Hello,

my name is Roosa Wingström and in this talk I will be discussing about creativity in the era of artificial intelligence and also introduce a bit of my own research I have done on the topic.

But first a few words about myself:

I'm a PhD student in economic geography from the University of Turku which is located in south-western Finland. Although I'm specializing in Economic geography, I work at the Faculty of Science at the Department of Geography and Geology. I did my undergraduate studies there as well and in my bachelor studies I was very interested in physical geography, meaning the formations of the land, climate and so on. But I also wanted to know more about the societal things and economy. So, in this sense Economic geography really combined these two nicely because you have to have knowledge about how the earth works, how resources are created and so on, but also how the human made things like society, economy and politics work. In my master's I wanted to specialize more closely into the issues of innovation and development and I actually spent a year abroad studying in Seoul, South Korea, in the program of international economics at the Kyung Hee University. I came back to Finland to finish my master's thesis and then I was first introduced to this project I'm currently working on. I must say I did not know much about AI back then, but I was really interested in the issues of creativity, particularly creative work and these are much research topics in economic geography as well, especially from perspectives of creative cities, at creative industries and so on. So, I started my PhD research right after I had graduated from the master's program in 2020. I joined the project LuotAI - Co-creativity in the Era of Artificial Intelligence that is funded by Kone Foundation and led by associate professor Johanna Hautala who is now working at the University of Vaasa.

The project involves a multidisciplinary group of researchers from economic and human geography, organization studies, new media art and computer science and LuotAI focuses on a creative process in the everyday work and moments of creativity with novel technologies and also on the outcomes that are evaluated as creative or not. The overall focus has been on creativity with AI but for instance in my PhD thesis I also consider other technologies and their effects on creative process, for instance on work times or places where work is done and so forth.

So, in this talk I have a closer look into these topics and particularly focus on the issues of artificial intelligence and creativity and I draw from my first research article where we interviewed 26 new media artists and 26 scientists who work with artificial intelligence and in that paper, we wanted to know how AI has affected the work of these professionals and how they see the creative work with AI themselves and then we also discussed about general topics like AI and what actually is creativity. So, it has been really inspiring to do this research because AI and especially the creative use of AI, has developed rapidly while I've been working on this topic for the past four years.

I will actually introduce some findings for my research during this talk but however to begin with, I would like to talk about the definition of artificial intelligence. So, it's shortly called AI – artificial intelligence is the simulation of human intelligence in machines that are programmed to think and learn like humans and AI involves a wide array of technologies including machine learning and deep learning. Basically, these technologies allow computers to analyze big amounts of data, recognize patterns and make decisions autonomously or at least somewhat autonomously. So, at its core AI aims to replicate human functions such as problem solving, speech recognition, language translation and so on. This is however, precisely why it's so difficult to define AI. Firstly, because the term intelligence is quite ambiguous like it's hard to define what constitutes as intelligent behavior because it's subjective and context dependent and it's therefore hard to set precise boundaries for AI because we don't really understand the human intelligence. And also, this raises questions about consciousness of moral and moral responsibility and the complex issues then further complicate the task of defining AI because it goes beyond these technical things into the realm of ethics and philosophy. Also, AI is not limited to a single technique or technology. On the contrary AI fields include machine learning, natural language processing, computer vision, robotics, expert systems to natures diffuse. These top fields have their own methods and algorithms and that's why it's hard to narrow AI down into one definition but to have common ground.

For discussion and for this talk I follow a definition that is widely used in European Union papers that says: “AI refers to systems that display intelligent behavior by analyzing their environment and taking action with some degree of autonomy to achieve specific goals.”

Also, in the context of AI, it's good to understand algorithms or rather what algorithm means. So, a classic example of an algorithm is a recipe you would follow to have a good dinner.

For instance, imagine a recipe for a favorite dish. So, when you start to cook, you follow these step by step instructions that tell you what ingredients to use and in what order and how to combine them to get the outcome which is your meal. So, in the context of computation, an algorithm is like a recipe for computers. So, it's basically a series of instructions that a computer follows to solve a problem or to perform a task. So, if we want to define AI as an algorithm, I would like to quote Professor Geisavan from the AI hub of Danbara University who said that AI is a developed set of algorithms. So, the AI algorithm is learned and evolved based on what they have learned, so the outcome is not always predetermined.

Now that we have defined AI we can look into its history a bit before coming back to the present day. So, the history of AI is actually quite long. The AI as we know it was first introduced in 1956 during the famous Darth Maul's conference. There a group of pioneering researchers gathered to explore the possibility of creating machines that could think intelligently, and this conference then marked the official birth of AI as a field of study. And then during the following decades current breaking research and technological advancements were made in this field. In the 1960's AI researchers developed programs that could play chess and prove mathematical theory of theorems and later in the 1970s the world saw the emergence of expert systems software designed to mimic human expertise in specific domains like medicine and finance. However, the development of AI has not been very linear and rather there have been times when the AI research has nearly stagnated and during these so-called AI winters funding, interest has been reduced to unmet expectations and technical limitations. So, after the latest AI winter in 1980's, the world saw researchers of AI and it was fooled by powerful computers and new algorithms that enabled significant progress in machine learning and natural language processing. And ever since the 1990's, this kind of AI development has been really blooming and as we entered the 21st century AI became integrated into our daily lives. Examples include virtual assistants on our smartphones, recommendation algorithms on streaming platforms and so forth.

So, it has in many ways transformed the way we interact with technology. And machine learning models, particularly deep learning, achieved remarkable results in image recognition, language translation and even playing video games. So back to my research a bit, we're interested in this kind of relationship between humans and artificial intelligence. Like I mentioned, I specifically focused on creativity and creative professions and the role of AI and other novel

technologies in those fields. So, AI is perhaps now more timely than ever because of its use in creative work meaning producing new pictures, texts and so on. But even this recent search of AI, even before this recent search of AI artists, and other creative professionals have been using AI for a long time and indeed it has been very common for artists to be pioneering with such things and testing new tools and technologies. In fact, there is a special multi-disciplinary field of study that has focused on such things that is called computational creativity. The history of computational creativity is nearly as long as the modern history of AI itself, because, the first examples of computational creativity appeared in 1950s when computer scientists and mathematicians experimented with early computers to generate artistic patterns like drawings or music. During the following decades artists and programmers collaborated to explore more of this kind of algorithmic art and the artists employed basic code to generate geometric shapes and patterns which then sparked the foundation for the computational methods in artistic work.

So, in the 1980s and 1990s there were the first examples of this kind of generative art. A famous example is artist Harold Cohen, who used algorithms to create visual and evolving artworks and during this project he developed a program called AARON. Actually, AARON is a group of programs, and those programs can or could create paintings based on how they were modeled, so they kind of draw these drawings, that then Harold Cohen would fill in with color and so on. These early works were a significant example of the fusion of artificial intelligence and artistic creativity. And so, the Aaron program is perhaps an example of a creative model, that is kind of independently creative – meaning it's programmed to produce novel outputs on its own, but there is also a big branch of computational creativity where they are interested in an interactive and evolutionary art. So, this means this kind of interactive relationship between the artist, the program and the audience and artists, have utilized them so-called genetic algorithms to evolve visual force and this allows audiences to participate in the creative process. So, interactive installations where viewers can influence the artworks behavior through their actions, have also become popular and they are really an example of dynamic interaction between humans and computational algorithms.

So, the history of computational creativity and so-called AI art is long and currently there are many artists who are sometimes referred to as AI artists. A few examples are Mario Klingemann, Souweng Chung or Refik Anadol who all have become world famous for their art with AI or some

other new technologies. For instance, Souweng Chung has built these robots that can mimic her hand movements while she paints but the robots are also somewhat autonomous, so the result is not always given, but it's rather evolving, based on how well the robot understands the movement of the artist. I really encourage you to look up these artists yourself because I really like their innovative work with technology, and I can really recommend it. I actually read this quote from NVIDIA researcher Jaakko Lehtinen who described the work of Refik Anadol in a manner that really explained the essential computational creativity:

"This is the beauty of fundamental research: To see the progress we have made on a hard technical machine learning problem being unexpectedly channeled to serve such an astounding creativity is extremely satisfying. We are thrilled to witness the deepening interplay between art and AI research and eagerly looking forward to seeing what we can do together in the future."

So, returning to the most recent AI issue, AI art has indeed become a hot topic lately because of these novel tools that are now used to create new pictures or that can write new pieces of text. Indeed, the big transformation in computational creativity during the past few years has been driven by advancements in machine learning and deep learning techniques. I will just shortly introduce the driving force of these advancements. Basically, they are related to these generative AI models, namely generative adversarial networks or shortly GANS and also variational auto encoders. These two models lie at the heart of this creative revolution in art in creative fields. So, for instance GANS consists of two neural networks. There is a generator and a discrenator and they are engaged in this constant dual. So, the generator creates synthetic data such as images or music, attempting to mimic real world examples and then the discriminator evaluates these creations, pushing the generator to refine its output continually. And on the other hand, variational auto encoders focus on learning the underlying structure of input data, allowing them to generate new similar data points. And both models use probability and statistics to then make these new outputs. And these generative AI models have many different usages. One of the most known examples is perhaps the so-called style transfer – meaning the model transfers ordinary images into artworks that imitate the style of known painters like Van Gogh or Picasso. And generative models are also used in the creation of artistic text, meaning they can generate poetry or stories and so on. Recently programs like mid-journey or chat GPT have become widely used. For instance, mid-journey can create new images that look like artworks based on a line of text or a

prompt that the user puts in. And you have probably seen many examples of these generations because they have been trending all over the internet during the past year or two. Similarly chat GPT is a chatbot that can produce even lengthy texts and interactively discuss with the user. It is argued that these generative AI models like mid-journey or chat GPT and many, many others have in a way democratized art creation because they allow both the professional artists and amateurs to experience and innovate without constraints. So, indeed, in terms of productivity and efficiency these kinds of models are really outnumbering humans in the sense that they are able to produce these things faster and kind of tirelessly in comparison to humans.

But despite these kinds of seemingly positive impacts the AI generated art has also brought kind of very big issues and that are currently being debated. And there are discussions regarding the definitions of creativity and the role of machine in this kind of creative or artistic work and also issues regarding ethics and copyright. And I think it's important to mention these as well. So first the notion of originality in art, or in creative fields, has been kind of essential in these topics. So, many professionals from artists to creativity researchers often use these specific terms to think about creativity. For instance, creative works are a novel, a valuable original and so on. So, then some claim, that the efficiency and volume of AI generated content could then overshadow this kind of uniqueness and emotions that are associated with art that is created by humans. And in my research when I interviewed the scientists and artists, I actually asked this question to the participants: do they think AI can be creative? And the answers to these questions varied. And approximately half of the people thought that at least some AI models can be creative if given kind of the right definition of creativity. And what I mean by this is, first is if you put two digital paintings in front of an audience and one of them is created by an AI model and the other is created by a human original artist, many people could not perhaps differentiate between what is made by AI and what is not. But also, if we would just ask the audience: Do you like these paintings? Do you think they are creative? Do you think they are nice? They might say yes, I think this is pleasant and so on. So, from this perspective, if we only look at the outcome; so for this creative outcome that the AI has made, it can be considered creative and that was also propped by my research participants. However, some of the participants also noted that AI is not creative in their opinion. And this really relates to the questions of consciousness, because they say or argue that creativity requires intent and motivation and AI does not have those qualities. And AI also cannot ascribe meaning to artworks it sees. It can maybe analyze them based on programming if it's been

programmed to analyze with some criteria, some pictures, but it can't kind of ascribe emotion or context to their artworks.

So, based on my research, answers or kind of the participants answers, I really could not give like one simple answer because it really depends on the context. But I would say the question about AI's creativity is quite an unanswered topic at the moment and I think it might be so on. It's a very philosophical question that might be debated forever and ever. And I think rather the question now is how this creativity of an AI is impacting our creativity or human creativity and what does it mean for us? Second, when AI generates art, there is a question that rises that can truly be considered original, because AI algorithms learn from vast datasets that emulate existing artistic styles or techniques and many artists and users have been concerned about plagiarism in this sense. So, it seems important to identify the line between inspiration and imitation. And this also relates to the concerns regarding ownership and authorship. So, when a machine learning algorithm generates a piece of art, who owns the rights to it? Is it the developer who created the algorithm or the person who initiated the AI to generate the art or the AI itself? Or is it okay that the programmers of a model profit from the labor of artists whose artworks they have used to train the model? There have already been examples of lawsuits where authors and artists have raised copyright issues and there has actually been lawsuits against AI companies, who are using their artistic work without consent. However, since the models often use large datasets with millions of data pieces, it is difficult for a single artist to prove that their work has been used by the model. Indeed, traditional copyright laws are not equipped to address this issue which has led to legal ambiguities. This lack of clarity here can result in disputes and challenges in creative professions. Third, the AI-based tools can be used to create hyper-realistic images and videos that then blur the lines between reality and fiction. In these so-called deepfakes, one person's face can be imposed to another person's body or even in a video. Even if this technology can be used in artistic ways, it also raises ethical concerns about misinformation, identity theft and the lack of trust in visual media. Moreover, such models might use public datasets or personal images without consent from the individuals depicted in the pictures. So, this raises privacy concerns, particularly when generated pictures of videos involving private individuals or sensitive contexts. And fourth, there is a common concern among creative professionals that the widespread adoption of AI art tools could potentially disrupt traditional creative industries. This also relates to the bigger discussion regarding the impact of AI and automation on labor. For instance, some digital artists find it

difficult to compete with the speed of AI-generated art because new digital pictures based on text prompts, can be created in seconds or minutes. Thus, there is a lot to take into consideration when the use of AI becomes commonplace in creative industries to secure the livelihoods of creative professionals who already often work in precarious conditions.

Luckily, many researchers predict that AI is not going to entirely replace the human worker, but rather creative work enhanced by AI tools might become commonplace as it already is very widespread. This was also a common idea amongst my research participants. And when I asked about it, many of them said that they could see themselves being creative with AI, meaning they could utilize AI in their own work in one way or another. However, there was a big difference between how artists and scientists saw this tool. Because for artists, it was kind of this playful companion that they could use to try new things and see what works. Whereas computer scientists said that they really want the AI to work well, and there have had been no faults because they need to trust the outcomes that the AI models produce.

So, to sum up these concerns regarding creative AI, I think it's crucial for artists, technologists, ethicists and policymakers to collaborate. And we need to establish guidelines and regulations that will then protect the rights of artists and cultural workers and that ensure content and privacy and also promote fairness in their creative industries. So, in this way, it's good to promote public awareness about the ethical implications of AI. And by thinking about these ethical challenges, I think society can then embrace the benefits of AI. And even AI generated art if we just uphold the rights of artists and then promote human values and what is morally right. And for instance, the European Union has already begun to regulate AI and aims to impose certain requirements for developers of AI to ensure the ethical use of these technologies.

So in conclusion, these generative AI models have really put us in the new era where the lines between human creativity and AI have been blurred. Here the responsible development and usage of AI models can unlock even more possibilities for creativity. And at the same time, we must value human creativity and work. So, advancements in machine learning techniques and algorithms continue to make the capabilities of these technologies better, which then enable even more sophisticated and novel results. And for instance, there are new developments regarding the integration of AI in virtual reality or augmented reality. And this can definitely open new doors for interactive and immersive AI art experiences. So as AI art evolves, it challenges our perceptions

and encourages us to think or rather rethink the boundaries of creativity and the very essence of what it means to be creative. I think researchers Simon Colton and Geron Wiggins have put it nicely in their article called *The final frontier* where they say: "The artifact resulting from a creative act should be seen as an invitation to engage in a dialogue with the artifact and the creator and the culture and yourself."

With this, I would like to finish my talk. I hope listening to me has inspired you to explore these issues that are so critical for us today.

Thank you very much for listening.