

Designing Extended-Reality (XR) Experiences

Thursday 9:00 AM - 11:45 AM, [MIX 232](#)

Instructor	<p>Instructor: Tejaswi Gowda, PhD</p> <p>Office Location: UGB 401B</p> <p>Email: tejaswi@asu.edu</p> <p>Telephone or Slack: 623-252-9347</p> <p>Office hours: <i>Thursday 11:45-12:30 and by appointment</i></p> <p>Preferred Contact Method: Email</p>
Course Description	<p>This advanced course explores the design and deployment of scalable, low-latency extended reality (XR) systems powered by edge and cloud computing technologies. Students will gain hands-on experience with cloud-native architectures, real-time data processing, and distributed systems that support immersive XR applications including augmented reality (AR), virtual reality (VR), and mixed reality (MR). Core topics include Infrastructure as a Service (IaaS), automation, edge inference, network optimization, and security in XR environments.</p> <p>In addition to technical foundations, the course emphasizes creative development of interactive XR experiences—from AR and VR games to advertising, installations, and media that integrate virtual objects into real-world environments. Through projects and case studies, students will design and prototype immersive, responsive XR systems that harness modern edge-cloud infrastructure while addressing both performance and user experience.</p>

	Designed for graduate students in engineering, computing, and media technologies, this course prepares participants with the technical expertise and creative skills needed to shape the future of interactive extended reality.
Enrollment Requirements	<i>Programming experience preferred. AME 220, AME 294 or equivalent.</i>
Course Objectives	To equip students with the foundational knowledge and practical skills needed to design, develop, and deploy XR systems, games, installations and media.
Student Learning Outcomes	<p>By the end of this course, students will be able to:</p> <ul style="list-style-type: none"> • Explain the principles of extended reality (XR), including AR, VR, and MR, and their role in emerging computing paradigms. • Analyze the requirements of low-latency, high-performance XR systems and the impact of network, edge, and cloud infrastructure on user experience. • Design and implement scalable XR applications using cloud-native architectures, containerization, and real-time data processing pipelines. • Deploy XR systems leveraging Infrastructure as a Service (IaaS), automation, and distributed edge-cloud environments. • Apply techniques for edge inference and network optimization to improve responsiveness of immersive XR environments. • Develop creative and interactive mixed-reality objects and environments for applications such as games, installations, and media experiences. • Collaborate effectively on projects that integrate both technical architectures and creative content design for XR. • Critically assess real-world XR case studies to connect theoretical concepts with industry practices. • Produce a final project that demonstrates an end-to-end extended reality experience, integrating technical scalability with engaging

	<p>user interaction.</p> <p>These objectives prepare students to tackle real-world challenges in XR development across domains such as entertainment, healthcare, smart cities, and remote collaboration.</p>
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Course Specifics

<p>List of Primary and Secondary Materials Needed</p>	<p>This course can be accessed by both my.asu.edu and myasucourses.asu.edu; bookmark both in the event that one site is down.</p> <p>Additional Requirements</p> <p>This course requires the following technologies</p> <ul style="list-style-type: none"> • Computer with Webcam, microphone, headset/earbuds, and speaker. • Web browsers (Chrome, Mozilla Firefox, or Safari) • Reliable broadband internet connection (DSL or cable). • Simple Text Editor (eg: TextMate on Mac, Notepad on Windows, VI on Unix) • GitHub account (Free account) • Minimal hardware requirement: Mac, Linux Box or Windows PC • AWS student access – provided • Other required software will be specified in class. <p>Classroom Technology</p> <p>It is encouraged that you bring technology (cell phones, tablets and laptops) to class to help you take notes and do research, however please turn off cell phone ringers and do not use your phone to make personal calls in class or use any technology to use social media in class. Do not answer your phone in class. If you believe you are receiving an emergency call, please step outside to take it.</p> <p>This course does not have a text-book. Appropriate reading material and tutorials will be assigned. Please follow along with the course on the class repo: https://github.com/tejaswigowda/game551-Fall2025</p> <p>You will need a simple Text Editor (eg: Atom on Mac, Notepad++ on Windows, VI on Unix) and a GitHub account (free account).</p>
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Assignments	All assignments will be turned in on GitHub. More details for each assignment will be introduced in class. There are 8 assignments in total and a final exam.																				
Grading	Assignments 1-6 are worth 10% of your grade and Assignments 7 and 8 are worth 20% of your grade. The final exam will be an opportunity for 10% extra credit. You will be given a one and a half hour task similar to one a prospective employer would give you to test your skill in coding. This brings the total amount of points in the class to 110 points and gives you the possibility of getting ten points extra credit.																				
Grade Scale	<p>This course uses +/- grading</p> <table border="1"> <tbody> <tr><td>98+</td><td>A+</td></tr> <tr><td>93-97</td><td>A</td></tr> <tr><td>90-92</td><td>A-</td></tr> <tr><td>88-89</td><td>B+</td></tr> <tr><td>83-87</td><td>B</td></tr> <tr><td>80-82</td><td>B-</td></tr> <tr><td>78-79</td><td>C+</td></tr> <tr><td>70-77</td><td>C</td></tr> <tr><td>60-69</td><td>D</td></tr> <tr><td>0-59</td><td>E</td></tr> </tbody> </table>	98+	A+	93-97	A	90-92	A-	88-89	B+	83-87	B	80-82	B-	78-79	C+	70-77	C	60-69	D	0-59	E
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Course Schedule

The instructor reserves the right to change portions of this syllabus (assignments, deadlines etc.) by verbal instructions during scheduled class time. The student is responsible for noting changes and acting accordingly. Grading and absence policies are not subject to change.

Date	Title	Topics Covered
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Week 1	Course Overview	<ul style="list-style-type: none"> • Fundamentals • Required Tech Stack • Basic Concepts
Week 2	Basic Concepts	<ul style="list-style-type: none"> • The Internet • Client Server Model • Programming Model • Networking basics
Week 3	Tech Stack	<ul style="list-style-type: none"> • Bash/zsh • Node.js • Browser Developer Tools • GIT (https://github.com) • Code Editor
Week 4	Cloud Computing Fundamentals	<ul style="list-style-type: none"> • Client-Server protocol • Front end design • Full stack • Cloud Storage
Week 5	IaaS providers with AWS as an example	<ul style="list-style-type: none"> • EC2/ Lightsail • Simple HTTP Server • Port management • Web sockets server
Week 6	3D environments	<ul style="list-style-type: none"> • Blender / Three.js • Game engines • XR frameworks
Week 7	3D basics	<ul style="list-style-type: none"> • Position tracking • Orientation tracking • Graphic Libraries/Engines

Week 8	Project proposals	
Week 9	Real time data processing and streaming	<ul style="list-style-type: none"> • Publish/subscribe protocols • Wearables • Streaming protocols
Week 10	Distributed Rendering and Compute Offloading	<ul style="list-style-type: none"> • Cloud Ops • Scaling and Automation • Digital Twins
Week 11	Edge Inference and AI Integration	<ul style="list-style-type: none"> • ML Ops • Edge/ Cloud co-design
Week 12	Case Studies and Industry Applications	
Week 13	Final Presentations	
Week 14	Peer Feedback	

Policies and Procedures

Almost everything in blue below must be included on your syllabus as written except for the three bullets below:

- you need to edit the first paragraph of the attendance policy,
- you may edit the AI policy
- The last row includes an **optional** inclusive excellence statement authored and updated by student leaders.

Other than these three, please include the exact language offered.

Attendance Policy

<The instructor's general policy AND university policy on absences due to religious observance and university sanctioned activities. (Your general absence policy, first paragraph, will vary from the below)>

Instructor Attendance and participation policy: For example, for the duration of the class period is mandatory. If you have more than 3 absences (unexcused), your final grade will be lowered 1/3 grade for each subsequent absence (i.e. B to B-). You should notify me by email prior to absence if possible and provide doctor's note where applicable. Repeated tardiness and leaving class early will be recorded, and as a result, your final grade will be lowered. It is the student's responsibility to keep track of their absences.

Excused absences related to religious observances/practices in accord with ACD 304-04, "Accommodation for Religious Practices." Students may be excused for the observance of religious holidays outlined at:

<https://eooss.asu.edu/cora/holidays>. Students should notify the instructor at the beginning of the semester about the need to be absent from class due to religious observances. Students will be responsible for materials covered during their absence and should consult with the instructor to arrange reasonable accommodation for missed exams or other required assignments.

Excused absences related to university sanctioned activities in accord with ACD 304-02, "Missed Classes Due to University-Sanctioned Activities." Students required to miss classes due to university sanctioned activities will not be counted absent. However, absence from class or

	<p>examinations due to university-sanctioned activities does not relieve students from responsibility for any part of the course work required during the period of the absence. Students should inform the instructor early in the semester of upcoming scheduled absences and immediately upon learning of unscheduled required class absences. Reasonable accommodation to make up missed exams or other required assignments will be made. Consult the instructor BEFORE the absence to arrange for this accommodation.</p> <p>Line-of-duty absence and missed assignment policy: A student who is a member of the National Guard, Reserve, or other U.S. Armed Forces branch who misses classes, assignments or examinations due to line-of-duty responsibilities shall have the opportunity to make up the coursework in accordance with SSM 201-18 Accommodating Active Duty Military Personnel. This accommodation also applies to spouses who are the guardian of minor children during line-of -duty activities. This policy does not excuse students from course responsibilities during their absence. Students should first notify the Pat Tillman Veterans Center of their activation and then the instructor to discuss options.</p>
Instructor Absence Policy	<p>Students should wait for an absent instructor 15 minutes in class sessions of 90 minutes or less, and 30 minutes for those lasting more than 90 minutes, unless directed otherwise by someone from the academic unit.</p>
Academic Integrity and Student Honor Code	<p>The ASU student honor code affirms the commitment of ASU to uphold the values, principles, and ethics of academic integrity. Every student is expected to produce their original, independent work. Any student whose work indicates a violation of the ASU Academic Integrity Policy including cheating, plagiarism, and dishonesty will be subject to disciplinary action. Arizona State University and the Herberger Institute for Design and the Arts expect the highest standards of academic integrity from all students. Failure to meet these standards may result in suspension or expulsion from the university or other sanctions as specified in the ASU Student Academic Integrity Policy (http://provost.asu.edu/academicintegrity).</p> <p>Should you have any question about whether or not something falls subject to this clause, feel free to contact me or review the university policy on academic integrity at the above link or review:</p>

	<p>https://tutorials.lib.asu.edu/tutorials/rise/academic-integrity/index.html#/. Per ASU policy, a student may not avoid the consequences of academic dishonesty by withdrawing from a course, and may be placed back in the course in order to face sanctions resulting from academic integrity violations. You are responsible for abiding by this policy.</p>
<p>Student Learning Community Conduct and HIDA Professionalism Standard</p>	<p>ASU's Student Code of Conduct emphasizes the importance of intellectual, personal, social, and ethical development. It promotes a respectful and open environment for discourse, encouraging self-discipline and respect for others. Students are expected to treat instructors and peers with kindness and respect differing viewpoints in all communications, avoiding criticism or ridicule. Given the lack of nonverbal cues in electronic communication, students should also be mindful of how humor may be interpreted. Additionally, students must be aware of their Rights and Responsibilities at ASU.</p> <p>Further, Herberger Institute students are expected to adhere to the Herberger Institute Professionalism standards. Professionalism entails a set of skills critical for workplace and creative successes, and professional behavior creates an atmosphere promoting safe and high-quality spaces for constructive learning as well as individual and community well-being. The institute expects students to show professional behavior with clients, members of the community, and others in the university environment (e.g., classrooms, clinics, labs, studios) including members of the faculty and administration, other students and staff. Students are expected to conduct themselves in a professional manner, including arriving on time with an open attitude to learning, engaging in ethical behavior, resolving conflicts in an appropriate manner at all times, holding partnership information confidential, and using prudence in written and verbal communications. Professionalism includes: self-control, respectful communication, following all university and studio safety protocols and behavioral expectations, attendance and punctuality, honesty and integrity.</p>
<p>Disruptive, Threatening, or Violent Behavior</p>	<p>In the classroom and out, students are required to conduct themselves in a manner that promotes an environment that is safe and conducive to learning and conducting other university-related business. All incidents and allegations of violent or threatening conduct by an ASU student will be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students. Such incidents will be dealt with in accordance with the policies and procedures</p>

	described in Section 104-02 of the Student Services Manual, available at https://public.powerdms.com/ASU/documents/1560490
Withdrawal	If you are unable to complete the course, it is your responsibility to arrange for withdrawal from the class. You will not be automatically withdrawn and unless you are officially withdrawn from the course you will receive a final grade based upon the total points you have earned for the semester. Students are required to pay all tuition and fees for any registered course unless enrollment is officially cancelled during the refund period. Please visit the Academic Calendar to review the withdrawal deadlines for this semester. For more information on Drop/Add and Withdrawal visit https://students.asu.edu/drop-add
Incomplete Policy	An incomplete is a limited academic exception—not a routine option—granted only when a student who is passing the course faces unexpected, serious circumstances beyond their control that prevent timely completion. It requires multiple stages of approval from academic leadership and is granted only for the minimum time needed to finish remaining work.
Special Accommodations	Your instructor is committed to making appropriate adjustments for any limitations caused by disabilities that have been documented with the Student Accessibility and Inclusive Learning Services (SAILS: https://eoss.asu.edu/drc). It is important to reach out to your instructor during office hours or by scheduling an appointment within the first week of class to discuss your accommodations and establish expectations. Please note that retroactive accommodations are seldom granted.
Title IX and Mandated Reporter Policy	Title IX is the federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. Anyone who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has

	<p>been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.</p> <p>As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish to discuss any concerns confidentially and privately.</p> <p>Arizona State University is committed to providing an environment free of discrimination, harassment, or retaliation for the entire university community, including all students, faculty members, staff employees, and guests. ASU expressly prohibits discrimination, harassment, and retaliation by employees, students, contractors, or agents of the university based on any protected status: race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, and genetic information.</p>
Copyright	<p>Students may not upload or share any content that isn't their original work without complying with copyright laws. Faculty may remove content suspected of infringement.</p> <p>Additionally, all course materials—including lectures, handouts, and notes—are copyrighted and may not be shared, uploaded, sold, or distributed. See ACD 304–06 for more on “Commercial Note Taking Services.”</p>
Artificial Intelligence Code of Conduct	<p>Arizona State University seeks to balance the promise of generative Artificial Intelligence (AI) tools to improve learning outcomes with the need for academic integrity, rigor and transparency.</p> <p>With that in mind, sample syllabi statements for three distinct approaches are provided at the link below: (1) generative AI use generally permitted without course restrictions; (2) generative AI use permitted under some circumstances; and (3) no generative AI use permitted.</p> <p>https://docs.google.com/document/d/1u9RGD8oU3e16XkdFNC6k8tgXlzYW2L7yZ2ELW5LfZqQ/edit?usp=sharing</p>

Optional Inclusive Excellence Statement

The Herberger Institute for Design and the Arts at Arizona State University upholds, values, and cherishes diversity among students and faculty—regardless of circumstance. As members of the ASU community, we have a profound responsibility to challenge injustice and inequity through education. These values are fundamental to our identity as an institution and should be upheld by all members of the ASU community, including—but not limited to—Herberger Institute students, faculty, and staff.

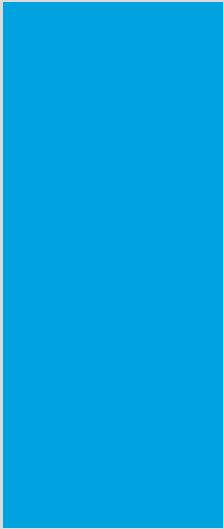
At ASU, the call is clear: each member of our community must contribute to fostering a culture of Inclusive Excellence that meaningfully advances equity for all and honors everyone's human and civic rights. For students, staff, and faculty alike, this culture cultivates role models, broadens perspectives, challenges negative stereotypes, and enables artists, designers, and makers of the 21st century to think creatively, critically, and—above all—compassionately about our collective impact on the world.

This course welcomes all students, regardless of race/ethnicity, gender identity, gender expression, sexual orientation, socioeconomic status, age, disability, religion, regional background, veteran status, citizenship status, nationality, politics or other aspects of identity that each person brings to class. We all carry perspectives shaped by our experiences and identities, and each of us contributes to our shared culture of Inclusive Excellence and community belonging.

As your instructor, I expect all students to honor the following community agreements:

- Bring a willingness to reflect deeply on your own assumptions, identifying areas where you may need to unlearn bias and exclusionary behaviors.
- Help others learn by respectfully voicing your thoughts and reactions, acknowledging that your perspective is shaped by your unique way of understanding the world. You can find further free speech resources at <https://eooss.asu.edu/resources/free-speech>.
- Engage with active listening, curiosity and openness when learning how others perceive and experience the world.

Diverse experiences, backgrounds, and viewpoints are essential to cultivating a rich academic and democratic environment. This diversity strengthens our ability to be ethical, empathetic, and imaginative thinkers. I aim for this course to

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serve students from all backgrounds equitably and to view the diversity you bring as a valuable resource and strength. Course materials—including readings and assignments—will reflect a commitment to diverse and inclusive knowledge.

If you feel that there is a discrepancy between my teaching practices and the university's commitment to Inclusive Excellence, I encourage you to speak with me directly or to Megan Cauthen. We welcome the opportunity to support your learning and to enhance the effectiveness of this course for all student groups.

Authored by HIDA student leaders in AY 2019/2020 and review and updated by student leaders in AY 24/25