Geographic Information Science & Technology
Body of Knowledge 2006
QUICK REFERENCE

Analytical Methods

AM1 Academic and analytical origins
1-1 Academic foundations
1-2 Analytical approaches

AM2 Query operations and query languages
2-1 Set theory
2-2 Structured Query Language (SQL) and attribute queries
2-3 Spatial queries

AM3 Geometric measures
3-1 Distances and lengths
3-2 Direction
3-3 Shape
3-4 Area
3-5 Proximity and distance decay
3-6 Adjacency and connectivity

AM4 Basic analytical operations
4-1 Buffers
4-2 Overlay
4-3 Neighborhoods
4-4 Map algebra

AM5 Basic analytical methods
5-1 Point pattern analysis
5-2 Kernels and density estimation
5-3 Spatial cluster analysis
5-4 Spatial interaction
5-5 Analyzing multidimensional attributes
5-6 Cartographic modeling
5-7 Multi-criteria evaluation
5-8 Spatial process models

AM6 Analysis of surfaces
6-1 Calculating surface derivatives
6-2 Interpolation of surfaces
6-3 Surface features
6-4 Intervisibility
6-5 Friction surfaces

AM7 Spatial statistics
7-1 Graphical methods
7-2 Stochastic processes
7-3 The spatial weights matrix
7-4 Global measures of spatial association
7-5 Local measures of spatial association
7-6 Outliers
7-7 Bayesian methods

AM8 Geostatistics
8-1 Spatial sampling for statistical analysis
8-2 Principles of semi-variogram construction
8-3 Semi-variogram modeling
8-4 Principles of kriging
8-5 Kriging variants

AM9 Spatial regression and econometrics
9-1 Principles of spatial econometrics
9-2 Spatial autoregressive models
9-3 Spatial filtering
9-4 Spatial expansion and Geographically Weighted Regression (GWR)

AM10 Data Mining
10-1 Problems of large spatial databases
10-2 Data mining approaches
10-3 Knowledge discovery
10-4 Pattern recognition and matching

AM11 Network analysis
11-1 Networks defined
11-2 Graph theoretic (descriptive) measures
11-3 Least-cost (shortest) path
11-4 Flow modeling
11-5 The Classic Transportation Problem
11-6 Other classic network problems
11-7 Accessibility Modeling

AM12 Optimization and location-allocation modeling
12-1 Operations research modeling and location modeling principles
12-2 Linear programming
12-3 Integer programming
12-4 Location-allocation modeling and p-median problems

Conceptual Foundations

CF1 Philosophical foundations
1-1 Metaphysics and ontology
1-2 Epistemology
1-3 Philosophical perspectives

CF2 Cognitive and social foundations
2-1 Perception and cognition of geographic phenomena
2-2 From concepts to data
2-3 Geography as a foundation for GIS
2-4 Place and landscape
2-5 Common-sense geographies
2-6 Cultural influences
2-7 Political influences

CF3 Domains of geographic information
3-1 Space
3-2 Time
3-3 Relationships between space and time
3-4 Properties

CF4 Elements of geographic information
4-1 Discrete entities
4-2 Events and processes
4-3 Fields in space and time
4-4 Integrated models

CF5 Relationships
5-1 Categories
5-2 Mereology: structural relationships
5-3 Genealogical relationships: lineage, inheritance
5-4 Topological relationships
5-5 Metrical relationships: distance and direction
5-6 Spatial distribution
5-7 Region
5-8 Spatial integration

CF6 Imperfections in geographic information
6-1 Vagueness
6-2 Mathematical models of vagueness: Fuzzy sets and rough sets
6-3 Error-based uncertainty
6-4 Mathematical models of uncertainty: Probability and statistics

Cartography and Visualization

CV1 History and trends
1-1 History of cartography
1-2 Technological transformations

CV2 Data considerations
2-1 Source materials for mapping
2-2 Data abstraction: classification, selection, and generalization
2-3 Projections as a map design issue

CV3 Principles of map design
3-1 Map design fundamentals
3-2 Basic concepts of symbolization
3-3 Color for cartography and visualization
3-4 Typography for cartography and visualization

CV4 Graphic representation techniques
4-1 Basic thematic mapping methods
4-2 Multivariate displays
4-3 Dynamic and interactive displays
4-4 Representing terrain
4-5 Web mapping and visualizations
4-6 Virtual and immersive environments
4-7 Spatialization
4-8 Visualization of temporal geographic data
4-9 Visualization of uncertainty

CV5 Map production
5-1 Computational issues
5-2 Map production
5-3 Map reproduction

CV6 Map use and evaluation
6-1 The power of maps
6-2 Map reading
6-3 Map interpretation
6-4 Map analysis
6-5 Evaluation and testing
6-6 Impact of uncertainty

Design Aspects

DA1 The scope of GI S&T system design
1-1 Using models to represent information and processes
1-2 Components of models: data, structures, procedures
1-3 The scope of GI S&T applications
1-4 The scope of GI S&T design
1-5 The process of GI S&T design

DA2 Project definition
2-1 Problem definition
2-2 Planning for design
2-3 Application/user assessment
2-4 Requirements analysis
2-5 Social, political, and cultural issues

DA3 Resource planning
3-1 Feasibility analysis
3-2 Software systems
3-3 Data costs
3-4 Labor and management
3-5 Capital: facilities and equipment
3-6 Funding

DA4 Database design
4-1 Modeling tools
4-2 Conceptual model
4-3 Logical models
4-4 Physical models

DA5 Analysis design
5-1 Recognizing analytical components
5-2 Identifying and designing analytical procedures
5-3 Coupling scientific models with GIS
5-4 Formalizing a procedure design

DA6 Application design
6-1 Workflow analysis and design
6-2 User interfaces
6-3 Development environments for geospatial applications
6-4 Computer-Aided Software Engineering (CASE) tools

DA7 System implementation
7-1 Implementation planning
7-2 Implementation tasks
7-3 System testing
7-4 System deployment

Data Modeling

DM1 Basic storage and retrieval structures
1-1 Basic data structures
1-2 Data retrieval strategies

DM2 Database management systems
2-1 Coevolution of DBMS and GIS
2-2 Relational DBMS
2-3 Object-oriented DBMS
2-4 Extensions of the relational model

DM3 Tessellation data models
3-1 Grid representations
3-2 The raster model
3-3 Grid compression methods
3-4 The hexagonal model
3-5 The Triangulated Irregular Network (TIN) model
3-6 Resolution
3-7 Hierarchical data models

DM4 Vector and object data models
4-1 Geometric primitives
4-2 The spaghetti model
4-3 The topological model
4-4 Classic vector data models
4-5 The network model
4-6 Linear referencing
4-7 Object-based spatial databases

DM5 Modeling 3D, uncertain, and temporal phenomena
5-1 Spatio-temporal GIS
5-2 Modeling uncertainty
5-3 Modeling three-dimensional entities

Data Manipulation

DN1 Representation transformation
- 1-1 Impacts of transformations
- 1-2 Data model and format conversion
- 1-3 Interpolation
- 1-4 Vector-to-raster and raster-to-vector conversions
- 1-5 Raster resampling
- 1-6 Coordinate transformations

DN2 Generalization and aggregation
- 2-1 Scale and generalization
- 2-2 Point, line, and area generalization
- 2-3 Classification and transformation of attribute measurement levels
- 2-4 Aggregation of spatial entities

DN3 Transaction management
- 3-1 Database change
- 3-2 Modeling database change
- 3-3 Reconciling database change
- 3-4 Managing versioned geospatial databases

Geocomputation

GC1 Emergence of geocomputation
- 1-1 Origins
- 1-2 Trends

GC2 Computational aspects and neurocomputing
- 2-1 High performance computing
- 2-2 Computational intelligence
- 2-3 Non-linearity relationships and non-Gaussian distributions
- 2-4 Pattern recognition
- 2-5 Geospatial data classification
- 2-6 Multi-layer feed-forward neutral networks
- 2-7 Space-scale algorithms
- 2-8 Rule learning
- 2-9 Neural network schemes

GC3 Cellular Automata (CA)
- 3-1 CA Model Structure
- 3-2 CA Transition Rule
- 3-3 CA simulation and calibration
- 3-4 Integration of CA and other geocomputation methods
- 3-5 Typical CA applications

GC4 Heuristics
- 4-1 Greedy heuristics
- 4-2 Interchange heuristics
- 4-3 Interchange with probability
- 4-4 Simulated annealing
- 4-5 Lagrangian relaxation

GC5 Genetic algorithms (GA)
- 5-1 GA and global solutions
- 5-2 Genetic algorithms and artificial genomes

GC6 Agent-based models
- 6-1 Structure of agent-based models
- 6-2 Specification of agent-based models
- 6-3 Adaptive agents
- 6-4 Microsimulation and calibration of agent activities
- 6-5 Encoding agent-based models

GC7 Simulation modeling
- 7-1 Simulation modeling

GC8 Uncertainty
- 8-1 Conceptual model of uncertainty
- 8-2 Error
- 8-3 Problems of scale and zoning
- 8-4 Propagation of error in geospatial modeling
- 8-5 Theory of error propagation
- 8-6 Problems of currency, source, and scale

GC9 Fuzzy sets
- 9-1 Fuzzy logic
- 9-2 Fuzzy measures
- 9-3 Fuzzy aggregation operators
- 9-4 Standardization
- 9-5 Weighting schemes

Geospatial Data

GD1 Earth geometry
- 1-1 History of understanding Earth's shape
- 1-2 Geoids
- 1-3 Spheres and ellipsoids

GD2 Land partitioning systems
- 2-1 Unsystematic methods
- 2-2 Systematic methods

GD3 Georeferencing systems
- 3-1 Geographic coordinate system
- 3-2 Plane coordinate systems
- 3-3 Tessellated referencing systems
- 3-4 Linear referencing systems

GD4 Datums
- 4-1 Horizontal datums
- 4-2 Vertical datums

GD5 Map projections
- 5-1 Map projection properties
- 5-2 Map projection classes
- 5-3 Map projection parameters
- 5-4 Georegistration

GD6 Data quality
- 6-1 Geometric accuracy
- 6-2 Thematic accuracy
- 6-3 Resolution
- 6-4 Precision
- 6-5 Primary and secondary sources

GD7 Land surveying and GPS
- 7-1 Survey theory and electro-optical methods
- 7-2 Land records
- 7-3 Global Positioning System

GD8 Digitizing
- 8-1 Tablet digitizing
- 8-2 On-screen digitizing
- 8-3 Scanning and automated vectorization

GD9 Field data collection
- 9-1 Sample size selection
- 9-2 Spatial sample types
- 9-3 Sample intervals
- 9-4 Field data technologies

GD10 Aerial imaging and photogrammetry
- 10-1 Nature of aerial image data
- 10-2 Platforms and sensors
- 10-3 Aerial image interpretation
- 10-4 Stereoscopy and orthoimagery
- 10-5 Vector data extraction
- 10-6 Mission planning

GD11 Satellite and shipboard remote sensing
- 11-1 Nature of multispectral image data
- 11-2 Platforms and sensors
- 11-3 Algorithms and processing
- 11-4 Ground verification and accuracy assessment
- 11-5 Applications and settings

GD12 Metadata, standards, and infrastructures
- 12-1 Metadata
- 12-2 Content standards
- 12-3 Data warehouses
- 12-4 Exchange specifications
- 12-5 Transport protocols
- 12-6 Spatial Data Infrastructures

GI S&T and Society

GS1 Legal aspects
- 1-1 The legal regime
- 1-2 Contract law
- 1-3 Liability
- 1-4 Privacy

GS2 Economic aspects
- 2-1 Economics and the role of information
- 2-2 Valuing and measuring benefits
- 2-3 Models of benefits
- 2-4 Agency, organizational, and individual perspectives
- 2-5 Measuring costs

GS3 Use of geospatial information in the public sector
- 3-1 Uses of geospatial information in government
- 3-2 Public participation in governing
- 3-3 Public participation GIS

GS4 Geospatial information as property
- 4-1 Property regimes
- 4-2 Mechanisms of control of geospatial information
- 4-3 Enforcing control

GS5 Dissemination of geospatial information
- 5-1 Incentives and barriers to sharing geospatial information
- 5-2 Data sharing among organizations and individuals
- 5-3 Legal mechanisms for sharing geospatial information
- 5-4 Balancing security and open access to geospatial information

GS6 Ethical aspects
- 6-1 Ethics and geospatial information
- 6-2 Codes of ethics for geospatial professionals

GS7 Critical GIS
- 7-1 Epistemological critiques
- 7-2 Ethical critiques
- 7-3 Feminist critiques
- 7-4 Social critiques

Organizational & Institutional Aspects

OI1 Origins of GI S&T
- 1-1 Public sector origins
- 1-2 Private sector origins
- 1-3 Academic origins
- 1-4 Learning from experience
- 1-5 Future trends

OI2 Managing the GI system operations and infrastructure
- 2-1 Managing the GI system operations and infrastructure
- 2-2 Ongoing GI system revision
- 2-3 Budgeting for GI system management
- 2-4 Database administration
- 2-5 System management
- 2-6 User support

OI3 Organizational structures and procedures
- 3-1 Organizational models for GI system management
- 3-2 Organizational models for coordinating GI systems and/or program participants and stakeholders
- 3-3 Integrating GI S&T with management information systems (MIS)

OI4 GI S&T workforce themes
- 4-1 GI S&T staff development
- 4-2 GI S&T positions and qualifications
- 4-3 GI S&T training and education
- 4-4 Incorporating GI S&T into existing job classifications

OI5 Institutional and inter-institutional aspects
- 5-1 Spatial data infrastructures
- 5-2 Adoption of standards
- 5-3 Technology transfer
- 5-4 Spatial data sharing among organizations
- 5-5 Openness
- 5-6 Balancing data access, security, and privacy
- 5-7 Implications of distributed GI S&T
- 5-8 Interorganizational and vendor GI systems

OI6 Coordinating organizations
- 6-1 Federal agencies and national and international organizations and programs
- 6-2 State and regional coordinating bodies
- 6-3 Professional organizations
- 6-4 Publications
- 6-5 The geospatial community
- 6-6 The geospatial industry

Knowledge Area

Unit
- Topic
- Topic

Core Unit
- Topic
- Topic

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