An important correction!

The midterm will cover everything we studied since the previous midterm, including writing systems and the mental lexicon!
Outline

1. Modeling meanings
   - Sentences
   - Predicates
   - Modeling connectives and determiners

2. Modification
   - Intersective adjectives
   - Gradable adjectives
   - Ordering ambiguities

Slides credit: Jessica Coon, Rebecca Starr
Recall... 

Truth conditions

To know the **meaning** of a sentence is to know the *conditions under which it is true*, known as “truth conditions”

Truth conditions are...

- ...what it would take for the sentence to be true or false, what the world would need to be like in order for the sentence to be true or false

**Note:** we don’t have to know *whether* the sentence is true or false to know its truth conditions

(1)  
a. It snowed 4 centimeters in Toronto yesterday.
b. A gallon of pure maple syrup weighs 11 pounds.
c. The smallest city park in the U.S. is in Texas.
Recall. . .

The extension and intention of a sentence

- The **intension** of a sentence = its meaning = its **truth conditions**
- The **extension** of a sentence in a given situation = its **truth value** (True or False) in that situation

This means that lots of sentences have the same extension, although they have different intensions.

- True sentences:
  - Justin Trudeau is the prime minister of Canada.
  - France is in Europe.
  - Hydrogen is the lightest element in the periodic table.
  - . . .

- False sentences:
  - It’s 2036.
  - Justin Trudeau is the president of the United States.
  - Hadas hates cats.
  - . . .
Recall.

Verification strategies

To determine the truth value of a sentence, we need to come up with a verification strategy.

A verification strategy is...

...one particular way in which we can find out whether the truth conditions of a sentence hold in a given context or situation.

How would you verify the truth value of...

- It snowed 4 centimeters in Toronto yesterday.
- The name of the student sitting closest to the front door starts with a “D.”
- There is life on Mars.
Predicates: Predicates are lexical heads with their complements (if any) —VPs

- *purr, read the newspaper, study Linguistics, watch a movie*
- *be furry, be black, be intelligent, be tall*
- *be a cat, be a student of linguistics, be a basketball player, be from Canada*
Predicates

The extension and intension of predicates

- The **intension** of a predicate = its meaning = the conditions under which it applies to entities
- The **extension** of a predicate in a given situation = the set of entities it applies to in that situation

Penguins *have wings*

- **intension**: true of an entity if and only if it has wings.
- **extension**: all the entities in the world that actually have wings.
  - chickens, robins, ostriches, hawks, mosquitoes...
  - Pegasus? airplanes? buildings?
Venn diagrams

We can use Venn diagrams to describe the entities that a predicate is true of.

![Venn Diagram](image)
Modeling sentences

Predicates

- Let’s think of the sentences:
  - (a) Cara is black
  - (b) Cara is a cat
  - (c) Cara purred

- We can think of predicates as mathematical sets of individuals.

A set is a collection of objects.

- **Purred** is the collection of all individuals who purred.
- **Black** is the collection of all black individuals.
- **Cat** is the collection of all individuals who are cats.
Let’s think about the sentences:

(a) Cara is black
(b) Cara is a cat
(c) Cara purred

We can think of predicates as mathematical **sets** of individuals.

Cara is a **member** of (or: belongs to) the set of individuals that are **black**.
Modeling sentences

Let’s think of the sentences:

(a) Cara purred
(b) Cara is black
(c) Cara is a cat

We can think of predicates as mathematical **sets** of individuals.

Cara is a **member** of (or: belongs to) the set of individuals that are **cats**.
Let’s think about the sentences:
(a) Cara purred
(b) Cara is black
(c) Cara is a cat

We can think of predicates as mathematical sets of individuals.

Cara is a member of (or: belongs to) the set of individuals that purred.
Now let’s think about the slightly more complex sentence:
Cara is a black cat

Cara is a member of the set of individuals that are black and a member of the set of individuals that are cats.

Set intersection: The set that results from collecting all the individuals that belong to two other sets.
Venn diagrams

The intersection of the predicate *have wings* and the predicate *be extinct* includes, among other things, dodos:
Modeling sentences

Predicates

- Now let’s think about the slightly more complex sentence:
  Cara is a cat or a dog

Cara is a **member** of the set of individuals that are **cats** *or* a **member** of the set of individuals that are **dogs**.

- **Set union**: The set that results from collecting all the individuals that belong to at least one of two sets.
The **union** of the predicate *have wings* and the predicate *be extinct* includes, among other things, dodos, flamingos, and golden toads:
**Venn diagrams**

This is a useful way to describe natural language **connectives**. Connectives relate entities to predicates in different ways:

**and:** Both predicates hold of a certain entity.

John is *tall* and *handsome* → John is a member of the set of *tall* entities and also a member of the set of *handsome* entities
Natural language connectives

Venn diagrams

This is a useful way to describe natural language connectives. Connectives relate entities to predicates in different ways:

(inclusive) or: At least one predicate holds of a certain entity. Mary has a dog or (has) a cat. → Mary is a member of the set of dog owners or a member of the set of cat owners (or both).
Venn diagrams

This is a useful way to describe natural language connectives. Connectives relate entities to predicates in different ways:

(exclusive) or: One predicate or the other (but not both) hold of an entity. Mary either has a dog or (has) a cat. → Mary is a member of the set of dog owners or a member of the set of cat owners (but not both).
Natural language connectives

Venn diagrams

This is a useful way to describe natural language **connectives**. Connectives relate entities to predicates in different ways:

**not:** A predicate does not hold of an entity.
Cara can **run** but not **fly**. → Cara is a member of the set of runners, but not a member of the set of fliers.
Venn diagrams
How would you diagram *but*?

Semantics is **hard** but **fun**.

*but* is logically equivalent to *and*, but it conveys an extra meaning of unexpectedness or contrast.
Venn diagrams

This is also a useful way to describe natural language **determiners**. Quantifiers relate predicates to other predicates in different ways:

**Every**: the extension of one predicate is contained within the extension of another predicate.
(every member of set A is also a member of set B)

**Every** cat hunts mice.
This is also a useful way to describe natural language **quantifiers**. Quantifiers relate predicates to other predicates in different ways:

**Some**/a: two predicates have some shared members.
(the intersection of sets A and B is non-empty)

**Some** cats are afraid of dogs.
This is also a useful way to describe natural language **quantifiers**. Quantifiers relate predicates to other predicates in different ways:

**No**: two predicates have no shared members. (the intersection of sets A and B is empty)

**No cats bark.**
Natural language quantifiers

Venn diagrams

This is also a useful way to describe natural language quantifiers. Quantifiers relate predicates to other predicates in different ways:

**Three**: two predicates have *three* shared members (by extension, other numerals would work the same). (the intersection of sets A and B contains three members)

**Three cats** are meowing.
Natural language quantifiers

Summary

- Predicates can be described as **sets of individuals**.
- Natural language **connectives** relate individuals to sets.
  - **Intersection** of two sets: an individual is a member of both sets.
  - **Union** of two sets: an individual is a member of at least one of the sets.
  - *and, or, either.. or, not, but*

- Natural language **quantifiers** express relations between sets.
  - *every, some/a, no, n(umerals)*
Modeling meanings
Modification
Intersective adjectives
Gradable adjectives
Ordering ambiguities

Recall...

Modeling adjectives

- We can describe the role of the adjective *black* using set intersection:
- It restricts the set of cats to just the part that also satisfies being black.

Cara is a black cat
Modeling meanings
Modification

Intersective adjectives
Gradable adjectives
Ordering ambiguities

Modification

Modeling adjectives

Set intersection can describe other adjectives too:

- Gianni is an Italian singer.
- T-Rex is a carnivorous dinosaur.
- This is a round ball.
- “Harry Potter” is a fascinating book.

These are called intersective adjectives.
Intersective adjectives

Intersective adjectives conform to an entailment pattern.

(2) Cara is a black cat. entails . . .
   a. Cara is black.
   b. Cara is a cat.

(recall: A entails B if whenever A is true, B is also true.)
Does the entailment pattern hold for the adjective *former*?

(3) George is a former president.

(4) a. George is a president [not valid].
   b. ?? George is former [not valid].

(recall: A entails B if whenever A is true, B is also true.)
Non-intersective adjectives

Adjectives like *former* are **non-intersective**.

(5) George is a *former* president.
(6) This is a *fake* diamond.
(7) Benedict is an *alleged* Englishman.

In fact:

(8) George is a former president. 
    a. George is not a president.
    b. George was a president in the past.
Modification

Modeling adjectives

- Some adjectives depend on the context that they appear in.

  (9)  
  a. Ella is a **tall** 3-year-old.
  b. Michael is a **short** basketball player.

  (10)  
  a. My 5-year-old nephew built a **tall** snowman.
  b. The frat boys built a **tall** snowman.

- Adjectives like **tall** are **gradable**, or **relative-intersective**.

- Other gradable adjectives include: **large, clean, sharp, safe**.

- Gradable adjectives are **scalar**. They can be modified with adverbs:
  “extremely short”, “kind of short”, “pretty tall”, “very tall”, etc.

  \[ \text{short} \longleftrightarrow \text{tall} \]
Modification

Antonyms

- Adjectives often come in **antonym** pairs: tall–short, dirty–clear, …
- You can also be in-between: neither tall nor short.

In contrast, **complementary** antonyms are not gradable: you are either completely A or completely B:

- dead vs. alive
- true vs. false
- pass vs. fail

Although we can still coerce modification and understand what the sentence would mean.

- That’s completely false.
- He is barely alive.
Modification

Stacked adjectives

- We can use multiple adjectives to describe one noun.
- In some cases, this has no effect on meaning.

  (11) a. A red silk shirt  
b. A silk red shirt

- In other cases, there does seem to be a difference in meaning.
- Which shirt is which?

  (12) a. A small large shirt  
b. A large small shirt

- The adjective nearest the noun determines the context for the comparison. The outer adjective provides further modification.
Stacked adjectives

Do we know if the person in (13a) is English? How about in (13b)?

(13)  a. An alleged English baron — not English
     b. An English alleged baron — English

Is the person in each case a baron?
Stacked adjectives

What kind of answers does (14a) refer to? How about (14b)?

(14)  a. A common wrong answer
       — an answer that is frequent among the wrong answers
       (but could be infrequent in general)

   b. A wrong common answer
       — an answer that is frequently given in general, and is also wrong
Adjectives can appear either before or after the noun. In that case, we might need to use brackets (or trees) to represent the structure.

(15) a. An [[expensive table] made of plastic]
    b. An [expensive [table made of plastic]]

Suppose that tables normally cost $200, and plastic tables cost $50.

How much would the tables in (15a) and (15b) cost?
Modification

Summary

- **Intersective adjectives** can be described using set intersection. They conform to an entailment pattern:
  - *Cara is a black cat* entails: Cara is black and Cara is a cat.

- **Non-intersective adjectives** do not conform to the entailment pattern:
  - *This is a fake diamond* does not entail: this is a diamond.

- **Gradable adjectives** depend on the context that they are interpreted in.
  - *A tall 5-year-old* vs. *a tall basketball player*.

- **Antonym** pairs can be **gradable** or **complementary**.
  - *tall* vs. *short*.
  - *correct* vs. *incorrect*. 
For next time...

- **Assignment 5** due today!
- **Read:** Parker & Riley, chapter 2 (pages 4-25), in course pack.