



Please note that this is a draft version of the syllabus. A finalized version of the syllabus will be provided closer to the start of the semester.

Virtualization and Container Technologies (ENPM 818R) Sections 0101 and AEB1

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Office Hours:

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Semester: Fall 2024

Credits: 3

Semester Dates: From August 26, 2024 – December 9, 2024

Course Times: Thursdays 7:00 – 9:40 PM

Classroom: TBA and Online

CANVAS/ELMS Link: XXXXXXXX

Course Description

This course on virtualization and container technologies will cover a range of topics related to these two fundamental concepts in the field of IT and software development. This comprehensive course is designed to provide participants with an in-depth understanding of virtualization and container technologies, empowering them to architect and optimize modern IT infrastructures.

Students will learn and develop an understanding of the following:

- Introduction to Virtualization
 - Understanding Virtualization Concepts
 - Definition and purpose of virtualization
 - Types of virtualization: hardware, software, network, storage
 - Virtualization Technologies
 - Hypervisors (Type 1 and Type 2)
 - Virtual Machine (VM) architecture
 - Benefits and use cases
- Hypervisor Technologies
 - Type 1 Hypervisors
 - Examples: VMware ESXi, Microsoft Hyper-V, KVM
 - Installation and configuration

- Type 2 Hypervisors
 - Examples: VMware Workstation, Oracle VirtualBox
 - Pros and cons
- Containerization Basics
 - Introduction to Containers
 - Definition and key concepts
 - Comparison with virtual machines
 - Containerization Technologies
 - Docker and container runtimes
 - Container images and registries
- Docker Fundamentals
 - Docker Architecture
 - Docker Engine components
 - Docker daemon and client
 - Working with Docker Containers
 - Running, stopping, and restarting containers
 - Managing container networks and volumes
- Container Orchestration
 - Introduction to Orchestration
 - Why orchestration is necessary
 - Key challenges in managing containers at scale
 - Kubernetes Overview
 - Kubernetes architecture
 - Deploying applications with Kubernetes
- Advanced Topics
 - Networking in Virtualized Environments
 - Virtual LANs (VLANs), virtual switches
 - Software-defined networking (SDN)
 - Security in Virtualized and Containerized Environments
 - Isolation and security measures
 - Best practices for securing virtual machines and containers
- Case Studies and Practical Applications
 - Real-world Use Cases
 - Industry examples of virtualization and containerization
 - Case studies of successful implementations
 - Hands-on Labs and Projects
 - Practical exercises using virtualization and container tools
 - Building and deploying applications in a containerized environment
- Future Trends and Emerging Technologies
 - Edge Computing and Virtualization
 - Virtualization at the edge
 - Implications for IoT and edge computing
 - Serverless Computing and Containers

- Serverless architecture and its relationship with containers
- Emerging trends in container technologies

During the course, there will be a midterm group project, a final group project and a final exam. Students will also perform hands-on exercises and assignments during and outside of class to reinforce the lecture material. While we will primarily focus on containerized services in the cloud and on-premises.

Prerequisites

Basic understanding of computer networks, operating systems, and programming concepts.

Learning Outcomes

Upon completion of the course, participants should be well-equipped to implement and manage virtualized and containerized solutions, contribute to efficient IT operations, and adapt to emerging trends in the rapidly evolving landscape of information technology. This virtualization course should also equip the students with the knowledge and skills needed to design, implement, and manage virtualized environments effectively. Participants should be able to apply these skills in diverse IT environments, ranging from small business setups to large enterprise infrastructures.

After successfully completing this course, you will be able to:

1. Understanding of Virtualization Concepts:
 - Define virtualization and articulate its significance in modern IT infrastructures.
 - Distinguish between various types of virtualization, including hardware, software, network, and storage virtualization.
2. Hypervisor Proficiency:
 - Demonstrate proficiency in installing, configuring, and managing both Type 1 and Type 2 hypervisors.
 - Compare and contrast popular hypervisors, such as VMware ESXi, Microsoft Hyper-V, and KVM.
3. Comprehensive Grasp of Containerization:
 - Explain the fundamental principles of containerization and its advantages over traditional virtualization.
 - Create, manage, and deploy containerized applications using Docker.
4. Docker Mastery:
 - Navigate the Docker ecosystem confidently, understanding its architecture, components, and command-line interface.
 - Build and optimize Docker containers, images, volumes, and networks.
5. Container Orchestration with Kubernetes:
 - Discuss the importance of container orchestration in managing large-scale deployments.
 - Deploy and manage containerized applications using Kubernetes.
6. Advanced Networking and Security:
 - Implement advanced networking concepts in virtualized environments, including VLANs and SDN.
 - Apply security measures to ensure the isolation and protection of virtual machines and containers.

7. Real-world Application:

- Analyze real-world use cases and apply virtualization and containerization to solve practical problems.
- Demonstrate the ability to design and deploy solutions in simulated environments.

8. Project Implementation:

- Complete a final project that requires participants to design and implement a virtualized or containerized solution.
- Showcase the ability to architect and optimize IT infrastructures using virtualization and container technologies.

Course Materials

Required Resources

Students will need a computer and will need to create accounts with Amazon Web Services, Microsoft Azure, and Google Cloud Platform. The hands-on exercises will all involve work either at no charge or within the free tiers of Amazon Web Services, Microsoft Azure, and Google Cloud Platform.

Total Estimated costs of required course materials: \$50.00

Supplemental Resources

- Readings: Additional readings will be provided in class or through ELMS discussion boards.
- Hardware/Software: A personal computer will be needed in class

Course Structure

This class meets face-to-face on Thursdays from 7:00 – 9:40 PM in the XXXXX Building, Room XXXXX. This course will be focused on content delivery during class and some activities outside of class including at least one group project. During class, there will be in-class activities including lab work as well as quizzes. The slides for each class will be posted within 24 hours of the scheduled class time. Quizzes will also be announced at least 24 hours before class.

Please note that F1 students enrolled in on-campus sections must attend class in person.

Communication Guidelines

Communicating with the Instructor

My goal is to be readily available to you throughout the semester. I can be reached by email at edaviage+818R@umd.edu. Please DO NOT email me with questions that are easily found in the syllabus or on ELMS-Canvas (e.g., When is this assignment due? How much is it worth? etc.), but please DO reach out about personal, academic, and intellectual concerns/questions.

While I will do my best to respond to emails within 24 hours, you will receive a response within 48 hours.

When constructing an email to me please put “ENPM 818R (Section 0101 or AEB1): Your Topic” in the subject line. This will draw my attention to your email and enable me to respond to you more quickly.

Additionally, please review [These tips for 'How to email a Professor'](#). By following these guidelines, you will be ensured to receive a timely and courteous response.

Finally, if you need to discuss issues not appropriate for the classroom and/or an email, we can arrange to talk by phone, over Zoom, or in person. Send me an email asking for a meeting and we can set something up.

Announcements

I will send IMPORTANT messages, announcements, and updates through ELMS-Canvas. To ensure you receive this information in a timely fashion, make sure your email and announcement notifications (including changes in assignments and/or due dates) are enabled in ELMS-Canvas ([How to change notification settings in CANVAS](#)).

Log into our ELMS-Canvas course site at least once every 24 hour period to check your inbox and the Announcements page.

Names/Pronouns and Self-Identifications

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering inclusive and equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to in this class, both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). Keep in mind that the pronouns someone uses are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, it is your choice whether to disclose how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity (e.g., should it come up in classroom conversation about our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Communicating with your Peers

With a diversity of perspectives and experiences, we may find ourselves in disagreement and/or debate with one another. As such, it is important that we agree to conduct ourselves in a professional manner and that we work together to foster and preserve a virtual classroom environment in which we can respectfully discuss and deliberate controversial questions. I encourage you to confidently exercise your right to free speech—bearing in mind, of course, that you will be expected to craft and defend arguments that support your position. Keep in mind, that free speech has its limit and this course is NOT the space for hate speech, harassment, and derogatory language. I will make every reasonable attempt to create an atmosphere in which each student feels comfortable voicing their argument without fear of being personally attacked, mocked, demeaned, or devalued.

Any behavior (including harassment, sexual harassment, and racially and/or culturally derogatory language) that threatens this atmosphere will not be tolerated. Please alert me immediately if you feel threatened, dismissed, or silenced at any point during our semester together and/or if your engagement in discussion has been in some way hindered by the learning environment.

Netiquette Policy

Netiquette is the social code of online classes. Students share responsibility for the course's learning environment. Creating a cohesive online learning community requires learners to support and assist each other. To craft an open and interactive online learning environment, communication has to be conducted in a professional and courteous manner at all times, guided by common sense, collegiality, and basic rules of etiquette.

Grading

Grade Breakdown

| Assignment | Percentage % |
|---------------------------------------|--------------|
| Homework | 20% |
| Quizzes | 20% |
| Participation/Engagement | 5% |
| Mid Team Project/Paper/Presentation | 25% |
| Final Team Project/Paper/Presentation | 30% |
| Total | 100% |

Course Assignments

Homework

- There will be four homework assignments during the course. Each assignment will have detailed instructions and will be due at 11:59 PM the due date.

Quizzes

- There will be 6 to 8 quizzes during the course. Each quiz will be given during a class session and must be completed during that class session.
- The quizzes will be through ELMS.

Participation & Engagement

- During live sessions
- During group discussion boards

Team Projects and Presentations

- There will be two team projects including a presentation in the class. These projects will be due at the midterm point and end of the semester. More details will be provided at the time they are assigned in class.

Grading Assignments

All assignments will be graded according to a predetermined set of criteria (i.e., rubric) which will be communicated to students before the assignment is submitted.

To progress satisfactorily in this class, students need to receive timely feedback. To that end, it is my intention to grade all assignments within **2 weeks** of their due date. If an assignment is taking

longer than expected to grade, students will be informed of when they can expect to see their grade.

Grade Computation

All assessment scores will be posted on ELMS/Canvas page. If you would like to review any of your grades (including the exams), or have questions about how something was scored, please email me to schedule a time for us to meet and discuss.

It is expected that you will submit work by the deadline listed in the syllabus and/or on ELMS-Canvas. Late work will be penalized according to the late work policy described in the **Course Policies and Procedures** section below.

Grade Disputes: I am happy to discuss any of your grades with you, and if I have made a mistake I will immediately correct it. Any formal grade disputes must be submitted in writing and within one week of receiving the grade.

Final letter grades are assigned based on the percentage of total assessment points earned. To be fair to everyone I have to establish clear standards and apply them consistently, so please understand that being close to a cutoff is not the same as making the cut (89.99 \neq 90.00). It would be unethical to make exceptions for some and not others.

| Final Grade Cutoffs | | | | | | | | | |
|---------------------|--------|---|--------|---|--------|---|--------|---|--------|
| + | 97.00% | + | 87.00% | + | 77.00% | + | 67.00% | + | |
| A | 94.00% | B | 84.00% | C | 74.00% | D | 64.00% | F | <60.0% |
| - | 90.00% | - | 80.00% | - | 70.00% | - | 60.00% | - | |

Course Schedule

| Week # | Topic | Assignments/Deliverables |
|--------|---|--------------------------|
| 1 | Introduction to Virtualization | Quiz |
| 2 | Virtualization Technologies - Hypervisors | |
| 3 | Virtualization Technologies - VM Architecture | Quiz |
| 4 | Containerization | |
| 5 | Docker Fundamentals | Quiz |
| 6 | Docker Practical Hands-On | In Class Assignment |
| 7 | Container Orchestration | Quiz |
| 8 | Midterm Project | In Class Assignment |
| 9 | Networking and Security in Containerized Environments | Quiz |

| | | |
|----|---|---------------------|
| 10 | Review of Case Studies and Practical Applications | Midterm Project Due |
| 11 | Final Project Review | Quiz |
| 12 | Future Trends and Emerging Technologies | |
| 13 | Course Review Sessions | Final Project Due |
| 14 | Final Exam | Final Exam Due |

Note: This is a tentative schedule, and subject to change as necessary – monitor ELMS-Canvas for current deadlines. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.

Course Policies and Procedures

The University of Maryland’s conduct policy indicates that course syllabi should refer to a webpage of course-related policies and procedures. For a complete list of graduate course-related policies, visit the [Graduate School website](#). Below are course-specific policies and procedures that explain how these Graduate School policies will be implemented in this class.

Satisfactory Performance

The Graduate School expects students to take full responsibility for their academic work and academic progress. The student, to progress satisfactorily, must meet all the academic requirements of this course. Additionally, each student is expected to complete all readings and any preparatory work before each class session, come to class prepared to make substantive contributions to the learning experience, and proactively communicate with the instructor when challenges or issues arise.

Questions about Assignments

Please ask all questions you may have about an assignment by XX:XX AM/PM the day before the assignment is due. Any questions asked after that time may not be answered in time for you to make changes to your work.

Late Work Policy

Assignments should be completed by the due date and time listed with the assignment, on the syllabus, and/or in the course calendar. If you are unable to complete an assignment by the stated due date, it is your responsibility to contact your instructor to discuss an extension, at least 24 hours BEFORE the assignment is due. Extensions are not guaranteed but may be granted at the instructor's discretion.

Assignments submitted late will receive a 10% deduction in total grade per each calendar day late up to a maximum of three days late (i.e., there is a maximum of a 30% grade reduction for assignments submitted late). Work submitted more than three days late will not receive feedback and will automatically earn a grade of zero.

Religious Observance

It is the student's responsibility to inform the instructor of any intended absences for religious observances in advance. Notice should be provided as soon as possible but no later than the end of the schedule adjustment period.

Academic Integrity

For this course, some of your assignments will be collected via Turnitin on ELMS/Canvas. I have chosen to use this tool because it can help you improve your scholarly writing and help me verify the integrity of student work. For information about Turnitin, how it works, and the feedback reports you may have access to, visit [Turnitin Originality Checker for Students](#)

The University's Code of Academic Integrity is designed to ensure that the principles of academic honesty and integrity are upheld. In accordance with this code, the University of Maryland does not tolerate academic dishonesty. Please ensure that you fully understand this code and its implications because all acts of academic dishonesty will be dealt with in accordance with the provisions of this code. All students are expected to adhere to this Code. It is your responsibility to read it and know what it says, so you can start your professional life on the right path. **As future professionals, your commitment to high ethical standards and honesty begins with your time at the University of Maryland.**







It is important to note that course assistance websites, such as CourseHero, or AI-generated content are not permitted sources unless the instructor explicitly gives permission. Material taken or copied from these sites can be deemed unauthorized material and a violation of academic integrity. These sites offer information that might be inaccurate or biased and most importantly, relying on restricted sources will hamper your learning process, particularly the critical thinking steps necessary for college-level assignments.

Additionally, students may naturally choose to use online forums for course-wide discussions (e.g., Group lists or chats) to discuss concepts in the course. However, **collaboration on graded assignments is strictly prohibited unless otherwise stated.** Examples of prohibited collaboration include: asking classmates for answers on quizzes or exams, asking for access codes to clicker polls, etc. Please visit the [Office of Graduate Studies' full list of campus-wide policies](#) and reach out if you have questions.

Finally, on each exam or assignment, you must write out and sign the following pledge: ***"I pledge on my honor that I have not given or received any unauthorized assistance on this exam/assignment."***

If you ever feel pressured to comply with someone else's academic integrity violation, please reach out to me straight away. Also, **if you are ever unclear** about acceptable levels of collaboration, **please ask!**

To help you avoid unintentional violations, **the following table** lists levels of collaboration that are acceptable for each graded exercise. Each assignment will contain more specific information regarding acceptable levels of collaboration.

| |  OPEN NOTES |  USE BOOK |  LEARN ONLINE |  GATHER CONTENT With AI |  ASK FRIENDS |  WORK IN GROUPS |
|----------------------|--|--|---|--|---|--|
| Homework Assignments | ✓ | ✓ | ✓ | --- | --- | --- |

| | | | | | | |
|---------------|---|---|-----|-----|-----|-----|
| Quizzes | ✓ | ✓ | ✓ | --- | --- | --- |
| Team Projects | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Final Exam | ✓ | ✓ | --- | --- | --- | --- |

Course Evaluation

Please submit a course evaluation through Student Feedback on Course Experiences in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to Course Experiences is confidential. The campus will notify you when Student Feedback on Course Experiences is open for you to complete your evaluations at the end of the semester. Please go directly to the [Student Feedback on Course Experiences](#) to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing through Testudo the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

Copyright Notice

Course materials are copyrighted and may not be reproduced for anything other than personal use without written permission.

Tips for Succeeding in this Course

1. **Participate.** I invite you to engage deeply, ask questions, and talk about the course content with your classmates. You can learn a great deal from discussing ideas and perspectives with your peers and professor. Participation can also help you articulate your thoughts and develop critical thinking skills.
2. **Manage your time.** Students are often very busy, and I understand that you have obligations outside of this class. However, students do best when they plan adequate time that is devoted to coursework. Block your schedule and set aside plenty of time to complete assignments including extra time to handle any technology-related problems.
3. **Login regularly.** I recommend that you log in to ELMS-Canvas several times a week to view announcements, discussion posts and replies to your posts. You may need to log in multiple times a day when group submissions are due.
4. **Do not fall behind.** This class moves at a quick pace and each week builds on the previous content. If you feel you are starting to fall behind, check in with the instructor as soon as possible so we can troubleshoot together. It will be hard to keep up with the course content if you fall behind in the pre-work or post-work.
5. **Use ELMS-Canvas notification settings.** Pro tip! Canvas ELMS-Canvas can ensure you receive timely notifications in your email or via text. Be sure to enable announcements to be sent instantly or daily.
6. **Ask for help if needed.** If you need help with ELMS-Canvas or other technology, IT Support. If you are struggling with a course concept, reach out to me and your classmates for support.

Student Resources and Services

Taking personal responsibility for your learning means acknowledging when your performance does not match your goals and doing something about it. I hope that you will speak with me so that I can help you find the right approach to success in this course, and I encourage you to visit the [Counseling Center's Academic Resources](#) to

learn more about the wide range of resources available to you. Below are some additional resources and services commonly used by graduate students. For a more comprehensive list, please visit the Graduate School's [Campus Resources Page](#).

Accessibility and Disability Services

The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The [Accessibility & Disability Service \(ADS\)](#) provides reasonable accommodations to qualified individuals to provide equal access to services, programs, and activities. ADS cannot assist retroactively, so it is generally best to request accommodations several weeks before the semester begins or as soon as a disability becomes known. Any student who needs accommodations should contact me as soon as possible so that I have sufficient time to make arrangements.

For assistance in obtaining accommodation, contact Accessibility and Disability Service at 301-314-7682, or email them at adsfrontdesk@umd.edu. Information about [sharing your accommodations with instructors, note-taking assistance](#) and more is available from the [Counseling Center](#).

Writing Center

Everyone can use some help sharpening their communication skills (and improving their grade) by visiting [The Graduate School's Writing Center](#) and scheduling an appointment with them. Additionally, international graduate students may want to take advantage of the Graduate School's free [English Editing for International Graduate Students \(EEIGS\) program](#).

Health Services

The University offers a variety of physical and mental health services to students. If you are feeling ill or need non-emergency medical attention, please visit the [University Health Center](#).

If you feel it would be helpful to have someone to talk to, visit [UMD's Counseling Center](#) or [one of the many other mental health resources on campus](#).

Notice of Mandatory Reporting

Notice of mandatory reporting of sexual assault, sexual harassment, interpersonal violence, and stalking: As a faculty member, I am designated as a "Responsible University Employee," and I must report all disclosures of sexual assault, sexual harassment, interpersonal violence, and stalking to UMD's Title IX Coordinator per University Policy on Sexual Harassment and Other Sexual Misconduct.

If you wish to speak with someone confidentially, please contact one of UMD's confidential resources, such as [CARE to Stop Violence](#) (located on the Ground Floor of the Health Center) at 301-741-3442 or the [Counseling Center](#) (located at the Shoemaker Building) at 301-314-7651.

You may also seek assistance or supportive measures from UMD's Title IX Coordinator, Angela Nastase, by calling 301-405-1142 or emailing titleIXcoordinator@umd.edu.

To view further information on the above, please visit the [Office of Civil Rights and Sexual Misconduct's](https://ocrsm.umd.edu) website at ocrsm.umd.edu.

Basic Needs Security

If you have difficulty affording groceries or accessing sufficient food to eat every day, or lack a safe and stable place to live, please visit [UMD's Division of Student Affairs website](#) for information about resources the campus offers you and let me know if I can help in any way.

Veteran Resources

UMD provides some additional support to our student veterans. You can access those resources at the Office of [Veteran Student Life](#) and the [Counseling Center](#). Veterans and active duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, disabilities) are welcome and encouraged to communicate these, in advance if possible, to the instructor.