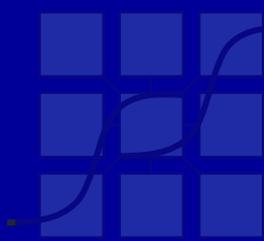


Evolution, Predictability, Lamarck, Altshuller, Darwin and Chaos



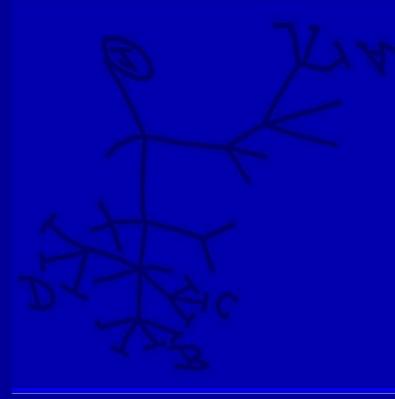
Ido Lapidot & David W. Conley





The best way to predict the future is to invent it

Alan Kay



Macro Level Predictions

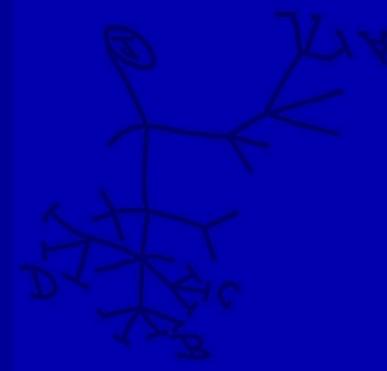
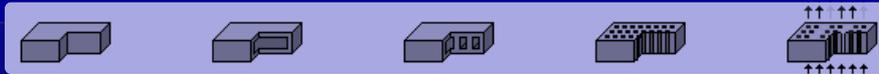
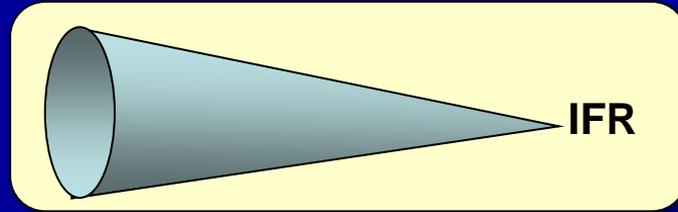
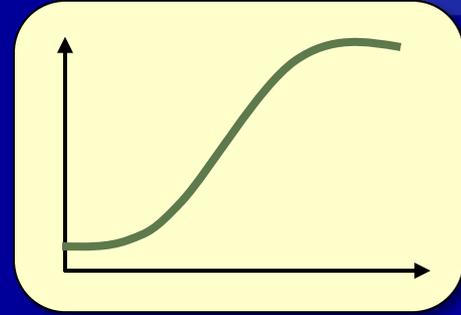
R. Kurzweil: The Law of Accelerating Returns



“Evolution applies positive feedback in that the more capable methods resulting from one stage of evolution progress are used to create the next stage. As a result, the rate of progress increases exponentially over time”.

System level Predictions

TRIZ Laws Of Evolution



Platonism Vs. Aristotelian Theories

Platonism, Theory of Forms:

- The material world is an image of an Ideal world
- The ideal world is built upon archetypes of Forms, which can only be perceived by reason
- The apparent forms are constantly in changes toward Ideal forms

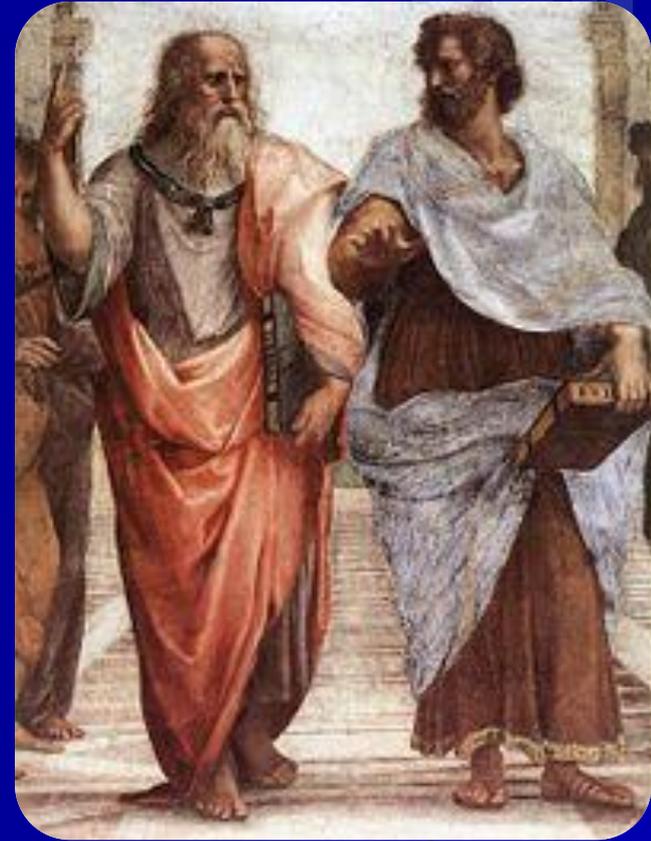


A Platonism theory describe a phenomenon, but do not explain it's caused.

Platonism Vs. Aristotelian Theories

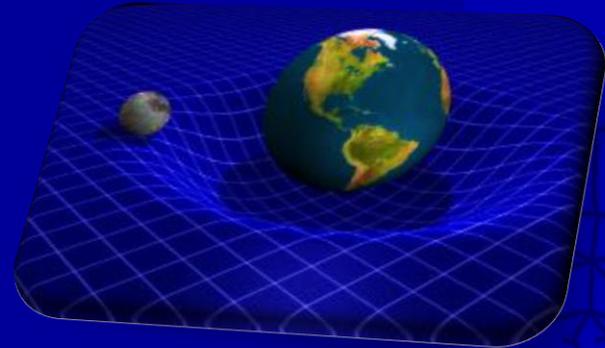
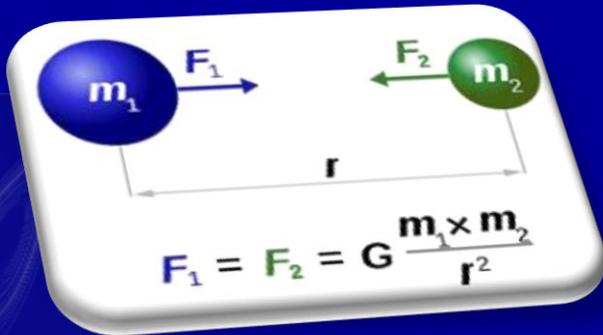
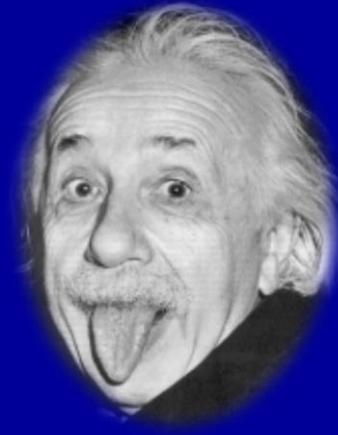
Aristotelian Theory:

- The existence of the Material world is the only real existence
- Everything in the world exists under the four factors:
 - The **Material** cause (what it is made of)
 - The **Form** cause (what has shaped it)
 - The **Causal** factor (what brought it into existence)
 - The **Goal-oriented** factor (purpose for which it exists)



An Aristotle's theory describe the reason or drive behind a phenomenon

Example: Platonism Vs. Aristotelian Theories



Is it possible to turn TRIZ into an Aristotelian Theory?

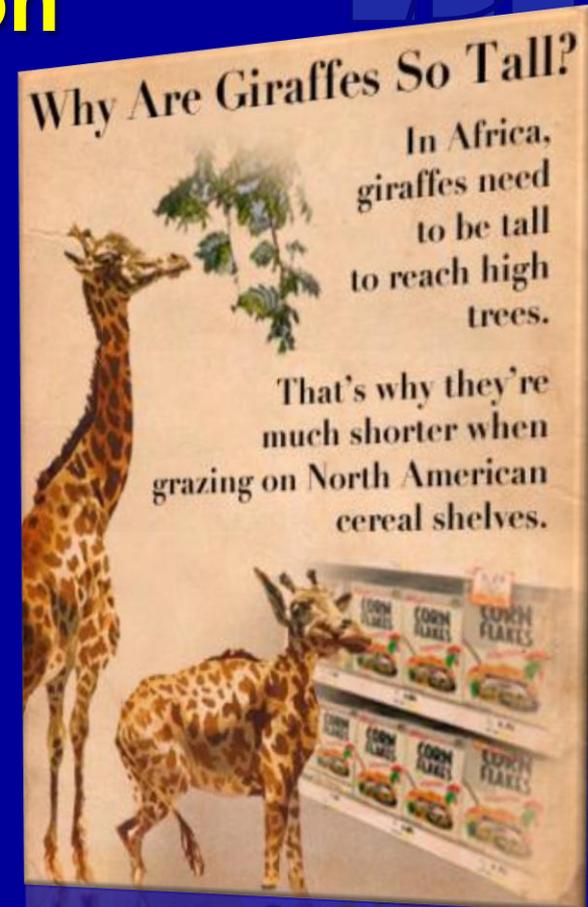
What drives systems toward Ideality?

Why systems evolve along trends of evolution?



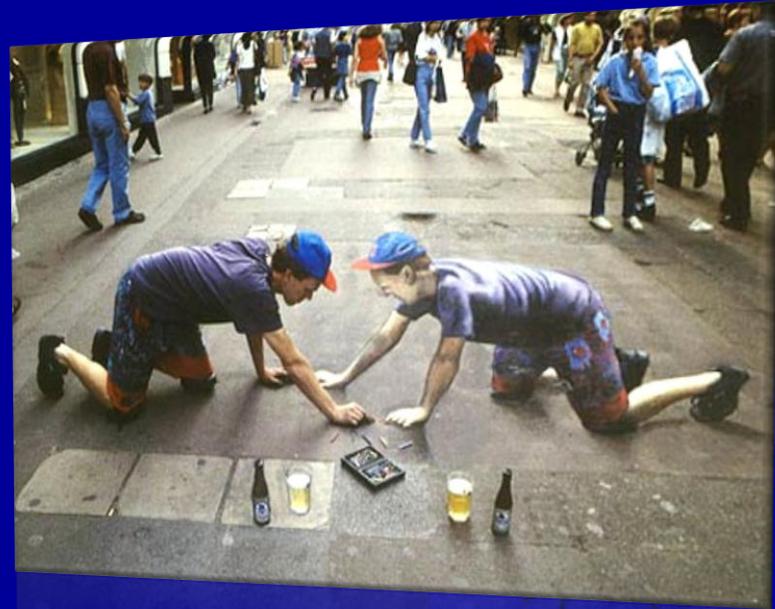
Lamarck's Theory Of Evolution

1. The development of an organism is based on needs
2. Evolution happens according to a predetermined plan
3. An organism changes during its life in order to better adapt to its environment
4. Those changes are passed onto its offspring.
5. The development of an organism trait or feature is proportional to the usage of that trait or feature and therefore, if it is not in use, it will eventually disappear.



TRIZ Law of Evolution

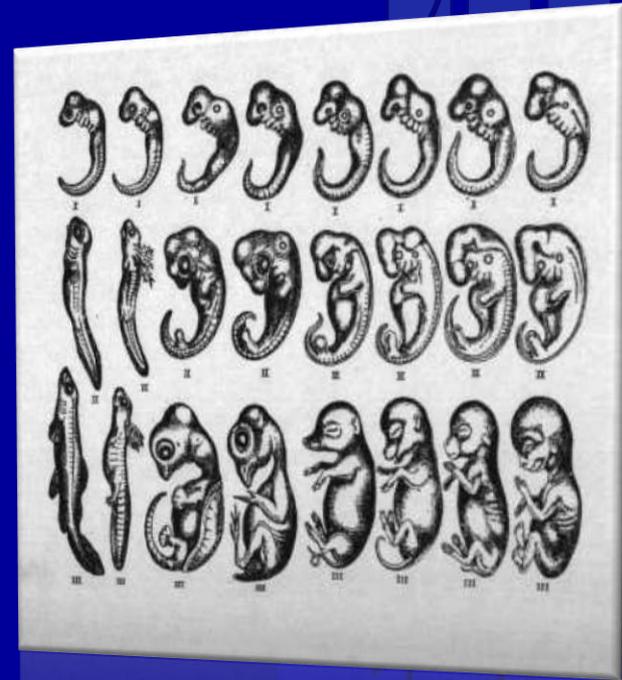
1. The development of manmade systems is based on **needs**
2. Evolution happens according to a **predetermined plan**, follows an S-Curve towards **increasing Ideality**
3. Systems changes in order to better **adapt** to its environment by improving usages of resources (increased Dynamization, increased synchronization, reduced human involvement and increased, followed by reduced complexity)



TRIZ is a projection of Lamarck's Theory on the Technology World

Darwin Theory of Evolution

1. **Natural Selection** - the available environment resources are insufficient to support all organisms, therefore those organisms having the most beneficial traits are more **likely** to survive and reproduce hence adaptation is ever increasing
2. **Preservation** - accurate **copying** of successful traits from one generation to the next
3. **Variety** - new traits are introduced through a random transfer of traits by way of mating, cross-species gene transfer and mutations.



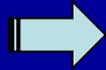
No Ideal System

Darwin's Vs. Lamarck's Evolution Theories

In Biology it is all Darwin's, What about Technology?

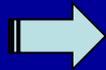
Memetics Theory definition (Preservation only):

Lamarck

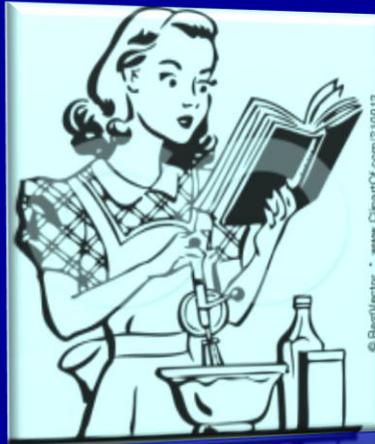


Copy a Product

Darwin



Copy a Recipe

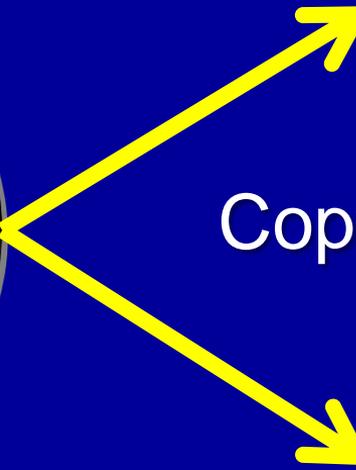


Copy a Product Vs. Copy a Recipe



Copy a Recipe – Darwin's type of evolution

Copy a Product Vs. Copy a Recipe



Copy a Product

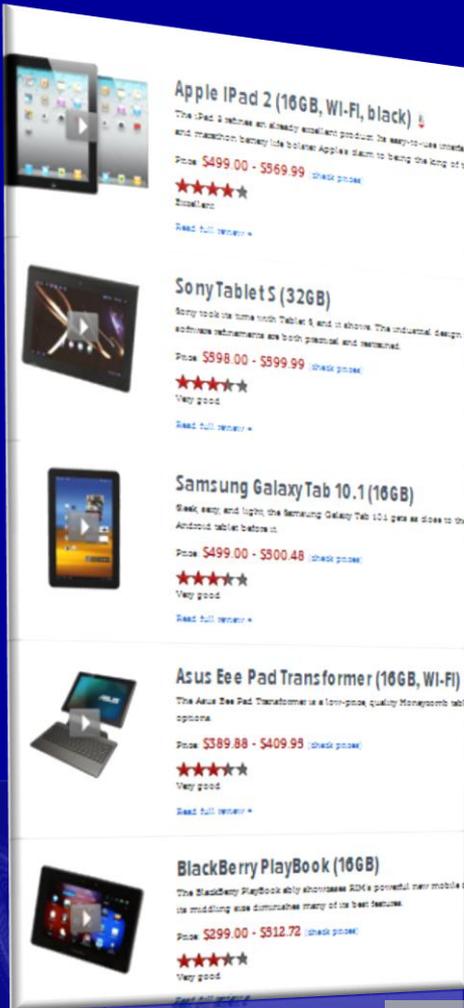


Lamarck's type of Evolution

Copy a Product Vs. Copy a Recipe

Apple iPad2 is the market leader at almost any parameter.

Other's might take the lead when "Copy a Recipe" will become their main copying mechanism



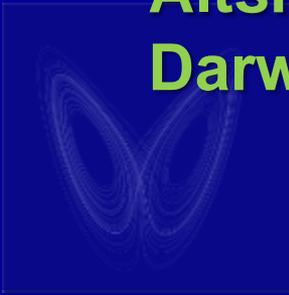
Source - CNET

Tablet name	Video battery life (in hours)	Web site load speed (in seconds)	Maximum brightness (in cd/m2)	Default brightness (In cd/m2)	Contrast ratio
Apple iPad	12.6	9	388	161	881:1
Dell Streak 5	4.7	8	416	330	868:1
Dell Streak 7	3.3	7	330	146	868:1
Motorola Xoom	9.3	6	312	131	1,200:1
Samsung Galaxy Tab	7.8	8	364	123	674:1
Viewsonic ViewPad G Tablet	7.8	8	364	123	1,093:1

Copy a Product Vs. Copy a Recipe

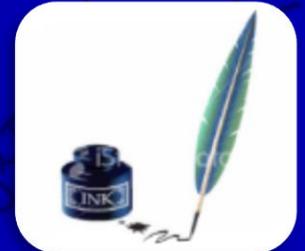
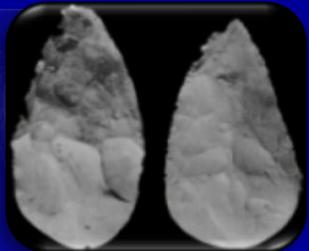
“Copy a Recipe“ (Darwin’s evolution) provide a breakthrough improvement in knowledge preservation, therefore it is most likely that it is dominant manmade systems progress (since invention of Writing)

How can the deterministic behavior observed by Altshuller and his successors, be explained using Darwin’s evolution mechanisms?



First Candidate: Convergent Evolution

Acquisition of similar traits by unrelated species Occurs in the presence of strong environment restriction forces



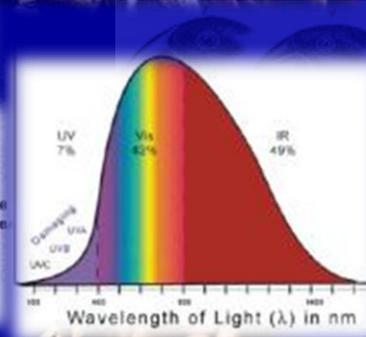
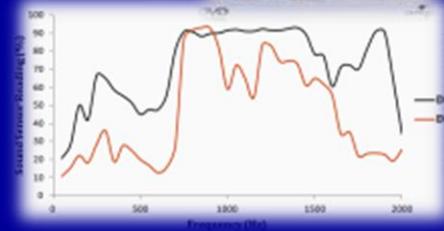
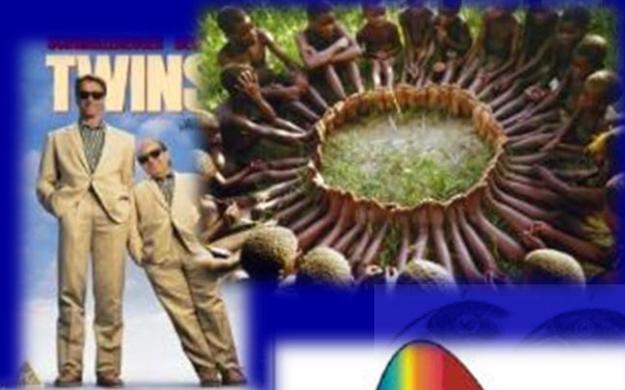
What Is The Cause Of Restriction Forces?

1. Environment rate of change is significantly lower than the systems rate of change

$$\frac{\delta E}{\delta t} \ll \frac{\delta S}{\delta t}$$

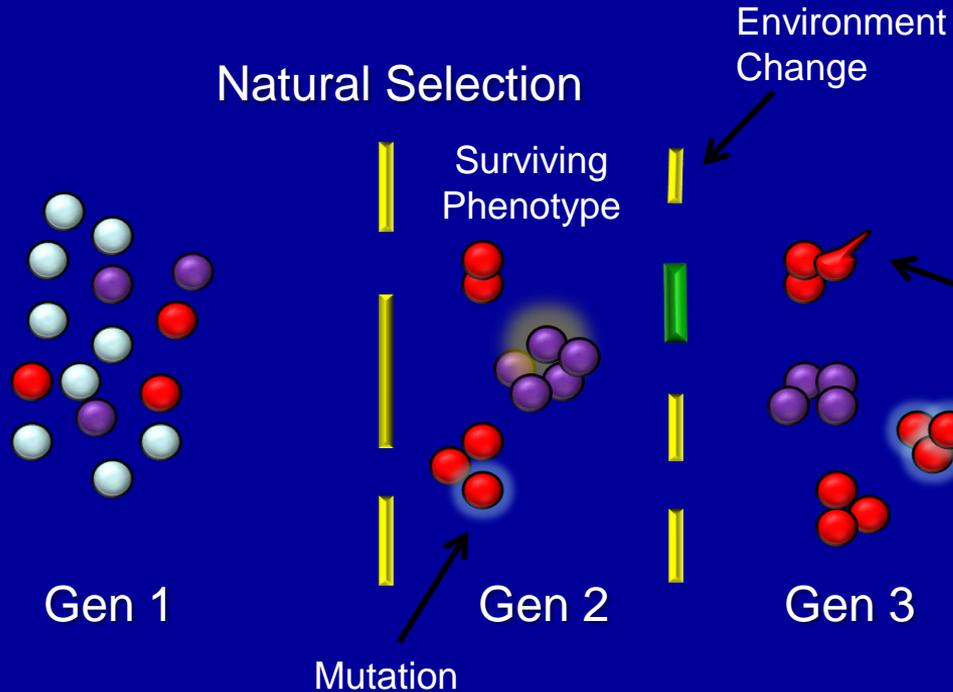
S - System
E - Environment
t - Time

2. Humans are the major environment restriction to manmade systems
(Manmade Systems were desian to serve Humans)

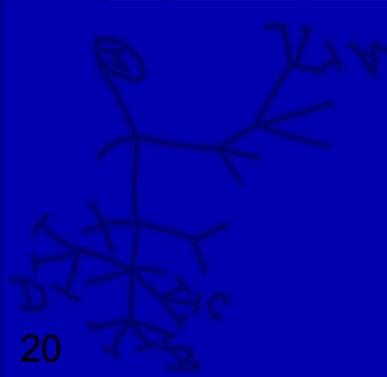


Evolution Mechanism

Current Phenotype



Complexity Rise



Convergent Evolution

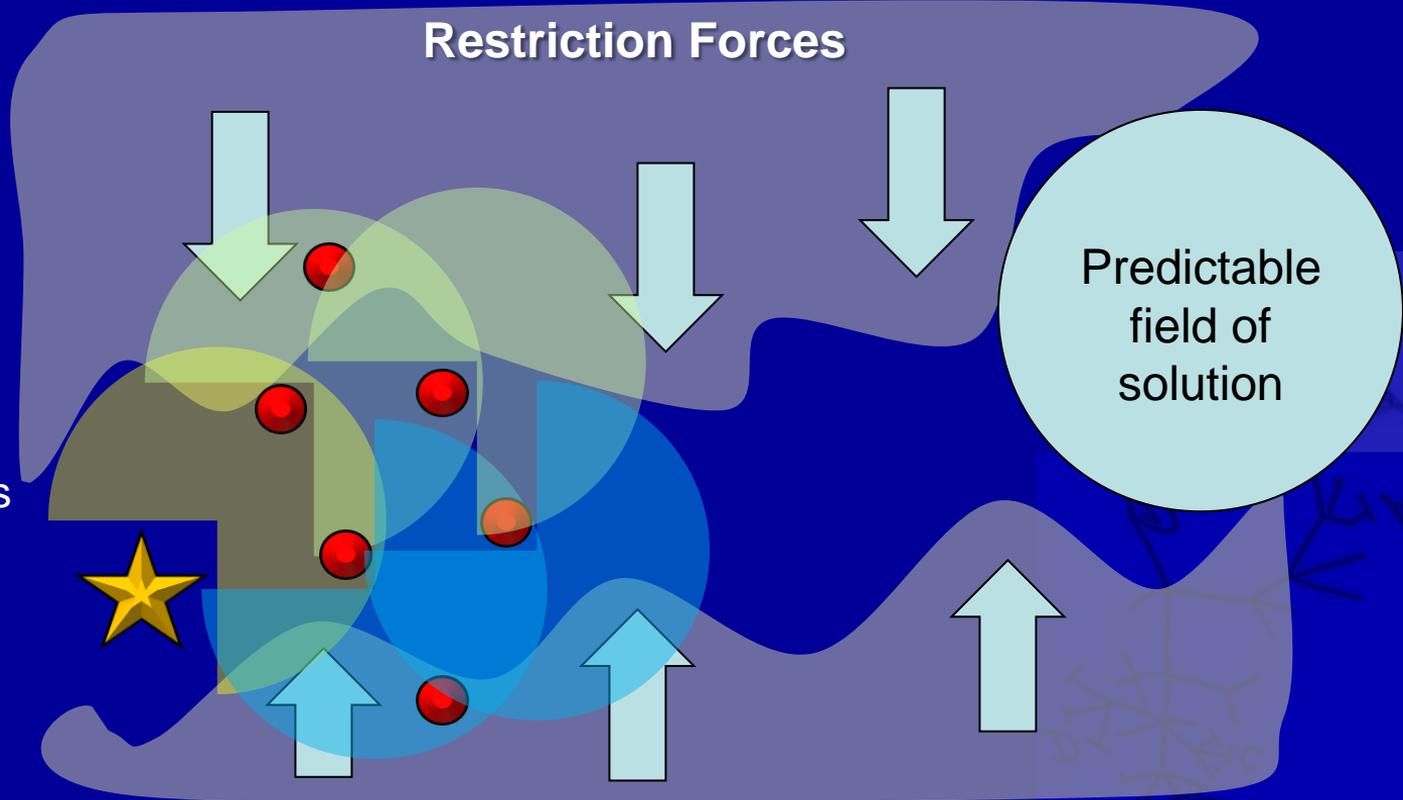
Restriction Forces
are vectors of
Natural selection

Field of
solutions

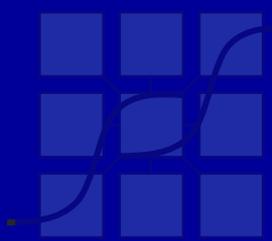
Restriction Forces

Predictable
field of
solution

- ★ Current system
- Valid solutions
- Non-valid solutions



Second Candidate: Nonlinear Dynamical System



Evolution is a “Nonlinear Dynamical System,” where each generation is depending on its previous generation:

$$G_n = f(t; G_{n-1}; E_{n-1})$$

$$E_{n-1} = f(G_n)$$



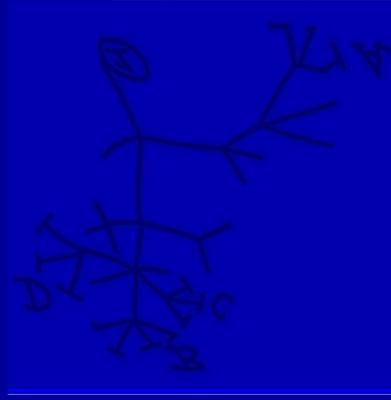
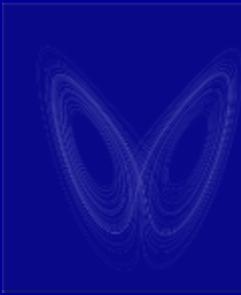
Where:

G – Generation

T – Time

E – Environment

n – Generation number

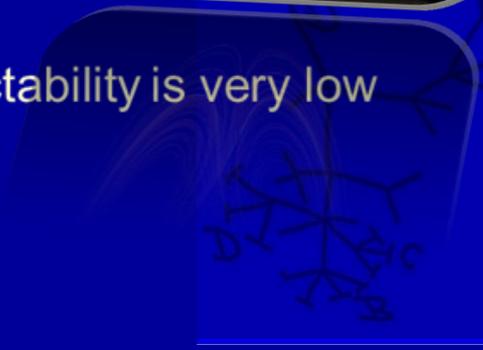


Nonlinear Dynamical System

A system that does not satisfy the "Superposition Principle"

$$(F(X_1 + X_2 + \dots) = F(X_1) + F(X_2) + \dots)$$

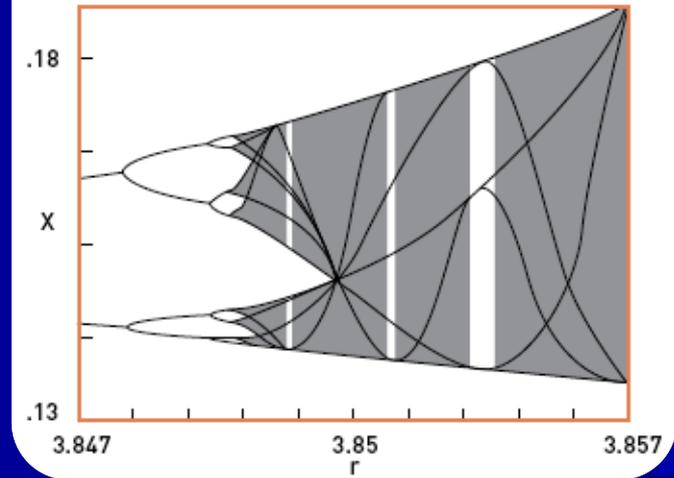
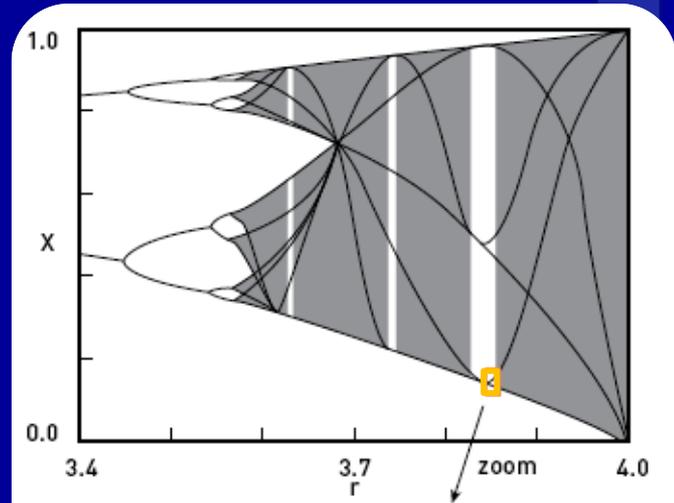
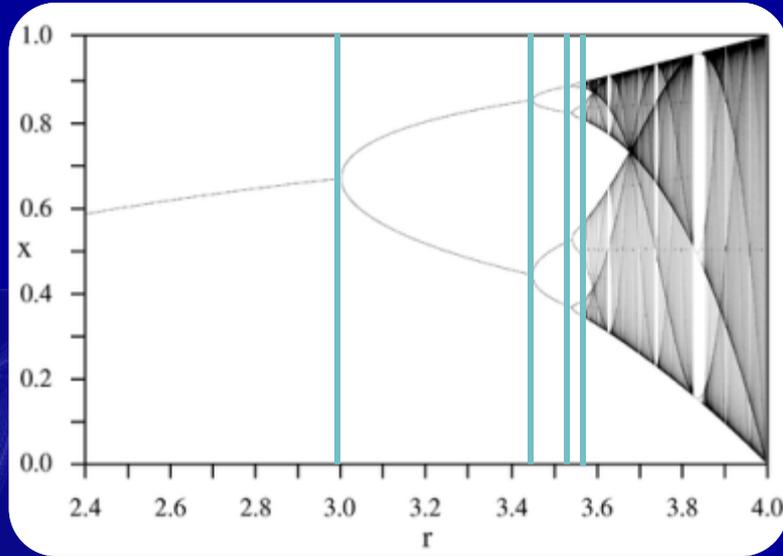
- ☞ Most physical systems are inherently nonlinear in nature
- ☞ Nonlinear equations is the base of Chaos theory which describe the behavior of dynamical systems, which are highly sensitive to initial conditions
- ☞ Although such system can be deterministic, their predictability is very low



Chaos Example: The logistic Equation

$$X_{n+1} = rX_n(1 - X_n)$$

- X – Population
- r – Driving Parameter
- n – Generation number

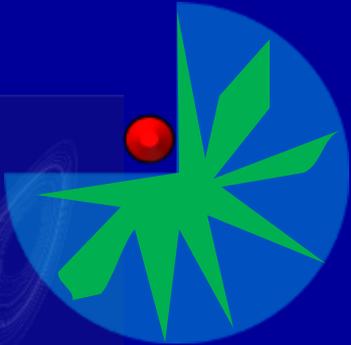
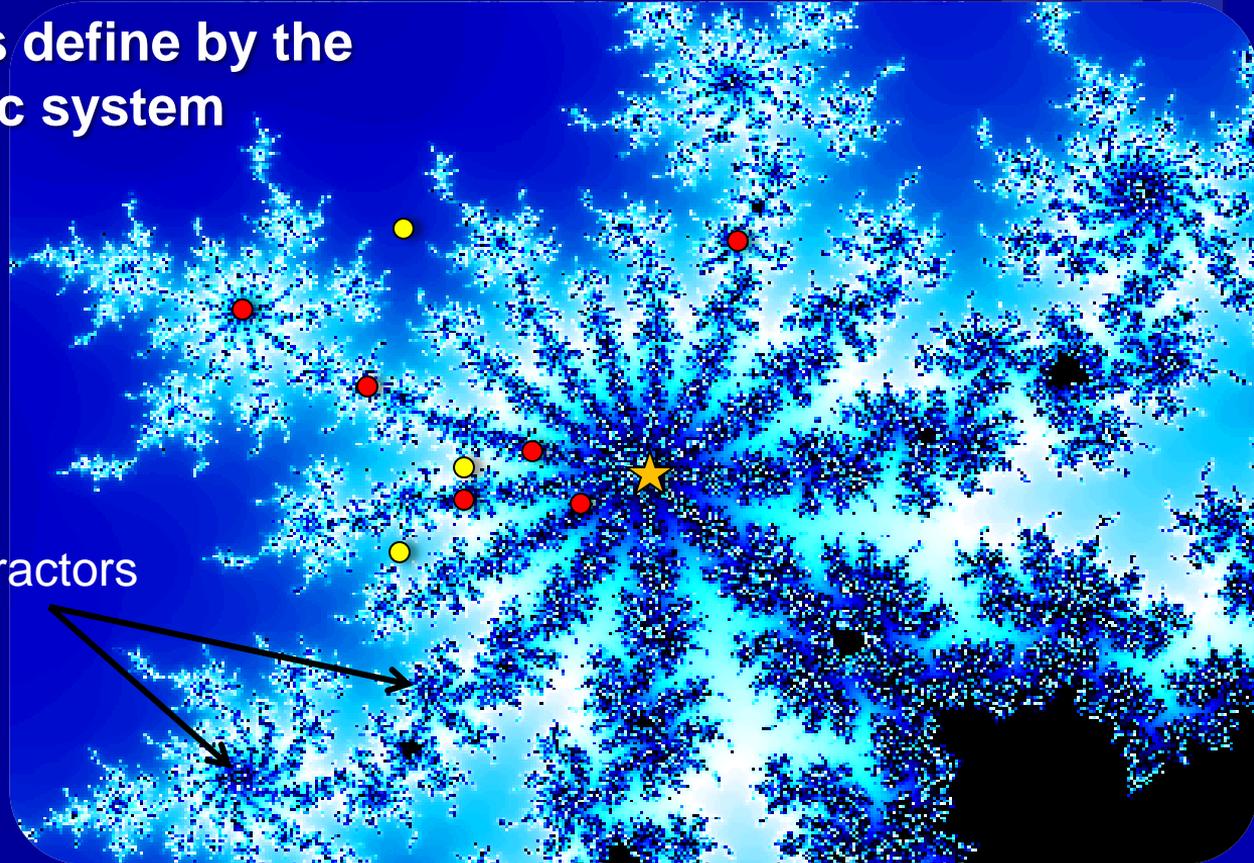


Proposed Mechanism – Evolution Trends

The field of solutions is define by the behavior of the dynamic system

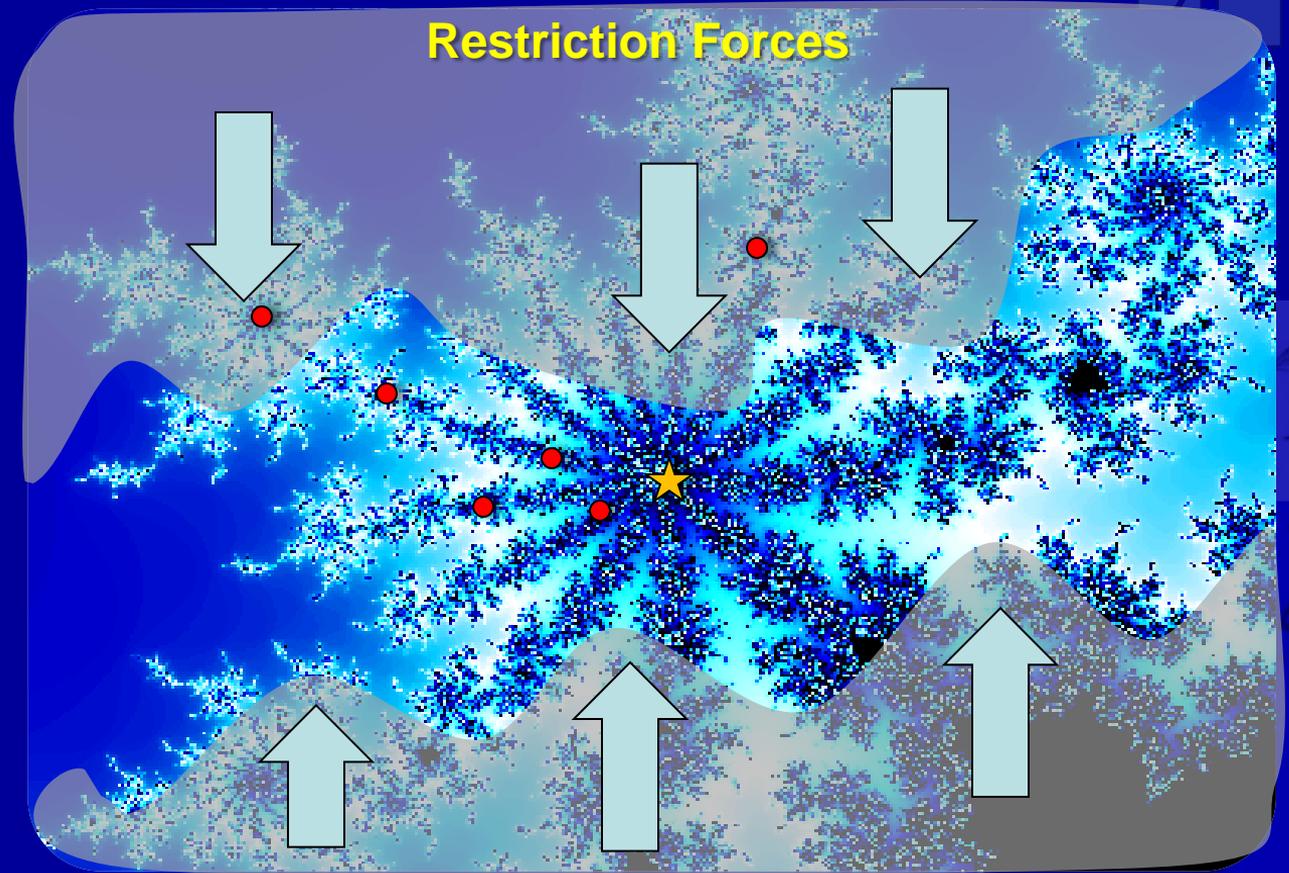
- ★ Current system
- Valid Step
- Non-valid step

Attractors



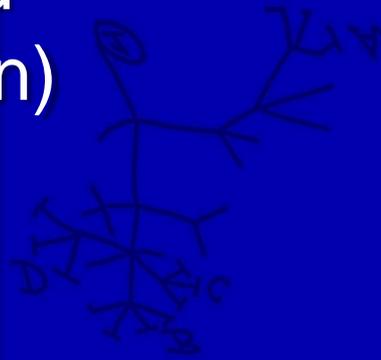
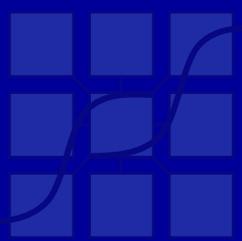
Proposed Mechanism – Evolution Trends

- ★ Current system
- Valid Step
- Non-valid step



Predictions

- There are systems which have low Driving parameter (r), therefore the systems will stabilize around limited number of values
- A similar behavior of accumulate solutions around attractors, is exist in Biology world (previously define as convergent evolution)



Biology

Upper jaw

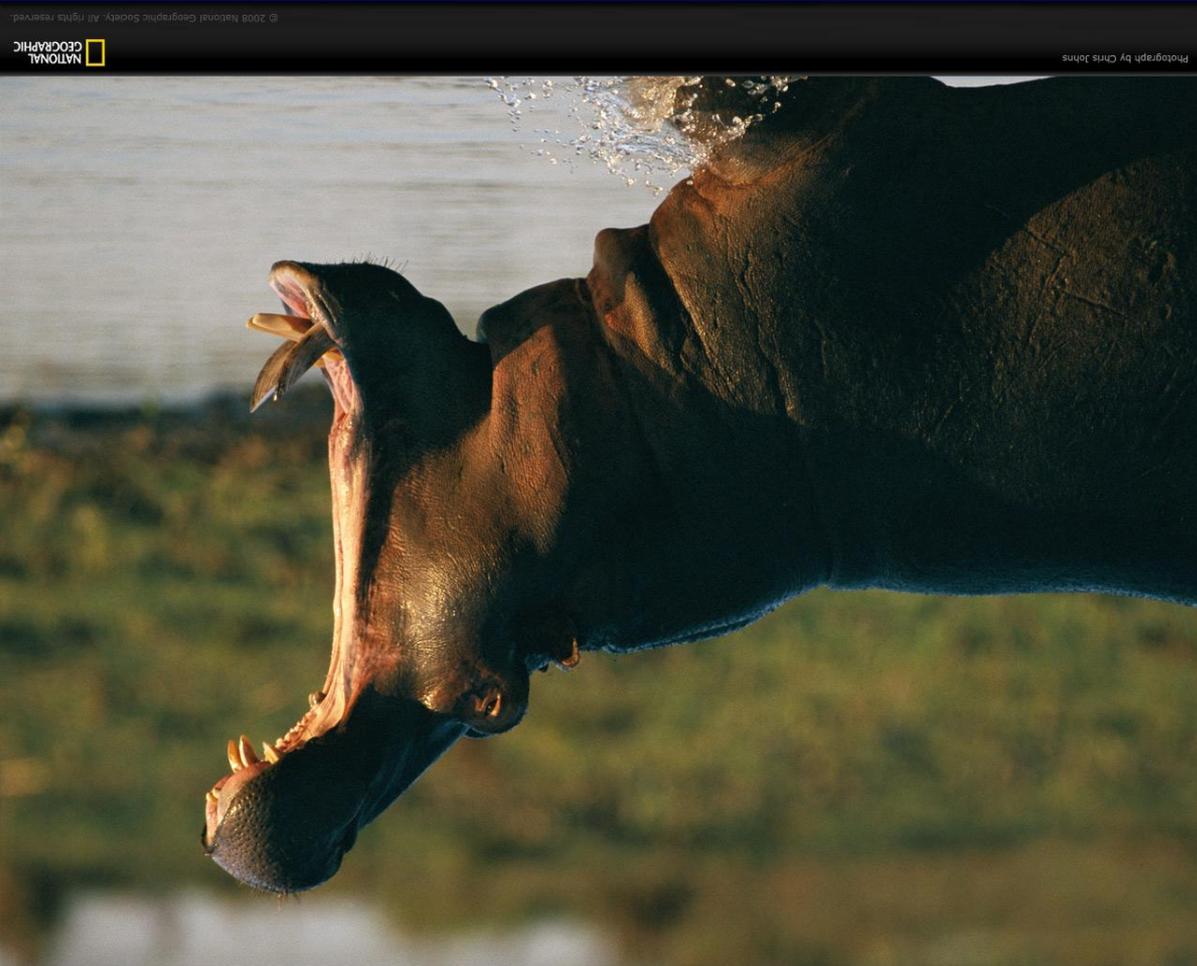
u



Thy

10 -

South America



NATIONAL GEOGRAPHIC
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Photograph by Chris Johns

North America

Cat



All continents

Example: Low (r) System, Eating Technology

- **Needed function** - move food from the plate to the mouth
- **Constraints** - Human anatomy and Food traits.
- **Solutions:**

1. Hands
2. Cutlery
3. Chopsticks



Each “utensils” has influenced its environment, so the tools and the food are adapted to each other, diminish the driving parameter

Summary

- TRIZ is a Platonism Theory describing observed phenomenon but do not provide explanation to the causes
- TRIZ is a projection of Lamarck's evolution over manmade systems
- Darwin's evolution is forceful than Lamarck's, therefore it is most likely dominate manmade systems since invention of writing.
- Darwin's evolution does not proposed ideal system, therefore there is a need for alternative explanation to TRIZ deterministic observation (Ideality and Laws of Evolution)
- Such mechanism might come from a combination of Dynamic Systems behaviors (Chaos) plus existing of Restriction forces induced by humans, acting to reduced the randomly of evolution.
- If proved right – the alternative explanation will allow an improved predictions of systems evolution, and will turn TRIZ from a Plato type of theory to an Aristotelian Theory