

WMT 2019

**Fourth Conference on  
Machine Translation**

**Proceedings of the Conference**

August 1-2, 2019  
Florence, Italy

©2019 The Association for Computational Linguistics

Order copies of this and other ACL proceedings from:

Association for Computational Linguistics (ACL)  
209 N. Eighth Street  
Stroudsburg, PA 18360  
USA  
Tel: +1-570-476-8006  
Fax: +1-570-476-0860  
[acl@aclweb.org](mailto:acl@aclweb.org)

ISBN 978-1-950737-27-7

## Introduction

The Fourth Conference on Machine Translation (WMT 2019) took place on Thursday, August 1 and Friday, August 2, 2019 in Florence, Italy, immediately following the 57th Annual Meeting of the Association for Computational Linguistics (ACL 2019).

This is the fourth time WMT has been held as a conference. The first time WMT was held as a conference was at ACL 2016 in Berlin, Germany, the second time at EMNLP 2017 in Copenhagen, Denmark, and the third time at EMNLP 2018 in Brussels, Belgium. Prior to being a conference, WMT was held 10 times as a workshop. WMT was held for the first time at HLT-NAACL 2006 in New York City, USA. In the following years the Workshop on Statistical Machine Translation was held at ACL 2007 in Prague, Czech Republic, ACL 2008, Columbus, Ohio, USA, EACL 2009 in Athens, Greece, ACL 2010 in Uppsala, Sweden, EMNLP 2011 in Edinburgh, Scotland, NAACL 2012 in Montreal, Canada, ACL 2013 in Sofia, Bulgaria, ACL 2014 in Baltimore, USA, and EMNLP 2015 in Lisbon, Portugal.

The focus of our conference is to bring together researchers from the area of machine translation and invite selected research papers to be presented at the conference.

Prior to the conference, in addition to soliciting relevant papers for review and possible presentation, we conducted 8 shared tasks. This consisted of four translation tasks: Machine Translation of News, Biomedical Translation, Robust Machine Translation, and Similar Language Translation, two evaluation tasks: Metrics and Quality Estimation, as well as the Automatic Post-Editing and Parallel Corpus Filtering tasks.

The results of all shared tasks were announced at the conference, and these proceedings also include overview papers for the shared tasks, summarizing the results, as well as providing information about the data used and any procedures that were followed in conducting or scoring the tasks. In addition, there are short papers from each participating team that describe their underlying system in greater detail.

Like in previous years, we have received a far larger number of submissions than we could accept for presentation. WMT 2019 has received 48 full research paper submissions (not counting withdrawn submissions). In total, WMT 2019 featured 12 full research paper oral presentations and 102 shared task poster presentations.

The invited talk was given by Marine Carpuat from the University of Maryland, College Park, USA. It was titled “Semantic, Style & Other Data Divergences in Neural Machine Translation”.

We would like to thank the members of the Program Committee for their timely reviews. We also would like to thank the participants of the shared task and all the other volunteers who helped with the evaluations.

Ondřej Bojar, Rajen Chatterjee, Christian Federmann, Mark Fishel, Yvette Graham, Barry Haddow, Matthias Huck, Antonio Jimeno Yepes, Philipp Koehn, André Martins, Christof Monz, Matteo Negri, Aurélie Névél, Mariana Neves, Matt Post, Marco Turchi, and Karin Verspoor

Co-Organizers



**Organizers:**

Ondřej Bojar (Charles University in Prague)  
Rajen Chatterjee (FBK)  
Christian Federmann (MSR)  
Mark Fishel (University of Tartu)  
Yvette Graham (DCU)  
Barry Haddow (University of Edinburgh)  
Matthias Huck (LMU Munich)  
Antonio Jimeno Yepes (IBM Research Australia)  
Philipp Koehn (University of Edinburgh / Johns Hopkins University)  
André Martins (Unbabel)  
Christof Monz (University of Amsterdam)  
Matteo Negri (FBK)  
Aurélie Névéol (LIMSI, CNRS)  
Mariana Neves (German Federal Institute for Risk Assessment)  
Matt Post (Johns Hopkins University)  
Marco Turchi (FBK)  
Karin Verspoor (University of Melbourne)

**Invited Speaker:**

Marine Carpuat (University of Maryland, College Park)

**Program Committee:**

Tamer Alkhouli (RWTH Aachen University)  
Antonios Anastasopoulos (Carnegie Mellon University)  
Yuki Arase (Osaka University)  
Mihael Arcan (INSIGHT, NUI Galway)  
Duygu Ataman (Fondazione Bruno Kessler - University of Edinburgh)  
Eleftherios Avramidis (German Research Center for Artificial Intelligence (DFKI))  
Amittai Axelrod (Didi Chuxing)  
Parnia Bahar (RWTH Aachen University)  
Ankur Bapna (Google AI)  
Petra Barancikova (Charles University in Prague, Faculty of Mathematics and Physics)  
Joost Bastings (University of Amsterdam)  
Rachel Bawden (University of Edinburgh)  
Meriem Beloucif (University of Hamburg)  
Graeme Blackwood (IBM Research AI)  
Frédéric Blain (University of Sheffield)  
Chris Brockett (Microsoft Research)  
Bill Byrne (University of Cambridge)  
Elena Cabrio (Université Côte d'Azur, Inria, CNRS, I3S, France)

Marine Carpuat (University of Maryland)  
Francisco Casacuberta (Universitat Politècnica de València)  
Sheila Castilho (Dublin City University)  
Rajen Chatterjee (Apple Inc)  
Boxing Chen (Alibaba)  
Colin Cherry (Google)  
Mara Chinea-Rios (Universitat Politècnica de València)  
Chenhui Chu (Osaka University)  
Ann Clifton (Spotify)  
Marta R. Costa-jussà (Universitat Politècnica de Catalunya)  
Josep Crego (SYSTRAN)  
Raj Dabre (NICT)  
Steve DeNeefe (SDL Research)  
Michael Denkowski (Amazon)  
Mattia A. Di Gangi (Fondazione Bruno Kessler)  
Miguel Domingo (Universitat Politècnica de València)  
Kevin Duh (Johns Hopkins University)  
Marc Dymetman (Naver Labs Europe)  
Hiroshi Echizen'ya (Hokkai-Gakuen University)  
Sergey Edunov (Faceook AI Research)  
Marcello Federico (Amazon AI)  
Yang Feng (Institute of Computing Technology, Chinese Academy of Sciences)  
Andrew Finch (Apple Inc.)  
Orhan Firat (Google AI)  
George Foster (Google)  
Alexander Fraser (Ludwig-Maximilians-Universität München)  
Atsushi Fujita (National Institute of Information and Communications Technology)  
Juri Ganitkevitch (Google)  
Mercedes García-Martínez (Pangeanic)  
Ekaterina Garmash (KLM Royal Dutch Airlines)  
Jesús González-Rubio (WebInterpret)  
Isao Goto (NHK)  
Miguel Graça (RWTH Aachen University)  
Roman Grundkiewicz (School of Informatics, University of Edinburgh)  
Mandy Guo (Google)  
Jeremy Gwinnup (Air Force Research Laboratory)  
Thanh-Le Ha (Karlsruhe Institute of Technology)  
Nizar Habash (New York University Abu Dhabi)  
Gholamreza Haffari (Monash University)  
Greg Hanneman (Amazon)  
Christian Hardmeier (Uppsala universitet)  
Eva Hasler (SDL Research)  
Yifan He (Alibaba Group)  
John Henderson (MITRE)  
Christian Herold (RWTH Aachen University)  
Felix Hieber (Amazon Research)  
Hieu Hoang (University of Edinburgh)

Vu Cong Duy Hoang (The University of Melbourne)  
Bojie Hu (Tencent Research, Beijing, China)  
Junjie Hu (Carnegie Mellon University)  
Mika Hämäläinen (University of Helsinki)  
Gonzalo Iglesias (SDL)  
Kenji Imamura (National Institute of Information and Communications Technology)  
Aizhan Imankulova (Tokyo Metropolitan University)  
Julia Ive (University of Sheffield)  
Marcin Junczys-Dowmunt (Microsoft)  
Shahram Khadivi (eBay)  
Huda Khayrallah (Johns Hopkins University)  
Douwe Kiela (Facebook)  
Yunsu Kim (RWTH Aachen University)  
Rebecca Knowles (Johns Hopkins University)  
Julia Kreutzer (Department of Computational Linguistics, Heidelberg University)  
Shankar Kumar (Google)  
Anoop Kunchukuttan (Microsoft AI and Research)  
Surafel Melaku Lakew (University of Trento and Fondazione Bruno Kessler)  
Ekaterina Lapshinova-Koltunski (Universität des Saarlandes)  
Alon Lavie (Amazon/Carnegie Mellon University)  
Gregor Leusch (eBay)  
William Lewis (Microsoft Research)  
Jindřich Libovický (Charles University)  
Patrick Littell (National Research Council of Canada)  
Qun Liu (Huawei Noah's Ark Lab)  
Samuel Lübli (University of Zurich)  
Pranava Madhyastha (Imperial College London)  
Andreas Maletti (Universität Leipzig)  
Saab Mansour (Apple)  
Sameen Maruf (Monash University)  
Arne Mauser (Google, Inc)  
Arya D. McCarthy (Johns Hopkins University)  
Antonio Valerio Miceli Barone (The University of Edinburgh)  
Paul Michel (Carnegie Mellon University)  
Aaron Mueller (The Johns Hopkins University)  
Kenton Murray (University of Notre Dame)  
Tomáš Musil (Charles University)  
Mathias Müller (University of Zurich)  
Masaaki Nagata (NTT Corporation)  
Toshiaki Nakazawa (The University of Tokyo)  
Preslav Nakov (Qatar Computing Research Institute, HBKU)  
Graham Neubig (Carnegie Mellon University)  
Jan Niehues (Maastricht University)  
Nikola Nikolov (University of Zurich and ETH Zurich)  
Xing Niu (University of Maryland)  
Tsuyoshi Okita (Kyushuu institute of technology)  
Daniel Ortiz-Martínez (Technical University of Valencia)

Myle Ott (Facebook AI Research)  
Santanu Pal (Saarland University)  
Carla Parra Escartín (Unbabel)  
Pavel Pecina (Charles University)  
Stephan Peitz (Apple)  
Sergio Penkale (Lingo24)  
Mārcis Pinnis (Tilde)  
Martin Popel (Charles University, Faculty of Mathematics and Physics, UFAL)  
Maja Popović (ADAPT Centre @ DCU)  
Matīss Rikters (Tilde)  
Annette Rios (Institute of Computational Linguistics, University of Zurich)  
Jan Rosendahl (RWTH Aachen University)  
Raphael Rubino (DFKI)  
Devendra Sachan (CMU / Petuum Inc.)  
Elizabeth Salesky (Carnegie Mellon University)  
Hassan Sawaf (Amazon Web Services)  
Jean Senellart (SYSTRAN)  
Rico Sennrich (University of Edinburgh)  
Patrick Simianer (Lilt)  
Linfeng Song (University of Rochester)  
Felix Stahlberg (University of Cambridge, Department of Engineering)  
Dario Stojanovski (LMU Munich)  
Katsuhito Sudoh (Nara Institute of Science and Technology (NAIST))  
Felipe Sánchez-Martínez (Universitat d'Alacant)  
Aleš Tamchyna (Charles University in Prague, UFAL MFF)  
Gongbo Tang (Uppsala University)  
Jörg Tiedemann (University of Helsinki)  
Antonio Toral (University of Groningen)  
Ke Tran (Amazon)  
Marco Turchi (Fondazione Bruno Kessler)  
Ferhan Ture (Comcast Applied AI Research)  
Nicola Ueffing (eBay)  
Masao Utiyama (NICT)  
Dušan Variš (Charles University, Institute of Formal and Applied Linguistics)  
David Vilar (Amazon)  
Ivan Vulić (University of Cambridge)  
Ekaterina Vylomova (University of Melbourne)  
Wei Wang (Google Research)  
Weiyue Wang (RWTH Aachen University)  
Taro Watanabe (Google)  
Philip Williams (University of Edinburgh)  
Hua Wu (Baidu)  
Joern Wuebker (Lilt, Inc.)  
Hainan Xu (Johns Hopkins University)  
Yinfei Yang (Google)  
François Yvon (LIMSI/CNRS)  
Dakun Zhang (SYSTRAN)  
Xuan Zhang (Johns Hopkins University)



## Table of Contents

<i>Findings of the 2019 Conference on Machine Translation (WMT19)</i> Loïc Barrault, Ondřej Bojar, Marta R. Costa-jussà, Christian Federmann, Mark Fishel, Yvette Graham, Barry Haddow, Matthias Huck, Philipp Koehn, Shervin Malmasi, Christof Monz, Mathias Müller, Santanu Pal, Matt Post and Marcos Zampieri .....	1
<i>Results of the WMT19 Metrics Shared Task: Segment-Level and Strong MT Systems Pose Big Challenges</i> Qingsong Ma, Johnny Wei, Ondřej Bojar and Yvette Graham .....	62
<i>Findings of the First Shared Task on Machine Translation Robustness</i> Xian Li, Paul Michel, Antonios Anastasopoulos, Yonatan Belinkov, Nadir Durrani, Orhan Firat, Philipp Koehn, Graham Neubig, Juan Pino and Hassan Sajjad .....	91
<i>The University of Edinburgh’s Submissions to the WMT19 News Translation Task</i> Rachel Bawden, Nikolay Bogoychev, Ulrich Germann, Roman Grundkiewicz, Faheem Kirefu, Antonio Valerio Miceli Barone and Alexandra Birch .....	103
<i>GTCOM Neural Machine Translation Systems for WMT19</i> Chao Bei, Hao Zong, Conghu Yuan, Qingming Liu and Baoyong Fan .....	116
<i>Machine Translation with parfda, Moses, kenlm, nplm, and PRO</i> Ergun Biçici .....	122
<i>LIUM’s Contributions to the WMT2019 News Translation Task: Data and Systems for German-French Language Pairs</i> Fethi Bougares, Jane Wottawa, Anne Baillot, Loïc Barrault and Adrien Bardet .....	129
<i>The University of Maryland’s Kazakh-English Neural Machine Translation System at WMT19</i> Eleftheria Briakou and Marine Carpuat .....	134
<i>DBMS-KU Interpolation for WMT19 News Translation Task</i> Sari Dewi Budiwati, Al Hafiz Akbar Maulana Siagian, Tirana Noor Fatyanosa and Masayoshi Aritsugi .....	141
<i>Lingua Custodia at WMT’19: Attempts to Control Terminology</i> Franck Burlot .....	147
<i>The TALP-UPC Machine Translation Systems for WMT19 News Translation Task: Pivoting Techniques for Low Resource MT</i> Noe Casas, José A. R. Fonollosa, Carlos Escolano, Christine Basta and Marta R. Costa-jussà ..	155
<i>Kyoto University Participation to the WMT 2019 News Shared Task</i> Fabien Cromieres and Sadao Kurohashi .....	163
<i>NICT’s Supervised Neural Machine Translation Systems for the WMT19 News Translation Task</i> Raj Dabre, Kehai Chen, Benjamin Marie, Rui Wang, Atsushi Fujita, Masao Utiyama and Eiichiro Sumita .....	168
<i>The University of Sydney’s Machine Translation System for WMT19</i> Liang Ding and Dacheng Tao .....	175
<i>UdS-DFKI Participation at WMT 2019: Low-Resource (en-gu) and Coreference-Aware (en-de) Systems</i> Cristina España-Bonet and Dana Ruiter .....	183

<i>The IIT-H Gujarati-English Machine Translation System for WMT19</i> Vikrant Goyal and Dipti Misra Sharma .....	191
<i>Kingsoft’s Neural Machine Translation System for WMT19</i> Xinze Guo, Chang Liu, Xiaolong Li, Yiran Wang, Guoliang Li, Feng Wang, Zhitao Xu, Liuyi Yang, Li Ma and Changliang Li .....	196
<i>The AFRL WMT19 Systems: Old Favorites and New Tricks</i> Jeremy Gwinnup, Grant Erdmann and Tim Anderson .....	203
<i>Evaluating the Supervised and Zero-shot Performance of Multi-lingual Translation Models</i> Chris Hokamp, John Glover and Demian Gholipour Ghalandari .....	209
<i>The MLLP-UPV Supervised Machine Translation Systems for WMT19 News Translation Task</i> Javier Iranzo-Sánchez, Gonçal Garcés Díaz-Munío, Jorge Civera and Alfons Juan .....	218
<i>Microsoft Translator at WMT 2019: Towards Large-Scale Document-Level Neural Machine Translation</i> Marcin Junczys-Dowmunt .....	225
<i>CUNI Submission for Low-Resource Languages in WMT News 2019</i> Tom Kocmi and Ondřej Bojar .....	234
<i>CUNI Systems for the Unsupervised News Translation Task in WMT 2019</i> Ivana Kvapilíková, Dominik Macháček and Ondřej Bojar .....	241
<i>A Comparison on Fine-grained Pre-trained Embeddings for the WMT19 Chinese-English News Translation Task</i> Zhenhao Li and Lucia Specia .....	249
<i>The NiuTrans Machine Translation Systems for WMT19</i> Bei Li, Yinqiao Li, Chen Xu, Ye Lin, Jiqiang Liu, Hui Liu, Ziyang Wang, Yuhao Zhang, Nuo Xu, Zeyang Wang, Kai Feng, Hexuan Chen, Tengbo Liu, Yanyang Li, Qiang Wang, Tong Xiao and Jingbo Zhu .....	257
<i>Multi-Source Transformer for Kazakh-Russian-English Neural Machine Translation</i> Patrick Littell, Chi-kiu Lo, Samuel Larkin and Darlene Stewart .....	267
<i>Incorporating Word and Subword Units in Unsupervised Machine Translation Using Language Model Rescoring</i> Zihan Liu, Yan Xu, Genta Indra Winata and Pascale Fung .....	275
<i>JUMT at WMT2019 News Translation Task: A Hybrid Approach to Machine Translation for Lithuanian to English</i> Sainik Kumar Mahata, Avishek Garain, Adityar Rayala, Dipankar Das and Sivaji Bandyopadhyay	283
<i>Johns Hopkins University Submission for WMT News Translation Task</i> Kelly Marchisio, Yash Kumar Lal and Philipp Koehn .....	287
<i>NICT’s Unsupervised Neural and Statistical Machine Translation Systems for the WMT19 News Translation Task</i> Benjamin Marie, Haipeng Sun, Rui Wang, Kehai Chen, Atsushi Fujita, Masao Utiyama and Eiichiro Sumita .....	294

<i>PROMT Systems for WMT 2019 Shared Translation Task</i>	
Alexander Molchanov .....	302
<i>JU-Saarland Submission to the WMT2019 English–Gujarati Translation Shared Task</i>	
Riktim Mondal, Shankha Raj Nayek, Aditya Chowdhury, Santanu Pal, Sudip Kumar Naskar and Josef van Genabith .....	308
<i>Facebook FAIR’s WMT19 News Translation Task Submission</i>	
Nathan Ng, Kyra Yee, Alexei Baevski, Myle Ott, Michael Auli and Sergey Edunov .....	314
<i>eTranslation’s Submissions to the WMT 2019 News Translation Task</i>	
Csaba Oravecz, Katina Bontcheva, Adrien Lardilleux, László Tihanyi and Andreas Eisele .....	320
<i>Tilde’s Machine Translation Systems for WMT 2019</i>	
Marcis Pinnis, Rihards Krišlauks and Matiss Rikters .....	327
<i>Apertium-fin-eng–Rule-based Shallow Machine Translation for WMT 2019 Shared Task</i>	
Tommi Pirinen .....	335
<i>English-Czech Systems in WMT19: Document-Level Transformer</i>	
Martin Popel, Dominik Macháček, Michal Auersperger, Ondřej Bojar and Pavel Pecina .....	342
<i>The RWTH Aachen University Machine Translation Systems for WMT 2019</i>	
Jan Rosendahl, Christian Herold, Yunsu Kim, Miguel Graça, Weiyue Wang, Parnia Bahar, Yingbo Gao and Hermann Ney .....	349
<i>The Universitat d’Alacant Submissions to the English-to-Kazakh News Translation Task at WMT 2019</i>	
Víctor M. Sánchez-Cartagena, Juan Antonio Pérez-Ortiz and Felipe Sánchez-Martínez .....	356
<i>CUED@WMT19:EWC&amp;LMs</i>	
Felix Stahlberg, Danielle Saunders, Adrià de Gispert and Bill Byrne .....	364
<i>Baidu Neural Machine Translation Systems for WMT19</i>	
Meng Sun, Bojian Jiang, Hao Xiong, Zhongjun He, Hua Wu and Haifeng Wang .....	374
<i>University of Tartu’s Multilingual Multi-domain WMT19 News Translation Shared Task Submission</i>	
Andre Tättar, Elizaveta Korotkova and Mark Fishel .....	382
<i>Neural Machine Translation for English–Kazakh with Morphological Segmentation and Synthetic Data</i>	
Antonio Toral, Lukas Edman, Galiya Yeshmagambetova and Jennifer Spenader .....	386
<i>The LMU Munich Unsupervised Machine Translation System for WMT19</i>	
Dario Stojanovski, Viktor Hangya, Matthias Huck and Alexander Fraser .....	393
<i>Combining Local and Document-Level Context: The LMU Munich Neural Machine Translation System at WMT19</i>	
Dario Stojanovski and Alexander Fraser .....	400
<i>IITP-MT System for Gujarati-English News Translation Task at WMT 2019</i>	
Sukanta Sen, Kamal Kumar Gupta, Asif Ekbal and Pushpak Bhattacharyya .....	407
<i>The University of Helsinki Submissions to the WMT19 News Translation Task</i>	
Aarne Talman, Umut Sulubacak, Raúl Vázquez, Yves Scherrer, Sami Virpioja, Alessandro Raganato, Arvi Hurskainen and Jörg Tiedemann .....	412

<i>Microsoft Research Asia’s Systems for WMT19</i>	
Yingce Xia, Xu Tan, Fei Tian, Fei Gao, Di He, Weicong Chen, Yang Fan, Linyuan Gong, Yichong Leng, Renqian Luo, Yiren Wang, Lijun Wu, Jinhua Zhu, Tao Qin and Tie-Yan Liu . . . . .	424
<i>The En-Ru Two-way Integrated Machine Translation System Based on Transformer</i>	
Doron Yu . . . . .	434
<i>DFKI-NMT Submission to the WMT19 News Translation Task</i>	
Jingyi Zhang and Josef van Genabith . . . . .	440
<i>Linguistic Evaluation of German-English Machine Translation Using a Test Suite</i>	
Eleftherios Avramidis, Vivien Macketanz, Ursula Strohrigel and Hans Uszkoreit . . . . .	445
<i>A Test Suite and Manual Evaluation of Document-Level NMT at WMT19</i>	
Kateřina Rysova, Magdalena Rysova, Tomař Musil, Lucie Polakova and Ondřej Bojar . . . . .	455
<i>Evaluating Conjunction Disambiguation on English-to-German and French-to-German WMT 2019 Translation Hypotheses</i>	
Maja Popovic . . . . .	464
<i>The MuCoW Test Suite at WMT 2019: Automatically Harvested Multilingual Contrastive Word Sense Disambiguation Test Sets for Machine Translation</i>	
Alessandro Raganato, Yves Scherrer and Jorg Tiedemann . . . . .	470
<i>SAO WMT19 Test Suite: Machine Translation of Audit Reports</i>	
Tereza Vojtechova, Michal Novak, Miloř Kloucek and Ondřej Bojar . . . . .	481
<i>WMDO: Fluency-based Word Mover’s Distance for Machine Translation Evaluation</i>	
Julian Chow, Lucia Specia and Pranava Madhyastha . . . . .	494
<i>Meteor++ 2.0: Adopt Syntactic Level Paraphrase Knowledge into Machine Translation Evaluation</i>	
Yinuo Guo and Junfeng Hu . . . . .	501
<i>YiSi - a Unified Semantic MT Quality Evaluation and Estimation Metric for Languages with Different Levels of Available Resources</i>	
Chi-kiu Lo . . . . .	507
<i>EED: Extended Edit Distance Measure for Machine Translation</i>	
Peter Stanchev, Weiyue Wang and Hermann Ney . . . . .	514
<i>Filtering Pseudo-References by Paraphrasing for Automatic Evaluation of Machine Translation</i>	
Ryoma Yoshimura, Hiroki Shimanaka, Yukio Matsumura, Hayahide Yamagishi and Mamoru Komachi . . . . .	521
<i>Naver Labs Europe’s Systems for the WMT19 Machine Translation Robustness Task</i>	
Alexandre Berard, Ioan Calapodescu and Claude Roux . . . . .	526
<i>NICT’s Supervised Neural Machine Translation Systems for the WMT19 Translation Robustness Task</i>	
Raj Dabre and Eiichiro Sumita . . . . .	533
<i>System Description: The Submission of FOKUS to the WMT 19 Robustness Task</i>	
Cristian Grozea . . . . .	537
<i>CUNI System for the WMT19 Robustness Task</i>	
Jindřich Helcl, Jindřich Libovicky and Martin Popel . . . . .	539

<i>NTT's Machine Translation Systems for WMT19 Robustness Task</i> Soichiro Murakami, Makoto Morishita, Tsutomu Hirao and Masaaki Nagata .....	544
<i>JHU 2019 Robustness Task System Description</i> Matt Post and Kevin Duh .....	552
<i>Robust Machine Translation with Domain Sensitive Pseudo-Sources: Baidu-OSU WMT19 MT Robustness Shared Task System Report</i> Renjie Zheng, Hairong Liu, Mingbo Ma, Baigong Zheng and Liang Huang .....	559
<i>Improving Robustness of Neural Machine Translation with Multi-task Learning</i> Shuyan Zhou, Xiangkai Zeng, Yingqi Zhou, Antonios Anastasopoulos and Graham Neubig ...	565



# Conference Program

Thursday, August 1, 2019

**8:45–9:00**     *Opening Remarks*

**9:00–10:30**     **Session 1: Shared Tasks Overview Presentations I (chair: Barry Haddow)**

9:00–9:35     *Findings of the 2019 Conference on Machine Translation (WMT19)*

Loïc Barrault, Ondřej Bojar, Marta R. Costa-jussà, Christian Federmann, Mark Fishel, Yvette Graham, Barry Haddow, Matthias Huck, Philipp Koehn, Shervin Malmasi, Christof Monz, Mathias Müller, Santanu Pal, Matt Post and Marcos Zampieri

9:35–9:50     *Test Suites*

9:50–10:10     *Results of the WMT19 Metrics Shared Task: Segment-Level and Strong MT Systems Pose Big Challenges*

Qingsong Ma, Johnny Wei, Ondřej Bojar and Yvette Graham

10:10–10:30     *Findings of the First Shared Task on Machine Translation Robustness*

Xian Li, Paul Michel, Antonios Anastasopoulos, Yonatan Belinkov, Nadir Durrani, Orhan Firat, Philipp Koehn, Graham Neubig, Juan Pino and Hassan Sajjad

**10:30-11:00**     *Coffee Break*

**11:00–12:30**     **Session 2: Shared Task Poster Session I**

11:00–12:30     *Shared Task: News Translation*

*The University of Edinburgh's Submissions to the WMT19 News Translation Task*

Rachel Bawden, Nikolay Bogoychev, Ulrich Germann, Roman Grundkiewicz, Faheem Kirefu, Antonio Valerio Miceli Barone and Alexandra Birch

*GTCOM Neural Machine Translation Systems for WMT19*

Chao Bei, Hao Zong, Conghu Yuan, Qingming Liu and Baoyong Fan

*Machine Translation with *parfda*, *Moses*, *kenlm*, *nplm*, and *PRO**

Ergun Biçici

**Thursday, August 1, 2019 (continued)**

*LIUM's Contributions to the WMT2019 News Translation Task: Data and Systems for German-French Language Pairs*

Fethi Bougares, Jane Wottawa, Anne Baillot, Loïc Barrault and Adrien Bardet

*The University of Maryland's Kazakh-English Neural Machine Translation System at WMT19*

Eleftheria Briakou and Marine Carpuat

*DBMS-KU Interpolation for WMT19 News Translation Task*

Sari Dewi Budiwati, Al Hafiz Akbar Maulana Siagian, Tirana Noor Fatyanosa and Masayoshi Aritsugi

*Lingua Custodia at WMT'19: Attempts to Control Terminology*

Franck Burlot

*The TALP-UPC Machine Translation Systems for WMT19 News Translation Task: Pivoting Techniques for Low Resource MT*

Noe Casas, José A. R. Fonollosa, Carlos Escolano, Christine Basta and Marta R. Costa-jussà

*Kyoto University Participation to the WMT 2019 News Shared Task*

Fabien Cromieres and Sadao Kurohashi

*NICT's Supervised Neural Machine Translation Systems for the WMT19 News Translation Task*

Raj Dabre, Kehai Chen, Benjamin Marie, Rui Wang, Atsushi Fujita, Masao Utiyama and Eiichiro Sumita

*The University of Sydney's Machine Translation System for WMT19*

Liang Ding and Dacheng Tao

*UdS-DFKI Participation at WMT 2019: Low-Resource (en-gu) and Coreference-Aware (en-de) Systems*

Cristina España-Bonet and Dana Ruiter

*The IIIT-H Gujarati-English Machine Translation System for WMT19*

Vikrant Goyal and Dipti Misra Sharma

*Kingsoft's Neural Machine Translation System for WMT19*

Xinze Guo, Chang Liu, Xiaolong Li, Yiran Wang, Guoliang Li, Feng Wang, Zhitao Xu, Liuyi Yang, Li Ma and Changliang Li

*The AFRL WMT19 Systems: Old Favorites and New Tricks*

Jeremy Gwinnup, Grant Erdmann and Tim Anderson



**Thursday, August 1, 2019 (continued)**

*Evaluating the Supervised and Zero-shot Performance of Multi-lingual Translation Models*

Chris Hokamp, John Glover and Demian Gholipour Ghalandari

*The MLLP-UPV Supervised Machine Translation Systems for WMT19 News Translation Task*

Javier Iranzo-Sánchez, Gonçal Garcés Díaz-Munío, Jorge Civera and Alfons Juan

*Microsoft Translator at WMT 2019: Towards Large-Scale Document-Level Neural Machine Translation*

Marcin Junczys-Dowmunt

*CUNI Submission for Low-Resource Languages in WMT News 2019*

Tom Kocmi and Ondřej Bojar

*CUNI Systems for the Unsupervised News Translation Task in WMT 2019*

Ivana Kvpilíková, Dominik Macháček and Ondřej Bojar

*A Comparison on Fine-grained Pre-trained Embeddings for the WMT19 Chinese-English News Translation Task*

Zhenhao Li and Lucia Specia

*The NiuTrans Machine Translation Systems for WMT19*

Bei Li, Yinqiao Li, Chen Xu, Ye Lin, Jiqiang Liu, Hui Liu, Ziyang Wang, Yuhao Zhang, Nuo Xu, Zeyang Wang, Kai Feng, Hexuan Chen, Tengbo Liu, Yanyang Li, Qiang Wang, Tong Xiao and Jingbo Zhu

*Multi-Source Transformer for Kazakh-Russian-English Neural Machine Translation*

Patrick Littell, Chi-kiu Lo, Samuel Larkin and Darlene Stewart

*Incorporating Word and Subword Units in Unsupervised Machine Translation Using Language Model Rescoring*

Zihan Liu, Yan Xu, Genta Indra Winata and Pascale Fung

*JUMT at WMT2019 News Translation Task: A Hybrid Approach to Machine Translation for Lithuanian to English*

Sainik Kumar Mahata, Avishek Garain, Adityar Rayala, Dipankar Das and Sivaji Bandyopadhyay

*Johns Hopkins University Submission for WMT News Translation Task*

Kelly Marchisio, Yash Kumar Lal and Philipp Koehn

*NICT's Unsupervised Neural and Statistical Machine Translation Systems for the WMT19 News Translation Task*

Benjamin Marie, Haipeng Sun, Rui Wang, Kehai Chen, Atsushi Fujita, Masao Utiyama and Eiichiro Sumita

**Thursday, August 1, 2019 (continued)**

*PROMT Systems for WMT 2019 Shared Translation Task*

Alexander Molchanov

*JU-Saarland Submission to the WMT2019 English–Gujarati Translation Shared Task*

Riktim Mondal, Shankha Raj Nayek, Aditya Chowdhury, Santanu Pal, Sudip Kumar Naskar and Josef van Genabith

*Facebook FAIR’s WMT19 News Translation Task Submission*

Nathan Ng, Kyra Yee, Alexei Baevski, Myle Ott, Michael Auli and Sergey Edunov

*eTranslation’s Submissions to the WMT 2019 News Translation Task*

Csaba Oravecz, Katina Bontcheva, Adrien Lardilleux, László Tihanyi and Andreas Eisele

*Tilde’s Machine Translation Systems for WMT 2019*

Marcis Pinnis, Rihards Krišlauks and Matiss Rikters

*Apertium-fin-eng–Rule-based Shallow Machine Translation for WMT 2019 Shared Task*

Tommi Pirinen

*English-Czech Systems in WMT19: Document-Level Transformer*

Martin Popel, Dominik Macháček, Michal Auersperger, Ondřej Bojar and Pavel Pecina

*The RWTH Aachen University Machine Translation Systems for WMT 2019*

Jan Rosendahl, Christian Herold, Yunsu Kim, Miguel Graça, Weiyue Wang, Parnia Bahar, Yingbo Gao and Hermann Ney

*The Universitat d’Alacant Submissions to the English-to-Kazakh News Translation Task at WMT 2019*

Víctor M. Sánchez-Cartagena, Juan Antonio Pérez-Ortiz and Felipe Sánchez-Martínez

*CUED@WMT19:EWC&LMs*

Felix Stahlberg, Danielle Saunders, Adrià de Gispert and Bill Byrne

*Baidu Neural Machine Translation Systems for WMT19*

Meng Sun, Bojian Jiang, Hao Xiong, Zhongjun He, Hua Wu and Haifeng Wang

*University of Tartu’s Multilingual Multi-domain WMT19 News Translation Shared Task Submission*

Andre Tättar, Elizaveta Korotkova and Mark Fishel

**Thursday, August 1, 2019 (continued)**

*Neural Machine Translation for English–Kazakh with Morphological Segmentation and Synthetic Data*

Antonio Toral, Lukas Edman, Galiya Yeshmagambetova and Jennifer Spenser

*The LMU Munich Unsupervised Machine Translation System for WMT19*

Dario Stojanovski, Viktor Hangya, Matthias Huck and Alexander Fraser

*Combining Local and Document-Level Context: The LMU Munich Neural Machine Translation System at WMT19*

Dario Stojanovski and Alexander Fraser

*IITP-MT System for Gujarati-English News Translation Task at WMT 2019*

Sukanta Sen, Kamal Kumar Gupta, Asif Ekbal and Pushpak Bhattacharyya

*The University of Helsinki Submissions to the WMT19 News Translation Task*

Aarne Talman, Umut Sulubacak, Raúl Vázquez, Yves Scherrer, Sami Virpioja, Alessandro Raganato, Arvi Hurskainen and Jörg Tiedemann

*Microsoft Research Asia's Systems for WMT19*

Yingce Xia, Xu Tan, Fei Tian, Fei Gao, Di He, Weicong Chen, Yang Fan, Linyuan Gong, Yichong Leng, Renqian Luo, Yiren Wang, Lijun Wu, Jinhua Zhu, Tao Qin and Tie-Yan Liu

*The En-Ru Two-way Integrated Machine Translation System Based on Transformer*

Doron Yu

*DFKI-NMT Submission to the WMT19 News Translation Task*

Jingyi Zhang and Josef van Genabith

11:00–12:30 *Shared Task: Test Suites*

*Linguistic Evaluation of German-English Machine Translation Using a Test Suite*

Eleftherios Avramidis, Vivien Macketanz, Ursula Strohrriegel and Hans Uszkoreit

*A Test Suite and Manual Evaluation of Document-Level NMT at WMT19*

Kateřina Rysová, Magdaléna Rysová, Tomáš Musil, Lucie Poláková and Ondřej Bojar

*Evaluating Conjunction Disambiguation on English-to-German and French-to-German WMT 2019 Translation Hypotheses*

Maja Popović

**Thursday, August 1, 2019 (continued)**

*The MuCoW Test Suite at WMT 2019: Automatically Harvested Multilingual Contrastive Word Sense Disambiguation Test Sets for Machine Translation*

Alessandro Raganato, Yves Scherrer and Jörg Tiedemann

*SAO WMT19 Test Suite: Machine Translation of Audit Reports*

Tereza Vojtěchová, Michal Novák, Miloš Klouček and Ondřej Bojar

11:00–12:30 *Shared Task: Metrics*

*WMDO: Fluency-based Word Mover's Distance for Machine Translation Evaluation*

Julian Chow, Lucia Specia and Pranava Madhyastha

*Meteor++ 2.0: Adopt Syntactic Level Paraphrase Knowledge into Machine Translation Evaluation*

Yinuo Guo and Junfeng Hu

*YiSi - a Unified Semantic MT Quality Evaluation and Estimation Metric for Languages with Different Levels of Available Resources*

Chi-kiu Lo

*EED: Extended Edit Distance Measure for Machine Translation*

Peter Stanchev, Weiyue Wang and Hermann Ney

*Filtering Pseudo-References by Paraphrasing for Automatic Evaluation of Machine Translation*

Ryoma Yoshimura, Hiroki Shimanaka, Yukio Matsumura, Hayahide Yamagishi and Mamoru Komachi

11:00–12:30 *Shared Task: Robustness*

*Naver Labs Europe's Systems for the WMT19 Machine Translation Robustness Task*

Alexandre Berard, Ioan Calapodescu and Claude Roux

*NICT's Supervised Neural Machine Translation Systems for the WMT19 Translation Robustness Task*

Raj Dabre and Eiichiro Sumita

*System Description: The Submission of FOKUS to the WMT 19 Robustness Task*

Cristian Grozea

**Thursday, August 1, 2019 (continued)**

*CUNI System for the WMT19 Robustness Task*  
Jindřich Helcl, Jindřich Libovický and Martin Popel

*NTT's Machine Translation Systems for WMT19 Robustness Task*  
Soichiro Murakami, Makoto Morishita, Tsutomu Hirao and Masaaki Nagata

*JHU 2019 Robustness Task System Description*  
Matt Post and Kevin Duh

*Robust Machine Translation with Domain Sensitive Pseudo-Sources: Baidu-OSU WMT19 MT Robustness Shared Task System Report*  
Renjie Zheng, Hairong Liu, Mingbo Ma, Baigong Zheng and Liang Huang

*Improving Robustness of Neural Machine Translation with Multi-task Learning*  
Shuyan Zhou, Xiangkai Zeng, Yingqi Zhou, Antonios Anastasopoulos and Graham Neubig

**12:30–14:00** *Lunch*

**14:00–15:30** **Panel on "Open Problems in Machine Translation" (chair Ondrej Bojar): Alex Fraser (Ludwig-Maximilians-Universität München), Alon Lavie (Unbabel), Marcin Junczys-Dowmunt (Microsoft), Yvette Graham (Dublin City University)**

**15:30–16:00** *Coffee Break*

**16:00–17:30** **Session 4: Research Papers on Modeling and Analysis (chair: Matthias Huck)**

16:00–16:15 *Saliency-driven Word Alignment Interpretation for Neural Machine Translation*  
Shuoyang Ding, Hainan Xu and Philipp Koehn

16:15–16:30 *Improving Zero-shot Translation with Language-Independent Constraints*  
Ngoc-Quan Pham, Jan Niehues, Thanh-Le Ha and Alexander Waibel

16:30–16:45 *Incorporating Source Syntax into Transformer-Based Neural Machine Translation*  
Anna Currey and Kenneth Heafield

**Thursday, August 1, 2019 (continued)**

- 16:45–17:00 *APE at Scale and Its Implications on MT Evaluation Biases*  
Markus Freitag, Isaac Caswell and Scott Roy
- 17:00–17:15 *Generalizing Back-Translation in Neural Machine Translation*  
Miguel Graça, Yunsu Kim, Julian Schamper, Shahram Khadivi and Hermann Ney
- 17:15–17:30 *Tagged Back-Translation*  
Isaac Caswell, Ciprian Chelba and David Grangier

**Friday, August 2, 2019**

**9:00–10:30 Session 5: Shared Tasks Overview Presentations II (chair: Mark Fishel)**

- 9:00–9:20 *Findings of the WMT 2019 Shared Tasks on Quality Estimation*  
Erick Fonseca, Lisa Yankovskaya, André F. T. Martins, Mark Fishel and Christian Federmann
- 9:20–9:40 *Findings of the WMT 2019 Shared Task on Automatic Post-Editing*  
Rajen Chatterjee, Christian Federmann, Matteo Negri and Marco Turchi
- 9:40–10:00 *Findings of the WMT 2019 Biomedical Translation Shared Task: Evaluation for MEDLINE Abstracts and Biomedical Terminologies*  
Rachel Bawden, Kevin Bretonnel Cohen, Cristian Grozea, Antonio Jimeno Yepes, Madeleine Kittner, Martin Krallinger, Nancy Mah, Aurelie Neveol, Mariana Neves, Felipe Soares, Amy Siu, Karin Verspoor and Maika Vicente Navarro
- 10:00–10:15 *Shared Task on Similar Languages*
- 10:15–10:30 *Findings of the WMT 2019 Shared Task on Parallel Corpus Filtering for Low-Resource Conditions*  
Philipp Koehn, Francisco Guzmán, Vishrav Chaudhary and Juan Pino

**10:30-11:00 Coffee Break**

**Friday, August 2, 2019 (continued)**

**11:00–12:30 Session 2: Shared Task Poster Session I**

11:00–12:30 *Shared Task: Quality Estimation*

*RTM Stacking Results for Machine Translation Performance Prediction*  
Ergun Biçici

*Unbabel’s Participation in the WMT19 Translation Quality Estimation Shared Task*  
Fabio Kepler, Jonay Trénous, Marcos Treviso, Miguel Vera, António Góis, M. Amin Farajian, António V. Lopes and André F. T. Martins

*QE BERT: Bilingual BERT Using Multi-task Learning for Neural Quality Estimation*  
Hyun Kim, Joon-Ho Lim, Hyun-Ki Kim and Seung-Hoon Na

*MIPT System for World-Level Quality Estimation*  
Mikhail Mosyagin and Varvara Logacheva

*NJU Submissions for the WMT19 Quality Estimation Shared Task*  
Hou Qi

*Quality Estimation and Translation Metrics via Pre-trained Word and Sentence Embeddings*  
Elizaveta Yankovskaya, Andre Tättar and Mark Fishel

*SOURCE: SOURCE-Conditional Elmo-style Model for Machine Translation Quality Estimation*  
Junpei Zhou, Zhisong Zhang and Zecong Hu

11:00–12:30 *Shared Task: Automatic Post-Editing*

*Transformer-based Automatic Post-Editing Model with Joint Encoder and Multi-source Attention of Decoder*  
WonKee Lee, Jaehun Shin and Jong-Hyeok Lee

*Unbabel’s Submission to the WMT2019 APE Shared Task: BERT-Based Encoder-Decoder for Automatic Post-Editing*  
António V. Lopes, M. Amin Farajian, Gonçalo M. Correia, Jonay Trénous and André F. T. Martins

**Friday, August 2, 2019 (continued)**

*USAAR-DFKI – The Transference Architecture for English–German Automatic Post-Editing*

Santanu Pal, Hongfei Xu, Nico Herbig, Antonio Krüger and Josef van Genabith

*APE through Neural and Statistical MT with Augmented Data. ADAPT/DCU Submission to the WMT 2019 APE Shared Task*

Dimitar Shterionov, Joachim Wagner and Félix do Carmo

*Effort-Aware Neural Automatic Post-Editing*

Amirhossein Tebbifakhr, Matteo Negri and Marco Turchi

*UdS Submission for the WMT 19 Automatic Post-Editing Task*

Hongfei Xu, Qiuhui Liu and Josef van Genabith

11:00–12:30 *Shared Task: Biomedical Translation*

*Terminology-Aware Segmentation and Domain Feature for the WMT19 Biomedical Translation Task*

Casimiro Pio Carrino, Bardia Rafeian, Marta R. Costa-jussà and José A. R. Fonollosa

*Exploring Transfer Learning and Domain Data Selection for the Biomedical Translation*

Noor-e- Hira, Sadaf Abdul Rauf, Kiran Kiani, Ammara Zafar and Raheel Nawaz

*Huawei’s NMT Systems for the WMT 2019 Biomedical Translation Task*

Wei Peng, Jianfeng Liu, Liangyou Li and Qun Liu

*UCAM Biomedical Translation at WMT19: Transfer Learning Multi-domain Ensembles*

Danielle Saunders, Felix Stahlberg and Bill Byrne

*BSC Participation in the WMT Translation of Biomedical Abstracts*

Felipe Soares and Martin Krallinger

11:00–12:30 *Shared Task: Similar Languages*

*The MLLP-UPV Spanish-Portuguese and Portuguese-Spanish Machine Translation Systems for WMT19 Similar Language Translation Task*

Pau Baquero-Arnal, Javier Iranzo-Sánchez, Jorge Civera and Alfons Juan



**Friday, August 2, 2019 (continued)**

*The TALP-UPC System for the WMT Similar Language Task: Statistical vs Neural Machine Translation*

Magdalena Biesialska, Lluís Guardia and Marta R. Costa-jussà

*Machine Translation from an Intercomprehension Perspective*

Yu Chen and Tania Avgustinova

*Utilizing Monolingual Data in NMT for Similar Languages: Submission to Similar Language Translation Task*

Jyotsana Khatri and Pushpak Bhattacharyya

*Neural Machine Translation: Hindi-Nepali*

Sahinur Rahman Laskar, Partha Pakray and Sivaji Bandyopadhyay

*NICT's Machine Translation Systems for the WMT19 Similar Language Translation Task*

Benjamin Marie, Raj Dabre and Atsushi Fujita

*Panlingua-KMI MT System for Similar Language Translation Task at WMT 2019*

Atul Kr. Ojha, Ritesh Kumar, Akanksha Bansal and Priya Rani

*UDS–DFKI Submission to the WMT2019 Czech–Polish Similar Language Translation Shared Task*

Santanu Pal, Marcos Zampieri and Josef van Genabith

*Neural Machine Translation of Low-Resource and Similar Languages with Back-translation*

Michael Przystupa and Muhammad Abdul-Mageed

*The University of Helsinki Submissions to the WMT19 Similar Language Translation Task*

Yves Scherrer, Raúl Vázquez and Sami Virpioja

11:00–12:30 *Shared Task: Parallel Corpus Filtering*

*Dual Monolingual Cross-Entropy Delta Filtering of Noisy Parallel Data*

Amittai Axelrod, Anish Kumar and Steve Sloto

*NRC Parallel Corpus Filtering System for WMT 2019*

Gabriel Bernier-Colborne and Chi-kiu Lo

**Friday, August 2, 2019 (continued)**

*Low-Resource Corpus Filtering Using Multilingual Sentence Embeddings*  
Vishrav Chaudhary, Yuqing Tang, Francisco Guzmán, Holger Schwenk and Philipp Koehn

*Quality and Coverage: The AFRL Submission to the WMT19 Parallel Corpus Filtering for Low-Resource Conditions Task*  
Grant Erdmann and Jeremy Gwinnup

*Webinterpret Submission to the WMT2019 Shared Task on Parallel Corpus Filtering*  
Jesús González-Rubio

*Noisy Parallel Corpus Filtering through Projected Word Embeddings*  
Murathan Kurfalı and Robert Östling

*Filtering of Noisy Parallel Corpora Based on Hypothesis Generation*  
Zuzanna Pancheta, Germán Sanchis-Trilles and Francisco Casacuberta

*Parallel Corpus Filtering Based on Fuzzy String Matching*  
Sukanta Sen, Asif Ekbal and Pushpak Bhattacharyya

*The University of Helsinki Submission to the WMT19 Parallel Corpus Filtering Task*  
Raúl Vázquez, Umut Sulubacak and Jörg Tiedemann

**12:30–14:00** *Lunch*

**Friday, August 2, 2019 (continued)**

**14:00–15:30 Session 7: Invited Talk (chair: Matt Post)**

14:00–15:30 *Marine Carpuat (University of Maryland): Semantic, Style and Other Data Divergences in Neural Machine Translation*

**15:30–16:00 Coffee Break**

**16:00–17:30 Session 8: Research Papers on Applications (chair: Marco Turchi)**

16:00–16:15 *Hierarchical Document Encoder for Parallel Corpus Mining*  
Mandy Guo, Yinfei Yang, Keith Stevens, Daniel Cer, Heming Ge, Yun-hsuan Sung, Brian Strope and Ray Kurzweil

16:15–16:30 *The Effect of Translationese in Machine Translation Test Sets*  
Mike Zhang and Antonio Toral

16:30–16:45 *Customizing Neural Machine Translation for Subtitling*  
Evgeny Matusov, Patrick Wilken and Yota Georgakopoulou

16:45–17:00 *Integration of Dubbing Constraints into Machine Translation*  
Ashutosh Saboo and Timo Baumann

17:00–17:15 *Widening the Representation Bottleneck in Neural Machine Translation with Lexical Shortcuts*  
Denis Emelin, Ivan Titov and Rico Sennrich

17:15–17:30 *A High-Quality Multilingual Dataset for Structured Documentation Translation*  
Kazuma Hashimoto, Raffaella Buschiazzo, James Bradbury, Teresa Marshall, Richard Socher and Caiming Xiong

