A Multi-head Self-relation Network for Scene Text Recognition

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Introduction

• The text embedded in scene images can be seen everywhere in our lives. However, recognizing text from natural scene images is still a challenge because of its diverse shapes and distorted patterns.
• The scene text recognition aims to retrieve all text strings from scene text images. It is a high-level and complicated task that translates between two different forms of information: Computer vision and Natural Language Processing.
• Extracting a meaningful text representation has become a challenge due to the complex environment in the irregular scene text recognition task such as uneven illumination, positional changes and so on.

Objectives

• A multi-head self-relation layer is proposed in this paper, which can be used to capture the relation between visual feature map cells. And the multi-head self-relation layer can learn 2-D attention in spatial.
• The MSRN is trained under the end-to-end training mode without any additional pixel-level or character-level supervision information, it means that the multi-head self-relation layer is weakly supervised by the cross-entropy loss on the final predictions.
• The proposed multi-head self-relation layer in this paper will not change the size of the feature map, if the multi-head self-relation layer is removed, the model can still work without any changes, so that it can be embedded in other models.

Method

The overall framework consists of two main components: MSRN(encoder) and multi-head attention(decoder).
• Firstly, the input includes a text image and its ground-truth sequence. Then the deep visual representations of the text image can be extracted by using the proposed Multi-head Self-relation Network in this paper.
• Secondly, the output of the last three multi-head self-relation layers is taken as the input of the decoder, resulting in three text representations.
• Finally, the text representations are concatenated and used to predict the result sequence.

Algorithm: Multi-head Self-relation Layer

Input: Visual feature vectors generated by a convolutional layer
1. Transform the visual feature vectors \( X = \{x_1, x_2, \ldots, x_n\} \) into higher-level features \( E = \{e_1, e_2, \ldots, e_n\} \) by a learnable weight \( W \).
2. Get the relation coefficient between each vector.
3. for head = 1: head numbers do:
4. for i = 1: n do:
5. \( a_{ij} = \exp(\text{LeakyReLU}(\text{LayerNorm}(x_i e_j))) \)
6. \( h_i = \sum_{j=1}^{n} a_{ij} e_j \)
7. \( end \ for \)
8. \( end \ for \)
9. \( end \ for \)
10. Then all the heads’ features are concatenated resulting in \( t_i = \text{Concat}(h_1, \ldots, h_n) \).
11. Output: \( y_i = x_i + W_1\text{ReLU}(W_2t_i) \)

Results

Table I shows that when the head number is 8, the recognition network gets the best performance.
Table II shows that when we use MSR2, MSR3, MSR4, and MSR5, the performance is best.
As shown in Table III, when the decoder includes MHA1, MHA2, and MHA3, our model gets the best recognition accuracy.
From Table IV we can also learn that the performance of our method improves more on irregular datasets than that on regular datasets.

Conclusion

In this paper, we propose a novel multi-head self-relation network, which can extract the relationship between each feature map cell.
• In our recognition network, a feature map is treated as a graph and each cell is treated as a node of the graph, then a correlation matrix is learnt to guide the nodes states updating.
• The performance of our recognition network shows that the MSRN is effective.

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