# CS 7292 – Reliability and Security in Computer Architecture

## Course Information

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| **Instructor** | Milos Prvulovic, Associate Professor, CS Tom Conte, Professor, CS |
| **Textbook** | No required textbook. Recommended text:  Architecture Design for Soft Errors, Shubu Mukherjee, Morgan Kaufmann, 2008. |
| **Prerequisites** | CS 6290 or equivalent. |
| **Homework** | Four homework assignments, to be done individually by each student. Each assignment consists of reading two papers and writing a report. The guidelines for reports and the specific questions to answer and issues to address in a report will be provided as each homework assignment is released. |
| **Exams** | One midterm and one final exam. One or both of the exams are gighly likely to be take-home exams. This will be decided (after discussion with students) in the first lecture. |
| **Project** | One project assignment, to be done in groups of up to two students. Students will form groups and propose project topics - some example topics will be provided by the professor, but students are free to propose other topics. These proposals will be refined in discussion with the professor (mostly to ensure that the proposed project is feasible to do in the time available) until final project assignments are made. |

## Final Grade Composition

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| **Project** | 40% |
| **Midterm Exam** | 15% |
| **Final Exam** | 20% |
| **Homework** | 20% (four homework assignments, equally weighted) |
| **Class Participation** | 5% (participation in in-class discussions) |

## Example Schedule

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| **Week** | **Topics** | **Notes** |
| 1 | Introduction and Course Overview |  |
| Reliability - Motivation and Definitions |  |
| Fault Models, Classification, and Data |  |
| 2 | Faults, Errors, and Failures |  |
| Redundancy, Voting, and Spares |  |
| Reliability Model of Redundant Systems |  |
| 3 | Official School Holiday (Labor Day) |  |
| Redundancy Example: Tandem |  |
| Redundant Multi-Threading |  |
| 4 | DIVA |  |
| Error Detection and Correction Codes | Project Group Proposals Due |
| Parity, Checksums, ECCs and More |  |
| 5 | Examples - RAID and Self-Checking Logic |  |
| Checkpointing and Recovery | HW1 Released |
| Checkpoint Consistency |  |
| 6 | Roll-Back and Roll-Forward Recovery |  |
| Examples - SafetyNet, ReVive, HARE | HW 1 Due |
| Concept of Architectural Vulnerability |  |
| 7 | Architectural Vulnerability Analysis | Projects Assigned |
| Architectural Vulnerability Analysis |  |
| Midterm exam |  |
| 8 | Lifetime Reliability Concerns |  |
| Security - Motivation and Definitions |  |
| Attack Models, Classification, and Data | Last day to drop with "W" grade |
| 9 | Fall Recess |  |
| Page-Based Protection and Protected-Mode Execution | HW2 Assigned |
| x86 system and virtualization support |  |
| 10 | Code Integrity |  |
| Dataflow Tracking | HW2 Due |
| Anomaly Detection |  |
| 11 | Monitoring and Introspection |  |
| Monitoring and Introspection Example: 3D Chips | HW3 Assigned |
| Hardware-Supported Trusted Computing |  |
| 12 | HW-Supported Trust Examples: TMP, ARM TrustZone |  |
| Hardware Attacks | HW3 Due |
| Hardware Attack Defenses - XOM |  |
| 13 | Hardware Attack Defenses - Recent Work |  |
| Covert Channels - Introduction | HW4 Assigned |
| Covert Channels - Caches |  |
| 14 | Covert Channels - Emanations |  |
| Covert Channels Example: Smart-Cards | HW4 Due |
| Official School Holiday (Thanksgiving) |  |
| 15 | Denial of Service Attacks |  |
| Denial of Service Attacks |  |
| Lifetime Reduction Attacks |  |
| 16 | Lifetime Reliability and Attacks Example: PCM | Final Projects Due |
| Project Demos/Presentations |  |
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|  | Final exam |  |