NLP, Social Network Analysis and Recommendation Systems

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My research group focuses on research problems in the area of NLP, Social Network Analysis and Recommendation Systems. We focus on applied data science research. My group has worked on data from community question-answer (CQA) sites such as StackExchange and Quora; product reviews from e-commerce sites such as Amazon and Yelp; and social media data from sites such as Twitter and Facebook. Following are few sample problems that we have worked on and published recently -- Finding the top-k CQA sites for posting a given question; Finding whether a given question is tagged well or not; Recommending experts who would be willing to answer a given question; Summarizing and tagging product reviews; Analyzing factors of social media to maximize information diffusion; Summarizing social media posts. To enhance users' navigation through huge volumes of data, we have been exploring personalized and context-based recommendation systems. In 2019, my first PhD student Nagendra Kumar graduated with his PhD in the area of Social Network Analysis. At present, he is working as an Assistant Professor in the Computer Science Department in IIT Indore. My other graduated students have also been working as data scientists in organizations such as Yahoo! Japan, Rakuten in Japan, Walmart Labs in Bengaluru, A*STAR in Singapore.

Automated generation of Natural Language Text

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Automated generation of questions and answers are helpful in various scenarios such as reading comprehension, conversational systems, focused retrieval, knowledge graph enrichment etc. Even for humans, generating questions or answers from a specific input context requires high cognitive skills and thorough understanding of the language. Automating the task is hence even more challenging. However, recent advancements in NLP related to semantic understanding of text has made it possible to address many of the challenges that are common in these problem settings, and has given rise to newer problems in this area. Our research group works on problems related to such understanding and generation of natural language texts.

One way to assess the language understanding capability of the readers is to test their comprehension skills - ask them to read a piece of text, and then ask questions to verify how far they have understood the text. Use of multiple-choice-questions (MCQs) is a commonly followed technique for reading comprehension – as it requires pointed response from the candidates, and automating the evaluation becomes easy. In MCQs, generally there is one correct answer, and there are a few incorrect answers. Given a passage, a question, and a correct answer, multiple incorrect answers can be listed by the instructors.

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However, if the generation of these incorrect answers can be done in an automated manner, it will be quite useful – as it will save time for the instructor, and different sets of incorrect answers can be shown to different candidates. However, it is very much necessary to ensure that the generated incorrect answers (called distractors) are in the context of the questions, and they are not semantically equivalent. Otherwise, they can be easily eliminated by the test taker. We are working on automatically generating such grammatically correct long distractors for reading comprehension tasks.

Automated generation of correct responses and appropriate follow-up questions are at the center of conversational systems. It requires correctly understanding the intent of the questions, and also keeping track of the entire conversation as the user can specify his/her complete requirement in multiple turns. We are developing algorithms that can keep track of such dialogue states and ask/answer appropriately to understand the complete requirement.

Thorough understanding of textual content can be helpful in many ways. Social media posts generated during disasters often carry ground-level information from the affected regions. Efficient retrieval of such posts generated during can give actionable insights regarding the effect at specific regions, the requirements of resources (food, water, medicines, blankets etc.) at different locations, the efforts of different NGOs and individuals. All this information can be quite helpful in the planning rescue and relief operations significantly, and mitigate the suffering of the people in the affected regions.

Natural Intelligence & AI –
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Most popular AI and ML algorithms from the perceptron to CNNs have been inspired by principles of computational neuroscience. Our lab works on building large multiscale simulations of the spinal cord, muscles and skeleton to achieve movement using biological mechanisms across scales. Using the in-silico movement platform NEUROiD built in our lab, we explore methods by which our brain learns to manipulate the spinal circuits in order to achieve the desired movement.

In the context of AI, we use this platform in order to understand the general algorithms that underlie movement circuits in nature. If one may think of the muscle and skeleton as a natural robot, the spinal cord is a robotic controller that constantly adjusts drive and works in a closed feedback loop with the natural robot. The brain can similarly be thought of as a reinforcement learning system that uses the natural robot along with the spinal controller to achieve a movement. The tautness in muscles informs the brain of the internal state of the robot. Our eyes and sense of touch provide the rewards to the brain, telling them whether a movement is desirable or not.

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