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Overview Forward-Chaining RBES Backward-Chaining RBES • Overview • How Does It Work? • Example • Uncertainty • Certainty Factors Examples	 Certainty Factors More recently (1986), it's been found that CFs aren't in conflict with basic probability theory Why, then, do they work and Bayesian techniques seem not to? 	Overview • More recently (1986), it's been found that CFs aren't in conflict with basic probability theory Backward-Chaining RES • Why, then, do they work and Bayesian techniques seem not to? • Overview • Heuristics • Uncertainty • They assume rule independence – conditional probabilities are 0 • Charlang Factors • The knowledge engineer has to ensure this • Leads to compound antecedents, but •makes it tractable and modular • Many recent expert systems are based on Bayesian networks
Overview Forward-Chaining RBES Backward-Chaining RBES Examples	DENDRAL BIACKDOARD Science - 31/3 Example Expert Systems I DENDRAL BIACKDON [J. McDermott] - DEC MYCIN, EMYCIN, ONCOCIN, PUFF, VM, CENTAUR, MDX, MDX2, Blackboard systems	Cepyright © 2014 UMaine School of Computing and Information Science – 31 / 32 The Fight Rest Rest Rest Rest Rest Rest Rest Res
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Structured KRep Frames • Overview • Inheritance • Representation • Example • Proc. attachment • Other info • Examples <u>Semantic Networks</u> CD CD Cyc Description Logics	Overview • Creates an abstraction hierarchy Knowledge Representation • Creates an abstraction hierarchy Isa Hierarchies • Captures relationships between classes and subclasses (or types and subtypes) • Nerview • Inheritance: class ⇒ subclass • Which nodes? • If X ISA Y, then X inherits Y's characteristics - unless explicitly overwritten by more specific class • Other Hierarchies • ISA is transitive and anti-symmetric • Saves space • Gives access to default information by identifying type
Artificial Copyright @ 2014 UMaine School of Computing and Information Science - 7/46	Copyright © 2014 UMaine School of Computing and Information Science - 17/24 Intelligence < 그 > < 문 > < 돌 > 돌 / 의 < 준







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	Examples		Examples
Intured KRep	<pre>(defframe living-thing (`natural-object) (living? t) (density `moderate) (physical-state `solid) (substance `protoplasm) (status `nominal-health))</pre>	Structured KRep Frames • Overview • Inheritance • Representation • Example • Proc. attachment • Other info • Examples Semantic Networks <u>CD</u> <u>Cyc</u> <u>Description Logics</u>	<pre>(defframe water-surface (^interface) (object1 - (isa ^air)) (object2 - (isa ^water)) (position (^above @object1 @object2)) surface-traffic ice-status ; nil? solid? percent? sea-state) .</pre>
ficial Itelligence	Copyright ⓒ 2014 UMaine School of Computing and Information Science - 14 / 46 석 다 논 색 등 본 색 등 본 색 등 본 중 및 중 및 중 및 중 및	Artificial	Copyright ⓒ 2014 UMaine School of Computing and Information Science – 15
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	Counting	Counting
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ficial Itelligence	Copyright ⓒ 2014 UMaine School of Computing and Information Science – 42 / 46 《 그 ▷ 《 @ ▷ 《 문 ▷ 《 문 ▷ 章 《 오 오	Artificial Intelligence Copyright © 2014 UMaine School of Computing and Information Science - 42
	Inference in DL	Different DLs





<pre>(D-LITERAL 19.115639 (D-BASE-TYPE float))) (D-FILLER hasUnitOfMeasure (D-LITERAL somerandomstring (D-BASE-TYPE string))))) (SOME hasNumber (AND Integer (D-FILLER hasNumericValue (D-LITERAL 31 (D-BASE-TYPE integer))) (D-FILLER hasUnitOfMeasure (D-LITERAL 31 (D-BASE-TYPE integer))) (D-FILLER hasUnitOfMeasure (D-LITERAL somerandomstring (D-BASE-TYPE string))))))) Certainty=0.482 </pre>	(D-LITERAL somerandomstring (D-BASE-TYPE http://www.w3.org/2001/XMLSchema#string))))) Certainty=0.243 Definition=(SOME hasFuzzyFeature (AND Danger (SOME hasFuzzyMembershipFunction (AND TrapezoidalFunction (SOME hasLocalMaxAt Number) (SOME hasLocalMaxAt Number) (SOME hasLocalMaxAt (AND Float (D-FILLER hasNumericValue (D-LITERAL 24.848389 (D-BASE-TYPE http://www.w3.org/2001/XMLSchema#f1 (D-FILLER hasUnitOfMeasure (D-LITERAL somerandomstring (D-BASE-TYPE
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(SOME hasOperationalSetting	(SOME hasCost
(AND SelfDepth (SOME hasAdvisedValue Medium))))	(AND SelfBatteryLevel (SDME basStateValue Medium)))))
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(D-FILLER hasEventDescription (D-LITERAL somerandomstring (D-BASE-TYPE http://www.w3.org/2001/XMLSchema#string)))))) Certainty=0.124	<pre>(AND Thruster (SOME hasObject (AND PeerAgent (SOME hasNumber Targeted))) (SOME hasSpeed AdversaryAgent))) Certainty=0.655</pre>
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Definition=(SOME definesAction	7