Being a Computational Social Scientist

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UK Data Service Webinar
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New Forms of Data Training Series

Upcoming webinars:

- Introduction to Text-Mining (02 June 2020)
- Text-Mining: Basic Processes (16 June 2020)
- Text-Mining: Advanced Options (29 June 2020)

Upcoming coding demonstrations:

- Collecting data I: web-scraping (13 May 2020)
- Collecting data II: APIs (20 May 2020)

Past webinars:

- Web-scraping for Social Science Research: APIs as a Source of Data
- Web-scraping for Social Science Research: Websites as a Source of Data

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What is computational social science?

Isn't most social science already dependent on/supported by computers?

Computational social science takes us beyond traditional activities due to:

- Big data
- Writing code
- Applying analytical methods from other disciplines

More formally, *computational social science* is an interdisciplinary branch of research, defined more by its methods and data than its substantive topics (Heiberger & Riebling, 2016).

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Why be a computational social scientist?

Computational social science is an opportunity.

Provides methodologies and tools for working with data (Halford & Savage, 2017):

- Process and analyse large-scale, unstructured data (e.g., text corpora)
- Capture data generated/published in real-time (e.g., smart home sensors)
- Access information on new/previously unmeasured activities (e.g., online-only behaviours)
- Access information on familiar/currently measured activities at an unprecedented scale, dynamism or complexity (e.g., social networks)
- Empirical social science is having its moment in the sun (move over social theorists…)

How do you be a computational social scientist?

Firstly, be a social scientist!

Social scientists possess knowledge - theoretical and empirical - of social systems and phenomena, and already have advanced data skills, especially around:

- Categorising and coding responses (qualitative and/or quantitative)
- Evaluating data quality (e.g., why is this survey response missing?)
- Making inferences from data (e.g., how representative is this pattern?)

It’s just the computational side you need to develop!

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How do you be a computational social scientist?

There is a lot to it, but *computational social science* typically involves the following practices:

- Writing programming scripts to collect and manipulate data.
- Employing analytical techniques - many derived from computer/information sciences - to reveal patterns in data.
- Using technological tools and e-Research best practice to structure and document your research workflow.

Focus on the skills and knowledge needed, or our *Big Five for Computational Social Science.*

Big Five for Computational Social Science

1. **Thinking computationally**
2. **Writing code**
3. **Knowing your computational environment**
4. **Understanding and manipulating data**
5. **Documenting and enhancing your workflow**

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Big 5 of CSS: #1

Thinking computationally

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What are human problems?

- Staying alive
  - Responding to danger
  - Curiosity about the unknown
  - Recognising patterns

Sub-rational thinking is just thinking...

What else are human problems?

- Other people
  - Understanding intentions
  - Predicting likely responses
  - Collaboration and/or competition

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Human thinking about human problems?

- Working memory capacity according to Kimberg, 1997 :
  - Limited focus (perhaps only one item)
  - Complexity matters
  - Different capacity for structured vs. unstructured
  - Chunking (and others) as a work-around strategy
- Bounded rationality according to Simon, 1997:
  - Satisficing
  - Heuristics

Human thinking about human problems?

- Communication assumptions according to Pinker, 2003 :
  - Speaker and listener interpret the same way
  - Objects and actions as distinct
  - Mid-level categories, but with knowledge of hierarchies
  - Transitive properties
- 2 types of thinking according to Kahneman, 2011:
  - Fast, error-prone, intuition-based
  - Slow, (more) accurate, rationality-based

Computer thinking for human problems…

- Especially human problems that humans are not good at:
  - More working memory needed (high volume or complexity)
  - Best option more important than speed
  - Reciprocal communication not assumed

Example problem =

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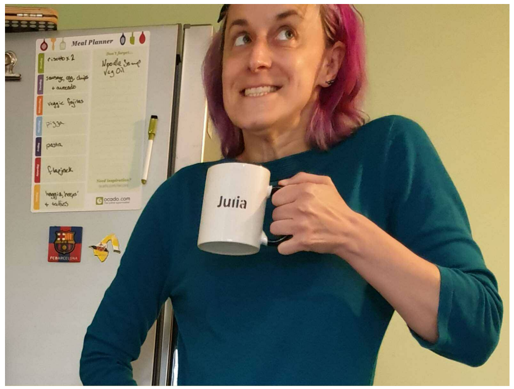
A human tries to tell a human how to make a cup of tea.

- Human 1 says:
  - Put the kettle on, put a tea bag in a mug.
- Human 1 says:
  - Pour just boiled water into the mug.
- Human 1 says:
  - Remove tea bag, add a splash of milk
- Human 1 says:
  - Enjoy!



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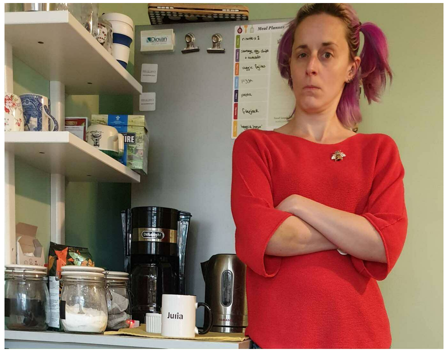
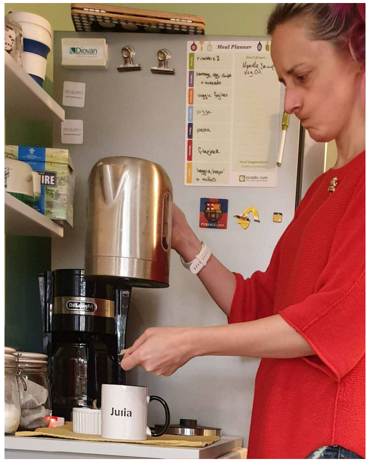
A human tries to tell a computer how to make a cup of tea.



- Human 1 says:
  - Put the kettle on, put a tea bag in a mug.
- Human 1 says:
  - Right. There is an electric kettle right there. That is the kettle. And that, right there, is the mug. And that, right there, is the tea bag. OK?!?
- Human 1 says:
  - Put the kettle on, put the tea bag in the mug.
- Human 1 says:
  - Gah! Put the kettle on its base, turn it on.



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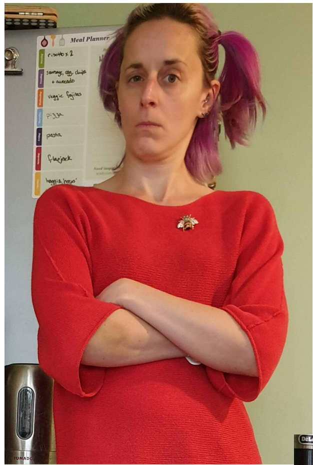
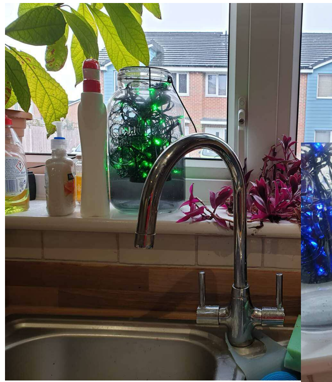
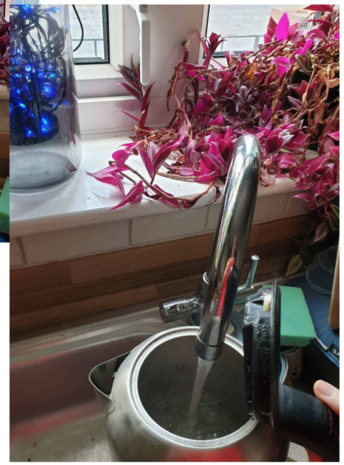
A human tries to tell a computer how to make a cup of tea.

- Human 1 says:
  - Put 250 ml of water in the kettle. Return it to its base. Turn it on.
- Human 1 says:
  - There is a tap. Put 250 ml of water from the tap into the kettle. Return kettle to its base. Turn it on.
- Human 1 says:
  - Put one tea bag into a mug.
- Human 1 says:
  - When the kettle indicates the boil cycle has finished, pour water into the mug.
- Human 1 says:
  - Gah! Start again, but pour water from the kettle into the mug.







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Humans and computers... Different.

Humans	Vs.	Computers
Abstract concepts		Concrete definitions
Inference		Defined terms/rules only
Shared/background knowledge		Nothing carried over from other scopes
Fuzzy categories		Strict categories
Context-dependence		Absolutes
Expertise accumulated over time		Equations, formuae, mathematical models
Citation lists		Charts, graphs, visualisations
Mental models		Detailed methods sections
Debates and discussions		Data sets, code repositories, etc.

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Some problems need both…

- Human thinking needed to identify the problem, possible solutions, relevant info, etc.
- Computer thinking needed to work accurately and reproducibly with large volumes of (complex) data.

- More mixed problems arise as
  - Resources become digital
  - Social media/Internet of Things/etc. grows more prevalent
  - Real-time data becomes available
  - Etc.

Computational Social Science example

- Travel to Work – before and after pandemic lockdown
  - Research questions like “How does lockdown change work commutes?
    - Right now?
    - In 3 months? 6 months?
    - A year? 3 years?
  - Knowledge of resources
    - UK Data Service census data (including 2011 travel to work data, household composition, etc.)
    - GIS data (maps, transport systems, etc.)
    - Apple and/or google maps open data
    - Upcoming 2021 census
  - Acquire data
  - Work with data
  - Compare complex patterns of behaviour derived from large volumes of data with spatial and temporal structure
  - Communicate results

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Big 5 of CSS: #2, #3, and #4

Writing code

Knowing your computational environment

Understanding and manipulating data

Big 5 of CSS: #5

Documenting and enhancing your workflow

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Documenting your workflow

Increasingly, people in the scientific community are demanding greater transparency and reproducibility of research. Put simply:

"*Reproducible research is necessary to ensure that scientific work can be trusted*." (The Turing Way Community, 2019)

Reproducibility can be summarised as the availability of data and code to fully rerun an analysis.

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Documenting your workflow

Reproducible: the same analysis steps performed on the same dataset consistently produces the same answer.

Replicable: the same analysis performed on different datasets produces qualitatively similar answers.

Robust: the same dataset is subjected to different analysis workflows to answer the same research question and a qualitatively similar or identical answer is produced.

Generalisable: Combining replicable and robust findings allow us to form generalisable results. (The Turing Way Community, 2019)

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Documenting your workflow

Five Simple New Rules of the Sociological Method (Gayle, 2017):

1. **Tell us about your software.**
2. **Tells us about your data.**
3. **Show us how you got your data ready.**
4. **Show us all the analysis you did.**
5. **Save all of this work openly.**

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Enhancing your workflow

There are a growing number of technological tools and approaches for supporting your workflow:

- **Writing code** – Jupyter notebooks + a programming language (Python, R, Julia)
- **Knowing your computational environment** – Anaconda distribution of Python; `conda` and `pip` package management tools; Binder
- **Understanding and manipulating data** – open data, open-source packages (`pandas` in Python, `tidyverse` in R)
- **Documenting and enhancing your workflow** – Jupyter notebooks, Github

Summary and links to further reading

- Bibliography

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Questions

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Further resources and help

Repository: https://github.com/UKDataServiceOpen/new-forms-of-data

Youtube: https://www.youtube.com/user/UKDATASERVICE

Help: ukdataservice.ac.uk/help/

Subscribe to UK Data Service news at https://www.jiscmail.ac.uk

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