H9CLAR: Cloud Architectures

Module Code:	H9CLAR
Long Title	Cloud Architectures APPROVED
Title	Cloud Architectures
Module Level:	LEVEL 9
EQF Level:	7
EHEA Level:	Second Cycle
Credits:	10
Module Coordinator:	Horacio Gonzalez-Velez
Module Author:	Horacio Gonzalez-Velez
Departments:	School of Computing
Specifications of the qualifications and experience required of staff	PhD degree in computer science or cognate discipline. Experience lecturing in the field. May have industry experience also.

Learning Outcomes

On successful completion of this module the learner will be able to:

#	Learning Outcome Description
LO1	Critically compare and contrast distinct parallel and distributed architectures in terms of their functional and non-functional characteristics and associated enabling technologies.
LO2	Demonstrate in-depth knowledge of different types of computing systems for data storing, staging, and processing.
LO3	Evaluate and assess virtualisation and software environments for cloud computing.
LO4	Construct and present a business case for a complex, dynamic high performance computing solution for clouds.
LO5	Apply data governance and ethical frameworks to complex computational problems and recommend cloud-based solutions.

Dependencies

Module Recommendations

No recommendations listed

Co-requisite Modules

No Co-requisite modules listed

Entry requirements	Internal to the programme

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Module Content & Assessment

Indicative Content
Quantitative Design and Analysis Computer Architecture review. Classes of Computers. Trends in Technology, Power, and Cost. Dependability
Performance Measuring, Reporting, and Summarising Performance. Performance, Price and Power. Amdahl's Law. Fallacies and Pitfalls.
Memory Hierarchy Levels of memory hierarchy. Cache: associativity and optimisations. Main memory. SRAM, DRAM, and SDRAM.
Memory Systems Virtual Memory and Virtual Machines. Virtual Machine monitors. Cache coherency. Containers.
Parallel Computing Architectures Flynn's Taxonomy; SIMD vs. MIMD. GPUs, TPUs, FPGAs, Neuromorphic computing. Vector and Loop-Level Parallelism
Warehouse-scale Computing Programming Models and benchmarks. Workloads. Computer architecture of warehouse-scale computers.
Cloud Datacentres Physical infrastructure, location, and power considerations for data centres.
Cloud Delivery Models NIST Model. DGI Data Governance Framework. Concepts for delivering infrastructure, platform, and software as a service.
Non-functional characteristics of cloud systems SLAs/QoS, MTTR/MTTF, Availability, Mobility, and Optimisation for Cloud
Cloud Infrastructures and Services Computation, storage and general resource deployment; Private and public cloud services (e.g. OpenStack, AWS and GAE service offerings).
Data-intensive storage management Graph parallel and Microservices. CAP Theorem; distributed file organisations, application staging.
Utility Computing Total cost of ownership. Influence of server cost and power. CAPEX vs. OPEX. ACM Code of Ethics.

Assessment Breakdown	%
Coursework	50.00%

Assessments

Full Time

Coursework

Assessment Type:	Project	**% of total:**	50
Assessment Date:	Week 10	**Outcome addressed:**	3,4,5
Non-Marked:	No		

Assessment Description:
Develop a complex business case for a cloud computing solution with specific emphasis on technical, ethical, and data governance constraints.

End of Module Assessment

Assessment Type:	Terminal Exam	**% of total:**	50
Assessment Date:	End-of-Semester	**Outcome addressed:**	1,2
Non-Marked:	No		

Assessment Description:
The test will assess learners' knowledge and understanding of computing architectures, programming models, and storage concepts.

No Workplace Assessment

Reassessment Requirement

Repeat examination
Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.

Reassessment Description
Reassessment of this module will be via proctored examination or a project examining all learning outcomes.

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Module Workload

Module Target Workload Hours 0 Hours

Workload: Full Time

Workload Type	*Workload Description*	*Hours*	*Frequency*	*Average Weekly Learner Workload*
Practical	No Description	24	Per Semester	2.00
Lecture	No Description	36	Per Semester	3.00
Independent Learning Time	No Description	190	Per Semester	15.83
			Total Weekly Contact Hours	5.00

Module Resources

Recommended Book Resources

Ian Foster,Dennis B. Gannon. (2017), Cloud Computing for Science and Engineering, MIT Press, Cambridge, p.392, [ISBN: 978-0-262-03724-2].

J. Hennessy, D. Patterson. (2017), Computer Architecture: A Quantitative Approach, 6. Morgan Kaufmann, Amsterdam, [ISBN: 978-0128119051].

Supplementary Book Resources

Dan C. Marinescu. (2017), Cloud Computing, Morgan Kaufmann, Amsterdam, p.586, [ISBN: 0128128100].

Kai Hwang. (2017), Cloud Computing for Machine Learning and Cognitive Applications, MIT Press, Cambridge, p.624, [ISBN: 026203641X].

Maurice Herlihy,Nir Shavit. (2012), The Art of Multiprocessor Programming, Elsevier, Amsterdam, p.508, [ISBN: 0123973376].

William Gropp,Ewing Lusk,Anthony Skjellum. (2014), Using MPI, MIT Press, Cambridge, p.336, [ISBN: 0262527391].

Irv Englander. (2014), The Architecture of Computer Hardware, Systems Software, and Networking, 5. Wiley, New York, p.696, [ISBN: 1118322630].

Joanna Kołodziej,Horacio González-Vélez. (2019), High-Performance Modelling and Simulation for Big Data Applications, Springer, Cham, p.352, [ISBN: 978-3-030-16271-9].

Recommended Article/Paper Resources

R. Buyya et al.. (2019), A Manifesto for Future Generation Cloud Computing: Research Directions for the Next Decade, ACM Computing Surveys, 51, p.105:1, https://doi.org/10.1145/3241737

Supplementary Article/Paper Resources

H. González-Vélez, M. Leyton. (2010), A survey of algorithmic skeleton frameworks: high-level structured parallel programming enablers, Software: Practice and Experience, 40, p.1135-, https://doi.org/10.1002/spe.1026

N. P. Jouppi et al.. (2017), In-Datacenter Performance Analysis of a Tensor Processing Unit, SIGARCH Comput. Archit. News, 45, p.12, https://doi.org/10.1145/3140659.3080246

Other Resources

[website], K. Brittle. (2019), Cloud Computing Subject Guide, Dublin, NCI Library, https://libguides.ncirl.ie/cloudcomputin g

Discussion Note:	