

Medical Informatics

Lecture 1: Introduction

Dr Areti Manataki



Nanjing Medical University

Welcome!

- Medical Informatics: a gentle introduction to data science in biomedicine and healthcare
- Dr Areti Manataki
 - Lecturer at the University of St Andrews, United Kingdom
 - Health informatics research: artificial intelligence methods to improve the delivery of healthcare services
 - Extensive experience of teaching health data science to a variety of audiences.
 - <http://homepages.ed.ac.uk/amanatak/>

Welcome!

- Medical Informatics: a gentle introduction to data science in biomedicine and healthcare
- Our aim: to equip you with the **key foundations** and **data skills** that are needed for the data-intensive medicine of the future
- In line with recommendations in the Topol Review and by the National Academy of Medicine

Data is everywhere!

- Genomic data
- Electronic patient records
- Medical images
- Clinical notes
- Wearable devices
- Social media posts
- Bank card transactions
- ...and much much more

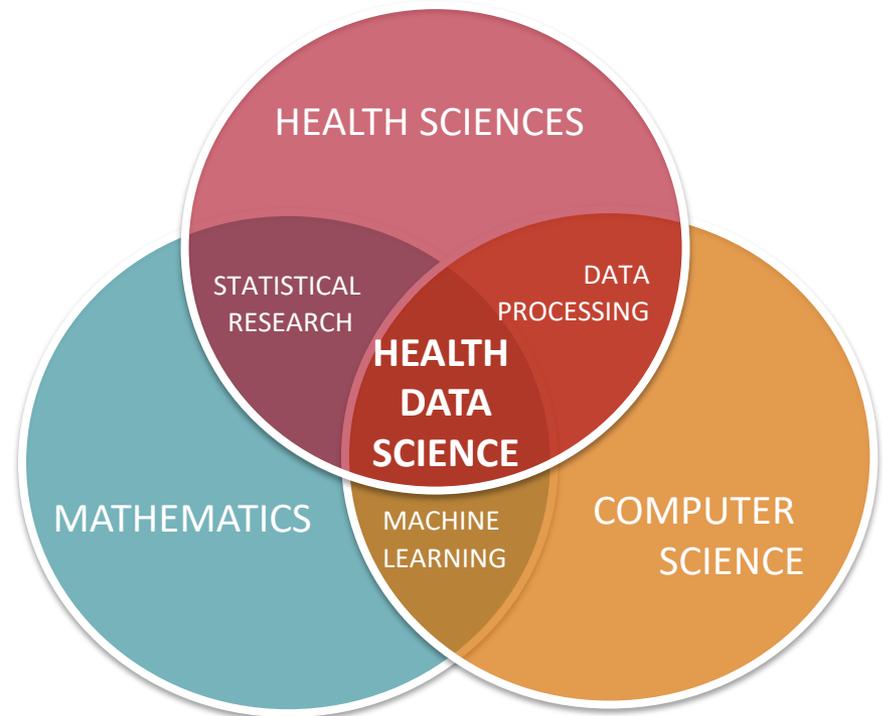


Nursing Care Plan		CLIENT ID:																			
<p>Patient: THOMAS D. FERRODAG, M.D. Referring Physician: THOMAS D. FERRODAG, M.D. Exam: MRI KNEE W/O CONTRAST RIGHT CI: 62 year old male, with right knee pain Procedure: Per protocol, reformats and subtracted images, when applicable, are performed.</p>		<p>NAME: _____ DOB: _____ POSITION: _____</p>																			
<p>INDICES: MENISCUS: The medial meniscus is obscured by the presence of hemiarthralgic components. The lateral meniscus displays fraying of the apex at the body, but is otherwise intact. CRUCIATE LIGAMENTS: The ACL is diminutive but intact fibers are still seen. The PCL is normal. COLLATERAL LIGAMENTS: None. PATELLOFEMORAL COMPARTMENT: Arthralgic components are noted in the patellofemoral compartment. Patellar and quadriceps tendons are intact. OTHER FINDINGS: Focal subchondral and subarticular marrow edema is noted in the posterolateral aspect of the LFC. Marrow changes are seen in the central femoral shaft presumably related to post-surgical change. There is a moderate joint effusion. No intraarticular body is detected. The patellofemoral soft tissues appear normal. There is no significant articular surface abnormalities and there is no evidence of bone marrow edema to suggest contusion or occult fracture.</p>		<p>CARE ALERT: FALL RISK <input type="checkbox"/> WANDERS <input type="checkbox"/> BLEED <input type="checkbox"/> DROF <input type="checkbox"/> CONVULSIVE DROG USE: _____</p>																			
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<p>1100 Montgomery Street, Suite 210 • San Luis Obispo, California 93401 (805) 542-9700 • Fax (805) 542-0964</p>		<p>Name: _____ Date: _____ Signature: _____ Designator: _____</p>																			

[Images by Louis Philippe Lessard and NurseRecord on Wikimedia, licensed as CC BY-SA 3.0]

Demystifying Health Data Science

- **Health Data Science** is a discipline that combines mathematics, computer science and health sciences to study different types of health problems using data.
- It provides the tools to manage and analyse very large amounts of different datasets across our healthcare systems.



[Image adapted from Shelly, P. 2015. Data Science for the C-Suite]

Opportunities brought by Health Data Science

Data and its analysis is revolutionising how medicine is understood, how biomedical research is conducted and how healthcare is delivered.

- Better understand disease
- Earlier and improved diagnosis
- Prevention of disease
- Enhanced predictions (e.g. in epidemiology)
- Safer and more effective treatments
- More effective integrated care pathways
- Driving clinical research
- Precision medicine

Challenges for Health Data Science

- Volume of data
- Data quality
- Data complexity
- Data sharing and linkage in a complex environment
- Digital maturity of health systems
- Culture in national health systems
- Data ethics
- Training the medics of the future

This course

How do we represent and interpret data?

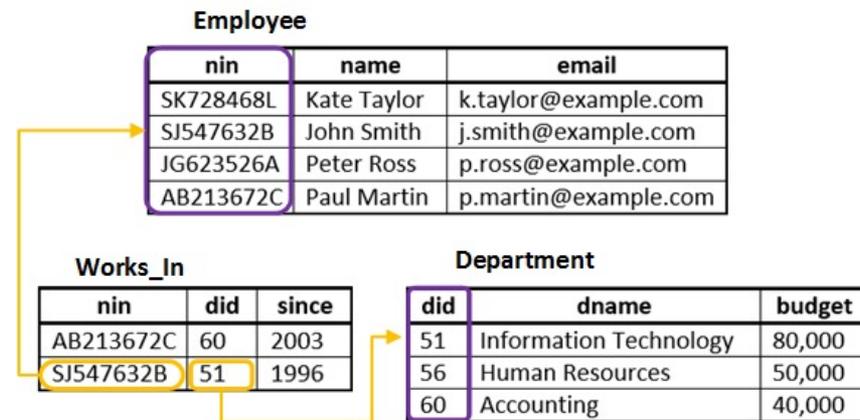
- Variety of approaches and methods available
- We'll have a look at:
 - Relational databases for medicine and healthcare
 - Medical ontologies and semantic web data
 - Advanced topics in Medical Informatics

Course syllabus

- Relational databases for medicine and healthcare
 - Design & Representation: ER model, relational model
 - Querying: SQL
- Medical ontologies and semantic web data
 - Concepts: ontologies, linked data
 - Representation: RDF
 - Querying: SPARQL
- Advanced topics in Medical Informatics
 - Artificial Intelligence in medicine and healthcare
 - Imaging and text data in medicine and healthcare

Relational databases for medicine and healthcare

- Tables with columns and rows and links between them

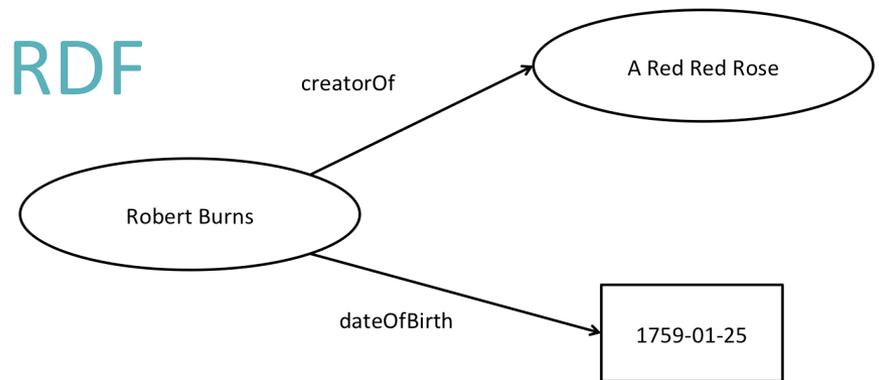


- How to design them: [ER model](#)
- How to specify tables: [DDL](#)
- How to query the data: [SQL](#)

Medical ontologies and semantic web data

- Ontologies: class hierarchy, relations, axioms, etc.

- How to represent data: **RDF**



- How to query the data: **SPARQL**

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Course structure

- The course runs over 10 days across 3 weeks.
- It is offered fully online.
- Learning activities:
 - Lectures
 - Tutorials
 - Labs
 - Coursework

Lectures

- Delivered live online by Dr Manataki.
- Active participation is expected.
- Three themes covered:
 1. Relational Databases for Medicine and Healthcare (lectures 2-7)
 2. Medical Ontologies and Semantic Web Data (lectures 8-12)
 3. Advanced Topics in Medical Informatics (lectures 13-14)
- Lectures are focussed on the technical side of things and are using examples from everyday life. The application to biomedicine and healthcare is achieved through tutorials and coursework.

Tutorials

- Tutorials will give you the opportunity to:
 - Apply what you've learnt in the lectures to particular scenarios and examples
 - Reflect on topics covered in the lectures
 - Clarify any questions you may have
- The main focus of tutorials will be practical exercises.
- Tutorial sheets will be released one week before the corresponding tutorial.
- You are expected to attempt all exercises in advance. There will also be some questions for group discussion in class.
- Tutorial sessions take place online and are facilitated by course staff.

Labs

- Labs will demonstrate how you can use particular software for representing and manipulating data in the different data models covered in the course:
 - MySQL
 - Apache Jena ARQ
 - WebProtégé
- Delivered live online by Dr Manataki.
- During the labs we'll go through practical examples of working with data.
- You will need to install the software in advance.

Optional textbooks

No compulsory textbooks for this course. If you are interested in reading further, we recommend the following optional textbooks:

- Relational databases for medicine and healthcare:
 - Raghu Ramakrishnan and Johannes Gehrke. Database Management Systems. McGraw-Hill, 3rd edition, 2003.
 - S. Sumathi and S. Esakkirajan. Fundamentals of relational database management systems. Springer, 2007.
- Medical ontologies and semantic web data:
 - Dean Allemang and Jim Hendler. Semantic Web for the Working Ontologist: Effective Modelling in RDFS and OWL. Morgan Kaufmann, 2nd edition, 2011.
 - Tom Heath and Christian Bizer. Linked Data: Evolving the Web into a Global Data Space. Morgan & Claypool Publishers, 2011.

Assessment

- No exams for this course.
- Your final grade will be based on the final course quiz, consisting mostly of multiple choice questions.
- The quiz will cover both theoretical and practical knowledge.
- Key dates for quiz:
 - Quiz released on 12th November 2021.
 - Quiz submission deadline on 26th November 2021.
- Coursework is individual. No groupwork is allowed.

People

- Course lead: Dr Areti Manataki A.Manataki@st-andrews.ac.uk
<http://homepages.ed.ac.uk/amanatak/>
- Course assistants:
 - Dr Cheng Wan chengwan@njmu.edu.cn
 - Dr Wei Feng 544299055@qq.com
 - Ms Huiting Sun 826064962@qq.com

Conclusions

- Medical Informatics: a gentle introduction to data science in biomedicine and healthcare
- Fundamental question: How do we represent and interpret data?
- Over the next few weeks, we'll be looking at:
 - Relational databases for medicine and healthcare
 - Medical ontologies and semantic web data
 - Advanced topics in medical informatics
- Bring your questions and ideas to class!