COMP47250: Literature Review

Analysing Character Arcs and Story Development in Fiction Writing using Natural Language Processing

Student: Declan Atkins 14388146

Supervisor: Derek Greene

Abstract. When reading a work of fiction, the character arcs and story development are often the most fundamental and defining aspects. While the details may fade from memory over time, readers tend to recall the overall plot and the evolution of the characters throughout the narrative. The success and failure of the characters we identify with become significant to us, and we become emotionally invested in their journeys. As such, the capacity to craft coherent character arcs is a critical component of the fiction writing craft, and one of the most vital skills that authors must master. It also forms the backbone of a critique of a novel or other piece of writing. In this dissertation we investigate the challenge of programmatically extracting the character and plot arcs from novels using Natural Language Processing techniques. Through the application of these techniques, we aim to uncover patterns and extract meaningful insights from literary texts, shedding light on the structural and emotional journeys of characters within narratives. This research not only contributes to the field of computational literature analysis but also provides valuable insights into the art of storytelling and character development, bridging the gap between literary analysis and computational approaches.

1 Introduction

The art of storytelling has been an integral part of human culture since time immemorial. Whether through ancient myths, epic poems, or contemporary novels, narratives have the power to captivate our imaginations and transport us to different worlds. Within the realm of fiction, the development of characters and the progression of their stories are central elements that engage readers on a profound level. While the specific details of a story may fade from memory, the overall plot and the evolution of characters tend to leave a lasting impression.

Understanding the character arcs within a novel is not only vital to the author, but also to us as readers and to critics reviewing the quality of the story. By unravelling the complexities of these narrative components, we gain insights into the art of storytelling and the underlying themes and messages conveyed through literature. However, the analysis of character arcs and story development in literature has predominantly relied on subjective interpretations and manual examinations of texts.

We can define a *character arc* as a transformative journey undertaken by a character throughout the course of a novel [14]. The character begins the novel as one kind of person and subsequently changes based on the events that occur over the course of the novel's plot. As discussed in [8], the main protagonist of a novel is the most likely to have a well-defined character arc, although side characters may also experience similar journeys throughout the plot. Noted examples of character arcs would be the downfall of Dorian Gray in *The Picture of Dorian Gray* by Oscar Wilde and the redemption of Ebeneezer Scrooge in *A Christmas Carol* by Charles Dickens. Though diametrically opposed to each other in terms of the direction of their arcs, both of these characters experience a drastic change in their personalities over the course of their respective novels.

In the past decade, the development of advanced Natural Language Processing (NLP) techniques, built on machine learning methods, traditional computational analysis or some combination thereof, has paved the path for new avenues of literary research (e.g. [5, 6]). By leveraging the power of NLP, we can extend on the subjective, qualitative analysis of literature provided by literary critics and provide a more quantitative model of a piece of fiction. Applying computational methods to this field of research also has the potential to unlock new analysis previously rendered impractical due to the time consuming nature of manual literary analysis. The technique of "distant reading" [24] has come to the fore in this field. It attempts to uncover the patterns and unspoken rules behind literature from a very technical perspective. Where traditional "close reading" of literature relies on qualitative analysis of what a single piece of literature means, distant reading compiles objective data about many works for analysis[28]. In terms of specifically studying character arcs, distant reading techniques have been employed to study the structural changes that define the arc. In [13] the authors studied plot development based on the changing structures of character social network graphs. Another approach that has been taken is literary event detection. In literary event detection, significant events, defined in [11] as those with a "singular occurrence at a specific place or time", are tracked through the novel. In [9], these were used to study character arcs based on the "shift of circumstance". Taking a character A and a character B, this is defined as the change in the ratio of events where A is the actor and B the acted upon to events where the opposite is the case.

The focus of this literature review is to explore the applications of NLP techniques both inside and outside the field of fiction writing. By critically examining the existing literature in this domain, we aim to provide an overview of the current state of research, identify gaps and limitations, and highlight potential future directions for investigation. Through this comprehensive examination of literature, we seek to gain a deeper understanding of the challenges, methodologies, and advancements in NLP and how they can be used in the development of this project. By combining insights from both the computational and literary domains, we can pave the way for a more nuanced and comprehensive analysis of narrative structures, enriching our understanding of storytelling as a whole.

2   State of the Art

While traditional literary analysis of fiction writing has been around for countless generations, the computational analysis of the same is still an emerging field. In recent years, however, thanks to the advancement in NLP, such as with the development of complex Named Entity Recognition, Social Network Analysis, and Topic Modelling, the door for this kind of research has been opened and several papers have been published in this field. In this section, we will examine some of the techniques that have been used and discuss how we can apply them in this project.

2.1   Named Entity Recognition

Named Entity Recognition (NER) is a crucial task in NLP that involves identifying and classifying named entities within text [25]. Named entities refer to specific types of entities, such as people, organisations, locations, and any other class of entity that we wish to extract from text content. By automatically identifying and categorising such entities, NER enables researchers to better understand the content and context of textual data, facilitating more accurate and meaningful analysis and interpretation. In this section, we will explore the concept of NER, its underlying methodologies, evaluation metrics, and notable advancements in the field.

In the context of analysing fiction writing, NER can be thought of as a way to automatically extract the characters and key locations from a novel or other literary work. In [20], several techniques for performing NER are discussed, such as through the use of deep pre-trained transformer models such as BERT. These models generate embeddings of the words within a piece of text and as such can provide accurate predictions of whether words in a sentence correspond to named entities.

While it seems intuitive to use NER in the context of fiction writing analysis, a large percentage of NER research has not been related to this field. As discussed in [5], this causes problems for traditional NER pipelines, as the entity structure of a novel tends to be quite different to that of a news article. In general, novels tend to have a much greater focus on individual characters and much more detailed description of the places visited and discussed by the characters. This requires the use of a more granular set of NER classes than the catch-all Location class used by many news based NER pipelines. Furthermore, in [3] it was shown that training NER models on the texts of fiction novels can improve the performance of character detection in this domain. Specifically, when looking at fantasy novels, different name structures such as "Rand al'Thor", from the series *The Wheel of Time* by Robert Jordan, can be harder to detect by more generic models.

As mentioned previously, character detection is an important outcome of NER. To perform this, NER must be combined with entity disambiguation to determine which entities refer to which characters. In [32] it was discussed how this is quite a challenging task, specifically for literary texts, due to the number

of different characters to keep track of and also the various different ways by which they may be referenced. For example, characters maybe referred to by forename, surname, nickname, title or pretty much any combination thereof. Moreover, pronouns will likely be used throughout dialogue sections, making this task even more challenging. In [4], this problem is further discussed, and models for character co-reference resolution are presented. Attention based models such as ACNN and BERT come to the fore once again due to their ability to store contextual information and use this in predicting.

BookNLP[1], first presented in [6], is a tool that frequently shows up in the literature. It provides both NER with the classes defined in [5] and character co-reference resolution, along with several other tools that we will be using throughout this project.

2.2 Social Network Analysis

In the realm of literature, the interplay of characters and their journeys lies at the heart of storytelling. Understanding the intricate dynamics that shape these arcs can often be a daunting task, particularly when it comes to examining the complex web of relationships within a fictional narrative. The field of social network analysis (SNA) has emerged as a powerful tool to shed light on the interconnectedness of individuals and their influence within various social contexts.

Another useful outcome of SNA is that it allows us to compare different pieces of literature based on the structure of their social network graphs. In [18], the authors compare the social networks of the *Táin Bó Cúlainge*, one of the epics of Irish Mythology, with *Beowulf* and the *Iliad*, epics from other cultures. In the paper, the authors use this comparison to analyse the historicity of the three texts, however this is not the only use for these kinds of comparisons. In [19], the authors propose a method of creating embedding vectors based on character social network graphs. Similar to how Word2Vec [21] provides word similarity based on embeddings, this Story2Vec model could be useful in recommending books to readers based on similarity.

For our project, network analysis is an approach that could be applied to study a novel at a more granular level. Instead of looking at the social network of an entire novel, we could model a character's arc based on their changing sub-graph. In [13], the change in the social network of a novel over time was used to study plot development. We could build upon this work to allow for analysing the dynamic sub-graph of a character, monitoring the change in character centrality within the graph, connections to other important nodes and noting when these changes happen. This would be a way of modelling the character arcs from the point of view of their importance to the plot.

Of course, to analyse the interconnectedness of characters within a novel, we first need to be able to automatically identify co-occurrences of those characters in the text. As such, NER and character extraction are pre-requisite steps for

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[1] https://github.com/booknlp/booknlp

performing SNA in this context. In [12], the authors provide an overview of tools and pipelines for extracting characters and subsequently building the social network for a given novel.

2.3   Topic Modelling

One of the most defining aspects of a character arc is how a character's personality and impact on the world they inhabit changes during the course of the novel. One of the key goals of this dissertation is to analyse how the shift in the words used around a character relates to their arc within the plot. Our hypothesis is that, if we sample these words over time, we should see distinct clusters of words that are relevant to the current state of character's arc. For example, if we consider *The Picture of Dorian Gray* once more, we should see more words relating to innocence and good at the start of the novel, and more words relating to darkness and evil by the end. At the other side of the spectrum, if we take *A Christmas Carol*, we should see a very different trend, with words relating to greed and cruelty at the start, and friendship and generosity at the end of the story.

Topic modelling is a common unsupervised text mining approach [10] that could prove very useful for this task. As described in [22] topic modelling is a text analysis method that provides an automated procedure for coding the content of a corpus of texts into a set of substantively meaningful coding categories called "topics". It is an unsupervised method, so instead of the researcher providing a list of topics, they are inferred based on the content of the text provided. The most common approach is Latent Dirichlet Allocation (LDA), which takes a probabilistic view of representing each document in a corpus as a mixture of different topics [10].

In the world of literature, topic modelling has been applied to study authors and the common themes within their works. In [30] it was applied to the works of Charles Dickens for this purpose. It has also been used as a similarity metric for book recommendation systems such as in [2], or for studying genres as a whole such as in [1]. While these draw from the same concepts as our work, we will be focusing on dynamic topics within shorter texts, namely segments within a novel. This could be done either on a chapter level, analysing the shift in topics from chapter to chapter, which should show the development of the plot as a whole, or on character mention level, monitoring the character arc.

While there is little literature for research into dynamic topics within fiction novels, there are several examples of this being applied in other domains. In [15, 27, 33] we see different examples of dynamic topic modelling being applied to shorter texts such as tweets and news articles, with the aim of monitoring changes in discussion of similar topics.

2.4   Combining Literary and Computational Studies

The convergence of literary and computational research has ushered in a new era of inquiry that marries the rich tradition of literary analysis with the power

of computational techniques. By blending the nuanced understanding of texts cultivated in literary studies with the analytical capabilities of computational methods, scholars can unlock deeper insights into the complexities of literature. This interdisciplinary approach facilitates the exploration of literary themes, narrative structures, character development, and stylistic elements through quantitative analysis, pattern recognition, and data-driven methodologies. By combining literary and computational research, researchers can bridge the gap between subjective interpretations and objective analysis, opening up new avenues for understanding and appreciating the intricate tapestry of human expression that lies within literary works.

The intersection of these fields has caused some consternation, however. One can see the merits and flaws of distant and close reading discussed in detail in the literature. Close reading refers to the more traditional study of literature, analysing in detail the different passages of text within a novel and trying to unlock a deep understanding of the content. Distant reading, on the other hand, is almost the exact opposite. Coined in [23], it refers to using graphs and other tools to generate a high level overview of the structure of a single novel or an entire collection of novels. In [28], these two methods are contrasted and a framework for combining the two is presented, whereby the researcher uses distant reading to find segments of a text that warrant further study using close reading. In our project, a combination of the two strategies will also be employed. To understand a character arc, we need both the close reading, low-level understanding of the character and their interactions, yet also the high-level, distant read understanding of the plot as a whole and the character's position within it.

3 Proposed Plan

Over the course of this project we aim to answer three key research questions. In this section, we will present and discuss these questions along with a plan and timeline for our research.

3.1 RQ1: How can we extract characters from fictional texts?

Extracting characters from fiction novels is a fundamental step in character analysis and understanding narrative structures. Several techniques and approaches have been developed to extract characters from textual data. It is worth noting that character extraction from fiction novels can be challenging due to variations in writing styles, ambiguous references, and multiple characters with the same or similar names. Therefore, a combination of techniques, including linguistic rules, machine learning, and human validation, is often necessary to improve the accuracy and completeness of character extraction. In this project, it is our intention to evaluate the performance of publicly available methods and to build a generic pipeline for character extraction that is suitable for our research.

To build a pipeline for extracting characters from fiction novels, we will evaluate the use of a number of popular Python NLP packages, which offer various functionalities that could aid in character extraction:

- BookNLP, mentioned briefly in section 2.1, specifically designed for literature analysis, utilises machine learning techniques and linguistic patterns to automatically identify and extract character names from novels. Its pre-trained models and customisable features make it a promising choice for character extraction.
- spaCy[2], a widely used NLP library, provides efficient named entity recognition (NER) capabilities. By leveraging its pre-trained models, we can extract character names as named entities from the novel text, improving the accuracy of the extraction process.
- NLTK (Natural Language Toolkit)[3] offers a range of NLP functionalities, including part-of-speech tagging and chunking. These features can be utilised to identify patterns indicative of character mentions, such as proper nouns followed by dialogue or narrative descriptions.

To evaluate the performance of our character extraction pipeline we will compare its outputs with available ground-truth information, such as that provided in the NovelTM datasets presented in [31]. This pipeline will lay the foundation for subsequent character analysis and provide valuable insights into the dynamics and development of characters within the narrative of each novel.

3.2   RQ2: How can quantitatively model a character arc?

Generating a quantitative model of a character arc involves capturing the structural and thematic aspects of character development. Techniques such as Social Network Analysis and Topic Modelling will provide good starting points for answering this research question.

Social network analysis allows us to explore the relationships and interactions between characters by representing them as nodes and their connections as edges in a network. By tracking changes in network properties over time, we can observe the growth, decline, or shifts in character relationships, revealing important elements of their arcs [16]. Network analysis tools, such as NetworkX [17] and Gephi [7], will allow us to compute graph metrics, such as centrality scores, and visualise the networks for further exploration.

Topic modelling, on the other hand, focuses on identifying and extracting thematic patterns from textual data. Through its application, we can uncover latent topics within the text and track their prevalence and evolution throughout the narrative. This enables us to quantitatively measure the emphasis and relevance of specific themes within a character's arc, providing insights into their personal growth, challenges, or transformations. Through the use of Python libraries such as Gensim [26] that implement algorithms such as LDA [10], we can identify these topics and thus monitor thematic shifts in the character arc.

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[2] https://spacy.io/
[3] https://www.nltk.org/

3.3 RQ3: How can we compare quantitative models of different character arcs?

An important outcome of our work will be the ability to compare different character arcs from novels. In answering this research question, focus will have to be placed on developing techniques for visualising a character arc so that they can be interpreted by a researcher. The metrics and plots we generate need not be generic, instead they may be chosen on an ad-hoc basis for comparing specific novels and character arcs.

In evaluating the success of our project we will compare the output of our pipeline with the existing literary research of the novels we analyse. This will allow us to ensure that the results we obtain align with the consensus in existing literature.

3.4 Data and Project Timeline

Our project timeline consists of milestones as defined by the research questions discussed above. Additionally, we have allotted time for the preparation of a dataset for our research. This task will involve the cleaning and preprocessing of the following 19th-century novels, which make up our initial corpus for study:

1. The Picture of Dorian Gray, Oscar Wilde (1890)
2. A Christmas Carol, Charles Dickens (1843)
3. Silas Marner, George Elliot (1861)
4. Pride and Prejudice, Jane Austen (1813)

We have selected these novels as they have been widely studied from a literary criticism perspective and have well-defined character arcs involving the central protagonist. These novels are also freely available in the public domain – we will use the proofread versions provided by Project Gutenberg [29]. The timeline to complete the project is shown in Fig. 1. For each of these milestones, we can define completion based on specific deliverables:

1. **Data Preparation:** A set of pre-processed representations generated for the above novels.
2. **Extracting Characters:** Implementation in Python of a character extraction pipeline.
3. **Analysis of Dynamic Character Networks:** Implementation of a Python process for building a social network from segments of a novel and extracting the subgraph of a specific character of interest in each case.
4. **Analysis of Topic Shifts in Novels:** Python pipeline for extracting topics from short text segments throughout the novel. This should be implemented at both the character mention level and at the chapter level.
5. **Comparison of Character Arcs:** Visualisation tool for comparing character arcs between novels, as part of the evaluation process.
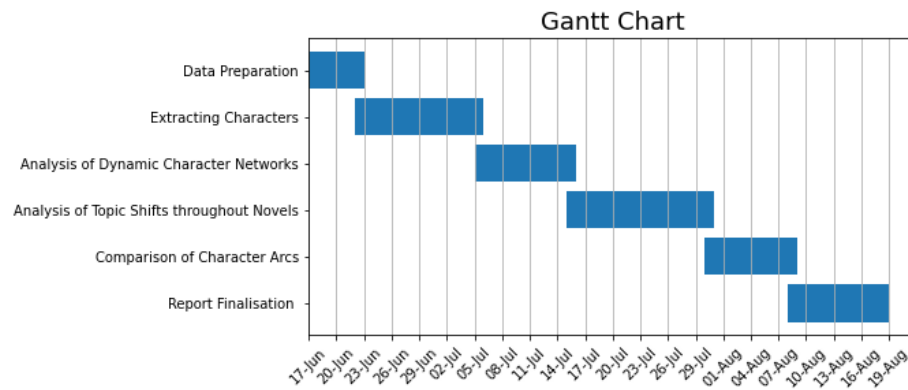6. **Report Finalisation:** Final report written and submitted.

Fig. 1. Gantt Chart of the project timeline.

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