

INDUCTIVE & DEDUCTIVE RESEARCH APPROACH

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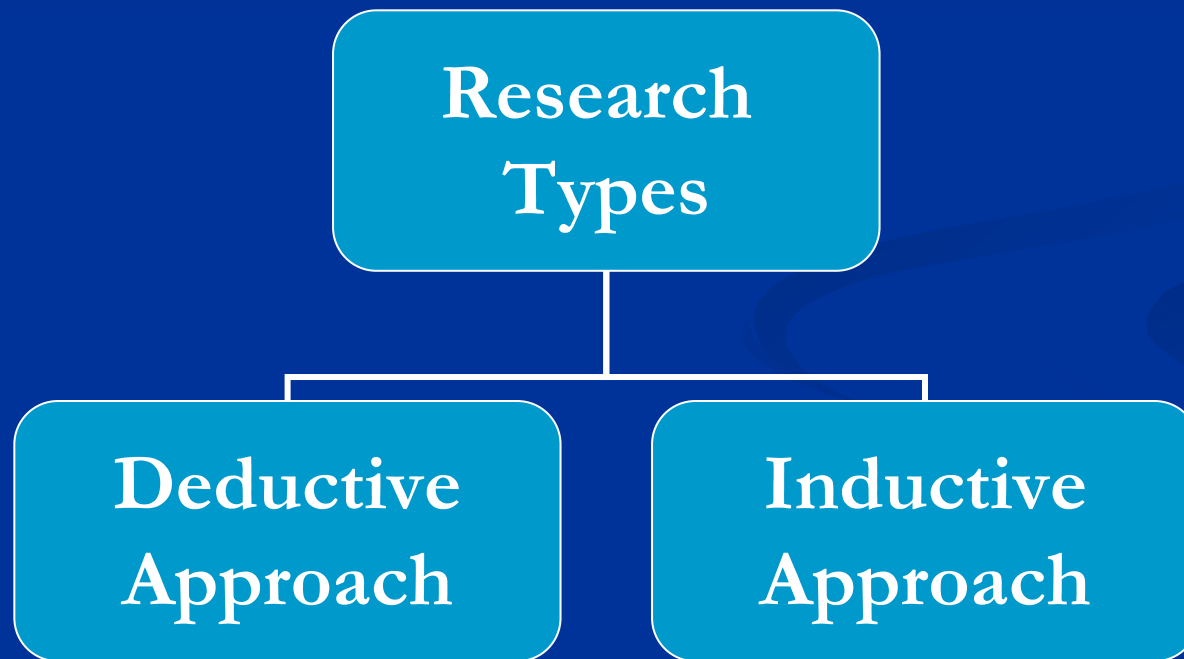
06th March 2008

"Well begun is half done"

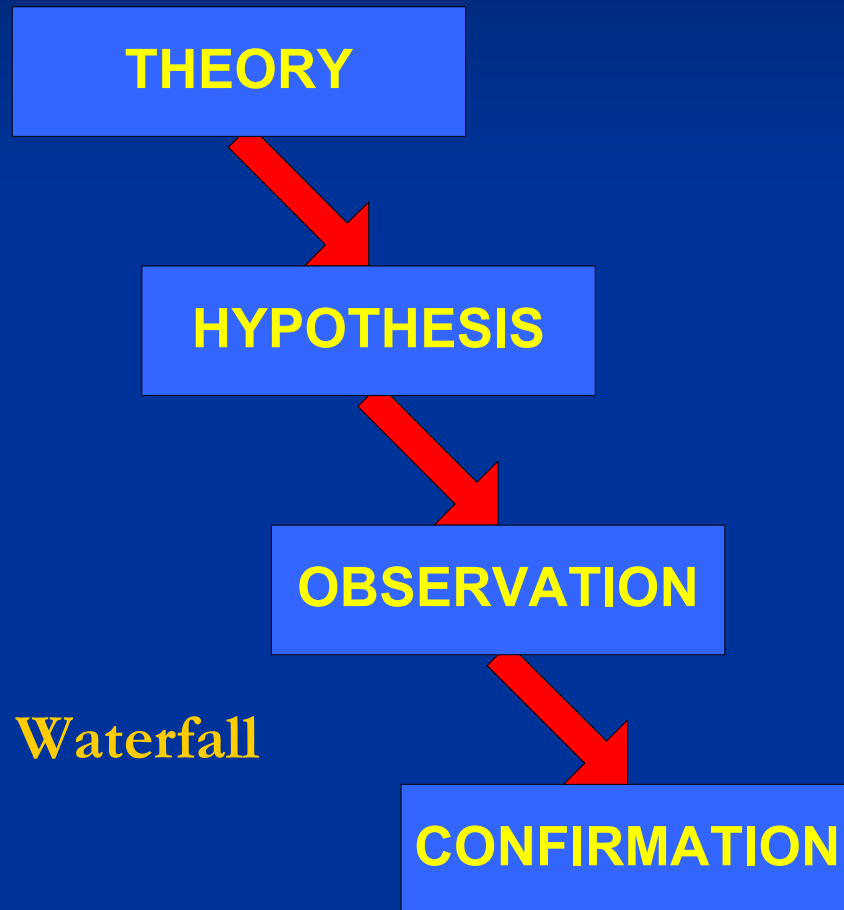
--Aristotle, quoting an old proverb

Research Methods

In research, we often refer to the two broad methods of reasoning as the *deductive* and *inductive* approaches.



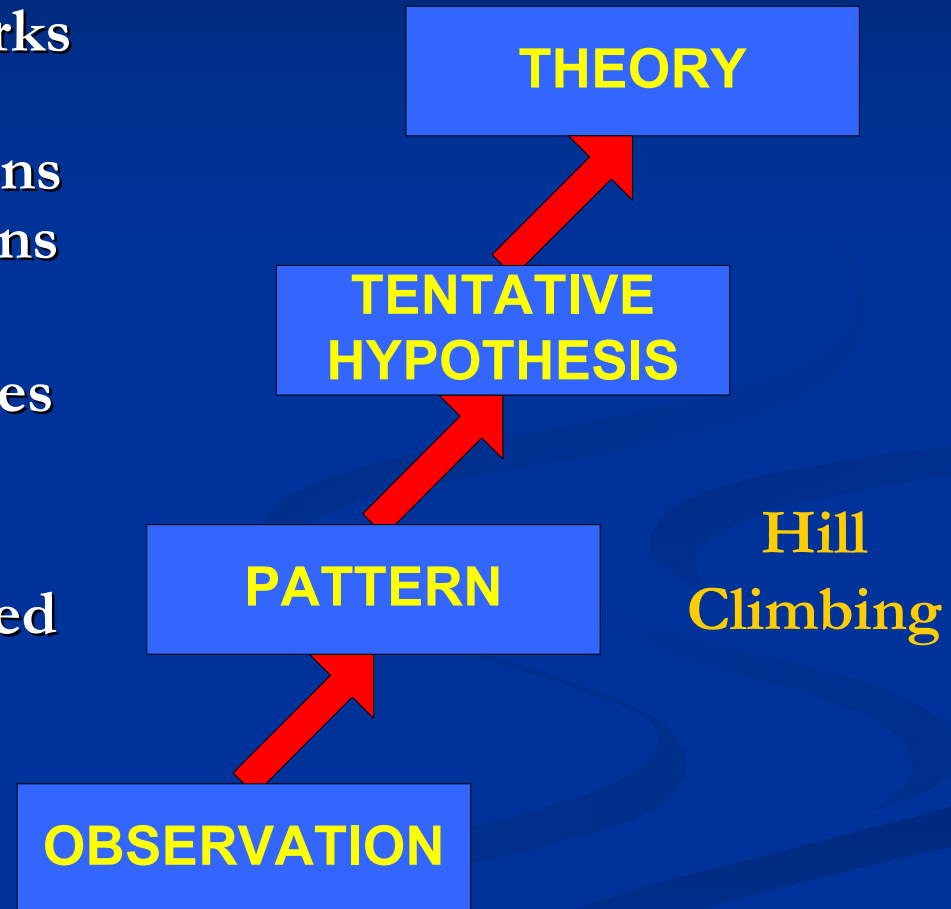
Deductive Research Approach



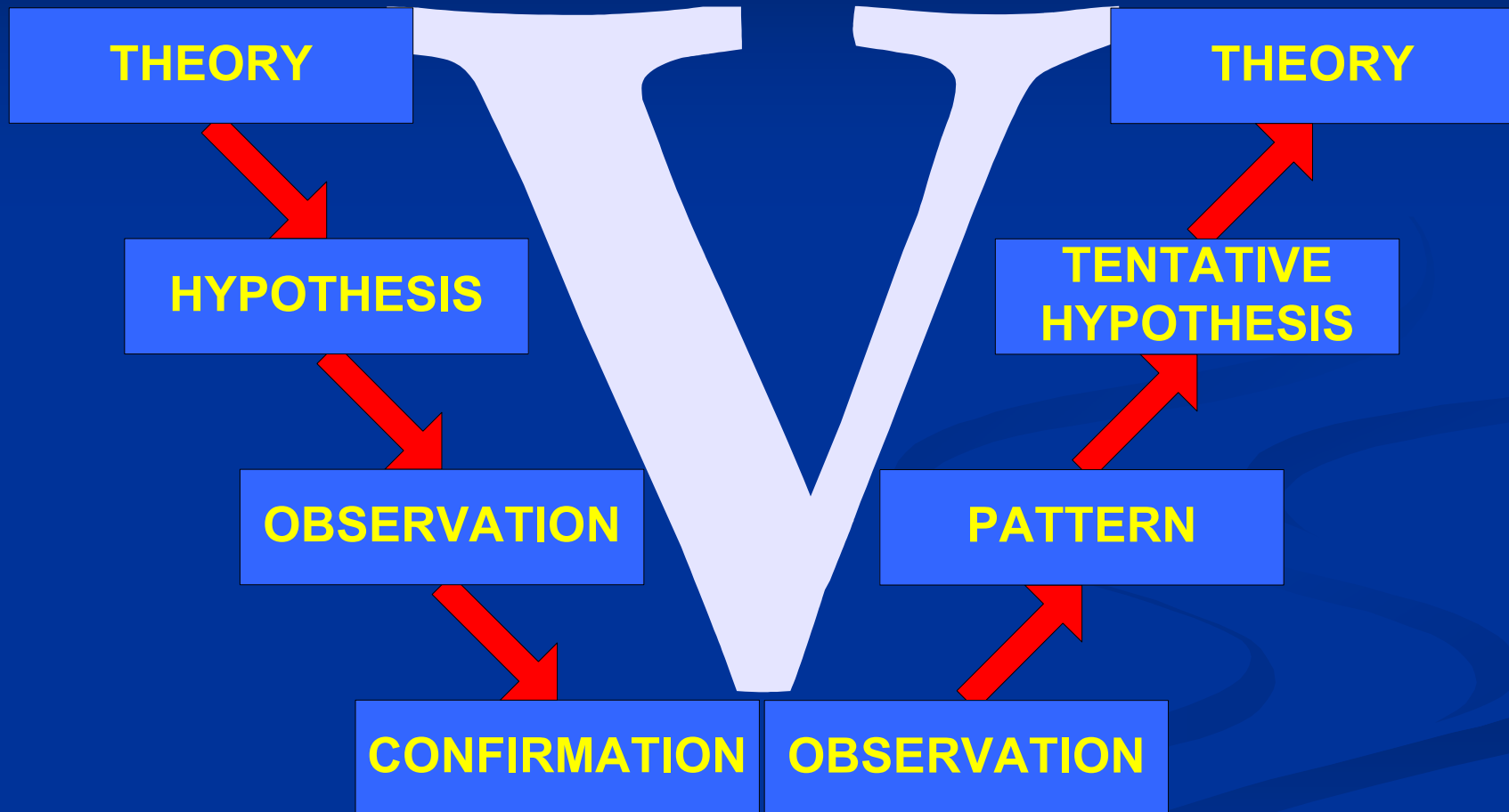
- Deductive reasoning works from the more general to the more specific.
- Sometimes this is informally called a "top-down" approach.
- Conclusion follows logically from premises (available facts)

Inductive Research Approach

- Inductive reasoning works the other way, moving from specific observations to broader generalizations and theories.
- Informally, we sometimes call this a "bottom up" approach
- Conclusion is likely based on premises.
- Involves a degree of uncertainty



Deductive Vs. Inductive

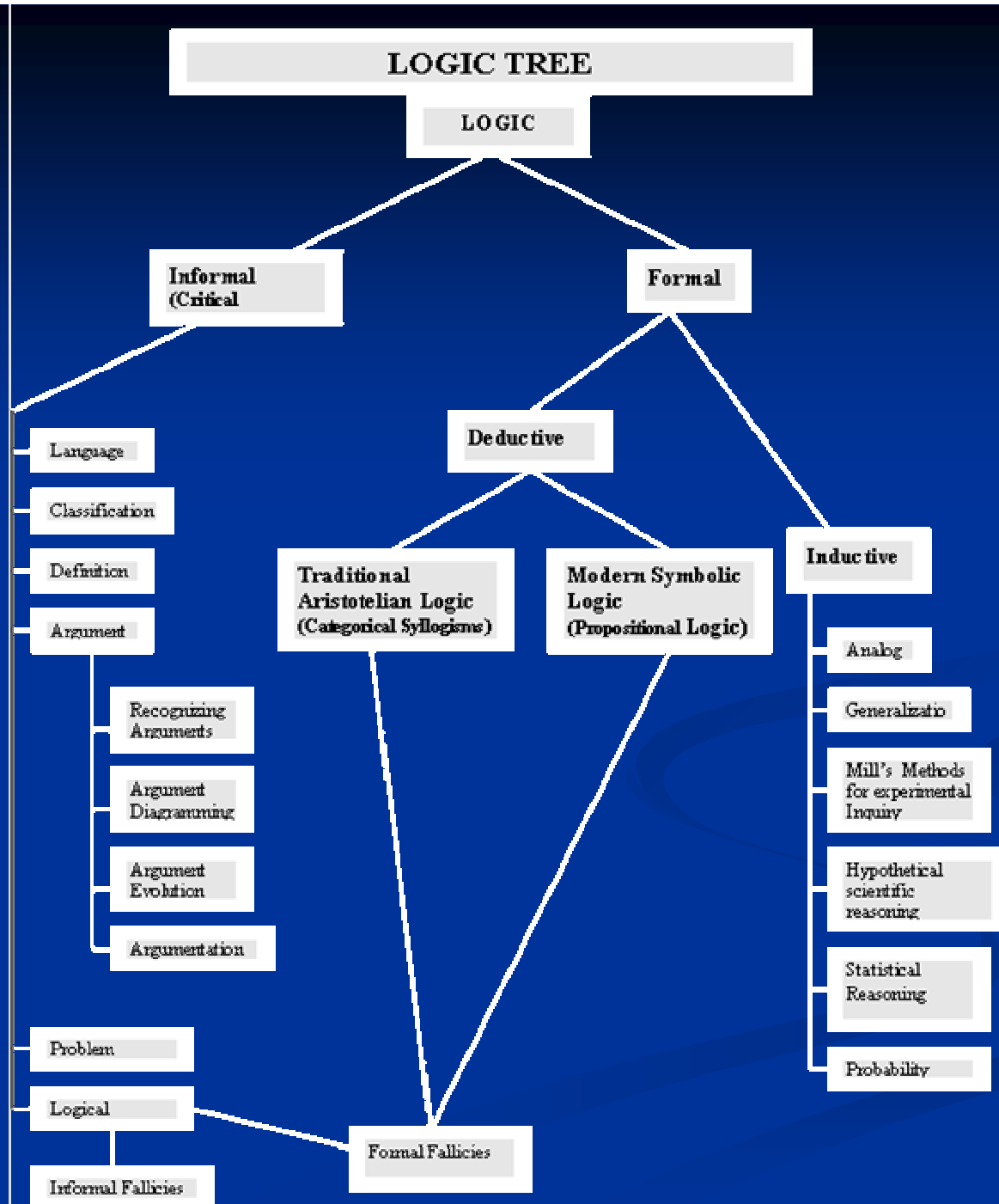


Deductive Vs. Inductive

- Induction is usually described as moving from the specific to the general, while deduction begins with the general and ends with the specific.
- Arguments based on laws, rules and accepted principles are generally used for Deductive Reasoning. Observations tend to be used for Inductive Arguments.

Logical Reasoning and Human Nature

- Historically, many researchers believed that logical reasoning is an essential part of human thought process and this dominates in scientific & Technological research and Development.
- However, humans are not natural logical reasoners
- REFERENCE:
S. M. Aqil Burney; Nadeem Mahmood, “A Brief History of Mathematical Logic and Applications of Logic in CS/IT”, Karachi University Journal of Science Vol.34 (1) July 2006. PP 61-75



Reasoning methods and Argumentation

- The main division between forms of reasoning that is made in philosophy is between deductive reasoning and inductive reasoning.
- Formal logic has been described as 'the science of deduction'.
- The study of inductive reasoning is generally carried out within the field known as informal logic or critical thinking.

Usual^a distinctions between quantitative and qualitative methods

Concepts usually associated with quantitative method	Concepts usually associated with qualitative method
<i>Type of reasoning</i>	
Deduction	Induction
Objectivity	Subjectivity
Causation	Meaning
<i>Type of question</i>	
Pre-specified	Open-ended
Outcome-oriented	Process-oriented
<i>Type of analysis</i>	
Numerical estimation	Narrative description
Statistical inference	Constant comparison

^a The use of the term "usual" is meant to remind readers that these distinctions are not entirely discrete. In fact, there is a spectrum of research that encompasses both methods that, in turn, crosses these traditional demarcations.

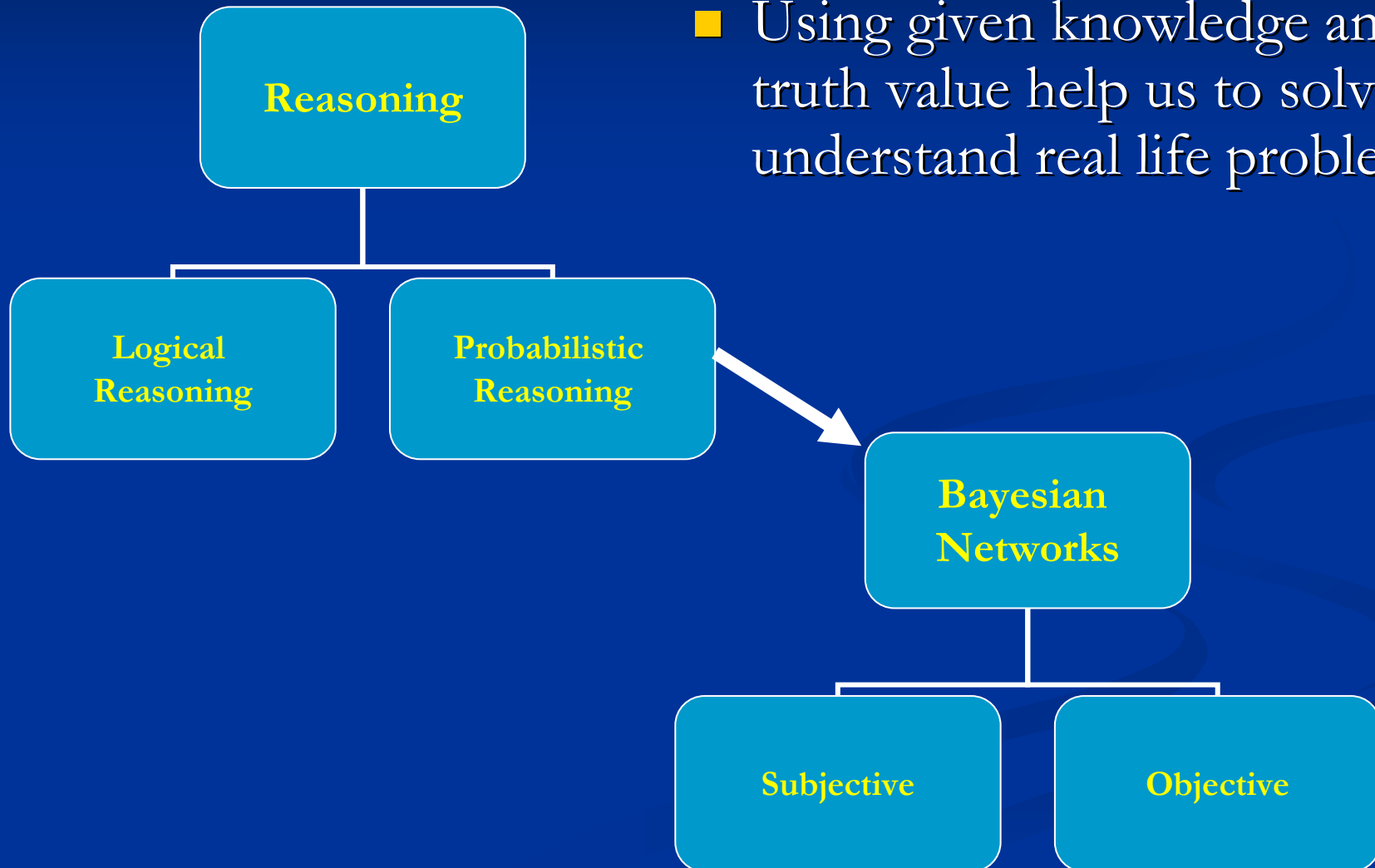
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Automated Reasoning

- Logic lends itself to automation.
- A variety of problems can be attacked by representing the problem description and relevant background information as logical axioms and treating problem instances as theorems to be proved.

Logic and Reasoning

- Using given knowledge and truth value help us to solve, understand real life problems.



EXAMPLE

- p : All mathematicians wear glasses
- q : Anyone who wears glasses is an algebraist
- r : All mathematicians are algebraist

$$p \wedge q \rightarrow r \equiv (\sim(p \wedge q) \vee r)$$

TRUTH TABLE

Truth Table for the formulae built with the Logical Operators

p	q	r	$p \wedge q$	$\sim(p \wedge q)$	$\sim(p \wedge q) \vee r$
T	T	T	T	F	T
T	T	F	T	F	F
T	F	T	F	T	T
T	F	F	F	T	T
F	T	T	F	T	T
F	T	F	F	T	T
F	F	T	F	T	T
F	F	F	F	T	T

- If r is the conclusion, and we know that p and q are true simultaneously then r is valid statement.
- In real life, the statements are true or false, here statement means an atomic statement, thus statements may be simple (atomic) or component. If p , q and r are independent statements, then we need to prove: $p \wedge q \rightarrow r$

Commitment

Ontological Commitment:

What exists in the world: Language of reasoning (Formal).

Epistemological Commitment

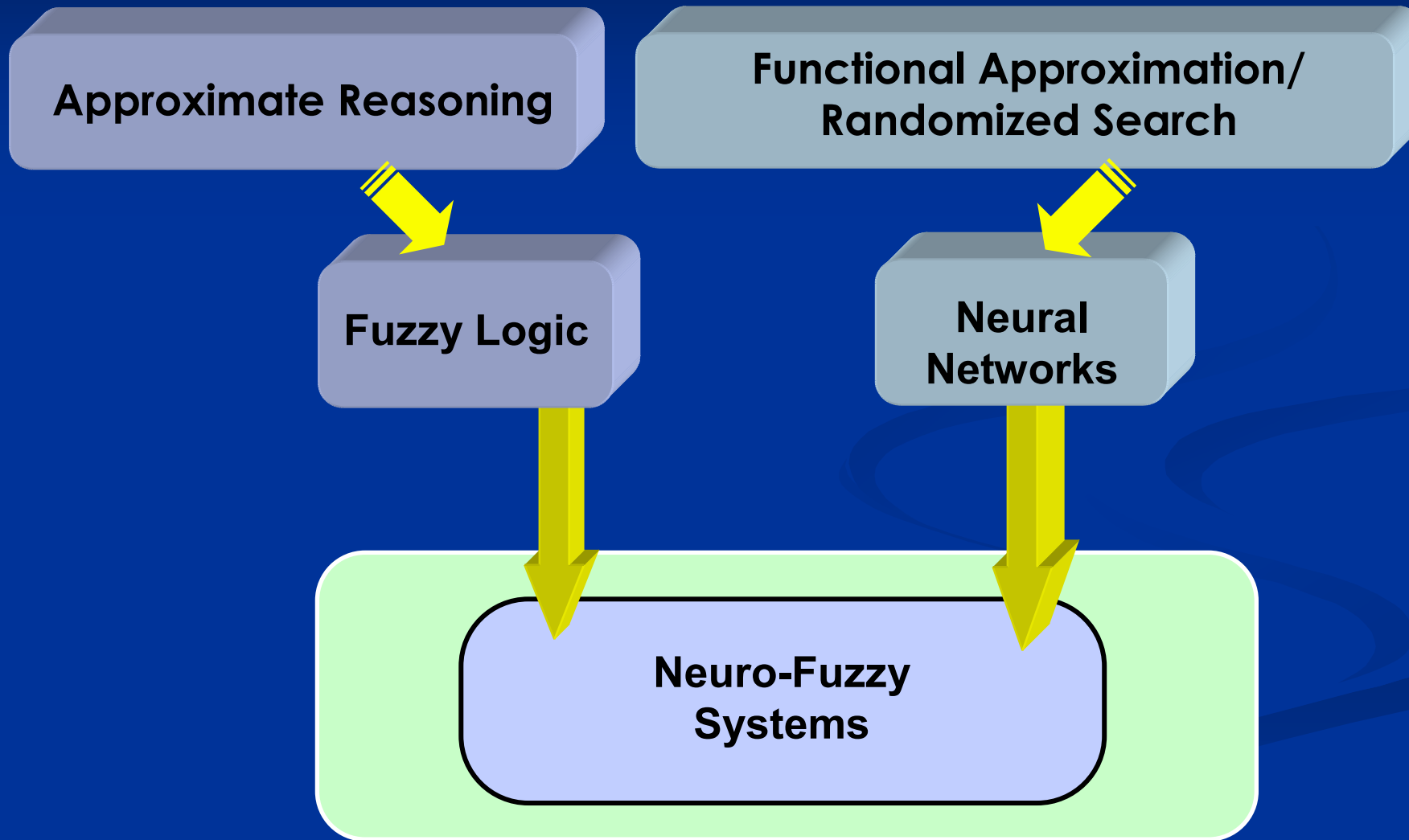
What an intelligent entity believes about the fact.

Believe System: True, False, Unknown, degree of believe,
degree believe with ranks (known values)

Formal Language	Ontology (What exists)	Epistemology
Propositional Logic	facts	True/False /Unknown
Predicate Logic	Facts, objects, relations	True/False /Unknown
Probability Theory	Facts with change	Degree of believe on $[0,1]$
Temporal Logic	Facts, objects, relation and time	True/False /Unknown

Fuzzy Logic	Facts with degree of believe	Known interval value
ANN-FL	Facts with degree of believe with learning	Known interval values with improvement in believe
Spatial Logic	Facts, objects, relation, time & Space	True/False /Unknown

Evolution of Neuro-Fuzzy Logic



*“The whole of science is nothing
more than
a refinement of everyday thinking”.*

- Albert Einstein

References:

- William M.K. Trochim, “Research Methods Knowledge Base” 2006.
- S. M. Aqil Burney; Nadeem Mahmood, “A Brief History of Mathematical Logic and Applications of Logic in CS/IT”, Karachi University Journal of Science Vol.34 (1) July 2006. PP 61-75
- Syed Muhammad Aqil Burney; Tahseen Ahmed Jilani, “A refined fuzzy time series model for stock market forecasting” Elsevier—Science Direct, Physica-A, January 2008 (in press).
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