

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

Foundational Concepts (FC)		Computing Platforms (CP)	
<u>Origins</u>	<u>Basic Measures</u>	<u>Computing Infrastructures</u>	<u>Software Systems</u>
Public & Private Sector Origins	Academic developments <i>Intro to the GIS&T BoK</i>	Graphics Processing Units (GPUs) Cyberinfrastructure Spatial Cloud Computing Mobile Devices e-Science, Evolution of Science	Spatial Database Mgmt Systems Artificial Intelligence Tools & Platforms Geospatial Technology Transfer Web GIS Enterprise GIS
<u>Cognitive</u>	<u>Interrogating Geog Info</u>	<u>Computing Approaches</u>	<u>Examples & Applications</u>
The Power of Maps and Mapping Place and Landscape <i>Foundational Ontologies</i>	Shape Areal Operations Directional Operations Distance Operations <i>First & Second Laws of Geography</i>	Origins: Computer Systems Origins: Peripheral Devices <i>High Throughput Computing and GIS</i> <i>High Performance Computing and GIS</i> <i>Science Gateways</i>	Google Earth Engine ArcGIS Online GIS&T and Computational Notebooks <i>Apache Spark</i> <i>OSGeo Live</i>
Perceptions & Cognitive Processing <i>Ontologies for Analysis</i>	Proximity and Distance Decay Adjacency and Connectivity Resolution Geometric Primitives & Algorithms Spatial Autocorrelation	<u>Social Media & Location Services</u>	
Semantic Information Elicitation	Set Theory SQL & Attribute Theories Spatial Queries	Location-based Services Social Media Analytics Social Networks <i>GIS and the Internet of Things</i> <i>GIS and Web Services</i>	
<u>Domains of Geog Info</u>	<u>Uncertainty</u>	Programming & Development (PD)	
Space Time Space-Time Relationships	Data Properties Conceptual Error/Uncertainty Models Networks Problems of Scale and Zoning Neighborhoods Thematic Accuracy & Assessment Events & Processes	<u>Algorithm Design & Approaches</u>	<u>Application Development</u>
<u>Philosophical</u>	Openness Epistemology Philosophical Perspectives	Real Time Prgrmmng & Geocomputation Natural Language Processing in GIS Machine Learning Programming for GIS Linear Programming and GIS GIS and Parallel Programming <i>Object-oriented programming</i>	Design, Develop, Test, Deploy <i>Verification & Validation of GIS Apps</i> Commercialization of GIS Apps Licensing of GIS Apps Open Source Software Development <u>Platform-Specific Programming</u>
Knowledge Economy (KE)		<u>Languages & Libraries</u>	<u>Development Tools</u>
<u>GIS&T Workforce</u>	<u>Coordinating Organizations</u>	Python for GIS PySAl and Spatial Statistics Libraries R for Geospatial Analysis & Mapping Javascript for GIS SQL Languages for GIS GDAL/OGR and IO Libraries	Programming of Mobile GIS Apps Web GIS Programming Visual Programming for GIS Apps SpatialMPI for GIS Apps GIS APIs
GIS&T Workforce Development Competence in Knowledge Work GIS&T Positions and Qualifications GIS&T Education & Training Professional Certification	Value of Geospatial Professional Orgs. <i>Regional GIS Coordination & Collaboration</i> Multi-Organizational GIS Coordination Publications and Conferences The Geospatial Community The Geospatial Industry	GIS&T and Society (GS)	
<u>Design & Implementation</u>	<u>GIS Operations</u>	<u>Law, Regulation, and Policy</u>	<u>Governance & Agency</u>
The Process of GIS&T Design Strategic Planning for GIS Design Project Planning & Management Measuring GIS ROI Measuring GIS Costs <i>Managing Infrastructure & Operations</i>	Systems Modeling for Mngmt Organizational Models for GIS Mngmt Funding	<i>The Legal Regime</i> Location Privacy Mechanisms of Control of Geosptl Info Legal Mechanisms for Sharing GIS&T for Equity and Social Justice	<i>Public Participation GIS</i> Professional & Practical Ethics of GIS&T Codes of Ethics for GIS Professionals Aggregation & Redistricting <i>Implications of Distributed GIS&T</i>
Data Capture (DC)		<u>Critical Perspectives</u>	
<u>History & Trends</u>	<u>Remote Sensing Platforms/Sensors</u>	Epistemological Critiques GIS and Critical Ethics Feminist Critiques of GIS Balancing Data Access, Security, Privacy	GIS&T and Citizen Science GIS&T and Spatial Decision Support Maps/Spatial Justice & Marginal Societies GIS&T and Community Engagement Geospatial Participatory Modeling
Changes Over Time Part 1: Tech Dev Changes Part 2: Implications & Cases Georeferencing & Georectification	Remote Sensing Platforms Overview Nature of Multispectral Images Unmanned Aerial Systems Landsat Light Detection & Ranging (LiDAR) Basics <i>Hyperspectral Imagery</i> <i>Airborne LiDAR Bathymetry</i> <i>Thermal Imagery</i> <i>Radar, Sonar, and Echolocation</i>	Domain Applications (DA)	
<u>Software & Data Coordinating Orgs.</u>	<u>Processing Remotely-Sensed Data</u>	Disaster Management <i>Land Administration</i> <i>Landscape Architecture</i> <i>Landscape Ecology</i> Ecosystem Science & Management Libraries, Archives, and Museums Local Government Marine Science Marketing Natural Resource Management Politics Public Health Public Policy	
Multi-Organization GIS Coordination National Organizations & Programs International Organizations & Programs	Image Interp: Photos & Satellites <i>Feature Extraction in Satellite Imagery</i> <i>Structure from Motion Photogrammetry</i> Ground Verification & Accuracy <i>Spectral Properties Terrestrial Surfaces</i>	Education & Training <i>Energy Development</i> <i>Environmental Science & Management</i> Epidemiology <i>Facilities Management</i> Forestry Geodesign <i>Humanitarian Mapping</i> <i>Hydrology and Hydraulics</i> <i>Insurance</i>	
<u>Digital Data Sources & Methods</u>	<u>GIS and Surveying</u>	Intelligence & National Security <i>Insurance</i> International Affairs	
Historical Paper Maps Global Navigation Satellite Systems Aerial Photos: History & Georeferencing Street-Level Imagery Social Media Platforms <i>Mobile Applications</i> <i>Texts</i> Volunteered Geographic Info (VGI) Time-of-Arrival Localization	Professional Land Surveying <i>Land Records</i> <i>Ocean Surveying</i>	GIS&T Body of Knowledge 6/30/2022 bold = revised & expanded regular = original & still limited <i>italics = future or forthcoming</i> https://gistbok.ucgis.org	
<u>Field Data Collection</u>	<u>Domain Applications (DA)</u>		
Sampling: Size, Selection, Types Field Data Capture Technologies U.S. Census Data	Agriculture <i>Climate Studies & Atmos. Science</i> Archaeology Computational Geography <i>Conservation</i> Business Criminal Justice / Law Enforcement Civil Engineering Digital Humanities		

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Data Management (DM)	
<u>Spatial Databases</u>	<u>Query Processing</u>
Spatial Database Mngmnt Systems <i>Relational DBMS and Extensions</i> <i>Geodatabases</i> <i>Topological Relationships</i> <i>Database Administration</i>	<i>Optimal I/O Algorithms</i> <i>Spatial Joins</i> <i>Complex Queries</i>
Conceptual Data Models Logical Data Models Physical Data Models Array Databases NoSQL databases Problems w/ Large Spatial Databases	<u>Georeferencing Systems</u> Linear Referencing Earth's Shape, Sea Level, Geoid <i>Geographic Coordinate Systems</i> Planar Coordinate Systems <i>U.S. National Grid</i> Vertical (Geopotential) Datums Horizontal (Geometric) Datums Map Projectoins
<u>Representation of Spatial Objects</u>	Georeferencing & Georectification
Raster Data Models Hexagonal Models Triangular Irregular Network (TIN) Models	<u>Data Manipulation</u> Point, Line, Area Generalization Vector-to-Raster and R-to-V Conversions Raster Resampling Coordinate Transformations Transaction Management
Hierarchical Data Models Topological Models Vector Data Models Network Models Entity-based Models Modeling 3-D Entities Fields in Space and Time Fuzzy Models Events and Processes Geneological Relationships, Lineage Geospatial Data Conflation	<u>Data Standards & Infrastructures</u> Metadata, Quality, and Uncertainty Geospatial Content Standards Spatial Data Warehouses Spatial Data Infrastructures U.S. National Spatial Data Infrastructure Ontology for Geosptl Semantic Interop. Hydrographic Geospatial Data Standards Marine Spatial Data Infrastructures
<u>Spatial Access Methods</u>	
Spatial Data Retrieval Strategies Spatial Indexing Space-driven Structures Data-driven structures Modeling Unstructured Spatial Data Modeling Semi-structured Spatial Data	
Cartography & Visualization (CV)	
<u>History & Trends</u>	<u>Map Design Techniques</u>
Cartography & Science Cartography & Art Cartography & Power	Common Thematic Map Types Multivariate Mapping Spatio-Temporal Representation
<u>Data Considerations</u>	Representing Uncertainty Terrain Representatoin Cartograms
Vector Formats & Sources Raster Formats & Sources	Map Icon Design
<u>Map Design Fundamentals</u>	Narrative & Storytelling Flow Maps
Scale & Generalization Statistical Mapping Map Projections Visual Hierarchy & Layout	Collaborative Cartography
Symbolization & Visual Variables Color Theory Typography Design and Aesthetics	<u>Interactive Design Techniques</u> User Interface & User Experience (UI/UX) Web Mapping Virtual & Immersive Environments Big Data Visualization
Map Production & Management	Mobile Maps & Responsive Design Usability Engineering & Evaluation
<u>Map Use</u>	Geovisual Analytics Geovisualization
Map Reading Map Interpretation Map Analysis Lesson Design in Cartography Education	

Analytics & Modeling (AM)	
<u>Methodological Context</u>	<u>Analysis of Errors & Uncertainty</u>
Geospatial Analysis & Model Building Evolution of Reasoning, Analytics	Conceptual Models of Error/Uncertainty Spatial Data Uncertainty Problems of Scale & Zoning Thematic Accuracy and Assessment Mathematical Models of Uncertainty Error-based Uncertainty Stochastic Simulation & Monte Carlo Fuzzy Aggregation Operators
<u>Building Blocks</u>	<u>Big Data & Geospatial Analysis</u>
Overlay Areal Interpolation Aggregation of Spatial Entities Grid Operations & Map Algebra Classification & Clustering <i>Boundaries & Zone Membership</i> Spatial Queries Buffering	Problems of Large Spatial Databases Pattern Recognition and Matching Artificial Intelligence Approaches Intro to Spatial Data Mining Rule Learning for Spatial Data Mining Machine Learning Approaches Cyberinfrastructure
<u>Data Exploration & Spatial Stats</u>	<u>Surface & Field Analysis</u>
Spatial Statistics Spatial Sampling for Spatial Analysis Exploratory Spatial Data Analysis Point Pattern Analysis Kernels & Density Estimation Spatial Interaction Cartographic Modeling Multi-Criteria Evaluation Landscape Metrics Hot-spot and Cluster Analysis Global Measures of Spatial Association Local Indicators Spatial Autocorrelation Simple Regression & Trend Surfaces Geographically Weighted Regression Spatially Autoregressive Models Spatial Filtering Models	Modeling Surfaces <i>Gridding, Interpolation, & Contouring</i> <i>Inverse Distance Weighting</i> <i>Radial Basis and Spline Functions</i> <i>Polynomial Functions</i> Kriging Interpolation <i>LiDAR Point Cloud Analysis</i> Intervisibility, Line-of-Sight, Viewsheds <i>DEM and Terrain Metrics</i> <i>TIN-based models and Terrain Metrics</i> Watersheds and Drainage <i>3D Parametric Surfaces</i> <u>Geocomputation Methods/Models</u> Cellular Automata Agent-based Modeling Simulation Modeling <i>Artificial Neural Networks</i> Genetic Algorithms / Evolutionary Cmptng
<u>Network & Location Analysis</u>	<u>Space-Time Analytics & Modeling</u>
<i>Intro to Network & Location Analysis</i> <i>Network Route & Tour Problems</i> Location & Service Area Problems Accessibility Modeling Location-Allocation Modeling The Classic Transportation Problem	Time Geography Capturing Spatiotemporal Dynamics GIS-based Computational Modeling Computational Movement Analysis <i>Volumes and Space-Time Volumes</i>
Domain Applications (DA) (continued)	
Recreation Planning & Management Retail Businesses State & Regional Government <i>Telecommunicaions</i>	Urban & Regional Planning <i>Utilities</i> <i>Water Resources</i> <i>Wildlife & Fisheries Science</i>

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