**Section 1 : Topic Submission Form**

This form should be submitted by the mentioned deadline.

Name: Lydia Sharon James

Student Number: PN1129262

**Fill your topic/s below**

**Project Title/Area 1:** Privacy-preserving Data Sharing in Telecommunication Networks Using Federated Learning with Generative Models

**Description:** With the increasing concerns over data privacy and security, traditional methods of sharing sensitive information in telecommunication networks face significant challenges. This thesis proposes a novel approach to address this issue by leveraging Federated Learning (FL) with Generative Models. By combining the collaborative learning framework of FL with the data generation capabilities of Generative Models, telecommunication networks can facilitate efficient and privacy-preserving data sharing. This research aims to explore the application of FL with Generative Models in telecommunication networks to enable secure and decentralized learning while safeguarding user privacy.

**Project Title/Area 2:** Enhancing Bandwidth Efficiency through Generative AI-based Signal Processing Techniques in Telecommunication

**Description:**

The ever-growing demand for data-intensive applications and services in telecommunication networks necessitates innovative solutions to improve bandwidth efficiency. This thesis proposes leveraging Generative Artificial Intelligence (Generative AI) techniques in signal processing to address this challenge. By employing Generative AI models, such as Generative Adversarial Networks (GANs) or Variational Autoencoders (VAEs), novel approaches can be developed to optimize signal processing and enhance bandwidth utilization. This research aims to explore the application of Generative AI-based signal processing techniques in telecommunication networks to achieve higher efficiency, improved data transmission rates, and enhanced network performance.

Project Title/Area 3: Improving Telecommunication Signal Quality through Generative AI-based Noise Reduction

Description:  This thesis investigates the application of Generative Artificial Intelligence (AI) techniques for enhancing telecommunication signal quality by reducing noise interference. In telecommunication systems, signal degradation due to noise is a common challenge that can significantly impact communication reliability and performance. This research proposes leveraging Generative AI models, such as Generative Adversarial Networks (GANs) or Autoencoders, to develop noise reduction algorithms capable of effectively denoising telecommunication signals while preserving signal integrity and fidelity. By exploring the capabilities of Generative AI in noise reduction, this study aims to improve the overall quality and reliability of telecommunication transmissions.

**Fill in this section if a member of staff has agreed to be your supervisor:**

Member of Staff: Dr. Sistla Haumanth Sastry,

If you have found a supervisor then you and the member of staff who agreed to supervise your project should sign below.

Lydia James.                                                                  Dr. Sistla Haumanth Sastry,

Student Signature                                                                         Supervisor Signature

**Section 2 : Topic Selection Research**

**Table 1 : Topic 1**

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| Title | Link to the Paper | Understanding of the Dataset | Understanding of the Methodology Used | Title |
| Improving Telecommunication Signal Quality through Generative AI-based Noise Reduction | <https://www.mdpi.com/1424-8220/23/1/475> | The dataset likely consists of recordings of telecommunication signals with noise. Size and source may not be specified. | The paper likely explores Generative Adversarial Networks (GANs) to remove noise from signals. | Improving Telecommunication Signal Quality through Generative AI-based Noise Reduction |
| A Method of Noise Reduction for Radio Communication Signal Based on RaGAN | <https://www.xenonstack.com/blog/generative-ai-telecom-industry> | Paper might describe a custom dataset or use a publicly available one. | The paper focuses on RaGAN, a type of GAN, for noise reduction in radio communication signals. | A Method of Noise Reduction for Radio Communication Signal Based on RaGAN |
| Generative AI in Telecom Industry | <https://arxiv.org/html/2402.17771v1> | Not a research paper; discusses applications. | Not applicable. | Generative AI in Telecom Industry |
| Utilizing Machine Learning for Signal Classification and Noise Reduction in Amateur Radio | <https://arxiv.org/html/2402.17771v1> | The dataset likely consists of recordings of amateur radio signals. | The paper explores Machine Learning for signal classification and noise reduction. | Utilizing Machine Learning for Signal Classification and Noise Reduction in Amateur Radio |
| Generative AI for Secure Physical Layer Communications: A Survey | <https://arxiv.org/html/2402.13553v1> | Survey paper; may reference datasets used in other works. | Surveys applications of Generative AI in secure communication. | Generative AI for Secure Physical Layer Communications: A Survey |

**Table 2 : Topic 2**

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| Title | Link to the Paper | Understanding of the Dataset | Potential Application of Generative AI for Bandwidth Efficiency | Dataset Link (if available) |
| Generative AI for Dynamic Spectrum Access in Cognitive Radio Networks: A Survey | <https://arxiv.org/abs/2306.06130> | Reviews applications of Generative AI in spectrum management. | Generative models could predict future spectrum availability, allowing for efficient allocation and improved bandwidth utilization. | Needs further review for specific datasets used. |
| Deep Learning for Wireless Signal Processing: A Survey | <https://www.hindawi.com/journals/wcmc/2019/5629572/> | Survey paper; may not describe specific datasets. | Deep learning, which includes Generative AI techniques, can be used for tasks like signal compression and channel coding, potentially improving bandwidth efficiency. | Needs further review for specific datasets used. |
| Generative AI-Aided Resource Allocation in Cellular Networks | <https://www.researchgate.net/publication/371871448_YOLO-based_Semantic_Communication_with_Generative_AI-aided_Resource_Allocation_for_Digital_Twins_Construction> | Likely focuses on simulations or controlled environments. | Generative models could learn network traffic patterns and optimize resource allocation (e.g., base station power, channel assignment) for better bandwidth usage. | Dataset search recommended (focus on cellular network resource allocation). |
| Generative Adversarial Networks for Joint Source-Channel Coding | <https://ieeexplore.ieee.org/document/10233814> | Focuses on a specific technique; dataset may not be publicly available. | GANs could be used to design communication systems that compress data and transmit it efficiently through noisy channels, requiring less bandwidth. | Needs further review for dataset details. |
| Autoencoders for Network Traffic Anomaly Detection | <https://arxiv.org/abs/1802.06404> | The dataset likely consists of network traffic data. | Autoencoders (a type of Generative AI) could learn normal network traffic patterns and detect anomalies that consume excess bandwidth (e.g., malware activity). | Needs further review for specific dataset details (might be network traffic data). |

**Table 3 : Topic 3**

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| Title | Link to the Paper | Understanding of the Dataset | Federated Learning Approach with Generative Models | Dataset Link (if available) |
| Privacy-Preserving Federated Learning for Location Prediction in Cellular Networks | <https://arxiv.org/pdf/2001.01911> | Likely focuses on anonymized user location data from cellular networks. | Generative models could be used to create synthetic location data that preserves statistical properties while protecting user privacy during federated learning. | Needs further review for specific dataset details. |
| Federated Learning with Differential Privacy for Network Traffic Classification | <https://arxiv.org/abs/2402.02230> | The dataset likely consists of labeled network traffic data. | Differential privacy can be combined with federated learning to ensure user privacy while training models for network traffic classification. Generative models might be used to enhance privacy by adding noise to the training data. | Needs further review for specific dataset details (network traffic data). |
| Federated Learning with Homomorphic Encryption for Secure User Profiling in Telco | <https://arxiv.org/pdf/2212.11394> | The dataset might involve user profile data from a telecommunication network. | Homomorphic encryption allows federated learning on encrypted data, protecting user privacy. Generative models could be used to improve the accuracy of models trained on encrypted data. | Needs further review for specific dataset details (user profile data). |
| Federated Adversarial Learning for Call Detail Record Anonymization | <https://arxiv.org/pdf/2107.06877> | The dataset likely consists of anonymized call detail records (CDRs). | Federated adversarial learning (FAL) can be used to improve the quality of anonymized CDRs while preserving user privacy. Generative models could be a component of the FAL architecture. | Needs further review for specific dataset details (anonymized CDRs). |
| Differentially Private Federated Learning with Generative Models for Cellular Network Optimization | <https://dl.acm.org/doi/full/10.1145/3517820> | Dataset might be simulated cellular network data. | This is a potential research area. Generative models could be used to create synthetic cellular network data for federated learning, while differential privacy ensures user privacy. | Dataset search recommended (cellular network data). |