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80 %

"80 % of all data throughout the world have some geographic background"

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Contents

1 – Introduction: from GIS to SC
2 – Smart Cities
- Realtime Massive Data
- Deep Learning
- Knowledge engineering
- Geovisualization

3 – Conclusions

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1 – Introduction: From GIS to SC

- Geographic Information Systems
- Important concepts
  - Coordinates, spherical geometry
  - Computational geometry
  - Data acquisition
  - Spatial Indexing
  - Mapping

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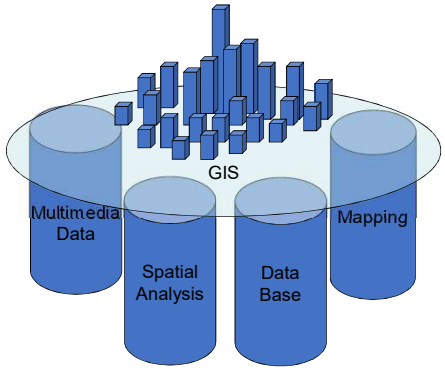
GIS pillars



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2 – Smart Cities

- Definition
- Pillars
  - Realtime Massive Data
  - Deep Learning
  - Knowledge Engineering
  - Geovisualization

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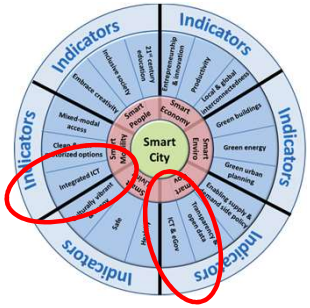
Boyd Cohen's Wheel



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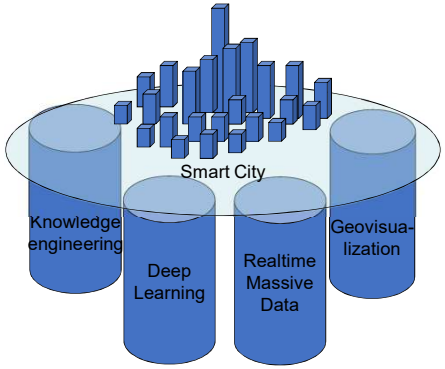
Smart City ICT pillars



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Data Acquisition Sensors

- Digital Sensors
- Citizens as Sensors - Crowdsourcing

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Usage of sensors

- Acoustic, sound, vibration
- Automotive, transportation
- Chemical
- Electric current, electric potential, magnetic, radio
- Flow, fluid velocity
- Ionizing radiation, subatomic particles
- Navigation instruments
- Position, angle, displacement, distance, speed, acceleration
- Optical, light, imaging, photon
- Pressure
- Force, density, level
- Thermal, heat, temperature
- Proximity, presence

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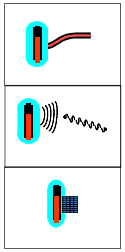
Various architectures for sensors



Sensors with cable

Wireless sensors

Sensors with storage capacity

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City-wide IoT

- Examples in Lyon
  - Automatic watering of trees
  - Bottle banks
  - Energy

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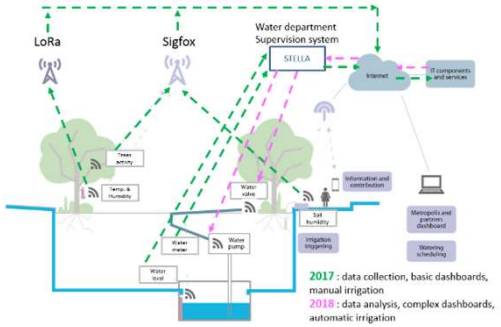
Automatic tree watering



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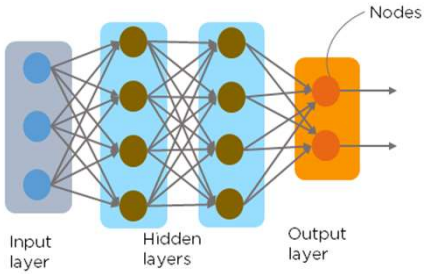
Deep Learning by Neural Network



Not so many applications:
- Road maintenance
- Energy forecasting

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About Knowledge

- Knowledge Society
- Basis for governance
  - Smart Cities
  - Territorial Intelligence
- Difference between data, information and knowledge
- Neighboring concepts
  - Smart People
  - Smart Governance

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Definition of Geographic Knowledge

- Geographic knowledge corresponds to information potentially useful to
  - explain,
  - manage,
  - monitor
  - and plan a territory.

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Knowledge and Rules

- RULES as first-class citizens in IT
  - IF-THEN-Fact
  - IF-THEN-Actions
- Business intelligence (1st order logic)
- Territorial Intelligence
  - Rewrite geoprocessing based on rules
  - Renovate concepts
- New types for geographic rules

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Specific Characteristics

- Space 2D, 3D, 3D+T ➔ coordinates
- Computational geometry, topology
- Cartography and geovisualization
- Spatial analysis
- Features and geographic objects
  - Measurement accuracy
  - Multiple representations
  - Acquisition devices

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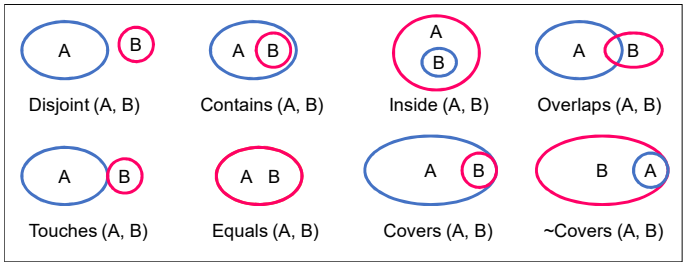
Egenhofer's topology



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Geographic Projects

- Where to put a new airport, a new hospital, a new stadium, etc.?
- Is this new construction project compliant with planning rules?
- What is the best mode or the best way to get from *A* to *B*?
- How to organize a plan for green spaces in a city?
- How to reorganize common transportation?
- etc.

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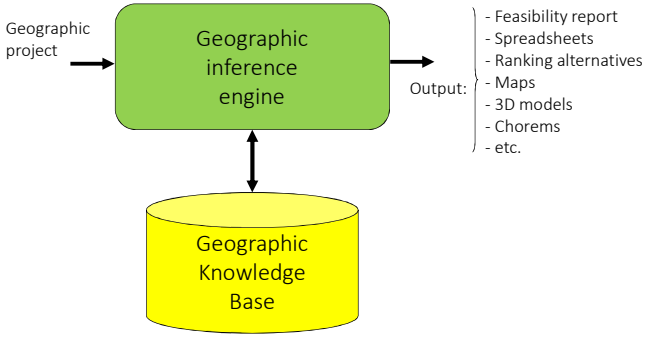
Usage



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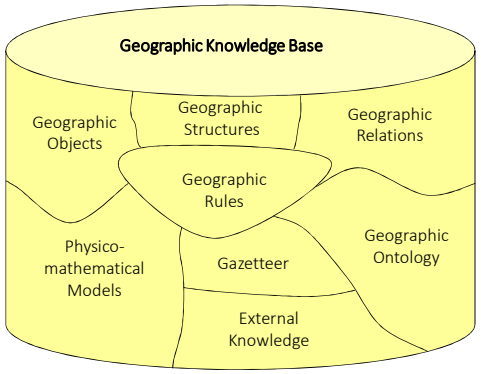
GKB Components



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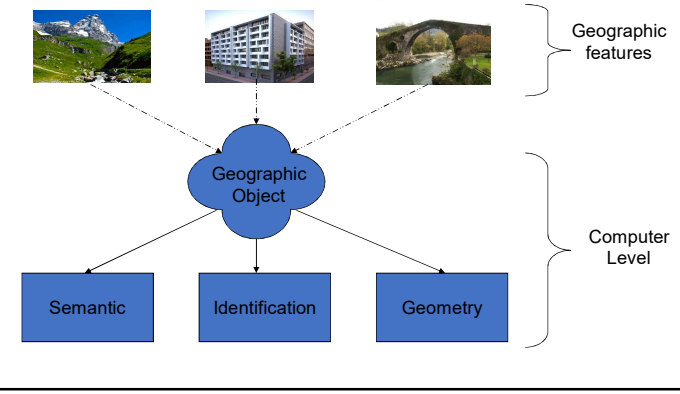
Geographic objects



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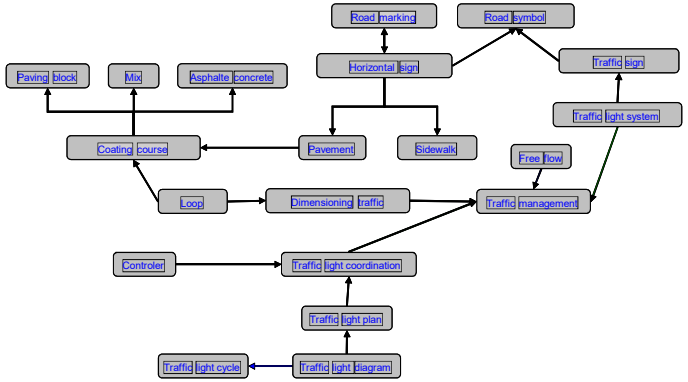
Excerpt of the ontology



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Example of Geographic Rules

- in the United Kingdom, we drive on the left
- in Canada, the majority of the population lives along the border with the United States
- each capital city has an international airport nearby
- in the Northern Hemisphere, the more you are going to the north, the colder (but locally this is not always true)
- heavy rain upstream, downstream flooding
- if a zone is a swamp, it is necessary to prohibit construction

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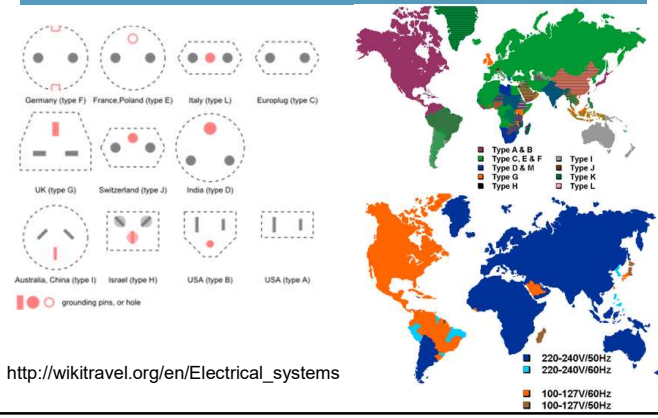
Decision Trees, Tables and Maps



http://wikitravel.org/en/Electrical_systems

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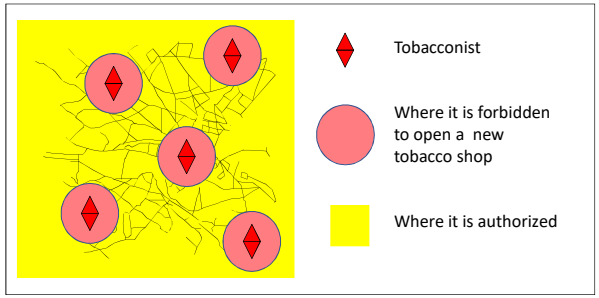
Tobacco Shop Rule in France



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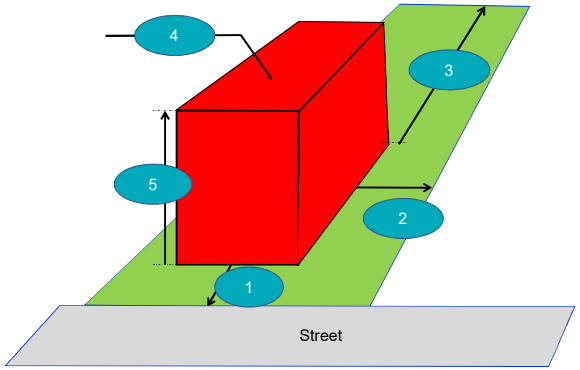
Urban Planning Rules



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Encoding

$\forall B \in PROJECT, \exists P \in GO$ $\Omega\text{-}Type\ (B)$ = "Building", $\Omega\text{-}Type\ (P)$ = "Parcels", $Contains\ (Geom\ (P), Geom\ (B))$: $Height\ (B) < 10$ $\wedge Street\_distance\ (B, P) > 3$ $\wedge Neighbor\_distance\ (B, P) > 3$ $\Rightarrow$ $UP\text{-}Allowed\ (B, P)$	Rule 10.9-10.13

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Geovisualization

- Beyond 2D cartography
- 3D, or perspectives
- Emphasizing semantics
- Global vision
- Visual summaries via chorems

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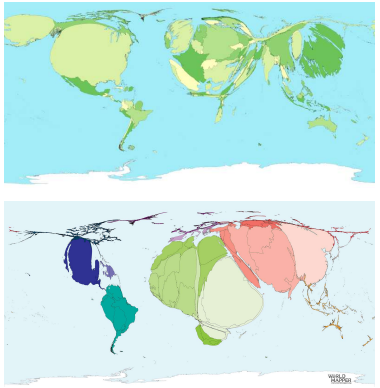
Cartograms of GDP and donkeys



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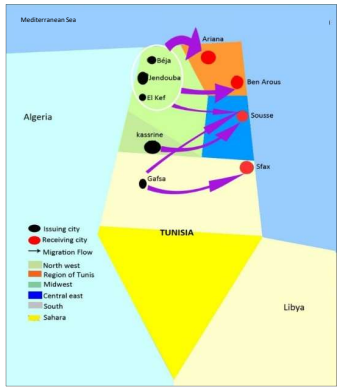
Chorem for inner migrations



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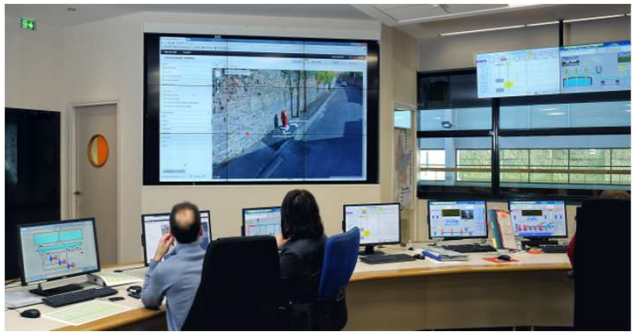
Dashboard for water management



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4 – Conclusions (1/2)

- 80 % of data in the world have some geographic base
- From GIS to Smart City's ICT
- Only a rapid presentation of geographic knowledge in urban planning
- Territorial intelligence more complex than business intelligence
- Many additional aspects must be developed

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4 – Conclusions (2/2)

- IoT, Big Data
- Deep Learning
- Geographic Knowledge Engineering
- Geovisualization
- Research: many ideas for PhD

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Thanks for you attention!

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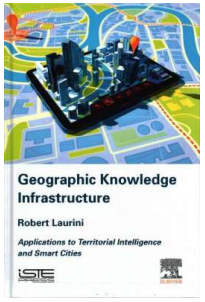

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