<table>
<thead>
<tr>
<th><strong>Module Code</strong></th>
<th>CS7NS1</th>
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<tbody>
<tr>
<td><strong>Module Name</strong></td>
<td>Scalable Computing</td>
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<tr>
<td><strong>ECTS weighting</strong></td>
<td>5</td>
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<tr>
<td><strong>Term</strong></td>
<td>MT</td>
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<tr>
<td><strong>Contact Hours</strong></td>
<td>2 lecture hours per week</td>
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<tr>
<td><strong>Module Personnel</strong></td>
<td>Professor Donal O'Mahony and Assistant Professor Stephen Barrett</td>
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### Learning Outcomes

On successful completion of this module a student will be able to:

- **NS1LO1** Describe the basic characteristics, structure and operation of a cloud based system;
- **NS1LO2** Identify and apply the economic, technical and security arguments for and against cloud computing, including energy expenditure;
- **NS1LO3** Identify and exploit appropriate architectural models, scaling abilities and data placement strategies for cloud problem scenarios;
- **NS1LO4** Reason about the performance trade-offs of cloud-base application architectures;
- **NS1LO5** Analyse, specify, design, implement, test, monitor and tune a complete cloud application solving a complex problem;
- **NS1LO6** Use a commercial or open-source cloud computing management system (AWS, OpenStack, Azure etc) to procure, provision and operate a cloud hosted application;
- **NS1LO7** Apply a subset of the main techniques for large-scale data processing (GFS, Map-Reduce, BigTable and related database technologies)

### Module Learning Aims

This module aims to provide both a theoretical and practical understanding of warehouse scale or cloud computing systems which are fast becoming the dominant model in distributed computing. The module introduces the relevant technologies including the underlying hardware architecture, virtualization techniques, networking techniques, the XaaS stack, before focussing on theoretical and practical strategies for high-parallel high-scale computation over this infrastructure. It explores both user-facing service delivery and analytics focussed computation over large scale data, covering the various architectures and techniques relevant to today’s deployments. These engineering challenges are approached both from a perspective of algorithmic efficiency and energy efficiency. In addition, students will complete an end-to-end cloud based project.

### Module Content

Specific topics addressed in this module include:

- Introduction to scalable computing and Cloud Computing, to include topics such as Application Characteristics, Cloud Reference Architectures, relevant Platform Standards, and an overview of application classes.
- Techniques for large scale data processing, to include solutions such as Object store, GFS, Map-Reduce, BigTable and related technologies.
- Cloud application architectures, to cover a study of programming stacks, languages and paradigms used in the practical development and delivery of high scale cloud systems.
- Cloud resource management
- Cloud security considerations
- Practical development and delivery of cloud systems

### Assessment Details

- Coursework 50%
- Examination 50%