Artificial Intelligence and the Copyright Survey

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Abstract: Artificial intelligence has emerged as a key contributor to American social, economic, and cultural development. Intelligent software increasingly plays a greater role in every creative industry. These industries rely on intellectual property protections to maintain equilibrium between productivity, remuneration, and competitiveness. American policymakers, however, have paid little attention to the intersection of artificial intelligence and copyright protection. This study collects data from fifty-seven AI scientists, tech policy experts, and copyright scholars through a survey and questionnaire. The data shows that while intelligent software is an important contributor to American cultural development, half of respondents believe that the US Copyright Office is not prepared to deal with an influx of computer-generated works. In light of rapid developments in artificial intelligence, this could present a serious challenge to the American copyright system and future advancements in the AI industry.

I. Introduction

Artificial intelligence (AI) is a loosely defined term which has been around for decades. AI encompasses the idea that computer programs can perform functions typically associated with the human mind. Although most people are only familiar with AI as a collective term, artificial intelligence can be divided into a number of unique sub-fields. Machine learning, natural language processing, robotics, and computer vision are just a few of the subfields of AI. Machine learning, and more specifically, its offshoot, deep learning, is present in countless academic papers and news headlines as a result of achievements which seemed unfathomable just a decade ago. With the help of Artificial Neural Networks (ANNs)—which loosely resemble the structure and functionality of biological neural networks constituting animal brains—AI has been able to outperform humans on an average IQ test; create works of art indistinguishable from those created by humans; and beat professional human players in highly complex games (Silver et al. 2016; Spice 2017; Wang et al. 2015).

Artificial intelligence has also become the status quo in the day-to-day operations of most tech companies. Alphabet's Google search uses powerful algorithms to serve up results and advertising that are both relevant and engaging. Amazon's recommendation engine relies on machine-learning techniques that contribute to higher company profits and greater customer satisfaction. Both Microsoft and Apple offer personal-assistant services which contribute to simplicity and efficiency of everyday tasks. These are some of the best-known applications of artificial intelligence. Companies and researchers alike are also exploring a new and fast-growing segment of the AI industry - generative AI. While still in its early stages of development, generative AI has the potential to disrupt the day to day operations of the creative and entertainment industries. The following section briefly introduces generative AI and outlines the intersection of Copyright and Artificial Intelligence.

i. Copyright and AI-produced works

Generative algorithms are responsible for producing unique works of varying complexity which differ from prior art. These works can be as a result of collaborative efforts between a human creator and an AI program, or entirely the result of independent AI processes (Hristov 2017; Thaler 2013). In both cases,

artificial intelligence is at least partially responsible for the production of innovative work. Instances of such works are becoming more common as AI use becomes more frequent and algorithms improve. To date, books, songs, visual art and computer programs have all been created by generative algorithms (IBM 2017). Advancements in the tech sector along with the development of new generative AI methods will likely contribute to a greater number and quality of AI-produced works, making intellectual property (IP) rights a pressing issue for artificial intelligence programmers and users. Programming and training an AI algorithm can be both time consuming and expensive. If AI programmers are unable to recoup their efforts through the financial benefits associated with IP protection, many may be dissuaded from investing their time, money, and expertise in AI development.

The United States lacks legislation and targeted policy that addresses the attribution of copyrights for AI-produced works. This would not be of concern if the US tech sector existed in a vacuum—not influenced or affected by outside forces or by the rapid development of novel AI technologies. In reality, most global actors, with even the slightest AI-research capacities, are actively jockeying for position as leaders of the international AI race. Japan and the European Union have dedicated resources and increased efforts in determining best practices when dealing with the attribution of copyrights for AI-produced works (Delvaux 2016). China is investing billions of dollars into its AI industry in hopes of reinvigorating its slowing economy and overtaking the US as leader in AI research and development (State Council 2017). As AI increasingly permeates every aspect of our lives, the stakes are quite high for US businesses and consumers. The right laws and policy could determine the global socio-economic outlook for decades to come.

Governments around the world have indicated their intent to adopt and invest in artificial intelligence as a way to improve their citizens' welfare and contribute to economic growth. Recent initiatives in Japan, the EU and China have attracted media attention and signaled governmental readiness to turn a new chapter in the technological forefront by openly and effectively adopting AI. Setting up policy research-taskforces and investing billions of dollars in the future development of the AI industry are tell-tale signs that the international AI race is well under way.

II. The current state of generative AI

Recent developments in AI have challenged the commonly accepted notion that human ingenuity is solely responsible for the production of creative works. Although human creativity is without a doubt the paramount force behind some of the most popular works known to man, non-human authors—including non-human animals and intelligent computer programs—have also been credited with the production of works which possess both an economic and esthetic value (Brueck 2016; Cohn 2018; Elgammal et al. 2017; Kaufman et al. 2011). Using ANNs which mimic the functions of a biological brain, Dr. Stephen Thaler, President and CEO of Imagination Engines Inc., developed "Creativity Machines", which generate copyrightable material with and without the assistance of a human author (Thaler 1996). The resulting works are often the outcome of independent processes within the ANNs and cannot be fully attributed to a human author under established copyright procedure (US Library of Congress 2017a). The question of works created as a result of automatic computer programs with limited or no human intervention is a topic of debate among intellectual property, policy, and tech experts around the world.

i. Artificial intelligence and visual art

The Next Rembrandt is a collaborative project between art historians, researchers, data scientists, and engineers who analyzed hundreds of paintings by Dutch artist Rembrandt to generate a new portrait in the painter's unique style using machine learning's deep learning approach (Yanitsky-Ravid and Moorhead 2017). The computer program used in the project accounted for virtually every minute detail in Rembrandt's entire collection: gender, age, head direction, and even the amount of facial hair of subjects who appear in the artist's masterpieces were all considered by the program when determining the final look of the AI-produced work. A facial recognition algorithm was part of the software that determined the geometric and stylistic look of human facial features used in Rembrandt's portraits (Microsoft, n.d.). The dimensions and placement of every feature were calculated by a separate algorithm and applied accordingly to the new painting. In addition, algorithms were used to determine appropriate use of lighting and shadows—two

distinctive characteristics of a true Rembrandt—and to determine the size, direction and type of brushstrokes used by the artist (Microsoft, n.d.). The end result was the Next Rembrandt, a new and unique portrait in the style of the artist which may fool some art historians and critics into believing it is the "real thing" (Microsoft, n.d.; see image below).

The Next Rembrandt, 2016, digital image, ING Group. https://www.flickr.com/photos/inggroup/26011850460. Image used under Creative Commons.

DeepDream, a computer program which algorithmically enhances images with the intent of generating new dream-like visual art, is another example of AI at work. Through the use of convolutional neural networks, DeepDream finds and enhances visual patterns in order to create psychedelic images which often have little in common with the original work (Auerbach 2015). This method is first fine-tuned by a human developer and usually goes through a number of iterations. The process performed by the algorithm responsible for the final work can most closely be associated with *pareidolia*, a psychological phenomenon in which the human mind responds to a visual stimulus (the original image) by perceiving a familiar or previously learned pattern where it does not exist (Zimmermann 2012). An analogous example may be a child identifying animals or other familiar objects in passing cloud formations, or a stargazer observing human-like forms in the night sky. Although human input is required in the initial stages of the program, most of the visual output is quite unique and often falls outside the realm of commonly produced human artwork (Auerbach 2015).

DeepDream's algorithmically produced images and the Next Rembrandt are representative of the majority of visual art produced by artificial intelligence. The common ingredients appear to be prior images from which the AI may learn, and a human "co-author" to initiate the creative process and guide the computer program. Exceptions, however, do exist. A method called creative adversarial networks (CAN), pairs up two neural networks—one to generate new images and a second to judge whether the images are unique enough not to be classified within commonly known art styles (Elgammal et al. 2017). This approach builds upon generative adversarial networks (GAN) which have recently gained popularity in machine learning (Creswell et al. 2018; Goodfellow et al. 2014). With CAN, the objective of the AI program is to produce paintings which do not neatly fit within a single art style, while ensuring that the resulting works do not excessively depart from aesthetic norms (Elgammal et al. 2017).

In essence, CAN-produced works incorporate the most appealing traits from DeepDream's novel images, and computer-generated art with established appeal like the Next Rembrandt. Images produced by creative adversarial networks are unique enough to be unlike any prior art (by falling outside of classic art styles), but also comply with commonly established art norms which makes them more appealing to human observers than the psychedelic images associated with the DeepDream project (Elgammal et al. 2017). By "maximizing deviation from established styles and minimizing deviation from art distribution," works could be unique from prior art while, at the same time, appealing to the general public (Elgammal et al. 2017). A study conducted by scientists researching CAN noted that participants preferred AI-produced works to human-created art and deemed CAN works as more novel, complex, and inspiring in comparison to human works which neatly fit into any one established art style (Elgammal et al. 2017).

ii. Artificial intelligence and music

Music is another creative realm recently infiltrated by AI. Aiva Technologies, a European startup, has created Aiva (Artificial intelligence virtual artist), an AI that composes classical music which resembles musical masterpieces created by the likes of Mozart, Beethoven and Bach (Kaleagasi 2017). Aiva's music has so far been used in film soundtracks, by advertising agencies and game studios. The computer program has also been recognized as a composer and registered with SACEM, a French professional association which protects the intellectual property rights of its members and collects royalties for their work (Kaleagasi 2017). In addition, Aiva has already released its first critically acclaimed album titled Genesis, and through the representation of Aiva Technologies, claims copyrights over the intellectual property of its work (Kaleagasi 2017).

Aiva's success may be attributed to reinforcement learning techniques. With reinforced learning, the AI does not receive explicit instruction along each part of the creative process, allowing it a more autonomous role (Kaleagasi 2017). The results are often more innovative and much less dependent on human intervention. By using classical music (which is largely in the public domain) and only relying on a human author in a limited capacity, Aiva appears to be the main creative force behind the newly produced musical works. Some might even go one step further (as in the case of SACEM) by attributing the computer program full authorship of its work in a legal capacity.

iii. Artificial intelligence and literary works

Notable literary works have also been produced by computer algorithms. *The Day a Computer Writes a Novel* is a novella written by an AI programmed by a team of researchers at Future University in Hakodate, Japan (Olewitz 2016). The novella was one of 1,450 submissions received by the organizers of the Japanese Hoshi Shinichi Literary Award competition. Although the short novel did make it past the first round (unlike many of the human-written works), it was eventually eliminated by the panel of judges due to a lack of sufficient character development (Olewitz 2016). *The Day a Computer Writes a Novel* was, in fact, a collaborative effort between researchers who input the literary guidelines and a collection of words and phrases to be used by the AI in the writing process (Tarantola 2016). It was the computer program's job to uniquely assemble all parts of the novel in an intelligible and thought-provoking way. According to the competition's judges, the AI-human collaborative work managed to do so, better than a lot of the literary works solely attributed to human authors (Olewitz 2016).

iv. Artificial intelligence and software

Software writing AI has also recently grabbed headlines for its ability to perform better than human programmers. Researchers at Google Brain's artificial intelligence lab have designed software that has developed a machine-learning system responsible for benchmarking language processing software (Simonite 2017). The software-generated software performed better than all previously published results of similar programs designed by human developers (Simonite 2017). In addition, researchers at the non-profit OpenAI; University of California, Berkley; MIT; and Google's DeepMind, have all, with various degrees of success, been able to create AI-learning software which produces new computer programs (Simonite 2017). According to US Copyright Code, AI algorithms ultimately serve a utilitarian purpose and are ineligible for copyright

protection.[1]. Some, however, do fit the requirements for another type of intellectual property protection: utility patents. The source code of some AI programs, however, does satisfy the requirements for copyright protection, which means that researchers at Google, MIT, UC Berkley and OpenAI could ultimately protect the IP associated with their software-generating software if they chose to do so (Villasenor 2014).

AI-produced content from nearly every category of copyrightable subject matter has recently been in the headlines of tech journals and IP law reviews. As the aforementioned examples of AI-produced works illustrate, each case varies in both creative complexity and human intervention. From the near-autonomous process of Dr. Thaler's Creativity Machine, to the carefully guided collaborative effort between human researchers and the AI author of *The Day a Computer Writes a Novel*, human assistance may be either trivial or highly involved. It therefore comes as no surprise that the countless nuances of human-computer interaction in the creative process have perplexed scholars from the legal, ethical and policy fields.

v. Copyright and artificial intelligence

Two main bodies of work determine the guidelines and regulations currently affecting the copyright of computer-generated works. Although the US Copyright Act and the Compendium of best practices (issued by the US Copyright Office) do not expressly mention AI machines or their place in the creative process, they do offer a glimpse into the stance of the Copyright Office in the debate on copyright protection of AI-produced works.

In order for a creative work to be deemed copyrightable, a number of requirements must be satisfied. Copyrightable subject matter must belong to one of the categories predetermined by the Copyright Office. In addition, a copyrightable work must also be original and fixed in a tangible form of expression.[2] Originality under copyright law entails that the work must be independently created by the author and must poses a minimum degree of creativity. [3] A tangible form of expression, on the other hand, may be any physical "medium of expression, now known or later developed, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device."[4]

A crude example of a copyrightable work is a photograph of the popular tourist attraction and arguably one of the most notable symbols of freedom of expression, the Statue of Liberty. The photograph would satisfy all requirements set forth by the US Copyright Office. It fits within the "Pictorial, graphic, and sculptural works" category of copyrightable subject matter defined by the US Copyright Act. The photograph would be considered fixed in a tangible form since both its digital (electronic file format) and physical (paper print) copies can be "perceived, reproduced, or otherwise communicated…directly or with the aid of a machine or device." [5] Although lacking novelty, the picture would also be deemed original since the photographer independently snapped the photo with some form of creative influence applied to the resulting work, whether the angle of the shot, lighting, composition, or even a creative filter.

The place of AI in the creative process, while sharing many parallels with other mediums of artistic expression, does not perfectly satisfy all requirements set out by the US Copyright Act or the guidelines listed in the Compendium of best practices. In fact, independently produced AI works are not copyrightable due to one major restriction: the human author requirement stipulated in the Compendium of best practices (US Library of Congress 2017a). It should be noted that unlike the US Copyright Act, the Compendium of US Copyright Office Practices is not a legal document, but an internal aid used to streamline the copyright attribution process. As such, it appears that the copyright limitations of AI-produced works are procedural as opposed to legislative or policy-related.

vi. Current opinion on copyright of AI-produced work

Scholars have weighed in on the decision of the US Copyright Office "not [to] register works produced by

[1] *Copyrights, US Code* Title 17 (2016), § 101
[2] *Copyrights, US Code* Title 17 (2016), § 102.
[3] Ibid.
[4] *Copyrights, US Code* Title 17 (2016), § 102a.
[5] Ibid.

a machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author (US Library of Congress 2017b)." Expert opinion appears divided on the issue. The proponents of the first group argue that copyright protection of AI-produced works should be awarded to the developers of the AI or the human authors responsible for initiating the creative process. This position has already been applied by the UK, New Zealand and a number of other Commonwealth countries. The copyright of computer-generated works in the UK is attributed to "the person by whom the arrangements necessary for the creation of the work are undertaken." (*Copyright, Designs and Patents Act* 1988) This notion is arguably the easiest way to implement copyright protection for computer-generated works and is a popular among IP scholars and tech industry researchers. Annemarie Bridy, a seasoned IP scholar, sees the UK's approach as a viable solution to the copyright dilemma currently facing the AI industry. Bridy (2012) points out that copyright may theoretically be passed on from the AI machine to its human programmer or user through the made for hire doctrine of the US Copyright Act. The doctrine examines the intellectual property rights of "work prepared by an employee during the scope of his or her employment." [6]

Kalin Hristov (2017) further contributes to Bridy's solution by proposing that "employee" and "employer" should be viewed as relative terms within the scope of the made for hire doctrine. This reinterpretation would prevent AI produced works from falling into the public domain by effectively assigning their copyright to a human author. The doctrine simply transfers all legal rights and responsibilities from the author-in-fact (the computer program which produced the work) to the author-in-law (the legal person, human author, or corporation who was responsible for the AI or initiated the creative process).[7] This method is significant since it resolves a number of long-standing issues which have been plaguing the tech intellectual property field for quite some time. Since machines (AI) are not legal persons, they cannot enjoy the financial incentives or account for the legal responsibilities associated with copyright protection (Adriano 2015). Human authors and corporations, on the other hand, are fully capable of fulfilling all obligations associated with copyright protection, including any future legal challenges which may arise from copyright infringement (Solum 1991).

James Grimmelmann sees computer algorithms as yet another form of expression for human creativity. According to Grimmelmann (2015), the novelties of AI works coupled with the complexity of the algorithmic process have contributed to a superfluous alarm for change of the US Copyright Code, when in fact computer programs are no different than any other tool used by a human author, and no special status should be given to algorithmically generated works. Although Grimmelmann (2015) believes that copyright protection of such works should be vested with humans, he sees "new copyright doctrines of computer-generated works [as] a terrible idea." Simply put, AI programs are a medium for expression—just like a camera, a canvass, or even a pen and paper—as such, no legal or policy changes are necessary in order to ensure the uninterrupted operation of the US intellectual property system.

According to the US Copyright Act, only the authors of a creative work may obtain copyright protection.[8] With the exception of the above mentioned made for hire doctrine, this rule generally indicates that only those directly responsible for producing a work may enjoy the benefits associated with its copyright. As a result, some scholars have argued that the term "author" should be reinterpreted to include both human and non-human creators. Professor Ryan Abbott is a leading proponent for the legal rights of non-human authors and inventors. Both Abbott and Colin Davies have argued that intelligent computer programs should be considered legal authors and inventors under relevant intellectual property law (Abbott 2016; Davies 2011). This seemingly novel approach is forward-thinking at its core and may resolve some of the issues related to independently produced works falling into the public domain.

A number of complications, however, may arise due to existing limitations in AI design and the American

[6] *Copyrights, US Code* Title 17 (2016), § 101.

[7] *Copyrights, US Code* Title 17 (2016), § 201b.

[8] *Copyrights, US Code* Title 17 (2016), § 201a.

IP system. First, AI machines are not legal persons and cannot be held accountable for their actions under current intellectual property law. Second, computer programs are not influenced by the financial incentives associated with copyright protection. Without a clear consensus among experts on the place of copyright in AI-generated works, a survey and questionnaire were used to collect and quantify data from AI scientists, tech policy experts, and intellectual property scholars. The following section details the methods and data collected for this survey.

III. Study methodology

A cross-sectional study was conducted over a 45-day period through a trusted third-party website popular for providing survey and questionnaire services (surveymonkey.com). The website was also used to analyze a portion of the collected data. The survey sample was chosen from a sampling frame which consisted of experts in public policy and intellectual property from primarily US higher learning institutions ranked within the top twenty positions determined by the US News and World Report. To ensure that that the sample of experts was adequately selected, their online institutional profiles were closely examined and only members with additional expertise related to emerging technologies or creative works were included in the final survey sample.

In addition, to account for experts in the fields of public affairs and intellectual property law who are not part of institutions ranked in the top twenty positions of the US News and World Report, or the fact that some of the top scholars in IP law and public affairs may not be from US institutions, an additional measure was introduced. Authors of the most downloaded articles on the Social Science Research Network (SSRN) at the intersection of artificial intelligence and intellectual property were also included in the survey sample. To determine sample members' eligibility, their article description and provided keywords were examined. A number of researchers with extensive experience in machine learning and other AI related offshoots were also included in the survey pretest group in order to ensure proper survey calibration and gauge the possible effects of discipline bias. Detailed participant demographics may be found in the next section of this paper.

i. Survey

The survey was sent to 350 experts determined through the aforementioned methods. In addition, a thirty-member pretest group, whose members were not part of the primary 350 experts, was established to test the efficacy of the survey. The results of the pretest group were not factored into the final data obtained from participants from the primary 350-member group. Both experts from the pretest group and the primary group were alerted about the survey via email. Potential respondents were given a brief introduction to the survey and were made aware of its type, topic, purpose, number of questions, estimated completion time, and intended use of collected data. In addition, the author of this study briefly introduced himself and his institutional affiliation. Contact information was provided in case questions or concerns associated with the survey were to arise.

The distributed survey comprised of twelve questions [see Appendix 1]. All questions were agree-disagree on a five point Likert-scale. Available choices for respondents were: strongly agree; agree; neutral/neither agree nor disagree; disagree; strongly disagree. Both the number of questions and the response method were chosen to encourage a high level of participation and a high rate of survey completion among the sample group. Survey brevity and simplicity were key characteristics which contributed to this objective. After minor adjustments, the survey was sent out to the primary survey group via email. The survey was closed forty-five days after the initial survey request was sent out. A 20% response rate was recorded (in line with general survey response rates). Upon completion, results were analyzed for completeness and accuracy. A total of fifty-seven eligible survey responses were received.

ii. Questionnaire

Since quantitative data alone cannot completely convey the nuances and reasons behind expert opinion, a follow-up questionnaire supplemented the survey [see Appendix 2]. The purpose of the questionnaire was to enrich and explain the previously gathered quantitative responses. The combination of quantitative and qualitative methods

was deemed both necessary and adequate to the research process, since the topic is both new and complex, requiring a comprehensive approach. The questionnaire allowed respondents to expand on their answers and focus on their own area of expertise.

The open questionnaire was sent out approximately one week after the original survey was closed. A subset of twenty respondents from the original survey was randomly chosen to further elaborate on provided answers through six open-ended questions. In addition to the original respondents, a new group was included in the open questionnaire process. Researchers and scientists from the top twenty AI research institutions, as determined by US News and World Report's rankings, also accounted for a fraction of respondents to the subsequent open questionnaire. The inclusion of AI researchers and scientists was done for two reasons. First, the opinions and insights of AI experts were seen as a crucial part in determining solutions to an issue that affects the industry which they are ultimately responsible for creating and developing. Second, the original survey had an emphasis on the fields of public policy and intellectual property law, areas that most computer scientists and researchers are unfamiliar with. Results were used to supplement data from the initial survey. The questions used in the open questionnaire were asked in an effort to better understand the opinions of public policy scholars, intellectual property experts and computer scientists on the intersection of artificial intelligence and intellectual property.

IV. Study Results

i. Sample demographics

Respondents' demographics were analyzed to ensure data quality and scope. Though hailing from multiple disciplines, the majority of respondents (61%) specialized in intellectual property law, and 58% listed an area of expertise as either public policy or public administration. A further 33% noted economics as a main research area. Finally, 82% specialize in technology with 23% claiming proficiency in programming as a user or instructor [See Figure 1]. These demographics are in line with the initial selection of survey recipients as experts in tech policy and/or law. In line with stereotypical technology demographics, 75% of respondents were male, and 89% are from US institutions. The remaining 11% hail from Europe and East Asia.

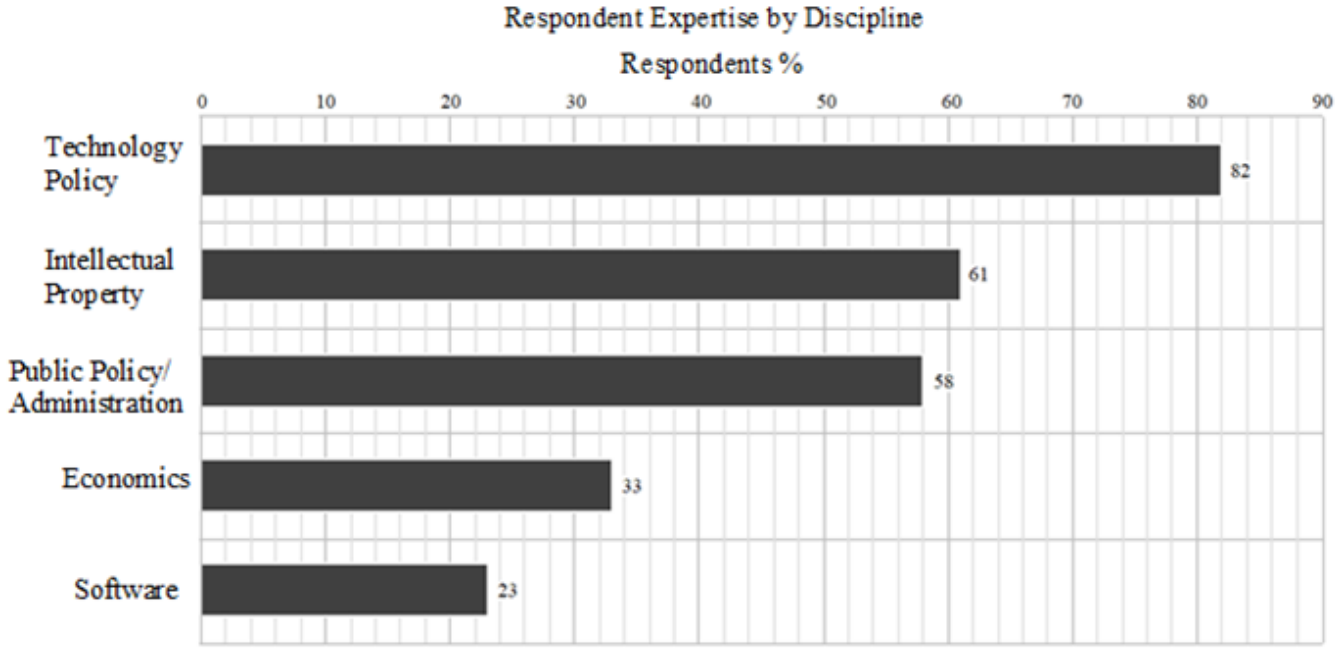

Figure 1: Respondent expertise by discipline. A number of respondents listed multiple disciplines within their expertise area, as a result the total surpasses 100%.

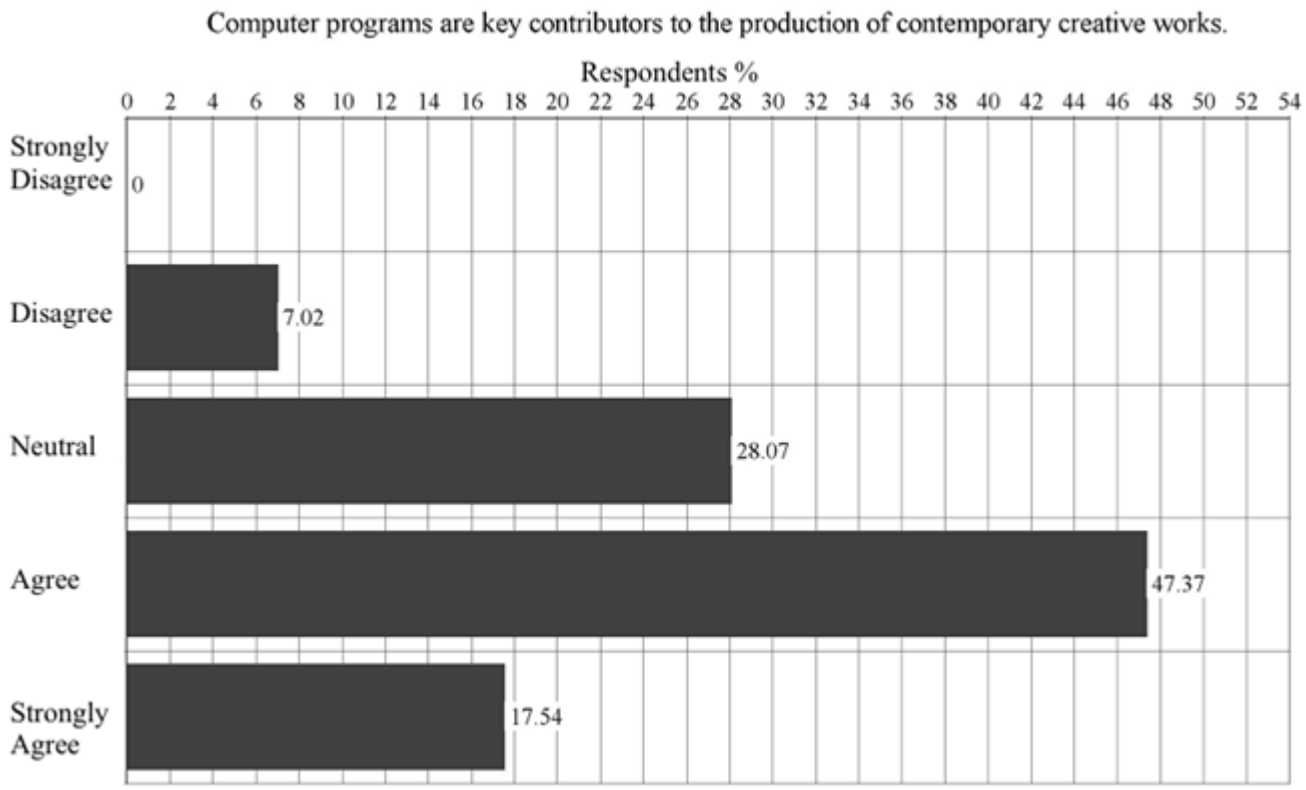

Figure 2: Surveyed expert opinion on computer programs as contributors to creative works.

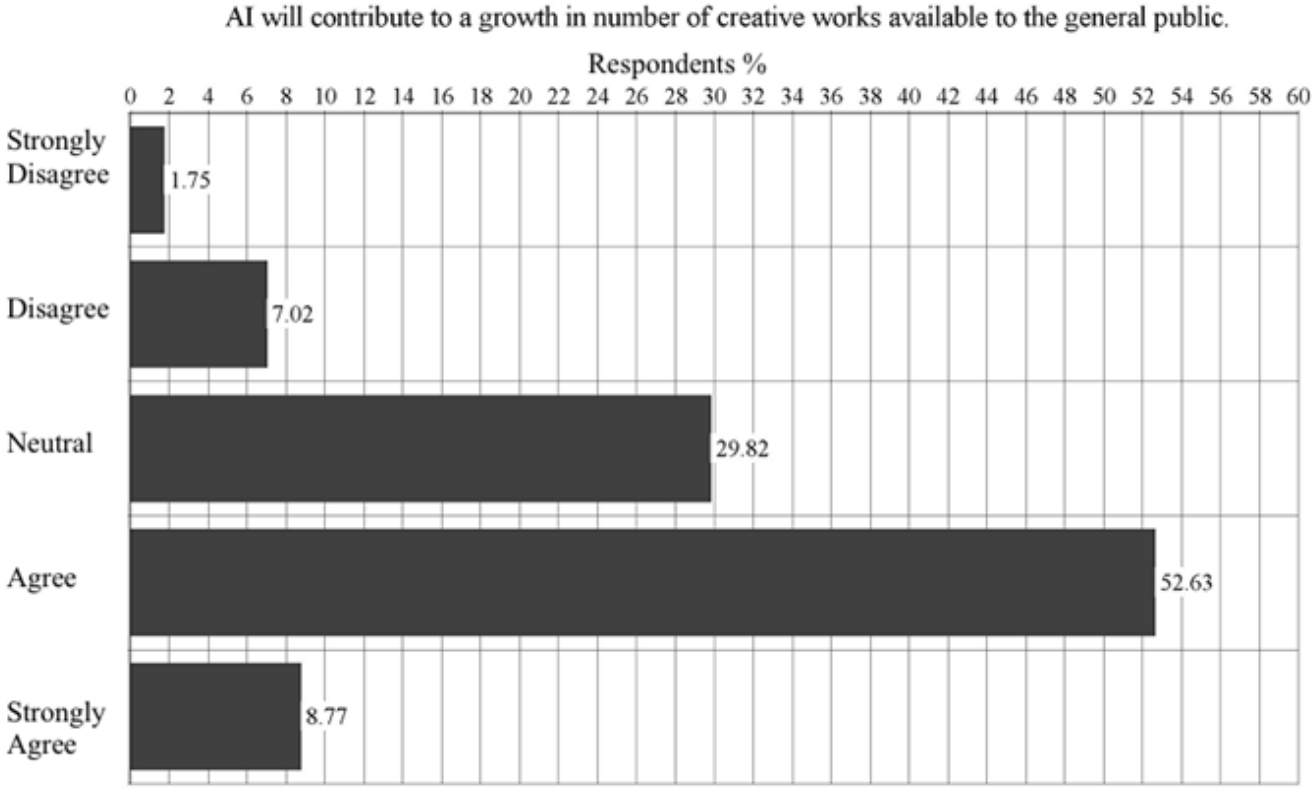

Figure 3: Surveyed expert opinion on AI-contributions to public creative works.

ii. Expert opinion

Approximately 65% of surveyed experts believed that computer programs, including AI software, were key contributors to the production of contemporary creative works like music, films, visual art, software, etc. Of those that did not answer that computer programs were primarily responsible for creative works, 28% were neutral or undecided, while just 7% disagreed [see Figure 2]. In addition, when asked if AI would contribute to a growth of creative works available to the general public, six out of ten respondents either strongly agreed or agreed, while only one out of ten either disagreed or strongly disagreed [see Figure 3].

When it came to AI's impact on the United States' economic growth, experts were more divided. Roughly 43% of respondents agreed or strongly reed that an increase in the number of commercially available AI-produced works will stimulate economic growth. A similar number of experts (40%) neither agreed nor disagreed with the statement. Respondents were more certain about the impact of AI-produced works on the development of the AI industry. Approximately 63% of surveyed experts either agreed or strongly agreed that an increase in the number of commercially available AI-produced works would stimulate AI industry growth. Nine percent of survey participants either disagreed or strongly disagreed with the statement, while more than a quarter (28%) were neutral or neither agreed nor disagreed [see Figure 4].

While 61% of survey respondents either agree or strongly agree that artificial intelligence will contribute to a growth in creative works available for use by the general public, around half of respondents (just over 50%) believe that the US Copyright Office is not adequately equipped to deal with a growing number of computer-generated works. In addition, one in four experts had no opinion or was uncertain of the ability of the US copyright system to adequately address the rise of AI in the creative sphere, while the remaining 25% believed that the current system was working adequately enough. [see Figure 5].

When surveyed on the importance of copyright protection as an incentive for authors to make their works commercially available, approximately 55% of

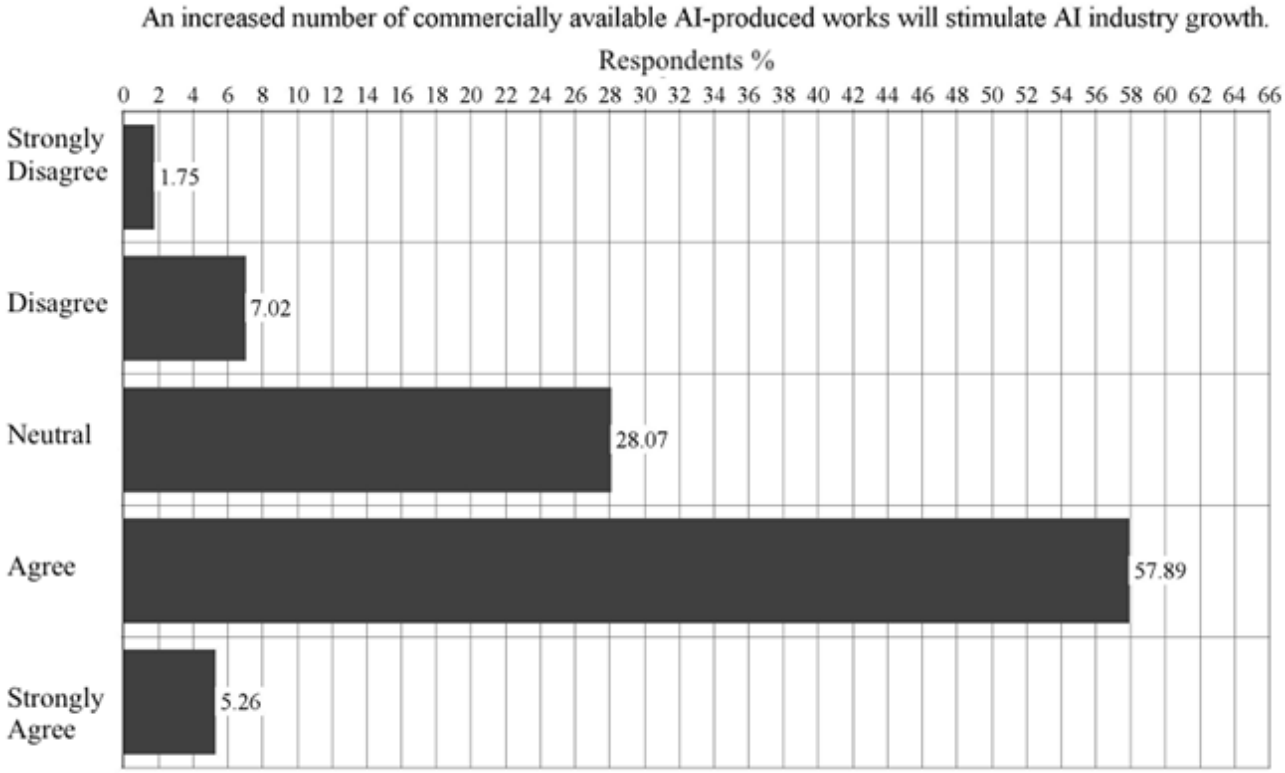

Figure 4: Surveyed expert opinion on AI-produced creative works stimulating growth in AI industries.

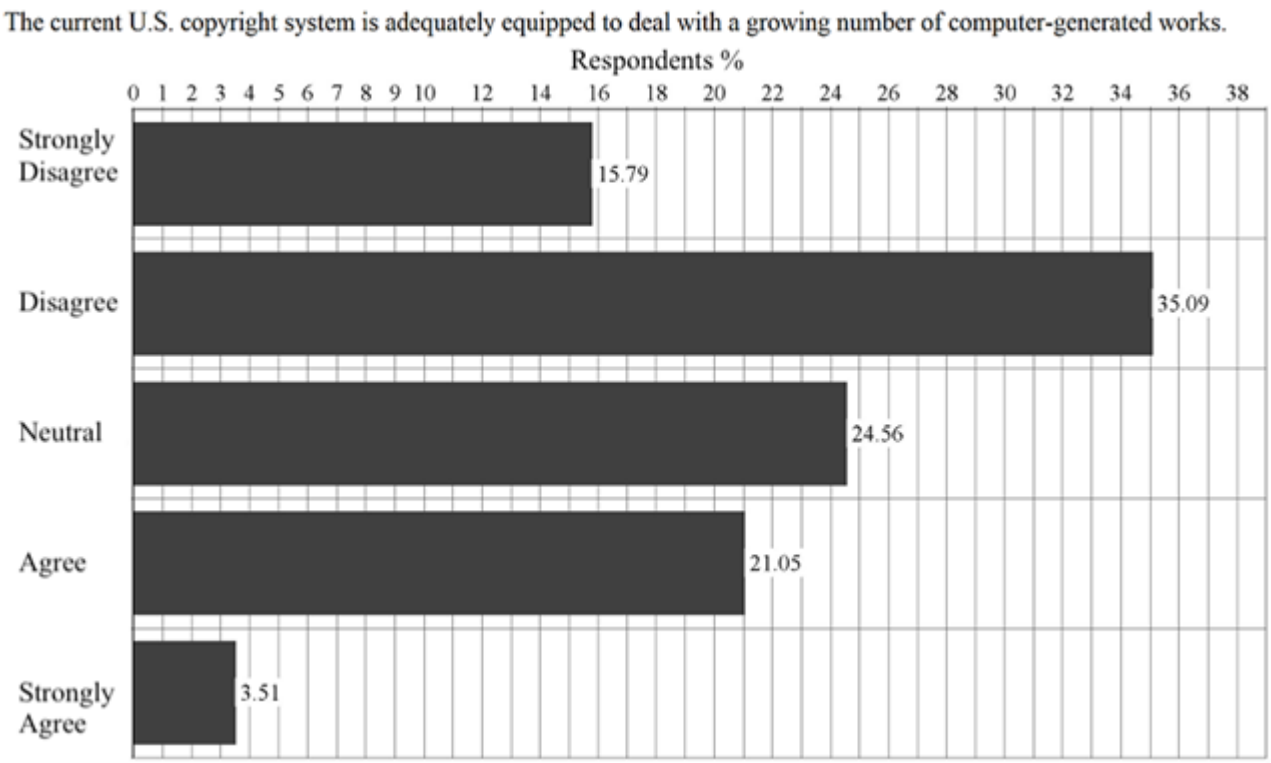

Figure 5: Surveyed expert opinion on US copyright system preparedness for computer-generated works.

experts either agreed or strongly agreed that copyright is an important incentive. The remaining respondents were split evenly, either taking a neutral position or disagreeing that copyright protection stimulates commercialization of creative works. When surveyed on the most important factor incentivizing the production of creative works, the majority of respondents (59%) disagreed or strongly disagreed that monetary compensation was most important to artists, with only 21% agreeing that financial gain was the primary incentive for the production of creative works.

iii. Surveying the stance of the copyright office

Expert opinion was also collected on the current intellectual property status of AI-produced works. Respondents were asked to share their opinion on the viability of various methods which may be used by the US Copyright Office when dealing with independently produced AI works. When presented with the statement, "The US Copyright Office should consider computer programs as sole authors of works they independently produce if there is no creative input or intervention from a human author," the majority of respondents (56%) either disagreed or strongly disagreed, while 33 % took a neutral stance, and one in ten surveyed agreed or strongly agreed. On the other hand, when presented with the statement, "The US Copyright Office should consider humans as sole authors of works independently produced by the AI they own or have created, even if these works lack any creative input or intervention from a human author," opinion was divided. Approximately 30% of experts disagreed or strongly disagreed with the statement, 39% were neutral, while around 32% agreed with the statement. It appears that a consensus could not be reached even on the solution which would most easily be implemented without a major overhaul of US Copyright Code.

Another statement attempted to gauge expert opinion on collaborative ownership of copyrights. When presented with the statement, "The US Copyright Office should consider joint authorship between AI machines and their human developers, in cases where the creative works were produced by the AI without any creative input or intervention from a human author," approximately 61% of surveyed experts either disagreed or strongly disagreed with the statement, 23% were neutral, while only 16% agreed. The final statement presented to respondents was worded in the following manner, "The US Copyright Office should deny copyright protection to

works independently produced by AI without any creative input or intervention from a human author, releasing them into the public domain." Of those surveyed, 17% disagreed or strongly disagreed, 26% were neutral, while a total of 56% of experts agreed or strongly agreed with the statement. These sentiments appear to echo the current stance of the Copyright Office—denying copyright protection of non-human created works. The narrow margins of this consensus, however, attests to the complexity and future uncertainty of the intersection between AI and intellectual property.

iv. Questionnaire

In addition to the conducted survey, results from an open questionnaire were also collected. Respondents shared their thoughts and opinions on a number of topics associated with AI-produced works and how copyright might affect the AI industry. For the purpose of brevity and clarity, three experts with representative answers for their respective fields were selected and their responses are detailed below. Respondent one (R1) is an intellectual property expert with decades of experience and a number of highly cited publications on the topic. Respondent two (R2) is a programmer with extensive knowledge in IP, who has worked for some of the biggest US tech firms. Respondent three (R3) is a computer scientist specializing in machine learning at a prestigious American research institution.

When asked if respondents believed that AI would contribute to a growth in the number of creative works available to the general public, R1 answered that it would take some time, but that eventually, "AI will become capable of producing the same kinds of creative works as human authors and perhaps do a better job." R2 gave a different response, emphasizing that AI will have a largely collaborative role, filling the position of an "artist's assistant." R3 saw the role of AI in the creative process as that of a tool which would allow artists and writers to better focus on the creative parts of their job while "automating a good deal of the drudgery."

Expert opinion on the current stance of the US Copyright Office to deny copyright protection to works produced by non-humans (including AI machines), was also surveyed. According to R1, "[Copyright law] only permits copyrights for authors. It is unlikely that the original meaning of 'authors' extends to AIs without moral personhood which we are not even close to achieving today." R2 expressed agreement with the current stance of the US Copyright Office, adding, "The current law [only] covers human creation. Much like a monkey could not own the copyright to the selfie it took, a program cannot either." R3 noted the need for in-depth future debate on the topic, adding, "This requires actual thought, not the usual lawyerly method of applying one inappropriate existing model or another. The copyright system is messed up in many ways, based on the assumption that 'copying' a work meant using a printing press."

When directly asked if copyright protection of AI-produced works would stimulate growth of the AI industry, R1 and R3 were uncertain, with R3 noting that although this question requires deeper thought, there need to be "some incentives for creators and for those who create creative systems and for those who set up these systems and edit the results." R2, on the other hand, answered no, elaborating that the respondent "[didn't] believe AI is being developed for the purpose of creating works covered by copyright."

When asked about creativity—one of the main requirements for copyright protection—and whether it is a human-only characteristic, respondents overwhelmingly agreed that creativity transcends humans and may be observed in both non-human animals and certain intelligent machines. R1 stated that "both existing AI and some non-human animals exhibit creativity." R2 strongly disagreed that creativity can only be prescribed to humans, additionally pointing out that "creativity and what we decide to protect—and thereby lead to more of it—are connected but different topics." R3 further noted that creativity "could be defined as a strictly human trait, but that would be a strange definition. Scientific creativity, or some aspects of it, is certainly something that machines can exhibit." R3 also expressed his reservation if machines could ultimately understand humans well enough to create works that appeal to them. Adding that such "creativity is not yet demonstrated, but probably will be in time."

V. Discussion

The survey reveals a number of insights into the current expert opinion on the intersection of intellectual property rights and artificial intelligence.

Respondents are confident in the strong impact of computer programs in the production of creative works. As AI scope and capabilities continue to grow, the spotlight inevitably shifts to facilitating generative AI use while maintaining fair remuneration for content creators. Out of the experts surveyed for this study, the majority (65%) believed that software programs, including AI, were key contributors to contemporary creative works like music, film, visual art, and software.

Since the entertainment/creative industry significantly contributes to the American economy, this belief indicates the important role of AI in American cultural and economic development (Department of Commerce 2017; Siwek 2018). A similar outcome was recorded when participants were asked if AI would contribute to a growth of available creative works. Six out of 10 respondents were confident in AI's abilities to contribute to the growth of creative works available to the general public. These results show that a great number of experts believe that AI's generative capabilities will surpass the limitations of private use, achieving commercial success. While a number of survey questions further probe the economic impact of generative AI, divided opinion leaves room for future research on the economic contributions of AI-produced works.

Respondents, on the other hand, were confident about the positive impact of AI-produced works on the American AI-industry. Intellectual property rights are an important incentive for the commercial availability of creative works like films, music, visual art, and software. Around half of respondents, however, believe that the current US copyright system is not adequately equipped to deal with computer-generated works. It is important to note that not all participants in the survey were intellectual property experts. Survey opinions on this topic, however, were equally distributed between IP experts and respondents from other fields (economics and tech policy). Only one in four of the overall number of participants believed that the US copyright system was adequately equipped to thrive in the digital era. This notion is far from surprising, as the rapid development of the tech industry has resulted in an endless game of catch-up for government institutions responsible for relevant policy and legislation.

Although a significant number of participating experts agree that the current copyright system is ineffective when dealing with computer-generated works, few agree on the most adequate method to address this issue. In the case of independently produced AI works, previous research has indicated four potential approaches by the US Copyright Office:

1) attributing copyrights to a human author
2) AI as sole author
3) joint authorship (between a human and an AI)
4) denying copyright protection

None of these approaches has received overwhelming support by study participants. With 56% of survey respondents echoing the current stance of the US Copyright Office, it appears that we are not yet at the proverbial crossroads requiring a change of direction in AI copyright policy. Divided opinion on the preparedness of the Copyright Office, however, signals the looming crisis at the intersection of artificial intelligence and intellectual property rights.

VI. Conclusion

This study has collected data from fifty-seven AI scientists, tech policy experts, and copyright scholars through a survey and questionnaire. The data confirms the significant role of intelligent computer programs in the American entertainment/creative industries. In addition, half of participants believe that the US copyright system is not adequately prepared for a future influx of AI-produced works. Respondents, however, fail to reach a resounding consensus on what changes should be implemented by the US Copyright Office. The divided nature of expert opinion and the limited data available to researchers studying intellectual property protection of AI works indicates the need for future research on the topic. This study has laid the groundwork for further investigation into the intersection of artificial intelligence and copyright protection. The survey and questionnaire have established a need for additional data and interdisciplinary research on a growing issue with the potential to significantly disrupt American economic and cultural development.

Appendix A: List of questions and response data from the survey segment of this study. Weighted average based on Strongly agree=5, Agree= 4, Neutral/Neither agree nor disagree=3, Disagree=2, Strongly disagree=1.

1. Computer programs are key contributors to the production of contemporary creative works.							
	Strongly agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	17.54%	47.37%	28.07%	7.02%	0.00%		
Participants	10	27	16	4	0	57	3.75

2. AI will contribute to a growth in number of creative works available to the general public.							
	Strongly agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	8.77%	52.63%	29.82%	7.02%	1.75%		
Participants	5	30	17	4	1	57	3.6

3. Do you agree or disagree with the following statement? The current U.S. copyright system is adequately equipped to deal with a growing number of computer-generated works?							
	Strongly agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	3.51%	21.05%	24.56%	35.09%	15.79%		
Participants	2	12	14	20	9	57	2.61

4. Copyright protection is an important incentive for authors to make their work commercially available.							
	Strongly agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	17.54%	36.84%	22.81%	21.05%	1.75%		
Participants	10	21	13	12	1	57	3.47

5. An increased number of commercially available AI-produced works will stimulate economic growth.							
	Strongly agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	3.51%	38.60%	40.35%	14.04%	3.51%		
Participants	2	22	23	8	2	57	3.25

6. An increased number of commercially available AI-produced works will stimulate AI industry growth.							
	Strongly agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	5.26%	57.89%	28.07%	7.02%	1.75%		
Participants	3	33	16	4	1	57	3.58

7. Monetary compensation is the most important factor in incentivizing the production of creative works.							
	Strongly Agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	1.75%	19.30%	19.30%	33.33%	26.32%		
Participants	1	11	11	19	15	57	2.37

8. All contributors of a work should benefit from its commercial success.							
	Strongly agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	10.53%	40.35%	40.35%	5.26%	3.51%		
Participants	6	23	23	3	2	57	3.49

9. The U.S. Copyright office should consider computer programs as sole authors of works they independently produce if there is no creative input or intervention from a human author.							
	Strongly agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	5.26%	5.26%	33.33%	28.07%	28.07%		
Participants	3	3	19	16	16	57	2.32

10. The U.S. Copyright Office should consider humans as sole authors of works independently produced by the AI they own or have created, even if these works lack any creative input or intervention from a human author.							
	Strongly agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	10.53%	21.05%	38.60%	15.79%	14.04%		
Participants	6	12	22	9	8	57	2.98

11. The U.S. Copyright Office should consider joint authorship between AI machines and their human developers, in cases where the creative works were produced by the AI without any creative input or intervention from a human author.							
	Strongly agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	0.00%	15.79%	22.81%	42.11%	19.30%		
Participants	0	9	13	24	11	57	2.35

12. The U.S. Copyright Office should deny copyright protection to works independently produced by AI without any creative input or intervention from a human author, releasing them into the public domain.							
	Strongly agree	Agree	Neutral / Neither agree nor disagree	Disagree	Strongly disagree	Total	Weighted Average
Percentage	22.81%	33.33%	26.32%	12.28%	5.26%		
Participants	13	19	15	7	3	57	3.56

Appendix B: List of the questions asked in the open questionnaire portion of this study.

1) Do you believe that AI will contribute to a growth in number of creative works available to the general public? If so, in what way?

2) Do you believe that AI will become a key producer of creative works? If so, in what time frame?
   - Within 10 years.
   - Between 10 to 20 years.
   - This will require more than 20 years
   - AI will not become a key producer of creative works.
   - Other (please specify)

3) Do you agree with the current position of the US Copyright Office to deny copyright protection to works produced by non-humans (including AI machines) if the works lack any creative input or intervention from a human author? Why or why not?

4) Do you believe that copyright protection of AI-produced works will stimulate growth of the AI industry? Please explain.

5) Do you agree or disagree with the following statement? Creativity is a characteristic which is only observed in human beings. Please elaborate.

6) Please share any additional thoughts you may have on the participation of AI in the production of creative works (music, art, software, etc.).

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