



GIS&T BoK PROJECT UPDATE

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2006 GIS&T BoK



- BoK as a book is excellent for serving as an authoritative resource
- Difficult to update (impossible)
- Difficult to access (relatively speaking)
 - 10 knowledge areas
 - 73 units
 - 329 topics
 - 1,660 objectives

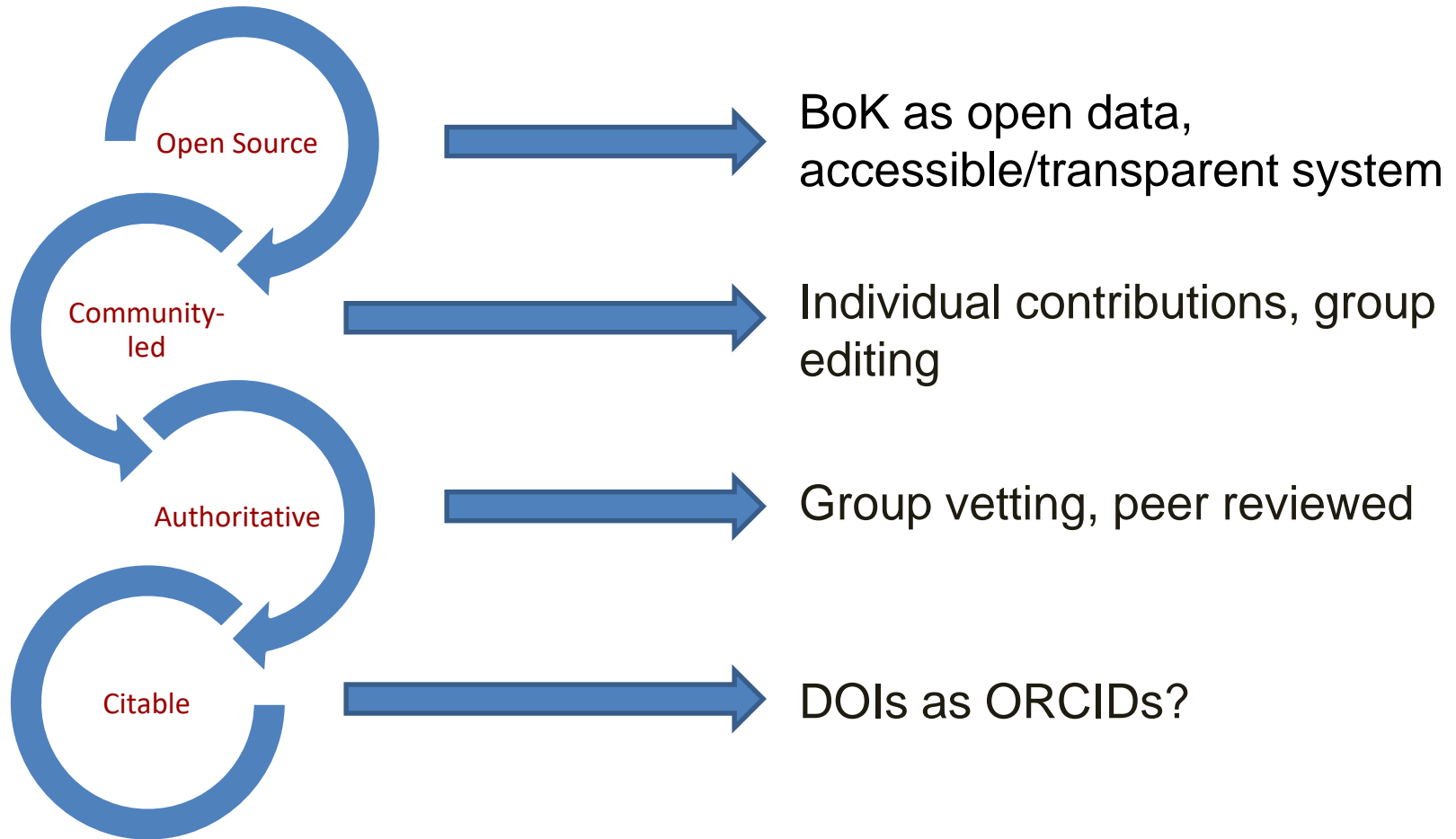
Geographic Information Science & Technology Body of Knowledge

Edited by David Dibbern, Michael DeMers, Ann Johnson, Karen Kemp, Ann Taylor Lock, Brandon Flewo, and Elizabeth Wentz
UNIVERSITY CONSORTIUM FOR GEOGRAPHIC INFORMATION SCIENCE

Analytical Methods	Cartography and Visualization
AM1 Academic and analytical origins <ul style="list-style-type: none"> 1-1 Academic foundations 1-2 Analytical approaches AM2 Query operations and query languages <ul style="list-style-type: none"> 2-1 Query theory 2-2 Structured Query Language (SQL) and database queries 2-3 Spatial queries AM3 Geometric measures <ul style="list-style-type: none"> 3-1 Distance and length 3-2 Direction 3-3 Shape 3-4 Area 3-5 Proximity and distance decay 3-6 Adjacency and connectivity AM4 Basic analytical operations <ul style="list-style-type: none"> 4-1 Buffers 4-2 Neighborhoods 4-3 Map algebra AM5 Basic analytical methods <ul style="list-style-type: none"> 5-1 Point pattern analysis 5-2 Kernel 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 <ul style="list-style-type: none"> 6-1 Calculating surface derivatives 6-2 Interpretation of surfaces 6-3 Surface features 6-4 Inter-visibility 6-5 Friction surfaces 	CV1 History and trends <ul style="list-style-type: none"> 1-1 History of Cartography 1-2 Technological transformations CV2 Data considerations <ul style="list-style-type: none"> 2-1 Source materials for mapping 2-2 Data abstraction: classification, selection, and generalization 2-3 Projection as a map design issue CV3 Principles of map design <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 4-1 Basic graphic 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 <ul style="list-style-type: none"> 5-1 Computational issues 5-2 Map production 5-3 Map reproduction CV6 Map use and evaluation <ul style="list-style-type: none"> 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
Conceptual Foundations	Design Aspects
CF1 Philosophical foundations <ul style="list-style-type: none"> 1-1 Identifying unit ontology 1-2 Epistemology 1-3 Philosophical perspectives CF2 Cognitive and social foundations <ul style="list-style-type: none"> 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 Comparative geographies 2-6 Cultural influences 2-7 Political influences CF3 Domains of geographic information <ul style="list-style-type: none"> 3-1 Space 3-2 Time 3-3 Relationships between space and time 3-4 Properties 	DA1 The scope of GIS&T system design <ul style="list-style-type: none"> 1-1 Usage models to represent information and processes 1-2 Components of modic data, structures, and processes 1-3 The scope of GIS&T applications 1-4 The scope of GIS&T design 1-5 The process of GIS&T design DA2 Project definition <ul style="list-style-type: none"> 2-1 Problem definition 2-2 Planning for design 2-3 Application/user assessment 2-4 Requirements analysis 2-5 Social, political, and cultural tensions DA3 Resource planning <ul style="list-style-type: none"> 3-1 Feasibility analysis 3-2 Software systems 3-3 Data users 3-4 Labor and management 3-5 Capital, facilities and equipment 3-6 Funding
Conceptual Foundations	Data Modeling
CF4 Elements of geographic information <ul style="list-style-type: none"> 4-1 Processes and events 4-2 Models in space and time 4-3 Integrated models CF5 Relationships <ul style="list-style-type: none"> 5-1 Categories 5-2 Basic data structures: structural relationships 5-3 Conceptual relationships: images, tolerance 5-4 Topological relationships 5-5 Relational relationships: distance and direction 5-6 Spatial distribution 5-7 Region 5-8 Spatial integration CF6 Imperfections in geographic information <ul style="list-style-type: none"> 6-1 Mathematical models of vagueness: Fuzzy sets and rough sets 6-2 Error-based uncertainties 6-3 Mathematical models of uncertainty: Probability and statistics 	DM1 Basic storage and retrieval structures <ul style="list-style-type: none"> 1-1 Basic data structures 1-2 Data retrieval structures DM2 Database management systems <ul style="list-style-type: none"> 2-1 Characteristics of DBMS and GIS 2-2 Relational DBMS 2-3 Object-oriented DBMS 2-4 Extensiveness of the relational model DM3 Tessellation data models <ul style="list-style-type: none"> 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 Resolutions 3-7 Hierarchical data models DM4 Vector and object data models <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 5-1 Spatialization GIS 5-2 Modeling uncertainty 5-3 Modeling three-dimensional entities



The alternative ...





Creating authoritative copy

- Currently exploring the combination of copyright registration and licensing that most effectively meets the needs of the organization and the contributors

Three “Layers” Of Licenses



Source: <http://creativecommons.org/licenses/>



Creating an agile platform

- MediaWiki is an open source platform that we will use to host the BoK content
- Easy to manage users for editing, but also open for easy access





Parallel resource

moodle

English (en) You are currently using guest access (Log in)

Community driven, globally supported.

Welcome to the Moodle community and discover the value of an open, collaborative effort by one of the largest open-source teams in the world.

COMMUNITY FORUMS

Once we get the wiki up and running, we would also like to create a parallel LMS resource to support the development and linking of learning material & related content. This will likely use Moodle, but options are open

The BoK Ecosystem – August launch



Future BoK

Content
Generation
Process

Content
Curation
Process

Infrastructure

Data

Wiki

LMS (phase2)

Authoritative

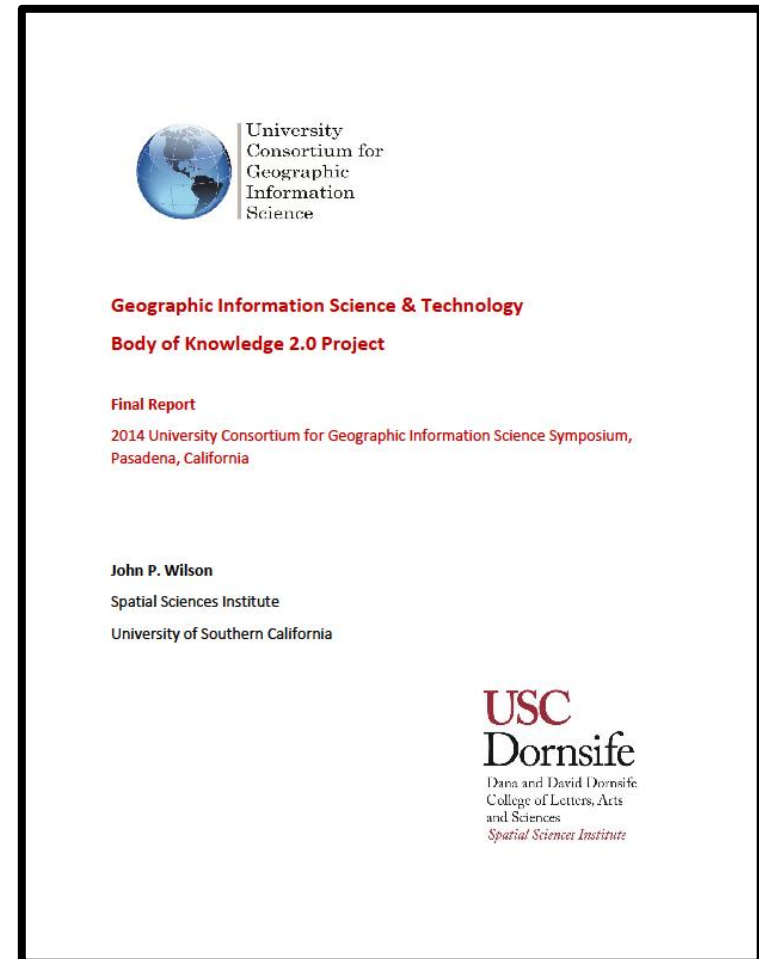
Vetted

Licensed

2014 Pasadena Meeting



- Two Qualtrics surveys
- Group discussions
 - Geospatial revolution, spatial thinking
 - Technology platforms, support & skills, spatial data acquisition & curation
 - Spatial modeling, analysis & visualization, outcomes, maps & services
 - Geospatial applications, emerging topics & trends
- Final report





BoK Steering Committee

- Ola Ahlqvist
- Sarah Battersby
- Michael Goodchild
- Diansheng Guo
- Rodney Jackson
- Krystoff Janowicz
- Joseph Kerski
- Werner Kuhn
- Wenwen Li
- Amy Lobben
- Marguerite Madden
- Jeremy Mennis
- David O'Sullivan
- Marco Painho
- Jane Read
- Doug Richardson
- Anthony Robinson
- Diana Sinton
- André Skupin
- Josef Strobl
- Lynn Usery
- Fahui Wang
- Shaowen Wang
- Nigel Waters
- Kenneth Yanow
- Xinyue Ye



Containers (1-5)

- **Guiding principles**
 - Spatial primitives, spatial turn, geospatial revolution
- **People power**
 - Human resources, professional development & support, project management
- **Computing platforms**
 - The cloud, servers, personal computers, mobile devices
- **Programming & customization**
 - Hadoop, Python
- **Data capture & acquisition**
 - GPS, remote sensing, volunteered geographic information



Containers (6-10)

- **Data management**
 - Organization, representation, storage
- **Data processing**
 - Analysis, modeling
- **Data display & dissemination**
 - Cartography, map production, visualization
- **Domain-specific applications**
 - Agriculture, hydrology, intelligence, location-based services, policing, real estate
- **Broader societal implications & concerns**
 - Professional ethics, privacy, public participation



Next steps – GIS&T BoK Steering Committee

- Project oversight
- **Recruiting & managing contributors**
- Editing existing content
- Generating new content

- **Go after low hanging fruit first**

Containers	Volunteers
Guiding principles	10
People power	3
Computing platforms	2
Programming & customization	1
Data capture & acquisition	5
Data management	1
Data processing	7
Data display & dissemination	7
Domain-specific applications	8
Broader societal concerns	5



Template ...

Digital Terrain Modeling (2-8 bullets, 240 word limit)

- Methods and data sources used to generate Digital Elevation Models (DEMs) and calculate land surface parameters.
- These workflows typically start with data capture, continue with data pre-processing and DEM generation, and conclude with the calculation of one or more primary and secondary land surface parameters.
- There may be multiple sources of elevation data, including contours, spot heights, LiDAR and RADAR remote sensing datasets, and some preprocessing is nearly always required to produce the final DEMs.
- There are many subtleties involved in calculating the primary land surface parameters that are derived directly from DEMs without additional inputs and the two sets of secondary land surface parameters that are commonly used to model solar radiation and the accompanying interactions between the land surface and the atmosphere on the one hand and water flow and related surface processes on the other.
- The computed terrain attributes are frequently used to classify landforms and soils and as inputs for environmental models.
- There will inevitably be some errors embedded in the DEMs, so it is important to know how these may be propagated and carried forward in calculating various land surface parameters and the consequences of this state-of-affairs for the work at hand.

Which concepts/skills are prerequisites of this concept? (4-6 bullets, if appropriate)

1. Scale
2. Remotely sensed data
3. Raster data model
4. Vector data model
5. Triangulated irregular networks (TINs)
6. Error and uncertainty

For which concepts/skills should this concept be a prerequisite? (4-6 bullets, if appropriate)

1. Spatial modeling
2. Geological applications
3. Geomorphic applications
4. Hydrological applications
5. Ecological applications
6. Soils applications

Sample Software Tools (4-6 examples; if appropriate)

1. ArcGIS (<http://www.esri.com>)
2. GRASS – Geographic Resources Analysis Support System (<http://grass.osgeo.org>)
3. LandSerf (<http://www.landserf.org>)
4. SAGA – System for Automated Geoscientific Analyses (<http://www.saga-gis.uni-goettingen.de>)
5. TAS – Terrain Analysis System (<http://sed.manchester.ac.uk/geography/research/tas/>)

Template (2)



Digital Terrain Modeling (cont.)

Key References (4-6 references)

1. Deng, Y.X. (2007) New trends in digital terrain analysis: Landform definition, representation, and classification. *Progress in Physical Geography* 31: 405-419
2. Hengl, T. and Reuter, H.I. (eds) (2009) *Geomorphometry: Concepts, Software, Applications*. Amsterdam, Elsevier
3. Mitášová, H., Mitas, L., Brown, W.M., Gerdes, D.P., Kosinovsky, I., and Baker, T. (1995) Modeling spatially and temporally distributed phenomena: new methods and tools for GRASS GIS. *International Journal of Geographical Information Systems* 9: 433-446
4. Wilson, J.P. (2011) Digital terrain modeling. *Geomorphology* 137: 107-121
5. Wilson, J.P. and Bishop, M.P. (2013) Geomorphometry. In Shroder, J.F. (ed) *Treatise in Geomorphology: Volume 3, Remote Sensing and GIScience in Geomorphology*. San Diego, CA, Academic Press: 162-186
6. Zhou, Q., Lees, B.G., and Tang, G.A. (eds) (2008) *Advances in Digital Terrain Analysis*. Berlin, Springer Lecture Notes in Geoinformation and Cartography

Version Notes (Sequential list)

Proposed by John Wilson, University of Southern California, 3/18/14

Revised by John Wilson, University of Southern California, 2/18/15



Template ...

Spatial Weights (2-8 bullets, 240 word limit)

- Methods (contiguity-based weights, distance-based weights, kernel weights) and data sources (polygon-based files, point files, data tables) used to generate weights matrices.
- The output of spatial weights operations are a weight matrix in which a cell value represents the spatial relation between feature 1 (row index) and feature j (column index).
- The weights data can be encoded in a GAL or SWT format.
- Spatial weights, which provide spatial relationships between features at different locations, are a key component in many spatial analysis methods and their generation often constitutes the first step in a spatial analysis workflow.
- These workflows usually need the support of a provenance module that can trace the data processing flow and record execution metadata in an interoperable format to ensure replicability.

Which concepts/skills are prerequisites of this concept? (4-6 bullets, if appropriate)

1. Vector data model
2. Spatial dependence
3. Contiguity
4. Transformation
5. Standardization / normalization

For which concepts/skills should this concept be a prerequisite? (4-6 bullets, if appropriate)

1. Spatial autocorrelation
2. Spatial regression
3. Spatial analytical workbench
4. Spatial statistics
5. Spatial econometrics

Sample Software Tools (4-6 examples; if appropriate)

ArcGIS (<http://www.esri.com/software/arcgis>)

GeoDa (<https://geodacenter.asu.edu/software/downloads>)

PySAL (<http://pysal.readtheocs.org/en/v1.7/>)

Spdep (<http://cran.r-project.org/web/packages/spdep/index.html>)

Template (2)



Spatial Weights (cont.)

Key References (4-6 references)

1. Anselin, L. (1988) *Spatial Econometrics: Methods and Models*. Berlin, Springer-Verlag
2. Anselin, L. (2001) Spatial econometrics. In Baltagi, B.H. (ed.) *A Companion to Theoretical Econometrics*. Oxford, UK, Blackwell Publishers: 310-330
3. Anselin, L., Rey, S.J., and Li, W. (2014) Metadata and provenance for spatial analysis” The case of spatial weights. *International Journal of Geographical Information Systems* 28: 2261-2280
4. Rey, S.J. and Anselin, L. (2010) PySAL: A Python library of spatial analytical methods. In Fischer, M.M. and Arthur Getis, A. (eds.) *Handbook of Applied Spatial Analysis*. Berlin, Springer: 175-193

Version Notes (Sequential list)

Proposed by Wenwen Li, Arizona State University, 11/17/14

Revised by John Wilson, University of Southern California, 2/18/15



Call to action ...

Become a contributor

Look for launch of wiki in August

Look for updates and status reports on UCGIS website

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