Syntax and semantics (cont.)

Week 10
The structure of situations
The structure of situations

- Situations: states and events
The structure of situations

- Situations: states and events
- The meaning behind sentences.
The structure of situations

- Situations: states and events
- The meaning behind sentences.
  - *It’s raining.*
The structure of situations

- Situations: states and events
- The meaning behind sentences.
  - It’s raining.
  - Jimmy is sleeping.
The structure of situations

- Situations: states and events
- The meaning behind sentences.
  - It’s raining.
  - Jimmy is sleeping.
  - Clark hugged Lois.
The structure of situations

- Situations: states and events
- The meaning behind sentences.
  - It’s raining.
  - Jimmy is sleeping.
  - Clark hugged Lois.
  - Luz loves Arnie.
The structure of situations

- Situations: states and events
- The meaning behind sentences.
  - It’s raining.
  - Jimmy is sleeping.
  - Clark hugged Lois.
  - Luz loves Arnie.
  - You wrote a book.
The structure of situations

- Situations: states and events
- The meaning behind sentences.
  - It’s raining.
  - Jimmy is sleeping.
  - Clark hugged Lois.
  - Luz loves Arnie.
  - You wrote a book.
  - The ball rolled off the table.
The structure of situations

- Situations: states and events
- The meaning behind sentences.
  - *It’s raining.*
  - *Jimmy is sleeping.*
  - *Clark hugged Lois.*
  - *Luz loves Arnie.*
  - *You wrote a book.*
  - *The ball rolled off the table.*
  - *Clark borrowed a computer from Lois.*
The structure of situations

- Situations: states and events
- The meaning behind sentences.
  - It’s raining.
  - Jimmy is sleeping.
  - Clark hugged Lois.
  - Luz loves Arnie.
  - You wrote a book.
  - The ball rolled off the table.
  - Clark borrowed a computer from Lois.
  - My keyboard smells funny.
The structure of situations
The structure of situations

- Situations have
The structure of situations

- Situations have
  - A state or event category
The structure of situations

- Situations have
  - A state or event category
  - Zero or more participants: core and peripheral participants
The structure of situations

- Situations have
  - A state or event category
  - Zero or more participants: core and peripheral participants

- Situations don’t have
The structure of situations

- **Situations have**
  - A state or event *category*
  - Zero or more *participants*: core and peripheral participants

- **Situations don’t have**
  - An order imposed on their arguments
The structure of situations

- Situations have
  - A state or event category
  - Zero or more participants: core and peripheral participants

- Situations don’t have
  - An order imposed on their arguments
  - To distinguish the meaning of Luz loves Arnie from the meaning of Arnie loves Luz, we need to assign participants to semantic roles
Graphical representation of a situation
Back to sentences and utterances
Back to sentences and utterances

- A sentence has
A sentence has
- syntax: a representation of the constituents in the sentence and how they relate to each
Back to sentences and utterances

- A sentence has
  - syntax: a representation of the constituents in the sentence and how they relate to each other
  - semantics: a representation of the situation referred to by the sentence
Back to sentences and utterances

- A sentence has
  - syntax: a representation of the constituents in the sentence and how they relate to each
  - semantics: a representation of the situation referred to by the sentence

- To make syntax look more like semantics and to handle languages with free word order, we’ll use syntactic roles to show constituent relations and a **pred** role to point to the semantics
A sentence as a DAG

S42

verb
subj
obj
pred
form
ref
lover
lovee
cat

[lʌvz]  [lus]  ['arni]  luz  arnie  LOVE

[form]  [form]  [ref]  [ref]  [lover]  [lovee]  [cat]
What’s in the lexicon/grammar
What’s in the lexicon/grammar

- Each entry in the lexicon/grammar has a form component and a meaning (semantic) component.
What’s in the lexicon/grammar

• Each entry in the lexicon/grammar has a form component and a meaning (semantic) component

• For verbs, the entry must specify how the participants in the situation are referred to by the constituents in the sentence
The lexical entry for love
Production example
Production example

S42
  ▼
   pred
     ▼
      lover ▼ lovee ▼ cat
          ▼
           luz ▼ arnie ▼ LOVE
Production example
Production example
Production example
Production example
Production example
Production example
Adding context elements
Adding context elements

- How could we produce or comprehend you love me?
Adding context elements

- How could we produce or comprehend \textit{you love me}?
- The Speaker and Hearer of the sentence are the Speaker and Hearer of the constituents of the sentence.
Contextual elements in a sentence
Constituent order
Constituent order

- Why are constituents ordered?
Constituent order

- Why are constituents ordered?
  - Language (especially spoken language) happens in time; this is built into the signal and the limitations on how much can be processed in parallel.
Constituent order

• Why are constituents ordered?
  - Language (especially spoken language) happens in time; this is built into the signal and the limitations on how much can be processed in parallel.

• What does order mean?
Constituent order

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- Order constraints
Constituent order

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• Order constraints
  - In English NPs, det < adj < noun
Constituent order

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- What does order mean?
  - It can specify the roles that the participants fill.
  - It can be related to informativeness: new information tends to come late in an utterance.

- Order constraints
  - In English NPs, det < adj < noun
  - In English sentences, subj < verb
Features for agreement constraints

[Diagram with nodes labeled as %S, subj<verb, verb, subj, order, pred, persnum]

- verb
- subj
- order
- pred
- persnum

 subj<verb
Features for agreement constraints

%loves

verb subj obj pred

form persnum ref

[lavz] +3psing

ref lovee cat

lover

LOVE
Features for agreement constraints

%love

- verb
- subj
- obj
- pred

form

persnum

ref

lover

lovee

cat

[Law] -3psing

LOVE
Features for agreement constraints

%arnie

form
['arni']

persnum
+3psing

ref

arnie
Inheritance hierarchy of lexical entries

\[
\text{%LOVE} \\
\text{verb} \quad \text{subj} \quad \text{obj} \quad \text{pred} \\
\text{lover} \quad \text{lovee} \quad \text{cat} \\
\text{lover} \quad \text{lovee} \quad \text{cat} \\
\text{LOVE} \\
\text{%loves} \\
\text{verb} \quad \text{subj} \\
\text{form} \quad \text{persnum} \\
\text{[lwz]} \quad +3psing \\
\text{%love} \\
\text{verb} \quad \text{subj} \\
\text{form} \quad \text{persnum} \\
\text{[lw]} \quad -3psing
\]
Inheritance hierarchy of lexical entries

%S

%LOVE

LOVE

verb
subj
order
pred
persnum

subj<verb

persnum

ref
ref
lovee
lover
cat

LOVE

persnum

verb
subj
obj
pred

LOVE
Comprehension example
Comprehension example
Comprehension example

NP29
- form
- persnum
- ref
- ['arni']
- +3psing
- arnie

NP95
- form
- persnum
- ref
- [lus]
- +3psing
- luz

S666
- subj
- verb
- obj
- pred
- order
- verb
- subj
- obj
- ref
- lover
- lovee
- cat
- [lʌvz]
- +3psing
- LOVE

subj<verb
verb<obj
Comprehension example

NP29

form persnum

['arni'] +3psing

arnie

NP95

form persnum

[lus] +3psing

luz

S666

subj<verb
verb<obj
Comprehension example
State and event types
State and event types

- Arnie is *sleeping*.
State and event types

- Arnie is *sleeping*.
- The milk *froze*. 
State and event types

- Arnie is \textit{sleeping}.
- The milk \textit{froze}.
- This painting \textit{appeared} out of nowhere.
State and event types

- Arnie is **sleeping**.
- The milk **froze**.
- This painting **appeared** out of nowhere.
- Arnie **pushed** Kazuo.
State and event types

- Arnie is **sleeping**.
- The milk **froze**.
- This painting **appeared** out of nowhere.
- Arnie **pushed** Kazuo.
- Almaz is **reading**. Almaz **read** War and Peace. **Luz is singing**. Arnie and Kazuo are **playing** go.
State and event types

- Arnie is *sleeping*.
- The milk *froze*.
- This painting *appeared* out of nowhere.
- Arnie *pushed* Kazuo.
- Almaz is *reading*. Almaz *read* War and Peace. *Luz is singing*. Arnie and Kazuo are *playing* go.
- Luz *built* a chicken coop.
State and event types

- Arnie is **sleeping**.
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- Almaz is **reading**. Almaz **read** War and Peace. Luz is **singing**. Arnie and Kazuo are **playing** go.
- Luz **built** a chicken coop.
- Arnie **owns** that bike. That bike **belongs** to Arnie.
State and event types

- Arnie is *sleeping*.
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- This painting *appeared* out of nowhere.
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- I *hear* something strange. I’m *listening* to something strange.
State and event types

- Arnie is **sleeping**.
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- Luz **built** a chicken coop.
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- I **hear** something strange. I’m **listening** to something strange.
- I **smell** smoke. **Smell** this soup and let me know what you think. It **smells** funny.
State and event types

- Arnie is *sleeping*.
- The milk *froze*.
- This painting *appeared* out of nowhere.
- Arnie *pushed* Kazuo.
- Almaz is *reading*. Almaz *read* War and Peace. Luz is *singing*. Arnie and Kazuo are *playing* go.
- Luz *built* a chicken coop.
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- I *hear* something strange. I’m *listening* to something strange.
- I *smell* smoke. Smell this soup and let me know what you think. It *smells* funny.
- Luz *loves* Kazuo. Almaz *respects* Arnie. Arnie *amazes* me. The tornado *surprised* us.
State and event types

• Arnie is **sleeping**.
• The milk **froze**.
• This painting **appeared** out of nowhere.
• Arnie **pushed** Kazuo.
• Almaz is **reading**. Almaz **read** War and Peace. **Luz is singing**. Arnie and Kazuo are **playing** go.
• Luz **built** a chicken coop.
• Arnie **owns** that bike. That bike **belongs** to Arnie.
• I **hear** something strange. I’m **listening** to something strange.
• I **smell** smoke. **Smell** this soup and let me know what you think. It **smells** funny.
• Luz **loves** Kazuo. Almaz **respects** Arnie. Arnie **amazes** me. The tornado **surprised** us.
• Arnie **remembers** my name. Almaz **understands** the formula.
More general state and event types
More general state and event types

• What evidence would there be for generalization?
More general state and event types

- What evidence would there be for generalization?
  - Comprehension of novel sentences
More general state and event types

- What evidence would there be for generalization?
  - Comprehension of novel sentences
  - Production of novel sentences
More general state and event types

- What evidence would there be for generalization?
  - Comprehension of novel sentences
  - Production of novel sentences
  - Cross-linguistic similarities and differences
More general state and event types

- What evidence would there be for generalization?
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  - Production of novel sentences
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- What more general types?
More general state and event types

- What evidence would there be for generalization?
  - Comprehension of novel sentences
  - Production of novel sentences
  - Cross-linguistic similarities and differences

- What more general types?

- Or generalize about the roles of the participants?
General semantic roles

- Responsibility, control: AGENT
General semantic roles

- Responsibility, control: AGENT
- Affectedness: PATIENT
General semantic roles

- Responsibility, control: AGENT
- Affectedness: PATIENT
- Mental states, events: PERCEIVER, EXPERIENCER
General semantic roles

- Responsibility, control: AGENT
- Affectedness: PATIENT
- Mental states, events: PERCEIVER, EXPERIENCER
- Core participant that’s unaffected: THEME
General semantic roles

- Responsibility, control: AGENT
- Affectedness: PATIENT
- Mental states, events: PERCEIVER, EXPERIENCER
- Core participant that’s unaffected: THEME
- Possession, control, part-whole: POSSESSOR
General semantic roles

- Responsibility, control: AGENT
- Affectedness: PATIENT
- Mental states, events: PERCEIVER, EXPERIENCER
- Core participant that's unaffected: THEME
- Possession, control, part-whole: POSSESSOR
- Mediation: INSTRUMENT, CAUSER
General semantic roles

- Responsibility, control: AGENT
- Affectedness: PATIENT
- Mental states, events: PERCEIVER, EXPERIENCER
- Core participant that’s unaffected: THEME
- Possession, control, part-whole: POSSESSOR
- Mediation: INSTRUMENT, CAUSER
- Other animate participants: RECIPIENT, BENEFICIARY, SUFFERER
General semantic roles

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- Mental states, events: PERCEIVER, EXPERIENCER
- Core participant that’s unaffected: THEME
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- Mediation: INSTRUMENT, CAUSER
- Other animate participants: RECIPIENT, BENEFICIARY, SUFFERER
- Transfer roles: SOURCE, GOAL, PATH
General semantic roles

- Responsibility, control: AGENT
- Affectedness: PATIENT
- Mental states, events: PERCEIVER, EXPERIENCER
- Core participant that’s unaffected: THEME
- Possession, control, part-whole: POSSESSOR
- Mediation: INSTRUMENT, CAUSER
- Other animate participants: RECIPIENT, BENEFICIARY, SUFFERER
- Transfer roles: SOURCE, GOAL, PATH
- Peripheral roles: TIME, LOCATION, MANNER
Problems with semantic roles
Problems with semantic roles

• How many are there?
Problems with semantic roles

- How many are there?
- Are they really universal?
Problems with semantic roles

- How many are there?
- Are they really universal?
- Is there any way to define them?
FrameNet
FrameNet

- **Semantic frame**: a description of a type of event, relation, or entity and the participants in it
FrameNet

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- **Frame elements**: semantic roles associated with a frame; intermediate between verb-specific roles and abstract roles like AGENT and EXPERIENCER
FrameNet

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- **FrameNet lexicon, annotations**
FrameNet examples
FrameNet examples

- Giving
FrameNet examples

- Giving
  - Barney gave the beer to Moe.
FrameNet examples

- Giving
  - Barney gave the beer to Moe.
  - $300 was endowed to the university to build a new performing arts building.
FrameNet examples

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• Attend
FrameNet examples

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• Attend
  - The Angolan guerrillas will attend a September meeting in Zaire.
FrameNet examples

- **Giving**
  - Barney gave the beer to Moe.
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- **Attend**
  - The Angolan guerrillas will attend a September meeting in Zaire.
  - We just go to the movies when it rains.
FrameNet examples

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  - The Angolan guerrillas will attend a September meeting in Zaire.
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  - His attendance at the funeral did not go unnoticed.
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- Cause_to_be_wet
FrameNet examples

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- **Cause_to_be_wet**
  - Jo soaked the dog with water.
FrameNet examples

- **Giving**
  - *Barney gave the beer to Moe.*
  - *$300 was endowed to the university to build a new performing arts building.*

- **Attend**
  - *The Angolan guerrillas will attend a September meeting in Zaire.*
  - *We just go to the movies when it rains.*
  - *His attendance at the funeral did not go unnoticed.*

- **Cause_to_be_wet**
  - *Jo soaked the dog with water.*
  - *Ellen wet the sponge with water.*
FrameNet examples

• Giving
  - Barney gave the beer to Moe.
  - $300 was endowed to the university to build a new performing arts building.

• Attend
  - The Angolan guerrillas will attend a September meeting in Zaire.
  - We just go to the movies when it rains.
  - His attendance at the funeral did not go unnoticed.

• Cause_to_be_wet
  - Jo soaked the dog with water.
  - Ellen wet the sponge with water.
  - The sprinklers drenched me.
FrameNet examples
FrameNet examples

- Diversity
FrameNet examples

- Diversity
  - A range of answers were proposed.
FrameNet examples

• Diversity
  - A range of answers were proposed.
  - The songs on the album are incredibly diverse.
FrameNet examples

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- Fastener
FrameNet examples

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- Fastener
  - The door seal prevented air from getting in and the kids' screams from getting out.
FrameNet examples

- **Diversity**
  - A range of answers were proposed.
  - The songs on the album are incredibly diverse.

- **Fastener**
  - The door seal prevented air from getting in and the kids’ screams from getting out.
  - She has an antique ivory button at the front and another vintage button on her apron.
FrameNet examples

- **Diversity**
  - A range of answers were proposed.
  - The songs on the album are incredibly diverse.

- **Fastener**
  - The door seal prevented air from getting in and the kids' screams from getting out.
  - She has an antique ivory button at the front and another vintage button on her apron.
  - NIST designed a high pressure seal for the extension sleeve using a series of metal washers to load the window under pressure.
Subject and object
Subject and object

- Core participants in a state or event
Subject and object

- Core participants in a state or event
- Short-term memory limitations
Subject and object

- Core participants in a state or event
- Short-term memory limitations
  - How many things can we keep in mind while we attempt to integrate them?
Subject and object

- Core participants in a state or event
- Short-term memory limitations
  - How many things can we keep in mind while we attempt to integrate them?
- Continuum of semantic roles but a small fixed subset for each event type.
Subject and object

- Core participants in a state or event
- Short-term memory limitations
  - How many things can we keep in mind while we attempt to integrate them?
- Continuum of semantic roles but a small fixed subset for each event type.
- Language’s solution: map the semantic roles for each event type onto two syntactic roles common to all sentences (subject) or all transitive sentences (direct objects)
Subject and object

- Core participants in a state or event
- Short-term memory limitations
  - How many things can we keep in mind while we attempt to integrate them?
- Continuum of semantic roles but a small fixed subset for each event type.
- Language’s solution: map the semantic roles for each event type onto two syntactic roles common to all sentences (subject) or all transitive sentences (direct objects)
  - Indirect object common to all ditransitive sentences
Subject and object
Subject and object

• To prevent ambiguity, each language needs a way for a Hearer to distinguish subject and direct object in transitive sentences and subject, direct object, and indirect objects in ditransitive sentences.
Subject and object

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  - Constituent order: SOV, SVO, VSO, VOS
Subject and object

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  - Constituent order: SOV, SVO, VSO, VOS
  - Case marking: marking on the noun that tells what its syntactic role is (not just subject vs. direct object vs. indirect object)
Subject and object

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  - Hints on the verb
Subject and object

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  - Hints on the verb
    - Marking on the verb that gives some properties of the subject (person, number, etc.) or the object
To prevent ambiguity, each language needs a way for a Hearer to distinguish subject and direct object in transitive sentences and subject, direct object, and indirect objects in ditransitive sentences.

- **Constituent order:** SOV, SVO, VSO, VOS
- **Case marking:** marking on the noun that tells what its syntactic role is (not just subject vs. direct object vs. indirect object)
- **Hints on the verb**
  - Marking on the verb that gives some properties of the subject (person, number, etc.) or the object
  - Different verbs depending on the person, etc. of the participants
“Subject” and “object” across languages
“Subject” and “object” across languages

- Identifying subject and object across languages
“Subject” and “object” across languages

- Identifying subject and object across languages
  - Semantically: take the subject to be the constituent that refers to the AGENT in prototypical AGENT-PATIENT events (referred to as “A”), the object to be the PATIENT (referred to as “O”)
“Subject” and “object” across languages

- Identifying subject and object across languages
  - Semantically: take the subject to be the constituent that refers to the AGENT in prototypical AGENT-PATIENT events (referred to as “A”), the object to be the PATIENT (referred to as “O”)
  - Syntactically: take the subject to be the constituent that is common to transitive and intransitive sentences
“Subject” and “object” across languages

- Identifying subject and object across languages
  - Semantically: take the subject to be the constituent that refers to the AGENT in prototypical AGENT-PATIENT events (referred to as “A”), the object to be the PATIENT (referred to as “O”)
  - Syntactically: take the subject to be the constituent that is common to transitive and *intransitive* sentences
  - Three arguments: A, O, single intransitive argument (“S”)
“Subject” and “object” across languages

- Identifying subject and object across languages
  - Semantically: take the subject to be the constituent that refers to the AGENT in prototypical AGENT-PATIENT events (referred to as “A”), the object to be the PATIENT (referred to as “O”)
  - Syntactically: take the subject to be the constituent that is common to transitive and intransitive sentences
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“Subject” and “object” across languages

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Less peripheral roles, promoting, demoting
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- Adpositional phrases and adjuncts
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- Adding participants
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  - Passive: (direct/indirect) object $\rightarrow$ subject, subject $\rightarrow$ adjunct or 0
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- **Adding participants**
  - Causative