

Deep Reasoning with Knowledge Graph for Social Relationship Understanding

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Abstract

- GRM(Graph Reasoning Model)
 - A deep neural network integrated from a knowledge graph to explore the interaction between persons of interest and the contextual objects by the propagation mechanism

Introduction

- Task: recognizing the social relationships of person pairs in still image reasoning the relationship in still image
 - There are differences between:
 - Relationships\ Occasions\ Contextual cues
 - Previous works: model correlations between social relationships and contextual cues
- GRM:
 - Organize the prior knowledge as a structured graph
 - Initialize the graph nodes with corresponding semantic regions and employ a GGNN

Related Work

- Social relationship recognition
 - As supplementary cues to improve tasks
 - Directly predict social roles and relationships
- Knowledge representation -- represent extr/prior knowledge in the form of graph structure -- explore message propagation by learnable neural networks

Graph Reasoning Model

- Nodes
 - Representing the social relationships and semantic objects
- Edges
 - Representing the probabilities of their co-occurrences
- Given an image and a person pair of interest
- GRM
 - Follows to extract features and initializes the relationship nodes
 - Use a Faster-RCNN detector to search semantic objects and extract their features to initialize the corresponding object nodes
 - Employs the GGNN to propagate node message and adopts the graph attention mechanism

Graph Reasoning Model

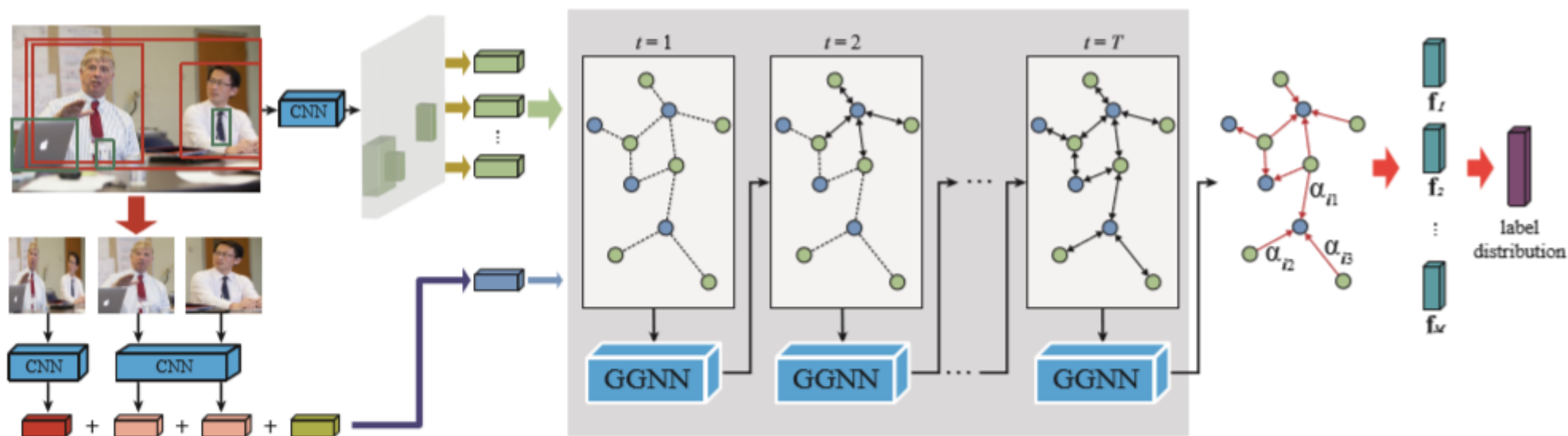


Figure 2: An overall pipeline of our proposed graph reasoning model. Given an image and a person pair, the GRM initializes the relationship nodes with features extracted from regions of person pair and the object nodes with features extracted from corresponding semantic regions in the image. Then it employs the GGNN to propagate node message through the graph to compute node-level features, and introduces a graph attention mechanism to attend to the most discriminative object nodes for recognition by measuring their importance to each relationship node.

Graph Reasoning Model

- Knowledge Graph Propagation
 - GGNN
 - Learn features by interactively updating node representation graph contains two types of nodes
 - Social relationship
 - Object
 - Features
 - Two person union+ One person+ Another person+ Position information =neural network=> Features
 - Nodes
 - Distinguish by one hot vector
 - Object nodes: using region information to initialize
 - Social relationship: use Faster-RCNN to collect semantic objects

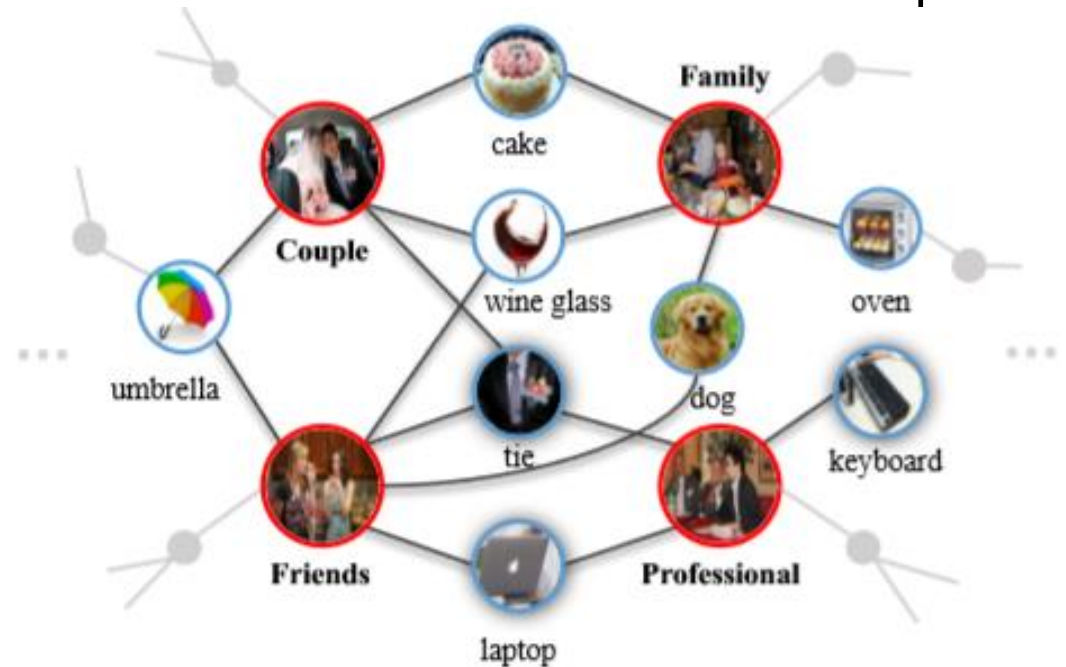
Graph Reasoning Model

- Graph Attention Mechanism
 - Introduce a novel attention mechanism reasons about the most relevant contextual objects
- Optimization
 - Cross entropy

Experiments

- Knowledge graph building
 - Train COCO dataset to detect **objects** of the image as the **semantic objects**
 - Count the **frequency** of the co-concurrences of each **relationship-object pair**
 - The knowledge graph can basically describe the correlation between relationship and object by counting their co-concurrence

An example knowledge graph



Experiments

- Experiments setting
 - Datasets: PISC, PIPA-Relation
- Comparisons with State-of-the-Art Methods
- Ablation study
 - Randomly **initialize** the adjacency matrix of the graph
 - Remove the **attention mechanism** module and directly concatenate features for recognition; replace the attention mechanism with randomly selected scores and retrain the model in an identical way
 - Use different **threshold** values for selecting an optional threshold
- Qualitative Evaluation



Datasets samples

Conclusion

- Propose a Graph Reasoning Model (GRM) that incorporates common sense knowledge of the correlation between social relationship and semantic contextual cues in the scene into the deep neural network to address the task of social relationship recognition.