# Paraphrase Identification via Textual Inference Ning Shi, Bradley Hauer, Jai Riley, Grzegorz Kondrak

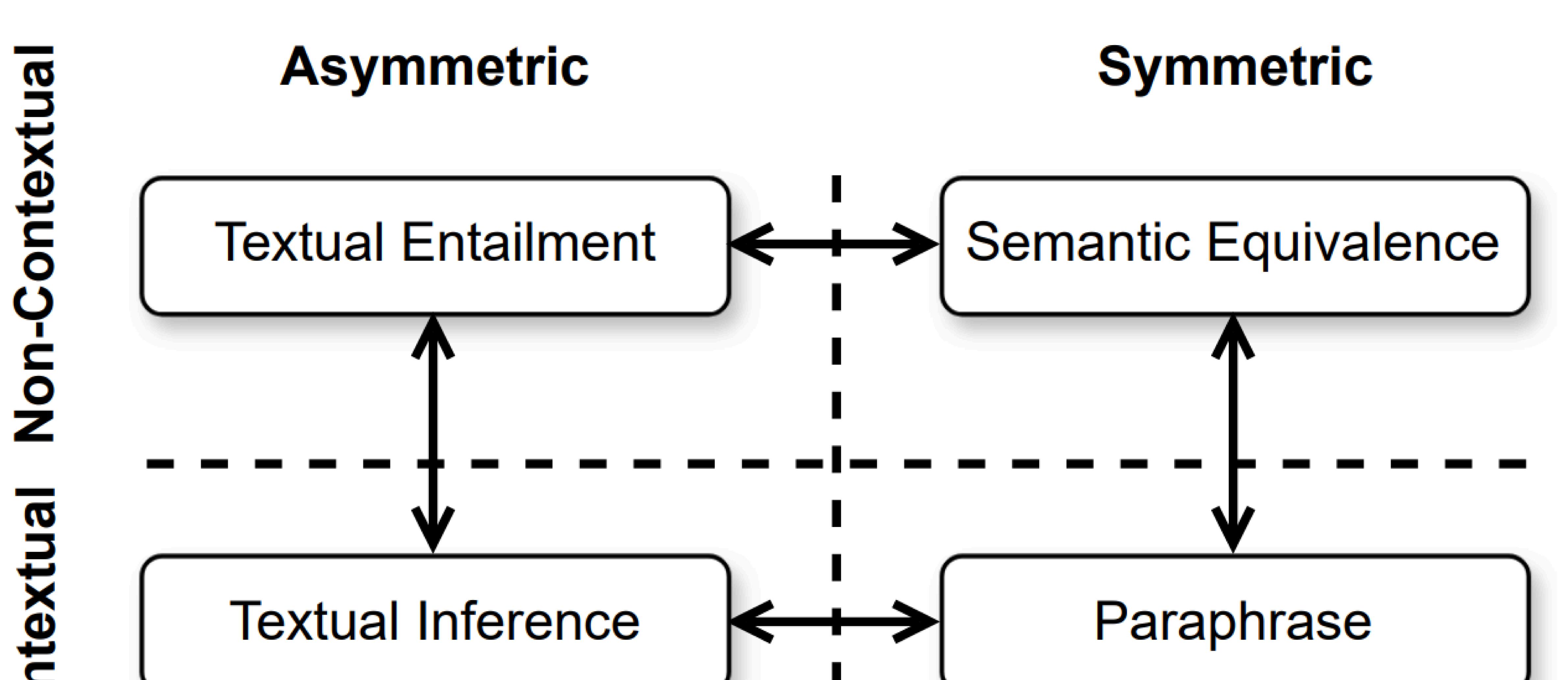
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### Introduction

Paraphrase Identification (PI) is the task of deciding whether two sentences convey the same meaning.

Natural Language Inference (NLI) involves three labels that describe the **relationship between two sentences: entailment**, contradiction, and neutral.

It has been hypothesized that **paraphrasing corresponds to bidirectional textual entailment**, but existing empirical methods lack theoretical formalization and resemble traditional PI approaches.

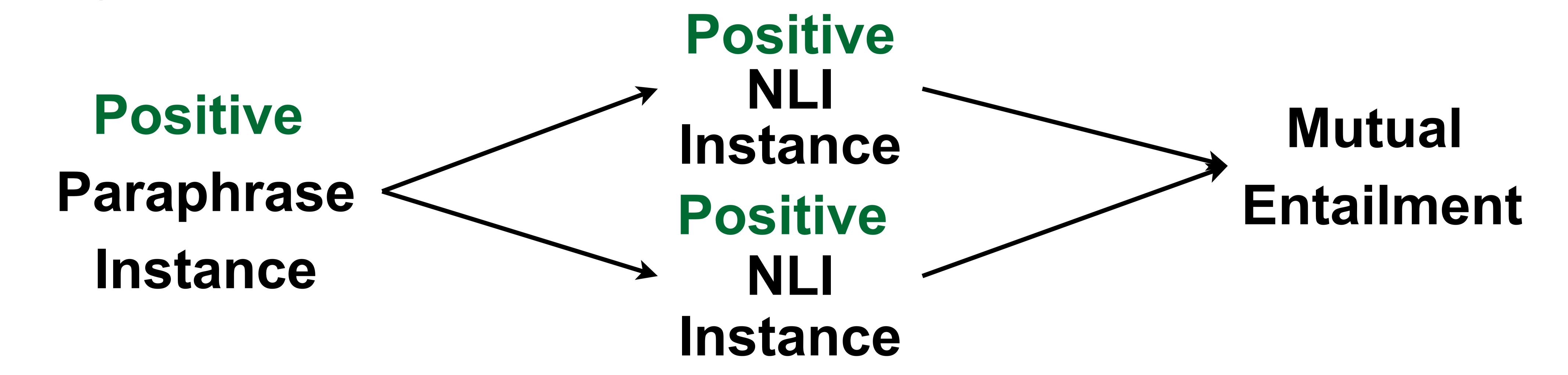


We present the first theoretical formalization implying a practical reduction of PI to NLI, validated by fine-tuning an NLI model for PI.

### **Dataset Adaptation**

We posit that the task of **PI can be reduced to NLI (PI2NLI)**, specifically the detection of the TI relation by training an NLI system on PI data.

To do this, we **convert each positive PI instance into two distinct positive NLI** instances (NLI label is entailment), one in each direction, indicating **mutual TI between two paraphrases.** 



A negative PI instance is transformed into a negative NLI instance

(NLI label randomly selected as either contradiction or neutral) in **one** randomly selected direction.

## Methodology

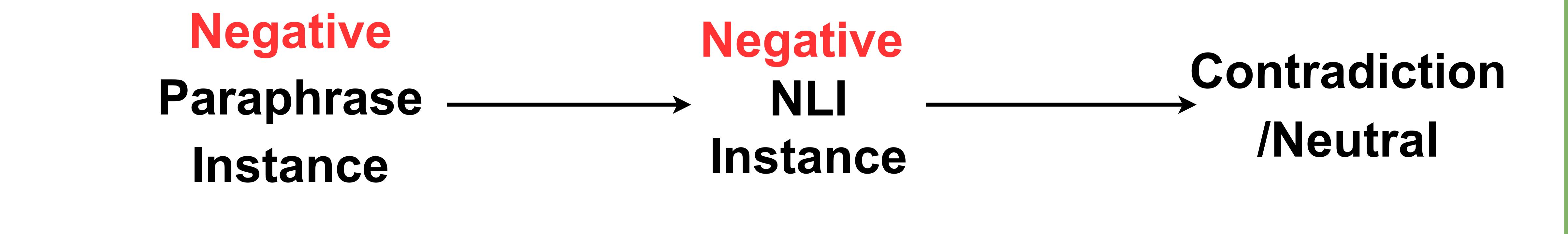
We solve Paraphrase Indentification (PI) by reducing the problem to Textual Inference (TI) and solving via a fine-tuning procedure that allows an NLI model to be fine-tuned for PI instances. To do this we make the following formalizations: Semantic Equivalence, SEQ( $S_1, S_2$ ) := "the sentences,  $S_1$  and  $S_2$ , convey the same meaning" Paraphrase Relation, PR( $C, S_1, S_2$ ) := "the sentences,  $S_1$  and  $S_2$ , convey the same meaning in the given context, C" For example:

 $S_1$  = We must work hard to win this election.

 $S_2 = The Democrats must work hard to win this election.$ 

Reduction from SEQ to PR:

 $SEQ(S_1, S_2) \Leftrightarrow \forall C : PR(C, S_1, S_2)$ 



#### Results

Our PI2NLI reduction yields consistently high F1 scores, outperforming the reported results obtained by prior work on all non-PAWS datasets.

**T**extual **E**ntailment, **TE**( $S_1$ ,  $S_2$ ) := "the sentence,  $S_2$ , can be

inferred from the sentence, S<sub>1"</sub>

Reduction from SEQ to TE:

 $SEQ(S_1, S_2) \Leftrightarrow TE(S_1, S_2) \land TE(S_2, S_1)$ 

**T**extual Inference, **TI**(C,  $S_1$ ,  $S_2$ ) := "the sentence,  $S_{2,}$  can be inferred from the sentence,  $S_1$ , given the context, C" **Reduction from TE to TI**: