台大地理系：空間分析
NTU Geography: Spatial Analysis

課程概述

Course Introduction

課程網址：https://cool.ntu.edu.tw/courses/44834

授課教師：溫在弘

E-mail: wenthung@ntu.edu.tw

為什麼要必修「空間分析 (計量地理學)」？
先從瞭解當代地理學的發展

- 1930s 之前：環境決定論 Environmental determinism
- 1930s-50s：區域地理學 Regional geography
- **1950s-70s：地理學計量革命 Quantitative revolution**
- 1970s-90s：批判地理學 Critical geography

1990s 以後：新地理學 Neogeography
(Collaborative & Crowdsourcing)

2010s 以後的地理學?

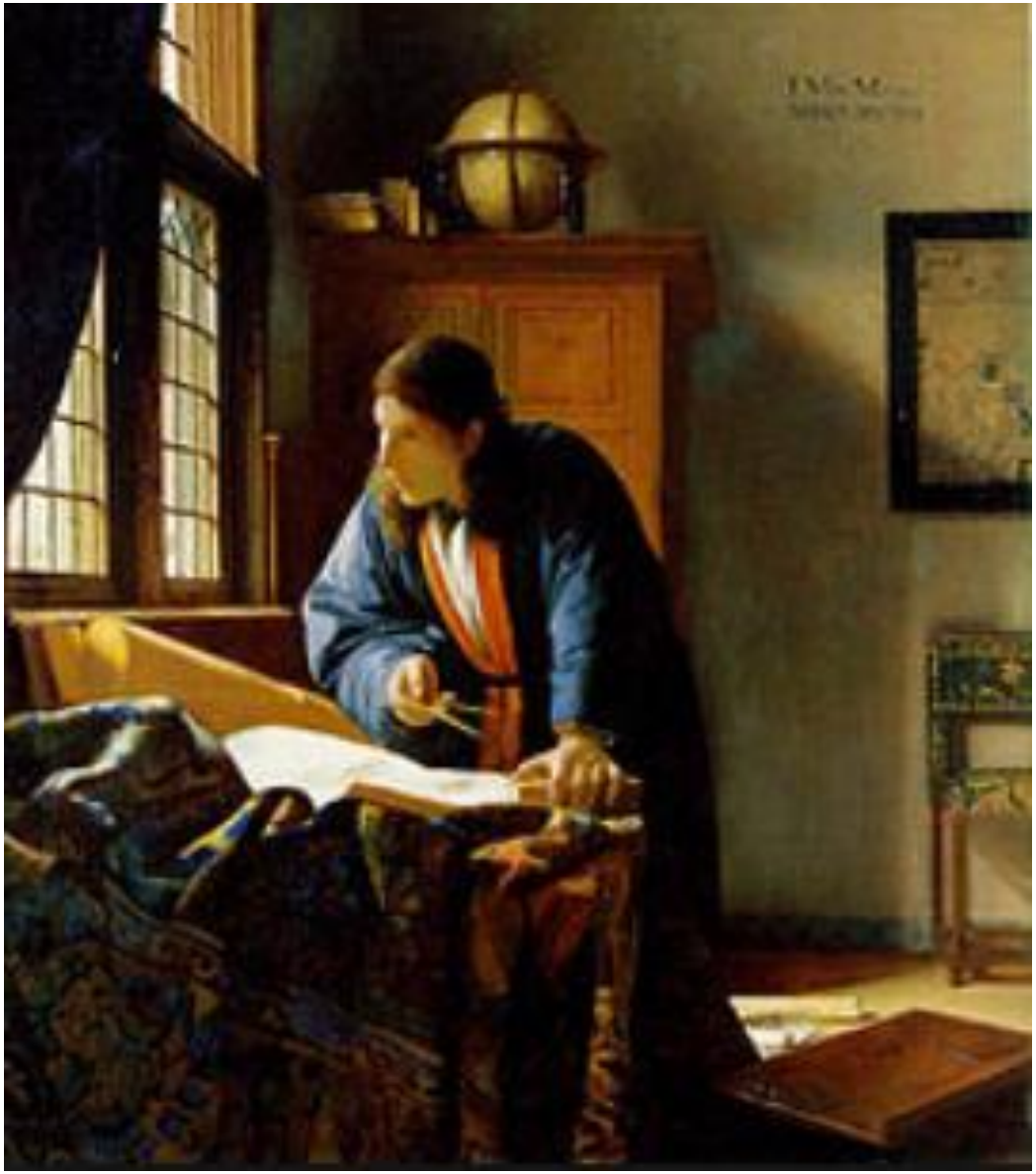
1998 Google 成立
2005 Google Earth/Maps
2007 Google Maps (Taiwan)
2011 Google 3-D 鳥瞰
2017 Google 位置分享功能

什麼是“空間分析(計量地理學)”

- 我們需先理解：什麼是“地理學”？[區域地理學]
  - 地理學是一門解釋**地區差異**的科學。
  - 地理學關心針對地表各不同地區的各種特性，提供**正確的、有條不紊的、合理的描述與解釋**。
  - 地理學尋求**世界之地區差異來獲得完整的知識**，以及從**地理獨特性的角度，區別世界各地區之現象間的差異**。

(Hartshorne,1939)

A Geographer



維梅爾，《地理學家》，1668

1950s-70s：地理學計量革命 (Quantitative revolution)

- Hartshorne專注於地域獨特性的描述，而**忽略因果關係的探討和理論法則建立的研究途徑**，終導致地理學的發展逐漸走向孤立。
- 1950年代以美國為首的地理學家，為使地理學更為「科學」，發動一場「計量革命」。**計量革命的結果，是將「空間分析」在1960年代以後，成為地理學研究的典範，開啟「空間科學 (Spatial Science)」的專業領域。**
- 然而，空間分析典範經過1960-1970年代的實踐卻顯示，以法則追尋的研究途徑和經驗統計的研究方法，集中精力於空間現象的分析，雖然有助於因果關係的釐清，**也促使理論地理學再現**。（Guelke,1977）
- 空間分析企圖透過距離及其衍生出來的空間概念，以理論化地表上人類組織各種活動的空間結構，導致原本植根於土地的地理學家，**所看到的只有點、線、面，而沒有山、水，更沒有人；空間分析為地理學發展的數理模式，並無法有效處理地表的複雜實體**。（Gilbert,1988）其結果，終將把地理學導向“貧困”。（施添福，1990）

Quantitative revolution

From Wikipedia, the free encyclopedia

In the history of geography, the **quantitative revolution** (QR or Quantitative Revolution)[n] was one of the four major turning-points of modern geography -- the other three being environmental determinism, regional geography and critical geography). The quantitative revolution occurred during the 1950s and 1960s and marked a rapid change in the method behind geographical research, from regional geography into a spatial science.[1] The main claim for the quantitative revolution is that it led to a shift from a descriptive (idiographic) geography to an empirical law-making (nomothetic) geography.

(Note: The quantitative revolution had occurred earlier in economics and psychology and contemporaneously in political science and other social sciences and to a lesser extent in history.)

Contents [hide]

Geography

History of geography

- Graeco-Roman
- Chinese
- Islamic
- Age of Discovery
- History of cartography
- Environmental determinism
- Regional geography
- **Quantitative revolution**
- Critical geography

http://en.wikipedia.org/wiki/Quantitative_revolution

nature.com

The world's best science and medicine on your desktop

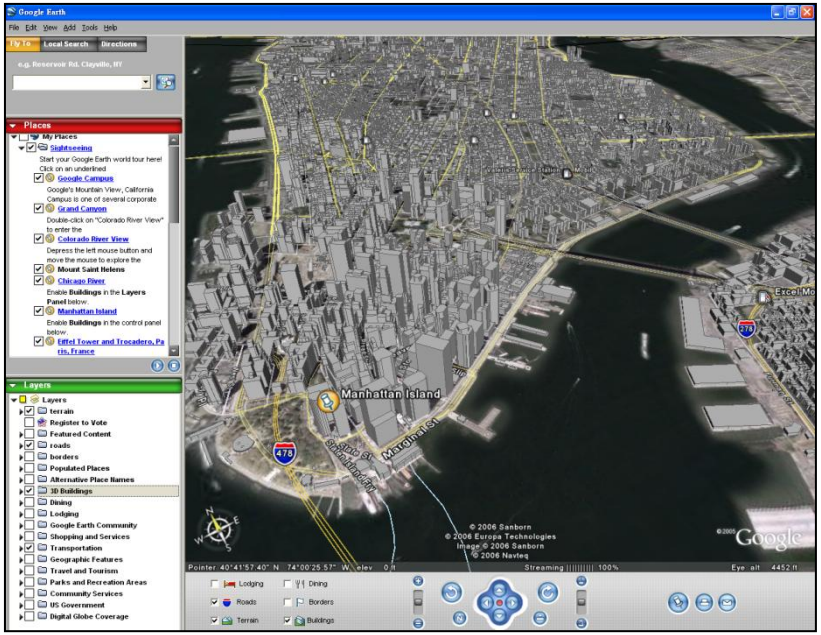
Login

Mapping opportunities

Scientists who can combine geographic information systems with satellite data are in demand in a variety of disciplines. Virginia Gewin gets her bearings.

Earlier this year, the US Department of Labor identified geotechnology as one of the three most important emerging and evolving fields, along with nanotechnology and biotechnology. Job opportunities are growing and diversifying as geospatial technologies prove their value in ever more areas.

Nature **427** (Jan 2004)



"…It really is opening up our world, and business is booming."

Nature **439**, 776-778 (Feb 2006)

Harvard University discontinued geography in 1948…

December 2005

From the Meridian

AAG Newsletter
of the
Association of American Geographers

Douglas Richardson, Publisher and Managing Editor
Megan D. Nortrup, Editor
AAG Voice 202-234-1450
AAG Fax 202-234-2744
newsletter@aag.org
www.aag.org

USPS 987-380 ISSN 0275-3995

The *AAG Newsletter* ISSN 0275-3995 is published monthly with July/August combined, by the Association of American Geographers, 1710 16th Street NW, Washington, DC 20009-3198. The cost of an annual subscription is $25.00 The subscription price is included in the annual dues of the Association. Not available to non-members. Periodicals postage paid in Washington, DC. All news items and

Bringing Geography Back to Harvard

I am extremely pleased to announce that geography is returning to Harvard. After more than three years of study and effort by many supporters, including the AAG, Harvard University has approved the establishment of a new Center for Geographic Analysis (CGA).

In a formal public announcement on October 20, 2005, Peter K. Bol, Harvard College Professor and the Charles H. Carswell Professor of East Asian Languages and Civilizations, was named the first Director of the Harvard University Center for Geographic Analysis. Peter, who has worked closely with the AAG during the establishment of the new Center, said his "aim is to see the Center assist in research projects and teaching university-wide. During the last two decades the miniaturization of computer technology, the ability to carry out continuous-time monitoring, the use of GPS, the increased use of remote

Richardson

fauna, and the comparatively recent but extraordinary consequential development of human societies. This vision is at the heart of the CGA's mission in the university… Geographic information sciences bridge earth and planetary sciences, engineering, medicine and public health, sociology, law, political science and economics, and history and the humanities. The interest at Harvard in geospatial analysis, spatial modeling, spatial statistics, and geographic information systems (GIS)—which has been the foundation for the development of spatial analysis generally—has been growing quickly."

Harvard's announcement noted that modeling the world computationally is a thorny problem for researchers across Harvard. Today more than twenty research projects at the Harvard School of Public Health depend on spatial analysis, all students in the Graduate School of Design are taught

FEATURES

Hello, Geotech

"Modeling our world," geography returns to Harvard.

by CHRISTOPHER REED

NOVEMBER-DECEMBER 2006

https://harvardmagazine.com/node/2621

FEATURES

Geographers See Death, Birth, and Job Prospects

NOVEMBER-DECEMBER 2006

https://harvardmagazine.com/2006/11/geographers-see-death-bi-html

Emerging Geospatial-tech Institutes in US

- Center for Geographic Analysis, Harvard University
- Spatial Sciences Institute, University of Southern California
- Department of Geography & Geographic Information Science, University of Illinois Urbana-Champaign (UIUC)
- School of Geographical Sciences & Urban Planning, Arizona State University (ASU)
- Committee on Geographical Sciences, University of Chicago
- National Geospatial-Intelligence Agency (NGA), United States Department of Defense
- …

nature.com
The world's best science and medicine on your desktop
Login

A place for everything

More researchers must record the latitude and longitude of their data.

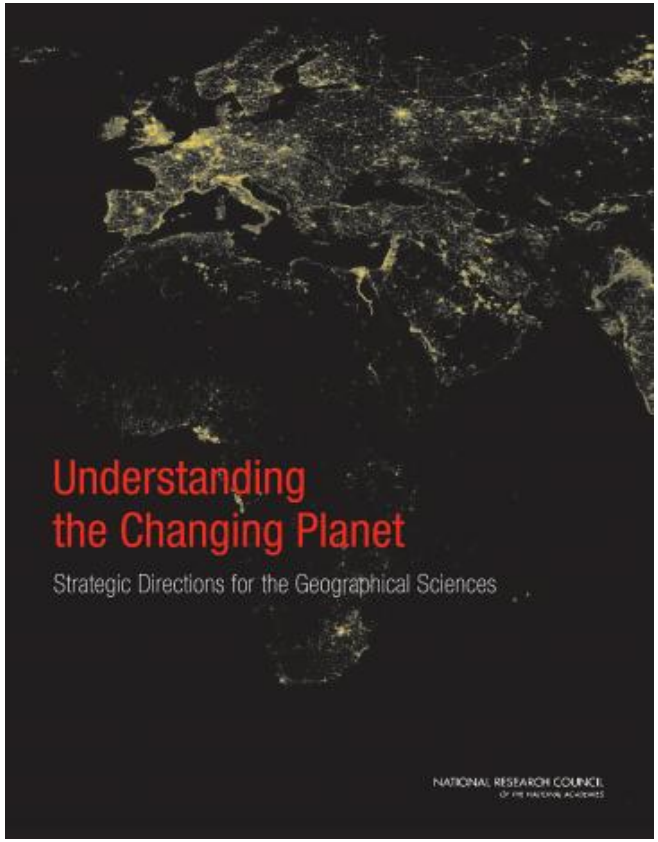
Who, what, where and when? Among the basic elements of scientific record-keeping, too often the 'where?' gets neglected. Now advances in satellite-positioning technology, online databases and geographical information systems offer opportunities to make good that neglect, and to add a much-needed spatial dimension to many types of biological research. Location data are essential for those modelling species' responses to climate change, or the spread of viruses, for example. Failure to include spatial information from the get-go may close off potentially highly productive routes to analysis — including those not yet foreseen. But those data are frequently inadequate or absent.

Many museums and herbaria are trying to make good this problem as best they can, geo-referencing their collections and putting them online. This frequently requires nightmarish work translating place names from various historical eras, languages and conventions into latitudes and longitudes. Although this is a necessary evil in matters retrospective, going forward there is a much simpler and easier answer in the form of coordinates and a time-stamp taken from the Global Positioning System (GPS) at the point of capture, or any other specified point of relevance.

This technology means that there is now much less excuse for allowing spatial data to fall by the wayside simply because they are not relevant to the data collectors' project in hand. Not only are the data easily collected, they are easily stored too. GenBank, for example, introduced fields for latitude and longitude in the metadata attached to its nucleotide sequence records in 2005. But few yet contain such information.

Gene sequence and structure databases have flourished in part because journals require authors to submit published data to them. It is worth considering a similar requirement that all samples in a published study be registered, along with GPS coordinates, in online databases such as the Global Biodiversity Information Facility. At the same time, it would behove spatial scientists to articulate to the broader research community the potential of recording and making accessible spatial data in the appropriate formats — and the painlessness of the process. ■

美國的國家科學院-國家研究理事會於2010年所出版的報告
《瞭解變化中的星球：地理科學的策略方向》



Key Messages

A major theme in **the geographical sciences** will be how to understand and respond to **environmental change and the human role in these changes.**

Geographical research should follow **eleven strategic directions** in order to **take advantage of recent technological advancements**, inspire continued innovation, and advance understanding of the major issues facing Earth.

Leveraging technological advances will allow scientists to better observe, analyze and visualize the changing world, leading to new insights for the betterment of society and environment.

The geographical sciences could help recognize and cope with the rapid reorganization of economy and society.

Strategic directions

1. How are we changing the physical environment of Earth's surface?
2. How can we best preserve biological diversity and protect endangered ecosystems?
3. How are climate and other environmental changes affecting the **vulnerabilities of coupled human–environment systems**?
4. How and where will 10 billion people live?
5. How will we **sustainably feed everyone** in the coming decade and beyond?
6. How does **where we live affect our health**?
7. How is the **movement of people, goods, and ideas** changing the world?
8. How is **economic globalization** affecting inequality?
9. How are **geopolitical shifts** influencing peace and stability?
10. How might we **better observe, analyze, and visualize** a changing world?
11. What are the **societal implications** of citizen mapping and mapping citizens?

MIT Sloan Management Review

Interview with Simon Thompson (Esri)

(2012)

Location Analytics: Bringing Geography Back

MENU Harvard Business Review

DESIGN

The Importance of Spatial Thinking Now

by Kirk Goldsberry

SEPTEMBER 30, 2013

(2013)

MENU Harvard Business Review

TECHNOLOGY

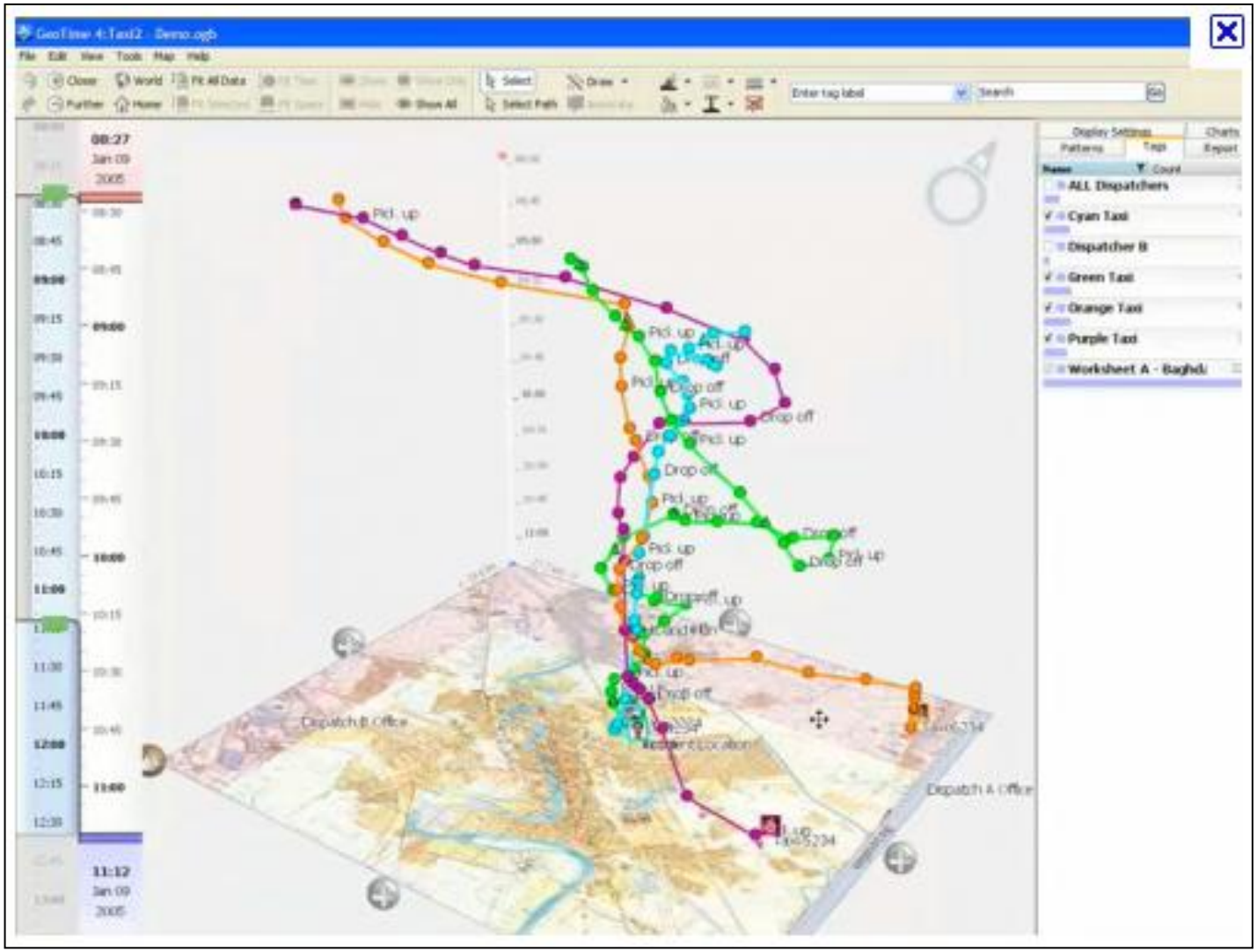
How Location Analytics Will Transform Retail

by Tony Costa

MARCH 12, 2014

(2014)

Space-time paths



Traffic flow in Google Maps

Google Maps gets real-time traffic, crowdsources Android GPS data

By Rick Burgess
On March 30, 2012, 5:30 PM EST

7 18 +1 15 Tweet 29

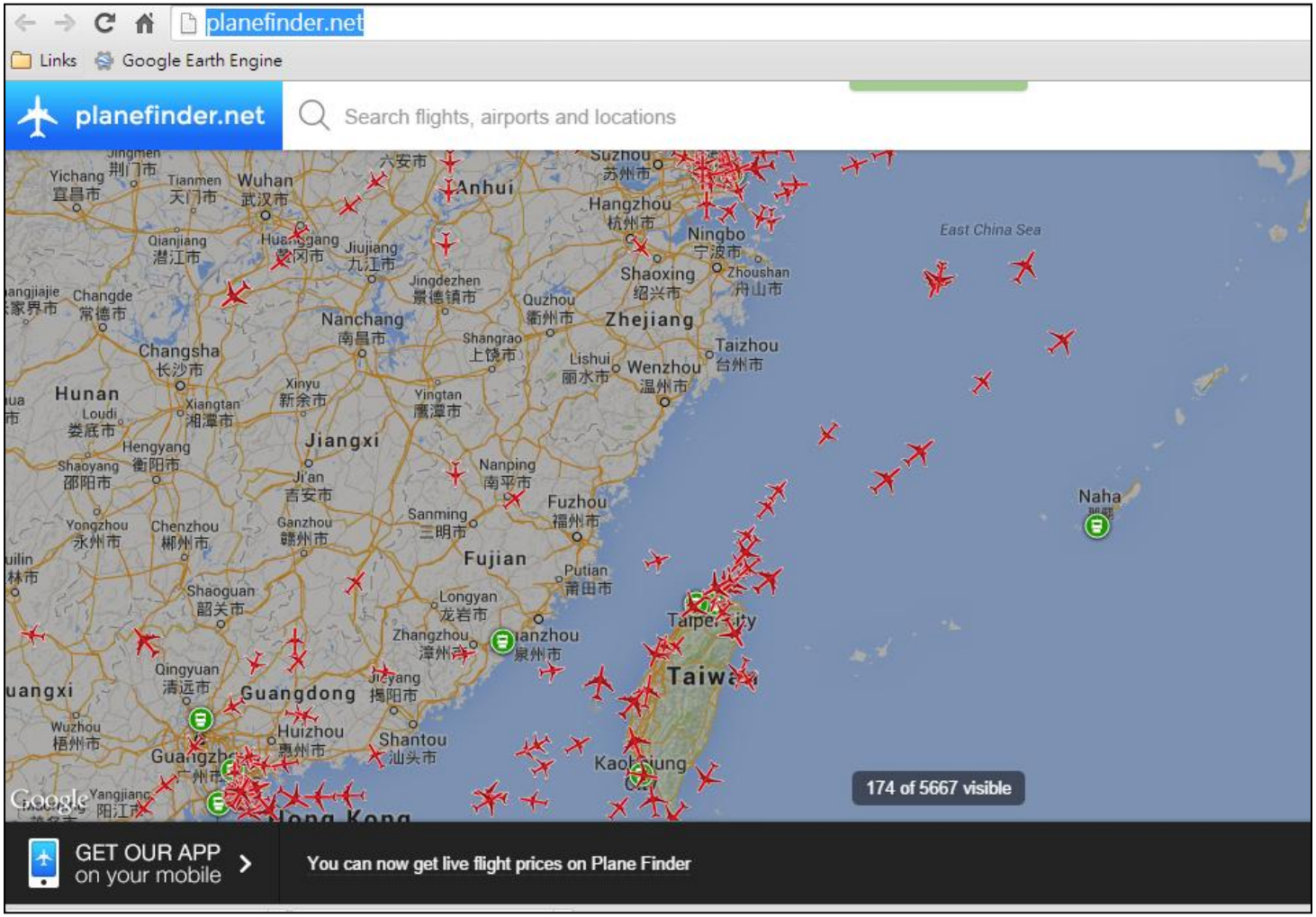
Although traffic data has been available on Google Maps for quite some time, the traffic information delivered by the popular mapping service was frequently stale or incorrect. In fact, estimated arrival times with traffic were so frequently incorrect, Google actually pulled the feature from Google Maps. As promised though, the company has finally decided to reintroduce the feature, but this time with improved real-time traffic data and far better arrival-time estimations.

Drivers will be pleased -- and privacy advocates will probably be infuriated -- to know that Google Maps will now take into account GPS data collected from Android-based smartphones. Rather than the old method of compiling historical data and making its best guesses on what traffic is like (eg. 'up to 50 minutes in traffic'), live data will be provided by the very commuters moving along (or I should say not moving?) in traffic.

The above is known as crowdsourcing, or at least a useful incarnation of it. Such techniques are already used by popular Internet-enabled GPS devices and apps. The popular crowdsourced GPS app, Waze, is a particularly pure and stunning example of this.

Source: http://www.techspot.com/news/48015-google-maps-gets-real-time-traffic-crowdsources-android-gps-data.html

Live flight tracking in the airspace



http://planefinder.net/

Industry Competency Model for Geospatial Technology

U.S. DEPARTMENT OF LABOR

Agency: Employment and Training Administration
Date: July 8, 2010
Release Number: 10-0950-NAT

News Release

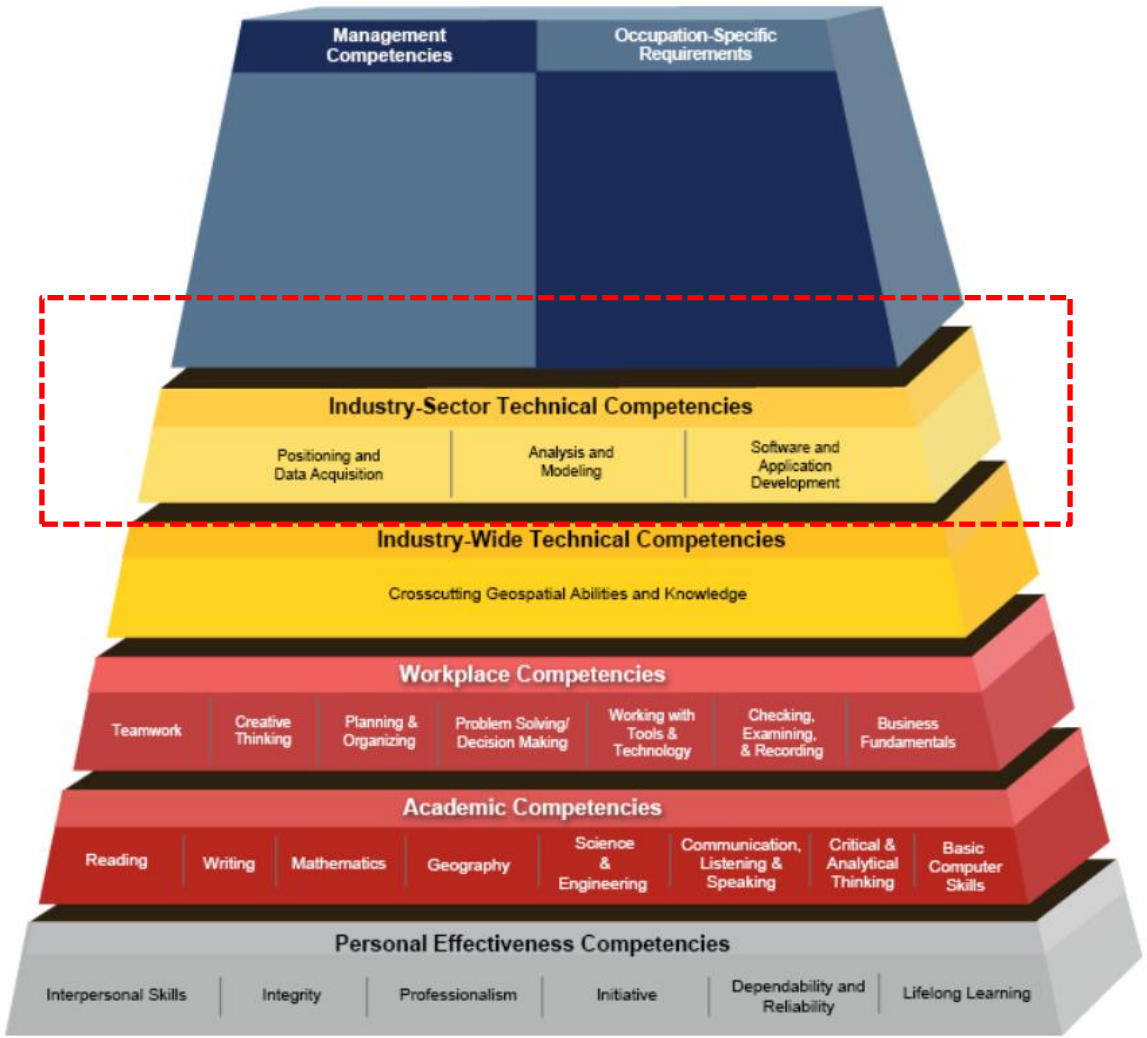
US DEPARTMENT OF LABOR ANNOUNCES RELEASE OF GEOSPATIAL TECHNOLOGY COMPETENCY MODEL

WASHINGTON – The U.S. Department of Labor's Employment and Training Administration today announced the release of an industry competency model for geospatial technology. There are now 16 models available on the Competency Model Clearinghouse available through the department's One-Stop Career Centers website. The Geospatial Technology Competency Model has been developed by researching and analyzing publicly available resources, existing skill standards, competency-based curricula and certifications to provide an employer-driven framework of the skills needed for success in geospatial technology.

"Competency models offer workers an opportunity to learn what it takes to enter a particular field," said Secretary of Labor Hilda L. Solis. "The geospatial model serves as a guide for those who want to both find a good job and map out a long-term career pathway in any of several geospatial technology fields including surveying and mapping, computer science and information science."

https://www.dol.gov/newsroom/releases/eta/eta20100708

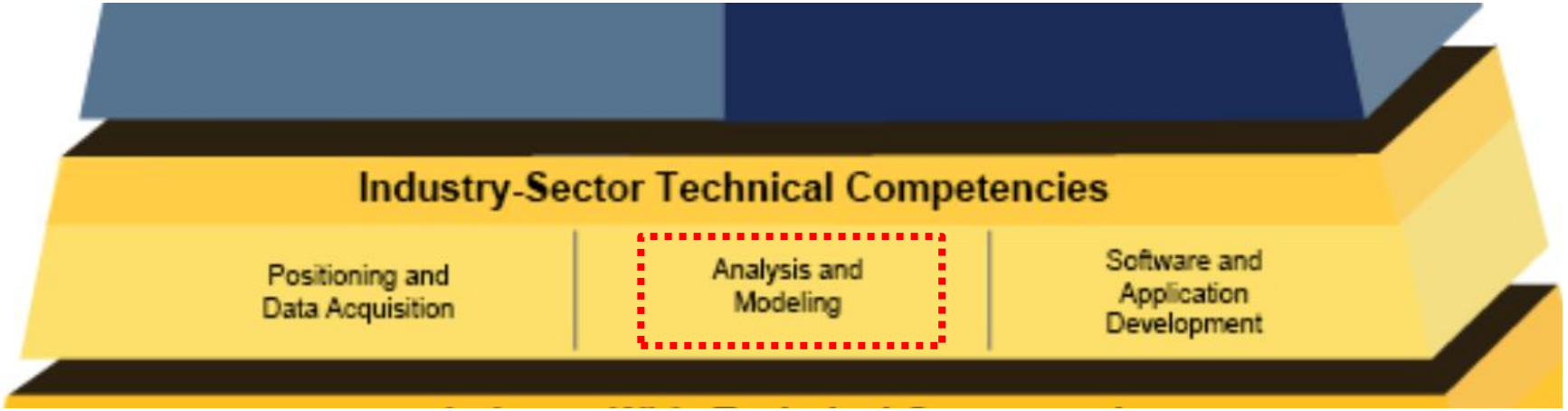
Geospatial Technology Competency Model



U.S. DEPARTMENT OF LABOR

https://www.careeronestop.org/competencymodel/competency-models/geospatial-technology.aspx

Geospatial Technology Competency Model (cont'd)



Technical Content Areas

5.2.19 Analytical Methods

5.2.20 Design Aspects

5.2.21 Data Modeling

5.2.23 Geospatial Data

5.2.24 Cartography and Visualization

5.2.25 GIS&T and Society

5.2.26 Organizational and Institutional Aspects

- **Basic Analytical Operations, such as buffers, overlay, neighborhoods, and map algebra**
- **Basic Analytical Methods, such as point pattern analysis, spatial cluster analysis, multi-criteria evaluation, and spatial process models**
- **Analysis of Surfaces, including interpolation of surfaces, surface features, and viewshed analysis**
- **Geostatistics, including spatial sampling, semi-variogram modeling, and kriging**
- **Data Mining, including pattern recognition**
- **Network Analysis, including least-cost paths, flow modeling, and accessibility modeling**

地理技術作為新創公司的可能 Geospatial Start-ups

- Using geospatial technologies to create innovative applications / services or art design
  - Technologies
    - Maps, location big data, location-based services (LBS), drones, apps, ibeacons, GIS/GPS, remote sensing…
  - Applications
    - Navigation, surveying, local discovery (tourism), traffic, transit and marketing

Top 100 **geospatial** companies

#Business #Featured

Global Top 100 Geospatial Companies – 2022 Edition

Muthukumar Kumar 01.31.2022 | 6 min

What are the top geospatial companies in the world right now in 2022? Since 2016, Geoawesomeness has been compiling THE list of the top 100 geospatial companies in the world.

The annual list is an essential source of information about companies that are utilising geospatial data and tools to solve problems and is aimed to help our community make sense of the ever-changing geospatial industry ecosystem.

Geoawesomeness is pleased to announce our #GlobalTop100Geo 2022 Edition. Hope you find the list useful.

If you have any questions regarding the list, please review the FAQ section at the bottom of this post. If you have further questions, comments and/or would like to collaborate with the team, feel free to reach us at info@geoawesomeness.com

https://geoawesomeness.com/global-top-100-geospatial-companies-2022-edition/

Keywords in geospatial companies/start-ups

Spatial Thinking Concepts

AAG
American Association of Geographers

SKILL	DEFINITION	EXAMPLE
COMPARISON	Comparing one place with another…	e.g., rainfall, income, satellite images, maps, graphs
AURA	Describing the influence that a place can have on neighboring locations...	e.g., smoke from a factory, noise from a highway, property value near a park
REGION	Drawing a line around all places that have similar characteristics or are linked together in some way...	e.g., Corn Belt, Ozark Highlands, Polish neighborhood, Tornado Alley
TRANSITION	Describing what happens between two places with known conditions...	e.g., Do features change gradually or abruptly from one place to another?
ANALOGY	Finding places on other continents (or in other cities, mountains, etc.) that have similar positions and therefore have similar conditions...	e.g., Mediterranean climate, subduction zones, inner ring suburbs
HIERARCHY	Identifying a spatial hierarchy, or how 'nested' features relate to one another...	e.g., river networks, distribution hierarchies, political hierarchies (town, county, state, country)
PATTERN	Describing the arrangement of features or conditions in an area...	e.g., evenly or unevenly spaced, clusters, donuts, strings
ASSOCIATION	Identifying the extent to which features have the same map pattern...	e.g., malls and freeway exits, malaria and anopheles mosquitoes

Spatial Thinking Skills

AAG
American Association of Geographers

SKILL	DEFINITION
COMPARISON	Comparing one place with another…
AURA	Describing the influence that a place can have on neighboring locations…
REGION	Drawing a line around all places that have similar characteristics or are linked together in some way…
TRANSITION	Describing what happens between two places with known conditions…
ANALOGY	Finding places on other continents (or in other cities, mountains, etc.) that have similar positions and therefore have similar conditions…
HIERARCHY	Identifying a spatial hierarchy, or how 'nested' features relate to one another…
PATTERN	Describing the arrangement of features or conditions in an area…
ASSOCIATION	Identifying the extent to which features have the same map pattern…

Spatial analysis methods

Statistical tests/heterogeneity

Neighborhood effect (dependency)

Grouping/regionalization

Space-time dynamics

Grouping/similarity

Scaling issues (multi-scale)

Geo-visualization/dependency

Regression

課程介紹

- **課程概述：**
  - 應用地理資料進行的空間分析方法為主要的授課內容，將包括：(1).複習基本觀念；(2).介紹空間分析方法及其應用的相關課題。**本學期課程將著重於空間型態分析（Spatial Pattern Analysis）。**內容除了**分析理論方法**的講授之外，輔以利用R程式語言實作各種分析方法與案例應用，並透過期刊論文的研究成果，來導引各種分析方法的運用。
- **課程目標：**
  - 授課方式以講授及實作為主，授課內容著重於地理課題的實際應用，期使學生能夠具備**獨立解決問題**的能力。

課程設計

- 分析方法的理解（授課內容與講義）
- 資料分析的實作能力（R 統計語言）
- 實證研究與應用（論文研讀與討論）

In-class: 3 hours / week (lecture/discussion + labs)

After-class activities: 3-5 hours / week (reading + labs)

近年修課同學的課後作業時間

112-2

3. 我每週平均花多少時間進行本課程課外學習活動？

(1)0小時 0人 (0.0%)	(2)1小時 0人 (0.0%)	(3)2小時 3人 (11.5%)
(4)3小時 3人 (11.5%)	(5)4小時 10人 (38.5%)	(6)5小時 5人 (19.2%)
(7)6小時 3人 (11.5%)	(8)7小時 1人 (3.8%)	(9)8小時以上 1人 (3.8%)

平均：4.4 小時

111-2

3. 我每週平均花多少時間進行本課程課外學習活動？

(1)0小時 0人 (0.0%)	(2)1小時 1人 (4.8%)	(3)2小時 1人 (4.8%)
(4)3小時 6人 (28.6%)	(5)4小時 3人 (14.3%)	(6)5小時 4人 (19.0%)
(7)6小時 4人 (19.0%)	(8)7小時 1人 (4.8%)	(9)8小時以上 1人 (4.8%)

平均：4.4 小時

110-2

3. 我每週平均花多少時間進行本課程課外學習活動？

(1)0小時 0人 (0.0%)	(2)1小時 0人 (0.0%)	(3)2小時 1人 (6.7%)
(4)3小時 3人 (20.0%)	(5)4小時 5人 (33.3%)	(6)5小時 3人 (20.0%)
(7)6小時 1人 (6.7%)	(8)7小時 1人 (6.7%)	(9)8小時以上 1人 (6.7%)

平均：4.5 小時

109-2

3. 我每週平均花多少時間進行本課程課外學習活動？

(1)0小時 1人 (2.9%)	(2)1小時 0人 (0.0%)	(3)2小時 3人 (8.6%)
(4)3小時 4人 (11.4%)	(5)4小時 10人 (28.6%)	(6)5小時 9人 (25.7%)
(7)6小時 5人 (14.3%)	(8)7小時 1人 (2.9%)	(9)8小時以上 2人 (5.7%)

平均：4.5 小時

近年修課同學的學習心得與回饋

學習到非常多，也算是我這學期最喜歡的課，就像老師在一開始提到的這是一門程式、地圖、統計集合起來的課，**一開始確實我因為R語言受盡了許多苦頭，後面的主題確實我非常喜歡**，空間的聚集一直都是一個滿難界定的問題，有不同學者提出不同方法，了解這些方法，也懂得他們的利用，讓我對空間分析的興趣增加了不少。

學期初的時候很喜歡這門課，**覺得透過R來畫地圖很有趣且實用**。而且老師給我的感覺也很認真，很用心地在教這門課，**若是有同學不會也會停下來慢慢講到大家都懂**。**給同學的作業負擔也不會太重**，也提供往年的助教課影片供同學複習。以上種種都讓我滿喜歡這門課的。

我以前總覺得「靠近」就是「靠近」ㄚ，哪還那麼多事，結果意外發現其中有很多奧妙，雖然並未全然理解，但**讓我在思考「相關」或「鄰近」的時候，會再多想一點**，並注意「靠近」並不全然。

是一門loading很重，但**看得出自己的用心成果的課程**。假如對統計學與程式設計有所了解，那我會蠻推薦這門課程給他。

對於0程式語言基礎的人而言，負擔繁重。但**期中後有漸入佳境的感覺，整體而言收穫甚多**。而在實習與作業上，發現期中考後的講解比較多且清楚，在實作上也順利許多，希望往後可以延續這樣的方式。

本課程的先修課程

(這些先修課程內容將視為理解或實作本課程內容的基礎)

Prerequisites

大一 地圖與地理資訊系統: 3 學分 (Cartography & GIS)

大一 程式設計: 3 學分 (Computer Programming)

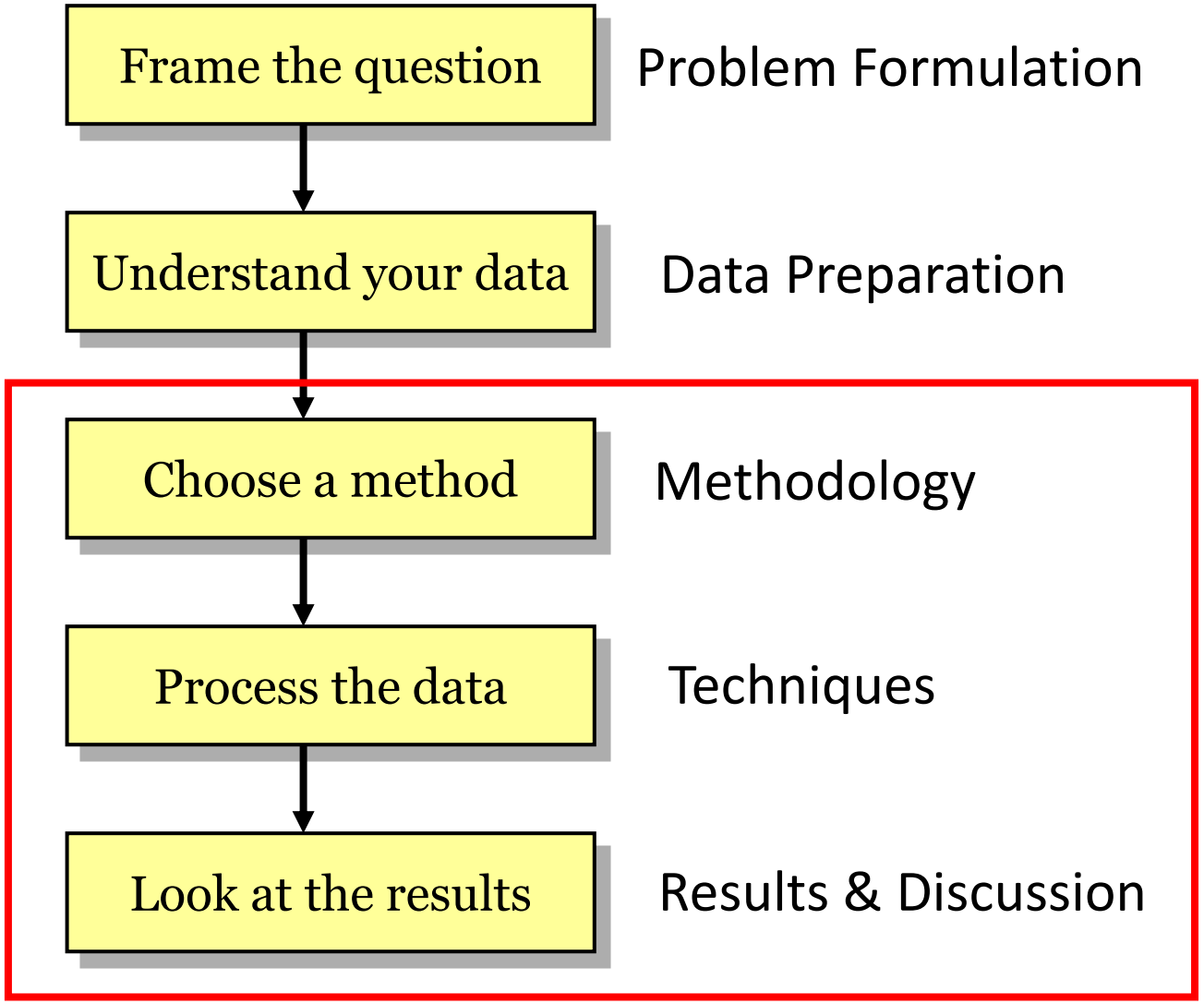
大二 統計學: 4 學分 或 6學分 (Statistics)

若尚未修習上述課程的修課同學，須 主動 找老師或助教尋求課後協助。

先修課程的基礎概念

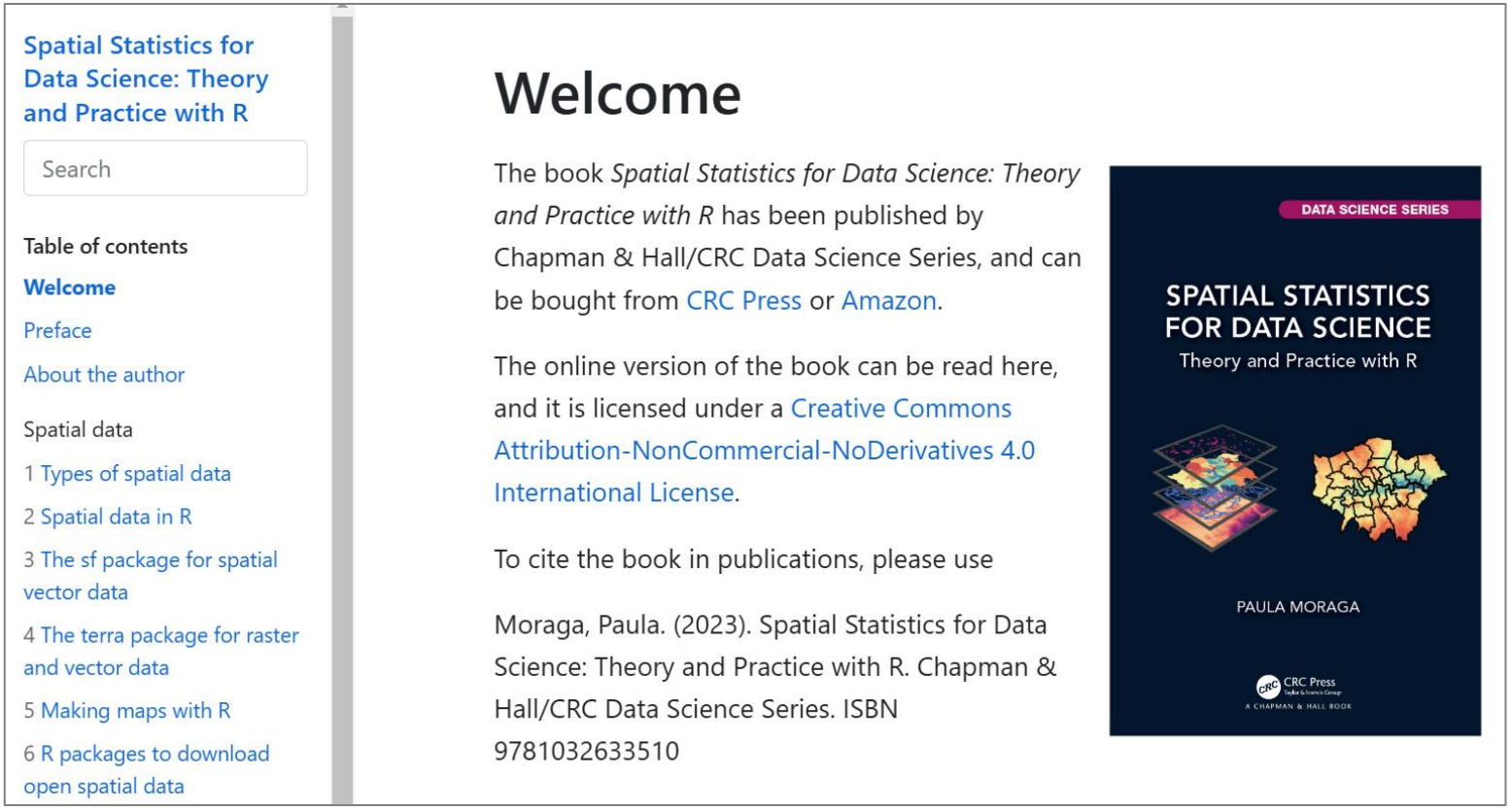
- Statistics: sampling, inference and estimation
- Cartography: coordinates and mapping concepts
- GIS: spatial data structures and manipulation
- Programming: if-then-else, iteration (for-loop), user-defined functions, data query & selection, data structures (e.g. list, vector, matrix,…)

The Process of Analyzing Geographic Data



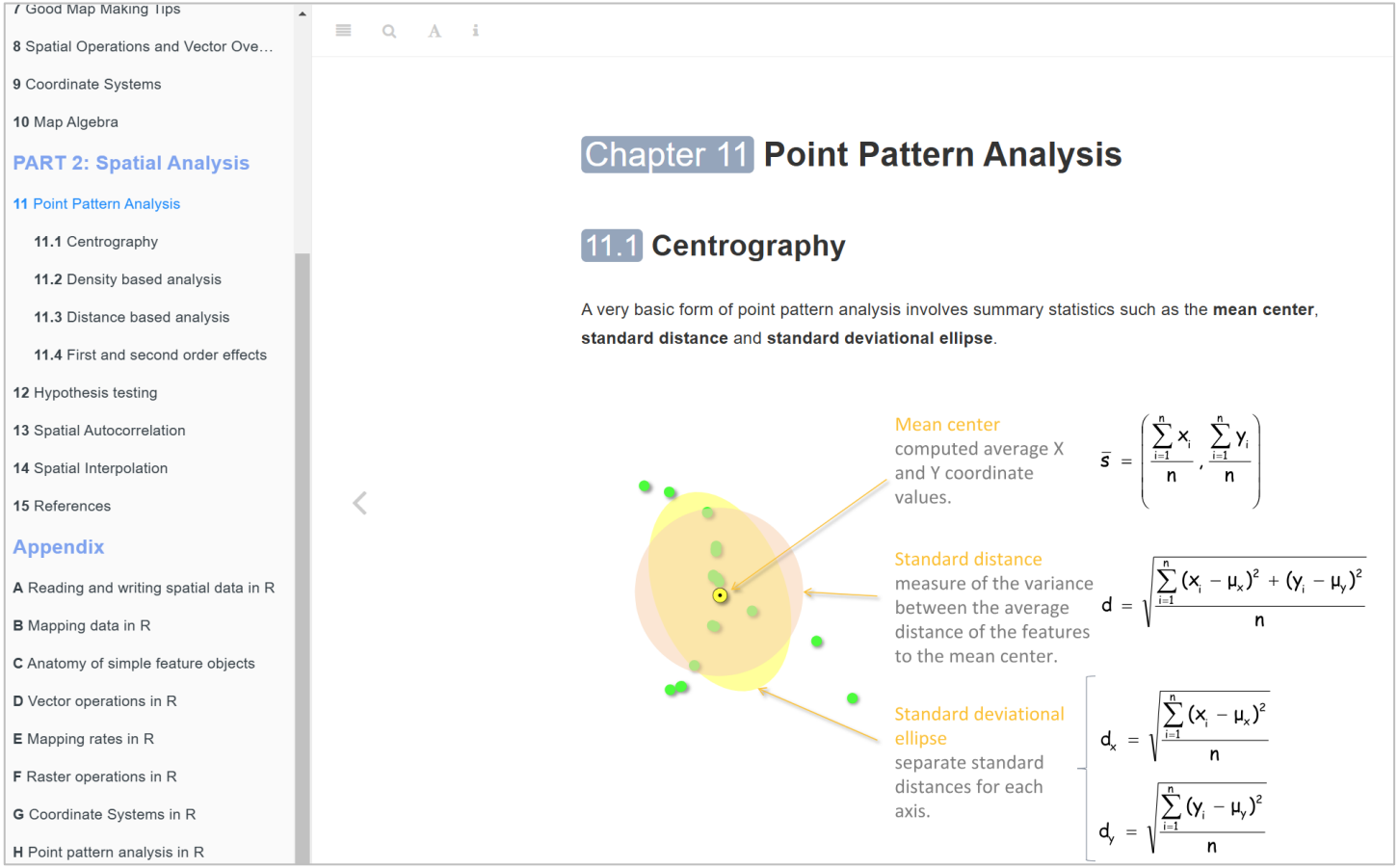
教科書 (部分章節)

Moraga (2024), ***Spatial Statistics for Data Science: Theory and Practice with R***. Chapman & Hall/CRC Data Science Series.
https://www.paulamoraga.com/book-spatial/index.html



教科書 (部分章節)

Gimond (2024), ***Intro to GIS and Spatial Analysis*** (lecture notes), https://mgimond.github.io/Spatial/index.html



授課主題 Part 1: Spatial data processing and mapping

- 1. Course Introduction
- 2. Data Analysis with R
- 3. Handling Spatial Data with R
- 4. Using R as a GIS: Geo-processing Operations
- 5. R for Spatial: More Complex Operations
- 6. Describing Spatial Patterns
- 7. Point Pattern: Quadrat Analysis
- 8. (4.07) * Midterm Exam (Individual) * (30%)

授課主題 Part 2: Spatial statistics

- 9. Point Pattern: Distance-based Methods
- 10. Point Pattern: Kernel Density Estimation (KDE)
- 11. Areal Pattern: Spatial Autocorrelation
- 12. Areal Pattern: Join Count Statistics
- 13. Areal Pattern: Hot-spot Analysis
- 14. Issues of Multiple Comparisons in Localized Spatial Analysis
- 15. * Final Exam + Oral (Group) * (20%)
- 16. * Final Report Submission * (30%)

課程相關規定

- 課程要求：
  - 需參與課程討論與實習、論文研讀與課後作業

- 成績評量：
  - **Weekly Assignment 20%**
  - **Mid-term Exam 30%**
  - **Final Exam 20%**
  - **Final Report 30%**
  - **Quiz/Bonus 10%**

學期等第成績按照本校教務處的百分制成績轉換標準

學生成績評量定義表

百分數	等第	定義
90-100(95)	A+	All goals achieved beyond expectation 所有目標皆達成且超越期望
85-89(87)	A	All goals achieved 所有目標皆達成
80-84(82)	A-	All goals achieved, but need some polish 所有目標皆達成，但需一些精進
77-79(78)	B+	Some goals well achieved 達成部分目標，且品質佳
73-76(75)	B	Some goals adequately achieved 達成部分目標，但品質普通
70-72(71)	B-	Some goals achieved with minor flaws 達成部分目標，但有些缺失
67-69(68)	C+	Minimum goals achieved 達成最低目標
63-66(65)	C	Minimum goals achieved with minor flaws 達成最低目標，但有些缺失
60-62(61)	C-	Minimum goals achieved with major flaws 達成最低目標但有重大缺失
<59(含)	F	No goals achieved 所有目標皆未達成

備註：()為中位數

實作資料與講解練習：https://wenlab501.github.io/GEOG2017/

課程助教

- 黃妍儒　r13228006@ntu.edu.tw
- 曹立品　r13228029@ntu.edu.tw

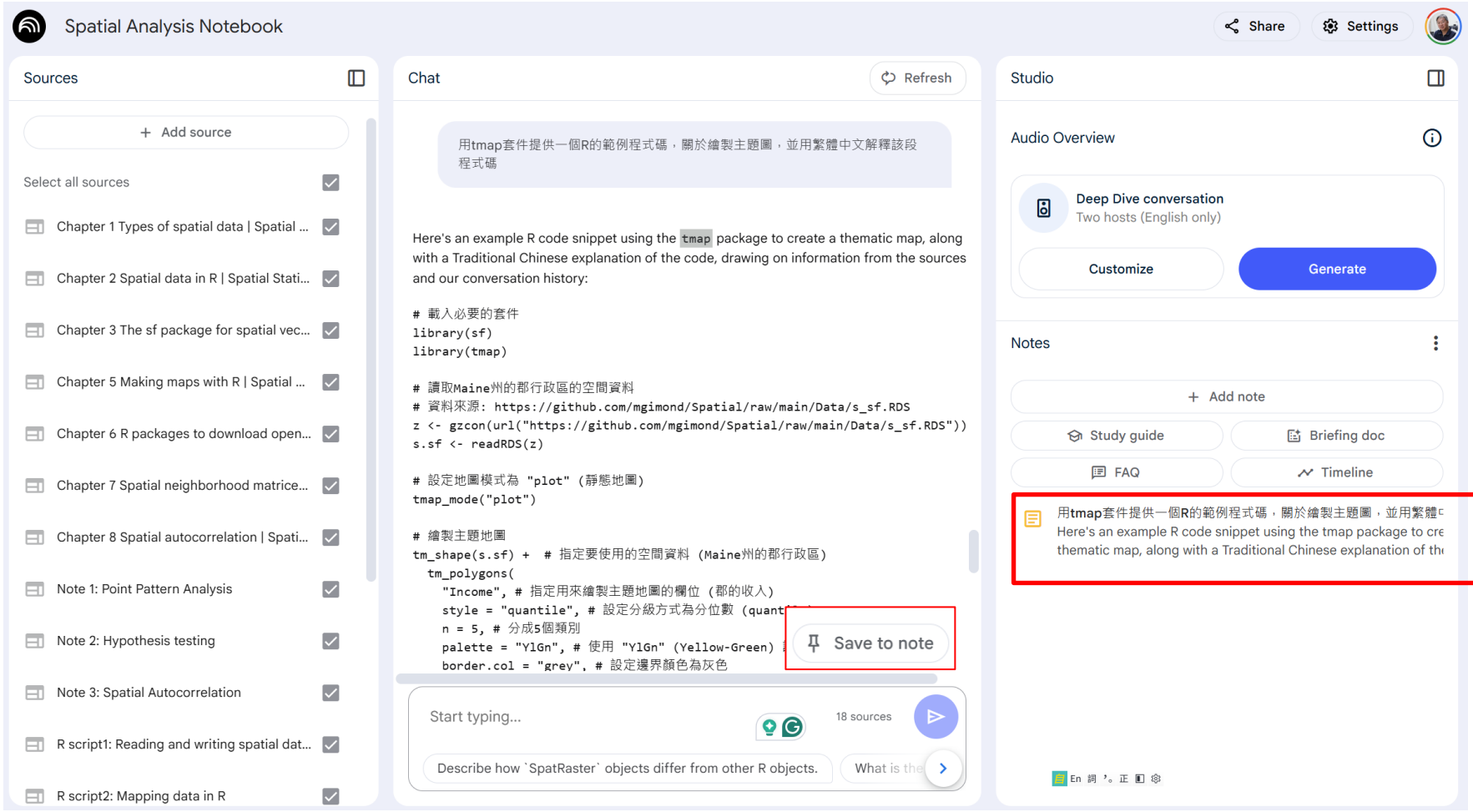
實習與考試方式

- 每週實習：自行觀看影片與演練，不算分
- 隨堂測驗(Bonus, 10%)：Open book exam (不使用電腦)
- 每週作業(20%)：同儕相互討論
- 期中考(30%)： Open book exam (不使用電腦)
- 期末考(20%+30%)：分組同儕討論 + 上機考試/報告

作業繳交規定

- 作業通常包括兩部分，分析實作與研讀心得，打包壓縮成zip或rar 檔，上傳NTU COOL繳交。研讀心得的格式為PDF檔；分析實作則以R Markdown編輯成動態檔案 (html file)。**格式不符合規定，斟酌扣分**
- 研讀心得的格式與字數不拘，評分標準為文字內容與課程內容的連結程度、個人反饋意見的思考深度。
- 每週作業，需於**下週上課之前 (2:00pm，以NTU COOL的上傳時間為準)**，完成上傳繳交，**作業不接受遲交或補交**。

使用AI協作平台的學習教材： NotebookLM



Bonus: 分享AI問答的學習心得

NotebookLM > [新增記事]

標題	[ChatGPT prompt：提問文字] (姓名_學號)
內容	分享：[ChatGPT Share] -> [Create link] -> [Copy link] [ChatGPT completion：回答文字]

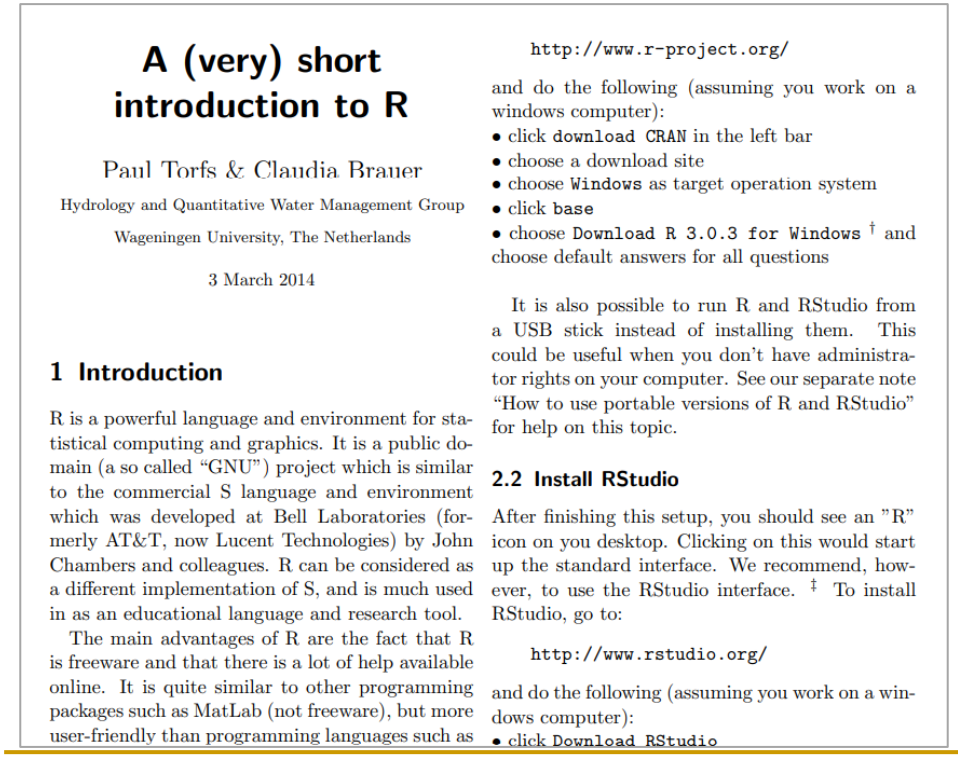
Bonus: 分享AI問答的學習心得（續）

本週作業 #1（將程式碼與執行結果以截圖方式，轉成PDF檔繳交）

- **實作教材，完成所有的ToDo 練習題**

  Torfs and Brauer (2014). A (very) short Introduction to R。

  https://cloud.r-project.org/doc/contrib/Torfs+Brauer-Short-R-Intro.pdf



A (very) short introduction to R

Paul Torfs & Claudia Brauer

Hydrology and Quantitative Water Management Group

Wageningen University, The Netherlands

3 March 2014

1 Introduction

R is a powerful language and environment for statistical computing and graphics. It is a public domain (a so called "GNU") project which is similar to the commercial S language and environment which was developed at Bell Laboratories (formerly AT&T, now Lucent Technologies) by John Chambers and colleagues. R can be considered as a different implementation of S, and is much used in as an educational language and research tool.

The main advantages of R are the fact that R is freeware and that there is a lot of help available online. It is quite similar to other programming packages such as MatLab (not freeware), but more user-friendly than programming languages such as

`http://www.r-project.org/`

and do the following (assuming you work on a windows computer):

- click `download CRAN` in the left bar
- choose a download site
- choose `Windows` as target operation system
- click `base`
- choose `Download R 3.0.3 for Windows` † and choose default answers for all questions

It is also possible to run R and RStudio from a USB stick instead of installing them. This could be useful when you don't have administrator rights on your computer. See our separate note "How to use portable versions of R and RStudio" for help on this topic.

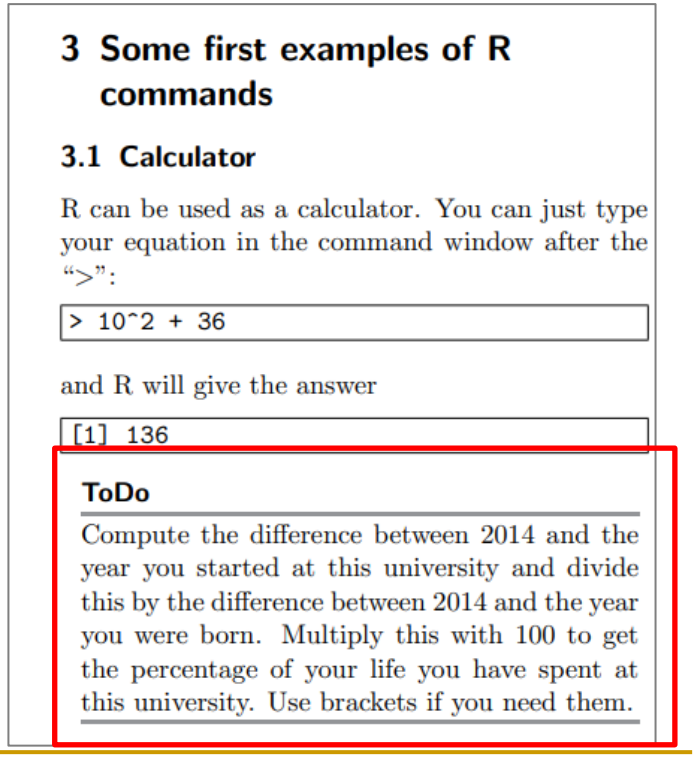
2.2 Install RStudio

After finishing this setup, you should see an "R" icon on you desktop. Clicking on this would start up the standard interface. We recommend, however, to use the RStudio interface. ‡ To install RStudio, go to:

`http://www.rstudio.org/`

and do the following (assuming you work on a windows computer):

- click `Download RStudio`



3 Some first examples of R commands

3.1 Calculator

R can be used as a calculator. You can just type your equation in the command window after the ">":

```
> 10^2 + 36
```

and R will give the answer

```
[1] 136
```

ToDo

Compute the difference between 2014 and the year you started at this university and divide this by the difference between 2014 and the year you were born. Multiply this with 100 to get the percentage of your life you have spent at this university. Use brackets if you need them.

基本統計概念複習

2/24 複習小考 Open book exam (不能使用電腦與網路)：

範圍：基本R語言實作 ＋ 統計學概念（機率與統計推論）

數值計算可用手機的計算機

練習測驗時間 20 分鐘（2:30pm - 2:50pm），共 20 分 。

分數將合併計入期中考成績

範例： 109-2 的機率與統計複習練習

1. 某個1萬人的城鎮有一家急診醫院，根據歷年統計平均該院每天需接收8位急診病患，該醫院共有20張急診病床，假設急診病患當日即能出院，且每天的病患就診皆為獨立事件。

請計算平均一週(7天)內有3天(含)以上出現急診病床不足的機率。

2. Rainfall.txt是台北、板橋與桃園各月份的降雨量（單位：公釐）。

請根據提供的資料，使用合適的統計方法，評估降雨量在北台灣是否存在顯著的空間變異？

（需說明使用的統計方法以及統計推論的過程）

範例： 111-2 的機率與統計複習練習

- 水利局在某地區擬規劃建設蓄水庫，預計需滿足 10萬家戶的用水需求，水利局想瞭解家戶用水狀況，因此委託調查公司，在該地區進行家戶用水量調查，針對該地區隨機抽樣 100 個家戶的用水量，抽樣結果在 data.Rdata（單位：公升）

- 假設家戶平均用水量服從常態分佈， 請計算：

  (1). 繪製該地區的家戶平均用水量的抽樣分布 (sampling distribution) 並計算95%信賴區間 (confidence interval)。

  (2). 若水庫供水穩定度需維持在 90%成功率，該水庫應規劃的蓄水容量至少為多少公噸？ (1 公噸= 1000 公升)

- 提示資料讀取的R語法：load("data.Rdata")