

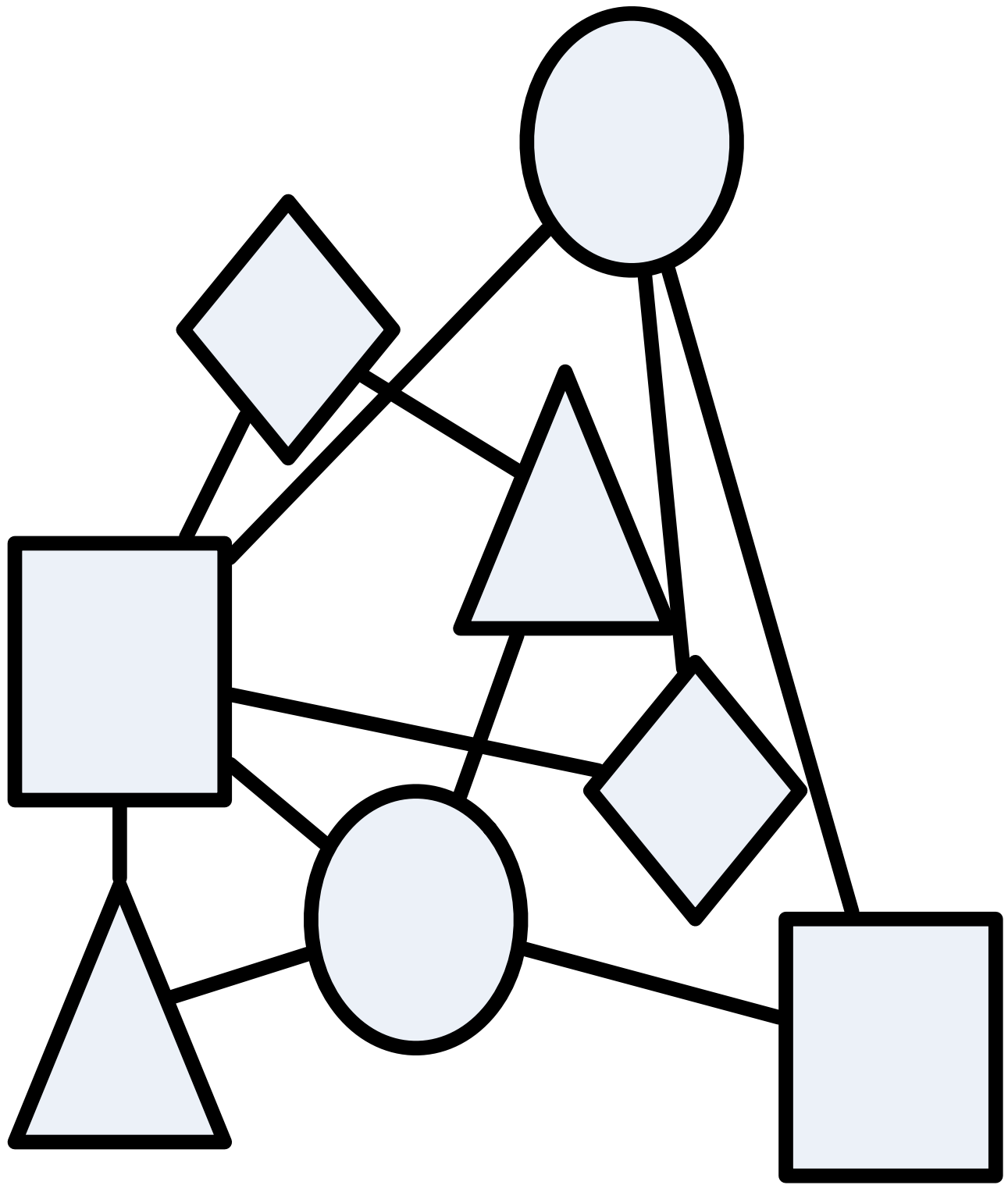


# Tools for Complexity

*Revision: August 19, 2008 Beta v0.5*

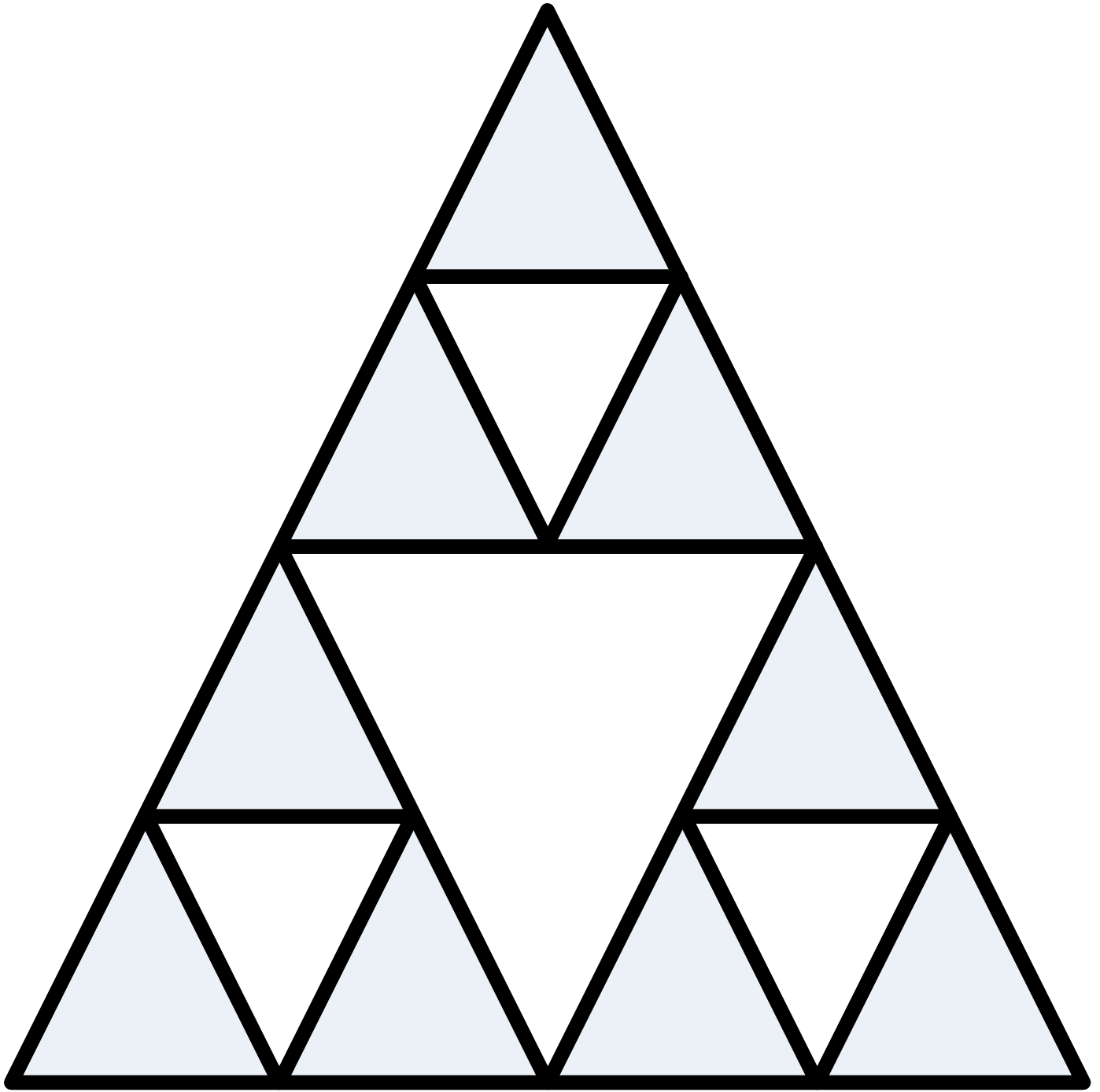


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Jonathan Bucki, Dendros Group, LLC.  
References & More: [www.GoodWorkTools.com](http://www.GoodWorkTools.com) Please share wildly!



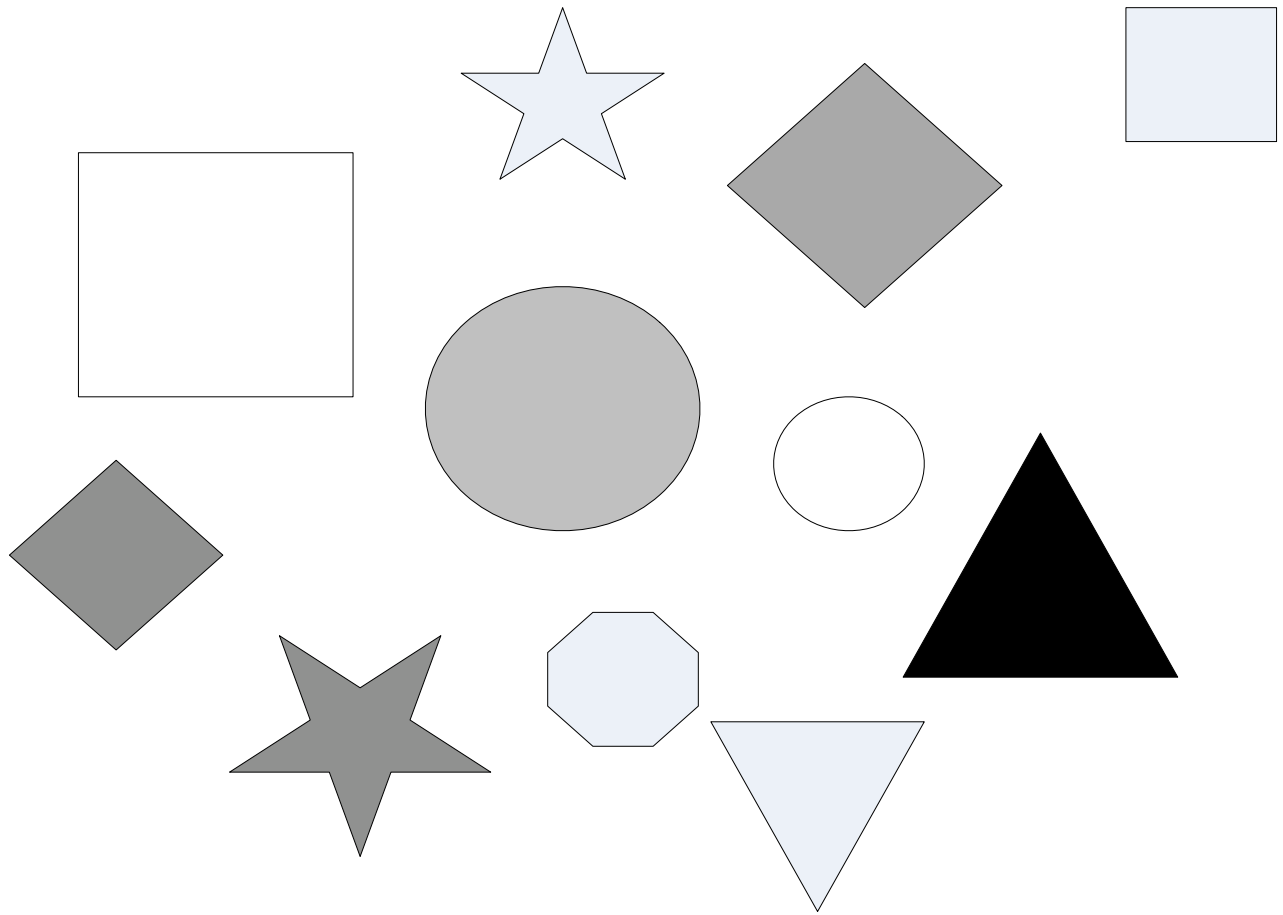
# Massively Entangled

- **Component parts of systems and variables describing those parts are large in number and interrelated in complicated ways**
- **Causality difficult to establish**
- **Driven by a large number of interdependent variables**
- **Variables can be nonlinear and discontinuous**
- **A small change in one variable may generate exponential change in another. This pattern is exacerbated because CASs depend on iterative processes**



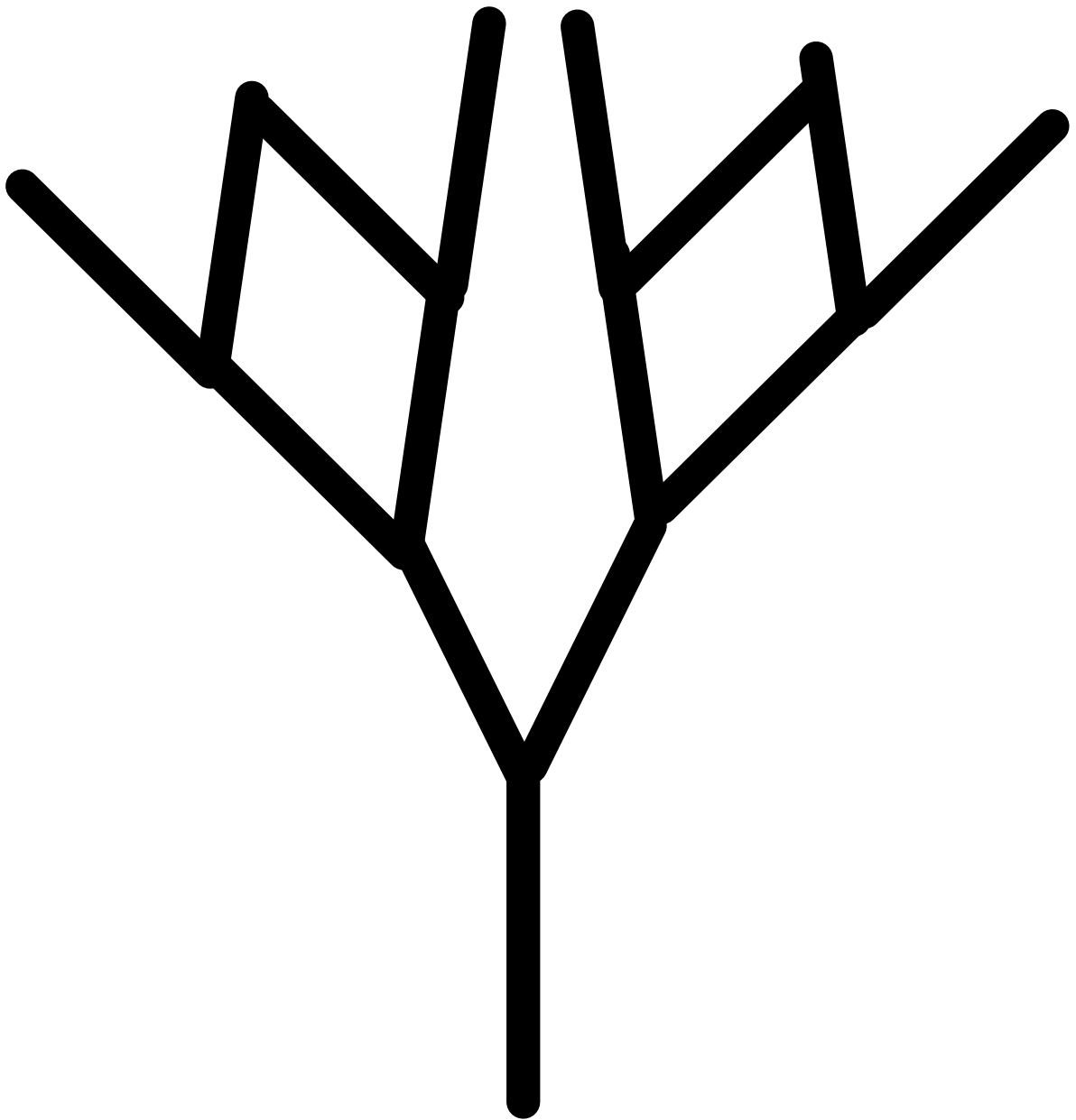
# Simple Rules

- **Complex does not mean complicated**
- **Rich variety, simple rules**
- **The rules are not necessarily shared, explicit, or even logical when viewed by others, nonetheless they contribute to patterns and bring coherence to behaviors in complex systems.**
- **Simple rules set the parameters and provide focus and freedom for system**



# **Difference, Diversity**

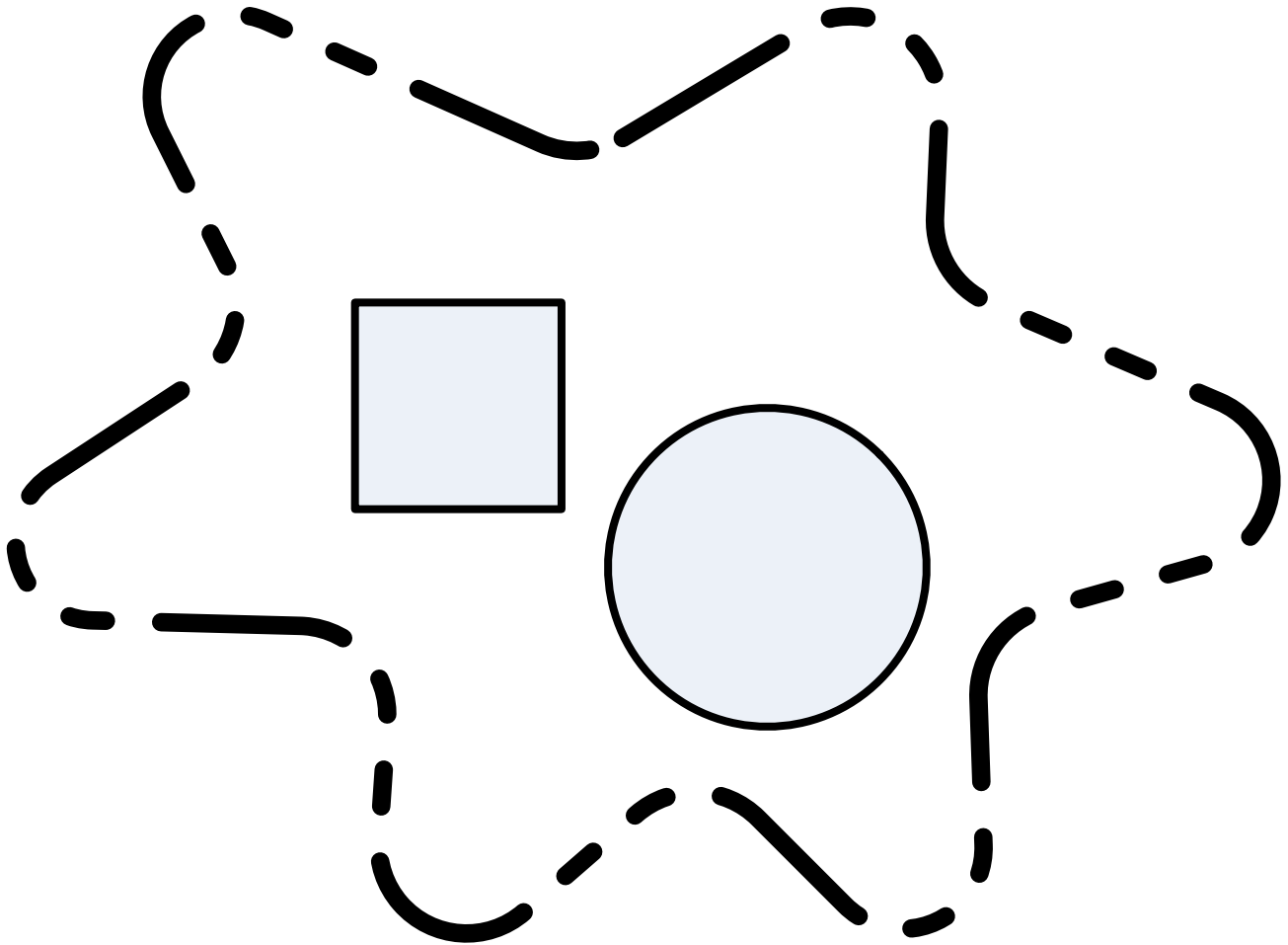
- **The greater the variety within the system the stronger it is.**
- **In fact ambiguity and paradox abound in complex adaptive systems which use contradictions to create new possibilities to co-evolve with their environment.**
- **Democracy is a good example; its strength is derived from its tolerance and variety of political perspectives.**



# Fractal Scalability

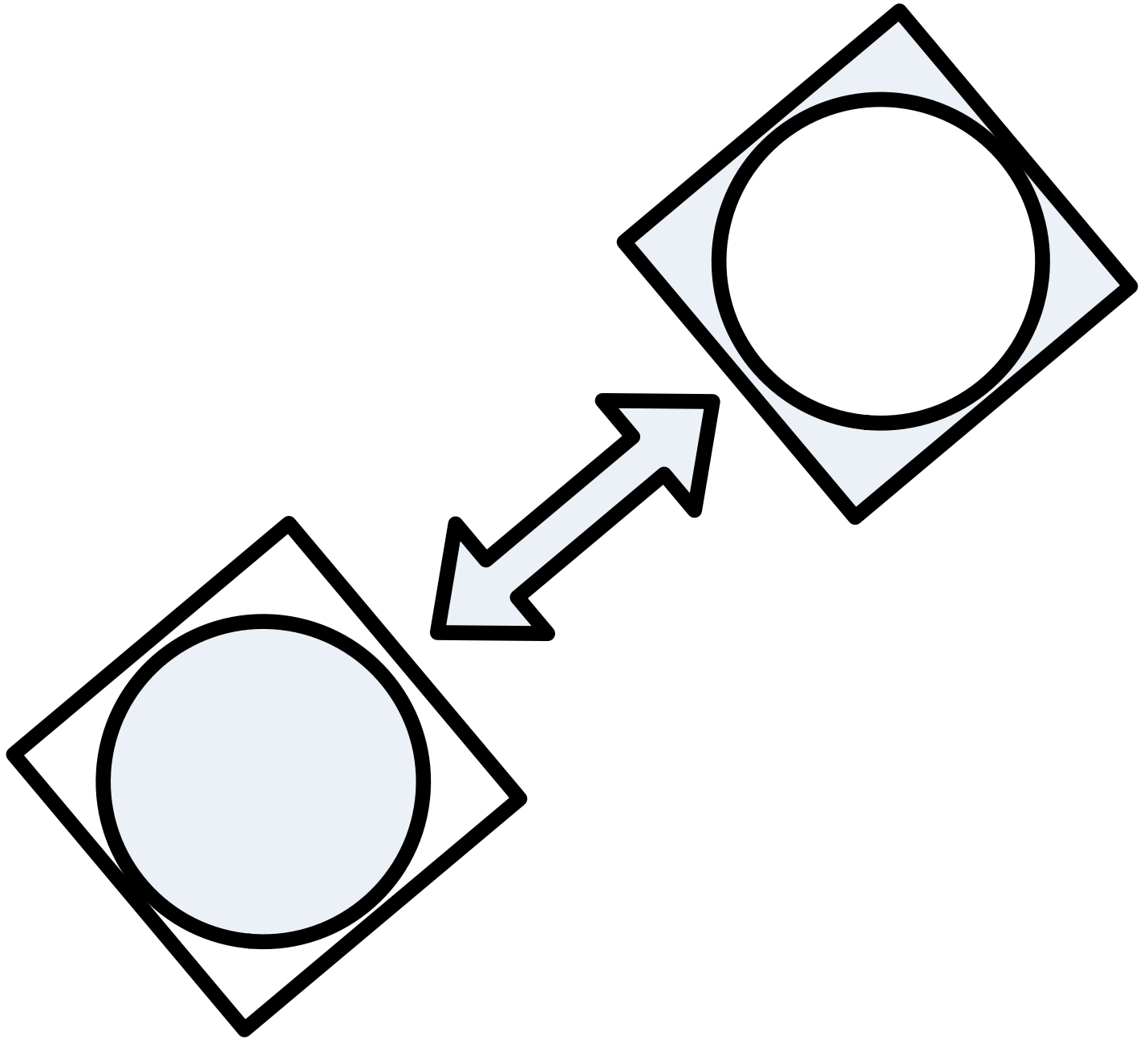


- **Results of multiple solutions to non-linear equation**
- **Visual image for how complex, chaotic systems can generate levels of differentiation and similarity from simple, core principles**
- **Self similarity**
- **Fuzzy boundaries**
- **Scalable**
- **Creative differences**
- **Variable stability**
- **Can serve iconic, metaphoric purposes**



# Boundary Effects

- **Systems include wide range of similarity and difference**
- **Boundaries separate regions of difference**
- **Different Kinds:**
  - **Permeable**
  - **Partially Permeable**
  - **Impermeable**
  - **Distinct**
  - **Indistinct**
- **Conditions around and in boundaries can be generative or degenerative**

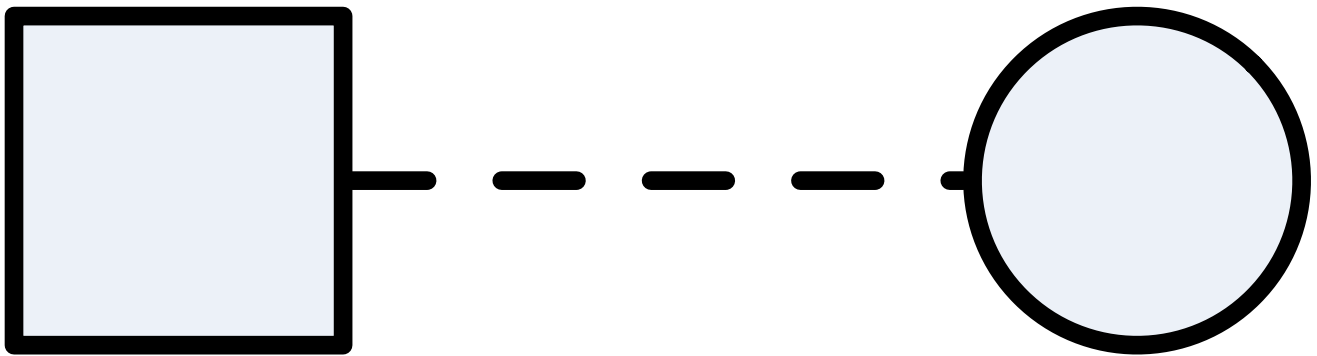


# Transforming Feedback

- **Information/Feedback generates changes in both sender and receiver**
- **Can amplify or dampen behaviors or transformations**
- **Lengths of feedback loops can alter the results of the feedback**
- **Links parts of a system into a functioning whole**



**Tight Couple**



**Loose Couple**



**Uncouple**

- **Attachments between subsystems within complex system**
- **Complex interdependencies**

## **Tight**

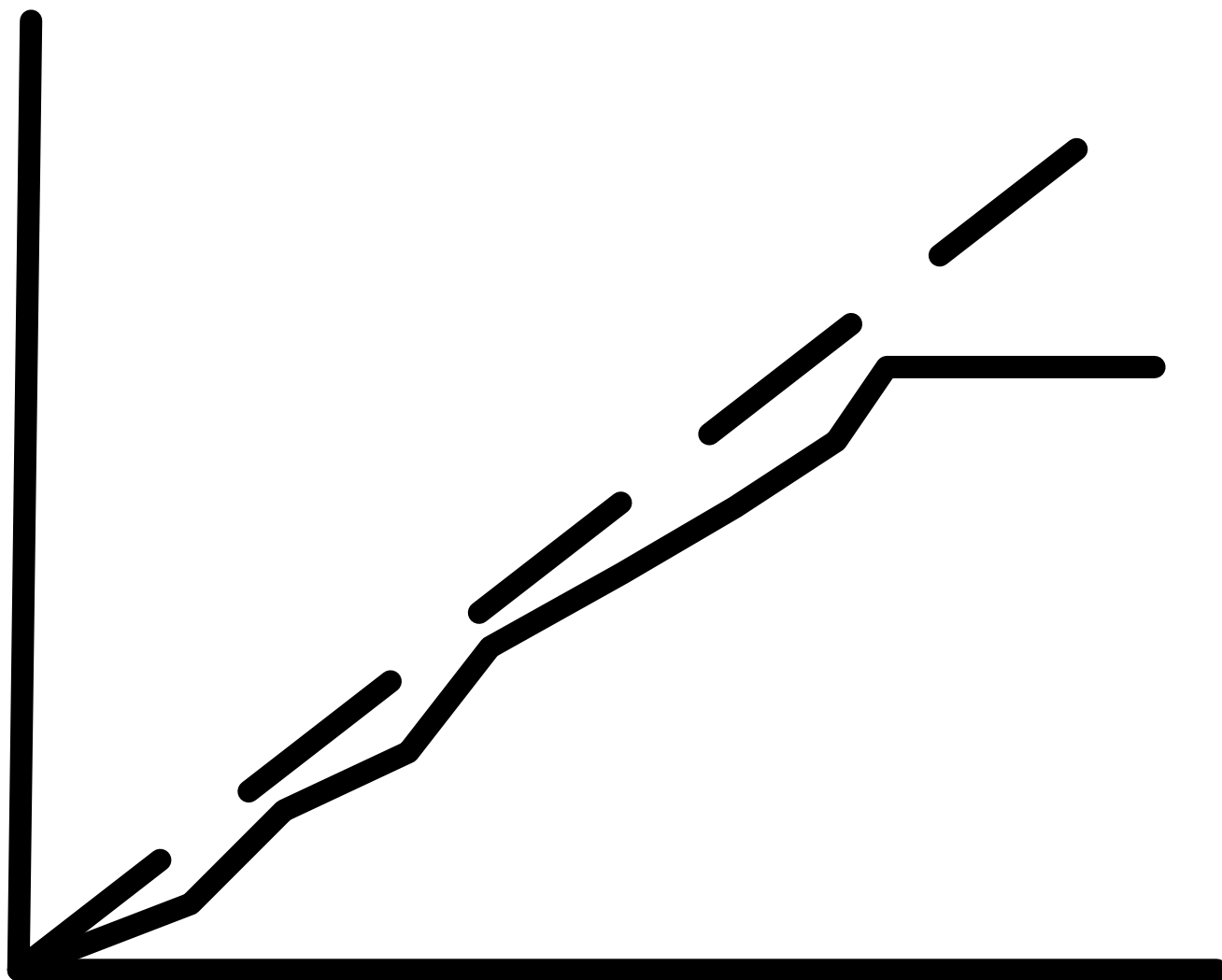
- **Strong Influence**
- **Immediate change in other**

## **Loose Couple**

- **Gradual, not radical**
- **Open to other influences**

## **Uncouple**

- **Neither affects the other**



# Sub Optimal

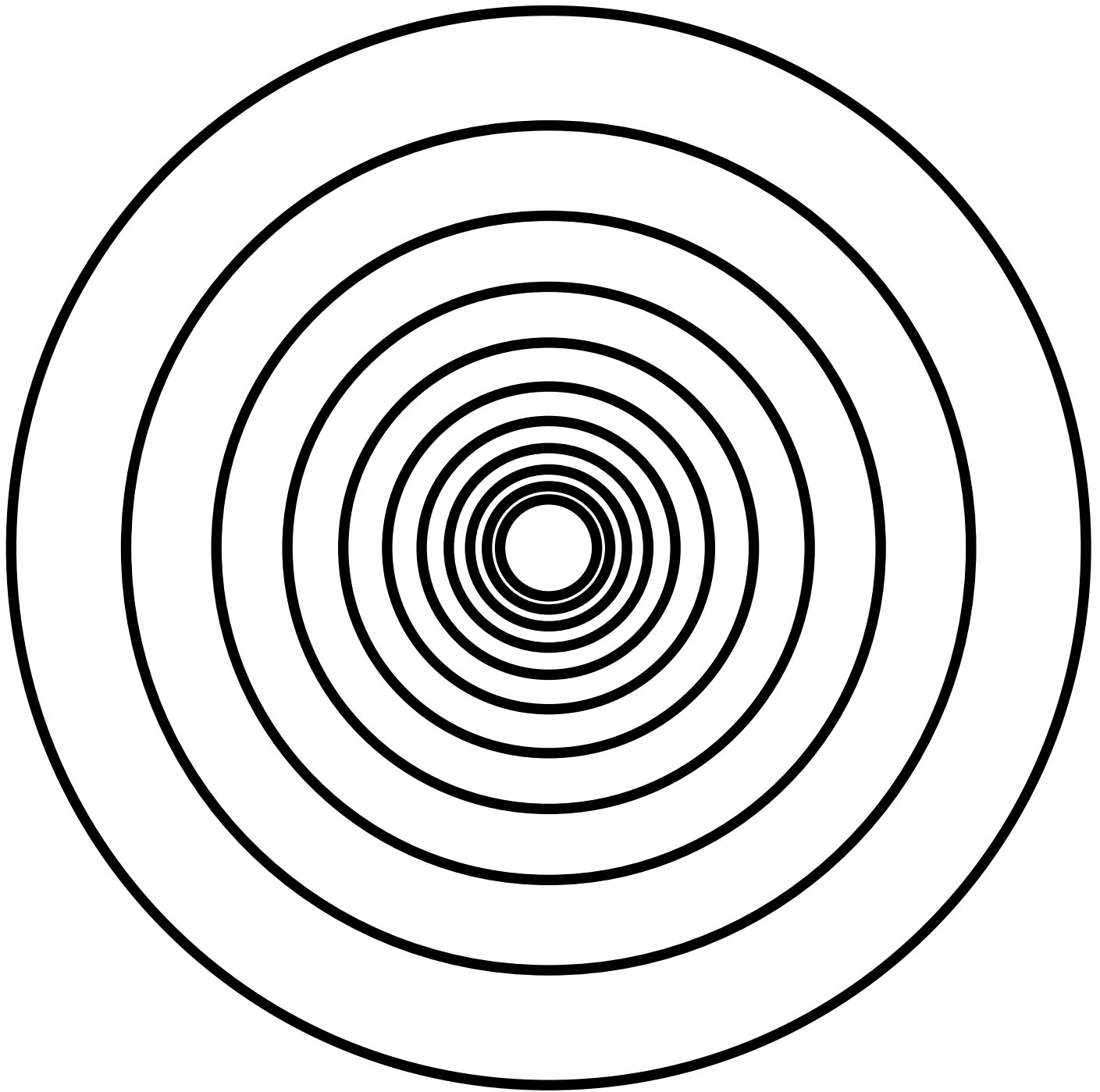


- **A CAS does not have to be perfect in order for it to thrive within its environment**
- **It only has to be better than its competitors**
- **Any energy used on being better than that is wasted energy**
- **Once it has reached its state of being good enough, it will trade off increase efficiency *every time* in favor of greater effectiveness**



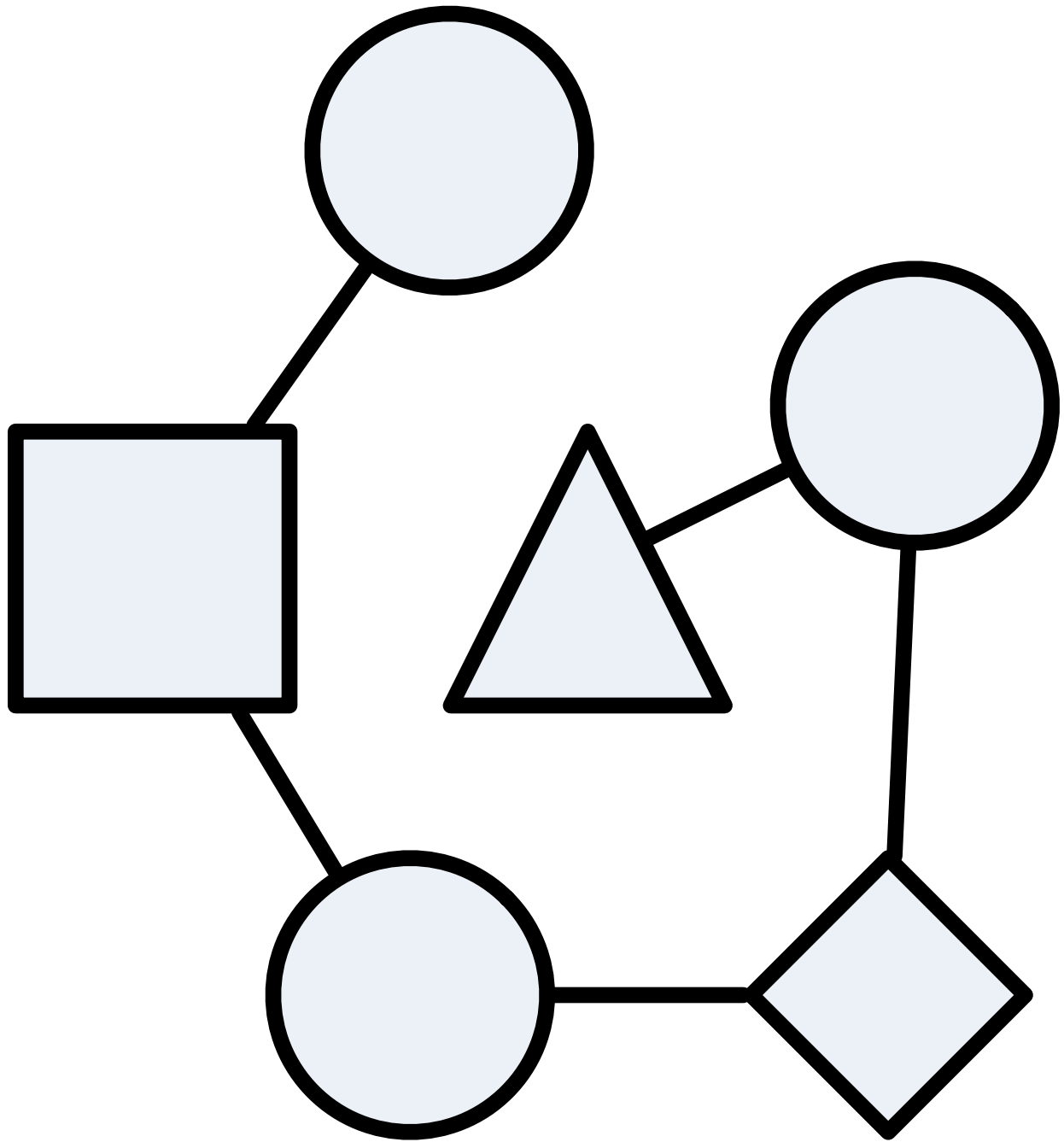
# Edge of Chaos

- **A system in equilibrium does not have the internal dynamics to enable it to respond to its environment and will slowly or quickly die.**
- **A system in chaos ceases to function as a system.**
- **The most productive state to be in is at the edge of chaos where there is maximum variety and creativity, leading to new possibilities.**



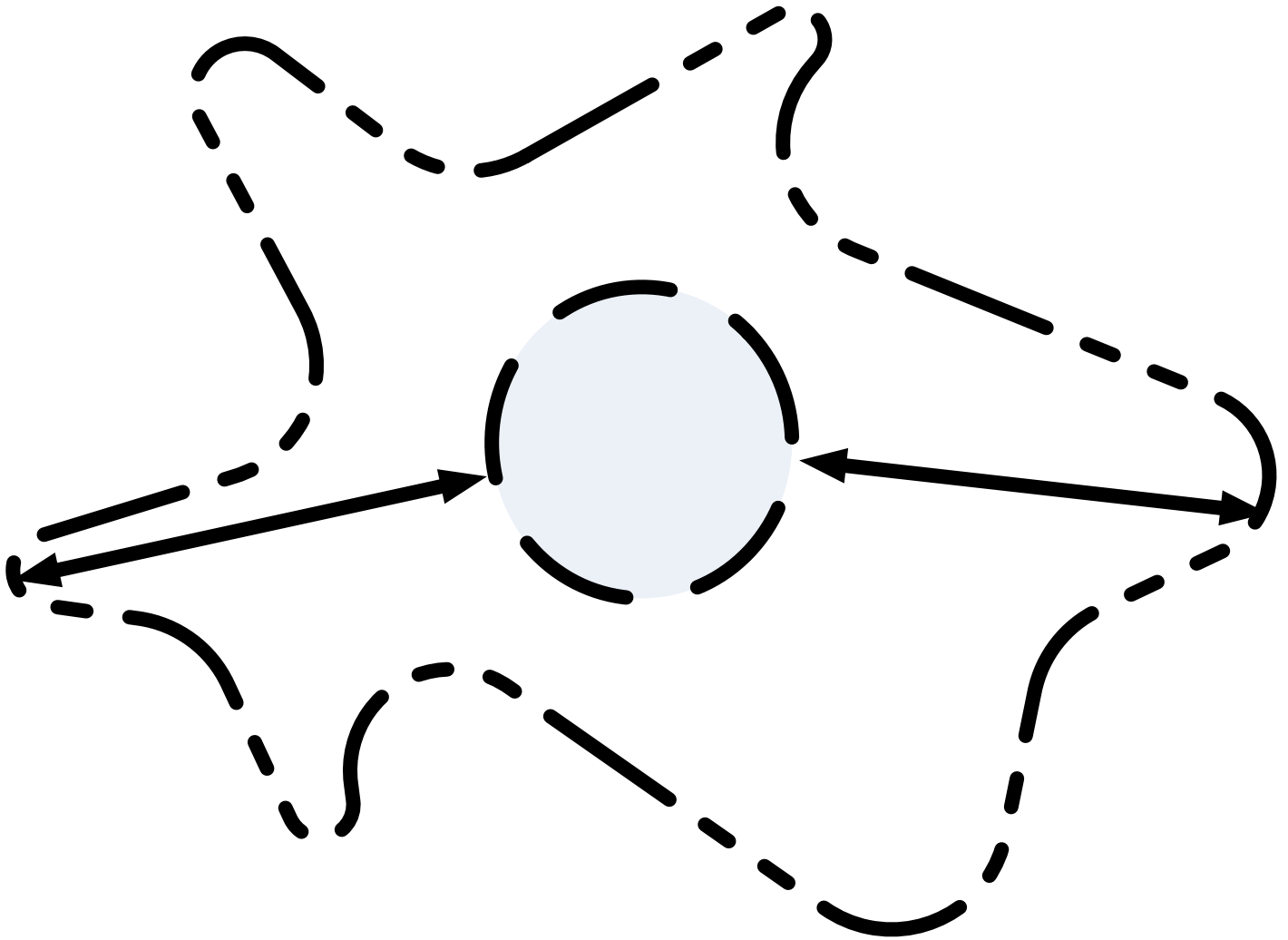
# **Nested Systems**

- **Most systems are nested within other systems and many systems are systems of smaller systems.**



# Emergent Self-Organizing

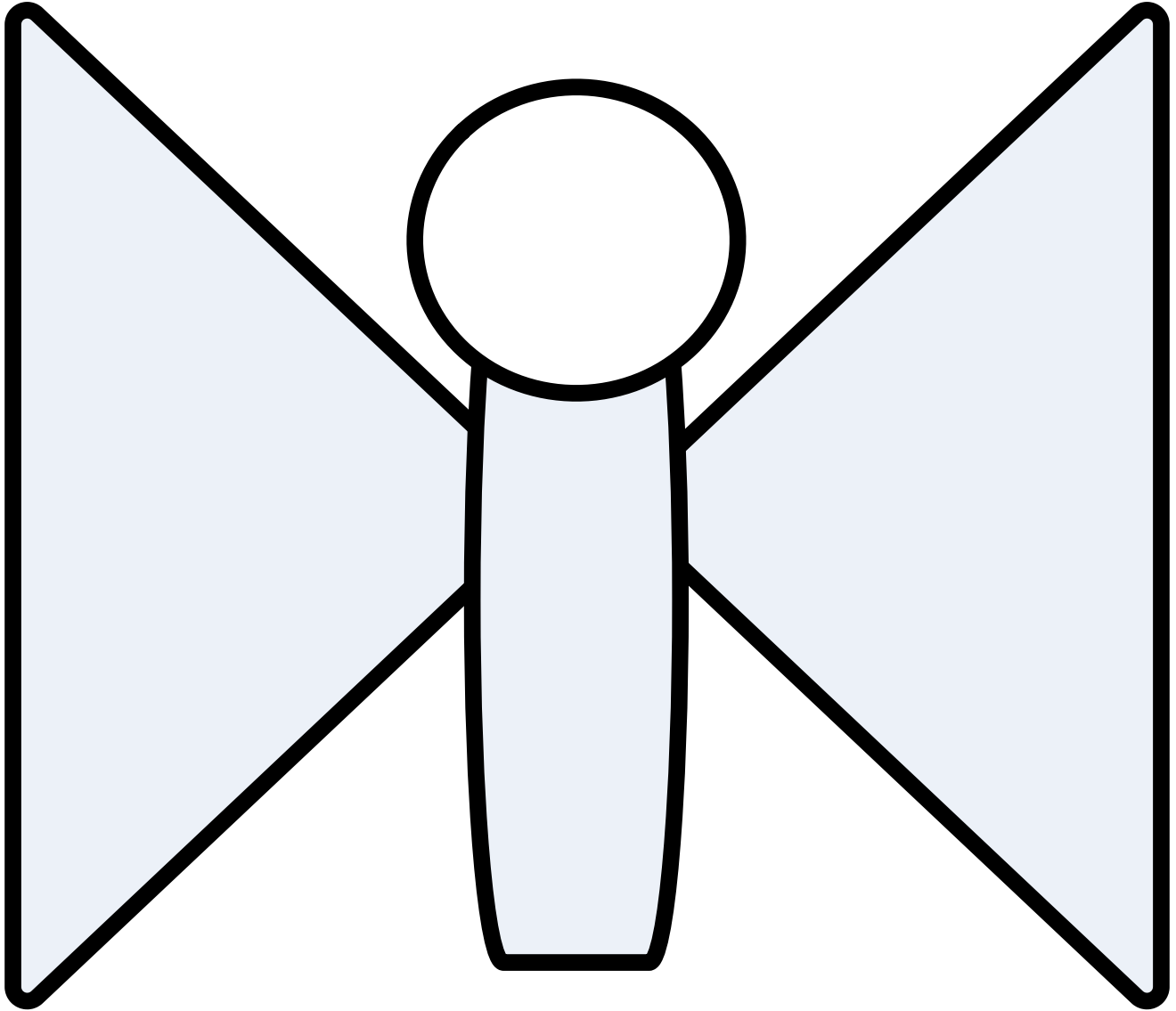
- **New patterns of behaviors are generated by agents**
- **Requires differentiation and transforming feedback**
- **When sufficiently disorganized systems generate their own order**
- **Structures arise and fall as landscape changes, behaviors become more or less effective**
- **No hierarchy of command and control**
- **No planning or managing, but constant re-organizing to find best fit**



# Co-Evolution

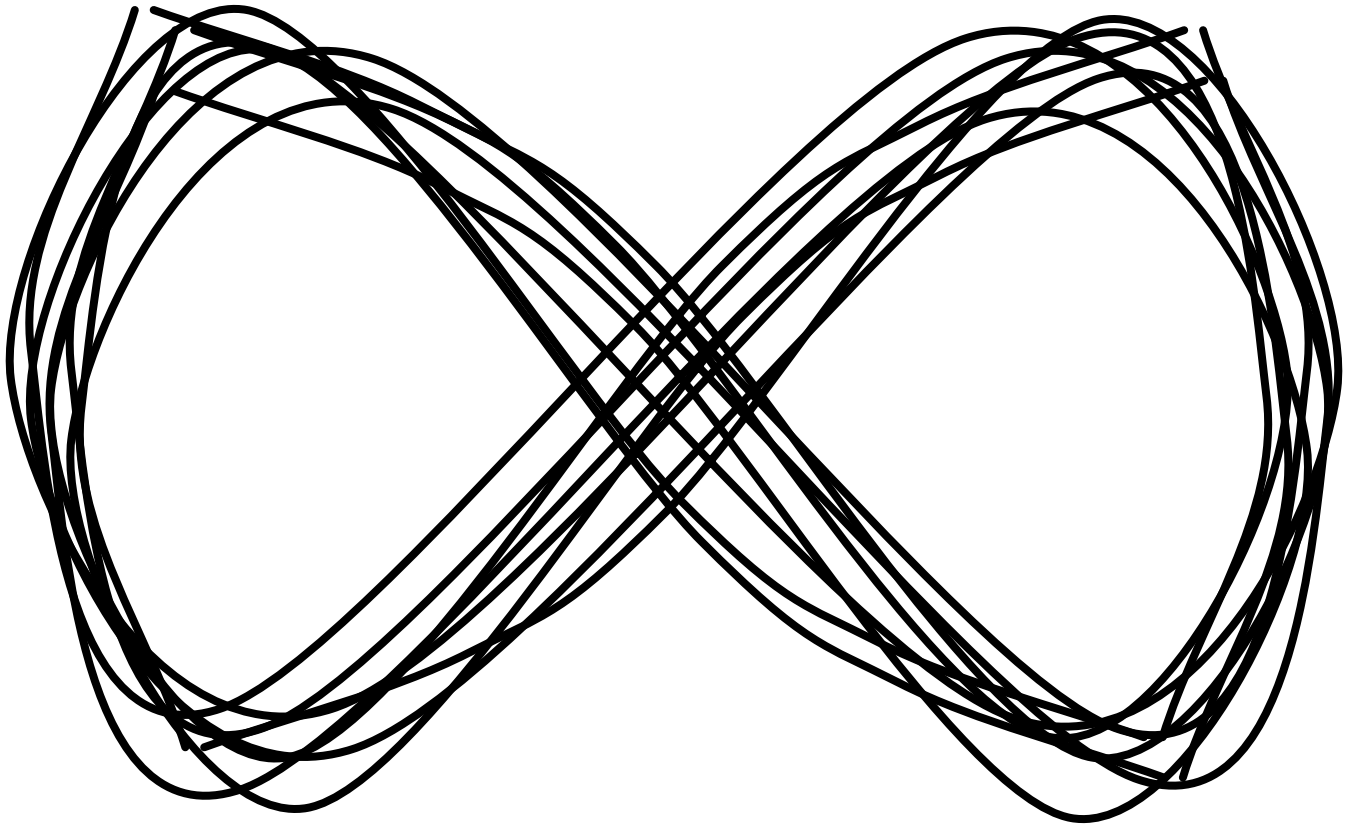


- **All systems exist within their own environment; they are also part of that environment.**
- **As their environment changes systems need to change to ensure best fit, effectiveness.**
- **But because they are part of their environment, when systems change, they change their environment, and as it has changed they need to change again**
- **So it goes on and on...**



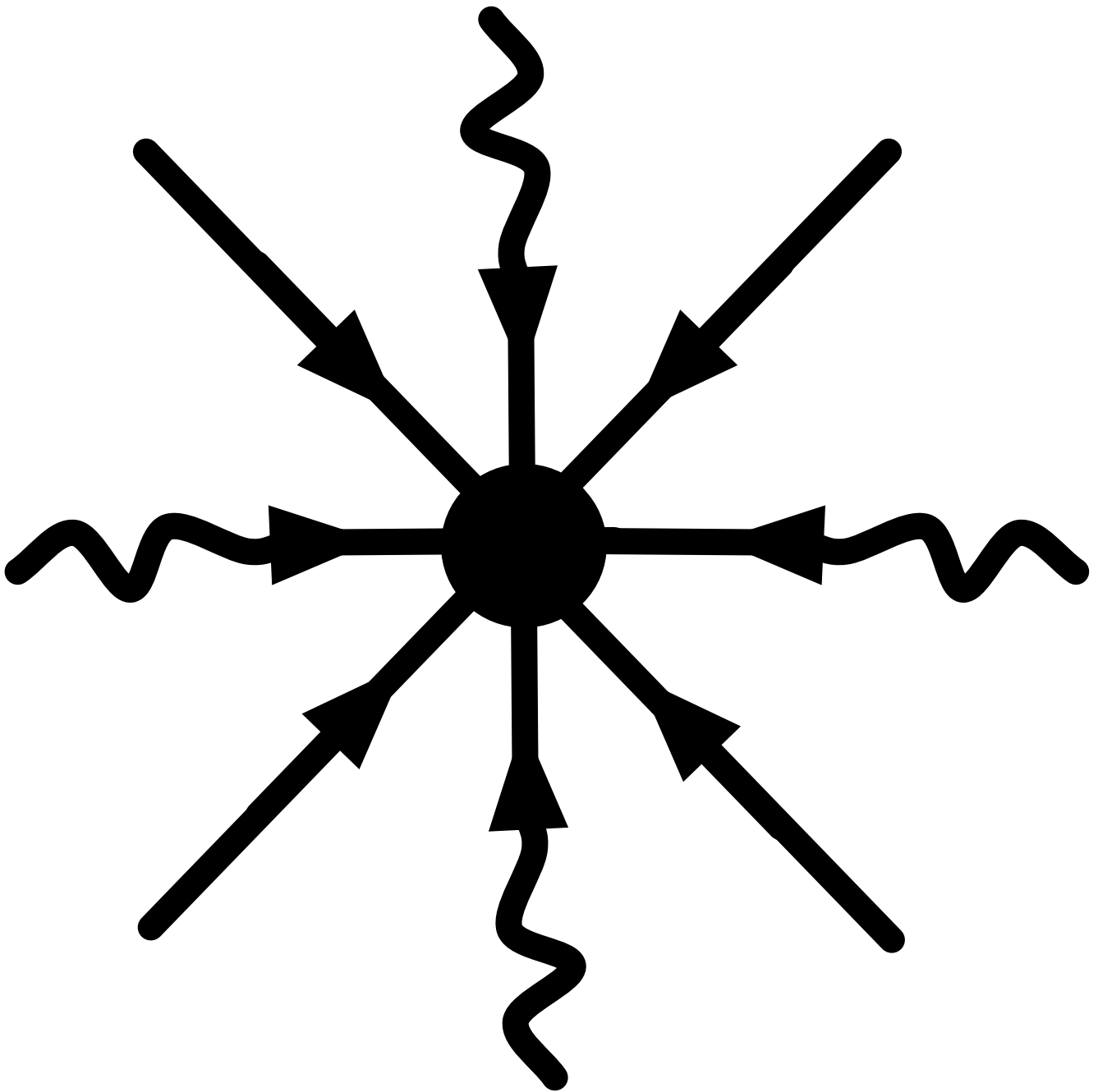
# Butterfly Effect

- **Small cause, tremendous effect**
- **Sensitivity of initial conditions**
- **Cannot tell which factors will represent butterfly effects, and which will yield predictable results**
- **Positive or Negative**



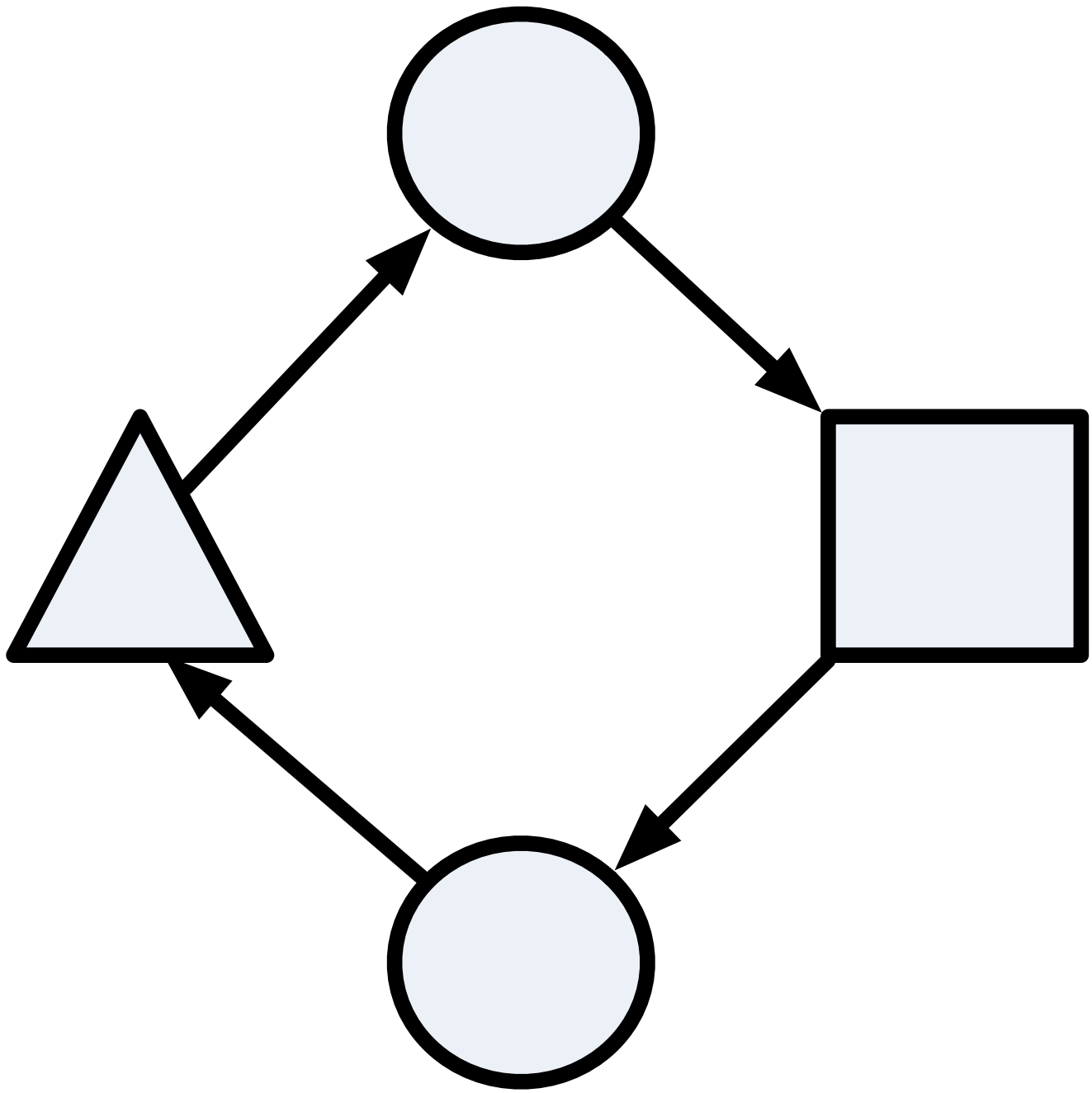
# Strange Attractor

- **Attractors describe the behavior of the whole system**
- **Behaviors of both individual and pattern whole**
- **Strange attractors appear random, but may have complex, unpredictable behaviors that may be patterned**



# Point Attractor

- **Point attractors describe systems where all activities converge towards a singular point or energetic level.**



**Periodic  
Attractor**



- **Periodic attractors describe systems where behaviors tend to be repeated in regular intervals.**