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Third Edition

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ISBN: 978-3-031-01047-7 paperback
ISBN: 978-3-031-02175-6 ebook
ISBN: 978-3-031-00186-4 hardcover

DOI 10.1007/978-3-031-02175-6

A Publication in the Springer series
SYNTHESIS LECTURES ON HUMAN LANGUAGE TECHNOLOGIES

Lecture #46
Series Editor: Grame Hirst, *University of Toronto*
Series ISSN
Print 1947-4040 Electronic 1947-4059

Cover art illustration by Anna Atefeh Farzindar.

Natural Language Processing for Social Media

Third Edition

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SYNTHESIS LECTURES ON HUMAN LANGUAGE TECHNOLOGIES #46

ABSTRACT

In recent years, online social networking has revolutionized interpersonal communication. The newer research on language analysis in social media has been increasingly focusing on the latter's impact on our daily lives, both on a personal and a professional level. Natural language processing (NLP) is one of the most promising avenues for social media data processing. It is a scientific challenge to develop powerful methods and algorithms that extract relevant information from a large volume of data coming from multiple sources and languages in various formats or in free form. This book will discuss the challenges in analyzing social media texts in contrast with traditional documents.

Research methods in information extraction, automatic categorization and clustering, automatic summarization and indexing, and statistical machine translation need to be adapted to a new kind of data. This book reviews the current research on NLP tools and methods for processing the non-traditional information from social media data that is available in large amounts, and it shows how innovative NLP approaches can integrate appropriate linguistic information in various fields such as social media monitoring, health care, and business intelligence. The book further covers the existing evaluation metrics for NLP and social media applications and the new efforts in evaluation campaigns or shared tasks on new datasets collected from social media. Such tasks are organized by the Association for Computational Linguistics (such as SemEval tasks), the National Institute of Standards and Technology via the Text REtrieval Conference (TREC) and the Text Analysis Conference (TAC), or the Conference and Labs of the Evaluation Forum (CLEF).

In this third edition of the book, the authors added information about recent progress in NLP for social media applications, including more about the modern techniques provided by deep neural networks (DNNs) for modeling language and analyzing social media data.

KEYWORDS

social media, social networking, natural language processing, social computing, big data, semantic analysis, artificial intelligence, deep learning

To my husband Massoud, and my daughters, Tina and Amanda,
who are just about the best children a mom could hope for:
happy, loving, and fun to be with.

– Anna Atefeh Farzindar

To my wonderful husband Nicu with whom I can climb any mountain,
and to our sweet daughter Nicoleta.

– Diana Inkpen

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Preface

This book presents the state-of-the-art in research and empirical studies in the field of Natural Language Processing (NLP) for the semantic analysis of social media data. Because the field is continuously growing, this third edition adds information about recently proposed methods and their results for the tasks and applications that we covered in the first and second editions.

Over the past few years, online social networking sites have revolutionized the way we communicate with individuals, groups and communities, and altered everyday practices. The unprecedented volume and variety of user-generated content and the user interaction network constitute new opportunities for understanding social behavior and building socially intelligent systems.

Much research work on social networks and the mining of the social web is based on graph theory. That is apt because a social structure is made up of a set of social actors and a set of the dyadic ties between these actors. We believe that the graph mining methods for structure, information diffusion or influence spread in social networks need to be combined with the content analysis of social media. This provides the opportunity for new applications that use the information publicly available as a result of social interactions. Adapted classic NLP methods can partially solve the problem of social media content analysis focusing on the posted messages. When we receive a text of less than 10 characters, including an emoticon and a heart, we understand it and even respond to it! It is impossible to use NLP methods to process this type of document, but there is a logical message in social media data based on which two people can communicate. The same logic dominates worldwide, and people from all over the world share and communicate with each other. There is a new and challenging language for NLP.

We believe that we need new theories and algorithms for semantic analysis of social media data, as well as a new way of approaching the big data processing. By semantic analysis, in this book, we mean the linguistic processing of the social media messages enhanced with semantics, and possibly also combining this with the structure of the social networks. We actually use the term in a more general sense to refer to applications that do intelligent processing of social media texts and meta-data. Some applications could access very large amounts of data; therefore the algorithms need to be adapted to be able process data (big data) in an online fashion and without necessarily storing all the data.

This motivated us to give three tutorials on ***Applications of Social Media Text Analysis*** at EMNLP 2015[1], on ***Natural Language Processing for Social Media*** at the 29th Canadian Con-

[1] http://www.emnlp2015.org/tutorials/3/3_OptionalAttachment.pdf
https://www.cs.cmu.edu/~ark/EMNLP-2015/proceedings/EMNLP-Tutorials/pdf/EMNLP-Tutorials06.pdf

ference on Artificial Intelligence (AI 2016)[2], and on ***How Natural Language Processing Helps Uncover Social Media Insights*** at the 33rd International Florida Artificial Intelligence Research Society Conference (FLAIRS 2020). Also on this topic, we organized several workshops (Semantic Analysis in Social Networks (SASM 2012)[3], Language Analysis in Social Media (LASM 2013[4], and LASM 2014[5]) in conjunction with conferences organized by the Association for Computational Linguistics[6] (ACL, EACL, and NAACL-HLT).

Our goal was to reflect a wide range of research and results in the analysis of language with implications for fields such as NLP, computational linguistics, sociolinguistics and psycholinguistics. Our workshops invited original research on all topics related to the analysis of language in social media, including the following topics:

- What do people talk about on social media?
- How do they express themselves?
- Why do they post on social media?
- How do language and social network properties interact?
- Natural language processing techniques for social media analysis.
- Semantic Web / ontologies / domain models to aid in understanding social data.
- Characterizing participants via linguistic analysis.
- Language, social media and human behavior.

There were several other workshops on similar topics, for example, the ***Making Sense of Microposts*** (#Microposts)[7] workshop series in conjunction with the World Wide Web Conference 2012 to 2016. These workshops focused in particular on short informal texts that are published without much effort (such as tweets, Facebook shares, Instagram-like shares, Google+ messages). There has been another series of Workshops on Natural Language Processing for Social Media (SocialNLP) since 2013. For example, SocialNLP 2017 was in conjunction with EACL 2017[8] and IEEE BigData 2017[9], and SocialNLP 2020 had two editions, one in conjunction with TheWebConf 2020 and one in conjunction with ACL 2020[10].

The **intended audience** of this book is researchers that are interested in developing tools and applications for automatic analysis social of media texts. We assume that the readers have basic knowledge in the area of natural language processing and machine learning. We hope that this book will help the readers better understand computational linguistics and social media analysis, in particular text mining techniques and NLP applications (such as summarization,

[2] http://aigicrv.org/2016/
[3] https://aclweb.org/anthology/W/W12/#2100
[4] https://aclweb.org/anthology/W/W13/#1100
[5] https://aclweb.org/anthology/W/W14/#1300
[6] http://www.aclweb.org/
[7] http://microposts2016.seas.upenn.edu/
[8] http://eacl2017.org/
[9] http://cci.drexel.edu/bigdata/bigdata2017/
[10] https://sites.google.com/site/socialnlp2020/

localization detection, sentiment and emotion analysis, topic detection and machine translation) designed specifically for social media texts.

Besides updating each section in this third edition, we added a new section on keyphrase generation from social media messages and one on neural machine translation in Chapter 3 and three new applications in Chapter 4: rumor detection, recommender systems for social media, and preventing sexual harassment. We discuss the new methods and their results. The number of research projects and publications that use social media data is constantly increasing. Finally, we added more than 50 new references to the approximately 400 references from the second edition.

Anna Atefeh Farzindar and Diana Inkpen
March 2020

Acknowledgments

This book would not have been possible without the hard work of many people. We would like to thank our colleagues and students at the University of Southern California and our colleagues at the NLP research group at the University of Ottawa. We would like to thank in particular Prof. Stan Szpakowicz from the University of Ottawa for his comments on the early draft of the book, and two anonymous reviewers for their useful suggestions for revisions and additions. We thank Prof. Graeme Hirst of the University of Toronto and Michael Morgan from Morgan & Claypool Publishers for their continuous encouragement.

Anna Atefeh Farzindar and Diana Inkpen
March 2020