

Current Topics in the UCGIS Geographic Information Science & Technology Body of Knowledge

Foundational Concepts (FC)		Computing Platforms (CP)	
Origins	Basic Measures	Computing Infrastructures	Software Systems
<p><i>Intro to the GIS&T BoK</i></p> <p>Academic developments</p>	<p>Shape</p> <p>Areal Operations</p> <p>Directional Operations</p> <p>Distance Operations</p> <p><i>First & Second Laws of Geography</i></p> <p>Proximity and Distance Decay</p> <p>Adjacency and Connectivity</p> <p>Resolution</p> <p>Geometric Primitives & Algorithms</p> <p>Spatial Autocorrelation</p>	<p>Graphics Processing Units (GPUs)</p> <p>Cyberinfrastructure</p> <p>Spatial Cloud Computing</p> <p>Mobile Devices</p> <p>e-Science, Evolution of Science</p>	<p>Spatial Database Mgmt Systems</p> <p>Artificial Intelligence Tools & Platforms</p> <p>Geospatial Technology Transfer</p> <p>Web GIS</p> <p>Enterprise GIS</p>
<p>Cognitive</p> <p>The Power of Maps and Mapping</p> <p>Place and Landscape</p> <p><i>Foundation, Domain, and Task Ontologies</i></p> <p>Perceptions & Cognitive Processing</p> <p>Semantic Information Elicitation</p>	<p>Interrogating Geog Info</p> <p>Set Theory</p> <p>SQL & Attribute Queries</p> <p>Spatial Queries</p>	<p>Computing Approaches</p> <p>Origins: Computer Systems</p> <p>Origins: Peripheral Devices</p> <p><i>High Throughput Computing and GIS</i></p> <p><i>High Performance Computing and GIS</i></p> <p>Science Gateways</p>	<p>Examples & Applications</p> <p>Google Earth Engine</p> <p>ArcGIS Online</p> <p>GIS&T and Computational Notebooks</p> <p><i>Apache Hadoop and Spark</i></p> <p><i>OSGeo Live</i></p>
<p>Philosophical</p> <p>Openness</p> <p>Epistemology</p> <p>Philosophical Perspectives</p>	<p>Domains of Geographic Info</p> <p>Space</p> <p>Time</p> <p>Space-Time Relationships</p> <p>GIS Data Properties</p> <p>Networks</p> <p>Neighborhoods</p> <p>Epistemology</p>	<p>Social Media & Location Services</p> <p>Location-based Services</p> <p>Social Media Analytics</p> <p>Social Networks</p> <p><i>GIS and the Internet of Things</i></p> <p><i>GIS and Web Services</i></p>	<p>Programming & Development (PD)</p> <p>Algorithm Design & Approaches</p> <p>Real Time Prgrmmg & Geocomputation</p> <p>Natural Language Processing in GIS</p> <p>Machine Learning Programming for GIS</p> <p>Linear Programming and GIS</p> <p>GIS and Parallel Programming</p>
<p>Knowledge Economy (KE)</p> <p>GIS&T Workforce</p> <p>GIS&T Workforce Development</p> <p>Competence in GIS&T Knowledge Work</p> <p>GIS&T Positions and Qualifications</p> <p>GIS&T Education & Training</p> <p>Professional Certification</p>	<p>Coordinating Organizations</p> <p>Value of Geospatial Professional Orgs.</p> <p><i>Regional GIS Coordination & Collaboration</i></p> <p>Multi-Organizational GIS Coordination</p> <p>Publications and Conferences</p> <p>The Geospatial Community</p> <p>The Geospatial Industry</p>	<p>Languagues & Libraries</p> <p>Python for GIS</p> <p>PySal and Spatial Statistics Libraries</p> <p>R for Geospatial Analysis & Mapping</p> <p>Javascript for GIS</p> <p>SQL Languages for GIS</p> <p>GDAL/OGR and IO Libraries</p>	<p>Application Development</p> <p>Design, Develop, Test, Deploy</p> <p><i>Verification & Validation of GIS Apps</i></p> <p>Commercialization of GIS Apps</p> <p><i>Licensing of GIS Apps</i></p> <p>Open Source Software Development</p> <p>Platform-Specific Programming</p> <p>GIS and GPU Programming</p> <p>Programming of Mobile GIS Apps</p> <p>Web GIS Programming</p>
<p>Design & Implementation</p> <p>Strategic Planning for GIS Design</p> <p>Project Planning & Management</p> <p>Measuring GIS ROI</p> <p>GIS Enterprise Costs</p> <p>Managing Infrastructure & Operations</p>	<p>GIS Operations</p> <p>Systems Modeling for Mngmt</p> <p>Organizational Models for GIS Mngmt</p>	<p>Development Tools</p> <p>Visual Programming for GIS Apps</p> <p>SpatialMPI for GIS Apps</p> <p>GIS APIs</p>	<p>GIS&T and Society (GS)</p> <p>Law, Regulation, and Policy</p> <p><i>The Legal Regime</i></p> <p>Location Privacy</p> <p>the Geospatial Information Market</p> <p>GIS&T for Equity and Social Justice</p>
<p>History & Trends</p> <p>Changes Over Time Part 1: Tech Dev</p> <p>Changes Part 2: Implications & Cases</p> <p>Georeferencing & Georectification</p>	<p>Remote Sensing Platforms/Sensors</p> <p>Remote Sensing Platforms Overview</p> <p>Nature of Multispectral Images</p> <p>Unmanned Aerial Systems</p> <p>Landsat</p> <p>Light Detection & Ranging (LiDAR) Basics</p> <p><i>Hyperspectral Imagery</i></p> <p><i>Multispectral Imagery</i></p> <p><i>Airborne LiDAR Bathymetry</i></p> <p><i>Acoustic Imaging of the Ocean</i></p>	<p>Critical Perspectives</p> <p>Epistemological Critiques</p> <p>GIS and Critical Ethics</p> <p>Feminist Critiques of GIS</p> <p>Balancing Data Access, Security, Privacy</p>	<p>Governance & Agency</p> <p><i>Public Participation GIS</i></p> <p>Professional & Practical Ethics of GIS&T</p> <p>Codes of Ethics for GIS Professionals</p> <p>Aggregation & Redistricting</p> <p>GIS&T and Citizen Science</p> <p>GIS&T and Spatial Decision Support</p> <p>Maps/Spatial Justice & Marginal Societies</p> <p>GIS&T and Community Engagement</p> <p>Geospatial Participatory Modeling</p>
<p>Software & Data Coordinating Orgs.</p> <p>National Organizations & Programs</p> <p>International Organizations & Programs</p>	<p>Processing Remotely-Sensed Data</p> <p>Fundamentals of Aerial Photo Interpret.</p> <p><i>Feature Extraction in Satellite Imagery</i></p> <p>Structure from Motion Photogrammetry</p> <p>Ground Verification & Accuracy</p> <p><i>Spectral Properties of Earth's Surface</i></p>	<p>Domain Applications (DA)</p> <p>Disaster Management</p> <p><i>Economic Development</i></p> <p><i>Ecosystem Science & Management</i></p> <p>Education & Training</p> <p><i>Energy Development</i></p> <p><i>Environmental Science & Management</i></p> <p>Epidemiology</p> <p><i>Facilities Management</i></p> <p>Forestry</p> <p>Geodesign</p> <p><i>Humanitarian Mapping</i></p> <p><i>Insurance</i></p>	<p>Landscape Ecology</p> <p>Libraries, Archives, and Museums</p> <p>Local Government</p> <p>Marine Science</p> <p>Marketing</p> <p>Natural Resource Management</p> <p><i>Politics</i></p> <p>Public Health</p> <p>Public Policy</p>
<p>Data Sources & Capture Methods</p> <p>Historical Paper Maps</p> <p>Global Navigation Satellite Systems</p> <p>Aerial Photos: History & Georeferencing</p> <p>Street-Level Imagery</p> <p>Social Media Platforms</p> <p>Mobile Applications & Technologies</p> <p><i>Texts</i></p> <p>Volunteered Geographic Info (VGI)</p> <p>Time-of-Arrival Localization</p>	<p>GIS and Surveying</p> <p>Professional Land Surveying</p> <p><i>Land Records</i></p> <p><i>Ocean Surveying</i></p>	<p>Intelligence & National Security</p> <p><i>Insurance</i></p> <p>International Affairs</p> <p><i>Land Administration</i></p> <p><i>Landscape Architecture</i></p>	<p>Domains continued below</p>
<p>Domain Applications (DA)</p> <p>Agriculture</p> <p><i>Climate Studies & Atmos. Science</i></p> <p>Archaeology</p> <p><i>Architecture</i></p> <p>Business</p> <p>Civil Engineering</p>	<p>Computational Geography</p> <p><i>Conservation</i></p> <p>Criminal Justice / Law Enforcement</p> <p>Digital Humanities</p>	<p>GIS&T Body of Knowledge</p> <p>5/24/2024</p> <p>bold = revised & expanded</p> <p>regular = original & still limited</p> <p><i>italics</i> = future or forthcoming</p> <p>https://gistbok.ucgis.org</p>	

Current Topics in the UCGIS Geographic Information Science & Technology Body of Knowledge

Data Management (DM)

<p><u>Spatial Databases</u></p> <p>Spatial Database Mngmnt Systems</p> <p> Relational DBMS and Extensions</p> <p> Geodatabases</p> <p> Topological Relationships</p> <p>Database Administration</p> <p> Conceptual Data Models</p> <p> Logical Data Models</p> <p> Physical Data Models</p> <p> Array Databases</p> <p> NoSQL databases</p> <p>Problems with Large Spatial Databases</p> <p> Geospatial Knowledge Graphs</p>	<p><u>Query Processing</u></p> <p> Optimal Geospatial I/O Algorithms</p> <p> Spatial Joins</p> <p> Defining and Designing Spatial Queries</p> <p> Complex Queries</p> <p><u>Georeferencing Systems</u></p> <p> Linear Referencing</p> <p> Earth's Shape, Sea Level, Geoid</p> <p> Geographic Coordinate Systems</p> <p> Planar Coordinate System & National Grids</p> <p> Vertical (Geopotential) Datums</p> <p> Horizontal (Geometric) Datums</p>
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Representation of Spatial Objects

<p><u>Raster Data Models</u></p> <p> Hexagonal Models</p> <p>Triangular Irregular Network (TIN) Models</p> <p>Hierarchical Data Models</p> <p> Vector Data Models</p> <p> Network Models</p> <p>Entity-based Models</p> <p> Modeling 3-D Entities</p> <p> Fields in Space and Time</p> <p> Fuzzy Models</p> <p>Events and Processes</p> <p> Genealogical Relationships, Lineage</p> <p>Geospatial Data Conflation</p>	<p><u>Data Manipulation</u></p> <p> Point, Line, Area Generalization</p> <p> Vector-to-Raster and R-to-V Conversions</p> <p> Coordinate Transformations</p> <p><u>Data Standards & Infrastructures</u></p> <p> Metadata, Quality, and Uncertainty</p> <p> Geospatial Content Standards</p> <p> Spatial Data Warehouses</p> <p> Spatial Data Infrastructures</p> <p> U.S. National Spatial Data Infrastructure</p> <p> Ontology for Geosptl Semantic Interop.</p> <p> Hydrographic Geospatial Data Standards</p> <p> Marine Spatial Data Infrastructures</p>
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Spatial Access Methods

<p> Spatial Data Retrieval Strategies</p> <p> Spatial Indexing</p> <p> Modeling Semi- and Unstructured Data</p>	
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Cartography & Visualization (CV)

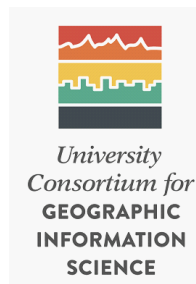
<p><u>History & Trends</u></p> <p> Cartography & Science</p> <p> Cartography & Art</p> <p> Cartography & Power</p> <p><u>Data Considerations</u></p> <p> Vector Formats & Sources</p> <p> Raster Formats & Sources</p> <p><u>Map Design Fundamentals</u></p> <p> Scale & Generalization</p> <p> Statistical Mapping</p> <p> Map Projections</p> <p> Visual Hierarchy & Layout</p> <p> Symbolization & Visual Variables</p> <p> Color Theory</p> <p> Typography</p> <p> Design and Aesthetics</p> <p>Map Production & Management</p> <p><u>Map Use</u></p> <p> Map Reading</p> <p> Map Interpretation</p> <p> Map Analysis</p> <p> Lesson Design in Cartography Education</p>	<p><u>Map Design Techniques</u></p> <p> Common Thematic Map Types</p> <p> Multivariate Mapping</p> <p> Spatio-Temporal Representation</p> <p> Representing Uncertainty</p> <p> Terrain Representatoin</p> <p> Cartograms</p> <p> Map Icon Design</p> <p> Narrative & Storytelling</p> <p> Flow Maps</p> <p> Collaborative Cartography</p> <p><u>Interactive Design Techniques</u></p> <p> User Interface & User Experience (UI/UX)</p> <p> Web Mapping</p> <p> Virtual & Immersive Environments</p> <p> Big Data Visualization</p> <p> Mobile Maps & Responsive Design</p> <p> Usability Engineering & Evaluation</p> <p> Geovisual Analytics</p> <p> Geovisualization</p>
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Analytics & Modeling (AM)

<p><u>Methodological Context</u></p> <p> Geospatial Analysis & Model Building</p> <p> Evolution of Reasoning, Analytics</p> <p><u>Building Blocks</u></p> <p> Overlay & Combination Operations</p> <p> Areal Interpolation</p> <p> Grid Operations & Map Algebra</p> <p> Classification & Clustering</p> <p> Boundaries & Zone Membership</p> <p> Buffering</p> <p><u>Data Exploration & Spatial Stats</u></p> <p> Spatial Statistics</p> <p> Spatial Sampling for Spatial Analysis</p> <p> Exploratory Spatial Data Analysis</p> <p> Point Pattern Analysis</p> <p> Kernels & Density Estimation</p> <p> Spatial Interaction</p> <p> Cartographic Modeling</p> <p> Multi-Criteria Evaluation</p> <p> Landscape Metrics</p> <p> Hot-spot and Cluster Analysis</p> <p> Global Measures of Spatial Association</p> <p> Local Indicators Spatial Autocorrelation</p> <p> Regressionl Fundamentals</p> <p> Geographically Weighted Regression</p> <p> Spatially Autoregressive Models</p> <p> Spatial Filtering Models</p> <p><u>Network & Location Analysis</u></p> <p> The Classic Transportation Problem</p> <p> Network Route & Tour Problems</p> <p> Location & Service Area Problems</p> <p> Accessibility Modeling</p> <p> Location-Allocation Modeling</p>	<p><u>Analysis of Errors & Uncertainty</u></p> <p> Spatial Data Uncertainty</p> <p> Thematic Accuracy and Assessment</p> <p> Mathematical Models of Uncertainty</p> <p> Error-based Uncertainty</p> <p> Stochastic Simulation & Monte Carlo</p> <p> Fuzzy Aggregation Operators</p> <p><u>Big Data & Geospatial Analysis</u></p> <p> Pattern Recognition and Matching</p> <p> Artificial Intelligence Approaches</p> <p> Intro to Spatial Data Mining</p> <p> Rule Learning for Spatial Data Mining</p> <p> Machine Learning Approaches</p> <p> Explainable AI Approaches</p> <p><u>Surface & Field Analysis</u></p> <p> DEM and Terrain Metrics</p> <p> Gridding, Interpolation, & Contouring</p> <p> Radial Basis and Spline Functions</p> <p> Polynomial Functions</p> <p> Kriging Interpolation</p> <p> LIDAR Point Cloud Analysis</p> <p> Intervisibility, Line-of-Sight, Viewsheds</p> <p> TIN-based models and Terrain Metrics</p> <p> Watersheds and Drainage</p> <p><u>Geocomputation Methods/Models</u></p> <p> Cellular Automata</p> <p> Agent-based Modeling</p> <p> Simulation Modeling</p> <p> Artificial Neural Networks</p> <p> Genetic Algorithms / Evolutionary Cmpntng</p> <p><u>Space-Time Analytics & Modeling</u></p> <p> Capturing Spatiotemporal Dynamics</p> <p> GIS-based Computational Modeling</p> <p> Computational Movement Analysis</p> <p> Volumes and Space-Time Volumes</p>
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Domain Applications (DA) (continued)

<p> Real Estate</p> <p>Recreation Planning & Management</p> <p> Retail Businesses</p> <p> State & Regional Government</p> <p> Telecommunications</p>	<p> Transportation</p> <p>Urban & Regional Planning</p> <p> Utilities</p> <p> Water Resources</p> <p> Wildlife & Fisheries Science</p>
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