Meeting Client Needs while Maintaining Spatial Integrity:   
A Spatial Project on Digitalization in Farming

*Abstract*

Describe the spatial problem and its context, explain the theoretical underpinnings of your proposed solution,  implementation, and results from your final project and illustrate them with figures or other outputs – suggested format follows. Script or software developed as part of the project, which reproduces the project, should be deposited on Github and referenced in text. Do not list code in text unless it is notable, essential to report, or markedly different from material covered in class.

*Author*

Mia Thuge Kuntz – 202006657

*Keywords*

XXX

*GitHub*

The data and script for my project can be found in the following GitHub repository:

<https://github.com/MiaKuntz/spatial_final_proj.git>

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* OPDATER METHODS
* 4-6 SIDER

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# 1. Introduction 0,5 side

When working in any type of specialised field, catering to client needs is always of the utmost importance. However, meeting these requirements can sometimes be a challenge for specialists, as this may compromise their expertise and understanding of standard practice versus what is specifically requested by the client. The paper seeks to explore a project conducted by researchers at Aarhus University, that focused on the growing development and interest in digitalization in farming and the adoption of digitalized agricultural practices, also known as smarter farming.

While the main aim of this paper is to highlight the workflow of this project, it also aims to offer insight into some of the decisions and compromises faced by a spatial analyst throughout the process. Both the client’s project and this paper seek to work with spatial data to be able to generate maps visualising the different countries appearing in the collection of articles. Furthermore, this paper examines the methods employed and evaluates the results based on their ability to meet the client’s requirements while maintaining spatial integrity.

# 2. Problems and background 1,5 side

IF I NEED MORE TEXT

* The ethics of spatial analytics and how the field of work is changing
  + Money versus integrity
  + Progress of spatial tools, and how todays software’s enable more spatial work to be done by “non spatial specialist”

## 2.1 Smarter farming project

In recent years, a significant increase in studies and research focused on smart farming technologies has occurred. With the introduction of the fourth industrial revolution (Industry 4.0) and Agriculture 4.0 in the 2010s, a revolution in the technologies available to farmers has taken place, with growing opportunities in growing efficiency and sustainability (https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9122412&casa\_token=QMGhG\_rvukkAAAAA:F4OdglZ83Bu4FKd8lWfZVp4iBn60BIvWP7gs\_SBkQNf5DIPFmsnLX57VbzL24vvbLsWA7-u9Cgsy&tag=1). Achieving this is made possible by adopting new emerging technologies such as precision tools and crop robots, but in order to do so farmers as well as other interested parties need to understand what factors influence why some farmers adopt these technologies and why some don’t.

A study conducted by researchers at Aarhus University in the spring of 2023 sought to recognize these factors, both by looking at previous research done in the field as well as using the obtained knowledge to prepare for their own study to be done in the fall of 2023. The client responsible for this project required a spatial analyst to collect and visualise the data required, and I was approached due to earlier collaboration with the client, who was aware of my acquired spatial skills. The client required a number of articles concerning research in smart farming technologies and adoption (for a more detailed description of the data collected, please see section 3.2) to be collected, and then an interactive map that depicts where previous research on the subject was done while being easy for people with no previous knowledge of the subject or spatial theory to understand to be generated. That implied that the map I had to generate didn’t necessarily need to adhere to standard spatial practices, as long as it lived up to these specifications. And yet, I set out to create maps that would both adhere to the client and their vision, as well as implement elements which are key to any map.

* The different types of maps, and how and why some maps (like cartograms) are preferred over others (like leaflet)
  + Explain the Mercator projection and other relevant theories that impact these issues
  + Explain the pros and cons for the different types of maps mentioned
    - How people who are not into spatial analytics might see the maps compared to a spatial analyst and how these differences can be okay depending on audience

# 3. Methods 1 side

## 3.1 Hardware and prerequisites

The code written for this project was done locally on a five year old 13-inch MacBook Pro (2017), which has 8 GB RAM and the macOS Ventura (version 13.3.1 a) operating system. It was developed and run in the desktop version of R (4.2.2) and RStudio (2023.03.1 Build 446).

The code was done in an R Markdown file, as the opportunity for knitting to an HTML file was needed for client needs, as this makes for easier viewing of results. To run the code, please clone the repository to your own device and ensure that you have both the desktop version of R and RStudio installed.

* Packages and libraries

## 3.2 Data

The repository includes a “data” folder that contains “articles.xlsx” and “countries.geojson” files (REFERENCE?). The “articles.xlsx” file is included in the “data” folder for offline work should that be needed. The code will pull the data from an online Google Spreadsheet, and a link will be provided here as well as in the code:  
INSERT LINK

The collection of articles was a collaborative effort with researchers at Aarhus University and will be updated even after the hand-in of this project. Please be aware that this may affect the outcome of the code should it be run after the hand-in date. The criteria for which articles should be included in the file were made in collaboration with the client. Different search words were defined, with the primary being “digital”, “farm\*”, “study”, and “survey”, and the search was primarily done on literary databases such as scopus.com, library.au.dk and sciencedirect.com. Since not all articles found via these portals and with these search words met the client’s requirements, a manual review through all considered articles for the file was done before those that met the criteria were added to the file.

After adding the articles to the file, their information was divided into 9 different columns based once again on client needs:

|  |  |
| --- | --- |
| **Column name** | **Description** |
| Author | The author(s) of the article |
| Year | The year the article was published |
| Title | The title of the article |
| Journal | The literary journal that published the article |
| Abstract | A short abstract of the article |
| Keywords | A number of keywords to describe the articles |
| Country | The country of origin of the article |
| Questionnaire/Interview | A binary variable for whether or not the article has a questionnaire or interview included in its study |
| URL | The URL of the article |

The “countries.geojson” file was pulled from an online GitHub repository (REFERENCE?). The GeoJSON file contains polygons for all the worlds countries, and is essential for visualising the “articles” data, as the client request was to show the country of origin of all articles in an appropriate manner. Polygons are a type of vector data that connects several lines to shape the area of the data (https://mgimond.github.io/Spatial/chp02\_0.html). That the “countries” file is a Multipolygon means that it contains several polygons which contains the area of several entities – In this case the countries of the world. The data uses the WGS84 geodetic CRS, which is quite common when working with maps on a global scale, exactly as this project does (https://mgimond.github.io/Spatial/chp09\_0.html).

The file contains three columns:

|  |  |
| --- | --- |
| **Column name** | **Description** |
| ADMIN | The common name of the country |
| ISO\_A3 | A three letter ISO code for the country |
| geometry | Multipolygon geometry of the country |

The main issue with pulling a GeoJSON file from another source was that I had to make sure that there was equivalence between the country names of this file and the “articles” file. Luckily, no issues in regards to country names not coinciding appeared when developing and running the code.

## 3.3 Maps

* Spatial methods
  + Maps, statistics etc…

# 4. Empirical Results 1 side

* Provide and explain the results of your investigation, illustrated with figures where essential and relevant. Relate to lessons learnt, counts, statistics, maps or other outcomes (product of your script ~slides, map, outline, timeline…)
* Briefly comment on 1) the main elements of your digital workflow, highlighting challenges and decision-making bottlenecks (e.g. how did you transform point data to make it into a continuous surface?) 2) functions/tricks you found useful and wish to promote or credit. Remember that the technical tasks should not clutter/interfere with your overall narrative and data analysis (unless your project is about developing a technical pipeline)
* Describe here the script(s) and what happens in them:

# 5. Critical evaluation 1 side

* Evaluate the results in light of the data sources and research premises/assumptions. How representative, reliable, complete and precise are your results? How transferable or generalizable? And briefly evaluate the results in light of digital tools, the learning process, time on task, vis-à-vis the final product
  + Discuss how the JSON file divided the countries and current issues with this (polygons of countries)
    - Territory disputes etc
  + Discuss the difference between static versus interactive maps, and how the static map may be viewed as the most “correct”
    - The Mercator projection happens when using leaflet and can therefore obscure ones view of the results of the map, since some countries appear bigger, and therefore maybe more important(?), than what they really are
    - Compare this to countries of equal size when using tiled map
  + What where the client’s needs? Comment on how a spatial analyst sometimes has to compromise on their knowledge of what is “the best” compared to what is asked and paid for
    - Discuss how this might sometimes be okay depending on need and audience and refer to the development the spatial field has gone through, and how it has made the tools used before only by spatial analyst’s accessible to more people

# 6. Conclusions 0,5 side

* Set out the conclusion of the project, summarize the achieved goals and highlight the most important lessons learnt while working on the project.

# \*Acknowledgements

* Optionally thank people and institutes you need to acknowledge

# References

* At least 5 are required, both domain-based literature as well as references to digital tutorials or internet resources consulted.

Websites/sources:

* <https://github.com/datasets/geo-countries>

# Required Metadata

Please fill in the right column column with the correct information about your digital resources, and leave the left columns as they are

## Table 1 – Software metadata

|  |  |  |
| --- | --- | --- |
| **Nr** | **Software metadata description** | ***Please fill in this column*** |
| S1 | Current software version | *for example R 4.0.3, RStudio 1.1.24c.* |
| S2 | Permanent link to your code in your Github repository | *example : https://github.com/combogenomics/DuctApe/releases/tag/DuctApe-0.16.4* |
| S3 | Legal Software License | *List the license for your code, e.g. Creative Commons 4.0;* |
| S4 | Computing platform / Operating System | *for example Linux 18.04, OS X, Microsoft Windows 10,...* |
| S5 | Installation requirements & dependencies for software not used in class | *XXX* |
| S6 | If available Link to software documentation for special software | *Example http://mozart.github.io/documentation/* |
| S6 | Support email for questions |  |

## Table 2 – Data metadata

|  |  |  |
| --- | --- | --- |
| **Nr** | **Metadata description** | ***Please fill in this column (you can link to license and metadata descriptions online;  where relevant remember to articulate data provenance and quality)*** |
| D1 | Data License | *List the license for your own data, and communicate the license of other used datasets* |
| D2 | Dataset name: *Geochem\_dk.grid* | *SpatialRaster layer, resolution 30x30m, attributes:  ID"   "Elev" "pH"   generated by KU Dept of Geochemistry, 2020 interpolated from 5x5km grid sampling, source: www.xxxx.dk* |