Rensselaer

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Semiotics, Cognitive and Social Science & Examples of Information Systems

Ahmed Eleish

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ITWS, ERTH, CSCI 4400/6400

Contents

- Current Events
- Semiotics, cognitive science
- Assignment 2 is available
- Teams Formation: (group member formation for the class group project)

Use Case

- Primary Actors: They initiate the use of the system. [initiate (act on)]
- Secondary Actors: They respond to the system (acted upon)
- Actors are external objects, they needed to be placed outside the boundary of the the system (outside the rectangle that denote the system)
- Actors can be considered roles

- Primary Actors should be placed on the Left-Hand Side of the System.
- Secondary Actors should be placed on the Right-Hand Side of the system.
- The use case represents an action that accomplishes some sort of task within the system.

Watch this video: UML Usecase diagrams(Actors, relationships, Systems… etc):
https://www.youtube.com/watch?v=zid-MVo7M-E&ab_channel=Lucidchart

UML Use-Case Diagram

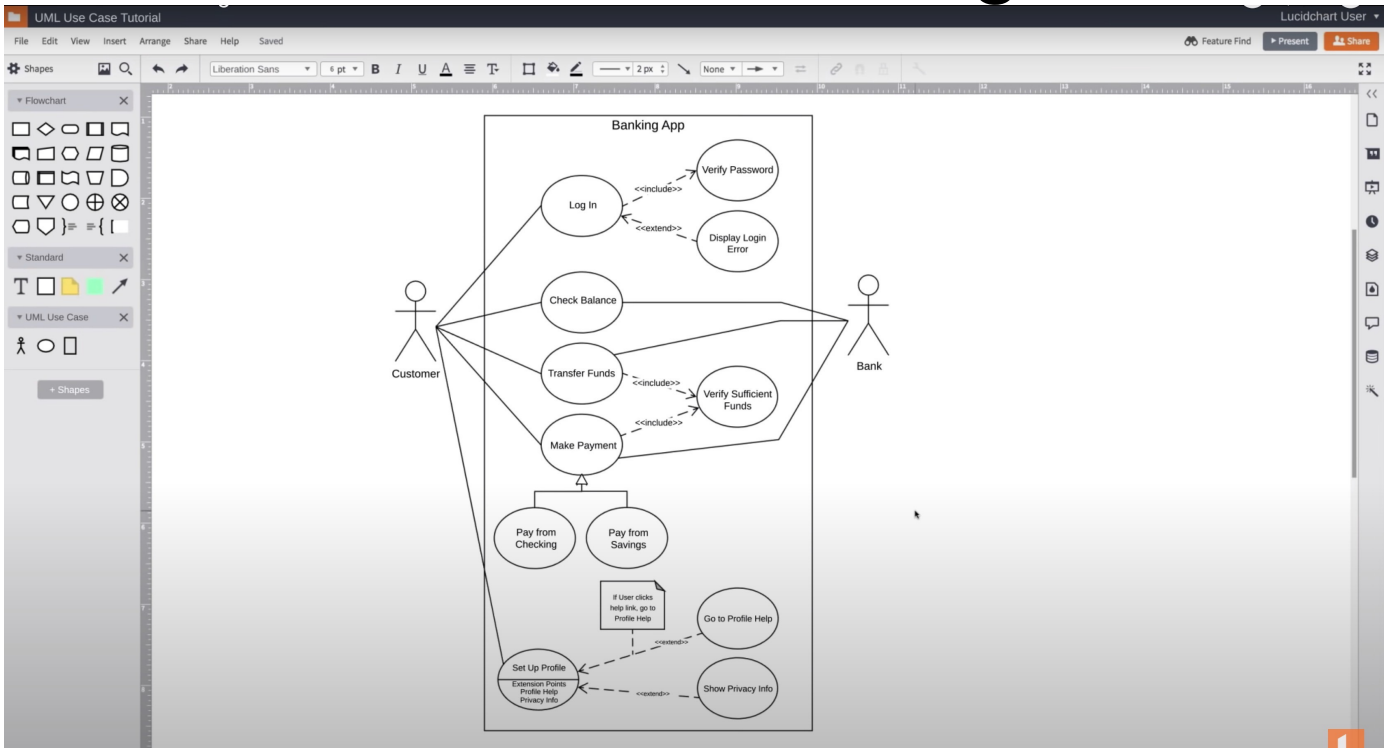


Image Resource Credit: https://www.lucidchart.com/pages/

Assignment 2

Shannon Entropy Calculator:

Many are available that may be more/less appropriate for your Use Case (this will be useful depending on your Use Case that you have chosen)

One example: http://planetcalc.com/2476/

Xinformatics : New York Times, October 18, 1981. SCHOLARS SIGN ON WITH SEMIOTICS By EDWARD ROTHSTEIN

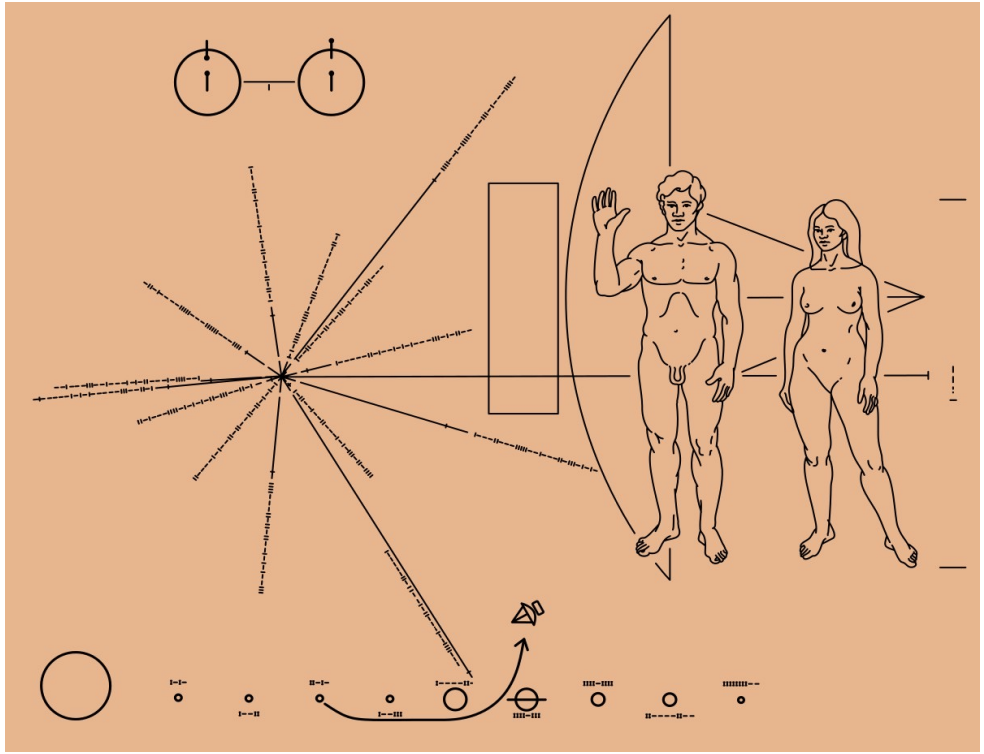
http://www.nytimes.com/1981/10/18/weekinreview/scholars-sign-on-with-semiotics.html

When Pioneer 10 was launched from Earth in 1972, it bore a plaque meant for extra-terrestrial beings. Scientists at the National Aeronautics and Space Administration wanted the imperishable goldcoated aluminum plate to be decipherable to any scientist, of any physiognomy, living anywhere in the universe.

The plaque contains a schematic drawing of a man and a woman drawn to scale in front of a sketch of the spacecraft; the man's hand is raised in greeting. A dumbbell figure pictures the hydrogen atom, to give a measure of time and space; it is the key to a star-figure, locating Earth relative to 14 radio-wave emitting pulsars. Circles below portray the solar system; a miniature Pioneer swerves between Jupiter and Saturn, soaring into the celestial beyond.

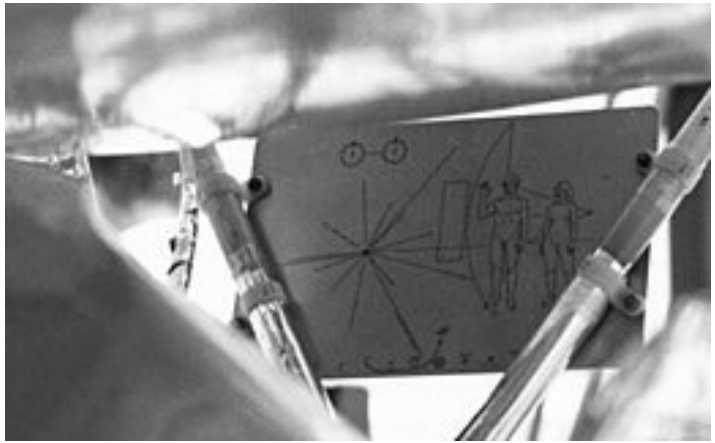
The plaque is interesting because it illustrates - on an interstellar level, perhaps - questions about every act of communication. Signs are used to convey meaning, but their interpretation is based upon unexamined, often hidden relations. There was a time when language was considered natural, linked directly to the world, the way the "species-proof" Pioneer language claims to be. But most linguistic signs are now viewed as arbitrary inventions. What assumptions then, does a language embody in its arbitrariness? How is language related to culture? How is it linked to the world? How, in a broader sense, is any information communicated?

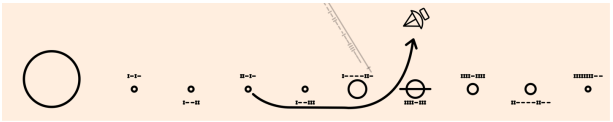
Xinformatics Current Events: New York Times, October 18, 1981.
SCHOLARS SIGN ON WITH SEMIOTICS By EDWARD ROTHSTEIN
http://www.nytimes.com/1981/10/18/weekinreview/scholars-sign-on-with-semiotics.html

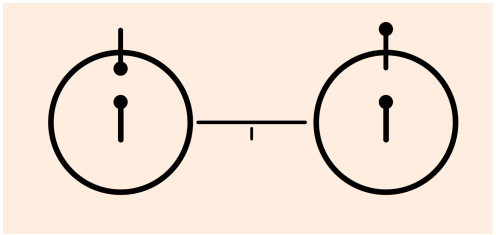


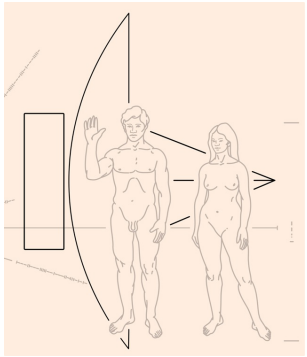
https://en.wikipedia.org/wiki/Pioneer_plaque

Pioneer plaque



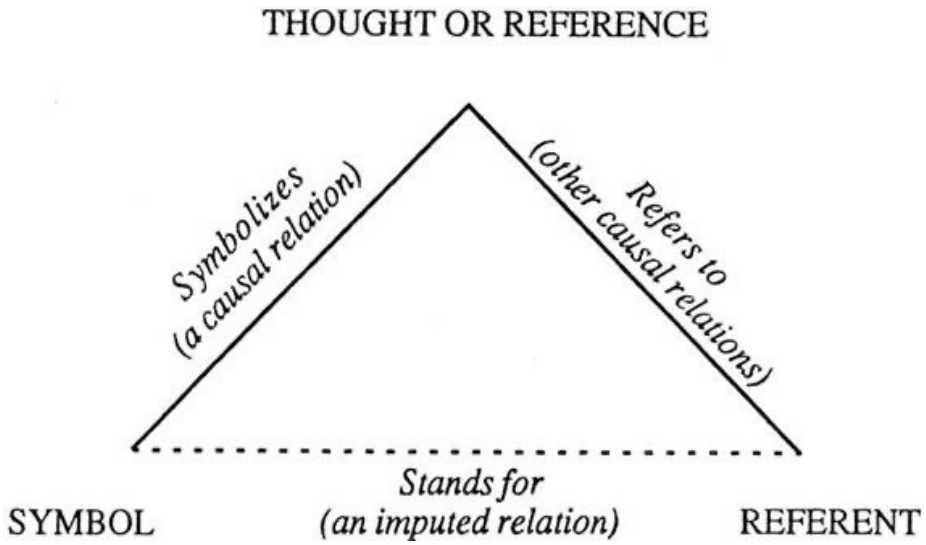






Semiotics

Also called semiotic studies or semiology, is the study of sign processes (semiosis), or signification and communication, signs and symbols



Semiotics: the study of signs

- https://www.youtube.com/watch?v=rEgxTKUP_WI

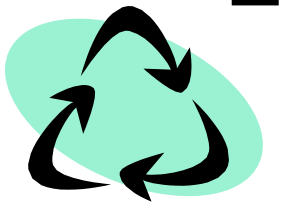
Semiotics Lesson

- https://www.youtube.com/watch?v=7lR7jz6M9iA&ab_channel=LorenHanna

A sign (Peirce and Eco 1979)

1. “A sign stands for something to the idea which it produces or modifies....
2. That for which it stands is called its object, that which it conveys, its meaning; and the idea which it gives rise, its interpretant
3. ....[the sign creates in the mind] an equivalent sign, or perhaps a more developed sign.” (Peirce)
4. “That sign which it creates I call the interpretant of the first sign.
5. This sign stands for something, its object.
6. It stands for that object, not in all respects, but in reference to a sort of idea which I have sometimes called the ground of that representation.” (Eco)

Examples



Icons

(Meaning based on similarity of appearance)

Index

- A sign *related to* an object
- Signifier <-> Signified
- *Meaning based on cause and effect relationships*
- *Correlation between signifier and signified*
- E.g. Smoke to represent a fire, align icon represents the result of the align action

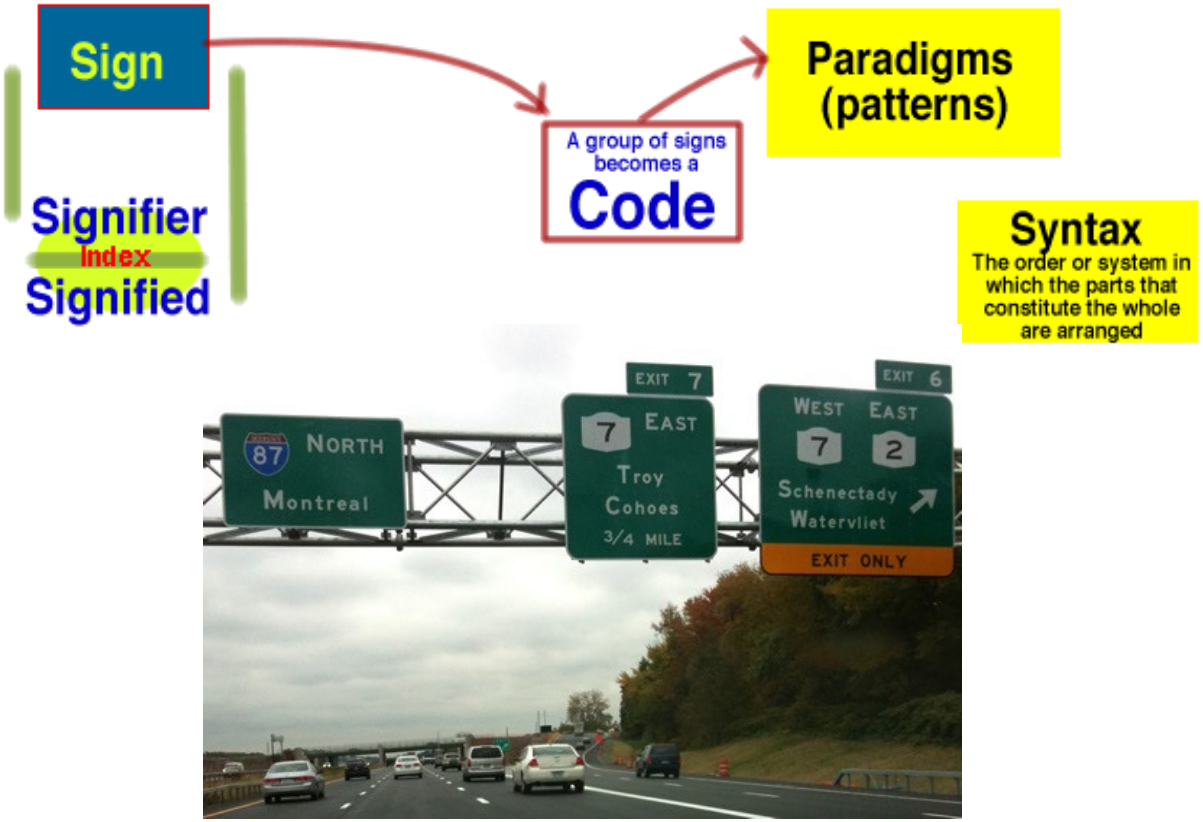
Exit Sign

Symbol (meaning based on convention)

Symbol (meaning based on convention)

IYKYK

Semiotic model




Portes
Gates
Puertas
D
E
Recollida equipatges
Baggage claim
Recogida equipajes
Sortida
Exit
Salida


Portes
Gates
Puertas
A
B
Portes
Gates
Puertas
C
Sky Centre


Recollida equipatges
Baggage claim
Recogida equipajes
Sortida
Exit
Salida
Sky Centre
A
B
C
D
E


HUGHES
A3-A4
BAR
B
PIER A BAR
ANY PASTRY
& ANY COFFEE
OR TEA
€4

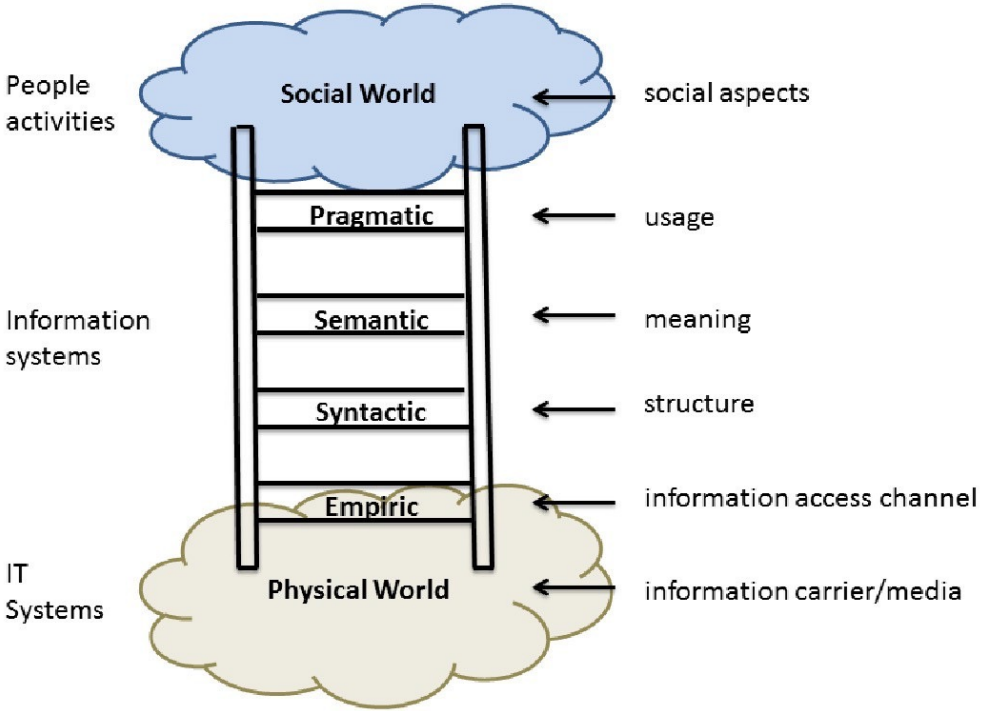
Syntax

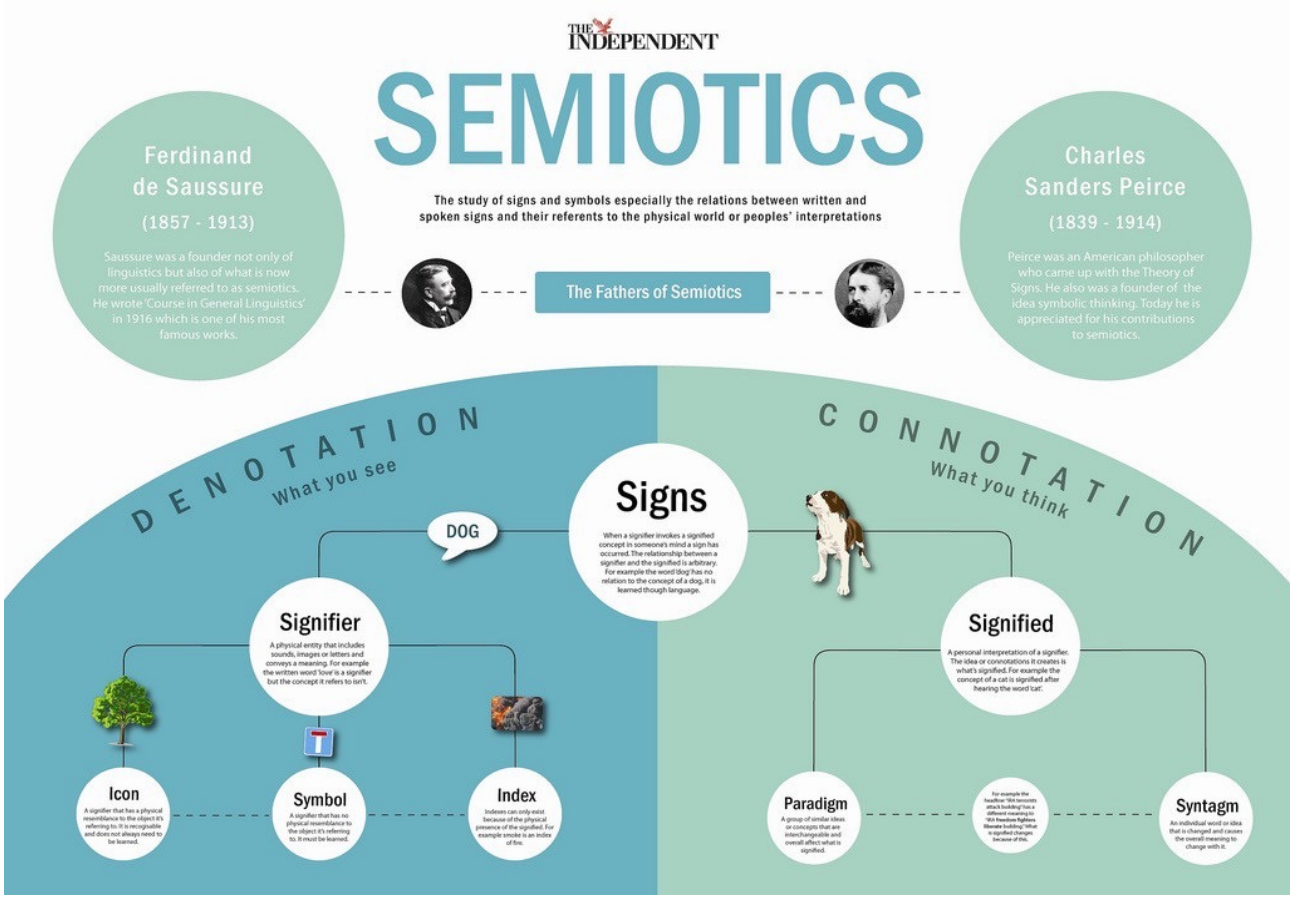
- Relation of signs to each other in formal structures
- … the term syntax is also used to refer directly to the *rules and principles* that govern the …
- But not the meaning or the use!

Pragmatics

- Relation of signs to their impacts on those who use them
- The ways in which context contributes to meaning, conveying and use

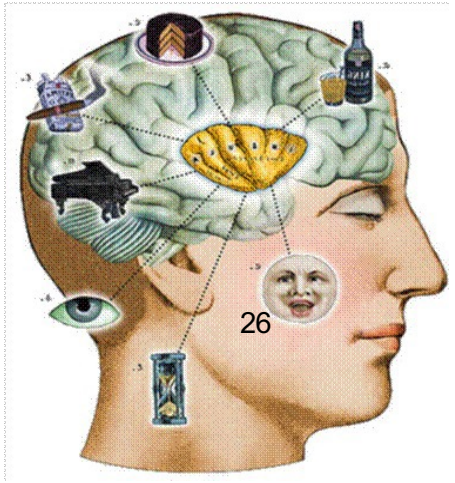
But in a digital world?




THE INDEPENDENT
SEMIOTICS
The study of signs and symbols especially the relations between written and spoken signs and their referents to the physical world or peoples' interpretations
Ferdinand de Saussure
(1857 - 1913)
Saussure was a founder not only of linguistics but also of what is now more usually referred to as semiotics. He wrote 'Course in General Linguistics' in 1916 which is one of his most famous works.
The Fathers of Semiotics
Charles Sanders Peirce
(1839 - 1914)
Peirce was an American philosopher who came up with the Theory of Signs. He also was a founder of the idea symbolic thinking. Today he is appreciated for his contributions to semiotics.
DENOTATION
What you see
CONNOTATION
What you think
Signs
When a signifier invokes a signified concept in someone's mind a sign has occurred. The relationship between a signifier and the signified is arbitrary. For example the word 'dog' has no relation to the concept of a dog, it is learned though language.
DOG
Signifier
A physical entity that includes sounds, images or letters and conveys a meaning. For example the written word 'love' is a signifier but the concept it refers to isn't.
Icon
A signifier that has a physical resemblance to the object it's referring to. It is recognisable and does not always need to be learned.
Symbol
A signifier that has no physical resemblance to the object it's referring to. It must be learned.
Index
Indexes can only exist because of the physical presence of the signified. For example smoke is an index of fire.
Signified
A personal interpretation of a signifier. The idea or connotations it creates is what's signified. For example the concept of a cat is signified after hearing the word 'cat'.
Paradigm
A group of similar ideas or concepts that are interchangeable and overall affect what is signified.
Syntagm
An individual word or idea that is changed and causes the overall meaning to change with it.

Cognitive Science

- Cognitive science is the interdisciplinary study of the mind and intelligence
- It operates at the intersection of psychology, philosophy, computer science, linguistics, anthropology, and neuroscience.



Mental Representation

- Thinking = representational structures + procedures that operate on those structures.

- Data structures + mental representations+ algorithms +procedures= running programs =thinking
- Methodological consequence: study the mind by developing computer simulations of thinking.

(https://en.wikipedia.org/wiki/Mental_representation)

What is an explanation of behavior?

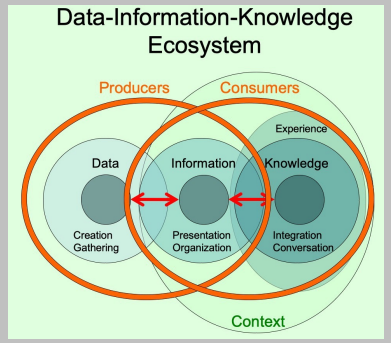
- **Programs that simulate cognitive processes explain intelligent behavior by performing the tasks whose performance they explain**.
- Neurophysiological explanation is compatible with computational explanation, but operates at a different level.
- **At the neural level, cognitive processes are parallel, but at the symbolic level, the brain behaves like a serial system**.
- The human mind is an adaptive system, learning to improve its performance in accomplishing its goals.

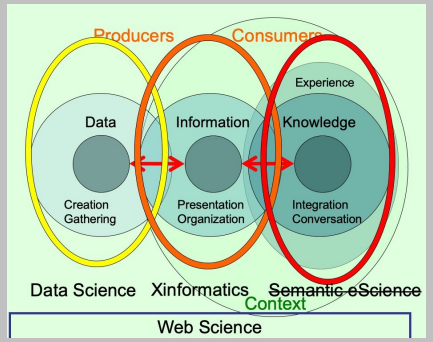
Nature of Expertise

- Manifests as cognition
  - refers to an information processing view of an individual's psychological functions
  - **Process of thought as ‘knowing’**
- **Indicates a level of knowing** and action that is above the non-expert
- **Characterizing the expert versus the non-expert (or specialist vs. non-) is very important in information systems**

Epistemology

- Theory of knowledge – and to do this effectively you need to be concerned with:
  - Truth, belief, and justification
  - Means of production of knowledge
  - Skepticism about different knowledge claims
- Understanding what part this plays in your modeling and architecture can be critical
- Recall the Data-Information-Knowledge ecosystem



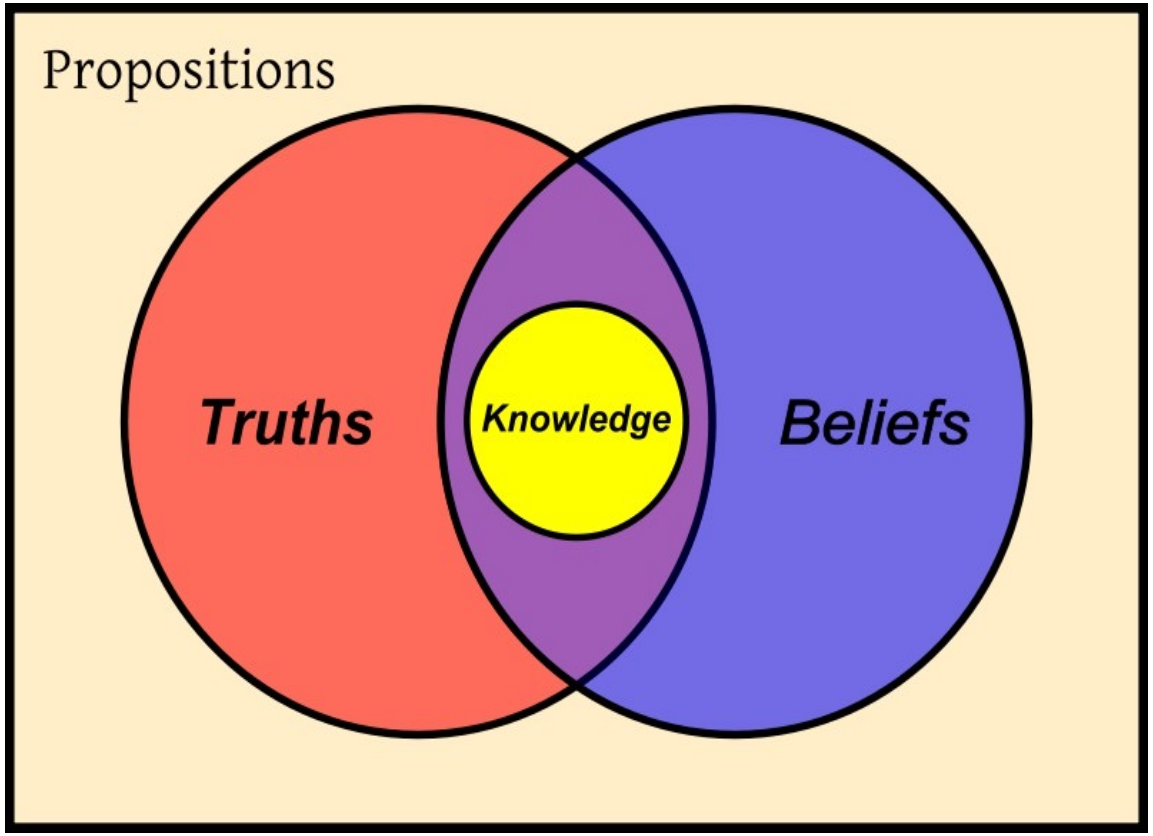


Epistemology

- Epistemology: Introduction to Theory of Knowledge

https://www.youtube.com/watch?v=r_Y3utIeTPg

Classical view of knowledge



Intuition

- This returns us to semiotics and to some extent heuristics and abduction –

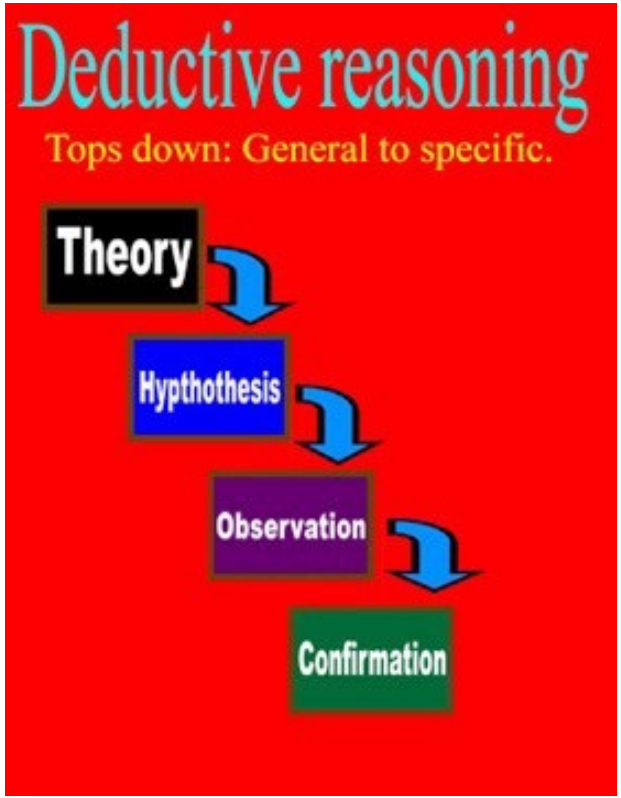
  understanding without apparent effort

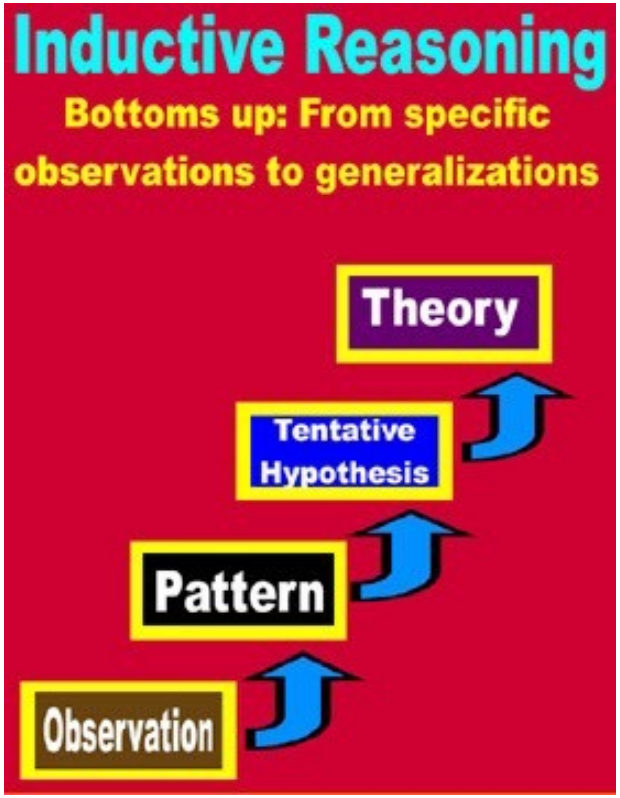
- Heuristics - experience-based techniques that help in problem solving, learning and discovery

Deductive vs Inductive vs Abductive Reasoning

- https://www.youtube.com/watch?v=jX3OXwpEpl8

Humans in the loop





Next …

- Information Systems…

Information Systems

Information systems (**IS**) are formal, sociotechnical, organizational systems **designed to collect, process, store, and distribute information.**

In a sociotechnical perspective, information systems are composed by four components:

- task
- people
- structure (or roles)
- technology.

Information Systems

- A **computer information system** is a system composed of *people and computers* that *processes or interprets* information.

Image Credit: https://www.elmhurst.edu/blog/computer-information-systems/

The 6 (or 5) components of IS

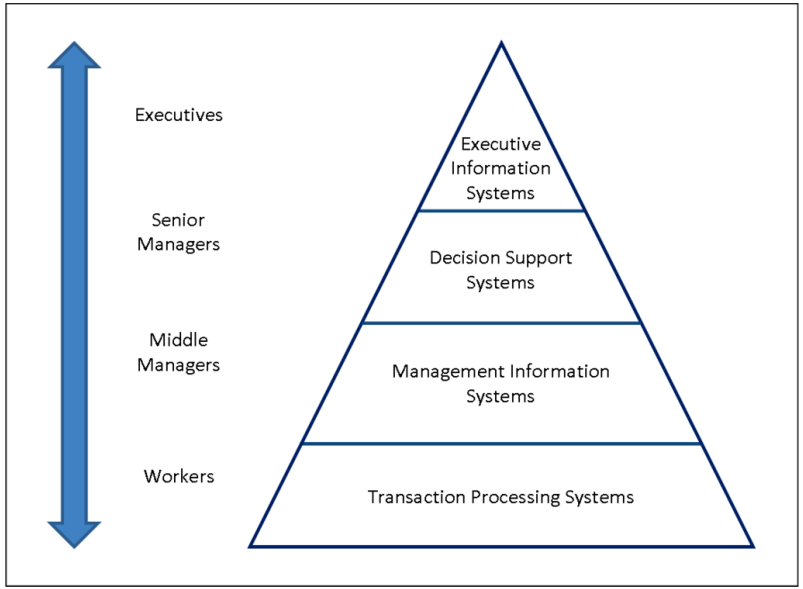
- The **six components that must come together in order to produce a modern information system** are:

  (Information systems are organizational procedures and do not need a computer or software) (i.e, an accounting system in the year 1400s using ledger (double-entry ledger) and ink utilizes an information system)

- **Hardware**: The term hardware refers to machinery. This category includes the computer itself, which is often referred to as the central processing unit (CPU), and all of its support equipment. Among the support, equipment are input and output devices, storage devices and communications devices.
- **Software**: The term software refers to computer programs and the manuals (if any) that support them. Computer programs are machine-readable instructions that direct the circuitry within the hardware parts of the system to function in ways that produce useful information from data. Programs are generally stored on some input/output medium, often a disk or tape.
- **Data**: Data are facts that are used by programs to produce useful information. Like programs, data are generally stored in machine-readable form on disk or tape until the computer needs them.
- **Procedures**: Procedures are the policies that govern the operation of a computer system. "Procedures are to people what software is to hardware" is a common analogy that is used to illustrate the role of procedures in a system.
- **People**: Every system needs people if it is to be useful. Often the most overlooked element of the system are the people, probably the component that most influence the success or failure of information systems. This includes "not only the users, but those who operate and service the computers, those who maintain the data, and those who support the network of computers." <Kroenke, D. M. (2015). MIS Essentials. Pearson Education>';
- **Feedback**: it is another component of the IS, that defines that an IS may be provided with a feedback (Although this component isn't necessary to function).

- The "classic" view of Information systems

In the 1980s was a pyramid of systems that reflected the hierarchy of the organization, usually transaction processing systems at the bottom of the pyramid, followed by **management information systems**, **decision support systems**, and ending with **executive information systems** at the top



LMS

- LMS (Learning Management System) is an Information System that you use at RPI

Image credit: https://www.123rf.com

In Information Systems:

- An example of inductive research:
  - Gather data
  - Analyze and reanalyze the data
  - **Organize the data within broad topics**
  - **Create categories within the topics**
  - **Identify relationships among the categories**
  - Synthesize the patterns into conclusions

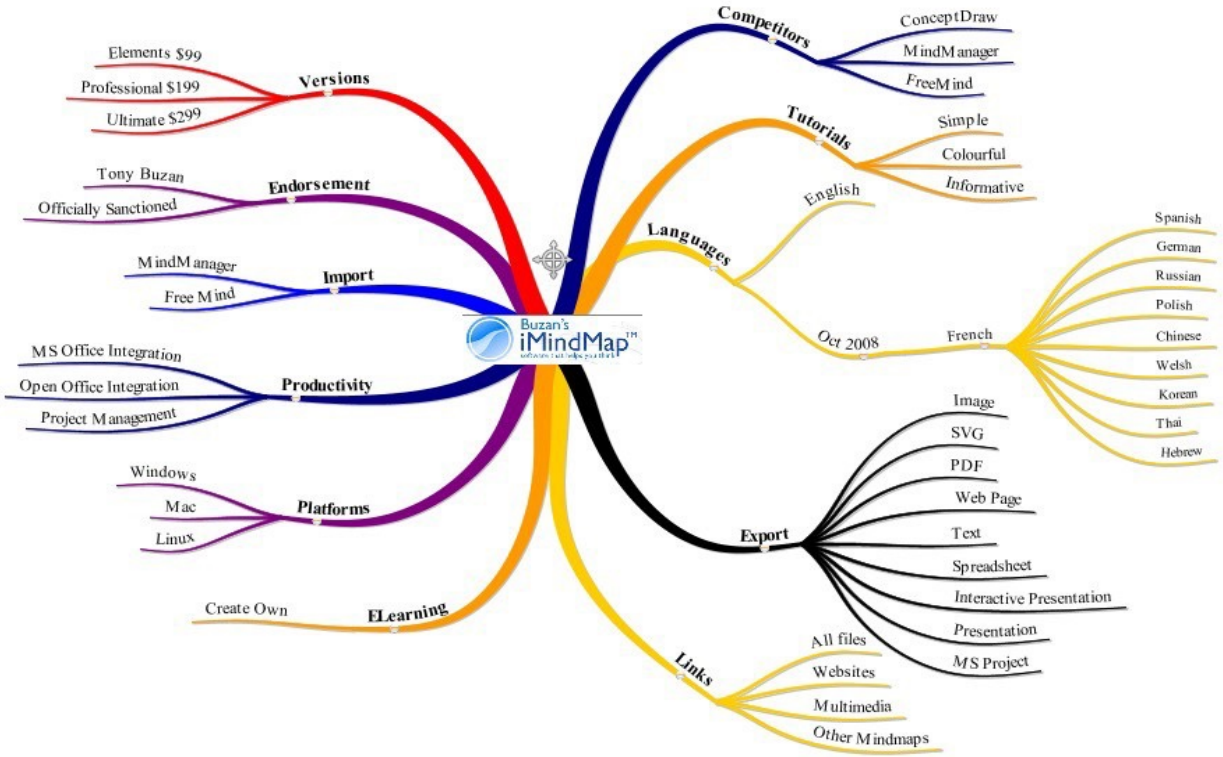
Information architecture (IA)

- **Information architecture (IA)** is the **structural design of shared information environments**;
- The art and science of organizing and labelling websites, intranets, online communities and software to support usability and findability; and **an emerging community of practice focused on bringing principles of design and architecture to the digital landscape**.
- Typically, **it involves a model or concept of information that is used and applied to activities which require explicit details of complex information systems**. These activities include library systems and database development.

content+structure+navigation=interaction

- **in any given information system, there are many *interactions* that can emerge when people use it**, influenced by the IA of the site
- IAs use combinations of these components to define the framework that constrains user interactions
  - Problem: we don't understand well how to study and design for emerging user experiences
  - We don't know how each contributes to the user experience

Metamodeling and Mindmaps



Some tools

- For use case development – simple graphics tools, e.g. graffle
- Mindmaps, e.g. Freemind
- For modeling (esp. UML):
  - http://en.wikipedia.org/wiki/List_of_Unified_Modeling_Language_tools
  - Lucidcharts UML designing tool: https://www.lucidchart.com/pages/
- For estimating information uncertainty, yes some algorithms and software exist
  - http://cmap.ihmc.us

Information on Water-Life-Cycle

Why it is important to have the information
On “Water-Life-Cycle” ?

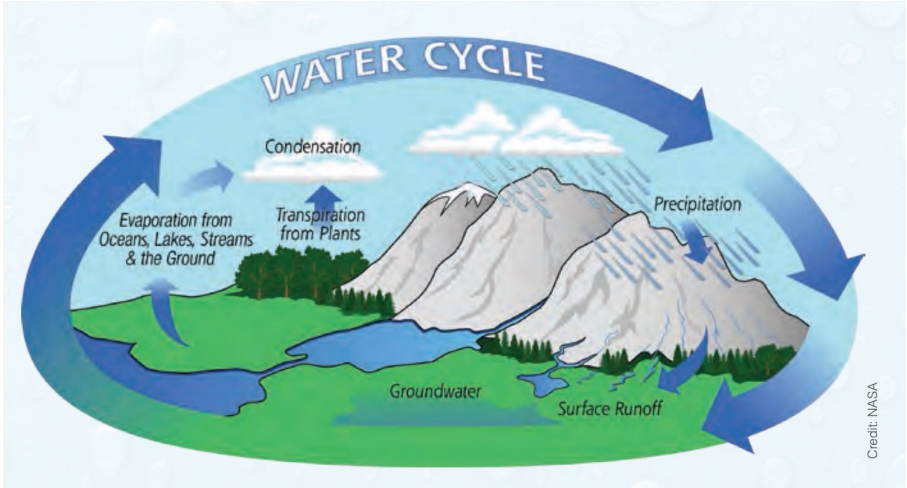
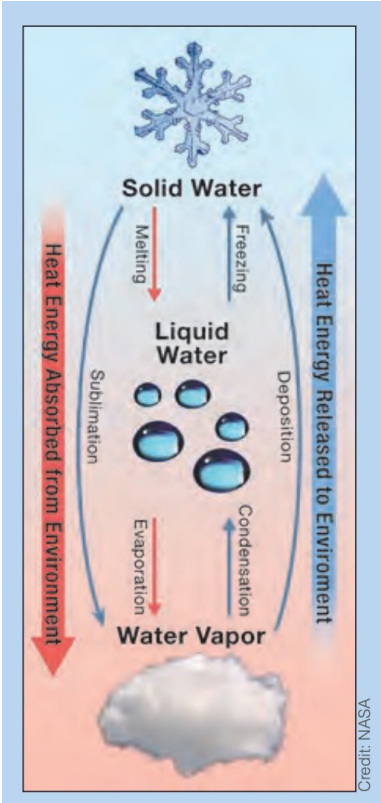


Image Resource: https://pmm.nasa.gov/sites/default/files/document_files/GPM%20Mission%20Brochure.pdf



Information Systems on:

- Weather information
- Disaster and Risk Management
- Disease outbreaks

Applications

- How do we use the information to build a better future?
- GPM Mission Applications – Global Understanding for a Better Future

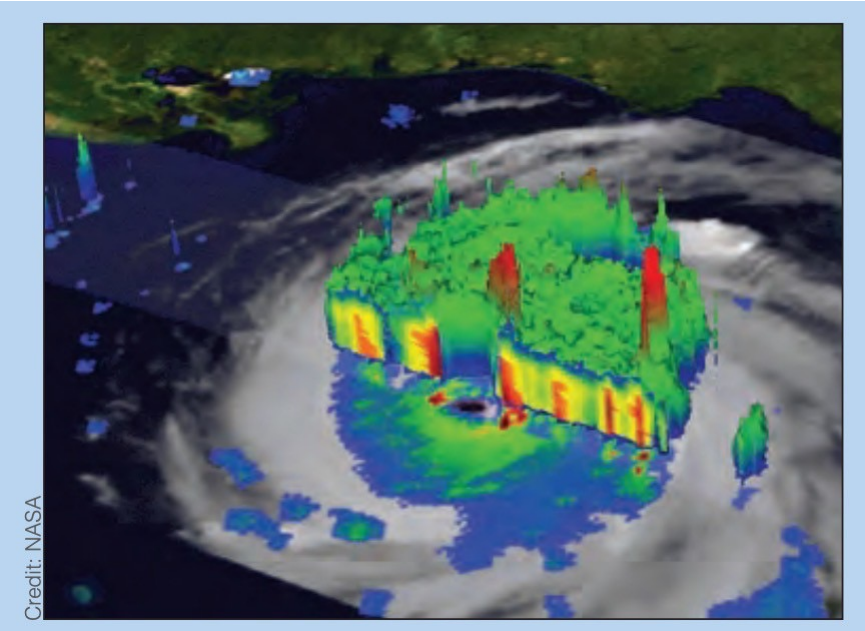
Credits (left to right): NASA, Orange County Archives, Kevin Conners/morgueFile.com, David Fine/FEMA, Beachgranny/morgueFile.com

https://pmm.nasa.gov/GPM

Image Resource: https://pmm.nasa.gov/sites/default/files/document_files/GPM%20Mission%20Brochure.pdf

Information on Global Precipitation

- Monitoring and Predicting Hurricanes



Information on Weather & Climate

- Enhanced Prediction Skills for Weather and Climate

Photo credit: Ben Grader

- Improve Forecasting Capabilities for Floods, Drought and Landslides

Better Agricultural Crop Forecasting

- The agricultural community needs to know the timing and amount of precipitation to forecast crop yields and warn of freshwater shortages that might affect irrigation and production
- Satellite data from the GPM mission will provide global precipitation estimates over land that can be incorporated into forecast models
- Land Surface Temperature (LST) data obtained from satellites provides useful information to model soil moisture levels which plays a key role in crop forecating.

Photo credit: Kevin Connors/morgueFile.com

https://pmm.nasa.gov/GPM

Image Resource: https://pmm.nasa.gov/sites/default/files/document_files/GPM%20Mission%20Brochure.pdf

Monitoring Freshwater Resources

Water resource managers rely on accurate precipitation measurements to monitor freshwater resources necessary for human activities including public consumption, irrigation, sanitation, mining, livestock and powering industries. Global observations of precipitation from the GPM constellation of satellites will allow scientist to better understand and predict changes in freshwater supply

Image Credit: https://www.worldwildlife.org/industries/freshwater-systems

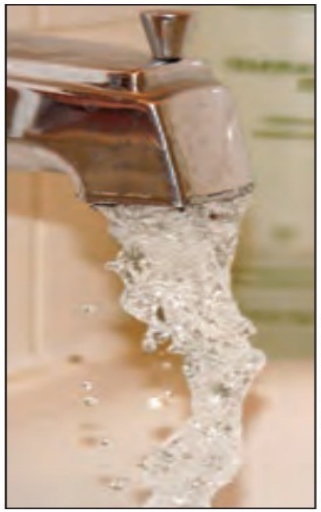
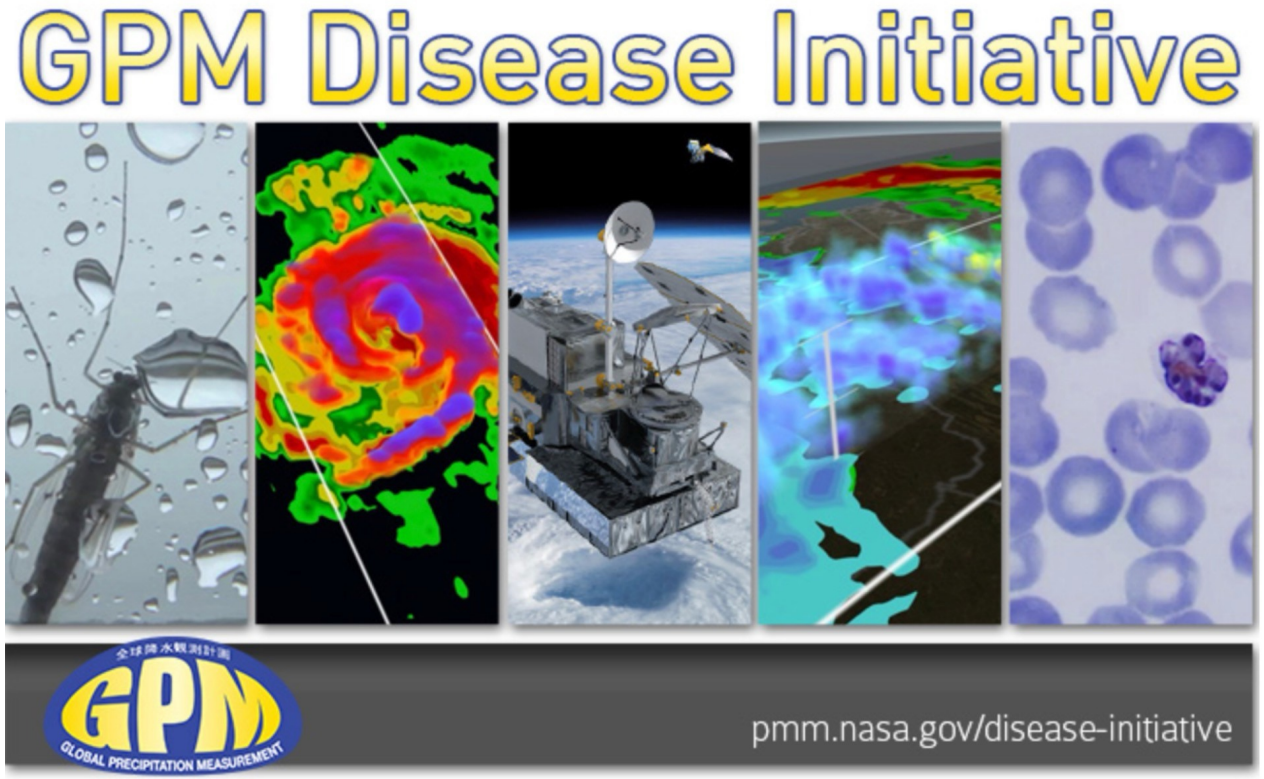


Photo credit: Jonah G. S.

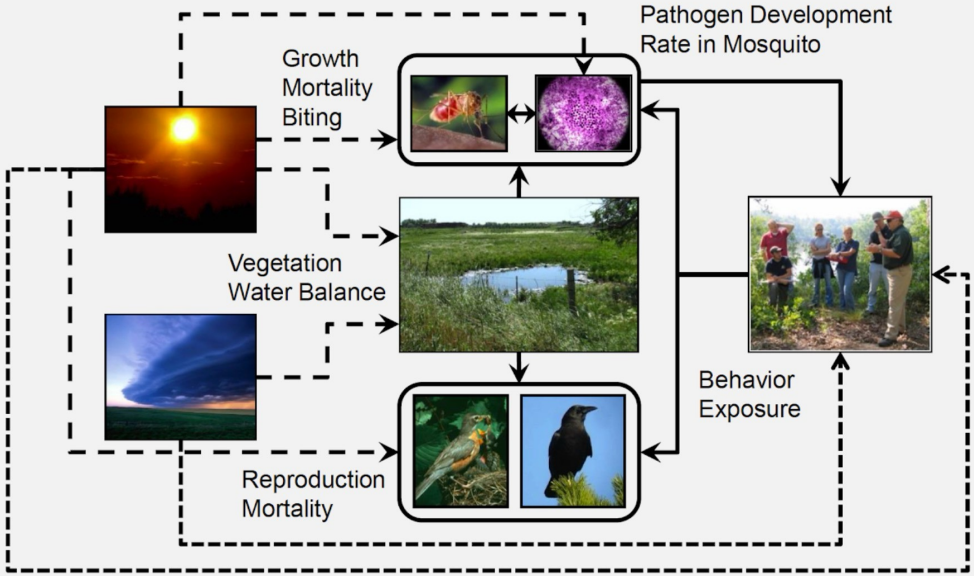
https://pmm.nasa.gov/GPM

Image Resource: https://pmm.nasa.gov/sites/default/files/document_files/GPM%20Mission%20Brochure.pdf


GPM Disease Initiative
全球降水観測計画
GPM
GLOBAL PRECIPITATION MEASUREMENT
pmm.nasa.gov/disease-initiative

- Relating Precipitation Information with the Disease Outbreaks.
- What makes the spread so quick?
- Where do we look for the next disease outbreak?
- Early Warning Systems
  - Dengue Early Warning System (DEWS)
  - Malaria Early Warning Systems (MEWS)

Meteorological variables and land cover influence mosquito-borne diseases through multiple pathways and can be monitored by earth-observing satellites



Slide/Image credit:
National Aeronautics and Space Administration

Image credit: Applied Remote Sensing Training Program

Thanks!

Work on Assignment 2!!