

Harmonies and Algorithms: Navigating the Future of Piano Music with AI

Growing up in a typical middle-class Indian family that valued professional courses over artistic pursuits, my initial exposure to music was through a modest CASIO keyboard my parents gifted me. Despite the early limitations, my curiosity quickly turned into a passion as I discovered I could play any tune by ear. This early musical exploration was unstructured but deeply influential, shaping my lifelong appreciation for music. It wasn't until 2019, after achieving financial stability through my fashion e-commerce business, that I was able to pursue music more seriously. I invested in a quality digital piano and began formal training in Western classical music, quickly progressing to challenging pieces like Debussy's "Reverie."

Exploring artificial intelligence to prepare well for the essay, I ventured into programming without any prior experience, learning Python with ChatGPT's guidance. I employed the Mido library on Google Colab to merge Bach's classical methods with the modern tune "Kal Ho Na Ho."¹ This endeavor was both a technical milestone and a personal discovery, highlighting AI's capability to innovate and broaden the scope of traditional piano music.



Sheet music of "Kal Ho na Ho" hindi song generated through the above python script

As artificial intelligence reshapes the landscape of piano music, it unveils a dual role—breathing new life into creation while challenging our cherished traditions of musical expression. In the spirit of Peter Drucker, who recognized technology's capacity to transform society², this narrative weaves through the realms of AI and piano music, exploring how it enriches and tests the enduring human touch in art. While technological advancements redefine our tools and methods, the fundamental human attributes of emotion, expression, and connections continue to anchor the arts, ensuring that the soul of music endures even amidst profound change.

¹ Link to the Google Colab Document : <https://bit.ly/3yATh9H>

² Peter F. Drucker, *Technology, Management, and Society* (Harvard Business Review Press, 1970)

Despite AI's impressive capabilities, human creativity and insight remain irreplaceable across disciplines. In chess, AI may surpass human tactical prowess, but players like Magnus Carlsen captivate with strategic depth and psychological nuance. In literature, AI can mimic authors' styles but lacks the emotional resonance and original insights of human writers. Yuval Noah Harari, in "21 Lessons for the 21st Century," notes that while AI optimizes data, humans uniquely navigate the complex social realms³. Additionally, in medicine, despite AI's diagnostic precision, the empathetic patient-doctor relationship and nuanced treatment decisions underscore the indispensable human element.

The Mathematical Symphony of Music and the Rise of AI Creativity

Music, often perceived purely as an art form, is deeply rooted in mathematical principles. This intrinsic connection underscores that music is fundamentally "playing mathematics."⁴ The structure of scales, the rhythms of compositions, and the harmonics of sounds are governed by precise mathematical relationships. A compelling example of this is the concept of frequency ratios in harmony. In Western music, the perfect fifth—the most consonant harmony after the octave—is based on a frequency ratio of 3:2. This ratio, when played, creates a sound that is particularly pleasing to the human ear due to its mathematical simplicity and auditory smoothness. For instance, in "Twinkle Twinkle Little Star," the first "Twinkle" is played at 400 Hz, and the second "Twinkle," which forms a perfect fifth, is at 600 Hz—1.5 times the frequency of the first, producing a harmonious sound.

Also, consider the time signatures that dictate the rhythm of pieces. These signatures, such as the common 4/4 or the waltz-time 3/4, help organize music into predictable patterns that are easy for both performers and listeners to understand and anticipate. This organization is not arbitrary but is a manifestation of mathematical order, providing a framework within which creativity flourishes.

According to cognitive scientist Margaret Boden⁵, there are three types of creativity: exploratory, combinatorial, and transformational. Exploratory creativity involves pushing the boundaries within an existing framework while adhering to established rules. Combinatorial creativity merges disparate ideas to create new connections. Transformational creativity overhauls existing norms and conventions, leading to revolutionary changes in a field.

Given the mathematical nature of music, coupled with advancements in deep learning and neural networks, AI has already achieved notable success in exploratory creativity. A fascinating instance of this was demonstrated by OpenAI's MuseNet, an AI model capable of generating four-minute

³ Yuval Noah Harari, *21 Lessons for the 21st Century* (Random House, 2018).

⁴ Marcus du Sautoy, *The Creativity Code: How AI is Learning to Write, Paint and Think*, Harvard University Press, 2019.

⁵ Margaret A. Boden, *The Creative Mind: Myths and Mechanisms*, Routledge, 2004.

musical compositions with 10 different instruments and in various styles from classical to jazz to pop⁶.

MuseNet was trained on a large dataset of MIDI files, allowing it to understand and replicate complex musical structures. When I shared these compositions with fellow music students and teachers, most of them were astonished to learn that the pieces were AI-generated, not by human artists. This example highlights how AI can explore and extend the boundaries of traditional music composition while maintaining the intricate patterns and emotional depth characteristic of human-created music.

Combinatorial creativity, which involves melding disparate elements to forge something novel, demonstrates AI's burgeoning capacity, though it hasn't fully matured yet. A recent example that gained virality on Instagram featured the voice of the legendary singer Mohammad Rafi, who passed away decades ago, seamlessly integrated into a popular contemporary Hindi song.⁷ The rendition was so convincing that many, including myself, initially believed it to be an original recording by Rafi. It was only upon further investigation that I discovered the audio was a product of AI, highlighting the impressive, yet still developing, capabilities of AI in the realm of combinatorial creativity.

While it might seem like music composition is a "solved world" for AI, transformational creativity remains elusive. This form of creativity, which involves altering the very rules of the game, is beyond the current reach of AI.

Breaking the Mold

Works of art make rules; rules do not make works of art.

This profound statement by Claude Debussy captures the essence of transformational creativity—the rarest and most revolutionary of Margaret Boden's three types of creativity. It's this form of creativity that has historically redefined artistic landscapes, setting new paradigms that challenge and transcend established norms.

Transformational creativity can be likened to a phase change in matter, much like water transforming into steam. Consider the seismic shifts brought about by Beethoven and Wagner in the world of classical music. Beethoven's integration of personal expression into the rigid structures of classical music and Wagner's development of the leitmotif radically altered the expectations and technical foundations of their times. Each composer, in his own way, did not just bend the rules—they rewrote them, expanding the horizons of what music could convey.

⁶ "MuseNet," OpenAI, 25 Apr. 2019, <https://openai.com/blog/musenet>.

⁷ Example of AI-generated Mohammad Rafi song, YouTube, 1-May-2024, <https://www.youtube.com/watch?v=ceikxNyqmec>

This narrative of rule-breaking is evident throughout the evolution of musical eras—from the precise order of Baroque to the emotive freedom of the Romantic period, and into the dissonant, abstract expressions found in Modernism. The progression from one musical movement to another has always been marked by groundbreaking artists who dared to challenge the status quo.

Yet, can such groundbreaking leaps in creative thought be expected from AI? Consider the concept of the square root of negative numbers, an idea that defied the logical constraints of its time, leading to the development of complex numbers in mathematics. This abstract concept, which initially seemed devoid of practical application, is now fundamental in fields ranging from engineering to physics. AI, by its nature, follows algorithms derived from data it has learned from; thus, its ability to conceive something entirely abstract and rule-defying like complex numbers seems limited. Algorithms optimize and iterate over the known, but can they venture into the unknown without a human at the helm?

Picasso's assertion that "The chief enemy of creativity is good sense" echoes the intrinsic limitations of AI in the realm of transformational creativity. AI excels in environments governed by rules and logic, but true innovation often requires a departure from conventional wisdom—a leap into the realms of irrational and the unknown.

Therefore, while AI may significantly enhance our exploratory and combinatorial creativity, pushing us to new heights within defined boundaries, it is unlikely to usurp the uniquely human ability to imagine the unimaginable. As we continue to integrate AI into the creative processes of music, it becomes crucial to remember that the most profound changes often arise not from following the rules, but from reimagining them entirely. The story of music, with its continual reinvention and defiance of preconceived notions, underscores the indelible value of human ingenuity that AI has yet to, and may never, replicate.

AI and the Democratization of Piano Education

Artificial Intelligence (AI) is reshaping piano education, making it more accessible and tailored than ever before. With innovations like intelligent learning platforms, AI allows students from various backgrounds to access quality piano instruction conveniently and affordably.

Take the example of apps like Flowkey (<https://www.flowkey.com/>) and Simply Piano (<https://www.hellosimply.com/>). These platforms utilize AI to provide immediate feedback to students as they play, closely mirroring the guidance typically offered by a personal tutor. Similarly, platforms like Skoove (<https://www.skoove.com/>) offer adaptive lessons that respond to the pace and ability of each user. This personalization keeps students engaged and motivated, adapting in real-time to their learning progress and style. For instance, if a student excels at tempo but struggles with harmony, Skoove can adjust the curriculum to reinforce weak points while continuing to challenge areas of strength.

This technology is especially beneficial for students in remote or underserved areas, who can now enjoy a structured learning experience that was previously out of reach due to geographical or financial constraints.

In the classroom, AI enhances educational practices through advanced analytics and assessment tools. Platforms like Tonara (<https://www.tonara.com/>) analyze student performance data to provide educators with actionable insights. For instance, if a student consistently misses certain notes or timing, the AI can highlight these patterns, allowing teachers to tailor their instruction to correct these specific issues effectively.

Moreover, the economic impact of AI in piano education cannot be overlooked. Traditional piano lessons and access to instruments can be prohibitively expensive, but AI-powered applications provide a more economical alternative. Many apps offer free or low-cost versions that, while perhaps limited, still provide substantial educational value, making piano learning more inclusive.

Reflecting on my own experience, if I had access to AI-based learning in Assam as a child, I would have progressed much faster in my piano studies. Some grade 8 pieces that I can play today, like Chopin's Nocturne in C# minor or Debussy's Reverie, might have been within my reach in my teens. While children in the early 2000s could certainly learn without these resources by moving to bigger cities or buying piano books, such opportunities were often limited to those pursuing music professionally. Hobbyists, especially in vast parts of India, were, and still are, effectively excluded from learning the piano. AI-based learning, therefore, is incredibly valuable for hobbyists, enabling them to pursue their passions well, even without financial incentives.

Artificial Intelligence (AI) is not only making piano education more accessible but also transforming the nature of piano related manual work itself. For example, my piano tuner, traditionally a manual technician, now uses AI to analyze room acoustics and optimize tuning processes. This ability to apply sophisticated technology in his work has elevated his role to that of a "knowledge worker,"⁸ a concept championed by Peter Drucker, which reflects a significant shift from manual labor to knowledge-based activities.

In essence, AI is not only breaking down barriers in education but also revolutionizing the workforce, ensuring that the future of piano music—and indeed all industries—is one where innovation, access, and empowerment converge.

Economic Implications of AI in Piano Music

While it can be concluded that pianists face no existential threat due to the unique human capabilities in combinatorial and transformational creativity, it remains crucial to consider the

⁸ Peter Drucker, *The Landmarks of Tomorrow*, 1959

economic implications of AI's growing influence in the piano industry. If we consider a hypothetical "Piano GDP," divided into multiple parts, we'll be able to make an assumption on revenue and job growth for 10 years in that segment. I have taken the simplistic assumption that new vocations/hobbies will generate at the same rate as it has happened over the past many years.

Piano Sales (including acoustic and digital pianos, keyboards) and service: With an expanding middle class in Asia, Africa, and Latin America, leading to higher discretionary spending; coupled with democratized personal music education via AI, the demand, along with music slowly becoming part of the educational curriculum in more and more developing countries, means demand for pianos should increase by 30-35% over ten years. Given a non-linear relation between production and labor increase, such a revenue increase should not increase/decrease any human jobs.

Teaching Revenue: Due to the factors discussed, the demand for teachers (human and AI) will definitely increase. However, since AI tools will be significantly cheaper than human teachers, overall teaching revenue can be the same. Although it looks like the number of teachers might go down, that is unlikely to happen. 80% learning might be done via AI tools, however, a teacher will still be required for fine-tuning, and most importantly, motivation. Despite my busy schedule as the founder of a fashion e-commerce company, I meet my teacher thrice a month for 40 mins despite having access to AI-based learning tools 24/7. We can assume constant teaching revenue and a slight reduction in human teaching jobs.

Online Content Revenue: The revenue is likely to grow by 100-150% led by increased digital consumption and cheaper data, along with other macro factors discussed above. The increase in revenue will not lead to an increase in human composers, and might also be decreased because with AI, a human can generate far more music than she/he could without AI.

Concert Ticket Sales: The next decade is expected to see a 30-35% rise in concert ticket sales, driven by the expanding "experience economy" and digitization. Yet, this increase may not lead to a similar growth in jobs due to AI's role in music, such as in the AI-composed song "Break Free" by Amper AI and Taryn Southern.⁹ Additionally, advancements in AR/VR could extend concerts' reach beyond traditional venues and potentially reshape the industry's employment landscape. This shift reflects a broader digital transformation influencing labor markets in the arts.

Segment	Revenue Growth	Job Impact	Key Factors
Piano Sales & Service	30-35%	Constant (↔)	Expanding middle class, democratized education, music in curriculum
Teaching Revenue	Constant	Slight Reduction (↓)	Demand for AI tools, cost-effectiveness, need for human motivation
Online Content	100-150%	Potential Decrease (↓)	Digital consumption, cheaper data, AI content production
Concert Tickets	30-35%	Constant or Slight Decrease (↔/↓)	Experience economy, AI-enhanced performances, concert digitization

⁹ For more info on Taryn Southern's AI-generated music album, visit <https://tarynsouthern.com/album/>

Harmonizing AI with Human Creativity—From Piano to Pedagogy

As we stand on the brink of a transformative era, the integration of Artificial Intelligence into the realm of piano music marks a renaissance, not merely a technological shift. This evolution in music, powered by AI's capabilities to enhance composition and education, embodies the visionary future Peter Drucker predicted—a future where technology profoundly elevates human creativity and potential.

AI's influence on democratizing music education could signal a broader societal shift towards a knowledge-based society. AI is not just automating processes; it's enhancing and personalizing learning, making it accessible to everyone, regardless of geographic or economic constraints. This shift in education and personal development aligns closely with Drucker's principle that technology should ultimately enhance and expand human potential.

Reflecting on the personal transformations within my own business, the profound impact of AI extends beyond the realms of music. In my garment factory, tailors traditionally constrained to manual tasks are now employing AI to enhance their craftsmanship and problem-solving capabilities. For instance, one tailor used AI to analyze and adjust the 'Time, Temperature, Pressure' settings for linen suits after noticing a recurring issue with fabric discoloration. This critical use of AI in troubleshooting and refining production processes exemplifies the shift from manual labor to knowledge-based work, epitomizing Drucker's vision of elevating workers into knowledge workers through innovative technology.

Furthermore, the influence of AI reaches into areas of coding and software development in my business. A college dropout, who became a self-taught coder through online AI-enhanced learning platforms, now leads the development of complex custom features for our website. This not only showcases the democratizing power of AI in education but also highlights its role in fostering innovation and entrepreneurial spirit across various sectors.

However, as we harness these technological advancements, it is crucial to consider Drucker's warnings about the potential displacement of traditional roles. We must ensure that our embrace of AI does not overshadow the indispensable human elements—emotion, intuition, and the unique imperfections that define artistic and creative expressions. By nurturing a synergistic relationship between AI and human creativity, we ensure that technology acts as a catalyst for new forms of artistic expression and deeper human connection.

Therefore, as we navigate the integration of AI with piano music and beyond, our approach should not only focus on innovation but also on maintaining a profound respect for the human spirit that animates all art forms. By doing so, we can ensure that our technological progress enriches not just the tools we use but enhances the very essence of human creativity. In this ongoing symphony of progress, we are composing a future where technology and humanity together play a melody

richer and more vibrant than either could achieve alone—fulfilling Drucker’s vision of a society where technology empowers every individual to achieve their fullest potential.



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