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World Literature According to Wikipedia: Introduction to a DBpedia-Based Framework

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Among the manifold takes on world literature, it is our goal to contribute to the discussion from a digital point of view by analyzing the representation of world literature in Wikipedia with its millions of articles in hundreds of languages. As a preliminary, we introduce and compare three different approaches to identify writers on Wikipedia using data from DBpedia, a community project with the goal of extracting and providing structured information from Wikipedia. Equipped with our basic set of writers, we analyze how they are represented throughout the 15 biggest Wikipedia language versions. We combine intrinsic measures (mostly examining the connectedness of articles) with extrinsic ones (analyzing how often articles are frequented by readers) and develop methods to evaluate our results. The better part of our findings seems to convey a rather conservative, old-fashioned version of world literature, but a version derived from reproducible facts revealing an implicit literary canon based on the editing and reading behavior of millions of people. While still having to solve some known issues, the introduced methods will help us build an observatory of world literature to further investigate its representativeness and biases.

1 Introduction

Ever since Johann Wolfgang von Goethe introduced his conception of ‘world literature’ in one of his conversations with Eckermann, in January, 1827 [1], the term refers to

authors and works that transcend national and language borders. While this might still be the least common denominator, opinions on what belongs to world literature have become very diverse in recent years, bringing several factors into play. In their introduction [2] to a 2013 special issue of *Modern Language Quarterly* entirely dedicated to the question “What Counts as World Literature?”, Levine and Mani ask: “Is world literature simply a prerogative of the professional reader, the literary theorist, or is it a much larger interactive space with numerous actors who range from authors, translators, and readers to librarians, publishers, collectors, and booksellers?”

The aim of this paper is to introduce another way to explore what counts as world literature in a variety of contexts. If “world literature as a publishing and teaching project was part of a push to democratize high culture in the early twentieth century” [2], then the launch of Wikipedia in 2001 can be understood as a project that democratized the gathering and distribution of general knowledge by harnessing the much-written-about “wisdom of the crowd”. The number of articles in the English Wikipedia version is, to date, two magnitudes higher than that of the last print edition of the Encyclopædia Britannica, and our idea is to show how world literature is represented in this vast digital resource. To pursue this goal, we make use of DBpedia, one of several attempts to formalize the contents of Wikipedia by converting a human-readable, hypertextual encyclopedia into a machine-readable, queryable database.

The individual steps described in this paper include:

- A comparison of three different approaches for identifying writers of literature across different language versions of Wikipedia.
- An evaluation of our set of extracted writers, including their temporal distribution.
- A comparison and evaluation of five different intrinsic and extrinsic ranking measures to assess the importance of writers on Wikipedia.
- A visualization of the network of the most important writers, a minimum definition of what world literature is, according to Wikipedia.
- An approach to identify writers who transcended language boundaries, in the 15 most comprehensive Wikipedia language editions, including a detailed analysis.
- Publication of additional results (tables and datasets) on <http://data.weltliteratur.net/>, our project page that is planned to become an observatory of the digital discourse on world literature.

The paper is structured as follows: In Section 2 we discuss possible definitions of world literature and briefly introduce Wikipedia and DBpedia. In Section 3 we explicate the used DBpedia datasets and the criteria for the selection of the 15 Wikipedia language editions. We introduce our approaches for the identification of writers in Section 4. In Section 5 we explain the dataset creation and subsequently present our results in Sections 6 and 7. Section 8 wraps up this paper drawing conclusions from our results and trying to cautiously describe Wikipedia’s inherent idea of world literature.

2 Related Work

In this section, we briefly introduce our understanding of the ongoing discourse on world literature. We also present the required technical background and introduce projects that were important to conducting our own research.

2.1 What is World Literature?

Definitions of world literature are manifold, and while postmodernism, postcolonial and gender studies significantly diversified our perception of world literature, there is still one consensual aspect that can be filtered out of ongoing discussions and according to which world literature comprises “all literary works that circulate beyond their culture of origin, either in translation or in their original language” [3]. This aspect does not seem to have changed since the term was coined by Goethe. However, when it comes to measuring the global significance of a work or author, opinions differ. Is it the number of translations of a work that counts (something that could be operationalized using the Index Translationum database)? Are sales important or is it an indication of questionable literary qualities if a literary work hits best-seller lists? It is difficult to find common grounds as world literature is an ever-changing entity depending on a continued conversation on value and influence.

While the formation of a world literary canon is an underlying part of literary criticism whenever a work or an author is selected instead of others, most notably and idiosyncratically in the works of Harold Bloom, world literature can also be studied based on the degree of international reception of certain works and authors. If we follow David Damrosch who makes his case for world literature as “a mode of circulation and of reading” [3], there still remains the problem of measurement. With our author-centric approach, we determine the degree of reception of a writer by measuring his or her presence in the different language editions of Wikipedia, a new spin on the question if and how an author crossed national and language borders.

2.2 Research on Wikipedia

Since its launch in 2001, the free-access and free-content internet encyclopedia Wikipedia has become the web’s largest and most popular general reference work, ranked among the top ten most popular websites. More than 60,000 active editors work on articles in editions for more than 200 different languages. Among these editions, the English Wikipedia sticks out with its more than 4.7 million articles at the beginning of 2015.

By now, Wikipedia is widely approved as a resource for scientific research. The encyclopedia has been called a “global memory place” [4] and a “goldmine of information” [5], emphasizing its value for researchers. Nielsen [6] presents various research results and groups them into several main categories, differentiating between research that examines Wikipedia and research that uses information from Wikipedia to draw conclusions about other matters. Also in the Digital Humanities, Wikipedia is regarded as an important research subject, be it by analyzing intellectual connections among philosophers [7] or

evaluating the significance of historical entities [8] based on infobox properties and page links. Another example is the application of social network analysis to famous persons on Wikipedia [9] by ranking them using the in-degree, out-degree, and PageRank of their articles, to show differences and similarities between different Wikipedia language versions. Using three different ranking algorithms, Eom et al. [10] determine the top historical figures of 24 Wikipedia language versions and their evolution over time. Gloor et al. [11] use a similar approach ranking historical persons according to their influence on other persons during their own lifetime. More recently, Laufer et al. [12] analyzed how European food cultures are represented in different Wikipedia editions. However, similar analyses for writers or literature have not been performed so far and the existing works do not comprehensively evaluate different approaches for identifying and ranking persons.

2.3 Quality Aspects of Wikipedia

While some early studies (e.g., [13]) already suggested that the quality of Wikipedia is comparable to that of commercial encyclopedias, there has also been severe criticism (e.g., [14]). Yet, in its 14 years of existence the Wikipedia project has been constantly evolving and has seen the introduction of several quality assurance measures. A good overview on papers, articles, and studies on different dimensions of the quality of Wikipedia is given by Nielsen [6]. The dimensions comprise, among others, accuracy, coverage, bias, conciseness, and up-to-dateness, and especially its up-to-dateness and multilingualism are regarded as major strengths of Wikipedia [15]. A research topic on its own is the diversity between Wikipedia language versions [16, 17, 18] with findings showing that Wikipedia has a cultural bias also when it comes to portraying famous persons [18]. Our results also suggest that the popularity of a writer within a Wikipedia language version depends on whether the writer is associated with the particular language. Wikipedia can therefore be seen as a “socially produced document” that represents the values and interests of the people who use it [19]. As we will see in Section 7.1 this can as well lead to situations in which single persons gain unusually high attention in some language versions due to the efforts of single editors.

Halavais and Lackaff [20] analyze the topical coverage of Wikipedia by examining a randomly-drawn set of 3,000 articles. They discover that Wikipedia is, like many other encyclopedias, not as strong in the humanities as it is in the natural sciences, though there actually exists a large number of articles representing literary criticism, especially regarding fiction. A quality study of Wikipedia examining the representation of the works of William Shakespeare in the English and German Wikipedia editions found that the articles in the English edition are of higher quality than their counterparts in the German edition [15].

Although these and other papers have analyzed different aspects of the quality of the representation of literature on Wikipedia as part of general quality analyses, there are, to the best of our knowledge, no works specifically targetting writers or literature. Furthermore, our approach does not focus on the quality aspect, but in fact considers Wikipedia data as a representation of world literature from the point of view of expert or non-expert editors and readers.

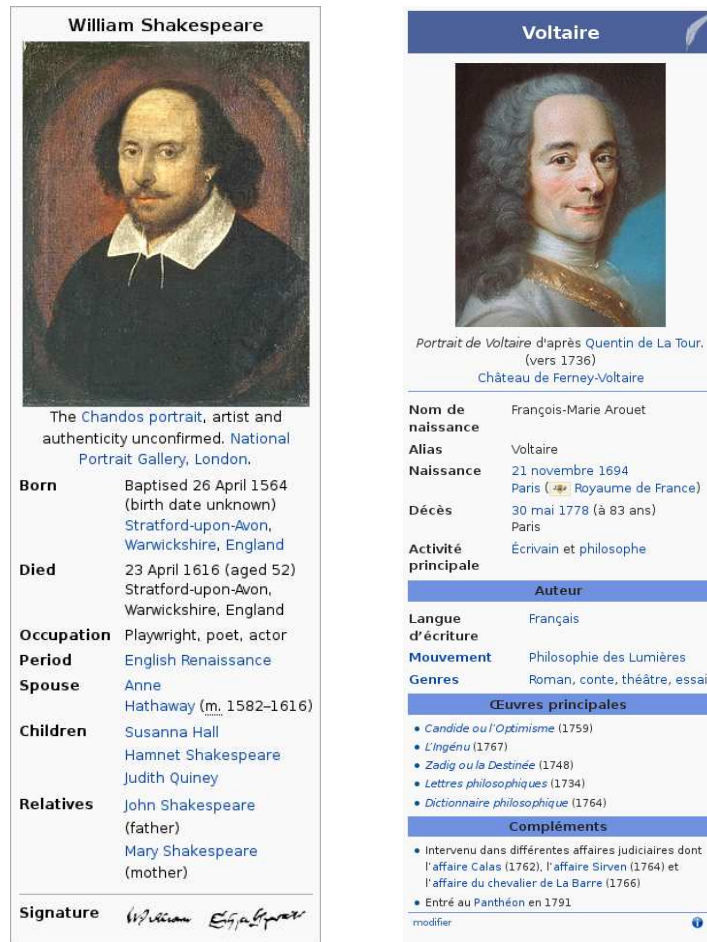


Figure 1: Infoboxes for *William Shakespeare* from the English Wikipedia and *Voltaire* from the French Wikipedia.

2.4 DBpedia

The crowdsourced community project DBpedia [21] provides a knowledge base of rich data extracted from Wikipedia. The entire DBpedia knowledge base describes facts for more than 38 million “things” from 125 Wikipedia language versions. Part of the project is the crowdsourced construction of an ontology by manually extracting infobox properties of different language versions (a Wikipedia infobox is a table in the top-right corner of an article presenting a subset of structured information in the form of attribute–value pairs; e.g., infoboxes on persons will usually contain data fields like “Born”, “Died”, or “Occupation”, see Fig. 1). Since its initial release in 2007, DBpedia has been used many times as a foundation for research with and about Wikipedia [22]. One of the major advantages of DBpedia is the possibility to query data from the infoboxes of articles, which is not possible from within Wikipedia. This enables us to extract specific writer sets, e.g., ‘all writers who were born after 1910’. However, due to different options for labeling articles about writers across different Wikipedia language versions, the identification of writers in the DBpedia datasets is not trivial. We test three

approaches to identify writers in Section 4. In an effort to simplify the handling of data across language versions and to enable rich queries similar to DBpedia, the Wikimedia foundation has started the Wikidata project [23] which provides a database for infobox (and other) data. However, at present, infoboxes are still curated within Wikipedia and therefore Wikidata can not yet substitute DBpedia.

3 DBpedia Datasets and Selection of Language Versions

The DBpedia 2014 download is based on the Wikipedia dump from late April/early May 2014 [24]. The files belonging to the datasets from a specific language version can be found in folders named with their respective language codes. All datasets are available in several RDF serializations (e.g., N-Triples and Turtle) and are compressed with bzip2. For example, the `page_links` dataset of the French Wikipedia can be found at the URL http://downloads.dbpedia.org/2014/fr/page_links_fr.nt.bz2. The following list shows all DBpedia datasets we use in this work:

article_categories: maps articles to their categories.

infobox_properties: properties extracted from the infoboxes of articles.

instance_types: maps articles to their types according to templates used within the article, for example a *Writer* infobox.

interlanguage_links: maps articles to their counterparts in other language versions.

mappingbased_properties: a cleaned version of the `infobox_properties` dataset. For example, the properties *birthYear* and *yearOfBirth* are both mapped to the property *birthYear*.

page_length: the number of characters for each article.

page_links: links between articles in the same language version.

skos_categories: the Wikipedia category graph containing the links between categories.

Since DBpedia follows a crowdsourcing approach based on extraction rules written by community members, not all datasets are available for all language versions. Some datasets, like `instance_types`, rely on the DBpedia ontology data. According to [25], the DBpedia ontology currently comprises mappings for infobox data for 27 language versions.

Due to this restriction and also for practical purposes, we have to restrict our analysis to a subset of the 125 languages available in DBpedia and look at two criteria: the size of the version, i.e., the *number of articles*, and the Wikipedia *article depth* [26]. The article depth is a measure of quality for a language version. A high depth indicates that articles are frequently updated, meaning that the average number of edits per article is relatively high.

In addition to articles created by humans, many Wikipedia versions also contain articles that were automatically generated by *bots*, e.g., by copying and translating (parts

Table 1: **Properties of the 15 Wikipedia language versions selected.**

language	code	#articles	depth	#edits	#writers	#writers in our set
English	en	4,738,257	895	759,894,686	25,995	10,765
German	de	1,822,322	88	145,142,072	0	5,202
French	fr	1,598,081	197	114,926,655	7,974	4,981
Russian	ru	1,197,015	117	81,444,167	11,515	3,286
Italian	it	1,177,497	107	76,520,585	0	3,514
Spanish	es	1,161,825	177	85,947,882	6,668	3,430
Portuguese	pt	867,553	124	42,572,971	1,104	2,226
Chinese	zh	814,358	134	35,959,378	–	1,468
Persian	fa	446,641	209	19,684,602	–	1,395
Arabic	ar	352,720	203	17,792,878	1,288	1,017
Korean	ko	306,641	86	15,571,911	968	1,052
Hungarian	hu	286,466	92	16,382,712	3,033	1,149
Serbo-Croatian	sh	278,382	355	9,143,222	–	849
Romanian	ro	271,118	93	9,489,089	–	1,617
Turkish	tr	242,778	206	16,123,456	1,314	1,217

of) existing articles from other languages. For instance, the Waray language spoken in the Philippines has less than 3 million native speakers, but the Waray Wikipedia [27] is among the top ten editions when just counting the number of articles. The majority of these articles were generated by a bot, the average number of edits per article is less than 3 (for comparison, the Finnish edition ranks 20th and has around 42 edits per article on average). The use of bots has been criticized by the community [28, 29] and also for our purpose of analyzing the perception of world literature, a too-large presence of bot-generated articles would be counterproductive. By taking the article depth into account we make sure that language versions with a high percentage of bot-generated articles are not too dominant.

We decided to consider the 15 language editions that were both among the top 30 by number of articles and by article depth as at March 7, 2015 (cf. Table 1). Although the ranking of language editions could have changed since the creation of the DBpedia dump, this would only affect our choice of languages but not the general results of our analysis. The `#writers` column depicts the number of articles of the type *Writer* according to the `instance_types` dataset. Language versions for which no such dataset exists are indicated by ‘–’. Even though there exist `instance_types` datasets for the German and Italian Wikipedia, these editions lack an equivalent to the English *Writer* type. Therefore, the number of writers for these two language versions equals zero. The last column (`#writers in our set`) is explained in Section 4.4.

4 Identifying Writers on Wikipedia

The automatic extraction of writers in DBpedia is a non-trivial task as there is neither a comprehensive nor coherent classification of writers across language versions. We experimented with several ideas to address this challenge, each of which leads to a different set of writers. As we will see, the decision for an approach depends on the question of who is considered a writer. We tested the following three approaches for writer identification:

template *Writer*: articles featuring the *Writer* template

category *Writers*: articles belonging to the *Writers* category in the category graph

property *Occupation*: articles featuring a writer-related *Occupation* infobox property

We first describe the three approaches and their application to the English Wikipedia and then discuss whether and how they can be applied to other language versions. We also evaluate and discuss which approach meets our requirements better than the others.

4.1 *Writer* Template

DBpedia provides `instance_types` datasets for several language editions which map instances to types. Each instance represents an article in the corresponding edition. An instance is classified as *Writer*, if the corresponding article contains a specific kind of template which in most cases is an infobox of the type *Writer*. As an example, Fig. 1 shows the infobox for *William Shakespeare* from the English Wikipedia and the infobox for *Voltaire* from the Wikipédia en français. Both infoboxes contain basic information like name, day of birth, day of death, and occupation. The French infobox further contains writer-specific information like writing languages, repertoire of genres, and important works. In addition, the French *Writer* infobox is marked with a pinfeather in the upper right corner to indicate that a person is a writer. All properties in the infoboxes are optional and many of them are general person properties, like *birthDate* and *deathDate*. Exploiting the `instance_types_en` dataset we are able to extract all articles in the English Wikipedia containing a *Writer* template.

After building this *basic set* of persons with *Writer* templates in the English Wikipedia, we use this set to identify writers in other language versions. By checking which of the persons in the English set are also featured in other language versions, we obtain subsets for all language versions. The articles in other language versions do not have to contain a *Writer* template. Thereby we bypass the problem that `instance_types` datasets are only available for a small number of language versions. The drawback of this approach is, however, that we omit writers that are neither mentioned nor classified as such in the English Wikipedia.

We also considered each language version separately. This would allow us to find writers without a *Writer* template or even without an article in the English Wikipedia, as long as their article in the particular language version contains some kind of *Writer* template. Unfortunately, DBpedia does not provide `instance_types` datasets for many

language versions and some language versions do not provide *Writer* templates. For example, in the German Wikipedia, writers are described through a simple (hidden) *Person* infobox and thus can not be classified as writers in the `instance_types_de` dataset. As a consequence, these writers are not recognized and the number of writers found for some language versions equals zero (see Table 1). The DBpedia community already dealt with this problem by providing specific datasets containing data extracted from the running text of the article to classify persons. Although we appreciate this effort, we decided not to use this data for our research to avoid a bias by mixing different extraction methods.

4.2 Traversal of the Category Graph

Wikipedia provides a facility to assign articles to *categories*. Accordingly, the article on *William Shakespeare* belongs to 19 categories including the categories *16th-century English Writers* and *17th-century English Writers*. Categories can be assigned to other categories, forming the Wikipedia *category graph*. In this graph topically similar categories are grouped together. Both *16th-century English Writers* and *17th-century English Writers* are a subcategory of *English Writers by Century*. Using the `article_categories` dataset from DBpedia we are able to extract all articles belonging to a particular category while the `skos_categories` dataset contains the category graph itself. The challenge we face is to find a way through the graph that will essentially give us articles on writers without delivering too many non-writer articles. Such an approach highly depends on the choice of the root category as starting point for the traversal and appropriate termination and filtering conditions.

Unfortunately, the assignment of articles to categories is inconsistent. To obtain the majority of writers we need to cover a large number of categories within a breadth-first search approach resulting in a larger number of articles that are not primarily about writers. Starting the traversal at the *Writers by Century* category in the English version, our set contained persons like *Winston Churchill* and *Leonardo da Vinci*, while omitting writers like *Gertrude Stein* and *Heinrich Heine* (Table 2). The selection of the *Writers* category as root category even increased the amount of non-writers, so we started to add filters to omit categories that were not directly related to writers, e.g., by involving only categories that contain the word ‘writer’ (writer filter). We also realized that we needed to add some kind of termination condition, since many famous writers were represented not by an article alone but by a category containing their works, etc. In addition, the category graph can contain cycles, so we had to make sure that each category was consulted only once. To ensure that the resulting set only contains persons, we compared all instances to DBpedia’s persondata set.

Even by trying several different root categories and filters we were not able to extract an appropriate set of writers from the category information. The difficulties that occur while using the Wikipedia category graph have been described before, e.g., in [5].

The benefit of this approach is that it can be applied to non-English language versions. However, the category graphs tend to be different in different editions, adjusting them would take individual effort. One would need to identify the appropriate root category of

each language version and verify the consistency of its subcategories. Even if the name of a category corresponds to a category in the English graph, it does not mean that the category is used in the same manner. If we would go with this assumption anyhow, it could deliver strongly inconsistent sets from the different language versions.

4.3 *Occupation* Infobox Property

As we have seen in Section 4.1, the type of an infobox can be used to classify an article. Another approach to identify writers on Wikipedia is to use the property values that are contained in the infobox of an article. For instance, the infobox of *William Shakespeare* in the English Wikipedia, depicted in Fig. 1, contains an *Occupation* property. In the case of *Shakespeare*, the value of this property is “Playwright, poet, actor”. The infobox of *Voltaire* in the French Wikipedia contains a similar property called *Activité principale* (main activity).

In the English Wikipedia the *Occupation* property is used quite frequently: The `infobox_properties` dataset contains 240,994 instances using the property, 32,722 of them include the term “writer” in the value of this property. For the extraction of writers it is useful to add further terms to the query, like “poet” and “novelist”. We also excluded particular terms like “songwriter” and “screenwriter” (as stressed before, these are contingent decisions, but we had to draw a line somewhere to operationalize our research).

This approach can be used for every Wikipedia language version that uses a similar infobox property, but the search terms have to be defined for every version separately. This might be a problem since we do not know whether the translations of terms are used in the same way in the respective language version as the English terms are used in the English Wikipedia. Of course, the idea of building a basic set of writers in the English Wikipedia and taking it from there can also be used for this approach.

4.4 Comparison of the Approaches

Our opting for one of the introduced approaches is influenced by several questions:

1. What is a writer? Should the set contain persons who are not primarily considered writers? Do we need to distinguish between different types of writers (e.g., fiction, non-fiction)?
2. Do we want to focus on precision or recall, i.e., should the set contain as few non-writers as possible or as many writers as possible?
3. Which language versions should be considered?
4. Which approach could be suitable to extract literary works?

To obtain an impression of the different approaches, Table 2 shows a comparison. For the category-based approach we show the results using two different root categories, namely *Writers by Century* and *Writers*. For each approach the table lists the top

Table 2: Comparison of writer identification approaches.

approach	a) only by this approach		b) missing by this approach	
	person	#in-links	person	#in-links
template	Robert Christgau	5,844	Arnold Schwarzenegger	2,255
<i>Writer</i>	James Berardinelli	409	Tupac Shakur	1,591
	Carlo Goldoni	380	Geoffrey Chaucer	1,250
	Constantin Stanislavski	338	Franz Kafka	1,229
#p: 25,995	John Osborne	291	William Shatner	1,184
#N: 102	(5,504 articles)		(633 articles)	
category	Bob Dylan	5,996	P. G. Wodehouse	941
<i>Writers</i>	George Washington	5,305	Robert Graves	662
	Paul McCartney	4,619	Bram Stoker	647
	Elton John	4,553	Oliver Goldsmith	424
#p: 95,541	John Lennon	4,487	Algernon Charles Swinburne	409
#N: 94	(62,310 articles)		(300 articles)	
category	Winston Churchill	5,208	Rabindranath Tagore	1,324
<i>Writers by</i>	Gautama Buddha	3,114	Alfred, Lord Tennyson	1,145
<i>Century</i>	Leonardo da Vinci	1,975	Walter Raleigh	752
	Strabo	1,620	Gertrude Stein	608
#p: 28,245	Maimonides	1,129	Heinrich Heine	582
#N: 57	(10,898 articles)		(5,272 articles)	
property	Tom Cruise	1,416	Roger Ebert	3,924
<i>Occupation</i>	John Travolta	1,128	Edgar Allan Poe	2,206
	Tim Burton	1,032	Stephen King	2,199
	Bruce Willis	960	George Bernard Shaw	1,812
#p: 18,534	Buster Keaton	795	Ernest Hemingway	1,764
#N: 76	(3,589 articles)		(2,061 articles)	

For each approach we list the top five writers (according to the number of incoming links to their articles) that are a) only identified by this approach, or b) missing by this approach but identified by all other approaches. The first column shows for each approach the number of persons (#p) and the number of Nobel laureates in literature (#N) it identifies.

five writers *only* identified by the corresponding approach and those *not* identified by the same approach (including the total number of articles in each of the two sets). In addition, the first column lists the overall number of Wikipedia articles that were identified as writers by each approach and the number of Nobel laureates in literature contained in the respective set (we know that using the list of Nobel laureates as some kind of fallback canon is an audacious venture and that this list is far from being a gold

standard, also because it was only started in the 20th century, but it proved insightful when evaluating our approaches). (For a more detailed description and analysis of the Nobel-laureate data cf. Section 6.3.)

While the top five authors show which kind of persons are considered writers by each approach (or not), the numerical values in the first column allow us to quantitatively assess the performance. Comparing the number of identified persons (#p) against the number of Nobel laureates in literature (#N), we can see that the template *Writer* approach yields the largest number of Nobel laureates (102 of 111) within a modest number of persons (25,995). Plus, only few articles (633) could not be found by the template *Writer* approach but by the other approaches. Although the category *Writers* approach misses even less articles (300), it does so at the cost of a much higher number of detected persons (95,541) and a still smaller number of correctly identified Nobel laureates. The other two approaches are much worse in correctly identifying Nobel laureates and also have a larger number of persons that they do not identify as writers. Altogether, the template *Writer* approach is clearly the most selective approach. One reason for the good performance of this method could be the fact that no *Writer* article in our dataset contains more than one template and is therefore not assigned to more than one type. In fact, it is very unusual for a Wikipedia article to contain more than one template. Thus, only articles about persons who are primarily considered writers by Wikipedia editors are equipped with the *Writer* template. Contrariwise, an article can have several categories and the *Occupation* property can contain several occupations.

From a qualitative point of view, the top five persons in Table 2 provide a mixed impression. Apparently, singer-songwriters are frequently categorized as *Writers* (which is not untrue, of course, but lacks the distinctiveness we need for our operationalization). In the property *Occupation* approach we could exclude them by blacklisting the term “songwriter”. On the other hand, this approach identifies a bunch of popular actors as writers who apparently have not been categorized as *Writers*. Reasons may vary, some might have written an autobiography or another kind of book or coauthored a screenplay. The template *Writer* approach is the only one identifying critics *Robert Christgau* and *James Berardinelli* as writers (which, again, is not untrue, but not helpful either). The top persons not identified by the corresponding approaches clearly show that there is room for improvement: every approach misses important writers, e.g., *Franz Kafka* has no template *Writer*, *P. G. Wodehouse* no category *Writers*, Nobel prize laureate *Rabindranath Tagore* lacks the *Writers by Century* category, and *Edgar Allan Poe* a property *Occupation*.

4.5 Discussion and Selection of an Approach

We decided to aim at a high precision and include only persons who are primarily considered writers, which correlates with the decision to prefer writers of fiction over non-fiction writers. If the set would grow too much in size, it would contain too many non-writers. On the other hand, we think that it is important that the set contains most famous writers, omitting only some special cases where the classification of the particular person is ambiguous. The template *Writer* approach best meets our requirements, given

that it identifies the largest number of Nobel laureates (102) in literature within a modest number of authors (25,995) and lacks only few articles (633) that were identified as writers by the other approaches.

Just in a few cases *Writer* templates are also used for articles on persons we would not usually classify as writers. We will filter such cases by using a measure of importance (cf. Section 5.1). On the other hand, we have to face the problem that not every article on a famous writer necessarily contains a *Writer* infobox. For example, Italian writer and philosopher *Umberto Eco* is not categorized as a writer referring to the `instance_types_en` dataset, since his article does not contain a *Writer* infobox but an infobox of the type *Philosopher*, just like in the cases of *Homer* or *Albert Camus*. Others are also lacking a *Writer* infobox, like *Franz Kafka*, *Geoffrey Chaucer* and *Marcel Proust*, to name the most prominent articles on writers (by number of their in-links) that feature a *Person* infobox rather than one of the *Writer* type (cf. also Table 2). This is an issue of the used datasets that leaves room for further work, but with the exception of these admittedly major omissions we just listed plus probably a handful more, we still catch a majority of what represents world literature inside Wikipedia as our results will show. On the plus side, this approach ignores the many persons who are only parenthetically active as writers, like, perhaps, a sportsman who published his autobiography.

With respect to the analysis of language editions other than English, we have to note that the template *Writer* approach omits writers in other language versions that are neither contained nor classified as writers in the English Wikipedia. We assume that the English Wikipedia covers most famous writers and contributors to world literature, whatever their writing languages may be (given that English works as *lingua franca* and taking into account that the English version is by far the largest corpus within the Wikipedia family). At a later stage, this approach can also be adopted if it comes to analyzing literary works using the *WrittenWork* type of the DBpedia ontology instead of the *Writer* type.

5 Data Selection and Analysis

In this section we first describe the creation of our basic set, which consists only of writers represented by an article in the English Wikipedia. We analyze the basic set in Section 5.2 and then extend our analysis to 14 other Wikipedia language versions.

5.1 Creation of the Basic Set

As described in Section 3, we used the DBpedia 2014 download for our analysis. To build our *basic set*, based only on data from the English Wikipedia, we extracted all instances from the `instance_types_en` dataset that are of the type *Writer*. We extracted 25,995 instances, each of which represents an article in the English Wikipedia. For each instance we gathered information from different datasets on DBpedia, e.g., we counted the number of incoming links (in-links) from within the English Wikipedia pointing to every other article by analyzing the `page_links_en` dataset. The number of in-links can

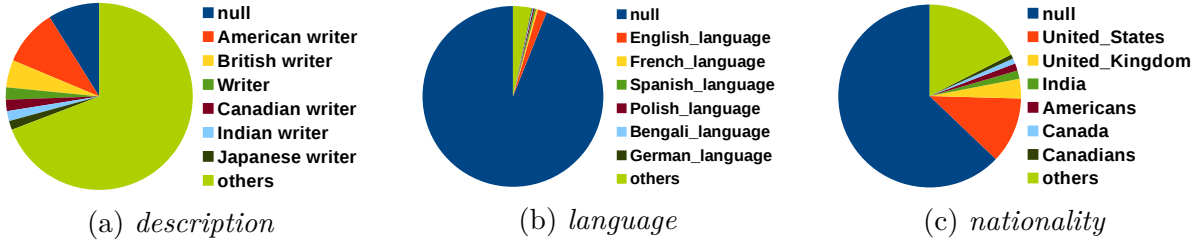


Figure 2: Distribution of property values within infoboxes of articles of type *Writer* from the English Wikipedia.

be used as an indicator for the importance of an article. We also added some infobox properties from the `mappingbased_properties_en` dataset, such as *birthDate*, *deathDate*, and *nationality*.

Fig. 2 depicts the number of distinct terms used for some properties, where the value *null* indicates cases where the property is not used in the infobox of an article at all. The plots show that the *description* property is frequently used in *Writer* infoboxes and contains many diverse values, while *language* and *nationality* are used only marginally. Given these distributions, it is difficult to identify the languages of writers from the data provided by the infoboxes. (Although a *description* is frequently provided, it typically only contains the nationality of the writers which, of course, does not necessarily indicate their writing language(s).) Therefore, if we want to analyze writers in consideration of their writing languages, we have to find alternative methods (something we will undertake in Section 7). In general, most infoboxes apply only a few properties, with a few exceptions such as *birthDate* and *name*. The *birthDate* property is used by 21,607 of 25,995 instances. Other instances only involve the *birthYear* property or no birth-related property at all.

Some articles on lesser known persons use the *Writer* template out of context, probably in lack of a better fitting person template. Aiming at a higher precision, we decided to delete instances that neither contain a value for *birthDate* or *birthYear* nor for *deathDate* or *deathYear*, assuming that for every important writer at least one of these properties would have been added to the infobox of the corresponding article (an approximate date would be enough). Additionally, we removed instances with less than 10 incoming links, using this number as a measure of importance. We hope that by this approach we can also evade most bot-generated articles. Eventually, our basic set includes 10,765 writers. As we will see in Section 6.3, this filtering step did not remove any Nobel laureates in literature, therefore, the resulting set of writers has the highest precision and recall compared to the results in Table 2.

5.2 Analyzing the Basic Set

As mentioned in Section 4.4, the English Wikipedia takes on a special role within the plenitude of Wikipedia language versions. Not just because English acts as a *lingua franca*, but also because the English Wikipedia is by far the largest of all language

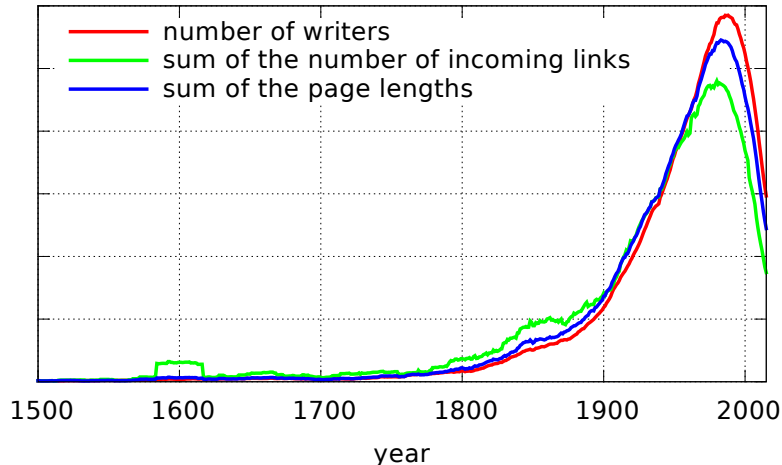


Figure 3: (Normalized) number of writers, sum of their articles’ page lengths, and sum of their articles’ number of incoming links from 1500 to 2015 in the English Wikipedia.

versions and we also expect it to explicate a greater cultural diversity than most other language versions.

To gain a first impression of the distribution of writers over time, we approximate their time-of-writing activity from the age of 20 until the age of 60 (unless they died earlier, of course). For instance, for a writer who was born in 1820 and died in 1890, we would assume an active phase from 1840 to 1880. We are aware that this is a rather non-realistic approximation, but it helps handle the fact that some writers in the set have no death date, and it will still show us epochal peaks. For each year we now count the number of writers that were ‘active’ that year, the sum of incoming links their articles received, and the sum of the page lengths of their articles. To make these three values comparable, we normalized them so that each area under the curve is equal to one. The resulting distribution for all writers active since 1500 is shown in Fig. 3 and is based on the data provided by our basic set for the English Wikipedia. (Only very few writers are contained from before 1500.) We omitted labels for the y -axis, since we want to focus on the order of magnitude of the curves.

As we can see, the numbers show a significant rise after 1800 and increase until around 1990. The reason for this can simply be attributed to the fact that Wikipedia’s coverage of recent events is much broader, as has been indicated by [30] and [31], among others. (Writers who were born after 1970, though, are less well represented as yet.) But we are also reminded of the division of world literature into an ‘old’ and a ‘new’ type, as suggested by [2], arguing that there is a ‘timeless’ and ‘deeply historical’ world literature and an ‘ephemeral’, ‘newly emerging’ one.

The three distributions in Fig. 3 are very similar. The noticeable rise in the sum of incoming links between 1584 and 1616 can be attributed to the immense influence of William Shakespeare who to no surprise is “widely regarded as the greatest writer in

the English language and the world’s pre-eminent dramatist”, according to the English Wikipedia itself [32]. Shakespeare also benefits from the fact that his epoch is represented by only a few writers, which is why his influence can be easily noted in the graph. Famous modern writers are hard to perceive in the diagram due to the large number of competing writers in the set.

5.3 Other Language Versions

As we have seen in Section 4.4, explicit information about writers is not available in some language versions. Furthermore, for only a small fraction of writers in our basic set their language is explicitly specified in Wikipedia. It is thus difficult to analyze important writers by their writing language. Hence, in this section we present an approach to identify writers in other language versions of Wikipedia and analyze their distribution over time.

We extracted writers from each language version by using the `interlanguage_links_en` dataset, which maps each article from the English Wikipedia to the corresponding articles in other language versions if such a corresponding article exists. Obviously, not every writer from our basic set can be found in each language version. The column “#writers in basic set” in Table 1 shows how many of the 10,765 writers of our basic set can be found in each Wikipedia language version. It is important to understand that only the writers of our basic set have been taken into account, so writers who are not represented in the English Wikipedia but in other language versions were not considered. The writers also do not necessarily need to be classified as *Writers* in the other versions as long as they are represented by an article. This approach, as described in Section 4.1, helped us to bypass the problem that `instance_types` datasets are only available for a small number of language versions. At the same time, the values obtained in this way have to be interpreted cautiously so as not to simply reinscribe the English model of world literary history as *the* model of world literature.

Like we showed before, a glance at the number of incoming links over time in Fig. 3 as a measure of relevance allowed us to identify the importance of *Shakespeare* for the English Wikipedia. Accordingly, we now analyze this distribution over all 15 language versions. We assume that writers who have been linked to frequently within a Wikipedia language version play an important role in this version. Fig. 4 depicts the sum of in-links of active writers by time in a normalized manner to neutralize the exponential rise of the number of writers in the modern age (meaning that the sum of the values for all language versions add up to one for each year).

It comes as no surprise that the English Wikipedia dominates the scene, especially regarding the 20th century, since all other language version sets of our approach are subsets of the English set. However, we can recognize several periods of time where the curves for other language versions stand out. It does not seem too far-fetched that these time periods correlate with major literature epochs in the particular languages. For instance, the number of incoming links of active writers in the German Wikipedia stands out, roughly, between the last third of the 18th century and the first third of the 19th century. These decades see the rise of the *Sturm und Drang* movement and

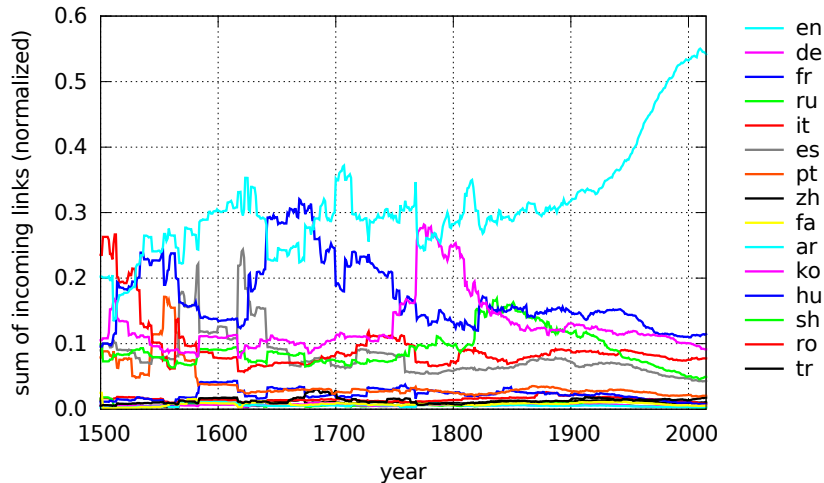


Figure 4: Distribution of incoming links for writer articles in different language versions.

the emergence of German Romanticism and Classicism, associated with authors such as *Johann Wolfgang von Goethe* or *Friedrich Schiller*. The influence of Portugal’s most famous poet and national hero *Luís de Camões* leads to a peak for the Portuguese Wikipedia at around 1550. The highest peak in the French Wikipedia pertains to the last two-thirds of the 17th century, the era of French Classicism under the reign of Louis XIV when playwrights like *Pierre Corneille*, *Jean Racine*, and *Molière* ruled the scene. Russian literature culminates in the middle of the 19th century which coincides with the life spans of *Alexander Pushkin*, *Nikolai Gogol*, and *Fyodor Dostoyevsky*. The Spanish curve peaks around 1600, the life spans of *Cervantes* and *Lope de Vega*. The harsh recess in the years before and after 1600 is a result of our normalization and the strong influence of *Shakespeare* around that time. The curve starts to rise again right after his death in 1616 and falls sharply only after the death of *Lope de Vega* in 1635.

As already mentioned in Section 5.2, it is much easier to identify writers and their influences before 1900 because of the strongly increasing number of writers in the modern and postmodern age.

The conclusions that can be drawn from Fig. 4 are even more remarkable if we recap that for each language version we only consider persons who are flagged as *Writer* in the *English* Wikipedia. E.g., although the coverage of English authors presumably reaches its optimum in the English Wikipedia, our approach does not automatically ensure a high coverage of German authors in the German Wikipedia. Nevertheless, just the distribution of incoming links over time allows us to identify the corresponding curve as that of the German Wikipedia. Since this claim also holds for other major language editions, this means that the language editions have a strong focus on their “own” writers (as already indicated by [18]) and thereby allow us to identify important literary epochs for each language, despite of considering only authors that are also contained in the English language edition. But for the time being, the unevenness of the per-language datasets should hold us back from reading too much into our experimental setup regarding other language versions.

6 Most Prominent Writers in Wikipedia

After all this preliminary work, let us come back to our initial purpose, the question as to how world literature is represented on Wikipedia. On the one hand, this means we want to get a fresh look at world literature without necessarily comparing the results to well-established canons. On the other hand, we propose several methods for ranking writers on Wikipedia, and it is difficult to judge which method can best be used to identify important writers without a comparison to some ground truth. To get out of this dilemma, we perform three different types of analyses:

1. We compare the different rankings by computing correlations for pairs of rankings. This allows us to identify similar rankings.
2. We evaluate how well the measures rank the Nobel laureates in literature to the top positions. This gives us an estimate on how a very specific canon of writers is represented on Wikipedia.
3. We analyze the graph of top writers in the English Wikipedia formed by the links between their articles. This provides insights into the link structure and potential groups of well-connected writers.

In addition, Section 7 is dedicated to writers and their writing languages and is looking at the performance of authors in Wikipedia versions whose language is different from the writing language of the author. But let us start this section by motivating and explaining the proposed ranking approaches before conducting the above-mentioned analyses.

6.1 Ranking Measures

Five different ranking measures are considered, among them basic measures that count properties of the writers' article pages (e.g., their page length) and more complex ones based on the PageRank algorithm [33]:

page length (PL): We rank writers by the *page length* of their articles, as provided by the `page.length` datasets.

number of in-links (IL): As we have seen, the *number of in-links* and their temporal distribution allow us to distinguish between different language versions. This value is also more robust against manipulation than the page length, since it requires changes to many pages, and it is clearly an indicator of relevance if a Wikipedia page is linked to from many other pages.

PageRank writers (PW): We additionally consider the importance of writers for other writers by computing the *PageRank* [33] of each article on the link graph of all the *writers* contained in our sets. PageRank is widely accepted as a solid measure for the relevance of nodes within a graph. A writer has a high PageRank if many writer articles with a high PageRank link to it.

PageRank complete (PC): We also compute the *PageRank* for the *complete* English Wikipedia and then extract the ranking for writers from our basic set. This ranking can be regarded as an indicator for the importance of writers among all Wikipedia articles.

number of page views (V12, V13, V14): The previous measures reflect properties of Wikipedia itself, i.e., as it was created by its editors. We supplement these with a measure that captures the importance of articles according to the visitors of Wikipedia. For that, we use the Wikipedia page view dataset [34]. We extract information on how often a writer’s article page was accessed in 2012, 2013, and 2014 (corresponding to measure V12, V13, and V14, respectively). We also include accesses to redirect pages in those counts, e.g., the page <https://en.wikipedia.org/wiki/Goethe> redirects to https://en.wikipedia.org/wiki/Johann_Wolfgang_von_Goethe – accesses to both pages increment the count for *Johann Wolfgang von Goethe*.

The English Wikipedia’s top five writers for each approach are shown in Table 3. We also show the results for the other 14 language editions for the approaches *number of in-links* (IL) and *PageRank writers* (PW). The top 25 writers for all seven measures can be found on <http://data.weltliteratur.net/>.

This tool can be put to use in several ways. First of all, it makes it easy to see how the hypercanon of world literature is represented across languages, but also how there are slight differences between the presence and rank. But just as important, one should be observant of more than just the hypercanonical strata in world literature and bring more attention to the shadow canon and the countercanon, as David Damrosch suggested in “World Literature in a Postcanonical, Hypercanonical Age” [35]. While Damrosch acknowledges that the strength of hypercanonical writers seems to grow in terms of critical work, e.g., the dominance of a few writers in British romanticism or the attention brought to Salman Rushdie’s work in postcolonial studies, he calls for an awareness of writers that may represent different literary qualities and norms that distinguish them from the hypercanonical authors, which could be called the countercanon. The dynamics of the literary field also produces a shadow canon of works whose canonical status used to be undisputed but which are now showing to be more in peril of being forgotten. The data gathered at <http://data.weltliteratur.net/> makes it easy to observe these dynamics that are grounded in the multifaceted use of Wikipedia and demonstrates, for example, the countercanonical fascination of science fiction or the endurance of writers such as Ernest Hemingway and Charles Bukowski in other languages.

6.2 Ranking Correlation

Let us first answer the question of how similar the ranking measures are to each other. From a mathematical point of view, some measures are closely related, i.e., the two *PageRank* variants and the *number of in-links*, since all three of them are based on the link structure between articles. Therefore, we expect a high correlation among the corresponding rankings. It is also interesting to check whether some of the intrinsic measures are correlated to the extrinsic *page views* measures.

Table 3: Top five writers according to different ranking approaches.

Wikipedia	1st	2nd	3rd	4th	5th	count ₂₅
PL English	Mircea Eliade	Mihail Sadoveanu	Ion Luca Caragiale	Benjamin Fondane	Alexandru Macedonski	14 (56%)
IL English	W. Shakespeare	Robert Christgau	Roger Ebert	Charles Dickens	J. R. R. Tolkien	18 (72%)
German	J. W. von Goethe	W. Shakespeare	Friedrich Schiller	Bertolt Brecht	Thomas Mann	11 (44%)
French	W. Shakespeare	Victor Hugo	Molière	Voltaire	Anton Chekhov	15 (60%)
Russian	Alexander Pushkin	W. Shakespeare	Anton Chekhov	Maxim Gorky	Leo Tolstoy	13 (52%)
Italian	Dante Alighieri	W. Shakespeare	Cicero	J. R. R. Tolkien	Virgil	14 (56%)
Spanish	W. Shakespeare	J. R. R. Tolkien	Miguel de Cervantes	Lope de Vega	Cicero	9 (36%)
Portuguese	W. Shakespeare	Robert Christgau	J. R. R. Tolkien	Vinicius de Moraes	Cicero	9 (36%)
Chinese	Lu Xun	J. R. R. Tolkien	W. Shakespeare	Jin Yong	Li Bai	12 (48%)
Persian	Ferdowsi	Ahmad Shamloo	W. Shakespeare	Ali-Akbar Dehkhoda	Mohammad-Taqi Bahar	10 (40%)
Arabic	W. Shakespeare	Naguib Mahfouz	J. W. von Goethe	Al-Maqrizi	Ahmed Shawqi	9 (36%)
Korean	W. Shakespeare	Yi Kwang-su	J. W. von Goethe	J. R. R. Tolkien	Dante Alighieri	4 (16%)
Hungarian	W. Shakespeare	Sándor Petőfi	János Arany	Attila József	Robert Christgau	7 (28%)
Serbo-Croatian	W. Shakespeare	Vjekoslav Klaić	Cicero	Roger Ebert	Plutarch	3 (12%)
Romanian	Ion Luca Caragiale	Mihai Eminescu	W. Shakespeare	Jules Verne	Mircea Eliade	10 (40%)
Turkish	W. Shakespeare	Bertolt Brecht	J. R. R. Tolkien	Anton Chekhov	Molière	7 (28%)
PW English	W. Shakespeare	T. S. Eliot	Charles Dickens	J. W. von Goethe	Ernest Hemingway	18 (72%)
German	W. Shakespeare	J. W. von Goethe	Voltaire	Thomas Mann	Friedrich Schiller	7 (28%)
French	W. Shakespeare	Victor Hugo	André Gide	J. W. von Goethe	Charles Baudelaire	14 (56%)
Russian	Heinrich Heine	Alexander Pushkin	Alexander Pope	W. Shakespeare	Gavrila Derzhavin	9 (36%)
Italian	W. Shakespeare	Dante Alighieri	J. W. von Goethe	Virgil	Petrarch	8 (32%)
Spanish	W. Shakespeare	Lord Byron	Dante Alighieri	Jorge Luis Borges	Edgar Allan Poe	2 (8%)
Portuguese	W. Shakespeare	Stephen King	T. S. Eliot	F. Scott Fitzgerald	Zelda Fitzgerald	0 (0%)
Chinese	W. Shakespeare	Victor Hugo	Dante Alighieri	George Orwell	Lu Xun	1 (4%)
Persian	Sanai	W. Shakespeare	Alexander Pushkin	Nikolai Gogol	Ferdowsi	5 (20%)
Arabic	W. Shakespeare	Christopher Marlowe	Leo Tolstoy	Friedrich Schiller	Fyodor Dostoyevsky	1 (4%)
Korean	W. Shakespeare	Dante Alighieri	J. W. von Goethe	Friedrich Schiller	Virgil	0 (0%)
Hungarian	W. Shakespeare	Giovanni Boccaccio	Petrarch	J. W. von Goethe	André Breton	3 (12%)
Serbo-Croatian	W. Shakespeare	Fyodor Dostoyevsky	Charles Dickens	Virgil	Dante Alighieri	0 (0%)
Romanian	W. Shakespeare	J. W. von Goethe	Miguel de Cervantes	Charles Baudelaire	Molière	3 (12%)
Turkish	W. Shakespeare	Peyami Safa	J. R. R. Tolkien	C. S. Lewis	Charles Baudelaire	2 (8%)
PC English	W. Shakespeare	Cicero	Charles Dickens	J. W. von Goethe	J. R. R. Tolkien	17 (68%)
V12 English	W. Shakespeare	Ernest Hemingway	Charles Dickens	Edgar Allan Poe	Dr. Seuss	23 (92%)
V13 English	W. Shakespeare	Ernest Hemingway	Edgar Allan Poe	Douglas Adams	J. R. R. Tolkien	23 (92%)
V14 English	W. Shakespeare	Maya Angelou	Ernest Hemingway	J. K. Rowling	George R. R. Martin	21 (84%)

Table 4: Rank correlation coefficients between different ranking measures.

	PL	IL	PW	PC	V12	V13	V14
PL		0.541	0.388	0.496	0.545	0.574	0.583
IL	0.391		0.606	0.886	0.765	0.768	0.773
PW	0.291	0.478		0.558	0.504	0.496	0.497
PC	0.349	0.731	0.429		0.744	0.735	0.743
V12	0.390	0.594	0.386	0.560		0.947	0.900
V13	0.409	0.595	0.378	0.550	0.849		0.953
V14	0.415	0.601	0.379	0.557	0.777	0.847	

The upper triangular matrix shows Spearman’s ρ , the lower triangular matrix Kendall’s τ .

For this analysis we compute the two rank correlation coefficients Spearman’s ρ and Kendall’s τ , which are standard measures for the comparison of rankings. For each pair of rankings we compute the two correlation coefficients for each language edition. For each such pair we then calculate the mean over all language editions. The resulting correlation coefficients for all pairs of ranking measures can be found in Table 4.

We can observe a high consistency between Kendall’s τ and Spearman’s ρ , with Kendall’s τ showing an overall lower correlation than Spearman’s ρ . In general, all pairs of rankings are positively correlated, most of them show a medium-to-high correlation. This indicates that the measures are similar to a certain extent. Most highly correlated to each other are the *page views* V12, V13, V14 – consistently for both correlation measures. This shows that the interest of the users of Wikipedia in certain writers remains fairly constant over time but is also subject to slight changes, since the page views of subsequent years have a higher correlation than the page views of V12 and V14. Aside from the page views, the *number of in-links* (IL) and the *PageRank complete* (PC) are most highly correlated which supports our expectation and indicates their close relationship. IL and PC are also most highly correlated to the page views, which means that those two intrinsic rankings best reflect the extrinsic rankings. The lowest correlations to all other rankings are exhibited by the *page lengths* (PL) and the *PageRank writers* (PW). This is not too surprising with regard to page lengths, since this measure can easily be influenced by the enthusiasm of individual Wikipedia editors. We will observe this exemplarily when analyzing the representation of native writers in Section 7.1. PW shows the lowest correlation of all rankings to the page views, which is quite surprising, given that the PageRank (although computed on the complete web graph) still is one of the main ingredients of most search engines’ rankings which also direct users to Wikipedia and therefore have a high influence on the number of page views. Overall, the results indicate that the *page length* and the *PageRank complete* differ most from each other and from the other three measures which in turn are more similar to each other.

6.3 Nobel Laureates

One simple way to verify the ranking methods was to check how high they ranked Nobel Prize winners in Literature, assuming that this group of people qualifies as some kind of fallback canon. We assembled the list of the 111 Nobel laureates so far, from 1901 to 2014, off of Wikipedia [36], and aligned it with the list of writers in our basic set. As already observed in Section 4.4, not all laureates could be identified by the approach since nine persons are missing in the basic set: *Theodor Mommsen* (1902), *Rudolf Eucken* (1908), *W. B. Yeats* (1923), *Henri Bergson* (1927), *Bertrand Russell* (1950), *Winston Churchill* (1953), *Albert Camus* (1957), *Jean-Paul Sartre* (1964), and *Patrick Modiano* (2014). This does not come unexpectedly, given that most of them are rather historiographers or philosophers than novelists, playwrights, or poets, so Wikipedians did not equip them with a *Writer* template. *W. B. Yeats*, by the way, is not contained in the basic set because the template in question was only added to his article on May 19, 2015, which was before the time our DBpedia dump was created. On the whole, 102 of the 111 laureates are contained in our basic set, which is quite good compared to other approaches (cf. Table 2).

To analyze which of the rankings has the Nobel laureates appear at the highest positions, we use standard methods from machine learning – the so-called *ROC curve* (ROC = receiver operating characteristic) and the *AUC* (area under the curve) [37]. For each writer in the ranking (starting at the top) we evaluate whether the writer is a Nobel laureate in literature (*true positive*) or not (*false positive*). We use this information to draw the ROC curve by starting at the coordinate position (0, 0) and then for each false positive we go one step to the right (along the *x*-axis which represents the *false positive rate*) and for each true positive one step to the top (along the *y*-axis which represents the *true positive rate*). The step size for the *x*-axis (*y*-axis) is the reciprocal of the number of false (true) positives. The resulting curves for each ranking measure can be seen in Fig. 5. If all 111 Nobel laureates would appear in positions 1 to 111 (in any order), the curve would go straight from (0, 0) to (0, 1) (and then to (1, 1)), resulting in an AUC of 1.0. A random ranking would result in a straight line from (0, 0) to (1, 1) with an AUC of 0.5. The distance on the *y*-axis missing to 1.0 arises from the fact that only 102 of 111 laureates appear in our basic set.

As we can see, the curve for the *PageRank complete* stays closer to the *y*-axis and therefore achieves the highest AUC of 0.865, followed by the *number of in-links* with an AUC of 0.863. This means that Nobel laureates have a high PageRank and a high number of incoming links in the English Wikipedia which clearly shows their importance. We can also observe that the *page length* has the lowest AUC which indicates that, although the articles on the laureates are well-linked in Wikipedia, they are often not as comprehensive as other writers' articles. The *page views* have an AUC of around 0.8 which is lower than the best AUC and higher than the worst. Articles on Nobel laureates are thus also viewed fairly frequently by readers of Wikipedia.

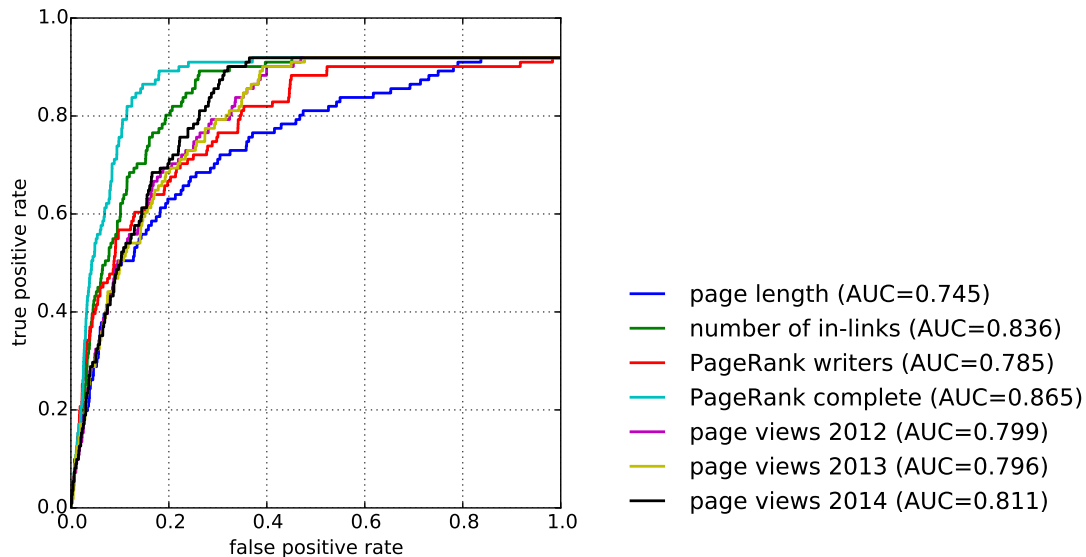


Figure 5: ROC curves for different approaches show how far to the top Nobel laureates are ranked.

6.4 Writer Graph

To visualize connections between writers, we created a graph of the top writers in the English Wikipedia. The graph is depicted in Fig. 6. It was generated with Gephi using a modularity-based clustering algorithm for coloring different densely-connected subsets of writers. A writer A is connected to a writer B , if the article on A contains a link to the article on B . The node and label size indicate the PageRank of the corresponding writer by approach PW as computed earlier in Section 6. For clarity, we filtered nodes such that only writers with 60 or more incoming links are shown.

Though the colored partition is not perfectly consistent, we notice some interesting aspects. For instance, Russian writers like *Dostoyevsky*, *Tolstoy*, or *Chekhov* are contained in the purple part on the left side of the graph. Similarly, three of the German writers, *Goethe*, *Thomas Mann*, and *Bertolt Brecht*, are also grouped together. On the right side of the graph we find authors of fantasy novels, horror and science fiction, like *J. R. R. Tolkien*, *H. P. Lovecraft*, *Stephen King*, *Ray Bradbury*, or *Isaac Asimov*. Their prominence on Wikipedia reveals a certain bias among editors, and we can say the same thing about the fact that only two women are contained in the graph, Jane Austen and Virginia Woolf. (To stress it once more, writers without a *Writer* template at the time of creation of the DBpedia dump do not appear in here, the likes of *Homer*, *Chaucer*, *Proust*, *Kafka*. To get them into the picture and create a more reliable basic set of contributors to world literature requires future work on the identification of writers.)

These few observations of interesting patterns already suggest that this kind of graph can be used to group writers based on the influences they exerted or received. Although the graph only contains a small fraction of what we would call world literature, it has a notable dimension and could be part of what [2] called a ‘timeless’ and ‘deeply historical’ world literature. Nevertheless, a more comprehensive analysis is required,

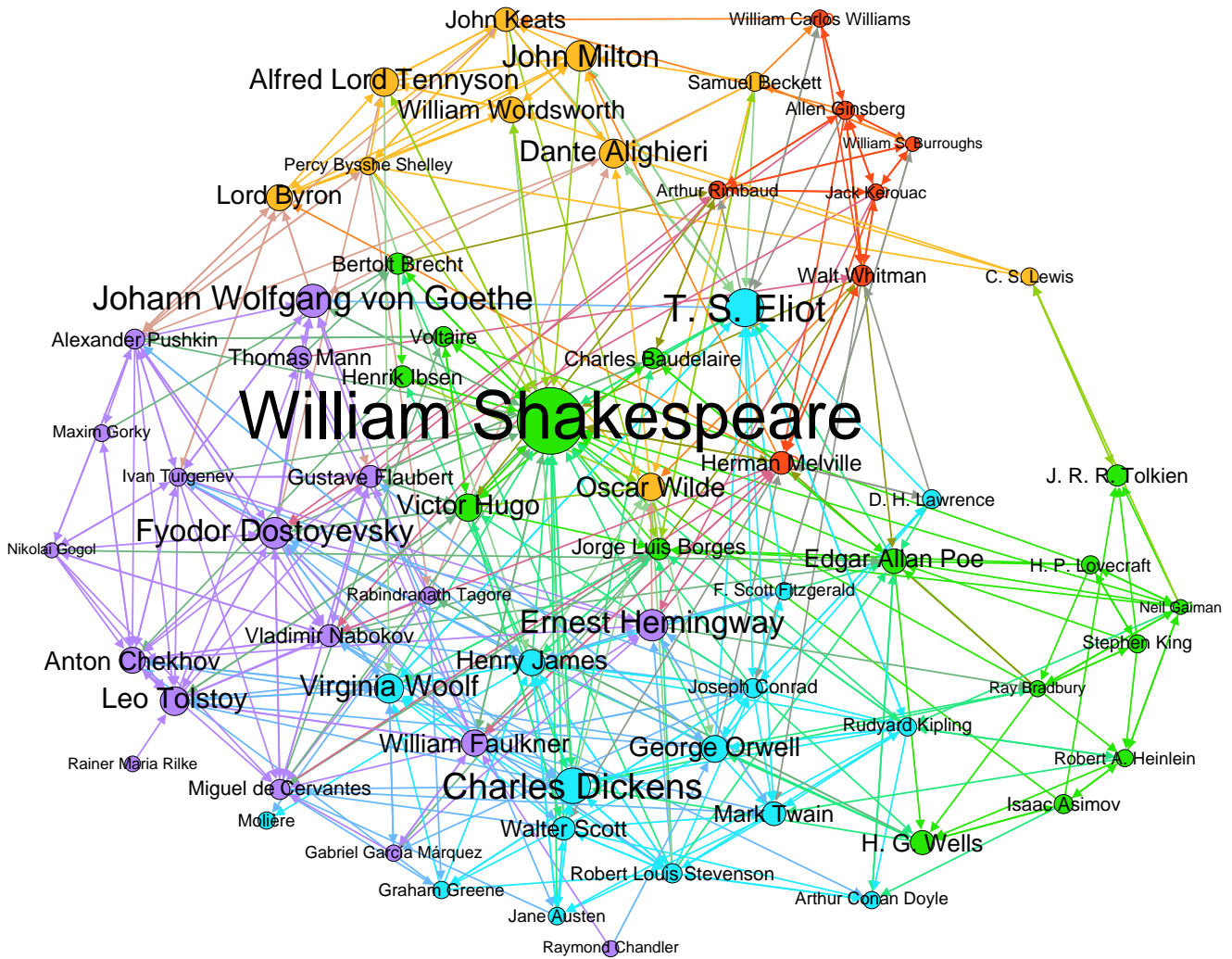


Figure 6: Clustered link graph containing all writers with at least 60 in-links from other writers in our set.

one that also includes other language versions and considers other relationships between writers, e.g., the similarity between their categories. Similar to [7], we already tried to include the *Writer* infobox properties *influenced* and *influencedBy*, but due to their infrequent and inconsistent use, the results were not meaningful. For example, Romanian poet *Alexandru Macedonski* appeared to be exceedingly influential, because in the used DBpedia dataset his infobox contains a huge list of *influenced* values, surely the work of an over-ambitious editor. Therefore, we decided not to use these two properties as they produce misleading results in their current state.

7 Transcending Language Boundaries

Our last venture in this paper is to focus on the native languages of writers (i.e., the languages they have predominantly used in their works) and to compare them to the languages of the Wikipedia editions in which they are ranked prominently. The assumptions underlying this analysis are: (a) famous native-language writers should appear among the top positions in the rankings for “their” language edition, (b) writers whose works are considered world literature should also appear among the top positions of foreign-language editions (transgressional aspect). Thereby, we again have the opportunity to compare the proposed ranking approaches in terms of their suitability to uncover the representation of world literature on Wikipedia.

In order to work with operable data, we manually identified the main languages of our writers’ works. More than one language was assigned to writers who wrote major works in different languages (Nabokov, for example, was assigned Russian and English). For what it’s worth, declaring *Virgil* and *Cicero* ‘Italian’ writers was probably the most daring intervention when operationalizing our data. In the rankings in Table 3 and on <http://data.weltliteratur.net/> we have highlighted writers whose writing language is equal to the corresponding Wikipedia language edition. The last column in Table 3 indicates how many (and which fraction) of the top 25 writers for each ranking can be considered native-language writers of the corresponding language. Since we have 7 rankings for each of the 15 language editions and regard the top 25 writers for each such ranking, we can have at most $7 \cdot 15 \cdot 25 = 2,625$ distinct writers. But only 530 distinct writers appear in all those rankings and only 29 of them have not mainly written in one of the 15 languages. (Notably, these 530 are more than the $15 \cdot 25 = 375$ writers contained in one ranking, thus the different approaches rank different writers to the top.)

The language of the writers will now be looked at from two directions: first, by analyzing which writers are among the top positions in the Wikipedia edition of “their” language, and second, by analyzing which writers transcend language boundaries and have top ranks in other language editions. We assess both aspects quantitatively and qualitatively.

7.1 Writers in Their Own Language

We start with a quantitative analysis by counting how many native-language writers are among the top 25 writers for each ranking measure and language edition. Table 5 shows for each ranking measure the mean number of native-language writers over all language editions.

The high fraction of native-language writers among the top 25 writers in the ranking by *page views* (around 57%) shows that native-language writers obviously are very important for readers of the corresponding language editions. Again, the *number of in-links* and the *PageRank writers* exhibit similar results with around 40% native-language writers. This is also the highest value among the intrinsic ranking measures, closely followed by the *page length*. This shows that native-language writers are well-represented on Wikipedia, i.e., they have comprehensive articles and they are mentioned in other articles.

Table 5: **Mean number of native-language writers.**

measure	native-language writers
page length	8.87±4.18 (35.5%)
number of in-links	10.07±3.87 (40.3%)
PageRank writers	4.87±5.24 (19.5%)
PageRank complete	9.80±4.83 (39.2%)
number of page views 2012	14.33±4.38 (57.3%)
number of page views 2013	14.20±4.46 (56.8%)
number of page views 2014	14.53±4.15 (58.1%)

For each approach we list the mean number of native-language writers (including standard deviation and percentage) among the top 25 writers.

Considering Table 3 again, a surprising result is that only Romanian writers are among the top five in the ranking by *page length* for the English Wikipedia. This shows in all clarity how much this ranking depends on diligent editors. It is certainly not usable to identify important writers. Surprisingly long articles can be found on other Wikipedia editions as well, e.g., *Agatha Christie* ranks 3rd in Portuguese and *George Orwell* 2nd in Arabic. All in all, 133 out of 375 writers (the top 25 for the 15 languages) match “their” language, although they often cannot be considered the most prominent writers for the corresponding language. (Cf. <http://data.weltliteratur.net/ranking.html#page-length> for details.) The ranking based on the *number of in-links* places a native-language writer on the first rank in 7 out of 15 languages while this is the case for only 2 writers in the *PageRank writers* ranking. If we leave out Shakespeare, 12 native-language writers are on the first rank regarding the *number of in-links* and 7 regarding the *PageRank writers*. Among the top five, more than half (40) of the 75 writers match “their” language when ranked by the *number of in-links* while this is true for around a quarter (20) of the writers in the *PageRank writers* ranking. Although *Shakespeare*, *Dickens* and *Tolkien* are certainly important English-language writers, *Robert Christgau* and *Roger Ebert* do not really fit into the list. Since both are critics, their articles receive many incoming links from articles on the many works they have reviewed – *Ebert* from articles on movies, *Christgau* from articles on music albums (e.g., of the 5,125 articles that link to *Robert Christgau*, 1,705 have the string “album” in their title and also most of the other ones seem to refer to albums or songs, too.). But, altogether, we are able to identify important authors by counting the *number of in-links* and are also able to rank, in many cases, important writers to the top positions for the corresponding language. As we have seen in Section 6.2, the ranking by *PageRank complete* is numerically similar to the ranking by the *number of in-links*, but there is an apparent difference: the two aforementioned critics are no longer among the top five, instead, *Goethe* and *Cicero* enter the picture.

Although we expected the ranking by *PageRank writers* to outperform the *number of in-links* approach, this is mostly not the case: the *PageRank writers* can identify

popular writers, but they typically do not fit to the corresponding language. It therefore is better suited to identify writers that transcend languages – an aspect we investigate in Section 7.2. One possible explanation could be that articles of native-language writers contain more references and thereby more outgoing links which in return reduces their PageRank.

The rankings by the *number of page views* also have important native-language writers among their top positions, but we can also observe that they reflect current events. For instance, German writer and publisher *Frank Schirrmacher* (who died in 2014) is among the top 10 in the German Wikipedia in 2014 and so is Polish-German literary critic and writer *Marcel Reich-Ranicki* in 2013 (also the year he died). Nevertheless, there are big constants, for example the three German writers *Goethe*, *Schiller*, and *Brecht* who are among the top five in all three rankings of the German edition.

7.2 Writers in Other Languages

Let us now change our perspective and consider the most important writers in Wikipedia language editions different from their writing languages, i.e., writers who transcend language boundaries. This is an interesting new perspective and adds to other methods for measuring the cross-lingual impact of authors, like counting the number of translations.

For each writer, we compute the sum of the reciprocal ranks over all language editions except the native language of the writer. E.g., German writer *Bertolt Brecht* has a score of $0.94 = 1/19 + 1/9 + 1/19 + 1/20 + 1/13 + 1/10 + 1/2$ for the *number of in-links* ranking which results from a 19th, 9th, 19th, 20th, 13th, 10th, and 2nd place in the English, French, Russian, Spanish, Portuguese, Hungarian, and Turkish Wikipedia, respectively. We then rank all writers with the same native language according to this score and repeat this for the other ranking measures. This results in one ranking for each ranking measure and language. Table 6 shows the top five native-language writers for six languages that appear most prominent among the top 25 writers in the rankings of the other 14 languages according to *PageRank complete*. For the remaining nine languages none of their native writers appear among the top 25 in other languages in those rankings.

The results show which foreign-language writers are well-represented in terms of links to their articles in the different editions of Wikipedia. There is a clear bias towards Western culture which likely is also induced by the selection of the 15 languages (of which 9 can be regarded to represent Western culture, give or take). Most of the writers in Table 6 also appear among the top 25 in the rankings by *PageRank complete* of their native language, except for *Isabel Allende*, and *Reinaldo Arenas*. *Allende* ranks 1st in the Serbo-Croatian and *Arenas* 11th in the Persian Wikipedia, so they might bear a special importance in those language editions.

The results for each of the other six rankings can be found at http://data.weltliteratur.net/ranking_native.html. Comparing the results of the intrinsic *PageRank complete* measure shown in Table 6 to the extrinsic *number of page views* measure on the web page, we can observe differences and commonalities:

Table 6: **Writers ranking highest in foreign-language editions.**

rank	English	German	French
1st	William Shakespeare (10.33)	Johann Wolfgang von Goethe (2.40)	Voltaire (1.18)
2nd	J. R. R. Tolkien (1.94)	Friedrich Schiller (0.26)	Victor Hugo (0.84)
3rd	Edgar Allan Poe (0.89)	Bertolt Brecht (0.12)	Molière (0.82)
4th	Mark Twain (0.64)	Thomas Mann (0.06)	Jules Verne (0.06)
5th	Charles Dickens (0.61)	Karl May (0.04)	Émile Zola (0.05)
count ₂₅	25	5	6
rank	Russian	Italian (Roman)	Spanish
1st	Leo Tolstoy (0.68)	Cicero (3.34)	Isabel Allende (1)
2nd	Fyodor Dostoyevsky (0.60)	Dante Alighieri (1.25)	Miguel de Cervantes (0.18)
3rd	Anton Chekhov (0.28)	Virgil (0.86)	Reinaldo Arenas (0.09)
4th	Alexander Pushkin (0.09)	Ovid (0.38)	–
5th	Constantin Stanislavski (0.06)	Petrarch (0.11)	–
count ₂₅	5	6	3

Top five native writers for English, German, French, Russian, Italian, and Spanish ranking highest in the other 14 foreign-language editions, respectively, according to *PageRank complete*. The last row (count₂₅) indicates how many native writers of each language are among the top 25 writers in *PageRank complete* rankings of the remaining 14 language editions.

- Deaf-blind American writer and activist *Helen Keller* is ranked much higher by the number of page views (always among the top five) than by the *PageRank complete* (not among the top 25). So her article is consulted by many people, but she is not that well integrated in the network of writers on Wikipedia.
- According to *PageRank complete*, *Johann Wolfgang von Goethe* is the top German writer in other language editions, followed by *Schiller*, *Brecht*, *Thomas Mann*, and *Karl May*. Page-view numbers from 2012 to 2014 also see *Goethe* upfront, but this time followed by *Hermann Hesse* and *Erich Maria Remarque*, showing different priorities of editors and readers.
- French writers *Victor Hugo*, *Jules Verne*, and *Voltaire* constantly rank 1st, 2nd, and 3rd over the three focal years.
- The first four Russian writers are also always the first four by the page-view measure.
- Roman/Italian writers *Cicero* and *Dante Alighieri* are also always the first two.
- The only Spanish-language writer among the top 25 by page views is *Gabriel García Márquez* who is not among the top 25 by *PageRank complete*.

These are just some few observations, but they already show how conveniently we can tell the difference between what editors and what readers find important. The project

website features much more incentives to take a closer look at the representation of world literature on Wikipedia.

8 Summary and Conclusion

In this method-oriented study, we presented a framework that can unlock Wikipedia as a new source for research on world literature. The methods we suggested and discussed are also meant to contribute to the growing tool set of the Digital Humanities and, more precisely, the emerging field of Digital Literary Studies.

Wikipedia itself is subject to constant change and so are the formalized datasets derived from it. In any case, the current limitations we discussed leave room for improvement. Our results show that although Wikipedia provides different options to classify articles on writers, the identification of writers of literature across different Wikipedia language versions is a challenging task, partially due to the inconsistent use of the *Writer* template. However, we were able to create sets that comprise the majority of famous writers of literature contained in the English Wikipedia, while presumably containing just few non-writers.

The most eminent author in all languages we considered is by far *William Shakespeare*. We find him in the top five of every analyzed language version for three of the chosen measures, even placed first in 9 of 15 languages based on the number of in-links and in 13 of 15 versions based on the PageRank between writers of our set. Shakespeare's central position in world literature, his strong influence on many writers around the world is not news, of course, but we confirmed this with an unconventional method, a method that produced many more insightful results.

There are three main things we can feed into the ongoing discourse on world literature. First, a specific Wikipedia language version tends to lay emphasis on the most eminent literary eras of the respective language. The preoccupation of a Wikipedia language version with its own classical authors can be interpreted as a possible precondition for these authors to eventually become a part of world literature. Second, our analysis of the top 25 writers in 15 language versions shows which writers actually crossed national and language borders and have retained a significant presence in foreign nations. The strength of this approach is that it both confirms the more or less intuitive knowledge of which writers are most influential and provides a much-needed nuance to the specific constellations of world literature in particular languages. Third, the network graph of the top writers in the English Wikipedia offers a new approach to present how world literature is currently represented in Wikipedia.

In this paper, our analysis is restricted to writers. The logical next step would be to develop an approach to reliably identify *literary works* of note. Although the methods presented in Section 4 could be applied by identifying appropriate Wikipedia templates and categories for literary works, a preliminary analysis showed that there are other alternatives. E.g., in some cases there are dedicated pages for some writers that list their works, as demonstrates [38], or the works are listed on the writer's page themselves, e.g., [39]. Furthermore, a more fine-grained and coherent classification of writers into fiction,

non-fiction writers, etc. within Wikipedia could help to answer the question *Who is a writer (of literature)?* That way, we could divide our basic set into sets of different types of writers. The analysis of the editing history of articles could also prove relevant for a definition of world literature in order to gain insights into actual editorial work that leads to the current representation of world literature within this growing repository of human knowledge production. An in-depth comparison and qualitative analysis of the different prominence measures could help to figure out whether the measures rank different types of writers to the top.

Wikipedia is still modified every few seconds, DBpedia sets are released twice a year. It is our plan to build an observatory around the measures introduced in this paper so that we can observe this ever-changing entity called world literature through the eye of the tens of thousands of Wikipedia editors and millions of readers.

Last not least, studies like ours could advocate for scholars to actively improve the quality of articles, add missing pieces and help repair structural shortcomings, especially with regard to the rather conservative version of world literature that Wikipedia implicitly conveys for the time being.

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