Research Summary

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My primary research interest is in the area of Natural Language Processing (NLP) with emphasis on Machine Learning and Information Theory methods. I am particularly interested in Natural Language Generation and its practical applications. My *Conversation Generation* and *Creative Language Generation* projects are defined in this area.

I am also interested in interdisciplinary research and applying techniques from one field to another. My *Bilingual Text Compression* project is a combination of Machine Translation, Compression and Information Theory techniques.

Here is the list of projects I have worked on since 2014:

1. **Conversation Generation:** Companies like Microsoft and Apple deploy algorithms to help people converse with their devices. Amazon Alexa has announced a $2.5 million award competition to advance conversational artificial intelligence.[1] However these challenges still remain to be solved:

   - How can computers use external sources of information to make a grounded conversation?
   - How can computers make coherent conversations with humans?

   I worked on the first challenge during my internship at Microsoft Research (MSR). We present a deep learning method that use external databases (such as Foursquare) to generate more informative responses.

   Publications

   - "A Knowledge-Grounded Neural Conversation Model" (M. Ghazvininejad, C. Brockett, M. Chang, B. Dolan, J. Gao, W. Yih, M. Galley), arXiv preprint arXiv:1702.01932, 2017.

   Future Work. Current models still lack the ability to make fluent and engaging conversation with humans. It is hard for them to follow long dependencies between sentences, and to understand the points in the conversation. I plan to use hierarchical deep models to capture the low level and high level dependency in conversation.

2. **Creative Language Generation:** For a long time, there was a line between texts generated by human and computer: creativity. Although there are a few pieces of work about computer generated metaphor, irony, and humor, most people believe that creativity is out of reach for computers. In this project, we address this challenge by attacking these problems:

   - How can computers generate creative language?
   - How can computers help humans generate creative language in an interactive mode?

   We design a poetry system that generates any number of distinct 14-line poems on a user-supplied topic.[2] In addition, it interacts with users to help them generate poems. In the 2016 Dartmouth Poetix Competition, our system was ranked first, and we received a $3000 prize.[3] We publish our system as an Alexa Skill.[4]

   In addition, we show that creative language generation can enable new applications. In the security field, human generated passwords tend to be memorable but not secure. We use Natural Language Generation techniques to convert each random 60-bit string to a distinct 2-line rhyming iambic poem. We show how this technique generates easy-to-remember passwords with high security.[5]

   Publications

[1] https://developer.amazon.com/alexaprize
[2] http://52.24.230.241/poem
[3] http://bregman.dartmouth.edu/turingtests
[4] http://amzn.to/2sLOOKT
[5] http://52.24.230.241/bc/password_generation.php

- "How to Memorize a Random 60-Bit String" (M. Ghazvininejad and K. Knight), Proceedings of the Conference on North American Chapter of the Association for Computational Linguistics (NAACL), 2015.
- "Generating Topical Poetry" (M. Ghazvininejad, X. Shi, Y. Choi, and K. Knight), Proceedings of the Conference on Empirical Methods in Natural Language Processing (EMNLP), 2016.
- "Hafez: an Interactive Poetry Generation System" (M. Ghazvininejad, X. Shi, J. Priyadarshi, and K. Knight), Proc. ACL Demo Track, 2017.

Media Coverage:

- "Human Or Machine: Can You Tell Who Wrote These Poems?", NPR, Posted on June 27, 2016. [link]
- "These Researchers Have Discovered The Perfect Password That's Also Easy To Remember", Washington Post, Posted on October 22, 2015 [link]

Future Work. I plan to study different ways that computer and human can collaborate with each other. In addition, I plan to extend our creative text generation system to other domains such as story telling, and to model the main point of each story and poem.

3. **Bilingual Text Compression:** Text compression exploits redundancy in natural language to compress documents. Human-translated documents contain even more redundancy. In this project, we investigate the amount of this redundancy in bilingual text. We ask:

   - How much information does a human translator add to the original? That is, given a source sentence, how many extra bits are required to encode its human translation? To answer this question, we propose an information theoretic way to measure the amount of extra information. We design a web based game, and ask people to predict the behavior of a human translator. We are the first to come up with a lower and upper bound on the amount of extra information existing in translated text.
   - How much compression can be done by a bilingual compression algorithm in practice? We practically combine compression and translation ideas, and develop a compressor algorithm to compress a bilingual text effectively. In addition, we design a public bilingual compression challenge to further drive interest this area.[6]

   Publications

   - "How Much Information Does a Human Translator Add to the Original?" (B. Zoph, M. Ghazvininejad, and K. Knight), Proceedings of the Conference on Empirical Methods in Natural Language Processing (EMNLP), 2015.
   - "Humans Outperform Machines at the Bilingual Shannon Game" (M. Ghazvininejad and K. Knight), Entropy 19(1), 2017.

   Future Work. I plan to use our information theoretic tool to measure the language variation in translation and use this tool to study poetry translation more.

[6] http://www.isi.edu/natural-language/compression