

Instructor Information

Course Title	Cloud Computing
Course Number	ECE 530
Credit Hours	3
Instructor	Ioannis Papapanagiotou
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Phone	505 277-0533
Office	ECE Building Room 125B
Office Hours	TBD

Instructor Response Time

I routinely check the course for postings or emails. M-F and sometimes over the weekend. You can anticipate a 24-48h response from me unless there are specific circumstances. I will also try to respond over the weekend.

Course Information

Course Description

This course provides an introduction in the techniques and technologies used in cloud computing. It consists of independent and intensive hands on labs. The course emphasizes on architecture and the development of web services that can scale on cloud infrastructure. The students learn how to deploy an IaaS, develop applications against common PaaS vendors. Students or attendees learn how to focus on service decoupling and the principles of a cloud native enterprise. Below we show some of the modules offered in this course.

Topics Covered

- Introduction to Cloud Computing
 - standardization, automation, rapid elasticity, pricing
- Cloud Architectures and Model (Service and Delivery Models, Virtualization, Hypervisors)
- IaaS and PaaS Cloud Services and Vendors (Amazon AWS, OpenStack, Google Cloud and Microsoft Azure etc.)
- Anatomy of the Cloud (Cloud tiers, Sharding, CAP Theorem, ACID/Base, Web Services)

- Replication, Consistency, 2/3 Phase Commits, and Paxos (Vector Clocks, Byzantine Failures, Chandy/Lamport)
- PaaS Cloud Storage and Case Studies (The Amazon Dynamo/Cassandra, Google's BigTable etc)
- Data Pipeline (Distributed Queues, Message Brokers, Pub/Sub, Service Decoupling, Exchange Types and Apache Kafka)
- Microservices, Containers, Container Orchestration (Control Groups, Namespaces, Docker, Kubernetes, Docker Swarm, Meson with Marathon)
- Network Virtualization (OpenStack Neutron, Software Defined Networks, OpenFlow)
- Security (security integration model, threats, Economic Denial of Sustainability, threat mitigation and case studies)
- Serverless (Function As a Service - FaaS)

Course Objectives

The goal of this course is to make the students competent in Cloud computing, answering critical questions on when and why migrating services on the cloud, analyze the cloud platform and how to decompose a monolithic application to microservices. Students will understand the cloud computing layers, data ingestion and data storage on the cloud and the layers of the computing services (including instances, containers and serverless).

Students Learning Outcomes

Students will learn the principles of Cloud Computing including, why Cloud Computing is relevant, how to deploy a Cloud computing infrastructure. In addition, the students will learn the principles of Platform as a Service (PaaS) and the Cloud platform and computing components.

Requirements

Prerequisites and Co-requisites

Graduate and or undergraduate course in computing networks (ECE 440 ECE 540 or equivalent) and Unix background. Background of Operating Systems (ECE 437 / CS 481, CS587 is not a requirement but it is good to have).

Course Orientation

The course will be delivered on online in a flipped mode. All lectures will be recorded and along with the corresponding slides they will be posted on UNM learn. Students are advised to attend the office hours every Tuesday at 10am. You can attend the office hours physically or virtually (though Blackboard Collaborate).

Technical Requirements

Computer

- A high speed Internet connection is highly recommended.

- Supported browsers include: Internet Explorer, Firefox, and Safari. Detailed Supported Browsers and Operating Systems: <http://online.unm.edu/lms/help/browsers>
- Any computer capable of running a recently updated web browser should be sufficient to access your online course. However, bear in mind that processor speed, amount of RAM and Internet connection speed can **greatly** affect performance.
- Online courses perform best on a high-speed Internet connection. Those using dial-up connections will experience longer page load times and much slower performance when accessing their online course. Many locations offer free high-speed Internet access including [UNM's Computer Pods](#) or one of UNM's many [Statewide Centers](#)
- **For UNM Learn Technical Support: (505) 277-0857 (M-F 8am - 5pm) or learn@unm.edu.**

As the course puts strong emphasis on hands-on experiences and practical training in deploying cloud services, your assignments require you to use virtual resources. Hence, in addition to the above requirements, students are expected to have full access to a computer that meets or exceeds the following capabilities to accomplish the projects of this course:

- Reasonably powerful x86 hardware. Any recent Intel or AMD processor should do.
- 4GB RAM
- 64GB free hard disk space
- OS that is supported by VirtualBox or VMware Client (Windows, Linux, Mac OS X, Solaris and OpenSolaris)

We recommend that you install a hypervisor, such as VirtualBox. The above hardware requirements are for a smooth experience with the virtual machines. For more information on VirtualBox, refer to <http://www.virtualbox.org/>

Web Conferencing

Web conferencing will be used in this course during the following times and dates:

TBD

For the online sessions, you will need:

- A USB headset with microphone. Headsets are widely available at stores that sell electronics, at the UNM Bookstore or online.
- A high-speed internet connection is highly recommended for these sessions. A wireless Internet connection may be used if successfully tested for audio quality prior to web conferencing.
- For UNM Web Conference Technical Help: (505) 277-0857 or media@unm.edu

Textbook and Supplemental Materials

The instructors will provide the appropriate notes from the course. Additional articles and papers to read will be posted. I would highly recommend optionally buying the following book:

- *Designing Data-Intensive Applications: The big ideas behind reliable, scalable and maintainable systems*, By M Kleppmann, ISBN-13: 978-1449373320

There are a few other books in the domain for generic reading:

- *Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)*, By Kavis et.al , ISBN-13: 978-1118617618.
- *Distributed and Cloud Computing: From Parallel Processing to the Internet of Things*, By K. Hwang et al., Elsevier 2012, ISBN-13: 978-0123858801
- *Docker Up and Running*, By Matthias et al., ISBN-13: 978-1491917572

Course Schedule (8 week)

Week 1	Introduction to Cloud Computing
Week 2	Cloud Architecture and Models
Week 3	Anatomy of the PaaS
Week 4	Replication, Consistency and Clocks
Week 5	Cloud Data at Rest and in Transit
Week 6	Microservices and Containers
Week 7	Cloud Security
Week 8	Cloud Networking and SDN

Assessment and Grading

Procedures for Completing Assessments

- For remote exams, a pre-arranged and approved proctor must have been established with the UNM Online program
- There will be no makeup exams or homework. Late submissions will not be graded.
- If an issue appears in which a student cannot attend a mandatory meeting, the student must provide a notice 72h in advance.
- All written work needs to be submitted online. If you have difficulty using UNM Learn, please create a support ticket (using the course menu) and notify your instructor as well.

Tracking Course Activity

UNM Learn automatically records all students' activities including: your first and last access to the course, the pages you have accessed, the number of discussion messages you have read and sent, web conferencing discussion text, and posted discussion topics. This data can be accessed by the instructor to evaluate class participation and to identify students having difficulty

Grading Procedures

- Hands on Lab: 40%
- Midterm Exams: 30%
- Final Project: 30%
- (no final exam)

Grading Scale

<u>Grade</u>	<u>Scale</u>	<u>Notes or Prior Term's Distribution</u>
A+	97 - 100 %	% of total points possible
A	94 - 96 %	% of total points possible
A-	90 - 93 %	% of total points possible
B+	87 - 89 %	% of total points possible
B	84 - 86 %	% of total points possible
B-	80 - 83 %	% of total points possible
C	70 - 79 %	% of total points possible
D	60 - 69 %	% of total points possible
E	not applicable	given only under very extenuating circumstances
F	0 - 59 %	% of total points possible
I		See policy .
W/WF		See policy .

Assignments and Participation

Assignments

Exemplar assignments (more information can be found on UNM Learn):

- Quizzes per module
- Compare and contrast public cloud providers
- Deploy an IaaS
- Learn microservices and container deployments
- Distributed systems on Containers
- Etc...

Please see at UNM Learn the details about the homework, assignments etc

Expectations for Participation

- Students are expected to learn how to navigate in UNM Learn before the beginning of the course
- Students are expected to know the basics of Computer networking and how to use a Linux operating system
- Students are expected to monitor UNM Learn for announcements on bi-weekly basis
- Students are expected to check their emails once every 24h.

Ground Rules:

- “In following with the UNM Student Handbook, all students will show respect to their fellow students and instructor when interacting in this course. Take Netiquette suggestions seriously. Flaming is considered a serious violation and will be dealt with promptly. Postings that do not reflect respect will be taken down immediately.” (Rebecca Adams, OLIT 535)
- This course encourages different perspectives related to such factors as gender, race, nationality, ethnicity, sexual orientation, religion, and other relevant cultural identities. The course seeks to foster understanding and inclusiveness related to such diverse perspectives and ways of communicating.”

Drop Policy:

UNM Policies: This course falls under all UNM policies for last day to drop courses, etc. Please see <http://www.unm.edu/studentinfo.html> or the UNM Course Catalog for information on UNM services and policies. Please see the UNM academic calendar for course dates, the last day to drop courses without penalty, and for financial disenrollment dates.

UNM Resources

CAPS Tutoring Services <http://caps.unm.edu/programs/online-tutoring/>

CAPS is a free-of-charge educational assistance program available to UNM students enrolled in classes. Online services include the Online Writing Lab, Chatting with or asking a question of a Tutor.

UNM Libraries <http://library.unm.edu>

Student Health & Counseling (SHAC) Online Services
<http://online.unm.edu/help/learn/support/shac>

UNM Policies

Copyright Issues

All materials in this course fall under copyright laws and should not be downloaded, distributed, or used by students for any purpose outside this course.

Students with Disabilities

The American with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodations of their disabilities. If you have a disability requiring accommodation, please contact me immediately to make arrangements as well as Accessibility Services Office in 2021 Mesa Vista Hall at 277-3506 or <http://as2.unm.edu/index.html>. Information about your disability is confidential.

Academic Misconduct

You should be familiar with UNM's Policy on Academic Dishonesty and the Student Code of Conduct (<http://pathfinder.unm.edu/campus-policies/other-campus-policies.html>) which outline academic misconduct defined as plagiarism, cheating, fabrication, or facilitating any such act.