CHAPTER ONE

Introduction: Exploring Inner Space
What is Cognitive Science?

- The scientific interdisciplinary study of the mind.
- Uses the scientific method as well as other methodologies.
- Encompasses multiple diverse disciplines.
- Cooperation and communication between these disciplines is important.
Two Key Concepts

- **Representation** – something in the “mental” world can stand for something in the physical world.

- **Computation** – actions applied to mental representations are the basis for thinking about them.
Aspects of Representation

- Realized in an information-processing system like a person or computer
- They have content and stand for something else known as a referent
- They are grounded through experience or programming
- Interpreted by the system itself or by some other system
Intentionality

- Representations are *intentional*. They are “about” something.
- In humans at least they have meaning.
- A representation is activated by its *referent* or something related to it.
- The activation produces referent-related behavior.
- This process is called an *appropriate causal relation*.
Computation

- Operations or transformations that are performed on representations.
- In mathematics, examples would include addition, subtraction, multiplication, and division.
- Broad categories of mental operations include sensation, perception, attention, memory, language, reasoning, and problem solving.
The Tri-Level Hypothesis

- The *computational level*. Specifies the problem.
- The *algorithmic level*. Specifies the way the problem is solved.
- The *implementation level*. Specifies the medium or physical substrate in which the problem-solving procedure is executed.
The Classical View of Representation

- Symbols are used to represent things.
- Computations involve the manipulation of those symbols.
- Symbols are changed based on a set of rules or syntax which is different from meaning or semantics.
- Knowledge is represented locally – at one particular place in the system.
- Processing is serial.
The Connectionist View of Representation

- Representations are non-symbolic.
- They are not local, but distributed throughout the system.
- Computation occurs in parallel.
Do Representations Change?

- No – classical and current artificial neural network approaches.
- Yes – the *dynamical systems approach*.
- Your concept of a car changes each time you think about it.
- Computation may be cellular as well as multi-cellular.
- Does an amoeba think?
The Interdisciplinary Perspective

The story of the three blind men
Cognitive Science Approaches

1. The philosophical approach.
2. The psychological approach.
3. The cognitive approach.
4. The neuroscience approach.
5. The network approach.
6. The evolutionary approach.
7. The linguistic approach.
8. The emotion approach.
9. The social approach.
10. The AI/Robotics approach.
Interdisciplinary Crossroads: Categories of Representation

1. **Concepts**. Stand for a single thing or group of things. The word Apple.

2. **Propositions**. Statements about the world. The sentence, “Mary has black hair.”

3. **Rules**. Specify the relationship between propositions. “If it is raining, I will bring my umbrella.”

4. **Analogies**. Allow us to make comparisons. Relationship between shoes and tires.