

COST ACTION C21 – TOWNONTOLOGY 3rd Workshop

“Urban ontologies for an improved communication in urban civil engineering projects”

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Extraction of Geosemantics and Ontology Integration

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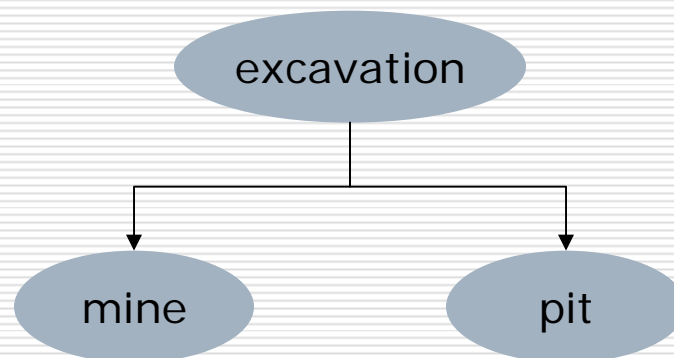


Ontology Integration

- ❑ Crucial issue for information **exchange** and **reuse**
– **semantic interoperability**
- ❑ **Explication issues** (e.g. communication protocols, architectures, etc.) are **resolved** to a great extent
- ❑ Focus on **semantic** issues to **preserve the meaning** of information and **assure its proper use**
- ❑ Important to deal with **existing information sources**, e.g., ontologies, categorizations, taxonomies, dictionaries, data standards, lexical databases

Definitions (2)

- use sufficient information to **differentiate similar concepts**, e.g. (WordNet):
 - “mine: **excavation** in the earth from which **ores** and **minerals** are extracted”
 - “pit: a surface **excavation** for extracting **stone** or **slate**”



Examples of Semantic Elements and Values

SEMANTIC ELEMENTS	EXAMPLES
IS-A	hotel : a building where travellers can pay for lodging and meals and other services
LOCATION	saltpan : a shallow basin in a desert region non-wooded forest areas : surfaces in a wood/forest but temporarily or permanently non-productive
COVER	fruit trees and berries : surfaces occupied by trees for the production of fruit and berries body of water : the part of the earth's surface covered with water
SIZE	snowfield : a permanent wide expanse of snow river : large natural stream of water
TIME	wadi : gully or streambed in North Africa and the Middle East that remains dry except during rainy season
PART-OF	seacoast : the shore of a sea or ocean
SEPARATION	coastal lagoons : stretches of salt or brackish water in coastal areas which are separated from the sea by a tongue of land or other similar topography
SURROUNDNESS	lake : body of water surrounded by land

PURPOSE

PATTERNS:

- for
- for the purpose of
- used for
- created for
-

canal

IS-A	waterway
PURPOSE	transportation

RULE (Vanderwende, 1995):

“If the verb used (intended, etc.) is post-modified by a prepositional phrase with the preposition “for”, then there is a PURPOSE semantic property with the head(s) of that prepositional phrase as the value”.

EXAMPLE:

canal: artificial or improved natural waterway used for
transportation

HAS-PART

PATTERNS:

- consist of
- composed of
- comprised of
-

way

IS-A	artifact
HAS-PART	a road or path

RULE:

“If the verb consist (comprise, compose, etc.) is post-modified by a prepositional phrase with the preposition “of”, then there is a HAS-PART semantic relation with the the head(s) of that prepositional phrase as the value”.

EXAMPLE:

way: artifact consisting of a road or path affording passage from one place to another

Extraction of Semantic Relation IS-A

The screenshot shows a software window titled "Parse Window" with two tabs: "DIMAP Parsing" and "DIMAP Parse".

Definition: hotel: a building where travelers can pay for lodging and meals and other services

Code:

```
Dim MyGroup
Dim MyGCursor
Dim aGroup
Dim thGroup
Set MyGCursor = GroupCursor
    MyGCursor.GroupCollection = Phrase.Groups
Set MyGroup = MyGCursor.NextGroup
Do While Not MyGroup Is Nothing
    If MyGroup.IsVerb and MyGroup.IsUnder ("VGER")
then
    Set aGroup=MyGroup.ReturnPreviousGroupNamed
("VGER")
    If Tools.IsValid(aGroup) then
        If Tools.IsValid(aGroup.ParentGroup)
then
            Set theGroup=aGroup.ParentGroup
            If theGroup.Contains("det") and
(theGroup.Contains("a") or theGroup.Contains("an")) then
                ReturnValue=MyGroup.Strip ("verb")
s "ing"
```

Parse:

```
[SEN
[PHP
[SUBJ
[pron this(sp(1))]
]
[verb be(la ln intr ipr sp(1) pres-t 3)]
[NP
[det a(sing sp(1))]
[VGER
[PX
[verb build(dn-n dn-pr intr tn tn-pr pres-p sp(1))]
]
]
]
[SUBC
[fsuc where(sp(1))]
[PHN
[SUBJ
[noun traveler(pl sp(1))]
]
[v-aux can(123456 sp(1))]
[verb pay(dn-n dn-pr intr ipr tn tn-pr sp(1))]
]
]
[PRP
[prep for(sp(1))]
[NP
[adj
[CONJ
[occonj and(sp(1))]
[adj lodge(intr ipr tn tn-pr pres-p sp(1))]
[noun meal(dngr ucn pl sp(1))]
[adj other(sp(1))]
]
]
]
[noun service(attrib cn ucn pl)]
]
```

Output: building

Extraction of Semantic Property PURPOSE

The screenshot shows a software window titled "Parse Window" with two tabs: "DIMAP Parsing" and "DIMAP Parse". The "DIMAP Parse" tab is active, displaying a parse tree for the sentence "Ditch: channel constructed for the purpose of irrigation or drainage".

The "Definition" tab shows the following code:

```
Ditch: channel constructed for the purpose of irrigation or drainage

Dim MyGroup
Dim aGroup
Dim theGroup
Dim ss
Dim MyGCursor
Dim MyGCursor1
  Set MyGCursor = GroupCursor
  Set MyGCursor1 = GroupCursor
  MyGCursor.GroupCollection = Phrase.Groups
  Set MyGroup = MyGCursor.NextGroup
  Do While Not MyGroup Is Nothing
    If MyGroup.IsVerb And MyGroup.Includes("use")
  Then
    Set aGroup = MyGroup.ReturnNextGroupNamed
("prep", "All")
    If Tools.IsValid(aGroup) Then
      If aGroup.Includes("for") Then
        If Tools.IsValid(aGroup.ParentGroup)
  Then
    Set theGroup =
```

The "DIMAP Parse" tab shows the corresponding parse tree structure:

```
{SEN
  {PHP
    {SUBJ
      {pron this(sp(1))
    }
    {verb be(la ln intr ipr sp(1) pres-t 3)}
    {NP
      {noun channel(attrib cn dngr sp(1))
    }
  }
  {VPAP
    {VP
      {verb construct(tn pt pp sp(1))
      {PRP
        {prep for(sp(1))
        {NP
          {det the(sp(1))
          {noun purpose(cn ucn sp(1))
        }
      }
    }
    {PRP
      {prep of(sp(1))
      {NP
        }
      }
    }
  }
  {NP
    {noun
      {CONJ ninfo(3yabmf)
      {oconj or(sp(1))
      {noun irrigation(attrib ucn sp(1))
      {noun drainage(ucn)}
    }
  }
}
{epunct .}
```

The "OutPut" tab shows the extracted semantic property:

irrigation or drainage

Extraction of Semantic Relation SURROUNDED-BY

The screenshot shows the 'Parse Window' application with three main sections: Definition, DIMAP Parsing, and DIMAP Parse.

Definition: lake: body of water surrounded by land

```
End If
If theGroup.IsAdj Then
    ss = ss & theGroup.Strip
End If
If theGroup.IsDet Then
    ss = ss & theGroup.Strip
End If
Set theGroup =
MyGCursor1.NextGroup
    Loop
    End If
End If
Set MyGroup = MyGCursor.NextGroup
Loop
ReturnValue = Tools.Clean(ss)
```

DIMAP Parsing:

```
(SEN
(PHP
(SUBJ
(pron this(sp(1)))
)
(verb be(la ln intr ipr sp(1) pres-t 3))
(NP
(noun body(cgp cn singnv ucn sp(1)))
)
(PRP
(pre of(sp(1)))
(NP
(noun water(attrib dngr singnv ucn sp(1)))
)
)
(VPAP
(VP
(verb surround(tn tn-pr pt pp sp(1)))
(PRP
(pre by(sp(1)))
(NP
(noun land(cn dngr ucn))
)
)
)
)
)
(epunct .)
)
```

OutPut: land

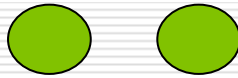
A 'Parse' button is located at the bottom right of the Definition section.

```
<Definition>
<DefinitionString=Lake: body of water surrounded by land/>
  <ISA=body/>
  <ADJACENCY=/>
  <AGENT=/>
  <BACKWARDHORIZONTALRELATIVEPOSITION=/>
  <BEYONDHORIZONTALRELATIVEPOSITION=/>
  <BOTTOMVERTICALRELATIVEPOSITION=/>
  <CONNECTIVITY=/>
  <CONTAINMENT=/>
  <COVER=water/>
  <DIRECTION=/>
  <EXCLUSION=/>
  <EXTENSION=/>
  <FORWARDHORIZONTALRELATIVEPOSITION=/>
  <HASPART=/>
  <INTERSECTION=/>
  <ISPARTOF=/>
  <POINTINTIME=/>
  <PROPERTY_DEFINED_LOCATION=/>
  <PROPERTY_DEFINED_TIME=/>
  <PROXIMITY=/>
  <PURPOSE=/>
  <SEPARATION=/>
  <SHAPE=/>
  <SIDEHORIZONTALRELATIVEPOSITION=/>
  <SIZE=/>
  <START_DESTINATION=/>
  <SURROUNDNESS=land/>
  <TOPVERTICALRELATIVEPOSITION=/>
  <RELATIVEPOSITION=/>
  <NATURE=/>
</Definition>
```

```
<Definition>
<DefinitionString=Sea: large body of salt water partially enclosed by land/>
  <ISA=body/>
  <ADJACENCY=/>
  <AGENT=/>
  <BACKWARDHORIZONTALRELATIVEPOSITION=/>
  <BEYONDHORIZONTALRELATIVEPOSITION=/>
  <BOTTOMVERTICALRELATIVEPOSITION=/>
  <CONNECTIVITY=/>
```

Comparison Cases Between two Concepts

1. Equivalence



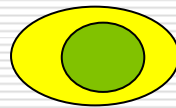
ONTOLOGY A

river: natural stream of water

ONTOLOGY B

river : natural stream of water

2. Subsumption



ONTOLOGY A

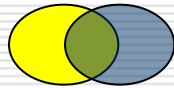
lake: **natural or artificial** body of water surrounded by land

ONTOLOGY B

lake: **natural** body of water surrounded by land

Comparison Cases Between two Concepts

3. Overlap



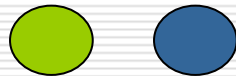
ONTOLOGY A

canal: artificial waterway used for transportation and irrigation

ONTOLOGY B

canal: artificial or improved natural waterway used for irrigation

4. Difference

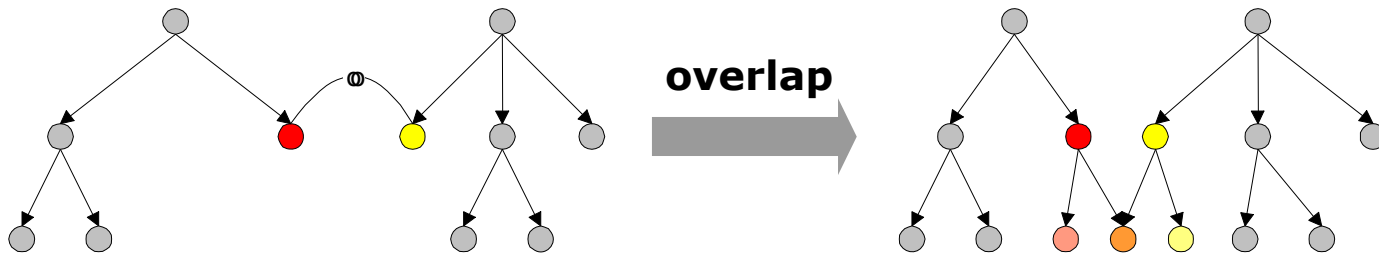
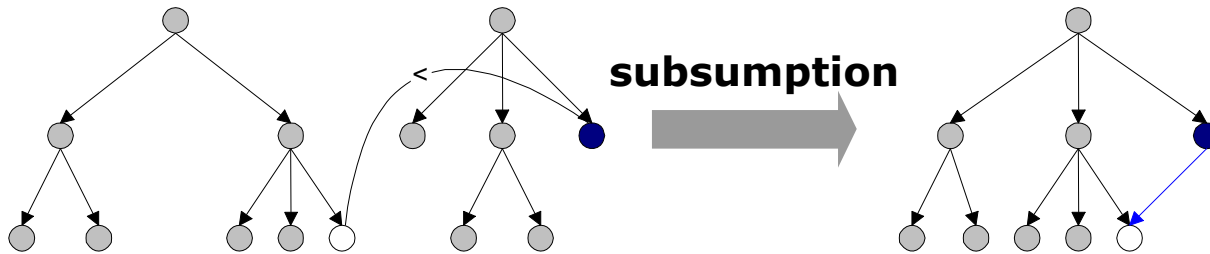
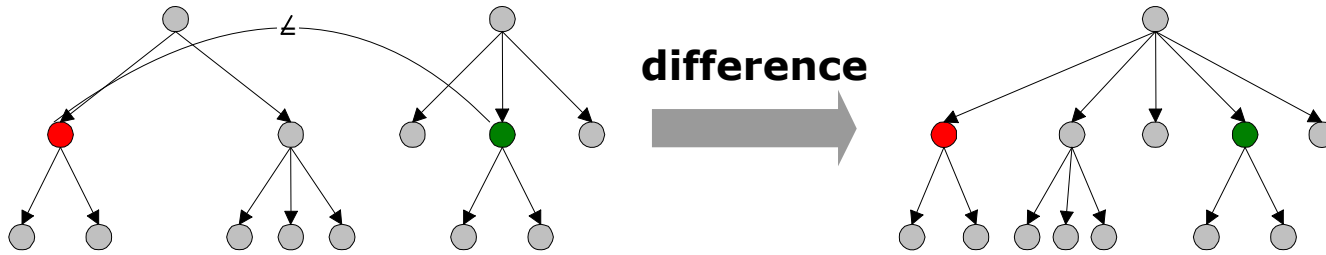
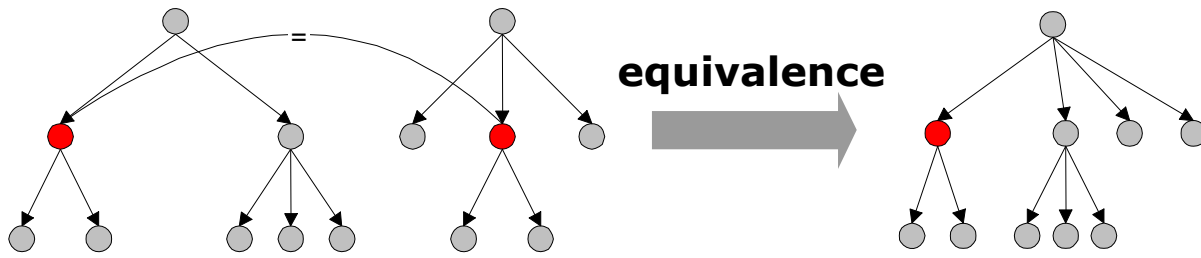


ONTOLOGY A

lake: body of water surrounded by land

ONTOLOGY B

sea: a large body of salt water partially enclosed by land



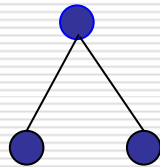
Structures for the Representation of Geographic Concepts

Hirtle (1995):

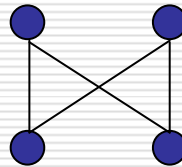
- trees
- ordered trees
- lattices

CONCLUSION

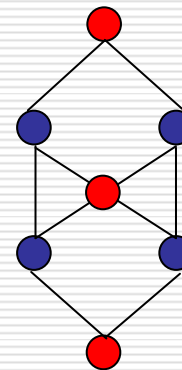
Lattices are more powerful and flexible for the representation of multiple, overlapping relations in geographic space.



tree



poset



lattice

Final Integrated Ontology

