Health Informatics
Continuing Professional Development Programme

December 2019 to March 2020

The Faculty of Clinical Informatics has approved this activity for CPD in accordance with the current FCI CPD guidelines.
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Programme Details

Objective
To provide a foundation for beginners in Health Informatics from which they can build additional knowledge in the field.

Outcomes
By the end of this programme, the participants will be able to:
1. Define Health Informatics
2. Identify the key Health Informatics concepts
3. Describe Health Informatics problems and discuss ways to address them
4. Reflect on their digital practice and learning.

Target Audience
The programme is aimed at Doctors, Nurses, Pharmacists, IT personnel, Clinical Coders, and other healthcare professionals interested in learning about Health Informatics. No prior knowledge on any of the topics is assumed.

Programme Level
All the 10 courses in the programme are at an introductory level aimed at beginners with little to no background knowledge on the respective topics. While participating in all the courses of the programme would give them a broad overview of key informatics and computing topics and help them to better understand the relation between the various topics, each course will also be available as a standalone offering. Therefore, learners can opt to participate in just one or more as there will be no expectation for the participants to have attended any of the other courses in the programme.

Delivery
The lectures will be delivered in a face-to-face format using presentation slides. The course material will also include reading lists and reflective questions for discussion. The timetable is provided on page 5 of this document. Each session will be of 3 hours with a 15 minutes refreshment break midway. The lectures will be delivered either in the Urban Sciences Building or The Core on the Newcastle Helix site.

Content Development
The course has been co-developed by the Institute of Coding (IoC) at Newcastle University with Health Education England North East and North Cumbria with feedback from several regional stakeholders.

IoC is an initiative funded by the Department for Education through the Office for Students to address the digital skills gaps. It is a partnership of 33 universities and more than 100 employers across England and Wales with Newcastle University being one of the partners. IoC at Newcastle University offers two postgraduate Degree Apprenticeships in Data Analytics and Cyber Security as well as CPD courses in digital skills, knowledge, and technologies.
## Schedule

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Topics

1. INTRODUCTION TO HEALTH INFORMATICS

Summary

This course will provide a broad overview and brief history of Health Informatics and then proceed to discuss the fundamental concepts in Health Informatics. Further, the key components of health information systems will be discussed with a particular focus on the Electronic Healthcare Record (EHR). By building on the topic of EHR, one of the primary applications of EHR – Health Information Exchange – will be introduced. Further, the many roles undertaken by health informaticians will be outlined, which will enable the learners to understand the various career paths in Health Informatics.

Learning Outcomes

By the end of this course, learners will be able to:

1. Define what is Health Informatics
2. Outline careers in Health Informatics
3. Explain the fundamental concepts of Health Informatics
4. Describe the structure, role, and challenges related to EHRs
5. Analyse the evolution of Health Information Systems
6. Explain what are Health Information Exchanges

Outline

Below is an outline of the content covered in the course:

1. Overview and history of Health Informatics
2. Careers in Health Informatics
3. Fundamental informatics concepts (data, information, knowledge, models)
4. Electronic Health Record:
   a. What is an EHR?
   b. EHR structure
   c. Implementation challenges and ways to address them
5. Health Information Systems of the future
6. Introduction to Health Information Exchange (HIE)

Lecturers

Thomas Webb:

Thomas is a Founding Director of Ethical Healthcare Consulting, which is the UK’s first not-for-profit NHS consultancy. In this role, he has authored the £12m business case for the London Healthcare Information Exchange programme (precursor to the One London LHCRE programme). Additionally, he also successfully developed a £9m interoperability business case for North Central London STP. Thomas is also as an adjunct lecturer in the Newcastle University Business School where he lectures post-graduate students on the Competing with IT course, focusing on technology strategy within the context of value chain mapping and benefits realisation. From 2008 to 2011, he worked as a Project Manager at the Newcastle upon Tyne Hospitals NHS Foundation Trust where he was responsible for redesigning prescribing and diagnostic test processes as part of the implementation of an Electronic Patient Record System into the trust. Thomas is a qualified MSP and Prince 2 practitioner.
Anne Cooper:
Anne is currently the Chief Clinical Digital Officer at mHabitat, which is part of Leeds and York partnership FT working on digital projects. She is also the Clinical Director at Ethical Healthcare Consulting where she delivers a leadership programme focussed on women who work in the digital sector. Previously (April 2015 – May 2018) she was the Chief Nurse at NHS Digital where she worked with technical professionals to deliver strategic leadership and insights on the national agenda as well as leading on clinical governance. From July 2013 to March 2015, Anne was the Clinical Informatics Advisor (Nursing) for NHS England providing strategic expert advice on digital health to a range of national programmes. Furthermore, she established a community of nurses working in informatics, linking to the Chief Clinical Information Officer leaders’ network, securing a space for nurses in what was a male dominated medical network. Anne has also served as the National Clinical Lead for Nursing in the Department of Health, Informatics Directorate and as the Head of Information Governance in NHS Connecting for Health. Anne is a Registered Nurse and also possesses a Diploma in Management Studies as well as a Post Graduate Diploma in Health Informatics.
2. INTRODUCTION TO HEALTH INFORMATION SYSTEM INTEROPERABILITY

Summary
This course will begin with a discussion on the key terms associated with health information systems and will then proceed to a discussion on standards, which are integral to the functioning of information systems. For health information to be useful and useable, it must be shared consistently and meaningfully between information systems. Standards play a critical role in ensuring this information exchange and interoperability. The course will thus focus on the role and usage of interoperability standards within healthcare information systems. The learners will also learn about the organisations that create and maintain these standards.

Learning Outcomes
By the end of this course, learners will be able to:

1. Explain the concepts 'interoperability standard' and 'terminology'
2. Interpret basic computer science language used when discussing health information systems
3. Name the main organisations responsible for the creation of health interoperability standards used within the UK
4. Describe the characteristics of the main interoperability standards used within the UK

Outline
Below is an outline of the content covered in the course:

1. What is an interoperability standard? [10 mins]
   a. ATMIST-AMBO
   b. interoperability standard vs terminology
2. Basics of information systems architectures and language: [30 mins]
   a. Client
   b. Server
   c. Database
   d. Network
   e. Data centre
   f. Cloud computing
   g. API
   h. XML
   i. JSON
3. Who creates standards?
   a. International standards organisations: [40 mins]
      i. HL7
      ii. OpenEHR
      iii. IHTSDO / SNOMED International
      iv. IHE
      v. NEMA
   b. Adapting international standards for local use
   c. UK standards organisations:
      i. NHS Digital
      ii. INTEROPen
      iii. PRSB
4. What standards are in use?
   a. International standards: [40 mins]
      i. HL7 V2
      ii. HL7 V3
      iii. HL7 CDA
iv. HL7 FHIR  
v. OpenEHR  
vi. SNOMED-CT  
vii. IHE-XDS  
viii. DICOM  
b. National standards: [40 mins]  
i. DM&D  
ii. ITK  
iii. GP Connect  
iv. Care Connect  
5. Further resources [10 mins]  
6. Summary  
7. Q&A  

Lecturer  
Dr Dunmail Hodkinson  

Dunmail is the Chief Technology Officer (CTO) at Black Pear Software Ltd. As the CTO, he is responsible for developing interoperable systems for Local Health and Care Record Exemplars using standards from HL7 and IHE. He has also developed Black Pear’s Prime Minister’s Challenge Fund software, the first production implementation of HL7 FHIR in the UK and one of the first globally. Dunmail is also the Immediate Past Chair at HL7 UK having served as the Chair from June 2017 to June 2019. HL7 is the global authority on standards for interoperability of health technology. HL7 UK looks after HL7 activities in the UK. As Chair of HL7 UK, Dunmail was responsible for providing advice on interoperability standards to stakeholders including INTEROPen, TechUK, NHS England, and NHS Digital. Dunmail has a PG Cert in Computing from The Open University, PhD from The University of Sheffield, and BSC in Biological Sciences from Durham University.
3. HUMAN COMPUTER INTERACTION IN HEALTHCARE

Summary
This course will introduce the subject of Human Computer Interaction as a field of research in its own right and identify how interface design is critically important in the context of digital health. The course is designed as an introduction to understanding how promoting good practices in human interaction with enabling digital technologies is an overriding influence in the success of health informatics products. Examples and case studies will be used to allow learners the ability to contextualise the material presented in accessible real-world settings.

Learning Outcomes
By the end of this course, learners will be able to:

1. Assess digital technology in the context of economy of use
2. Identify engineering terms that help communicate with designers to improve (digital) interface design
3. Recognise the different interaction patterns and their usefulness
4. Analyse an interface design and describe good and poor design judgement based on the design’s intended use
5. Explain the theory underlying Human Computer Interaction

Outline
Below is an outline of the content covered in the course:

1. Evolution of Human Computer Interaction
2. Human Factors Engineering
3. Good and poor judgement in interface design
4. User-centric design for data analysis within health informatics

Lecturer
Dr Graham Morgan

Graham is a Reader in the School of Computing at Newcastle University. He works extensively with healthcare professionals to create digital health solutions for diverse medical conditions using the latest cloud and virtual reality technologies. For example, he has led several projects, some of which are: i) ICURe Cohort 9: ASTEROID, the fun 3D eye test (Research England), ii) HICF - Accurate and patient friendly measurement of binocular visual function using a 3D mobile device (Wellcome Trust), iii) Augmented Reality Stories for Upper Limb Rehabilitation of Preschool Children with Hemiplegic Cerebral Palsy (Action Medical Research), iv) and Additional vision tests for Asteroid device (Medical Research Council) among others. His work and projects involve innovative use and application of human computer interaction principles and technology, game technology, and artificial intelligence.

Graham also leads the Computer Game Engineering MSc and runs the Game Lab at Newcastle University. The Game Lab carries out research and provides education related to video game technology. It is the only lab of its type within a Russell Group university in the United Kingdom.
4. CLINICAL INFORMATION SYSTEMS

Summary
This course will begin with an overview of Clinical Information System (CIS) in healthcare and take learners through the different types of CIS in practice. The course will then focus on Clinical Decision Support System (CDSS) as a specific type of CIS. With the context of CDSS, learners will learn about the key considerations in the different stages of CIS development including design, implementation and evaluation. As the course progresses, learners will be able to analyse how CDSS assist human-decision making and lead to improved care outcomes.

Learning Outcomes
By the end of this course, learners will be able to:

1. Define Clinical Information Systems (CIS) including the different types of CIS in practice
2. Describe the purpose of CDSS and their applications
3. Critically analyse the enablers and barriers for the adoption of CDSS
4. Analyse the key considerations when designing and implementing CIS in the context of Clinical Decision Support (CDS)
5. Recognise the different approaches to evaluating CIS (in the context of CDS) and determine which one(s) to utilise in practice

Outline
Below is an outline of the content covered in the course:

1. Introduction to Clinical Information Systems (CIS) in healthcare
   a. Overview of CIS at different stages of care delivery (diagnostic, prescribing, administration, monitoring, patient facing)
2. Clinical Decision Support Systems (CDSS) and their applications in practice
3. Enablers and barriers to the adoption of CDSS
4. Examples of designing and implementing CIS for CDS
   a. Different approaches: Active and Passive; workflow considerations
   b. ‘Building blocks’ of CDSS – leveraging data within the EHR
   c. Safety (overreliance) and Alert fatigue
5. Approaches to evaluation
6. Group Activity: Identification of a clinical problem or target where CDSS could be beneficial and design an end to end project to address this.

Lecturer
Dr Clare Tolley

Clare is currently a Research Associate in the Institute of Health and Society at Newcastle University. In this role, she project manages a large programme of work funded by an EU Horizon 2020 grant. Further, she also engages with patient and public involvement groups, is involved in the implementation of a healthcare intervention in a large Hospital Trust and smooth running of the project, and performs data collection and analysis. Clare received her PhD from Durham University in 2018 on the topic entitled, “An investigation of healthcare professionals’ experiences of training and using electronic prescribing systems” as part of which, she undertook four literature reviews and two qualitative studies in the UK hospital context. Clare is a Registered Pharmacist, has a Certificate in Clinical Pharmacy, and is a Fellow of the Higher Education Academy.
5. DIGITAL ETHICS

Summary
This course will explore ethical considerations relating to digital innovation in healthcare and health systems. It will consider how broader debates around digital ethics (e.g. relating to artificial intelligence and data collection and reuse) apply in health contexts.

In particular, the course will focus on the uses of data in healthcare and health systems and ethical considerations relating to data collection, storage and use/reuse. This includes use of data in developing and utilising new technologies including Artificial Intelligence (AI).

The course will move from considering broader issues around digital ethics to focus on practical examples and actual clinical applications. The learners will examine current governance mechanisms in place to address digital ethics and a range of approaches that can be employed (including the role of Patient and Public Involvement in the use/reuse of health data).

Learning Outcomes
By the end of this course, learners will be able to:

1. Explain how digital ethics applies in health contexts
2. Describe updated and clinically relevant governance procedures relating to the increase in digital technologies for example, grey areas such as use of personal mobile devices to communicate patient information
3. Recognise the ethical considerations relating to the transfer and retrieval of digital patient data including elements of shared care, data protection and security;
4. Identify the current governance mechanisms and approaches: including regulations, the role of Caldicott Guardian, and Patient and Public Involvement (PPI)

Outline
Below is an outline of the content covered in the course:

1. Background: why digital ethics?
2. Examples of ethical dilemmas in digital innovation (particularly in health contexts)
3. Consideration of practical examples in relation to clinical applications
4. Current governance mechanisms and approaches: including regulation, policy, the role of Caldicott Guardian, and Patient and Public Involvement (PPI)

Lecturer
Dr Mhairi Aitken
Mhairi is a Senior Research Associate at Newcastle University where she primarily works on an EPSRC funded project (FinTrust), which explores the role of machine learning in banking. Her responsibilities include conducting social science research to examine social and ethical dimensions of data driven innovation in finance, to explore the ways in which data-driven financial products and services might be conceived to be “trustworthy”. Prior to joining Newcastle University, she was a Research Fellow in the University of Edinburgh where she held roles as a Public Engagement Research Fellow in both the Farr Institute of Health Informatics Research and the Scottish Health Informatics Programme (SHIP). As a research fellow, she worked on two consecutive large interdisciplinary and multi-institution projects, examining social and ethical dimensions of innovation in health informatics research and their implications for governance. Mhairi has been a guest lecturer/tutor between 2016 and 2018 on University of Edinburgh’s Distance Learning MSc Global EHealth. As part of this role, she developed online tutorials, online course materials, and
participated in discussion forums with students. Mhairi holds a PhD and a Postgraduate Certificate in Research Methods from The Robert Gordon University.
6. SNOMED CT BASICS

Summary
SNOMED CT is a complex terminology and since it supports reasoning, the consequences of incorrect or inappropriate coding can be severe and impact upon a patient’s care. Therefore, a good understanding of SNOMED CT’s structure is critical in ensuring its correct and intended use.

This course will introduce the users to SNOMED CT including its history, structure, benefits, and applications. Learners will receive guided and exploratory opportunities to understand the structure and content in SNOMED CT through hands-on activities. They will also have the opportunity to participate in discussions around real-world examples of SNOMED CT implementation to understand the benefits of using SNOMED CT to record patient information.

Learning Outcomes
By the end of this course, learners will be able to:

1. Differentiate between healthcare terminologies and classifications
2. Describe the background of SNOMED CT and the role of SNOMED International
3. Identify the arguments in favour of using SNOMED CT to record patient information
4. Describe SNOMED CT’s structure and where to find specific content
5. Differentiate between the types of SNOMED CT expressions
6. Demonstrate the ability to navigate SNOMED CT using the NHS Digital SNOMED CT browser
7. Describe SNOMED CT reference sets and their purpose

Outline
Below is an outline of the content covered in the course:

1. What are healthcare terminologies and classifications?
2. Introduction to SNOMED CT and SNOMED International
3. Why SNOMED CT?
4. SNOMED CT structure and content
5. SNOMED CT expressions
6. Exploring SNOMED CT using NHS Digital SNOMED CT browser
7. SNOMED CT reference sets

Lecturers
Denise Downs
Denise is the Principal Terminology Implementation and Education Specialist at NHS Digital. In this role, she has been the terminology SME (subject matter expert) for project to transition general practice to SNOMED, now SME for mental health. Denise has also worked with a number of professional bodies to drive up implementation of SNOMED CT. Previously, she has held various posts in Huddersfield University from Senior Lecturer in Software Engineering to Director of Research and Knowledge Transfer. Denise has a MA in Software Systems Design from Manchester University, MA in Education from Open University, and BA (First-Class Honours) in Computing and Mathematics from Lancaster University.

Tejal Shah
Tejal is a Teaching Fellow in the Institute of Coding at Newcastle University where her responsibilities include designing computing courses for those from non-computing backgrounds. Previously, she was a Research Associate in the Institute of Health and Society at Newcastle University working on the Connected Health Cities (CHC) Programme. Prior to joining Newcastle
University, she worked as a Research Assistant in the School of Information Technologies at the University of Sydney where she was responsible for implementing SNOMED CT in the in-house health information system that was developed as part of a research project. Tejal received her PhD in Computer Science from the University of New South Wales, Sydney, Australia. She holds a Master of Health Informatics degree from The University of Sydney, Australia and Bachelor of Dental Surgery (BDS) from Government Dental College, Mumbai, India.
7. CYBER SECURITY FOR HEALTHCARE

Summary
This introductory course will begin with an explanation of some of the fundamental concepts in cyber security and impart an understanding of information system security requirements. By analysing real-world examples, practical aspects of cyber security including threats and vulnerabilities, with a particular focus on the potential threats to health data, will be discussed. The learners will learn about good practices in cyber security to establish a security culture. Through the course, important questions such as “why is cyber security important for healthcare?” and “does healthcare have a cyber security problem?” will be considered and discussed.

Learning Outcomes
By the end of this course, learners will be able to:

1. Identify the fundamental concepts of cyber security
2. Recognise the relevance of the National Cyber Security strategy and the NDG Data security standards
3. Explain the importance of cyber security in the information age
4. Identify the vulnerabilities and threats and respond to cyber security incidents
5. Recognise what constitutes the cyber essentials scheme and what are the key security controls
6. Review the lessons learnt from WannaCry

Outline
Below is an outline of the content covered in the course:

The basics:
1. Cyber security fundamentals
2. NDG Data Security Standards

The threats:
1. Cyber security threats in general (STRIDE model)
2. Risk assessment
3. Specific aspects to clinical information system safety and patient safety
4. Hazards and accidents: Introduction to safety culture, risk management and ALARP incident response
5. Cyber security technologies (technologies for implementing privacy, security and trust)
6. Examples:
   a. Learning from the 2017 WannaCry ransomware attack

The practical stuff:
1. Cyber security good practices
   a. UK Cyber essentials scheme (https://www.cyberessentials.ncsc.gov.uk/)
      i. Key security controls (secure devices and software, access control to data and services, malware and virus protection, devices and software update, secure internet connection)
   b. 10 steps to cyber security (https://www.ncsc.gov.uk/collection/10-steps-to-cyber-security)
2. Multiple attack steps: Mat Honan attack
Lecturers

Dr Charles Morisset

Charles is a Senior Lecturer in Security in the School of Computing at Newcastle University. He leads the undergraduate System and Network Security module and co-leads the postgraduate System Security Module. Charles also co-organised the Cyber Security: Safety at Home, Online, in Life online course that explores practical cyber security including privacy online, payment safety and security at home. His research interests include decision-making for security systems in general, and access control in particular as well as security and resilience of infrastructure systems.

Professor Aad van Moorsel

Aad is a Professor in Computer Science, specialising in Cyber Security, at Newcastle University. His research focusses on security, privacy and trust where it takes the perspective of the user and the decision-maker, and asks the questions: how can we run IT, make decisions about IT, and implement IT such that the business is secured but efficient and people feel safe but can be productive.

Aad is also the lead for Newcastle University in the Institute of Coding, a scheme offering postgraduate degree apprenticeships and various CPD courses to improve digital skills. He teaches on several undergraduate and postgraduate courses as well as regularly consults and delivers CPD sessions on Blockchain and Cyber Security to professionals from several industries and diverse backgrounds.
8. DATA PRIVACY AND PROTECTION IN HEALTHCARE

Summary
With the goal of improving patient care and health outcomes, an ever-increasing amount of patient data is being collected and analysed by healthcare organisations. This however raises the critical challenges of ensuring data privacy and protection. Regulations such as the Data Protection Act (DPA) 2018 and the General Data Protection Regulation (GDPR) are aimed at organisations that handle personal data implement appropriate measures to protect against data breaches and inappropriate use. Given the sensitivity of health data, it is considered as special category of data and requires additional measures for protection as stipulated in the regulations.

This course will focus on the key provisions of GDPR that apply to health data as well as on the rights and obligations associated with the processing of health data. Further, the impact of GDPR on cyber security will also be analysed. The learners will be guided through exercises to understand the privacy challenges associated with some common problems such as data re-identification and de-anonymisation.

Learning Outcomes
By the end of this course, learners will be able to:

1. Explain why privacy and data protection laws matter for the healthcare sector
2. Describe the types of health data as defined in the legislations
3. Identify the key elements of DPA and GDPR that apply to health data
4. Recognise the roles and responsibilities of organisations under DPA and GDPR
5. Explain the relationship between GDPR and cyber security

Outline
Below is an outline of the content covered in the course:

1. Privacy & Data Protection in general: the basics
2. What constitutes personal and special category data?
3. The problem of re-identification/de-anonymisation
4. Key elements of the Data Protection Act 2018 and GDPR
5. How does the GDPR relate to the DPA and what does it mean for the healthcare sector?
6. Role of the Data Protection Officer
7. Accountability, obligations, and transparency under GDPR
8. National data opt-out
9. Review of Caldicott principles to ensure safe and respectful handling of information
10. What does GDPR mean for cyber security?
11. Misuse of GDPR
Lecturers
Dr Charles Morisset
Charles is a Senior Lecturer in Security in the School of Computing at Newcastle University. He leads the undergraduate System and Network Security module and co-leads the postgraduate System Security Module. Charles also co-organised the Cyber Security: Safety at Home, Online, in Life online course that explores practical cyber security including privacy online, payment safety and security at home. His research interests include decision-making for security systems in general, and access control in particular as well as security and resilience of infrastructure systems.

Professor Aad van Moorsel
Aad is a Professor in Computer Science, specialising in Cyber Security, at Newcastle University. His research focusses on security, privacy and trust where it takes the perspective of the user and the decision-maker, and asks the questions: how can we run IT, make decisions about IT, and implement IT such that the business is secured but efficient and people feel safe but can be productive.

Aad is also the lead for Newcastle University in the Institute of Coding, a scheme offering postgraduate degree apprenticeships and various CPD courses to improve digital skills. He teaches on several undergraduate and postgraduate courses as well as regularly consults and delivers CPD sessions on Blockchain and Cyber Security to professionals from several industries and diverse backgrounds.
9. eHealth Technologies I

Summary
In this course, the appropriate usage of digital information and associated technologies within medicine in the context of their risk, fiscal economy, and improved patient outcomes and safety will be discussed. The course is designed as an introduction to understanding how digital information and enabling technologies based on such information are influencing current medical practices and the possibilities for the future. Examples and case studies will be used to allow learners the ability to contextualise the material presented in accessible real-world settings.

At the end of the course, learners will be able to analyse how eHealth technologies add value to healthcare systems and be better prepared to participate in the digital transformation of healthcare.

Learning Outcomes
By the end of this course, learners will be able to:

1. Describe how information evolution impacts working practices
2. Analyse how Artificial Intelligence may be utilised for improved outcomes
3. Identify problematic issues in information leakage across digital platforms
4. Assess the usefulness of digital products in personalised medicine
5. Identify the applications of Gamification in healthcare

Outline
Below is an outline of the content covered in the course:

1. Present how near future information innovations may impact medical industries
2. Describe how digital infrastructures can influence current working practices
3. Use case studies that highlight balancing risks and benefits in the digital age
4. Introduce Gamification within the context of medical products and services

Lecturer
Dr Graham Morgan

Graham is a Reader in the School of Computing at Newcastle University. He works extensively with healthcare professionals to create digital health solutions for diverse medical conditions using the latest cloud and virtual reality technologies. For example, he has led several projects, some of which are: i) ICURe Cohort 9: ASTEROID, the fun 3D eye test (Research England), ii) HICF - Accurate and patient friendly measurement of binocular visual function using a 3D mobile device (Wellcome Trust), iii) Augmented Reality Stories for Upper Limb Rehabilitation of Preschool Children with Hemiplegic Cerebral Palsy (Action Medical Research), iv) and Additional vision tests for Asteroid device (Medical Research Council) among others. His work and projects involve innovative use and application of human computer interaction principles and technology, game technology, and artificial intelligence.

Graham also leads the Computer Game Engineering MSc and runs the Game Lab at Newcastle University. The Game Lab carries out research and provides education related to video game technology. It is the only lab of its type within a Russell Group university in the United Kingdom.
a) IoT for Healthcare

**Summary**
As we delve deeper into the ‘Digital Age’, hundreds of petabytes of heterogeneous data (images, text, video, and the like) will be generated and required to be efficiently processed (stored, distributed, and indexed with a schema and semantics). Many of the existing ICT systems that store, process, distribute, and index such data fall short of addressing this challenge or do not exist. Therefore, we are witnessing the processing of Big Data, produced in the healthcare domain, being moved from physical hardware- and locally managed software-enabled platforms to virtualised cloud computing environments.

In this course, the ‘Big Data’ problem in healthcare will be examined and solutions to optimally manage and analyse such data will be discussed. In particular, the course will focus on the technologies that lead to data explosions as well as the technologies that are employed to effectively handle the large amount of data. In this course, learners will be introduced to the new and emerging technologies that are bringing a paradigm shift in health data management.

**Learning Outcomes**
By the end of this course, learners will be able to:

1. Explain the role of IoT in healthcare
2. Analyse Big Data issues related to IoT-based healthcare applications
3. Describe the fundamentals of Cloud Computing
4. Identify the challenges of managing IoT-based healthcare application in clouds

**Outline**
Below is an outline of the content covered in the course:

1. Introduction to Internet of Things and Big Data Analytics Issues in Healthcare
   a. Big Data Challenges & Characteristics
2. Introduction to Cloud Computing
   a. Challenges and Delivery Models
   b. Big Data Processing frameworks (MapReduce, Hadoop, Spark)
3. Engineering Cloud-based Big Data Analytics Systems
   a. Data Management
   b. Resource Management

**Lecturer**

**Professor Rajiv Ranjan**
Rajiv is a Chair and Professor of Computing Science and Internet of Things at Newcastle University. He leads on the Cloud Computing and Internet of Things modules to postgraduate students and Computer Science Honours to undergraduate students. Rajiv’s research interests lie at the intersection of multiple, inter-dependent research disciplines within distributed systems research area including Internet of Things, Big Data Analytics, Cloud Computing, and Edge Computing. He works with healthcare professionals on projects that involve the application of cutting-edge distributed systems technologies for efficient management of health big data. Currently, he is working with South Tees Hospitals NHS Foundation Trust on how to scale querying over NEWS2 data that currently includes over 5 million patient records. Each record represents temporal (time of visit,
duration of visit, frequency of observations, etc.) and physiological characteristics (respiration rate, oxygen saturation, systolic blood pressure (heart muscle pressure), pulse rate, level of consciousness, temperature). To this end, he has been investigating how cloud computing and big data programming techniques can speed up the querying process that currently takes days if not weeks (for multi-dimensional join queries). Another line of collaboration includes how to develop healthcare data provenance framework based on Distributed Ledger Technologies (DLTs) such as Blockchain.
b) Blockchain

**Summary**
The course will provide a broad overview of the concept of blockchain and the use of smart contracts. Additionally, the case for blockchain in healthcare will be considered and some of its applications identified. The advantages and challenges of employing blockchain will also be discussed.

**Learning Outcomes**
By the end of this course, learners will be able to:

1. Define blockchain
2. Analyse the case for blockchain for healthcare
3. Identify how blockchain has been applied in healthcare
4. Describe the risks and challenges associated with the use of blockchain

**Outline**
Below is an outline of the content covered in the course:

1. What is blockchain? Public versus private blockchain.
2. What are smart contracts?
3. Is there a case for blockchain in healthcare?
   a. Data sharing
   b. Data privacy and security
4. What are the applications of blockchain in healthcare?
   a. Blockchain and EHRs
5. Challenges and risks associated with blockchain

**Lecturer**
**Professor Aad van Moorsel**

Aad is a Professor in Computer Science, specialising in Cyber Security, at Newcastle University. His research focusses on security, privacy and trust where it takes the perspective of the user and the decision-maker, and asks the questions: how can we run IT, make decisions about IT, and implement IT such that the business is secured but efficient and people feel safe but can be productive.

Aad is also the lead for Newcastle University in the Institute of Coding, a scheme offering postgraduate degree apprenticeships and various CPD courses to improve digital skills. He teaches on several undergraduate and postgraduate courses as well as regularly consults and delivers CPD sessions on Blockchain and Cyber Security to professionals from several industries and diverse backgrounds.