



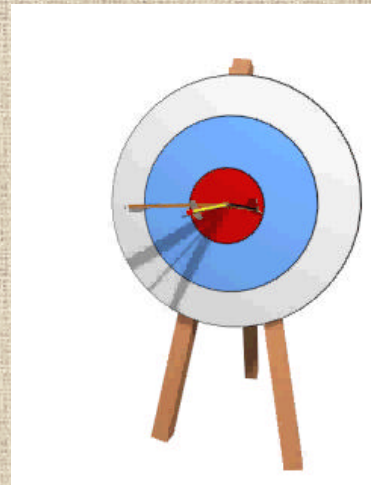
Software



presented by:
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Columbia

The aim of this presentation...

- Introduce the parts and pieces of a GIS
- Explain the components of a GIS system
- Review computer networks
- Examine peripherals
- What the future holds



Components of a GIS



- People - needs
- Data
- Methods
- Software
- Hardware

People, People, People



- building the GIS
 - who KNOWS the data
 - sharing experience
- maintaining the GIS
 - develop & maintain skills
 - salaries to retain qualified personnel
- creating the products
 - maps, reports, applications
- plan for the future
 - upgrading, maintenance
 - personnel

Data

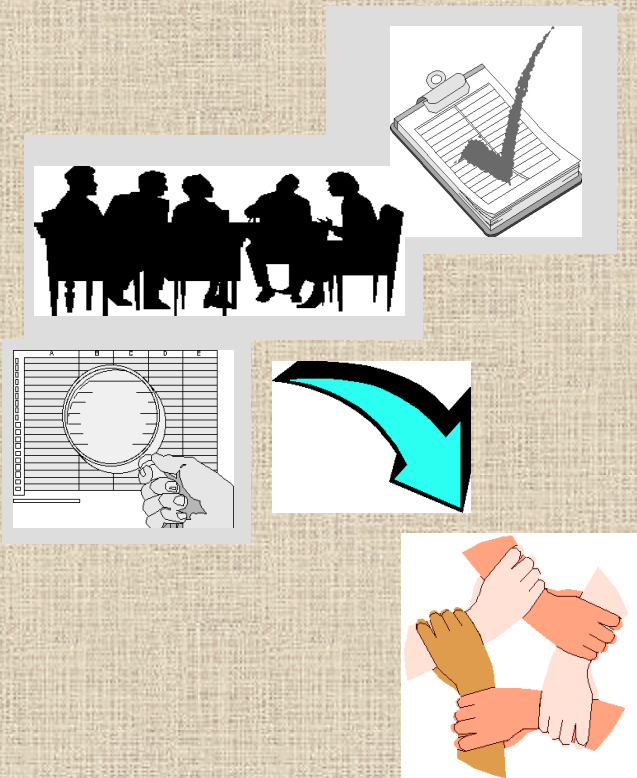
The image shows a screenshot of a database application with two overlapping tables. The top table is titled 'Attributes of California Counties' and the bottom table is titled 'income data'.

Fips	City no.	City pop.	Sub-region	Stat. flag
6001	1526	1	Pacific	1
6003	1384	3	Pacific	1
6005	1430	5	Pacific	1
6007	1853	7	Pacific	1
6009	1466	9	Pacific	1
6011	1139	11	Pacific	1
6013	1502	13	Pacific	0
6015	1472	15	Pacific	1
6017	636	17	Pacific	1
6019	1283	19	Pacific	1
6021				

Fips	City name	inc. p. cap.
6001	Alameda	12455
6003	Alpine	11019
6005	Amador	9365
6007	Butte	9047
6009	Calaveras	9554
6011	Colusa	8791
6013	Contra Costa	14553
6015	Contra Costa	14553
6017	Dal Norte	7554
6019	El Dorado	10927
6019	Fresno	9238

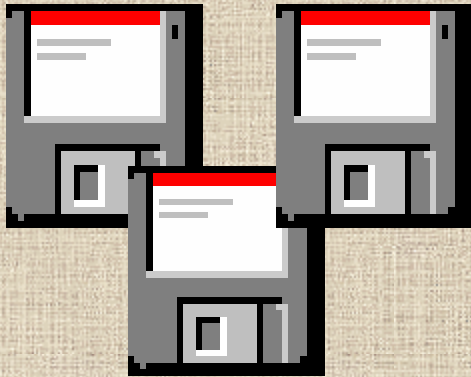
- who, what, when, where
- conversion issues
- hypermedia & retrieval
- automation
- ownership & sharing
- quality control
- database design
- normalization

Methods



- Operate according to a well-designed plan and business rules
 - models and operating practices unique to your organization
 - decide what you do well and what could be done better to meet your goals
 - flow of information
 - buy-in at all levels

Software



- System software
- Peripheral drivers
- Firewall
- Inter / Intranet
- GIS software
- Desktop applications
 - word processing
 - desktop publishing
 - spreadsheets
 - RDBMS

Computer Hardware and Peripherals



- server/mainframe
- PC/workstation
- digitizers
- scanners
- CD-ROM
- external storage devices
- UPS
- printer

Before you jump...



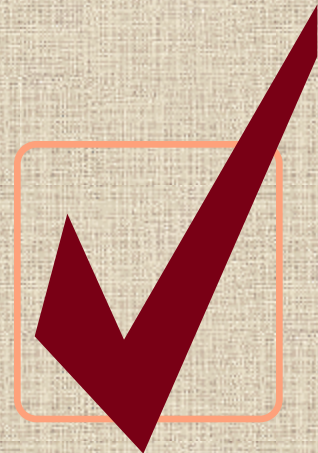
- Know what you can handle
 - business plan -strengths and room for improvement
 - well designed methodology
 - buy-in from top to bottom of agency
- Plan for the future-where are you going?
 - two years? five years? ten years?
- Don't forget maintenance and upgrade
 - equipment -obsolescence and repair
 - people -skill sets and salary increases

GIS Software

Needs should define what you use!

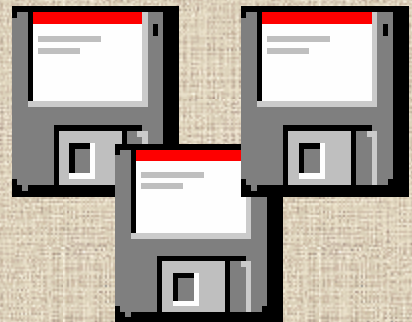
Software Functional Components

- User Interfaces
- Database Management
- Database Creation
- Data Manipulation and Analysis
- Data Display and Product Generation



GIS Software Issues

- Identification of GIS needs and functions
- GIS Software Differences
- Differentiating Factors
 - Attribute links to graphics
 - Database management system
 - Topology capture
 - ‘Seamless’ database
 - Network connectivity
 - Applications available



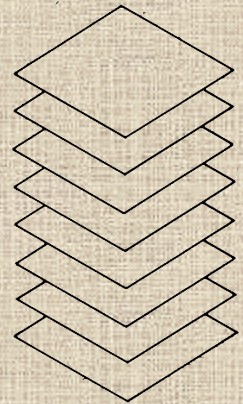
User Interfaces

- ❑ Command driven interface with ___ without ___ prompt and answer interface with default answers
- ❑ Capability for pull-down or pop-up menus
- ❑ Interactive command language interface
- ❑ Ability to use command aliases
- ❑ Allow for macros, scripts, or batch
- ❑ Online help screens to summarize commands (available, syntax, function, limitation)
- ❑ Online ___ or draft ___ users manual & tutorials
- ❑ Undo command to retract entry
- ❑ Recall command to restore entry
- ❑ User-friendly error messages
- ❑ Soft error recovery
- ❑ Password access protection

Database Management

GENERAL

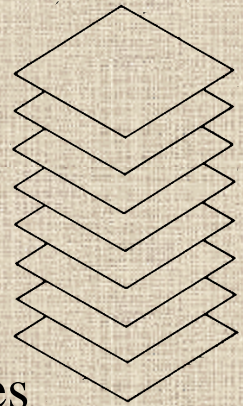
- ⇒ Facility for entering data quality information for both spatial and attribute database, including: lineage, positional accuracy, logical consistency, & completeness.
- ⇒ Facility for tracking database transactions
- ⇒ Support for sequential, direct, and keyed access to data files
- ⇒ Data Dictionary
- ⇒ Direct access to specific features in addition to sequential file access
- ⇒ Allow sorting of tabular or graphic files by attribute or spatial data field



Database Management

GENERAL

- ⇒ Calculate values for new fields - arithmetic / LUT
- ⇒ Capability to relate data files by shared fields
- ⇒ Capability to set read, write, access authorities on both spatial and attribute databases
- ⇒ Provide ability to create, store, retrieve & generate standard reports
- ⇒ Provide the following formatting capabilities (line breaks, page breaks, totaling, subtotals, headings)



Spatial Database Components

- ☑ Provision for organizing spatial files by location, project, theme & map unit.
- ☑ Provision for multiple access to permanent data files.
- ☑ Provision for authorized user for database modification.
- ☑ Provision for full add, delete, modify of user created files.
- ☑ Capability to automatically catalog or index data in database.
- ☑ Generation of status reports on content and condition of database.
- ☑ Capability to add data files without regard to size or scale.

Database Creation

METHODS

- Manually digitize 2-D point, line, polygon, & arc/node data
- Photogrammetrically digitize 3-D point, line, & polygon data
- Manually encode cellular data (raster)
- Scanned map data
- Scanned photographic data



Database Creation ~ Continued

TAGGING

- Assign feature names or codes which may be pointers to feature attributes while digitizing
 - keyboard entry
 - numeric
 - field length
 - menu pad entry
 - text
 - string length
 - cursor pad entry
- Facility for setting initial default values and duplicating previous entries



Database Creation - Continued

ASSIGNING TOPOLOGY

- Arc pointers to areas (Automatic & Manual (A/M))
- Arc pointers to nodes (A/M)
- Node pointers to arcs (A/M)
- Node pointers to areas (A/M)
- Area pointers to arcs (A/M)
- Area pointers to nodes (A/M)
- Polygon assembly from arcs (A/M)
- Identification and linking of complex objects (A/M)
- Snapping environments
- Automatic polygon closure
- Automatic polygon centroid generation



Database Creation - Continued

ERROR DETECTION & EDITING

- Raster or Vector Data
- Automatic topologic error checking, graphic display of errors & facility for interactive correction
- Format checking, range checking, value checking on vector coordinate data or raster pixel data during digitizing or batch mode
- Interactive insertion, deletion, changing, moving, or vector features or raster pixels by feature or groups of features
- Automatic checking for over/undershoots at line intersections during digitizing and correction tools



Database Creation - Continued

ATTRIBUTE & FEATURE NAMES/CODES

- Interactive insertion, deletion, changing, moving of feature names or codes
- Check for feature names or codes that are missing
- Check for illegal names/codes while digitizing
- Check for illegal attribute values or combinations of attribute values
- Query select function for updating groups of graphic, feature name, or attribute records

IMPORT / EXPORT

- Ability to import various data set formats
- Ability to export various data set formats





Data Manipulation & Analysis **RETRIEVAL**

- ✓ Selection of a specific data category
- ✓ Selection of spatial or attribute data through graphic interface
- ✓ Selection of spatial or attribute data through redefined or reclassified data categories
- ✓ Selection of spatial or attribute data by feature name or group
- ✓ Selection of spatial data by Boolean retrievals on attributes
- ✓ Selection of spatial or attribute data by graphic hooks
- ✓ Browsing either spatial or attribute databases



Data Manipulation & Analysis ~ Continued

RESTRUCTURING

- ✓ Data conversion from raster to vector & vector to raster
- point, line & polygon
- ✓ Interactive or automatic edge matching using user-specified tolerances
- ✓ Compression and decompression routines
- ✓ Modify raster cell size through resampling
- ✓ Coordinate smoothing
- ✓ Contour generation from Z-value data and converse
- ✓ TIN generation from Z-value data
- ✓ Constrain contour generation (ridge, streams, faults)
- ✓ Provision for input and modification of coordinate geometry (survey data)



Data Manipulation & Analysis ~ Continued

TRANSFORMATION

- ✓ Mathematical adjustment of vector or raster data using control points (4 or 6 parameter)
- ✓ Recovery of geographic ground coordinates from digitized photographic data
- ✓ Transformation of ground survey bearing and distance data to geographic coordinates
- ✓ Radiometric calibration of remotely sensed digital imagery or scanned photography
- ✓ Re-scaling of raster data values (contrast stretching)
- ✓ Projection conversions (robust set with documentation)



Data Manipulation & Analysis ~ Continued **VECTOR or RASTOR OVERLAY**

- ✓ Boolean overlay operators for vector data
(point/poly; poly/poly; point/line; line/poly)
- ✓ Boolean overlay operators for raster data
(point/poly; poly/poly; point/line; line/poly)
- ✓ Ability to weight features within a data category during overlay
- ✓ Ability to superimpose one data category on another w/replacement
- ✓ Ability to merge attribute data resulting from graphical composting process



Data Manipulation & Analysis ~ Continued

RASTER CELL OPERATIONS

- ✓ Ability to assign binary, discrete, or real continuous data values to class
- ✓ Ability to perform mathematical operations on two or more raster data categories
- ✓ Ability to perform mathematical operations on single raster data categories
- ✓ Ability to replace cell values with new values reflecting neighborhood operations
- ✓ Ability to conduct supervised and unsupervised clustering



Data Manipulation & Analysis ~ Continued

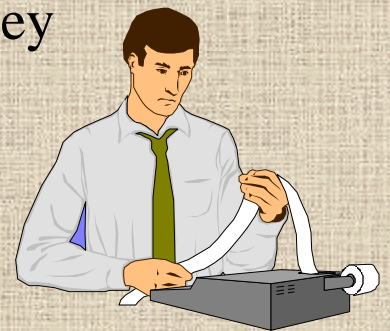
GENERAL

- ✓ Ability to specify distance buffers from point, line & polygon features
- ✓ Determine alternative & optimum paths through a network
- ✓ Automatically identify drainage networks, watersheds and viewsheds
- ✓ Perform cut/fill and profile analysis on terrain data
- ✓ Generate slope, aspect, and sun intensity data categories
- ✓ Compute azimuth, bearings, and geographic point locations
- ✓ Define, open and close, and adjust traverses



Data Manipulation & Analysis ~ Continued STATISTICS

- ✓ Calculate areas, perimeters, lengths, and volumes
- ✓ Calculate acreage and percent of total for cross tabulations
- ✓ Computer simple descriptive statistics
- ✓ Conduct statistical analysis on tabular data (regression, correlation, ANOVA, etc.)
- ✓ Support T-test, chi-square, Mann-Whitney
- ✓ Support normal, Poisson and binomial distributions
- ✓ Calculations of confidence intervals



Data Display & Product Generation

GENERAL

- Generate graphic displays on terminals, plotters, printers
- Display source raster or vector files
- Generate maps via copy of display screen
- Generate maps larger than the physical dimensions of output device (mosaic)
- Generate 2.5-D perspectives
- Compose display interactively
- Capability to specify location, size, scale, orientation of multiple viewports on a single display
- Ability to display point, line and polygon info
- Ability to display neat lines, grid lines, tick marks, other reference marks
- Ability to select point symbols, line types, area fill patterns and character fonts



Data Display & Product Generation

MAP & MAP FEATURE ANNOTATION

- Facility for creating, naming, storing, retrieving and interactively positioning map titles, legends, scale bars, orientation, text strings
- Ability to specify font type, case, size, color, and string orientation
- Ability to automatically position text at prespecified point locations
- Facility for creating, name, storing, editing, and selecting point symbols, line patterns, and area fill patterns

