Computational Composition and Artificial Intelligence in Music.

INDEPENDENT STUDY – WORD COUNT: 4348

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'The Analytical Engine might act upon other things besides number, were objects found whose mutual fundamental relations could be expressed by those of the abstract science of operations, and which should be also susceptible of adaptations to the action of the operating notation and mechanism of the engine… Supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent.' – Ada Lovelace, 1843

Introduction

Computational composition and artificial intelligence in music is a vast topic. Ranging from fully automated compositions of a computer to some that are a collaboration process. The idea of collaboration between a human and computer in order to generate new ideas occurs commonly with the computer aided composition sector becoming an ever-growing field that. Computers have already begun to shape how music is written with digital audio workstations becoming a large part of this. However, artificial intelligence in music and more specifically artificial intelligence in music composition has a limited usage by musicians and composers.

This growing field of artificial intelligence techniques are explored within this essay alongside a look at computer aided composition and a brief look at computational creativity. The aim of this essay is to establish how a computer might be utilised as a tool for a person to generate melody, with the discussions based from semi-structured interviews undertaken during the research process for this essay. These semi-structured interviews used open ended questions to obtain qualitative data based around the ideas of computational composition, artificial intelligence and philosophies of computer aided composition.

The interviews with producers, composers and computing researchers utilised varying questions based around:

- The theory of computational composition and AI – How it can be implemented and the next steps in terms of research areas
- Music theory – How to train a computer on music theory and rules followed in composition
- Tacit rules vs Theory Rules
- Arguments in philosophical debates on copyright, creative ownership, the idea of what is 'real music' and whether a computer can write music (is it lacking in human input to say such a thing).

Finally, this essay will propose future usage of computational composition and artificial intelligence in music.

Theory

Usage of algorithms to generate melody is not a new concept (Maurer, 1999). The most recent usages of algorithms in composition focus around the use of models developed by individuals in the 1990s with researchers such as David Cope (2000). A starter algorithm to look at is the Markov model chains. This process largely uses probability to generate an output dependent on one or more previous outputs (Miranda, 2001, p69). This conditional probability is analysed using a transition matrix, showing the probability of each outcome. The probability of the next state depends only upon the current state for first order Markov chains and can generally be used to show the randomness of choice in comparison to an $\mathcal{N}^{\text{th}}$ order Markov chain which considers previous $\mathcal{N}$ states for the next state of probability.

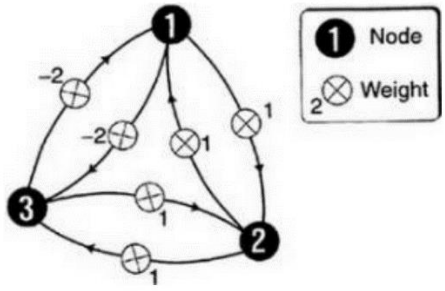
Research undertaken looking at Markov chain music to generate music based upon mood inputted from a user shows that 76.4% of respondents of a survey agreed that the music generated was 'adequately composed' and 62.5% of users stated that it fitted the mood (Ramanto, Nur and Maulidevi, 2017). This shows that while looking at Markov chains can be seen as old research, the complexity of research into the models to the modern day shows the efficacy of this approach.

It is worth mentioning this model as it can serve as a benchmark for future ideas for algorithmic composing. A look at David Cope's ALICE model from 1996 shows usage of algorithmic composition. Inputting data can occur to shape the program as well as utilising very little data (Cope, 2000, p227).

Artificial neural networks are a branch of machine learning used within artificial intelligence to train machines using inputted data. These algorithms are modelled like a human brain, using artificial neurons. As music is an art form, it is not just about following rules which is where an algorithm can fall short (Miranda, 2001, pg103). Tacit rules and tacit knowledge is internalised knowledge that cannot be shared fully by just explaining it (Polanyi, 1983). Within a musical context therefore, some context might be missing that can affect the output from a computer. Within all the interviews (See appendix), tacit rules are discussed and acknowledge to be a part of music that will need to be further researched and understood.

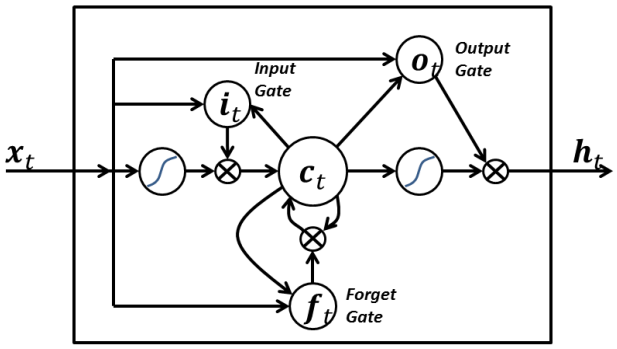
Research into artificial intelligence (AI) and composition is an emerging field with companies such as AIVA being one of the first to profit from this.

There are many different approaches to this that are used within melody generation. A simple recurrent neural network (RNN) has two sources of input, the present state and the short-term past, which combine to determine how to respond to inputted data. The Hopfield net (see fig 1.1), popularised by John Hopfield in 1982, is an early example of constructing a neural network capable of performing associative recall (Gurney, 2004, pp.140–250).



(Fig 1.1) Three-node Hopfield net (Gurney 2004)

Long short-term memory (LSTM) recurrent neural networks can capture patterns over a longer period. They use three gates; an input, output and forget gate. These are sigmoid[1] gates that determine how much information to pass with their own weightings which are adjusted with gradient descent (Mikami and Alvarez, 2016). Figure 1.2 provides an overview of the LSTM network.



(Fig 1.2) LSTM Network (BiObserver, 2015)

The input gate adds information to the cell state, in this instance this would be MIDI data. It must regulate what needs to be added to the cell state. A vector of new candidate values is created

[1] Sigmoid Function – A squashing function used to input values and output them between zero and one. $y = \frac{1}{1+e^{-x}}$. (Mikami and Alvarez, 2016)

using a tanh layer, which for example, would be utilised to input the sequences of notes from a piece. (Mikami and Alvarez, 2016) (Nguyen, 2019).

The forget gate removes information from the cell that is no longer required for the LSTM to understand things, or the information that is of less importance is removed via multiplication of a filter. This is required for optimizing the performance of the network. Not everything is necessary to remember. For example, changing data sets might require the LSTM model to remove all data from the old music (Mikami and Alvarez, 2016) (Nguyen, 2019).

The output gate selects useful information from the current cell state and shows it as an output. Not all information that runs along the cell state is fit for being output at a certain time. Therefore, the output cell controls the encoded data to be sent to the network in the following time step.

For application in melody generation, LSTM networks can be useful in capturing harmonic and melodic structure. Bachbot and Deepbach utilise LSTM networks to generate melody and harmony based around inputted midi data of Bach's work (Kotecha and Young, 2018). Classical music for data training is a go to for computer scientists as it is out of copyright restriction and there are also many compositions by historical composers.

Kotecha and Young demonstrate the usages of LSTM networks and suggest that a long train time for these models will incur more engaging and concise music generation. Upon listening to the midi files generated from the LSTM models, a lack of structure and simplicity is first noticed (Kotecha and Young, 2017). Kotecha and Young also conclude that the output from this *'sounded as if a human were learning to play piano but trying to play songs that were too difficult*.'

There are many variations of the recurrent neural network, each with their own advantages and disadvantages. Hochreiter and Schmidhuber (1997), the original researchers behind the LSTM model, highlights the advantages and potential limitations of this RNN. Advantages include the fact that the LSTM model works well over a broad range of parameters with no need for fine tuning. This however could be seen as a bias opinion, as long train times have been highlighted as a disadvantage. While the LSTM model does take in a lot of data, this process is over a long period (Kotecha and Young, 2018). The output is generally short melodies that have no correlation to chord sequence or song structure either.

Google Magenta boasts recent work utilising artificial intelligence and recurrent neural networks (Waite, 2016). While utilising the original idea of recurrent neural networks, Magenta generated two neural networks; the lookback RNN and attention RNN which overcome the issue of long-term structure in melody generation.

The lookback RNN, utilises the LSTM model with extra vectors, one of which mimics the idea of a Markov chain. The lookback RNN inputs events from one and two bars ago, as well as inputting whether it was a repeat event or not. An advantage to this is the fact that the model can more easily recognise patterns that are either repetitive or not. Current position in a bar is also recorded utilising research from Daniel Johnson (2015). These ideas allow for lookback, not only on the inputted data, but for the melody that the neural network is producing also.

Magenta also introduce the attention RNN within the same blog (Waite, 2016). The main idea behind the attention RNN is to produce further lookback than the lookback RNN. This also uses an LSTM model with research from Bahdanau, Cho and Bengio (2016) being utilised. This paper outlines using an encoder-decoder RNN with the 'attention' to look at all the encoder outputs while at the decoding step (Cheng-Zhi et al., 2018). Magenta's attention RNN looks at outputs from the last $\mathcal{N}$ steps when generating the current step. Figure 1.3 shows the attention mechanism utilised:

$$u_i^t = v^T \tanh(W_1' h_i + W_2' c_t)$$
$$a_i^t = \text{softmax}(u_i^t)$$
$$h_t' = \sum_{i=t-n}^{t-1} a_i^t h_i$$

(Fig 1.3) Google Magenta's attention mechanism (Waite, 2016).

The h_t' vector is a combination of the outputs from the previous $\mathcal{N}$ steps. This vector directly injects information from those previous steps into the current step's network of calculations. This allows for the model to learn long-term structure without having to store previous data in the RNN's cell state.

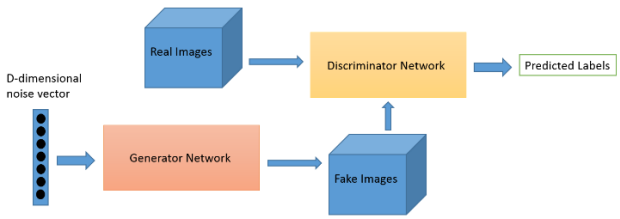
Upon listening to both the melodies generated by Google Magenta's lookback RNN and attention RNN, it is clear the attention RNN provides a more structured and balanced melody. Previous incarnations of my surveys and interviews would allow for comparison of different RNNs that would have led to quantitative data to fully understand which RNN would be a possible way forward. This did not occur for this assignment. Moving forward, it should be implemented as to gain a perspective from musicians, computer scientists and the general public as to which neural network, algorithms and combinations of ideas lead to the most coherent of melodies to a listener.

This is a weakness for researching melody generation techniques as it leads to sole opinion of author(s) at their discretion. Upon researching from this assignment, there is a lack of input from other sectors such as composers, producers and the general public when generating ideas. Instead, a musician is given the research and ideas post generation to use as a tool.

The semi structured interview with artificial intelligence researcher, David Moffat alluded to some interesting points while researching AI and composition. He suggests that Markov models still has a lot to attain to for neural networks as they provide structure whereas neural networks *'basically just throw music in and see what falls out'* (See Appendix 1). This idea of utilising a Markov chain with a neural network could lead to a neural network training a Markov chain while it is generating music. While brainstorming this idea, it became apparent that if an encoder with a small latent space of ten controls for a user to utilise, this might lead to more of a collaboration between humans and computers and provide a way forward to utilise this theory for composers to use.

From this interview, Moffat promotes the idea of using generative adversarial networks (GANs). As described by Moffat: '*So GANs kind of tends to approach it from a very different perspective. Which becomes a little bit more human in that you're defining something on what it's not instead of what it needs to be.'.*

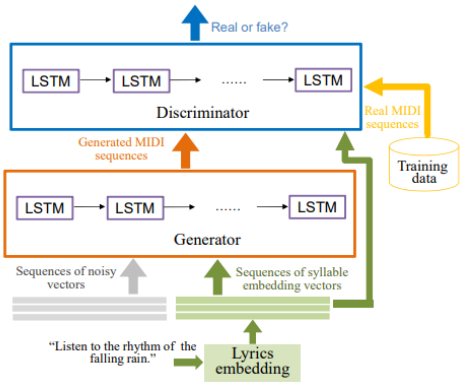
Generative adversarial networks are a framework for generative models proposed in 2014 by Goodfellow et al. This utilises two neural networks, a generative network and a discriminative network. These networks are pitted against each other to generate new data (Goodfellow et al., 2014). The generative network creates new data while the discriminative network decides whether the data belongs in the dataset. It is commonly used in picture manipulation, where it manipulates the training data with generated data. Figure 1.4 provides a look at how the networks obtain data and in what order the output is processed.



(Fig 1.4) Generative adversarial network schema of images (Nicholson, 2014)

There are both advantages and disadvantages to this approach also. Advantages include the fact that they utilise an unsupervised learning method; they can be trained using unlabelled data. GANs also generate data that is like real data, allowing for widespread usage. They do, however contain long training times and input distribution changes cause the network to adapt to this situation, causing further slowing of the networks. This can be circumvented with normalisation techniques.

In music, there is application of an LSTM-GAN model for melody generation from lyrics (Yu and Canales, 2019). This utilised 12,197 MIDI songs each with paired lyrics and melody alignment. The LSTM network captured syntactic structures of lyrics; from syllable structure to word structure. This LSTM then generates data (Generative network) that is fed into the discriminative network alongside the training MIDI data. Figure 1.5 is much like figure 1.4 however it shows more usage for midi data and how lyrical data might exist as well as the midi data.



(Fig 1.5) a visual representation of the LSTM-GAN (Yu and Canales, 2019).

From the undertaken interviews, researchers within this field see many different ways of moving forward with computer training and creative outputs. Computer aided composition researcher, Aurelian Antoine suggests that it's not just the output from a melody generator that needs to be looked at. Instead, Antoine discusses the psychoacoustics of computer aided composition. What a computer lacks is the knowledge of instruments and how they are perceived by a human. Further research is therefore needed into looking at how melodies are written for instruments and how a computer might be able to perceive these changes.

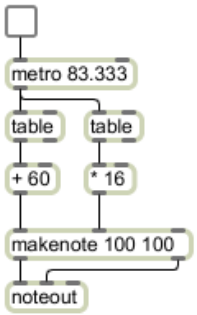
Computer aided composition

Computer aided composition (CAC) is a field in which this melody generation occurs. Computer aided composition works within the framework of interactivity between a computer and a musician. This is not a new concept, with the first usages of CAC aging back to Bells labs in the early 1950s (Saitis, 2010). David Cope, however, suggests that this term is flawed as '*many composers use algorithms that do not interact at all.'* (Cope, 2000, p2). This however negates the composers that do interact with their software. Digital audio workstations (DAWs) for example, are digital audio editors used commonly on personal computers by musicians, composers, producers and general hobbyists (Manning, 2013). Collaboration based practice is heavily favoured amongst the interviewees from the interviews undertaken (Drury, 2020). While it is recognised that automated composition does not

occur; human interaction from coding to inputting data exists, a more collaborative based practice between the user and computer is generally seen as more desirable.

Performance based research into creating a musical instrument also exists (Wang and Cook, 2004). On-the-fly programming of computers allows performers/composers to interact with the systems they create in real-time, which can allow for new compositions and instruments to be created on stage. The level of control for this project is what brings it close attention. The idea that a composer and computer scientist could work together while using this programme to fully generate new ideas in a collaborative based practice is a collaboration like any other. The collaboration is of course with the computer instead of another person.

Max MSP is a visual programming language for audio manipulation (Agostini and Ghisi, 2013). It is relatively simple by my own admission to create an object that will generate an output of random notes and name it a melody, shown in figure 1.6.



(Fig 1.6) A random note generator in Max MSP (Mgalvao, 2013).

Within Max MSP, there is an environment solely created towards the goal of computer aided composition. Bach is an environment that allows the computer and human to interact on a predefined basis and allows a human to programme something of their own creation while using the environments (Agostini and Ghisi, 2013). This idea, to create an environment/plugin that can be freely manipulated to incorporate what a person wants to do allows for collaboration that can be built upon. A melody generator within this programme would therefore be a direct collaboration between the original programmer/s, the user and the computer.

There is of course, a fine line between collaboration and autonomy within computer aided composition. Companies that specialise in computer aided composition such as AIVA, have their own controversies. AIVA technologies, is a company founded in Luxembourg and London that utilises artificial intelligence to create pieces of music across a spread of genres (Machuron, 2016).

Upon reading their helpdesk (AIVA, 2019), the question of 'How can I use AIVA in my creative process?' is present. The response is that inspiration can be drawn for what AIVA produces. This suggests that although no artificial intelligence is completely autonomous, there is no collaboration process between the user (composer) and the artificial intelligence at this step. Instead, a composer is to use what the artificial intelligence creates to generate separate ideas. While the developers have inputted training data, the composer has no control over this or the ability to see what data is inputted. This might explain why The Luxembourg federation of authors and composers (FLAC) published an open letter in which they describe using AIVA to create music for Luxembourg's national day as *'a slap in the face of all creators in all artistic fields.'* Interviews with both artificial intelligence researchers and composers about the usage of artificial intelligence within music generation makes it very clear that autonomy in computer aided composition is generally seen as not the way forward within computer aided composition.

There are two sides to this argument. Pierre Barreau, CEO of AIVA technologies suggests that the artificial intelligence can be used in video game composition to create *'hundreds of hours of personalised music for those cases where human creativity doesn't scale'* (TED, 2018: 4.55). This argument of course suggests that composition for specific scenes in either video games or films need to have personalised music for each scene to fit with what happens on screen. While this is a good argument for automation within computer aided composition, it does lead to questions about thematic material utilised within soundtracks. For example, musicals commonly use melody and harmony to explain scenes.

Shadow of the Tomb Raider, a game published in 2018 uses a soundtrack based around instruments from South America (Tomb Raider, 2018). This required ethnographic research and study to create a soundtrack that fitted with the company's trilogy and stayed true to the countries that the game is based in. Foley is also introduced as a bridge between the base music and actions within the game, this required the imagination of composers in using instruments to signify screams from beasts, underwater sections and the background music heard in villages within the game. If an automated artificial intelligence were to create music based around South American music, the results would likely differ as the instruments that are created and used by the musicians and composers in this instance, is completely new and does not follow traditional rules set out by previous composition.

However, collaboration-based computer aided composition could be utilised in this instance. Ethnographic study can occur with composers and musicians using an artificial intelligence with trained example melodies alongside encoders to generate musical ideas that can be extracted and performed alongside the composition of the composers. When interviewing composers, artificial intelligence researchers and producers, the idea of collaboration-based practice between computers and musicians is seen as the best practice going forwards. This would explain why the Luxembourg federation of authors and composers felt disgruntled at the use of AIVA; the automation of the composition takes away from the authentication of the composed piece (Huberty, 2017).

For a melody generation plugin for a digital audio workstation to therefore be utilised as a tool, the collaboration between the user and the software must be to the extent that a user has enough control to make their own, personalised melody. A semi-structured interview with Nuria Bonet, a composer and researcher fully endorsed this idea of thinking (See appendix 2). The discussion of what would make the music 'real music' occurred and it was agreed that while computers can create music, the meaning behind it is somewhat lost if the user has little to no control. Other interviews discussed similar ideas where the consensus would be that a melody generator plugin; using research based around neural networks, Markov chains and even generative adversarial networks, would need enough input from a user for it to be recognised as a tool. Lee Whittock, another interviewed musician (See appendix 2) suggested that a melody generator would have to be available to the correct market, as a well-rounded musician like himself might not see the need for it other than to work around writers block.

Computational Creativity

This essay relies on the study of computational creativity. This is a cross-disciplinary research area involving computing, artificial intelligence, cognitive psychology, philosophy and the arts (ACC, 2020). Computational creativity looks at how a creativity can be modelled, stimulated or replicated using computational means (Zhang, 2017).

The field has fundamental problems within its' definitions. For example, creativity is hard to define with complete objectivity; it takes many forms both eminent and mundane. However, if modelling, stimulating and replication are the main ideas then it can be argued that this can in fact be taught.

As Professor Margaret Boden (2005) points out, arguments occur over creativity as scientists take a reductionist view of something that is supposed to be unimaginable outside of a living organism. In Boden's opinion, creativity should be studied as the ability to create something new, surprising and valuable (Zhang, 2017). Boden describes combinational creativity to suggest that although a computer may create something from previous work, the output itself is a new outlook, therefore being a creative process.

From the interviews undertaken, a broad understanding of computational creativity occurred. As Zhang (2017) also mentions in his research, computational creativity, in the current climate should be researched to assist with human thinking. As computers are better at certain things than humans, humans are also better at others; which is why the research currently being undertaken looks at combining both computational and human creative processes.

Following the interviews undertaken with musicians (appendix 2), a market for computational creativity can evolve. For melody generation, musician Lee Whittock suggests that the 'mumble rap' community might be the target market, as their musicianship is not as evolved. This is not a negative however, because the mumble rap and similar genres generate new ideas by taking what other musicians have done to be creative. Therefore, a melody generator that can take some of the music theory side of composition would be of interest. Similarly in assistive technologies highlighted by Nuria Bonet in the interview, while a melody generator might not be as appropriate, the theory behind it can be implemented to help disabled musicians.

Conclusion

The primary objective of this essay was to propose future usages of computational composition and artificial intelligence in music. From the theory, computer aided composition and computational creativity research it is clear to conclude; computers can be used to generate music composition (in this instance, melody) but should however aim to achieve a balance of autonomy and collaboration.

The limitations of this essay are worth mentioning. The theory aspect is very brief and does not contain enough detail to fully obtain a clear picture of computational composition and artificial intelligence so that is can be definitive. It instead shows the main ideas, a general overview and a basic understanding of some theories currently being developed. The main bulk of the research is from secondary sources which limits the relationship between the investigator and the original data source (Morse, 1994, p.264). This can lead to misinterpretation and loss of meaning. However, looking at many sources at once can provide an overview which could be previously missed in primary research. Primary sources are utilised, but they are small scale and require further research and work to be seen a full overview which could then be generalised further. Further primary research was initially planned in the form of a web survey so that quantitative data could be collected. This however never came to fruition due to limitations occurred from studying off campus.

Future Ideas

The main reasoning behind this essay was to propose a melody generator. The interactive phrase generator for Cubase dates to the turn of the century. This allowed *'you to model new music from existing, create one finger accompaniments, generate complicated arpeggios and more.'* Background on this is scarce, as it was discontinued. However, the optimisation of this VST for digital audio workspace is apparent.

Future work on this topic would include looking at the feasibility of creating a melody generator VST for digital audio workstations. This would require input from users however pretrained models on genre could be preinstalled to save train times. If a user can input musical direction (Length, key, tempo, structure), then the computer can return a number of melodies which can be

chosen by the user at their pleasure. To further utilise this, research into audio perception and computer aided composition for instrumentation could be observed so that the computer could also suggest instrument choice or create a new, synthesised sound. Google's Nsynth (Engel et al., 2017) utilises this already with a plugin available for Ableton Live 10 Suite (Max for Live processes this).

To conclude, the usages of computers are endless within computational composition and artificial intelligence in music. While the lack of limitation for a computer can be daunting for many, this could provide new ways of composing with computational creativity ideas furthering generating models of creativity that can be utilised as research progresses. The usages for a musician can therefore be only bound by the creative outlook of the person.

Reference list

Abolafia, D. (2016). *A Recurrent Neural Network Music Generation Tutorial*. [online] Google Magenta. Available at: https://magenta.tensorflow.org/2016/06/10/recurrent-neural-network-generation-tutorial [Accessed 6 Mar. 2020].

ACC (2020). *Association for Computational Creativity*. [online] Association for Computational Creativity. Available at: https://computationalcreativity.net/home/ [Accessed 26 Apr. 2020].

Agostini, A. and Ghisi, D. (2013). Real-Time Computer-Aided Composition with Bach. *Contemporary Music Review*, 32(1), pp.41–48.

Aiva (2019). *How can I use AIVA in my creative process?* [online] AIVA Helpdesk. Available at: https://aiva.crisp.help/en/article/how-can-i-use-aiva-in-my-creative-process-180j3u0/ [Accessed 14 Apr. 2020].

Bahdanau, D., Cho, K. and Bengio, Y. (2016). Neural Machine Translation by Jointly Learning to Align and Translate. [online] Available at: https://arxiv.org/abs/1409.0473 [Accessed 25 Feb. 2020].

BiObserver (2015). *Long Short-Term Memory Units.* [online] Wikimedia Commons. Available at: https://commons.wikimedia.org/wiki/File:Long_Short_Term_Memory.png [Accessed 29 Mar. 2020].

Boden, M.A. (2005). *The Creative Mind: Myths and Mechanisms*. London: Routledge.

Cheng-Zhi, A.H., Vaswani, A., Uszkoreit, J., Shazeer, N., Simon, I., Hawthorne, C., Dai, A.M., Hoffman, M.D., Dinculescu, M. and Eck, D. (2018). Music Transformer: Generating Music with Long-Term Structure. *Google Research*. [online] Available at: https://research.google/pubs/pub47717/ [Accessed 26 Mar. 2020].

Cope, D. (2000). *The Algorithmic Composer*. Madison, Wis.: A-R Editions.

Cubase VST (2000). *The Interactive Phrase Synthesizer*. [online] Available at: ftp://ftp.steinberg.net/Archives/Cubase ... ta/IPS.pdf [Accessed 26 Apr. 2020].

Eduardo Reck Miranda (2001). *Composing Music with Computers*. Oxford, Uk ; Boston, Massachusetts: Elsevier Focal Press.

Elman, J.L. (1990). Finding Structure in Time. *Cognitive Science*, [online] 14(2), pp.179–211. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1207/s15516709cog1402_1 [Accessed 7 Apr. 2019].

Engel, J., Resnick, C., Roberts, A., Dieleman, S., Eck, D., Simonyan, K. and Norouzi, M. (2017). *Neural Audio Synthesis of Musical Notes with WaveNet Autoencoders*. [online] Google Research. Available at: https://research.google/pubs/pub46119/ [Accessed 26 Apr. 2020].

FLAC (2017). *Lettre ouverte à Monsieur le Ministre de la Culture*. [online] flac.lu. Available at: https://flac.lu/site/articles/detail/lettre-ouverte-a-monsieur-le-ministre-de-la-culture [Accessed 15 Apr. 2020].

Goodfellow, I., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., Courville, A. and Bengio, Y. (2014). *Generative Adversarial Nets*. [online] Available at: https://papers.nips.cc/paper/5423-generative-adversarial-nets.pdf [Accessed 26 Apr. 2020].

Gurney, K. (2004). *An Introduction to Neural Networks*. London: Routledge, pp.140–290.

Hochreiter, S. and Schmidhuber, J. (1997). Long Short-Term Memory. *Neural Computation*, 9(8), pp.1735–1780.

Huberty, M. (2017). *An artificial intelligence song for national day?* [online] Delano. Available at: https://delano.lu/d/detail/news/artificial-intelligence-song-national-day/145508 [Accessed 25 Apr. 2020].

Johnson, D. (2015). *Composing Music with Recurrent Neural Networks*. [online] Hexahedria. Available at: http://www.hexahedria.com/2015/08/03/composing-music-with-recurrent-neural-networks/ [Accessed 25 Mar. 2020].

Kotecha, N. and Young, P. (2017). *nikhil-kotecha/Generating_Music*. [online] GitHub. Available at: https://github.com/nikhil-kotecha/Generating_Music/tree/master/Output [Accessed 25 Mar. 2020].

Kotecha, N. and Young, P. (2018). Generating Music Using an LSTM Network. *Cornell University - arXiv*. [online] Available at: https://arxiv.org/abs/1804.07300 [Accessed 25 Apr. 2020].

Machuron, C.-L. (2016). *AIVA: the Artificial Intelligence Composing Classical Music*. [online] Silicon Luxembourg. Available at: http://www.siliconluxembourg.lu/aiva-the-artificial-intelligence-composing-classical-music/ [Accessed 26 Apr. 2020].

Manning, P. (2013). *Electronic and computer music - fourth edition*. New York: Oxford University Press.

Maurer, J. (1999). *The History of Algorithmic Composition*. [online] Stanford.edu. Available at: https://ccrma.stanford.edu/~blackrse/algorithm.html.

mgalvao (2013). *Random | Computer Music*. [online] sites.uci.edu. Available at: https://sites.uci.edu/computermusic/tag/random/ [Accessed 26 Apr. 2020].

Mikami, A. and Alvarez, S. (2016). *Long Short-Term Memory Recurrent Neural Network Architectures for Generating Music and Japanese Lyrics*. [online] Available at: https://www.bc.edu/content/dam/files/schools/cas_sites/cs/pdf/academics/honors/16Mikami.pdf [Accessed 23 Mar. 2020].

Morse, J.M. (1994). *Critical Issues in Qualitative Research Methods*. Thousand Oaks: Sage Publications, p.264.

Nguyen, M. (2019). *Illustrated Guide to LSTM's and GRU's: a Step by Step Explanation*. [online] Medium. Available at: https://towardsdatascience.com/illustrated-guide-to-lstms-and-gru-s-a-step-by-step-explanation-44e9eb85bf21 [Accessed 25 Mar. 2020].

Nicholson, C. (2014). *A Beginner's Guide to Generative Adversarial Networks (GANs)*. [online] Pathmind. Available at: https://pathmind.com/wiki/generative-adversarial-network-gan [Accessed 26 Apr. 2020].

Polanyi, M. (1983). *The Tacit Dimension*. Chicago, Ill: The University of Chicago Press.

Ramanto, A., Nur, U. and Maulidevi, S. (2017). *Markov Chain Based Procedural Music Generator with User Chosen Mood Compatibility*. [online] Available at: https://www.jstage.jst.go.jp/article/adada/21/1/21_19/_pdf/-char/en [Accessed 25 Mar. 2020].

Saitis, C. (2010). *Computer-Assisted Composition, a Short Historical Review*. [Essay] Available at: http://www.music.mcgill.ca/mumt303/materials/essay.pdf [Accessed 26 Apr. 2020].

TED (2018). *How AI could compose a personalized soundtrack to your life | Pierre Barreau*. *YouTube*. Available at: https://www.youtube.com/watch?v=wYb3Wimn01s&feature=emb_title [Accessed 24 Mar. 2020].

Tomb Raider (2018a). *Shadow of the Tomb Raider - Sound and Music [PEGI]*. *YouTube*. Available at: https://www.youtube.com/watch?v=Y6LRk7SXaE8 [Accessed 25 Apr. 2020].

Tomb Raider (2018b). *Shadow of the Tomb Raider Music*. [online] Shadow Of The Tomb Raider | SQUARE ENIX. Available at: https://tombraider.square-enix-games.com/en-us/news/shadow-of-the-tomb-raider-music- [Accessed 25 Apr. 2020].

Waite, E. (2016). Generating Long-Term Structure in Songs and Stories. Available at: https://magenta.tensorflow.org/2016/07/15/lookback-rnn-attention-rnn [Accessed 25 Feb. 2020].

Wang, G. and Cook, P. (2004). *On-the-fly Programming: Using Code as an Expressive Musical Instrument*. [online] Available at: https://soundlab.cs.princeton.edu/publications/on-the-fly_nime2004.pdf [Accessed 26 Apr. 2020].

Yu, Y. and Canales, S. (2019). *Conditional LSTM-GAN for Melody Generation from Lyrics*. [Paper] Available at: https://arxiv.org/pdf/1908.05551.pdf [Accessed 26 Apr. 2020].

Zhang, L. (2017). *Foundations of Research in Creative Computing*. [PhD Thesis] Available at: https://ethos.bl.uk/ProcessOrderDetailsDirect.do?documentId=2&thesisTitle=Foundations+of+research+in+creative+computing&eprintId=760278 [Accessed 26 Apr. 2020].

Appendix 1. Interviews with Computer Scientists and AI Researchers

Semi – Structured Interview for Computer Scientists Questions

Date:

Interviewer:

Interviewee:

Location/Context:

1. Do you play any instruments?

2. What is your background in computing for music?

3. Are there any specific research areas you would highlight in computing that can be transferred over to melody generation?

4. What do you think is the way forwards with melody and music composition and computing? I have read into encoders and decoders that can be used to place more structure upon the input and outputs from a neural network, do you think this is a promising way forward for structured melody?

5. I have spoken to an AI researcher before this interview, one of his suggestions for research was to look at using a neural network to train a markov model, what are your thoughts for implementing this?

6. Do you see melody generation by a computer as 'Real Music'?

7. How would you describe the uses of a melody generator to the composer?

8. Do you think melody generation can be used as a tool just like DAWs are used? If so, does that lead to the contention of who owns the melody in terms of copyright?

9. In your opinion, what is the way forwards in terms of AI, encoders, decoders to provide a software that is useful for a musician in terms of melody generation?

Interview Transcription 18/04/2020 - 15:50

Interviewer: Harriet Drury (HD)

Interviewees: David Moffat (DM) (AI researcher within audio manipulation)

Location: Internet Call (Zoom)

Overview

This document summarises an interview using smooth vebatim editing with the above interviewee that discusses computer aided composition, the theory and research currently undertaken and the philosophical arguments surrounding the topic.

Summary

Time:	Brief Description	Details
>00:15	Discussing background	Instruments DM plays, what qualifications DM has, where he worked and what research he has done in the area topic
>07:30	First question, discussion of melody generation	Talk about varying techniques used in computer aided melody generation alongside possible usages for a musician.
>09:07	Idea of usage	Discussion based around how to implement a usage for a software based around computer aided composition
>13:00	Computational Theory	Look at encoders/decoders in depth. Discussion on GANs occurs as well as a conversation about the way forward with the theory side to create coherent music that is useful for musicians.
>20:55	Philosophical Debates	Discussion continues to the idea of is computers can write real music and if so who owns it and how it would all work legally.
>30:08	Computational Creativity	Field of research discussed and what it means for the work of a computer in terms of composition
>33:00	End of interview	Further 10 minutes of discussion here along with various topics that are not part of the interview

Transcript

HD: My first question, it is a very random question, but do you play any instruments?

DM: I do yes.

HD: Brilliant, what do you play?

DM: I have a bass guitar right here, there's an acoustic guitar in the corner there. My main instrument is probably the saxophone.

HD: I did not know you played the saxophone!

DM: Not that I've played it in a good few years.

HD: interesting do you play more classical or jazz?

DM: Jazz mainly, it's jazz and pop things but more jazz stuff. I used to do a lot more with performance and to be perfectly honest, the tail end of my degree I spent more time working doing engineering than I did in performance.

HD: Yes I sure, would you say you were more jazz trained to read more complex chords and such?

DM: ummm... I mean the thing I liked about jazz primarily is the ability to freestyle a bit and do a bit more. I was grade 5/6 when I was at school when I started my degree.

HD: That's cool. My next question is what is your background in computing and music?

DM: So I, basically I started off at school I kinda ventured into doing a little bit of..... well I studied music, I studied computing and I also started venturing into theatre with stage management, lighting and sound management.

HD: Oh wow you did spread yourself out!

DM: I mean that was more of a hobby as I ended up with free time in high school. So that was definitely a hobby. Then I went to Edinburgh University to do a degree in Artificial Intelligence because I wanted to pursue the computing thing. But the one thing that I found was that I spent more time working in the local student theatre than I actually did working on my degree.

HD: Oh Dear

DM: So I spent a lot of time sorta doing theatre sound design, doing sound things. I started working for the Edinburgh student union as well so then got employed as one of the techs and then moved up to be one of the senior technicians and was involved in train and I was training people in lightening and sound systems

HD: That's cool!

DM: Did my degree and working in Scotland for a number of companies

HD: Was that Artificial Intelligence [work]?

DM: Yeah, AI and computer science BSC hons. I did my final project on music and information retrieval so my project title for my bachelors was 'Beat Tracking with Style Specific Euristics'. And it was all about Jazz music actually.

Conversation continues to talk about jazz and beat tracking algorithms.

DM: Then I left university and and worked as a self employed audio engineer

in Scotland for a number of years. Then as a project manager as an events manager.

Conversation continues about life and discussion of Plymouth. Talking about the life of an events manager and Edinburgh Fringe Festival and then the Covid-19 event cancelling issues.

DM: I was missing computer engineering so I went to do a masters. So I moved down to London about seven years ago to do a masters in digital music processing. It was basically signal processing and computing and music stuff.

HD: wow

DM: Then I did a PhD then a postdoc[torial] and then moved to Plymouth.

Discussion about being employed at ICCMR and working in researching as a career. Discussing current research areas within the university of Plymouth and what happens in ICCMR.

HD: So what I'm basing my essay on is actually melody generation and using AI and algorithms to do so.

DM: Okay

HD: So my next question was, are there any specific research areas you would highlight in computing that could be transferred over to melody generation? So I think I ask that question mainly because obvious there's a lot of work going on to look at different AI's that can do this and also different algorithms. Are there any that you think should stand out? As a way forward? Or is that a big question to ask all at once

DM: It is quite a big question

HD: yeah..

DM: You first need to get an understanding of the big picture. So for me it kind of depends on what you're trying to do. I focus on music mixing because I think there's an art and also an engineering technical skill to it. When it's generating a melody there's a whole bunch of questions. What is the melody? What is the counter melody? and do you have to write the backing track before you write the melody or vice versa. So you've got a whole bunch of questions but also what's the point of trying to get a computer to write that melody?

HD: Yeah.

DM: and do you want it to be a creative tool to inspire you, to give you ideas or are you more looking for it to be automated. I think that will drastically influence what the answer is.

HD: So what I was, well my next few questions are based around that really. So what I wanted to do was look at melody generation with computers and stuff to be more of a tool for musicians. So say if someone's stuck in writers block or can't think of something that will work in a specific genre or style. The work I've been looking at has been feeding an algorithm or AI pieces of music and looking at patterns to make something new that the musician can then apply and even change the melody depending on what they want to do. They would then take that into their music as needed. So it wouldn't be completely autonomous. I mean that would always be the goal obviously but obviously it's very hard to write a whole piece of music autonomously. That's a whole other kettle of fish almost.

DM: I mean I would argue the goal should never be that it should be completely autonomous to write a piece of music because what's the value of a computer writing a piece of music over a person. Actually that collaboration and that interaction is the point that I think is more interesting. In some ways it might be easier to get computers to automatically generate a full thing from end to end that it is to try and come up with a very clever way that a human and a computer can be collaborative but not annoying each other. In the same way you need to learn how to co write with people, if two people are trying to write the same piece of music and how they can interact with each other and how they can develop that relationship. I think the same is true with humans and computers as well. There needs to be a bit of an agreement as to how structures are going and it's not a case of you change one thing and the computer instantly changes it back. But if you change one thing, there is still a possibility of it querying or even understanding it is what you're trying to do and apply that somewhere else and say yeah and move it in a direction rather than it being a battle of you vs computer. At that point, then it kind of comes down to how you will interact with the system in and of itself. Will it be a case of sitting and writing your music in your usual format on a midi score or something and then you just click a button of 'oh I don't know I just need some suggestions' and then it gives you say five suggestions. Or does it give you 1 at a time and you have to say yes or no? And then you can modify whatever it suggested. There are different ways to approach.

HD: So that idea of it being a tool, so that it can generate more than just one melody, it can give you five suggestions because I know Google Magenta, they did a bit like that. With their code you can choose the amount of outputted files that the AI gives back to you. Midi data seems to be the go to because obviously it's very easy to read for computers.

Explains Google Magenta's research to DM and what direction has been taken already. A little discussion on the gimmick of melody generation code already used. Further depth spoken about how the computer might not cope with certain scenarios etc etc.

HD: So one of my questions later on would be 'do you think it's worth more research going into encoders and decoders that can sort of give more of a view and more of a shape to the music?

DM: So I think the encoder and decoder structure is quite interesting because basically you kind of end up in this what they call a 'Latent space'. and the idea is that at that point then you have a smaller number of parameters/control things that you interact with it. So with a nerual network if you're feeding some information in you've got hundreds of thousands if not milions of parameters and it's just impossible to understand what they all do. But then the key point is that if you can shape it into a smaller latent space and you've got ten things you can change you've got ten controls to relate something that has some sort of semantic meaning, some meaning for human then you have more of a collaboration and you've got more of an interaction. You put something, control the parameters and then you get something out then.

HD: yeah and you can define what you're trying to do in a more compact space. Yeah that makes a lot of sense actually.

Further discussion on what the parameters could be and what they would mean (Tempo, harmony, happier, saddder). Further talk of implementing into a plugin for ableton with a neural network. Further information for variational auto encoders (VAE). Further reiteration on collaborative process and options for encoders. Genetic algorithms are discussed alongside.

DM: generative adversarial networks (GANs) have strong opportunities. So GANs kind of tends to approach it from a very different perspective. Which becomes a little bit more human in that you're defining something on what its not instead of what it needs to be. Which sounds really weird but half the time when you're trying to describe things, the easiest thing to do is describe them as is what they're not. Timbre is an example. What is timbre? Well it's the sound but it's not the frequency and it's not the time. It's not pitch but it's kind of the bit in between. Sometimes it's easier to describe especially like kind of complex musical terms to describe what they're not instead of what they are.

HD: Yeah, okay

DM: and that's what GANs are really powerful for. Because they're generative adversarial networks. The idea of the adversarial is that you're saying 'I want you to give me a bunch of examples that are wrong'. Then the generative thing needs to then find things that will break the adversarial bit. So the two networks basically fight against each other.

HD wraps head around GANs further. Further explanation then given to fully describe. Generic discussion about using these ideas to make money is then discussed. HD realises more research into some areas are needed.

DM: I still think there are a lot of legs in the Markov chain model and things like that. Looking at the actual structure and the information from the music. Cus the things with all these new neural networks things is that they basically just throw music in and see what falls out. More traditional approaches, Markov chains and that sort of thing. They're basically describing how music works and the fact you have some structure and the fact that you've got some chord progression and chord sequences that are likely and you can add probability to them. So, it could be in the future that there's actually the potential to basically take a neural network approach to try and create some Markov chains so you learn a Markov chain from the data.

HD: So you're using the neural network to train the markov chain?

DM: Yeah because you're also using that to extrapolate some information out of that. And then once you do that you've created it in a semi musical structured system that then again allows you to interact with it in a very different way.

Examples given of usages to humanise the neural network. HD reiterates what's been previously said to fully understand. Discusses that this is a new idea that has not been looked at previous.

HD: So moving onto more of a philosophical point of view now because that was all more of the computer science side of things to see what you would say and suggest. It would be interesting to hear your viewpoint on.... what do you see melody generation by a computer to be? Who's intellectual rights is that and assuming you've thought of this before, it's very much a musician question to be asking a computer scientist but it's a valid point isn't it?

DM: It's a philosophical question that exists across the entirety of computing.

HD: yeah I'm sure.

DM: It's quite a prominent one, especially when.. so the big example that was given to me about 15-20 years ago was.. it wasn't 20 years ago.. was it? Anyway was what happens if you build some

system that helps diagnose someone or some medical application, you're trying to do something that helps medicine but it says 'No no you're fine' but then the person dies the next day. I mean is the computer responsible? Is the programmer responsible?

HD: Oh I see

DM: and that's a much more important than who owns a piece of music right?

HD: Well yeah I mean, putting it into perspective then yes but I mean a lot of lawyers would be rubbing their hands together right now sort of figuring out how they could make money from the both, that's the issue

DM: in terms of who.. I mean ownership is incredibly difficult think, especially when you start getting into the computer generative or not. Whatever else..... at which point the easiest thing to say is no one owns anything.

HD: *laughs*

DM: It's a very difficult thing to define, but that's where when you start having collaborations, it starts to become a bit more define. If I built a box and you put seven numbers into it and something else falls out of it, do I own it or do you own it? Or do we co own it? Does the box own it? Is the box now sentient? If I take the box back from you do you still own the content?

HD: I suppose the idea would be you owned the box and then I own the content produced by the box. But then again you've also had your say in what will come out yeah..

DM: I potentially spent years developing the box and you spent ten minutes putting some numbers into it. Does that seem fair?

Discussion continues in a similar vain. The training music copyright comes under discussion.

DM: I think in the modern age, legally it is a combination between whoever uses the system and whoever built the system. And I think it's currently an even weighting. But it depends on the licence under which you use the box. If I let you use the box and whatever you create with it is yours then whatever you create with it is yours.

HD: Yeah I see what you mean, because obviously all the research is free. Google magenta has released everything for free, there's only a handful of companies that I can see actually profiting from this research at the moment but it's a serious consideration moving forward.

DM: But even if you go down the route of using VSTs (Virtual Studio Technology) it's that well, with all these VSTs plugins that generate some sounds if you create a piece of music using their sound they don't own that because of the licences

HD: That's true actually, so you could see it almost as an external plugin for DAWs. As long as you're paying for a licence then the music that you make with it can then be yours.

DM: Basically you just need to, in a very human way, just define exactly what it is and who it is. So if you make a plugin that you're gonna sell to hundreds of people and make hundreds of thousands of pounds you just say part of it, whatever you make with it is yours!

HD: As long as you pay us!

DM: Yeah, that's it. Obviously if you crack the software then whatever you make with it is ours and y'know whatever else. It kinda seems the only really real way of subverting that question. It's either everyone's or no one's.

HD: But from that discussion you see the point of that a lot of people have the idea that music composed by a computer isn't 'real music' or it isn't music because it's not emotion or it's not genuine because it's not a person who's written it. So that's obviously the other ethical dilemma is the fact that obviously not only is it sort of a thing of intellectual property rights, it's the thing of do people perceive it as real music but obviously if I'm using it as a tool then it's still got human input but if a computer wrote a whole piece of music does that count as 'real music'?

DM: So it is quite simply just a tool right?

HD: Yeah

DM: So does that mean that if you use a computer to arrange some music that it's no longer music because you've used a tool. Does that mean that if you've happened to commission the San Francisco symphony orchestra because you've used them as a tool to perform it because it sounds better for that, then its then not music? I mean you can take it even wider and take it to piece of art. Well if you've used a paint brush then it's not really art because you didn't finger paint it. The question is because its AI specifically and so therefore the level of control you might have for that tool or the interaction might be different and more nuanced but I don't see how that would be any different from going from finger painting to brush painting or even computer aided design.

HD: I mean yeah because the usage of digital audio workstations, you're using a computer there so does that mean because you made that workstation then does that mean it's not real?

DM: That's it really, the power of having that DAW and all those plugins vs back in the old days where you had to use your head to write down some music or people couldn't read you had to find a way of annotating something and find some folk down the pub to play your music for you. Yes so I think if you're defining it as a tool the difference is at the point of which that then becomes a question is when a computer has fully created an entire piece of music without human interaction. And then you've got questions as to whether or not a computer can create a piece of art? Well, can a dolphin create a piece of art? Can a monkey create a piece of art?

HD: Well you'd say yes wouldn't you.

DM: So why couldn't a computer? Okay maybe it's gonna be different, maybe it's perspectives on what a piece of art is, is going to be very different but I don't see how that could ever preclude it from, well first of all it doesn't stop it from being a piece of art. Second of all there is no artificial intelligence that will have had zero human input on all stages that will have been able to create a piece of music because you need someone to code it, you need someone to create a piece of music to feed into it, you need someone to put it in a room and turn it on.

HD: So it's almost as if it's a null and void question then really. Because there's nothing that would ever be fully autonomous that had no human input, it would have been like you said coded, everything.

DM: Because even in that context it's like using a printer to make something. Well someone still had to sit and do the CAD (computer aided design) design before the click print. And so the computer is just rearranging some sort of ideas that you've had whether it's the music you put in or it's some parametric control that you have. Even the code to build it and run it. Some human is feeding a bunch of stuff into it. Even if it's just printing something off, you still end up to create the physical medium there's still human input at some point therefore it's impossible for it to be 100% computer. Which kind of avoids the question...

HD: Well yeah but it is an important point to say really because obviously I will be speaking to a lot of other people who might even disagree with you or they might not have the view that you have [on computers], so it's nice to have your AI opinion so I can actually throw that into my essay. I can state 'Well y'know there isn't anything that's completely autonomous so...'

DM: There is also, to go completely the opposite direction with that, there's an entire field of research called computational creativity, and basically they cover across the whole breadth of everything and it's all about understanding how computers can be creative and if computers can be creative. Apparently there are some very fun conferences because, so one of the conferences they had not too long ago was they got computers to create a whole bunch of new cocktail recipies and then they had a session where they had to try a few different cocktails and figure out which ones had been made by humans and computers

HD: and they can call that work! That's incredible!

DM: It's a tough day in the office. But there's a few people in the UK that are very very prominent in working in computational creativity, it's all about understanding how computers can be creative and how they can create content and if it can. There's some really really nice online discussions.

Carry on discussing computational creativity as a field of research, where to research and exploring the topic. End of questioning here.

HD: That's all I had to ask you today, thank you for all your input it's been great

DM: That's okay

Conversation finalises into a casual chat about life in Plymouth and discussing computing.

Interview Transcription 22/04/2020 - 16:57

Interviewer: Harriet Drury (HD)
Interviewee: Aurelian Antoine (AA) (Computer aided composition researcher)
Location: Internet Call (Zoom)

Overview

This document summarises an interview using smooth verbatim editing with the above interviewee that discusses computer aided composition, the theory and research currently undertaken and the philosophical arguments surrounding the topic.

Summary

Time:	Brief Description	Details
>00:20	Discussing background	AA musical background, what qualifications AA has, where he worked and what research he has done in the area topic
>01:30	First questions, discussion of melody generation	Talk about varying techniques used in computer aided melody generation alongside possible usages for a musician.
>03:00	Deep learning and complexity of music. Encoders usage	Discussion based around how deep learning works, and how the rules of music are not as clearly defined as suggested. Brief chat about encoders and the implementation of the
>8:00	Philosophical Debates	Conversation about if computers could write real music, why computers would be used and how a composer might utilise the work.
>9:10	Melody generation tool	A discussion about previous usages of melody generation tools, future use and how a user would work with computer aided composition
>11:00	Ownership rights and psychoacoustics	A brief look at copyright issues that might occur and how to overcome. A look at the psychoacoustics of music and the aspects of this that need to be researched alongside computational creativity.
>17:00	End of interview	Final 3 minutes thanking the interviewee, chatting about ideas and debrief.

Transcript

HD: So, my first question, do you play any instruments?
AA: I don't
HD: I thought it was a bit of a silly question to start with but it's an interesting question to ask

just to see what the researchers in the area sort of did in terms of musical outputs. So that's interesting to know. My next question is, what is your background in computing for music and such.
AA: I did a degree in computer science and then a degree also in audio engineering. So it's already two big things in computing music. And then I did a masters and PhD in computer music, at the university of Plymouth and now I'm a postdoctor[al researcher] at McGill university in the music tech area.
HD: I mean obviously you're very extensively researched in the area of computing and music then really. I remember Ed (Eduard Braund, a university of Plymouth lecturer) mentioning that you did computer aided composition so this is obviously a perfect set of questions for you.

Both Laugh

HD: So, my next question was: Are there specific research areas that you would highlight in computing that can be transferred over to melody generation? So that was basically because I've been looking into the algorithms that a lot of previous researchers used and looking at neural networks that are now being used. Is there anything else that I should potentially be looking into?
AA: The big thing at the moment is machine learning, deep learning. So if you apply all those algorithms and technique into melody generation or any other aspect of music it's a big thing at the moment. And the good thing is now it's quite easy to get tools to do it, you don't need to do it yourself, you can use the big packages and it's quite easy. And you can do it on your own machine.
HD: Its seems to be quite a dynamic area. I've seen a lot of research coming from a lot of places all over the world currently with deep learning and stuff. It's very easy to get a hold of these days. I've looked at a few models that have been made from various people and yeah it seems to be the way everyone is going at the moment (deep learning). So what do you personally think is the way forward with melody and music composition? Would you agree with the deep learning route?
AA: I guess it's a good tool because with deep learning works with a lot of data and you can process a lot of data. So I guess it's useful to learn styles or techniques or rules. And you can apply that to any output you want. So for that aspect, it's very useful and I guess it's the way forward into melody generation because there has been a lot of algorithms, like the feat of algorithmic composition is quite old now, it's like over 60 years old, maybe more. So I guess it's deep learning that's the next stage. It's already ongoing so yeah.

Discusses Deep learning as an idea, with the aspects of implementation discussed.

AA: Music is very complex, there is a lot of work to do on that aspect.
HD: I have done a little research explaining that obviously it's not all just about rules that are being followed. It's hard to tell a computer what to learn when you yourself don't fully understand what it is that you're telling it to learn really. I suppose music is one of those things that can really highlight that because I did a bit of this in ethnomusicology, it's almost like tacit rules. You don't think these things and you don't know how to tell a computer how to do that. So I had a quick chat with someone else about encoders and decoders that are being used at the moment. Unfortunately I don't know really too much about them, I've only just started researching them, so we spoke about we could use the encoders to try and stylise

what is outputted a bit easier, do you think that's another way that we can work with a neural net[work] to create something that is a bit more structured?
AA: I guess yeah, it depends on what you want as an output because music is very broad and hard to define genres that have their own like you said tacit rules. So it's quite difficult to structure because if you don't know exactly what is going on and there are a lot of styles that are free, you can do whatever you want more or less. You don't nessarily want to follow tbe rules because if you follow the rules and you're just copying in a way.
HD: it's not a new idea, it's more of a mix of what came before. Yeah I see what you're saying there. It would be hard to market this type of learning when it's not actually anything new, it's a reiteration of something that's already been done so that could potentially be the shortfall of using computers to make a melody really.
AA: You could, with that type of model (Deep learning) input a lot of music that is either successful or people like and you don't know why because there are a lot of characteristics and a lot of features in music that you could just input that and see what is recurrant characteristics and then you can use that to make your output for melody generation. Because then you will be following what is going on without the rules of just combining the pitches or the rules.
HD: It's very interesting actually to see what you could do with it. So an idea proposed is to use a Markov model with a neural network. So have the neural network training the markov model as it's going. Do you think that's something that might be of interest?
AA: Markov models are being used like excessively in algorithmic composition. Well it was one of the first algorithms to be used to generate music. So, the good thing with that is you know that there is a lot of experience with that, so you know what to expect and how to implement it and learn from that. And then, neural network is a new big thing now. So I guess combining those two techniques could potentially do something useful and interesting. It's something interesting to look into.

Discusses the idea further. end of computing questions and further looking into philosphical viewpoints for rest of interview.

HD: I found that people like yourself have a very different viewpoint to what composers would have. What I'm trying to look into is the thought that computer scientists see computers as a tool and musicians see it more of a cheat or as a copy.So a very generic first question on this would be: do you see melody generation by a computer to be 'real music'?
AA: I would say yes. People will argue what is not played by a musician is not real music. I guess if you take that approach then if it is used by a composer and then used by a musician then being played by musician then it's real music. But also people say if you generate by a computer then it's not from the composer or musician so is it music?
HD: At what point does the music stop is the implication I suppose.
AA: Yeah exactly.

Implication of the lack of humanisation and loss of meaning if a computer writes the music. Both sides of the argument discussed

AA: What's the difference with using a sound sample for example. It's premade sound, if you're using it in your composition then is it real music? I mean it's kind of the same, well I would say it's the same aspect as it's just a tool.
HD: Yeah. So that leads onto my next question really. So I was looking into using this

research to create a melody generator type thing as a tool. So do you think that that is completely possible to implement then? Do you think it would be useful for a composer to have as a tool that they can use. I'm only hypothetically speaking, I'm not actually going to go out and make this now obviously, too much work. But if (the composer) were able to input data based around a genre or style and they can take a melody out of it. It would almost be like an additional plugin/ tool for a digital audio workspace really. Do you think that is the way forward for musicians to use this type of research?
AA: Probably yeah because people are more prone to use computers nowadays. So, I guess if you could have access to it and used to use it then you don't see them as [an] 'evil' tool like all composers will say. But then that idea of melody generation is not actually new because there was a plugin by Steinberg in Cubase called the 'Interactive Phrase Synthesizer'. Tool wise, [it would be] processing MIDI data and trying to generate phrase according to what the user/ composer was inputting.
HD: That's cool, I've not actually heard of it.
AA: Yeah it's from the 90s and I think they stopped using it in the 2000s. So it's quite old but if they stopped using it and it would be quite useful to do it again nowadays. I'm sure people would use it more [now that computers are more accessible/ widespread].

Discusses the Steinberg Interactive Phrase Synthesizer further

HD: So my next question is about using this sort of tool in a digital audio workspace then. So it's obviously had some history with being used in the 90s. So do you think there will be issues in terms of copyright (With melody ownership)?
AA: If they include a clause saying 'everything made with this tool is owned by us' then I guess yes it would be copyrighted. So then if you just had a creative licence to keep as your own product because then you can use it as a tool to stimulate your own creative ideas, not just a copy and paste and that's it. So there is still your own input into it.
HD: Okay so this is my last question now, so in your opinion, what is the way forwards in terms of AI, encoders/ decoders to provide a software that is useful for musicians in terms of melody generation? So we've already stated previously that deep learning would be the way forward. Do you think using that (deep learning) with encoders that can provide a stimulus will actually change what's being outputted quite heavily, would be a good way of doing things?
AA: I guess yes, also there is another aspect that needs to be taken into consideration. Evaluating the output, not just in terms of looking at pitches and things like that but it's not just that because you need also to evaluate the sound quality of it. And this is a bigger area to improve because you can follow the rules and yknow apply what has been done before. But then at the end of the day, people are going to listen to the music and its' processing in the brain and it's different. The perception is different not only for every individual so I think they (researchers) need to focus a bit more on evaluating the output and assessing the sound qualities and so on because it's a big part of it. Music is made to be listened to and not to just be looked at as a score.
HD: It would be fascinating to look at the psychoacoustics of computer aided composition really. Again, it would depend on how you used the melody. If you used the score and recorded it with a live instrument that would be an interesting thing on it's own. It would be an interesting study to see if a person could tell if it were a computer or a real life composer who had written it if was recorded with a live instrument. As you said, tone and perception is

of huge importance to music. It's very important.
AA: So this is what I did for my PhD. I was focusing on the sound qualities and the psychoacoustics of it because not just combining pitches or so, what's the quality at the end? Because assuming the composer has ideas in mind and knows what they want at the end, then they know the combinations of instruments. That was my motivation, to make those tools to help a composer in that aspect.

Further discussion into orchestration continues with the interviewing ending and thanks given to the interviewee

Appendix 2. Interviews with Musicians

Semi – Structured Interview Questions

Date: 18.4.20

Interviewer: Harriet Drury

Interviewee:

Location/Context: Zoom Call

1. What is your background as a composer/producer/musician (Ask where appropriate)?

2. Do you have any experience or background with using computers to compose music?

3. If for example, you had a bought of writer's block and needed aid in writing a melody, would a plugin for a DAW interest you? How much creative control would you like?

4. Do you see melody generation by a computer as 'Real Music'?

5. How would you like to interact with a computer to create melody? Would you take the outputted midi data and transfer over to a virtual instrument of your choice or would you take the transcription and have a performer record it?

6. The collaboration between human and computer is what is highlighted by the AI researchers I've spoken to. Are there any ways you'd like to work with computer aided composition to create something new?

Interview Transcription 22/05/2020 - 13:54

Interviewer: Harriet Drury (HD)
Interviewee: Nuria Bonet (NB) (Composer, Researcher and multi-instrumentalist)
Location: Internet Call (Zoom)

Overview

This document summarises and interview using smooth verbatim editing with the above interviewee that discusses the utilisation of computational creativity and computer aided composition to create a melody generator tool.

Summary

Time:	Brief Description	Details
>01:30	Discussing background	Musician Background, personal insights. Chats about personal perspectives on music technology and research.
>08:28	More discussion of computing and music	A chat about how NB would approach a programme and what NB would want to do with it.
>11:20	Creativity Questions	Discussion based around using someone's code, looking at if it is genuine work. A brief look at the composing vs performing world.
>21:05	Computing and Music	Looking at other ways computing and music exists
>25:00	Working With a Computer	Discussion continues to look at how a person would want to work with a computer and assistive technologies.
>28:20	End of Interview	End of interview, further five minute chat and debrief occurs.

Transcript

HD: So my first question, what is your background as a composer?

Internet cut on zoom call, restarting the interview

HD: Are we back?
NB: yep
HD: Cool, I'll start again! So what is your background as a composer/musician?
NB: So i started very classically in Luxembourg. I studied at a conservatoire. You know, music theory and harmony and piano/clarinet.
HD: Was that in Luxembourg?
NB: Luxembourg yeah. And then I went to Manchester University to study music. Again, very classical. But I had at and I had applied to music technology courses and sort of sound engineering courses as well. In the end I went for the straight music route. But I went into the

electro acoustic composition route and I did it through to my 3rd year. So I was always interested in technology. But always from a very music perspective.
HD: So would you say that you're look was using technology to it's advantages in a classical context?
NB: Not just in classical composition. So electroacoustic composition is slightly different. But I was also always interested in the science behind it so in the second year I took an acoustics module and did very well. I wanted to do my dissertation on it and they just didn't have the personnel basically. It was something that I was interested in, I did my masters in electroacoustic composition. Then didn't know what to do. Then I randomly signed up to do another masters in Edinburgh and that was an MSc and it was in acoustic technology. That one, that was hardcore

Both Laugh, discuss the difficulties of Maths

NB: It gave me an incredible insight into the science behind it. I'm sure I only scratched the surface but I think it made me a far more rounded musician and composer to have seen it. Then I applied to Plymouth [University] for a PhD. With Eduardo Miranda, he's obviously a pioneer in this stuff. My PhD was in sonification which is the audio representation of data. But I always did it from a musical perspective. So the whole perspective of the PhD was how can we use this a musical tool? How can this technology help me as a composer? For a start I knew there was no point in doing it the other way around because I just didn't have the technical knowhow. But also in my terms of interest it was very much to write music with it.
HD: That sounds very interesting, so obviously you finished your PhD. So nowadays obviously you've carried on composing, I know that because I helped you perform one! So is that what you do now? Carry on composing alongside lecturing and whatever else takes your interest?
NB: Yeah I suppose I'm doing less of the sort of the sonification stuff now. PhDs are a funny thing. I mean it's a bit like music degrees, you might end a bit fed up with it and you need some time to come back to it. I got a bit frustrated with the whole world because I felt like a lot of people were doing it very cheaply and not necessarily well. I often feel that composers might use certain techniques almost as a selling point.
HD: Yeah I see that
NB: and not very well and they don't really understand the science behind it. Then I feel some scientists make music because they think it'll..... again it's novelty.
HD: It's kind of the way they (the music and technology) don't mix properly almost. You've got your composers who do it for fun, as a gimmick and you've got computer scientists that have obviously studied it, know it very well but don't have what the composers have. I suppose you exist in a sort of grey area where you've got the two.
NB: So there's sort of ideal composer that I was trying to get to with my PhD was the scientist composer. Who actually understands what the techniques are that they're using and the musical knowhow as well. Which is this sort of mythical creature. I think the main thing for me is that people have integrity and that they try to do things genuinely. and I think sometimes a lot of scientists tend to do thinks genuinely but because they're not musicians they just do stuff that when you see it as a musician you just think you know, this is very boring.
HD: It's the audience isn't it. They're writing for their peers and computing peers where as a composers you're used to trying to gauge what an audience wants and stuff.
NB: and it's tricky because sometimes, and I think as a composer as well is that you can get used to trying to make some very complex, interesting music when actually what attracts the audience might be something else. So I've moved away slightly from it at the minute but I

think that's yknow what you do as a composer goes in cycles as well. at the minute I'm doing other stuff but I do think it's something I'll back to.

Cat interrupts chat for attention. Apologies given to interviewee

NB: But I think people are very interested in it so I do get requests for it.
HD: Yeah definitely, it's cool what you do.
NB: I do think there's interesting stuff that can be done but I suppose I'm quite careful with how I accept my projects just because I want to be enthusiastic about it.
HD: Well my next question was about your experience and background with computers to compose music and I suppose sonification comes under that.
NB: Yeah that's right I mean, so it was an interesting one because I didn't really have anyone who gave me a programme and just went you know, use this program so I battled a lot with matlab and max (MSP) sort of skills I had. But for me that was interesting as well to actually have to do that work, I'm not what it'd be like if I someone just gave me a ready made programme
HD: Do you think you would want to sort of understand how it works, break it all down and sort of twist it. That is the issue I had, that fact that if someone else had written some code that I would want input into it or know how it works.
NB: and I think because there way I writer any sort of sonification programme I do is that I think very much about the result I want. So it's very important to me to think about the musical result from the very beginning and I think that a lot of people who do sonification sort of AI start with the tech part but don't real think about the musical result.
HD: I would tend to agree to be honest with you. With people I've interviewed, a very basic question I've been asking but literally the first question I asked was "do you play any instruments?" and it's very interesting because some people are like "ah yeah I play all these" and I've spoken to computer scientists who don't have any instrumental ability or know anything about music theory. They know how to code a computer.

Further discussion on the computing/musician divide, as well as chats about sonification. Off topic chats ensue
Topic picks up discussing using someone else's code for a composition

HD: Is that because you don't feel as if it is genuine work? Would you see it as because you're taking someone else's work and then using it to make your own...
NB: No I don't think it is about authorship a such. i mean maybe it'd be cool to use a programme if it produced cool results and then using those results. But still it would just be a tool to make my own stuff. I feel perhaps if I were using someone else's code I was performing more on their programme rather than composing.

discusses the fine line between performance and composition further

HD: So what I was basically researching is basically melody generation and how computers can do that. I've been looking at what Eduardo (Miranda) done with that. I've got David Cope's stuff which obviously you suggested. So speaking to a lot of computer scientists and such, they've given me some ways forwards in terms of research. For yourself as a composer. If a tool was created that made a melody for you that say, would be used for writers block or if you just need some examples say for ideas. So it would throw out say 5-10 examples when you out in specific information. Would that interest you?

NB: So stuff like what David Cope has done, I think for me would really just be a creative tool where I would just pick out stuff. It really depends on how much of my input it was. If I chucked a melody in there, trained it on a couple of things and then it brings it back, I feel like there's a lot of David Cope in there. Whereas if I start playing with a programme and changing rules and training it, then there's more of me in there.
HD: I see what you're saying because what I was looking at doing was, well it's very computer generic. You give it the midi data and then it comes out and gives you what you want at the end yknow. What I was looking into actually is the use of encoders and decoders to do that as well. When I spoke to David Moffat he explained it could be millions of parameters that you could control and we as humans have no understanding and perception as to what half of them (the parameters) do. But if you could create say 4/5 parameters that somehow relate to key musical ideas such as timbre, pitch, harmony and rhythm etc, I suppose that would create more of a conversation with the computer and the human.
NB: Yeah and I think if you speak to Aurelian (Antoine, computer aided composition researcher), as far as I understand it you tell the program what you want it to sound like and the programme helps you with it. So I think there the creative decision is still yours and the tool is the technical elements for you. So I think that gives you enough control that you're actually doing it, that you're actually composing it. I mean in classical music someone like John Williams for example. When he writes his soundtracks, he will write out main melodies and structures and stuff but the rest of it, the filling out the dots is done by other people. A lot of classical composers have done that where they write out the melody and then the boring bits, because they're all rules basically, was done by some sort of student. But we wouldn't doubt that that's Mozart symphony for example so I think it is very much about the fact that they've done the creative decision bit. Then the sort of technicalities of it is done by a computer or by a human because it's just rules.
HD: It's very much a fine line really isn't it. It's not as clear cut as people think I don't think.
NB: Absolutely
HD: That's what we sort of gotten into here is the fact you can have computer/human interaction. My next question was actually do you see melody generation by a computer as real music. But realistically that doesn't go far enough because I mean melody generation by a computer can mean that you've got no input at all or you've got loads of input into that.
NB: I mean the thing is for me melody is such a small part of a whole piece of music that actually I suppose the question is a bit limiting in that sometimes I might start with a great melody but often I start with an idea or character or a sound you know. The melody is sort of a by-product of it. I find it frustrating in many ways trying to understand why computer scientists often work with midi and work with melody. So for example sonification the goal was putting numbers to pitches on the piano and actually that's such a limited range of things to do when you could be doing so much more interesting stuff. So I think it'd be fine for a computer to generate melody because actually what is a lot more interesting is what I would do with it so I think that the way it becomes my music is a completely different process.
HD: It's interesting to hear really, so we were talking about the interaction between a human and melody then, so what I was looking at doing then if this (coursework) was more than just a 4000 word essay say, I was going to look at creating a plugin for a audio workstation that revolved around this sort of idea. I know one used to exist years ago for Cubase. You could give it some parameters and feed it some data and then from that it would create 5-10 ideas. The idea being that you could presave ideas but every time you used it it'd be slightly different because say the training data you give it might be different, the issue at the moment is that training times is a long period for computers but if you had premade sets of melody almost..

NB: Something i programmed during my masters which was very simple but worked was basically you just give it chord progressions and for each chord progression you tell it which notes it's allowed to go to. Again Markov chains are great for music because probabilities in music are a thing. And you don't even need to train anything for that. You just need to give it probabilities or literally just options. And that's the thing. If you're going with that sort of strict rules like chord progressions it can be very simple programmes that you use. Absolutely if you had a plugin where you specified the chord progressions it could easily add melody on top of it.
HD: Things like that exist already, I've also coded a similar program.

Quick chat about programming and Markov chains

NB: There's a lot of research going on how computers can accompany you as well so, if you're playing on your own, there's some really interesting stuff around that is actually pretty impressive
HD: So it learns what you're doing while you're doing it? That would be interesting actually. So the collaboration between humans and computers is what's highlighted by AI researchers I've spoken to, you've highlighted yourself also. It's not all about having the computer do it all because that's no longer a useful tool to somebody.
NB: Yeah and I think anyone who does AI and music needs to be clear on why they're doing it. So I know that the pioneers, Eduardo often does things because he can and because he's at the forefront of it and that's great but now we've shown we can do it we need to find a reason to do things you know. If you're a composer it might be cool for you as a personal developer point to just do it, if you put it out into the world I don't think it's really a valid argument anymore.
HD: I suppose there isn't much use for it any more, why train a computer on something a human can already do. There are already composers that can compose without...
NB: Have you listened to Holly Hearndon? She did a pop music album with AI so it's interesting to hear why she did it. People are interested in it and I think often it's about personal development and trying to go beyond what you're doing. I think that the creative block which is why David Cope went into it is an interesting one because it is about trying to further your own practice and I think that's why I used sonification as well. With sonification to start is that it adds meaning to you piece. The data's about climate change say, it adds narrative to it. But it can also make you do creative stuff that you wouldn't have done before. So the orchestral piece for example. I'd never written an orchestral piece before but that sort of solved a lot of problems for me you know. and I liked the way it sounded so it's a interesting tool to explore in your own practice. But there's a difference as well with what you put out and what you just write.
HD: I suppose the difference is the fact that say if a computer scientist just came along and gave you a plugin, the way you would use it might differ completely to say how a different user would use it and I suppose it's very personally to how people would use this.
NB: It would be the same sort of debate that you would be having so if I'm teaching you composition and you guys come up with a great melody in class am I allowed to use it in my own composition you know, and I think that's sort of similar. Am I stealing from you? Or are you just my tool you know? Me as your overlord is allowed to use it.
HD: That would get quite difficult quite quickly
NB: Because I've basically given you some rules and you've gone away and made me a melody and I've picked the one I like which is just the same thing.
HD: So if I find my coursework somewhere, I'm coming for you

Both Laugh

NB: You must be flattered then.
HD: So my last question basically is are there any ways you'd like to work with computer aided composition to create something new? I know we've already discussed it but what would you want to do with computers and computer aided composition to be able to write music?
NB: An area I'm obviously interested in is the sort of assistive music technology and how we can help those who might have some sort of disability or some sort of obstacle to making music. How that can help. Because that's where I've been most convinced really. Eduardo's project with the BCMI cap and with paraplegic patients.

Quick chat about assistive technologies

NB: Musically, that is basic and if you did that in a concert I'd be like meh
HD: Well you're not really writing music are you
NB: Well you're deciding on which bars would go well together. But the fact that it allowed someone to have some sort of musical agency by having choice. I mean composition is just organising sound isn't it. So you allowed that patient to organise that sound even if it is fixed. So this idea that because AI is taking over some of the task, for someone who has less capacity to do all the music bits would still be able to compose and make music and I think that's where I'd quite like to see it implemented.

Recap or previous discussion, philosophical debates occur and debrief.

Email Transcript 20/04/2020

Interviewer: Harriet Drury
Interviewee Lee Whittock (Musician, Composer, Producer)

Overview

This document is a copy of the email encounter. Using the questions for musicians. A direct copy and paste occurs for accuracy.

Text

HI Harriet

I have answered these questions in advance of our interview tomorrow.
There are a few things that I need feedback n before I can answer any further.

Harriet's Q's

1 – What is your background as a composer/producer/musician
All of the above + performer. (Musician, Composer, Producer)

2 – Do you have any experience or background with using computers to compose music?
Yes. I predominately use computers to compose music these days. It used to be guitar-based composition, but really why would you choose to compose on one instrument when you can choose them all whilst working on a DAW. The DAW is essentially the studio, the performance space & the experimental jam session rolled into one and it does one thing that no other musical invention has done before, it makes you truly self-sufficient.

3 - If for example, you had a bought of writer's block and needed aid in writing a melody, would a plugin for a DAW interest you? How much creative control would you like?
Writers block I believe, (at this stage of my career), is essentially your creative mind not really having anything to say. It essentially needs input to remedy the problem, if indeed you see it as a problem. Many of us would just accept that today is not the day for music, however, when studying or creating a record to time constraints, you may not have that option. A plug in that develops melodic inspiration would therefore be a good thing that I would definitely look at. As for creative control, I would suggest that by using it you were already stuck, and therefore you would want it to generate ideas built on pre-determined parameters (tempo, key, mode, instrument to be played on). Then after it generated an idea that you liked, you would want the ability to (via midi) change, develop any part of it at any point. Therefore, it finds a place as a stimulator of ideas, and not a sample melody that you cannot change and therefore cannot truly own.

4- Do you see melody generation by a computer as 'Real Music'?
Yes. It is an instrument right? Electric guitars were considered to be only noise by the generation that came before them, every traditionist finds issue with what challenges their 'norm', especially when considering classically trained instrumentalists. Does it take longer to be a great violin player than a great producer? Does it take more skill to become a composer on paper than on a DAW? Is Hans Zimmer less successful or innovative, or prolific than his more traditional counterparts? It also has an advantage over traditional instrumentation, can you create a sonata with a string trio, Yes. Can you create a sonata on a DAW, Yes. Can you create drum & bass, or trip hop, or any of the countless forms of modern electronic music on anything other than a DAW? No. There are no alternatives for the music

that has been invented since music technology became the tools of choice, it is in that way unique.

5 - How would you like to interact with a computer to create melody? Would you take the outputted midi data and transfer over to a virtual instrument of your choice or would you take the transcription and have a performer record it?
In regard to the previously mentioned plug in melody generator, it would have to be midi based. You would need to be able to change every aspect of the melody for the sake of development if nothing else. Plus, you would want to be able to remove it as midi information from the plug in and use it on whatever software you had to hand. Potentially you could also transcribe it within a piece of software for performers, this would be a good addition to the plug in.

6 - The collaboration between human and computer is what is highlighted by the AI researchers I've spoken to. Are there any ways you'd like to work with computer aided composition to create something new?

Difficult question. There is a potential for AI technology to unlock melody from your unconscious mind I guess, but this is surely a way ahead of us at this point, in regard to a DAW based plug in. Every interaction with computer music making is a collaboration between human and the computer I think. You do vibe off of what the DAW does when you change parameters of a synth sound, or over compress something to get an effect. In that respect it isn't that far removed from working with other people in a live environment.
I think some musicians are scared of the computer making them unnecessary in the music making process, however we are just talking about traditional musicians here. Young grime composers & producers don't care about such things. They don't read music, they don't care about the authenticity of that string sample, or the timbre of that timpani.
They actually think that we (live performer based muso's) are old school, too concerned with B.S. that they find a waste of time. The reason that mumble rap is HUGE commercially, is because they purposefully don't put effort in, it's casual, easy, lyrically bland and meaningless, anyone can do it as long as you are willing to get a face tattoo or 2. Essentially there are millions of composers that couldn't care less about the human – computer connection and its need to keep us (musicians) relevant.
So, I ask you, is this a commercial venture & subsequently a commercial question, or is this an academic one? Because they are completely different worlds.
Academically, yes sure, some kind of controlled AI combination would spark interest, the ICCMR wouo[l]d be all over it regardless if it has commercial applications or not.
Commercially though, a piece of software that wrote, designed and gave composers the answers they require to continue to work on a piece, that is what that industry wants. That is why the companies that sell sample-based plug-ins (series of samples that do not necessarily have changeable or adaptable parameters) do so well. They label them well so non-traditional musician composers can pin point the genre they are into and then just use them. Easy, little effort, maximum kudos from their peers.
So, before I can answer this question any further, what is your market Harriet?