Interfacing R with Web Technologies for Data Acquistion and Interactive Visualization

by

Carson Sievert

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DOCTOR OF PHILOSOPHY

Major: Statistics

Program of Study Committee:

Heike Hofmann, Major Professor

Di Cook

Jarad Niemi

Ulrike Genschel

Gray Calhoun

Iowa State University

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Thank you to all my collaborators, especially Toby Dylan Hocking. Toby and Susan Van-

derPlas laid the initial framework for **animint** – which I first worked on as a Google Summer of Code student under Toby's guidance. Toby later went on write the initial version of the `ggplotly()` function in **plotly**, borrowing a lot of ideas from **animint**. As Toby became busy with other things, he introduced me to the plotly team, and eventually handed over the reigns on the project, which has helped to financially support the last year or so of grad school.

Thank you also to the plotly team, and in particular, the software engineers who work on the open source project plotly.js. My work has benefited greatly from your responsiveness to my questions, feature requests, and bug reports. I have a great amount of respect for the work that you do, and I hope this project keeps improving at its current break neck pace.

Finally, thank you to my family for their encouragement and keeping me grounded throughout this experience. Thank you to my father for the initial encouragement to pursue a PhD, conversations surrounding work-life balance, and also pushing me to "graduate before I'm 40". Thank you to my mother for her unconditional love, endless care, and predenting to understand what I do for a living. Thank you to my brothers for providing me with shelter, beer, and Twins tickets. Thank you all for your willingness to drop everything to help me at any given moment. I can't say I've done the same, as I have been selfish with my time in pursuing a PhD, but I hope to change that after graduation.

ABSTRACT

The following describes a collection of software interfaces for data acquisiton and visualization. All of these interfaces are freely available as extension packages to the R language and leverage web technologies to achieve accessible, portable, and reproducible workflows. The majority of this work (LDAvis, animint, and plotly) focuses on interactive visualization. These interfaces fall roughly into two categories: (1) domain-specific (LDAvis) and (2) general purpose tools for interactive data visualization (animint and plotly). More specifially, the LDAvis package produces an interactive visualization to aid interpretation of Latent Dirichlet Allocation (LDA) model output. The animint and plotly packages are more general, and build upon principles from the grammar of graphics, but extend those principles in slightly different ways to enable interactivity, such as animation and brushing a scatterplot matrix.

CHAPTER 1. OVERVIEW

This is the opening paragraph to my thesis which explains in general terms the concepts and hypothesis which will be used in my thesis.

With more general information given here than really necessary.

1.1 Introduction

Here initial concepts and conditions are explained and several hypothesis are mentioned in brief.

1.1.1 Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

1.1.1.1 Parts of the hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

1.1.2 Second Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

1.1.2.1 Parts of the second hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

1.2 Criteria Review

Here certain criteria are explained thus eventually leading to a foregone conclusion.

CHAPTER 2. REVIEW OF LITERATURE

This is the opening paragraph to my thesis which explains in general terms the concepts and hypothesis which will be used in my thesis.

With more general information given here than really necessary.

2.1 Introduction

Here initial concepts and conditions are explained and several hypothesis are mentioned in brief.

Allen (1984), Bruner (1960) and Cox (1974) did the initial work in this area. But in Struss' work [Struss (1996)] the definitive model is seen.

2.1.1 Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

2.1.1.1 Parts of the hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

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2.1.2.1 Parts of the second hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

2.2 Criteria Review

Here certain criteria are explained thus eventually leading to a foregone conclusion.

CHAPTER 3. METHODS AND PROCEDURES

This is the opening paragraph to my thesis which explains in general terms the concepts and hypothesis which will be used in my thesis.

With more general information given here than really necessary.

3.1 Introduction

Here initial concepts and conditions are explained and several hypothesis are mentioned in brief.

As can be seen in Table 3.1 it is truly obvious what I am saying is true.

Table 3.1 This table shows a standard empty table

3.1.1 Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

This can also be seen in Figure 3.1 that the rest is obvious.

Figure 3.1 This table shows a standard empty figure

3.1.1.1 Parts of the hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

3.1.2 Second Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

3.1.2.1 Parts of the second hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

3.2 Criteria Review

Here certain criteria are explained thus eventually leading to a foregone conclusion as can be seen in Table 3.2.

Table 3.2 This table shows a standard empty table with a limited captionwidth

CHAPTER 4. RESULTS

This is the opening paragraph to my thesis which explains in general terms the concepts and hypothesis which will be used in my thesis.

With more general information given here than really necessary.

4.1 Introduction

Here initial concepts and conditions are explained and several hypothesis are mentioned in brief.

Of course, data on this as seen in Table 4.1 is few and far between.

Table 4.1 Moon Data

Element	Control	Experimental
Moon Rings	1.23	3.38
Moon Tides	2.26	3.12
Moon Walk	3.33	9.29

4.1.1 Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

Or graphically as seen in Figure 4.1 it is certain that my hypothesis is true.

4.1.1.1 Parts of the hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

Figure 4.1 Durham Centre

4.1.2 Second Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

4.1.2.1 Parts of the second hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

4.2 Criteria Review

Here certain criteria are explained thus eventually leading to a foregone conclusion.

CHAPTER 5. SUMMARY AND DISCUSSION

This is the opening paragraph to my thesis which explains in general terms the concepts and hypothesis which will be used in my thesis.

With more general information given here than really necessary.

5.1 Introduction

Here initial concepts and conditions are explained and several hypothesis are mentioned in brief.

Or graphically as seen in Figure 5.1 it is certain that my hypothesis is true.

5.1.1 Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

As can be seen in Table 5.1 it is truly obvious what I am saying is true.

5.1.1.1 Parts of the hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

5.1.2 Second Hypothesis

Here one particular hypothesis is explained in depth and is examined in the light of current literature.

Table 5.1 This table shows almost nothing but is a sideways table and takes up a whole page by itself

Element	**Control**	**Experimental**
Moon Rings	1.23	3.38
Moon Tides	2.26	3.12
Moon Walk	3.33	9.29

5.1.2.1 Parts of the second hypothesis

Here one particular part of the hypothesis that is currently being explained is examined and particular elements of that part are given careful scrutiny.

5.2 Criteria Review

Here certain criteria are explained thus eventually leading to a foregone conclusion.

Figure 5.1 Durham Centre— Another View

APPENDIX A. ADDITIONAL MATERIAL

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More stuff

Supplemental material.

APPENDIX B. STATISTICAL RESULTS

This is now the same as any other chapter except that all sectioning levels below the chapter level must begin with the *-form of a sectioning command.

Supplemental Statistics

More stuff.

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