Title:	Knowledge Representation APPROVED
Long Title:	Knowledge Representation
Module Code:	COMP9016
Credits:	5
NFQ Level:	Expert
Field of Study:	Computer Science
Valid From:	Semester 1 - 2018/19 (September 2018)
Module Delivered in	1 programme(s)
Module Coordinator:	TIM HORGAN
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Module Description:	Knowledge representation and reasoning (KR) is a field of AI that focuses on the representation of domain specific knowledge in a form that can be utilised by computer systems. Knowledge representations within a domain are often conceived as formalisms, a description of something in formal mathematical or logical terms. This module will introduce students to methodologies for the visualisation and interpretation of domain specific knowledge and the translation of interpretations into KR formalisms. It will provide the student with an appreciation of how to evaluate the suitability of knowledge representation schemes, balance competing features/requirements and make informed decisions when designing KR formalisms. The module will also focus on the application of KR to appropriate real world problems such as the semantic web, time-series indexing and temporal abstraction of expert knowledge.

Learning Outcomes	
On successful completion of this module the learner will be able to:	
LO1	Appraise domain specific formalisms used in knowledge representation schemes.
LO2	Compare and contrast current knowledge representation approaches integrated in systems relevant to AI.
LO3	Select, apply and evaluate a knowledge representation scheme for a specified domain.
LO4	Design and implement KR formalisms for a real world time series data set.
LO5	Interpret, critique and communicate the suitability of data visualisation techniques used in conjunction with the design of KR formalisms and the analysis of the resulting output.

Pre-requisite learning
Module Recommendations *This is prior learning (or a practical skill) that is strongly recommended before enrolment in this module. You may enrol in this module if you have not acquired the recommended learning but you will have considerable difficulty in passing (i.e. achieving the learning outcomes of) the module. While the prior learning is expressed as named CIT module(s) it also allows for learning (in another module or modules) which is equivalent to the learning specified in the named module(s).*
No recommendations listed
Incompatible Modules *These are modules which have learning outcomes that are too similar to the learning outcomes of this module. You may not earn additional credit for the same learning and therefore you may not enrol in this module if you have successfully completed any modules in the incompatible list.*
No incompatible modules listed
Co-requisite Modules
No Co-requisite modules listed
Requirements *This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.*

No requirements listed
Co-requisites
No Co Requisites listed

Module Content & Assessment

Indicative Content
Introduction Central role of knowledge representation; desired properties of representation schemes; overview of representation schemes including, e.g., logic, frames, neural networks, common-sense knowledge; the frame problem in logic.
Formalism Propositional and predicate logic; syntax and semantics; rules of inference; logical consequence and proof; logic as knowledge representation formalism; unification; resolution theorem proving.
Knowledge Representation formalisms, semantic nets, systems architectures, frames rules and ontologies; automated reasoning, inference engines, theorem provers and classifiers; roles within KR frameworks, ontology engineering.
Knowledge Representation vrs Data Representation Temporal reasoning and abstraction; change, causality and actions described in terms of time, decision analysis, spatial–temporal reasoning; time series representation, symbolic representation, discrete wavelet transform, discrete fourier transform; dimensionality reduction; comparison of data mining tasks (clustering, classification, indexing), upper and lower bounds, distance measures.
Data Visualisation Data visualisation theory - targeting appropriate visual elements on a page, mapping values in the data domain to visual domain, human visualisation interaction - adding computation steering to visualisations. Charts, Plots & Layouts - graphical representations of data: Line Charts, Area Charts, Bubble Charts, Bar Charts, Scatterplots, Scaling Data, Axes, Geomapping.
Discussion Topics For example, semantic web and natural language processing, expert systems; knowledge-based systems - acquisition and representation; indexing time series at scale.

Assessment Breakdown	%
Course Work	100.00%

Course Work

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Project	Detail and critically evaluate a knowledge representation scheme, its utilisation of formalisms and relevance to Artificial Intelligence.	1,2,3	30.0	Week 8
Practical/Skills Evaluation	In class lab e.g. design, develop and implement a KR formalism for a specified problem domain.	1,2,3,4	25.0	Week 11
Project	Design, develop and deploy a KR solution for a real world problem domain. e.g. a system for automating the interpretation of biomedical data requires a KR scheme that enables the translation of data such that the integrity of all domain specific information is maintained. Provide a rationale for the chosen visualisation approach taken at both the design and analysis stage.	1,2,3,4,5	45.0	Sem End

No End of Module Formal Examination

Reassessment Requirement
Coursework Only *This module is reassessed solely on the basis of re-submitted coursework. There is no repeat written examination.*

The institute reserves the right to alter the nature and timings of assessment

Module Workload

Workload: Full Time				
Workload Type	*Workload Description*	*Hours*	*Frequency*	*Average Weekly Learner Workload*
Lecture	Lecture underpinning learning outcomes.	2.0	Every Week	2.00
Lab	Lab supporting content delivered.	2.0	Every Week	2.00
Independent & Directed Learning (Non-contact)	Student undertakes independent study. The student reads recommended papers and practices implementation.	3.0	Every Week	3.00
			Total Hours	7.00
			Total Weekly Learner Workload	7.00
			Total Weekly Contact Hours	4.00

Workload: Part Time				
Workload Type	*Workload Description*	*Hours*	*Frequency*	*Average Weekly Learner Workload*
Lecture	Lecture underpinning learning outcomes.	2.0	Every Week	2.00
Lab	Lab supporting content delivered.	2.0	Every Week	2.00
Independent & Directed Learning (Non-contact)	Student undertakes independent study. The student reads recommended papers and practices implementation.	3.0	Every Week	3.00
			Total Hours	7.00
			Total Weekly Learner Workload	7.00
			Total Weekly Contact Hours	4.00

Module Resources

Recommended Book Resources

- **R. Brachman & H. Levesque H 2004, *Knowledge Representation and Reasoning*, 1st Ed Ed., Morgan Kaufmann [ISBN: ISBN 1558609326, ISBN-13: 9781558609327]**
- **S. Russell & P. Norvig 2003, *Artificial Intelligence A Modern Approach*, 2nd Ed Ed., Prentice-Hall [ISBN: S. RUSSELL & P. NORVIG, ARTIFICIAL INTELLIGENCE A]**

Supplementary Book Resources

- **Michael Gelfond, Yulia Kahl 2014, *Knowledge Representation, Reasoning, and the Design of Intelligent Agents: The Answer-Set Programming Approach*, 1 Ed., Cambridge University Press [ISBN: 978110702956]**

This module does not have any article/paper resources

Other Resources

- **website: *IEEE***
  http://www.ieee.org
- **website: *Jeff Heaton***
  http://www.heatonresearch.com
- **website: Prof. Eamonn Keogh *UCR Time Series Classification Archive***
  http://www.cs.ucr.edu/~eamonn/time_serie s_data/
- **website: Prof. Yuval Shahar *Temporal Abstraction***
  http://www.ise.bgu.ac.il/faculty/shahar/

Module Delivered in

Programme Code	Programme	Semester	Delivery
CR_KARIN_9	Master of Science in Artificial Intelligence	1	Mandatory