Plumber: A Modular Framework to Create Information Extraction Pipelines

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Information Extraction (IE) tasks are commonly studied topics in various domains of research. Hence, the community continuously produces multiple techniques, solutions, and tools to perform such tasks. However, running those tools and integrating them within existing infrastructure requires time, expertise, and resources. One pertinent task here is triples extraction and linking, where structured triples are extracted from a text and aligned to an existing Knowledge Graph (KG). In this paper, we present Plumber, the first framework that allows users to manually and automatically create suitable IE pipelines from a community-created pool of tools to perform triple extraction and alignment on unstructured text. Our approach provides an interactive medium to alter the pipelines and perform IE tasks. A short video to show the working of the framework for different use-cases is available online.

Additional Key Words and Phrases: Information Extraction, NLP Pipelines, Software Reusability, Semantic Web

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1 INTRODUCTION

Continuous efforts has been made in the Web community since the early 21st century to extend the Web as a global data graph using RDF [2]. Such efforts produced valuable linked resources that are prominent on the Web such as DBpedia [1] and YAGO [4] Knowledge Graphs (KGs). The Web research community has used these KGs in Information Extraction (IE) tasks such as triple extraction [10], keywords and topics extraction [3], to entities & relations extraction and linking [8]. Researchers compose information extraction pipelines via chaining the aforementioned tasks together to perform a variety of applications such as question answering, KG completion, fact checking, and dialog systems [10]. We demonstrate Plumber, a Web-based tool that consolidates the community efforts by bringing in various open-sourced and online-available tools under one umbrella. Plumber is the core implementation of a methodology (see Figure 1) which is grounded in three principles 1) Reusability: the framework is open source and reusable that includes a web-based UI for choosing and integrated components. 2) Isolation: all IE components implemented under Plumber operate in isolation of each other. 3) Extensibility: the framework is extensible to new components and other variation of pipelines.

1https://www.youtube.com/watch?v=XC9eFIUv8g

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Plumber distinguishes itself from other pipelining frameworks by allowing two modes of operation. 1) Manual: a user is able to select the components composing the resulting pipeline by hand. 2) Automatic: the framework makes use of contextual embeddings to automatically compose a suitable pipeline for a given input text.

For wider adaptation of Plumber, it is integrated within the Open Research Knowledge Graph (ORKG) infrastructure [5] throughout its user interface. The interface allows users to provide text snippets or files as input and allows Plumber to compose a suitable pipeline based on the provided input to produce the final set of triple statements extracted from the input text.

2 PLUMBER

Plumber is a modular framework that integrates 40 information extraction components. The framework relies on the principle of Isolation, Extensibility, and Reusability. Like other counterparts in the Question Answering (QA) domain (i.e., Frankenstein [9]), Plumber also composes suitable pipelines based on user input. Frankenstein relies on logistic regression-based pipeline selection. However, Plumber we use RoBERTa based classifier [7], which is trained on micro F-score of each pipeline executed end-to-end. In the Information Extraction community, no such effort has been made other than Plumber. Our proposed framework re-uses an ontology from Frankenstein for solving data interoperability issues of various integrated components. Plumber abstracts the details of creating IE pipelines and has two modes of operation: Manual and Automatic, depending on IE pipeline selection. These IE pipelines are composed of the following IE tasks 1) Text Triple Extraction: firstly, a set of text triple needs to be extracted from the input text snippets. 2) Coreference Resolution: all mentions and pronouns are resolved and replaced with their original mention. 3) Entity and Relation Linking: these tools extract the surface form of entities and predicates in an unstructured text and link it to their corresponding KG mentions. The implementation of Plumber is available and released on GitHub2. For a detailed empirical evaluation on effectiveness of pipeline composition, we refer readers to [6]. Plumber’s approach for creating pipelines is as follows:

Pipeline Pool Population — Plumber has an internal repository of candidate components that implement the three IE tasks mentioned earlier. Plumber generates all possible pipelines from the underlying pool and tags them with specific characteristics (i.e., which KG they align to) and adds them to its pipelines pool.

2https://github.com/YaserJaradeh/ThePlumber
Pipeline Composer — The user can guide the framework’s selection process (i.e., components of the pipeline are user specified). A RoBERTa model selects the most suitable pipeline from the pipeline pool that can produce the best results out of the input text.

Pipeline Runner — Once a pipeline is selected, the framework then instantiates the pipeline, passes the input text specified by the user, and waits for the results (i.e., aligned triples), which are then displayed for users via the user interface.

Triples Feedback — Considering that the aforementioned process is automatic, once the user can see the triples via the UI, they can report incorrect triples that feedback into the framework to improve accuracy.

3 DEMONSTRATION

In this demonstration, we will show Plumber in action, highlight the two different use cases of selecting an IE pipeline manually, and let the framework choose a suitable one based on the input text’s characteristics. The demonstration transitions step by step from providing the input text and then showing the two different use cases of manual and automatic pipeline selection to comparing the resulting final set of triples. We believe our work to connect disjoint IE efforts on the Web will motivate the researchers to provide more efficient components complementing other domains’ efforts.

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