Modelización de datos Geográficos

Software SIE/SIG

Geographical Information Systems and Science
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John Wiley and Sons Ltd

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- Modelos de datos / modelización
- Modelos de datos en SIG/SIE
  - Topología
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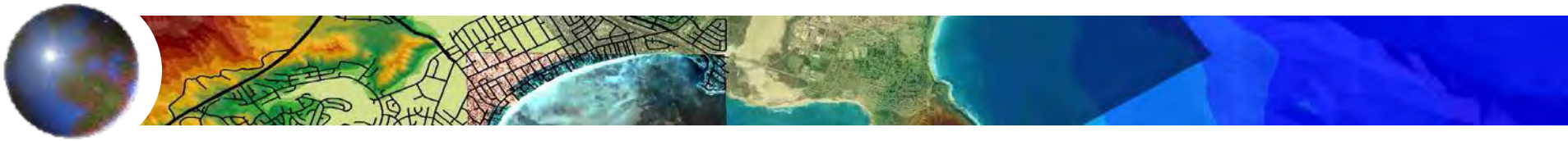
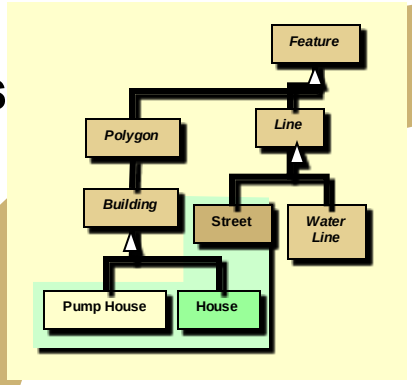


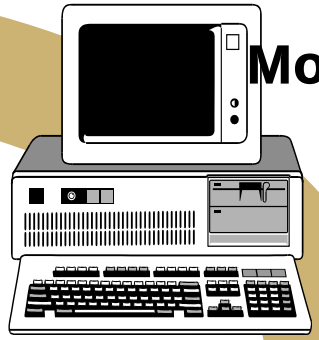
Definiciones

- Modelo de datos
  - Sistema para representar objetos y procesos en un entorno digital.

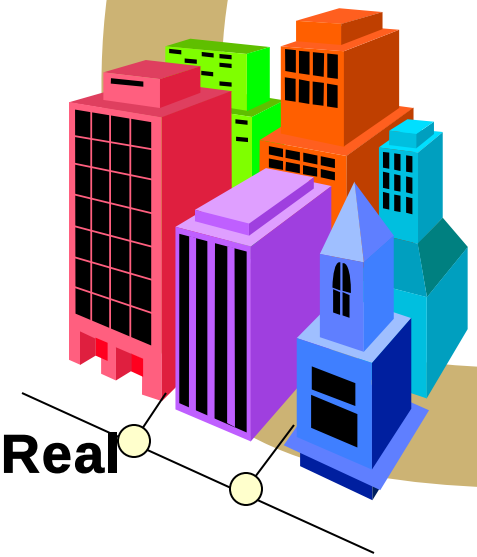
Papel del Modelado de Datos

Modelo de Datos en SIG/SIE
Descripción y Representación





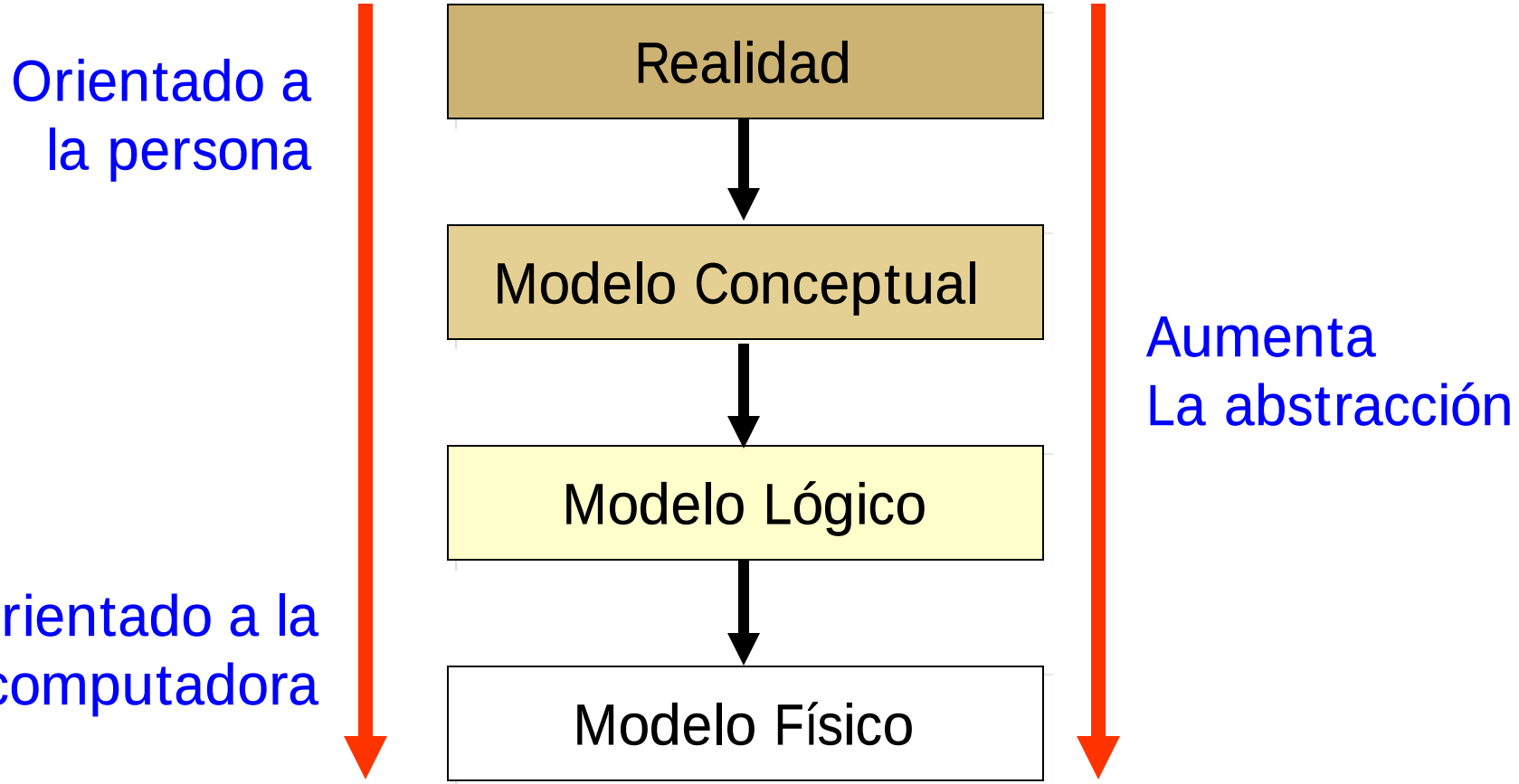
Modelo Operacional En SIG /SIE
Análisis y Presentación



Mundo Real

Personas
Interpretación y Explicación

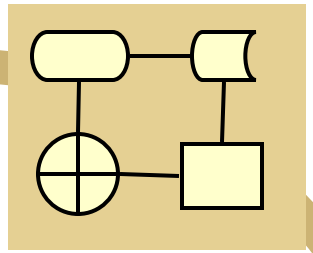
Niveles en Modelos de Datos



Proceso de Modelado

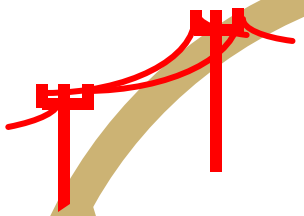
Modelo Conceptual

Listas, flujos,diagramas, etc



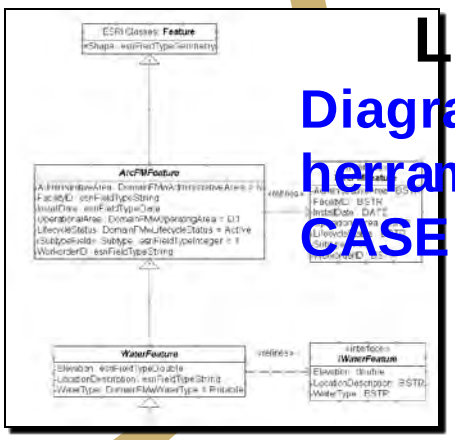
Mundo Real

Objetos y relaciones



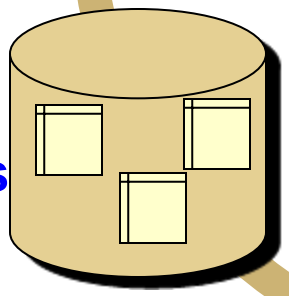
Modelo Lógico

Diagrama en herramientas CASE



Model físico

Esquema de Base de Datos (Estado del objeto



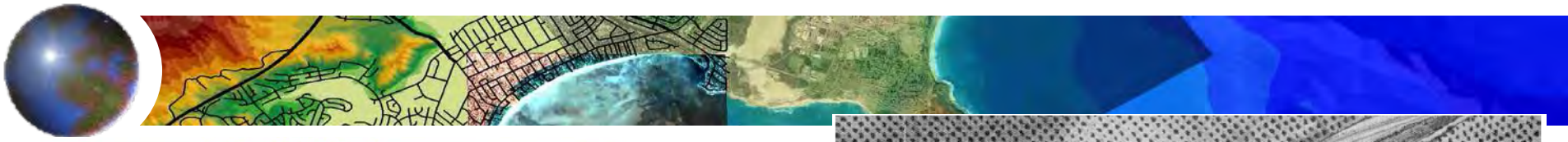
Modelo de datos SIG /SIE& Aplicaciones

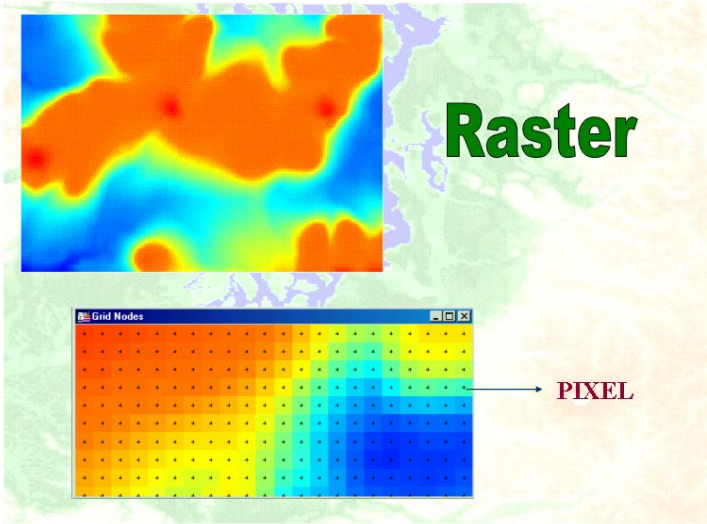
- CAD
- Gráficos sin topología
- Imagen
- Raster/Grid
- TIN
- Vector /Geo-relacional
- Objeto

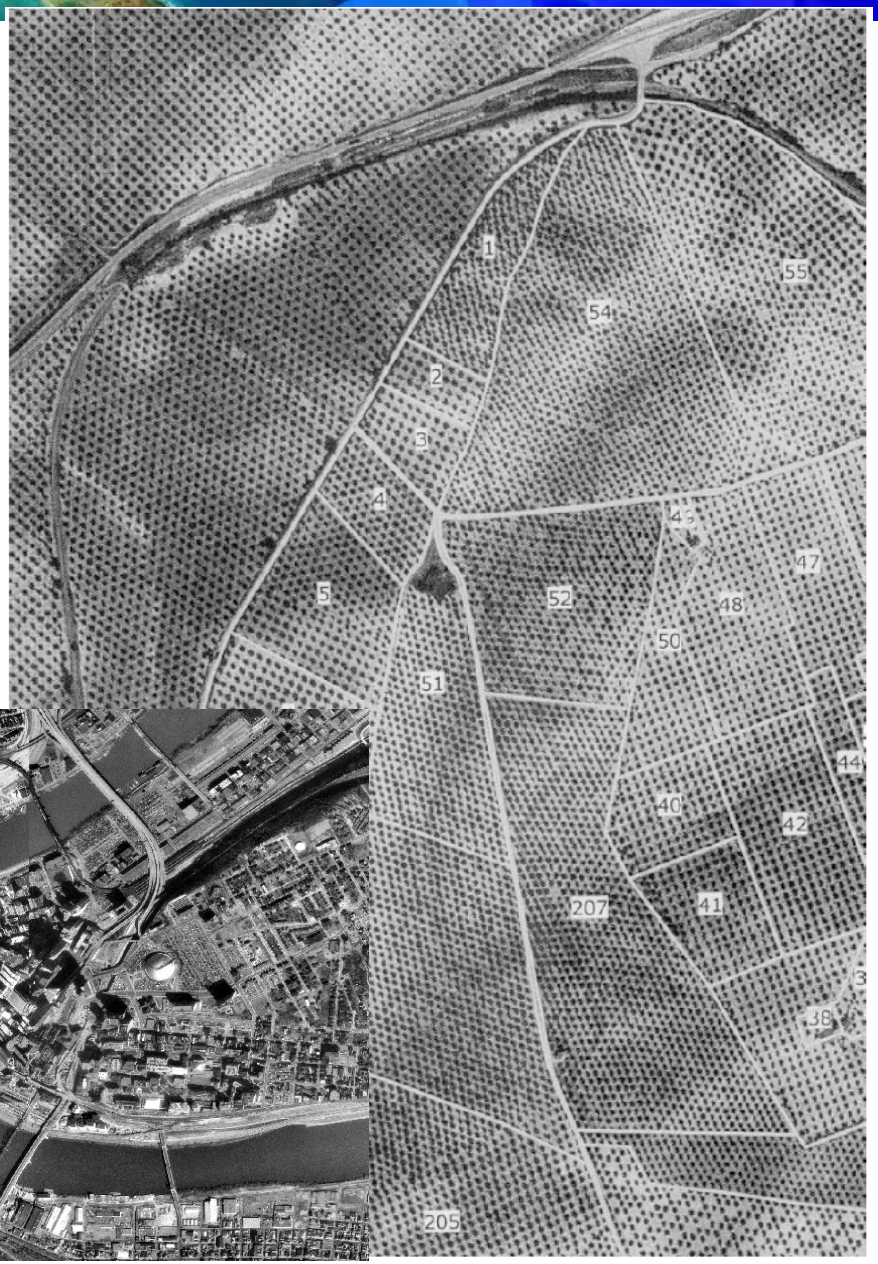
- Diseño en Ingeniería
- Mapas básicos
- Análisis y procesamiento de imágenes
- Análisis espacial / Modelización espacial
- Superficies /análisis de terrenos / modelado
- Geoprocesamiento de entidades geométricas
- Entidades con comportamiento

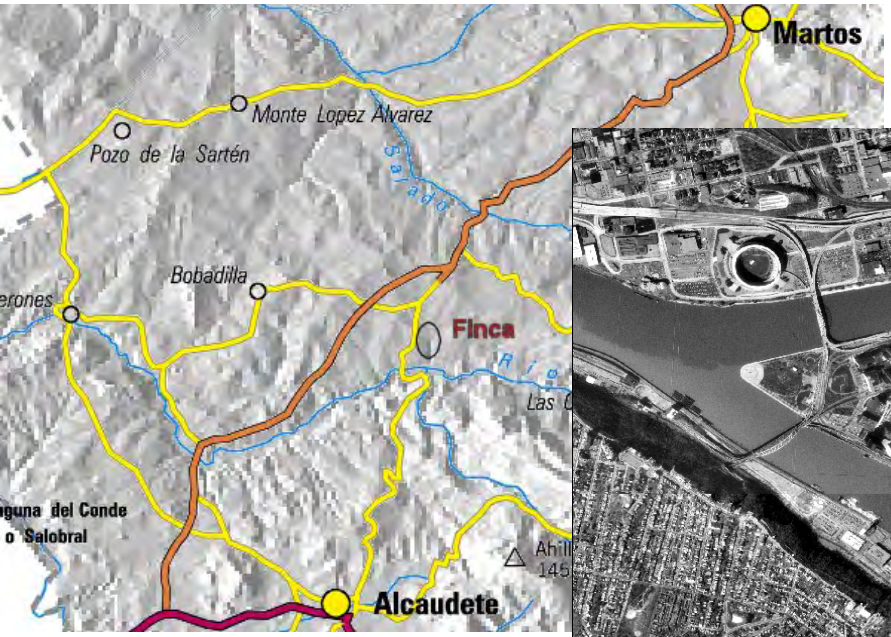
Modelos Raster y Vector

- Raster – implementación del modelo conceptual de campo
  - Matrices de celdas usadas para representar objetos
  - Util como fondo para mapas y para análisis espacial
- Vector – implementación del modelo conceptual de objeto discreto
  - Representaciones de punto, línea y polígono
  - Ampliamente usado en cartografía y análisis de redes

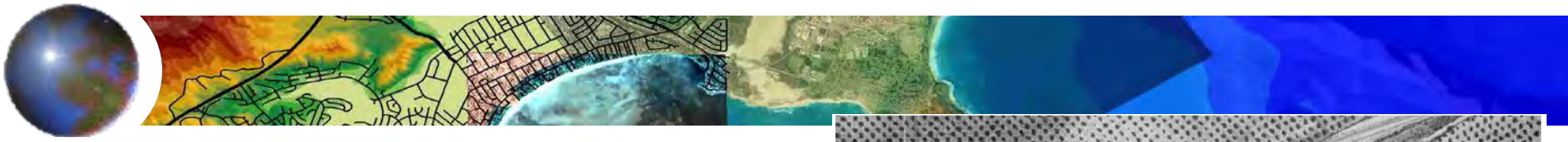


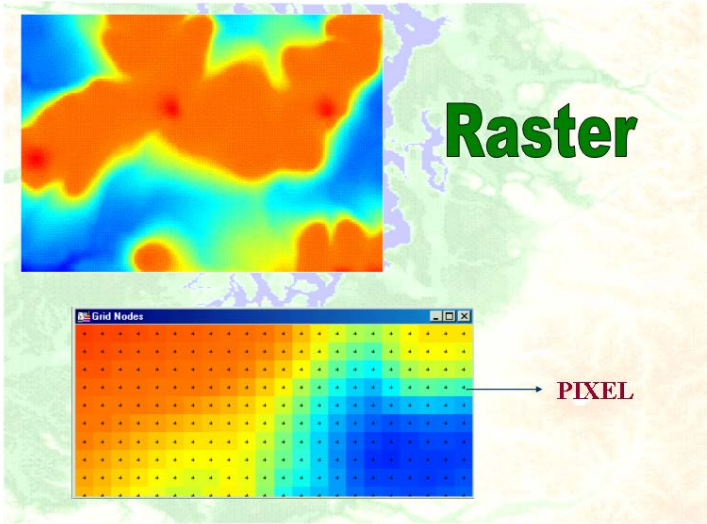


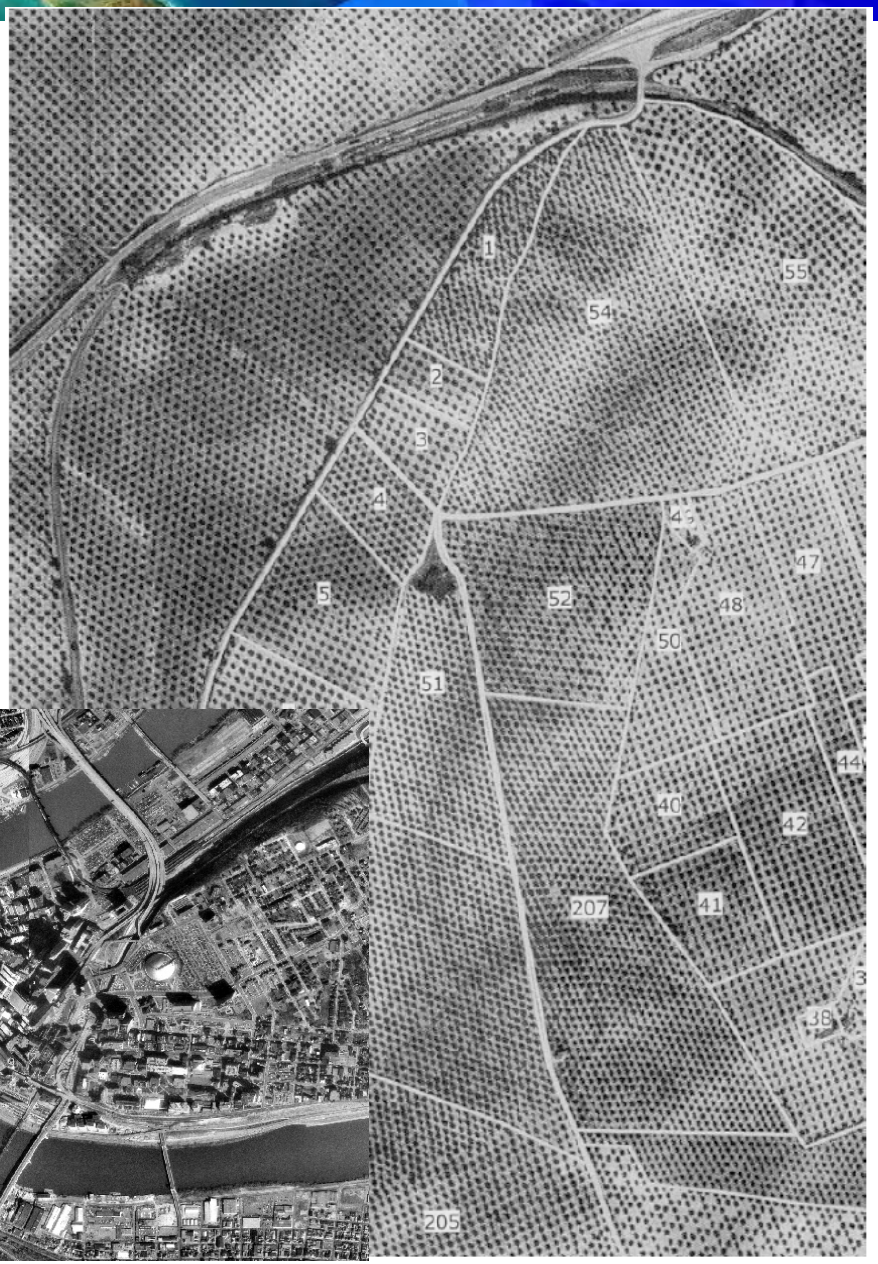


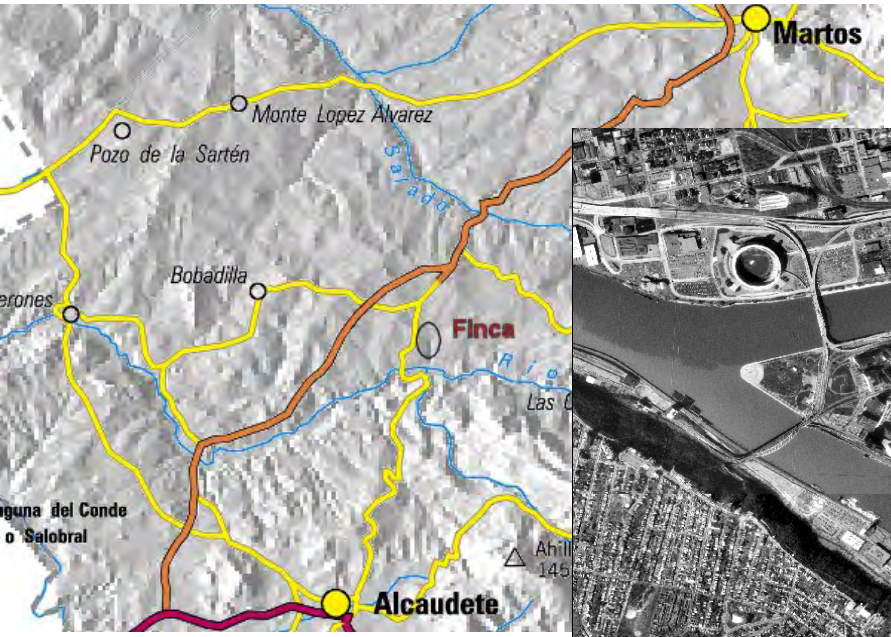


Fuente: SIG Oleícola Español (MAPA, 2001b)



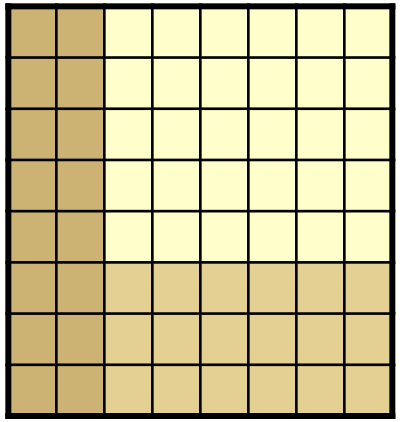


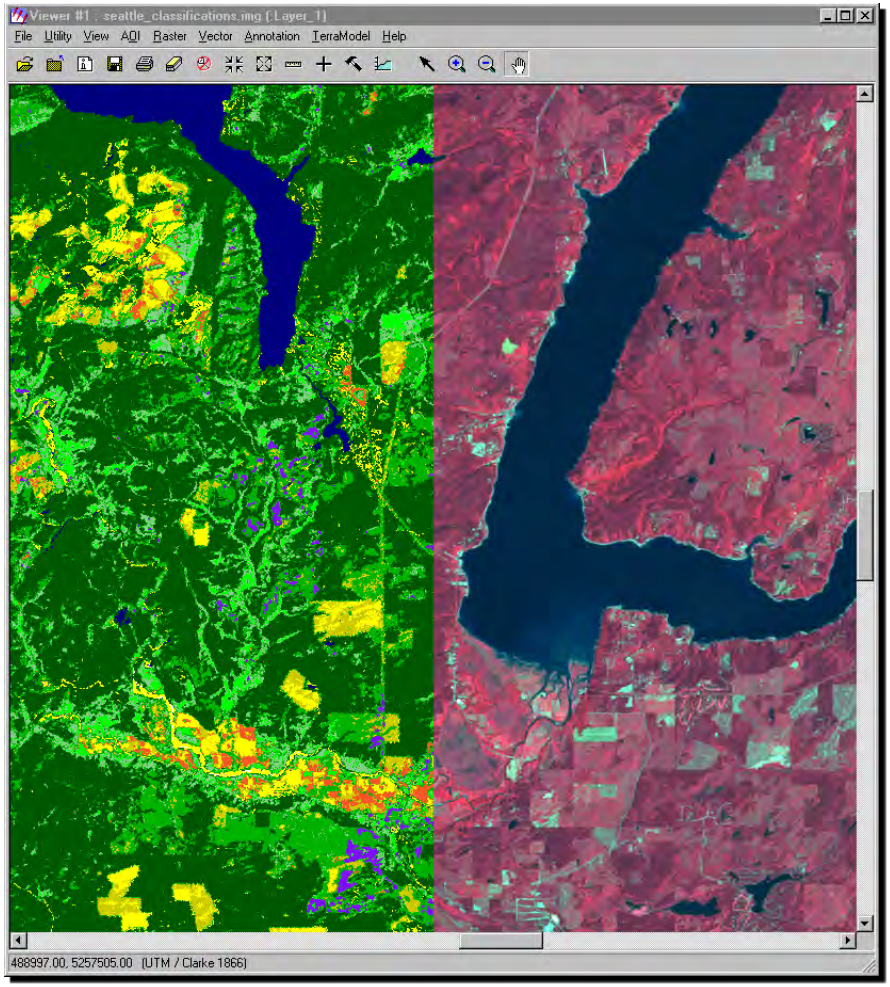




Fuente: SIG Oleícola Español (MAPA, 2001b)

Raster – Imágenes de Satelite

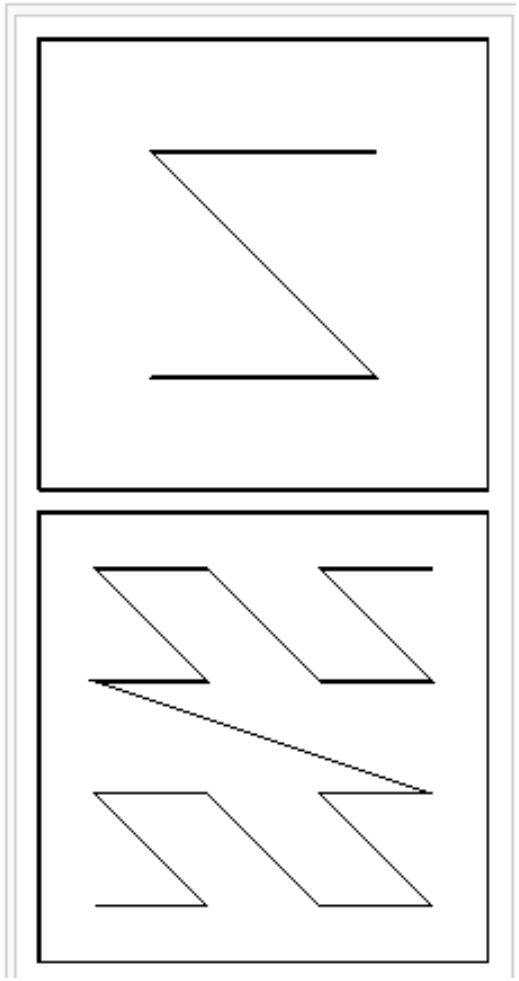


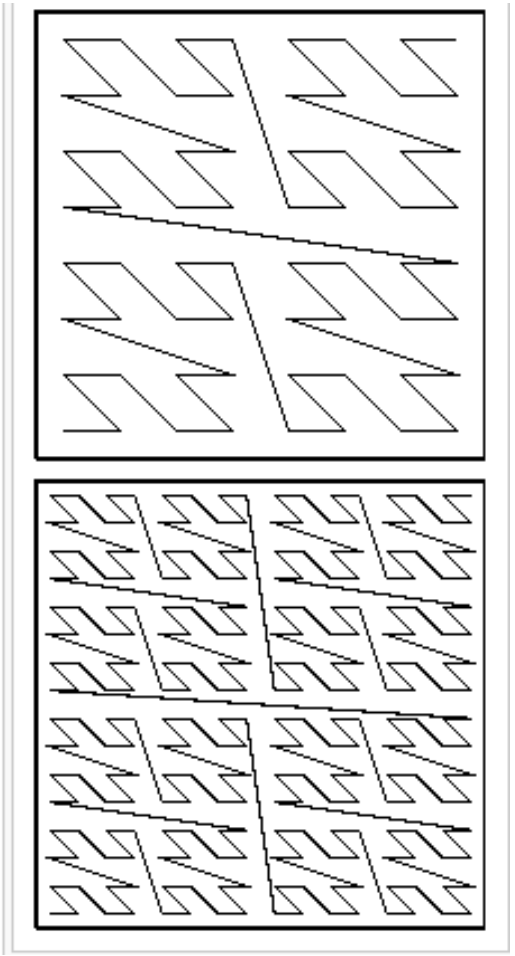


Enumeración exahustiva
Codificación Run-Length
Codificación quad-tree

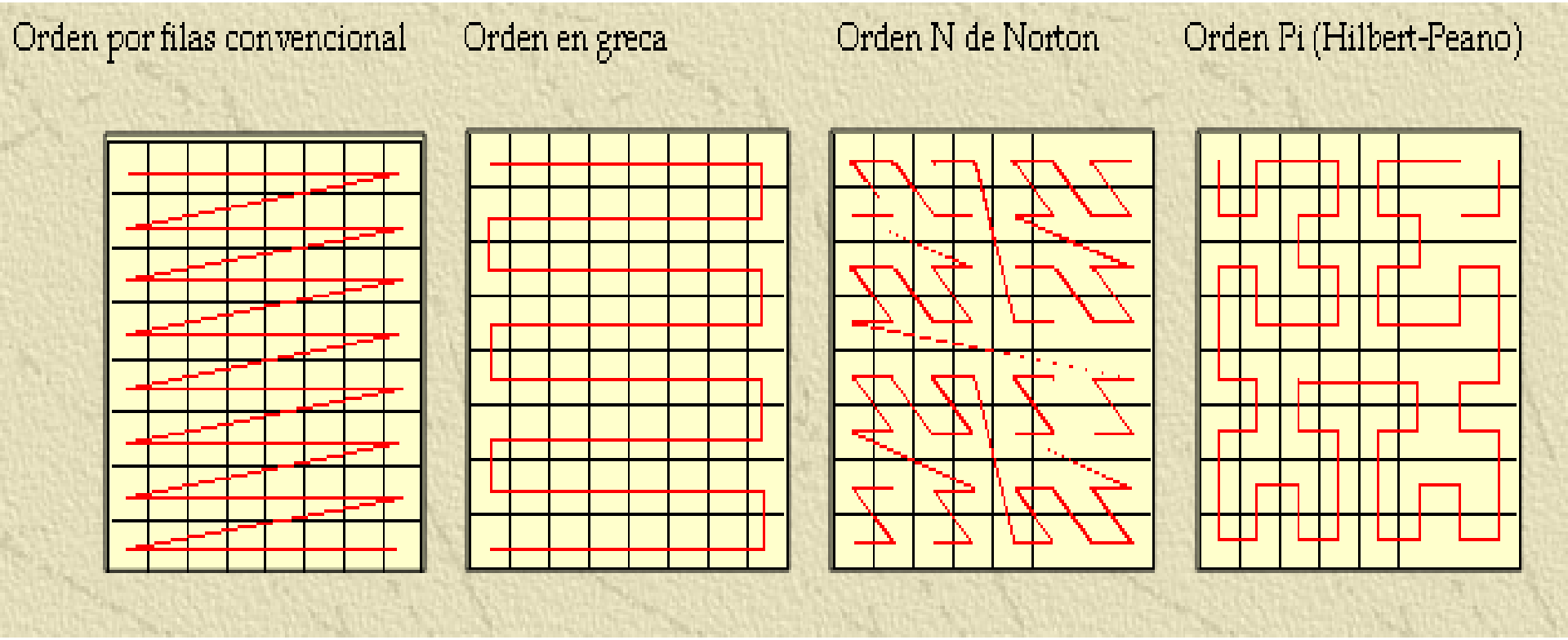
Otras (wavelet)

Raster –





Raster –



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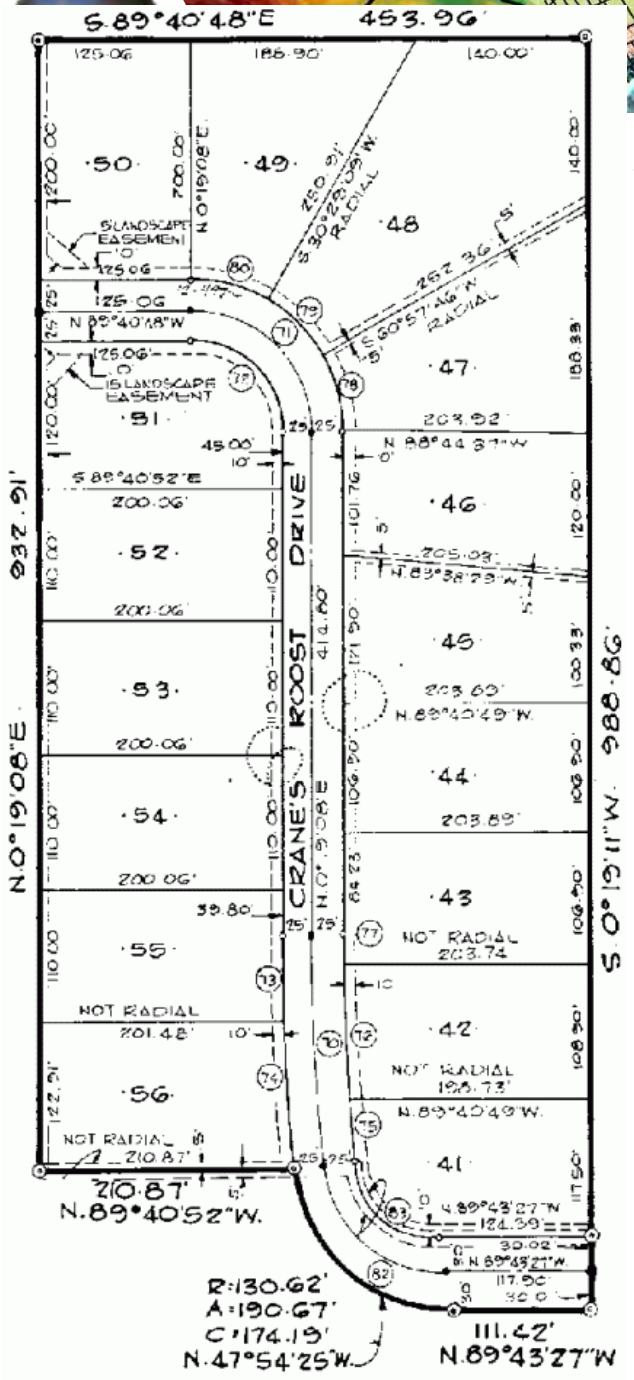
Raster:

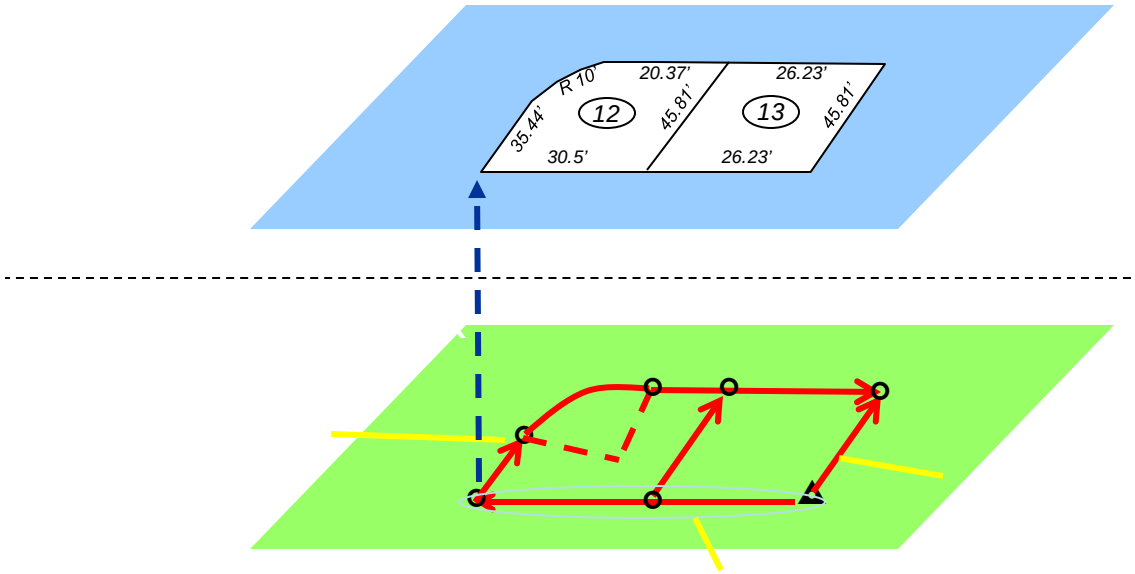
- Matriz de datos; - Multibanda; - Modelo Piramidal; - Coordenadas imagen/mundo: transformaciones
- Valor Cuantitativo, Valor Cualitativo
- Análisis raster: transformaciones espaciales; coincidencia espacial; proximidad; análisis de superficies; coincidencias; caminos mínimos

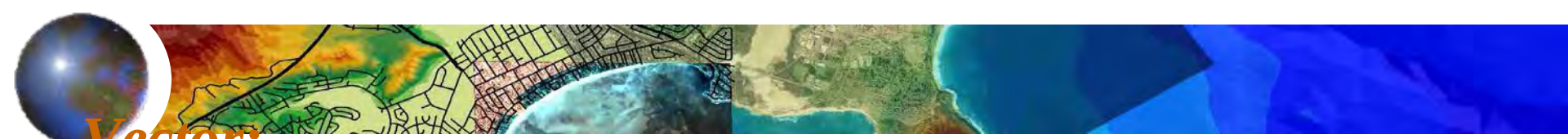
** Ventajas: -estructura de datos simple; fácil superposición; - diversos tipos de análisis; tamaño y forma uniforme; más barato; ...

** Desventajas: -voluminoso; -menos exactitud; -complejidad de las transformaciones; - problemas de escalas diferentes entre capas; - pérdida de información al generalizar; ...



Vector – Registro de tierras





Vector:

- Puntos(); líneas(); polígonos(); paralelepipedos(); poliedros

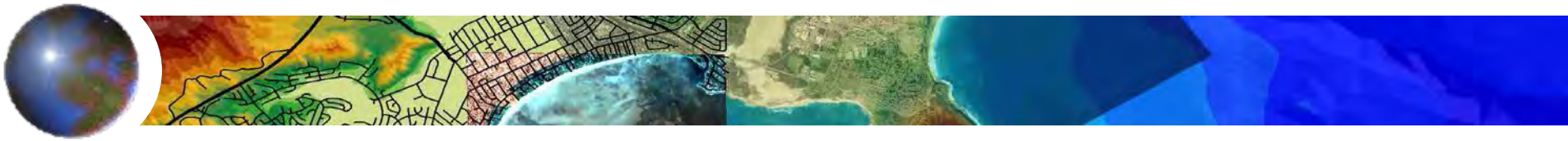
-Enlace de atributos a entidades

- ventajas:

- ***buena representación de la realidad***
- ***estructura de datos compacta***
- ***la topología se reduce a un grafo***
- ***gráficos adecuados***

- desventajas:

- ***estructura de datos compleja***
- ***la simulación puede ser difícil***
- ***algunos análisis difíciles o imposibles***



Topología

- Ciencia y matemáticas de las relaciones geométricas
  - Entidades simples + reglas topológicas
  - Conectividad
  - Adyacencia
  - Nodos /aristas compartidos
- Usos de la Topología

Topología

- Usos de la Topología
  - Validación de datos (calidad y usabilidad)
    - Conectividad
    - Intersección de líneas (“espagueti”; 2D-3D)
    - Superposición
    - Líneas – elementos duplicados
  - Modelado del comportamiento en entidades gráficas comunes o parcialmente comunes
  - Edición adecuada: compartición de elementos, rubberbanding, “snapping”-ajuste, auto-closure, trazabilidad
  - Consultas optimizadas (análisis): análisis de redes, adyacencia, conectividad, intersección, contenido,...

Estructuras de datos: Modelo vectorial

- Ficheros DIME (Oficina del censo de USA)
  - Topología completa.

    - Fichero de vértices:
      - Código
      - coordenadas.
    - Fichero de segmentos:
      - Código
      - Polígono izquierda y polígono derecha
      - Vértice inicial y vértice final
    - Fichero de polígonos:
      - Código
      - Código de los segmentos rectos
- TIGER: (tambien censo USA): Topologically Integrated Geographic Encoding Referencing:

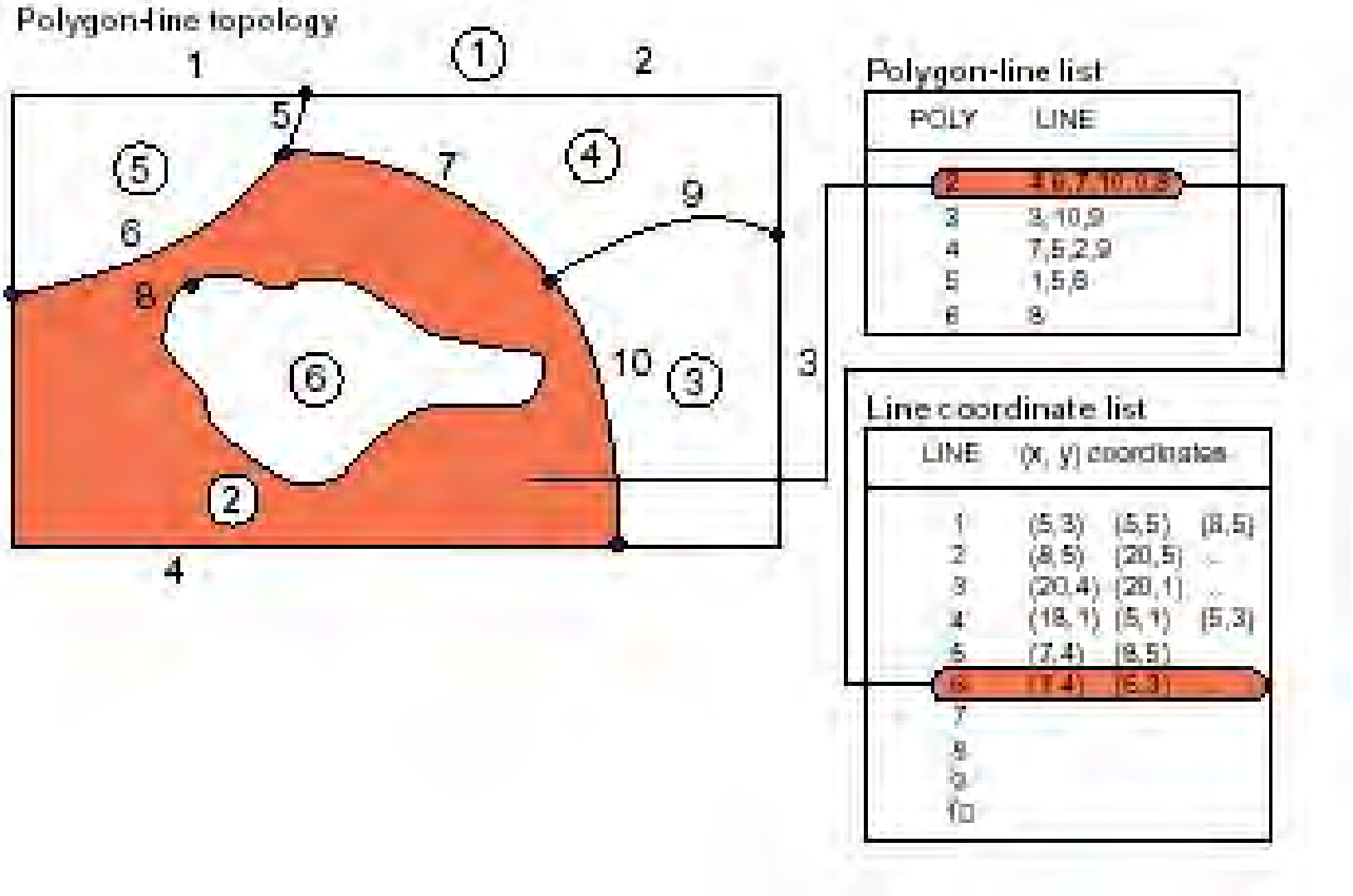
Estructuras de datos: Modelo vectorial

- Modelo arco-nodo: más adaptada a entidades naturales.
- Laboratorio de Harvard (1975)

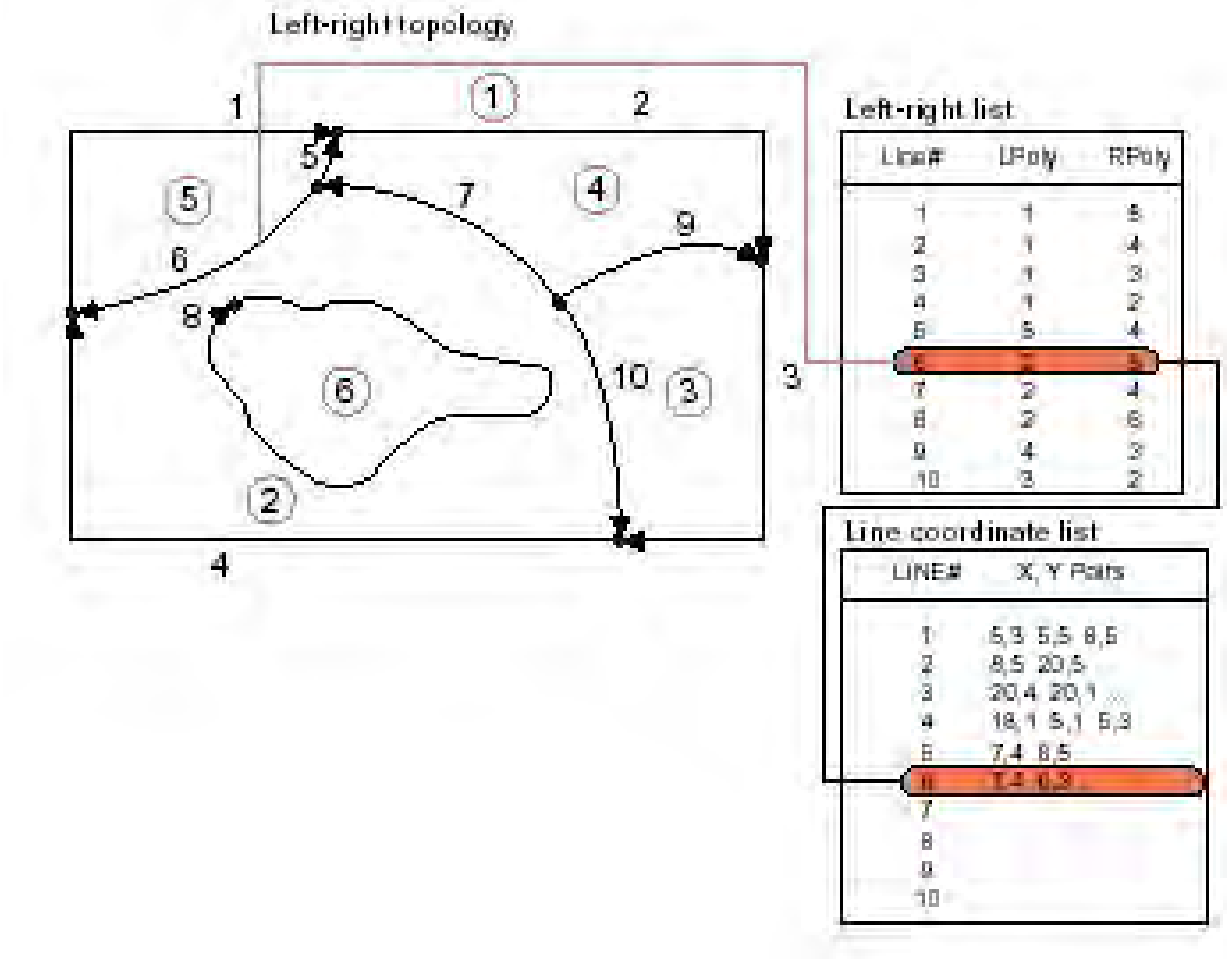
  - Fichero de arcos.
    - Código
    - Nodo origen, intermedios (VERTICES) y final (en coordenadas)
  - Topología de arcos
    - Código
    - Código nodo_origen, nodo_fin, poli_derecha y poli_izquierda
  - Topología de polígonos: arcos que lo definen. Signo-
  - Topología de nodos.
    - Codigo de nodo
    - Código de los arcos que lo contienen

      (Los objetos puntuales se codifican como nodo y como arco)

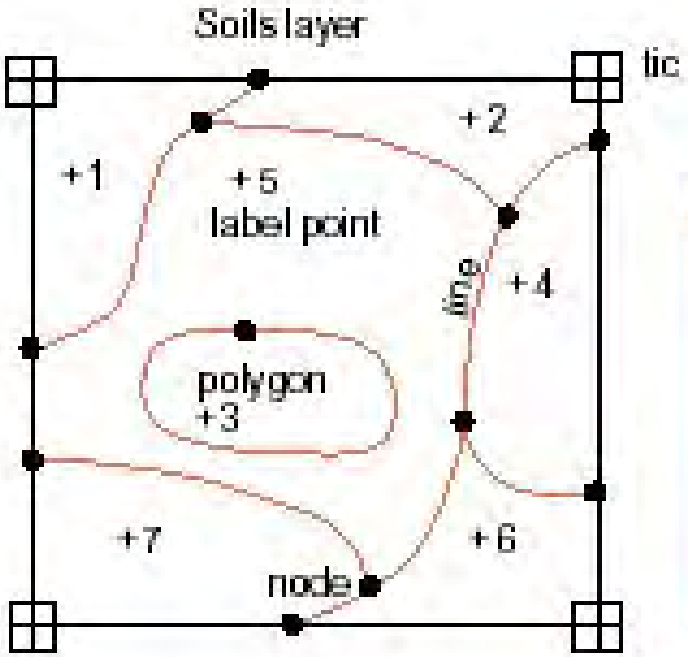
Polígonos



Arcos



Modelo Geo-relational



Soils attributes

ID	Soil	Class	Suitability
1	A3	113	HIGH
2	C6	95	LOW
3	B7	212	MODERATE
4	B13	201	MODERATE
5	Z22	86	LOW
6	A6	77	HIGH
7	A1	117	LOW

Modelo de datos de RED

Especial tipo de modelo topológico

-Tipos:

-Radiales (dos direcciones)

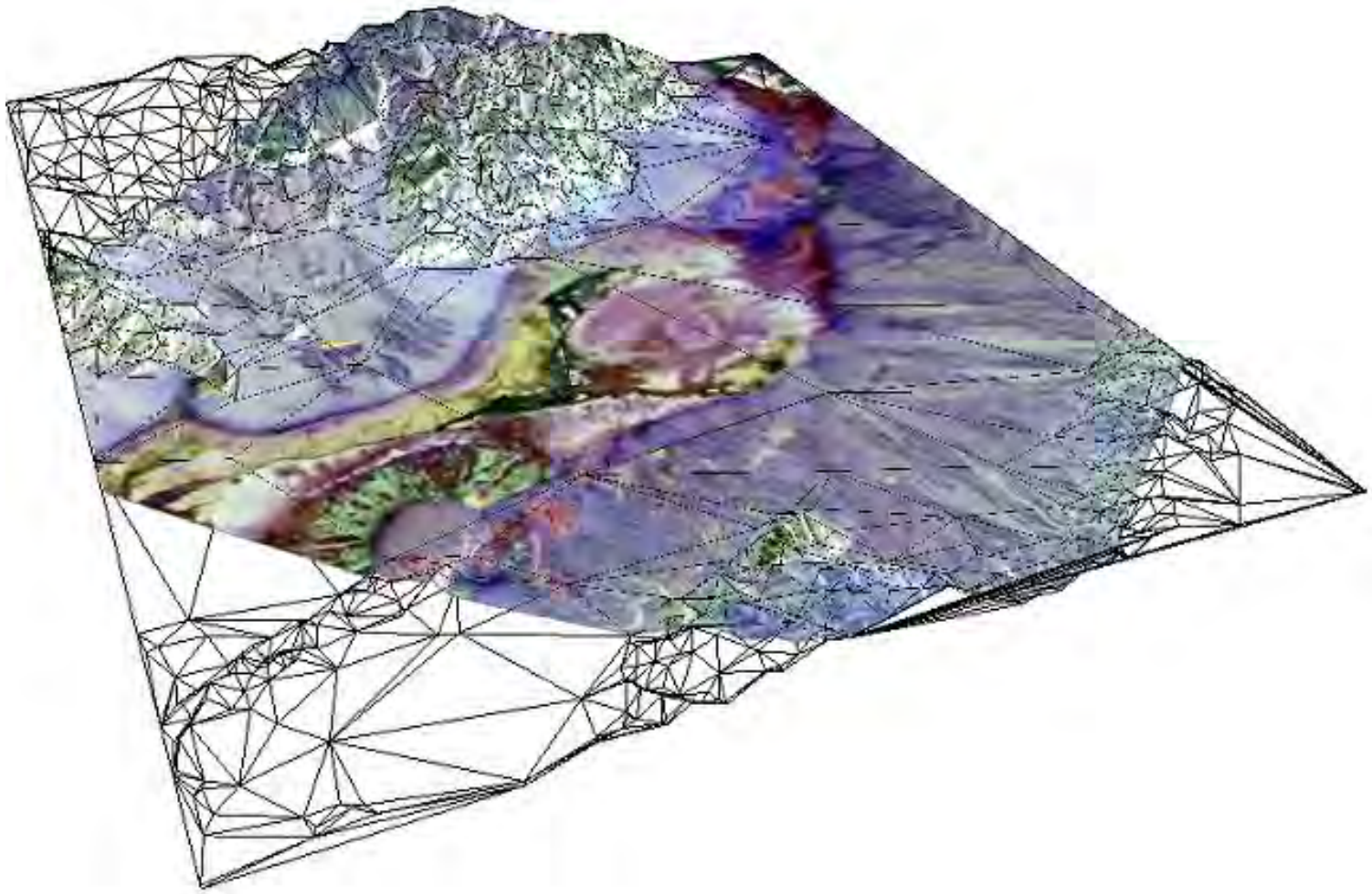
-Bucle: posibles intersecciones

-Se modelan: puntos (nodos), líneas y …

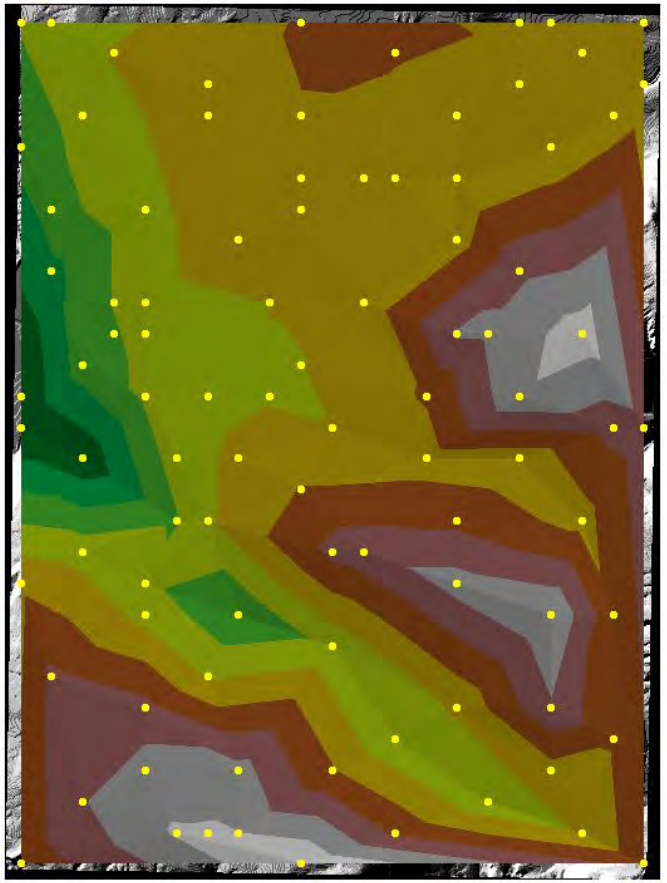
…direcciones de flujo (con un valor de peso o impedan

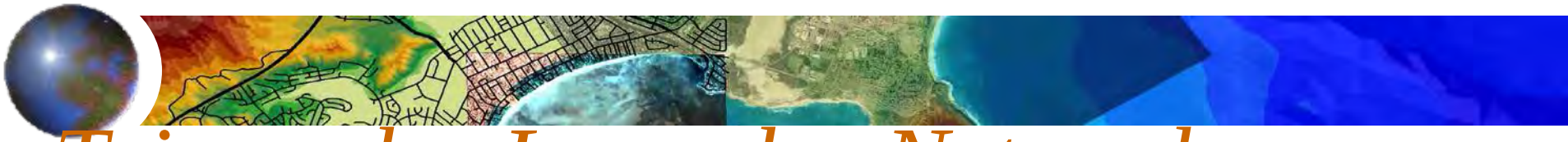
-Usar, si es posible, georreferenciación lineal

Triangular Irregular Network



- **Modelo de datos usado para representar objetos tridimensionales. X,Y y X coordenadas de puntos. Métodos de la geometría computacional. Los puntos se conectan mediante triángulos. Aristas y Caras.**
- **Aunque más complejo que otros modelos, es el más usado para elevaciones de terrenos y otro tipo de superficies. Permite tratar mayor densidad de valores en unas zonas que en otras.**
- **Figura: TIN de un terreno a partir de datos de altitud.**
  - **Se determinan una serie de puntos.**
  - **Se crean los TIN**
  - **Se aplican texturas a las caras para simular la realidad**

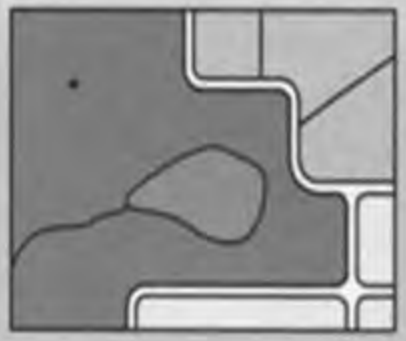
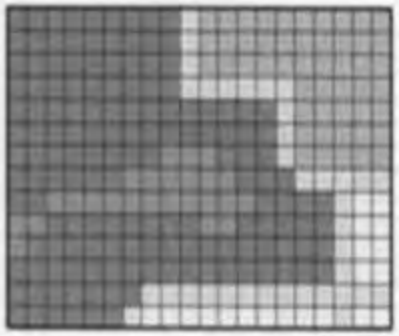
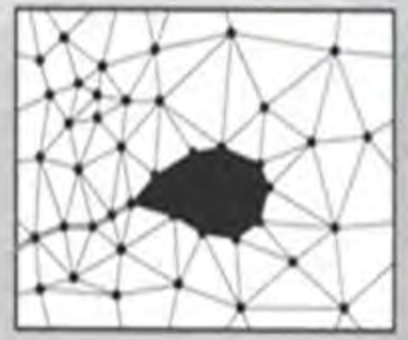




Triangular Irregular Network

- Modelado de superficies
- Relación con los DEM
- Distancias y Triangulación Delaunay (Thiessen)
  - Triángulos mínimos, Líneas de rotura,...
- Estructura: Id, nodos, vecinos
- LOD

Anotaciones: Simbología, texto,…

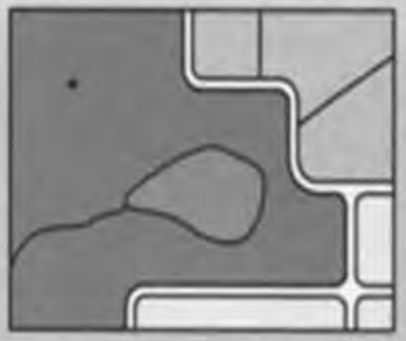
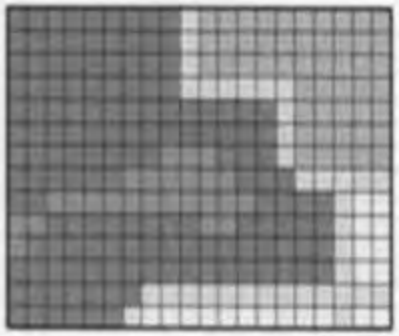
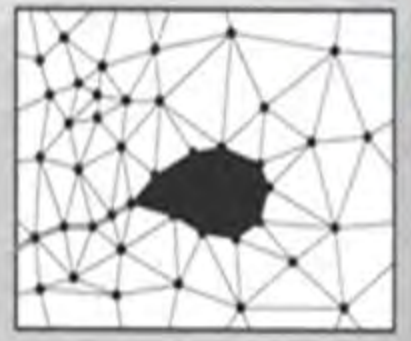
	Vector data representation	Raster data representation	Triangulated data representation
			
Focus of model	Vector data is focused on modeling discrete features with precise shapes and boundaries.	Raster data is focused on modeling continuous phenomena and images of the earth.	Triangulated data is focused on an efficient representation of a surface that can represent elevation or other quality, such as concentration.

Características:

Vector

Raster

TIN

	Vector data representation	Raster data representation	Triangulated data representation
			
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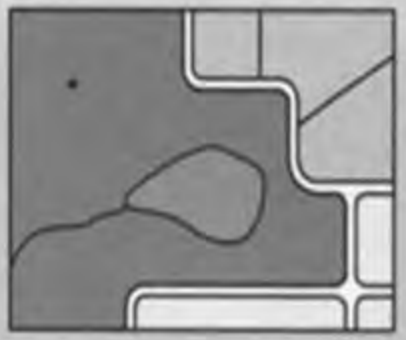
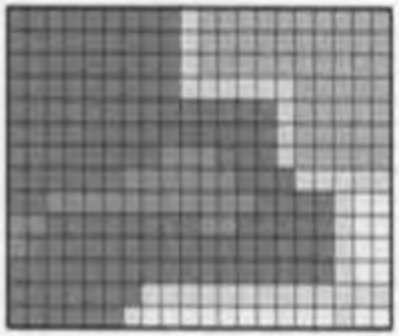
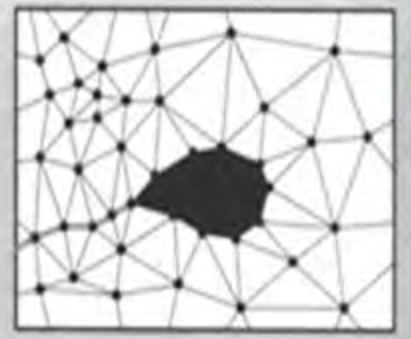
Sources of data	Compiled from aerial photography Collected from GPS receivers Digitized from map manuscripts Sketched on top of raster display Vectorized from raster data Contours from triangulation Reduced from survey field data Imported from CAD drawings	Photographed from an airplane Imaged from a satellite Converted from a triangulation Rasterized from vector data Scanned blueprints, photographs	Compiled from aerial photography Collected from GPS receivers Imported points with elevations Converted from vector contours

Características:

Vector ***Raster*** ***TIN***

	Vector data representation	Raster data representation	Triangulated data representation
			
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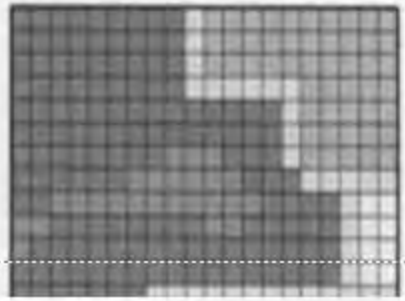
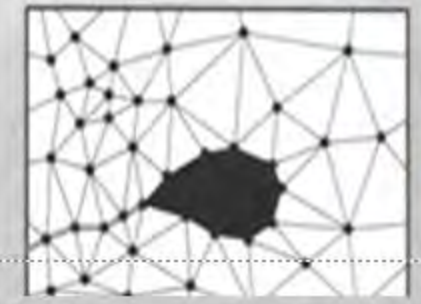
Spatial storage	Points stored as x,y coordinates. Lines stored as paths of connected x,y coordinates. Polygons stored as closed paths.	From a coordinate in the lower-left corner of the raster and cell height and width, each cell is located by its row and column position.	Each node in a triangle face has an x,y coordinate value.

Características:

Vector ***Raster*** ***TIN***

	Vector data representation	Raster data representation	Triangulated data representation
			
Spatial storage	Points stored as x,y coordinates. Lines stored as paths of connected x,y coordinates. Polygons stored as closed paths.	From a coordinate in the lower-left corner of the raster and cell height and width, each cell is located by its row and column position.	Each node in a triangle face has an x,y coordinate value.
Feature representation	Points represent small features. Lines represent features with a length but small width. Polygons represent features that span an area.	Point features are represented by a single cell. Line features are represented by a series of adjacent cells with common value. Polygon features are represented by a region of cells with common value.	Point z values determine the shape of a surface. Breaklines define changes in the surface such as ridges or streams. Areas of exclusion define polygons with the same elevation.

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		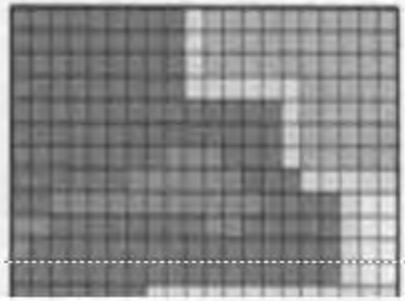	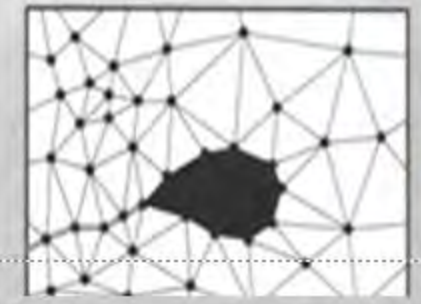
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Topological associations	Line topology keeps track of which lines are connected to a node. Polygon topology keeps track of which polygons are to the right and left sides of a line.	Neighboring cells can be quickly located by incrementing and decrementing row and column values.	Each triangle is associated with its neighboring triangles.

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		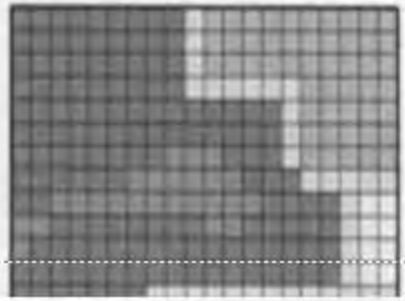	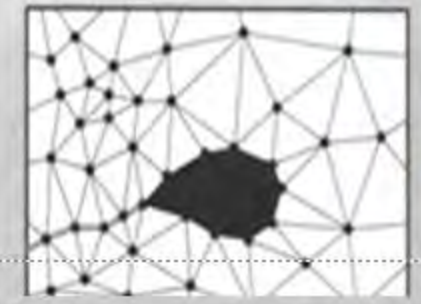
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		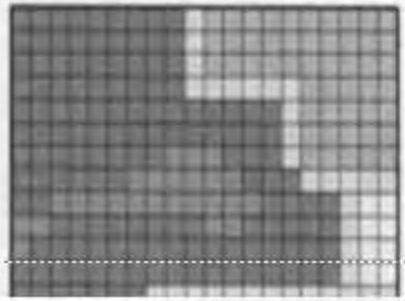	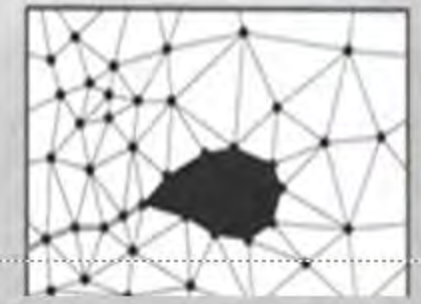
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Cartographic output	Vector data is best for drawing the precise shape and position of features. It is not well suited for continuous phenomena or features with indistinct boundaries.	Raster data is best for presenting images and continuous features with gradually varying attributes. It is not generally well suited for drawing point and line features.	Triangulated data is best for rich presentation of surfaces. This data can be viewed by using color to show elevation, slope, or aspect or in a three-dimensional perspective.

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	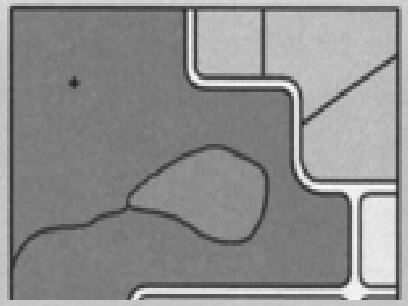	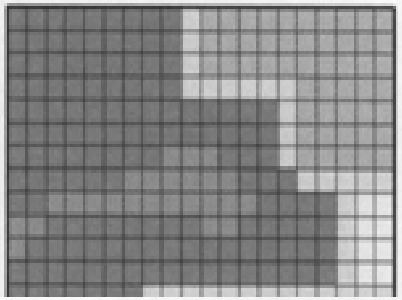	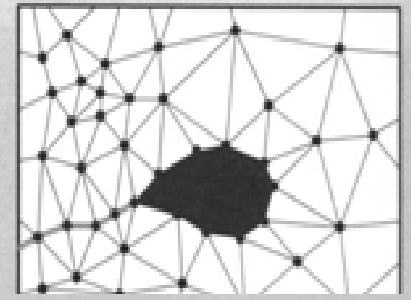
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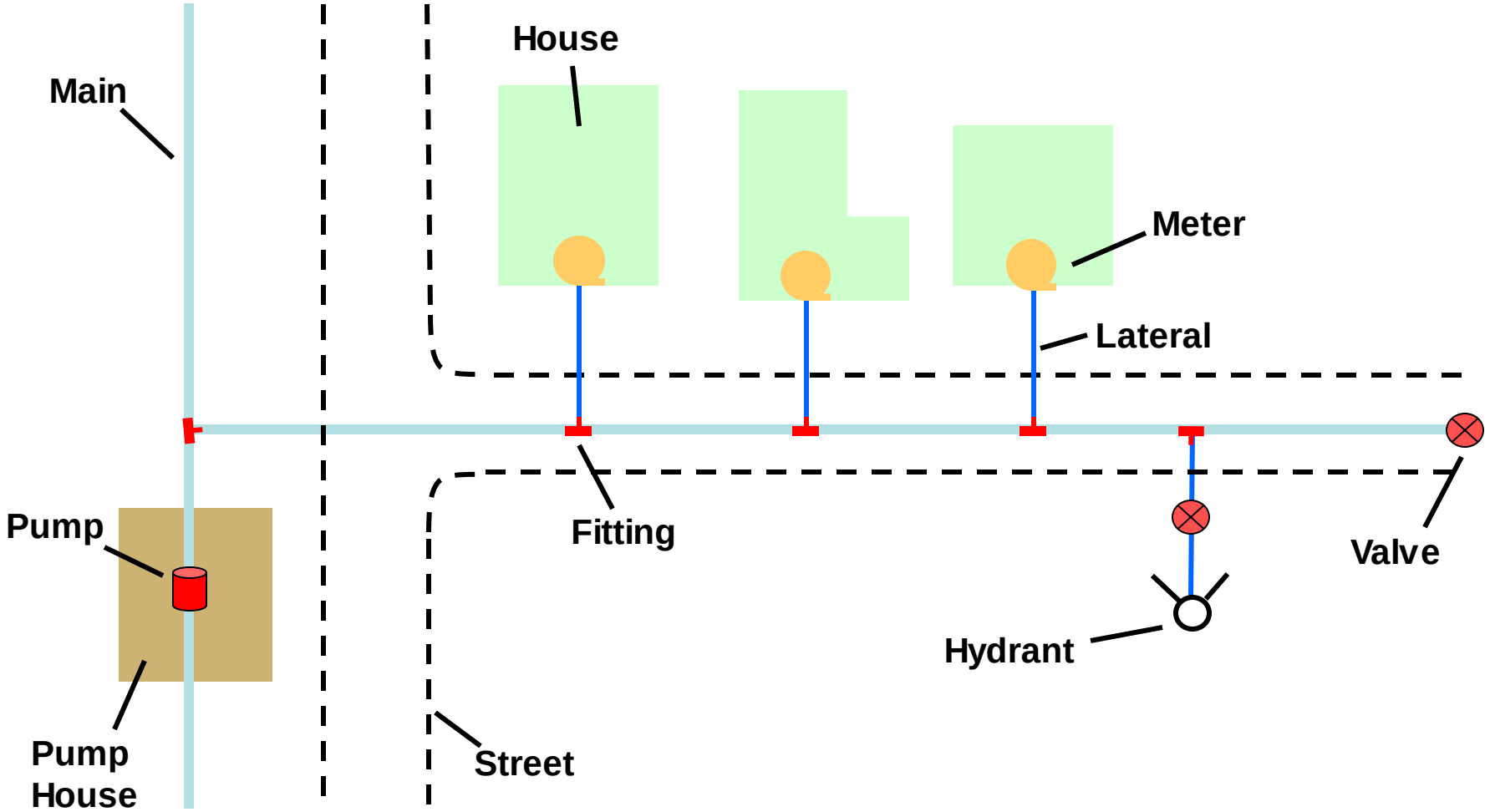
Modelos de Datos

- Capas
- Temas
- Topología
- Cuadrícula
- QUADTREES

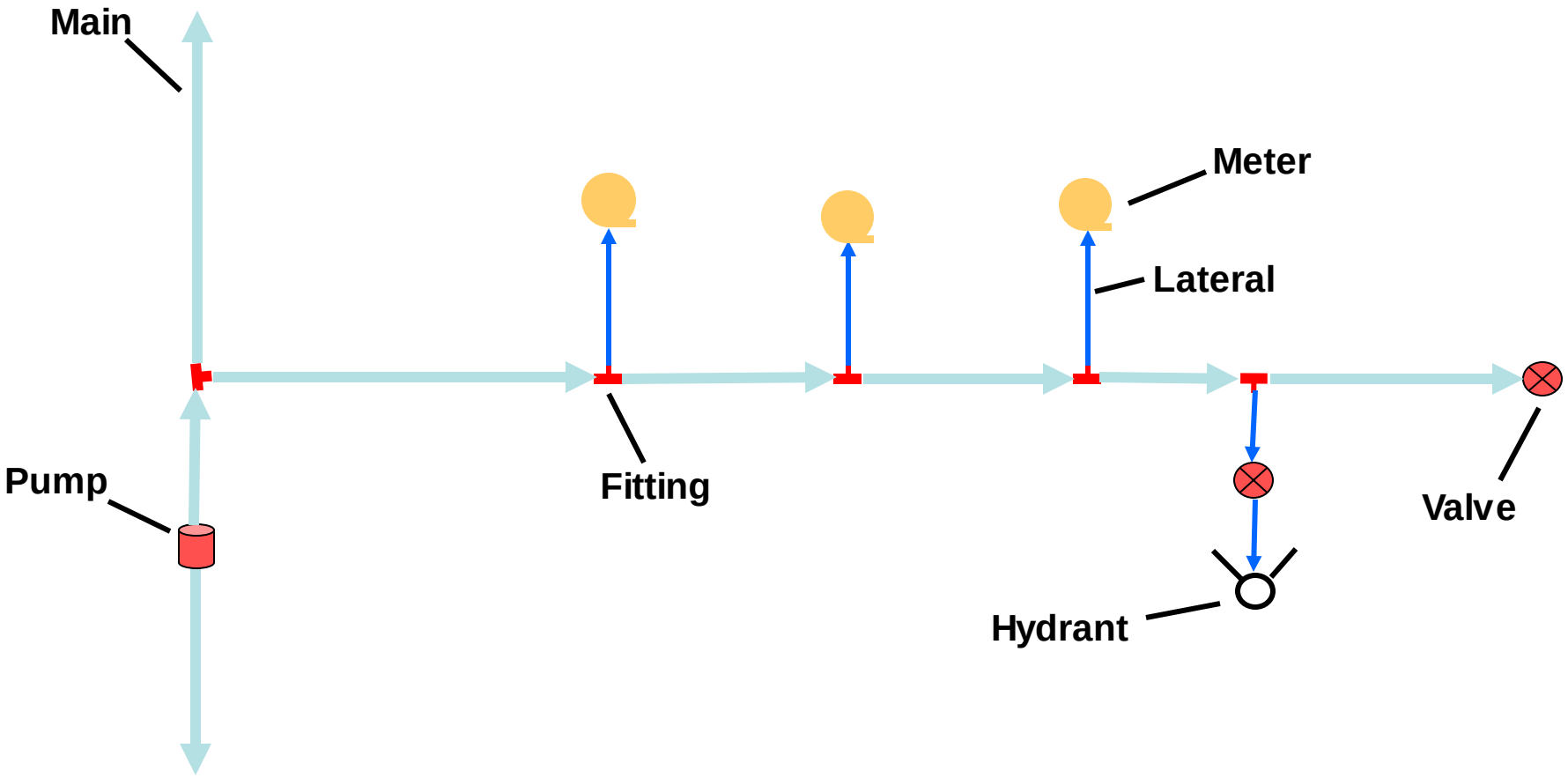
Ejemplo: Modelo de datos de un sistema de agua

- Se comienza con objetos y relaciones
- Modelo como tipos de objetos y relaciones
  - Red topológica
  - Jerarquía: ‘tipo de’
  - Colección ‘compuesto de’
- Se añaden tablas de atributos relacionados

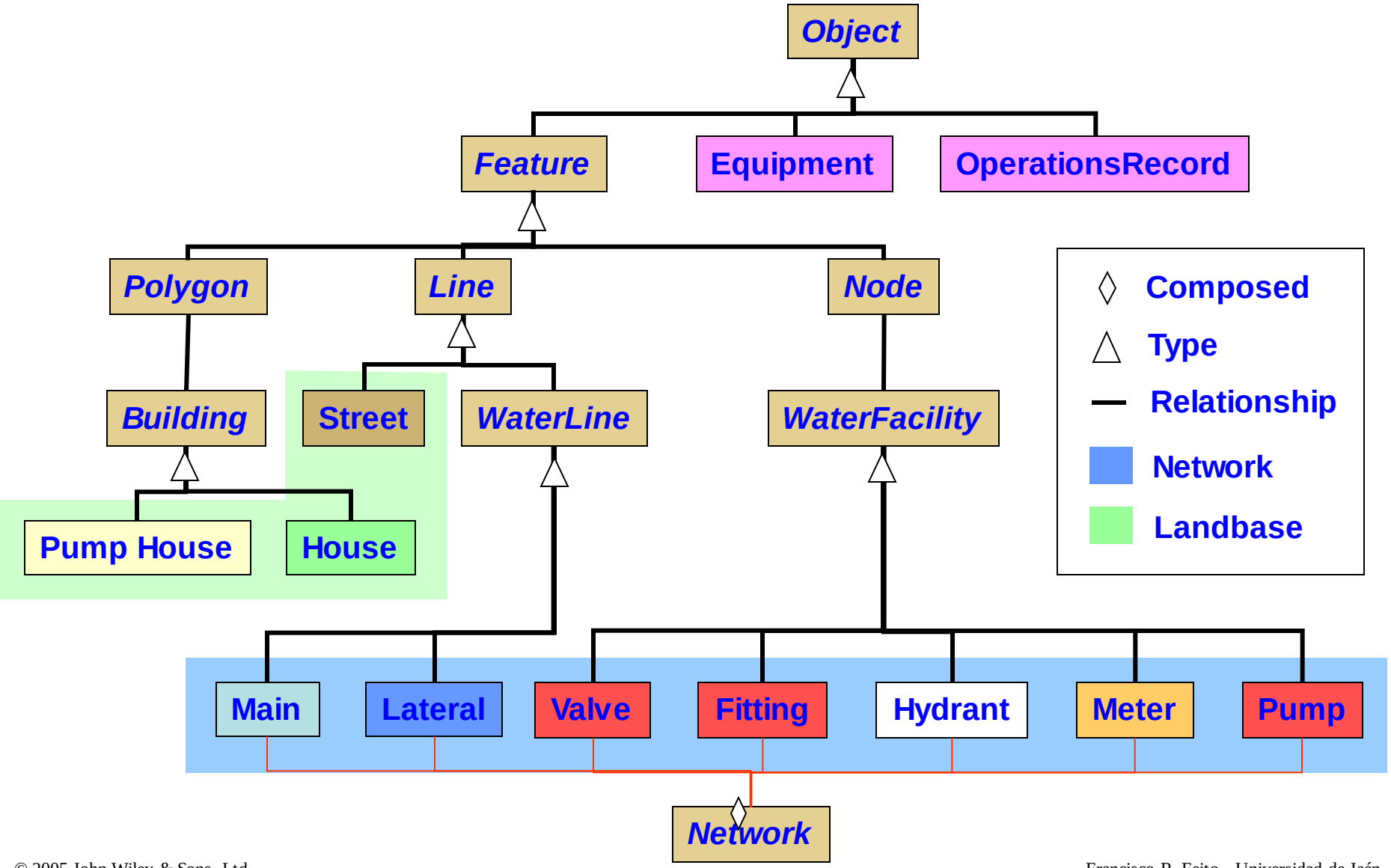
Tipos de datos : servicio de aguas



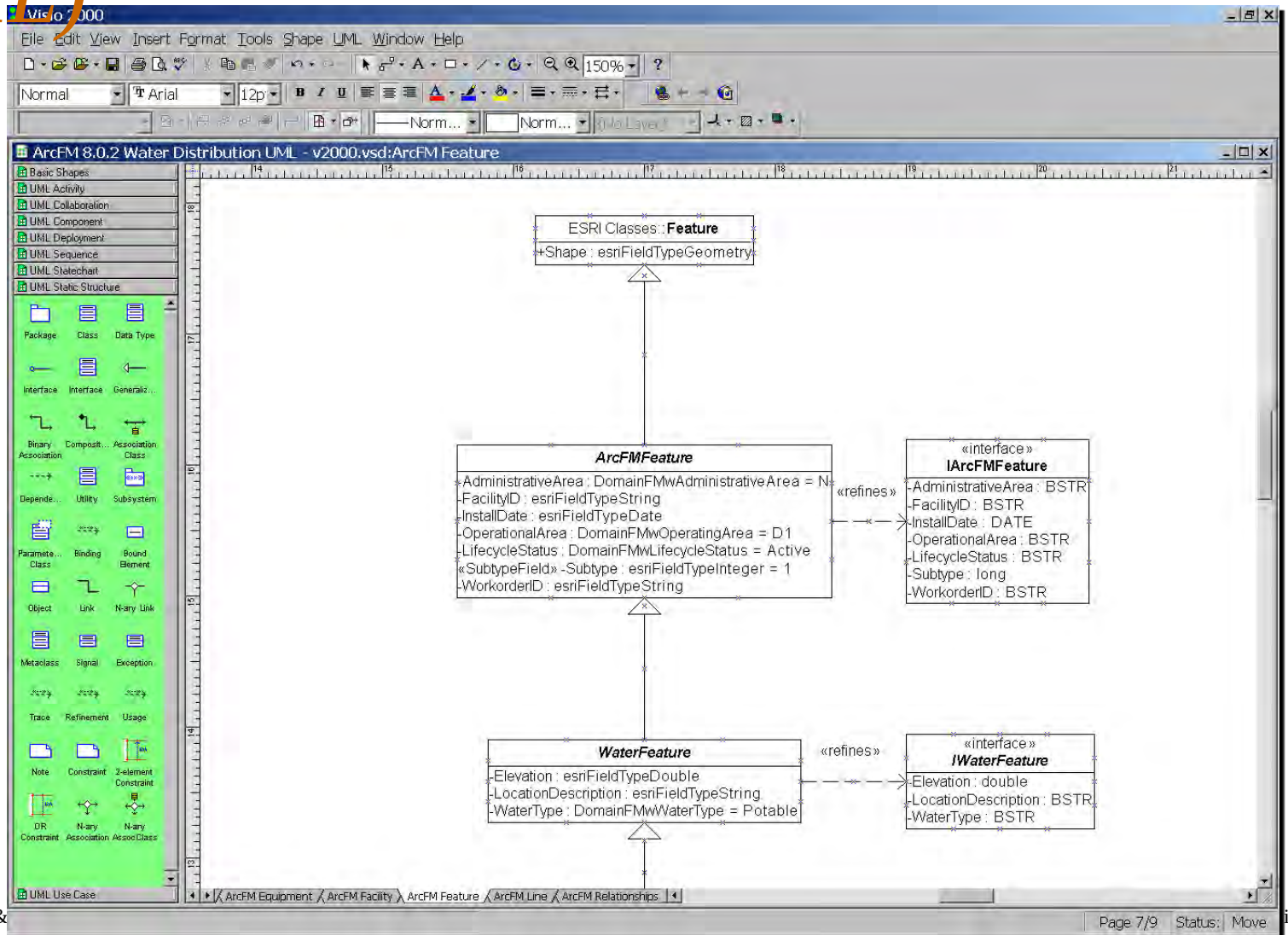
Modelo topológio de la red



Modelo de objetos del servicio de aguas



Visio (herramienta CASE Representation UML)



Errores comunes

- Diseñar en abstracto, sin referencia al modelo de datos central en el software SIG/SIE
- No dedicar el tiempo adecuado
  - Demasiado o muy poco
- Intentar abarcar un rango excesivamente amplio y genérico en vez de específico y práctico
- Diseñar por la elegancia y no por el funcionamiento

Conclusiones

- Modelado de datos: arte y ciencia
- No se puede entender sin experiencia practica
- Existencia de herramientas adecuadas de ayuda
  - CASE, UML
- Nunca hay que olvidarse de modelizar los datos SIG /SIE