01. Course Introduction

GE3238 GIS Design and Practices
Geography @ NUS
Dr. Chen-Chieh Feng

Spatial Information

Everyday Life

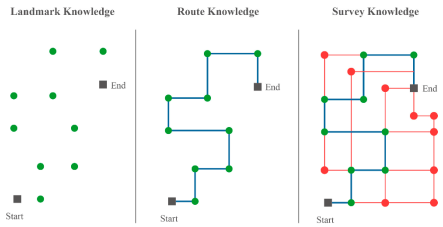
- What do you think it is?
- In practice?

Spatial Information
Everyday Life

- Examples
  - Find direction
  - Query information by location
  - Provide services by location
  - Visualize spatial pattern

Source: SLA

- Main types of knowledge
  - Landmark-route-survey



Source: http://www.mdpi.com/2220-9964/4/1/1/htm

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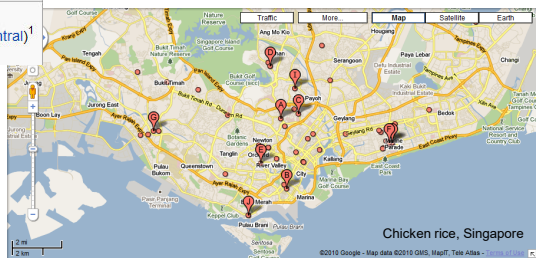
(Digital) Spatial Information … is everywhere



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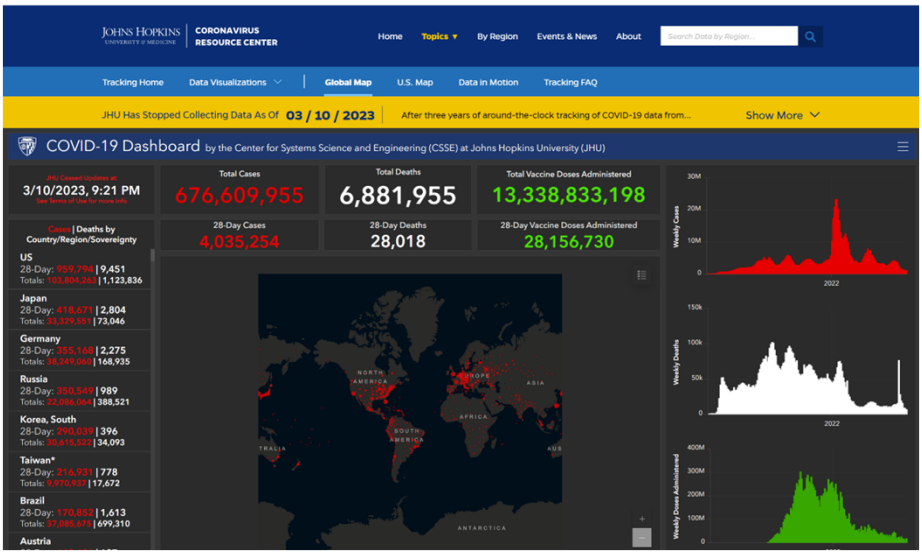
An example of a dashboard



https://coronavirus.jhu.edu/map.html

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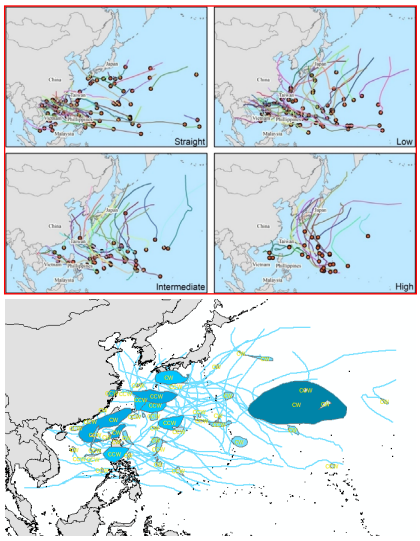
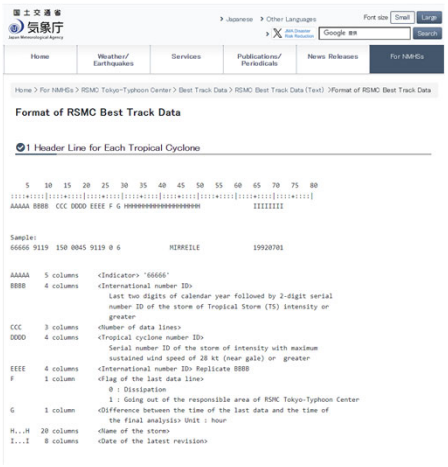
Spatial Information … geographic knowledge

RAW data are accessible here





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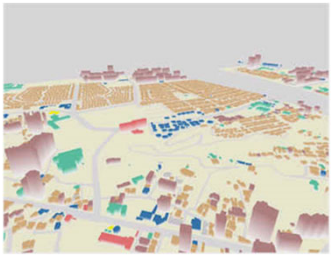
Definition of GIS (from GE2215)

- A computer system
- Spatial data
- Specialized software
  - Captures
  - Manages
  - Manipulates
  - Analyzes
  - Models
  - Displays
- People



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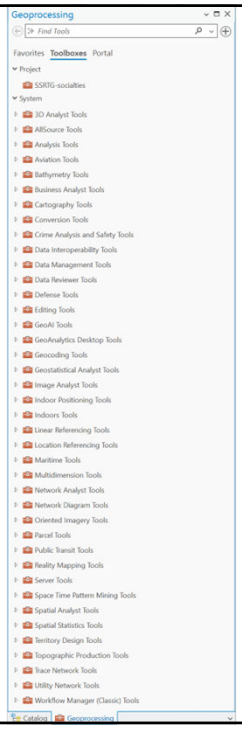
As a spatial expert in a team, what are possibly your contribution?

- Spatial representations and data sources
- Levels
  - Conceptual
  - Logical
  - Physical



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1 *Identify the information products that will be produced with your GIS.*

Inventory map products, analytical models, database reports, Web access, data flows, and enterprise requirements.

2 *Identify the key thematic layers based on your information requirements.*

Specify the map use, data source, spatial representation, map scale and accuracy, and symbolology and annotation.

3 *Specify the scale ranges and spatial representations for each thematic layer.*

GIS data is compiled for specific scale use; feature representation often changes between points, lines, and polygons at larger scales. Rasters are sampled to include multiresolution pyramids.

4 *Group representations into datasets.*

Discrete features are modeled with feature datasets, feature classes, relationship classes, rules, and domains. Continuous data is modeled with raster datasets. Measurement data is modeled with survey datasets. Surface data is modeled with raster and feature datasets.

conceptual design

5 *Define the tabular database structure and behavior for descriptive attributes.*

Identify attribute fields, specify valid values and ranges, apply subtypes to control behavior, and model relationships.

6 *Define the spatial properties of your datasets.*

Use networks for connected systems of features and topologies to enforce spatial integrity and shared geometry. Set the spatial reference for the dataset.

7 *Propose a geodatabase design.*

Make informed decisions on applying structural elements of the geodatabase and prepare a design. Study existing designs for examples.

logical design

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Source: Arctur and Zeiler (2004), pp9

9

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logical design

8 *Implement, prototype, review, and refine your design.*

From the initial design, build a geodatabase and load data. Test and refine your designs.

9 *Design work flows for building and maintaining each layer.*

Each layer has distinct data sources, accuracy, currency, metadata, and access. Define work flows to conform to your agency's business practices.

10 *Document your design using appropriate methods.*

Use drawings, layer diagrams, schema diagrams, and reports to communicate your data model.

physical design

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Source: Arctur and Zeiler (2004), pp9

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An Example

- What should be the system design of a navigation system within the Kent Ridge campus?
- Scenario:
  - A visitor from NTU has to come to AS7 01-02
  - The visitor drives a car
  - The visitor is not familiar with the Kent Ridge campus
  - Parking is needed and toll (ERP) should be avoided

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Immediate Issues for Us

- How do we create a database that
  - comply with the needs of the customers?
  - avoid inconsistency?
- How do we design and implement a database?
  - What are the jobs for us?
  - What are the jobs handled by the existing “systems”, e.g., ArcGIS, OSM, SDI, iPhone?

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Data Models

- A representation of the reality
- The result of conceptual data modeling

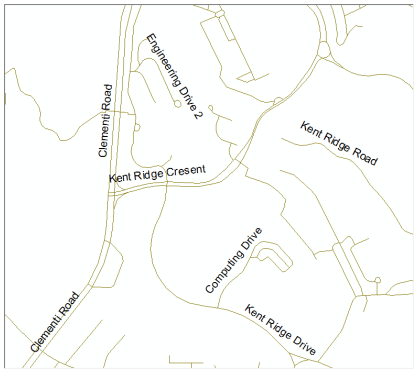

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Table

singapore_highway

FID	Shape	TYPE	NAME	ONEWAY	LANES
0	Polyline	secondary	Jalan Tanjung Kupang		0
1	Polyline	secondary			0
2	Polyline	trunk	Lebuhraya Tanjung Pelapas		0
3	Polyline	residential			0
4	Polyline	secondary			0
5	Polyline	secondary			0
6	Polyline	motorway	Lebuhraya Hubungan Linkedua Malaysia-Singapura	yes	2
7	Polyline	motorway	Lebuhraya Hubungan Linkedua Malaysia-Singapura	yes	2
8	Polyline	motorway_link		yes	0
9	Polyline	residential			0
10	Polyline	primary			0
11	Polyline	primary	Jalan Gelang Patah		0
12	Polyline	motorway		yes	0
13	Polyline	motorway_link			0
14	Polyline	primary			0
15	Polyline	motorway		yes	0
16	Polyline	primary	Lebuhraya Persiaran Pantai Johor Bahru-Nusajaya		0
17	Polyline	trunk_link		-1	1

1 (0 out of 13140 Selected)

singapore_highway

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Things to Consider

- Why are these “features” and “relationships” needed?
- What do they mean?
  - What do they tell you?
  - What they do not tell you?
- How are they tied to the implementation of a GIS database using
  - Esri Geodatabase vs web-based platform?
  - Desktop versus service-oriented architecture?

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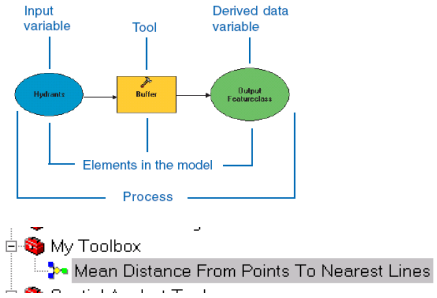
Customization of ArcGIS

- Reuse existing tools
- Find scripts from someone else
- Write your own codes



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Main Goals of the Class

- Understand the process of running a GIS project with respect to
  - GIS database design steps
  - spatial analysis
  - physical implementation (in computers)
  - data presentation/visualization
  - service-oriented architecture
- Understanding basics on customizing ArcGIS for specific tasks
- Understand the importance of documentation

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Class Format

- Weekly lectures (and in-class activities)
- Four lab exercises + one group project
  - Lab rules
    - Attendance is a must.
    - Late lab over a week will not be accepted
    - Any excuse should be supported by proper documentation (e.g., medical certificate)
    - The lab will be graded on promptness, accuracy, completeness, and tidiness

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Other Policies

- In the case of plagiarism, 0 marks will be given and the University's regulation will be enforced

https://www.nus.edu.sg/celc/statements-and-e-resources-on-plagiarism/

- You are responsible for completing all course requirements and for keeping up with the class schedule
- All lab reports are to be typed

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Evaluation

100% CA

Four individual lab exercises

One group project

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See GE3238_Syllabus_Updated20250114.xlsx for the most updated weekly topics

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