

Lateral Computation

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Abstract

The presence of computer networks and the associated algorithms rises daily. Filter systems on the internet offer less and less room for unexpected, yet refreshing, encounters. As most of the existing systems aim for precision and personalization of these filters, there are little applications that address the aspect mentioned above. *Lateral Computation* explores the potential of enforcing serendipity in knowledge retrieval systems by making use of alternative computation. The experiments implemented within this project have been utilized to analyze users behavior and the very nature of serendipitous confrontations. This thesis proposes different approaches to deal with the issue at hand as well as one final website, being the practical outcome of previous testings and experiences.

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Introduction

Lateral Computation deals with the phenomena and thereby caused problems of algorithms, or more specifically, the methods used within the filtration of content. Digital programs and computer networks are omnipresent in the current era. Internet technology has brought great benefit, from communication to the organization of knowledge. Instant queries to databases offer precise responses, tailored to the input. It is the rapid advancement of internet speeds, the rising capacity of storage mediums and the efficiency of databases, that has made all this possible. However, the key component within the process of a search engine, for instance, is its underlying program and the methodology.

"It's about our relationship with the algorithms that are already here, the ones working alongside us, amplifying our abilities, correcting our mistakes, solving our problems and creating new ones along the way."
(Fry, 2018, p. 14)

Eli Pariser introduced the term Filter Bubble within his eponymous book in 2012. He describes a variety of effects which these algorithms and trained machine-learning models induce on the human brain and mankind in general. He ranges from social networks to online shopping, often mentioning the effects of personalized filtering (Pariser, 2012). However, this thesis deals with the algorithms used in search queries, or more specifically within knowledge retrieval systems.

Digital encyclopedias, such as Wikipedia, for instance, are driven towards precision. Querying a term, to which an article of the same name exists, will continuously result in viewing this specific article. Searching for *violin* always results in seeing the article about the instrument named *Violin*. Now, in most of the scenarios, this is the desired outcome. Users seek help on the net to receive these precise and correct answers, yet with the

rise in the accuracy of these search engines, it has become nearly impossible to be surprised. There is less and less room for purely inspiring and more serendipitous encounters. Creativity has become the exception.

"Es ist der Flâneur, der als kultureller Weltenbummler diesem Ernst Leichtigkeit verleiht. Lustvoll findet er, was er nicht gesucht hat, und bezeugt gerade darin seine Freiheit." [Translation by the author: *It is the Flâneur who, as a cultural globetrotter, lends lightness to this seriousness. He pleasurably finds what he has not sought, and it is precisely in this that he testifies to his freedom.*]
(Goldstein, 2017, p. 10)

The so-called *Flâneur* builds a contrasting analogy to these digital examples. He wanders without a clear purpose and seeks the unknown. While the lifestyle of continually experiencing the unexpected may not suit everybody, it is pleasant to everyone, to be surprised. German professor Jürgen Goldstein uses the *Flâneur* in correlation to a cabinet of curiosities, which were presented with the purpose of astonishing and served not only education but the spectacle (Goldstein, 2017).

"Die kartographierte Erlebniswelt lässt immer weniger Überraschungen zu. Aufgrund der Monokultur der eigenen Erwartungen findet niemand mehr, was er nicht gesucht hat." [Translation by the author: *The mapped world of experience allows fewer and fewer surprises. Due to the monoculture of one's expectations, nobody finds what they were not looking for.*]
(Goldstein, 2017, p. 17)

Pariser argues that we learn most with the encounter of the unknown and moving out of our comfort zone (Pariser, 2012). So how can we learn from the logic and predictable results we expect? It is precisely this, which

motivated me to work with the potential of computation, regarding the unpredictable, serendipitous.

During the thesis, I experienced multiple unintended influences, which have affected the development of the project. Even the previously quoted book from Goldstein (2017), I would have never stumbled upon. It is thanks to my mother, or more accurately to a friend of my mother, who gave her the book as a gift. While explaining the idea and concept, she recommended looking into the first pages of the book, since it seemed to remind her of the project. Interestingly, it ended up suiting my thoughts and concept very well.

There is a rise in the field of creativity, enforced by computation. Generative design is used as an aid in architecture, creative coding for visuals at festivals, and whole books are being generated using predictive text machines. If digital programs can be fitted for these usages, I wondered how I, as an Interaction Designer with some knowledge in code, could make use of them as a means to serendipitous encounters and hidden associations.

Research Field

Background and Content

The Filter Bubble

I initially started my research on the topic of the Filter Bubble. A term introduced by Eli Pariser in his eponymous book back in 2012. The Filter Bubble describes the phenomenon of filtering content, mostly based on a specific persona. These mechanisms are implemented in a wide range of today's applications.

In 1994, Jeff Bezos developed the idea for Amazon's first, reasonably simple, personalization algorithm. The idea was to create an online shop that works similar to a small bookstore in your neighborhood, where the owner is basically a friend that knows you to a certain extent. He's the curator of your books, recommending you things you might like, based on other things you enjoyed reading.

This principle works precisely the same way on a website, only much more abundant in terms of the number of people generating data. The service, in this example, an algorithm developed by Amazon, suggests you books that you might like based on what other people read and rated as useful. If you liked reading Harry Potter, Amazon would then recommend the books people rated good, which have enjoyed Harry Potter as well (Pariser, 2012).

Personification in selling books is probably one of the rather harmless examples, which produce the phenomena known as the Filter Bubble. There are many influences that the Filter Bubble promotes. One of those is the distortion of the reality we see on our screens. People who are not aware of the personalized view they experience lose their relation to reality. The user does not know what he doesn't see, how can he know what's happening in the world, if his news app only shows the newest gossip?

"Our bodies are programmed to consume fat and sugars because they're rare in nature... In the same way, we're biologically programmed to be attentive to things that stimulate: content that is gross, violent, or sexual and that gossip which is humiliat-

ing, embarrassing, or offensive. If we're not careful, we're going to develop the psychological equivalent of obesity. We'll find ourselves consuming content that is least beneficial for ourselves or society as a whole." (Pariser, 2012, p. 34)

The human mind doesn't necessarily have the self-control to act rationally, as Eli Pariser states in the quote above. It might be more driven towards entertainment than towards self-improvement while self-improvement is a more complex topic itself.

Experiments in the 1960s from Olds and Milner have shown, that a reasonable amount of rats chose brain stimulation over food or accepted electric shock in exchange for it. In some cases, this behavior even resulted in the death of the test rats by starvation or overstimulation (Olds & Milner, 1954). These observations show how we might underestimate our desire for stimulation.

Serendipity

Post-It notes, the microwave oven, and LSD were all unexpected findings, discovered by scientists that have investigated and experimented in the hope of achieving a goal – yet inventing a very different thing ("Serendipity", n.d). The discovery of something somewhat unrelated can be very refreshing. Ironically, even the experiment mentioned above from Olds and Milner was only possible due to a misplacement of the electrode within the rat's brain, as Milner confessed (1989).

In the early days of the internet, browsing was a pure source of inspiration. Before the invention of search engines, it was nearly impossible to find something intentional, without remembering the exact address. It was a diverse, alien-like medium, where people clicked themselves through sites by links.

Google is known to provide you with very personalized search results. My neighbor could get a completely different result, looking

for the same term as me. If I search for something, I see a collection of articles that other people clicked which looked for the same term. I find websites, optimized for search engine recognition and sources that Google thinks might suit me (Pariser, 2012; Foster & Ford, 2003).

By only showing me relevant things, I become more efficient. Google is driven towards answering whatever question I type. In numerous scenarios, I value the accuracy of the Google search engine. However, it has become nearly impossible to *drift*, as I might have if it were shortly before 2000, where the diversity on the internet was much easier to perceive. Only seldom, I find unexpected things. Serendipity has become an exception (Gelernter, 2010; Basu, 2014).

"One of the hardest, most fascinating problems of this cyber-century is how to add 'drift' to the net so that your view sometimes wanders (as your mind wanders when you're tired) into places you hadn't planned to go. Touching the machine brings the original topic back. We need help overcoming rationality sometimes, and allowing our thoughts to wander and metamorphose as they do in sleep." (Gelernter, 2010, p. 34)

Algorithms and Humanity

Cathy O'Neil writes in her eponymous book *Weapons of Math Destruction* about math-powered applications which don't serve us well. One of the mentioned systems, called *the IMPACT evaluation*, was introduced by the mayor of Washington D.C., in 2007. This system should evaluate the work of teachers in response to underperforming schools across the state. Evaluating which teachers were performing well based on numbers seemed like a good choice since the teachers seemingly were responsible for the students' lack of education. It would reduce human bias in

choosing whom to weed out, to hire new, more competent teachers. In the end, over 200 teachers were fired because of a bad overall score in the system and reviews of the school community.

Wysocki, being one of the teachers who was let go, felt cheated, due to the good reviews which she got from the school itself and the students. Nonetheless, the overall score outweighed the opinion of the people directly involved. Subsequently, Wysocki demanded an explanation of how the value-added model worked and what exactly it was measuring. As a response, she learned that it is complicated, but the primary basis for the scores lie in the grades the students receive, or more precisely, the difference between their last and their current grade.

This may seem ridiculous, but there are obviously not that many factors which can be applied as an input for an algorithm. In O'Neil's view, these statistics can't work with such a low amount of data. Allegedly, a teacher would need to be tested with thousands or even millions of students in a uniform environment, reducing the impacts on the students outside of school and other disruptive factors (O'Neil, 2017).

Many of the examples stated from O'Neil are driven towards efficiency and numbers, which is precisely where I see the cause of errors. Mathematical systems are usually created to serve one specific goal, often ignoring other impacts and factors, let alone room for creativity. How can rational algorithms detect human emotions or activities? I find it extremely hard to think about systems that understand and accurately judge humans.

Nevertheless, by definition, an algorithm is nothing less than following a sequence of instructions. Cooking bread from a recipe, therefore, means that you're following an algorithm (Christian & Griffiths, 2017). This seems very human to me. So how is it that digital algorithms are sometimes so biased or *incompatible with the human mind*, as Hannah Fry stated it in 2018?

Hypothesis

I find it extremely interesting to think about how we can better use algorithms for humans in general. To specifically not create O'Neils mentioned Weapons of Math Destruction (2017). In my opinion, many of these unfortunate systems originate in the initial idea of a concept. If a product or service aims at keeping users on a site at any cost, the issue might not lie within the algorithm, but rather the purpose of the application. However, the focus of my work should not lie too much on the political influences of these systems, but rather on alternative usages of algorithms, which promote serendipity and creativity, free from any other purpose or financial gain.

"For a quantified system like a personal filter, it's nearly impossible to sort the usefully serendipitous and randomly provocative from the just plain irrelevant."
(Pariser, 2012, p. 146)

Based on statements from Gelernter (2010) or Pariser (2012), like those mentioned above, I framed the following research question. It has helped me to not drift too much off topic within the subject of serendipity and the unpredictable.

How can I computationally enforce serendipity?

Motivation and Intended Contribution

"The invisible pieces of code that form the gears and cogs of the modern machine age, algorithms have given the world everything from social media feeds to search engines, satellite navigation to music recommendation systems, and are as much a part of our modern infrastructure like bridges, buildings and factories ever were."

(Fry, 2018, p. 13)

The presence of technology and algorithms is undeniable. However, I wanted to present it in different use. By transforming it to a creative, maybe ineffective application, I intended to let users and viewers experience that it is not just a tool for mathematical purposes. Neither is it a tool exclusively made for applied cases. Most users are familiar with personalization on search engines and social media, but not with the potential that algorithms have for serendipity and creativity. Whether algorithms and code are suitable for such purposes, I aimed to challenge.

I saw my contribution in providing an alternative in the topic of filters and the relation to serendipity. This might be in a very abstract sense and could have resulted in something very short-lived. In any way, the alternative should be unaffected by efficiency and aim at inspiring and exploring, rather than solving problems or answering questions.

Methodology

Interviews and Talks

In terms of the methodologies chosen, I intended to speak to experts on the topic. These so-called experts may not be specific experts, but rather a range of people working in different fields which correlate to algorithms, art and or serendipity. As a first reference, I planned to question the founders of the *MuDA*, the independent *Museum of Digital Art* in Zurich. Because of their relation to alternative computation, I was keen on knowing about their insights on filters and personification, as well as the connection to digital art. Other professions which hold a helpful insight into my interests are artists like Zach Lieberman or Gramazio Kohler, which use algorithmic procedures and computational typologies in a more creative context, as well as theoretical researchers on the relationship between human and technology, like Dieter Mersch.

Experiments

Early on, I planned to experiment with different, smaller projects which include algorithms and playful, less *standard* interactions. As my concept wasn't too concrete at this stage, I defined the overall goal, which I imagined would be to observe how people react and experience these experiments and then conclude these findings into more advanced prototypes in the phase of the project development. As mentioned, the main goal was to generate serendipitous moments. Later on in the process, while I specified my concept, these experiments began to shape (see *Experiments* on page 44).

Research

There is a wide range of references available on the internet and in literature, as described in the following chapter, where I saw much

potential in contributing to my project. Serendipity is frequently discussed and often in a different context and correlation. Due to the nature of serendipity, which is not limited to a specific industry or topic, numerous people with very diverse backgrounds have mentioned or discussed the influence of serendipity on their practice.

During this thesis, there have been a large number of influences from events, readings, or conversations which weren't intentional at all. Many of these experiences have helped to shape my project and confirmed the significance of serendipitous encounters.

Literature

I constructed a list of literature that covers or correlates with the topic of algorithms and society. Most of those have influenced and inspired me while choosing the theme for my bachelor's thesis and therefore, appear a lot in the research context chapter. During this phase of my Bachelor's Thesis, I arranged these in order of relevance for my concept, to then read while working with other methods. This way, I hoped to get a more in-depth insight into the topic and experience a range of different opinions.

- *The Filter Bubble: How the New Personalized Web Is Changing What We Read and How We Think* (Pariser, 2012): Pariser talks about personification on social networks and the internet in general. Political and personal influence is just one of the effects of the biased view people get.
- *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy* (O'Neil, 2017): Weapons of Math Destruction is a term, introduced by Cathy O'Neil, a mathematician who argues that a lot of logical procedures are used in an unethical way. Algorithmic systems that judge the competence of teachers on the sole source of their stu-

dents' grades are just one of the projects that O'Neil describes.

- *Hello World: How to be Human in the Age of the Machine* (Fry, 2018): Hello world is about a range of algorithms that are present in our daily life. How well do they perform in making decisions and replacing human actions? Fry lists advantages, problems, and the general limitations of algorithms.
- *Algorithms to Live By: The Computer Science of Human Decisions* (Christian & Griffiths, 2017): Algorithms to Live by specifically targets algorithms which have been developed for human beings. As they've talked to many computer scientists who have developed algorithms in this field, they went on a quest on what guidelines there are in developing algorithms for humans and their relation to human psychology and cognition.

The following list contains additional literature that relates to the topic, however, hasn't significantly influenced my work. Therefore, these aren't mentioned any further within this thesis.

- *The Serendipity Machine: A Voyage of Discovery Through the Unexpected World of Computers* (Green, 2004): Green is an Australian computer scientist who describes computers as Serendipity Machines. He deals with the correlation between accidents, randomness, and computation.
- *The Dark Net: Inside the Digital Underworld* (Bartlett, 2016): The Dark Net shows differences between the internet we know and the Dark Net. Bartlett introduces a range of personas which frequently use the darknet for different reasons, ranging from drug traffic to political extremists.
- *The Shallows: What the Internet Is Doing to Our Brains* (Carr, 2011): The Shallows demonstrates how our thinking has changed since the rise of the world wide

web. As an example, how our attention spans allegedly has reduced since we consume more and more visual content. Carr reports very fascinatingly, often analyzing himself and his experiences with the issue.

- *New Dark Age: Technology and the End of the Future* (Bridle, 2018): Bridle argues that with the rise of new technology, our knowledge about it decreases statically. Large companies with the workforce to develop and use these technologies can use it to their benefit, as the rest of the consumers don't understand how they are being manipulated.
- *Geek Sublime: Writing Fiction, Coding Software* (Chandra, 2014): Geek Sublime deals with programming in a different approach. Since it is categorized as a biography, Chandra allegedly explains technology at the same time as he references happenings in his life.
- *The Master Algorithm: How the Quest for the Ultimate Learning Machine Will Remake Our World* (Domingos, 2017): Domingos searches the Master Algorithm in the relation of Machine Learning. Which technology will derive and how will it influence business, politics, and other societal things?

Concept

Related Projects

Cybernetic Serendipity

In 1968, the Institute of Contemporary Arts in London opened an exhibition called *Cybernetic Serendipity*. Jasia Reichardt curated the exhibition which featured many artists. Since computers weren't prevalent in the 60s, most of the artists were in fact scientists that used their equipment in creative content. The overall topic was essentially algorithms, creativity, and computers. Works ranged from generated music, graphics, texts to robots in general ("Cybernetic Serendipity", n.d; ICA, 2014).

The exhibition's title was chosen concerning the countless serendipitous encounters that viewers and the people who worked with these creative technologies experienced (Media Art Net, n.d).

Cybernetic Serendipity inspired me since the works were revolutionary at that time and paved the way for new interpretations of technology. This is where I saw a strong correlation to my intention. Similar to these projects, I aimed to provide an alternative use of algorithms and their connection to art and serendipity.

The Filter Bubble: Algorithms to Manipulate thoughts

Four artists have created this project in Seoul, Korea. The heart of the installation is a computer, on which questions in the form of a survey are displayed. Visitors can then participate and answer these personal questions, while an algorithm creates an impression of who they are. When finishing the poll, a receipt is being printed that shows a summary of the impression, that the machine has of the individual (Da Eun Et al., 2018). The artwork deals with the issue of algorithms that form an image of people and how accurately these work.

Mix.com

Mix, formerly known as Stumble Upon, is a website which particularly aims for serendipitous encounters. They relate to users who provide their interest during the process of signing up, to then show users their *next favorite thing*. (Mix, n.d.)

Interestingly, they are using algorithms and machine learning to determine what people like and based on that, generate a feed full of stories from a variety of sources. They advertise themselves as a service which promises discoveries. This seems like a paradox to me. According to reviews in the Apple shop, the service used to work great and more diverse, when it was still called Stumble Upon.

To me, the approach of predefining a set of interests seems better than most services, yet still promotes being trapped in a bubble. Actively setting them in the beginning, causes the users to be aware of their preferences and avoids the effect of a misperception, as there is on other platforms. Nevertheless, I intended to provide serendipitous confrontations which aren't affected by one's settings or character.

Digitaltag

For the *Digitaltag 2018*, the Chaos Computer Club Zurich organized a stand in the heart of Zurich to educate people about the issues of digital privacy and surveillance. For the event, Hernâni Marques used Machine learning to determine what vocabulary which political party of Switzerland uses most, based on their website. Using this data, he created an algorithm that analyzes users twitter posts and then measures the concordance to the vocabulary of the political parties. Marques' goal wasn't to prove facts, but rather to experiment and use the results to pose further questions.

Hal 101

The Museum of Digital Art in Zurich sets its aim on the connection between code and society. Therefore, the founders Hirt and Etter have decided to outsource the curation to a machine. More precisely, they created a Bot called *Hal 101* which selects future artists in the hope of electing a diverse collection, unbiased by their own taste and judgment. Solely the first four artists have been chosen by the founders. The MuDA team has put much value on the variety of the initial exhibitors, to provide the algorithm with a valid starting point.

The bot is a web crawler which analyzes links and references on social media platforms and websites from each preceding artist. Subsequently, a rating system grades the connected experts and creates a ranking list. Whenever the MuDA seeks their next artists, they consult the bot's list, which is being updated continually. Due to the rather small community of artists in the field of generative art and creative coding, this concept works reasonably well. However, if it were used in a more conventional field such as art in general, the bot would most probably value painters like Picasso or Van Gogh excessively, leaving smaller artists no chance. However, the bot also supports the MuDAs belief that we should appreciate and push the field of creative technology more by embracing and actively publishing works in that area.

Crossroads

For her master thesis in Media Design at HEAD – Geneva, Marion Couesnon dealt with the structure of the hypertext. She analyzed the paths that people took while playing a modified version of the Wikirace method. The game's idea is almost identical to the famous Wikipedia challenge, which consists of the quest to start at a specific article and arrive at a predefined entry by only clicking the links on the articles.

For the graduate installation in 2017, Couesnon repurposed an old HP plotter. Once people succeeded within the game, they were rewarded with a drawing of the articles they visited. The users then get to decide whether they would like to keep the artifact or install it alongside other journeys (Couesnon, 2017).

Apart from the connection to Wikipedia and the serendipitous challenge, the project is visually exciting. Using randomness and a retro device from 1983 to document a user journey is aesthetically very pleasing to me. Another aspect I found interesting is the feelings and ideas the drawing might trigger shortly after when the users rediscover their journey through hyperspace by looking at the titles of their visited articles. Couesnon found a simple yet creative and effective way to generate something lasting from the short-lived experience.

An Exploration of Serendipity

Nils Röller

I met Nils during the Concept Seminar module. After I outlined my former state of the project, Nils talked about medial changes in general. People have always treated newer inventions or changes skeptically. According to Nils, even Plato despised writing, how ironic, considering that we probably would have never heard his name if fonts and writings weren't invented. New things meant danger and warning. He affirmed when I told him about Pariser's theory.

We then continued to talk about libraries and the difference between selection in the content on the web and libraries. In the analog world, the collection of books needs to be curated too. A reduction is at some point essential, and filtering often is unavoidable. The question might lie within the methods of filtering. The books of the Zentralbibliothek, for instance, are sorted by their admission date, and not their genre.

Encounters

In general, the whole research process is somewhat serendipitous. Of course, by definition, serendipity is the occurrence of something that you might not have expected in the first place, but while looking for specific things, we often drift to somewhat unrelated things or see correlations to our topic when we're not actively looking for it.

After the first examples of serendipity that I found in readings and other references, I took a different approach and went outside to experience it first hand. The idea was to find patterns within these happenings and think about different scenarios which enforce it.

Today, I noted some ideas on where to find such phenomena, before attending Martin Dušek's talk about his work. Amongst other projects, Martin presented *Zurich unbezahlbar*, a website with a list of free events, sponsored by Caritas and the city of Zurich

("Zurich unbezahlbar", n.d.). Apart from viewing events on Facebook, where the happenings are often biased and filtered by their algorithm, this project granted me with unbiased options and activities that I could have attended within my research phase.

A few weeks later, Björn Franke was the lecturer of the IAD Insight lunch. Björn presented a few of his favorite projects and design inspirations. One of these projects was the works of Olds and Milner (1954). I had previously heard about the research on rats and their drive for electric stimulation but didn't connect it to my work until then. While I was sitting there, I remembered wanting to write some sort of assertion that the filters might not serve us well in an earlier chapter, because we're more attracted to entertainment than knowledge or self-improvement. Moreover, so I did find an association with actual scientific proof.

The phenomenon of being able to relate encounters to myself might also occur because I was somewhat biased. While I was not actively working on my thesis, I still kept it in the back of my head and tried to connect it to whatever was happening at that moment. In my opinion, this might also be necessary to experience serendipity. One might need to be ready to correlate a particular finding towards his current project or idea.

As a start of physical locations which could inhabit serendipity, I chose a thrift shop. I, personally, mostly use thrift shops to look for a specific thing which I think is too expensive to buy unused, or is very long-living, meaning its current quality is mostly equal to the initial one. Often I end up buying something entirely different than what I initially looked for.

As I went to the Heilsarmee Brocki in Zurich to experience and reflect on serendipitous moments, nothing significant happened. Of course, I saw interesting objects, but I would not classify any of these moments as really serendipitous. Discouraged, I walked into the furniture store across the street in search of something I might at least like to buy, if I had

more money. Most of the furniture they sell are popular vintage pieces, like chairs from Charles & Ray Eames and so forth.

I then came across a small desk that looked very familiar. It took some time for me to realize where I had seen this desk before, but I eventually realized: Aurelian Ammon, Carlo Natter and I had bought this exact table at a thrift shop for a school project. We paid 15 Swiss francs, colored it, drilled holes in it and glued rock-shaped styrofoam on it, to then let a large amount of dispersion color flow over and out of it. After the magnificent happening, we quickly got rid of the desk, since it didn't seem to be worth the effort of fixing and cleaning it.

This same desk was for sale next to a vast amount of revolutionary design pieces. The label said: *Famous design piece from the 50/60s*, whereas the price was 390 Swiss francs. How ironic.



Figure 1. Table for sale at the price of 15 Swiss francs in Dietikon. 28 October, 2017.



Figure 2. Famous design piece from the 50/60s in Zurich, price: 390 Swiss Francs. 2. February, 2019

Uncertainty and Serendipity

ETH professor Buhmann held a talk at the Cortona Week in 2016, where the topic was Uncertainty and Serendipity in algorithms. According to Buhmann, it should very much be possible to use algorithms in serendipity. He describes how we were having difficulties because of a lack of storage capacity. Our brains couldn't handle large amounts of data. However, due to the inventions of computers, hard-, and solid-state-drives, we're now capable of processing massive datasets.

Buhmann expresses the value of uncertainty and how he makes use of it to show *where you have no chance to think*. We can use algorithms to mimic what other humans have already done by using the unknown to trim a mechanism towards a stable prediction. Algorithms need to be able to deal with the noise of reality. According to him, sorting algorithms need to be prepared that a five sometimes is smaller than a three (Buhmann, 2016).

CCCZH

The Chaos Computer Club is an organization consisting of people with a fascination for new technology and their relation to society. They're an organization with the aim of using devices independently and anonymously.

Contacting the CCCZH was a challenge by itself. They do provide an e-mail address and a phone number for the press, but not for people interested in their activities. However, they do encourage people to attend their *Chaostreff* personally, or contact them using their IRC channel. Since their website stated that the hackerspace is currently closed and I didn't want to get in touch with them, using the press contacts, I tried to reach them using IRC (Chaos Computer Club Zürich, n.d.). First of all, I had to look up what IRC is and how to set it up. After installing a client, I had to play around with the ports and settings until I final-

ly received the welcoming message: CCCZH / *We like mathematically enforced privacy*.

To my surprise, there was quite an amount of users online. After they reassured me that the Chaostreff still exists, they asked me about my plans, or more precisely about my BA. As short as possible, I tried to tell them about my current state and interests in two sentences. Due to my inexperience with IRC, I closed my laptop shortly after sending the text to attend a party within the Toni-Areal. As I anxiously returned to check what they responded to my text about the topic, I realized that I disconnected the network the moment I closed my notebook. Using the IRC network, there is, at least to my knowledge, no way to access the messages sent while you were offline. I had successfully ruined the first stage of receiving confirmation from the Chaos Computer Club, leaving me no alternative than to meet them at the *Chaostreff*.

After a slightly awkward introduction from my side, I was shown their hackerspace. Luckily, one person immediately asked whether it was me, who wrote about my project the day before on their IRC channel. He introduced me to a few people with similar projects. Eventually, I met Hernâni, a computational linguist and sociologist, who wrote his master thesis on mass surveillance using computational linguistics (Marques Madeira, 2015). He introduced me to a few exciting projects in the world of digital surveillance, politics, and linguistics.

The CCCZH's primary motivation is electronic freedom and the preservation of human rights within the digital world. Their focus is on politics and technology, whereas I would position my project more towards digital art. The association is less concerned with serendipity. Nevertheless, the insights gained were refreshing and valuable.

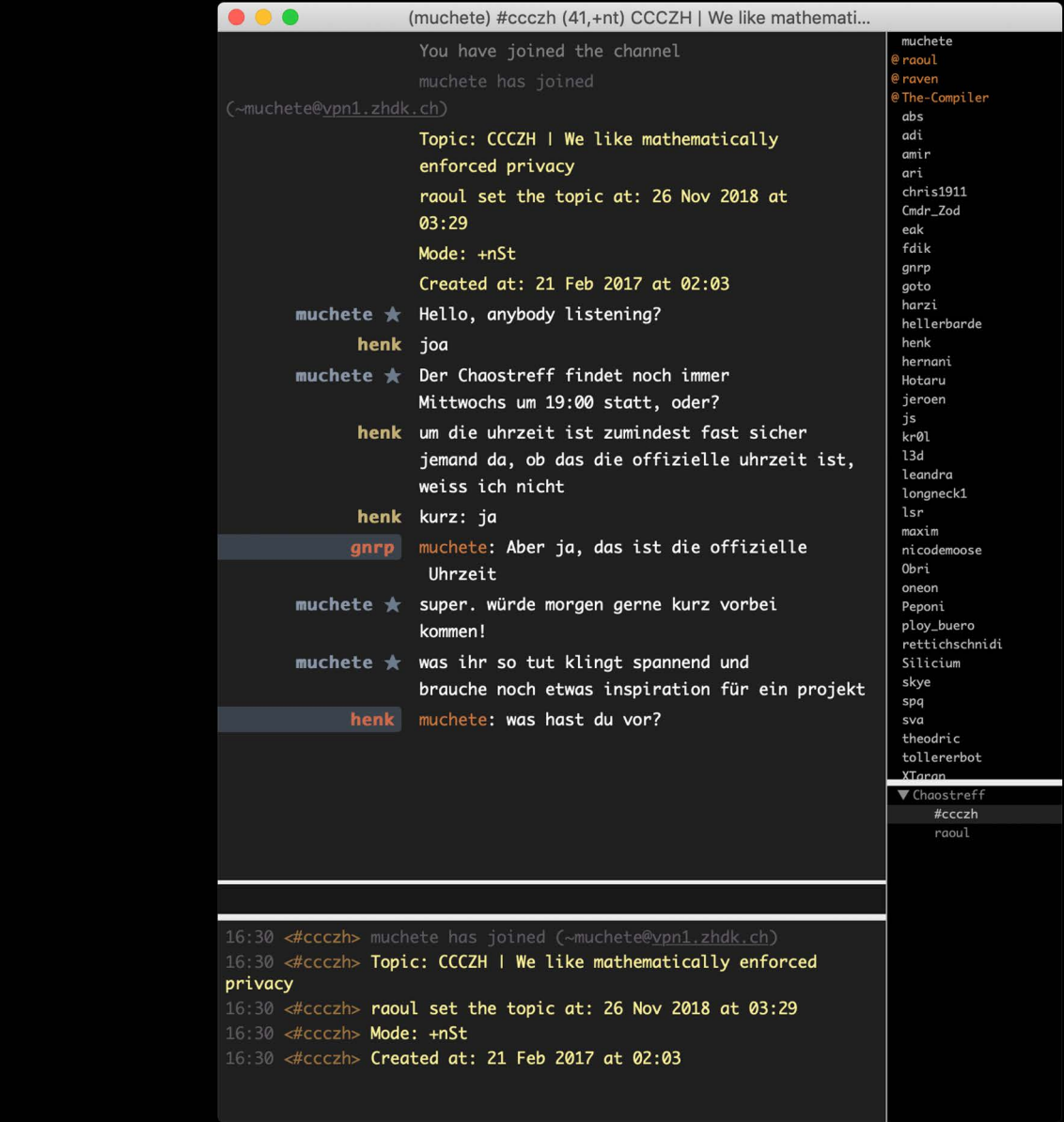


Figure 3. IRC chat window. 5. March, 2019

Christian Etter

I casually met Christian Etter, co-founder of the Digital Arts Association and the Museum of Digital Art in Zurich. Besides, he established the Etter Studio to create a small company that strives to work interdisciplinary on projects that range from furniture design to hooded sweaters with a pattern generated by algorithms.

We started with the general notion of bias. Christian referred to the early example of filtering in application processes. There was, and at certain places probably still is quite a gender imbalance in music orchestras. A group of experts then remarked that the cause of the issue was due to biased judgment during the audition. By placing sight protection such as curtains in between the jury and the applicant, the judges were unable to get a visual hold of the person behind the curtain. The cause of the error might not have been bad juries. It might have lied within the subconscious (Goldin & Rouse, 2000). The new method spread quickly in the 70s and was, according to my mother, who auditioned for the orchestra of the Zurich opera in 1978, already well imposed by then.

Of course, this system works very well and is a prime example of a great filter. The only criteria for hiring a musician should, in my belief, be their ability to play music. However, there are other tasks which are harder to filter.

Etter and Hirt have emphasized a lot on the process of curation for the exhibitions in the MuDA. They developed an algorithm to determine which artist gets displayed in the next exhibition (see *Hal 101* on page 27). Since the concept of their algorithm isn't adaptable to all filters and depending on the platform, might result in a very prejudiced view, Etter proposed more transparency and randomness. In his own company, Etter Studio, the focus lies on utilizing more alternative services. Instead of relying entirely on industry standards when it comes

to technological services, they make more use of their users preferences and consider their judgment higher. The users itself might also be positioned in a very market-oriented environment, but surely bring a different perspective into the decision process.

Kritik an der Algorithmischen Rationalität

[Translation by the author: Criticism of algorithmic rationality] In the event series from the Collegium Helveticum, Prof. Dr. Mersch held a talk on algorithmic rationality and the relation to the human mind. Firstly, he elucidated the term rationality as *reason* in the context of his speech.

As a start, he talked about the analogies between logical systems and synaptic systems. In anatomical researches, it quickly became clear that the nerve system works digitally, with electronic impulses. Mersch described the similarity of the human mind to a *Regelwerk* [Translation by the author: rule book], which reacts on inputs and transforms them into an output. Generally speaking, the human mind does the same thing. The process becomes interesting when a human is confronted with an irregularity. What if I were shown a set of Chinese characters as an input. I can't accurately process this information because of my lack of knowledge in Chinese reading, and neither could a machine which hasn't learned to do so. The outcome of the rulebook can only be accurate if there is an understanding of the input (Mersch, 2019). After defining the difference between predictable and unpredictable functions, Mersch argued using a quote from Lucas.

"Now any mechanical model of the mind must include a mechanism which can enunciate truths of arithmetic, because this is something which minds can do: in fact, it is easy to produce mechanical models which will in many respects pro-

duce truths of arithmetic far better than human beings can. But in this one respect they cannot do so well: in that for every machine there is a truth which it cannot produce as being true, but which a mind can. This shows that a machine cannot be a complete and adequate model of the mind."

(Lucas, 1961, p. 115)

Based on this argumentation, he called algorithms within rule books as excellent. Programs which are used in applications like stock market speculations or Alpha Go are correct and work well. In an irregularity, computation doesn't perform as good and often fails.

Furthermore, he introduced the aspect of creativity in the context of algorithms and machines. Mersch argued that within this field, creativity only describes a process which is random or parametric. Computational typologies are often used within an applied scenario, where a designer creates the foundation for the outcome and then modifies different elements of the process and makes use of algorithms to generate a modified result.

Within this context, I agree with Mersch, yet I think the interesting question lies within the authorship. Who signs a generated piece of art? The computer or the artist? Of course, the main design will, in almost all cases, be developed by humans. The algorithms serve the purpose of quick iteration and or randomization. However, this very process serves a truly serendipitous purpose. The algorithm is a crucial element within the process, but maybe not the artist itself.

Mersch also defined history as a key element of art. What experience or historical event has influenced and inspired the artist? In this argument, algorithms only seldom relate to happenings, and if so, only if it was actively implemented within the program. There is hardly an unintentional influence from something the algorithm has previous-

ly experienced. Nonetheless, this leads towards the highly puzzling question of what defines art (Mersch, 2019).

Politics of Data

For the first FIBI – For Interaction By Interaction – of this semester, Max Frischknecht held a talk about his master project. Max is a graphic and interaction designer from St. Gallen who currently works on the politics of data. Max mentioned a few aspects that O'Neill also mentioned in *Weapons Of Math Destruction* (2017). He provided a few principles, which he developed during his research:

"1: Don't assume that the data is without bias. 2: The data is as neutral as the underlying algorithm. 3: Algorithms should not be seen as objective systems but as cultural artifacts."

(Frischknecht, 2019)

The tenets that Frischknecht proposed induced me to think about the data and the code which I currently used for the Infamous Wiki experiment. How unbiased is the data that I am using, and are the algorithmic procedures neutral? I tried to answer these questions within the project development chapter (see *Evaluation* on page 68).

Concept and Angle

By definition, serendipity is a pleasant surprise, which makes it differ from randomness. Randomness can happen anytime and does not explicitly refer to something positive or negative, whereas serendipity is finding something in the process of actively looking for a particular subject which is fruitful and welcomed at that time (Serendipity, n.d.). How related the encounter is to the initial objective is in my mind somewhat hard to define. This implies that randomness sometimes can be defined as serendipitous, but not the other way around.

Due to the nature of the phenomena, I sometimes struggled to find a method which would reliably enforce serendipity. Although it might also be due to too high expectations, in the beginning, I expected mind-blowing results, which presumably was a little bit naive. During this rather unfruitful time of the research phase, where I assumed too much, I started a discussion on a platform called Research Gate. I created a thread to ask for examples of irrational algorithms, serendipity, and general thoughts on the topic. The answers have helped me to shape my angle and idea (Schönenberger, 2019a).

An interesting perspective to my topic is code, that is inspired by natural sensations. O'Neil argued that the algorithms are often inappropriate because of the difference between human thinking and the constitution of number based calculations, which establish the foundation for code and technology (O'Neil, 2017). By imitating and using processes from the environment, algorithms might get closer and closer towards assisting humankind well. These algorithms adapt processes of nature and are contrasting general mechanisms that originate from mathematic operations. In biology, it is common practice to observe mechanisms of other living entities. The prime example of this is probably the axolotl and its healing ability, which researchers have been observing for quite some time.

As one of my primary purposes, I wanted to create serendipitous algorithms to steer

away from typical usages. In the time of a performance-oriented society, algorithms and filters are mostly made for applied usages. Google, YouTube, and Amazon make use of the algorithm for customer relations. This motivated me to think of applications with less efficiency and more creativity and exploration. Projects which make use of computation without the sole goal of an economic gain like Processing, Open Frameworks, or the artworks of the Cybernetic Serendipity exhibition inspired me. At the same time, I was fascinated with the shift in the economy created by artists like Gramazio Kohler that already use creative coding in applied usages.

In addition to this, I saw potential in conveying the possibilities for creative applications, similar to the MuDAs aim to spread digital art more. Standard products such as web- and mobile-based interfaces are well known to people, yet generative art and computational typologies still have had only seldom an impact on our everyday life.

Field

While investigating the topic and thinking of possible outcomes, I was questioned by my mentors about the area in which I'd like to position myself in. The Filter Bubble and the lack of serendipity exist on many platforms, ranging from newspapers and general browsing to social networks. Due to the large dimension of these digital spaces, I often got lost within them, which is why my mentors motivated me to narrow down on a more specified field.

After I put some thought in it, I decided to steer towards information and knowledge retrieval. I imagine this to be a field in which serendipity is very valuable and welcome. Plus, I see Wikipedia as a platform which is already used very serendipitous and creative. There are a variety of games and interpretations which make use of their excellent source of information in a rather uncasual way. I then started to investigate in an early experiment, which I created as an aid in the process of defining a target group and concretizing my concept. Furthermore, I wanted to evaluate my decision in picking this specific field.

The Infamous Wiki helped me to verify the idea of using serendipity in the field of knowledge. The existence of serendipity has caused many inventions. We, as designers, are used to taking influences from a variety of sciences and phenomena. We cross these so-called branches of science to find analogies or inspiration. However, other fields might not know about it this good.

Findings and Next Steps

For the second progress session of our Bachelor's thesis, I presented my prototype to the audience. I showed the example of the cloud article, appearing while searching for the term *rain* (see *Infamous Wiki* on page 51). However, I found out that this result might have been too rational. People might have been expecting such an outcome and therefore, did not perceive it as much serendipitous. Luckily, I demonstrated the prototype once more, to get a wholly new and unbiased result. As some Korean actor from a TV show with rain in its title appeared, people laughed. It seemed that the audience was more interested in purely fun facts than too effective results.

I considered this as a slight confirmation of my initial idea, creating something without the goal of productivity. We know so many alternatives which we address when needing something specific that my concept doesn't have this requirement. Furthermore, the feedback verified my idea of testing the current prototype to get a hold of peoples experiences with it. Through this process, I aim to find out what people use it for, to better develop the next model towards this direction.

Project Develop- ment

Experiments

Moirer

For our first presentation on our Research Field, part of the task was to present an early, yet advanced prototype. Many of us struggled to find a meaningful first prototype, because to this point, most of us couldn't imagine an actual outcome yet. After I spoke to my mentors, it became clear that I should keep my early prototype abstract and straightforward, instead of creating something too complex and confusing.

I intended to create a small device, which enables the user to experience a very abstract form of serendipity. I quickly got the idea to use a visual representation by overlaying two drawings on transparent papers. I thought of two shapes, which would generate a third, ideally unexpected form. After thoughtfully looking for ways of overlapping models, the thought of using Moiré patterns crossed my mind. The Moiré effect is being used quite often and seems unavoidable.

Nonetheless, the unexpected and mesmerizing effect suited my approach. Moiré patterns can be predicted using mathematical calculations, but using our sole eyesight, we can't foresee the result which arises when overlaying or moving two exemplars. I would, therefore, characterize the effect as somewhat serendipitous. The visual impressions and aesthetics, as well as the overall prototype, suited my thoughts and ideas at this stage.

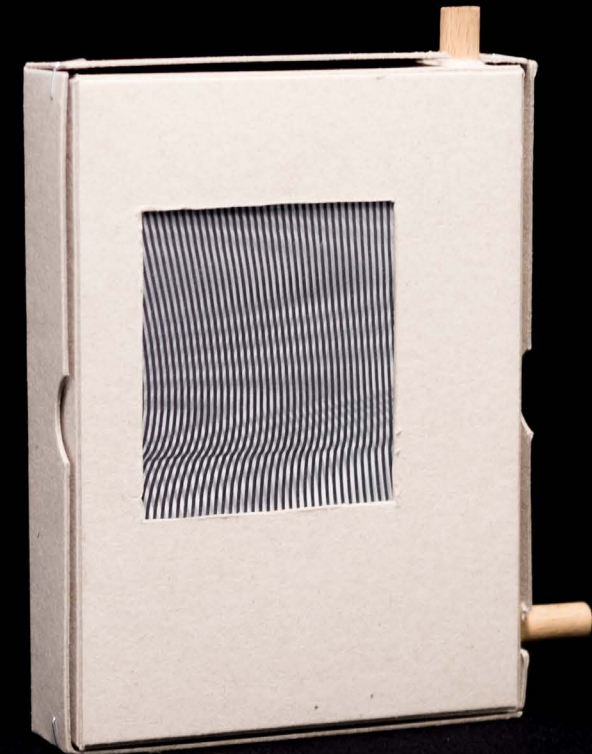


Figure 4. Moirer, prototype device used for the BA progress session 1. 7 May, 2019.

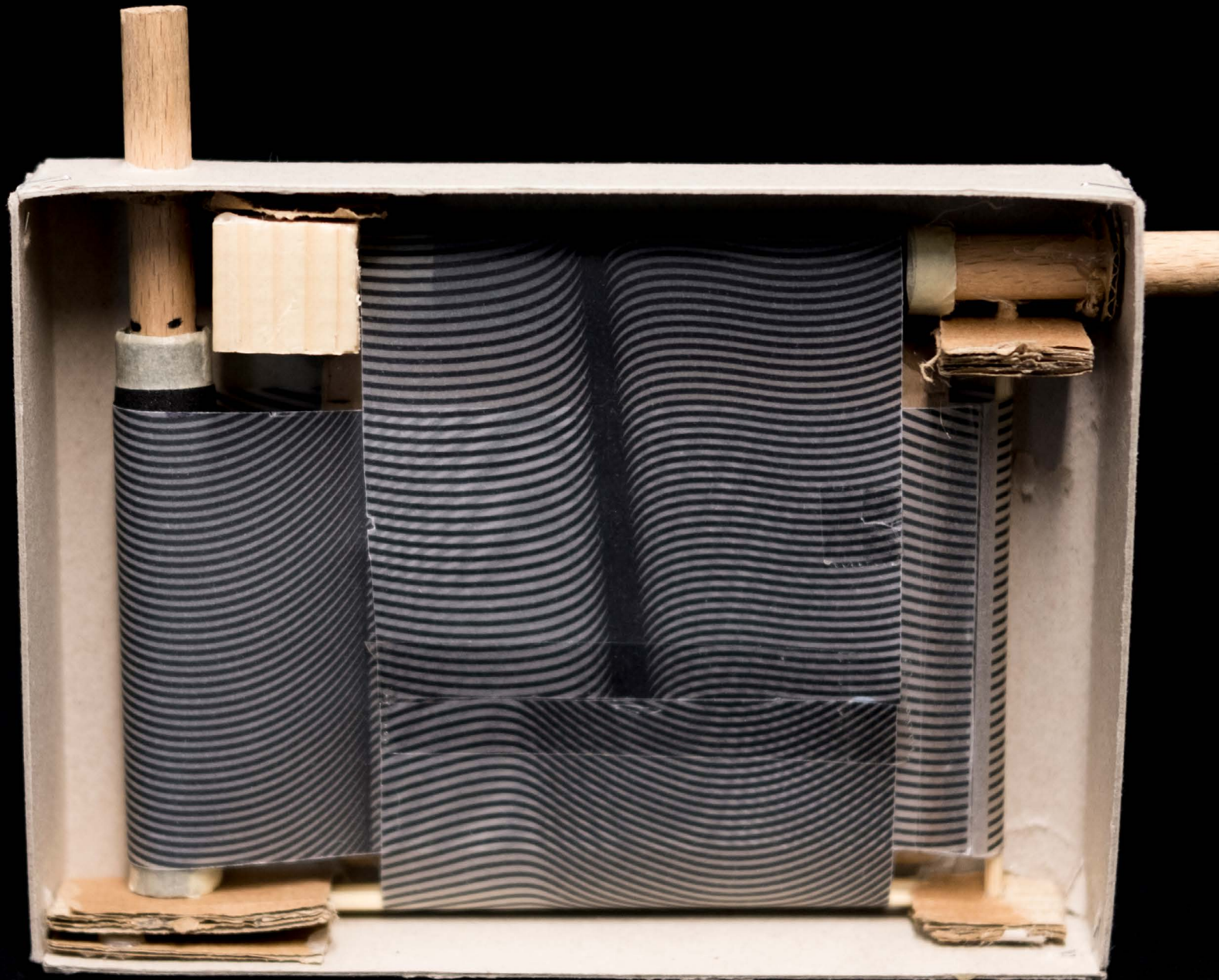


Figure 5. Moirer, prototype device used for the BA progress session 1. 7 May, 2019.

Drifter

After struggling a bit with what to do next during the research phase, I decided to do something practical for a change, after spending the last few weeks talking and doing research.

I pursued an idea I had quite early in the concept seminar week, which I called Drifter. The reason was simple. Gelernter argued that *it had become impossible to drift* on the internet (2010). Using an HTML element called the *iframe* to display a whole website within a website, I simulated an alternative browser. Using some code to analyze that website, I was able to get all the links URLs, and where they lead to. I then placed two buttons on top of the iframe, launch, and next site. Launch analyzed all the links and continued to a random link. Clicking on the launch button again, the software would index all the links on the current page, redirect to an arbitrary URL and so on. After I tested this early experiment, I realized that most of the links on *20min.ch*, for example, led to other sites on the same domain, in this case, other articles or pages. Which is why I created the next site button that filters the links that lead to a page on the current domain, meaning it will redirect to a somewhat different site. As an example, I went from *20min.ch* to *tutti.ch*, to an offer of a book from the author Sarah Lark and so forth.

The experiment clearly shows the drifting and interconnectivity of the web, yet it is not really enforcing serendipity. It provides the possibility of a happy encounter but doesn't necessarily implement it. However, there are exciting aspects to which sites show interconnections with what other websites, and it raises the question of what the common interest or reason behind the connection is, and how I could transform this into something serendipitous.



Figure 6. The Drifter experiment, currently on the news portal *20min.ch*. 24 May, 2019.

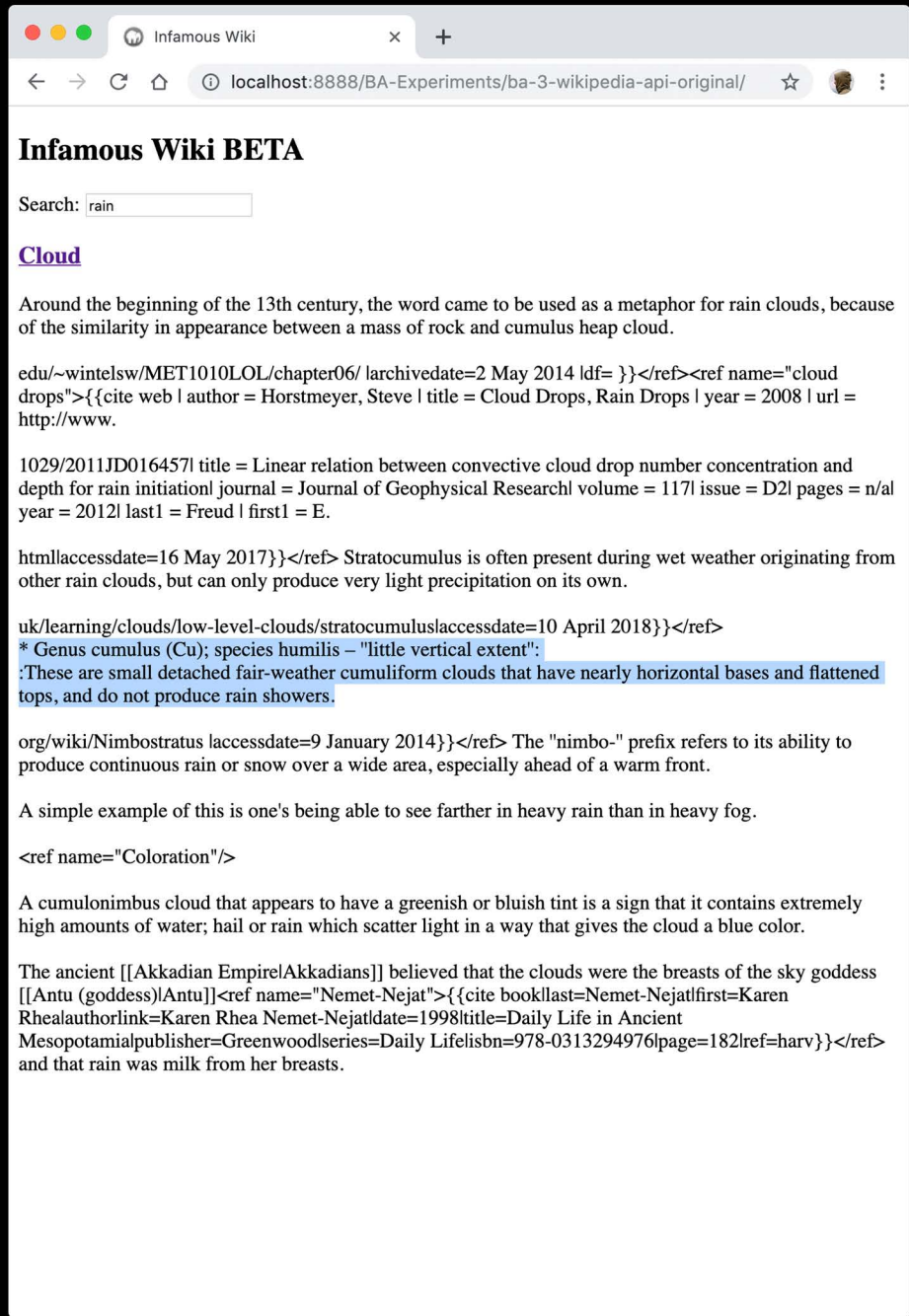


Figure 7. Infamous Wiki experiment showing sentences of the *Cloud* article containing *rain*. 14 March, 2019.

Infamous Wiki

Realizing that the Drifter experiment was only slightly serendipitous, I created a new experiment. Based on a code snippet from Shiffman, a quite famous programmer who often pursues coding challenges on YouTube, I wanted to create something in the field of knowledge retrieval. Shiffman built a Wikipedia web crawler, which started at a certain point and then went from article to article, based on random words within the previous article (Shiffman, 2017).

My approach was the following. Using the MediaWiki API, I queried a given term. Let's take *rain* as an example. MediaWiki would then respond with a variety of articles, which correlate to rain. The first article will most probably be the general weather phenomena rain. Some less relevant article might be the American movie *Singin' in the Rain*, and even more extraneously, the query might return some music album named *Rain Tree Crow*. The code would then select one of the rather irrelevant articles, and look for sentences, containing the word *rain*. In a first test, the algorithm then loaded the *Cloud* article, and stated, among other things, the following:

"Genus cumulus (Cu); species humilis – little vertical extent: These are small detached fair-weather cumuliform clouds that have nearly horizontal bases and flattened tops, and do not produce rain showers."
(*Cloud*, n.d.)

The algorithm had presented me with a type of cloud, as far as I know, which does not produce rain. In my opinion, this classifies as somewhat of a serendipitous encounter. If I had looked for rain on the regular Wikipedia website or another search engine, I definitely would have received a lot more specific results on rain, but less diverse facts.

Prototyping

To evaluate my early experiment, the *Infamous Wiki*, I uploaded it to my personal domain, and then shared it on the ResearchGate platform. I previously made great experiences on the platform as I asked for insights and thoughts on serendipity and algorithms in general. This allowed me to directly target the people that showed interest in my topic and additionally enabled me to reach people from very diverse backgrounds.

In the meantime, I updated the visual representation of the experiment slightly. After making early testings with Verena, I noticed, that the interface which only showed the sentences with the search terms were confusing her. The quotes weren't comprehensible because the user had no idea what the loaded wiki entry was about. Using the previous example of the term *rain* and the cloud article, one could only assume it was regarding a cloud. By clicking the link to the original site and seeing the original article, the correlation became more evident. Though this extra step was somewhat counter-intuitive and resulted in a constant switching between Wikipedia and the infamous Wiki.

Using a parsing function of the MediaWiki, I was able to load the whole article in an HTML format within my site. The search term was indicated with a simple yellow animation that hinted statements with the term. Version one was born!

Upon showing the prototype to Joëlle, we talked about the visual aspects of the prototype. She mentioned the relation to Net-Art and the early internet. Because of the technical limitations at the beginning of the internet, many sites had this technological look. It suits my project well, due to the relation of the early, unindexed internet to serendipity.

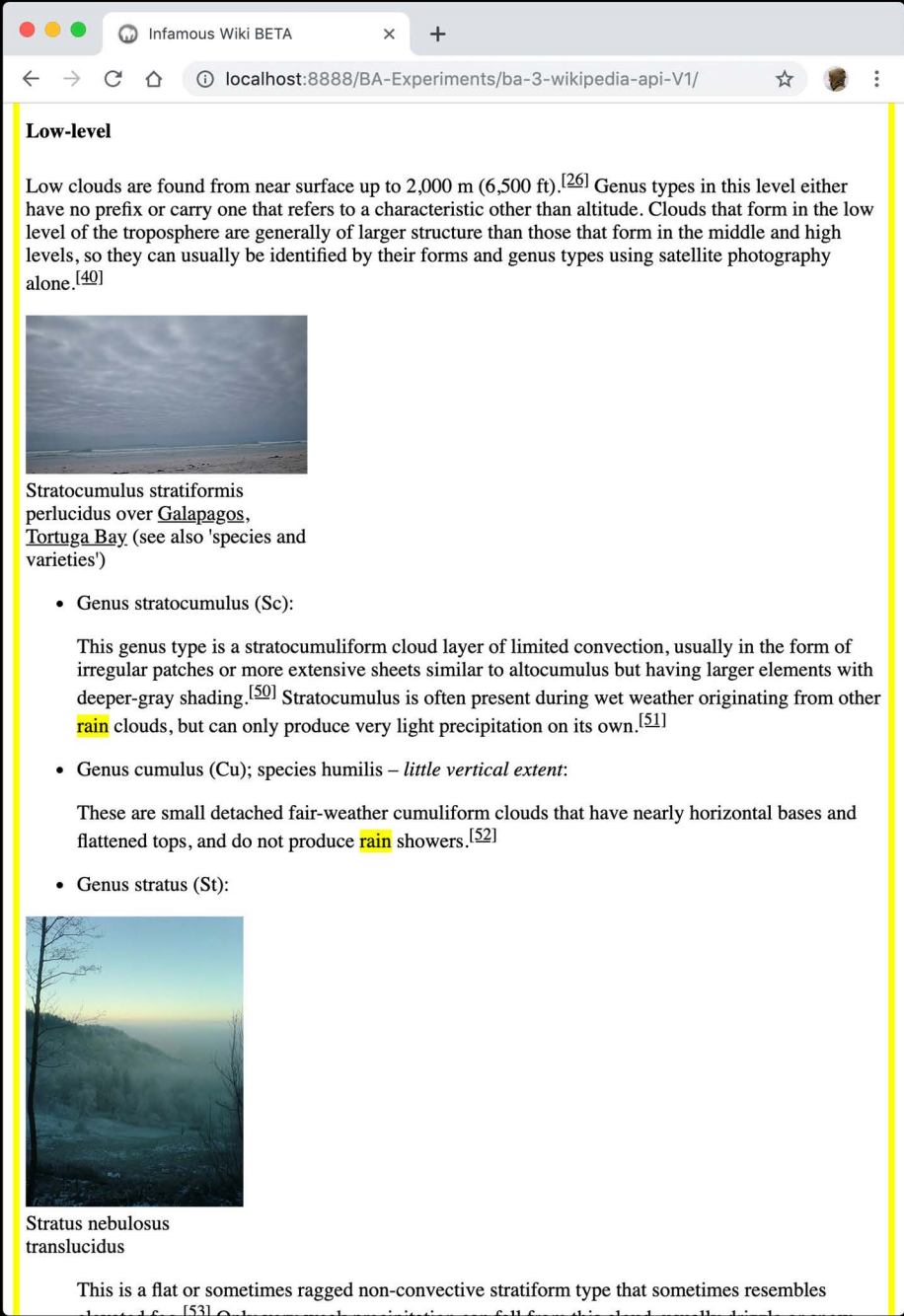


Figure 8. Infamous Wiki experiment showing the entire *Cloud* article. 20 March, 2019.

V2

In Version two, I added a slider to control how safe or accurate a query should be. By using it on the very safe side, it was very similar to the basic usage of Wikipedia. Querying *rainbow*, obviously resulted in looking at the article about the rainbow. Performing the same search term very inefficient, resulted in some somewhat unrelated article on a phenomenon which occurs when looking at an airplane from below.

However, thinking about the effect of this version, I miss the aspect of being surprised by how related or diverged the result is. Also, in terms of serendipity, the slider takes away the magic of the unknown outcome. The feature might work if it is set within some setting on a separate page. However, directly above the search, it doesn't improve version one, in my opinion.

Furthermore, the terms *efficient* and *inefficient* were very improper. For one thing, *inefficient* is a very negative term, additionally *efficient* doesn't fit the method of searching very accurately. Since I decided to discard this feature until further notice, I didn't improve the naming.



Figure 9. Infamous Wiki experiment V2 including the slider feature. 10 May, 2019.

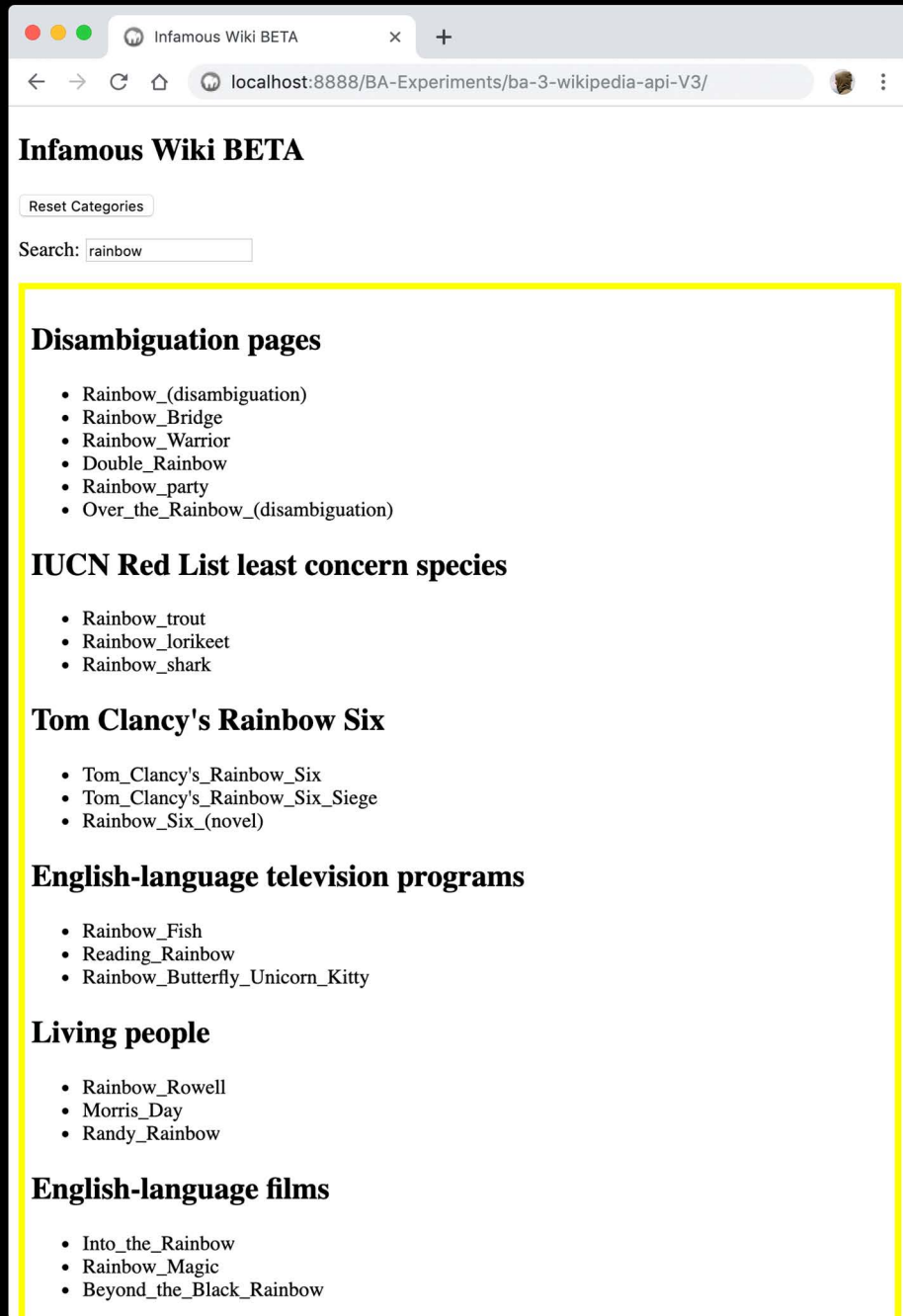


Figure 10. Infamous Wiki experiment V3 listing categories regarding *rainbow*. 10 May, 2019.

V3

In version three, I thought about the French book *Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers* [Translation by the author: Encyclopedia, or a Systematic Dictionary of the Sciences, Arts, and Crafts]. The tree of knowledge is a classification system, which categorizes different fields of expertise (Encyclopédie, n.d.). It categorizes different professions or branches into literal branches of a tree. Similar to this arrangement, I thought it might be interesting to sort the results of a query within categories and provide an overview. I imagined that a search would then show to which of these branches that a specific term correlates. Therefore, the user would have the ability to spot associations which weren't intended directly.

I developed a code which loaded the MediaWiki categories of all the articles which appeared when a search query was executed. The categories are then listed with the included articles and sorted by the number of articles they contain. The category, including most search results, would appear on top.

The prototype often resulted in a large number of disambiguation pages, living people, and English-language television programs, for instance, because of the high amount of these sites within Wikipedia. Furthermore, the nesting and exactitude of the categories spoiled the results. The idea was rather to show common types which people understand, rather than the category of Tom Clancy's Rainbow Six games, which was way too specific. It might have been much more interesting to see the category of video games, instead of such an exact match within the particular ego-shooter group.

During the development of the program for version three, I forgot to implement a resetting function, which deletes the content of the variable that stores the list of categories and the containing articles from the query. As a result of this mistake, the site continuously merged the results of the previous and following queries. Since this thesis favors serendipity, and this clearly classified as such, I figured it might make sense to embrace the mistake and make use of it.

I added a function, which assigns a random color to each search query, making intersections in categories of different queries more visible. By doing this, I thought it might create even more serendipitous results when looking for two seemingly unrelated things. However, the exactness of the categories was counterproductive within this example. Overarching categories were mostly disambiguation pages or other rather dull kinds, whereas the exciting results were too specific, and therefore never merged.

All in all, I realized the first version of the prototype remained the most compelling. The effect of proposing only a single article enforces serendipity the most so far. The beauty of being confronted with one magically appearing article seemed to be unbeatable.



Figure 11. Infamous Wiki experiment V4 listing categories regarding *rainbow* and *fire*. 10 May, 2019.

Results and Evaluation

To my surprise, I haven't gotten the number of responses I hoped for on ResearchGate. In contrast to the earlier questions I posted, I received almost zero answers. However, on Xing, I had a short conversation about the prototype with a user who seemed to show interest, although not too much enthusiasm about the project. Other platforms such as Hacker News and specific LinkedIn groups like the CILIP: Library, Information and Knowledge Professionals provided more detailed feedback a little later in the process.

As I felt slightly disappointed by the lack of answers I received on some platforms, I checked the tracking service, which I installed on the site. Interestingly, many ResearchGate and Xing members seemed to visit the website but didn't feel the need to give some feedback on the idea. The tracking site showed around 80 visitors from a variety of countries all over the world. Due to privacy reasons, the input fields are obfuscated in the recordings. The only chance to get a glimpse at the user's input term is by looking at the highlighted keywords within the article. Luckily, this worked in almost all the cases, which allowed me to evaluate how the visitors behaved on the site and interpret their intentions. After realizing this, I implemented a log file that keeps track of the exact terms for further reference. The following examples are a few exciting use-cases from these recordings. Since I don't know the user's name, either sex, I named them after their anonymous user id, which the tracking service creates for each visitor.

d7a0bcea

- Accessed: 1 Apr, 03:41 PM
- Referrer: ResearchGate
- Time on site: 2:47
- Country: France

d7a0bcea first typed *god* and landed on the article about *Hymenaios*, the Roman God of

marriage, weddings, and reception. In my opinion, the person looked for this term because of the richness regarding stories and beliefs which deal with God. This might have helped to establish a first impression of the site, and the results it displays.

After looking through the text for around a minute, the user proceeded to his next search. Typing *Alzheimer* resulted in seeing the *Alzheimer's Association, Central New York Chapter*, which is a non-profit organization to support Alzheimer research, patients, and so forth. This search is already much more precise. However, speculating what exactly triggered the decision to search for that term seems a little far off. It might be something work-related, or a private matter.

Lastly, entering *science* led to the *Philosophy of science* article. The user quickly scrolled towards the end of the article, eventually returning to the top of the site and staying there for about one minute. Likely, d7a0bcea either kept the website open while doing something else on the computer or read through the first abstract of the article.

In my opinion, the person tested the application in a rather general matter. While the term God might have indicated a search for something to entertain the user, Alzheimer and Science could have been examples for an exploration of the tool's possibilities.

b3033778

- Accessed: 30 Mar, 10:22 AM
- Referrer: Xing
- Time on site: 1:08
- Country: Germany

b3033778 spent only about one minute on the application but searched for a total of 3 terms. First off, the standard term *rainbow* led to the stage musical *Finian's rainbow*. Reflecting on the example term, which I adapted from Shiffman, it might have been smarter to leave the input field blank. Similar to the

bias people experienced by reading Wiki in the title, they might have subconsciously classified the tool as a more playful, maybe less research-driven tool. An empty field could have resulted in purer and more direct thoughts of the testers.

After a quick look at the top section and the album cover, the user typed *cat* and landed on *Murder of a Cat*, an American thriller comedy film. *Cat* seems to be a prominent term in people's minds when it comes to internet sensations. b3033778 wasn't the only person that sought this term. Three out of around 30 users which my tracking service observed either looked for *cat* or *cats*.

Lastly, the user promptly left the site while looking at the *List of banks in Cuba*. The search for the island nation might have been related to the holiday destination or the person's origin, but in my eyes can't be speculated accurately.

Overall, b3033778 seemed to start with the intention of entertainment and fun, lastly, resulting in a rather detailed search.

cbd8edc1

- Accessed: 22nd Mar, 09:05 PM
- Referrer: ResearchGate
- Time on site: 1:34
- Country: Colombia

cbd8edc1 seemed to carefully read the instructions which I added by following the words with the mouse. Interestingly, the person looked for *Yuzusoft*, a rather specific search term. The eponymous tech-company was founded in 2006 and is specialized in Japanese pornographic games. Most likely, the user has a preference for hentai games or is at least quite familiar with this particular industry. Assumingly, due to the small number of articles on the English platform regarding this topic, the experiment showed the *Dracu-riot!* article, an adult novel published by Yuzusoft.

However, the user then switched from pornographic context towards tech-related terms. He first typed *python* twice and later *java*, which are both programming languages that could indicate cbd8edc1's profession. The fact that both of the queries resulted in articles which are entirely unrelated to programming made me smile and wonder whether the user was delighted or disappointed. Unfortunately, I will never know.

cbd8edc1 quickly looked at *Monty Python sketches* and then read the introduction on *Carol Cleveland*, an American actress, known for her work with Monty Python. After a glance at the *Javanese Christian Church*, a bond of churches on the Indonesian Island of Java, the user left the site.

The Columbian visitor showed an interesting pattern. First, looking for a company producing adult content and then going towards the entirely different world of programming is fascinating to me.

20a00514

- Accessed: 27 Mar, 12:23 PM
- Referrer: ResearchGate
- Time on Site: 4:04
- Country: Pakistan

The connection from Pakistan, first typed *quantum* and landed on *Quantum error correction*. The article displayed a specific method used in quantum computation, which prevents certain errors. 20a00514 might have clicked on the Wikipedia link and quickly looked at the original article since the cursor stayed on the link for a few seconds.

However, the next terms, *Iqbal* and *Paracha* indicate a name, as I found out after looking up the terms myself. The user might have looked for himself since Iqbal is a typical eastern first name and Paracha is a common family name in India and Pakistan. This reminded me of a feature Wikipedia offers. A particular function displays happenings on

a given date. I remember using this function to browse through events that happened on my birthday when I was a teenager. 20a00514 then scrolled through the occurrences of *Iqbal Paracha* in the article about a former cricket player from Pakistan, *Misbah-ul-Haq*.

Sadly, I couldn't get a hold of the persons next search term, because of the obfuscation of the input field. The article about the Indonesian dessert, *Bubur kacang hijau*, didn't show any matching terms within the text. However, I assume the user typed something related to an eastern dish or a Muslim term since this would explain the correlation to Indonesia.

Conclusion of Recordings

The recordings helped me to collect patterns of the users' search terms and behaviors on the site. From this, I hoped to obtain insights into peoples interests and therefore, the potential that lies within the website. I first tried to get a sense of the areas in which people explored. To do so, I categorized the search queries:

- Science (*Quantum, Group Theory, Information Seeking Behavior*)
- Programming (*Java, C, Python, Diffie-Hellman*)
- Political Celebrities (*Berset, Assange, Trump*)
- Personal Names (*Iqbal Paracha, Frederic De Ranter*)
- Adult Content (*Cunnilingus, Yuzusoft, Cock*)
- Uncategorized (*Cat, Loud typing, Flower, Fish, Blade*)
- Default term: *Rainbow*

I realized that the search terms are frequently related to the site I shared the link on. Users looking for *Cat, Cunnilingus*, and *Fish*, for example, originated from Reddit. Users looking for *Java, Python*, and *Quantum er-*

ror correction read the link on my research gate post with many hashtags on the topic of algorithms. Also, a member of the LinkedIn group CILIP: Library, Information and Knowledge Professionals self-evidently queried *Information Seeking Behavior*. Concerning the topic of bias, the context, in which a project is shared in, proved to be a very prominent influence on the choice of the term.

By looking at the different search queries that the subjects made, a kind of knowledge feedback loop emerged. Often, I wasn't familiar with the words the user entered due to the exactness or cultural diversity of them. Analyzing these patterns forced me to look for uncommon knowledge myself and moving out of my general interests.

I visited translated Japanese websites on Yuzusoft and inevitably went on a terrain unknown to me. A Pakistani visitor familiarized me with eastern naming such as Iqbal Paracha and an Indonesian dessert called Bubur Kacang Hijau. Further, after talking with my mentors about the irony of the Monty Python article that arose upon looking for Python, I gained interest in knowledge about the naming of programming languages. Ironically, a few of the entries that revealed themselves after looking for programming related topics were indeed connected to the origin of the languages naming. Once more, a phenomenon which I'd categorize as serendipitous.

Specific Feedback

Alongside the digital recordings, I talked to people on forums and friends about the usages of the prototype or the idea in general. A few people argued that the site could be interesting in the sense of revealing unconventional knowledge. It has proven to be a tool worth examining when looking for connections, one might not think of otherwise. Depending on the background of the people questioned, different usages were mentioned. A person working in the marketing branch considered

using random or hidden facts about a topic as a way to entertain people.

Other people talked more specifically about the experience and the structure of the site. A key element seemed to be the relation to Wikipedia. The project shouldn't need to be seen as a search engine since we are prone to think of them as a tool providing us with exactly what we were looking for, or at least the closest result possible. This is one aspect which I aim to solve by changing the title and altering the visual.


Visual Aesthetics

While improving the mechanics of the algorithm, I tried to think about the structure and visual aesthetics of a future version. Apart from applying a unique style to the interface for solely aesthetical reasons, it also makes the user think of something else than Wikipedia. Multiple people have compared the application to the encyclopedia, which is reasonable given the fact that I included the name within the prototypes title, and the styling of the article remained the same.

However, in my opinion, the project can only be purely experienced without directly thinking of Wikipedia. Otherwise, the subject might see randomness and uncommon entries as a weakness or a worsening improvement of the existing system. Since people are well aware of the behavior on the encyclopedia, I was forced to create an unbiased environment, where they don't expect anything untrue.

Taking this as the first and most important aspect, I changed the background color. Wiki's most often use a white or grayish background. Therefore, I went with black. This required me to change the font to white since I didn't want to limit the readability of the content. For the font, I chose Inter UI, an open source sans-serif font which is optimized for screens, and accordingly worked well and opposed the serif fonts, generally used on Wikis.

Joetsu Line

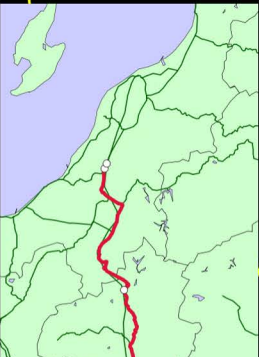


An E129 series EMU at Echigo-Nakazato Station in April 2016

Overview

Native name	上越線
Type	Heavy rail
Locale	Gunma, Niigata prefectures
Termini	Takasaki Miyauichi
Stations	34
Operation	
Opened	1920
Operator(s)	JR East
Technical	
Line length	162.6 km (101.03 mi)
Track gauge	3 ft 6 in (1,067 mm)
Electrification	1,500 V DC overhead catenary

Route map



The **Joetsu Line** (上越線 *Jōetsu-sen*) is a major railway line in Japan, owned by the East Japan Railway Company (JR East). It connects Takasaki Station in Gunma Prefecture with Miyauichi Station in Niigata Prefecture, linking the northwestern Kanto region and the Sea of Japan coast of the Chūbu region. The name refers to the old provinces of Kōzuke (上野) and Echigo (越後), which the line connects.

Services

Before the opening of the Jōetsu Shinkansen in 1982, the Joetsu Line had frequent service by express trains connecting Tokyo and Niigata. With the opening of the Jōetsu Shinkansen, however, the line became dominated by local and freight trains.

The branch of the Jōetsu Shinkansen between Echigo-Yuzawa Station and Gala-Yuzawa Station (the Gala-Yuzawa Line) technically belongs to the Joetsu Line.

Stations

Station	Japanese	Distance (km)		Transfers	Location	
		Between Stations	Total			
Takasaki	高崎	-	0.0	<ul style="list-style-type: none">Joetsu ShinkansenHokuriku ShinkansenTakasaki LineShōnan-Shinjuku LineHachikō LineShinetsu Main LineJōshin Dentetsu: Jōshin Line	Takasaki	Gunma
Takasakitonyamachi	高崎問屋町	2.8	2.8			
Ino	井野	1.2	4.0			
Shin-Maebashi	新前橋	3.3	7.3	Ryōmō Line	Maebashi	
Gumma-Sōja	群馬総社	4.8	12.1			
Yagihara	八木原	5.6	17.7		Shibukawa	
Shibukawa	渋川	3.4	21.1	Agatsuma Line		
Shikishima	敷島	6.4	27.5			
Tsukuda	津久田	3.0	30.5			
Iwamoto	岩本	5.8	36.3		Numata	
Numata	沼田	5.0	41.3			
Okuniwa	尾根	5.0	46.3			

In terms of the layout, I tried to use the left column as quick access for the table of contents and other, normally aligned on the right side, infoboxes, or images. The header, on the other hand, solely contained the page's title and the search field, with an additional search button, for people who don't hit enter and prefer a mouse click. I fixed the header on top, to enable quick access to the search field, which constitutes the central element of the site. Within the search field, I used to place the default value *rainbow*. Because of the large number of visitors that immediately explored this term without thinking, I changed the default word to *Search*. I also changed the term's property to a placeholder, meaning that it disappears on peoples click into the input field, leaving them no option but to type something themselves.


As a further aesthetic element, I created a line that highlights and connects the searched term within the article. Influenced by the beautiful prints from *Crossroads*, I used lines as a means of showing interconnectivity and flow. Also, users had difficulties in finding the appearance of their entered term, if it was far down in the article. Using the line, I could ensure that people would get a hint towards where to look for their search term.

Shortly after, I realized that the direct lines might not be as fitting as I thought. Regarding my topic, I figured that the lines would be too straight and determined. Lines that are not as straightforward would fit the effect of serendipity more. If my algorithm aims at providing indirectly related articles, why should the connecting lines be direct?


Figure 12. Prototype with improved styling and the direct line. 6 May, 2019.

Jōetsu Line

Joetsu Line



An E129 series EMU at Echigo-Nakazato Station in April 2016

Overview	
Native name	上越線
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Shibukawa	渋川	3.4	21.1	Agatsuma Line		
Shikishima	敷島	6.4	27.5			
Tsukuda	津久田	3.0	30.5			
Iwamoto	岩本	5.8	36.3		Numata	
Numata	沼田	5.0	41.3			
Gala-Yuzawa	最上	5.0	46.3			

Figure 13. Prototype with improved styling and the rounded line. 6 May, 2019.

Evaluation

After listening to the Max Frischknecht talk, I tried to verify the neutrality and ethics of my prototype using the three aspects he presented (see *Politics of Data* on page 37).

*“Don’t assume that the data is without bias.”
(Frischknecht, 2019)*

The way I see it, I use the MediaWiki database in order not to get hung up on the task of collecting data myself and purely focus on the filtering process within querying information. Nonetheless, most of the data on Wikipedia is biased itself. Looking at the diversity of the articles, it quickly becomes clear that the field of World Wars, for instance, is much more covered than say, information on gardening. Wikipedia isn’t a neutrally curated source. Because regular people can edit and create sites, the neutrality will always be subject to peoples interests and perspectives.

Changes within the different languages of articles are also a known issue of the database. Conflicts have been documented objectively by opposing sides in different languages, as Karmen Franinović explained. *Ustashe*, an article about the eponymous Croatian Revolutionary Movement, consists of contrary information in the English and Croatian version about the ideals and acts of the organizations (Ustashe, n.d.). This is likely to occur since people based in the country of the issue, for instance, might perceive happenings different and are not depending on politically filtered news or similar. Therefore, it is hard to distinguish between correct and incorrect sites, especially if there are multiple languages involved.

*“The data is as neutral as the underlying algorithm.”
(Frischknecht, 2019)*

One key algorithm I use is the query action of the MediaWiki API. The filtering that lies

within this function is inevitable in the current usage. MediaWiki analyzes the terms within the search and looks for correlating or even eponymous articles. The response is sorted by relevance, but by setting a parameter that accesses different ranges within this list re-sets some of the bias implied by this function. In terms of neutrality of the algorithm that I coded, I feel very contented. The code itself doesn’t do much filtering. The query it receives is entirely dependent on the process on the side of the MediaWiki API. One restriction that I create is due to the limitation of search queries. The API limits the search request to 500 results for regular requests. This means the algorithm can only access the 500 most prominent results, no matter how neutral I code.

*“Algorithms should not be seen as objective systems but as cultural artifacts.”
(Frischknecht, 2019)*

Exhibition Concept

Impact Without Input

One of the initial ideas for the exhibition was to surprise the visitors with knowledge related to them. I imagined that it’d be fascinating if a projection would automatically show exciting articles based on the surroundings, without needing the user to type a term. I then started to think about the influences which I could make use of. One option would have been to use Bluetooth or Apple AirDrop device names. Because most people in our environment name their devices equal to their name, and the Apple default naming format, which is *Michael’s* iPhone, for instance, I could have extracted visitors first names. After receiving these names, my program then would’ve obtained an article concerning this name. Zoe’s iPhone, for instance, would have triggered the article *Dear Zoe*, a book. I felt that this would have an excellent effect on the visitor, seeing an article relating to their name.

Apart from the pleasant surprise, I would have created a small homage to the exhibition *Cybernetic Serendipity* from 1968 (Cybernetic Serendipity, n.d.). I would have made use of influences from the environment, that results in an effect on the visitor, which again influences the program. The strength of the signaling loop would have been depending on the exact type of inputs that the program would’ve measured.

In the end, I decided against this idea because of the improper connection to hacking and surveillance. Furthermore, querying names usually results in an article about a celebrity, which would have limited the serendipitous effect.

Indexing the Exhibition

Daniel Holler, a colleague from my studies, told me about a bachelor project from a few years ago, where a team of Industrial Design students created miniature models of other bachelor projects for the exhibition. This mo-

tivated me to think about using projects from the diploma exhibition as a source.

What if I created a serendipitous search engine which recommended different works and motivated people to see specific exhibition spaces? I liked the idea of using a unique dataset but faced the fact that collecting this data might be extremely costly. The differences between the formats, languages, and contents would have formed an immense potential for mistakes. Furthermore, I couldn't quite estimate what the effect might be. Indisputably, part of the surprise would have been lost because of the lack of diversity within the dataset. The visitor couldn't stumble upon bizarre Japanese companies or the *Javanese Christian Church* anymore. The search would be limited to, presumably, mostly serious Bachelor projects.

Booth

As I talked to my family about a potential exhibition idea, my sister mentioned the old 3D glasses. The ones where one eye peaked through a blue foil, and the other one through a red one, resulting in a three-dimensional appearance of something almost unrecognizable without the goggles. This got me thinking.

What if I used a visual effect, to display my prototype? What if people could only see the serendipitous version by looking through some magic device or object. Also, having a comparison might make sense. By displaying my project next to the regular results, I could demonstrate how refreshing and exciting alternative articles are, in direct relation to the standard result. Because I'm not a very big fan of VR goggles, I thought about some isolated booth, where one could experience this, similar to some private cinema, or adventure room. In the meanwhile, the other visitors would only see the standard article, but the user might read exciting things within the booth.

While I started to sketch this idea, I began to wonder if it makes sense to isolate the

user this extremely. Thinking of the research I did on Filter Bubbles and personalization, the other way around would make more sense. What if the person that queried a term, would see the standard, slightly dull, article within the booth? On the projection outside, the exciting article would show. This way, the user is limited within the enclosure. It's almost as if he is trapped inside the bubble and has to step out of the booth to glance a view at the surprising article.

Trace

After testing a simple version of the previously introduced concept, I realized that nobody understood my idea. I figured that if there was so much explanation needed for the visitors to understand the principle of comparison, it wouldn't create the effect I hoped for at the exhibition. These findings made me realize that building a booth won't work, and will only be a waste of time.

After talking to my mentors, I recognized the importance of a trace. Providing something that the viewer could take home would add another layer to the project. The idea was to print generated postcards with viewers queries and the occurring results. An aesthetical example might be the famous painting *Ceci n'est pas une pipe*, from the surrealist René Magritte. Similar to the misleading message and the connection to the image behind, I could overlay text from a serendipitous article on a picture of a search term. This could have the effect of confusion and might result in an artifact that only the receiver truly understands.



Figure 14. Temporary rendering of the booth idea. 13 May, 2019.

Conclusion and Reflection

Conclusion

A few months ago, I explored the effects of the Filter Bubble, eventually landing on the lack of potential for serendipitous findings. Realizing this, I tried to collect hints towards where and how these encounters appear in our everyday life, as well as the connection to algorithmic methods. So I spent my research phase on getting to know about the opportunities and issues of algorithms. Further, I used small pieces of code in experiments to evaluate how I can promote serendipity.

Coming back to my research question, “*how can I computationally enforce serendipity?*”, there are a variety of possibilities. For one thing, I imagine that the leading cause of error and bias often lies within the purpose of an algorithm. If the service aims at always providing the most accurate result, there is limited space for the unexpected. However, by taking diversity and chance into the equation, the monotony of the results decreases. It is precisely this that I tried to achieve with the project published on *lateralcomputation.ch*. The search displays articles that are related to the search term, but not the most common one. Further, slight randomness ensures that the article that reveals isn't always the same.

To escape the bubble, filtering might need to work across categories. I often realized that results which are in an entirely different matter than the searched term, make a great surprise, and highlight correlations across different kinds. Also, the opportunity to drift towards whatever you're interested in is crucial. If an algorithm predefines the entire path, there is little room for personal preference, and uniform knowledge is present.

Considering the simplicity and achievements of my code, I believe there are many options worth examining while creating an algorithm to enforce serendipity.

The following chapters should provide a more in-depth insight into my reflection on the outcome, the process, and the lessons learned from this thesis.

Outcome

During the chat with my family about the exhibition, I talked to my mother and decided to show her how my prototype works. Therefore, I told her to type anything she wanted within the search field. After I insured her, that she could also type *violin*, the article about the Singaporean island *Pulau Biola* appeared. The island is called Violin Island on account of the island's shape. We then looked at satellite images of the island, guessing what might be on there or who of us had traveled closer to the island's location. Exploring the term further back on my site, resulted in seeing pages about the connection to music but also other awe-inspiring things such as the *Shrew's fiddle*, a Middle Age tool for punishment.

Within this scenario, I wasn't trying to evaluate the project, yet, I was surprised by the articles that arose. Having tested the program a thousand times, I typed all kinds of things. Seeing how the algorithm performed on a term I had never entered before and then observing such impressive results amazed me. Some of the articles which I haven't explicitly mentioned were less interesting and more guessable, yet, I was delighted with the overall performance of my code.

I think it is fair to say that the algorithm doesn't always enforce things categorizable as serendipitous. However, while working on this project, I realized that often, the serendipity is only triggered by the encounter and additionally relies on the user. The algorithm can only do so much in the direction of surprising a person, as users are willing to understand and connect to their interest or aim. The further impact of the shown article then depends on the subject.

Process

Reconsidering the process I chose, I think I am generally quite satisfied with the procedures I followed. Early on, I imagined making use of lots of mathematical research and theoretical knowledge on developing algorithms. However, after looking at prior works within this field, as the Serendipity Model for News Recommendation (Jenders et al., 2015), I realized that these formulas were way too complicated and that I would never achieve at developing something even remotely reasoned.

After realizing this, I started to experiment with more trivial things, which would enforce the notion of drifting or encountering things that are somewhat, yet not too directly related matters. During the process, I wasn't always satisfied with these common methods. However, I have concluded that regarding how great they work, they were an excellent choice. Considering how much time I could have misused on complex mathematical calculations, I am pleased with the practices I chose. Especially regarding the given structure of a bachelor thesis in Interaction Design, I am happy that I was able to spend time on analyzing users behavior and the visual aesthetic of the project.

There has been a significant amount of serendipity and irregular methods within the process of this thesis. Many, mostly somewhat unpredictable, happenings have influenced this project and helped not to get stuck within a too linear process. The sole fact that the actual topic of my work has influenced my work and the almost cybernetic loop that this creates astonishes me and makes me smile.

Furthermore, I found beauty in the effect of using the tool that I created for specific tasks within this work. For instance, while choosing a title for the project, Aurelian Ammon, a friend from my studies, hinted me towards using the algorithm itself to pick a name and a caption. After stumbling upon the article *Lateral thinking*, as I sought serendipity, I tried to connect this to a plausible title. Since my project consists of the possibilities that computation allows for in this context, *Lateral Computation* seemed like a perfect choice.

Lessons Learned

I gained an entirely unique set of information because of knowledge feedback loops. As I observed the recordings of users on my prototypes, I intuitively tried to guess or inspect the relationship between the sought term, the article, and the user. Not only enabled me this to speculate on peoples personality or interests, but it also taught me about very particular topics in which I would never have investigated otherwise. This knowledge ranged from the origins in the naming of programming languages to weird Japanese adult video game producers.

Furthermore, I experienced the importance of literacy and naming within the user testings, as well as in searches. As most of the persons I questioned have pointed towards the naming of the *Infamous Wiki* and asked how my project improved the popular encyclopedia, I realized that the relation to Wikipedia depreciated my prototype and led to false assumptions (Schönenberger, 2019b). I then realized how important the process of accurately naming and promoting a project is. A falsely advertised prototype can bias the testings immensely.

In connection to search terms, literacy became a very prominent factor. Unknown associations between the programming language Java and the Indonesian island, for instance, became clear as I investigated in their relation. Similar to this event, I learned a lot about how the search results might relate to other things and the importance of naming and language.

From the start, I had quite positive beliefs towards the effect of serendipity and its value. However, during the process, these beliefs have been confirmed multiple times, as I experienced the unexpected and made great use of it.

Impact

Concerning the impact, I initially wanted to achieve and the actual outcome, I have exceeded my expectations. I planned to provide an alternative in the field of knowledge retrieval systems that works less linear, yet, to be honest, I didn't think that I'd come across users that understand the potential in what I was doing or would continue to use the platform if I were to publish it.

However, after *ColinWright*, a Hacker News member questioned how long the link I posted would remain working, I felt the need to publish the project after my thesis (Schönenberger, 2019c). Many users had previously described how they'd use the site, but being questioned for how long the link worked confirmed me that there is a genuine interest in using what I developed.

That being said, I mean to publish the final project of *Lateral Computation* under *lateral-computation.ch*. The purpose of this is to ensure a backdoor to the serendipitous search engine and inspire future people seeking serendipity.

With this thesis, I aimed to question existing systems. I hope to create an awareness of the argument. I don't want to discourage people from using Wikipedia or Google, but to be aware of the methods behind these systems, and the disadvantages they bring with them.

Moreover, I see my contribution in providing an alternative to the existing efficiency-driven filter methods. Whether or not my project will be used in the future, it is necessary to alternate and use computation in unconventional matters. I hope to reach people and inspire to embrace these less linear methods.

lateralcomputation.ch

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