend } and {fall, descend} may be conceptual opposites, but they are not antonyms; [rise/fall] are antonyms and so are [ascend/descend], but most people hesitate and look thoughtful when asked if rise and descend, or ascend and fall, are antonyms
- Antonymy is a lexical relation between word forms, not a semantic relation between word meanings. Or, some call it semantic relations between words [MPC93].



{Hot}
Used of physical heat; having..

{Cold}
Having a low or inadequate..

{New}
Unaffected by use or exposure

{Worn}
Affected by wear; damaged by …

{New}
Not of long duration; having..

{Old}
Of long duration

{Young, Immature}
in an early period of life…

{Old}
having lived for a relatively

{Rise, Uprise, Come up, Go up, Move up, Lift}
Move upward

{Ascend, Move up, Rise}
Move to a better position in life …

{Ascend, Go up}
Travel up

{Ascend, Come up, Rise, Uprise}
(astronomy) come up, of celestial bodies

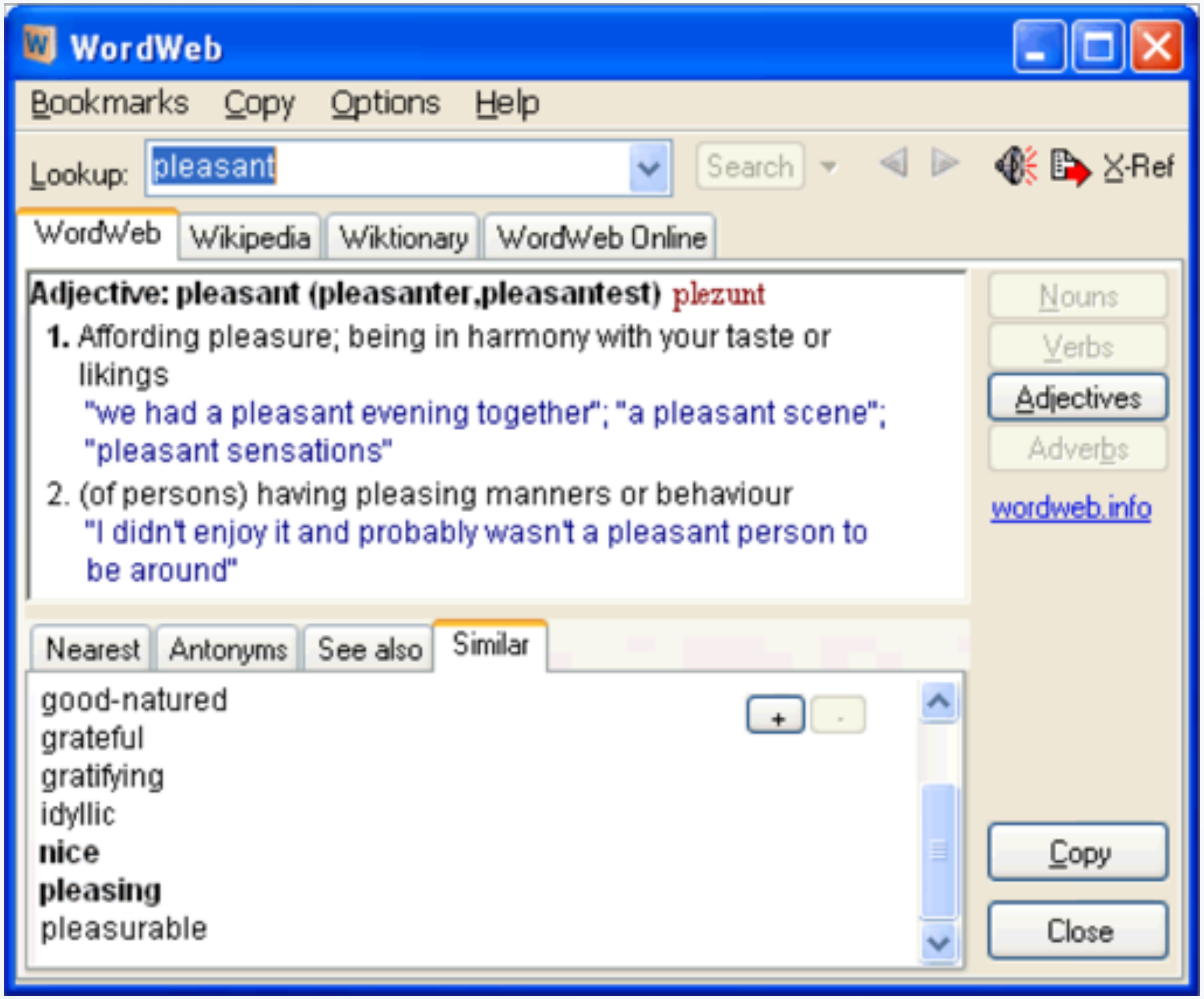
{Fall, Come Down, Go Down, Descend}
Move downward and lower, but not necessarily all the way

{Set, Go down, Go Under}
(astronomy) disappear beyond the horizon

WordWeb

http://wordweb.info/free/

A nice and intuitive interface for WordNet



Adjective: pleasant (pleasanter,pleasantest) plezunt

1. Affording pleasure; being in harmony with your taste or likings
"we had a pleasant evening together"; "a pleasant scene"; "pleasant sensations"

2. (of persons) having pleasing manners or behaviour
"I didn't enjoy it and probably wasn't a pleasant person to be around"

good-natured
grateful
gratifying
idyllic
nice
pleasing
pleasurable

Other WordNet Relations

- Although the main interest of WordNet was on specifying semantic relations but other lexical/morphological relations between word forms were added.

- For example: stems, singular-plural, verb tenses, etc.

Is WordNet a Thesaurus?

Yes:

- it groups together meaningfully related words

and more:

- WordNet provides **more accurate** relations,

  Thesaurus contains only related-to.

- Related words are **linked to specific concepts** (disambiguated),

  Thesaurus is a “bag of words”

➔ **Wordnets are next generation Thesauri**

Is WordNet an Ontology?

Ontological Precision:

WordNet: based on what native speakers agree roughly.

Ontology: based on Scientific and philosophical findings.

Classification:

WordNet: based on what native speakers agree roughly (Student IsA person)

Ontology: based on strict formal methodologies (student IsA role)

Formal Specification:

WordNet: logically vague (and, contains concepts without instance)

Ontology: strictly formal (every concepts can be instantiated)

Examples of ontological matters in WordNet

Examples problems in WordNet, which limited its use in IT applications:

- (Nile *Is-a* River) is **formal mistake**, Nile is an instance of River.
- (Student *Is-a* Person) is **ontologically incorrect**; Student is a *Role*
- (Reflate$_2$ *Is-a* Inflate$_3$) (Inflate$_3$ *Is-a* Change$_1$) and (Reflate$_2$ *Is-a* Change$_1$) is **meaningless**, this is an implied relation.
- (Restrain$_1$ *Is-a* Inhibit$_4$) and (Inhibit$_4$ *Is-a* Restrain$_1$) is a **cycle**.
- (Islamic Month *Is-a* Month) is **inaccurate**, Month = twelve divisions of the Gregorian year (i.e., 30.43 days); but Islamic month is 29.53 days.
- Moring and Evening Stars as different stars is **inaccurate**. They are the same instance (i.e., Venus) that people see at different occasions.
- (Italy *Is-a* Land5) and (Italy *Is-a* Nation) is **ontologically incorrect**. cannot subsume the two disjoint concepts, land5 and nation, at the same time.

➔ **From thesaurus to wordnet to linguistic ontology**

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- ❑ Part 1: What and why Thesaurus
- ❑ Part 2: What is WordNet
- ❑ Part 3: **Euro Wordnet**
- ❑ Part 4: Global Wordnet

EURO WordNet

[Vossen]

- The development of a multilingual database with WordNets for several European languages.

- Funded by the European Commission, DG XIII, LE2-4003 and LE4-8328
- March 1996 - September 1999 (2.5 Million EURO)
  http://www.hum.uva.nl/~ewn
  http://www.illc.uva.nl/EuroWordNet/finalresults-ewn.html

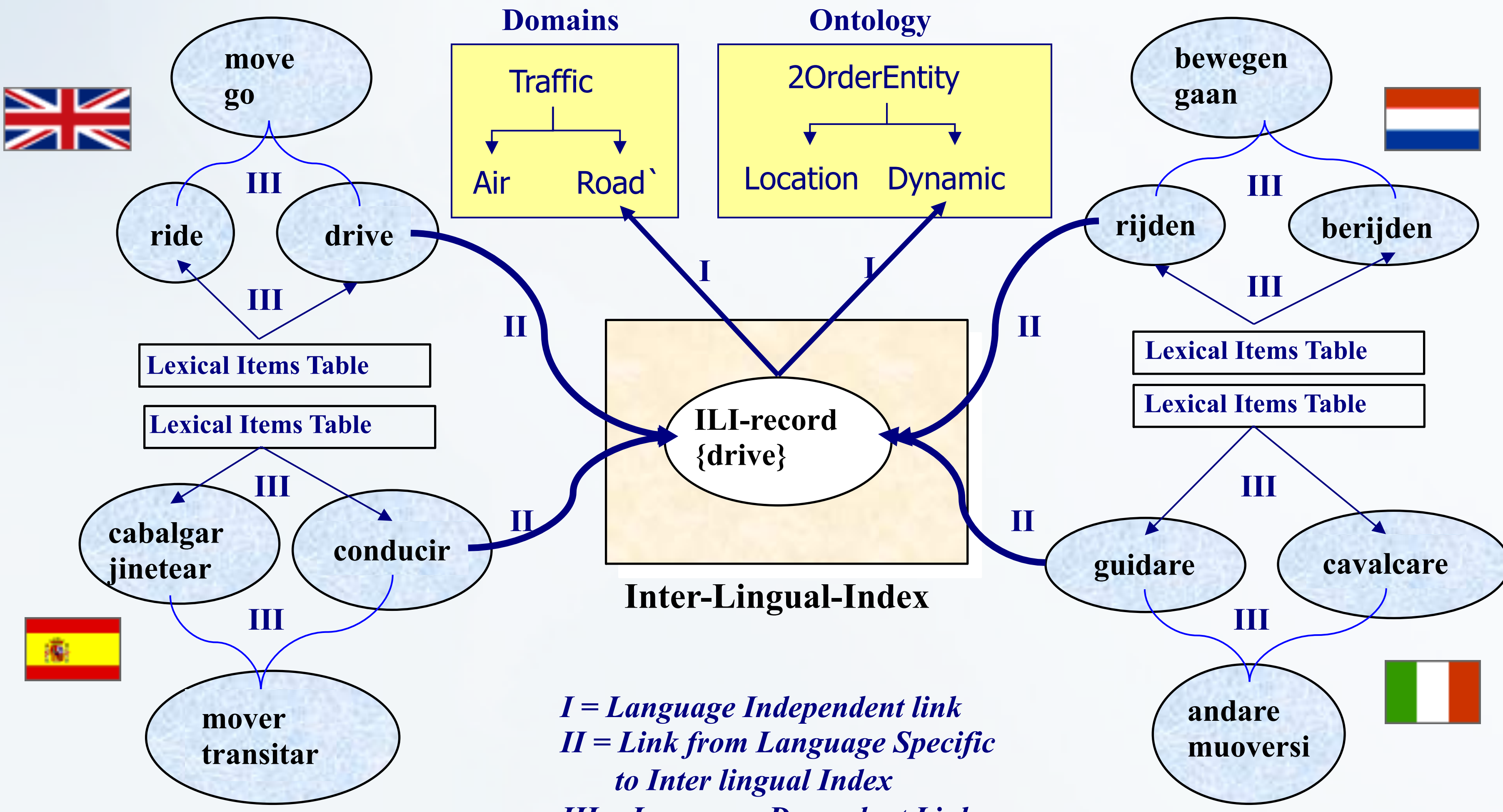
- **Languages covered:**
  EuroWordNet-1 (LE2-4003): English, Dutch, Spanish, Italian
  EuroWordNet-2 (LE4-8328): German, French, Czech, Estonian.

- **Size of vocabulary:**
  EuroWordNet-1: 30,000 concepts - 50,000 word meanings.
  EuroWordNet-2: 15,000 concepts- 25,000 word meaning.

- **Type of vocabulary:**
  the most frequent words of the languages
  all concepts needed to relate more specific concepts.

EURO WordNet Model

[Vossen]



I = Language Independent link
II = Link from Language Specific to Inter lingual Index
III = Language Dependent Link

The Multilingual Design

[Vossen]

- Inter-Lingual-Index: **unstructured fund of concepts** to provide an efficient mapping across the languages;
- Index-records are mainly **based on WordNet synsets** and consist of synonyms, glosses and source references;
- Various types of **complex equivalence relations** are distinguished;
- Equivalence relations from synsets to index records: **not on a word-to-word basis;**
- **Indirect** matching of synsets linked to the same index items;

EURO WordNet Model

[Vossen]

- WordNets are unique language-specific structures:
  - same organizational principles: synset structure and same set of semantic relations.
  - different lexicalizations
  - differences in synonymy and homonymy:

    "decoration" in English versus "versiersel/versiering" in Dutch

    "bank" in English (money/river) versus "bank" in Dutch (money/furniture)

•BUT also different relations for similar synsets

Some Downsides of the EuroWordNet Model

[Vossen]

- Construction is not done uniformly
- Coverage differs
- Not all wordnets can communicate with one another, i.e. linked to different versions of English wordnet
- Proprietary rights restrict free access and usage
- A lot of semantics is duplicated
- Complex and obscure equivalence relations due to linguistic differences between English and other languages

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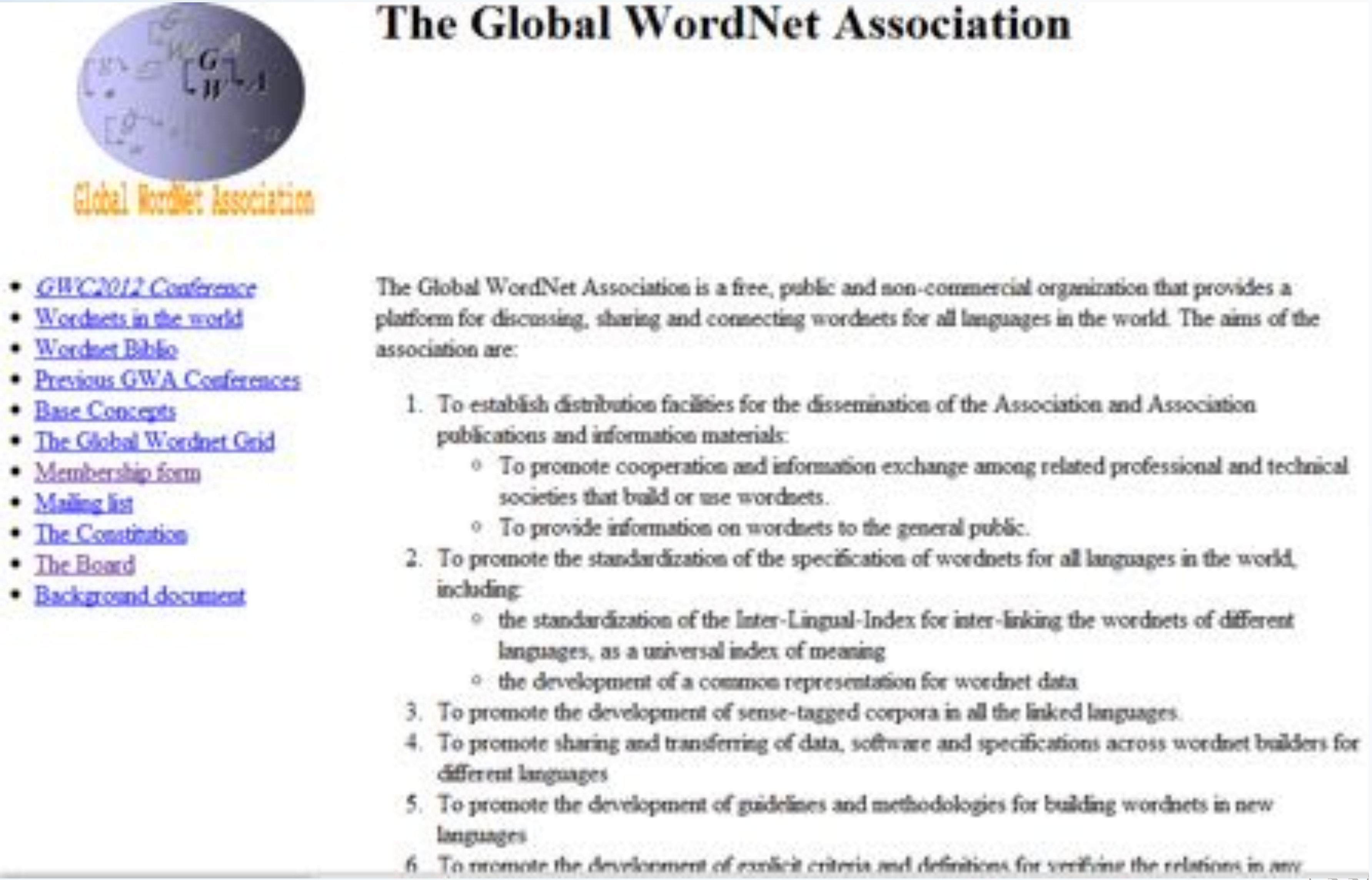
From EuroWordNet to Global WordNet

http://www.globalwordnet.org



The Global WordNet Association

- GWC2012 Conference
- Wordnets in the world
- Wordnet Biblio
- Previous GWA Conferences
- Base Concepts
- The Global Wordnet Grid
- Membership form
- Mailing list
- The Constitution
- The Board
- Background document

The Global WordNet Association is a free, public and non-commercial organization that provides a platform for discussing, sharing and connecting wordnets for all languages in the world. The aims of the association are:

1. To establish distribution facilities for the dissemination of the Association and Association publications and information materials:
   - To promote cooperation and information exchange among related professional and technical societies that build or use wordnets.
   - To provide information on wordnets to the general public.
2. To promote the standardization of the specification of wordnets for all languages in the world, including:
   - the standardization of the Inter-Lingual-Index for inter-linking the wordnets of different languages, as a universal index of meaning
   - the development of a common representation for wordnet data
3. To promote the development of sense-tagged corpora in all the linked languages.
4. To promote sharing and transferring of data, software and specifications across wordnet builders for different languages
5. To promote the development of guidelines and methodologies for building wordnets in new languages
6. To promote the development of explicit criteria and definitions for verifying the relations in any

From EuroWordNet to Global WordNet

[Vossen]

- EuroWordNet ended in 1999
- Global Wordnet Association was founded in 2000 to maintain the framework: http://www.globalwordnet.org
- Currently, wordnets exist for more than 50 languages, including:

  Arabic, Bantu, Basque, Chinese, Bulgarian, Estonian, Hebrew, Icelandic, Japanese, Kannada, Korean, Latvian, Nepali, Persian, Romanian, Sanskrit, Tamil, Thai, Turkish, Zulu...

- Many languages are genetically and typologically unrelated

➔ The Arabic WordNet extension was not successful, will be explained later.

Arabic WordNet

- Literal and ad hoc translation for 10000 English synsets, and never extended!

- The 10000 synsets were selected as the following:
  - A set of concepts (called **base concepts**) were selected as they exist in 12 languages (in EuroWordNet and BalkeNet, (Elkateb et al 2006), thus they are assumed to also exist in Arabic.
  - The base concepts were then extended mostly downwards with more specific concepts, and upwards with more general concepts, to improve the maximal connectivity of those base concepts.

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