# Neural Networks for Negation Cue Detection in Chinese

**Hangfeng He[1], Federico Fancellu[2] and Bonnie Webber[2]**
[1]School of Electronics Engineering and Computer Science, Peking University
[2]ILCC, School of Informatics, University of Edinburgh
hangfenghe@pku.edu.cn, f.fancellu@sms.ed.ac.uk, bonnie@inf.ed.ac.uk

p **Negation Cue Detection**

    p Recognize the tokens (words, multi-word units or morphemes) inherently expressing negation

    p A prerequisite for detecting negation scope

p **An Example**

所有住客均表示不会追究酒店的这次管理失职。

(All of guests said that they would **not** investigate the dereliction of hotel.)

Negation Cue "不(not)":
Indicate the clause is negative

p **Previous Work**

- p [Zou et al. 2015]
  - sequential classifier
  - Lexical features (word n-grams)
  - Syntactic features (PoS n-grams)
  - Morphemic features (whether a character has appeared in training data as part of a cue)
  - Chinese-to-English word-alignment.

p **Question:**

    p Can we detect negative cues <span style="color:red">without highly-engineered features</span> ?

p **Challenges**

    p Homographs (e.g. "非常(very)" → "非(not)").

    p *False* negation cue (e.g."非要(can't help)" -> "非(not)").

    p High combinatory power of negation affixes

        (e.g. "够(sufficient)"-> "不够(insufficient)").

p **Introduction**

p <span style="color:red">**Model**</span>

p **Experiments**

p **Error Analysis**

p **Conclusion**

p **Sequence Tagging**

    p Given a sentence $ch = ch_1 \ldots ch_{|c|}$. (We do not do segmentation and the input is <span style="color:red">a sequence of character</span>.)

    p We represent each character $ch_i \in ch$ as a $d$-dimensional character embedding

    p The goal of automatic cue detection is to predict a vector

$s \in \{O, I\}^{|n|}$ s.t. $s_i = I$ if $ch_i$ is <span style="color:red">part of</span> the cue or otherwise.
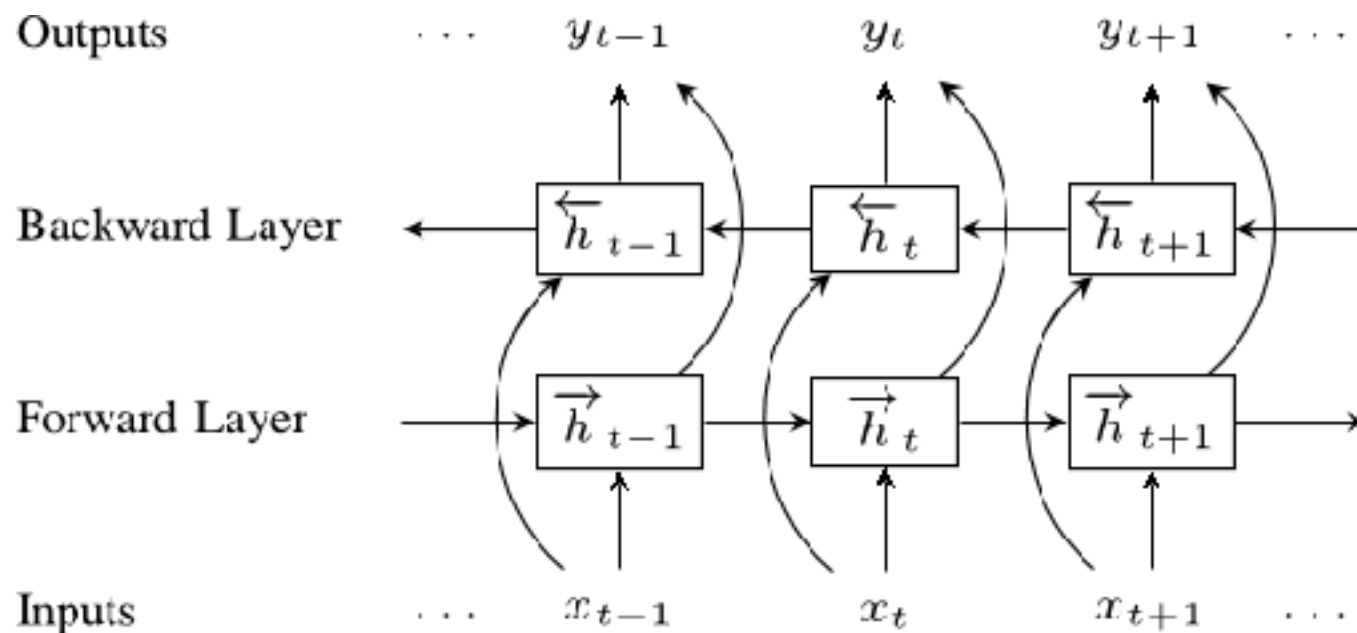
p   The predictions made are independent from each other

p   A new **joint** model

p   Add a 4-parameter transition matrix to create the dependency on the <span style="color:red">previous input</span> $s_{i-1}$.

$$p(s|ch) = \prod_{i=1}^{n} p(s_i|s_{i-1}, ch)$$

p **Introduction**

p **Model**

p **Experiments**

p **Error Analysis**

p **Conclusion**

p **Data**

  p  Chinese Negation and Speculation (CNeSp) corpus [Zou et al., 2015]

  p  CNeSp is divided into three sub-corpora: Product reviews (*product*), Financial Articles (*financial*) and Scientific literature (*scientific*).

| | Sentence Number | Cue Number |
|---|---|---|
| *Financial* | 6550 | 1461 |
| *Product* | 4969 | 3914 |
| *Scientific* | 4626 | 171 |

Table 1: Details of the three CNeSp subcorpora.

  p  Although [Zou et al., 2015] ... idation. We use a fixed 70%/... ne a fixed
     development set for error analysis.

p **Negation cues in training data:**

    p Such as "不(not)","非(not)"...

p **An Example**

    p Ground truth

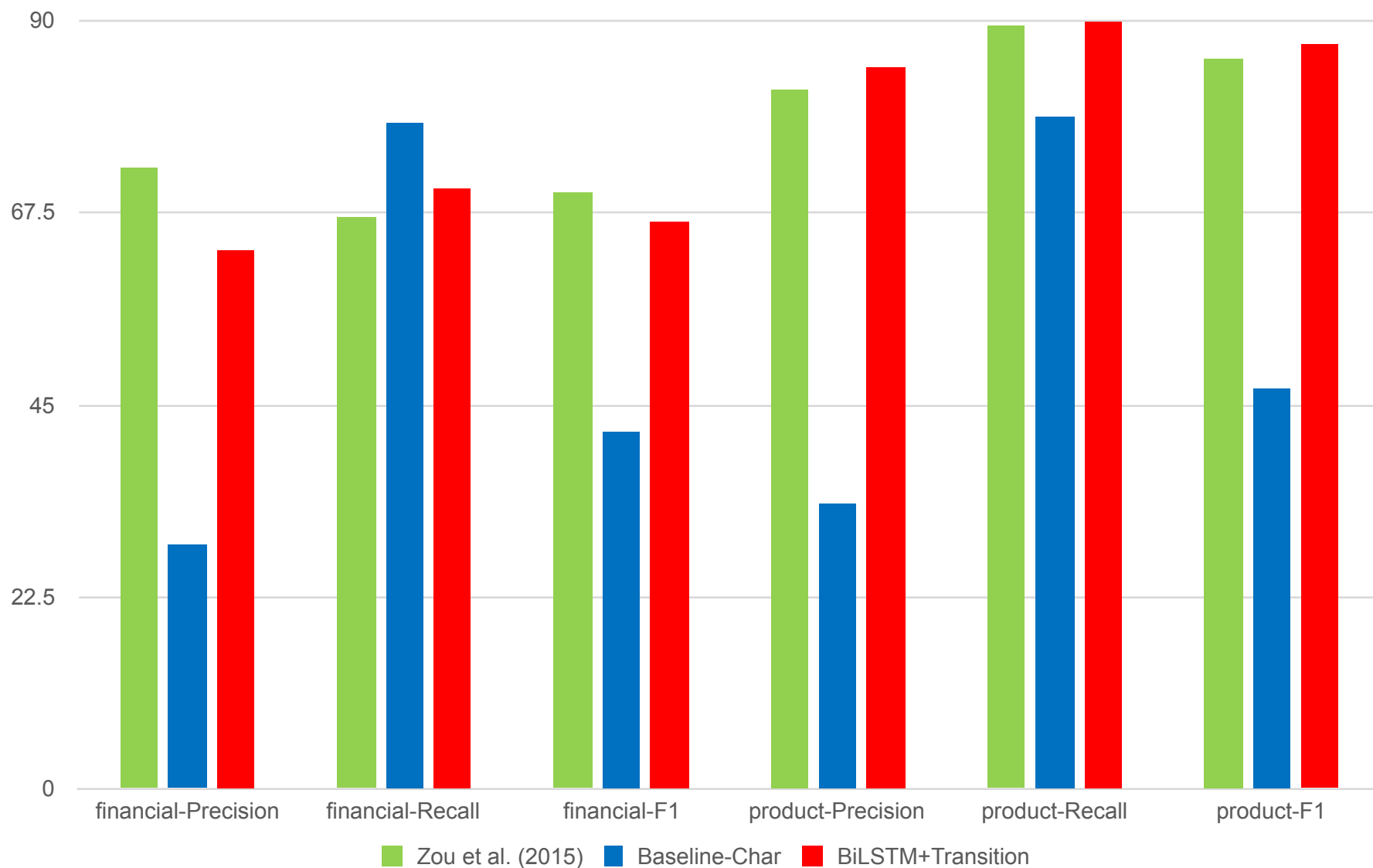    …,受经济不景气影响 ,…

    (…,influenced by the economic depression,…)

    p Baseline-Char

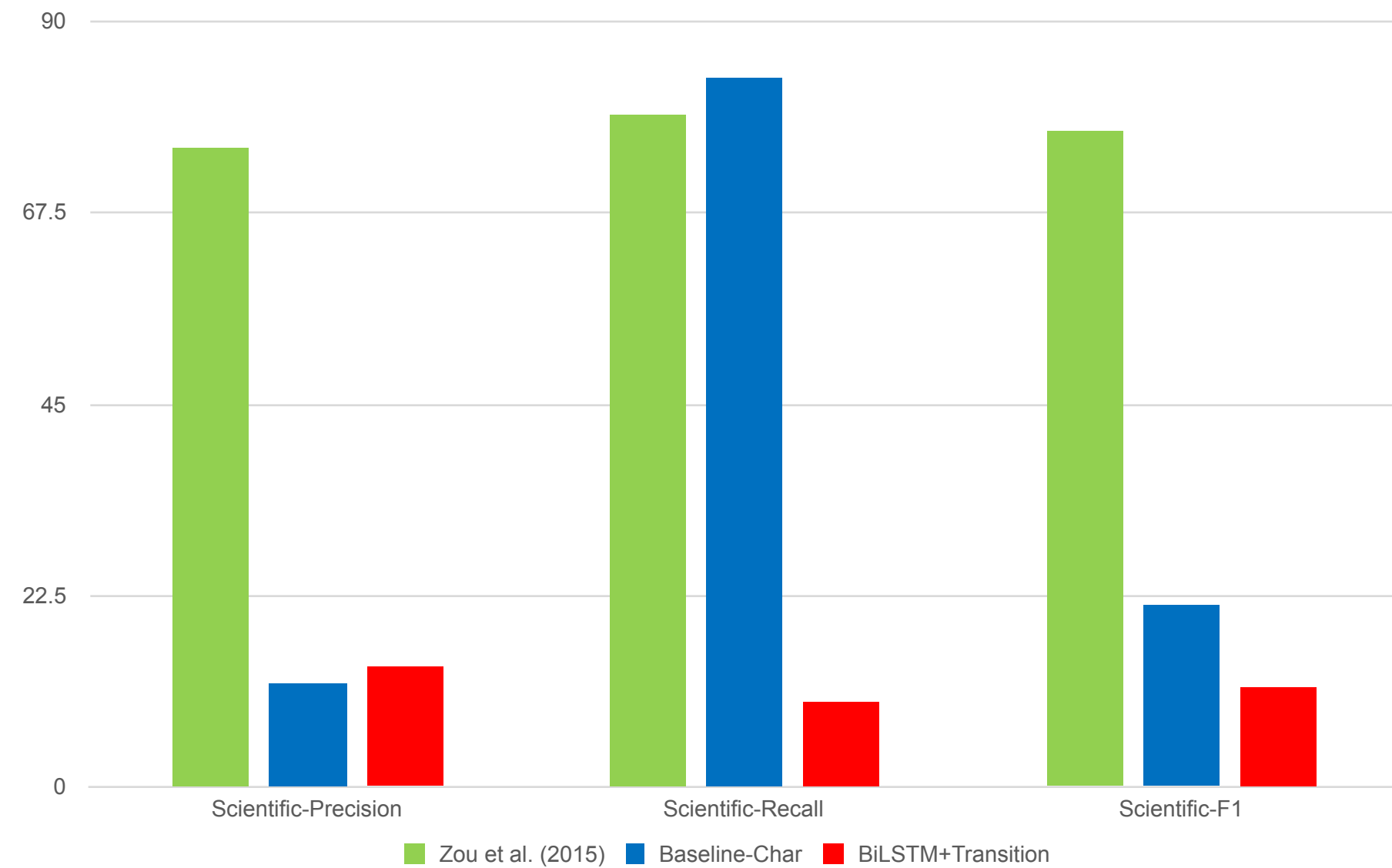…,受经济不景气影响 ,…

    p Baseline-Word

…,受　经济　不景气　影响 ,… (segment first)

# Results



Legend: Zou et al. (2015) (green), Baseline-Char (blue), BiLSTM+Transition (red)

Categories: financial-Precision, financial-Recall, financial-F1, product-Precision, product-Recall, product-F1

14

p **Introduction**

p **Model**

p **Experiments**

p <span style="color:red">**Error Analysis**</span>

p **Conclusion**

p **Error**

    p most of the errors are under-prediction errors.

p **An Example**

……,受经济<u>不景</u>气影响 ,……

(…,influenced by the economic depression,…)

p **Method**

> p We first used the NLPIR toolkit to segment the sentence and if the detected cue is part of a word, then the whole word is considered as cue.

p **Improvement**

| | Precision | Recall | F1 |
|---|---|---|---|
| Original | 65.15 | 73.02 | 68.86 |
| Post Process | **66.39** | **74.42** | **70.18** |

Table 4: Difference between before and after post process in financial sub corpora

p **Error**

    p  Our models predict more negative cues than gold one. These errors concern the most frequent negative cues such as "不(not)"and "没(not)".

p **An Example**

房间设施一般，网速<u>不</u>仅慢还经常断网。

(The room facilities are common and the network ***not only*** is slow but also often disconnect.)

p **Introduction**

p **Model**

p **Experiments**

p **Error Analysis**

p **Conclusion**

p  **We confirm that character-based neural networks are able to achieve on par or better performance than previous highly-engineered sequence classifiers.**

p  **Future Work**

  p  Given the positive results obtained for Chinese, future work should focus on testing the method in other language as well.

# Thank you!

# Any question?