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University College London (UCL) における GIS 教育

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UCL は、連合大学である University of London の中で、最も古くかつ最も規模が大きい college の 1 つで、その学生数は約 19,400 人（学部生は 12,100 人）である。

UCL の GIS 教育は、複数の Faculty に分散する、地理学部（Geography）、建築学部（Bartlett）、ジオマティック・エニジニアリング（Geomatic）などでの学部教育および大学院教育において行われている（資料１、２）。また、1995 年に、Mike Batty 教授を所長とする、The Centre for Advanced Spatial Analysis (CASA)が UCL 設置され、GIS に関する博士課程の大学院教育・研究は、主にそこで行われている。

UCL における GIS 教育の具体的な内容を理解するために、GIS 関連科目を教えている Geography、Bartlett、Geomatic の学部教育でのカリキュラム全体とそれら GIS 関連科目の内容をみる必要がある。また、UCL の大学院教育においては、Geomatic が中心となって、MSc in Geographic Information Science でおこなわれており、そこでの教育内容をみる必要がある。

１．UCL の Geography での学部教育

英国における学部教育は 3 年間である。UCL の Geography は、いくつかの学士を提供するが（資料 1 参照）、GIS 学士という学位は提供されていない（英国で、学部教育で GIS 学士を提供している大学はまれで、その事例としては、Kingston University がある）。

ここでは、地理学学士（BA と BSc）で行われる地理学全体の科目とその中での GIS 関連科目をみる（資料 3）。UCL の Geography での学部教育では、1～3 回生のそれぞれの回生で毎年 4 単位の計 12 単位をとることを要件とする。（1 つの科目（0.5 単位）は、3 学期制のうちの 1 学期（12 週）と 2 学期（11 週）に置かれ、毎週、講義 2 時間あるいは講義 1 時間・実習 2 時間で行われる。日本の通常の 90 分 15 コマで 2 単位は、UCL の 0.5 単位にほぼ対応する。

GIS 関連授業に関しては、1 回生の必修科目（太字）の中に、数コマの GIS の紹介があるが、本格的なものは、2 回生の選択科目「2021 Environmental Remote Sensing」と「2022 Geographic Information Systems and Science」、3 回生の選択科目「3010 Earth Observation（隔年）」と「3011 Principles and Applications of GIS（隔年）」などがある。なお、Geography の教員は資料 4 のようである。

次に、2 回生の 2 学期に行われる、「2022 Geographic Information Systems and Science」の内容をより細かくみる。

２．「2022 Geographic Information Systems and Science」の講義内容

Paul Longley 教授の 2005/2006 の「2022 Geographic Information Systems and Science」の講義概要は資料 4 のようである。

この授業は、2 学期（2006 年 1 月 9 日から 3 月 24 日）の 11 週間の毎週木曜日に、10-11 の講義 1 時間と、11-12 と 12-13 の実習 2 時間のセットで行われる。

講義の主要なトピックスは以下の 5 つで、トピックごとの参考文献は、資料 5 にある。

1. Geographic information: systems, science and study、2. A gallery of applications、3. Representing geography、4. The nature of geographic data、5. Uncertainty

実習は、PhD の学生 2 名が担当して、ESRI の Virtual Campus を行っている。そして、評価は、筆記試験（資料 6）と課題によってなされる。

1 時間の講義の後に、2 時間続きの実習では、EDINA など高等教育機関や研究機関に対して GIS データの提供を行う Web サイトからのデータ・ダウンロードやその利用方法を習得する。

- DIGIMAP data – these will form the digital framework of the GIS.
- Code Point - Postcode data available to download at area level.
- UK Street Map - Aerial Photograph of study area.
- CASWEB – 2001 census data.
- Experian Ltd. – A 'geodemographic' profile for each unit postcode.

具体的な実習内容は以下のようである。

Below is a summary of what you should be achieving in each practical. Remember that 80% of a GIS project is concerned with inputting, editing and checking the data. It is very labour intensive and is an important factor influencing the use and up-take of GIS.

Week 4 3rd February: Collating Digimap and CodePoint Data

Creating and downloading Digimap Classic map(s) after reading into issues of cartographic design. Downloading Digimap data and converting it from NFT to shapefile using MapManager. Download code point data related to your study areas.

Week 5 10th February ：Collating ancillary data

Downloading socio-economic and environment data from the Internet. Inputting data into an Excel spreadsheet and the map data into ArcGIS. Subsequently you will be required to construct the GIS by: a) Importing data and matching map data with attribute data; b) Cleaning and editing GIS data; and, c) Creating some map displays.

Week 6 Reading Week

Week 7 24th February: Attaching ancillary data to UPCs

Spatial analysis using the GIS. Creating summary statistics and maps.

Week 8-9 3/10th March: Finishing your profiles

Finalising and finishing off your profile.

３．UCL の大学院での GIS 教育

UCL では、Geomatic が窓口となって、Geography や CASA などが協力しながら、MSc in Geographic Information Science が運営されている。教員一覧は資料 7 を参照。

GIS 修士は、フルタイムの場合 1 年コースで、講義・実習 120 単位＋個人プロジェクト 60 単位が必要である【定員は 40 名】。パートタイムの場合 2~3 年かけて同じ内容を履修する。また、個人プロジェクト 60 単位がない場合は Diploma となる。

1 学期には以下の表のように必須科目のモジュールを全て習得(60 単位)する必要がある。

Module code	Title	Status
tbc	Geog & GIS/ Analytical Methods (7.5 credit points)	*Mandatory*
tbc	GI Science Analysis (7.5 credit points)	*Mandatory*
tbc	GIS Algorithms & Data Structures (15 credit points)	*Mandatory*
tbc	IT & GIS (15 credit points)	*Mandatory*
tbc	Mapping Science (15 credit points)	*Mandatory*

なお、1 モジュール（15 単位）は、1 コマ 3 時間が毎週 2 つで、10 週続けて提供される（日本の単位に換算する（90 分 15 コマで 2 単位)、UCL の 15 単位は日本の 5.333 単位となる)。

2 学期には、以下の表のように必修科目の Advanced Topics in GIS 1&2（7.5＋7.5 単位）と Managing GIS（15 単位）と選択科目で 60 単位を習得する必要がある。

tbc	Advanced Topics in GIS 1 (7.5 credit points)	*Mandatory*
tbc	Advanced Topics in GIS 2 (7.5 credit points)	*Mandatory*
tbc	Digital Mapping (7.5 credit points)	*Optional*
tbc	Image Understanding (15 credit points)	*Optional*
tbc	Introduction to Environmental GIS (7.5 credits)	*Optional*
tbc	Introduction to Environmental Remote Sensing (15 credit points)	*Optional*
tbc	Management/Group Project (15 credit points)	*Mandatory*
tbc	Oceans 1 (7.5 credit points)	*Optional*
tbc	Oceans 2 (7.5 credit points)	*Optional*
tbc	Positioning 1 (7.5 credit points)	*Optional*
tbc	Positioning 2 (7.5 credit points)	*Optional*
tbc	Research Methods in GIS (7.5 credit points)	*Optional*
tbc	Spatial Decision Support Systems (7.5 credit points)	*Optional*
tbc	Topographic Mapping (7.5 credit points)	*Optional*

各モジュールは、極めてシステマティカルに構成されているが、ここでは、前期の必修科目である「Geography and GIS – Systems, Science and Study」の講義概要を資料 8 であげる。

以上

資料 1　UCL の学部教育

Undergraduate

Faculty of Arts and Humanities

School of Slavonic and East European Studies

Faculty of Social and Historical Sciences
- Anthropology
- Archaeology
- Economics
- Geography
  - BA and BSc Geography (UCAS code: L700/F800)
    【定員：BA45、BSc35】
  - BSc Environmental Geography (UCAS code: F810)
    【定員：10】
  - BSc (Econ) Economics and Geography (UCAS code: LL17)
    【定員：15】
  - BA and BSc Anthropology and Geography (UCAS cde: LL67/LF68)
    【定員：BA+BSc15】
- History
- History of Art

Faculty of Laws

Faculty of the Built Environment [The Bartlett]
- Architecture
- BSc in Architecture (RIBA/ARB Part 1)
- Project Management for Construction
- BSc in Construction Management (CIOB Parts 1 and 2)
- Urban Planning, Design & Management / Urban Studies
- BSc in Urban Planning, Design and Management (RTPI)
- BSc in Urban Studies

Faculty of Engineering Sciences
- Biochemical Engineering
- Chemical Engineering
- Civil and Environmental Engineering
- Computer Science
- Electronic and Electrical Engineering
- Geomatic Engineering
  - Geoinformatics BEng
  - Geoinformatics MEng
- Mechanical Engineering
- Medical Physics and Bioengineering
- Naval Architecture and Marine Engineering

Faculty of Mathematical and Physical Sciences

Faculty of Life Sciences

UCL Medical School

資料 2　UCL の GIS 関連の大学院教育

Graduate School

Geography
Research Degrees MPhil, PhD
MSc in Conservation
MSc in Freshwater and Coastal Sciences (jointly with Queen Mary, University of London)
MSc in Modernity, Space and Place
MSc in Environment, Science and Society
MSc in Geographies of Globalisation
MSc in Remote Sensing 【10-20 人】
MSc in Quaternary Science (jointly with Royal Holloway College)
MSc in Geographic Information Science (jointly with the Department of Geomatic Engineering)
MSc in Micropalaeontology (jointly with the Department of Earth Sciences)

Geomatic Engineering
Research Degrees MPhil, PhD
MSc/Postgraduate Diploma in Photogrammetry with Remote Sensing
MSc/Postgraduate Diploma in Surveying
MSc/Postgraduate Diploma in Hydrographic Surveying
MSc/Postgraduate Diploma in Geographic Information Science

The Bartlett
Research Degrees MPhil, PhD
MPhil/PhD by Architectural Design
EngD in Virtual Environments, Imaging and Visualisation
MSc/MPhil/PhD Town Planning
MArch (Architectural Design)
MSc/Postgraduate Diploma in Adaptive Architecture and Computation
MSc/Postgraduate Diploma in Advanced Architectural Studies
MSc/Postgraduate Diploma in Architectural History
MSc/Postgraduate Diploma in Construction Economics and Management
MSc/Postgraduate Diploma in Environmental Design and Engineering
MSc/Postgraduate Diploma in Facility and Environment Management
MSc/Postgraduate Diploma in Housing Futures
MSc/Postgraduate Diploma in Interdisciplinary Management of Projects
MSc/Postgraduate Diploma in Light and Lighting
MSc/Postgraduate Diploma in Project and Enterprise Management
MSc/Postgraduate Diploma in Sustainable Heritage
MSc/Postgraduate Diploma in Urban Design
MSc/Graduate Diploma in Building and Urban Design
MSc/Postgradate Diploma in Building and Urban Design
MSc/Postgradate Diploma in Development Administration and Planning
MSc/Postgraduate Diploma in Environment and Sustainable Development
MSc/Postgraduate Diploma in European Property Development and Planning
MSc/Postgraduate Diploma in International Housing Studies
MSc/Postgraduate Diploma in Social Development Practice
MSc/Graduate Diploma in Town and Country Planning
MSc/Graduate Diploma in Urban Development Planning
MSc/Graduate Diploma in Urban Economic Development
MSc/Graduate Diploma in Urban Regeneration
MSc in International Planning
MSc in Spatial Planning
Graduate Diploma in Architecture Planning
Certificate in Professional Practice and Management in Architecture (ARB/RIBA Part 3)

Archaeology
Research Degrees MPhil, PhD
MA in African Archaeology
MA in Archaeology
MA in Archaeology of London
MA in Artefact Studies
MA in Archaeology of the Eastern Mediterranean and the Middle East
MA in Comparative Art and Archaeology
MA in Cultural Heritage Studies
MA in Egyptian Archaeology
MA in Field Archaeology
MA in Maritime Archaeology
MA in Managing Archaeological Sites
MA in Museum Studies
MA in Principles of Conservation
MA in Public Archaeology
MA in Research Methods for the Humanities
MSc in Conservation for Archaeology and Museums
MSc in Forensic Archaeological Science
MSc in GIS and Spatial Analysis in Archaeology
MSc in the Palaeoecology of Human Societies
MSc in Skeletal and Dental Bioarchaeology
MSc in Technology and Analysis of Archaeological Materials

資料 3　G eography の教員と学部教育：Teaching - Undergraduates – Modules

●Staff

Tim Atkinson	Professor
Jan Axmacher	Lecturer
Mark Bassin	Reader
Rick Battarbee	Professor
Jacquie Burgess	Professor
Helene Burningham	Lecturer
Hugh Clout	Professor
Gail Davies	Lecturer
Richard Dennis	Reader
Paul Densham	Reader
Mat Disney	Lecturer
Claire Dwyer	Lecturer
Jurgen Essletzbichler	Lecturer
Jon French	Reader
Matthew Gandy	Reader
Alan Gilbert	Professor & HoD
Ray Harris	Professor
Jonathan Holmes	Reader
Alan Ingram	Lecturer
Peter Jones	Lecturer
Khalid Koser	Lecturer
James Kneale	Lecturer
Philip Lewis	Reader
Paul Longley	Professor
Anson Mackay	Lecturer
Mark Maslin	Reader
Richard Munton	Professor
Ben Page	Lecturer
John Salt	Professor
Carl Sayer	Lecturer
Richard Taylor	Lecturer
Julian Thompson	Lecturer
Martin Todd	Lecturer
Ann Varley	Reader
H J B Birks	Visiting Professors
David Goode	Visiting Professors
David Norse	Visiting Professors

※下線は GIS 関連

●First Year Course Units

Data Acquisition and Interpretation
Writing and Analysis in Geography
1001 London: A Geographical Introduction
1002 Environmental Systems & Processes
1004 Human Ecology: Geographical Perspectives
1005 Environmental Change
1006 Ideas in Geography
1007 International Problems in Geography

●Second Year Course Units

The Practice of Geography
2002 Physical Geography Methods
2003 Methods in Human Geography
2005 Geomorphology
2007 Ecological Patterns and Processes
2008 Reconstructing Past Environments
2009 Environmental Management
2010 Regional Development in a Global Context
2011 Population Geography
2012 Political Geography of European Integration
2014 Geography of Global Poverty
2015 Latin American Development
2016 Society and Space
2017 Nature and Culture
2019 Political Geography and Geopolitics
2020 Hydroclimatology
2021 Environmental Remote Sensing
2022 Geographic Information Systems and Science

●Third Year Course Units

Dissertation
3004 Coastal and Estuarine Environments
3007 Past Global Environmental Change
3009 Ecology and Natural Resource Management *
3010 Earth Observation *
3011 Principles and Applications of GIS *
3012 Environmental Management II
3014 Services and Regional Development
3015 International Migration
3017 The Latin American City *
3018 Tropical Africa: Postcolonial Perspectives
3021 Historical Geography of France
3022 Public and Private: Gendered Geographies
3023 Geography of Russian National Identity *
3024 Environmental Issues and the Mass Media
3026 Geographies of Modern Culture: Popular Spaces & Practices
3028 Energy Markets in the UK *
3033 France a Social Geography
3035 Geographies of Work and Employment *
3037 Climatology *
3038 Water and Development in Africa

* indicates that the course is not taught in 2005/2006

学費は、UK/EU1,175 ポンド;海外 13,750 ポンド

資料 4 「GEOGRAPHIC INFORMATION SYSTEMS AND SCIENCE」の講義概要

GEOG2022: GEOGRAPHIC INFORMATION SYSTEMS AND SCIENCE

Professor Paul Longley

Unit Value: 0.5 units **Year 2** **Term 2**

Brief Course Description

This course attempts to capture and define the richness and diversity of GIS in an accessible form. It presents a clearly-defined path to a world of learning about GIS, using the Internet and closely-coupled reference sources. It considers:

- What is special about Geographic Information;
- Geographic Information Science – the scientific context to GIS, technical content and geographic implications;
- The real value of GIS – illustrated using real world applications; treatments emphasise operational, tactical and strategic issues;
- The impact of Internet GIS on interdisciplinary science and on society.

Lectures are complemented by Internet-based learning. A series of modules of the ESRI **Virtual Campus** (http://campus.esri.com) has been specially written around the course material and forms the basis to many of the practical exercises.

Course Aims

After successful completion of this course, students will:

1. Understand the ways in which digital representations of the real world are created, and how geographic phenomena are referenced
2. Understand the nature of geographic data, and the concepts of spatial autocorrelation and modifiable areal units
3. Understand the sources and operation of uncertainties in the creation of geographic representations, and the importance of generalisation, abstraction and metadata
4. Understand how GI software systems are configured in practice
5. Develop practical skills in these areas, which may be useful in the planning of **Dissertations**

Course Content

The course will consist of approximately 10 lectures and 10 practical sessions. Lecture topics will include:

- the relationship between geographic information (GI) systems and science
- geographic representation
- the nature of geographic data
- uncertainty

The practical exercises will use ArcView software, and will develop out of ESRI Virtual Campus material: students will thus gain skills in using the world's leading GIS.

Method of Teaching

Lectures followed practicals in a weekly slot (2 + 1 hours).

Form of Assessment

(a) Unseen written examination (1 two hour paper, 60% of assessment)
(b) Written coursework and problem papers (40% of assessment)

Suggested Reading

The course text is

Longley P A, Goodchild M F, Maguire D J and Rhind D W (2005) **Geographic Information Systems and Science** (Second Edition). Wiley, Chichester. You can get a feel for what this book entails by visiting www.wiley.com/go/longley. The Website also includes downloads of some of the supplementary material that will be used.

Extensive reference will also be made to

Longley P A, Goodchild M F, Maguire D J and Rhind D W (2005) **Geographic Information Systems: Principles, Techniques, Management and Applications**. Wiley, Hoboken, NJ. Multiple copies of this are available in the library, as is the original edition, published in 1999.

資料 5　GEOGRAPHIC INFORMATION SYSTEMS AND SCIENCE」の参考文献

Reference list: general

The course text is:
Longley P A, Goodchild M F, Maguire D J and Rhind D W (2005) *Geographic Information Systems and Science (Second edition)*. Chichester: Wiley. You can get a feel for what this book entails by visiting www.wiley.com/go/longley. The Web site also includes downloads of some of the supplementary material that will be used.

Extensive reference will also be made to:

Longley P A, Goodchild M F, Maguire D J and Rhind D W, editors 2005 *Geographic Information Systems: Principles, Techniques, Management and Applications (Abridged edition)*. Hoboken, NJ: Wiley. Multiple copies of this and the 1999 original edition are available in the library.

Maguire D J, Goodchild M F, Rhind D W, editors 1991 *Geographical information systems: principles and applications*. Harlow, UK: Longman. Copies are available from the library

Some of the overhead slides used in the lectures may be downloaded from www.wiley.com/go/longley (password to be supplied in the lectures).

It is anticipated that asterisked (*) references may be particularly relevant to course material.

1. Geographic information: systems, science and study

Longley P A, Goodchild M F, Maguire D J and Rhind D W (2005) *Geographic Information Systems and Science (Second edition)*. Chichester: Wiley. Chapters 1 (3-33) and 2 (35-60).

Maguire D J, Goodchild M F, Rhind D W, editors 1991 *Geographical information systems: principles and applications*. Harlow, UK: Longman
*Chapter 1, An overview and definition of GIS (Maguire D J)
*Chapter 2, The history of GIS (Coppock J T, Rhind D W)
Chapter 3, The technological setting of GIS (Goodchild M F)
Chapter 4, The commercial setting of GIS (Dangermond J)
Chapter 6, The academic setting of GIS (Unwin D J)
Chapter 7, The organizational home for GIS in the scientific professional community (Morrison J L)

Longley P A, Goodchild M F, Maguire D J, Rhind D W, editors 2005 *Geographical information systems: principles, techniques, management and applications (Abridged edition)*. Hoboken, NJ: Wiley.
*Preface, New developments in geographical information systems: principles, techniques, management and applications (Longley P A, Goodchild M F, Maguire D J, Rhind D W)
*Chapter 3, Geography and GIS (Johnston R J)
*Chapter 4, Arguments, debates and dialogues: the GIS-social theory debate and the concern for alternatives (Pickles J)
*Chapter 40, The future of GIS and spatial analysis (Goodchild M F, Longley P A)
Chapter 54, Enabling progress in GIS education (Forer P, Unwin D)

Other online resources

See Section 1.5.4 of Longley et al (op cit) for a selection of Web sites that feature online news, chatrooms, lists of events, and other resources for the GIS community.

For an excellent summary of the history of GIS see the GIS Timeline at www.casa.ucl.ac.uk/gistimeline/

NCGIA Core Curricula (www.ncgia.ucsb.edu/pubs/core.html):

Core Curriculum in GIScience, Sections 0 (*Michael F. Goodchild, What is Geographic Information Science?), 4.1 (Stephen J. Ventura, Land Information Systems and Cadastral Applications), and 4.2 (material by PrecisionAg.org)

Core Curriculum in GIS, 1990, Units 1, 23, 51-56

Other references

Chrisman N R 2002 *Exploring geographic information systems (2nd ed.)*. Chapter 11 (Social and institutional context). Hoboken, NJ, Wiley.

Curry M R 1998 *Digital places: living with geographic information technologies*. London: Routledge.

Foresman T W editor 1998 *The history of geographic information systems: perspectives from the pioneers*. Upper Saddle River, New Jersey: Prentice Hall PTR.

*Goodchild M F 1992 Geographical information science. *International Journal of Geographical Information Systems* 6: 31-45.

Harder C 1998 *Serving maps on the Internet*. ESRI Press, Redlands, California

Pickles J 1993 *Ground truth: the social implications of geographic information systems*. New York: Guilford Press.

Plewe B 1997 *GIS Online: information retrieval, mapping, and the Internet*. Onword Press, Santa Fe, New Mexico

Shannon C E, Weaver W 1963 *The mathematical theory of communication*. Urbana: University of Illinois Press.

Thill J C 1999 *Spatial multicriteria decision making and analysis: a geographic information sciences approach*. Aldershot, England: Ashgate.

2. A gallery of applications

Longley P A, Goodchild M F, Maguire D J and Rhind D W (2005) *Geographic Information Systems and Science (Second Edition)*. Chichester: Wiley. Chapter 2 (35-60).

Maguire D J, Goodchild M F, Rhind D W, editors 1991 *Geographical information systems: principles and applications*. Harlow, UK: Longman (see www.wiley.co.uk/gis) Section III Applications (Chapters 35-56)

Longley P A, Goodchild M F, Maguire D J, Rhind D W, editors 2005 *Geographical information systems: principles, techniques, management and applications (Abridged edition)*. Hoboken, NJ: Wiley. Part 4: Applications (CD-ROM Chapters 57-71)

Other online resources

Yang, F 2000 GIS Applications for Tax Assessors. ESRI Virtual Campus http://campus.esri.com

NCGIA Core Curricula (www.ncgia.ucsb.edu/pubs/core.html):
Core Curriculum in GIScience, Section 4.1 (Stephen J. Ventura. (1997) Land Information Systems and Cadastral Applications) and 4.2 (links to material from PrecisionAg.org)
Core Curriculum in GIS, 1990, Units 51-56

Other references

Bonham-Carter G F 1994 *Geographic information systems for geoscientists: modeling with GIS*. New York, Pergamon (see the various applications developed throughout the book).
Goodchild M F, Parks B O, Steyaert L T 1993 *Environmental modeling with GIS*. New York, Oxford University Press (see the various applications developed throughout the book).
Greene R W 2000 *GIS in public policy*. ESRI Press, Redlands
Haines-Young R, Green D R, Cousins S 1993 *Landscape ecology and geographic information systems*. London, Taylor and Francis
Johnston C A 1998 *Geographic information systems in ecology*. Oxford, Blackwell
Longley P A, Martin D J, Higgs, G 1994 The predictive use of GIS to model property valuations. *International Journal of Geographical Information Systems* 8: 217-35
Longley P A, Higgs G, Martin D J 1996 The rates revisited? A geographical reassignment of property valuations and local tax burdens under the council tax. *Environment and Planning C* 14: 101-20
Martin D J, Longley P A 1995 Data sources and their geographical integration. In P Longley, G Clarke (eds) *GIS for Business and Service Planning*. New York, John Wiley: 15-32
O'Looney J 2000 *Beyond maps: GIS and decision making in local government*. Redlands, ESRI Press

3. Representing geography

Longley P A, Goodchild M F, Maguire D J and Rhind D W (2005) *Geographic Information Systems and Science (Second edition)*. Chichester: Wiley. Chapter 3 (63-83).

Maguire D J, Goodchild M F, Rhind D W, editors 1991 *Geographical Information Systems: Principles and Applications*. Harlow, UK: Longman (see www.wiley.co.uk/gis)

Chapter 9, Concepts of space and geographical data (Gatrell A C)
Chapter 14, GIS and remote sensing (Simonett D S)
Chapter 16, High-level spatial data structures for GIS (Egenhofer M J, Herring J)

Longley P A, Goodchild M F, Maguire D J, Rhind D W, editors 2005 *Geographical Information Systems: Principles, Techniques, Management and Applications (Abridged edition)*. Hoboken, NJ: Wiley.

Chapter 5, Spatial representation: the scientist's perspective (Raper J F)
Chapter 6, Spatial representation: the social scientist's perspective (Martin D J)
Chapter 7, Spatial representation: a cognitive view (Mark D M)
Chapter 8, Time in GIS and geographical databases (Peuquet D J)

Chapter 9, Representation of terrain (Hutchinson M F, Gallant J C)
Chapter 32, Digital remotely sensed data and their characteristics (Barnsley M)

Other online resources

NCGIA Core Curricula (**www.ncgia.ucsb.edu/pubs/core.html**):
Core Curriculum in GIScience, Section 1.1.1 (Dan Montello, Human Cognition of the Spatial World)

Core Curriculum in GIS, 1990, Unit 48

Other references

Chrisman N R 2003 *Exploring geographic information systems (2nd edition)*. Hoboken, NJ: Wiley.

Gore A 1992 *Earth in the balance: ecology and the human spirit*. Boston: Houghton Mifflin

Mardia K V, Jupp P E 2000 *Directional statistics*. New York: Wiley

Ryerson R A editor 1998 *Manual of remote sensing*. New York: Wiley.

4. The nature of geographic data

Longley P A, Goodchild M F, Maguire D J and Rhind D W (2005) *Geographic Information Systems and Science (Second edition)*. Chichester: Wiley. Chapter 4 (85-107).

Maguire D J, Goodchild M F, Rhind D W, editors 1991 *Geographical Information Systems: Principles and Applications*. Harlow, UK: Longman (see www.wiley.co.uk/gis)

Chapter 9, Concepts of space and geographic data (Gatrell A C)
Chapter 30, Generalization of spatial databases (Muller J-C)

Longley P A, Goodchild M F, Maguire D J, Rhind D W, editors 2005 *Geographical Information Systems: Principles, Techniques, Management and Applications (Abridged edition)*. Hoboken, NJ: Wiley.

Chapter 2, Space, time, geography (Couclelis H)
Chapter 16, Spatial statistics (Getis A)
Chapter 17, Interactive techniques and exploratory spatial data analysis (Anselin L)

Other online resources

NCGIA Core Curricula (**www.ncgia.ucsb.edu/pubs/core.html**):
Core Curriculum in GIScience, Section 1.6.1 (Sampling the World)
Core Curriculum in GIS, 1990, Units 6 (Sampling the World) and 47 (Fractals)

Other references

Batty M, Longley P A 1994 *Fractal cities: a geometry of form and function*. London: Academic Press

Goodchild M F 1986 *Spatial autocorrelation*. Concepts and Techniques in Modern Geography 47. Norwich: GeoBooks

Mandelbrot B B 1983 *The fractal geometry of nature*. San Francisco: Freeman

Goodchild M F 2001 Models of scale and scales of modelling. In Tate N J, Atkinson P M (eds) *Modelling scale in geographical information science*. Chichester: Wiley

5. Uncertainty

Longley P A, Goodchild M F, Maguire D J and Rhind D W (2005) *Geographic Information Systems and Science (Second edition)*. Chichester: Wiley. Chapter 6 (127-53).

Maguire D J, Goodchild M F, Rhind D W, editors 1991 *Geographical Information Systems: Principles and Applications*. Harlow, UK: Longman (see www.wiley.co.uk/gis)

Chapter 11, Language issues for GIS (Frank A U, Mark D M)
Chapter 24, Spatial data integration (Flowerdew R)

Longley P A, Goodchild M F, Maguire D J, Rhind D W, editors 2005 *Geographical Information Systems: Principles, Techniques, Management and Applications (Abridged edition)*. Hoboken, NJ: Wiley.

Chapter 7, Spatial representation: a cognitive view (Mark D M)
*Chapter 13, Models of uncertainty in spatial data (Fisher P F)
*Chapter 18, Applying geocomputation to the analysis of spatial distributions (Openshaw S, Alvanides S)
Chapter 35, Multi-criteria evaluation and GIS (Eastman J R)
Chapter 40, The future of GIS and spatial analysis (Goodchild M F, Longley P A)

Other online resources

NCGIA Core Curricula (**www.ncgia.ucsb.edu/pubs/core.html**):
Core Curriculum in GIScience, Section 2.10 (Handling Uncertainty, ed. G. Hunter, especially 2.10.1, 2.10.3 and 2.10.4)
Core Curriculum in GIS, 1990, Units 45 (Accuracy of Spatial Databases) and 46 (Managing Error)

Other references

Burrough P A, Frank A U editors 1996 *Geographic objects with indeterminate boundaries*. London: Taylor and Francis ('dip into' all chapters)

Fotheringham A S, Wong D W S 1991 The modifiable areal unit problem in multivariate statistical analysis. *Environment and Planning A* 23: 1025-1044

Openshaw S 1984 *The modifiable areal unit problem.*Concepts and Techniques in Modern Geography 38. Norwich, UK: GeoBooks

資料 6 「GEOGRAPHIC INFORMATION SYSTEMS AND SCIENCE (04/05)」の試験問題

UNIVERSITY COLLEGE LONDON
University of London
EXAMINATION FOR INTERNAL STUDENTS
For The Following Qualifications:-
B.A. B.Sc. B.Sc.(Econ)
Geography 2022: Geographic Information Systems and Science
COURSE CODE : GEOG2022
UNIT VALUE : 0.50
DATE : 16-MAY-05
TIME : 10.00
TIME ALLOWED : 2 Hours
05-C0485-3-50

GEOGRAPHY 2022: GEOGRAPHIC INFORMATION SYSTEMS AND SCIENCE
Answer TWO questions.

1. Assess the relative importance of the human individual, the computer and society inthe future development of Geographic Information Science over both the short- and the long-term.
2. With reference to real-world applications of GIS that you have studied, assess whether good science is necessary for success in GIS?
3. 'No representation of geographic phenomena can ever be perfect.' Discuss this contention and assess its implications for users of GIS.
4. Define the terms raster and vector in the context of GIS. With reference to examples, explain how you would decide which representation to use in a specific project.
5. 'To use GIS effectively, one needs to understand both how the software is constructed, and also something about the nature of geographical phenomena and processes.' Discuss.
6. Describe the common sources of data inaccuracy and uncertainty, and explain the possible consequences of the use of inaccurate data in a GIS.

GEOG2022 1 END OF PAPER

資料 7　MSc/PgDip Geographic Information Science の教員

STAFF ASSOCIATED WITH THE MSc & DIPLOMA IN GIS

Mr John Arthur Lecturer in Surveying.

Professor Mike Batty (UCL Centre for Advanced Spatial Analysis). Director of the Centre for Advanced Spatial Analysis (CASA).

Dr Rodéric Béra is Lecturer in GIS.

Dr David Chapman Formerly a senior lecturer in Geomatic Engineering

Professor Paul Cross Leica Professor of Geomatics and Head of the Department of Geomatic Engineering.

Dr Paul Densham (UCL Department of Geography)

Dr Mike de Smith Visiting Lecturer in GIS Analysis.

Professor Ian Dowman Professor of Remote Sensing

Dr Mordechai Haklay Lecturer in Geographic Information Science and Course Tutor.

Dr Jonathan Iliffe Senior Lecturer in Geodesy and tutor to the Surveying and Hydrographic Surveying courses.

Professor Paul Longley (UCL Department of Geography and Centre for Advanced Spatial Analysis)

Mr Jeremy Morley Lecturer in GIS.

Professor Jan-Peter Muller Professor of Image Understanding.

Dr Stuart Robson Lecturer and tutor to the MSc in Photogrammetry with Remote Sensing.

Dr Martin Wooster (King's College, London Department of Geography)

Professor Richard Webber is a Visiting Professor at CASA

学費は、UK/EU3,085 ポンド;海外 15,000 ポンド

資料 8 「Geography and GIS – Systems, Science and Study」の講義概要

UNIVERSITY COLLEGE LONDON

Gower Street, London WC1E 6BT

Programme(s): **MSc/PgDip Geographic Information Science** *Academic Year*: **2005/2006**

Module Title: **Geography and GIS – Systems, Science and Study** *Module Code*: ***tbc***

Credit Points: **7.5** *Term:* **1 (week 1)**

Brief description, aims and learning outcomes

The principal objective of this introductory overview is to acquaint students with GIS concepts and ways of working with GIS, with a heavy emphasis upon wider social science epistemologies, methodologies and techniques. The sessions thus have the objective of providing overviews of and context to many of the themes that are revisited in more detail later in the course. By the end of the unit, the student should:

Session 1:
- Understand some representative architectures of GIS software systems
- Understand the enterprise wide computing environment at UCL
- Be able to access the Internet through the UCL gateway
- Understand how to run ArcGIS on enterprise and Internet platforms

Session 2:
- Be able to define various terms, including GIS itself
- Be familiar with a brief history of GIS
- Recognise the sometimes invisible roles of GIS in everyday life, and the roles of GIS in business
- Understand the significance of geographic information science, and how it relates to the philosophies and epistemologies of geography
- Understand the many impacts GIS is having on society, and the need to study those impacts

Session 3:
- Understand the theories of representation in GIS and how quantitative and qualitative data are used to sustain them
- Understand the concepts of fields and objects and their fundamental significance
- Understand raster and vector representation and how they affect many GIS principles, techniques, and applications
- Understand the particular position of the paper map as a representational form and GIS product
- Grasp the art and science of representing real-world phenomena in GIS, through the experience of current researchers
- Have a sense of the important research issues in advanced spatial analysis, and some of the social scientific and scientific foundations that underpin current research

Session 4:
- Have practical experience of running ArcGIS on an Internet platform
- Have practical experience of geographic data handling in GIS
- Be able to compare the discrete object and field views of geographic data
- Understand how to explore geographic data in decision support
- Have experience of the interrelationship between spatial sampling, autocorrelation and interpolation
- Be able to apply some quantitative geographical techniques using GIS

Session 5:
- Understand how GIS is fundamentally about real world applications and sensitivity to geographic context
- Understand how GIS can be used as an applied research tool for evidence-based policy
- Gain a sense of the range and breadth of interdisciplinary social and ecological research applications currently being undertaken at the UK's largest interdisciplinary spatial analysis centre
- Understand the relationship of the researcher to the researched and the philosophical assumptions underlying empirical enquiry
- Understand some of the ethical and political issues inherent in using GIS-based representations

Session 6: Understand:
- How Tobler's First Law of Geography is formalised through the concept of spatial autocorrelation
- The relationship between scale and the level of geographic detail in a representation, and how GIS can reveal interconnections between geographic phenomena across a range of scales
- The ways in which representations are generalised about spatial samples
- How the property of smoothness and continuous variation can be used to characterise geographic variation

Session 7: Understand:
- How GIS visualization offers richer possibilities than paper maps or even direct inspections of reality
- The common visualisation conventions used in mapping and GIS
- How to use queries and WIMP interfaces to extract information from spatial databases
- How the Internet is can be used as a powerful environment for GIS query
- How dasymetric mapping and multivariate mapping helps you draw conclusions about data that would not otherwise be apparent

Session 8: Understand:
- The general scientific methods used in social and environmental science to derive useful information from digital data
- The different views of data a GIS provides

- How to query a catalog view
- How to query data for specific attribute and spatial conditions
- How to link views to see relationships between maps, tables, and graphs
- How distance is measured on planar and spherical surfaces
- How compactness is measured
- How slope and aspect are measured on raster surfaces
- How to derive slope and aspect surfaces from an elevation surface

Session 9: Understand:

- Measures of central tendency for numbers (mean, median, and mode) and some geometric counterparts (centroids, MAT points, and fractal dimension)
- How histograms, pie charts and scatterplots can be used to visualise the distribution of values in a dataset.
- How qualitative data are depicted in GIS
- How to measure spatial autocorrelation
- How to measure spatial fragmentation

Module Coordinator:	Prof Paul Longley	*plongley@geog.ucl.ac.uk*
Module Team:	Dr Muki Haklay	*m.haklay@ucl.ac.uk*

Pre- and Co- Requisites:

Pre-requisite(s) for this module:
- None

Co-requisite(s) for this module:
- None

Teaching Session Outlines:

Session	**Morning Session**	**Afternoon Session**
Tuesday 27 September	(1) The UCL Managed Computer System (Muki Haklay). **Chandler House 101/B11 0930-1300** (and computer registration desk)	(2) Systems, Science, and Study.**Chandler House 101/B11 1400-1700**
Wednesday 28 September	(3) Digital Representation. **Chandler House G1 0930-1100;** followed by (4) Internet GIS practical **Chandler House B11 1100-1300**	(5) A Gallery of GIS Applications (followed by tea@CASA, an introduction to current research and a reception at the Department of Geomatic Engineering). **Torrington Place BLT 1400-1800; Reception in Geomatics Classroom 1800-1900**
Thursday 29 September	(6) The Nature of Geographic Data **Torrington Place Ground Floor LT 0930-1230**	(7) Observation, visualisation and Interaction practical followed by (8) Query and Measurement practical. **Torrington Place Cluster Room 1400-1700**
Friday 30 September	(UCL Postgraduate Student Reception)	(9) Transformations and Descriptive Summaries practical. **Chandler House B11 1400-1700**

Breakdown

Session 1: The UCL Managed Computer System (Dr. Muki Haklay)

GIS software systems, the geoprocessing engines of GIS, are made up of integrated collections of computer programs. The three key parts of a GIS software system are the user interface, the tools and the data manager. They may be located on a single computer, spread over multiple machines in a department or enterprise, or scattered over the Internet. This session introduces you to the Windows (WTS) environment of the UCL managed system. It also provides an introduction to the latest release of ESRI Inc.'s GIS products (ArcMap, ArcCatalog and ArcToolbox) and the environment of Internet browsers.

Session 2: Systems, Science, and Study

This session begins to address several major questions:

- What exactly is qualitative and quantitative geographic information, and why is it important? What is special about it?
- What is information generally, and how does it relate to data, knowledge, evidence, wisdom, and understanding?
- What kinds of decisions make use of geographic information?
- What is a geographic information system, and how would I know one if I saw one?
- What is geographic information science, and how does it relate to the use of GIS for scientific purposes?
- How do scientists use GIS, and why do they find it helpful?
- How does GIS help public policy and how do companies make money from GIS?

Session 3: Digital Representation

Representations have many uses, because they allow us to learn, think and reason about places and times that are outside our immediate experience. This is the basis of social scientific and ecological research, planning, historiographic awareness, and many forms of day-to-day problem solving. Explicitly geographic representations are often necessary to think about relations between the social and natural worlds.

The geographic world is extremely complex, revealing more detail the closer one looks, almost *ad infinitum*. So in order to build a representation of any part of it, it is necessary to make choices, about what to represent, at what level of detail, over what time period, etc. This session illustrates how the large number of possible choices creates a problem for designers of GIS software, since it is virtually impossible to accommodate all of them. It also illustrates how spatial relations are inherent to human activity and how spatial relations reflect and reify social relations.

Session 4: Internet GIS

The Internet has become the platform of choice for synthesising and interpreting information and evidence from multiple sources, very frequently by accessing a diverse range of GIS applications. In this session you will create a user account at the ESRI **Virtual Campus** (http://campus.esri.com) and use it to review some of the fundamental concepts regarding data and information. You will see how geographic data represent the Earth's surface and how geographic representations are unique. You will also review how geographic information systems (GIS) can be used to turn data into information that can be used to support decisions. The hands on exercises make use of ArcMap and Spatial Analyst to reinforce concepts concerning data structures, data interpolation, and spatial analysis.

Session 5: A Gallery of GIS Applications

GIS is fundamentally about building these basic representational models into workable applications. This session also seeks to

give a flavour of the breadth and depth of real-world GIS implementations through demonstrations by staff at UCL's **Centre for Advanced Spatial Analysis**.

Session 6: The Nature of Geographic Data

Geographic information is sufficiently special to warrant its own type of information system, because *spatial is special*. Yet what is it about geographic data that distinguishes them from all other kinds, and what special tools are needed to analyse and work with them? A key property of geographic information is its level of detail. This session introduces the key concepts of spatial and temporal autocorrelation, and shows how they can be measured. We also discuss the nature of sampling and discuss how to sample and how to interpolate between sample elements

Session 7: Observation, Visualisation and Interaction

Observation and visualisation are processes of representing data in space—as a map, in other words. Visualization is useful because human beings are better at recognizing patterns than they are at interpreting columns of numbers or verbal descriptions of spatial relationships.

A GIS can show data in much more realistic and informative ways than a paper map can. For example, consider a paper map of elevation contours compared to a 3-D terrain model produced from a GIS. It also provides valuable ways of interpreting large scale social surveys and extrapolation of data from experimental and quasi-experimental research. But the very power of GIS is also an inherent danger: you may be so impressed by the look of the 3-D mountain with its crags, coloured elevation bands, and light and shadow effects that you forget the most important thing: how accurately do the data represent reality, what are the sources of errors, and how do they operate in the building of the representation?

This tutorial and exercise introduces you to a range of visualisation conventions and techniques, and shows you how to interact with, and improve, representations.

Session 8: Query and Measurement

Just like the miller's daughter who was locked in a room full of straw and had to spin it into gold, the task of the GIS user is to turn data into information. (And if you can do it, like a modern Rumpelstiltskin, feel free to ask your boss for her first-born child.) This online session will discuss the first steps of spinning straw into gold—how to query a GIS.

You will learn about different views of data (maps, tables, graphs, catalogs) and how to get the information that each contains. You will learn how to use a GIS database creatively with advanced queries. And you will learn about the various kinds of measurements a GIS can make: from the simple straight-line distance between two points, to surface analysis that creates maps of slope and aspect from elevation. As the saying goes, to ask the right question you must already know half the answer. A similar point can be made of querying a GIS: before you get started, you need to know what you need to know. The exercises will show you how different queries can be organised to solve some practical problems, like deciding where to build a football stadium.

Session 9: Transformations and Descriptive Summaries

One of the most powerful abilities of a GIS is that it can create new data from existing quantitative and qualitative data. The operation may be simple, such as drawing a buffer to show a zone of protection around an object, or it may be highly mathematical, such as the Kriging method of estimating surface values. In this module, you will examine many of the ways in which a GIS can produce new data by combining existing data sets or analyzing them mathematically.

A formidable challenge when turning data into information is to condense the overwhelming quantity of geographic facts and numbers in a meaningful way. In this exercise, you will examine a variety of ways to summarize numeric attributes and geographic patterns to express their essential characteristics.

Resources

The teaching is scattered all around UCL, and will introduce you to the main sites where the course is taught: Chandler House, Bedford Way, Torrington Place and the Chadwick buildings. The course is based on several introductory lectures, with extensive use of ESRI's Virtual Campus.

Part time students

The practical classes are based upon materials that I co-authored for the on-line ESRI Virtual Campus programme. If block release for this course is a problem, you may find it more convenient to complete the assignments in your own time, at home.

Assessment

0% examination
100% coursework

Detailed coursework

1. Self tests at the end of up to 4 Virtual Campus exercises. Marked as pass/fail, given in to Dr. Muki Haklay by **10a.m. on Friday 7 October**.

Reading list – Recommended

This course is based heavily on:

Longley P A, Goodchild M F, Maguire D J and Rhind D W 2005 **Geographic Information Systems and Science (Second Edition)**. Chichester, Wiley, Chapters 1, 2, 3 and 4

The exercises are taken from http://campus.esri.com.
Some of the PowerPoint slides are available from:
http://www.wiley.com/go/longley . Follow the links to 'Powerpoints', click that you have received a password, and enter it in the pop up box.

Reading list – Further readings

Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W., (eds.) 2005. **Geographical Information Systems: Principles, Techniques, Management and Applications (Abridged Edition)**. Hoboken, NJ, Wiley. (Multiple copies of this book, and the two volume 1999 set of the same title are available in the library. Pages (ix) – (xxxii) of the Abridged Edition provide a useful current statement of the state of GIS.)