Plan Overview

A Data Management Plan created using DMPonline

Title: From semigroups to simple groups

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Template: EPSRC Data Management Plan Customised By: University of Manchester

Project abstract:

One of the oldest and most fruitful fields in mathematics is group theory. Group theory is the study of symmetry, a ubiquitous concept that describes a variety of situations. Symmetry is widely known to be aesthetically pleasing, so group theory has appeared in art, architecture, and the study of aesthetics since the formulation of group theory. It also has a much less visible, but arguably more significant impact on our everyday life. In the last 200 years, applications of group theory have featured heavily behind the scenes of scientific innovation. Internet security, quantum physics, vibrational spectroscopy, and virus classification would not be possible without mathematicians' deep insight into how symmetry works.

The basic object of study is a group, an abstract structure that describes the symmetry of an object in terms of abstract algebra. Mathematicians are particularly interested in simple groups; the fundamental building blocks from which other groups are built. We understand finite simple groups well. They were classified in 2006, an achievement akin to obtaining a periodic table of finite groups.

The next natural step would be to try to understand infinite simple groups. Infinite groups arise in nature too. For example, crystals have a fascinating symmetrical structure which is used to identify them, by breaking down these infinite groups into finite simple parts. These sorts of ideas also form the basis of internet security.

However, understanding infinite simple groups has proven to be an extremely difficult task. A major obstacle is that infinite simple groups with “finiteness” regularities such as finite generation are difficult to construct. We know they exist, but it has been difficult to find new examples, which in turn makes it near-impossible to form new theories.

The good news is that this difficulty is starting to ease. A new way to generate examples arose in 2009, with a highly influential paper from Prof. Hiroki Matui of Chiba University. He was able to show that when you have a group-like object called a group*oid*, you can use it to build a new example of an infinite simple group. This framework has been highly successful in

aiding our understanding of infinite simple groups. These significant new examples have helped mathematicians to formulate interesting theoretical questions and answer long-standing questions.

My research proposal is to use this framework to generate more examples that have not been considered before. This would help us prove the existence of new types of symmetries which we have not seen before. Studying these will inform new theories, paving the way for scientists to understand concrete questions that affect our everyday life.

More specifically, the examples that have not yet been considered are the groupoids that come from *semi*groups. *Semi*groups are a generalisation of groups, which capture partial symmetries, for example, the symmetries of fractals.

The various recipes that allow us to turn *semi*groups into group*oids* are well understood. However, it has not yet been studied what the associated classes of *infinite simple groups* are, and this is the pertinent question that this project addresses. To take *semi*groups and turn them into *infinite simple groups* we are sure to find new kinds of symmetry that we have not seen before.

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From semigroups to simple groups

Manchester Data Management Outline

1. Will this project be reviewed by any of the following bodies (please select all that apply)?

- None of the above

2. Is The University of Manchester collaborating with other institutions on this project?

- No – only institution involved

3. What data will you use in this project (please select all that apply)?

- Re-use existing data (please list below)

4. Where will the data be stored and backed-up during the project lifetime?

- University of Manchester Research Data Storage Service (Isilon)

5. If you will be using Research Data Storage, how much storage will you require?

- < 1 TB

6. Are you going to be receiving data from, or sharing data with an external third party?

- No

7. How long do you intend to keep your data for after the end of your project (in years)?

- 5 - 10 years

Guidance for questions 8 to 13

Highly restricted information defined in the Information security classification, ownership and secure information handling SOP is information that requires enhanced security as unauthorised disclosure could cause significant harm to individuals or to the University and its ambitions in respect of its purpose, vision and values. This could be: information that is subject to export controls; valuable intellectual property; security sensitive material or research in key industrial fields at particular risk of being targeted by foreign states. See more examples of highly restricted information .

If you are using 'Very Sensitive' information as defined by the Information Security Classification, Ownerships and Secure Information Handling SOP, please consult the Information Governance Office for guidance.

Personal information, also known as personal data, relates to identifiable living individuals. Personal data is classed as special category personal data if it includes any of the following types of information about an identifiable living individual: racial or ethnic origin; political opinions; religious or similar philosophical beliefs; trade union membership; genetic data; biometric data; health data; sexual life; sexual orientation.

Please note that in line with data protection law (the UK General Data Protection Regulation and Data Protection Act 2018), personal information should only be stored in an identifiable form for as long as is necessary for the project; it should be pseudonymised (partially de-identified) and/or anonymised (completely de—identified) as soon as practically possible. You must obtain the appropriate ethical approval in order to use identifiable personal data.

8. What type of information will you be processing (please select all that apply)?

- No confidential or personal data

9. How do you plan to store, protect and ensure confidentiality of any highly restricted data or personal data (please select all that apply)?

- Not applicable

10. If you are storing personal information (including contact details) will you need to keep it beyond the end of the project?

- Not applicable

11. Will the participants' information (personal and/or sensitive) be shared with or accessed by anyone outside of the University of Manchester?

- Not applicable

12. If you will be sharing personal information outside of the University of Manchester will the individual or organisation you are sharing with be outside the EEA?

- Not applicable

13. Are you planning to use the personal information for future purposes such as research?

- No

14. Will this project use innovative technologies to collect or process data?

- No

15. Who will act as the data custodian for this study, and so be responsible for the information involved?

Owen Tanner

16. Please provide the date on which this plan was last reviewed (dd/mm/yyyy).

2023-08-16

Data Collection

What data will you collect or create?

I will not collect or create data

How will the data be collected or created?

N/A

Documentation and Metadata

What documentation and metadata will accompany the data?

N/A

Ethics and Legal Compliance

How will you manage any ethical issues?

I do not anticipate any ethical issues.

How will you manage copyright and Intellectual Property Rights (IPR) issues?

I will be private about what I am working on.

Storage and Backup

How will the data be stored and backed up during the research?

On the cloud.

How will you manage access and security?

Secure passwords, VPNs.

Selection and Preservation

Which data are of long-term value and should be retained, shared, and/or preserved?

N/A

What is the long-term preservation plan for the dataset?

N/A

Data Sharing

How will you share the data?

My research, once ready, will be published in a peer-reviewed Journal.

Are any restrictions on data sharing required?

No.

Responsibilities and Resources

Who will be responsible for data management?

Owen Tanner

What resources will you require to deliver your plan?

No additional resources.