DES203T:
Designing Intelligent Systems

Session 5 (Module-2)

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY,
DESIGN AND MANUFACTURING,
KANCHEEPURAM

- Dr. Sudhir Varadarajan

SESSION OUTLINE

- Recap

- Architecture for intelligent behavior: Living Systems Model

Recap

- Abductive logic, Analogy in design
- Ashby's analogy (adaptation & equilibrium; IA-intelligence amplifier)
- Intelligent behavior <- Equilibrium & IA <- Feedback Process <- Information

HOW?

Two approaches:

Build on well researched models in nature (beyond human brain)

Trial & error / learning by doing / synthetic brain (robotics)

SESSION OUTLINE

- Recap

- Architecture for intelligent behavior: Living Systems Model

Architecture for Intelligent Behavior based on principles of Living Systems

- Developed by James G. Miller (1980s)
- Governed by principle of negative feedback / stability
- Useful to understand Complex Engineering Systems/Products

Living systems comprise eight hierarchical levels

Level	Emergent Property
Cell	Life
Organ	Ability to replace its constituent cells as they die
Organism	Associative learning
Group	Co-operative activity
Organization	New forms of social associations
Society	Nations bound by geographies, culture
Supranational	International Agencies

Living systems at each level have 20 sub-systems / functions

- Matter-energy-information (2)
- Matter-energy (8)
- Information (10)

Subsystems that process both matter-energy and information

1. Reproducer (Re): responsible for replication and evolution
    - Example: DNA

2. Boundary (Bo): contains, protects, and permits entry and exit of matter-energy and information
    - Example: Skin

Subsystems that process matter-energy

3. Ingestor (IN): brings matter-energy across boundary.

4. Distributor (DI): carries inputs from outside or outputs from within to subsystems.

5. Converter (CO): transforms certain inputs into internal formats.

6. Producer (PR): synthesizes material for growth, repair or replacement.

7. Matter-energy storage (MS): stores and retrieves matter-energy

8. Extruder (EX): transmits products or wastes out of the system.

9. Motor (MO): moves the system or parts in relation to environment.

10. Supporter (SU): maintains spatial relationships of subsystems.

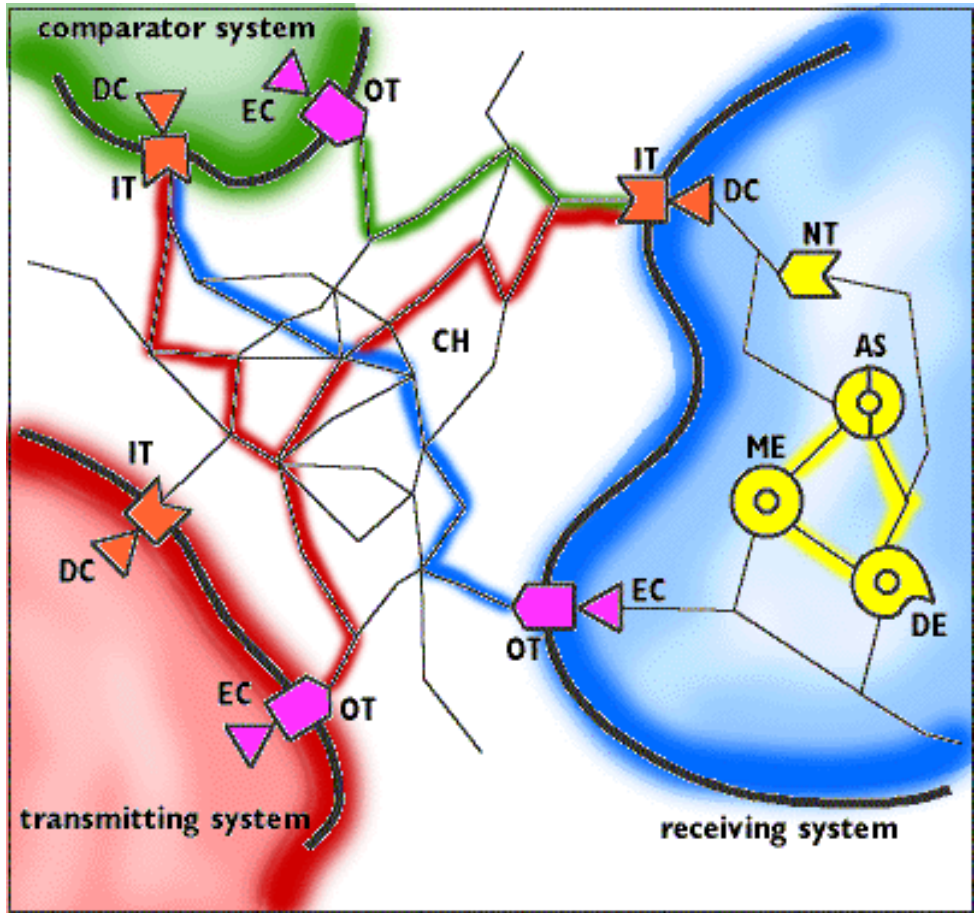
Subsystems that process information (1/3)

11. Input Transducer (IT): sensory subsystem that brings information markers in and transforms them into internal formats suitable for transmission.

12. Internal Transducer (NT): receives internal subsystem information markers and transforms them into internal formats suitable for transmission.

13. Channel and net (CH): provides for transmission of markers.

14. Timer (TI): transmits to decider information about environment or internal subsystem states.



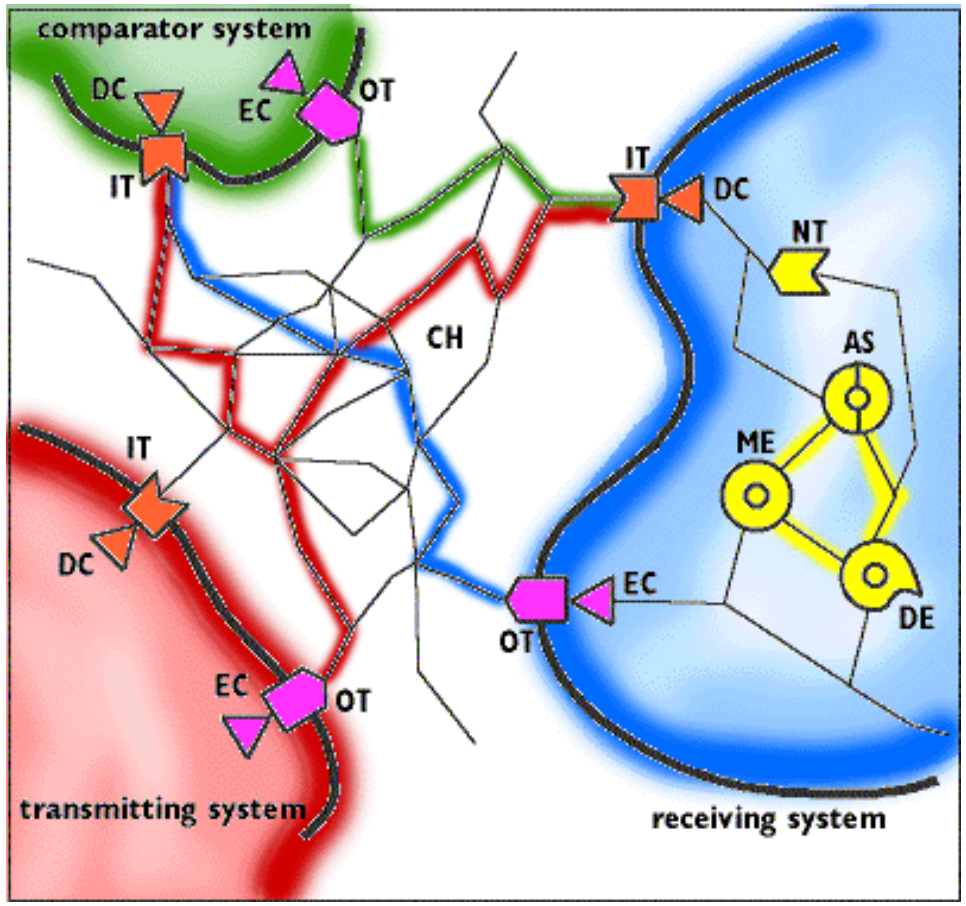
Subsystems that process information (2/3)

15. Decoder (DC): transforms code of marker into private format.

16. Associator (AS): first stage of learning and forms associations.

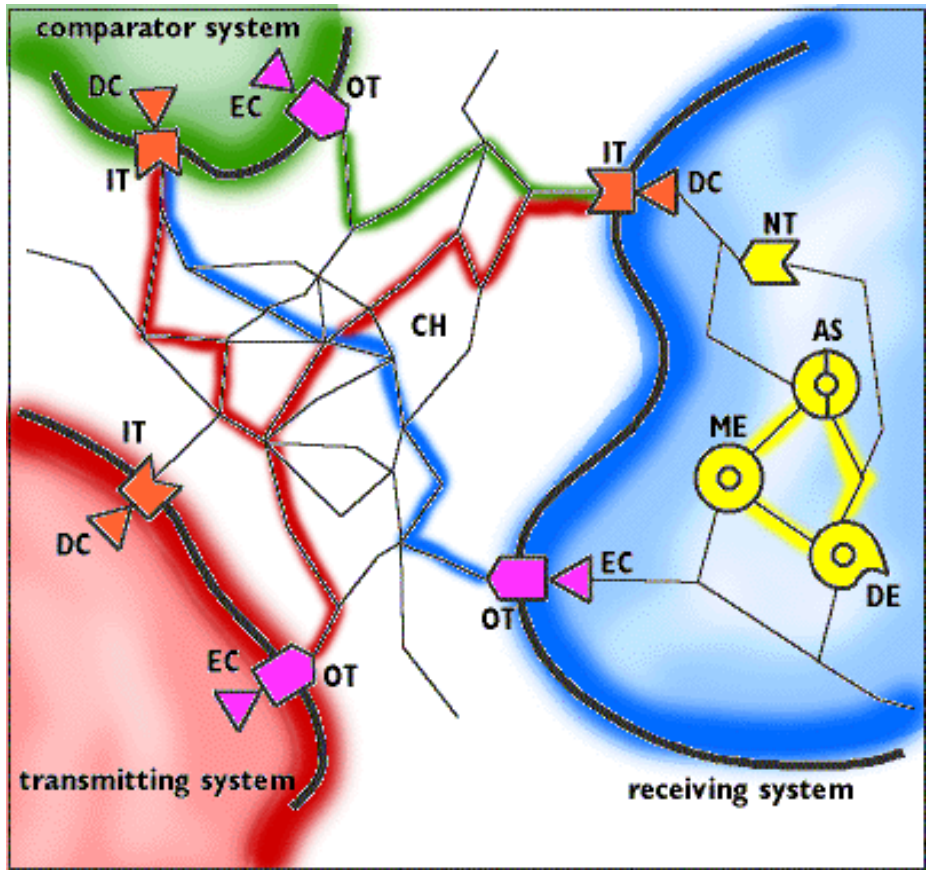
17. Memory (ME): second stage of learning, stores and retrieves information.

18. Decider (DE): receives inputs from and transmits control information to all subsystems.



Subsystems that process information (3/3)

- 19. Encoder (EC): transform privately coded information into public coded format.
- 20. Output transducer (OT): transforms and outputs information markers.



Exercise 5

- Analyze the functional model of your product concept using the living systems theory and identify potential gaps w.r.t intelligent behavior

- Enrich the functional model of your product concept using suggested analogies and design directions for intelligent products

Reflect on today's session and plan for the next one – Viable Systems Model

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