CSIP5403: Research Methods and Applications

Lecture 1: Introduction to Module and Research

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Part I

Introduction to the Module

Outline

Module Convenors

Prof. Shengxiang Yang, Covering Unit 1 Research Methods

- Professor, Deputy Director of Institue of Artificial Intelligence
- Office: GH4.58D, Email: syang@dmu.ac.uk
- Web: http://www.tech.dmu.ac.uk/∼syang/
- Research Interests: Computational Intelligence, Evolutionary Computation, Machine Learning, Data Mining, Optimisation

Dr. Nathanael Baisa, Covering Unit 2 AI Appications:

- Lecturer in Artificial Intelligence
- Office: GH6.74, Email: nathanael.baisa@dmu.ac.uk
- Research Interests: Computer Vision, Image Processing, Machine Learning, Deep Learning

Unit 1 Research Methods: Aims

Coverage:

- Research methods for MSc level
- Examples of research studies from AI
- Research process is examined
- Project management
- Issues in funding and ethics

In summary, Research Methods Part of this module will

1. Expose you to a variety of research approaches
2. Encourage the analysis of research papers
3. Help you in carrying out your MSc project

Unit 1 Research Methods: Learning Outcomes

- Critically appraise a given research method
- Justification of application to appropriate research problem
- Write a research proposal
- Management of a research project

Unit 1 Research Methods: Lectures

Lectures will be used to

- Introduce an overview of the Research Process
- Present the principal Research Methods
- Analyse and review of Research Papers
- Show how important Literature Review is
- Present and use the main Sources of Knowledge
- Provide Basic Statistics for Research
- Give you the opportunity to develop your own Research Proposal
- Introduce you the use of the Software package: LaTeX

Unit 1 Research Methods: Lecture Plan

Week	Topic	Lecturer
1	Introduction to the Module/Research	Shengxiang
1	The Research Process	Shengxiang
1	Literature Review	Shengxiang
2	Critical Evaluation of Research	Shengxiang
2	Formulating a Research Problem	Shengxiang
2	Data Collection: Statistics for Research	Shengxiang
3	Ethical Issues and Risk Management in Research	Shengxiang
3	Writing Research Proposals	Shengxiang
3	Typesetting Document with LaTeX	Shengxiang

Unit 1 Research Methods: Practicals

Practicals will be used for you to

- Find suitable papers
- Analyse the research method applied
- Evaluate the validity of the outcomes
- Experience the development of a research proposal
- Develop communication and self-management skills

Unit 1 Research Methods: Assessment

Assessments for Unit 1 Research Methods

- Entirely based on coursework
- Communication and written skills
  - Assessment 1: Contribution to discussion on research context
  - Assessment 2: Production of a PhD research proposal and issues in practicals

Assessment 1	10% of Unit 1 Research Methods
Assessment 2	90% of Unit 1 Research Methods
Unit 1 Research Methods	50% of the module

Unit 1 Research Methods: Re-assessment

- Resubmission of a PhD research proposal and an assessment by interview
- Coursework will be guided by revision recommendations from the tutor
- Resubmissions will be evaluated by the convenor

Part II

Introduction to Research

Outline

Research is

- Undertaken within most professions
- More than a set of skills
- A way of thinking
  1. examining critically
  2. understanding and formulating guiding principles
  3. developing and testing new theories

Need to Answer Questions

- How do robots communicate?
- How to measure the consistency of people's opinions?
- What is the relationship between two phenomena?
- What is the best way to find out the effectiveness of a particular treatment?
- How can we provide good and personalised recommendations to our clients?

Research helps us to answer such questions objectively

Process is Called 'Research'

1. is undertaken within a framework of a set of philosophies;
2. uses procedures, methods and techniques that have been tested for their validity and reliability;
3. is designed to be unbiased and objective.

Philosophy: Main Paradigms

Paradigm: A very general conception of the nature of scientific endeavour within which a given inquiry is undertaken

1. Positivist approach
2. Phenomenalism approach

Validity and Reliability

Validity ensures correct procedures have been applied to find answers to a question

Reliability refers to the quality of measurement procedures that provides repeatability and accuracy

Unbiased and Objective

Each step taken in an unbiased manner and conclusions drawn without introducing any vested interest

Some definitions

- 'Systematic, controlled empirical and critical investigation of propositions about presumed relationships about various phenomena'
  Fred N. Kerlinger 1986 *foundations of Behavioral Research*, Rinehart and Winston
- "A considered activity which aims to make an original contribution to knowledge"
  Christian W. Dawson 2000 *The Essence of Computing Projects: A Student Guide*, Pearson Education
- "Original investigation undertaken in order to gain knowledge and understanding"
  Higher Education Funding Council for England 1998

Implications of the above definitions

- Innovation

  Vital if a discipline is to grow and prosper

- Contribution

  Providing new data; suggesting an answer to a specific question; testing or refining an existing hypothesis, theory or methodology; proposing a new idea, hypothesis, theory or methodology

- Process

  Procedures follow a certain logical sequence (systematic); are relevant, appropriate and justified (rigorous);
  Conclusions are correct and can be verified by others (valid and verifiable); based upon hard evidence gathered from information collected from real-life experiences or observations (empirical)
  Must be able to withstand critical scrutiny

Classification of Research

Research can be classified from three perspectives:

Application of the findings of research study;

Objectives in undertaking the research;

Inquiry mode employed.

Not mutually exclusive

Research from the Viewpoint of Application

Applied Research to understand a phenomenon/issue or to bring change in a program/situation

Pure Research is academic in nature with no application in the near future

Research from the Viewpoint of Objectives

Descriptive Research to describe a situation, phenomenon, problem or issue

Correlational Research to establish or explore relationships between two or more variables

Explanatory Research to explain why certain things happen the way they do

Exploratory Research to examine the feasibility of conducting a study or exploring a subject area where nothing or little is known

Research from the Viewpoint of Mode of Inquiry

Qualitative Research to describe the variation in a phenomenon, situation or attitude

Quantitative Research in addition quantify the variation

Mixed approach uses the best of both qualitative and quantitative research methods

Forms of Research

- Different ways in which the world and human behaviour is viewed and understood
- Different forms of research
  - Positivism: Based on positive facts and observable phenomena
    - "hard science"
  - Phenomenalism: Description and classification of phenomena (the science of interpretation)
    - "humanistic disciplines"
- It is rare for any research project to rely exclusively on one form or the other

Positivism - Scientific Method - Quantitative

- Research has its historical origins in science
- Most research methodology in natural and social sciences subscribes the '**scientific method**'
- Based on empirical observations and experiments
- Research adopting the scientific method is described as **positivistic** (also empirical research)
- Positivistic research frequently draws upon measurable evidence: **quantitative**

Scientific Method

- A primary goal is not only description but prediction and explanation
- Initial investigation may lead to "laws"
- Laws should always be regarded as tentative
- They may be changed or discarded as result of subsequent investigation
  - Movement of planets was first based upon a circle, then as epicycles on that circle, then as an ellipse around the sun

Assumptions of the Scientific Method

Order Events occur in an orderly, systematic way, following some logical sequence

- If not, futile to attempt to theorize about casuality or make predictions regarding events

Determinism All events must have a cause

- For every event there are preceding events or causes, although they may not be readily apparent

Discoverability Each step in the causal chain can be traced or discovered

- Fundamental belief: Given enough resources (knowledge, skill, technology, time, money) the answers could be discovered

The Basic Elements of the Scientific Method

1. **Observation**: Certain events, called variables, tend to occur together - seem to be related in some way
2. **Hypothesis**: The scientist makes a prediction or formulates a hypothesis
3. **Testing the hypothesis**: The hypothesis formulated must be testable - research study
4. **Data**: Empirical evidence gathered through *scientific observation:* Objective and measurable, Public, Repeatable
5. **Analysis**: Data gathered trough scientific observation is analysed
6. **Drawing Conclusions**: Hypothesis is supported or refuted
7. **Generation of additional or new hypothesis**

Phenomenalism - Naturalistic - Qualitative - Hermeneutics

- Each and every phenomenon is unique
- This uniqueness is its most important quality
- No two situations, by definition, can be identical
- Cannot be the basis for generalization
- Does not rely on the acceptance of the assumptions described before: order and determinism
- This research position is referred to as **phenomenological** (also conceptual research)
- Other terms are also used: **Naturalistic, Qualitative, Hermeneutics**

The Basic Elements of Phenomenological Research

- Accepts that all situations are problematic to some degree
- The nature of the problems is revealed by examining the situation
- Such research is not preceded by the formulation of research questions
- However, anticipates that questions will arise during the period of enquiry
- Takes the form of an argument and aims to define and clarify concepts, to interpret or reinterpret ideas, etc.
- It is essentially inter-subjective on the part of the researcher: Two researchers may interpret the same event differently (both equally valid)
- Outcomes are invariable qualitative descriptions or interpretations in the form of narrative

Conclusions

- Research projects characterized by a main or principal methodology
- However, most utilise aspects of several methodologies
- Two main methodologies:
  - Positivism - Scientific, Quantitative method
  - Phenomenalism - Naturalistic, Qualitative method

Further Reading


Gavin J. Fairbairn and Christopher Winch.
Reading, Writing and Reasoning: A Guide for Students.
The Society for Research into Higer Education and Open University Press, 1996.


Bill. Gillham.
Case Study Research Methods
Continuum, 2000.


Christian W. Dawson.
The Esence of Computing Projects: A Student's Guide
Prentice Hall, 2000.


Andrea V. Spata
Research Methods: Science and Diversity
John Wiley & Sons, Inc., 2003