# Beyond Bugs:

## Thinking in Systems

Samet Atdağ – 2024/10/24

# Who am I?

## My name is Samet Atdağ.

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# Definition:

## What is a “System”?

Oxford Languages sağlayıcısından tanımlar · Daha fazla bilgi

**system**

/ˈsɪstɪm/

*noun*

1. a set of things working together as parts of a mechanism or an interconnecting network; a complex whole.
   "the state railway system"
2. a set of principles or procedures according to which something is done; an organized scheme or method.
   "the public school system"

We’ll get back to this word soon

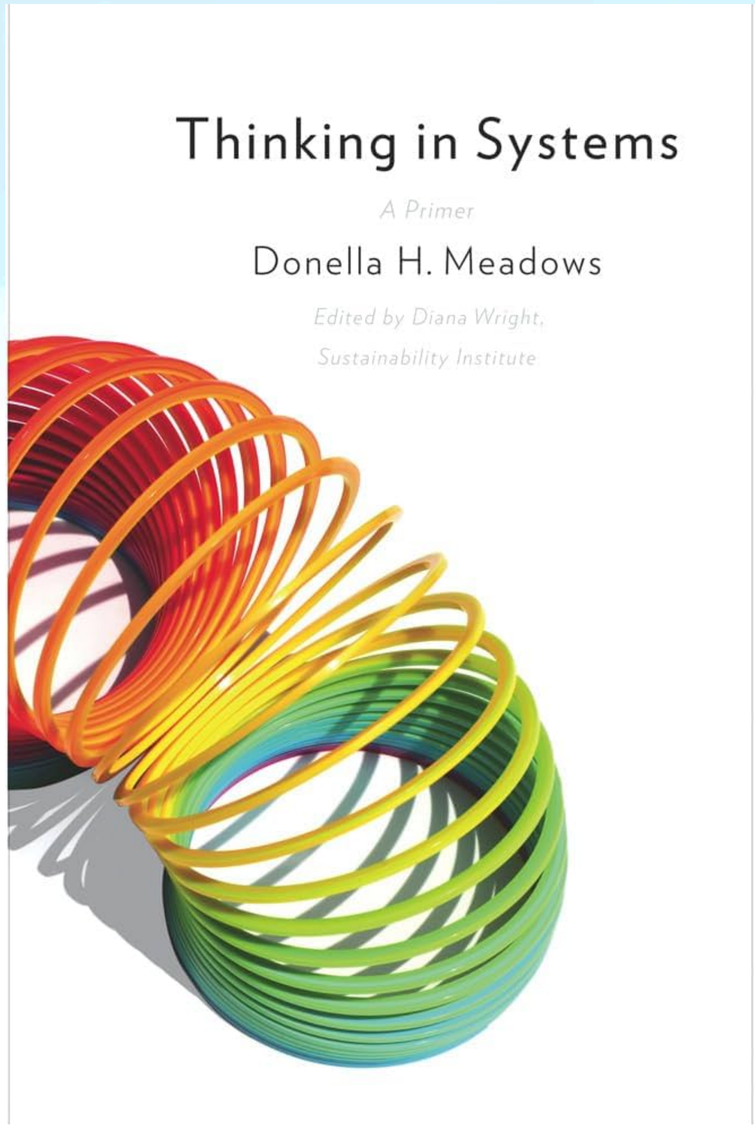
# Definition:

## A System contains…*

**Elements**

**Connectors**

**Purposes**




Meadows, Donella H. (2009). Thinking in systems : a primer. London ; Sterling, VA :Earthscan,

# Definition:

**Purposes divert.**

**Meetings become ceremonies**

**Atlassian Jira becomes the purpose**

**Bugfixing replaces development.**

# Definition:

## Complex Systems…

# Complex system

From Wikipedia, the free encyclopedia

A **complex system** is a system composed of many components which may interact with each other. Examples of complex systems are Earth's global climate, organisms, the human brain, infrastructure such as power grid, transportation or communication systems, complex software and electronic systems, social and economic organizations (like cities), an ecosystem, a living cell, and, ultimately, for some authors, the entire universe.[2][3][4]

# Definition:

## Properties of Complex Systems…

- …
- may be open
- **may be nested**
- may exhibit critical transitions
- **may produce emergent phenomena**
- Relationships are non-linear
- Relationships contain feedback loops
- …

We'll get back to this word soon

# Definition:

## Emergent Phenomena…

# Emergence

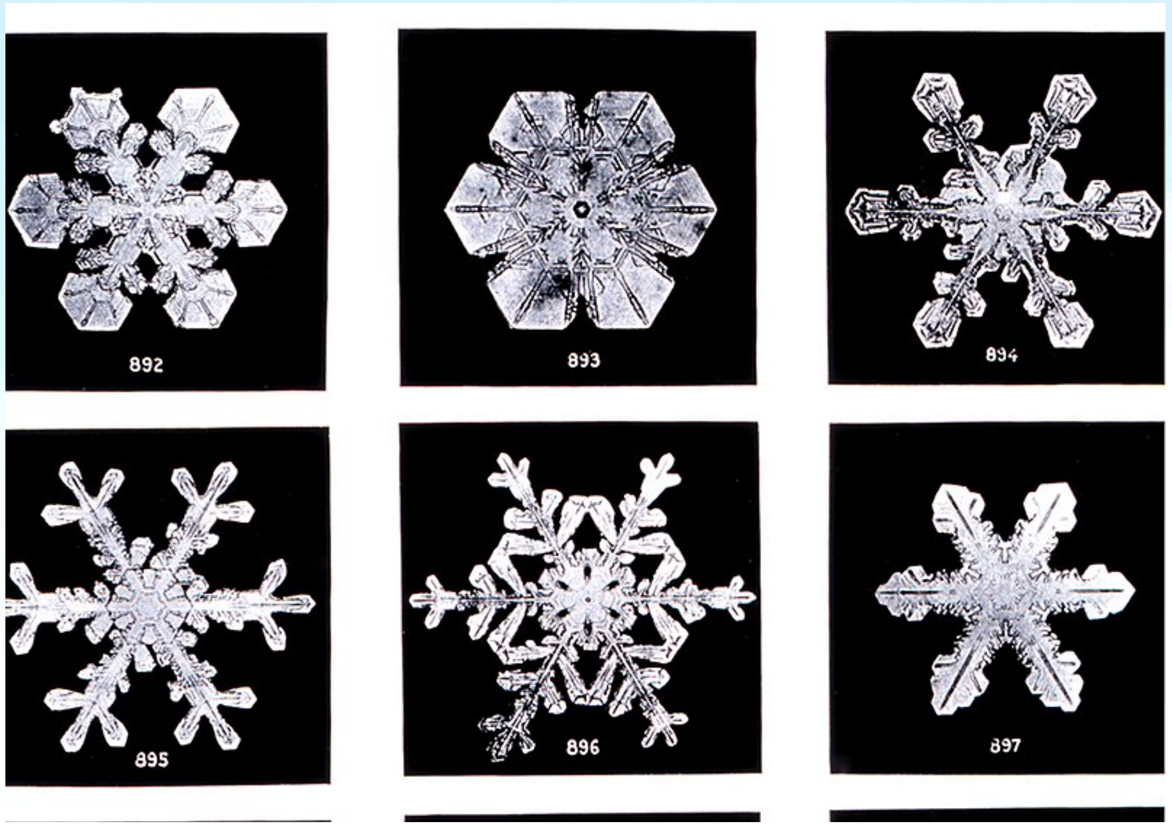
From Wikipedia, the free encyclopedia

In philosophy, systems theory, science, and art, **emergence** occurs when a complex entity has properties or behaviors that its parts do not have on their own, and emerge only when they interact in a wider whole.

Emergence plays a central role in theories of integrative levels and of complex systems. For instance, the phenomenon of life as studied in biology is an emergent property of chemistry and physics.

# Definition:

## Examples of Emergent Behaviour




By Wilson Bentley - Plate XIX of "Studies among the Snow Crystals ... " by Wilson Bentley, "The Snowflake Man." From Annual Summary of the "Monthly Weather Review" for 1902., Public Domain, https://commons.wikimedia.org/w/index.php?curid=22130

# Definition:

## Examples of Emergent Behaviour

Emergence. (2024, October 9). In *Wikipedia*. https://en.wikipedia.org/wiki/Emergence

# Definition:

## Examples of Emergent Behaviour

# Definition:

## Examples of Emergent Behaviour

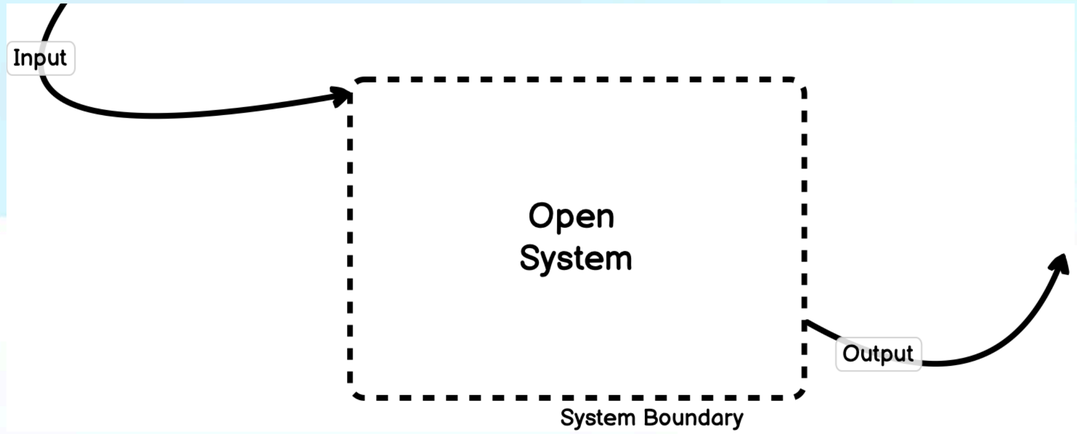
# Definition:

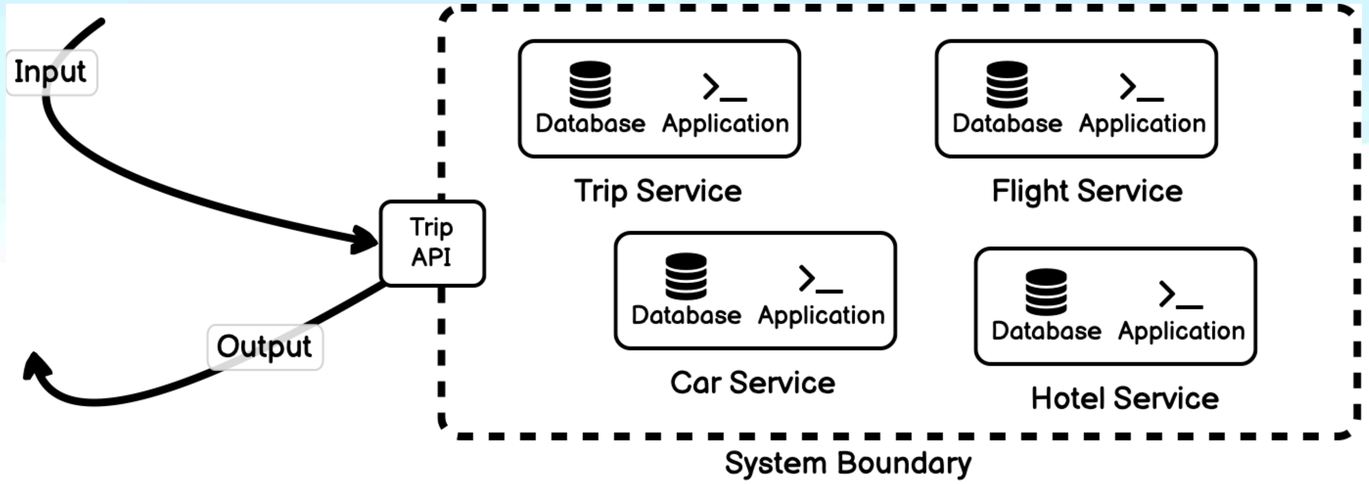
## Examples of Emergent Behaviour

- traffic jam
- gossip
- stock market
- cloud formation
- culture
- software systems 🫠

# Definition:

## System vs. Software as a System




Sookocheff, Kevin (2022). “What complex systems can teach us about building software”
https://sookocheff.com/post/systems/what-complex-systems-can-teach-us-about-building-software/

# Definition:

## What is a “Bug”?

Merriam-Webster Dictionary ·

bug

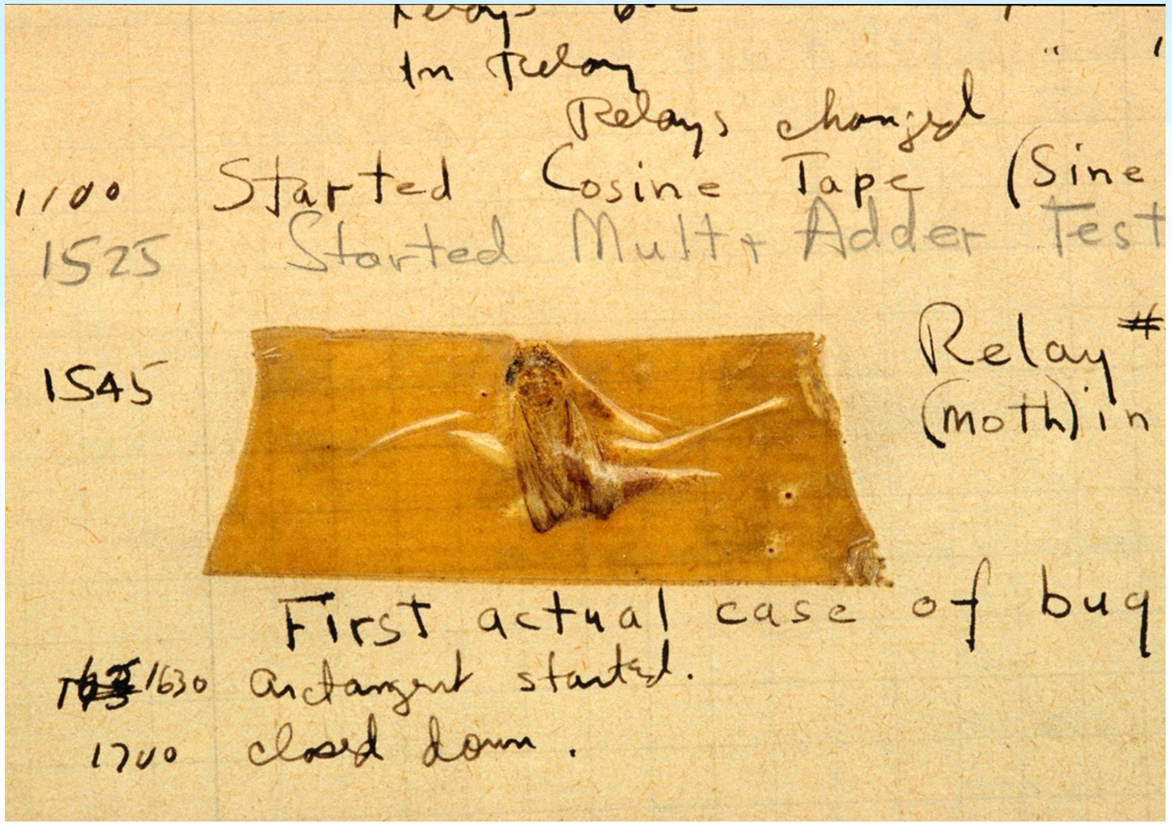
/bʌg/

*noun*

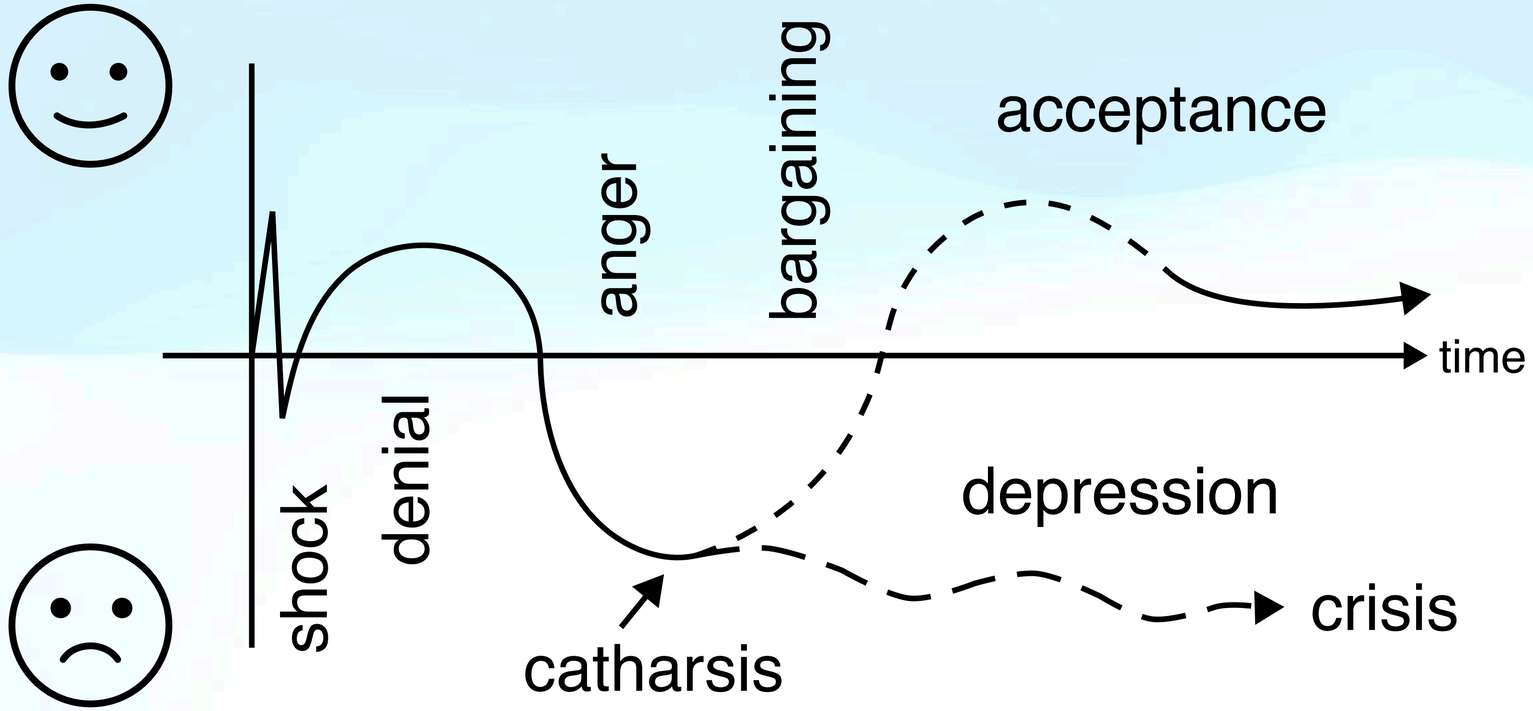
an unexpected defect, fault, flaw, or imperfection
"The software was full of bugs."

# Definition

## The first “bug”



# Close encounters with a bug




By Saurmandal - Own work based on: Kübler Ross's stages of grief.png by Timpo, CC0, https://commons.wikimedia.org/w/index.php?curid=138357417

# Close encounters with a bug

## What do we do

A suggested emoji - “Software developer holding his head screaming and laughing” - AI Emojis

| Stage | Dialog |
| --- | --- |
| Shock | “Prod patlamış duydun mu?” |
| Denial | “bin defa test ettik o kodu - lokalimde çalışıyor” |
| Anger | “Hay ABV nası patlar ya” |
| Bargaining | “Abi acaba config’de değişiklik yapsak” |
| Acceptance | “Bunu gelecek sprint’e aldık” |

# Close encounters with a bug

## What do we actually do?

👨‍🏫 Read the report / listen the reporter

🤓 See with your own eyes

👩‍💻Try to reproduce in local

👩🏻‍🦳Try to access the prod logs

🎯 Try to localize / pinpoint the related line of code

# Close encounters with a bug

## What do we actually do?

👨‍🏫 Listen the reporter - they've seen a flock

🤓 Can you see yourself? No. They're gone.

👩🏻‍💻 Can you try it at home? No.

👩🏻‍🦳 Can you see the video of the flock. Yes.

🎯 Can you find the actual property in a bird's body? No.

# Close encounters with a bug

## Proposal

**Bugs 🐞🐞🐞:**
**emerging side effects/behaviors of complex systems.**

**My proposal:**
**Replace “bug thinking” with “systems thinking”**

# Close encounters with a bug

## Systems thinking

**Focus on:**

- **Elements, Connectors and long term purposes**
- **Always keep complex systems properties in your mind.**

# Thinking in Systems

## Examples-1

| | |
|---|---|
| **Bug thinking** | A dev focusing on fixing a crashing module, isolating the rest of the system. |
| **Systems thinking** | Instead of just patching the crash, think about flow of data, dependencies between components, fixing the root cause. |
| **Example** | A microservice fails.<br>Entire system experiences latency.<br>Rather than patching the service,<br>consider service communication protocols,<br>resiliency measures, overall architectural design. |

# Thinking in Systems

## Examples-2

| | |
|---|---|
| **Bug thinking** | Fixing a bug where a user causes a delay. |
| **Systems thinking** | The delay might be the result of feedback loops, like a database query causing retries, leading to more delays. Dev focuses on optimizing the query and retry policies, instead of clearing the delay off. |
| **Example** | Your Youtube recommendations. When you are watching long videos while sleeping, YT suggests that kind of videos only. Instead of adding more if, revise the recommendation algorithm. |

# Thinking in Systems

## Examples-3

| | |
|---|---|
| **Bug thinking** | A developer fixes memory leaks that occur when the app scales to thousands of users. |
| **Systems thinking** | Scaling to thousands is a thing but to millions is another type of thing. It requires pre-planning of scaling, architecture, database sharding, infra automation. |
| **Example** | Single point of failure in a database query. Fixing the query seems to handle the issue but a systems thinker would build redundancy, load balancing, and partitioning in mind from the beginning. |

# Thinking in Systems

## Examples-4

| | |
|---|---|
| **Bug thinking** | A service cannot connect to database. I think DB is down. |
| **Systems thinking** | Services are nested systems. Write down all the systems between you and the subsystems you are connecting to. State and check all the expected inputs and outputs of subsystems. |
| **Example** | If services connect over network, they probably have traffic authorization. Can you telnet to db? Is port open? Is your user allowed to connect? Is your IP whitelisted? Is the URI correct? |

# Thinking in Systems

## Some more examples

- Technical Debt vs. Long-Term Vision
- Monitoring and Observability
- Security and Vulnerability Management
- Trade-Offs and Optimization
- …

# Mindset for Systems Thinking

## again, Donella Meadow's suggestions

- **Be patient**: Complex systems resist to quick fixes.
- **Embrace uncertainty:** All models are wrong, some are useful.
- **Focus on long-term solutions:** Quick fixes create larger problems.
- **Understand dynamic behavior:** Linear cause and effect doesn't work IRL.
- **Cultivate flexibility:** Rigid control is non-existent. Seek for self-organization and evolution.

# Take away

## a summary

- Software is an example of complex system
- Complex systems produce emergent behaviour
- Software produces bugs
- Complex systems may produce different goals than they’re built for
- So do the software systems.
- Think in systems instead of lazer focusing on the bugs

# Thanks

## for joining me today.

**Samet Atdağ – 2024/10/24**