AS.430 (GEOGRAPHIC INFORMATION SYSTEMS)

AS.430.600. Web GIS. 4 Credits.
Web GIS is an important foundation course in which students will become familiar with the current platforms available for delivering Web GIS and sharing geographic content over the web. Professionals in various industries often have to make information readily available and with current developments this has become easier than ever. The class offers a fundamental understanding of creating and designing web maps and web apps using various approaches and platforms. Capabilities such as editing, geoprocessing, geocoding, image analysis, 3D, mobile and real-time GIS in a web environment will be examined. Cloud-based and on premises infrastructure to deliver Web GIS will be utilized. Offered twice a year.

AS.430.601. Geographic Information Systems (GIS). 4 Credits.
In this introductory course, students become familiar with the concepts and gain the experience necessary to appreciate the utility of Geographic Information Systems in decision-making. Topics covered include the fundamentals of data structures, georeferencing, data classification, querying, cartography, and basic spatial data analysis. The course provides an overview of the capabilities of GIS software and applications of GIS. Class time is divided between lectures and GIS exercises that reinforce critical concepts. Students must complete a term project as part of the course. Offered every semester. Elective option for Govt. Analytics students.

AS.430.602. Remote Sensing: Systems and Applications. 4 Credits.
This course introduces remote sensing as an important technology to further our understanding of Earth's land, atmospheric, and oceanic processes. Students study remote sensing science, techniques, and satellite technologies to become familiar with the types of information that can be obtained and how this information can be applied in the natural and social sciences. Applications include assessment of land cover and land use, mapping and analysis of natural resources, weather and climate studies, pollution detection and monitoring, disaster monitoring, and identification of oceanographic features. Offered once a year in Spring.

AS.430.603. Geospatial Statistics. 4 Credits.
This course introduces theory and practical application of statistical methods in spatial analysis. Statistical fundamentals will be introduced to expose students to descriptive and inferential methods in spatial statistics. Geostatistical fundamentals will also be covered to introduce methods (in particular, kriging) for modelling spatial and spatio-temporal phenomena. This course will provide working knowledge of theory and practice in spatial statistics and Geostatistics, and will serve as a primer to more advanced courses in spatial statistics and machine learning. Theoretical knowledge will be supplemented with real-world use cases through in-class projects and assignments. Throughout the course, students will be exposed to open-source statistics libraries in R, no previous programming knowledge will be assumed. Offered twice a year.

AS.430.604. Spatial Analytics. 4 Credits.
This course introduces students to using various techniques for solving spatial problems. The course teaches a proven process one can utilize to address common inquiries related to understanding spatial relationships and patterns. Traditional analytical methods such as suitability analysis, network analysis, geostatistical analysis, spatial interpolation, etc. are examined, along with recent data science and analytics methodologies that help us extract knowledge and insights from data. Examples and assignments are drawn from many applications, such as business, urban planning, public safety, public health, transportation and natural sciences. Offered twice a year. Elective option for Govt. Analytics students.

AS.430.605. Development and Management of GIS Projects. 4 Credits.
This course introduces students to project, program, and portfolio management standards, which will guide them on how to successfully manage GIS projects. Students will learn how to apply core project management principles and guidelines to real project scenarios. The course will impart knowledge and skills for managing GIS projects throughout their entire lifecycle, while addressing technical, ethical, and institutional problems. Students will explore key issues in organizational management, including earned-value management, resource planning, and communications. During the course, students will learn how to determine the return on investment of a GIS project, create a comprehensive schedule and budget, and determine risk management, quality control, and contract management skills in support of your GIS project. Offered once a year.

AS.430.606. Programming in GIS. 4 Credits.
In this course students will learn how to automate workflows and develop tools using Python as a fundamental language for geospatial technology. The course will first cover introductory python basics, then move into geospatial concepts. It will teach students how to automate simple and complex GIS tasks and functionality, thus simplifying workflows and increasing efficiency. Focus will be placed on following proper coding techniques and patterns. The course will introduce students to Python, ArcPy, Python API, Pandas, Numpy, Jupyter, and Markdown to name a few. Offered twice a year. Prerequisites: 430.600 Web GIS
Prerequisite(s): You must enroll in AS.430.600 prior to enrolling in AS.430.606.

AS.430.607. Spatial Databases and Data Interoperability. 4 Credits.
A well-designed database is necessary to construct relevant spatial data queries. In this course, students learn the different database designs for stand-alone databases and enterprise database systems. This course examines the requirements for a GIS Decision Support System by focusing on the design of the data schema, identifying the necessary data elements and their formats, and exploring data interoperability as a designed constituent of a database. Data management routines for maintaining the spatial integrity will also be introduced. Offered once a year. Prerequisites: 430.600 Web GIS.
Prerequisite(s): You must enroll in AS.430.600 before you enroll in AS.430.607.

AS.430.608. GIS and Spatial Decision Support Systems. 4 Credits.
GIS can be a very effective tool to assist in making decisions for a wide range of applications at the local, regional, and global scale. This course will examine the use of GIS as a spatial decision support system for systematic policy analysis and scenario modeling. Case studies will be used from the areas of agriculture, conservation planning, homeland security, land use planning, natural disasters, transportation, urban planning, and water resources. Offered once. a year. Prerequisites: 430.601 Geographic Information Systems, 430.604 Spatial Analysis with GIS.
Prerequisite(s): You must enroll in AS.430.601 AND AS.430.604 before enrolling in AS.430.608.

AS.430.609. Spatial Data Management: Quality and Control. 4 Credits.
Spatial data quality is a major concern for any GIS. This course examines the nature of errors in spatial data and various aspects of spatial data quality, including positional and thematic accuracy, resolution, precision, completeness and logical consistency. The impacts of errors on the reliability of GIS-based analysis are explored. Various strategies to improve the quality of spatial data are addressed, including the use of standards for spatial data (FGDC, OGC and ISO) and data management tools. Offered once a year. Prerequisite: 430.601 Geographic Information Systems,
Prerequisite(s): You must enroll in AS.430.601 before you can enroll in AS.430.609.

AS.430.610. GIS for Infrastructure Management. 4 Credits.
This course will familiarize students with applications of Geographic Information Systems (GIS) for infrastructure management. Building, utilizing and sharing reliable asset information and integrating enterprise data will be emphasized, in order to help stakeholders make informed decisions and capitalize on efficiencies of using GIS to support various kinds of facilities and infrastructure. Students will have the opportunity to use GIS applications to do project work in support of facility operations, strategic planning, real estate management, architecture design and construction, sustainability, utilities, buildings and interior space management, drones mapping, among others. Samples will be drawn from large university enterprise with multiple campus locations yet applicable to cities and various other settings. Research and spatial analysis will be conducted using recently acquired GIS orthoimagery, LIDAR and planimetric data for the Johns Hopkins' own Homewood campus. Prerequisite: 430.601 Geographic Information Systems.
Prerequisite(s): You must enroll in AS.430.601 before you can enroll in AS.430.610.

AS.430.611. Geospatial Ontologies and Semantics. 4 Credits.
The development of very large databases requires innovative approaches to data handling to efficiently communicate information meaning to users. The Geospatial Semantics and Ontologies course examines the foundations, design, and use of data structured as linked data, geospatial ontology, knowledge graphs, and related technology. Linked data and knowledge graphs are based on the node-edge-node triple data model to form graphs that can represent information networks. Triple graphs formatted as Resource Description Framework (RDF) can address challenges associated with information management such as inconsistencies within GIS applications, data associations within related enterprises, and information exchange over the Internet. The course begins with some general approaches to semantics and ontology, and basics of information interchange on the Internet. Linked Data in the form of Extensible Markup Language (XML), its extension Geography Markup Language (GML), and other standards for formal semantics such as Well Known Text (WKT) for specifying geographic coordinate geometries, SPARQL and GeoSPARQL query language, and Web Ontology Language (OWL) for automated logical reasoning and data inference are discussed. Subsequent lessons examine semantic system architecture, ontology design, and linked data mapping. No programming is required, but some required technical literacies, such as Java Script Object Notation (JSON) and Scalable Vector Graphics (SVG), are reviewed. Students complete a project in the last few weeks of the semester. The introductory skills offered in this course build a foundation for advanced geospatial Linked Data and Knowledge Graph applications in the future. Offered once a year. Prerequisite: 430.600 Web GIS
Prerequisite(s): You must enroll in AS.430.601 before you can enroll in AS.430.611.

AS.430.612. Cartographic Design and Visualization. 4 Credits.
The Cartographic Design and Visualization course focuses on the fundamentals of cartography, spatial statistics, thematic mapping techniques, 3D mapping, and web based mapping. Students will gain an inter-disciplinary understanding of cartographic representation and visualization with hands on applications using cutting edge GIS and graphic design software to create purpose tailored maps. Upon successful completion of this course, students will be able to interpret and appropriately communicate spatial data; will have developed a personalized cartographic style; will have created a professional GIS portfolio for current/potential employers; and most importantly will have developed a keen appreciation for maps and spatial awareness!Offered once a year. Prerequisite: 430.601 Geographic Information Systems.
Prerequisite(s): You must enroll in AS.430.601 before you can enroll in AS.430.612.

AS.430.613. Advanced Topics in Remote Sensing. 4 Credits.
This course explores the various remote sensing platforms, collection systems, processing methods, and classification approaches to remotely sensed data. Course content includes the Electromagnetic Spectrum, Lidar, Interferometric SAR, Sonar, Unmanned Autonomous Vehicles (drone technology), 2D vs. 3D modeling, volumetric analysis, ecological research with remote sensing and applications of technology and datasets in GIS models. Offered once a year. Prerequisite: 430.602 Remote Sensing: Systems and Applications.
Prerequisite(s): You must enroll in AS.430.601 AND AS.430.602 before you can enroll in AS.430.612.

AS.430.615. Big Data Analytics: Tools and Techniques. 4 Credits.
The explosion of data collection methods from a vast array of data sources in volumes previously unimaginable has tested the limits of traditional technology, which are not able to scale to the requirements of massive data. Big Data is the field of data studies where the data is identified by very large volumes, high velocity in data generation, and data format variety. This course explores Big Data technologies while utilizing cloud infrastructures. We will discuss the characteristics and architectural challenges surrounding Big Data, and explore geo-visualization techniques of data processed using Big Data Analytics. Students will work in a cloud computing environment to build Hadoop clusters, NoSQL databases, and work with other open source technologies to process data stores like Census data, and twitter feeds. Offered twice a year. Prerequisites: 430.606 Programming in GIS. Python programming experience is highly recommended.
Prerequisite(s): You must enroll in AS.430.600 and AS.430.606 before you can enroll in AS.430.615.

AS.430.617. Census Data Mining: Visualization and Analytics. 4 Credits.
Census data is the most often used data in geospatial studies. Census data provide information on the demographic composition of households all the way through state and national population trends. Census data also serve the data layers that form the basis of most mapping applications. In this course, students will learn how to work with Census data in GIS by understanding the vast amounts of data collected in support of the decadal Census, how to discover and read the various tables that associate with the raw Census data, and how to create custom data layers for demographic models in economics, housing, and population studies. Offered once a year. Prerequisite: 430.601 Geographic Information Systems, or permission of the instructor.
Prerequisite(s): You must enroll in AS.430.601 before you can enroll in AS.430.617.

AS.430.618. Advanced Python Scripting for GIS. 4 Credits.
This course focuses on advanced uses of Python as a scripting tool to automate workflows in GIS and create customized applications. This includes the development of script tools, utilizing advanced ArcPy modules, working with third-party modules, implementing Python geoprocessing services, customizing GIS applications, and more advanced Python functionality. Offered once a year. Prerequisites: 430.606 Programming in GIS.
Prerequisite(s): You must enroll in AS.430.606 before you can enroll in AS.430.618.

AS.430.619. Web Application Development. 4 Credits.
This course is designed to provide students with experience in web programming and application development. It focuses on uses of Web APIs for developing rich and interactive web mapping applications. HTML, CSS and several popular JavaScript frameworks, such as Dojo, JQuery and AngularJS, will be covered. Interchange languages (JSON, XML) and responsive design will also be explored. Widgets will be examined to quickly develop solutions, and emphasis will be placed on tasks which provide further functionality. Conceptual and technical documentation, and samples, will be greatly utilized. The course will facilitate heavy engagement with the large and growing community of Web API developers. Offered once a year. Prerequisite: 430.600 Web GIS

AS.430.621. GIS for Emergency Management. 4 Credits.
Geographic Information Systems (GIS) have become an integral part of understanding the natural hazards in our world and how emergency management agencies respond to events and mitigate the impact of disasters. Furthermore, the advent of Web GIS has helped agencies overcome many challenges previously associated with GIS in Emergency Management. This course is an opportunity to learn about the use of GIS in studying natural hazards and apply cutting edge GIS technology to help emergency management agencies in the field. In today's device-driven world, maps need to work on mobile devices so there will be an emphasis on enabling GIS in the field. You will use Web GIS to deploy maps that assist agencies with their incident command functions: Planning, Operations, Logistics, Command, and Public Information. While the industry focus will be on Emergency Management, the knowledge, skills and abilities you develop will be widely applicable in both public and private sector industries.Offered once a year. Prerequisite: 430.601 Geographic Information Systems or permission of the instructor.

AS.430.623. Geo Apps. 4 Credits.
The Geo Apps course is designed to reflect current developments in the GIS industry. The course will teach you to extend your reach beyond common desktop GIS workflows, allowing you to present information and tools to a broader audience. You will learn how to create information models for field and crowdsource data collection apps, best practices for publishing geospatial information and configuring a range of web and native applications, and how to create meaningful information products that match specific user needs. You will work with different types of 2D and 3D data in desktop, web, and mobile geo apps to simulate how GIS is being used in modern organizations. Offered once a year. Prerequisite: 430.601 Geographic Information Systems, or permission of the instructor.

AS.430.625. System Architecture for Enterprise GIS. 4 Credits.
This is a project-based course, which allows students to build an Enterprise GIS implementation. Various enterprise architecture components, such as portals, servers, data stores, web adaptors, load balancers, enterprise databases and big data stores, real time servers, geoanalytics servers, etc. will be examined and implemented in a deployment scenario. Students will first design the enterprise architecture, then implement it. Students will have multiple Amazon EC2 instances configuration available to them at least for part of the semester, in order to practice setting up this enterprise implementation. Topics such as high availability and disaster recovery, enterprise authentication, and administration through scripting, will be applied. Offered once a year. Prerequisites: 430.600 Web GIS.

AS.430.627. Artificial Intelligence and Machine Learning in Geospatial Technology. 4 Credits.
The transformational impact of artificial intelligence and machine learning in geospatial data science is profound. This course presents a hands-on approach of applying automated modeling and predictive analytics to solve problems. Smart capabilities are powered by machine learning and GeoAI through the use of correlations of pattern detection to build predictive models and classify outcomes for data never seen before. Use cases from various sectors focusing on prediction and optimization, finding patterns and correlations, advanced object detection and automatic feature extraction, are examined. Offered once a year. Prerequisites: 430.606 Programming in GIS. Python programming experience is required.

AS.430.629. Drones in Geospatial Decision Making. 4 Credits.
This compressed format field course will explore current and future techniques of close-range remote sensing utilizing unmanned aerial vehicles (UAVs or drones) for environmental monitoring, urban cybersensing, and infrastructure assessment related to emergency response, leading to FAA Remote Pilot Certification to operate UAVs for commercial, professional, and research purposes. The course will focus on four basic objectives: (1) demonstrating knowledge and operational skills to successfully execute data acquisition using a variety of UAV remote sensing collection devices; (2) applying different methods of data acquisition and processing to identify, cross-validate and interpret data collected from UAV sensors; (3) discussing existing and emerging trends of UAV applications in various academic and professional situations, and (4) synthesizing and extrapolating data from these novel collection techniques to solve real-world problems. Students will act as flight crewmembers and scientific crew on numerous daily missions during the field portion of the course. Prerequisite: 430.600 Web GIS, or 420.603 Environmental Applications of GIS, or introductory GIS course.

AS.430.631. Spatial Algorithms and Data Structures. 4 Credits.
This course will teach students about the fundamental data structures and algorithms behind GIS and computer science. These data structures and algorithms are what all complex GIS systems are built upon. The topics presented are a mixture of computer science data structures and computational geometry topics. This course will stress code optimization and runtime analysis of code, teaching students how to program efficiently – just because a set of code works, it does not mean it is optimal. The course will use Python to cover such fundamental concepts and help students become better GIS Professionals. Offered once a year.

AS.430.633. Advanced Spatio-Temporal Statistics. 4 Credits.
This course will examine the theory and practical application of statistical methods. Students will examine advanced concepts in descriptive and predictive statistical approaches to spatial, temporal and spatio-temporal data. Students will be exposed to time-series analysis in GIS and its applications. The course will include labs to be completed in Python and R, in addition to theoretical work. Students will work on a comprehensive final project. Offered once a year. Prerequisites: 430.601 Geographic Information Systems

AS.430.800. Capstone for Geographic Information Systems. 4 Credits.
The capstone is the culmination of the instruction and training a student receives in the MS in GIS program. In this course, the student selects a mentor, identifies a topic of interest, acquires the relevant data required for the study, develops a data model and/or analysis method, devises the visualization of the data as part of the data interpretation, and summarizes the study in a final report. Students are encouraged to make their presentations at a GIS conference or publish the results of their study in a peer-reviewed GIS publication. Students are responsible for selecting a mentor who may be a JHU faculty member, a qualified and appropriate person from the student's place of work, or any expert with appropriate credentials. Offered every semester. Prerequisite: core course requirements for MS in GIS, at least eight courses taken in the program.