c

**Cloud Computing Development**

2022/23

**Level 6, 7 Semester A**

**School of Built Environment, Engineering & Computing**



# What this Module is About

## Module Overview

The module provides an understanding of Cloud Computing technologies and a new service-oriented paradigm of software engineering for Cloud Computing. It provides a set of principles that computing and storage resources can be delivered as services. Demand for skills for Cloud Computing development is also growing rapidly. Assuming you have an undergraduate level background in software engineering or computer science, this module will focus on architectural principles, underlying technologies and software methods for Cloud Computing including service-oriented architecture, web services, virtualization and network technologies.

This module covers various service computing models, including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) and focuses on software processes and methods for Cloud Computing. The module contents will help you to choose appropriate design and architectural solutions from a range of methods and technologies and to be able to critically evaluate each of them against a set of desired characteristics of the systems.

The module is practical-oriented. You will get experience in working with the oVirt private university cloud as well as renting virtual instances, developing and deploying your applications at Amazon EC2/Microsoft Azure/Google Compute Engine.

The Cloud Computing Development module represents the culmination of your experience, knowledge and studies preparing you for your postgraduate award and for further study or for employment beyond university. You will be encouraged to develop projects that allow you to best further your portfolio and employability.

The assessment is designed to develop the student rather than to just test their knowledge of what they have been taught. They are asked to research and analyse subject domains to a depth that can’t be achieved in class. In addition to enhancing their knowledge of the subject area the students enhance transferable skills such as research, analytical, software development and writing skills.

# Module Team

The module team is given below. You should refer to your timetable to confirm the tutor that is allocated to your group for any particular session.

| **Name** | **Room** | **Tel** | **Email** |
| --- | --- | --- | --- |
| Dr. Anatoliy Gorbenko  (Module Leader) | LE G13 | x24752 | A.Gorbenko@leedsbeckett.ac.uk |
| Kiran Voderhobli | LE G13 | x25152 | k.voderhobli@leedsbeckett.ac.uk |
|  |  |  |  |

# Prerequisites and Expectations

We would expect students to have an undergraduate level background in software engineering or computer science and be familiar with software development. The delivery mechanism to be utilised requires students to undertake appropriate directed reading in advance of the scheduled sessions, to participate in those sessions and to carry out critical review / reflection of the work following the scheduled sessions. The final assessment deliverable will be a practical experience report and the final test as defined below.

# Module Aims

This module aims to give students an understanding of the Cloud Computing architecture, technologies and providers. The module will enable students to develop, deploy and run cloud services and applications.

## Module Learning Outcomes

On completion of this module the student should be able to:

* Learning outcome 1: to have a critical understanding of the various cloud service providers and the technologies used.
* Learning outcome 2: critically evaluate various cloud service providers and their services.
* Learning outcome 3: understand cloud architectures and technology and the protocols that are used to communicate with server side software.
* Learning outcome 4: to develop cloud services and programming paradigms to provide these to client side systems.

# Module Learning Activities

Face-to-face via scheduled Contact Sessions: Details of scheduled face-to-face sessions will be in your online time-table.

Self directed Study: The contact time will not be sufficient to complete the work you are asked to do. We would typically expect students to spend three hours per week on self-study for each hour of timetabled contact. The time needed on self-study will be irregular and may have peaks and troughs associated with assessment.

**Students are expected to attend regularly and to complete the assigned reading tasks outside the timetabled sessions if necessary. All weekly activities and tasks should be completed before the following week’s session in order to keep to the schedule below.**

# Module Timetable 2022-23 Semester 1

| **Week** | **Session** |
| --- | --- |
| Week 1 | **Lecture**: Introduction to CCD module and assessment brief;  **Lab**: Register with Cloud Providers: AWS, AWS Educate, Microsoft Azure |
| Week 2 | **Lecture**: Evolution of Distributed Computer Systems  **Lab**: IaaS – Deployment of Windows and Linux VMs with AWS EC2 |
| Week 3 | **Lecture**: Fundamentals of Cloud Computing  **Lab**: IaaS – Deployment of Windows and Linux VMs with Microsoft Azure |
| Week 4 | **Lecture**: Cloud Computing Models  **Lab**: PaaS - Exploration and Deployment of WCF C# web services with AWS Elastic Beanstalk and Microsoft Azure |
| Week 5 | **Lecture**: Service Oriented Architecture and Web Services  **Lab**: PaaS - Development of WCF C# web services and deployment with AWS Elastic Beanstalk and Microsoft Azure |
| Week 6 | **Lecture**: SOAP and RESTful Web Services  **Lab**: PaaS - Development of SOAP Java web services for deployment on IaaS |
| Week 7 | **Lecture**: Virtualization Technologies  **Lab**: PaaS - Exploration and Deployment of RESTful Java web services with AWS Elastic Beanstalk |
| Week 8 | **Lecture**: Introduction to BigData  **Lab**: PaaS - Development of RESTful Java web services and deployment with AWS Elastic Beanstalk |
| Week 9 | **Lecture**: BigData storage and processing: NoSQL and Hadoop  **Lab**: FaaS - Development of a serverless web service with AWS Lambda |
| Week 10 | **Lecture**: No new lecture this week; work on your report  **Lab**: Infrastructure-as-code/Devops – Automated VMs provisioning on Amazon EC2 using Terraform |
| Week 11 | **Lecture**: No new lecture this week; work on your report  **Lab**: No new lab this week; work on your report |
| Week 12 | **Report due**: 16/12/22 (23:59) |
| Week 13 | **Recap week**: take a sample quiz and get prepared for the final test |
| Week 14 | **Final test**: W/C 09/01/2023 |

# Key Resources to Support Learning

Students will be provided with a good deal of material during the delivery of the module. They will also be directed to websites, journals and other relevant sources. They will also be expected to conduct their own research into topics associated with the module. The items listed below are an indication of the authors and sources that should be consulted to complement the lecture materials.

## Recommended Books:

*David Chou, John deVadoss, Thomas Erl, etc. SOA with .NET and Windows Azure: Realizing Service-Orientation with the Microsoft platform, Prentice Hall .*

*Steve Smith. Architecting Modern Web Applications with ASP.NET Core and Microsoft Azure. Microsoft Inc. .*

*Dan G. Marinescu. Cloud Computing: Theory and Practice, Morgan Kaufmann .*

*Douglas K. Barry, David Dick. Web Services, Service-Oriented Architectures, and Cloud Computing, Morgan Kaufmann .*

*Michael Kavis. Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, AND IaaS), Wiley .*

*John W. Rittinghouse, James F. RansomeCloud Computing: Implementation, Management, and Security, CRC Press .*

*Rajkumar Buyya, James Broberg, Andrzej Goscinski (Eds.). Cloud Computing: Principles and Paradigms, Wiley .*

*M. Ramachandan. Advances in Cloud Computing Research, Nova .*

*Thomas Erl, Ricardo Puttini and Zaigham Mahmood.* [*Cloud Computing: Concepts, Technology & Architecture*](http://www.amazon.co.uk/Cloud-Computing-Concepts-Technology-Architecture/dp/0133387526/ref=sr_1_1?s=books&ie=UTF8&qid=1396949281&sr=1-1&keywords=cloud+computing)*, Prentice Hall .*

**Some more electronic sources are:**

* Amazon AWS: <http://aws.amazon.com/free/>
* AWS Cost Calculator: <http://calculator.s3.amazonaws.com/calc5.html>
* Windows Azure: <http://www.azurepilot.com/>
* Google App Engine (GAE): <http://code.google.com/appengine/docs/whatisgoogleappengine.html>

The nature of the field is such that there is quite a range of books, to repeat, those listed above are those available in our library.

As a post-graduate (Masters) level activity, students should also be making use of research material, such as that published in journals, conference proceedings and similar documents, whether electronically or in paper form. Some references (pointers to suggested articles) may be provided at various points during the delivery of the module, but you should be ready to supplement this by material found during your own research.

All disabled students requiring additional support or alternative arrangements must declare and provide evidence of their disability to the Disability and Advice Team as early as possible: <https://www.leedsbeckett.ac.uk/studenthub/disability-services.htm>.

# Assessment

## Formative Assessment Opportunities

Each set of advanced reading and seminar events is a formative assessment activity, because you should produce a brief report, or a set of notes, to collect your ideas. If you make these notes available to us, we can comment on them, thus providing you with feedback.

## Summative Assessment Outline

The important element of MSc assessment is that it must allow the opportunity to carry out “critical evaluation” of the ideas and concepts. Therefore, we will be looking for evidence that you can not only collect, present and discuss ideas (which you will probably have already done in your first degree), but also that you can “think critically” about what these findings mean in a particular situation– such as by considering what might happen if these ideas are applied in a particular situation, environment or application area. Therefore, you should expect the allocation of marks to reflect this – there will be relatively few marks for the “facts”, and most marks for the critical evaluation of the effect of these “facts”. Since there will also be a page limit/word count, you should approach your work accordingly: be brief about the background (use citations and references); spend most effort on the effect of these ideas. Remember, we will have an agreed “marking scheme” and we have to apply it in the same way to all students.

## Assessment Timing

As always, the “best” time for the summative assignment is at the end of the module, since this allows you to make the most use of most of the material covered. However, this does mean that any feedback and suggested amendments are difficult to give, so please make good use of the formative assignment opportunities as well.

## Coursework Assessment

Details of this assignment (requirements, submission details etc.) are defined in Section 8.2: Assessment details.

## A Note on Assignment Submission

**The required assignment work for this module must be submitted electronically via the appropriate MYBECKETT upload link – this applies to the original submission and to any deferral or reassessment work.** *Do not email attachments to the module team’s mail addresses, or hand in paper(printed) copies of the work, they will not be accepted.* Familiarity with the MYBECKETT process and any problems with MYBECKETT upload are each student’s responsibility to address, and you must make yourself familiar with the procedures in good time, so that you are able to meet the submission requirements. You are reminded that it is your responsibility to ensure that your work is submitted on or before the due date.

## Turnitin

Your work will be automatically processed by the turnitin software, which reports on similarities between this and other texts accessed via the turnitin database. This database includes published material; work from students at other universities across the world, and assignment work submitted in earlier deliveries of this module at this University. Your attention is also drawn to the section “*What is the percentage reported by turnitin below which work is not plagiarised?”* on page 10 of this module guide.

## Assessment Summary

| **Assessment Method:** | **Weighting:** | **Assessment date:** | **Feedback Method:** | **Feedback date:** |
| --- | --- | --- | --- | --- |
| **1. Coursework:** Practical Experience Report (word count: 3000-4000) | 50%  Learning Outcomes Assessed: 2, 4 | 16/12/22 (23:59) | Via MYBECKETT | Within 4 weeks |
| **2. Phase Test:**  **Online** multiple choice quiz | 50%  Learning Outcomes Assessed: 1, 3 | W/C 09/01/2023  Specific details will be available on the MYBECKETT | Via MYBECKETT | Immediately |
| **Reassessment Method:** | **Weighting:** | **Assessment date:** | **Feedback Method:** | **Feedback date:** |
| **1. Coursework:** Practical Experience Report (word count: 3000-4000) | 50%  Learning Outcomes Assessed: 2, 4 | W/C 03/04/2023  Specific details will be available on the MYBECKETT | Via MYBECKETT | Within 4 weeks |
| **2. Phase Test: Online** multiple choice quiz | 50%  Learning Outcomes Assessed: 1, 3 | W/C 03/04/2023  Specific details will be available on the MYBECKETT | Via MYBECKETT | Immediately |

## Assessment Details

**Coursework Overview**

You will plan, carry out an audit and report your practical experience on choosing and using IaaS or PaaS cloud systems to develop and deploy your own SaaS application. The major purpose of the report is to demonstrate your practical skills on using cloud services, developing and deploying cloud-based applications. In order to achieve this outcome, you will be required to:

* Select a Cloud provider which cloud service you are going to use;
* Select IaaS or PaaS cloud service to work with;
* Research in depth architectural and other features of the chosen cloud service;
* Get access to the chosen cloud service, deploy and configure your virtual machine/environment (most of the cloud providers offer a free trial access to their IaaS/PaaS services);
* Develop, deploy and run your own testbed web service on your IaaS/PaaS service (for instance, it can be a web-service which converts different units between UK and metric system; though, your own ideas are appreciated and a complexity and originality of your service will be accounted during assessment; you can use any programming language you \*-want);
* Develop a testbed client application to communicate with your cloud web service (it can be a command-line, window or web-based applications written in any programming language).
* Produce a practical experience report, which presents (i) the background to the decisions made, (ii) describes the chosen IaaS/PaaS cloud service, (iii) reports the process of virtual machine/environment deployment, configuration and use, (iv) describes a process of cloud web service/client development and deployment, and (v) demonstrates the usage of your testbed cloud web service.

**Submission Dates**

* Final Report Submission: 16.12.2022 (23:59)

**Note:** Your **electronic completed work (report and source code)** will be submitted **via the MYBECKETT** site.

**Marking Scheme**

| **Course Title(s):** | BSc Computer Science, MEng Computer Science | | |
| --- | --- | --- | --- |
| **Module Title:** | Cloud Computing Development | **Level:** | 6, 7 |
| **Assessment Title:** | **Research Report (Assessment Component 1)** | **Weighting:** | 50% |

| ***CRITERIA AND WEIGHTING*** | ***DISTINCTION 70+*** | ***MERIT 69-60*** | ***PASS 59-40 (59-50 for MSc)*** | ***FAIL 39-0 (49-0 for MSc)*** |
| --- | --- | --- | --- | --- |
| ***Crit. Review***  *Critical evaluation and overview of Cloud Computing technologies: definitions, characteristics, models and providers (40)* | *Excellent coverage of Cloud Computing technologies (definitions, characteristics, service and deployment models and providers) and their critical evaluation* | *Good coverage of Cloud Computing technologies and their critical evaluation* | *Fair coverage of Cloud Computing technologies and their overview (some aspects might be missing or not critically evaluated)* | *Poor coverage of Cloud Computing technologies (many of aspects are missing and/or poorly discussed; lack of critical evaluation)* |
| ***Development***  *Service and Client Development (15)* | *Excellent development of ORIGINAL service and client according to high-level SW standards (e.g. requirements specification, use of UML diagrams, implementation details discussion, testing)* | *Good development of ORIGINAL service and client according to high-level software development standards* | *Fair development of ORIGINAL service and client OR good development of service and client which are similar to ones from the labsheets OR missing client* | *No service/client have been developed or poor service/ client development, lack of its description, implementation details, testing* |
| ***Deployment***  *Guidance of a cloud service deployment, cloud infrastructure/platform usage and management (15)* | *Excellent guidance of the process of cloud service/platform deployment, configuration and management* | *Good guidance of the process of cloud service/platform deployment, configuration and management* | *Fair guidance of the process of cloud service/platform deployment, configuration and management* | *Poor or missing guidance of cloud service/platform deployment, configuration and management* |
| ***Demonstration***  *Demonstration of a deployed cloud service and its interaction with the client app (20)* | *Excellent demonstration of cloud platform and service deployment and its interaction with a client* | *Good demonstration of cloud platform and service deployment and its interaction with a client* | *Fair demonstration of the deployed service and its interaction with the client or good service demonstration but missing client* | *No service has been deployed on clouds or poor demonstration of the deployed service* |
| ***Acad. writing***  *Academic writing (10)* | *Well structured, clear and consistent report; written in third person; formatting is consistent and appropriate; correctly put all cited work into your own words with good number of references (20+)* | *Clear and consistent report; written in third person; formatting is mostly consistent and appropriate; correctly put most of cited work into your own words with good number of references (15+)* | *Reads more like a tutorial than a technical report; mostly in third person; formatting is not very consistent; fair number of references (~10) or some verbatim coping - be careful not to copy text from external sources* | *Tone is overly informal for a report; a report such as this should be in third person; formatting is inconsistent; there are no citations or a very few references or you have extensive unattributed verbatim copying and have done very little actual work of your own (this is very serious and can be considered plagiarism!)* |

**Phase Test Overview**

The purpose of the Quiz component is to encourage you to study the lecture material. You will not be able to retry the quiz, so before beginning a quiz make sure you are somewhere with a reliable Internet connection and that you have time to complete it.

The quiz is on-line, supervised, closed book. The quiz will be made up of 60 multiple choice questions with a one hour time limit.

**Submission Dates**

* Submission: W/C 09/01/2023

## Reassessment/Deferral For Assessment

Enhance the original assessment report and oral presentation (only if necessary).

## Student Instructions for Submission of Coursework



# Frequently Asked Questions

*What do I need to do to pass the module?*

Experience has shown that there is a strong relationship between attendance at sessions and final mark, therefore making sure you attend the timetabled sessions is an essential first step. However, “attending” is not enough: you should also take part in the sessions, by listening and taking notes, and by thinking about the issues raised and asking (or answering) questions when appropriate.

As noted above, the range of material covered by the module is presented in a number of different ways – as lectures, as tutorial work, as suggested reading, remember that the lecture notes provide a starting point for your study, and do not provide the full depth or breadth of material you will need – higher-level study is about being able to read around the subject, follow up references and filling in the gaps. You will need to do all these activities to succeed; the module material is designed that way. Do not forget the assignment either – there is a penalty system for late hand-ins which will be enforced. Every year some students end up getting reassessed because they hand work in late, and the penalty takes their mark from a “pass” to a “fail” grade.

*What if I am unsure about how best to study the material?*

Everyone has an individual approach to study, so you should try to find the best one for you. However, the University has a comprehensive set of study skills material on the skills for learning websitehttp://skillsforlearning.leedsmet.ac.uk/. This is recommended reading for all our students, but there are particular sections of interest if this is your first experience of studying at Leeds Metropolitan University. As a minimum, you should expect to attend all the scheduled sessions, take part in the activities, and – most importantly – be prepared by looking at the material on X-Stream **before** the scheduled session.

*What is this “postgraduate level” that the lecturers keep talking about?*

This is a module on a postgraduate award, if you complete the award successfully, you will become a Master of Science. One of the skills which a Master of Science is expected to possess is the ability to apply knowledge and findings from one application to a different situation –especially one which has not been considered before. This is sometimes called *transferrable skills*. This involves finding out what the current situation / application area is and making a personal assessment of its importance, then deciding how the information gained can be applied to the new problem – what needs to be changed, what the expected effects of that change might be, etc. This is postgraduate thinking, it is important because it allows you to apply knowledge to situations different from those in which the information was presented and in a way which has not been done before, so you are expanding the set of useful applications of that information. Since most of the time, you will not be in the “text book” situation, this is a very useful skill to have.

*What do I do if I do not understand something in a session?*

Please ask. If the question comes to mind during the session, then ask at that time. The chances are that others in the group are also having the same problem and will be grateful for you for asking it. If the question comes to mind outside the session, then contact us by email, we will either reply by email, or give a general answer in the class.

*What sort of work should I be submitting?*

The assignment specification will give you details of what is required, but in general, you should ensure that your work answers the question as set out (we have a marking scheme which we have to follow, and can only give marks when the question is being answered). You will be told elsewhere about ensuring that work is your own (the skills for learning website can help with this too). If you are unsure, then please ask us. Whilst we cannot give you the answer to your coursework before you submit it, we will be able to tell you if you are working in the right direction, at the correct level etc. You should also take advantage of any formative assignment work. Formative assignments are things like tutorial questions, or the questions found at the end of chapters in recommended text books, you should try to answer these and discuss your answers with us, that way you can get some idea that the style and level of detail in your work is appropriate.

*What feedback about my progress will I get?*

In the 10th Edition of the *Concise Oxford Dictionary* “feedback” is defined as

*…information given in response to … a person’s performance of a task, etc.*

Therefore, the nature and volume of feedback depends on the nature and volume of the evidence you provide us about your “performance”. If this evidence is restricted to the assessed work, then feedback will be similarly restricted. If you attempt the non-assessed material, or produce your summaries of the supplementary materials, and show it to us, we will give feedback on that as well.

*What kind of marks will I get?*

You should have the scheme and course information given to you at induction which gives these details, but remember we mark on a scale of 0– 100%, and that 40% (50% for the postgraduate study) is the minimum to pass a particular piece of assessment, 60% gives a “merit” mark and 70% a “distinction”. Marks of 80 and above are awarded to work which is very exceptional, showing all the merits of postgraduate level work – critical thinking, good application of source material to the problem, clearly thought-out recommendations for further work etc. etc.

*When will I get my results?*

Your coursework marks and feedback will be returned within the University guidelines, but note that any mark is provisional until the relevant examination committees have met to agree the marks.

*What happens if I do not pass (or do not submit) the assessed work?*

The University regulations should be referred to for full information about the reassessment / deferral procedure. Please note though, that the reassessment work is of equally challenging standard to the original, and therefore requires the same level of application and effort, and that any reassessment (whether through a substandard mark in the first attempt, or through a non-submission which has not been sanctioned by the extenuating circumstances committee) will be awarded a mark of, at best 40%.

*What is the percentage reported by turnitin below which work is not plagiarised?*

There is no such thing! The turnitin software produces a “similarity index” and identifies where the matched material has been found. We then use this information – together with other information about your assignment(such as changes in writing style and in text font, size and colour; references to diagrams, sections or cited material which do not appear in the work submitted; phrases like “in this chapter” and claims to have implemented some software in an unlikely location, or statements that the work being presented is part of a larger project, or that extensive surveys have been carried out) to form a judgement on whether we suspect that plagiarism has occurred. That judgement takes into account the seriousness of the suspected plagiarism – for example it is generally thought to be “worse” to attempt to claim someone else’s results and conclusions than to plagiarise others’ presentation of factual information. Ultimately, you know whether the work you submit is your own. Your respect for yourself, for your fellow students and for the reputation of the course should govern your behaviour.

# Understanding Your Assessment Responsibilities

## Mitigation and Extenuating Circumstances

If you are experiencing problems which are adversely affecting your ability to study (called 'extenuating circumstances'), then you can apply for mitigation. You can find full details of how to apply for mitigation at: <http://www.leedsbeckett.ac.uk/studenthub/mitigation.htm>.

The University operates a fit to sit / fit to submit approach to extenuating circumstances which means students who take their assessment are declaring themselves fit to do so.

## Late Submission

Without any form of extenuating circumstances, standard penalties apply for late submission of assessed work. These range from 5% to 100% of the possible total mark, depending on the number of days late. Full details (section C1.5.7) of the penalties for late submission of course work are available at <http://www.leedsbeckett.ac.uk/about/academic-regulations.htm> (see C1).

## Cheating, Plagiarism and Other Forms of Unfair Practice

Academic misconduct occurs when you yourself have not done the work that you submit. It may include cheating, plagiarism, self-plagiarism, collusion and other forms of unfair practice. What is and what is not permitted is clearly explained in *The Little Book of Cheating, Plagiarism and Unfair Practice* which is available to view at: <https://www.leedsbeckett.ac.uk/joining/hss/Little_Book_of_Cheating_Plagiarism_and_Unfair_Practice_-_v1.pdf>

The serious consequences of plagiarism and other types of unfair practice are detailed in section C9 of the Academic Regulations at <http://www.leedsbeckett.ac.uk/about/academic-regulations.htm>.