Modeling Spatial Business Cases with Geodatabases

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Legend
Ecological Zones

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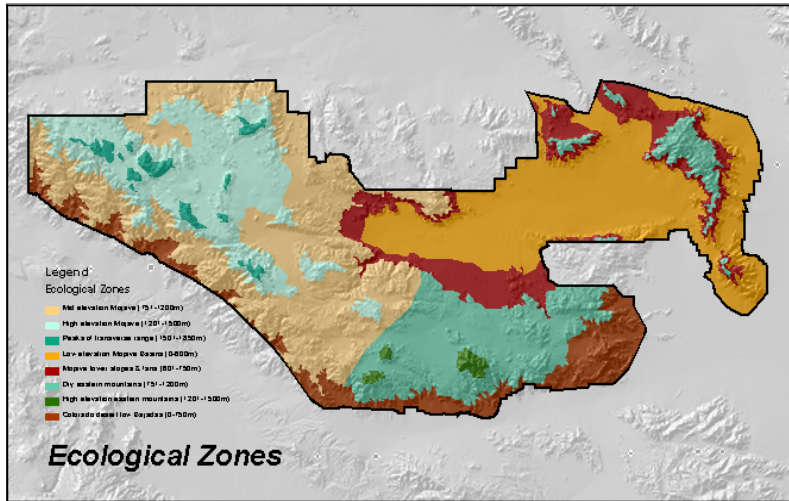
Maps work because we know the "rules" of conventional map reading: blue lines are rivers, North is toward the top of the page, and so on. In a similar way, geographic data models define their own set of concepts and relationships, which must be understood before you can expect to create or interpret your own data model. These concepts relate to how you can represent geographic information in a computer system, rather than, as in the map example, on paper.
   -- Scott Morehouse
      Director of Software Development, ESRI

Geospatial Data Models offer today's spatial professionals several advantages not previously available with traditional CAD, GIS, or relational database technology. To understand these new benefits, it helps to also understand how spatial technology has changed over time.

Introducing Cartography

Cartography existed even in preliterate cultures as early as 2000 B.C. on rocks, sculptural media, or, later, vellum and paper.

Introducing Computer Aided Drafting

Until the 1960's, design of objects, buildings, and infrastructure relied on t-squares, triangles, drafting tables, and similar tools. CAD made the creation, editing, and sharing of design documents more efficient.

Introducing Geographic Information Systems

The file-based data model combining spatial data with attribute data has been dominant from the 1970s through the early 1990s. GIS vendors call this data model the coverage, theme, or layer.

Introducing Relational Databases

In parallel with spatial computing, databases made storage and retrieval of text, numbers, and dates highly performant through use of indexes and sophisticated physical data-storage techniques beginning in the mid-1960s.

**Introducing Spatially Enabled Databases**

In the mid-1990's, some professional database vendors extended their databases to handle not just text, numbers, and dates, but additional types like audio, video, and spatial data (among others).

Introducing Geospatial Data Models

Spatial data stored in a database can be a data "ecosystem" rather than simply raw data. Sharing not only your data, but the rules governing its use and behavior conveys several advantages over the traditional file-system storage techniques.
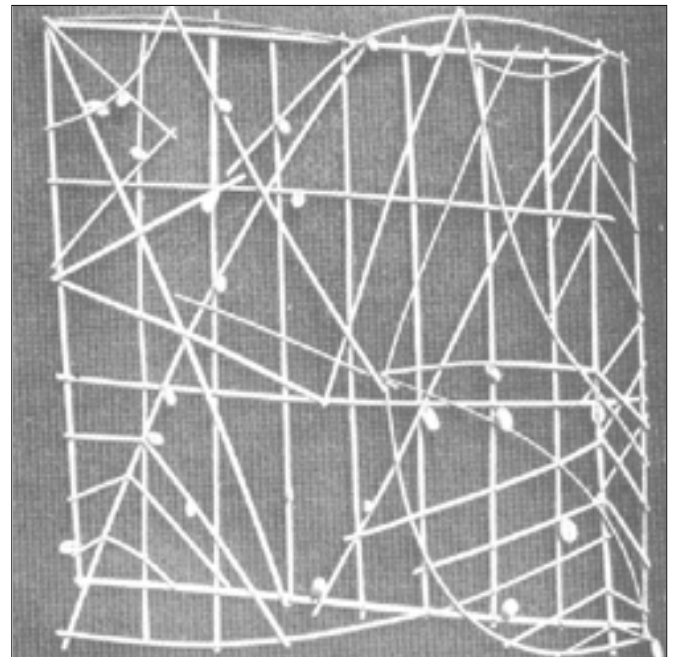
Introducing Cartography

Satisfying navigation and inventory needs with two-dimensional media
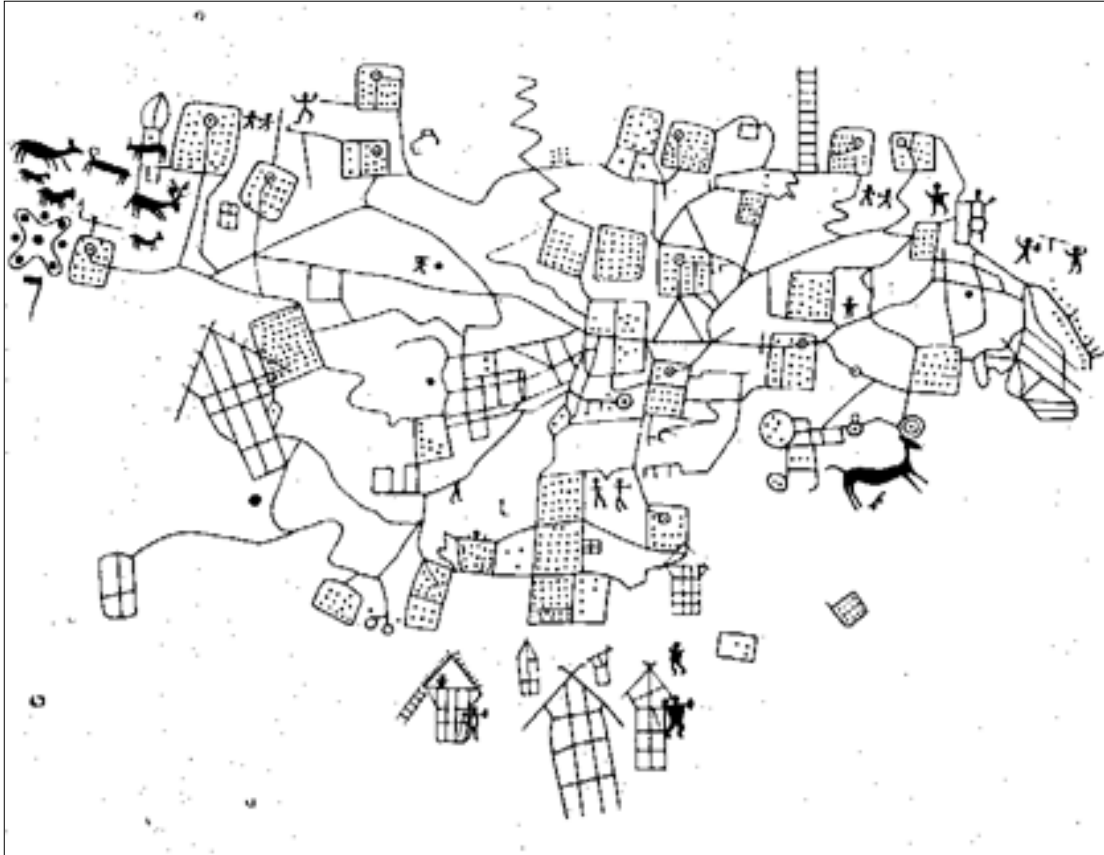
A Bedolina map from northern Italy, ca. 2000-1500 B.C. carved into a rock, possibly depicting humans, animals, houses, fields, streams and wells.

Marshall Islands stick charts show the pattern of wave swells caused by winds, with island positions marked by shells or coral.

# Introducing Computer Aided Drafting (CAD)

Digital drawing software creates efficient ways to share, edit, and print design documents

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Before the 1960's, traditional drafting was the only method of producing technical drawings and architectural drawings. The traditional drafting station was made up of pencils, scales, T-squares, triangles, various other manual drafting tools, and a drafting table.

CAD was popular with people needing professional quality drawings that could also be quickly modified, shared, and reprinted for construction jobs.
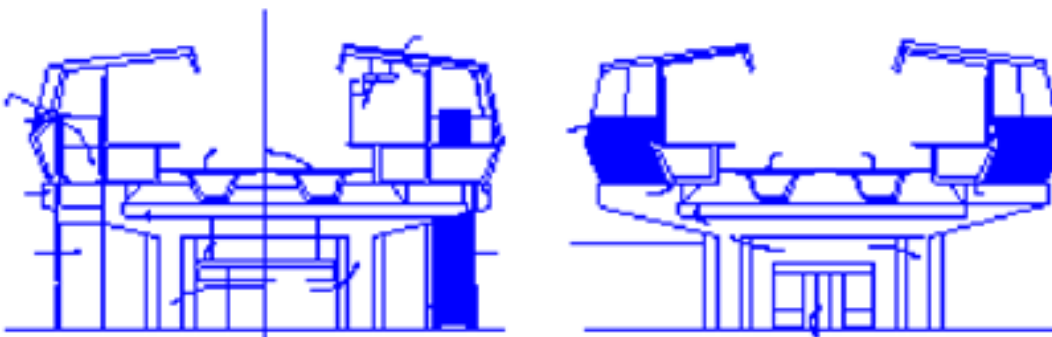
CAD programs store data in binary file formats with representations for points, lines, and areas, but scant information about textual attributes.

Introducing Geographic Information Systems (GIS)

Spatial data is combined with attribute data

Spatial data is stored in indexed binary files, which are optimized for display and access.

Population per Block Group	
	0 - 972
	973 - 1874
	1875 - 3343
	3344 - 6420
	6421 - 35682
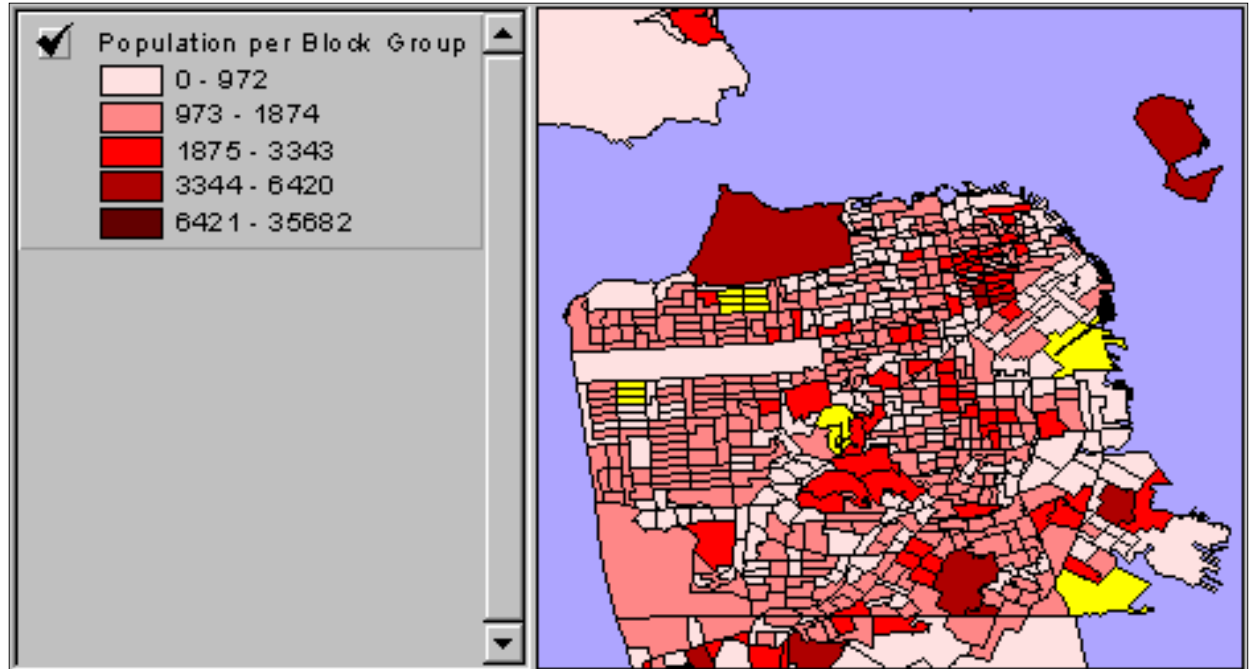
Pop1990	Pop90_sqmi	Households	Males	Females	White	Black	Ameri
1380	33357.5	606	651	729	948	0	
555	8345.9	194	291	264	123	354	1
35	350000.0	0	16	19	16	12	
869	11488.6	303	430	439	290	473	
1245	26728.2	751	588	657	468	366	
990	23365.6	536	433	557	679	25	
1515	19453.0	657	669	846	1151	6	
2246	37203.9	952	1076	1170	1133	32	1
1525	20641.6	535	830	695	303	318	5
118	2220.1	69	19	99	72	39	
1738	38366.4	739	778	960	849	17	
656	37897.2	492	378	278	370	147	3
1243	36764.3	599	665	578	706	299	1
2813	48143.1	683	1485	1328	299	451	1

The attribute data is stored in tables with a number of rows equal to the number of features in the binary tables and joined by a common identifier.

Coverages can store topology.

Introducing Relational Databases

Multiple users and fast response time to questions involving text, numbers, and dates

In a relational database, data is stored in tables. Some tables are related to one another by sharing a common key value. It's possible to join together separate tables based upon their join relationship and answer questions involving both tables, as shown below.
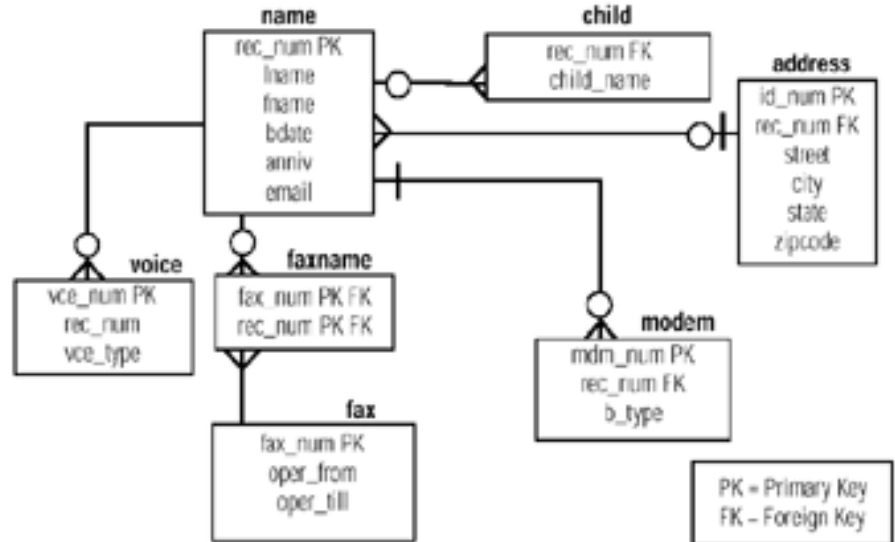

```
SELECT UNIQUE city, state, zipcode, sname
    FROM customer, state
    WHERE customer.state = state.code
```

city	state	zipcode	sname
Bartlesville	OK	74006	Oklahoma
Blue Island	NY	60406	New York
Brighton	MA	02135	Massachusetts
Cherry Hill	NJ	08002	New Jersey
Denver	CO	80229	Colorado
Jacksonville	FL	32256	Florida
Los Altos	CA	94022	California

Introducing Spatially Enabled Databases

The late 1990's, 2000 and onward: The Geodatabase Data Model

This new data model lets you make the features in your GIS datasets smarter by endowing them with natural behaviors, and to allow any sort of relationship to be defined among features. Implementation happens not with code, but through domains, validation rules, and other functions provided by GIS manufacturers.

Introducing Geographic Data Models

Using database triggers and procedures to enforce business rules and relationships

(Trigger) Whenever anyone INSERTS, UPDATES, or DELETES records in this table…
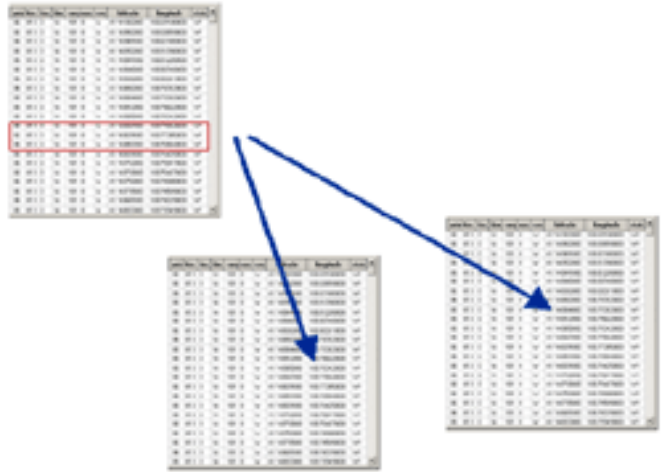
(Procedure) Also make a change to records, rows, or columns in the same table, other tables, or both.

Consider a real-world example:

(trigger)
   Whenever a new student is added to the students table…

(procedure 1)
   Geocode her address into the address-points table,
(procedure 2)
   Calculate the distance between her address and the location of her department's main building in facilities table,
(procedure 3
   If the distance is greater half a mile, set the value of the "mail a bus brochure" field in the new students table to TRUE.