

CS1800

9/19 - Tues.

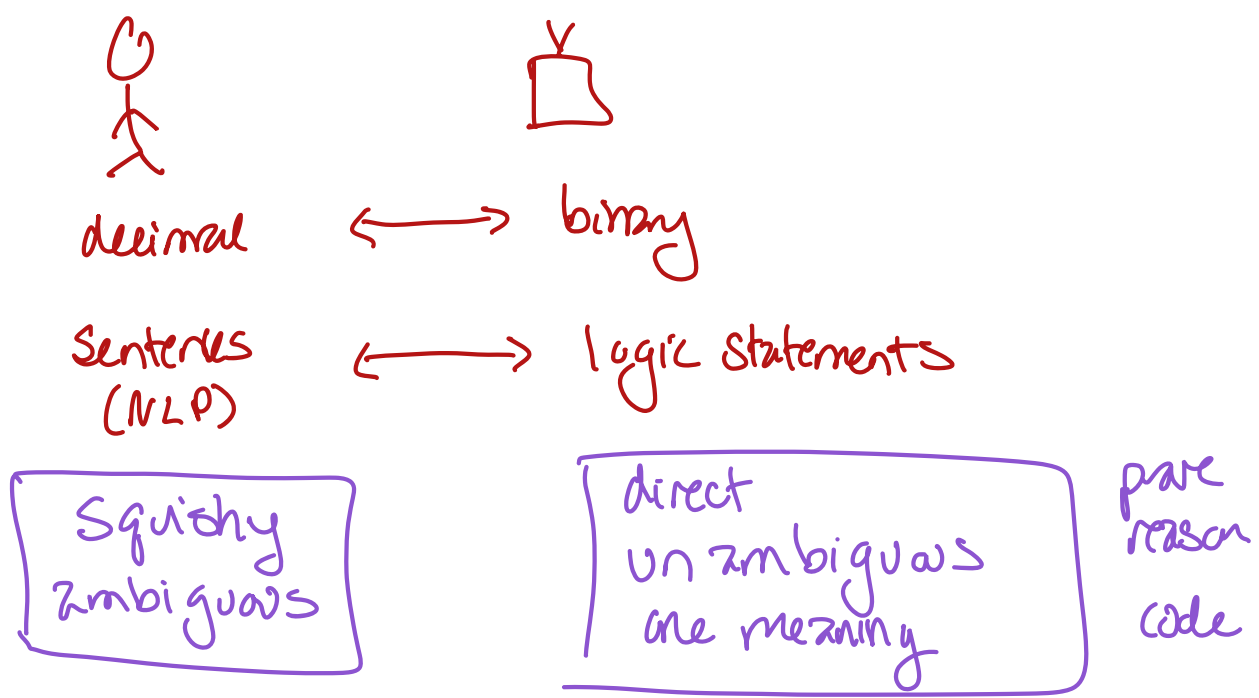
Admin

- HW1 due Fri 11:59
- OH online/in person
- notes on website
- live Q+A on piazza

Agenda

1. Logic statements + operators
2. Truth table
3. Implications (aka "conditionals")

1. Logic Statements



- computers have 0/1
 ↳ False / True

- logic statement
 - declarative
 - has a truth value (T/F)
 - usually labelled P, Q, R, ...

ex

	<u>decl?</u>	<u>truth val?</u>
• There is <u>life</u> on mars	✓	✓
• $4 + 2 = 6$	✓	✓
• $x + 2 = 6$	✓	⋮ x?

• Bostonians love Antin ✓



||
|
~

nick
Bostonians

• when is Hw due?

||
|
~

↳ Simple statements

- one thing
- one truth value

Compound Statement - more common

- combine ~~to~~ one or more simple statements
- use logical operators ...

↳ not, and, or
...
...

all that's
needed!

ex's with operators

$P = -2 \leq -2$ (T) \rightarrow logic statement

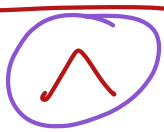
negation/not (¬)

$\neg P$ is the negation of P

↳ P and $\neg P$ have complementary truth values

$\neg P = -2 > -2$ (F)

And



$P = \text{Lancy is an Aries}$

$Q = \text{Lancy is a Horse}$

$P \wedge Q$

- P has a truth value
- Q has a truth value
- $P \wedge Q$ has a truth value

True
↳ False when $P, Q,$ or both are false
otherwise True

Or \checkmark

P = Kayla \heartsuit Cooper

Q = Kayla \heartsuit Sarge

P \vee Q


- P has a truth value
- Q has a truth value
- $P \vee Q$ has a truth value
 - \hookrightarrow True when P, Q, or both are True
 - False otherwise

2. Truth tables

- specify value of a compound statement, when it depends on values of simple statements
- also: mini proof to show 2 compound statements are equivalent
- one column = one step
- start with inputs of simple statements


negation

<u>P</u>	<u>$\neg P$</u>
T	F
F	T

input 

and

<u>P</u>	<u>Q</u>	<u>$P \wedge Q$</u>
T	T	T
T	F	F
F	T	F
F	F	F

inputs 

or

	P	Q	$P \vee Q$
inputs	T	T	T
	T	F	T
	F	T	T
	F	F	F

10:48

P	Q
T	T
T	F
F	T
F	F

$\neg(P \wedge Q)$	$\neg P \vee \neg Q$

P
T
T
F
F

Q
T
F
T
F

$P \wedge Q$
T
F
F
F

$\neg(P \wedge Q)$
F
T
T
T

$\neg P$
F
F
T
T

$\neg Q$
F
T
F
F

$\neg P \vee \neg Q$
F
T
T
T

- Compound statements have same truth values for all inputs

$$\neg (P \wedge Q) \equiv \neg P \vee \neg Q$$

De Morgan's law

3. Implications (conditionals)

- and/or/not are the only logical operators we need
- other operators exist for convenience!

$P \Rightarrow Q$ P implies Q
if P , then Q



↳ respect the original statement

English statement: if Aces win championship, Lanny gets \$

$P =$ Aces win champs

$Q =$ Lanny gets \$

$P \Rightarrow Q$

<u>P</u>	<u>Q</u>	<u>$P \Rightarrow Q$</u>
T	T	T
T	F	F
F	T	T
F	F	T

English Statement:

We get cake if it's my birthday

P = we get cake

Q = It's my birthday

<u>P</u>	<u>Q</u>	<u>Q</u> \Rightarrow <u>P</u>
T	T	T
T	F	F
F	T	T
F	F	T

$P \Leftrightarrow Q$?

Fill in truth values

(Don't worry about implication)

P = we get cake

Q = it's my birthday

P Q

T T

T F

F T

F F

We get cake
only if it's
my birthday

We get cake
if and only if
it's my birthday

cake today $P \Rightarrow Q$

<u>P</u>	<u>Q</u>	<u>only if</u>
T	T	T
T	F	F
F	T	T
F	F	T

<u>if and only if</u>
T
F
F
T

$$(P \Rightarrow Q) \wedge (Q \Rightarrow P)$$

$P \Leftrightarrow Q$
 Bi conditional

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