Glossary

— explanations of the most important terms and logical rules used in this thesis —

Glossary of Terms

A word in SMALL CAPITALS indicates a cross-reference.

a-deductive reasoning reasoning that is very different from DEDUCTION, such as INDUCTION.

abduction the process of forming an explanatory hypothesis; usually referred to as 'explanatory reasoning'.

adequacy condition term used by Hempel for a condition to be satisfied by any material definition of CONFIRMATION.

admissible a formula is admissible if it allows itself as a possible conclusion, i.e. if it is compatible with the BACKGROUND KNOWLEDGE.

argument a pair of premisses and conclusion, an element of a CONSEQUENCE RELATION; the set of premisses is usually treated as a conjunctive formula.

attribute dependency a statement indicating the existence of a certain relationship between attributes in a database.

attribute-value language a propositional language in which each proposition is an attribute-value pair.

background knowledge any knowledge used for drawing conclusions without being explicitly represented in an ARGUMENT; formalised as a restricted set of models.

closed-world reasoning a form of reasoning based on the assumption that everything that is not explicitly stated in the premisses is false.

compatible two formulas are compatible if their conjunction is CONSISTENT.

concept learning the process of inferring the definition of a concept from descriptions of instances and non-instances.

confirmation a qualitative relation between EVIDENCE and certain HYPOTHESES (Hempel); a quantitative function defined for every pair of evidence and hypothesis (Carnap).

confirmatory consequence relation a CONSEQUENCE RELATION that satisfies the rules of Confirmatory Reflexivity and Right Weakening.

confirmatory reasoning the process of forming a confirmed hypothesis.

conjectural reasoning the process of forming conjectures.

conjecture a DEFEASIBLE statement; the terms 'conjecture' and 'hypothesis' are used interchangeably.

consequence relation a set of pairs of formulas in a logical language, formalising the behaviour of an agent performing a certain REASONING FORM on the basis of certain BACKGROUND KNOWLEDGE.

consistency-based confirmatory reasoning a weak form of CONFIRMATORY REASONING requiring satisfiability of evidence and hypothesis, possibly over a restricted set of models.

consistent a formula is consistent if it does not both entail another formula and the negation of that formula.

consistent consequence relation a CONSEQUENCE RELATION is consistent if it satisfies the rule of Consistency, i.e. if for every ARGUMENT the premisses and the conclusion are COMPATIBLE.

convex a consequence relation is convex if it satisfies the rule of Right Interval, i.e. if the set of possible conclusions of given premisses is convex wrt. the ordering of logical entailment.

cumulative reasoning a weak form of PLAUSIBLE REASONING, axiomatised by the KLM system **C**.

deductive reasoning non-DEFEASIBLE reasoning.

defeasible an ARGUMENT is defeasible if it is possible for new knowledge to contradict (defeat) the conclusion without contradicting the premisses.

descriptive logic the formal study of REASONING FORMS.

discovery procedure a procedure that infers only formulas that are potentially useful wrt. a certain goal; realised by equipping a PROOF PROCEDURE with a heuristic.

evidence premisses in an inductive ARGUMENT; 'evidence' and 'observations' are used interchangeably.

examples as classifications in CONCEPT LEARNING: adding the description of an instance to the background knowledge, and treating the classification of the instance as a premiss in the inductive argument.

examples as implications in CONCEPT LEARNING: treating the implication from description to classification of an instance as a premiss in the inductive argument.

explanation mechanism a PROOF PROCEDURE used to build explanations.

explanatory consequence relation a CONSEQUENCE RELATION that satisfies the rules of Explanatory Reflexivity, Admissible Converse Entailment, and Additivity.

explanatory power the set of observations a formula can explain; approximated by the set of consequences of the formula using an EXPLANATION MECHANISM.

explanatory reasoning the process of forming an explanatory hypothesis; synonymous with 'abduction'.

generality an extensional relation between concepts.

Hempelian consequence relation a CONFIRMATORY CONSEQUENCE RELATION satisfying the rule of Right And.

hypothesis a DEFEASIBLE statement; the terms 'conjecture' and 'hypothesis' are used interchangeably.

incremental a form of INDUCTION is incremental if hypotheses are only rejected on the basis of known observations, not on the basis of assumptions; formalised by the rule of Incrementality (Left Weakening).

induction the process of inferring a general rule from specific observations.

inductive data engineering the process of RESTRUCTURING a database after inducing INTEGRITY CONSTRAINTS.

inductive logic Carnap's term for his truth-estimating semantics based on a degree of CONFIRMATION.

integrity constraint a non-classificatory statement; in logic, a clause with no or more than one positive literals.

KLM-framework the DESCRIPTIVE THEORY of PLAUSIBLE REASONING developed by Kraus, Lehmann & Magidor.

logic the formal study of REASONING.

logical system a system consisting of semantics, proof procedure, and metatheory.

monotonic synonymous with 'non-DEFEASIBLE'.

non-deductive reasoning DEFEASIBLE reasoning; further divided into QUASI-DEDUCTIVE REASONING and A-DEDUCTIVE REASONING.

observation a premiss in an inductive ARGUMENT; 'evidence' and 'observations' are used interchangeably.

Peircean consequence relation an EXPLANATORY CONSEQUENCE RELATION that satisfies the rule of Admissible Right Strengthening; this requires an EXPLANATION MECHANISM which is MONOTONIC.

plausible reasoning reasoning with general cases and exceptions.

preferential reasoning a form of PLAUSIBLE REASONING, axiomatised by the KLM system **P**; the name derives from the fact that the semantics employs a preference ordering on semantic objects.

preservation semantics a generic model for the semantics of various REASONING FORMS.

proof procedure a set of axioms and inference rules.

quasi-deductive reasoning reasoning that approximates DEDUCTIVE REASONING by making assumptions about missing information, such as PLAUSIBLE REASONING.

reasoning form informally, a distinguished way of reasoning, such as deductive, inductive, and plausible reasoning; the subject of DESCRIPTIVE LOGIC.

reasoning informally, the process of drawing conclusions from premisses; the subject of LOGIC.

regularity-based confirmatory reasoning a form of CONFIRMATORY REASONING in which the hypothesis is required to be satisfied by certain regular SEMANTIC OBJECTS constructed from the premisses.

restructuring the process of making the implicit structure of a database explicit.

rule system a set of formal properties of CONSEQUENCE RELATIONS.

satisfaction-preserving a semantics is satisfaction-preserving if every interpretation satisfying the premisses also satisfies the conclusion; such a semantics is necessarily TRUTH-PRESERVING.

satisfiable a formula is satisfiable if it has a model.

semantic object generic term for the entities assigned to formulas by the semantics, such as interpretations or STATES.

state a SEMANTIC OBJECT in the KLM FRAMEWORK.

subsumption an intensional relation of GENERALITY.

θ-subsumption an intensional GENERALITY relation for clauses.

truth-estimating semantics a procedure for assessing the truth of the conclusion, given the truth of the premisses; e.g. Carnap's 'INDUCTIVE LOGIC'.

truth-preserving a semantics is truth-preserving if the truth of the conclusion follows from the truth of the premisses, where truth is defined as satisfaction by the intended model.

Version Space in CONCEPT LEARNING: the set of possible concept definitions or hypotheses, given a set of examples.

GLOSSARY OF RULES

Additivity	[redacted] $\mathrel{\mid\!\!<}\gamma \,,\, \beta \mathrel{\mid\!\!<} \gamma$ / $\alpha\wedge\beta \mathrel{\mid\!\!<} \gamma$	evidence for an explanatory hypothesis can be accumulated
Admissible Completeness	α [redacted] / $\alpha \mathrel{\mid\!\!<} \beta$	[redacted]issible evidence confirms either a hypothesis or its negation (closed-world reasoning)
Admissible Contraposition	α [redacted] / $\neg\beta \mathrel{\mid\!\!<} \neg\alpha$	[redacted] is explained by β then ¬β is explained by ¬α, provided ¬α is admissible
Admissible Converse Entailment	[redacted] / $\alpha \mathrel{\mid\!\!<} \beta$	[redacted]dmissible hypothesis entailing the evidence is explanatory
Admissible Entailment	[redacted] $\to\beta \,,\, \alpha \mathrel{\mid\!\!<} \alpha$ / $\alpha \mathrel{\mid\!\!<} \beta$	a hypothesis entailed by admissible evidence is confirmed
Admissible Right Strengthening	[redacted] $\to\beta \,,\, \alpha \mathrel{\mid\!\!<} \beta \,,\, \gamma \mathrel{\mid\!\!<} \gamma$ / $\alpha \mathrel{\mid\!\!<} \gamma$	an explanation can be logically strengthened, provided it remains admissible
Cautious Monotonicity	$\dfrac{\alpha \mathrel{\mid\!\!<} \beta \,,\, \alpha \mathrel{\mid\!\!<} \gamma}{\alpha\wedge\beta \mathrel{\mid\!\!<} \gamma}$	the set of confirmed hypotheses does not decrease when confirmed observations are added (*cf* Verification)
Conditionalisation	$\dfrac{\alpha \mathrel{\mid\!\!<} \beta\wedge\gamma}{\beta\to\alpha \mathrel{\mid\!\!<} \gamma}$	representing examples as implications is as strong as representing them as classifications
Confirmatory Reflexivity	$\dfrac{\alpha \mathrel{\mid\!\!<} \alpha \,,\, \alpha \not\mathrel{\mid\!\!<} \neg\beta}{\beta \mathrel{\mid\!\!<} \beta}$	if some admissible evidence does not confirm a hypothesis, its negation must be admissible (contraposition: arbitrary admissible evidence confirms the negation of any inadmissible formula)

G[redacted]ssary of rules

Consistency	$\frac{[redacted] \mathrel{\mid\!<} \beta}{[redacted]\beta \to \neg\alpha}$	evidence and hypothesis share a model
Consistent Right Strengthening	$\frac{\alpha \mathrel{\mid\!<} \gamma\ ,\ \neg\beta \mathrel{\not\mid\!<} \gamma}{\alpha \mathrel{\mid\!<} \beta\wedge\gamma}$	any explanation can be extended with the negation of something it doesn't explain
Disjunctive Rationality	$\frac{[redacted]\vee\beta \mathrel{\mid\!<} \gamma\ ,\ \beta \mathrel{\not\mid\!<} \gamma}{\alpha \mathrel{\mid\!<} \gamma}$	at least one of the disjuncts of disjunctive confirming evidence confirms the hypothesis
Explanatory Reflexivity	$\frac{[redacted]}{\beta \mathrel{\mid\!<} \beta}$	[redacted]an admissible hypothesis does not explain certain evidence, the negation of the evidence must be admissible (contraposition: an [redacted]trary admissible hypothesis explains the negation of any inadmissible formula)
Falsification	$\frac{[redacted]}{\alpha\wedge\neg\gamma \mathrel{\not\mid\!<} \beta}$	[redacted]observation, the negation of which was predicted, falsifies the hypothesis
Incrementality	$\frac{[redacted]\to\beta\ ,\ \alpha \mathrel{\mid\!<} \gamma}{\beta \mathrel{\mid\!<} \gamma}$	the set of possible hypotheses is monotonically non-increasing with the observations
Left Consistency	$\frac{\alpha \mathrel{\mid\!<} \beta}{\neg\alpha \mathrel{\not\mid\!<} \beta}$	the set of explained observations is consistent
Left Logical Equivalence	$\frac{[redacted]\leftrightarrow[redacted]\ ,\ \alpha \mathrel{\mid\!<} \gamma}{\beta\ [redacted]\ \gamma}$	the logical form of the evidence is immaterial
Left Or	$\frac{[redacted]\alpha \mathrel{\mid\!<}\ [redacted]\ \beta \mathrel{\mid\!<} \gamma}{\alpha[redacted]}$	confirming evidence can be [redacted]ely combined
Left Reflexivity	$\frac{[redacted]\beta}{[redacted]}$	evidence allowing some [redacted]is admissible (contraposition: inadmissible [redacted])
Partial Consistency	$\frac{[redacted]\beta}{[redacted]}$	evidence and hypothesis share a [redacted]el in which both are verified
Partial Left Logical Equivalence	$\frac{\alpha\ [redacted]\ \beta\ [redacted]\ \alpha\quad \alpha \mathrel{\mid\!<} \gamma}{\beta \mathrel{\mid\!<} \gamma}$	partial version of Left Logical [redacted]valence
Partial Predictive Incrementality	$\frac{\alpha\ [redacted]\ \gamma\to\beta\ ,\ \alpha \mathrel{\mid\!<} \gamma}{\beta \mathrel{\mid\!<} \gamma}$	partial version of Predictive Incrementality

[redacted]

Partial Predictive Right Weakening	[redacted] $\beta\rightarrow\gamma$, $\alpha \mid\!\!< \beta$ / [redacted]	partial version of Predictive [redacted]t Weakening
Partial Verification	[redacted] $\beta\rightarrow\gamma$, $\alpha \mid\!\!< \beta$ / $\alpha\wedge\gamma \mid\!\!< \beta$	partial version of Verification
Predictive Incrementality	[redacted] $\wedge\gamma\rightarrow\beta$, $\alpha \mid\!\!< \gamma$ / $\beta \mid\!\!< \gamma$	equivalent to the combination of Verification and Incrementality
Predictive Right Weakening	[redacted] $\wedge\beta\rightarrow\gamma$, $\alpha \mid\!\!< \beta$ / [redacted]	equivalent to the combination of Right Extension and Right [redacted]eakening
Right An[redacted]	[redacted] $\mid\!\!< \beta$, $\alpha \mid\!\!< \gamma$ / [redacted]	the set of confirmed hypotheses [redacted] itself confirmed
Right Consistenc[redacted]	$\alpha \mid\!\!< \beta$ / [redacted]	the set of confirmed hypotheses [redacted]onsistent
Right Exce[redacted]	[redacted] $\beta\rightarrow\gamma$, $\alpha \mid\!\!< \beta$ / $\alpha \not\mid\!\!< \beta\wedge\neg\gamma$	no hypothesis can be extended with the negation of a prediction
Right Extensio[redacted]	[redacted] / $\alpha \mid\!\!< \beta\wedge\gamma$	[redacted] hypothesis can be extended with a prediction
Right Interval	[redacted] $\beta\rightarrow\gamma$, [redacted] $\rightarrow\delta$, $\alpha \mid\!\!< \beta$, $\alpha \mid\!\!< \delta$ / [redacted]	the set of possible [redacted]ypotheses is convex wrt the ordering of logical entailment
Right Logical Equivalence	[redacted] $\leftrightarrow\gamma$, $\alpha \mid\!\!< \beta$ / $\alpha \mid\!\!< \gamma$	the logical form of the hypothesis is immaterial
Right Or	[redacted] $\mid\!\!< \beta$, $\alpha \mid\!\!< \gamma$ / [redacted]	the disjunction of two [redacted]anations is an explanation
Right Reflexivity	$\alpha \mid\!\!< \beta$ / [redacted]	any hypothesis allowed by [redacted]me evidence is admissible [redacted]traposition: inadmissible formulas are not allowed by any evidence)
Right Weakening	[redacted] $\rightarrow\gamma$, $\alpha \mid\!\!< \beta$ / $\alpha \mid\!\!< \gamma$	a logical consequence of a confirmed hypothesis is confirmed
Verification	[redacted] $\wedge\beta\rightarrow\gamma$, $\alpha \mid\!\!< \beta$ / $\alpha\wedge\gamma \mid\!\!< \beta$	a predicted observation verifies (ie does not refute) the hypothesis