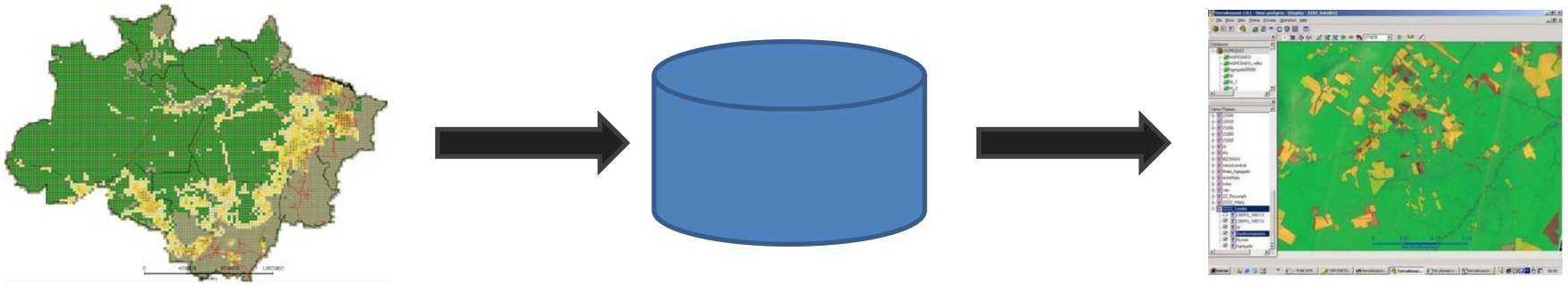
Spatial Databases

Institute for Geoinformatics

Winter Semester 2014

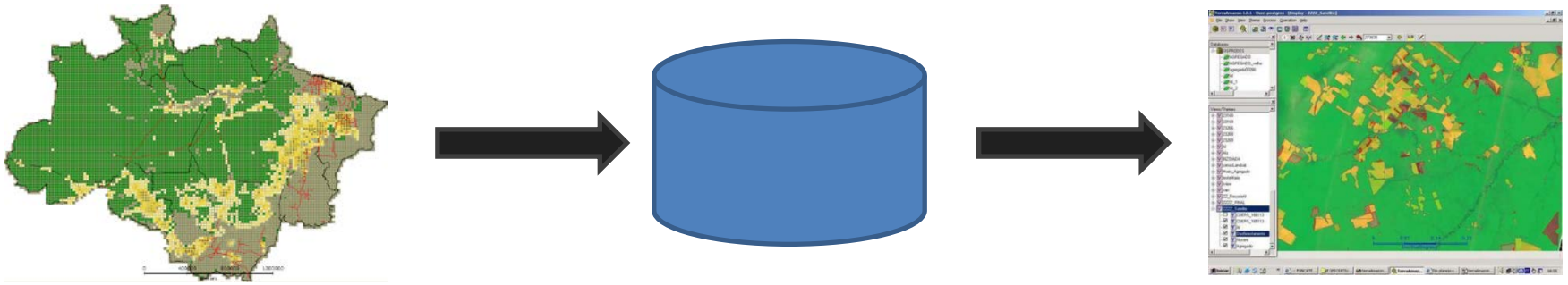


Malumbo Chipofya: room 109

SPATIAL INTELLIGENCE LABORATORY

Welcome to the Course!

- What is a Spatial Database?

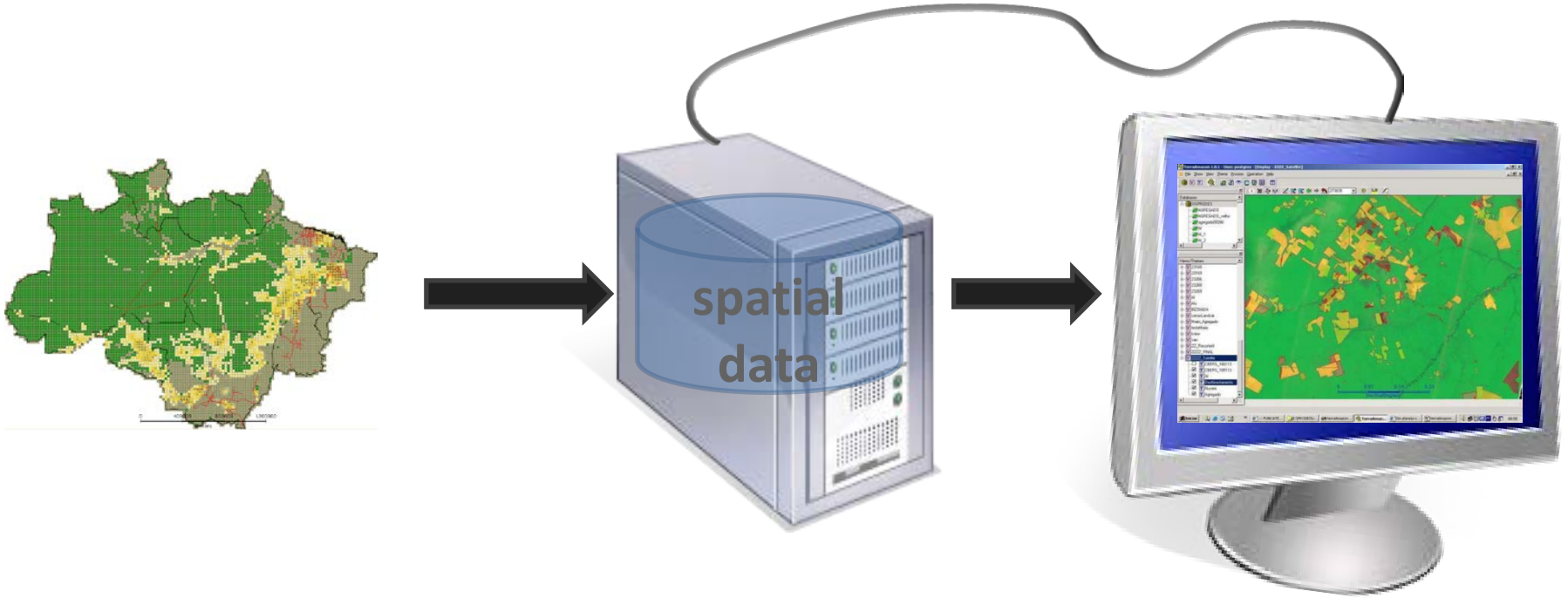


SPATIAL INTELLIGENCE LABORATORY

Welcome to the Course!

- What is a Spatial Database?

In a nutshell



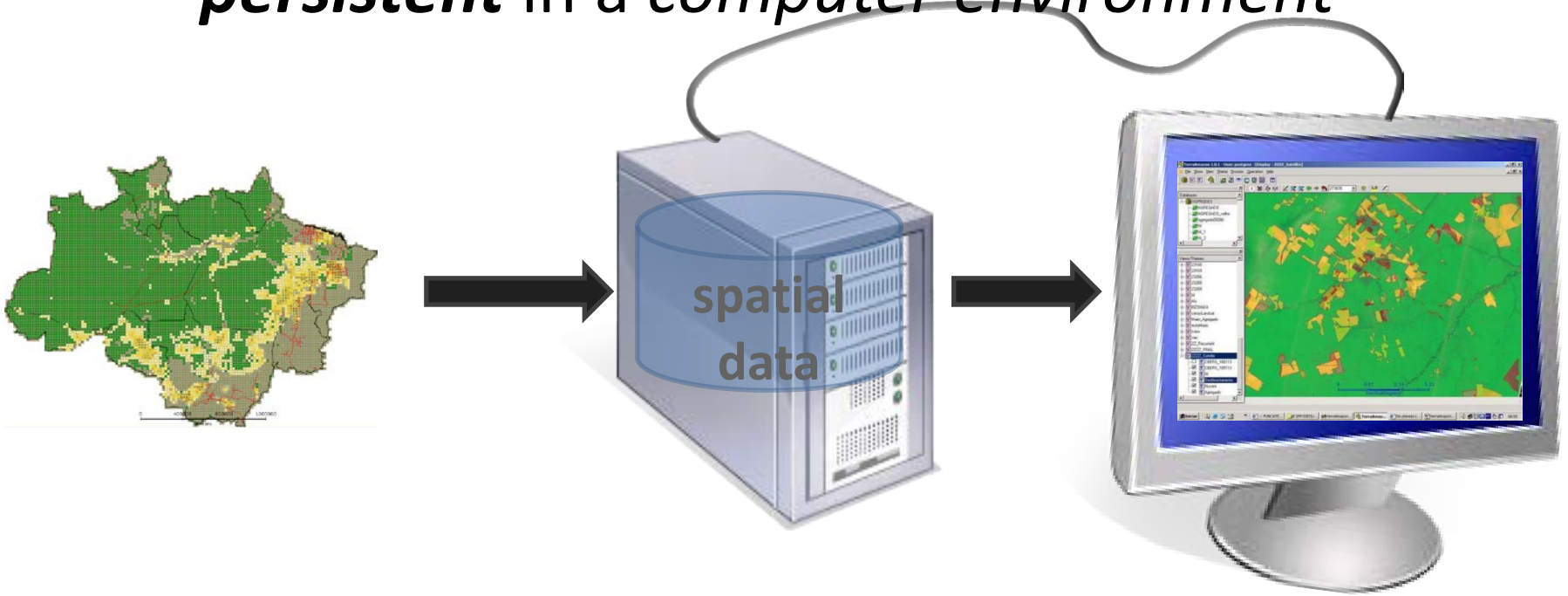
SPATIAL INTELLIGENCE LABORATORY

Welcome to the Course!

- What is a Spatial Database?

In a nutshell: a set a spatial data values

persistent in a *computer environment*



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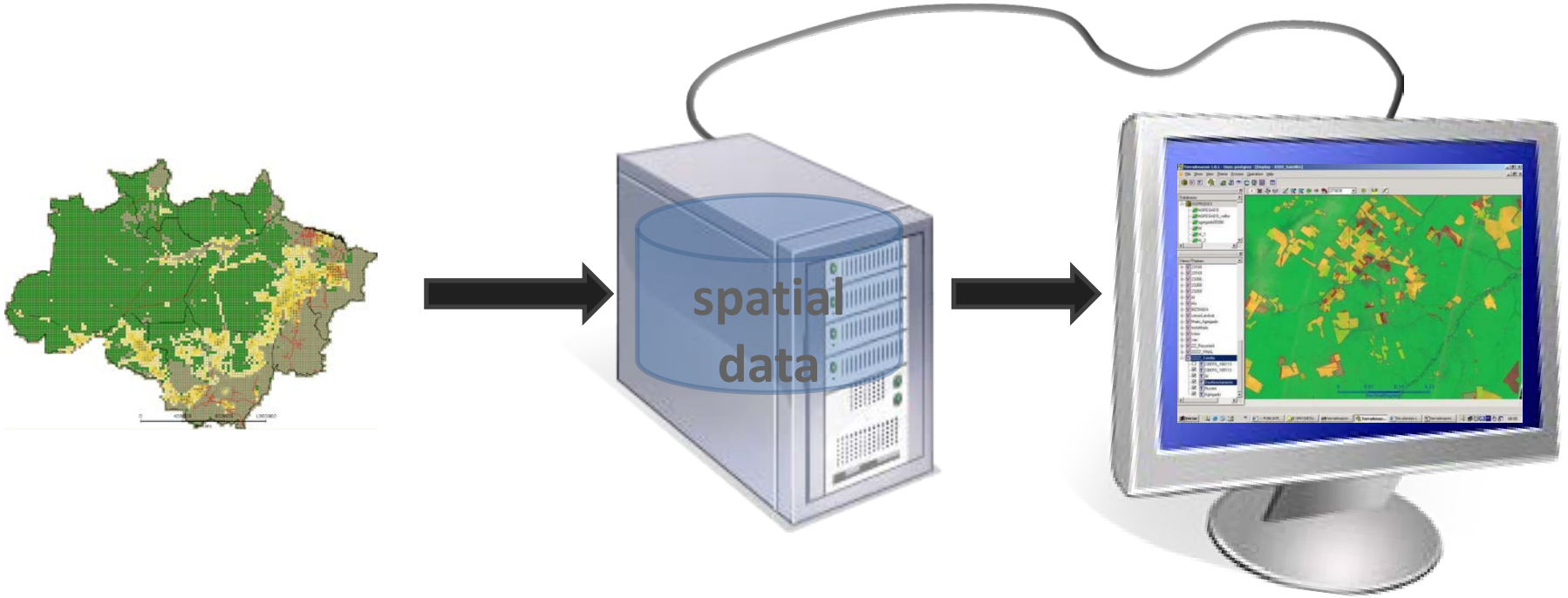
Welcome to the Course!

- What about a SDBMS - Spatial Database Management System?



SPATIAL INTELLIGENCE LABORATORY

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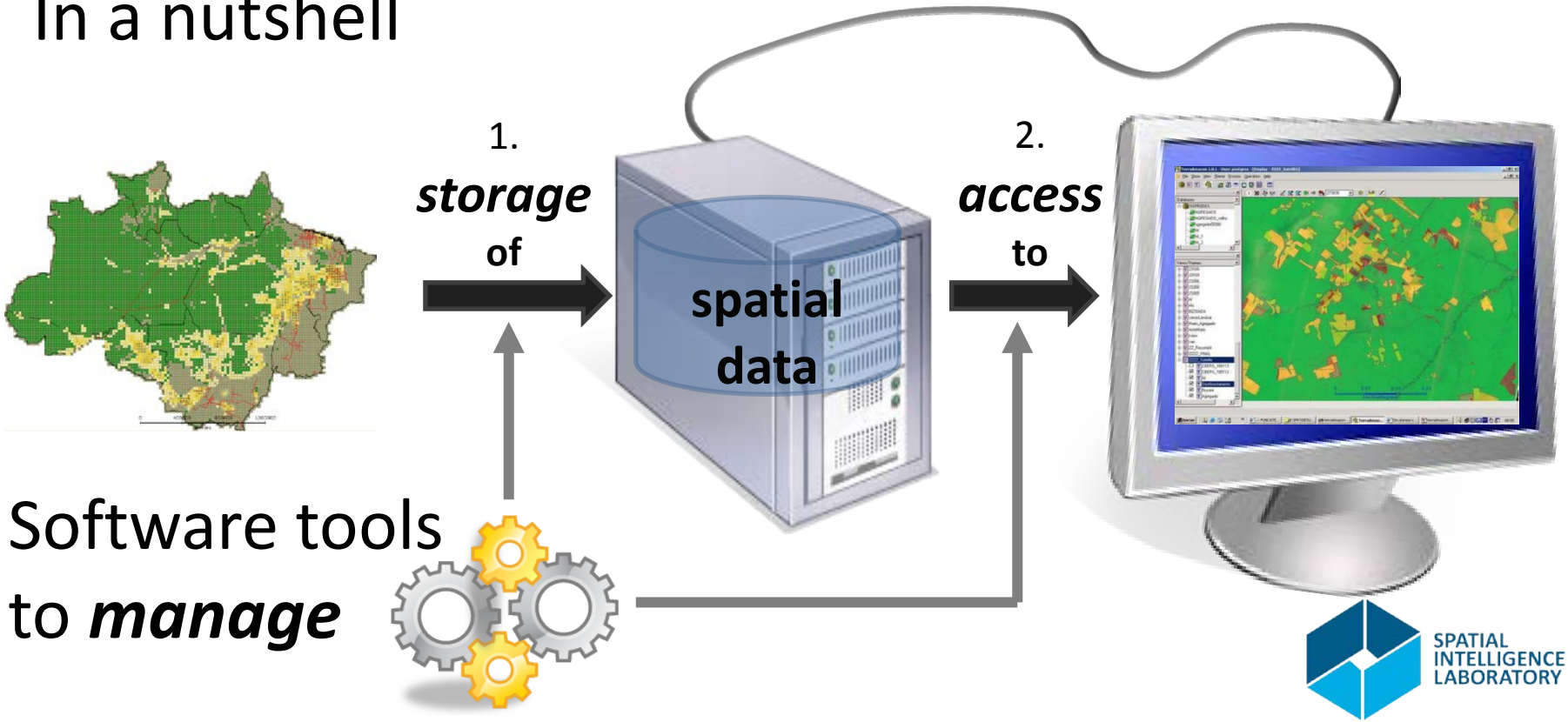
In a nutshell



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What is this Course About?

- Database Management Systems

AND

- Spatial Databases (DBs)
  - Understand what they do (**Relational DBs**)
  - Learn (***some*** apps) where they are used
  - Learn to use them
  - Explore a few contemporary database models

SPATIAL INTELLIGENCE LABORATORY

Today's Lecture

1. Introduction of the participants
2. Course format
3. Course schedule
4. Qualification requirements
5. Introduction to the Course
   a) Overview of presentation topics

      You must have received a link to download location for course papers in the mail (I will resend it)

   b) Selection of topics

      You will received a link + instructions to choose a topic

SPATIAL INTELLIGENCE LABORATORY

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5. Topic Overview
6. Introduction: A Prelude

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SPATIAL INTELLIGENCE LABORATORY

Course Format

- Course type: [Lecture + Exercises] + Seminar
  - Lecture + Exercises will be done in class and completed after class if necessary
  - Seminar is on Qualitative Spatial Reasoning
- intended audience
  - MSc Geoinformatics, BSc Geoinformatics
    - Advanced Topics in Computer Science (4 SWS, 5 ECTS credits)
- Communications
  - By email

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SPATIAL INTELLIGENCE LABORATORY

Course Schedule

- 2 times per week
- Locations and Times:
  - Wednesdays, 08:15 am. StudLab 125 (Seminar QSR)
  - Thursdays, 10:15 pm. StudLab 125 (Lecture)
- A detailed schedule will be uploaded to http://www.geoinformatics.cc/

SPATIAL INTELLIGENCE LABORATORY

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Qualification Requirements

The course will be graded as follows:

- Lecture component -> 60%
  - Exercises
- Seminar component -> 40%

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SPATIAL INTELLIGENCE LABORATORY

Topic Overview

1. Prelude: Data and problem solving in science and applications

Topic Overview

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2. The Relational Database model

SPATIAL INTELLIGENCE LABORATORY

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3. Interacting with relational databases

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4. Spatial Relational Database Management Systems

SPATIAL INTELLIGENCE LABORATORY

Topic Overview

1. Prelude: Data and problem solving in science and applications
2. The Relational Database model
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4. Spatial Relational Database Management Systems
5. Applications: Terraview and Terralib: Prof. Dr. Gilberto Camara

SPATIAL INTELLIGENCE LABORATORY

Topic Overview

1. Prelude: Data and problem solving in science and applications
2. The Relational Database model
3. Interacting with relational databases
4. Spatial Relational Database Management Systems
5. Applications: Terraview and Terralib: Prof. Dr. Gilberto Camara
6. A sample of Nosql Databases: brief introductions + example applications
    a. Array databases: SciDB
    b. Document databases: MongoDB
    c. Graph databases: Neo4J

SPATIAL INTELLIGENCE LABORATORY

Topic Overview

1. Prelude: Data and problem solving in science and applications
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4. Spatial Relational Database Management Systems
5. Applications: Terraview and Terralib: Prof. Dr. Gilberto Camara
6. A sample of Nosql Databases: brief introductions + example applications
    a. Array databases: SciDB
    b. Document databases: MongoDB
    c. Graph databases: Neo4J
7. Summary of all lectures given.

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SPATIAL INTELLIGENCE LABORATORY

Prelude: Data and problem solving in science and applications

1. Questions
2. A gallery of geospatial applications
   a. Land use change modelling and detection
   b. Logistics and Transportation
   c. Social and business applications: demographics
3. Spatial Data Models: Field/Object vs. Raster/Vector
4. Spatial Analysis methods and input data models and formats

SPATIAL INTELLIGENCE LABORATORY

Questions

- How should I store and access data for my spatial application?
  - What do I need to know to answer that question?
    - What sort of data do I expect (IN/OUT)?
    - How often do I need to access or store the data?
    - How often will the data change?
    - How much data will I use at a go?
    - Will someone else be using the same data at the same time as me?

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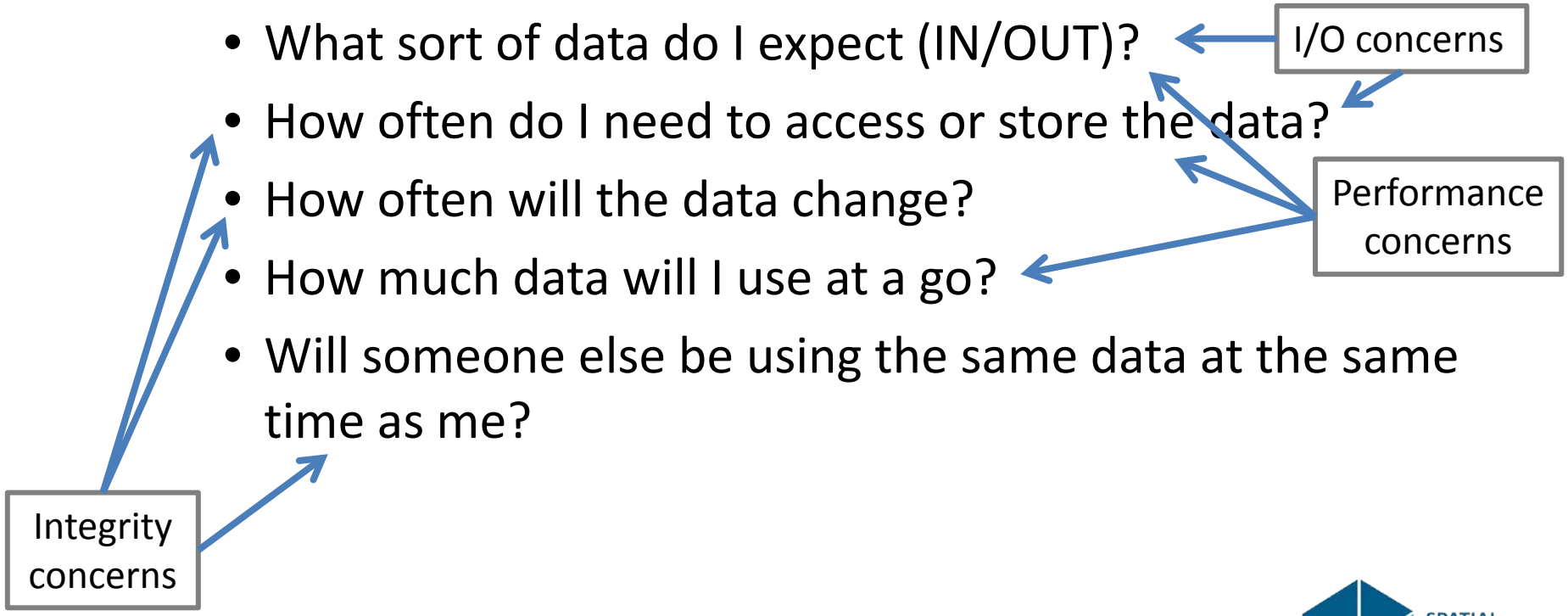

SPATIAL INTELLIGENCE LABORATORY

A gallery of geospatial applications

a. Land use (change) modelling and detection

Land use detection is one of the foremost applications of geo-spatial technologies

Image: East Kilbride, Lanarkshire, SCOTLAND.
- 1946 (left), and
- 1988 (right)

Source:
http://ncap.org.uk/case-studies/land-use-change

SPATIAL INTELLIGENCE LABORATORY

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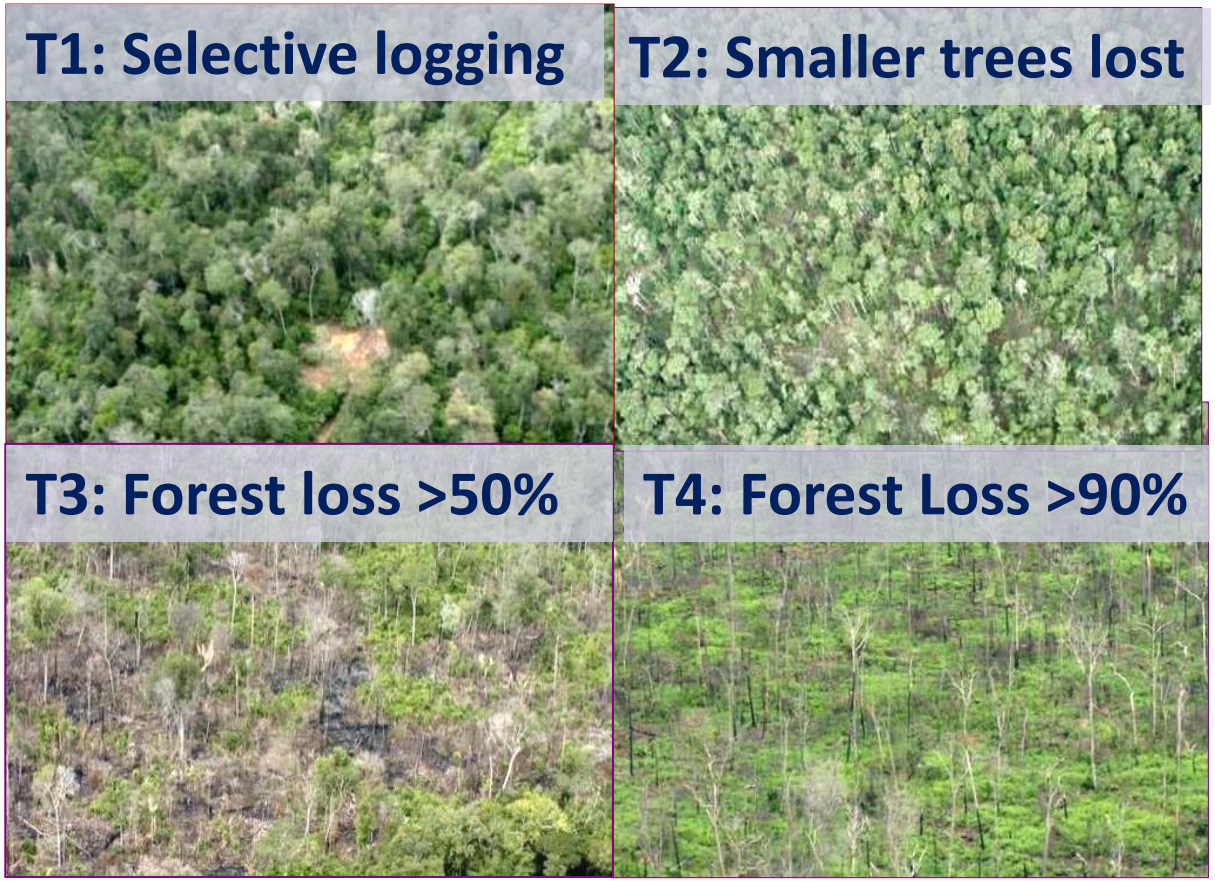


Image: Forest loss in the Amazonia

Source:

Gilberto Camara. ***Land change in Brazilian Amazonia: A case study in nature-society interaction***, November 2013.

http://www.dpi.inpe.br/gilberto/present/gcamara_ilok_2013.pptx

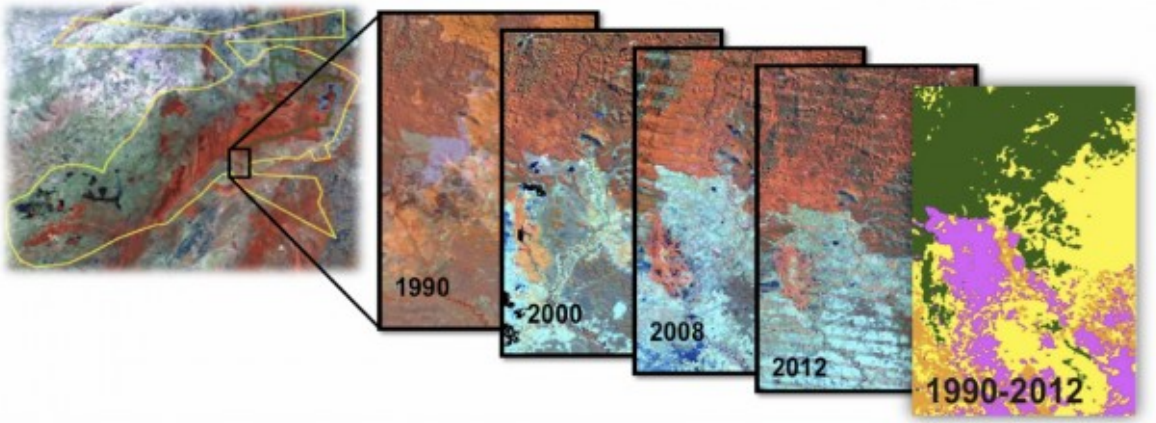
SPATIAL INTELLIGENCE LABORATORY

A gallery of geospatial applications

a. Land use (change) modelling and detection

A lot of work goes on in the background

- Segmentation
- Classification
- Integration with survey or history data
- Analysis



	1990	2012	% change
Human Population	380,638	608,562	+37%
Agriculture	4,500 km² - 23% of ZOI	5,197 km² - 38% of ZOI	+15%
Forest	2,600 km² - 13% of ZOI	2,551 km² - 13% of ZOI	-0.4%
Other Land Cover	12,018 km² - 62% of ZOI	11,350 km² - 59% of ZOI	-4%

Source:
http://eijournal.com/2013/conservation-international-does-nature-right

SPATIAL INTELLIGENCE LABORATORY

A gallery of geospatial applications

a. Land use (change) modelling and detection

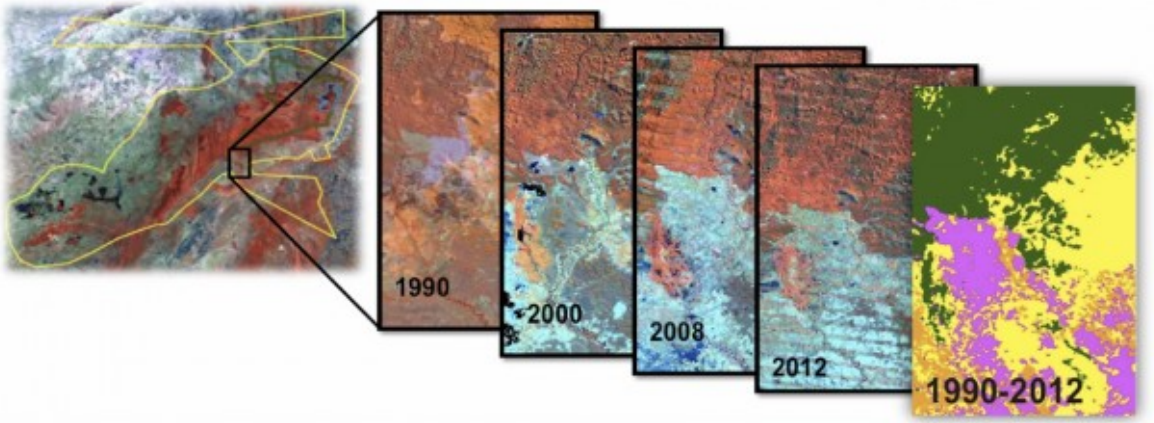
The Data?

1. Location

2. Time

3. Attr-1.: Veg. index value

4. Attr-1.: Num. of Jaguar citings



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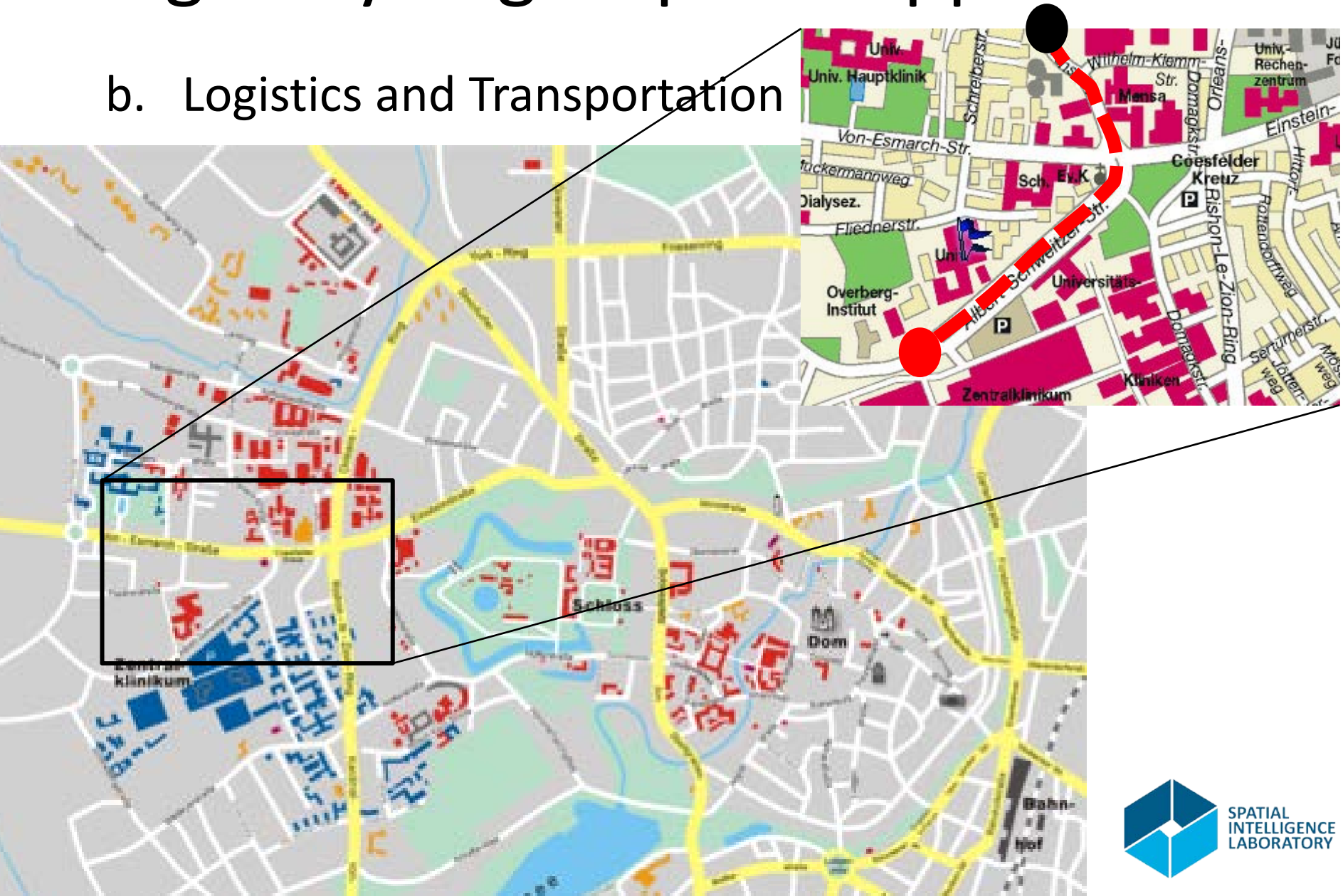
A gallery of geospatial applications

b. Logistics and Transportation



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A gallery of geospatial applications

b. Logistics and Transportation
   - How to get from black to red?

The Data?

1. Location of street centerline

2. Width of street

3. Stadtteil

4. Average traffic conditions

5. Intersecting streets

6. Location of intersections

7. Plots along street

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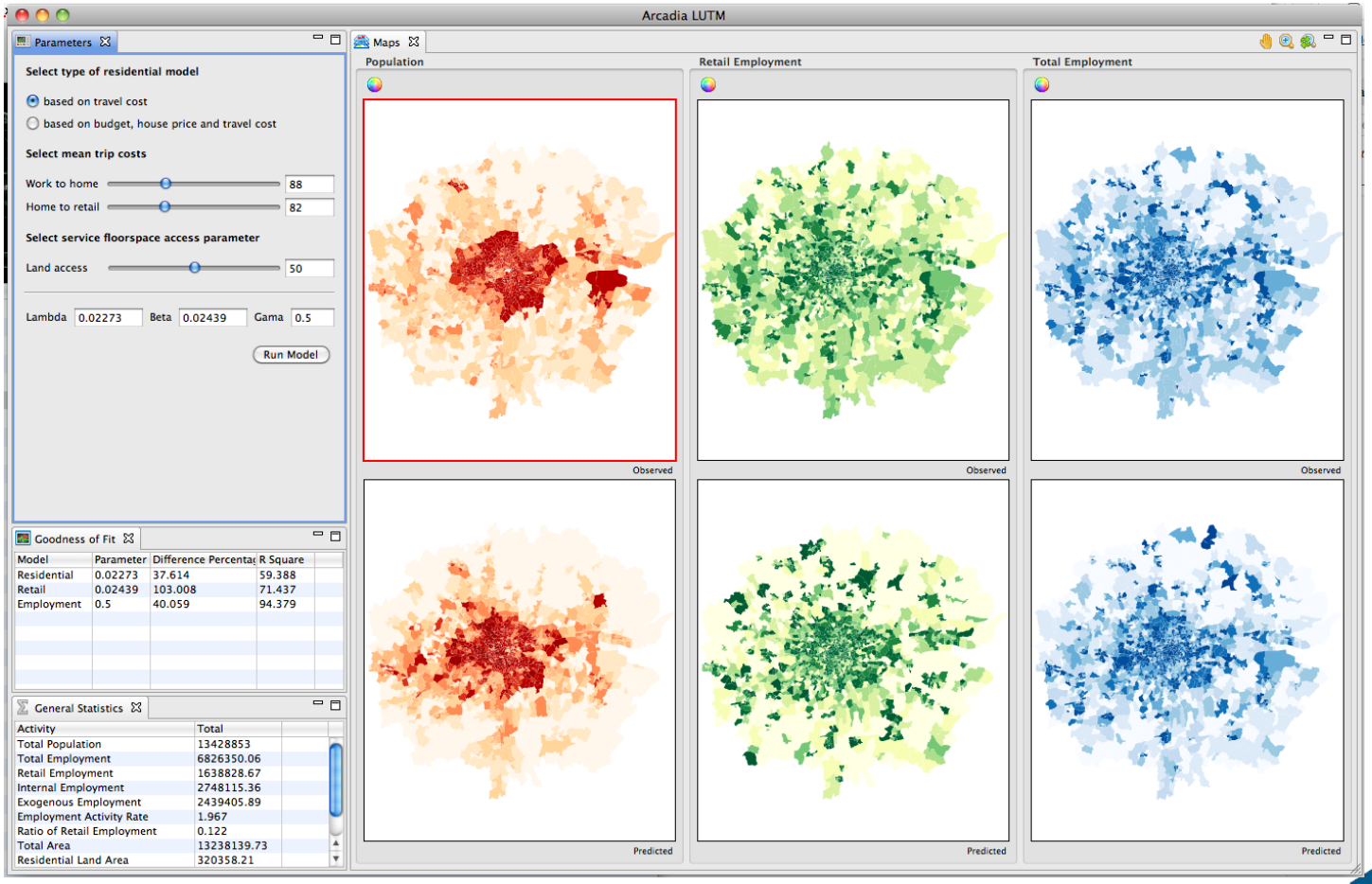
A gallery of geospatial applications

c. Social and business applications: finding a home



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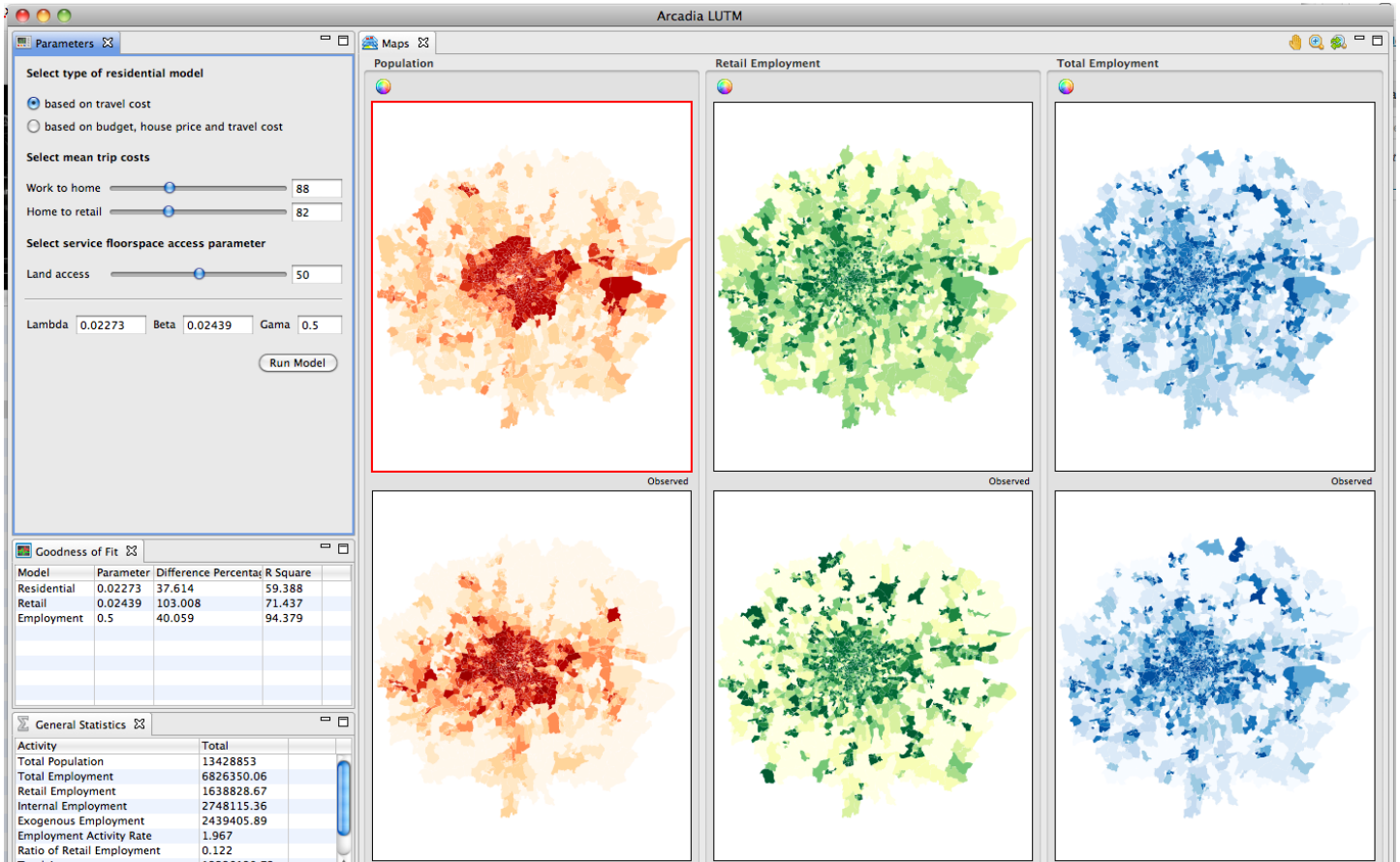
A gallery of geospatial applications

c. Social and business applications: finding a home

- Questions?
- Data?



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Spatial Data Models: Field/Object vs. Raster/Vector

Conceptualization of space

- Field: a continuum of points [with attached measurements]
- Objects: physical entities that occupy space

Representation of space

- Raster: divide a space into array of cells
- Vector: assign specific points to spatial entities

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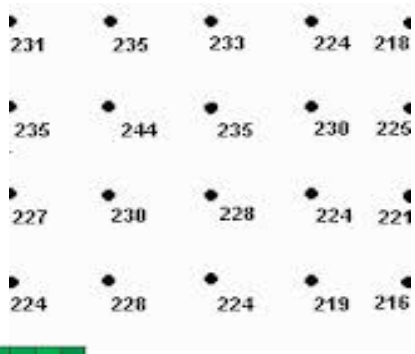
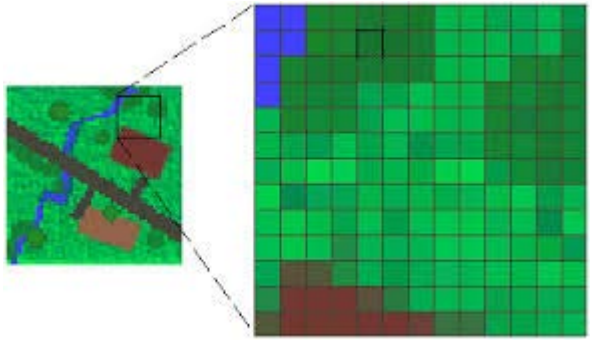
Spatial Data Models: Field/Object vs. Raster/Vector

Representing fields

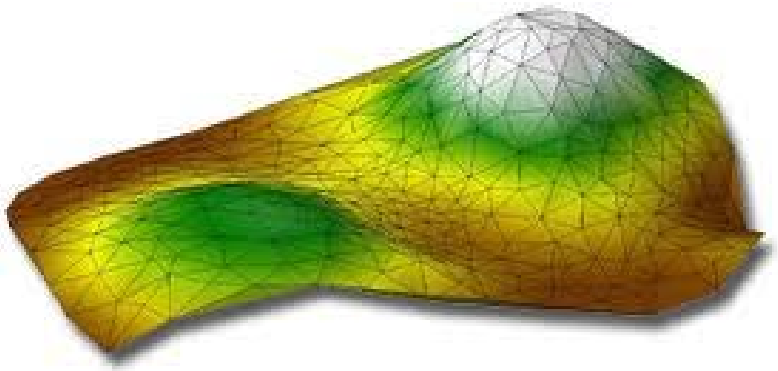
- Regularly spaced sample points



- Rectangular cells



- Triangular Irregular Network (TIN)



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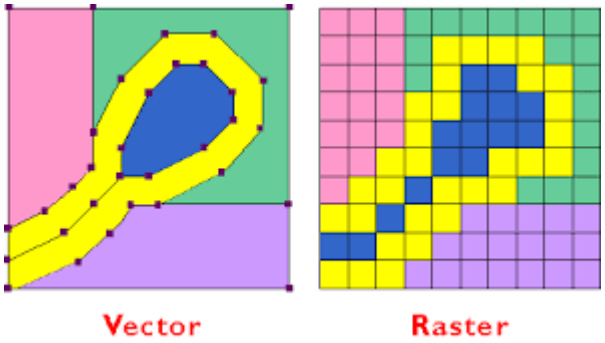
Spatial Data Models: Field/Object vs. Raster/Vector

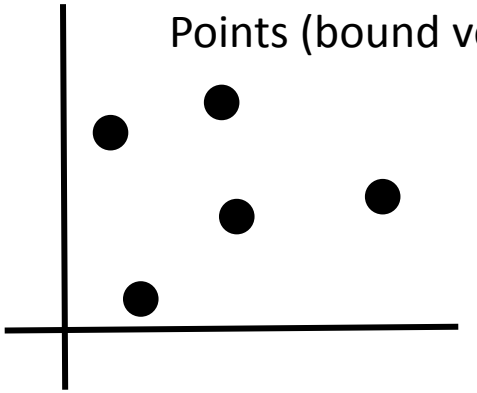
Representing objects

- As groups of points of a field

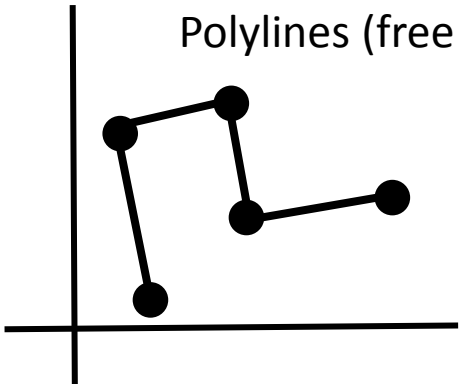


- As a set of vectors

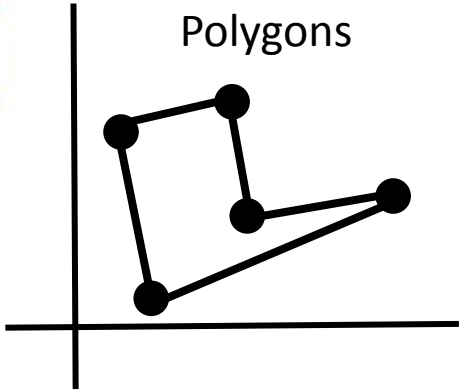
Points (bound vectors)



Polylines (free vectors)



Polygons



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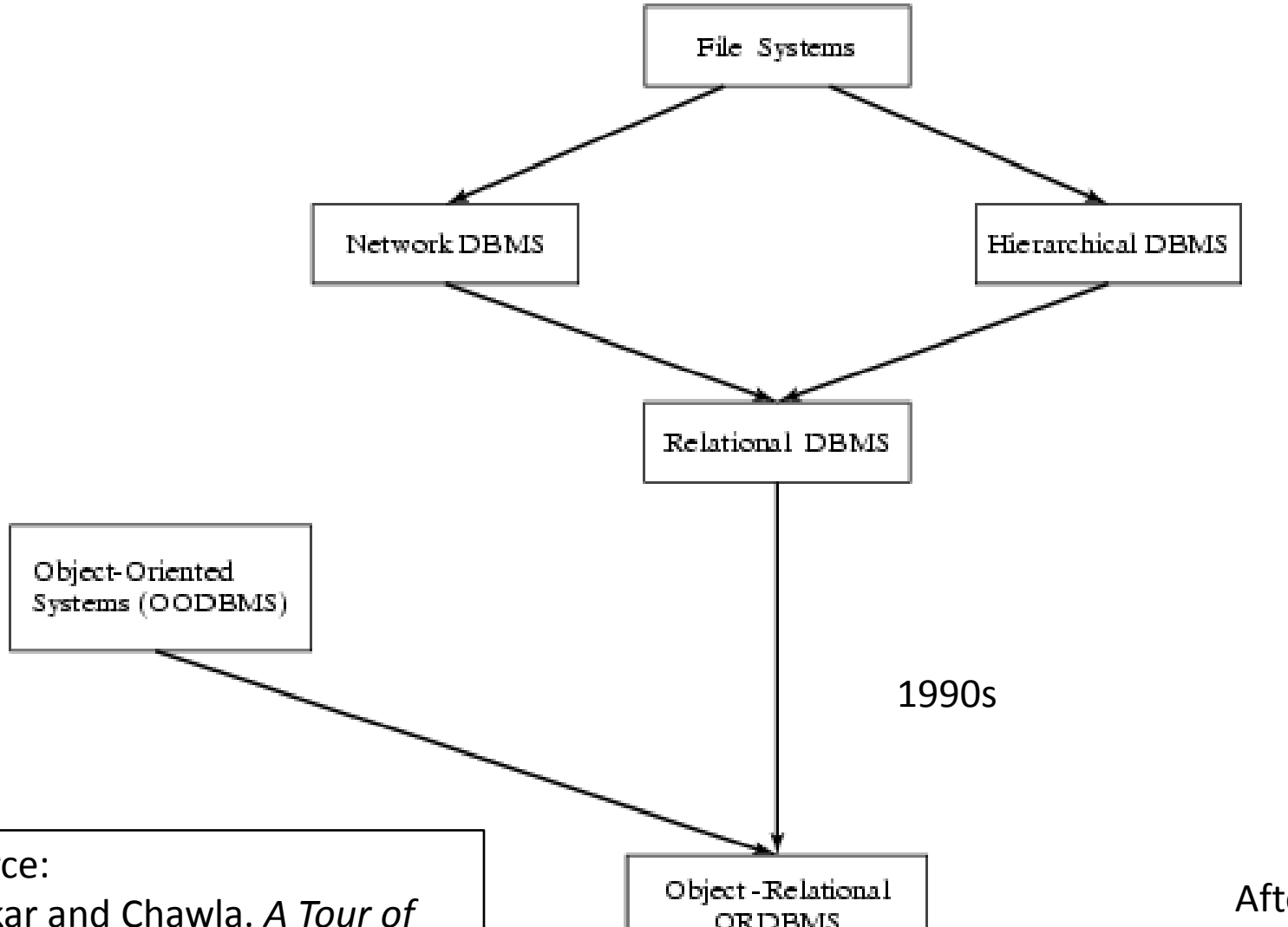
A Very Brief Historical Overview

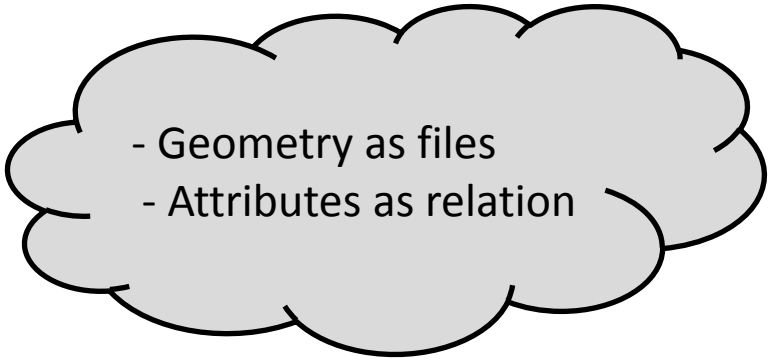


Source:
Shekar and Chawla. *A Tour of Spatial Databases*. Prentice hall 2002, page 15.

A Very Brief Historical Overview

File Based

Dual model



OGC Model

OGC Model +
Raster

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Next Class

- Introduction to Relational Database Systems
- Definitions
  - Relation Schemas
  - Relations
  - Tuples
  - Attributes
  - Keys and References
- 1st Exercise

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References

- See www.geoinformatic.cc

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That’s all for today

Thank you!

Questions?

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