# What is Neo-Informatics?

Peter Fox[1]

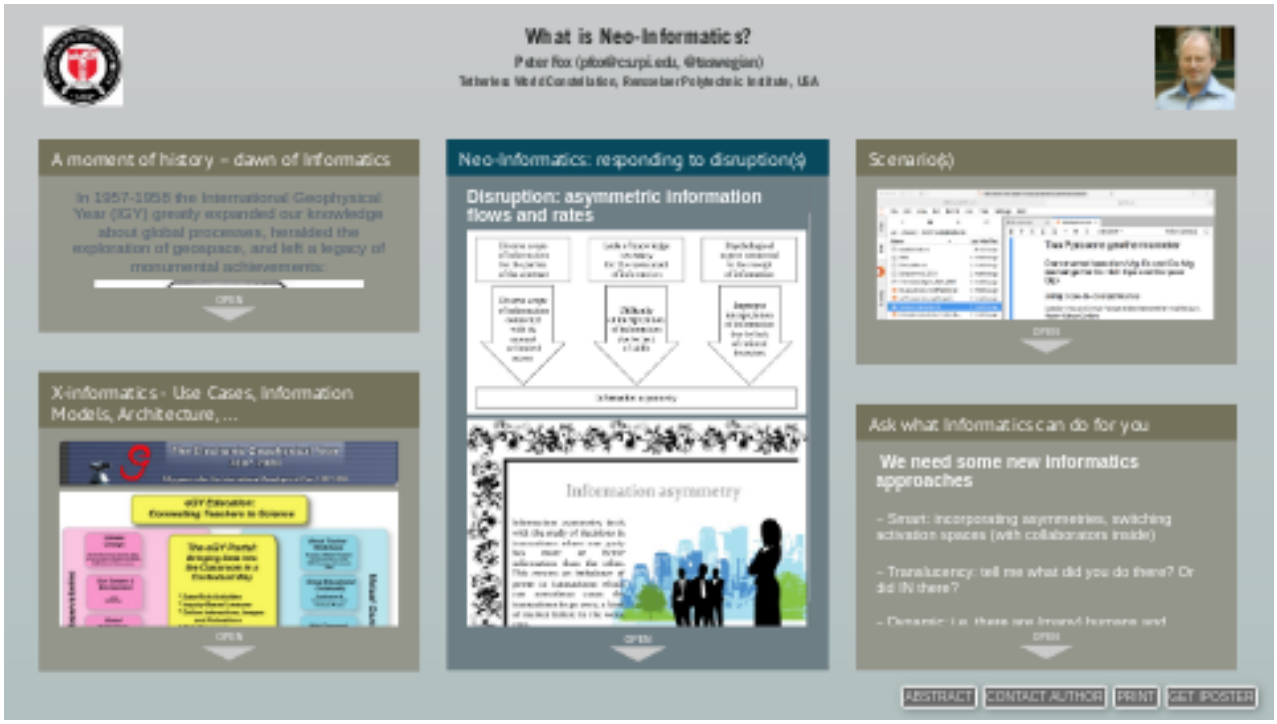
[1]Rensselaer Polytechnic Institute

November 22, 2022

**Abstract**

The discipline of informatics, generically cast as the science and engineering of information system within a socio-technical framework, originating in the middle of last century has undergone generational adaptations as computer hardware, networks and software have evolved. Within the "eScience" era of the last two decades, discipline-specific fields of informatics have flourished, such as geoinformatics, mineral informatics and many more. In fact even in geosciences, there may be few fields of study that have not added an informatics sub-field. Over the same time, efforts at systematizing the common (or core, i.e. discipline neutral) aspects of informatics have been successful: use cases, human-centered design, iterative approaches, information models and more are some of the key elements. However new pressures are being placed on functional and non-functional requirements of information systems: with the now somewhat routine underlying data that are high dimensional, heterogeneous, sparse and with uncertain quality. However, demands have arisen from renewed attention to hub/ server/ cloud-based provision of the application of machine learning, neural networks and artificial intelligence in general. Those methods as implemented in software libraries producing results to be assessed and interpreted (often leading to decisions made) by "humans-in-the-loop". Informatics, revisited is a possible answer. This presentation features some history of informatics, recent disruptions that need to be addressed, and offers ideas for new directions, with the goal of advancing geoscience in general.

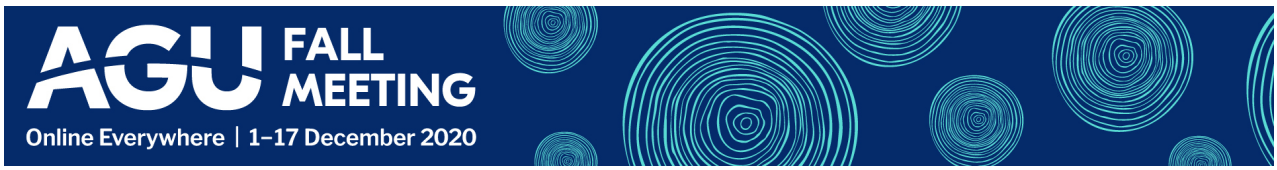
# What is Neo-Informatics?




Peter Fox (pfox@cs.rpi.edu, @taswegian)

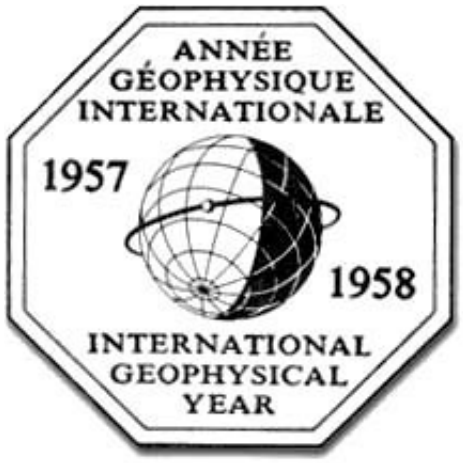
Tetherless World Constellation, Rensselaer Polytechnic Institute, USA

**PRESENTED AT:**



# A MOMENT OF HISTORY – DAWN OF INFORMATICS

In 1957-1958 the International Geophysical Year (IGY) greatly expanded our knowledge about global processes, heralded the exploration of geospace, and left a legacy of monumental achievements:




• Huge increase in the number and spread of geophysical observing stations around the globe, particularly in Antarctica (12 nations maintained 65 stations in Antarctica, 40 on the continent)

• Discovery of the Van Allen Radiation Belts

• Investigation of large unexplored areas of Antarctica

• First measurement of the thickness of the Antarctic ice sheet

• First artificial satellite was launched - the Russian Sputnik-1, launched 4 October 1957

• Establishment of the World Data Center system

• The Antarctic Treaty

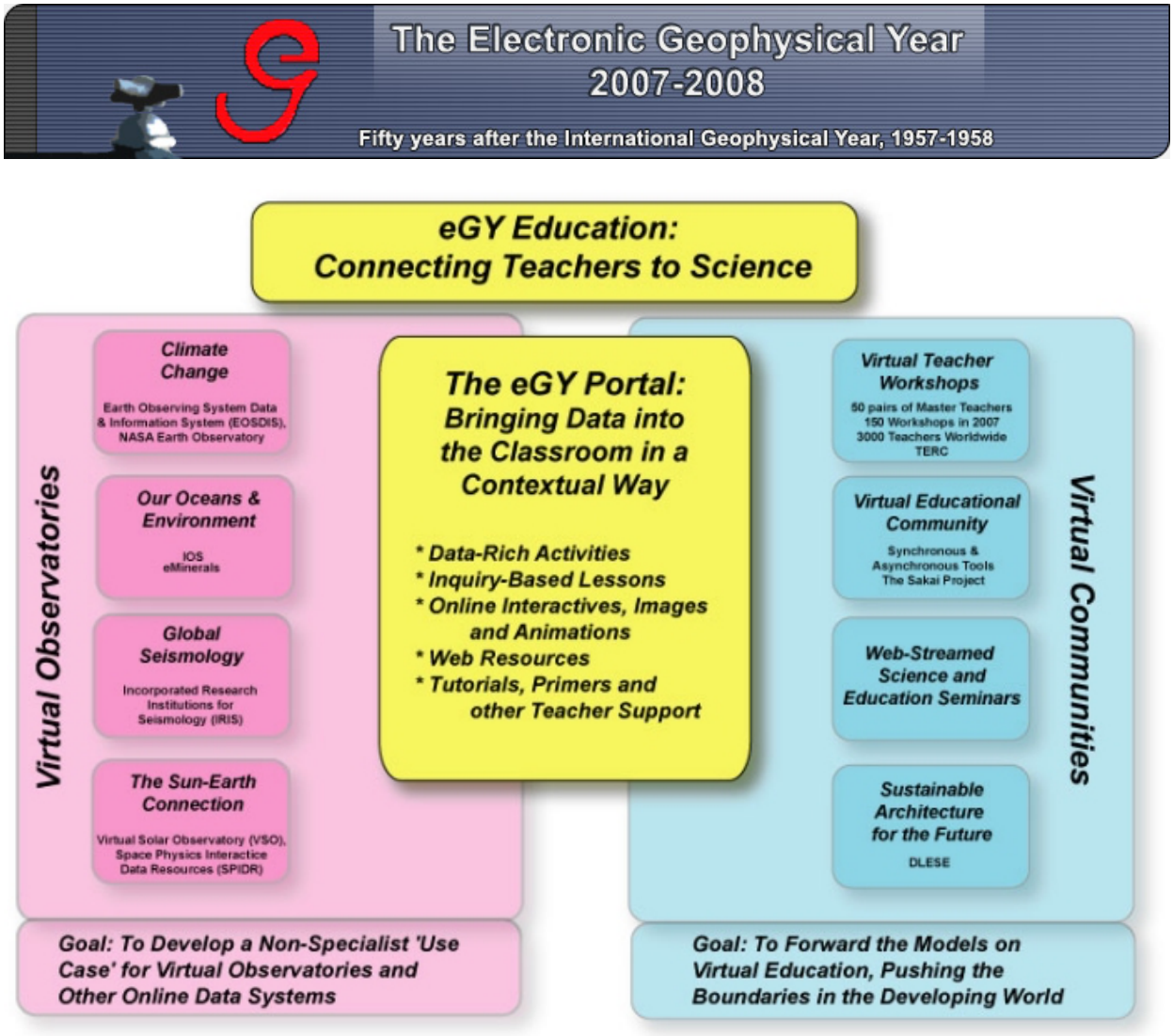
• Global Atmospheric Research Programme (GARP - predecessor to World Climate Research Program)

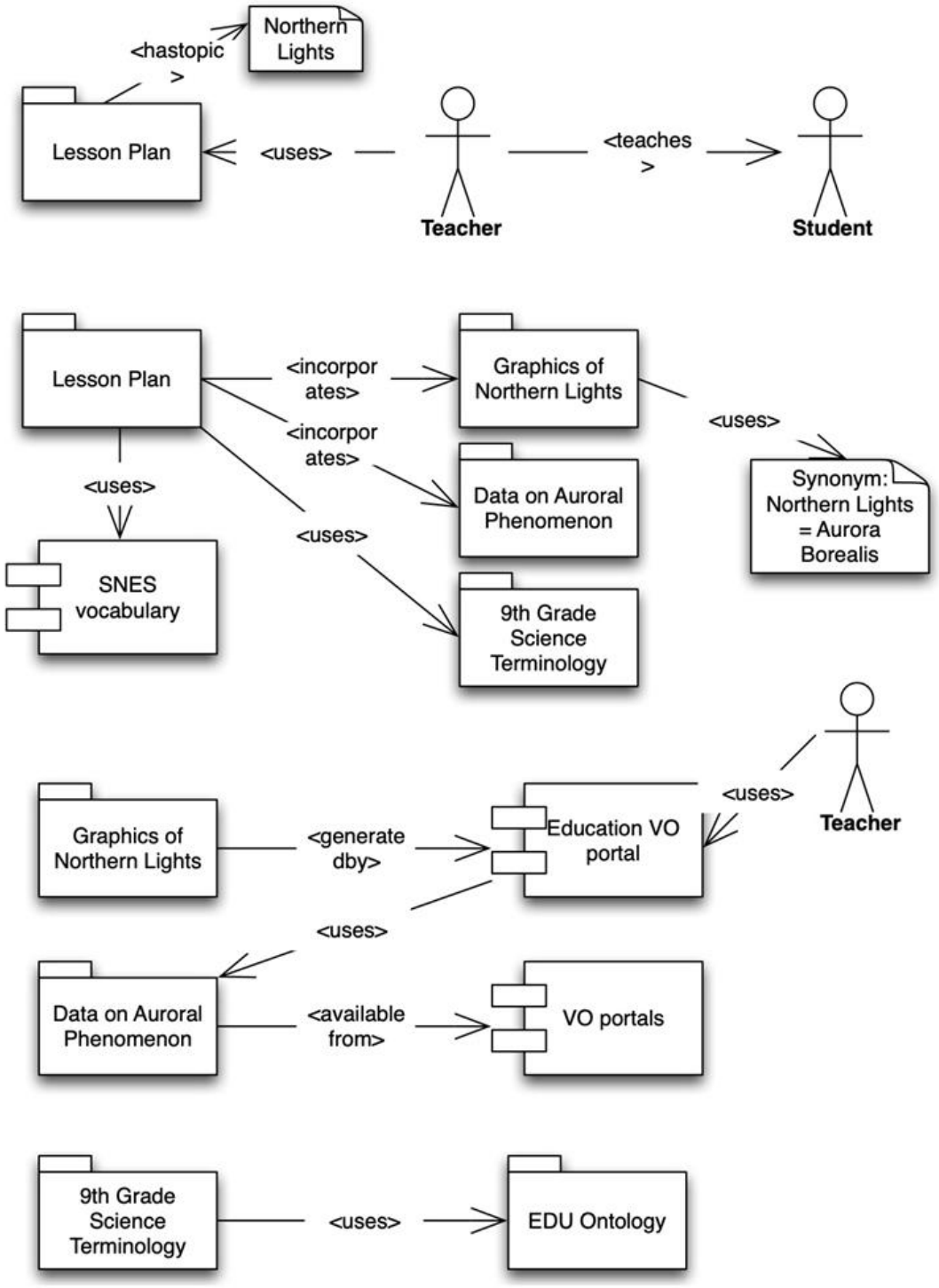
• New spirit of international cooperation and harmony was created despite a background of political tension.

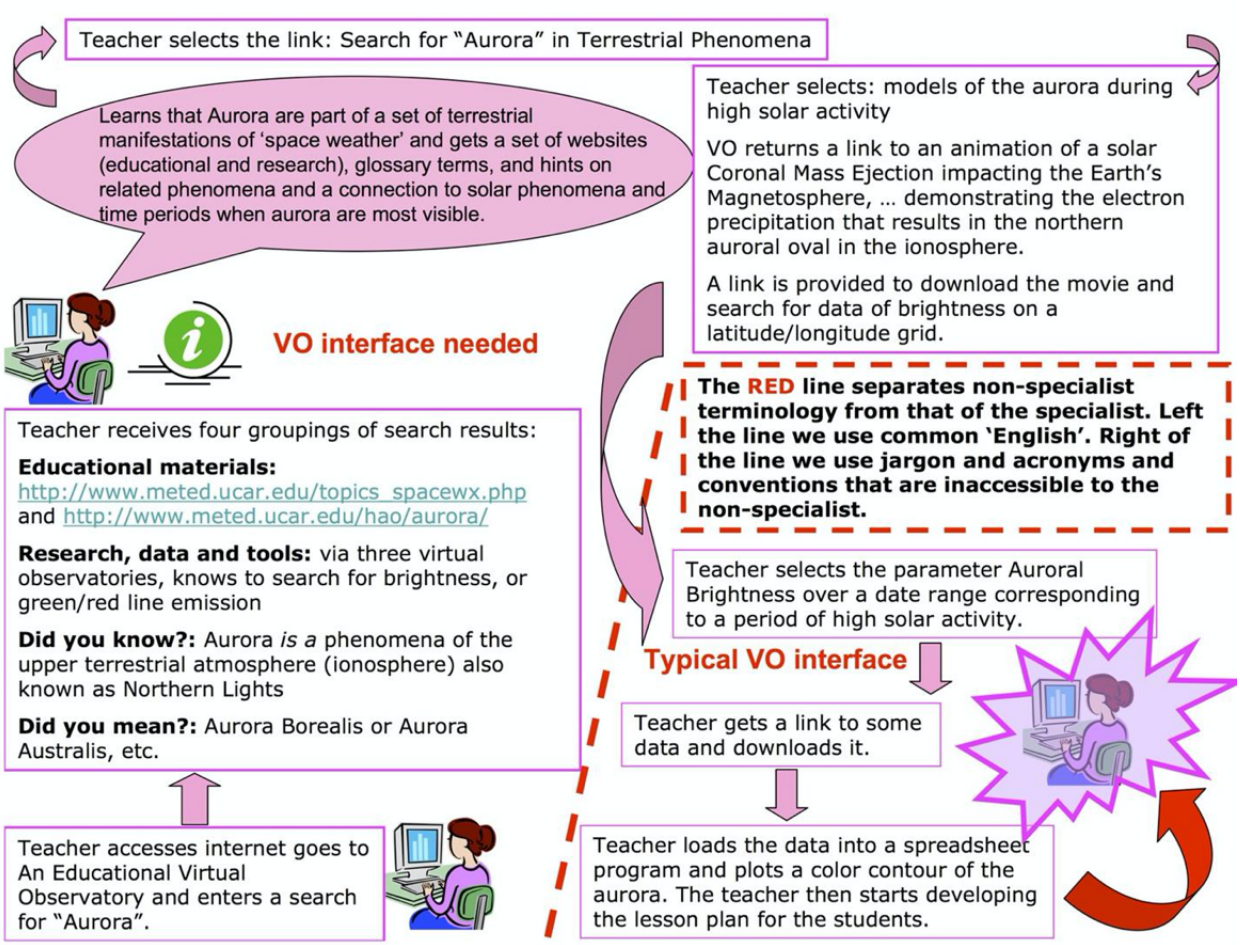
**The field of Informatics was defined.**


**In 2007-2008 Informatics was redefined: www.egy.org**

# X-INFORMATICS - USE CASES, INFORMATION MODELS, ARCHITECTURE, ...

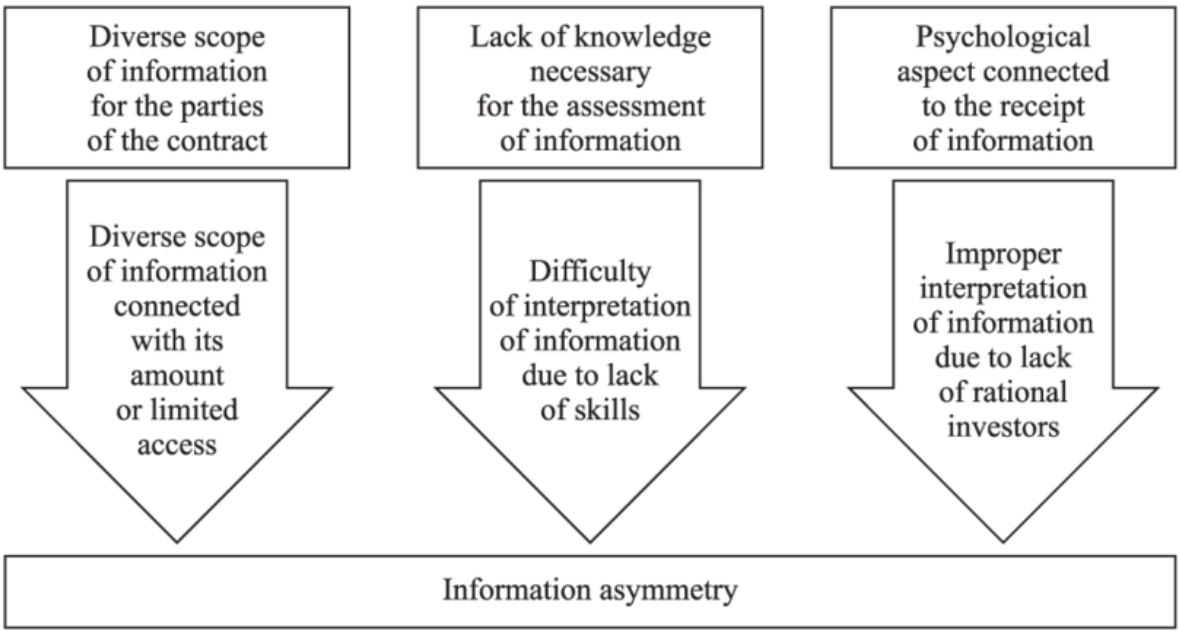


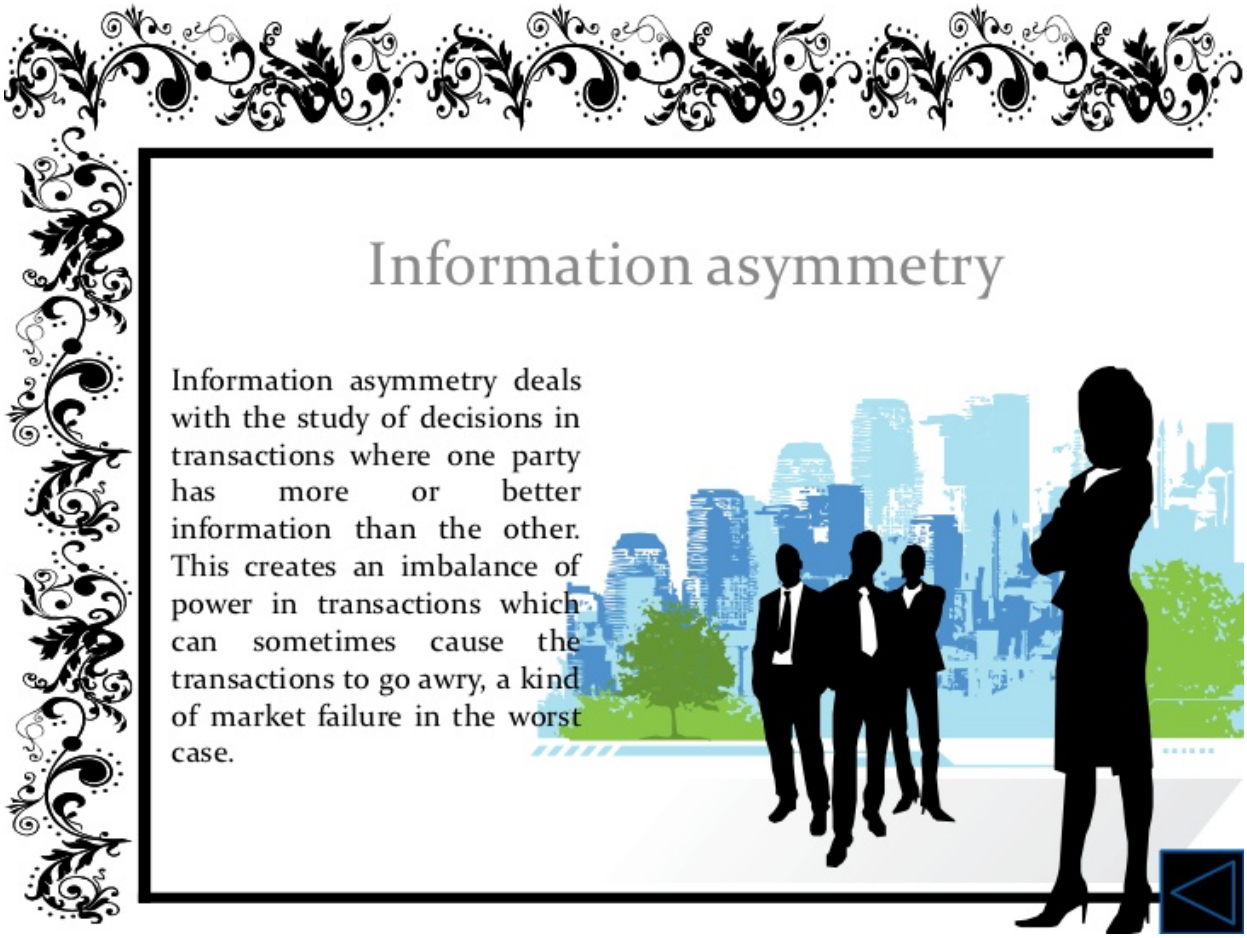

<hastopic
>
Northern Lights
Lesson Plan
<uses>
Teacher
<teaches
>
Student
Lesson Plan
<incorpor
ates>
Graphics of Northern Lights
<incorpor
ates>
<uses>
Synonym: Northern Lights = Aurora Borealis
<uses>
Data on Auroral Phenomenon
<uses>
SNES vocabulary
9th Grade Science Terminology
Graphics of Northern Lights
<generate
dby>
Education VO portal
<uses>
Teacher
<uses>
Data on Auroral Phenomenon
<available
from>
VO portals
9th Grade Science Terminology
<uses>
EDU Ontology


Teacher selects the link: Search for "Aurora" in Terrestrial Phenomena
Learns that Aurora are part of a set of terrestrial manifestations of 'space weather' and gets a set of websites (educational and research), glossary terms, and hints on related phenomena and a connection to solar phenomena and time periods when aurora are most visible.
VO interface needed
Teacher receives four groupings of search results:
Educational materials: http://www.meted.ucar.edu/topics_spacewx.php and http://www.meted.ucar.edu/hao/aurora/
Research, data and tools: via three virtual observatories, knows to search for brightness, or green/red line emission
Did you know?: Aurora is a phenomena of the upper terrestrial atmosphere (ionosphere) also known as Northern Lights
Did you mean?: Aurora Borealis or Aurora Australis, etc.
Teacher accesses internet goes to An Educational Virtual Observatory and enters a search for "Aurora".
Teacher selects: models of the aurora during high solar activity
VO returns a link to an animation of a solar Coronal Mass Ejection impacting the Earth's Magnetosphere, … demonstrating the electron precipitation that results in the northern auroral oval in the ionosphere.
A link is provided to download the movie and search for data of brightness on a latitude/longitude grid.
The RED line separates non-specialist terminology from that of the specialist. Left the line we use common 'English'. Right of the line we use jargon and acronyms and conventions that are inaccessible to the non-specialist.
Teacher selects the parameter Auroral Brightness over a date range corresponding to a period of high solar activity.
Typical VO interface
Teacher gets a link to some data and downloads it.
Teacher loads the data into a spreadsheet program and plots a color contour of the aurora. The teacher then starts developing the lesson plan for the students.

# NEO-INFORMATICS: RESPONDING TO DISRUPTION(S)

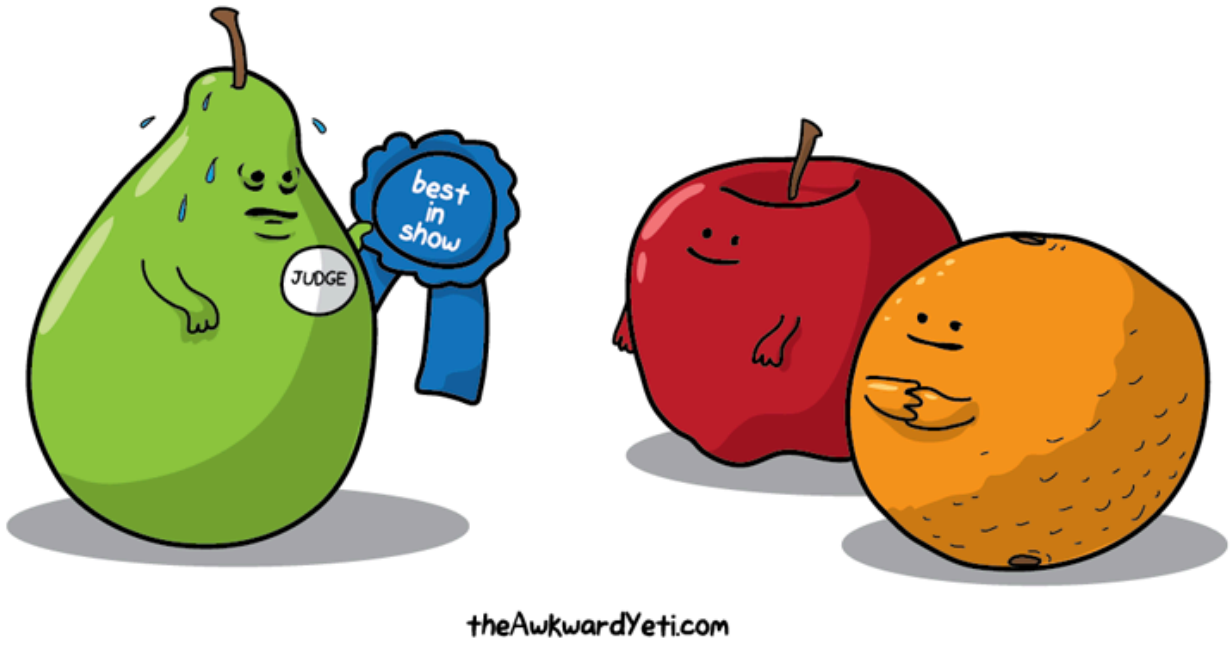
## Disruption: asymmetric information flows and rates



## Disruption: blacker boxes


## Disruption: fruit baskets




## Disruption: activation spaces in the face of many 'data' dimensions

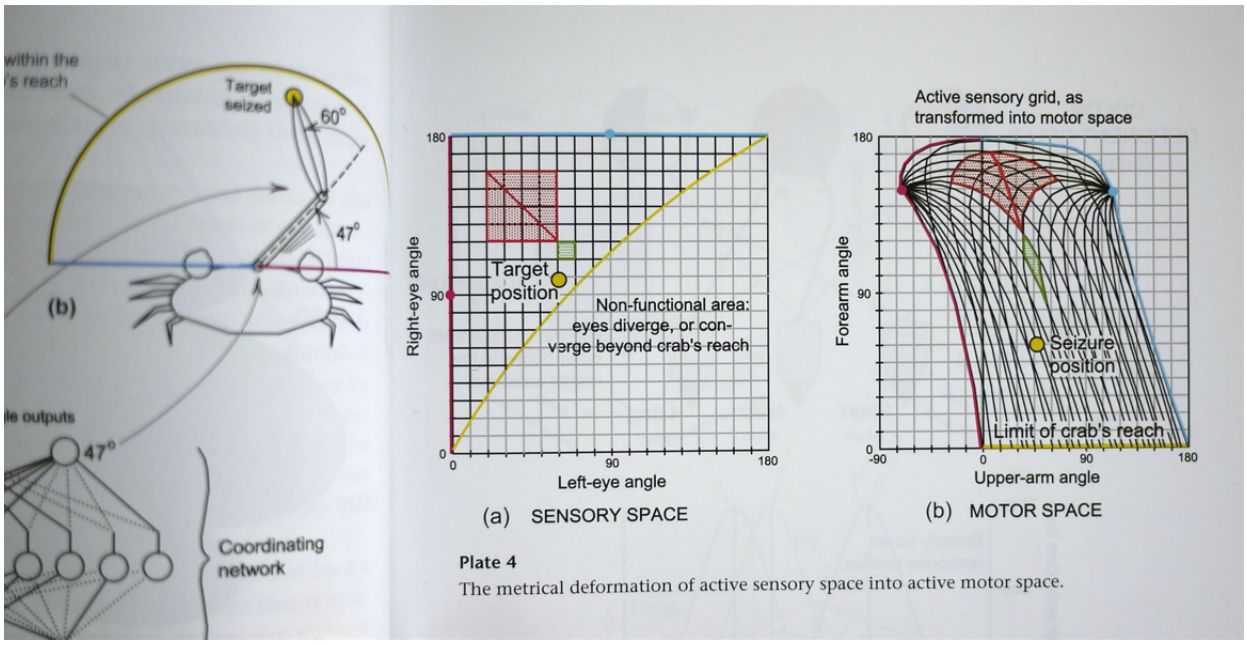
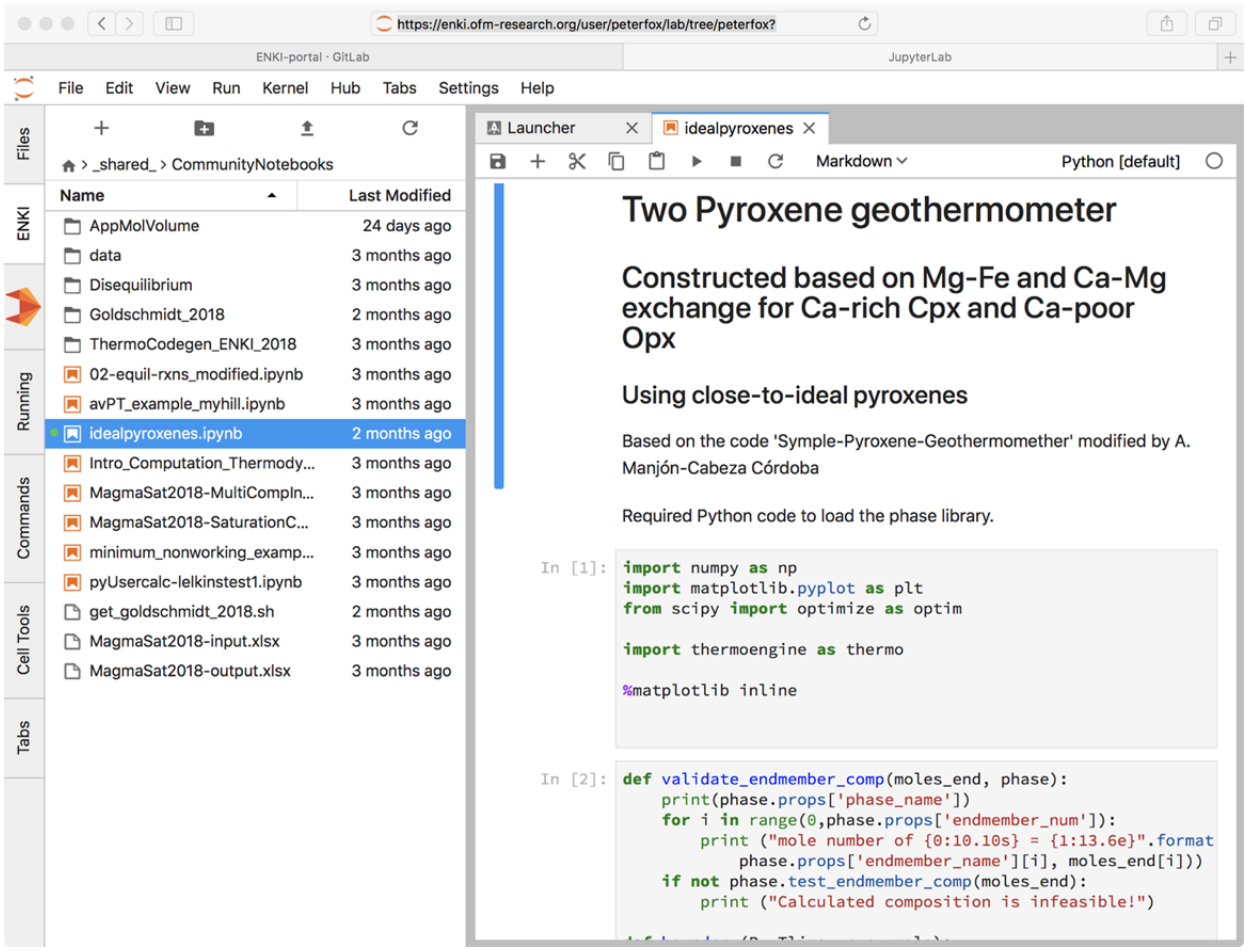
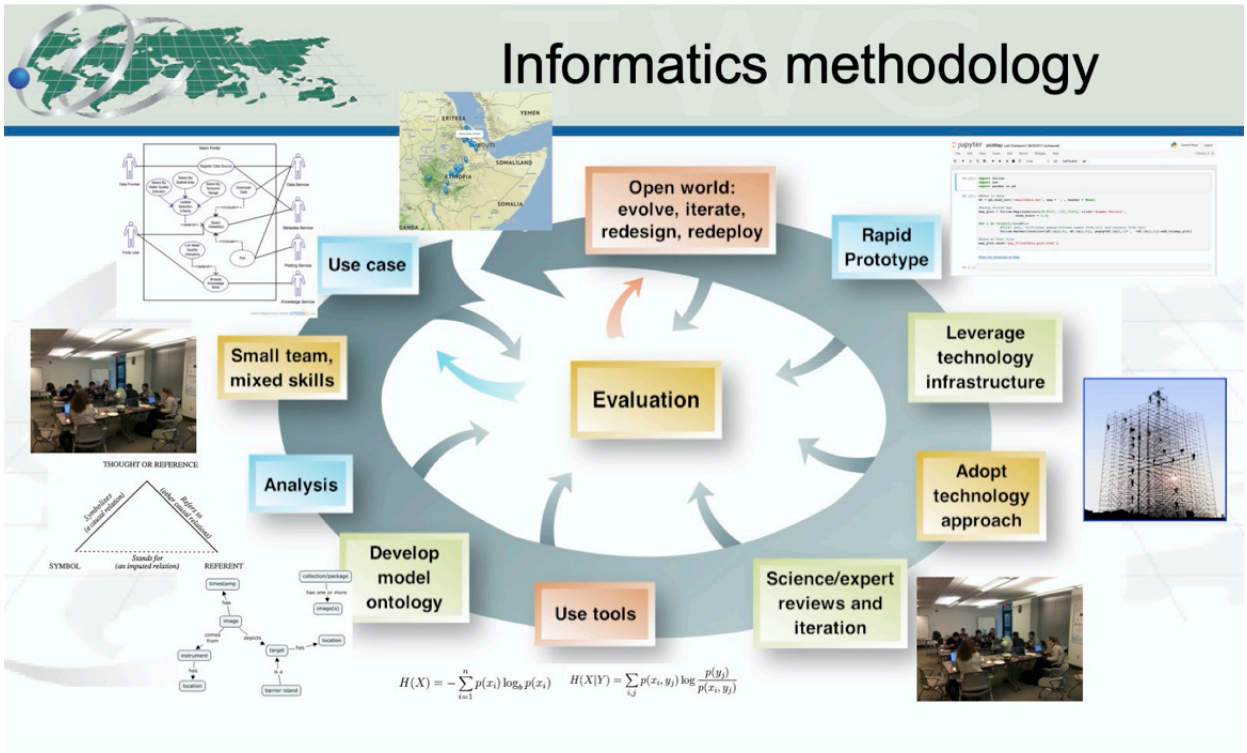


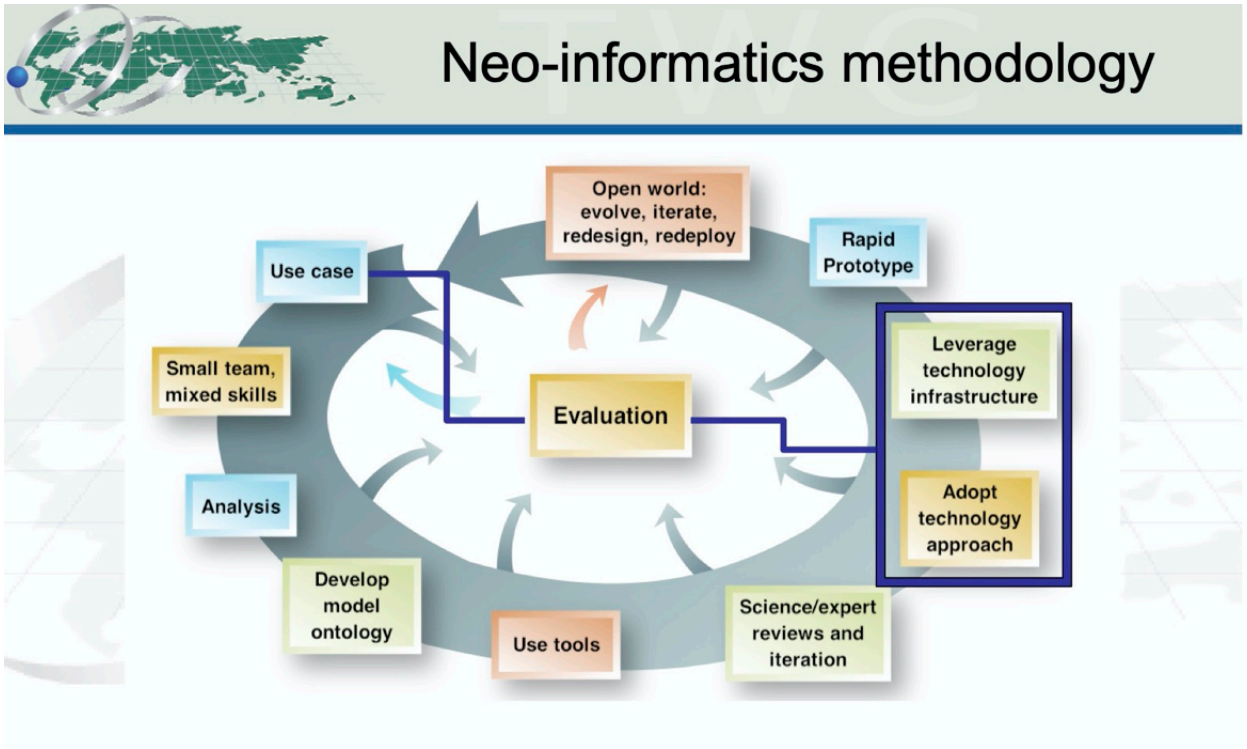

**Plate 4**

The metrical deformation of active sensory space into active motor space.

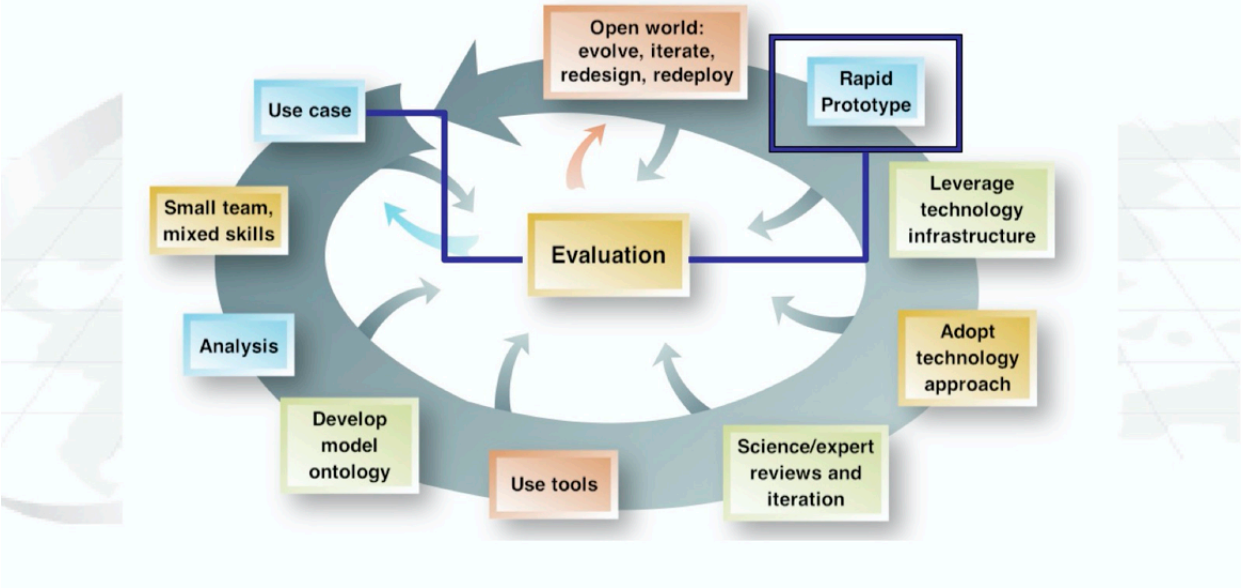
# SCENARIO(S)


https://enki.ofm-research.org/user/peterfox/lab/tree/peterfox?
ENKI-portal · GitLab
JupyterLab
File Edit View Run Kernel Hub Tabs Settings Help
Files
ENKI
Running
Commands
Cell Tools
Tabs
_shared_ > CommunityNotebooks
Name
Last Modified
AppMolVolume 24 days ago
data 3 months ago
Disequilibrium 3 months ago
Goldschmidt_2018 2 months ago
ThermoCodegen_ENKI_2018 3 months ago
02-equil-rxns_modified.ipynb 3 months ago
avPT_example_myhill.ipynb 3 months ago
idealpyroxenes.ipynb 2 months ago
Intro_Computation_Thermody... 3 months ago
MagmaSat2018-MultiCompIn... 3 months ago
MagmaSat2018-SaturationC... 3 months ago
minimum_nonworking_examp... 3 months ago
pyUsercalc-lelkinstest1.ipynb 3 months ago
get_goldschmidt_2018.sh 2 months ago
MagmaSat2018-input.xlsx 3 months ago
MagmaSat2018-output.xlsx 3 months ago
Launcher
idealpyroxenes
Markdown
Python [default]
Two Pyroxene geothermometer
Constructed based on Mg-Fe and Ca-Mg exchange for Ca-rich Cpx and Ca-poor Opx
Using close-to-ideal pyroxenes
Based on the code 'Symple-Pyroxene-Geothermomether' modified by A. Manjón-Cabeza Córdoba
Required Python code to load the phase library.
In [1]:
import numpy as np
import matplotlib.pyplot as plt
from scipy import optimize as optim
import thermoengine as thermo
%matplotlib inline
In [2]:
def validate_endmember_comp(moles_end, phase):
print(phase.props['phase_name'])
for i in range(0,phase.props['endmember_num']):
print ("mole number of {0:10.10s} = {1:13.6e}".format
phase.props['endmember_name'][i], moles_end[i]))
if not phase.test_endmember_comp(moles_end):
print ("Calculated composition is infeasible!")


Informatics methodology
Open world: evolve, iterate, redesign, redeploy
Rapid Prototype
Leverage technology infrastructure
Adopt technology approach
Science/expert reviews and iteration
Use tools
Develop model ontology
Analysis
Small team, mixed skills
Use case
Evaluation
THOUGHT OR REFERENCE
SYMBOL
REFERENT
Stands for (an imputed relation)
$H(X) = -\sum_{i=1}^{n} p(x_i) \log_b p(x_i)$
$H(X|Y) = \sum_{i,j} p(x_i, y_j) \log \frac{p(y_j)}{p(x_i, y_j)}$


Neo-informatics methodology
Open world: evolve, iterate, redesign, redeploy
Rapid Prototype
Leverage technology infrastructure
Adopt technology approach
Science/expert reviews and iteration
Use tools
Develop model ontology
Analysis
Small team, mixed skills
Use case
Evaluation

# Neo-informatics methodology



# ASK WHAT INFORMATICS CAN DO FOR YOU

## We need some new informatics approaches

– Smart: incorporating asymmetries, switching activation spaces (with collaborators inside)

– Translucency: tell me what did you do there? Or did IN there?

– Dynamic: i.e. there are (many) humans and machines in the loop of execution

– Stateful: "… don't you, forget about me …"

## Executable use cases?

– Dynamic analysis for actors, resources, "workflow", pre-conditions, post-conditions, alternate flows

– Dynamic iteration of use case narrative (and diagrams) based on actor(s) mediation = as you are typing in a Jupyter notebook, modifying code, etc. – smart mediation brings up the next optional cells for you

– Leverages asymmetry while reducing complexity of mediation

– Determines optimal activation spaces using conditional entropy and semiotic considerations

– Makes you the best coffee (or tea) you have ever had

Activation spaces - thanks to Chris Rose (RISD).

# ABSTRACT

The discipline of informatics, generically cast as the science and engineering of information system within a socio-technical framework, originating in the middle of last century has undergone generational adaptations as computer hardware, networks and software have evolved. Within the "eScience" era of the last two decades, discipline-specific fields of informatics have flourished, such as geoinformatics, mineral informatics and many more. In fact even in geosciences, there may be few fields of study that have not added an informatics sub-field. Over the same time, efforts at systematizing the common (or core, i.e. discipline neutral) aspects of informatics have been successful: use cases, human-centered design, iterative approaches, information models and more are some of the key elements. However new pressures are being placed on functional and non-functional requirements of information systems: with the now somewhat routine underlying data that are high dimensional, heterogeneous, sparse and with uncertain quality. However, demands have arisen from renewed attention to hub/ server/ cloud-based provision of the application of machine learning, neural networks and artificial intelligence in general. Those methods as implemented in software libraries producing results to be assessed and interpreted (often leading to decisions made) by "humans-in-the-loop". Informatics, revisited is a possible answer. This presentation features some history of informatics, recent disruptions that need to be addressed, and offers ideas for new directions, with the goal of advancing geoscience in general.