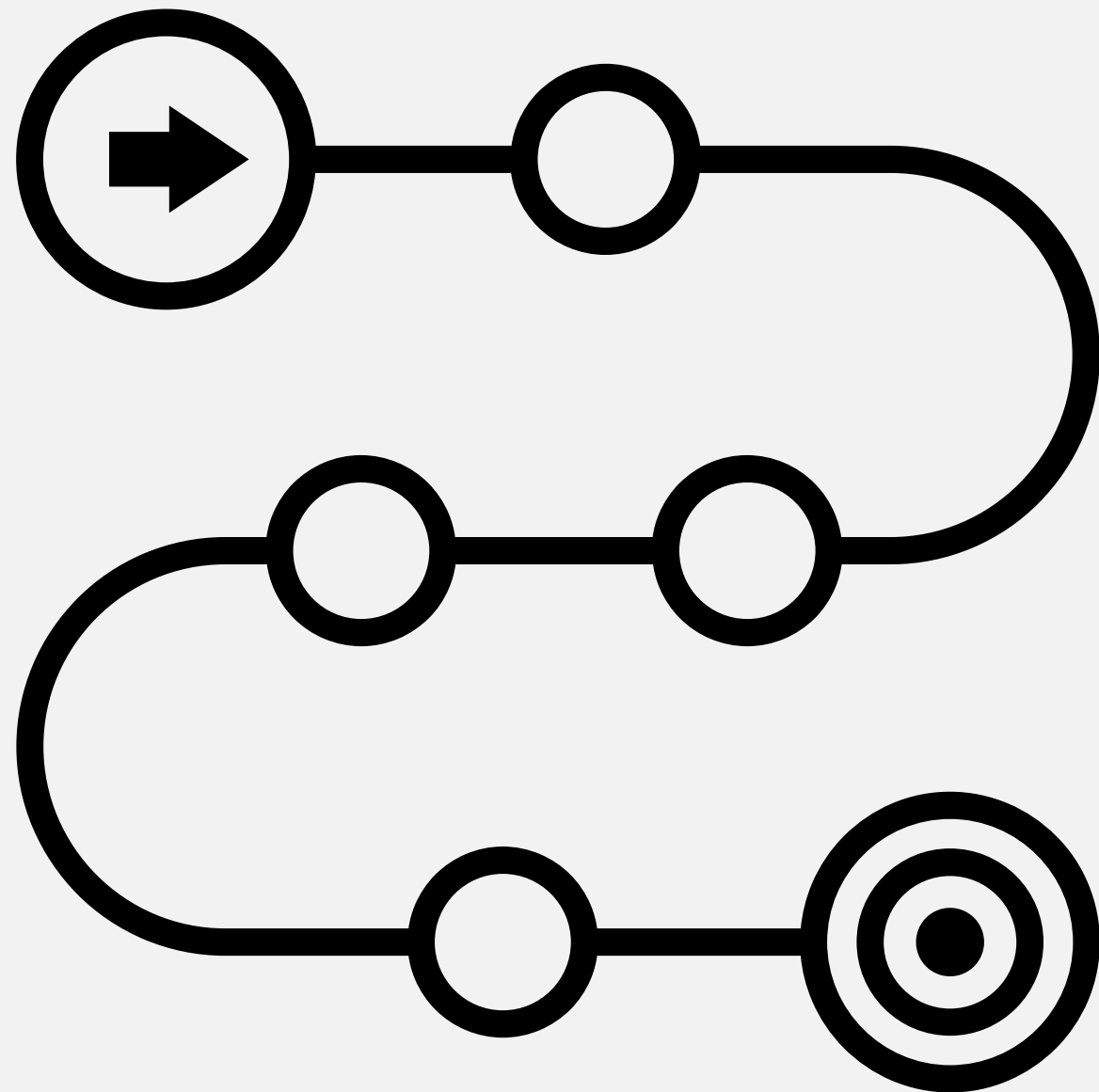


# **The Dynamics of Meaning: Towards the Evaluation of Diachronic Semantic Drift in Sinhala Language**

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Supervised By Dr. Nisansa de Silva

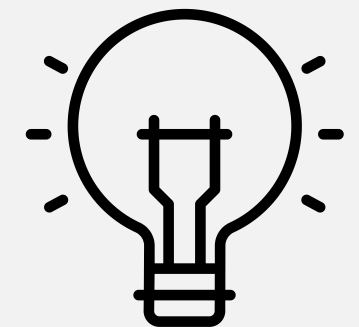
# Agenda



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# Introduction

- Language is an evolving system, continuously reshaped by its speakers. [1].
- As we explore the fascinating process of language evolution, we find that words can shift in meaning for a variety of reasons [2].
- The Sinhala language possesses a rich and diverse literary heritage that has developed over the course of several millennia, with its origins tracing back to between the 3rd and 2nd centuries BCE [3].
- This language has undergone significant evolution and transformation throughout its history, resulting in the form of modern Sinhala that we engage with today.



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# What is Semantic Drift?

- The concept of semantic drift refers to a change in the meaning of certain words for a variety of reasons and in different contexts.
- In technical terms, it involves a shift in a word's position within the latent space.

## Semantic Drift

Synchronic

semantic sense changes across domains [4]

Diachronic

semantic sense changes across time [4]

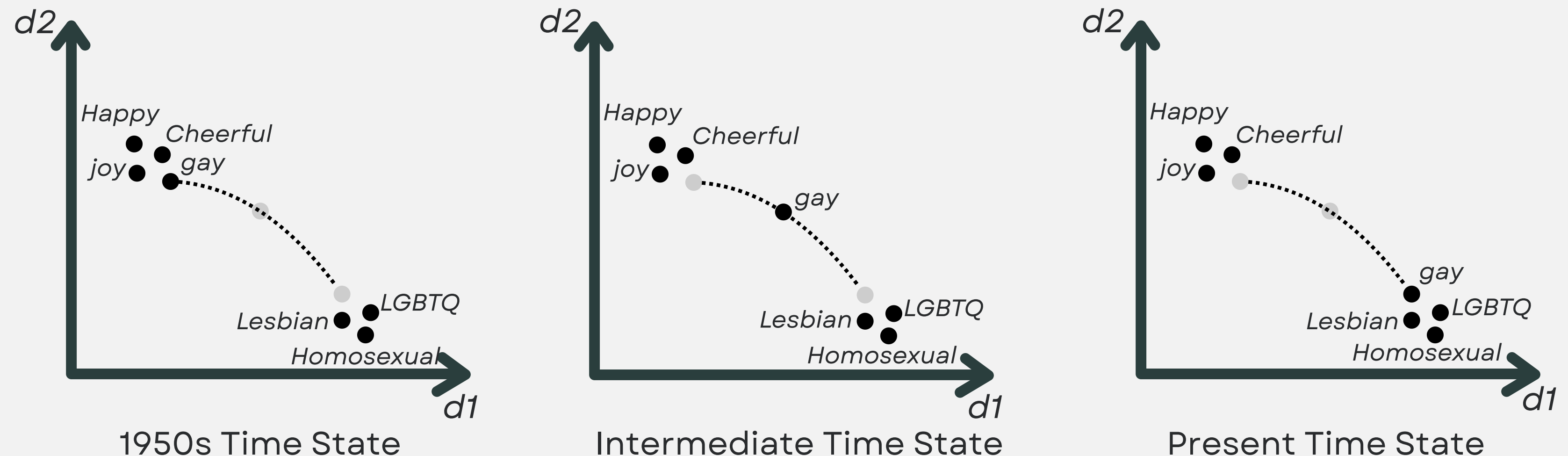
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[4] Schlechtweg, D., Häddy, A., Del Tredici, M. and im Walde, S.S., 2019, July. A Wind of Change: Detecting and Evaluating Lexical Semantic Change across Times and Domains. In Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics (pp. 732-746).

# Diachronic Semantic Drift

- Semantic drift is primarily identified in diachronic studies, highlighting the evolution of meaning over time.

*A well-known example is the transformation of the word “gay,” which has shifted in meaning from cheerful → homosexual over the years [5]*



# Diachronic Semantic Drift: Current Perspectives

- Diachronic semantic drift studies consider time as either a continuous dependency or a sequence of contiguous time intervals [6][7].
- The study area focuses on semantic drift detection [4][6], semantic appearance and disappearance [8], and dynamic embedding creation [9].
- Static word embeddings, such as those trained with algorithms like Word2Vec or FastText, are trained independently for each time slice of a corpus [10].
- Contextualized word embeddings, derived from Transformer-based language models like BERT, ELMo, and XLM-R, represent each word occurrence based on its specific context [10].
- However, research suggests that contextualized embeddings do not consistently outperform static embeddings for this specific task [10].
- There is a critical research gap in studying semantic drift in the Sinhala language, with no exploration by computational linguists and a lack of relevant datasets.

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[4] Schlechtweg, D., Häddy, A., Del Tredici, M. and im Walde, S.S., 2019, July. A Wind of Change: Detecting and Evaluating Lexical Semantic Change across Times and Domains. In Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics (pp. 732-746).

[6] Frermann, L. and Lapata, M., 2016. A Bayesian Model of Diachronic Meaning Change. Transactions of the Association for Computational Linguistics, 4, pp.31-45.

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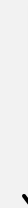
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[10] Periti, F., Dubossarsky, H. and Tahmasebi, N., 2024, March. (Chat) GPT v BERT Dawn of Justice for Semantic Change Detection. In Findings of the Association for Computational Linguistics: EACL 2024 (pp. 420-436).

# Research Objectives

- Identifying Sinhala linguistic resources within a defined acceptable timeframe for dataset creation, and digitizing them for research on diachronic semantic drift.
- Identifying semantics that exhibit significant diachronic drift and those that remain constant, serving as anchor or pivot words for further research.
- Assess the phenomenon of semantic emergence and disappearance in the evolution of the Sinhala language.
- Implementing a novel temporal dynamic embedding mechanism that captures the semantic drift of words over time by generating word vector representations for each time period.



*Reaching the final objective will directly contribute to a system that can detect semantic drift.*

# Proposed Methodology

- We will create a data set for research using Sinhala linguistic resources, including:
  - Material from the Internet
  - Books
  - Articles
  - Newspapers
- Physical resources will be digitized using existing OCR systems for the Sinhala language.
- The research aims to:
  - Identify effective techniques for recognizing semantic changes over time.
  - Identify stable semantic changes within the latent space.
- Evaluation mechanisms will be developed to assess:
  - Emergence of new semantics.
  - Disappearance of old semantics in the evolution of the Sinhala language.
- We aim to establish the best methodology for:
  - Creating dynamic word embeddings that capture semantic drift.
  - Producing word representations that evolve over time.

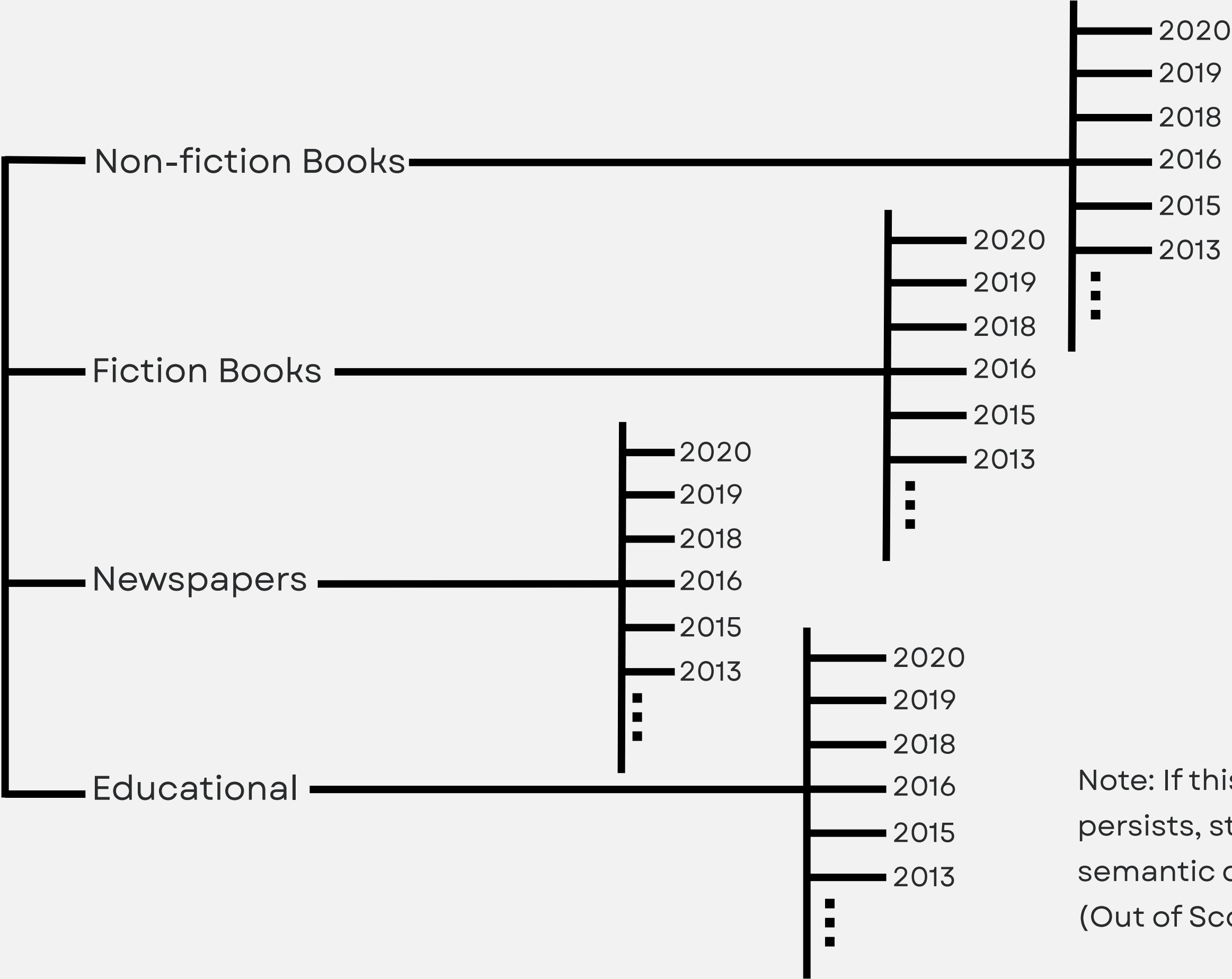
# Data Acquisition Plan

- We have already identified several sources to acquire linguistic resources beyond the internet archives;
  - Department of Archives
  - National Library
  - Museum Libraries
  - University Libraries
  - Royal Asiatic Society of Sri Lanka
  - Buddhist Cultural Centre
  - Sinhala Dictionary Office
  - Postgraduate Institute of Archaeology
  - Department of Official Languages

# Dataset Assembly Strategy

- The dataset will consist of yearly data.
- The aim is to collect literature published:
  - Ranging from the latest to the earliest (e.g., 2024, 2023, 2022, 2021, 2019, 2016, etc.).
  - Till 1737, which marks the beginning of the printing press in Sri Lanka. (They may have been written before 1737.)
- Initially, 100 sentences will be collected per year. (Approximately 1500 - 2000 word tokens)
- The goal is to categorize the dataset into distinct classes based on the type of literature.
- The identified categories are as follows;
  - Non-fiction books - high priority
  - Fiction books - high priority
  - Newspapers - high priority
  - Educational - medium priority
  - Gov and Law - low priority

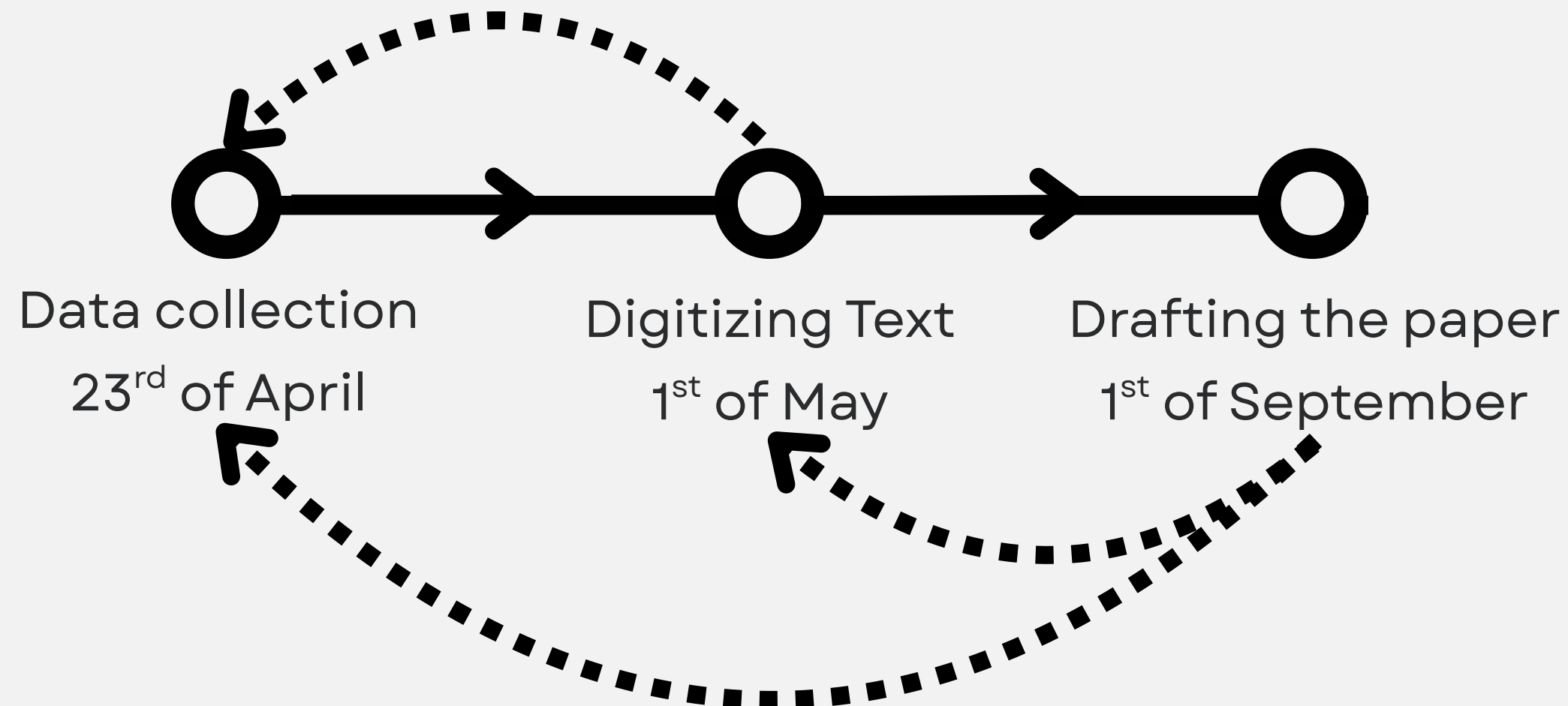
# Dataset Overview



Note: If this data set creation plan persists, studying synchronic semantic drift will also be possible. (Out of Scope for this study)

# Timeline of Dataset Publication

- Our goal is to publish the base dataset for LREC 2026, where we expect the paper deadlines to be by the end of October 2025.
- Thus, the entire initial dataset creation process, including the accompanying paper, should take about six months.



# Digitization of Literature using OCR

- The majority of our literature resources will primarily be in physical format, as we are focusing on Sinhala texts that span several centuries.
- Therefore, digitizing the identified sources will be a crucial task for dataset creation.
- We have identified several systems to conduct Optical Character Recognition (OCR) for Sinhala text;
  - Subasa OCR [11]
  - Tesseract OCR [12]
  - OCR with Document AI [13]
  - Google Cloud Vision API [14]
- The project's scope does not include developing OCR systems; however, we will use existing systems and modify them further if necessary to digitize the literature.

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[11] LTRL UCSC, "Sinhala ocr," 2022. [Online]. Available: <https://ocr.subasa.lk>

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# Challenges in the studies of Lexical Semantic Change

- Many existing semantic change detection methods using contextual embeddings are **unscalable in terms of memory and computation time** [17].
- Vector space alignment is a technical challenge in diachronic LSC, as embeddings from different time periods need to be compared in a common space [16].
- Distinguishing between **semantic change and other linguistic changes**, such as syntactic changes, can be challenging [15].
- Dataset creation will be extremely difficult, from acquiring literature to digitizing and formatting them.



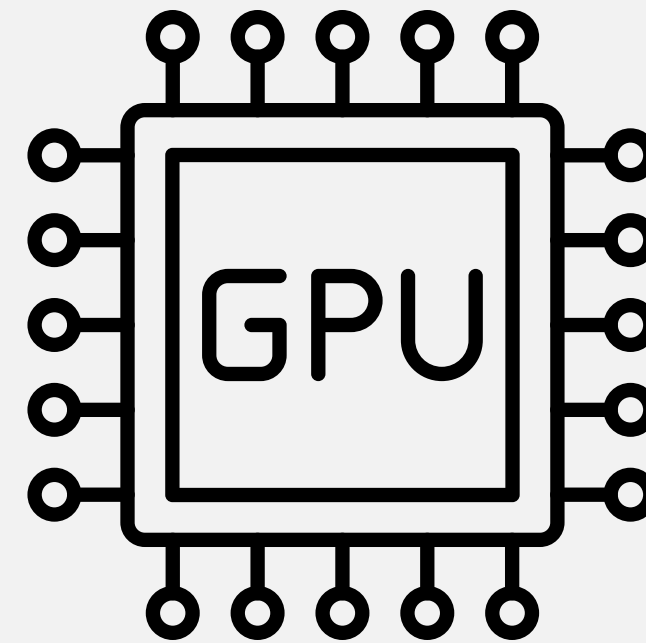
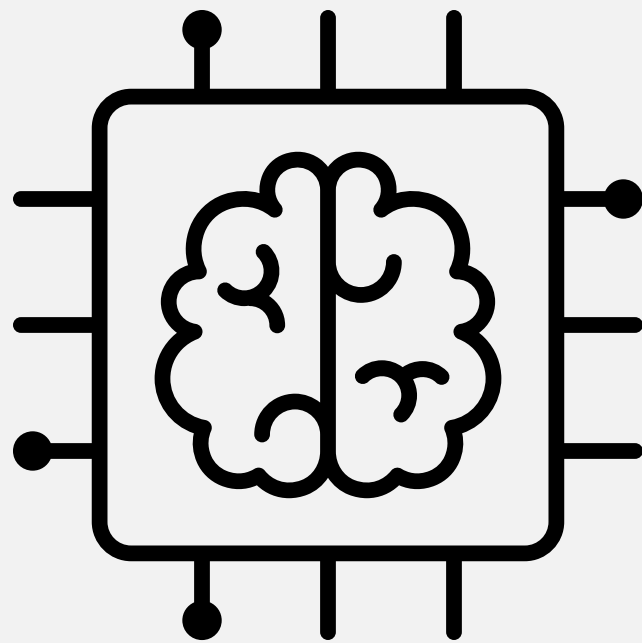
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[17] Montariol, S., Martinc, M. and Pivovarov, L., 2021, June. Scalable and interpretable semantic change detection. In Proceedings of the 2021 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies (pp. 4642-4652).

# Resources

- **Models:** Pre-trained models will be sourced from HuggingFace to generate contextual embeddings.
- **Data:** The dataset will be assembled to conduct diachronic studies.
- **Computational Resources:** GPU cluster available in CSE department, UOM.



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# Thank You!

Presented by Nevidu Jayatilleke