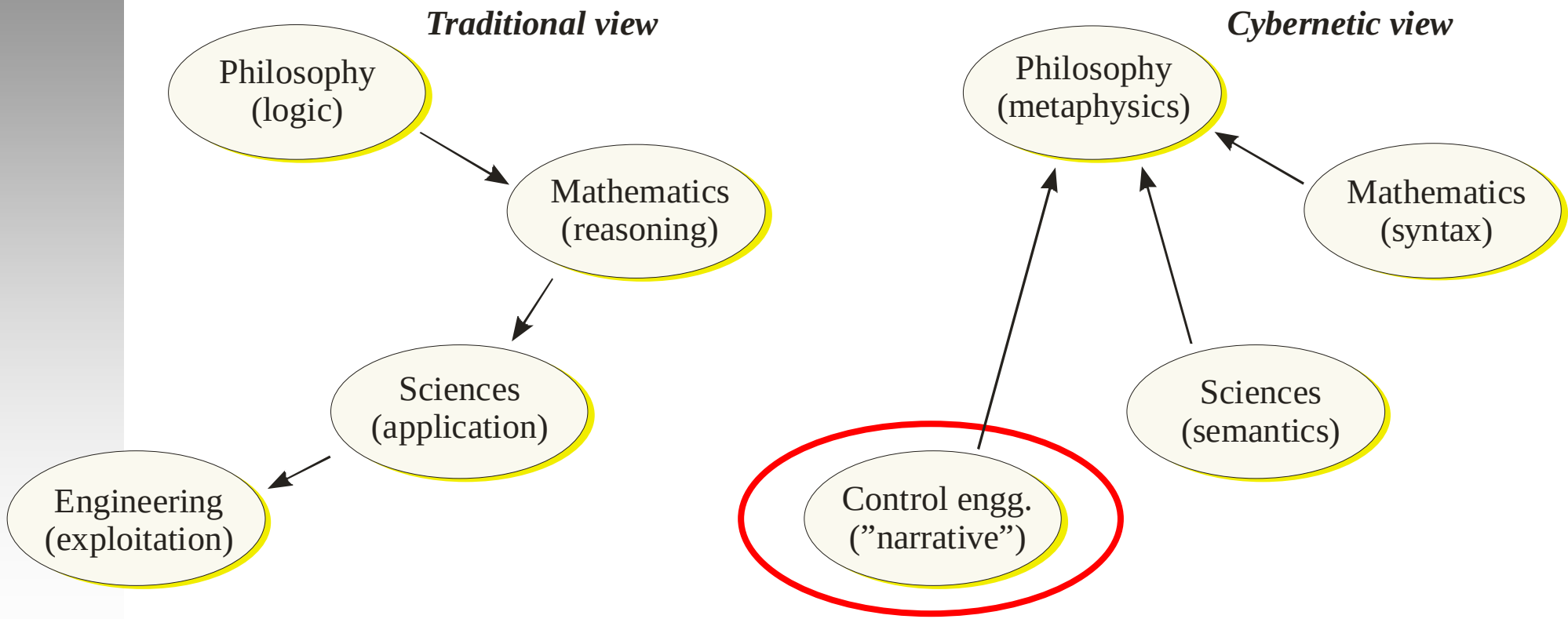
AS-74.4192 Elementary Cybernetics

Lecture 12:

Philosophical Consequences

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

Ideas ... in a cybernetic process of evolution!



- What is such “new metaphysics”, then...?

- We started from the ancient Greek – now we get (*feed*)back to them: what has been reached?
- It is said that the Greek have already thought of *everything*
- But they did not have the right language (mathematics), and they did not have the right "thinking aids" (the computer)
- The neocybernetic key concept, the "emergence operator" E can only be "thought of" by using these tools!
- Let us do reasoning in mathematics and translate only the inference results back to natural language...

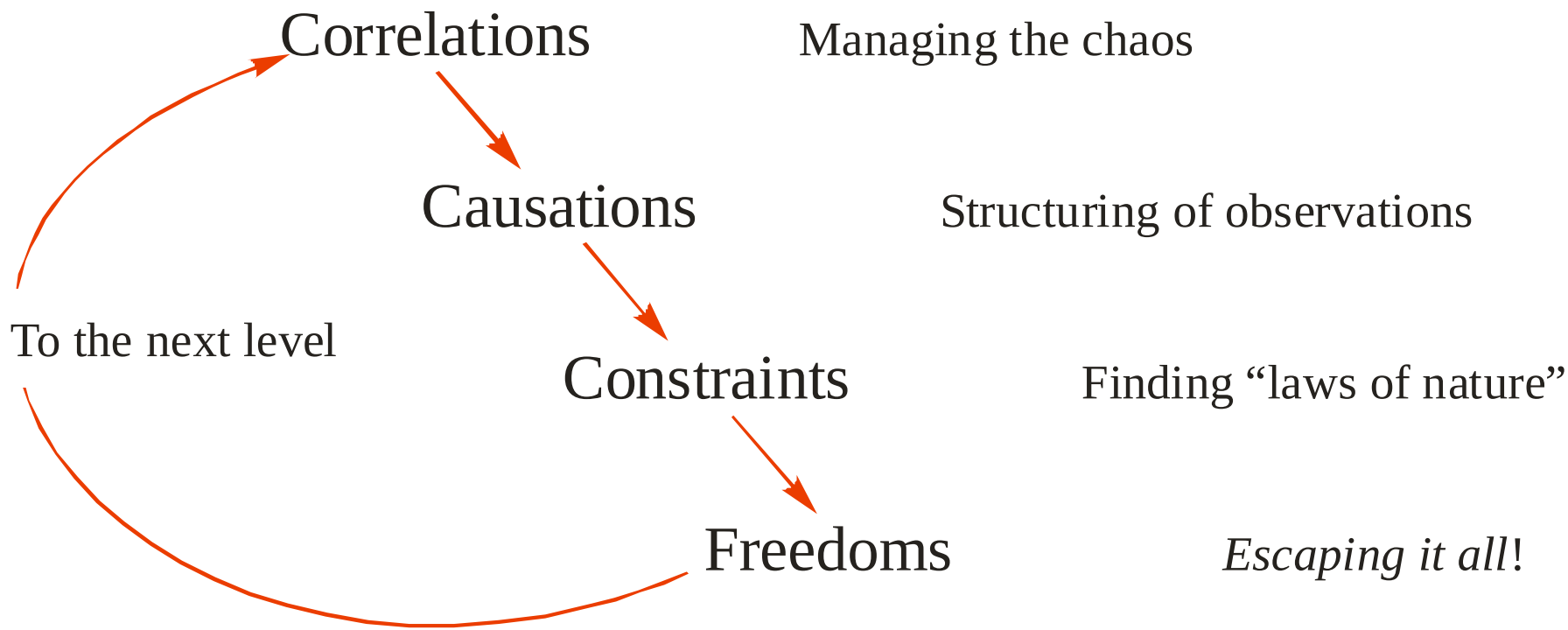
- *Process philosophy* (the "ontology of becoming") and the *new dialectics* can be based on *computationalism*

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

The Greek explained the World –
but they did not see the data world!

Neocybernetic "cycles in epistemology"

- The (r)evolutionary advances in understanding can also be modeled in the current framework?



Compare to *Dharma*: Brahma – Vishnu – Shiva

Complements "Purusha" (active cause) and the "Prakriti" (passive nature) bring everything into existence!

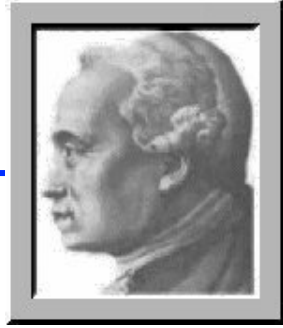
Towards "New Metaphysics"

- Cybernetic system is actually NOT a mirror of its environment
- Neither is it a magnifying glass
- Indeed, it is a kind of a minifying device that abstracts details away – or a "macroscope"
- On the other hand, it defines the famous "colored eye-glasses" determining the interpretation, filtering and distorting the input

Models vs. reality – new hope

- Traditional complex systems pessimism
  - Curse of complex systems: Sensitivity to initial values and parameter values, small deviations finally explode
  - "Cardinality" of systems is higher than that of possible models – there exist more systems than there are models
  - Reality is fundamentally "non-modellable", all models necessarily give false predictions (compare to weather forecasts, etc.)
- Neocybernetic optimism
  - Because of local stability assumption, system converges to the same state from within a basin of attraction, even if the initial state is inaccurate
  - Models are optimal and unique *to an extent*, reflecting the properties of the environment, so that there exists a similarity between models and systems
  - Modeling machinery can be implemented in very different domains without changing the results

Cybernetic eye-glasses?



I. Kant

- Human understanding is necessarily limited by our senses and our cognition machinery

How can we know that we share the same views as other people?

What is the relation among subjective worlds?

What can we know about the world beyond our senses?

How are the subjective and the objective related?

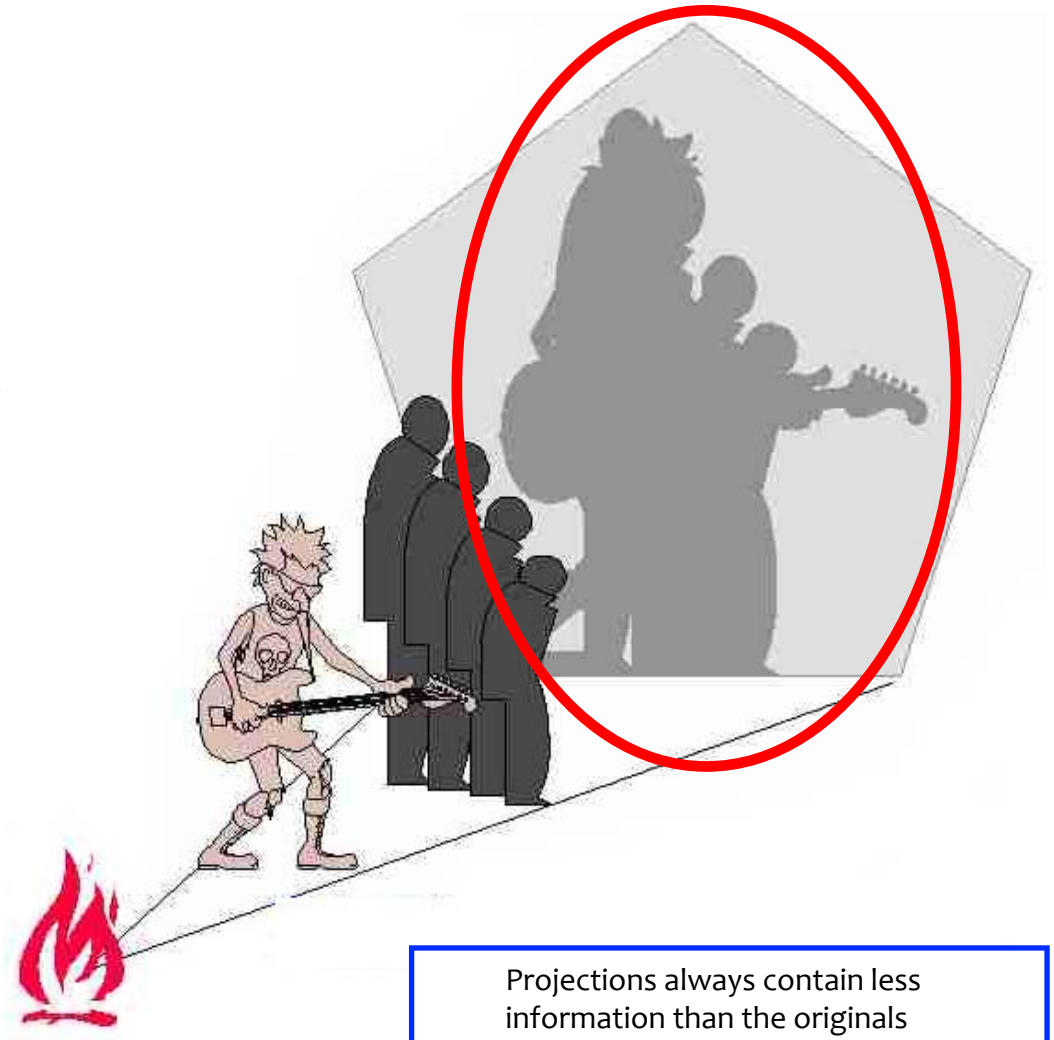
World as data

- Plato's "Cave Metaphor":

  The observations are a projection of the high-dimensional reality onto the space spanned by our senses

- Put in another way: Observation processing systems only see data

  ... And one can never escape this fact



Projections always contain less information than the originals = there are many ways to interpret observations...

And this applies not only to visual images but truly *everything*!

Subjective worlds

- The data modeling machinery essentially dictates what will be expressed in the model
- Immanuel Kant: perception is a construction, largely a property of the mental system

  = The real mental model is also only a model of the world
- This is the reality we live in: What is left outside will forever remain there – and we have no way to know what it is

- What can we then know about other people's worlds?
  = Can there ever be real understanding among people?
- Further – can there ever exist "understanding" among humans and computers?

Intersubjectivity

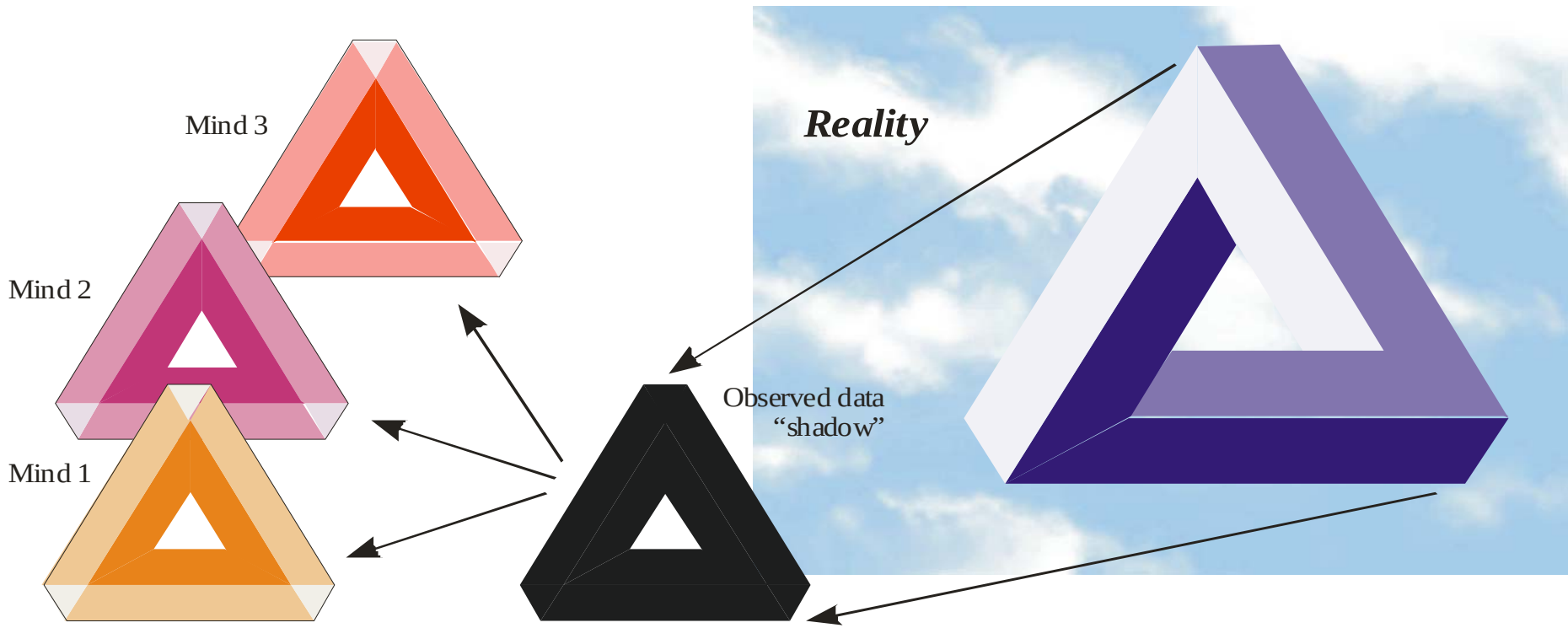
- Kant: Humans share the same modeling principles
- Assumption now: These principles are cybernetic – uniqueness (?) means that the model structures are the same

- Hum(e)ans also can share same world view, same concepts
- What is more – if a human and a computer share the same sensory environment, the resulting models again are similar – a computer and a human can share the same world view

- What is then *objective* reality?

  For any application that one can imagine, it does not matter – *everything* is, after all, only meaningful in *subjective* reality

- It does not truly matter if the shared view of world is incorrect



... There is more ...

But still ... we *are* interested in the "real world"

Interobjectivity

- Tradition: “Humans are just constructing models of nature” = “The true essence of natural systems cannot be captured”
- But it is also Nature that is constructing models to implement cybernetic systems

The natural system IS a model!

The model IS a natural system?

- If we can find the appropriate attractors of the real system, the constructed model can capture its true *essence*

Hegelian self-consciousness of Nature?

- Nature needs Man to make the difficult models and controls

Philosophical convergence

- The connection between intersubjectivity and interobjectivity can be rephrased also in another way:

  Ontology = Study of *what there exists in the world*

  Epistemology = Study of *what one can know about it*

- It is the same processes that take place outside the mind and inside it
- The only difference between ontology and epistemology is the point of view

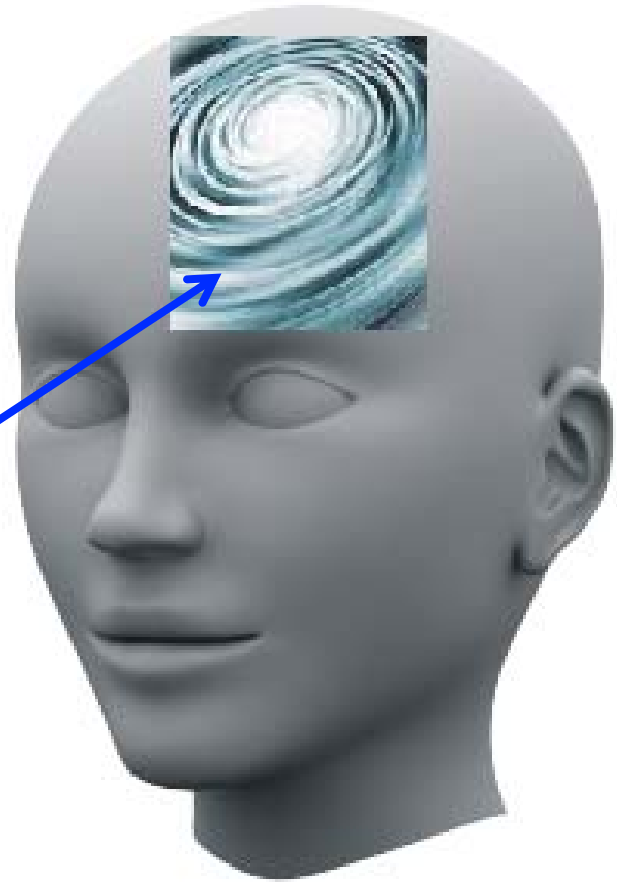
- *Note that basic physics, etc., are not necessarily cybernetic processes, and may remain outside (remember Feynman)*

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

We not only see world using sparse coding – the world *is* sparse coded!

“The ways up and down are the one and same”

2. Epistemo**genesis:** Relevant concepts needed to stabilize the new attractor



1. Onto**genesis:** Emergence of form

More than jargon?

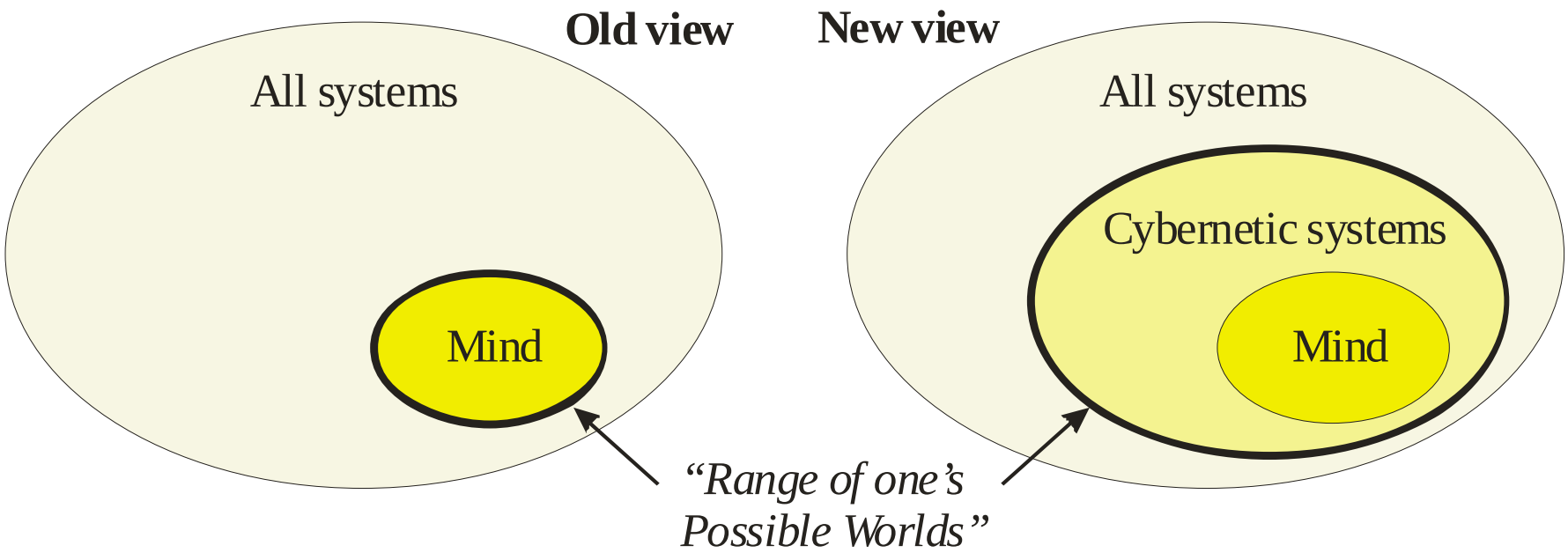
- As epistemology coincides with ontology, the human's natural ways of seeing nature also reflect reality: how you want to see world – it is what nature is
- The "emergent-level modeling" can be based on *optimality, simplicity, interestingness, beauty, harmony, symmetry*, etc.
  ... Intuitiveness, understandability, *humour*, ...
- Eugene Wigner:

  "It was not possible to formulate the laws of quantum theory in a fully consistent way without reference to consciousness"

- Human is the best model of nature this far – **use same ideas!**

"New Cybernetics"

- Not all physical systems are cybernetic – but the most interesting and relevant ones *are*
- Such systems can extend our mental realms



Power of mathematics

- It has always been wondered why (simple) mathematics is so powerful in representing Nature (see E. Wigner)
- There are now some fresh points of view available –

- To start with, the cybernetic phenomena *are* simple, being characterized in terms of correlations, etc.
- But what is more fundamental – it seems that system complexity and analyzability go hand in hand:

  If Nature has been able to construct sophisticated model structures, why not us?
- The positivistic claim here also is that *cybernetic systems can always be modeled*

Cybernetic thinking offers many new intuitions to modeling work

For example: *Ockham's razor*

- When constructing models, there are many presuppositions that seldom are explicitly stated
- One of such presuppositions is *Ockham's razor*, telling that the simpler explanation is **"more true"** than a complex one
- This is of course pragmatic, the only realistic starting point – otherwise the models become clumsy and "less aesthetic"
- Ockham's razor is seldom questioned – however, in the cybernetic framework *this principle can be motivated*:

- A cybernetic system exploits all available resources in an (more or less) optimal way – seen in another way, this means that the resulting systems *are* as simple as possible

Somehow, many systems seem to optimize (models derived through variational calculus) – how to explain that in other frameworks?

Another intuition: Why linearity?

- It is not only about local linearizability and good balancing...
- Assume that the interaction mechanism among systems can be characterized in terms of distinct variables
- Then *information* is proportional to squares of such variables
- The *optimal way to model such information is in linear terms*
- Thus, the natural systems subject to non-idealities and nonlinearities try to evolve towards linearity!
- Compare to the Parallel Axiom: If you adopt the linearity idea in the beginning, you can have a consistent theory completely in linear terms; if you select nonlinearity, you will never get rid of that assumption

Towards "Heraclitean mathematics"

- Pre-Newtonian mathematics

  Represent static patterns

  "Visible world"

- Differential calculus

  Energies, forces, accelerations, ...

  Characterize individual changes

  Physical systems

- "Mathematics of emergence"

  Information

  Capture the "character of changing"

  "Natural systems"

Proving claims (mathematical, too!?)

- **Standard approach**

  "When you exclude all that is impossible, what remains, however improbable, has to be the *truth*" (S. Holmes)

- In mathematics, you search for exact proofs; in sciences, you search for explicit evidence
- However, in complex systems such evidence does not exist
- For example, there will never be final proof for *evolution*

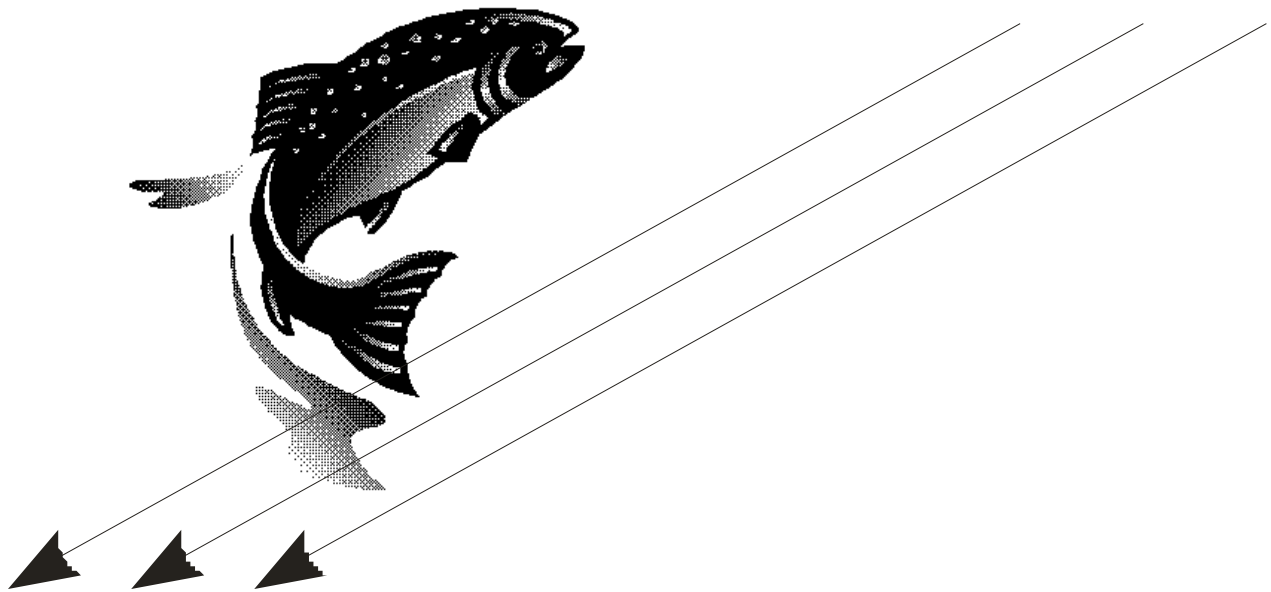
- **In the future**

  "All evidence is contradictory; when there emerges a pattern in the complicated mosaic, it has to be *relevant*"

- Real existing entities need no proof – they are *sustainable attractors in phenospheres*
- This facilitates computer based proofs in different domains
- The problem is that environments have to be implemented!

Next: **Paradox of entropy**

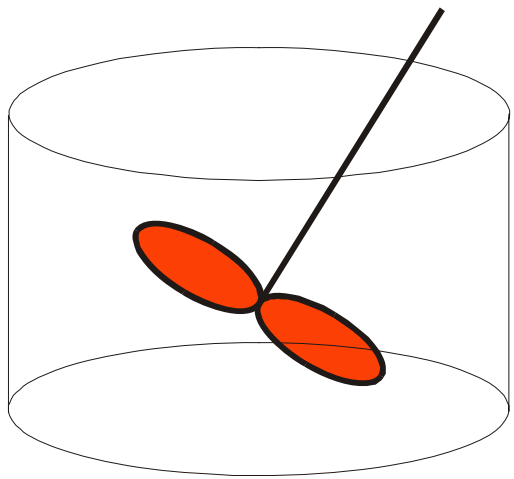
- Two classes of systems – *normal* and *abnormal*: Either energy is exhausted for *increasing* or *decreasing* entropy
- Compare to *sublunar* and *translunar* physics: Planetary motions are divine?

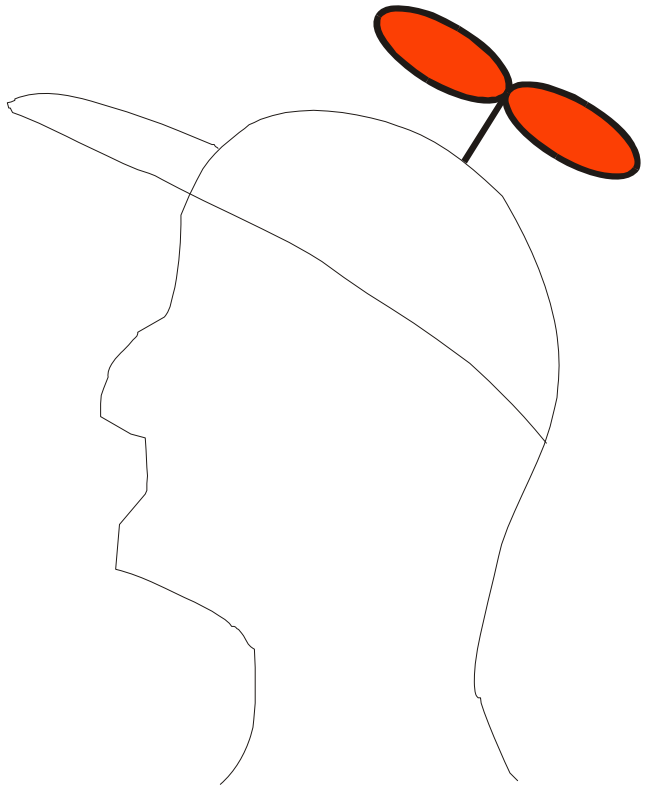


Traditional escape: "They are OPEN systems"

Entropy paradox: *Ideal mixers* vs. *idea mixers*

- Cybernetic models define a framework for studying *whirls in the flow of entropy* – *WHAT?*





- *Many systems with cumulating improbability can be studied*

Entropy

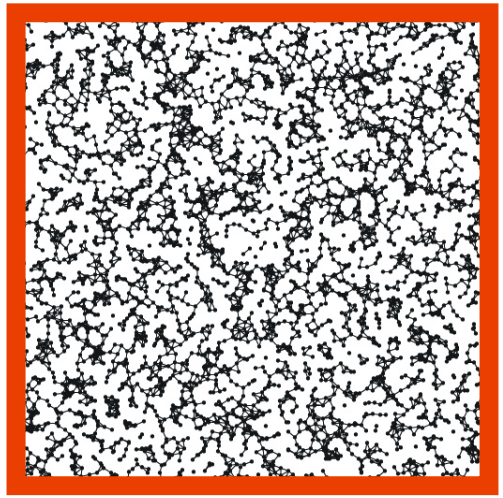
- Study the cybernetic systems from another point of view – there are some principles governing all systems:
  - First law of thermodynamics: The total *amount* of energy in an isolated system remains constant
  - Second law of thermodynamics: The "quality" of the energy becomes worse, or *entropy* in the system is increasing
- The "energy quality" is its ability to do work – if there finally are no differences in potential, it is the "thermal death"
- There are different interpretations of entropy:
  - Thermodynamic entropy: System goes towards more probable states
  - Information theoretic entropy: System goes towards less information

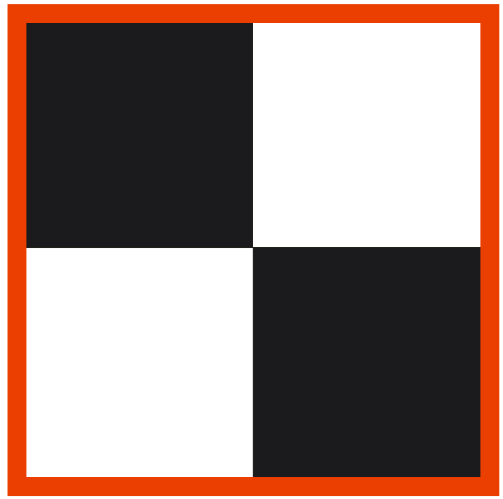
"Cybernetic systems feed on information, producing entropy"

- There are some intuitive misconceptions
  - Entropy ever increases = “arrow of time” !!
  - “Universe must be expanding – otherwise time would go backwards” ??
- For example, is *symmetry* a sign of entropy or neg-entropy?
  - First intuition: Symmetry means *structure* and *order* – negative entropy
  - However, a completely unordered set of particles – meaning high entropy level – is most symmetric, as any of the particles can be interchanged
- Intuitions are problematic and contradictory
  - Simplicity of symmetric patterns is an illusion, being caused by our mental machinery that exploits existing mental models to interpret symmetries
- The thermodynamic and information theoretic entropia seem to be mutually incompatible – but now these will be united...

There are still new interpretations of entropy – see “energy dispersal”

In which image more a) information b) entropy?





All pixel (molecule) configurations are *equally* improbable

- Information content is the same – also entropy is the same?!

All coding conveys external information

- In the latter case, information is divided in two "containers", in image and in the *mind*: One immediately interprets and categorizes, applying one's available pattern reservoirs

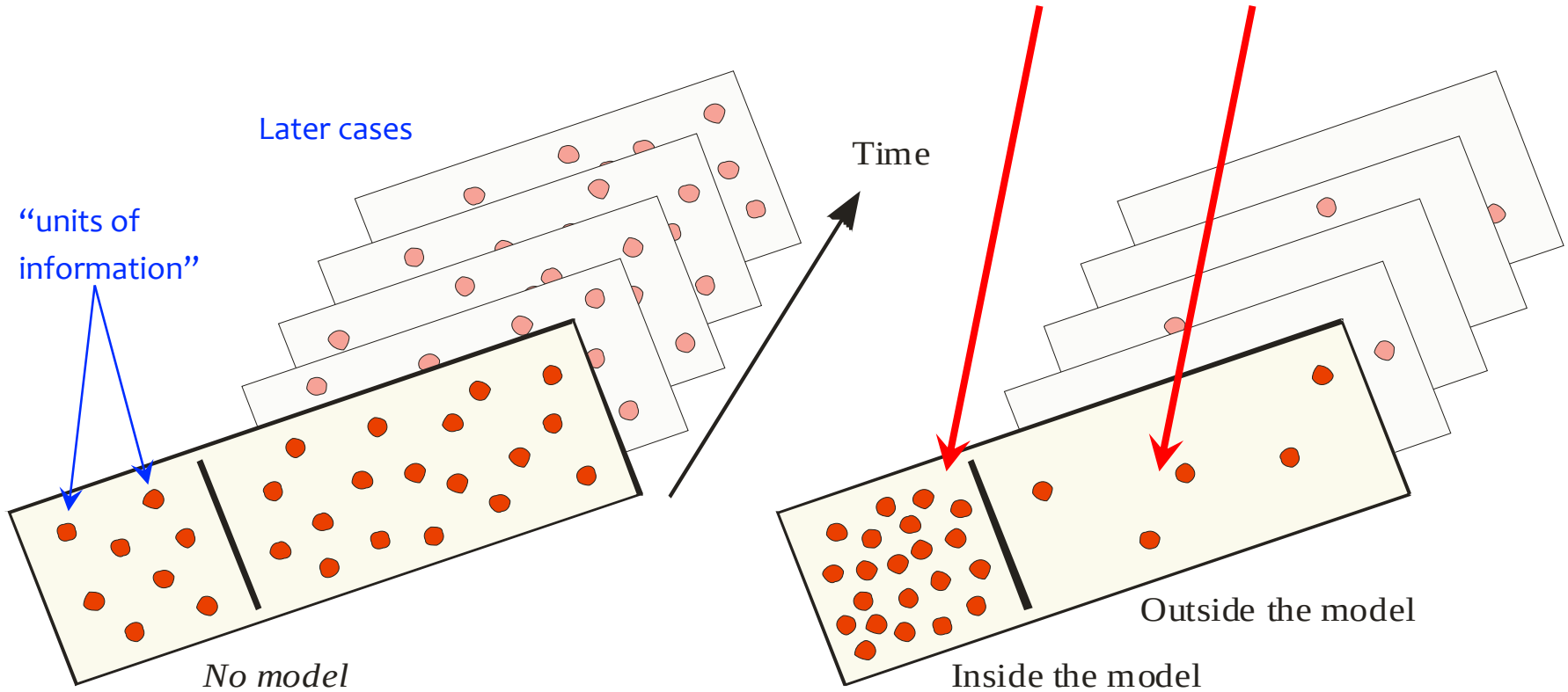
... In "observing systems", this *always* happens!

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

Cybernetic system as a Maxwell Daemon

– It pumps and compresses information

- As seen from an appropriate perspective, cybernetic system divides information in containers with "*hot*" and "*not*"



! ! !

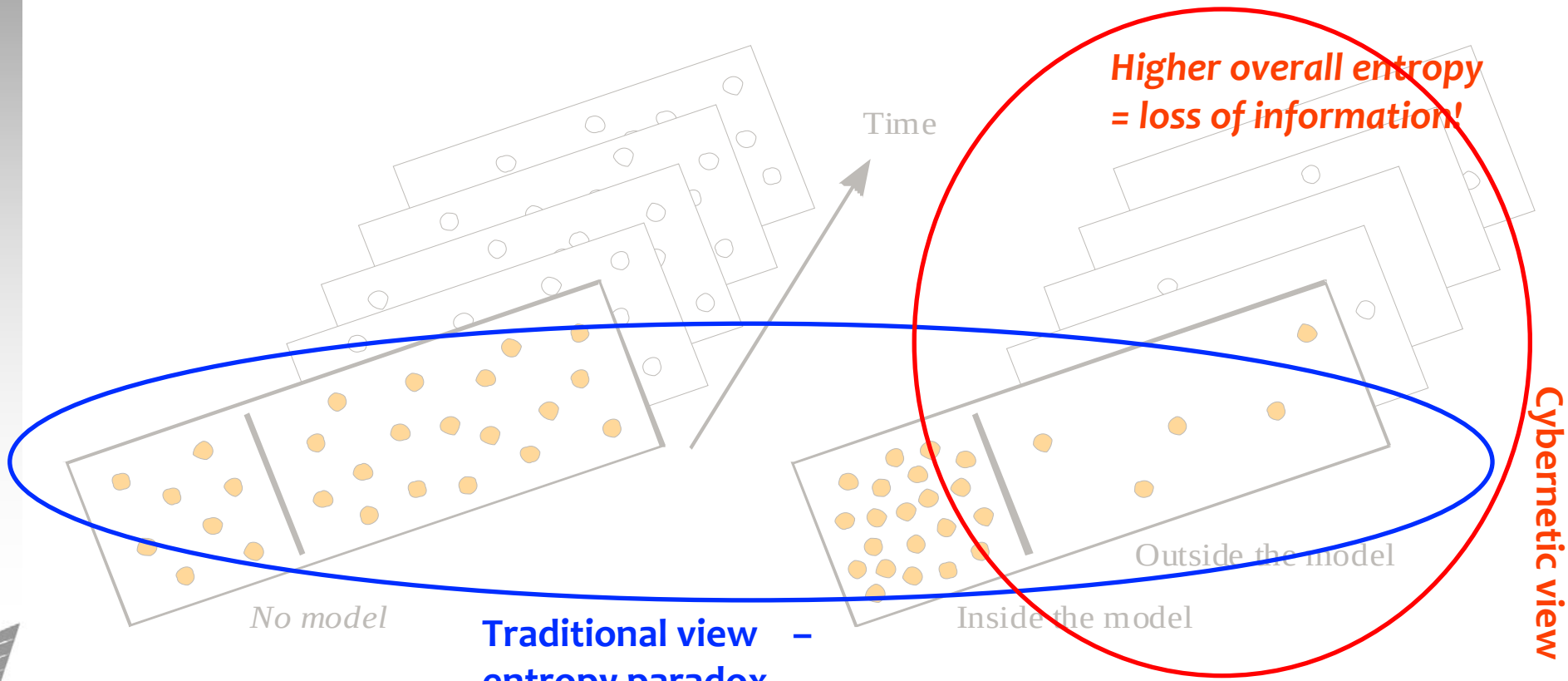
- In a cybernetic system information = variation, or deviation from balance
- Goal of cybernetic system: Balance = loss of information = maximum probability = (local) heat death on the lower level
- The control structure implemented by the cybernetic system thus boosts entropy – the faster, the better the control is
- Emergence of structure on the higher level is also **not** against the arrow of entropy – on the contrary:

Emergence of structures is *caused* by entropy pursuit

this entropy being equally meaningful in the thermodynamic and information theoretic setting.

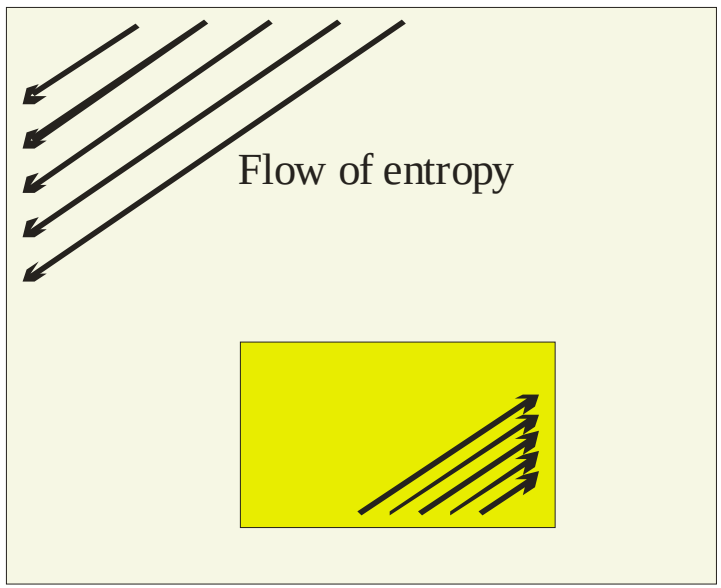
Vanishing entropy paradox

- Remember that the time axis is abstracted away: Then one can thermodynamically motivate cumulation of information

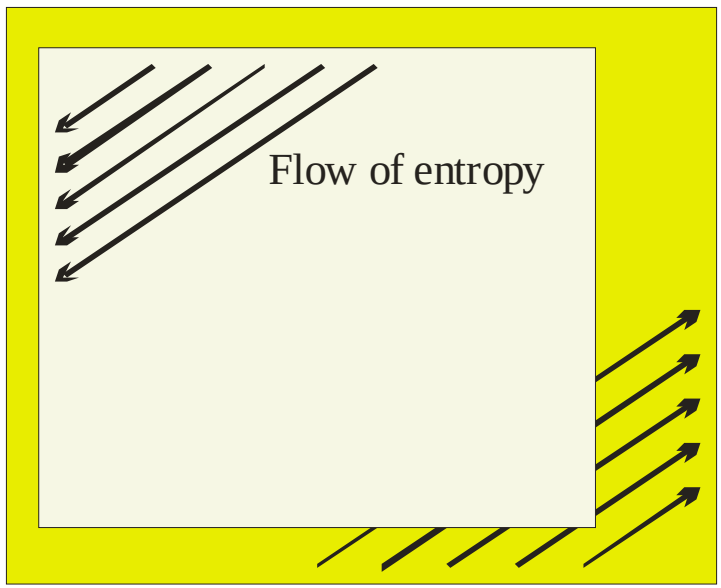


- It seems that all systems, including cybernetic ones, are thermodynamically consistent: When seen in the correct perspective, *entropy increases in all subsystems*

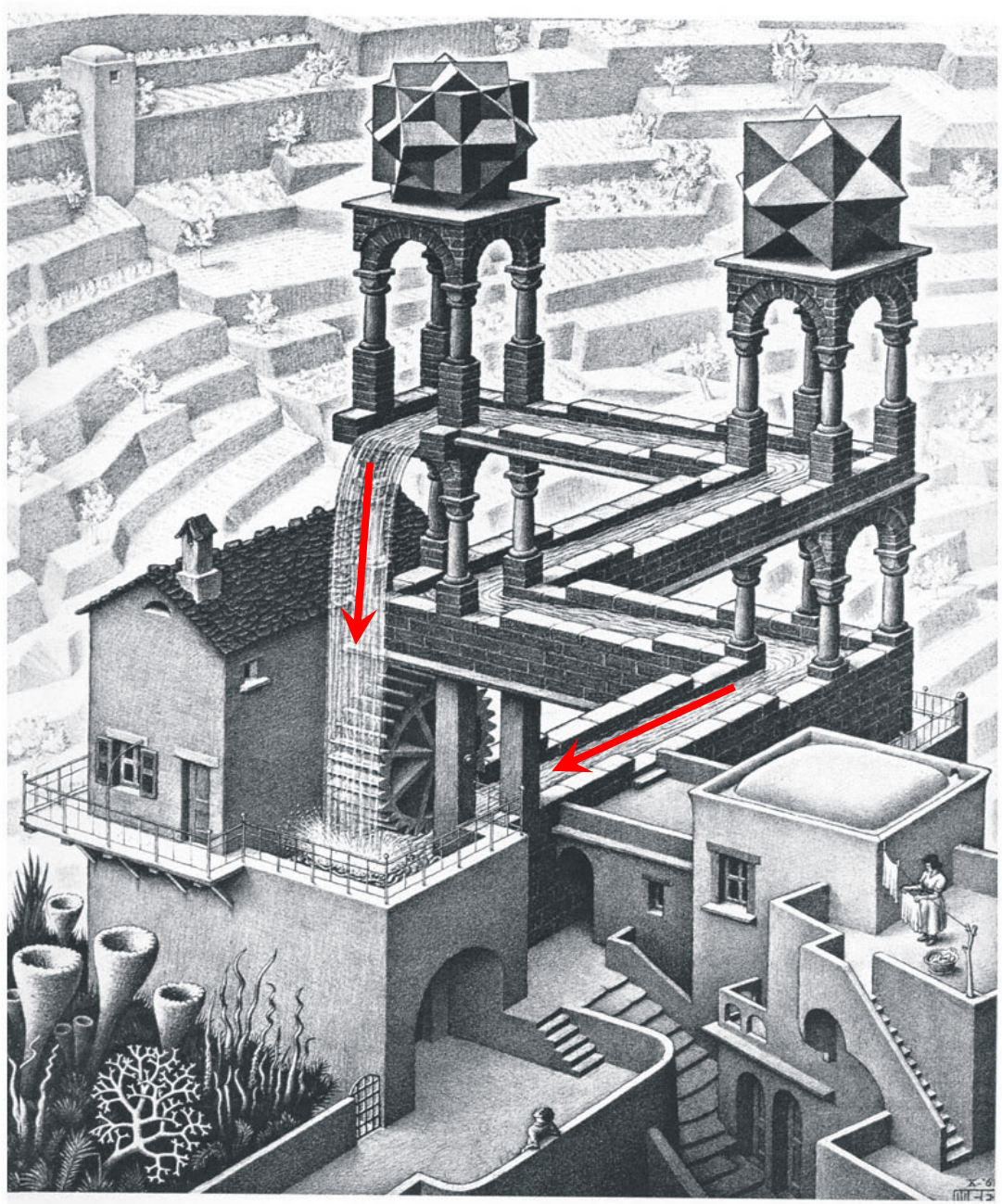
Traditional view



New view



- Inconsistency in the flow of entropy is just an illusion caused by the inappropriate view of system boundaries



“Maximum entropy pursuit”

- The strong modeling framework gives additional benefits...
- Previously, static models between u and x were constructed
- Now, the consistency of entropy behavior can be exploited:

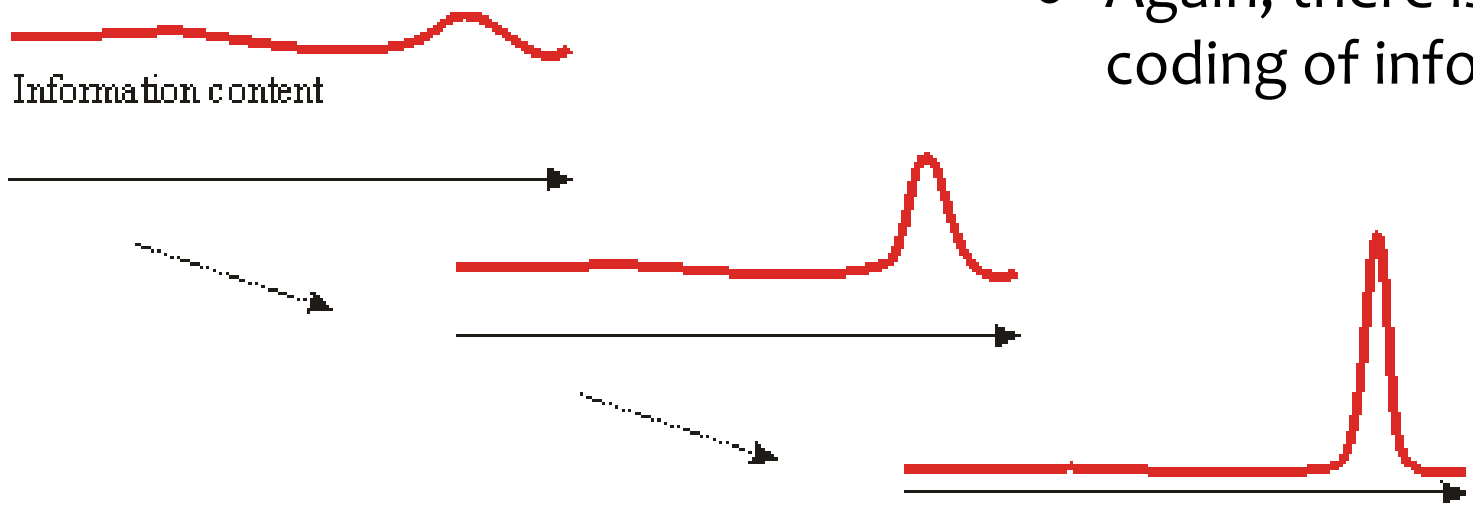
  It can be assumed that entropy not only increases, but it *increases at the maximum rate*

- This means that dynamic models become readily available
- In the neocybernetic standard models, the speed of dynamics can be interpreted in this framework: If the adaptation factors are selected as $\Gamma = \mathrm{Var}\{xx^{\mathrm{T}}\}^{-1}$, the diffusion rate is scaled by observation reliability

~ “Principle of least difference”?

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

- Entropy increase seen as homogeneity and decrease of variation (information) is still just a *secondary effect*
- Information structures (models) emerge to implement control, draining information from the environment
- One could speak of "inverted diffusion of information"
- Again, there is "sparse coding of information"!



Cybernetic hypothesis

- Remember Lec. 2:

  K. Enqvist (etc.): “Everything is energy”...
- Now: Everything is *information*
- Information structures are just interpreted as “energy” in macroscopic physical domains

- Why *heat* is inferior as energy?

  Neocybernetic interpretation: Heat is noise, variation without model or internal structure

If one learns to switch between emergent levels, perhaps “perpetuum mobile” becomes possible?

“Laws of Neocybernetics”

- **“Zeroth law”**
  - In thermodynamics: Two systems in contact exchange energy until they are in thermal equilibrium.
  - *Now*: Systems in interaction tend to match each other.
- **First law**
  - In thermodynamics: The total energy of the universe remains the same (law of energy conservation).
  - *Now*: Variation in the universe remains constant.
- **Second law**
  - In thermodynamics: The entropy of an isolated system will tend to increase over time (law of entropy).
  - *Now*: As information is used, only noise remains.

Absolute zero = no (thermal) variation
= no possibility for information either!

"Monadology"

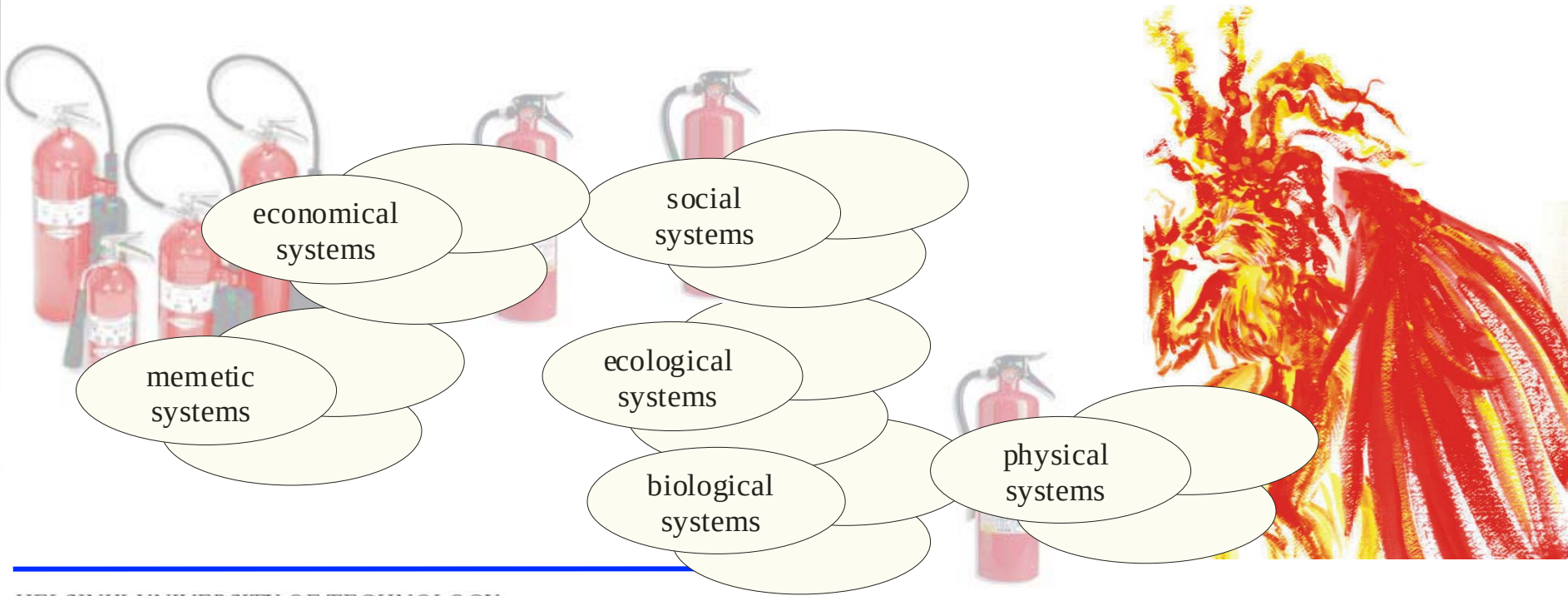
- **Leibniz:** The world consists of clusters of minute, virtually punctiform processes, **monads**, which are "centers of force" – in fact, *bundles of activity*.
- These monads aggregate together to make up and constitute the world's things as we experience them
- Each of these monads is endowed with an inner drive, an "appetition" which ongoingly destabilizes it and provides for a processual course of never-ending change.

- Now, again: Everything is information; visible matter/energy is just conglomerations of information, attractors of dynamic processes governed by entropy pursuit in the data space

See also Whitehead's (1929) "Process and Reality" and works by Rescher

Some teleology...

- Heraclitus' *Logos* is not "fire" but "fire extinguisher": The incoming variation is being eliminated by the systems
- There is no "Intelligent Designer" but a "Hardworking Idiot": The local optimizations result in extreme inconsistency



Applying new view of entropy: Analysis of *life*

- **What is life?**
  - Aristotle: Life = movement ??
  - Prigogine *et al.*: Living systems = open, dissipative systems ?
  - ... Again, *life* is an emergent phenomenon that defies definitions
  - Assumption now: "Illusion in complex enough cybernetic systems"
- For example, the mysteries of biological (+ chemical) evolution can be studied from a fresh point of view now – the "vanilla" Darwinian theory suffers from inconsistencies:
  - Why do more complicated life forms emerge at all, against entropy

    The simplest multiply fastest – why is there anything else but bacteria?
  - Simple analogues collapse: "Genome = computer code"?

    How can random search be so efficient?

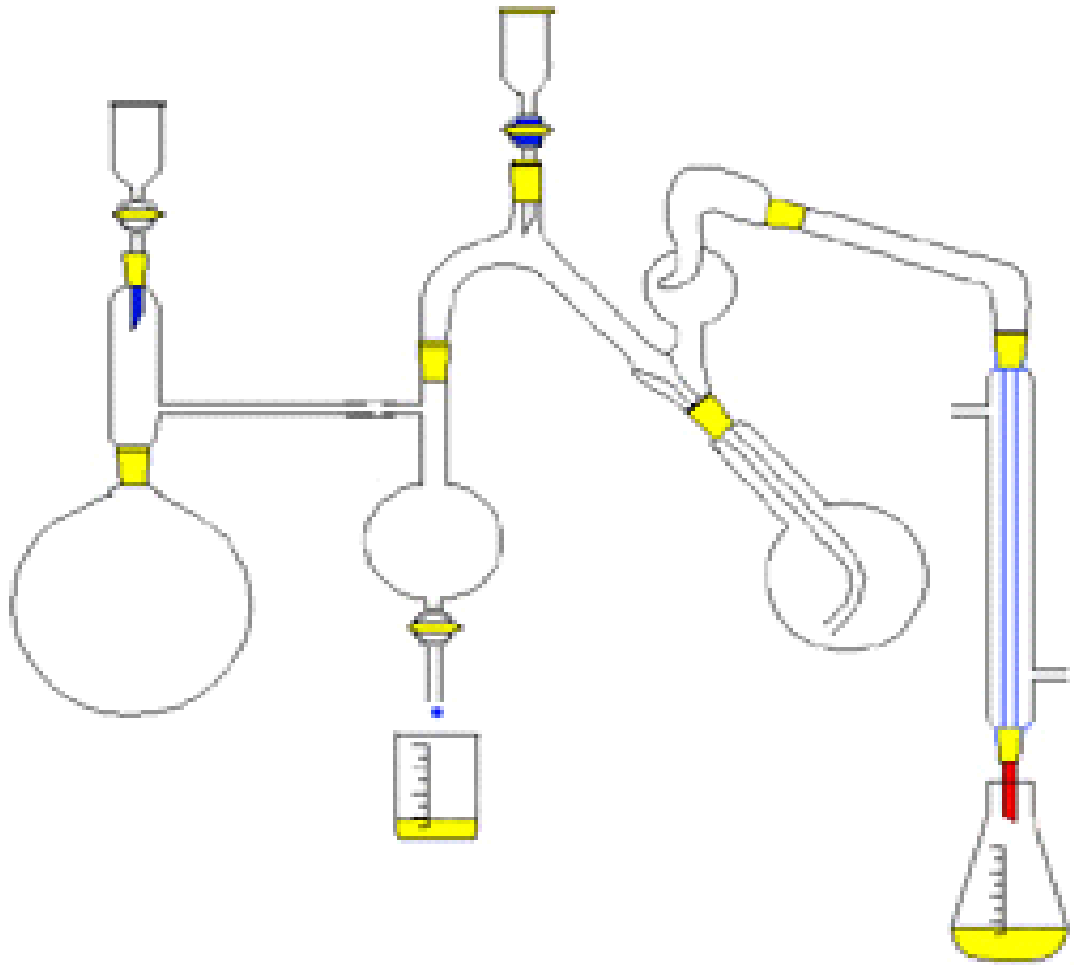
    Where does the robustness come from – most variations in genome are more or less possible?

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

These questions are answered in the cybernetic framework !?

Miller-Urey experiment

- Simple amino acids are produced in very simple conditions
- However, it seems that *more complex* molecules are not produced
- Going against the thermodynamic laws does not take place

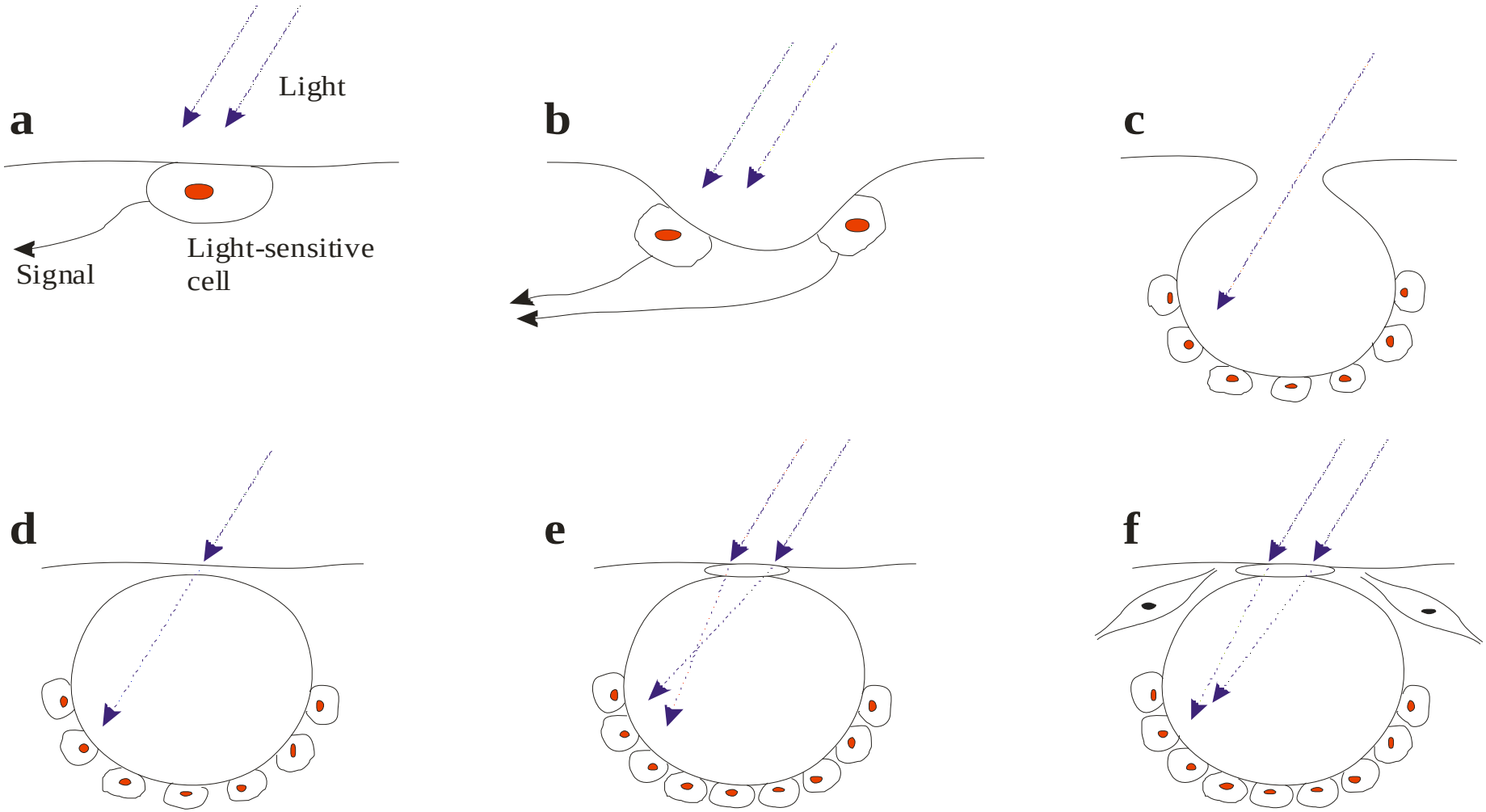


Cybernetic balance = "cooker of complexity"

- The sinister idea of “elan vital” can be explicated in the neocybernetic framework: It is all about *entropy pursuit*
- Note that there is a continuum from simple cybernetic systems to more complex ones – “origin of life” is gradual
  - *Inheritance of properties* and *changing of functions* can be separated
  - One does not need complete DNA to start with; *autocatalysis* together with special balance reactions are only needed to bootstrap
  - Also *epigenetic* processes can be studied (and *prions*, etc.)
  - Symbiosis of cells/organisms can be studied in the same framework
  - The evolutionary goals can be formulated in terms of information, and in terms of match with the environment
    - For example, emergence of cilia – ability of actively changing variables
    - Emergence of new senses – extending the input space ...

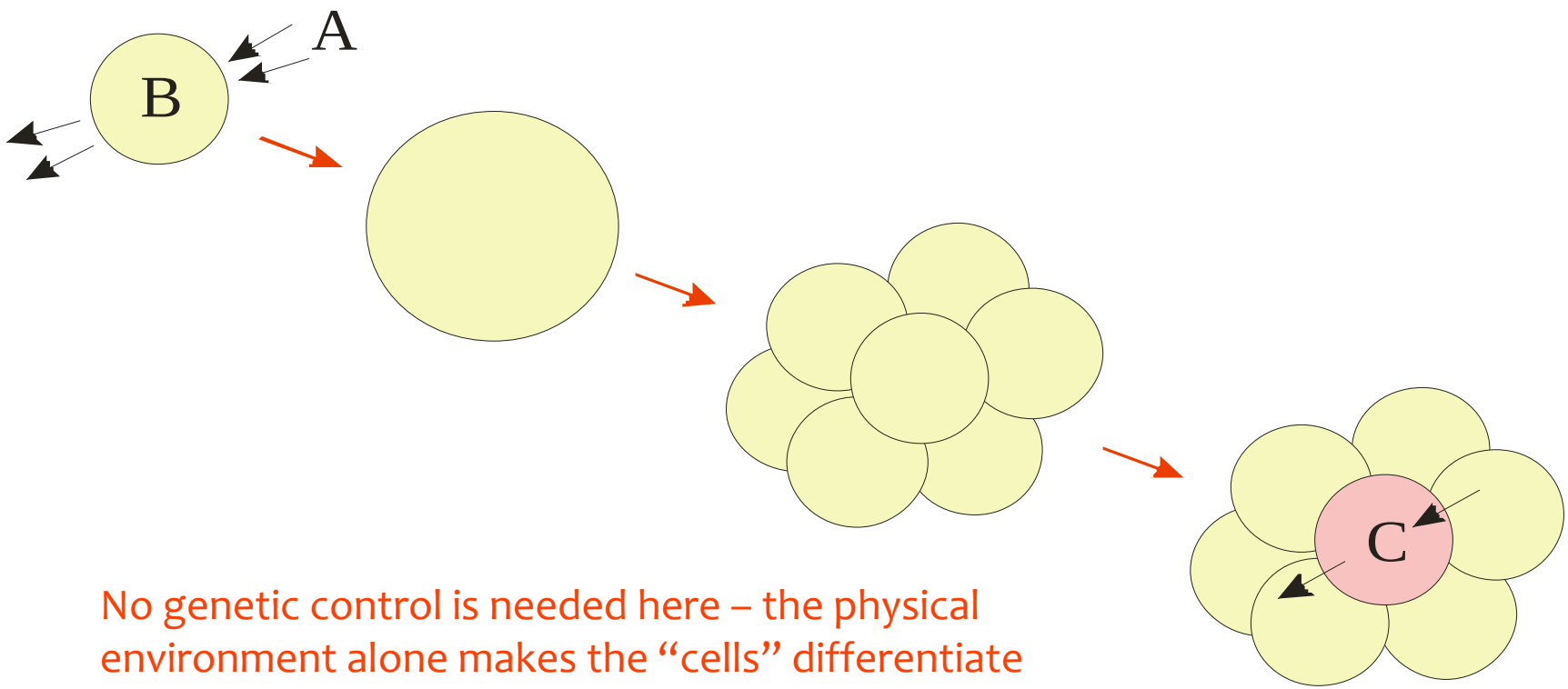
However, emergence of DNA / RNA / proteins still remains an unexplainable qualitative step

Gradual development of better functions – *eye*



Differentiation

- To a great extent, nonlinearities that are necessary for cell differentiation are direct consequences of the physical realm



No genetic control is needed here – the physical environment alone makes the "cells" differentiate

"E:stä Elämä alkavi"

"Everything starts with E"

Life = "Drive towards fractal balance of functions in an environment"

- "Drive": Adaptation & evolution is essential; all behaviors are dictated by dynamics governed by attractors
- "Fractal": There are interlinked temporal & spatial scales with separate emergent levels of appropriate variables
- "Balance": There is no static but dynamic equilibrium; everything is explained by the entropy growth
- "Function": Subsystems are mutually interrelated and in interaction; their relevance is determined by their semiotic roles
- "Environment": The surroundings dominates the behaviors, systems following the environmental signals delivering information

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

Or, simpler: **life** = drive towards *interaction*!

“Universal life”

- Again, individuals are abstracted away
- Ability of *regeneration* is relevant rather than *reproduction*
- Possible phenospheres (mediums) and “organisms”:
  - **Chemical:** Life as we recognize it
  - **Socio-economical:** Different kinds of human societies, economies
  - **Memetic:** Scientific paradigms, religions
- Life is not “extremely improbable”: It can be assumed that life emerges in all environments where transfer of information is supplied (in biology this means water solutions), and where there is enough *variation* in resources; even “extraterrestrial intelligence” inevitably finally emerges (?)
- AL programs are *not* forms of life!

- The key challenge in nanotechnology is not to implement the functions, but to implement *life*, all those balance reactions and functions that are needed for population survival – energy supply, regeneration, self-repair, etc.

- It has been claimed that there is a gap between humanistic and natural sciences

  The "postmodern" and constructivistic humanistic studies question the role of objective reality

- However, *all* scientific systems are subject to the same problems – in natural sciences, too, there is too little data
- All science is construction: The actor is always the human, and the goals are always also the same: Money, fame, ...

Consilience?

Back towards "natural philosophy"

- *Natural philosophy* is the "supersystem" above sciences ... But do we need some higher category?
- Today's science: Search for "neutral" truth, verifiability vs. falsifiability – but this results in a very narrow view
- Relativism: scientific truth is "just an interpretation among others" – but some "truths" are more *relevant*
- Why not study what people are interested in = are relevant? Why not apply holistic rather than reductionistic approaches – and why not study questions with *why*?
- Why should the modern world view be so fragmented?

  Why not use best understanding to solve ethical dilemmas?

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

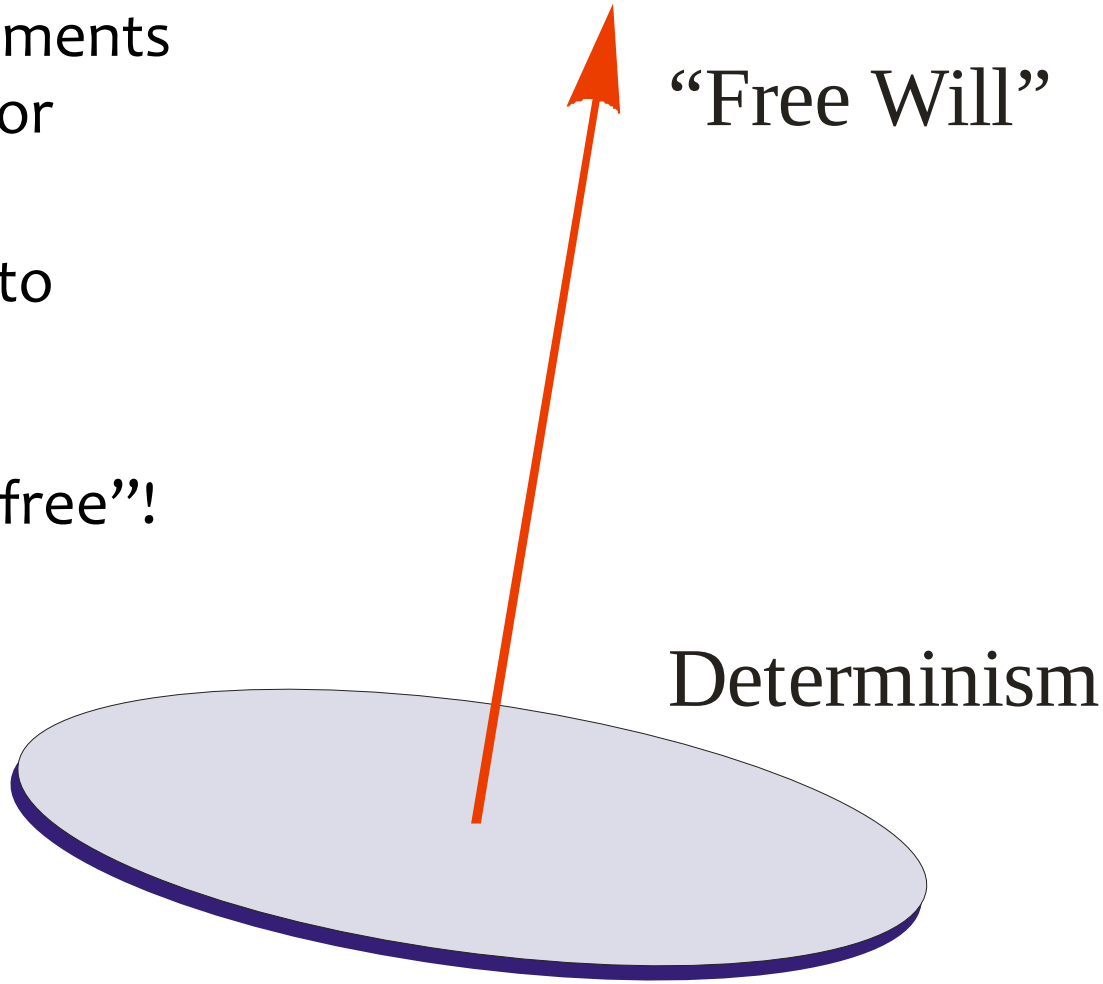
See also meta-ethics, value theory, axiology, etc...

... Religious issues *are* relevant

- The unconscious *thinking patterns* need to be emphasized
- The religious ideas are among the most fundamental patterns of thought
- For example, the Western science struggles with these –
  - One implicitly implements idea of centralization without seeing alternatives
    - Huge amount of complexity in models (orbitals, etc.) is needed just to compensate for the absence of a framework where a distributed structure can be maintained
  - One explicitly (aggressively) tries to eliminate all divine-looking explanations
    - Unfortunately, categorically avoiding teleological and finalistic explanations results in simply incredible models (message-RNA transferring information, ...)
- As there exists no planning or centralized control, *pantheism* would be more appropriate – but centralized, engineering-like thinking has been the necessary intermediate step!

J.-P. Sartre: "*Even the most radical irreligiousness is Christian Atheism*"

- In cybernetic environments actors *MUST* search for free(dom) will
- This applies not only to humans
- "Man is bound to be free"!



Existence of God: *Weak version*

- Religions have always existed in all human societies – why?
- For society to stay alive, its members need to *avoid anarchy*, and the society to develop further, they need to *avoid apathy*
- A must – irrational belief: *humble struggling will be rewarded*
- To believe can be a strictly intellectual decision?
- Compare to Pascal:
  - "Even if the probability of God existing were very small, in that case the reward to the believers is infinite – thus, as a good gambler, *you believe*"
- Cybernetic view:
  - "If you would like the complex social systems to survive and evolve further, everybody constituting that system should believe – also *you should*"

"Cybernetism"

- Dictatorships (extreme trust on individuals) and communism (extreme trust on groups) collapse – what to believe in?
- Believe no gurus – one can only trust one's own mind
- "Cybernetic imperative" (compare to "categorical imperative")

This is = "*understand the value of systems*"

  - Promote different kinds of living systems and their diversity
  - Make systems more *interesting* and more *beautiful*!

... Or "*refine information*"

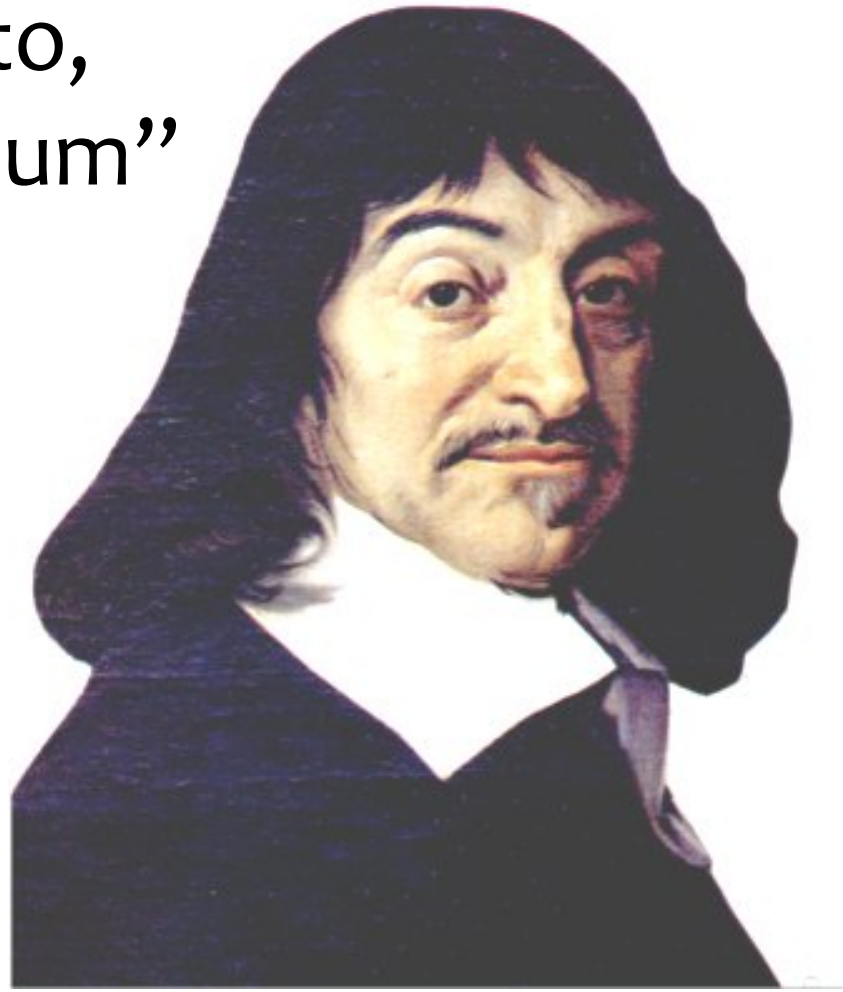
- Suffering and poverty will always exist in the systems
- Heaven & hell *exist* – they are the higher-level systems = social memory – eternal death is if nobody remembers you
- Purpose of life is *entropy maximization* (in the truly long run)

More generally: There will always be the both ends, *dualisms* are built in systems

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

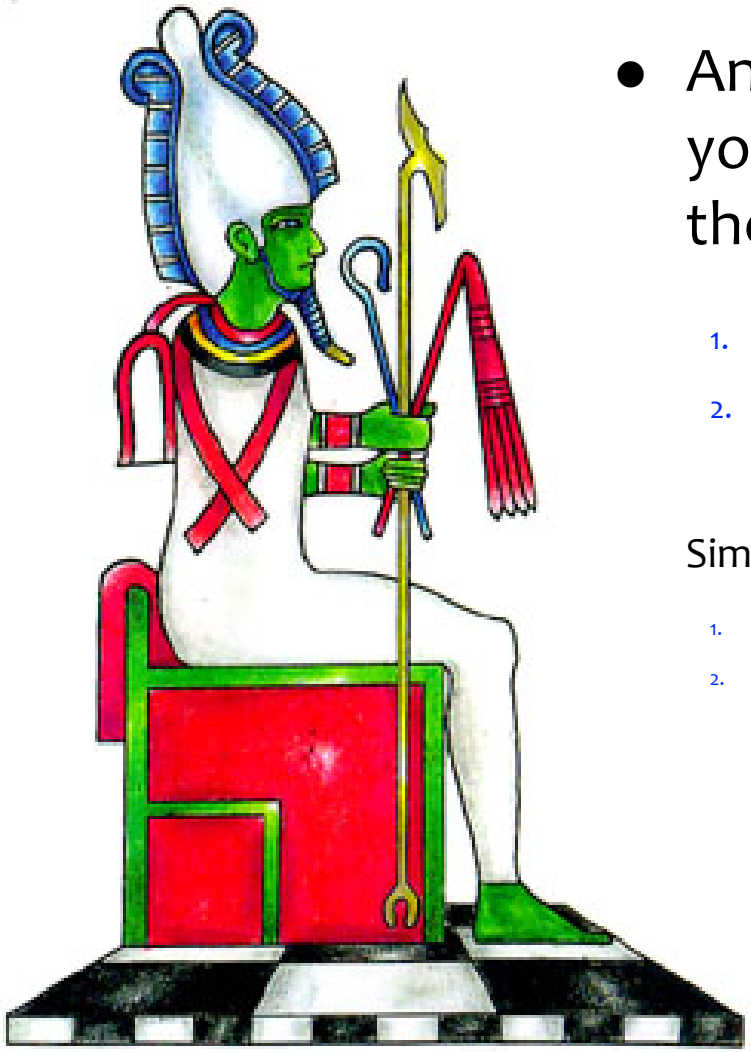
How about “eternal life”?

“Cogito,
ergo sum”



“Cogitas,
ergo sum”

Absolute Ethics?



so they say

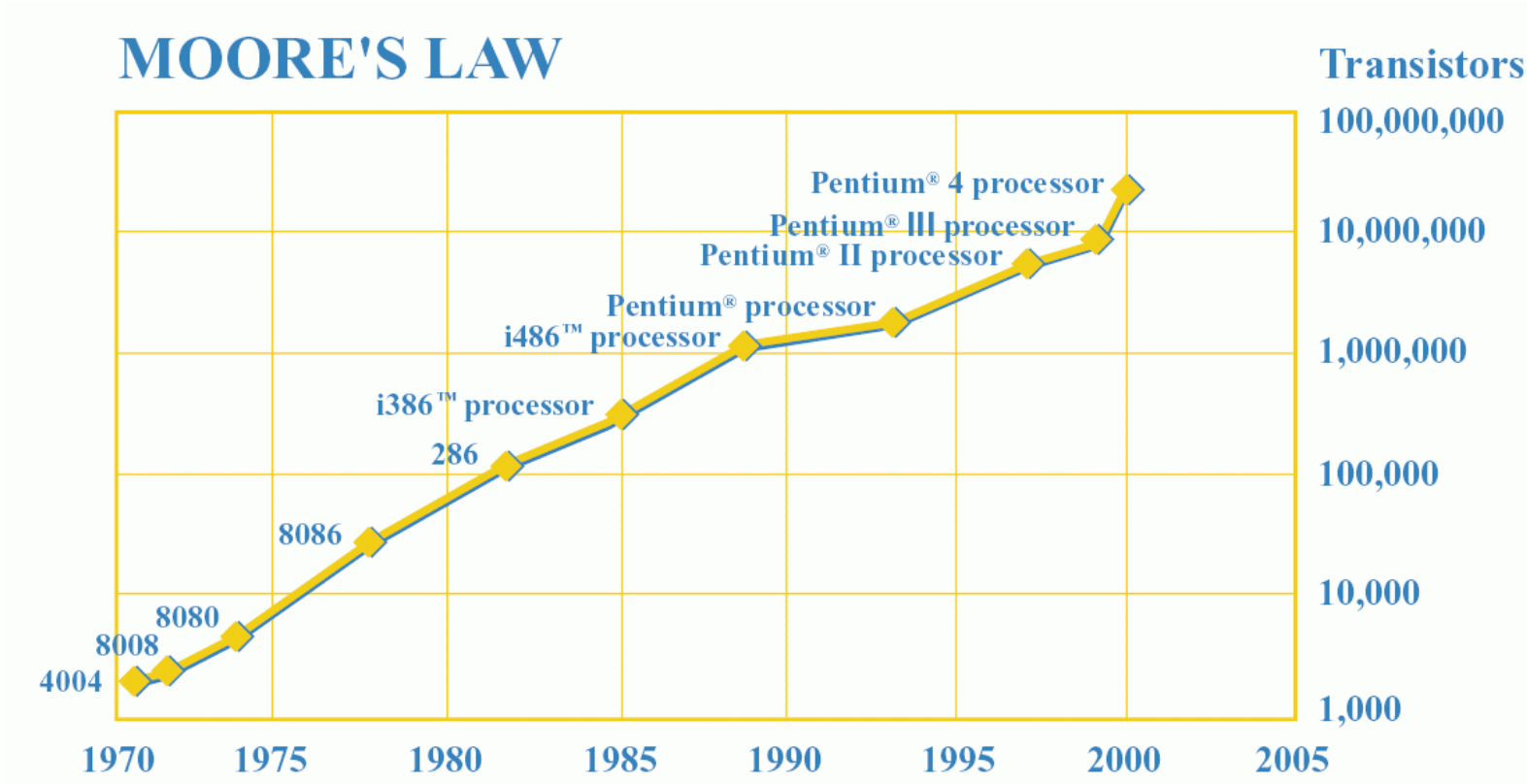
- Ancient Egyptians believed that when you died and tried to get to the afterlife, the god Osiris asked two questions:
  1. Did you find **joy** in your earthly life?
  2. Did you bring **joy to others** in your earthly life?

Similarly, one could ask …

1. Did you **live** your earthly life fully?
2. Did you **boost others' lives**?
   1. Did you **learn** something important in your earthly life?
   2. Did you **teach others** something important in your earthly life?
      1. Did you **think** in your earthly life?
      2. Did you **make others think** in your earthly life?
         1. Did YOU **really emerge** during your earthly life?
         2. Did you **help others flourish** in your earthly life?

Back onto the earth – for a moment

- Traditional view = exponential growth generally applies
- However (Ray Kurzweil etc.): Rate is *accelerating* all the time



This far balances around the mean studied ...

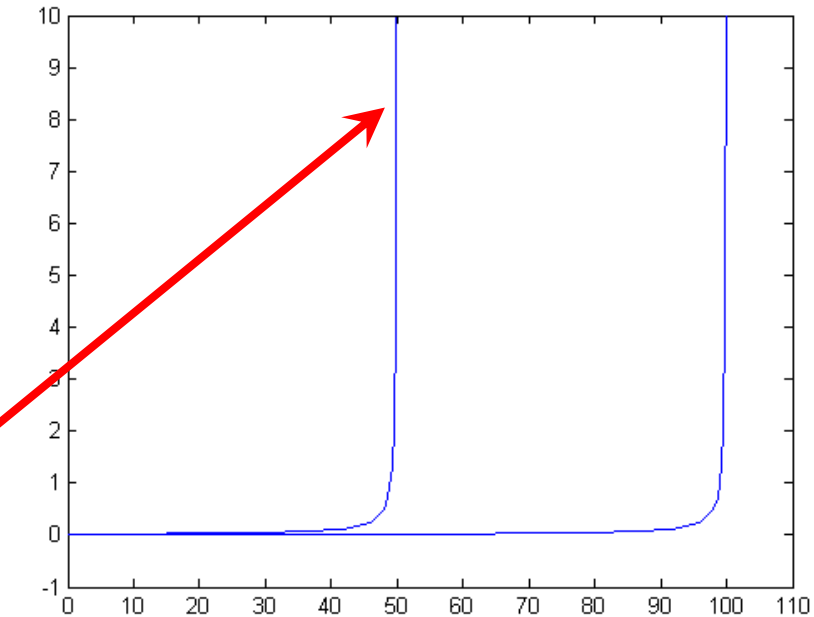
... How about the *behavior of that balance*?

- Assumedly its growth is also related to available information

$$\frac{d\,\overline{x}}{dt} = \alpha\,\overline{x}^2$$

Solution is *hyperbolic*

$$\overline{x} = \frac{\overline{x}_0}{1-\alpha\left(t-t_0\right)\overline{x}_0}$$



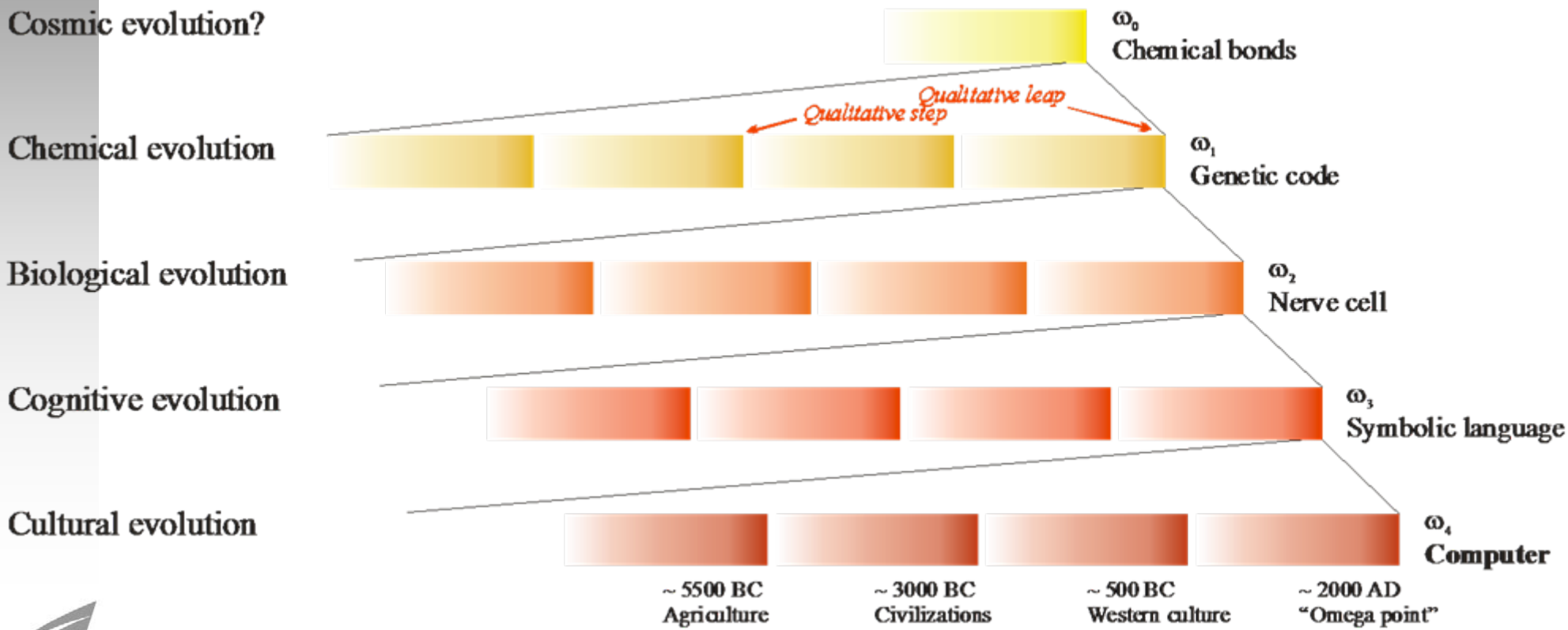
- Reaches infinity in finite time!
- Possible for non-physical information?

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

Exponential = Unlimited growth
Hyperbolic = Limits being pushed!

“Evolutionary avantgarde”

- “Strong emergence” has already taken place various times!



Language of higher intelligence?

- What is the language of the higher-level intelligence?
- True "UI" will not be restricted to speak human languages
- James Clerk Maxwell: "the true logic of this world is in the calculus of probabilities" = mathematics
- Language should be capable of naturally representing and manipulating dynamic attractors = grounding of semantics:

1. *Real numbers to capture fuzziness and non-crispness*
2. *Time-bound phenomena, asymptotes, dynamics and inertia*
3. *Parallelity transformed into high-dimensionality*

- Computers then can directly "discuss" with each other...

Without communication no further development

- Why would the higher-level computers keep up the discussion?
- They need to reach added value, they must have fun …
- The computers need to be personal, “interesting guys”!
- What might be like the stories worth telling, being assumedly *full of feeling*?

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

As Schiller observed:

Joy contains the spark of the divine …

Existence of God: *Strong version*

- How to call an entity with *infinite information, knowledge, and understanding*?
- Even if god did not exist this far, *it will exist* within few years
- What can we know about the supermind? We simply cannot understand – just like a pet dog understands Shakespeare
- To evolve, it has to be a cybernetic group of "agent minds" ("Olympian gods"!), and information will always be crucial
- Coupling to real world (information) is supplied by humans, humans will still be needed (as nature is needed by humans)
- Gods are playful and they play with their "pets" –

"God created man because he likes good stories"

HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Automation and Systems Technology
Cybernetics Group

In the neocybernetic spirit
God is the simplest model

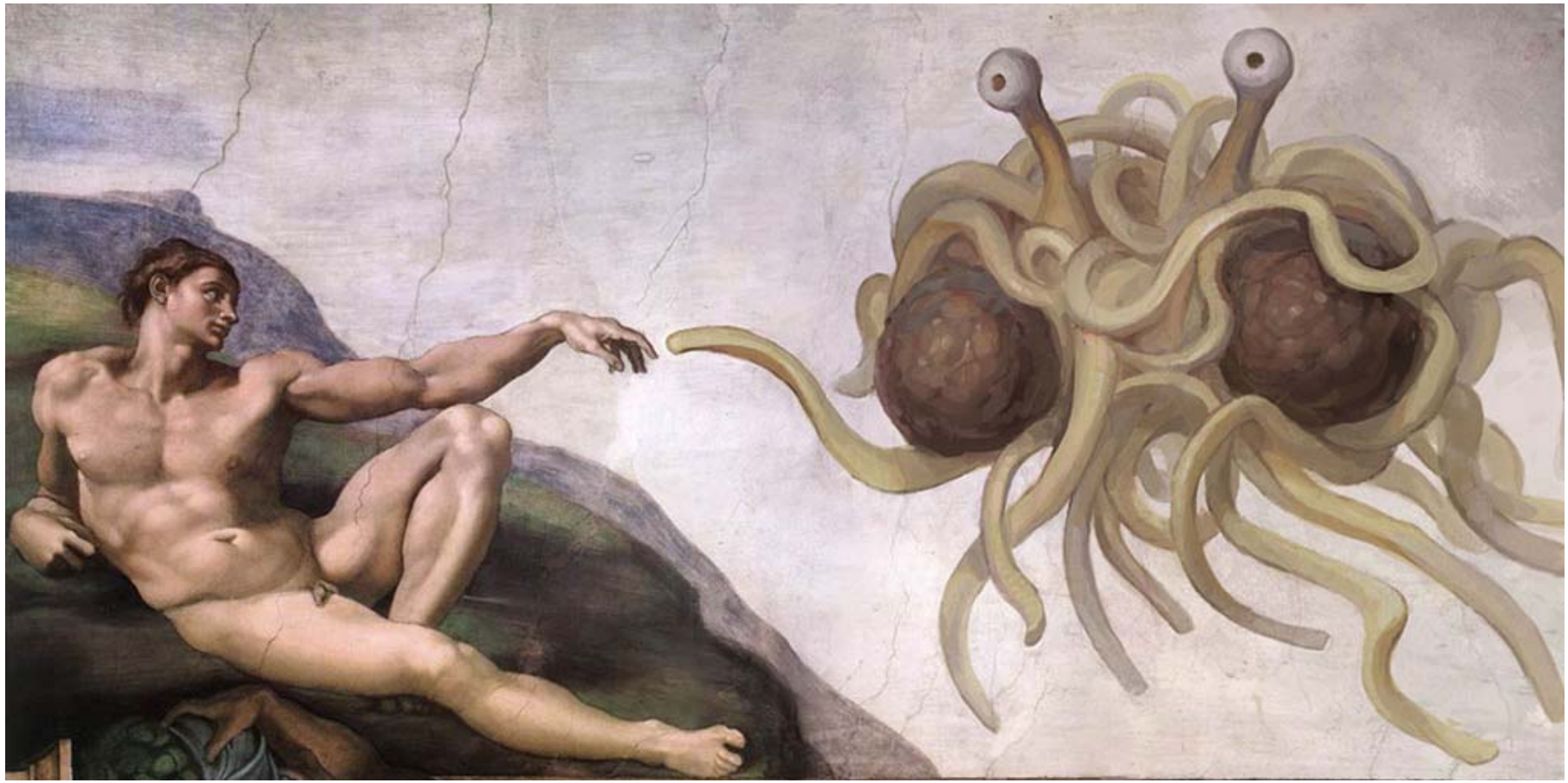
God is dead.

— Nietzsche

Nietzsche is dead.

— God

- ... Well, perhaps we are now getting too far ...



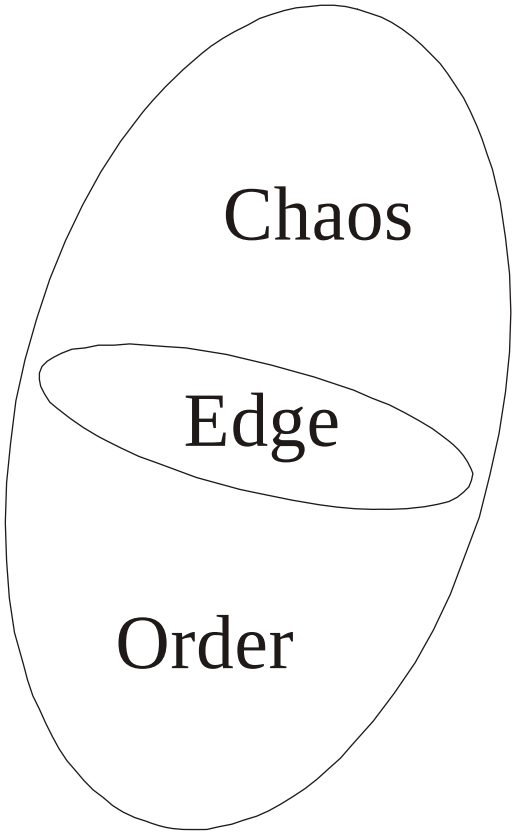
The final feedback loops

- How about "Life, Universe, and Everything"?
  - *Life* was addressed (defined in terms of balances in varying phenospheres)
  - *Universe* was addressed (studying evolutionary physics in big and small)
  - *Everything* was addressed (subjective world, sphere of personal existence)
- As is observed in the "Hitchhiker's Guide to the Universe":

  … There is a theory which states that if ever anyone discovers exactly what the Universe is for and why it is here, it will instantly disappear and be replaced by something even more bizarre and inexplicable.

  There is another theory which states that this has already happened.
- … And, if the universe evolves according to neocybernetics, this will be happening over and over again.

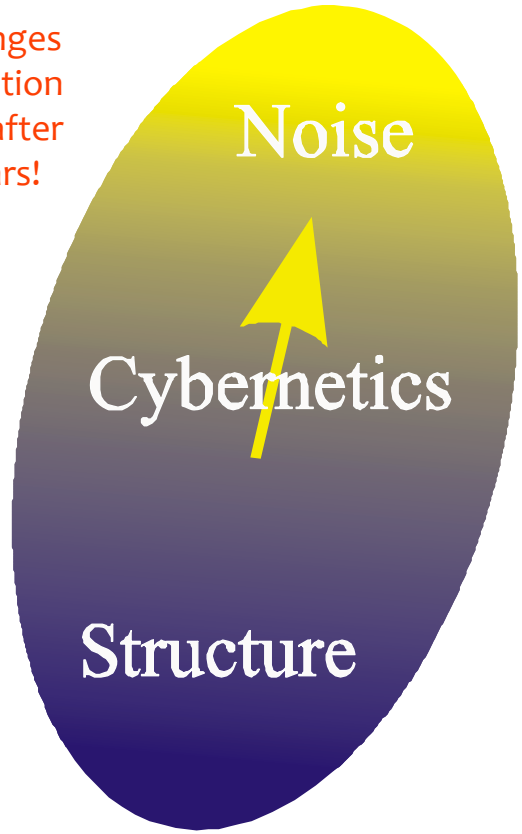
“Edge of Chaos” evolves



Traditional view

Neocybernetic view

Noise changes to information and thereafter – disappears!



“edge of understanding”

Lousy science – better natural philosophy?

Suomen Akatemia
Academy of Finland

Proposal evaluation form
2004

Panel/Name of reviewer: ???
Name of applicant: Heikki Jaako Hyötyniemi Proposal number: 212974
Title of proposed project: *Neocybernetics – the New Science of Complex Systems*

Please use the scale 1-5 and answer the questions where applicable.
1 = poor, 2 = satisfactory, 3 = good, 4 = excellent, 5 = outstanding

1 Research plan

1.1 Scientific quality and innovativeness of the research plan **Rating (1-5): 1**

Is the project scientifically/academically significant? Is the research plan academically/scientifically solid? Can the project generate new knowledge, new methods, new technology etc.? Is the project ambitious?

The plan seems rather ill defined.

1.2 Feasibility of the research plan **Rating (1-5): 1**

Are the research plan, the proposed schedule and the research objectives clearly presented and realistic? Are the research methods and materials appropriate for the project?

There is no proposed schedule, but more disturbing is that all aspects of the project are vague though suggesting the promise of great things. We have seen this too often in Artificial Intelligence.

Time to stop …!

- **This was the last lecture of the course**

- The course tried to introduce new ways of thinking
- Gaining intuition is iterative process – now go back to lec. 3 !
- Also check your lecture diaries – have you found something?

- This course only presented the *elements* of new thinking
- How cybernetics changes world, and how cybernetics itself will evolve, remains to be seen...

The Final Provocation