Machine Learning and Remix:
Self-training Selectivity in Digital Art Practice

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In this essay, I focus on the emerging role of machine learning as an integral part of the elements of selectivity and remix in art and music. I first discuss how selectivity forms part of communication, to then consider its increasing importance in creativity. I then evaluate how machine learning is implemented by artists for the production of works in ways that revisit questions of authorship as an individual and collective practice in terms of metacreativity – a delegation of workmanship from humans to automation. In closing, emerging artificial intelligence's agency is reflected upon as the paradigm of metacreativity continues to be established.

Introduction

The creative process is integral to humans; no other animal in the world is as creative, at least with the level of human self-awareness.[1] Once science emerged as a major paradigm during the 17th century, systematic approaches to all aspects of human life were implemented in order to study not only questions on how our world functions, but also, more specifically, how humans relate to the world. The commercial implementation of scientific re-

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1 Creativity is found in animals in terms of play, read Stan Kuczaj and Radhika Makecha: »The Role of Play in the Evolution and Ontogeny of Contextually Flexible Communication«, in: D. Kimbrough Oller / Ulrike Griebel (ed.): *Evolution of Communicative Flexibility: Complexity, Creativity, and Adaptability in Human and Animal Communication*, Cambridge, Massachusetts: MIT Press 2008, pp. 254–255.

search in part has been used to bend the world to human needs. In terms of creativity humans are able to remix deliberately, even though it may not always be evident. Remix as an integral process of human production has become more transparent with the emergence of technology that makes the recycling of material easier and more efficient. Remix is a highly specialized action that only humans can perform with a high degree of sophistication. Arguably, it is one of the key cultural variables that result from human innovation.

Technology has played a major role in the evolution of human creativity, and thousands of tools that in large part consist of optimizing different ways to remix pre-existing objects and/or ideas have been developed as extensions of human action. The enhancement of humanistic research, and all the tools leading up to our age have functioned as enhancers of human's ability to examine the world. Part of this process includes automating repetitive labor-intensive work, initially in the direct form of rudimentary robots, and more recently, with the rise of AI computer programs that can ›teach‹ themselves based on the repetition of simple actions. This remains controversial in terms of loss of jobs, but while in the past there was some mention of humans being replaced by robots in future societies, or robots becoming integral in human life, there was no clear disposition to claim that machines could ever be creative in any real way until the rise of artificial intelligence in recent times.

We have, in turn, entered an advanced cultural state in which the ongoing delegation of work to different forms of automation now also increasingly includes creative processes that, in the past, were exclusive to humans. This was not possible previously because artificial intelligence was approached with the aim to equal and supersede human intelligence on general terms, but once intelligence was approached with the focus on specific tasks, it became possible to program self-training algorithms; Generative Adversarial Networks (GANs) is a common example of this approach.[2] The outcome is that the creative process which in the past was exclusive to humans is challenged, and in turn humans need to rethink what it means to be creative.

Our evaluation on this occasion focuses on art and its relation to music in terms of remix as a selective process. An important aspect of studio

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2 Ian Goodfellow et al.: »Generative Adversarial Nets«, ArXiv, in: https://arxiv.org/abs/1406.2661 (accessed: 14. 12. 2019).

art that emerged as a key element in contemporary practice is selectivity, a foundational process for general communication. Selectivity emerged as a defining factor in art practice, enabling it to differentiate itself from other expressive forms, to become an autonomous discipline. In what follows I consider how creativity functions as a selective process that implements key principles of remix in art and music, to then consider how it relates to the contemporary rise of machine learning as a specific form of artificial intelligence. I will then consider how artists are delegating aspects of their creative process with different approaches of remix to machine learning algorithms to produce works. To begin we look at the elements of selectivity, which are the foundation of human communication.
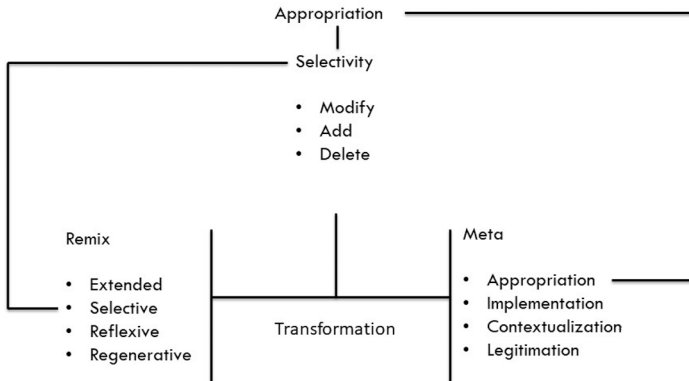
Selectivity and Creativity

Selectivity is part of all forms of communication. It is foundational for art practice and in contemporary times, it is a key element of remix as a creative form that crosses over from the arts to culture at large. Remix as a cultural variable is popularly part of music since the late 1970s and turned mainstream during the 1980s once music samplers became accessible in the music studio. Remix principles were actually at play in the visual arts since the 1920s most commonly in the forms of collage and photomontage; and with the rise of computing across the world, remix evolved into an ubiquitous element of communication in part due to the easiness of cut/copy and paste for image, sound and text.[3]

Selectivity is the process by which remix and all other forms of communication take effect (Figure 1). It consists of making decisions to include and/ or omit and/or modify units of communication. The elements of selectivity, which include modify, add, delete are closely linked to communicative processes of appropriation, implementation, contextualization and legitimation, which comprise a meta-process that makes possible communication. The ele-

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3 Various publications cover this subject. Some include Aram Sinnreich: *Mashed Up: Music, Technology, and the Rise of Configurable Culture*, Amherst and Boston: University of Massachusetts Press 2010; David J. Gunkel: *Of Remixology: Ethics and Aesthetics after Remix*, Cambridge and Massachusetts: MIT Press 2016 and my own contribution to the field: Eduardo Navas: *Remix Theory: The Aesthetics of Sampling*, New York and Wien: Springer 2012.

The Loop of Selectivity and Appropriation

Appropriation

Selectivity

- Modify
- Add
- Delete

Remix

- Extended
- Selective
- Reflexive
- Regenerative

Transformation

Meta

- Appropriation
- Implementation
- Contextualization
- Legitimation

ments of selectivity and the communicative processes play a major role in creativity in general and define four different forms of remix: The extended (to make longer or expand), the selective (to add, delete, and/or modify), the reflexive (to edit selectively to the point of autonomy) and the regenerative (to combine material that is constantly updated). All of these forms of remix are found and combined across media.[4]

Appropriation is the first step towards developing the selective process. As newborns, we learn by being repeatedly exposed to things in the world. We come to associate sounds to objects to understand what to call things we encounter such as bananas, apples, toys, cars, houses, etc.; eventually, we develop the ability to entertain abstract ideas linked with feelings, such as love, hate, happiness, etc. We build a conceptual database which we use to communicate via image, sound, and text. We repurpose (appropriate) terms that are not technically ours and reuse them. Appropriation is executed for the sake of communication, and it can only become meaningful through implementation.

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4   What follows here is a general statement on the theory of selectivity. For a more detailed analysis read Eduardo Navas »Re-versioning the Elements of Selectivity: Transformation and Originality in Remix«, in: Lukas Feireiss (ed.): *Radical Cut-Up: Nothing is Original*, Amsterdam: Sternberg Press 2019.

Implementation is the process through which appropriation is used to develop the value of communication. To appropriate anything for no specific purpose has little value; in the case of creative practice, appropriation is essential in order to develop creative works. No artist develops a work without studying numerous works of other artists, which is why a large part of an artist's education is the exposure to works previous artists created. This is done in preparation for eventual production of works that artists in training will develop and call their own. Implementation can take place by way of cultural citation or material sampling; both of these processes can be combined as well. Material sampling means taking something as it already exists (appropriate it) to present it in a recognizable form. Cultural citation consists of taking an idea or concept and reenact it intertextually to develop a work that may not appear derivative, but which nevertheless relies on material previously produced. Implementation is the process of taking that which is appropriated to develop something that can be potentially new. A conceptual work such as Joseph Kosuth's *One and Three Chairs* (1965) exposes the process of appropriation and implementation in terms of cultural citation. In this work, Kosuth is pointing to the concept of the chair (denotation) by placing the dictionary definition on the wall, along with a photo image of a chair; the chair that appears in the photo is also physically present in front of the wall on which the image and dictionary definition of *chair* hang. In Kosuth's method, we see a physical object, image and text appropriated and recontextualized through implementation in order to question and reposition the work of art.

Continuing with Kosuth's work as example, we can note that how a work of art comes to be understood is based on the two preceding processes of appropriation and implementation which now need to be evaluated in terms of contextualization. Kosuth's work openly questions the very concept of originality in that it points to ideas being foundational for a work of art's agency in the world. The context of his production is art practice; Kosuth decided to create a work that is reflective and critical of works of art as well as the institution that validates them. The context in turn plays a major role in the way it will be perceived by its audience. Any work introduced into a specific context could be seen as derivative, unique, or just not *very good*. This takes place in part based on the decisions to appropriate and implement by the artist, which in turn is defined by the context in which the object is introduced for legitimation.

Legitimation is defined according to appropriation, implementation and contextualization. Kosuth's work at the time it was introduced was considered polemical. Historically, all of conceptual art was radical in that it openly questioned the institution of art itself for the commodification of the work. Kosuth's work was radical because it asked to be legitimated by way of rejecting the established art paradigm. He took a gamble in this case by testing the process of legitimation, which is not controlled by the artist, but rather is a negotiation among multiple parties. Politics of culture are certainly at play in this process, and at times it may not seem fair, but legitimation is a complex process that also defines, based on cultural politics, what is included in history. This is the case for all aspects of our heritage, which is why historical precedents are always up for revision.

An important variable that binds all of the elements of selectivity is transformation, which makes possible the emergence of new ideas, concepts and all forms of cultural and material objects.[5] Depending on an individual's awareness of the selective process upon which we rely on to communicate, how unique or derivative a work may or may not be, can vary. This is the challenge that remix constantly faces, and the emergence of machine learning pushes the conundrum into the paradigm of metacreativity. All of the elements of meta discussed above are integral to the process of remixing and general communication. Expanding beyond our example of Joseph Kosuth, the elements of selectivity are foundational for machine learning.

Machine Learning and Creativity

Selectivity and remix are entering a new stage of creativity because computer algorithms are able to produce content by teaching themselves how to produce new cultural objects. This process known as machine learning (ML), modeled after human learning, is possible through various discriminative methods. Before we dive into machine learning processes, it must be noted that ML is implemented after the process of appropriation as described in the elements of selectivity. This will be discussed further once machine learning is evaluated in relation to creativity.

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5 Kirby Ferguson: *Everything is a Remix, Part 3: The elements of Creativity*, in: https://vimeo. com/25380454 (accessed: 15. 11. 2019).

One of the most popular forms of machine learning at the time of this writing is GANs (Generative Adversarial Networks). Ian Goodfellow developed this particular process which he explains functions according to adversity:

>»In the proposed adversarial nets framework, the generative model is pitted against an adversary: a discriminative model that learns to determine whether a sample is from the model distribution or the data distribution. The generative model can be thought of as analogous to a team of counterfeiters, trying to produce fake currency and use it without detection, while the discriminative model is analogous to the police, trying to detect the counterfeit currency. Competition in this game drives both teams to improve their methods until the counterfeits are indistinguishable from the genuine articles.«[6]

In other words, the discriminator plays the role of telling its adversary whether or not what is being produced can be considered ›real‹, the adversary in turn evaluates the assessment and makes adjustments to the next version it produces until it is able to produce something that passes the test of the discriminator. This process consists of feeding the algorithm a lot of data which it uses to learn what to do according to specific parameters set by the computer programmer. Note that the parameters in this instance are defined at the levels of appropriation and selectivity. In other words, the programmer decides how to optimize the algorithm to achieve specific goals. This is at the top level where both selectivity and appropriation come together to develop a task to complete (Figure 1).

GANs have already been implemented by artists to develop creative projects that directly put in question the concept of the author as a sole individual creator. The most popular example at the moment is *The Portrait of Edmond de Belamy*, by the collective Obvious.[7] The work was created with a GANs algorithm which was fed a large number of images, so that it could learn to produce images of its own that appear to have been made by a hu-

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6 Goodfellow et al., p. 1.

7 This work is popular in part because it received much press attention when it sold for $432,000.00 during a Christie's art auction in December 2018, »Is artificial intelligence set to become art's next medium?«, in: https://www.christies.com/features/A-collaboration-between-two-artists-one-human-one-a-machine-9332-1.aspx (accessed: 15. 12. 2019).

man. The work is actually part of a series of portraits of the fictional Belamy family.[8] The group of artists deliberately appropriated code echoing strategies of appropriation by Dadaists, during the first half of the 20th century as well as conceptual artists during the second half. Joseph Kosuth's work previously discussed is a clear example of the latter period.

Machine learning when analyzed on its basic function, is a form of systematic appropriation that functions based on metacreativity. We can note this in the research of Demis Hassabis, the computer scientist behind Deep Mind; a lab acquired by Google in 2014[9] known for developing AlphaGo, a computer program written to beat the best human Go players. Mathematician Marcus Du Sautoy notes that Hassabis's work falls within a posthuman paradigm:

> »His idea was that, rather than try to write the program himself that could play Go, he would write the meta-program that could write the program to play Go.«[10]

Du Sautoy uses the term ›meta‹ to explain the conception of AlphaGo. From a broader perspective we can note that Hassabis basically delegates work that would normally be considered creative to a self-learning algorithm. The result was that between March 9–15, 2016, AlphaGo beat Lee Sedol, the Go World Champion, 4 to 1.[11] We can consider this a clear manifestation of metacreativity; a process that will become more common in the future as we enter the age of posthumanism.

Keeping in mind Hassabis's approach to artificial intelligence, we can reflect further on Obvious's *Portrait of Edmond de Belamy* and consider that the work relies on the same conceptual framework of AlphaGo, which is to train itself by analyzing large amounts of data for a specific task in order to become competent. For Hassabis, it consisted in developing a computer program

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8 You can find the list of fictional family member on Obvious Website, in: https://obvious-art. com/gallery.html (accessed: 15. 12. 2019).

9 Catherine Shu: »Google Acquires Artificial Intelligence Startup DeepMind For More Than $500M«, in: *TechCrunch*, https://techcrunch.com/2014/01/26/google-deepmind/ (accessed: 14. 12. 2019).

10 Marcus Du Sautoy: »Ready Steady Go«, in: Du Sautoy (ed.): *The Creativity Code: Art and Innovation in the Age of AI*, Cambridge und Massachusetts: The Belknap Press of Harvard Univeristy Press 2019, p. 22.

11 Du Sautoy 2019, pp. 26–36.

that could play Go at the top level, while for art collective Obvious it consisted of developing an algorithm that could create portraits of fictional people. However, there is a difference between the two approaches. Obvious deliberately took pre-existing code to develop their works. In other words, their approach falls well within appropriation even more in that the artists did not write the code themselves. They actually reused the code developed by Robbie Barrat, who claimed that Obvious took it without acknowledgment. (It must be noted that Barrat actually worked with preexisting algorithms as well).[12] In this sense the work was actually developed with ›stolen‹ materials. Questions of plagiarism may arise for some of us, but the work actually comes to form part of appropriation art that was well explored in conceptual art and was initially introduced by Marcel Duchamp with his readymades. From this position, we can think of GANs as digital readymades, because they are programming libraries that can be repurposed for specific projects. Obvious, in their work, updates questions that have been part of contemporary art. The most basic one is: »Is it art?« This question takes us on an unprecedented direction when we consider the stage on which it functions in terms of meta: »Is it art if it was made by a computer program rather than a human?« Other questions also emerge: »If it is art, what is the process of validation at play in this case?« And: »How did the process of art making evolve to the point that human labor appears to have been streamlined for automation with the eventual rise of metacreativity, as we currently experience it?«

At this point, we can define metacreativity as:

»[…] a cultural variable that emerges when the creative process moves beyond human production to include non-human systems. This definition includes artificial intelligence and machine learning; for emerging intelligent technology, specifically, this means that a non-human entity is able to ›learn‹ in order to produce something that appears creative. But most importantly, metacreativity as an abstract concept, points to the next cultural stage of posthumanist production.«[13]

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12   James Vincent: »How Three French Students Used Borrowed Code To Put the First AI Portrait in Christie's«, in: *The Verge,* https://www.theverge.com/2018/10/23/18013190/ai-art-portrait-auction-christies-belamy-obvious-robbie-barrat-gans (accessed: 5. 11. 2019).

13   This definition is discussed in my upcoming book *The Rise of Metacreativity: AI Aesthetics after Remix.*

Metacreativity is at play across all forms of communication and human expression. It can be found in music as well. Music compositions can be produced with similar approaches to GANs. David Cope developed a computer program during the early 1980s designed to help him write music whenever he was not able to come up with something initially on his own. (Note that this is much earlier than Hassabis's conception of Deep Mind). Cope called his program Experiments in Musical Intelligence (EMI).[14] With the aid of his computer application he produced in two weeks an opera titled *Cradle Falling*. It is worth mentioning that he had struggled for over seven years to finish this project.

Cope decided not to tell anyone that he used a computer to finish his opera. As he experimented with his program, he decided to enhance it so that it could compose entirely on its own. The program went through many iterations and eventually it was able to produce compositions that, when performed by a human, were indistinguishable from music composed by an actual person.[15] What is interesting about Cope's story is that he initially made it clear that the music was composed by a computer. When he did this the work was dismissed as lacking soul or being »shallow«.[16] And people felt cheated when they listened to a composition and found it compelling only to learn later that it was written by a computer program. The acceptance of computers producing work that can be considered creative is now being openly explored in projects such as Deepbach, which is a machine learning algorithm that composes polyphonic music in the style of Bach.[17] While artificial language projects such as Deepbach are becoming part of the creative process, how to evaluate their role in relation to authorship and originality remains a challenge.

Cope's early story of artificial intelligence in music is important to emphasize because in it we find specific parameters that preceded the foundational principles of current machine learning implementation including GANs in the visual arts. Cope's research is validated differently from con-

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14 Marcus Du Sautoy: »Music: The Process of Sounding Mathematics«, in: Du Sautoy 2019, p. 183.

15 Ibid., pp. 188–198.

16 Ibid., p. 189.

17 Gaëtan Hadjeres/François Pachet/Frank Nielsen: »DeepBach: a Steerable Model for Bach Chorales Generation«, in: https://arxiv.org/abs/1612.01010 (accessed: 25. 1. 2020).

temporary work because his process was not necessarily developed with the specific goal to create artificial intelligence, but rather help a human compose music. The premise of aiding human creativity is at the core of Cope's initial interest, and it is also, at least in part, the justification of AlphaGo as a research project. In this regard, Lee Sedol took a philosophical view on his loss against AlphaGo:

> »I have grown through this experience. I will make something out of it with the lessons I have learned. I feel thankful and feel like I have found the reason why I play Go. I realize it was a good choice, learning to play Go. It has been an unforgettable experience.«[18]

Fang Hui, European Go Champion (2013–15), goes further on the relation of artificial intelligence and humans:

> »It's just when I played with AlphaGo, he showed me something. I feel something beautiful. That was it. I see the world differently, before everything began. What is really behind the game of Go? What that is, can change my game. Maybe it can just show humans something we have never discovered. Maybe there is beauty.«[19]

Arguably it may well be in part due to the philosophical approaches taken by individuals such as Lee Sedol and Fang Hui in combination with the commercial investment on machine learning why the relation of humans and smart algorithms continues to thrive with open source collective projects such as Google's Magenta, which is trying to bring together art and music for anyone online to repurpose code and push further the creative potential of artificial intelligence. Admittedly the project mainly focuses on music, but there are a few art projects included.[20] A research project taking place in an academic environment with a good balance to explore metacreativity in mu-

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18 Greg Kohs: *AlphaGo* (2017), USA, Netflix, 29. 11. 2017, Film online: https://www.youtube. com/watch?v=jGyCsVhtWoM (accessed: 15. 12. 2019), min. 1:25.

19 Ibid.

20 Magenta, in: https://magenta.tensorflow.org/ (accessed: 27. 1. 2020).

sic and art is the Metacreation Lab based in Vancouver, Canada.[21] The lab not only supports creative exploration but also organizes exhibits.

What becomes clear with the examples above is that the ideological validation behind the development of intelligent algorithms is to use AI technology to enhance the possibility of human creativity. And this is where we can notice the emergence of creativity as the common validation for the rise of artificial intelligence more broadly, to the point that developers in different areas of technology are making a case for the support and enhancement of human creativity as a major goal of AI development. Gavin Miller, the Head of Adobe Research explains how he sees AI playing a role in graphic design software, when he discusses how smart technology can help humans focus on the creative process:

> »[...] in the future, using neural nets for actually doing a great job, say, with a single click, or even in the case of well-known categories, such as people or animals, with no clicks, where you just say ›select the object‹, and it just knows the dominant object is a person in the middle of a photograph; those kinds of things are really valuable if they can be robust enough to give you quality results.«[22]

The delegation of workmanship — of assigning creative tasks that can be automated to a computer algorithm, in effect, is an advanced state of meta, which, at least in theory, enables humans to focus on things that are less repetitive in order to problem solve and make selective decisions. In terms of art and music, we can consider metacreativity as a critical stage on which an artist or musician no longer makes choices through a selective process intertwined with technical competency. Rather he or she is reliant on a self-training algorithm that makes technical choices to come up with results according to specific preset parameters that can lead to creative works that may be undiscernible from those produced solely by humans. As the work by Obvious and the compositions by Cope demonstrate, the metacreative state in which we currently function pushes us on a loop to reconsider questions

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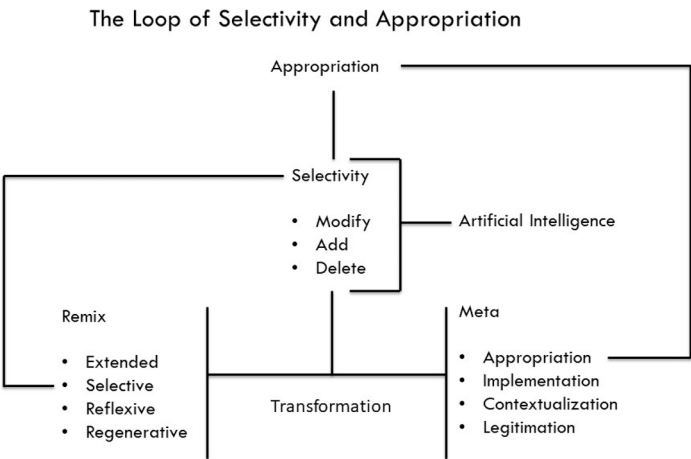21 Metacreation lab: Generative Systems, in: http://metacreation.net/ (accessed: 27. 1. 2020).

22 Lex Fridman: »Gavin Miller: Adobe Research, Artificial Intelligence (AI) Podcast«, in: *Artificial Intelligence Podcast,* in: https://www.youtube.com/watch?v=q0mokx-iiws (accessed: 14. 12. 2019), min. 12:25.

of authorship as an individual and collective practice. Only in this case, the collective no longer consists of humans, it can be neural nets or another form of machine learning/artificial intelligence that in turn can show us new possible combinations and approaches, as is the case with AlphaGo defeating Lee Sedol.

Conclusion

Metacreativity makes way for questions on the agency of intelligent algorithms that in the past would have been considered mere tools for creative and cultural production. The elements of selectivity and appropriation become intertwined with artificial intelligence when they are implemented to create works that challenge our assumptions of authorship in digital art practice in relation to originality, and unexpected, though arguably, speculative agency.

Machine learning can be implemented to automate any part of the selective process once appropriation takes place (Figure 2). All of the other elements can be automated by delegating the action to a machine algorithm. To evaluate this, we must summarize the correlation of machine learning with the elements of selectivity. Machine learning can be implemented to modify, add, and/or delete, which are integral for remix as well as for meta. In terms of

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remix, machine learning can be implemented to produce extended, selective, reflexive and regenerative remixes. In terms of meta, machine learning can be applied for appropriation (at the meta level), implementation, contextualization and legitimation. Meta and remix in turn loop to produce signification; remix correlates this process by making ongoing metaproduction possible, sometimes parallel and other times as a subprocess of production according to meta. Remix due to its contemporary reliance on technology is also prone to form part of the delegation of workmanship on to emerging forms of artificial intelligence. This should give us pause, because remix has always been viewed as a form that questions human creativity and now it appears, due to its reliance of automation that sampling has always pointed to, to become more closely linked with processes of automation that are gaining creative agency. We see this at play in the examples discussed throughout this essay.

This in effect in an emerging metaloop within the selective process. Machine learning creates a layer of meta-selectivity which makes possible for signification to continue evolving in ways that are no longer completely defined directly by humans. The difference of repetition revered as a key factor for humans to strive to find something new in the already familiar is now delegated to be produced at a meta-stage.[23] In terms of remix, material can be repeatedly appropriated, or sampled, and in turn, it can be reintroduced in culture as something derivative or new, produced by non-human agents. The greatest challenge humans may well face is that we are participating in an advanced stage in contemporary creative production which includes the defining role of non-human agents moving towards attaining an apparent will of their own.[24] The outcome perhaps should be to consider human creativity as a vectoral variable of constant flux towards difference and repetition across the universe, rather than being an exemption that celebrates individual achievement. The answer may well be in the appreciation of collective flows rather than individual output. The very technology humans are producing makes this process increasingly evident.

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23 Gilles Deleuze: »Repetition for Itself«, in: *Difference and Repetition*, trans. Paul Patton, New York: Columbia University Press 1968, pp. 70–128.

24 There is a growing number of publications that deal with the implications of this possibility. Two recent publications are David J. Gunkel: *The Machine Question*, Cambridge and Massachusetts: MIT Press 2012; David J. Gunkel: *Robot Rights*, in: Cambridge Massachusetts: MIT Press 2018.