Module Code	CS4021/4521
Module Name	Advanced Computer Architecture
Module Short Title	*n/a*
ECTS weighting	5
Semester/term taught	Semester 1
Contact Hours	*Lecture hours 27* *Lab hours 0* *Tutorial hours: 6* *Total hours: 33 + Coursework*
Module Personnel	Dr Jeremy Jones
Learning Outcomes	Students who successfully complete this module should be able to: 1. use Spin to check the correctness of parallel algorithms 2. implement and evaluate a selection of lock algorithms 3. implement and evaluate a selection of lockless algorithms 4. describe the operation of hardware transactional memory 5. implement and evaluate a selection of lockless algorithms that make use of hardware transaction memory
Module Learning Aims	To provide students with theoretical and practical experience of concurrent programming with and without locks.
Module Content	• simple locks • using Spin to check the correctness of parallel algorithms • IA32 and x64 atomic and serialising instructions • load locked / store conditional (LL/SC) instructions • the impact of cache coherency • the cost of sharing data between threads in a multiprocessor • lock implementations and their evaluation (eg. testAndSet, testAndTestAndSet, ticket, MCS, Peterson, …) • the compare and swap instruction • lockless algorithms [eg. a Trieber Stack, lockless ordered lists, …] • memory ordering and consistency • the ABA problem • memory management for lockless algorithms [eg. Hazard pointers] • hardware transactional memory [eg Intel Haswell CPUs] • hardware lock elision
Recommended Reading List	• ***The Art of Multiprocessor Programming***, Maurice Herlihy and Nir Shavit • ***The Spin Model Checker: Primer and Reference Manual***, Gerald J. Holzmann • ***Principles of the Spin Model Checke****r*, Mordechai Ben-Ari
Module Pre	CS3021 CS3421

Requisite	
Module Co Requisite	
Assessment Details	Annual assessment Exam (2 hrs): 80% typically answer 3 out of 4 questions Coursework: 20% Supplemental assessment is by examination ONLY (100%). Students repeating 'off-books' (OBA) are also assessed by examination ONLY (100%) in all examination sessions.
Module approval date	*August 2012*
Approved By	*Jeremy Jones*
Academic Start Year	*2012*
Academic Year of Data	*2018/19*
Website	https://www.scss.tcd.ie/Jeremy.Jones/CS4021/CS4021.htm