#### Semantic Annotation: from Text to Multimedia Content

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## Talk Outline

#### 1 Language Resources and Multimedia

- **2** Annotation and Representation
- **3** Spatio-temporal Annotation
- Annotating Maps and Pictures
- **6** Annotating Dynamic Information
- **6** Concluding Remarks

# What are Language Resources?

Language resources include

- language data and descriptions in machine readable form used to assist and augment language processing applications, such as
  - 1 written or spoken corpora and lexica,
  - 2 multimodal resources, grammars, terminology
  - or domain specific databases and dictionaries, ontologies, multimedia databases, etc.,
- as well as basic software tools
  - for their acquisition, preparation, annotation, management, customization, and use.

Source(s): A web page introducingLanguage Resources and Evaluation, Springer, 2012-11-13

# What is Multimedia?

- Multimedia refers to a combination of many different forms of conveying information
- or to its content.
- Multimedia includes
  - 1 not only traditional hand-written or printed material,
  - 2 and rudimentary computer displays of text-only,
  - but also a combination of text, audio, still images, video, animation, pictures, tables, diagrams or interactivity content forms.

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# What is Annotation?

- Annotation literally means adding a note to any form of text or its content.
- Wallis and Nelson (2001): Annotation consists of the application of a scheme to texts.
- Annotations may include structural markup, part-of-speech tagging, parsing, and numerous other representations.
- Annotated corpus: The Penn Tree Bank, WordNet (word sense annotated corpus)

Source(s): Wallis, S., and G. Nelson G. (2001); Wikipedia: Corpus Linguistics, 2012-11-19

# ONE VIEW: How to Construct Language Resources



# Types of Annotation

- Basic Annotation
  - 1 Base segmentation
  - 2 Tokenization (word segmentation)
- Higher-level annotation
  - 1 Morpho-syntactic annotation
  - **2** Syntactic annotation
  - **3** Semantic annotation

Source(s):

# Structure of Annotation: Annotation Scheme

Given a fragment  $L_f$  of a language L, an annotation scheme  $\mathcal{AS}$  with respect to  $L_f$  is a tuple < M, E, R, @>, where

- $M \subseteq L_f$ , a non-empty set of markables,
- *E* is a non-empty set of entities or entity types each of which is assigned to each of the marakbles in *M*,
- *R* is a relation over *E*, and
- @ is a set of functions from attributes to values for each entity in *E* and each relation in *R*.

Source(s):

## Semantic Annotation

- Semantic annotation is the process of adding semantic information to language data, raw or processed.
- Examples are various parts of ISO's semantic annotation framework:
  - 1 Time and events (ISO-TimeML)
  - 2 Spatial information (ISO-Space)
  - 3 Named entities
  - 4 Semantic roles
  - **5** Dialogue acts (SemAF-DA)
  - 6 Semantic relations in discourse

# Representation: XML Serialization

- Annotations can be represented in various forms.
- The currently most popular form is to use XML, opposed to tree banks such as PTB (Penn Tree Bank).
- Examples are:
  - BNC (British National Corpus)
  - ANC (American National Corpus)
  - ISO-TimeML
  - MITRE's SpatialML.

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#### Annotation 1: Email Text for Restaurant Reservation

We made a tentative reservation at the Italian restaurant that I mentioned for five seats, so you and Ikeya sensei can join us. Alternatively, it is quite flexible and you can go out with him elsewhere. It is near Jimbocho subway station, which is two subway stations away from your hotel, and is quite near from the hotel and also from the university.

Source(s): Email from Yasunari, harada@waseda.jp, to Kiyong, 2012-11-05

# Annotation 1: Markables for Spatial Information and Entity Types Marked UP

We made a tentative reservation<sub>e1</sub> at<sub>s1</sub> the Italian restaurant<sub>p/1</sub> that I mentioned for five seats, so you and Ikeya sensei can join us. Alternatively, it is quite flexible and you can go  $out_{m1}$  with him elsewhere<sub>p/2</sub>. It is near<sub>s2</sub> Jimbocho subway station<sub>p/3</sub>, which is two subway stations away<sub>me1</sub> from<sub>s3</sub> your hotel<sub>p/4</sub>, and is quite near from<sub>s4</sub> the hotel<sub>pl5</sub> and also from<sub>s5</sub> the university<sub>pl6</sub>. Source(s): Email from Yasunari harada@waseda in to Kiyong 2012-11-05

#### Annotation 1: Entity Types

- Event and Motion: reservation<sub>e1</sub>, go out<sub>m1</sub>
- Place: the Italian restaurant<sub>p/1</sub>, elsewhere<sub>p/2</sub>, Jimbocho subway station<sub>p/3</sub>, your hotel<sub>p/4</sub>, the hotel<sub>p/5</sub>, the university<sub>p/6</sub>
- Spatial Signal: at<sub>s1</sub>, near<sub>s2</sub>, from<sub>s3</sub>, quite near from<sub>s4</sub>, from<sub>5</sub>
- Measure: two subway stations away<sub>me1</sub>
- Other entity types: Path, Spatial entity

#### Annotation 1: Links - QSLINK

- Qualitative Spatial Link: <QSLINK xml:id="qsl1" figure="#e1" ground="#pl1" trigger="#s1" relType="IN"/>
- a tentative reservation<sub>e1</sub> at<sub>s1</sub> the Italian restaurant<sub>p/1</sub>

#### Annotation 1: Links - OLINK

- Orientation Link: <OLINK xml:id="ol1" figure="#pro1" ground="#pl3" trigger="#s2" relType="NEAR"/> <REF xml:id="pro1" corresp="#pl1"/>
   It is poor limboche subway station
- It<sub>pro1</sub> is near<sub>s2</sub> Jimbocho subway station<sub>p/3</sub>

#### Annotation 1: Links - MLINK

- Measure Link: <MLINK xml:id="ml1" figure="#pl3" ground="#pl4" relType="distance" value="#me1"/>
- Jimbocho subway station<sub>p/3</sub>, which is two subway stations away<sub>me1</sub> from<sub>s3</sub> your hotel<sub>p/4</sub>

#### Annotation 1: Interpretation

- Partially Annotated: you<sub>sne1</sub> may [go out]<sub>m1</sub> with him<sub>sne2</sub> elsewhere<sub>pl2</sub>.
- Annotation: <SPATIAL\_NE xml:id="sne1"/>
   <MOTION xml:id="m1" motion\_type="PATH"
   motion\_class="MOVE EXTERNALLY"
   sense="LITERAL"/>
   <PLACE xml:id="pl2" countable="YES"
   quant="EVERY\_otherThan"/>
   <MOVELINK xml:id="mvl1" mover="#sne1,#sne2"
   trigger="#m1" goal="#pl2"/>
- Interpretation:

 $\exists x [the Restuarant(x) \land \Diamond \forall y \exists e [[place(y) \land x \neq y] \rightarrow$ 

# Annotation 2: Email with Flight Schedules in Tabular Forms

 Professor Lee will take JAL flights, but I had to switch to ANA because I couldn't secure a return seat with JAL.
 Prof. Kiyong Lee Gimpo-Haneda (11/30, Fri) 12:10-14:15 JL0092 Haneda-Gimpo (12/02, Sun) 15:30-18:05 JL0093 I will meet Prof. Lee at the Haneda airport after our separate arrivals there, and will get to the hotel together, perhaps around 5.

# Annotation 2: Focusing on Some Particular Information

• Professor Lee will take JAL flights, but I had to switch to ANA because I couldn't secure a return seat with JAL.

Prof. Kiyong Lee Gimpo-Haneda (11/30, Fri) 12:10-14:15 JL0092 Haneda-Gimpo (12/02, Sun) 15:30-18:05 JL0093 I will meet Prof. Lee at the Haneda airport after our separate arrivals there, and will get to the hotel together, perhaps around 5.

Source(s): email from Jae, jchoe@korea.ac.kr, to Yasunari, 2012-11-xx

#### Annotation 2: Primary Data

- Prof. Kiyong Lee Gimpo-Haneda (11/30, Fri) 12:10-14:15 JL 0092
- Information presented in a tabular form
- Both spatial and temporal information

Source(s):

#### Annotation 2: Spatial Annotation

- [Prof. Kiyong Lee]<sub>sne1</sub>
   Gimpo<sub>p/1</sub>-Haneda<sub>p/2</sub> (11/30, Fri) 12:10<sub>t1</sub> 14:15<sub>t2</sub>[JL 0092]<sub>sne2</sub>
- <isoSpace xml:id="space-a2"> <SPATIAL NE xml:id="sne1"/> <PATH xml:id="pa1" beginPoint="#pl1" endPoint="#pl2"/> <MOTION xml:id="m1" motion type="COMPOUND" motion class="FLY" sense="LITERAL"/> <SPATIAL NE xml:id="sne2"/> <MOVELINK xml:id="mvl1" mover="#sne1" triger="#m1" pathID="#pa1" source="#pl1" goal="#pl2" means="#sne2" goal reached="YES"/>

#### Annotation 2: Temporal Annotation

<isoTimeML xml:id="time-a2"/> <EVENT xml:id="e1" pred="LEAVE"/> <EVENT xml:id="e2" pred="ARRIVE"/> <TIMEX3 xml:id="t1" type="DATE" value="2012-11-30:t12:10"/> <TIMEX3 xml:id="t2" type="DATE" value="2012-11-30:t14:15"/> <TLINK eventID="#e1" relatedToTime="#t1" relType="DURING"/> <TLINK eventID="#e2" relatedtoTime="#t2" relType="DURING"/>

#### </isoTimeML>

Source(s): ISO 24617-1 LRM - Semantic annotation framework - Part 1: Time and events

#### Some Observations

- The annotation or interpretation of the flight schedule relies on conventionally available information.
- The tags that refer to the flight or the departure and the arrival have no corresponding markables in the given data.
- The two events of leaving and arriving are sub-events of the motion of flying.

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#### Gimpo to Haneda



## Flight Time

- <PLACE xml:id="pl1" form="NAM" type="FAC" city="Seoul" country="KR"/> <PLACE xml:id="pl2" form="NAM" type="FAC" city="Tokyo" country="JP"/> <MEASURE xml:id="me1" value="P2H3OM" measureFunction="YES"/> <MLINK xml:id="mlink" figure="pl1" ground="pl2" val="#me1" relType="timeAmount"/>
- TimeAmount(P2H30M,Gimpo/Seoul,Haneda/Tokyo)

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# Annotating Dynamic Information

Here is a list of images from James Pustejovsky that together illustrate how moving from one place to another is represented.

# A Four Day Trip: Day 1



David left San Cristobal de Las Casas 4 days ago.
Leave(David,S.C.,20060303)

# A Four Day Trip: Same Day 1



David arrived in Ocosingo that day.Arrive(David,Ocosingo,20060303)

# A Four Day Trip: Day 2



The next day, David biked to Agua Azul...Bike(David,to\_Agua\_Azul,2000304)

# A Four Day Trip: Same Day 2 Afternoon



and played in the waterfalls there for 4 hours.
Play(David,Agua\_Azul(waterfalls),P4H)

# A Four Day Trip: Day 3



- David spent the next day at the ruins of Palenque.
- Spend(David, Ruins, 20060305)

# A Four Day Trip: Day 4



- The following day, David drove to the border with Guatemala.
- Drive(David, to\_Border, 20060306)

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#### Two Basic Questions

- What types of information data can or need to be annotated?
- In what machine readable forms can annotations be represented and also interpreted?

#### Possible Answer-1?

• Any language data: Graphic representations, maps and pictures, both still and moving as well as ordinary text can and need to be annotated. Possible Answers-2?

- Answer for representation: XML serialization? Feature Structures in XML?
- Answer for interpretation: first-order logic, Lambda Calculus? DRT? MRS?

# Taking Credit for a Cast of Thousands

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