

# Introduction to Informatics

## Lecture 2: The Nature of Information



# Readings until now



- Lecture notes

- Posted online @

- <http://informatics.indiana.edu/rocha/i101>

- *The Nature of Information*

- @ *infoport* and web

- *What are blogs?*

- *The Library of Babel* by Jorge Luis Borges

- [http://jubal.westnet.com/hyperdiscordia/library\\_of\\_babel.html](http://jubal.westnet.com/hyperdiscordia/library_of_babel.html)

- From course package

- Von Baeyer, H.C. [2004]. *Information: The New Language of Science*. Harvard University Press.

- Chapters 1, 4 (pages 1-12)

# Assignment Situation

- Labs

- Past

- Lab 1: Blogs

- Due this Friday, January 19

- Next

- Lab 2: Basic HTML

- Thursday and Friday, January 18 and 19

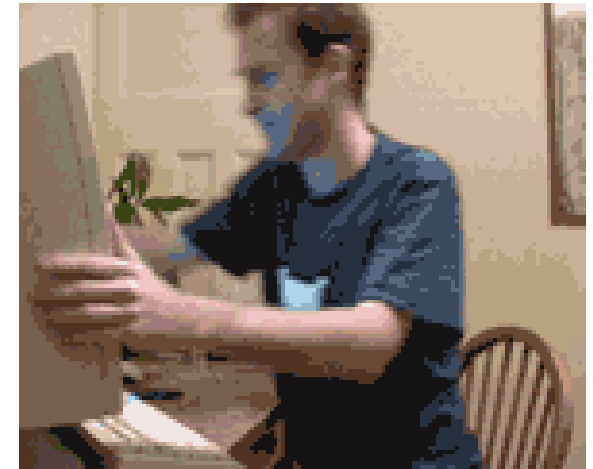
- Due Friday, January 26

- Assignments

- Individual

- First installment

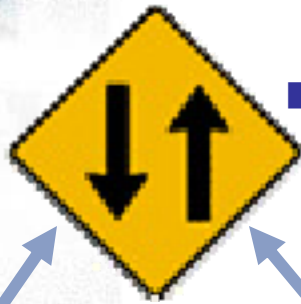
- End of January



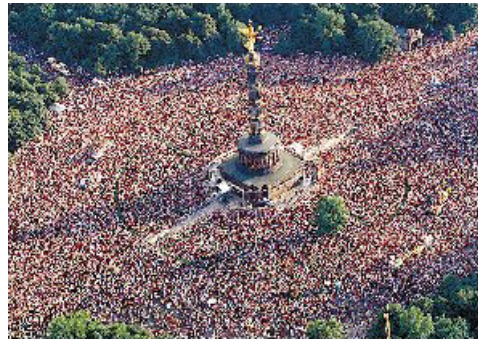
# Information is a Relation!

- The central structure of information is a relation
  - among *signs*, *objects or things*, and *agents* capable of understanding (or decoding) the signs.
- Agents are informed by a Sign about some Thing.

Sign



Thing



Agents

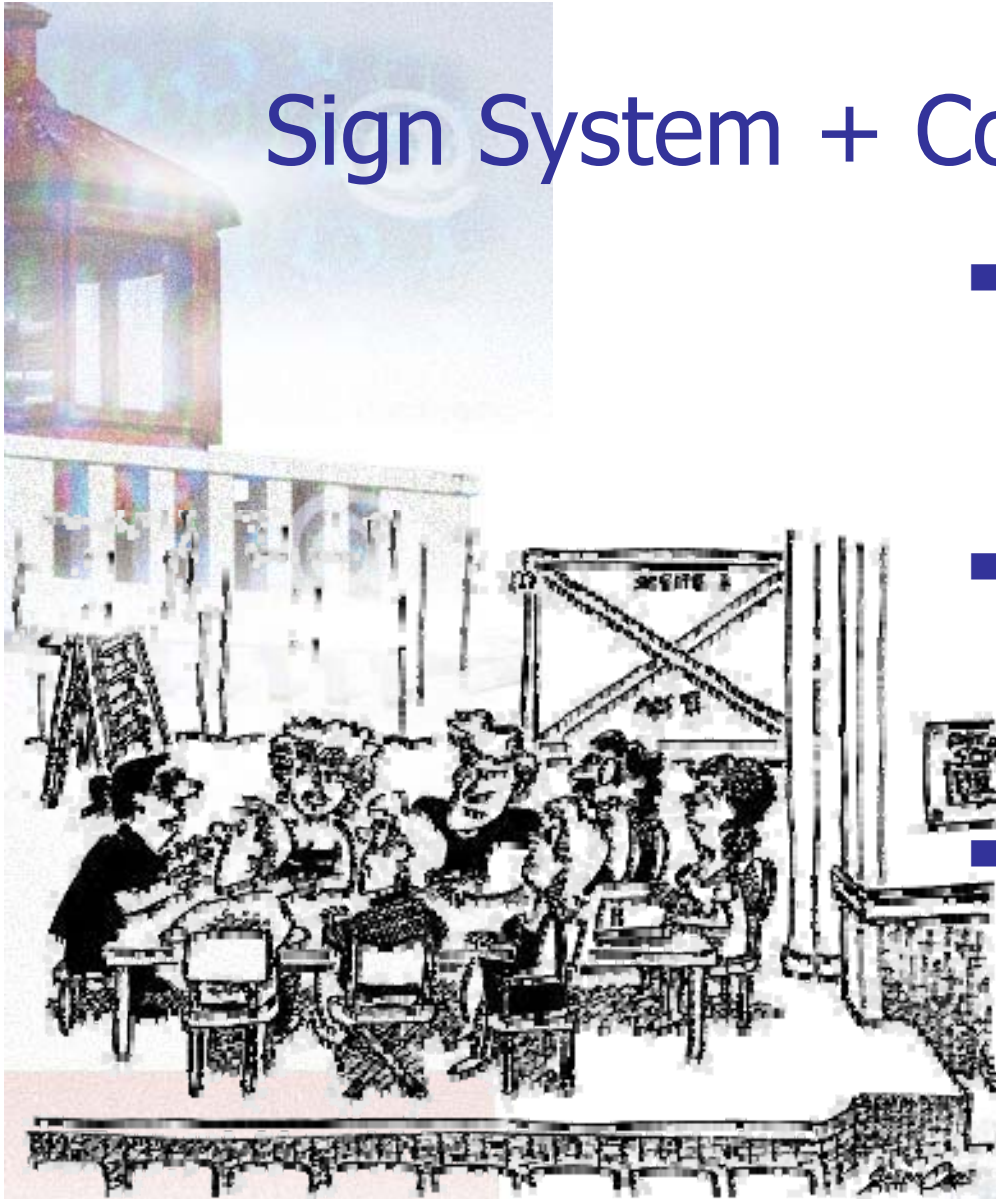


"RUN FOR YOUR LIVES! IT'S AN ASTERISK!!!"

Luis M. Rocha and Santiago Schnell

# Sign System + Context = Semiotics

- A complete understanding of Information requires
  - Sign System + Context
- An Agent is informed by a Sign about some Thing in certain Context
- Semiotics
  - Syntax, Semantics, and Pragmatics



"In theatre, words are only a design on the canvas of motion. Theatre is a nexus of symbols, many of them visual, and dramatic literature cannot find an audience until those symbols are embodied in appropriate stage imagery. Very important then, in my view, is a scene with buck naked actors."

Luis M.Rocha and Santiago Schnell

# Semiotics and Informatics

Information

- **Semantics**
  - the content or **meaning** of the Sign of a Thing for an Agent
    - Relations between signs and objects for an agent
    - the study of meaning.
- **Syntax**  $\leftarrow$  **Information Technology**
  - the characteristics of signs and symbols devoid of meaning
    - Relations among signs such as their rules of operation, production, storage, and manipulation.
- **Pragmatics**
  - the context of signs and repercussions of sign-systems in an environment
    - it studies how context influences the interpretation of signs and how well a signs-system represents some aspect of the environment

Informatics

# (Peirce's) Typology of Signs

- **Icons** are direct representations of objects.
  - Similar to the thing they represent.
  - Pictorial road signs, scale models, computer icons.
    - A footprint on the sand is an icon of a foot.



# (Peirce's) Typology of Signs

- *Indices* are indirect representations of objects, but necessarily related.
  - Smoke is an index of fire, the bell is an index of the tolling stroke
    - a footprint is an index of a person.





# (Peirce's) Typology of Signs

- **Symbols** are arbitrary representations of objects
  - Require exclusively a social convention to be understood
    - Convention establishes a code, agreed by a group of agents, for understanding (decoding) the information contained in symbols.
    - Smoke is an index of fire, but if we agree on an appropriate code (e.g. Morse code) we can use smoke signals to communicate symbolically.



# (Peirce's) Typology of Signs

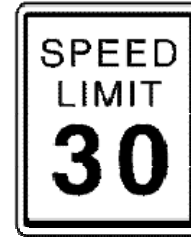
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# Signs may be hybrid

- Iconic, symbolic and indexical elements

- Road signs

- Purely Symbolic
- Symbolic + Iconic
- Symbolic + Indexical + Iconic



symbolic



iconic

- Convention

Mick Underwood:

<http://www.cultsock.ndirect.co.uk/MUHome/cshtml/semiomean/semio1.html>

# Hybrid Signs

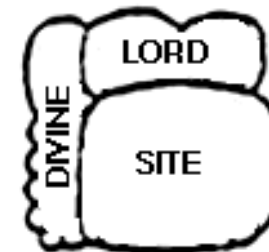
- Iconic, symbolic and indexical elements
  - Alphabets
    - Roman: Completely symbolic
    - Hieroglyphs (Egyptian and Mayan): symbolic, indexical, and iconic

Egyptian logograms signify morphemes



## Mayan EMBLEM GLYPHS - GENERAL FORM

These glyphs most often included "divine" as a prefix and "lord" as a superfix, and followed a ruler's name. This can be translated as "Lord [name], Divine Lord of [place name]"  
 As you can see from the examples below, however, there was considerable variation.



Dos Pilas



Palenque



Tikal






















Yaxchilan



Seibal

# More Egyptian Glyphs

## Phonograms

biconsonantal			triconsonantal						
	<i>ir</i>		<i>ir</i>		<i>ʿnh</i>		<i>rwd</i>		
	<i>wp</i>		<i>ms</i>		<i>k3</i>		<i>w3h</i>		<i>hṯp</i>
	<i>wf</i>		<i>nb</i>		<i>s3</i>		<i>nfr</i>		<i>hpr</i>
	<i>fr</i>		<i>fw</i>		<i>dd</i>		<i>nt</i>		<i>šmʿ</i>

Determinatives  
(no phonetic value: clarify meaning)

	man		house, building		book, writing, abstract
	woman		town, village		small, bad, weak
	god, king		desert, foreign country		wood, tree
	force, effort		sun, light, time		logogram indicator
	eat, drink, speak		walk, run		plural indicator

Lawrence Lo: <http://www.ancientscripts.com/egyptian.html>

# Mayan Glyphs

## Vowels

<http://www.halfmoon.org/>

### COLORS AND DIRECTIONS



**k'an**  
(yellow)



**yax**  
(green, blue)



**sak**  
(white)



**ok'**  
(black)



**chik**  
(red)



**A'ank'in**  
(north)



**ik'in**  
(east)



**noh'ol**  
(south)



**chik'in**  
(west)



**northeast**



**southeast**



**northwest**



**southwest**

(drawn by David Stuart)

<b>A</b> 	<b>BA</b> 	<b>CHA</b> 
<b>E</b> 	<b>BE</b> 	<b>CHE</b> 
<b>I</b> 	<b>BI</b> 	<b>CHI</b> 
<b>O</b> 	<b>BO</b> 	<b>CHO</b> 
<b>U</b> 	<b>BU</b> 	<b>CHU</b> 

# Play on Signs and Reference

When is an object a sign or a thing?



Rene Magritte



Michel Gondry

Personal Semantics

Luis M.Rocha and Santiago Schnell

# Symbol Manipulation

- Symbols can be manipulated without reference to content (syntactically).
  - due to the arbitrary nature of convention
  - Allows computers to operate,
- All signs rely on a certain amount of convention, as all signs have a pragmatic (social) dimension, but symbols are the only signs which require exclusively a social convention, or code, to be understood.





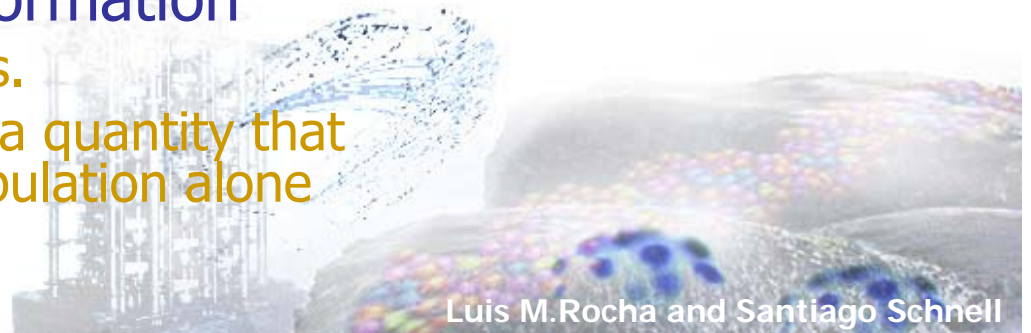
# Manipulating Symbols

<i>DEAL</i>	EALD	ALDE	LDEA	$4! = 4 \times 3 \times 2 \times 1 = 24$ Permutations
DELA	EADL	ALED	LDAE	
DLEA	ELDA	ADEL	LEDA	
DLAE	ELAD	ADLE	<i>LEAD</i>	
DAEL	EDLA	AELD	<i>LADE</i>	
DALE	EDAL	AEDL	LAED	

- Symbols Manipulated without recourse to meaning
- Some have meaning (in some language)
- The code between symbols and meaning is arbitrary
  - Example: cut-up method for generating poetry pioneered by Brion Gysin and William Burroughs and often used by artists such as David Bowie, or use of samples

# Information Theory

- article published in 1948 by Claude Shannon
  - “The mathematical theory of communication”
  - Developed to deal with the efficiency of information transmission in electronic channels
- Key concept: information quantity that can be measured unequivocally (*objectively*).
  - Does not deal at all with the *subjective* aspects of information
    - Semantics and pragmatics.
    - Information is defined as a quantity that depends on symbol manipulation alone



# What's an information quantity?

- How to quantify a relation?
  - Information is a relation between an agent, a sign and a thing, rather than simply a thing
  - The most palpable element in the information relation is the sign
    - More palpable still is the system of conventional signs we call symbols
- But which symbols do we use to quantify the information contained in messages?
  - Several symbol systems can be used to convey the same message
    - We must agree on the same symbol system for all messages!

Machine

機器

# Communication basics

- Both sender and receiver must use the same code, or convention, to encode and decode symbols from and to messages.
  - We need to fix the *language* used for communication
    - Set of symbols allowed (an *alphabet*)
    - the rules to manipulate symbols (*syntax*)
    - the meaning of the symbols (*semantics*).
  - A language specifies the universe of all possible messages
    - Set of all possible symbol *strings* of a given size.
- *Shannon Information* is then defined as “a measure of the freedom from *choice* with which a message is *selected* from the set of all possible messages”

<i>DEAL</i>	EALD	ALDE	LDEA
DELA	EADL	ALED	LDAE
DLEA	ELDA	ADEL	LEDA
DLAE	ELAD	ADLE	LEAD
DAEL	EDLA	AELD	LADE
DALE	EDAL	AEDL	LAED

DEAL is 1 out of 4!  
=  $4 \times 3 \times 2 \times 1 = 24$   
*choices.*

# Information Quantity

- information is defined as the act of selecting a specific message (a string of symbols) from the set of all possible messages (in some language).
  - Information content of a message
    - Number of operations needed to select that message from the set of all possible messages
    - Selection process depends on the *likelihood* of occurrence of symbols.
      - depends on the number of choices that exist when we encode a message of a given size.
    - Depends on symbols not at all on meaning!
      - "information" and "anerthingly" written in the Roman alphabet with 26 symbols are one of  $26^{11}$  ( $=3,670,344,486,987,776 \approx 3.7 \times 10^{15}$ ) possible words of size 11. Both have the same information content!
      - In the phonetic language of 40 symbols there are 100 times more alternatives!
- as **Information**.



# Next Classes!

## ■ Topics

- Digital vs. Analog
- What is Technology?
  - What is Information Technology?
  - Examples of important IT

## ■ Readings for Next week

- Lecture notes Posted online @ <http://informatics.indiana.edu/rocha/i101>
  - *Technology*
- @ *infoport*
- From course package
  - From Andy Clark's book "*Natural-Born Cyborgs*"
    - Chapter 2: "Technologies to Bond With" (pages 19 - 44)

## ■ Lab

- Basic HTML