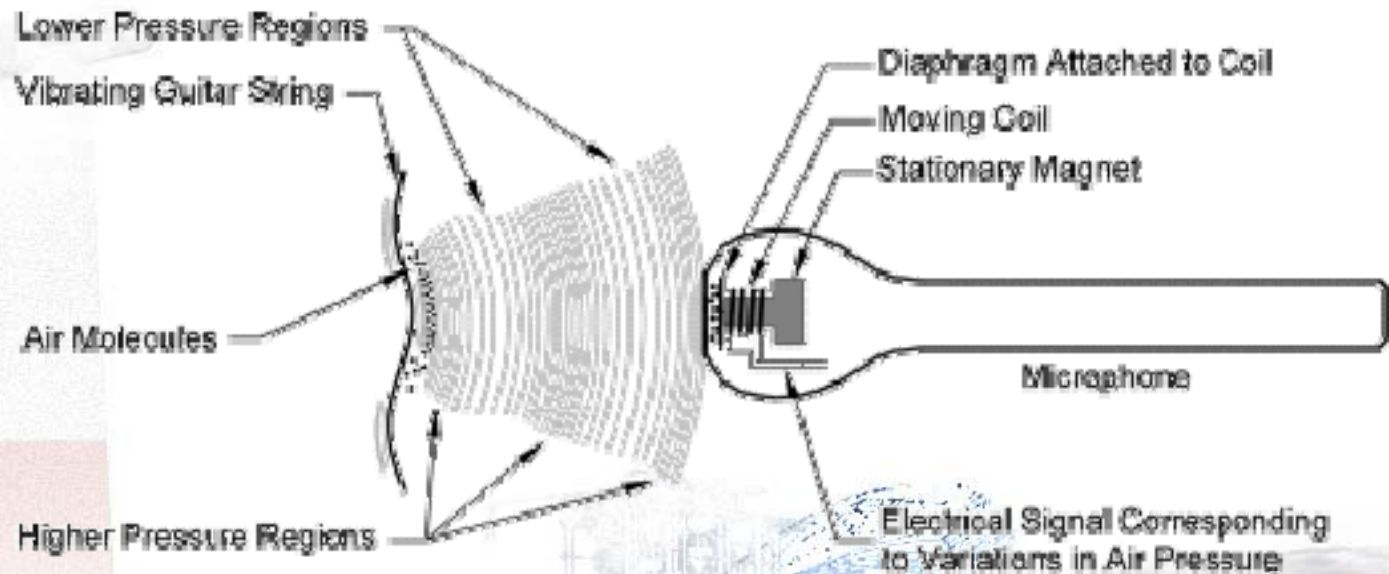


Sound

- **Sound Waves**
 - Rapidly varying waves of air pressure caused by a vibrating object
 - E.g. guitar string pushing air molecules
 - Repeating cycles of higher and lower pressure
 - Frequency (pitch) is number of times per second cycles occur
 - Measured in Hertz (Hz)
 - Amplitude (intensity) is the size of variations



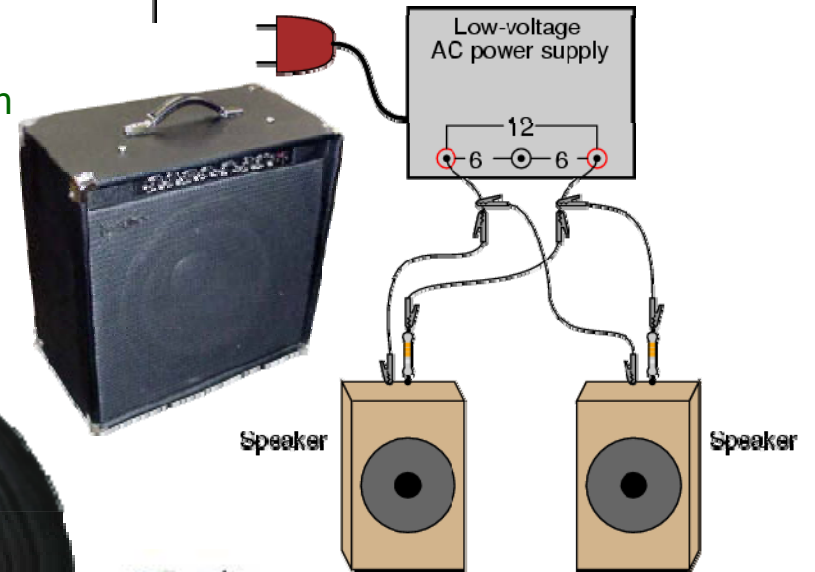
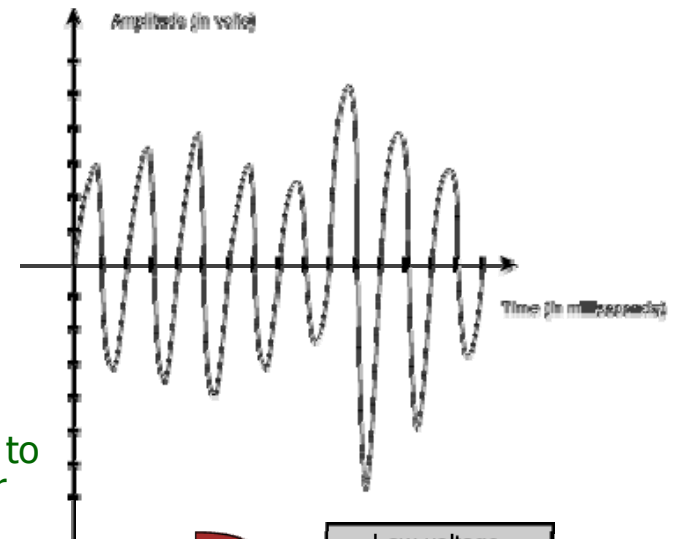
The Mp3 and Internet Audio Handbook, Bruce Fries

<http://www.teamcombooks.com/mp3handbook/>

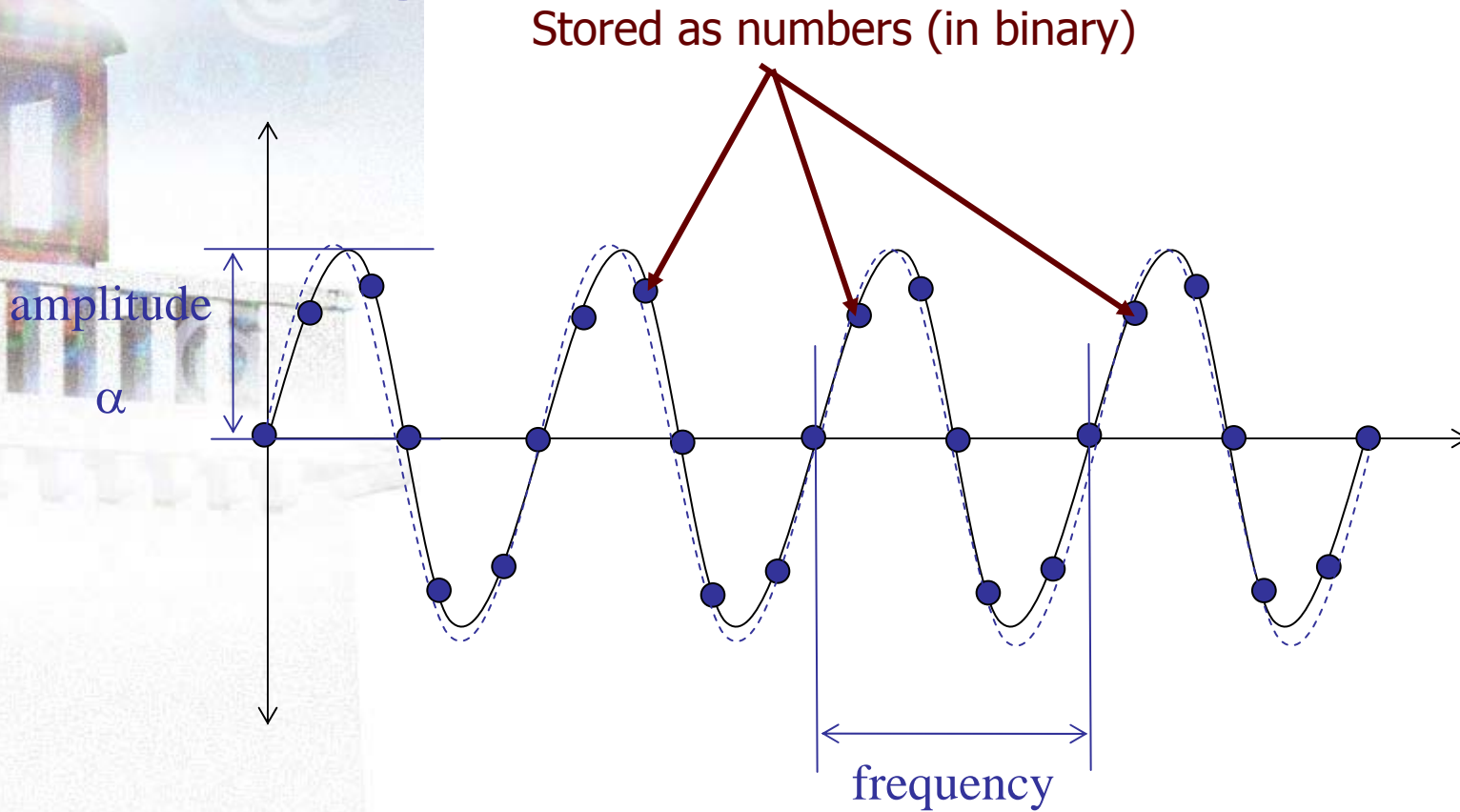
Luis M.Rocha and Santiago Schnell

Analog Sound

- **Sound Waves**
 - Represented as varying voltage
 - E.g. produced by a microphone
 - Analogous to pressure variations of sound
 - Vinyl
 - Variations in the width of the groove correspond to voltage variations which in turn correspond to air pressure variations (sound)
 - **Amps**
 - Amplify voltage variations to sound waves in loudspeakers



Sampling



- Sampling via an analog-to-digital converter (ADC)
- Converted to voltage via digital-to-analog converter (DAC)

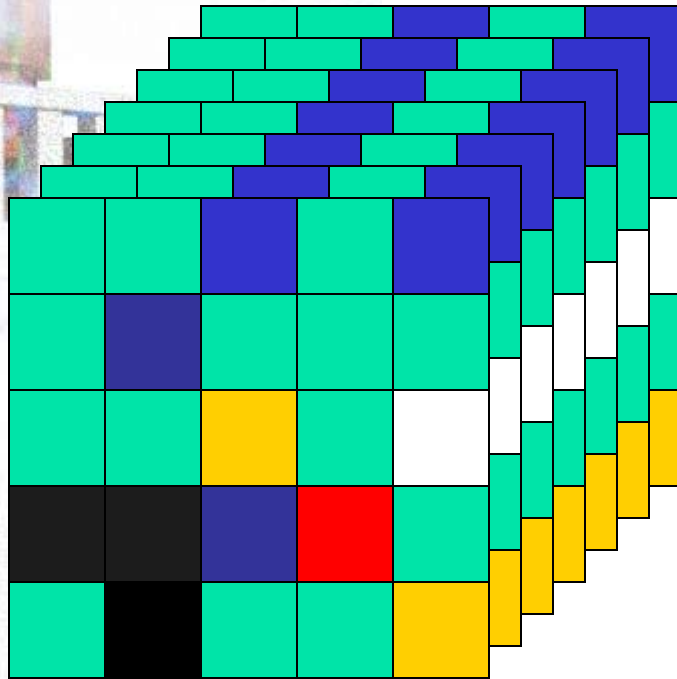
Adapted from Cathy Wyss (I308)

Compressing Audio

- Lossless data compression
 - Eliminates redundancy
 - E.g. Zip archives, FLAC
 - Up to $\sim 50\%$
- Lossy Data Compression
 - The restored data is degraded, but “close enough”
 - Up to $\sim 95\%$ or more
 - Mp3: *MPEG-1/2 Audio Layer 3*
 - Developed in Europe (Fraunhofer Society)
 - Uses a hybrid transform from a time to a frequency domain
 - 112...128 kbit/s, compression 10:1...12:1
 - excellent at 224...320 kbit/s, very good at 192...224 kbit/s, good at 128...192 kbit/s

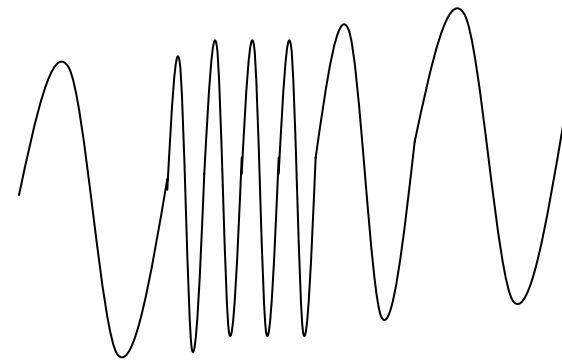


Video



frames

+



sound



Luis M.Rocha and Santiago Schnell

Adapted from Cathy Wyss (I308)

Video

- Data is the same as image and audio, but in huge amounts!
 - Resolution 640 x 480 pixel in RGB true color (16 million colors) at a *frame rate* of 30 frames per second
 - $640 \times 480 \times 3 \text{ bytes} \times 30 \text{ fmps} = 27.56 \text{ Mbytes per second!}$
 - MPEG-2 is a compression algorithm
 - 30-40 Mbytes per minute
 - Used in DVDs with some modification and in HDTV
 - Real Video, Quicktime, WMF, Indeo

Introduction to Informatics

Lecture 12: Classical Logic



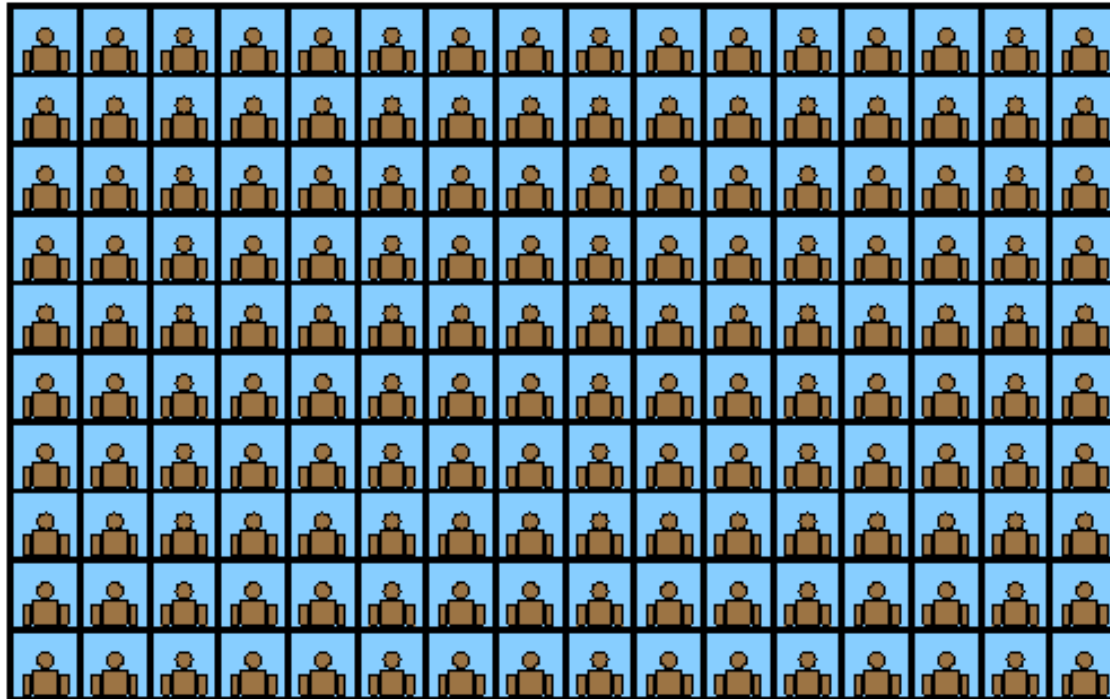
USING LOGIC AND REASON,
ERNEST AND WENDELL SETTLE A
RULES INTERPRETATION DISPUTE
AT WEDNESDAY NIGHTS GAME.

Readings until now

- Lecture notes
 - Posted online
 - <http://informatics.indiana.edu/rocha/i101>
 - *The Nature of Information*
 - *Technology*
 - *Modeling the World*
 - @ *infoport*
 - <http://infoport.blogspot.com>
 - From course package
 - Von Baeyer, H.C. [2004]. *Information: The New Language of Science*. Harvard University Press.
 - Chapters 1, 4 (pages 1-12)
 - From Andy Clark's book "*Natural-Born Cyborgs*"
 - Chapters 2 and 6 (pages 19 - 67)
 - From Irv Englander's book "*The Architecture of Computer Hardware and Systems Software*"
 - Chapter 3: Data Formats (pp. 70-86)
 - Klir, J.G., U. St. Clair, and B.Yuan [1997]. *Fuzzy Set Theory: foundations and Applications*. Prentice Hall
 - Chapter 2: Classical Logic (pp. 87-98)



NO LAB THIS WEEK !!!



Assignment Situation

- Labs

- Past

- Lab 1: Blogs
 - Closed (Friday, January 19): Grades Posted
- Lab 2: Basic HTML
 - Closed (Wednesday, January 31): Grades Posted
- Lab 3: Advanced HTML: Cascading Style Sheets
 - Closed (Friday, February 2): Grades Posted
- Lab 4: More HTML and CSS
 - Closed (Friday, February 9): Grades Posted
- Lab 5: Introduction to Operating Systems: Unix
 - Closed (Friday, February 16): Being graded
- Lab 6: More Unix and FTP
 - Due Friday, February 23

- Next: Lab 7

- Intro to Statistical Analysis using Excel
 - March 1 and 2, due Friday, March 9

- Assignments

- Individual

- First installment
 - Closed: February 9: Grades Posted
- Second Installment
 - Due: March: 2nd

- Group Project

- First installment
 - Presented: March 6, Due: March 9th

Midterm Exam

- March 1st (Thursday)



Get a Group!

Individual assignment

- Individual Project
 - 1st installment
 - Presented: February 1st
 - Due: February 9th
 - 2nd Installment
 - Presented: February 15th
 - Due: March: 2nd
 - 3rd Installment
 - Presented: March 8th
 - Due: March 30th
 - 4th Installment
 - Presented: April 5th
 - Due: April 20th

The Black Box

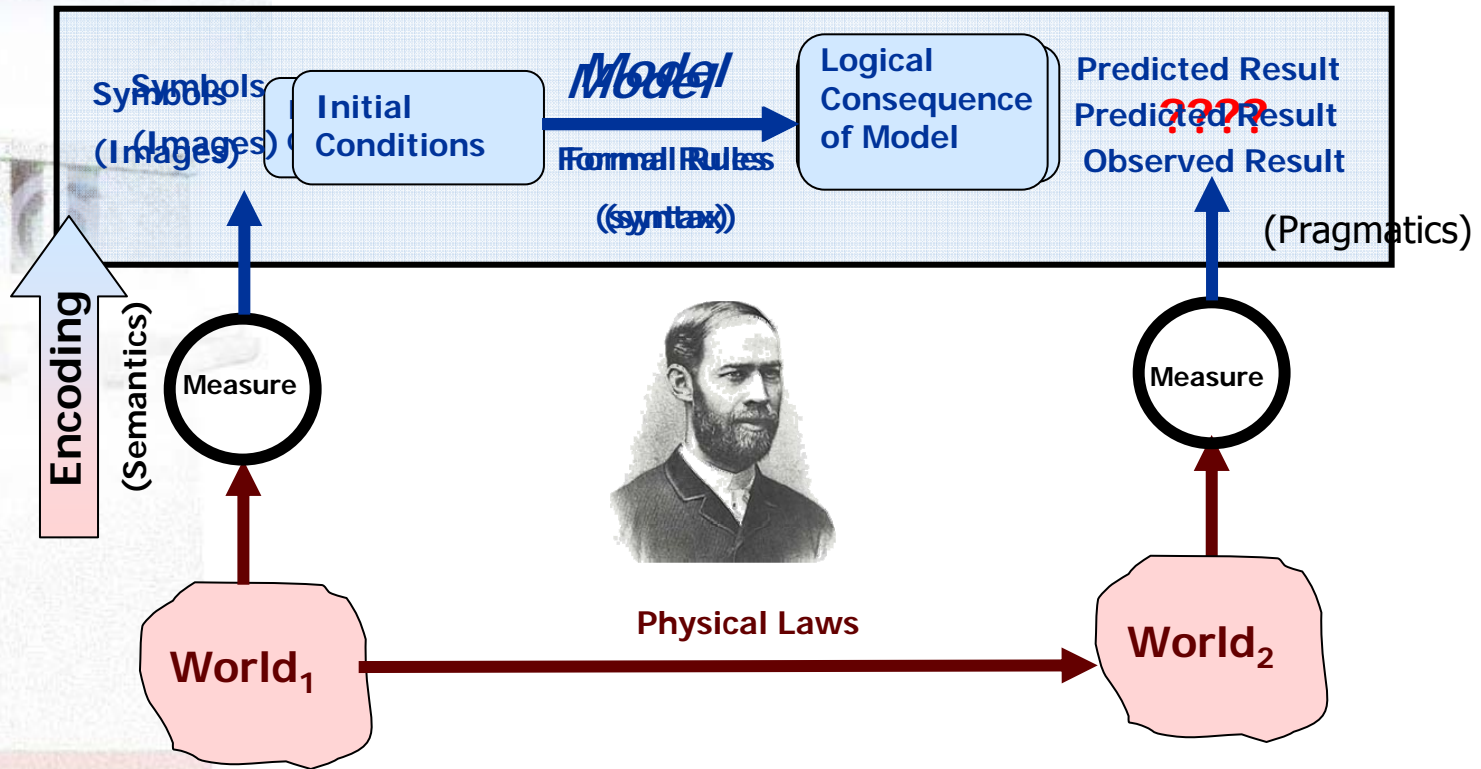
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2	0	2	1	5	1	6	6	4	8	1	6	0	6	9	0	1	3	6	7
4	7	2	3	8	0	8	1	4	5	9	5	1	6	6	2	3	5	3	6

Cycles = 1

What is it??

The Modeling Relation

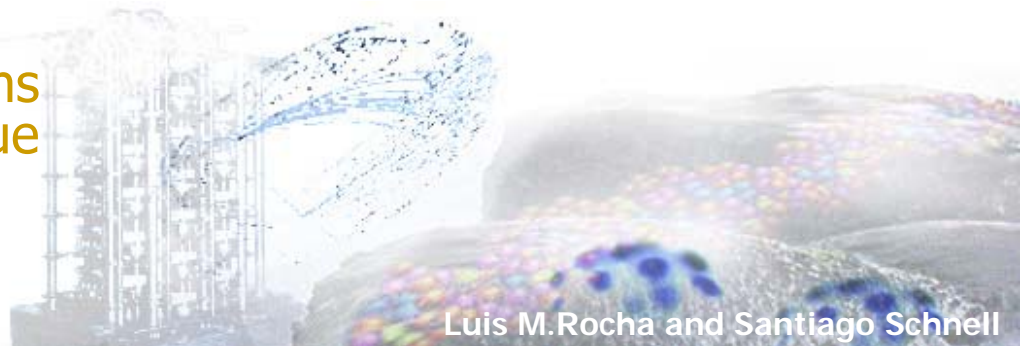
Hertz' Modeling Paradigm



- **Formal Rules**
 - From symbolic representations of observables
 - Produce Conclusions

What is Logic?

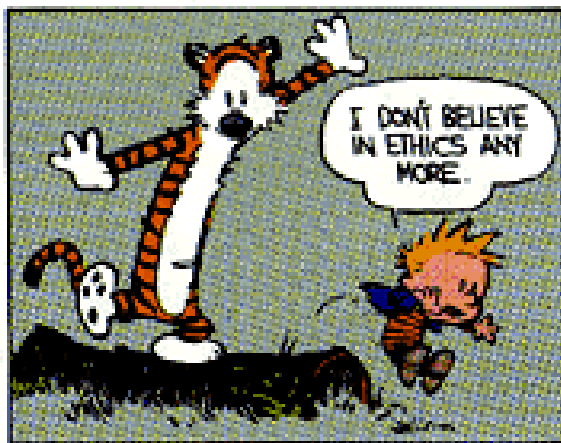
- From Greek Logos (*λόγος*)
 - word, speech, discourse, *reason* (OED)
- Classical logic is the study of the *forms of correct reasoning*, also called *formal logic*. Its focus is on *abstract, basic patterns of reasoning*.
 - “Correct reasoning”: ensures that true conclusions follow from true premises under perfect evidence.
 - We can trust our conclusions when they are based on true premises



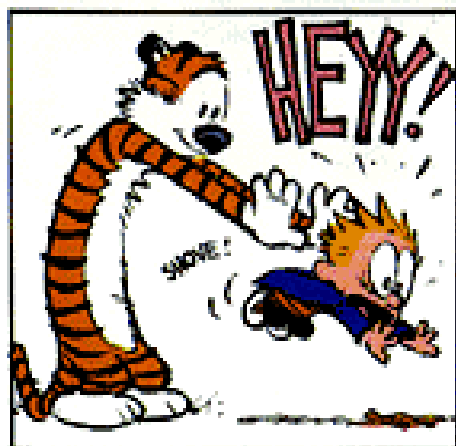
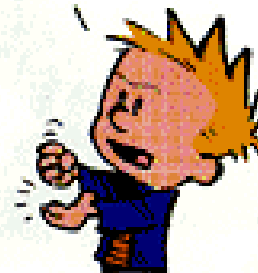
calvin and hobbes

BY BILLY WATSON

Logical Conclusions?



GET WHAT YOU CAN WHILE THE GETTING'S GOOD - THAT'S WHAT I SAY! MIGHT MAKES RIGHT! THE WINNERS WRITE THE HISTORY BOOKS!



Monty Python: Holy Grail

- Villagers: (enter yelling) A witch! A witch! We've found a witch! Burn her! Burn her!
- Bedimere: there are ways of telling if she's a witch. What do you do with witches?
- Villagers: Burn them!
- Bedimere: And what do you burn, apart from witches?
- Villagers: Wood?
- Bedimere: Right! So why do witches burn?
- Villagers: Because they're made of wood?
- Bedimere: Right! . Now, what else do you do with wood?
- Villagers: Build bridges with it!
- Bedimere: But do we not also build bridges from stone; does wood float in water?
- Villagers: Yes
- Bedimere: And what else floats in water?
- King Arthur: (after more confused suggestions from the villagers) A duck!
- Bedimere: Right! So, if she weighs the same as a duck, she'd float in water, and she must be made of wood, so.
- Villagers: A witch! Burn her!
- (They weigh the woman on a large scale with a duck in the other balancing basket, but inexplicably the scales do not tilt one way or the other. As the villagers drag the woman away, the witch looks at the camera and says with resignation "it was a fair court".)
- Bedimere: (to King Arthur) Who are you who are so wise in the ways of science?

(C) Python (Monty) Pictures

<http://www.RossAnthony.com>

Western Logic

- **Aristotle (384-322 BC)**
 - Provided the first systematic account of correct forms of reasoning
 - Syllogistic Logic
 - Four kinds of quantified sentences, each of which contain a *subject* and a *predicate*:
 - Universal affirmative: Every S is a P.
 - Universal negative: No S is a P.
 - Particular affirmative: Some S is a P.
 - Particular negative: Not every S is a P.
 - Syllogisms (The Greek "sullogismos" means "deduction")
 - Combinations of sentences: one proposition (the *conclusion*) follows of necessity from two others (known as *premises*)
 - Can be valid
 - All humans (B) are mortal (A) (major premise)
 - All Greeks (C) are humans (B) (minor premise)
 - then all Greeks (C) are mortal (A). (conclusion)
 - And invalid (e.g. *logical fallacy* which is a metaphor)
 - Wood (B) burns (A)
 - Witches (C) burn (A)
 - Witches (C) are Wood (B)



Raphael's "Plato and Aristotle"

Symbolic Logic

- Logic uses a set of symbols and rules to represent the structure of reasoning with precision.
- This kind of logic is known as *symbolic logic* and divides in **propositional** and **predicate** logic.
 - A formal system for representing knowledge in terms of *sentences* that represent *propositions*
 - Proposition is the meaning of the sentence, rather than the sentence itself



Propositional Logic

A *proposition* is a statement that is either TRUE or FALSE (not both)

Proposition is the meaning of the sentence, rather than the sentence itself

Different sentences, even in different languages, express the same proposition when they have the same meaning

Examples:

- I101 is Marc's favorite class.
- $2 + 2 = 4$
- $2 + 2 = 7$
- The Earth is flat as a pancake.
- The Earth is a sphere.

Deduction vs. Induction

- Propositional Logic is used to study *inferences*
 - How conclusions can be reached from premises
- Deductive Inference
 - If the premises are true, **Logic** guarantee *certainty* of the conclusion
 - February has 29 days only in leap years
 - Today is February 29th
 - This year is a leap year
- Inductive Inference
 - Conclusion supported by *good evidence* (significant number of examples/observations) but not full certainty -- *likelihood*
 - Ran BlackBox for 1000 cycles, "dead box" observed
 - Ran BlackBox for 1000 cycles, "dead box" observed
 - Ran BlackBox for 1000 cycles, "dead box" observed
 -
 - Ran BlackBox for 1000 cycles, "dead box" observed
 - "Dead Box" always appears after 1000 cycles

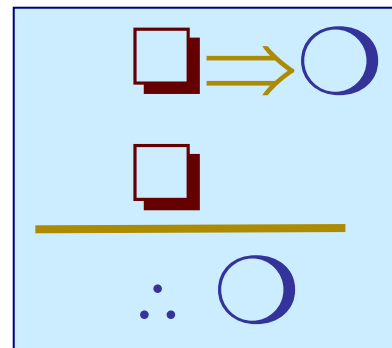
Form of Inference

- An inference is used to convey the idea that if both premises are true, then the conclusion must also be true

- If \square then \circ

- \square

- Therefore \circ



- Any inference with this structure produces a true conclusion from true premises

- Valid inference

The structure of propositional logic

- *Simple propositions* are represented by single, lower case letters
 - Bloomington is a town – p
 - Indiana is a state - q
- *Complex propositions* are constructed by applying logical operations to simple propositions
 - Bloomington is a town *and* Indiana is a state – p and q
- *Logic Operations*
 - Conjunction [and] \wedge
 - Disjunction [or] \vee
 - Negation [not] \neg
 - Conditional [implies] \Rightarrow (if, then)
 - Biconditional [equivalent] \Leftrightarrow (if and only if)



Next Class!

- Topics
 - Classical Set Theory
- Readings for Next week
 - @ *infoport*
 - From course package
 - Klir, J.G., U. St. Clair, and B.Yuan [1997]. Fuzzy Set Theory: foundations and Applications. Prentice Hall
 - Chapter 2: Classical Logic (pp. 87-98)
 - Chapter 3: Classical Set Theory (pp. 99-107)
- Lab 7
 - Intro to Statistical Analysis using Excel
 - NO LAB THIS WEEK!!!!