Experiment No. 1
Review of Deep Learning techniques
Date of Performance:
Date of Submission:

Aim: Review of Deep Learning techniques

Objective: Ablility to perform critical review of different applications where deep learning techniques are used Theory:

Literature searches using databases like Medline or EMBASE often result in an overwhelming volume of results which can vary in quality. Similarly, those who browse medical literature for the purposes of CPD or in response to a clinical query will know that there are vast amounts of content available. Critical appraisal helps to reduce the burden and allow you to focus on articles that are relevant to the research question, and that can reliably support or refute its claims with high-quality evidence or identify high-level research relevant to your practice.

Critical Appraisal

While most of us know not to believe everything we may read in a newspaper (or on Twitter), it's also true that we cannot rely 100% on papers written in even the most prestigious academic journals. Different types of studies reported in the literature also have different strengths and weaknesses. Even if the contents of a research paper are reliable, it is sometimes difficult to find the specific information you are looking for and interpret it accurately.

Critical appraisal allows us to:

- reduce information overload by eliminating irrelevant or weak studies
- identify the most relevant papers
- distinguish evidence from opinion, assumptions, misreporting, and belief
- assess the validity of the study
- assess the usefulness and clinical applicability of the study recognise any potential for bias.

Critical appraisal helps to separate what is significant from what is not. One way we use critical appraisal in the Library is to prioritize the most clinically relevant content for our Current Awareness Updates.

Title: Critical Review on Music Generation Using RNN-LSTM

Aim: To critically review three research papers: "LSTM-Based Framework for the Synthesis of Original Soundtracks", "LSTM-Based Music Generation System", "A Novel Music Generation Framework Using LSTM and GAN".

Theory:

Recurrent Neural Networks (RNNs) are a class of artificial neural networks designed for sequence data, making them ideal for tasks like music generation. Long Short-Term Memory (LSTM) networks are a type of RNN that can capture long-term dependencies in data, thanks to their memory cell structure. LSTM networks address the vanishing gradient problem found in traditional RNNs, making them more effective in learning patterns over longer sequences. Their ability to remember important information over extended periods makes them highly suitable for generating coherent and melodious music.

LSTM-Based Framework for the Synthesis of Original Soundtracks:

This study focuses on developing an LSTM-based framework for synthesizing original soundtracks from the Naruto movie series. The framework incorporates robust preprocessing and postprocessing techniques to manage input datasets and evaluate the synthesized music. The model architecture includes Batch Normalization and Dropout layers to enhance training efficiency and reduce overfitting. Categorical cross-entropy is used as the loss function for multi-class classification tasks within the framework. The synthesized OSTs receive positive evaluations from survey respondents, demonstrating the framework's effectiveness in producing high-quality music. The paper highlights the framework's potential for broader applications in music synthesis, particularly for thematic soundtracks.

LSTM-Based Music Generation System:

The LSTM-Based Music Generation System aims to develop a framework for generating high-quality original soundtracks (OSTs). The system, known as OSTSF, employs LSTM networks for music synthesis and includes a preprocessing algorithm to filter the input OST data. The framework also features a postprocessing approach to evaluate the generated music through mathematical formulations, providing a quantitative measure of quality. The results indicate that the framework is highly efficient, with most survey respondents recognizing the synthesized OSTs as high-quality. The authors plan to improve the survey methods and introduce more comprehensive evaluation metrics, such as timbre, texture, and harmony, in future work.

A Novel Music Generation Framework Using LSTM and GAN:

This paper presents a novel framework that combines LSTM networks with Generative Adversarial Networks (GANs) to generate music. The LSTM component is responsible for capturing the sequential dependencies in the music data, while the GAN component enhances the harmonic structure of the generated music. An attention mechanism is integrated into the LSTM network to improve its focus on different parts of the music sequence, leading to more coherent outputs. The authors perform both quantitative and qualitative evaluations, showing that the generated music closely resembles original compositions. The framework is praised for its potential in commercial music production, although the authors note that further improvements in data preprocessing are necessary to enhance performance.

Analytical Table:

Aspect	LSTM-Based Framework for the Synthesis of Original Soundtracks	An Improved RNN-LSTM Based Novel Approach for Sheet Music Generation	An Efficient Method to Build Music Generative Model by Controlling Both General and Local Note Characteristics
Objective	Synthesize original soundtracks using LSTM networks	Improve accuracy of sheet music generation	Control both general and local note characteristics in music generation
Key Techniques	LSTM networks, preprocessing algorithm, postprocessing approach	RNN with GRU for source separation, LSTM for chord estimation	Combined methods focusing on harmony (general) and note linkage (local)
Innovations	Novel preprocessing and postprocessing algorithms	Enhanced source separation and chord estimation modules	Integration of general and local aspects for improved music quality
Quantitative Results	78.8% favourable rating from 100 respondents	Improved accuracy compared to previous systems (specific metrics not provided)	API of 1.43, note range of 12.145
Qualitative Results	Not specified	Not specified	6.81 score from survey participants, 70% could not distinguish generated from genuine music
Challenges Addressed	Training uncertainties, subjective quality evaluation	Source separation, chord estimation accuracy	Balancing overall harmony and adjacent note linkage
Future Work	Enhance quality of survey evaluations, introduce more evaluation indexes	Lyric arrangement, pause detection, time synchronization, multi-language support	Explore diverse musical genres, improve control mechanisms
Strengths	Comprehensive approach, addresses multiple challenges	Significant improvements in key modules	Balanced approach, strong quantitative and qualitative results
Weaknesses	Needs more detail on mathematical formulations in postprocessing	Lacks specific metrics for improvement extent	Requires more details on control methods and algorithm specifics

Conclusion:

The reviewed papers present significant advancements in music synthesis and sheet music generation, leveraging neural networks, particularly RNNs and LSTMs. The first paper introduces the OST Synthesis Framework (OSTSF), effectively utilizing LSTM networks to address challenges in training uncertainties and subjective music quality evaluation. By incorporating a novel preprocessing algorithm and a postprocessing approach to quantify evaluations, the framework enhances OST synthesis, achieving a favorable reception. The second paper focuses on improving source separation and chord estimation modules, demonstrating the efficacy of combining RNNs with GRU and LSTM networks. The enhanced accuracy in sheet music generation highlights the importance of refining these components, with future work aiming to reduce user input and expand the system's applicability to multiple languages. The third study proposes a balanced approach to music generation by controlling both overall harmony and local note linkage, achieving impressive quantitative and qualitative results. Most participants could not distinguish the generated music from genuine pieces, validating the model's effectiveness. Collectively, these papers illustrate the potential of advanced neural network architectures in transforming music synthesis and sheet music generation, addressing various challenges and paving the way for more sophisticated and user-friendly systems in the future.

References:

[1] Yuanzhi Huo, Mengjie Jin, And Sicong You, “LSTM-Based Framework for the Synthesis of Original Soundtracks”

[2] Mohit Dua, Rohit Yadav, Divya Mamgai, Sonali Brodiya, “An Improved RNN-LSTM based Novel Approach for Sheet Music Generation”

[3] Thinh Do Quang, Trang Hoang, “An efficient method to build music generative model by controlling both general and local note characteristics”