Geographic Information System (GIS)

IS 454

Lecture 1: (GIS Definition)

Professor Dr. Safa A. Najim

Computer IS department

College of CS and IT

GIS Definition

- What is a GIS?
- Why does GIS matter?
- Spatial problem solving
- Geo-science, technology and business
- Where is a GIS from?
- Components of a GIS
- The future

- **GIS**: A particular form of *information system* applied to *geographical data*
- A **system**: A group of connected entities and activities which interact for a *common purpose*
- An **information system**: A set of processes, executed on raw data, to produce information which will be useful for *decision making*
- **Geographical data**: *Spatially* referenced data sets

GIS – a system

- A GIS is an information system
- Its common purpose: decision making for managing use of land, resources, or any spatially distributed activities or phenomena
- It processes raw geographical data
- It produces information for decision making of spatial activities

Why does GIS matter?

"Almost everything that happens, happens somewhere. … Knowing where something happens can be critically important."

—— Longley, *et al*., 2015, pp. 2

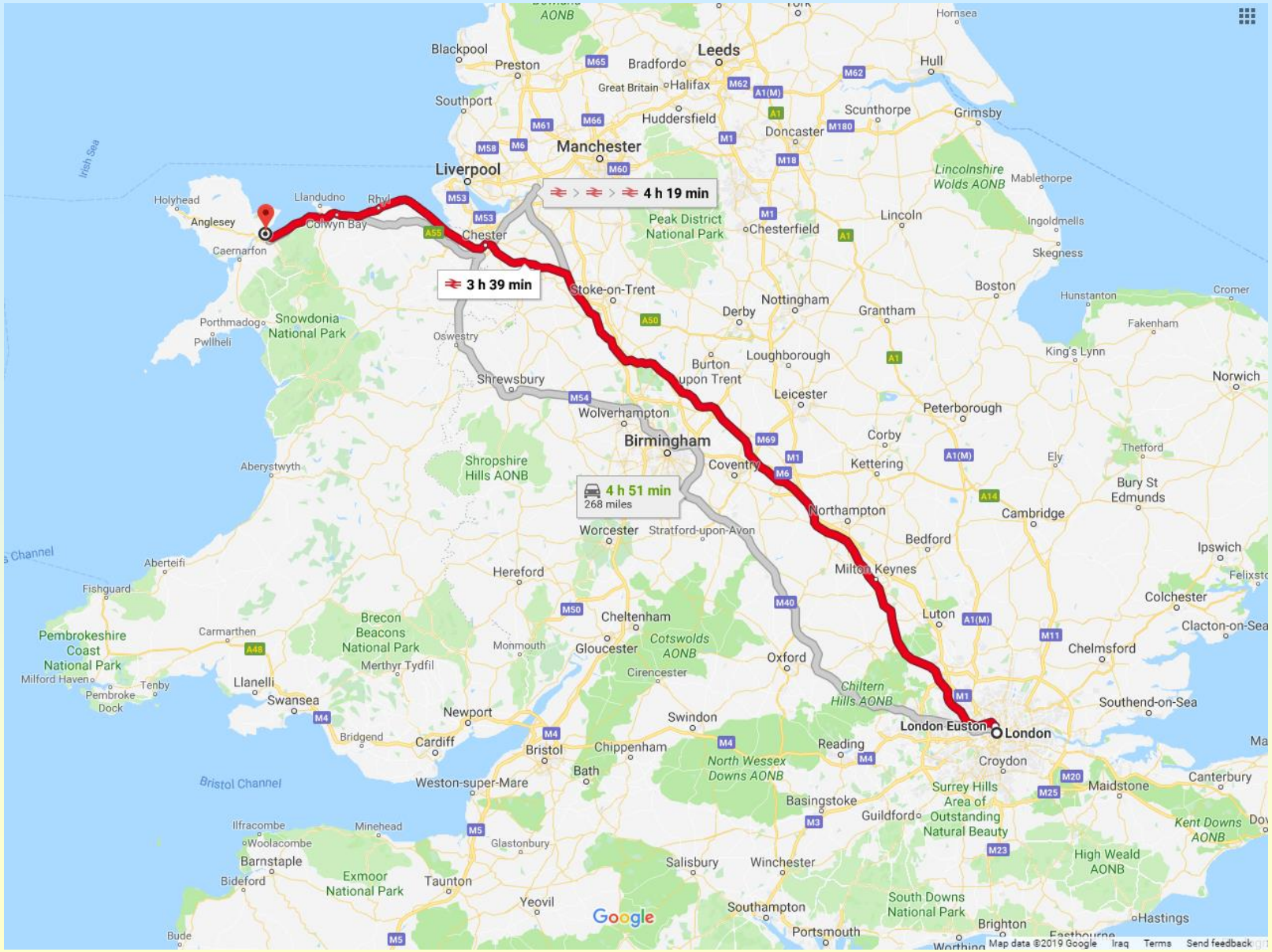
The importance of location

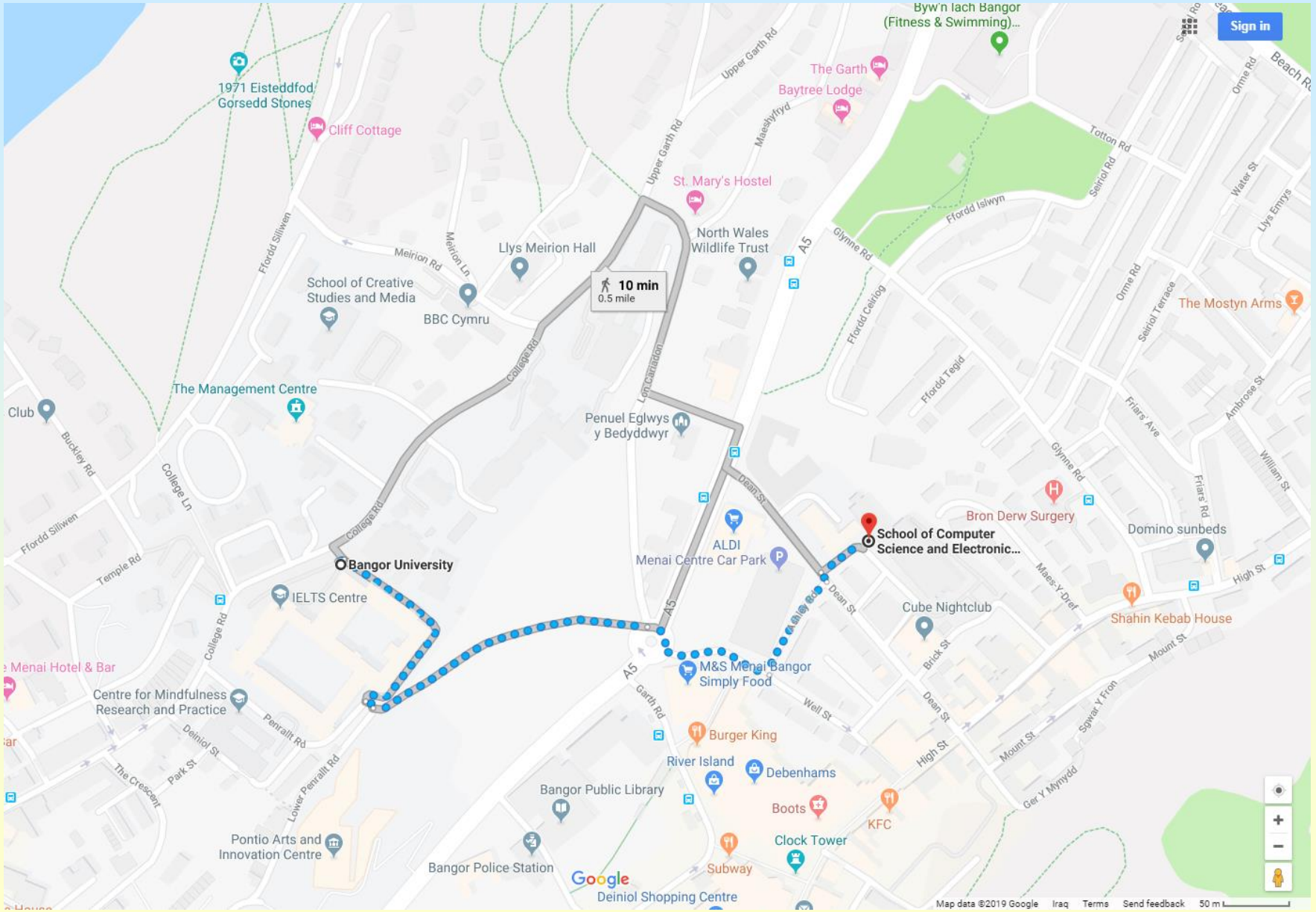
- Geographic location is an important attribute of activities, policies, strategies, and plans.
- Geographic problems involve an aspect of location, either in the information used to solve them, or in the solutions themselves.

Examples of geographical problems

- Government: where to locate public facilities (e.g. schools, hospitals and police stations)?
- Transportation: where to build the new highway that serves most critical bottleneck of the road network?
- Commercial: where to build new shops or good distribution centres that make most cost effective services?
- Travellers: where am I and how can I travel from an International Airport to a University?
- Country park management: where to locate hiking tracks that provide the best scenery for hikers at different levels with the minimum impact on the environment?

How to find a University


4 h 19 min
3 h 39 min
4 h 51 min
268 miles
Liverpool
Manchester
Leeds
Chester
Stoke-on-Trent
Birmingham
London Euston
London
Google


Sign in
1971 Eisteddfod Gorsedd Stones
Cliff Cottage
Upper Garth Rd
Maeshyfryd
The Garth
Baytree Lodge
Bywn Iach Bangor (Fitness & Swimming)...
Totton Rd
Seiriol Rd
Orme Rd
Beach Rd
Water St
Llys Emrys
St. Mary's Hostel
Fford Islwyn
Glynne Rd
A5
North Wales Wildlife Trust
Llys Meirion Hall
Meirion Rd
Meirion Ln
School of Creative Studies and Media
BBC Cymru
10 min
0.5 mile
College Rd
Lon Cariadon
Fford Celynog
The Mostyn Arms
Seiriol Terrace
Ambrose St
The Management Centre
Club
Buckley Rd
College Ln
Fford Siliwen
Penuel Eglwys y Bedyddwyr
Fford Tegid
Friars' Ave
Glynne Rd
William St
Dean St
Bron Derw Surgery
School of Computer Science and Electronic...
Domino sunbeds
Friars Rd
ALDI
Menai Centre Car Park
Bangor University
Temple Rd
IELTS Centre
High St
Maes-Y-Dref
Cube Nightclub
Shahin Kebab House
Brick St
Mount St
M&S Menai Bangor Simply Food
Menai Hotel & Bar
Centre for Mindfulness Research and Practice
Penralit Rd
Deiniol St
Park St
The Crescent
Lower Penralit Rd
Garth Rd
Well St
Burger King
River Island
Debenhams
Boots
KFC
Clock Tower
Bangor Public Library
Pontio Arts and Innovation Centre
Bangor Police Station
Subway
Google
Deiniol Shopping Centre
Sgwar Y Fron
Ger Y Mynydd
Map data ©2019 Google
Iraq
Terms
Send feedback
50 m


Bangor, Wales
Google
Street View - Jun 2011
ALDI
School
Scienc
M&S Menai Ban
Simply Food
Google
Image capture: Jun 2011
© 2019 Google
Iraq
Terms
Report a problem

Spatial is special

- Geographical: the Earth's surface and near-surface
- Spatial: any space (not just the space of the Earth's surface)
- Spatial Analysis: application of techniques to geographical and non-geographical spaces
- Geospatial: (subset of spatial, applied specifically to the Earth's surface and near-surface)

Technical concerns

- Multi-dimensional
- Voluminous
- Projected onto a flat surface
- Special methods of analysis
- Large variety of geographical information
- Updating is complex and expensive
- Visualization and map making requires large amount of data

Spatial problem solving

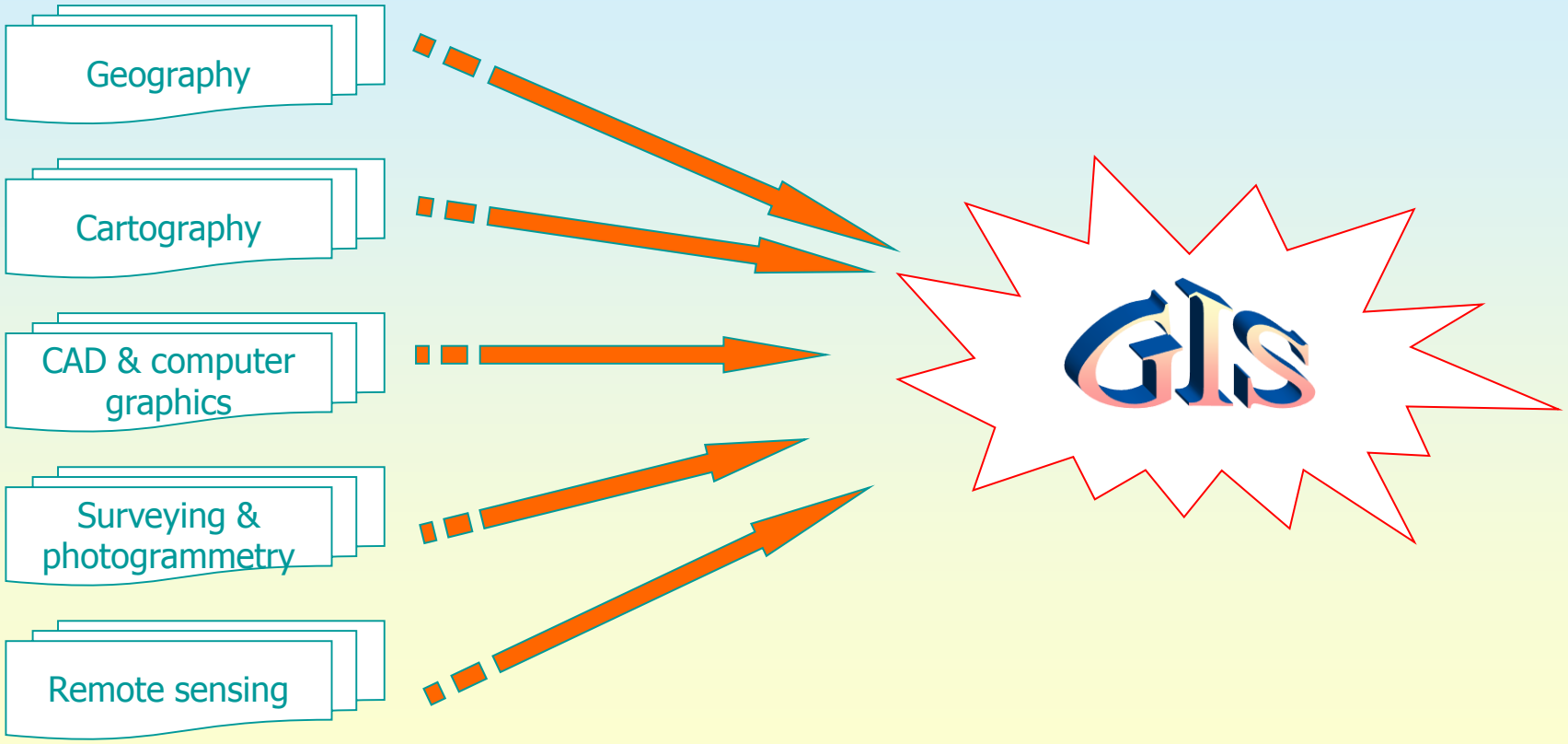
"Information systems help us to manage what we know by making it easy to organize and store, access and retrieve, manipulate and synthesise, and apply to the solution of problems." (Longley, *et al.*, 2015)

- Data: raw facts
- Information: contents assembled from raw facts
- Evidence: results of analysis
- Knowledge: information that is understood
- Wisdom: Policies developed and accepted

Geo-science, technology and business

- Geo-science: knowledge about how the world works
  - Information on how it looks, its forms and how it works
  - Prediction
  - GIS combines general scientific knowledge with specific information, and gives practical value to both.
  - The “test-bed” for geography
- Geo-technology: to support both science and problem solving.
- Geo-business: software, data, geo-service, publishing and education

Where is a GIS from?



A brief history of GIS

- The era of innovation
  - 1960s – 70s
- The era of commercialization
  - 1980s – 90s
- The era of openness and pervasive use
  - The 21st century

The era of innovation

Year	Type	Event
1963	Technology	CGIS development is developed (Roger Tomlinson)
1964	Academic	Harvard Lab established (SYMAP, 1966)
1967	Technology	DIME developed (for 1970 US Census)
1969	Commercial	ESRI formed (Jack Dangermond)
1969	Commercial	M&S Computing (Intergraph) formed (Jim Meadlock)
1969	Academic	'Design with Nature' published (Ian McHarg)
1969	Academic	First technical GIS textbook (Nordbeck & Rystedt)
1972	Technology	Landsat 1 launched (ERTS-1)
1973	General	First digitizing production line (Ordnance Survey, UK)
1974	Academic	AutoCarto 1 conference
1976	Academic	GIMMS (Tom Waugh)
1977	Academic	Topological data structures (ODYSSEY GIS)

The era of commercialization

1980's

Year	*Type*	*Event*
1981	Commercial	ArcInfo launched (first major commerical GIS software)
1985	Technology	GPS operational
1986	Academic	'Principle of GIS and Land Resource Assessment' (Burrough)
1986	Commercial	MapInfo formed (first desktop GIS product)
1987	Academic	IJGIS launched (first academic journal)
1987	General	Chorley Report ('Handling Geographical Information', UK)
1988	General	GISWorld begins (first world-wide GIS magazine)
1988	Technology	TIGER announced US census
1988	Academic	US and UK research centres announced (US NCGIA, UK RRL)

The era of commercialization

1990's

Year	Type	Event
1991	Academic	'GIS: Principles and Applications' published (Maguire, et al.)
1992	Technical	Digital Chart of the World released (US Defence Mapping Agency)
1994	General	Executive Order 12906 signed by President Clinton (NSDI)
1994	General	OpenGIS Consortium born
1995	General	First complete national digital map coverage (Great Britain's Ordnance Survey)
1996	Technology	Internet GIS products introduced
1996	Commercial	MapQuest (Internet mapping service, later purchased by AOL for $1.1 billion)
1999	Commercial	New generation of commercial satellites launched with submeter spatial resolution capability.
1999	General	GIS Day (first GIS Day attracted over 1.2 million global participants)

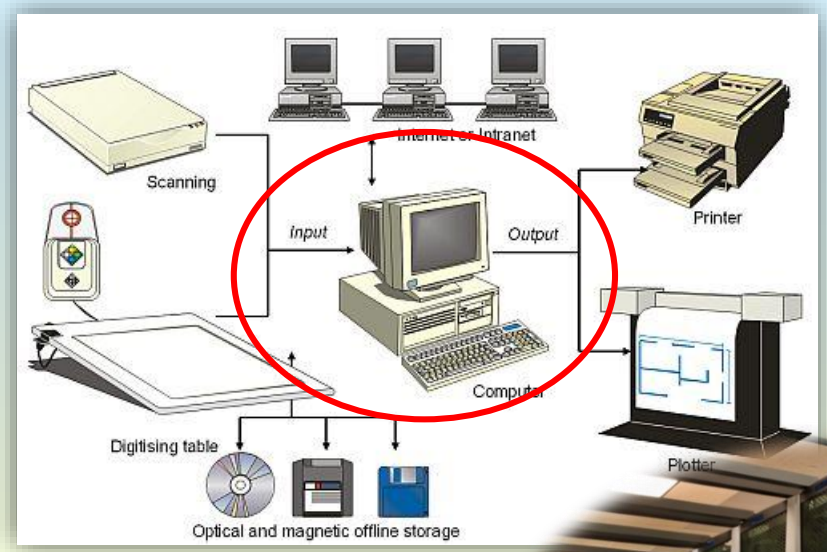
The era of openness and pervasive use

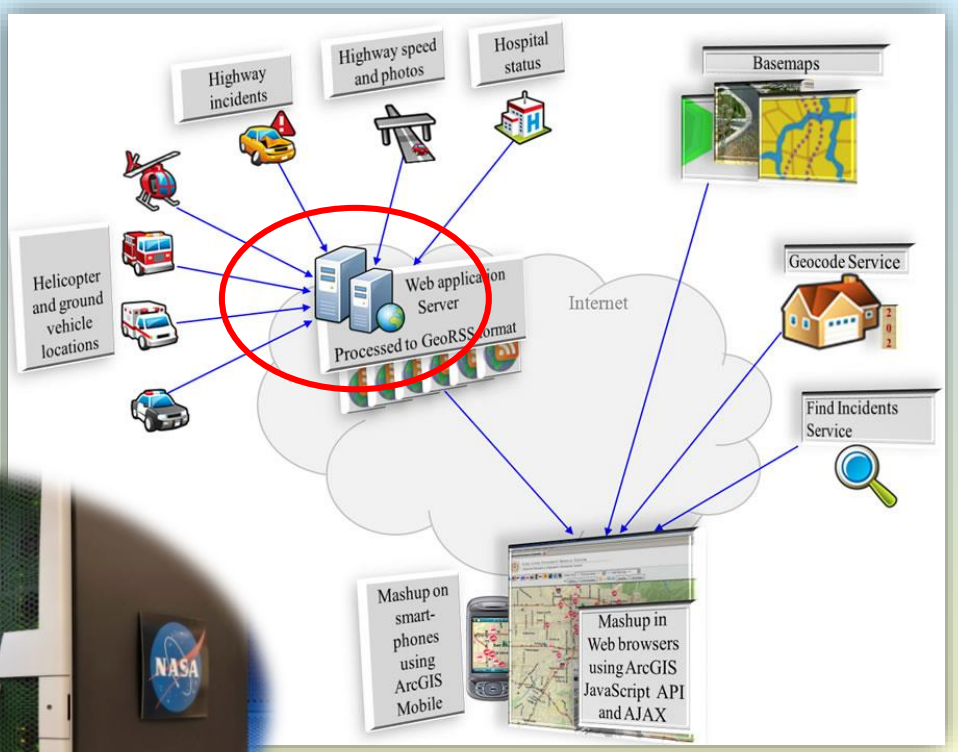
Year	*Type*	*Event*
2000	General	The US ceases the deliberate degradation of GPS
2003	General	The US initiative provides “one-stop” access to geospatial data and information (now part of geo.data.gov/geoportal/)
2004	commercial	OpenStreetMap founded to create citizen-enabled mapping for the UK (Steve Coast)
2004	General	National Geospatial Intelligence Agency (NGA) formed
2005	Technology	Launch of Google Earth service
2006	Technology	Launch of Amazon Web Services (AWS)
2007	Commercial	Navtech was purchased by Nokia (street data provider, $8.1 billion)
2007	Technology	Launch of iPhone, GPS-enabled mobile device
2008	Commercial	TeleAtlas purchased by TomTom (street data provider, $2.9 billion)
2009	Commercial	Quantum GIS (QGIS) launched under public license
2010	Technology	ESRI launches a cloud-based GIS platform
2011	Technology	Google launches indoor maps

Components of a GIS

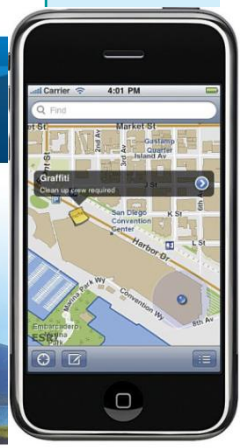
- Computer hardware
- GIS software
- People
- Data

Computer hardware

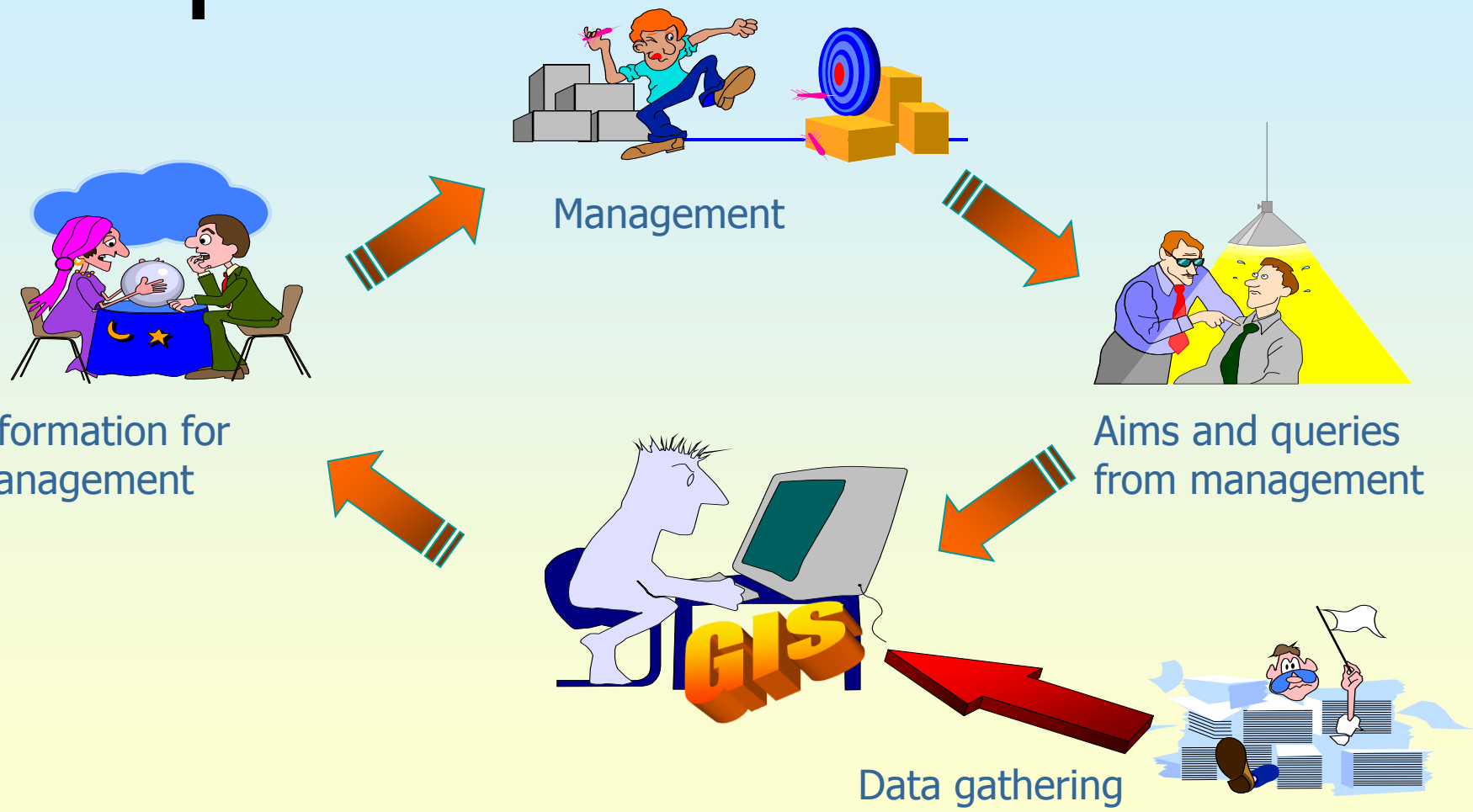




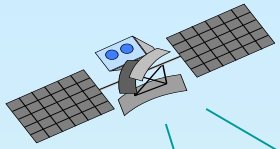
GIS software



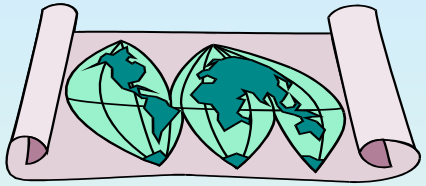
People


Management
Aims and queries from management
Data gathering
GIS
Information for management

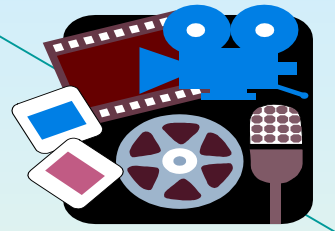
Data



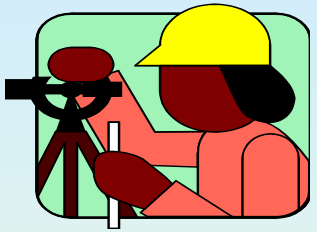
Satellite imagery



Maps

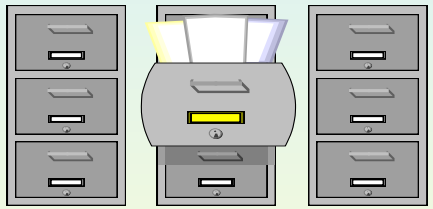


Multimedia

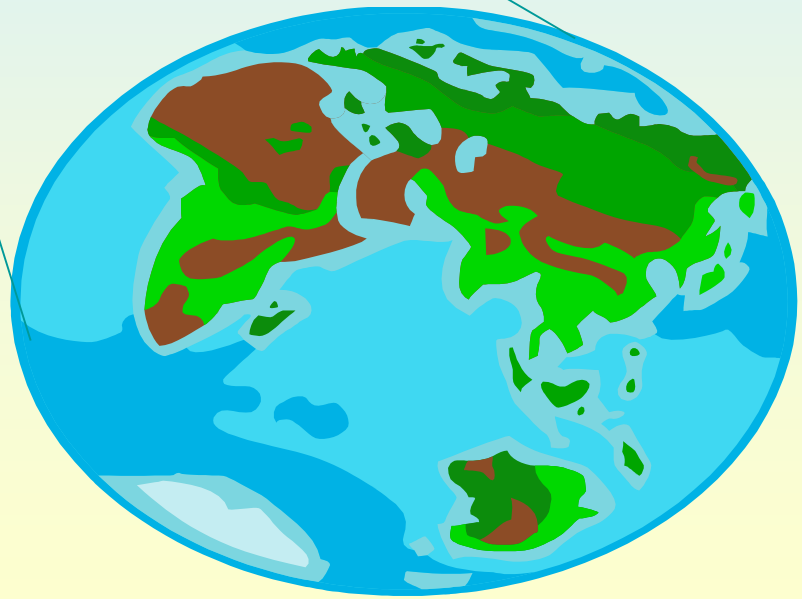


Ground survey

GIS User



Existing data



Data gathering and retrieval

The future

- Technology diffusion
- People oriented applications
- Interactive and real-time applications
- Cleverer and more comprehensive
- To use GIS, or not to use?

System, science, study and service

- Geographical information system
  - Emphasising infrastructure
- Geographical information science
  - Emphasising principle and theory
- Geographical information study
  - Emphasising data and data mining
- Geographical information service
  - Emphasising socio-economic service

GIS and computer geography

- Many roots of GIS come from principles of computer geography.
- However, many computer geographers remain suspicious of the use of GIS in geography.
  - Lack of geospatial data
  - Science and technology, with which GIS is strongly associated, are viewed by some as fundamentally flawed.
  - Geography itself is sometimes too “ambiguous”.
  - The ‘bias’ that GIS presents the Earth’s surface is often at the expense of others.

Why do we bother?

- GIS is becoming an essential tool for computer geography study and practices.
- Geographical data is becoming more widely available and less expensive so that the ability in using such data efficiently and wisely gives competitive margin for a business.
- Using GIS will eventually make your study in computer geography easier, more efficient and enjoyable.
- After all, the technology is already in your life, whether you like it or not!

Summary

- GIS was initially a system, or merely a toolbox for computer geographical applications.
- It has now advanced as science, technology, service and business.
- It has become an essential part of management and decision-making practices.
- In modern era, people's life is increasingly dependent upon the information and services provided by GIS.