Serendipity & Recommender Systems

Book of Abstracts

Symposium
November 22-25, 2021

Organised by the Serendipity Society
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The ubiquity of ***Recommender Systems*** has grown fast in the past years, reaching from news and public debate to film industry, music and everyday life. However, while technical studies on RS have been advancing significantly for already for over two decades (specially in business-related applications), it was only recently that researchers from other areas have started to analyse RS's impacts on societies. Albeit the freshness of this debate, it is already evident that nowadays RS carry with them a variety of *legal, ethical, societal, epistemological and cultural issues* brought about by AI and big data technologies, that are used, in this case, to identify the "best" information or content to a certain user or to groups of users. Issues include, for instance, the transparency of the system, the source of the collected data, the influence of the recommendation on individual autonomous decisions, and, last but not least: **the role of automatised recommendations in blocking and/or fostering discoveries, novelties, diversities and serendipitous findings** — and the implications of the latter in different domains, such as news, political debate, scientific information, communication, entertainment, cultural industries, etc.

In this context, some of the relevant questions are:

- Is it important that a RS allows the user to make serendipitous discoveries? Why?
- Can RS be programmed as to stimulate serendipitous findings? And how to evaluate that?
- Can RS have negative impacts on users's sensibility for serendipitous encounters?
- Can a RS "understand" that a user has serendipitously discovered something relevant? How? And if not: can we say that RS might inhibit the user's potential to change his/her preferences or interests? And how to avoid that?
- Is there any relationship between RS and (the lack of) serendipity in actual political and cultural issues such as polarisation and attention economy?

Bearing that in mind, and as a follow up to the last symposium of SerSoc on Serendipity and Big Data held in February 2021, we would like to invite researchers from theoretical and empirical areas to discuss current issues related to **Serendipity and Recommender Systems** in our **online symposium**.

Symposium Program Chair: *Vinícius Jonas de Aguiar (CFCUL)*
Serendipity Society Symposia Chair: *Wendy Ross (London Met)*

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Hacking into excessive mimesis in the age of >platforms< of >prompt<

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By a philosophical detour on excessive mimesis (Benjamin/Caillois/Taussig), I will introduce *recommender systems* such as the musical *platform*>>Spotify<< - derived from the former open, decentralized platform of file sharing >>Napster<<- within a framework of the *power of platforms of prompt*. Platforms (Seemann 2021) not only hinge on an already existing network of relationships or a context of interaction but must be tapped, iterated, or integrated by going beyond "proof of concept" and a few lines of code. My focus delimits the internal recommender system debate on algorithmic platform technologies such as its temporal dependencies and feature-based representation learning tools of textual data -such as based on short MIDI sequences of songs- (Damak et al 2021), the explainability problem of a chosen sample content recommended and personally pre-selected for you, heeding a) collaborative filtering and the b) cold start problem overcoming mere (in) transparent models or post-hoc techniques of personalized explanations of personal relevance c) deep learning architectures, d) matrix factorization proposals and e) deep sequence models, in order to model sequential data for explaining recommendations (sequence model-based recommender systems that predict the next interaction based on previous interactions, and at the same time extends the scope of the debate on interaction selection/algorithmic sorting machines and politics of cueing heuristics in aesthetic judgments and path decision in artificial creativity of crowd-production styles and media-performative artistic approache*s.* Platforms of prompt incite actions triggered by ML/IA algorithmic programs, or algorithmic rationality cultures, cue social resonance between a pre-given standard such as preceding human artistic productions or production styles for comparisons and adaptations of pre-given images- or even acting- styles. Now I am interested in how platforms are real-life social, aesthetic, and political-cultural, and economic sorting machines (cf. the concept of country borders as sorting machines in the age of globalization in Mau 2021) and, as such, influenced by control over diagrams. The growing power of platforms in their infrastructural hegemony and platform sovereignty as fostered by bottleneck politics is put into question. Platform power represents an interim cultural form that might be integrated into a larger context of peer production, powerful decentralized collectivities, and the contemporary cultural industry (cf. NFT Avatars Art using blockchain technology and its attributed value; cf. Reichert 2021). Diagrams are the underlying architecture that a platform cannot create itself. A platform can create the conditions to make the connections and relations or choices possible - as an expected selection of potential relationships and operating on their articulations. But the platform diagrams are only helpful if they correlate to the concrete connections of a life-world reality outside the platform. Platforms require deviations/ detours, abductive jumps, gaps, leaps, syncope, and even retardations such as pensiveness (Hans Blumenberg 2021). These are all related to real human life and embodied music passions, significant friendships, F2Fencounters, significant (material and ideal) needs, historical and culturally formed interests, individual and collective experiences, and events in time, significant places, paths, or passions. Thus, even new choices and aesthetics can arise - including serendipitous ones within the human-based realm of platforms of prompt. This

paper investigates specific artistic projects, dramaturgies of technological action such as time-based artistic dramaturgies of prompt or even examples of acting styles are essential in prompt acting such as in the visual, theatre, and the theater and visual/VR artist *Suzanne Kennedy's* immediate mimesis performing on stage with prompted masks of the actor's faces but with prerecorded decentralized (crowd) voices (contextless recordings that create estrangement in between actor, acting style, mask, and prerecorded voices, by including the whole production team in the construction of a character or the AI-aided coder-artist-scientist *Mario Klingemann* and his decentralized AI generative- evolutionary algorithm art creation community platform "Botto" (an AI aided artificial "artist" and art auction platform). Prompt aesthetics heeds shadow writers, >oracles<, digital-human body, voice and face double deviations/interactions, and music shadows and digital twins. All these might be hinging on AI aided aesthetics and new cultural economies of strange and radical mimetic platform *a*ffects *(cf.* the musician-producer-theorist *Herndońs album "Platform")* of not only Visual art creation (cf. >DAO I Crossing the Interface<; 2021: *Holly Herndon "*) by the introduction of new platforms of collaborations ("We are AI!") and co-creation with for example the human-voices-chorus-trained AI algorithm >Spawn< of the platform >>Holly+<<.

Keywords: Platforms; Prompt Aesthetics; Mimesis; AI Aesthetics; Recommender Systems

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Framing serendipity in recommender systems as a multi-stakeholder problem

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In media and communication studies, the academic discourse on serendipity in recommender systems is to some extent dominated by the alleged lack of it. In the light of discussions on preference amplification and a lack of exposure diversity, serendipity is considered as an antidote that will promote viewpoint diversity and eventually enrich end-user experiences. Scholars have been studying how algorithms can support exploration and serendipity, what it means when there is too much or not enough – and when is that? In this way, the aim is to provide answers to the question of how a system can be designed to promote serendipity, and what the consequences could be. While these are all indisputably relevant contributions, my claim is that there is one important question we are failing to ask: what is the value of serendipity in recommender systems for other actors than the serendipist? After all, recommender systems are not magically resulting from a void. They are the result of a deliberate design and negotiation process among multiple actors involved. The purpose of the recommender and the metrics it is designed to optimize for, are hence the result of this interaction among more than just one stakeholder. This perspective to recommender systems is known as multi-stakeholder recommendation, which is emerging in the recommender systems community and contrasts the current research paradigm that holds a narrow (mostly user-centered) perspective on the recommendation task. Indeed, a music recommender, for example, not only aims to satisfy the end-user, but also artists and advertisers. How does serendipity matter to them and, perhaps more importantly, what do these multi-stakeholder interests mean for the design of the recommender system and thus how serendipity is interpreted and implemented? In this contribution, I will explore what it means when we start framing serendipity as a multi- stakeholder recommender problem.

Keywords affordances, design, multi-stakeholder recommendation, serendipity, value

Annelien Smets is a PhD Candidate at Vrije Universiteit Brussel and member of research group SMIT (Studies in Media, Innovation and Technology). Her research is situated in the domain of media and communication studies and focuses on designing for serendipity in multi-stakeholder environments. In her doctoral research she puts a particular emphasis on serendipity and recommender systems in urban environments. Annelien has a background in business information systems management and artificial intelligence. She is co-chair of the Serendipity Academic Researchers Network (SARN).

Fate, luck and serendipity: experiencing an AI saturated world

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Systems that embed artificial intelligence offer the potential to improve our lives by reducing certain kinds of work and enabling a variety of richer experiences. At the same time, though, they may change substantially our experience of the world and what we do and don't realize of our own potential. I argue here that recommender systems, even those that attempt to preserve the experience of serendipitous discovery, will lead to experiences that will feel to the experiencer as fated rather than as manifestations of personal capacity. To support this argument, I start with a taxonomy of three types of unplanned discovery - fate, luck and serendipity - that maps them against certain aspects of search (discovery) strategy. Along the way, I briefly address the gap between working and popular definitions of serendipity and the stronger requirements of Walpole's definition, proposing that there is a useful distinction between weak and strong serendipity. This is followed by an attempt to elucidate the nature of several different historical and quotidian discovery examples in the context of the proposed taxonomy. I close with some observations about the status of recommender systems as agents of serendipitous discovery.
Keywords: AI, recommender systems, serendipity, fate, luck, experience

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An overview of serendipity in recommender systems

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This talk will cover definitions of recommender systems and serendipity, why recommender systems need serendipity, what recommendation algorithms currently exist and how to measure the ability of a recommender system to suggest serendipitous items. Recommender systems are software tools that suggest items of potential interest to users. For example, YouTube suggests videos, while Spotify – audio recordings. To generate recommendations, these systems employ algorithms, such as user-based collaborative filtering. These algorithms detect users who have similar tastes to the target user based on their past behavior in the system and recommend items that these users liked, but the target user has not consumed yet. As recommender systems by design suggest items similar to those the user liked in the past, it is often difficult for users to find items that differ from those they indicated initially (the so-called filter bubble effect). Another common problem of recommender systems is that they suggest items that users are either already familiar with or would find on their own anyway. This happens because (1) recommender systems are designed to suggest to the user items that are similar to what the user consumed in the past and (2) they often suggest very popular items, as these systems have extensive information on them. A common strategy to overcome these problems is to suggest serendipitous items. According to the dictionary, serendipity is "the faculty of making fortunate discoveries by accident". In recommender systems, the term serendipitous item refers to an item, which the user had not seen before and would not even look for on their own, but when the user consumes this item, they enjoy it. The ability of a recommender system to suggest serendipitous items can be assessed in online or offline experiments. Online experiments involve users interacting with the system and typically explicitly indicating whether a particular item is serendipitous to them. Offline experiments involve logs of recommender systems. In these experiments, researchers typically mark certain items, with which the user interacted in the past, as serendipitous, hide part of logs from the recommender system and observe how often the system recommends serendipitous items in a simulated environment. There is a number of recommendation algorithms that are designed to suggest serendipitous items (serendipity-oriented). They are usually based on existing algorithms designed to predict items the users are going to like (relevance-oriented). The serendipity-oriented algorithms increase serendipity of these algorithms by (1) altering the input data for these algorithms, (2) altering the way the recommendations are generated, (3) altering the output of relevance-oriented algorithms or (4) combining multiple methods: 1, 2 and 3.

Keywords: serendipity, recommender systems, evaluation, machine learning

Denis Kotkov is a postdoctoral researcher at the University of Helsinki. He defended his doctoral dissertation titled: Serendipity in Recommender Systems in 2017. He is also the main author of the first publicly available dataset, which contains user feedback on serendipitous items. His research interests include serendipity, recommender systems, exploratory search and machine learning.

Serendipity and explainability in recommender systems

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Recommender systems are designed to help users find interesting items, when the number of items is overwhelming. An item can refer to any object, for example a song or a movie. Serendipity and explainability are two active research topics in recommender systems. However, the intersection of these two topics is largely unexplored. In particular, the impact of explanations on serendipity is largely unexplored. In recommender systems research, serendipity is usually defined by three components: novelty, unexpectedness and relevance. It is relatively easy to achieve novelty and unexpectedness. For example, a random item drawn from a large catalogue would probably be both novel and unexpected. It is more difficult to achieve relevance, especially for unexpected items. This is known as the unexpectedness-relevance trade-off. We argue that explanations -which are human-oriented pieces of information describing why an item is recommended- can help increase the perceived relevance of unexpected items, and thus can help increase serendipity. Our argument may be tested by employing some tools we developed in our research. In a recent contribution, we provided an algorithm for generating short item-to-item textual connections, which we called segues. If the items are songs, a segue links two songs. For example, the song “Post Requisite” by Flying Lotus and the song “Wisdom Eye” by Alice Coltrane can be linked by the segue “Flying Lotus is the grandson of Alice Coltrane”. Segues are strongly related to explanations. A recommendation can be explained with a segue that links the recommended item to an item that is familiar to the user. We also introduced an interestingness measure for segues. Given a segue, we can calculate its interestingness in a range from zero to one. We assessed our interestingness measure in a user trial. We found that segues with high interestingness can spark interest in items, which leads credence to our argument.
Keywords: serendipity; explainability; segues.

Giovanni Gabbolini is a PhD student in the School of Computer Science and Information Technology at University College Cork, Ireland. His research focuses on Recommender Systems and on Music Information Retrieval.
Derek Bridge is a senior lecturer in the School of Computer Science and Information Technology at University College Cork, Ireland. He is also a Principal Investigator in the Insight Science Foundation Ireland Research Centre for Data Analytics and a co-leader of the Science Foundation Ireland Centre for Research Training in Artificial Intelligence. His research focuses on Recommender Systems and on Case-Based Reasoning.

Recommender system to guarantee serendipity for stuck researchers

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A r**ecommender system (RS)** first of all **filters** the global possibilities. This filtering process eliminates items that are definitely not of interest. Next the RS provides a **rating** for each of the items found to ensure that the most relevant can be **ranked**, and displayed first. If done properly, then the recommended **item** can be presented first. Surely it will be judged by the user as being **serendipitous**. We concentrate on the problem of generating a **serendipitous recommendation** to **users** who are **researchers**. We analyse the **things** that block progress in research. So we investigate how researchers suffering from **research block** can have **unknown unknowns** revealed **serendipitously**. The question that we pose is – as a researcher – what is it that I do not know I critically need, to solve my research question? In other words, what would a wiser advisor recommend to me? 1.We first rank the **things** that researchers may need in order to progress in their research. Then we rank the **things** where the researchers may easily and commonly fall short. 2. Then we make a ranked list of key keywords that can enable the researchers to figuratively open blocked doors to crucial rooms. 3. Next we make a ranked list of the virtuoutios actions for the researchers to try. 3. Next we make a ranked list of exhortations to the researchers in order that the researcher can ultimately confirm: ”Yes I did not know that, and I sorely needed to know that! I feel so lucky that I now know it!” The problems that we face in designing such a RS is that we know all too little about the individual researchers and their fields of endeavour. This is the **cold start problem**. Another problem is the **fickleness** of the researcher. For every question answered another direction is taken. 1. We provide our ranked list of **things** that the typical researcher would regard as an **unknown unknow**n. This is something that the researchers do not know they do not know! 2. We also reproduce our current, ranked list of key keywords. 3. Next we provide a ranked list of (serious) virtues, derived from our serendipity teaching board-game.4. Finally, we provide our ranked list of 40 exhortations. Our predetermined ranked lists offer relevance, and novelty, which is a prerequisite to guarantee serendipity. The truly unexpected, recommended item is something that the researchers have not seen anywhere in the past, and the researchers were oblivious even to its existence! The recommended items may all be presented in order of ranking and result in serendipitous recommendations to researchers who are stuck.

Keywords: Unknown Unknowns, Key Keyphrases, virtuous actions, exhortations

Ian G. Kennedy PhD MSc(Eng) BSc(Eng) (Wits). Dr. Kennedy is retired from the University of the Witwatersrand. He started researching serendipity in 2012. For more than two decades, he has lectured on how to do research to industrial, business, commerce, accounting, engineering, mining, financial, management, medical CPD, and academic audiences. He has supervised students to successful doctoral degrees – in more than one faculty – and has advised master's students in most faculties. He has six dozen publications yo his name and has presented in a dozen countries for more than two dozen academic organizations. He has served as guest lecturer, program committee member, paper referee, book editor, guest editor, and keynote speaker. His ResearchGate Score was 339.05 on 2021-09-2.

Content curation in online platforms

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In this talk, I will discuss online *content curation* mechanisms: socio-technical systems that mix human labor and machine learning models to govern social networks. These systems determine what to recommend to users, what content to keep and what content to remove, and how to share revenue with popular content creators. Also, importantly, the control of these systems lies largely in the hands of platforms, making research in this direction *actionable*. Recommender systems can be improved and tuned, and moderation and monetization policies may be adjusted and tweaked. I will discuss three projects I have been involved in the last few years, each of which captures a different content curation mechanism. First, I will discuss my work on Auditing Radicalization Pathways on YouTube, published at FAT*2020, where my co-authors and I inspected whether users migrate from controversial to radical communities in the platform (which is mostly driven by its recommender system). Second, I will discuss my work on community bans on Reddit, where my co-authors and I analyzed the effectiveness of the bannings of two communities, r/The_Donald and r/Incels. Third, I will discuss my work on Alternative Monetization Practices on YouTube, where my co-authors and I discuss the influence of monetization strategies such as patronage in our online information ecosystem. Lastly, I will also try to discuss the role of serendipity in our online information ecosystem as informed by the aforementioned research. Fields like medicine and economics have greatly benefited from an evidence-based approach, leveraging scientific information to guide policy and decision-making. I believe that studying best practices for content curation can lead to similar benefits for social networks and the Web ecosystem. To address current issues on the internet, it is not sufficient to describe them, it is necessary to find scalable solutions with the tools at hand.

Keywords: content curation; online platforms; content moderation; monetization

Manoel Horta Ribeiro is a second year Ph.D. student at EPFL in Switzerland. His research uses a diverse methodological toolkit to characterize troublesome online phenomena and to assess how moderation policies and recommendation algorithms can be leveraged to improve our online information ecosystem. His work has received multiple awards such as the 2021 Facebook Fellowship Award and a Google Latin America Research Award, and has been covered by a variety of news outlets including The Washington Post, Rolling Stone, DER SPIEGEL, and El País.

Recommender serendipity and the new mechanistic view of the world

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With the development of the *Metaverse algorithm*, new forms of online interactions have been proposed that aim at the "improvement" of people's communication in virtual environments. This algorithm, with special tools for simulation of the perception of images in three dimensions, gives a new dynamic to human interactions in workplaces. In a similar vein, *mechanical recommender systems* are now entering into everyday activity and into the domain of serendipitous scientific discovery. Proponents of *serendipity recommenders* (SR) argue that unexpected regularities can be found not only in the domain of commerce, to assist clients in purchasing novel products, but also in the areas of Biology, Chemistry, Physics, and Social Sciences. Given that one of the central characteristics of serendipitous experience is unexpected discovery (achieved by accident), while in pursuit of an unrelated finding (Copeland, 2019), the question to be addressed in our round table is as follows: **What are the epistemological and ethical consequences brought about by the development of new mechanicism in our serendipitous experience of the world?** Emphasis will be given to enquiry into *serendipity in recommender systems* aimed at producing serendipitous experience in everyday life.
Keywords: Ethical consequences; Metaverse; Serendipity Recommenders; Virtual environment

Maria Eunice Quilici Gonzalez has a BSc in Physics, and an MSc in Logic and Philosophy of Science. Her PhD thesis "A cognitive approach to visual perception" was completed in 1989 at the University of Essex, UK. She is a founder member of the Brazilian Society for Cognitive Science, and the Research Group on Cognitive Studies at UNESP, the CLE research group on self-organization at UNICAMP, and a Latin-American representative at the Council of the Complex Systems Digital Campus UNITWIN/UNESCO. She is the Brazilian head of the Project Trans-Atlantic Platform (T–AP), Digging into Data: *Understanding opinion and language dynamics using massive data* (OpLaDyn) (FAPESP Number 2016/50256-0). She is interested in the interdisciplinary analysis of philosophical, and ethical issues related to the influence of Big Data and ubiquitous computing in autonomous decision- making processes.

Guiou Kobayashi has a BA in Electronic Engineer from the Polytechnic School of the University of São Paulo. He also holds an MA and a PhD degrees in Digital Systems from the same institution. He is Associate Professor at UFABC, where he works since the institution started in 2006. There he has worked as Adjunct Director in the Centre of Mathematics, Computation, and Cognition; Pro-Rector of the University Extension; and for three consecutive years he was an elected member of the University Council. His areas of interest include Ubiquitous Systems, Complex Systems, and fault-tolerant Computational Systems. Besides that, he is interested in humanitarian and ethical applications of technologies. He is a member of the IEEE (Institute of Electronic and Electric

Engineers), where he was the president (2015-2016) of the Section South Brazil. He coordinates the Nubisys (Nucleus of Research in Ubiquitous Systems) at UFABC.

Mariana Claudia Broens is an associate Professor of Philosophy at UNESP – University of Sao Paulo State – Brazil, CNPq research fellow and member of the Centre for Logic, Epistemology and History of Science – CLE-UNICAMP – State University of Campinas – Brazil. She teaches Philosophy of Mind, Information Ethics and Theory of Knowledge and has a special interest in the following research topics: Self-organization, embodied embedded cognition, ecological information, information Ethics, and Big Data. She is a member of the Research Group on Cognitive Studies at UNESP, the Research Group on Self-Organization at UNICAMP, and the Complex Systems Society.

Vinicius Romanini is Professor at the University of São Paulo, Department of Communication and Arts (ECA). He is scientific editor of the journal SEMEIOSIS (Transdisciplinary Journal of Semiotics and Design), and researcher at the Centre for Latin-American Studies on Culture and Communication (CELACC) and at the Centre for Logic, Epistemology and the History of Science (CLE/Unicamp). He was the president of the Brazilian Society of Cognitive Science (SBCC) between 2015 and 2019.

A pragmatic and communicational approach to the exploitation of data and algorithmic mediations

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The dynamics of how algorithms work on the Internet has been the subject of discussion today due to their supposed ability to modulate behaviors, whether for marketing or political purposes. Several approaches are made regarding this theme – from the psychological, sociopolitical or communicational point of view, among others. The permeability of algorithmic mediations takes place within the context of wide access to the Internet, mobile devices connected to it, the digitization of everyday activities and the wide presence of individuals in digital social networks. Affections mobilized in networks by algorithmic mediations are a phenomenon that has been attracting attention for some time, due to the effects they have had on political organization in the world. The idea is that there is a universe of data obtained about individuals, via navigation patterns, use of applications and technical tools contained in smartphones, and that can be used to target them with hyper-segmented advertising pieces, customized from their consumption patterns and psychological profiles. This strategy supposedly has the power to amplify certain actions via certain specific stimuli, whether these actions are in the direction of purchase, access to certain websites and, as will be discussed in more detail, in gaining supporters for certain political strands. Both algorithms and the online environment itself are actors that allow for the growth of radical rhetoric. More than that, their working dynamics tend to thrive in the wake of this radicalization. It appears that the intention is to change something in the order of a mental state that, according to Charles Peirce's pragmatism, is understood as a habit. The concepts of habit and belief are used to address the actions of algorithms and the fertility of the online environment in political radicalization. Peircean thought considers it a natural evolutionary tendency to seek restful mental states. When any event happens that irritates such states, doubt arises and must be resolved. Online environments seem to be feeders of situations in which tenacious forms of fixation of beliefs occur, since the state of mental tranquility can be reached regardless of the veracity of the new formed belief, apparently enabling a prevalence for the immediacy of the resolution in detriment of criteria for evaluating the logic of belief. Naturally there is, for all individuals/users, a material context in which they are inserted, and these contexts always put them in contact with a myriad of semiotic Objects. In some cases, therefore, there may already be some predisposition to fix radical beliefs in radicalizing environments because there is a previous familiarity with those semiotic Objects that constitute the stimuli from online environments by collateral experience.
Keywords: Fixation of belief; Algorithmic mediations; Political radicalization; Semiotic analysis.

Marcelo H. Alvim is a PhD student in Communication Studies at Universidade de São Paulo (USP), Brazil, where he is researching the semiotic approaches to algorithmic tools and mediations with a framework in the epistemology area.

Epistemic fragmentation and the social dimension of serendipitous recommendations

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Recommender systems typically aim to personalise content to users, making it easier to find or discover items that are relevant. Sometimes, the recommendations can be serendipitous, in the sense that they can lead to a novel, unexpected and relevant discovery. In many domains, serendipitous recommendations have a positive effect on user satisfaction, contributing to the commercial appeal of a recommender system. Designing for serendipity can give users a chance for creativity and personal growth, as well as help to mitigate problematic aspects often connected to recommender systems, such as the risk of creating filter bubbles or reinforcing popularity bias. Serendipitous recommendations are therefore important from an ethical and political perspective (Reviglio, 2019). However, designing for serendipity in recommender systems can be difficult. One of the issues involved is a relatively scarce understanding of the types and mechanisms that can give rise to serendipitous experiences. Existing work on serendipitous recommender systems tends to focus on individual user experience. This raises the question if this research focus favours a particular type of serendipitous discovery, and whether there are other avenues that could be explored. Adapting a taxonomy of serendipity in scientific discovery developed by Yaqub (2018), I distinguish four types of serendipitous experiences and four mechanisms or factors that can produce serendipity in recommendations. These four mechanisms are not mutually exclusive; to the contrary, serendipitous discoveries often involve more than one mechanism. Among them, the 'network' mechanism, which produces serendipitous discoveries through meaningful and unexpected social interactions, seems saliently absent from recommender systems design, which instead exhibits what Milano et al. (2021) call epistemic fragmentation, that is a state where each user is unaware of what others (even in their close social circles) see, because recommendations are personalised. Epistemic fragmentation is independent of diversity of exposure: users of a recommender system may be exposed to varied sources of information, and yet their personalised recommendations may still be hidden from one another. Epistemic fragmentation in recommender systems entails that users miss out on possibilities to share and compare their recommendations, blocking one important mechanism through which serendipitous discoveries can emerge. This has important implications for the governance of recommender systems, especially in domains of public interest. In response, I conclude by exploring some possibilities to facilitate serendipitous discovery via social interaction in recommender systems design, including the creation of flexible 'recommendation collectives'.
Keywords: epistemic fragmentation; recommender systems; serendipitous recommendations; ethics of AI.

Silvia Milano is a Research Fellow at the Future of Humanity Institute (FHI) in the Faculty of Philosophy and a William Golding Junior Research Fellow at Brasenose College, University of Oxford. From January 2022, she will be Lecturer in Philosophy of Data and Data Ethics in the SPS Department and IDSAI at the University of Exeter. Prior to joining FHI, she was a Postdoctoral Researcher at the Oxford Internet Institute, where she remains affiliated with the Governance of Emerging Technologies (GET) research programme. Before that, Silvia Milano completed a PhD in Philosophy at the London School of Economics and Political Science in 2018. Her interests lie primarily in epistemology, ethics, and intersections between the two, especially in connection with

Artificial Intelligence. Her current research investigates epistemological and ethical issues relating to recommender systems.

The sterility of recommender systems

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In Peirce's original formulation of the pragmatism, abduction is a form of ampliative inference that arises from the perception of surprising facts. Faced with the novelties, flexible minds have the ability to break ingrained mental habits - our beliefs - and introduce new ones. Abduction is, therefore, the inference responsible for introducing information into our minds and sharing it through communication. This fruitful process of discovery, essential for both creativity, diversity, Peirce calls "uberty" (EP 2: 472) - a concept very close to serendipity. Automated recommendation systems, widely used by digital platforms, use big data and machine deep learning to find correlations in huge databases and make predictive assumptions about user preferences. There are similarities between abductive inference and the type of inference produced by neural networks capable of deep learning. In fact, we can say that the second is a kind of proxy for the first. The principle that governs artificial neural networks capable of deep learning was originally presented by Friston (2009, 2010). Put simply, it postulates that biological systems - and any other autopoietic system - devote a large part of their resources to garner information that can serve as evidence for a model about the environment. Systems that survive over time continuously seek evidence that their beliefs about the external world be sufficiently correct and, therefore, are "mental habits" that deserve to be preserved. Friston calls this search process *active inference*, and its similitude with Peirce's abductive inference is evident (Beni & Pietarinen, 2021). We will comparatively present Peirce's abductive inference and Friston's active inference, showing where they separate. While abductive inference depends on aesthetic musement and, semiotically, on the admirability of icons, active inference simulated in algorithms depend on correlations extracted from carefully prepared data sets, often biased or even distorted by the way in which they were collected and treated. The data used in machine learning is symbolic in nature. For this reason, uberty (and serendipity) is only simulated on platforms that use automated recommendation systems, giving users the false impression that they are being surprised in a similar way to the real surprise that accompanies the experience in the world.

Keywords: ubert, active inference, abduction, deep learning.

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