• An explanation of any relevant background you have in category theory or any of the specific projects areas

Before describing my relevant background in categorial theory, I would like to briefly introduce my research theme. Currently I am working in the field of Natural Language Processing, specifically in Argumentation which involves trying to identify implicit assumptions and logical reasoning between sentences. Similar to most NLP tasks, my research requires best representation of sentences which captures underlying meanings and relationships based on its context. Recently, ELMo embeddings introduced a way to address this feature but capturing logical relations still remains a hard task.

Although I don't have any specific background in Categorial Theory, I have been in touch with the recent works by Bob Coecke and Mehrnoosh Sadrzadeh, and the focus on combining categorial grammar with distributional semantics. I believe its application in NLP will provide a new direction in addressing the problem of context specific embeddings along with a new way to identify implicit reasoning and logic.

• The date you completed or expect to complete your Ph.D and a one-sentence summary of its subject matter.

Currently I am pursuing my Master's degree in Information Sciences from Tohoku University and I am expecting to complete post-graduation by April 2020. I wish to continue my Ph.D under my current supervisor: Professor Kentaro Inui. My research focuses in the field of Argumentation more specifically towards identifying implicit assumptions and common-sense reasoning in argumentative sentences.

Order of project preference

- Mehrnoosh Sadrzadeh (Highly prefer)
- Pieter Hofstra
- Tobias Fritz
- Mariam Backens, Bartosz Milewski, David Spivak

• To what extent can you commit to coming to Oxford (availability of funding is uncertain at this time)

I believe that the application of this field is relatively new and significant for many NLP tasks. The importance of this field and its application in relation to my research is significant and can prove to be an inflection point in NLP community. If I am provided with this opportunity then definitely I will be willing to move forward.

• A brief statement (300 words) on why you are interested in the ACT2019 School.

I came across the proceedings of ACT 2018 through a booklet written by T. Bradley last year in relation to the application of category theory in NLP. Since the latter is my research domain and I had been in touch with the initial paper on Mathematical Foundations for a Compositional Distributional Model of Meaning, this workshop is very interesting to me. My current research in the sub-field of argumentation is concerned with identifying implicit assumptions and logical reasoning in arguments, more specifically using warrants to segregate claim and premise relations as relevant and non-relevant. Since embeddings play a major role in encoding the sentence, word2vec and glove embeddings are a highly referenced for most NLP tasks. But as these embeddings are unable to differentiate between words eg. watch as verb and watch as noun, it becomes really difficult to address semantics and syntax of a sentence at the same time. To counter this, recent state of the art approach in this field was ELMo embeddings which provided different embeddings as per the context in which the word appears. But the problem to address reasoning and identifying logical connection between sentences still remains an unexplored domain.

Since my current research is concerned with the aspect of logical reasoning, I believe a new approach and that of Applied Category theory can be a major turning point for my current research and other NLP tasks. The recent idea to capture syntax and semantics with functors has shown promising results - computers able to understand grammar and interpret the meaning of the sentence in a much better way without using deep neural networks. Hence, I think it will be very interesting to learn more about this field and model the experiments by using deep neural networks. At the same time incorporating logical and reasoning part, which is my central research area, will be a highly interesting task.

Since I am looking forward to further extend my current approach on a wider scale in my Ph.D, I believe ACT workshop and its learning can help me further my knowledge in this fast developing field which will help me in my future career.

Keshav Singh

Curriculum Vitae

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Research Interests

- Natural Language Processing
- Commonsense Reasoning
- Argumentation and Logical Inference

Education

2018–present **MS, Computer Science**, *Inui-Suzuki lab, Tohoku University*,Sendai, Japan.
Advisor: Professor Kentaro Inui
2013-2017 **BS, Mechanical Engineering**, *University Institute of Technology, Bhopal, India*.
CGPA: 7.25/10.0
2012 **Intermediate**, *Mount Carmel School, Bhopal, India 90.25%*.

Research Experience

Tohoku University, Japan

2018-present **Improving Evidence Detection using Warrants as External Knowledge**
Evidence detection is an important sub-task of argument mining and finds an application in a wide range of natural language comprehension tasks like identifying support and attack relation, essay evaluation and identifying entailment between sentences. Given a claim and a set of candidate premises (or evidences), the evidence detection task identifies the correct link between the given claim and a candidate premise. In this paper, we explore a new approach for identifying this link between a claim and premise by using warrants as external knowledge useful for evidence detection

University Institute of Technology, India

2016-2017 **Introduction, Application and Scope of predictive data analysis(PDA) in Boiler feed systems**

Internships

2016-2017 **Mechanical Engineer trainee**, *Bharat Heavy Electricals Limited*, BHEL, Bhopal, India

Honors

2017-present MEXT Research Scholarship by Government of Japan
2013-2017 M.P. Government merit based Student Scholarship, India
2015 3rd place, Virtual Stock Trading Championship by Reliance, India
2014 Ranked in top 50 National GoKart Championship, India
2013 North South Foundation Scholarship, Illinois, US

Scholastic and Curricular Achievements

2016 **IDYF, Japan**: Represented India in International Development Youth Forum, Tokyo, Japan

2015 **Agribida, Philippines**: Executed development project for water conservation with Davao Water Department, Philippines

2014-2015 Organised and executed **YSF** Youth speak forum with **AIESEC** *(with a team of 36 members)* in Central India

Skills

Programming	Python, Matlab, HTML-CSS, Java*
ML tools	Keras for Deep Learning, NLTK, Stanford Core NLP tool, Scikit-learn*
Operating Systems	Linux, Windows, Mac

* Ongoing

Languages

English	Fluent
Hindi	Fluent
Japanese	Conversational

Publications

National Conferences

ANLP 2019 Keshav Singh, Naoya Inoue, Paul Reisert, Kentaro Inui. Improving Evidence Detection using Warrants as External Knowledge. In Proceedings of The 25th Annual Meeting of the Association for Natural Language Processing 2019*

* -To be held in March 2019

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http://www.cl.ecei.tohoku.ac.jp/

January 30, 2019

Adjoint School,
ACT 2019
University of Oxford, UK

Sub: Recommendation letter

To, ACT2019 School,

I have had the pleasure of supervising Keshav Singh for the past one year as my student. He has been sincere and hard working with a consistent academic performance. His ability to ask questions and conduct his research and studies out of the classroom, reflects his potential for research.

In my observation, his current research project co-relates with one of the project areas of your program. His participation would be helpful for his future research and the experience he gains would also be an asset to his colleagues.

I believe that this program will be helpful for him and, hence, strongly recommend him to apply for it.

If I can be of any further assistance, or provide you with further information, please do not hesitate to contact me.

Sincerely,

Kentaro Inui, Professor