Announcements & Such

- *Funkadelic*: Selections from *Maggot Brain* (it's funk week).
- Administrative Stuff
  - **HW #1 re-submissions are due on Today (4pm, drop box).**
    - You can just re-circle the correct answers on your original sheet.
  - ☞ **Homework formatting. Please put the following information:**
    - **Name, GSI, section time, and date.**

    on all assignments and exams (upper-right corner of first page).
  - The In–Class Mid-term has been moved up 1 week (to March 11).
  - **HW #2 has been posted — 1st-sub due next Thursday.**
    - Note: This involves problems from chapters 2 and 3.
- Chapter 2 — LSL Symbolizations of English Sentences & Arguments
- Next: Chapter 3 — *Truth-Functional Semantics* for LSL

English $\mapsto$ LSL II ($\sim$, &, $\leftrightarrow$): Example #2

- 'If, but only if, they have made no commitment to the contrary, may reporters reveal their sources, but they always make such a commitment and they ought to respect it.'
  - Step 0: Decide on atomic sentences and letters.

    S: Reporters may reveal their sources.

    C: Reporters have made a commitment to protect their sources.

    R: Reporters ought to respect their commitment to protect sources.
  - Step 1: Substitute into English, yielding "Logish":

    If, but only if, it is not the case that C, then S, but C and R.
  - Step 2: make the transition into LSL (in stages as well, perhaps):

    S iff not C, but C and R.

    Final Product: $(S \leftrightarrow \sim C) \,\&\, (C \,\&\, R)$

English $\mapsto$ LSL II ($\sim$, &, $\vee$, $\rightarrow$, $\leftrightarrow$): Example #3

- 'Sara is going unless either Richard or Pam is going, and Sara is not going if, and only if, neither Pam nor Quincy are going.'
  - Step 0: Decide on atomic sentences and letters.

    P: Pam is going. Q: Quincy is going.

    R: Richard is going. S: Sam is going.
  - Step 1: Substitute into English, yielding "Logish":

    S unless either R or P, and not S iff neither P nor Q.
  - Step 2: Make the transition into LSL (in stages again):

    S unless $(R \vee P)$, and $\sim S$ iff $(\sim P \,\&\, \sim Q)$

    $(\sim(R \vee P) \rightarrow S) \,\&\, (\sim S \leftrightarrow (\sim P \,\&\, \sim Q))$
- It is also acceptable to replace the 'unless' with '$\vee$', yielding:

  $(S \vee (R \vee P)) \,\&\, (\sim S \leftrightarrow (\sim P \,\&\, \sim Q))$

English $\mapsto$ LSL VIII: Some More Problems to Try

- A Bunch of LSL Symbolization Problems:

1. California does not allow smoking in restaurants.
2. Jennifer Lopez becomes a superstar given that *I'm Real* goes platinum.
3. Mary-Kate Olsen does not appear in a movie unless Ashley does.
4. Either the President supports campaign reform and the House adopts universal healthcare or the Senate approves missile defense.
5. Neither Mylanta nor Pepcid cures headaches.
6. If Canada subsidizes exports, then if Mexico opens new factories, then the United States raises tariffs.
7. If Iraq launches terrorist attacks, then either Peter Jennings or Tom Brokaw will report them.
8. Tom Cruise goes to the premiere provided that Penelope Cruz does,

but Nicole Kidman does not.

9. It is not the case that either Bart and Lisa do their chores or Lenny and Karl blow up the power plant.
10. N'sync winning a grammy is a sufficient condition for the Backstreet Boys to be jealous, only if Destiny's Child getting booed is a necessary condition for TLC's being asked to sing the anthem.
11. Dominos' delivers for free if Pizza Hut adds new toppings, provided that Round Table airs more commercials.
12. If evolutionary biology is correct, then higher life forms arose by chance, and if that is so, then it is not the case that there is any design in nature and divine providence is a myth.
13. Kathie Lee's retiring is a necessary condition for Regis's getting a new co-host; moreover, Jay Leno's buying a motorcycle and David Letterman's telling more jokes imply that NBC's airing more talk shows is a sufficient condition for CBS's changing its image.

Symbolizing/*Reconstructing* Entire English Arguments

- Naïvely, an argument is "just a collection of sentences". So, naïvely, one might think that symbolizing arguments should just boil down to symbolizing a bunch of individual sentences. It's not so simple.
- An argumentative passage has more structure than an individual sentence. This makes argument *reconstruction* more subtle.
- We must now make sure we capture the inter-relations of content across the various sentences of the argument.
- To a large extent, these interrelations are captured by a judicious choice of atomic sentences for the reconstruction.
- It is also crucial to keep in mind the overall intent of the argumentative passage — the intended argumentative strategy.
- Forbes glosses over the art of (charitable!) argument reconstruction. I will be a bit more explicit about this today in some examples.

Symbolizing Entire Arguments: Example #1

- 'If God exists, then there is no evil in the world unless God is unjust, or not omnipotent, or not omniscient. But, if God exists then He is none of these, and there is evil in the world. So, we must conclude that God does not exist.'
- Step 0: Decide on atomic sentences and letters.

  G: God exists. *E*: There is evil in the world.
  J: God is just. *O*: God is omnipotent.
  K: God is omniscient.
- Step 1: Identify (and symbolize) the *conclusion* of the argument:
  - 'God does not exist.' (which is just '$\sim G$' in LSL)
- Step 2: Symbolize the premises (in this case, there are two):
  - Premise #1: 'If God exists, then there is no evil in the world unless God is unjust, or not omnipotent, or not omniscient.'

Symbolizing Arguments: Example #1 (Cont'd)

- Premise #1: 'If God exists, then there is no evil in the world unless God is unjust, or not omnipotent, or not omniscient.'

  If G, then ($\sim E$ unless ($\sim J$ or ($\sim O$ or $\sim K$)))

  $G \rightarrow (\sim E \vee (\sim J \vee (\sim O \vee \sim K)))$

- Premise #2: 'If God exists then He is none of these (*i.e.*, He is *neither* unjust *nor*…), and there is evil in the world.'

  If G, then not not-J and not not-O and not not-K, and E.

  $[G \rightarrow (\sim\sim J \;\&\; (\sim\sim O \;\&\; \sim\sim K))] \;\&\; E$

- This yields the following (valid!) sentential form:

$$G \rightarrow (\sim E \vee (\sim J \vee (\sim O \vee \sim K)))$$

$$[G \rightarrow (\sim\sim J \;\&\; (\sim\sim O \;\&\; \sim\sim K))] \;\&\; E$$

$$\therefore \sim G$$

Symbolizing Arguments: Example #1 Notes

- The sentential form:

  $G \rightarrow ({\sim}E \vee ({\sim}J \vee ({\sim}O \vee {\sim}K)))$

  $[G \rightarrow ({\sim}{\sim}J \,\&\, ({\sim}{\sim}O \,\&\, {\sim}{\sim}K))]$

  E

  $\therefore {\sim}G$

  with *three* premises is *equivalent* to the *two*-premise sentential form we wrote down originally (why?).

- Alternative for premise #1: '$G \rightarrow \{{\sim}[{\sim}J \vee ({\sim}O \vee {\sim}K)] \rightarrow {\sim}E\}$'.

- Moreover, if we had written '$({\sim}{\sim}K \,\&\, ({\sim}{\sim}J \,\&\, {\sim}{\sim}O))$' rather than '$({\sim}{\sim}J \,\&\, ({\sim}{\sim}O \,\&\, {\sim}{\sim}K))$' in premise #2, we would have ended-up with yet another *equivalent* sentential form (why?).

- All of these forms capture the meaning of the premises and conclusion, and all are close to the given form. So, all are OK.

Symbolizing Arguments: Example #1 More Notes

- Premise #1: If God exists, then there is no evil in the world unless God is unjust, or not omnipotent, or not omniscient.
- Two Questions: ① Why render this as (*i*) $\ulcorner p \rightarrow (q \text{ unless } r)\urcorner$, as opposed to (*ii*) $\ulcorner (p \rightarrow q) \text{ unless } r\urcorner$? ② *Does it matter* (*semantically*)?

① First, there's no comma after 'world'. Second, (*i*) is probably *intended*. The second answer assumes (*i*) and (*ii*) are *not* equivalent *in English*.

- That *may* be right, but it's not clear. It presupposes two things:
  (1) *In English*, $\ulcorner q$ unless $r\urcorner$ is equivalent to $\ulcorner$If not r, then $q\urcorner$.
  (2) *In English*, $\ulcorner$If p, then (if q then r)$\urcorner$ [*i.e.*, $\ulcorner p \rightarrow (q \rightarrow r)\urcorner$] is *not* equivalent to $\ulcorner$If (p and q), then $r\urcorner$ [*i.e.*, $\ulcorner (p \,\&\, q) \rightarrow r\urcorner$].
- We're *assuming* (1) in this class. (2) is controversial (but defensible).

② In LSL, (*i*) and (*ii*) *are equivalent*, *i.e.*, *in LSL* (2) is *false*. Thus, it seems to me that both readings are probably OK. This is a subtle case.

Symbolizing Arguments: Example #2

If Yossarian flies his missions then he is putting himself in danger, and it is irrational to put oneself in danger. If Yossarian is rational he will ask to be grounded, and he will be grounded only if he asks. But only irrational people are grounded, and a request to be grounded is proof of rationality. Consequently, Yossarian will fly his missions whether he is rational or irrational.

- Basic Sentences: Yossarian flies his missions (F), Yossarian puts himself in danger (D), Yossarian is rational (R), Yosarian asks to be grounded (A).
- Premise #1: If F then D, and if D then not R. $[(F \to D) \,\&\, (D \to \sim R)]$
- Premise #2: If R then A, and not F only if A. $[(R \to A) \,\&\, (\sim F \to A)]$
- Premise #3: But not F only if not R, and A implies R. $[(\sim F \to \sim R) \,\&\, (A \to R)]$
- Conclusion: Consequently, F whether R or not R. $[(R \to F) \,\&\, (\sim R \to F)]$. [Alternatively, the conclusion could be symbolized as: '$(R \vee \sim R) \to F$']
- Note: this is a valid form (we'll be able to prove this pretty soon).

Symbolizing Arguments: Example #3

Suppose no two contestants enter; then there will be no contest. No contest means no winner. Suppose all contestants perform equally well. Still no winner. There won't be a winner unless there's a loser. And conversely. Therefore, there will be a loser only if at least two contestants enter and not all contestants perform equally well.

- Step 0: Decide on atomic sentences and letters.

  T: At least two contestants enter. C: There is a contest.

  E: All contestants perform equally well.

  W: There is a winner. L: There is a loser.

- Step 1: Identify (and symbolize) the *conclusion* of the argument:
  - Conclusion: There will be a loser only if at least two contestants enter and not all contestants perform equally well.
    - ∗ "Logish": L only if T and not E.
    - ∗ LSL: '$L \rightarrow (T \,\&\, \sim E)$'. [Why not '$(L \rightarrow T) \,\&\, \sim E$'?]

- Step 2: Symbolize the premises (here, there are as many as five):

  (1) Suppose no two contestants enter; then there will be no contest.
  - “Logish”: Suppose that not T; then it is not the case that C.
  - LSL: ‘$\sim T \rightarrow \sim C$’.

  (2) No contest means no winner.
  - “Logish”: Not C means not W. [*i.e.*, not C *implies* not W.]
  - LSL: ‘$\sim C \rightarrow \sim W$’.

  (3) Suppose all contestants perform equally well. Still no winner.
  - “Logish”: Suppose E. Still not W. [*i.e.*, E *also* implies not W.]
  - LSL: ‘$E \rightarrow \sim W$’.

  (4) There won’t be a winner unless there’s a loser. And conversely.
  - “Logish”: Not W unless L, *and conversely*.
  - LSL: ‘$(\sim L \rightarrow \sim W) \,\&\, (\sim W \rightarrow \sim L)$’. [*i.e.*, not W *iff* not L.]

- The final product is the following *valid* sentential form:
  $\sim T \rightarrow \sim C$. $\sim C \rightarrow \sim W$. $E \rightarrow \sim W$. $\sim L \leftrightarrow \sim W$. Therefore, $L \rightarrow (T \,\&\, \sim E)$.

A Few Final Remarks on Symbolizing Arguments

- We saw the following premise our last argument: 'There won't be a winner unless there's a loser. And conversely.' I symbolized it as:
  - "Logish": If not L, then not W, *and conversely*. [*i.e.*, not L *iff* not W.]
  - LSL: '$\sim L \leftrightarrow \sim W$', *equivalently*: '$(\sim L \rightarrow \sim W) \,\&\, (\sim W \rightarrow \sim L)$'.
- One might wonder why I didn't interpret the "and conversely" to be operating on the *unless* operator itself, rather than the *conditional* operator. This would yield the following *different* symbolization:
  - "Logish": not W unless L, and L unless not W.
  - LSL: '$(\sim L \rightarrow \sim W) \,\&\, (\sim\sim W \rightarrow L)$', *equivalently*: '$(\sim L \rightarrow \sim W) \,\&\, (W \rightarrow L)$'.
- Answer: This is a *redundant* symbolization in LSL, since '$\sim L \rightarrow \sim W$' *is equivalent to* '$W \rightarrow L$'. Moreover, the resulting argument *isn't* valid.
- **Principle of Charity**. If an argument $\mathscr{A}$ has two *plausible but semantically distinct* LSL symbolizations (where neither is *obviously* preferable) — and *only one of them is valid — choose the valid one*.

Chapter 3 — Semantics of LSL: Truth Functions I

- The semantics of LSL is *truth-functional* — the truth value of a compound statement is a function of the truth values of its parts.
- Truth-conditions for each of the five LSL statement forms are given by *truth tables*, which show how the truth value of each type of complex sentence depends on the truth values of its constituent parts.
- Truth-tables provide a very precise way of thinking about *logical possibility*. Each row of a truth-table can be thought of as a *way the world might be*. The actual world falls into *exactly one* of these rows.
- In this sense, truth-tables provide a way to "see" "logical space."
- Truth-tables will also provide us with a rigorous way to establish whether an argument form in LSL is valid (*i.e.*, sentential validity).
- We just look for rows of a salient truth-table in which all the premises are true and the conclusion is false. That's where we're headed.

Chapter 3 — Semantics of LSL: Truth Functions II

- We begin with negations, which have the simplest truth functions. The truth table for negation is as follows (we use $\top$ and $\bot$ for true and false):

p	$\sim p$
$\top$	$\bot$
$\bot$	$\top$

- In words, this table says that if p is true than $\sim p$ is false, and if p is false, then $\sim p$ is true. This is quite intuitive, and corresponds well to the English meaning of 'not'. Thus, LSL negation is like English negation.
- Examples:
  - It is not the case that Wagner wrote operas. ($\sim W$)
  - It is not the case that Picasso wrote operas. ($\sim P$)
- '$\sim W$' is false, since 'W' is true, and '$\sim P$' is true, since 'P' is false (like English).

Chapter 3 — Semantics of LSL: Truth Functions III

p	q	$p \& q$
⊤	⊤	⊤
⊤	⊥	⊥
⊥	⊤	⊥
⊥	⊥	⊥

- Notice how we have four (4) rows in our truth table this time (not 2), since there are four possible ways of assigning truth values to p and q.
- The truth-functional definition of & is very close to the English ‘and’. A LSL conjunction is true if *both* conjuncts are true; it’s false otherwise.
  - Monet and van Gogh were painters. ($M \& V$)
  - Monet and Beethoven were painters. ($M \& B$)
  - Beethoven and Einstein were painters. ($B \& E$)
- ‘$M \& V$’ is true, since both ‘M’ and ‘V’ are true. ‘$M \& B$’ is false, since ‘B’ is false. And, ‘$B \& E$’ is false, since ‘B’ and ‘E’ are both false (like English).

Chapter 3 — Semantics of LSL: Truth Functions IV

p	q	$p \vee q$
⊤	⊤	⊤
⊤	⊥	⊤
⊥	⊤	⊤
⊥	⊥	⊥

- Our truth-functional $\vee$ is not as close to the English 'or'. An LSL disjunction is true if *at least one* disjunct is true (false otherwise).
- In English, '*A* or *B*' often implies that '*A*' and '*B*' are *not both true*. That is called *exclusive* or. In LSL, '$A \vee B$' is *not* exclusive; it is *inclusive* (true if both disjuncts are true). But, we *can* express exclusive or in LSL. How?
  - Either Jane austen or René Descartes was novelist. ($J \vee R$)
  - Either Jane Austen or Charlotte Bronte was a novelist. ($J \vee C$)
  - Either René Descartes or David Hume was a novelist. ($R \vee D$)
- The first two disjunctions are true because at least one their disjuncts is true, but the third is false, since both of its disjuncts are false.

Chapter 3 — Semantics of LSL: Truth Functions V

p	q	$p \rightarrow q$
⊤	⊤	⊤
⊤	⊥	⊥
⊥	⊤	⊤
⊥	⊥	⊤

- Our truth-functional → is farther from the English 'only if'. An LSL conditional is false iff its antecedent is true and its consequent is false.
- Consider the following English conditionals. [M = 'the moon is made of green cheese', O = 'life exists on other planets', and E = 'life exists on Earth']
  - If the moon is made of green cheese, then life exists on other planets.
  - If life exists on other planets, then life exists on earth.
- The LSL translations of these sentences are both true. '$M \rightarrow O$' is true because its antecedent 'M' is false. '$O \rightarrow E$' is true because its consequent 'E' is true. This seems to deviate from the English 'if'.

  [Soon, we'll *prove* the following *equivalence*: $\ulcorner p \rightarrow q \urcorner \mathrel{\dashv\vDash} \ulcorner {\sim} p \vee q \urcorner$.]

Chapter 3 — Semantics of LSL: Truth Functions VI

p	q	$p \leftrightarrow q$
$\top$	$\top$	$\top$
$\top$	$\bot$	$\bot$
$\bot$	$\top$	$\bot$
$\bot$	$\bot$	$\top$

- Our truth-functional $\leftrightarrow$ is also farther from the English ‘if and only if’. An LSL biconditional is true iff both sides have the same truth value.
- Consider these two biconditionals. [M = ‘the moon’s made of green cheese’, U = ‘there are unicorns’, E = ‘life exists on Earth’, and S = ‘the sky is blue’]
  - The moon is made of green cheese if and only if there are unicorns.
  - Life exists on earth if and only if the sky is blue.
- The LSL translations of these sentences are true. $M \leftrightarrow U$ is true because M and U are false. $E \leftrightarrow S$ is true because E and S are true. This seems to deviate from the English ‘iff’. Soon, we’ll *prove* the following:

$$\ulcorner p \leftrightarrow q \urcorner \dashv\vDash \ulcorner (p \,\&\, q) \vee (\sim p \,\&\, \sim q) \urcorner$$