

GGG 773-001 Interoperability of Geographic Information Systems

Instructors: Dr. Liping Di and Dr. Chen Zhang

Center for Spatial Information Science and Systems (CSISS)
and Department of Geography and Geoinformation Science
George Mason University
MSN 6E1

Office Address: Commerce I Building, 4087 University Drive, Suite 3100
Fairfax, VA 22030

Tel: 703-993-6114, E-mail: ldi@gmu.edu, czhang11@gmu.edu

Spring 2025 Semester

Office Hours: Friday 1-2 pm

Class: Friday 3:30 pm - 6:10 pm, Commerce I, Room 2006

Course Overview

GGG 773 is an advanced course designed for students who are interested in theory, standards, and implementation of Web-based interoperable geographic information systems for on-line data and information services. The course structure includes lectures for foundational knowledge, experiments for hands-on application, and classroom discussions to encourage critical thinking and collaborative learning.

Learning Outcomes

By the end of this course, students will:

- Have a thorough understanding of concepts, terms, and techniques of interoperable GIS.
- Be familiar with the format and standards of geospatial data used in web-based GIS.
- Gain hands-on skills and knowledge through tutorials and experiments.
- Be aware of some limitations and potential improvements of current GIS, develop critical thinking and new research questions.

Prerequisite

Students registered to this class should have some knowledge of Geographic Information Systems and geospatial data. Prefer to have taken either GGS 553 or GGS 754.

Textbook and References

Textbook: Not specified

Standards and interoperability specifications (the instructors will also provide some ISO standards, which are not available through the ISO website, for reviews and discussions):

- Federal Geographic Data Committee (FGDC): <http://www.fgdc.gov>
- International Organization for Standardization (ISO) TC 211: <http://www.isotc211.org>, <https://www.iso.org/committee/54904.html>
- Open Geospatial Consortium (OGC): <http://www.opengeospatial.org>

Course Work and Grading

Presentation and classroom discussions (25%): Each student is required to review and present a standard or specification.

Mid-term exam (25%): The examination will be based on materials covered in the lectures, including multiple choice questions, definitions, and short answer questions.

Semester paper (50%): Each student is required to turn in a semester paper of their selected topics related to GIS interoperability and standards.

Syllabus

Week 1 (1/24/2025): Introduction

- About the course
- What is GIS
- Types and examples of GIS data
- Needs and definition of GIS interoperability

Week 2 (1/31/2025): Geographic Information Standards

- How to make the geographic information interoperable (the roles of standards)
- Types of geographic information standards, their definitions, and roles
- Major players in defining federal, national, and international standards on geographic information
- Relationships among the standards defined by different players

Week 3 (2/7/2025): OGC Standards

- Introduction to Open Geospatial Consortium, its organization, roles, and activities
- OGC SP and IP programs; OGC Abstract Specifications on geographic information
- OGC Implementation Specifications
- The relationships between geographic information standards
- The relationship between ISO standards and OGC specifications

Week 4 (2/14/2025): ISO and FGDC Standards

- Introduction to Federal Geographic Data Committee and its roles and standards
- Information on US national GIS standards
- InterNational Committee on Information Technology Standards (INCITS) Technical Committee L1 and their roles
- The ISO TC 211 organization
- The ISO 191XX series of standards

Week 5 (2/21/2025): OGC Web Services

- OGC Web Map Service Specification (WMS)
- OGC Web Coverage Service Specification (WCS)
- OGC Web Feature Service Specification (WFS)
- OGC Web Processing Service (WPS)
- OGC Catalog Service for Web (CSW)

- OGC APIs

Week 6 (2/28/2025): Experiment 1 - Interoperable Map Services

- Using WMS/WCS with QGIS/ArcGIS
- Map service implementation with MapServer and Apache Web Server

Week 7 (3/7/2025): UML and Metadata

- Introduction to Unified Modeling Language (UML)
- What is metadata?
- The FGDC Content Standard for Digital Geospatial Metadata
- The FGDC Remote Sensing Metadata Extensions
- The ISO 19115-1, ISO 19115-2, and ISO 19115-3 Geographic Information—Metadata
- The ANSI adoption processes of ISO metadata standards
- Assign standards and specifications to students for review

Week 8 (3/14/2025): Spring Break

Week 9 (3/21/2025): Mid-term Exam

Week 10 (3/28/2025): Interoperable Geospatial Data Services

- Web-based interoperable Geographic Information Services
- Big data and geospatial cloud
- Implementation considerations of the geographic information standards
- CropScape, VegScape, Crop-CASMA, iCrop

Week 11 (4/4/2025): Experiment 2 - Interoperable Geoprocessing Services

- Using WPS in web application
- Implementing geoprocessing service with PyWPS

Week 12 (4/11/2025): Student Presentation

Week 13 (4/18/2025): Recent Progress and Research

- OGC Testbed
- OGC Disaster Resilience Pilot
- NSF Convergence Accelerator - CropSmart Digital Twin
- Progress on final project by students

Week 14 (4/25/2025): Invited Talk

- Interoperable GIS for selected topics in agro-geoinformatics (Guest lecturer: TBD).

Week 15 (5/2/2025): Discussion and Student Presentation

- Where are the interoperability technologies heading (classroom discussions).
- Student presentation for the semester paper

(The last day to turn in the semester paper: 5/9/2025)

Student Expectations:

Academic Integrity Students must be responsible for their own work, and students and faculty must take on the responsibility of dealing explicitly with violations. The tenet must be a foundation of our university culture. [See <http://academicintegrity.gmu.edu/distance>].

Honor Code Students must adhere to the guidelines of the George Mason University Honor Code [See <http://oai.gmu.edu/honor-code/masons-honor-code/>].

MasonLive/Email (GMU Email) Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account. [See <https://thanatos.gmu.edu/masonlive/login>].

Patriot Pass Once you sign up for your Patriot Pass, your passwords will be synchronized, and you will use your Patriot Pass username and password to log in to the following systems: Blackboard, University Libraries, MasonLive, myMason, Patriot Web, Virtual Computing Lab, and WEMS. [See <https://thanatos.gmu.edu/passwordchange/index.jsp>].

University Policies Students must follow the university policies. [See <http://universitypolicy.gmu.edu> <https://stearnscenter.gmu.edu/home/gmu-common-course-policies/>].

Responsible Use of Computing Students must follow the university policy for Responsible Use of Computing. [See <http://universitypolicy.gmu.edu/1301gen.html>].

University Calendar Students must follow the university policies. [See <http://catalog.gmu.edu>].

Students with Disabilities Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester [See <http://ods.gmu.edu>].

Religious Holidays

A list of religious holidays is available on the University Life Calendar page (<http://ulife.gmu.edu/calendar/religious-holiday-calendar/>). Any student whose religious observance conflicts with a scheduled course activity must contact the Instructor at least 2 weeks in advance of the conflict date in order to make alternative arrangements.

Students are expected to follow courteous Internet etiquette.

Student Services:

University Libraries University Libraries provides resources for distance students. [See <http://library.gmu.edu/distance>].

Writing Center The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing. [See <http://writingcenter.gmu.edu>]. You can now sign up for an Online Writing Lab (OWL) session just like you sign up for a face-to-face session in the

Writing Center, which means YOU set the date and time of the appointment! Learn more about the Online Writing Lab (OWL) (found under Online Tutoring).

Counseling and Psychological Services The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See <http://caps.gmu.edu>].

Family Educational Rights and Privacy Act (FERPA) The Family Educational Rights and Privacy Act of 1974 (FERPA), also known as the "Buckley Amendment," is a federal law that gives protection to student educational records and provides students with certain rights. [See <http://registrar.gmu.edu/privacy>].