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Information technology - Neural network representation and model compression - Part 3: Graph neural networks

信息技术 神经网络表示与模型压缩 第3部分：图神经网络

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2 Normative references

This document has no normative references.

4.Abbreviations The following abbreviations apply to this document. AM-GCN. Adaptive Multi-channel Graph Convolutional Network APPNP. Approximate Personalized Propagation of Neural Predictions BERT. Bidirectional Encoder Representations from Transformers BNS. Boundary Node Sampling ChebNet. Chebyshev Spectral Graph Convolutional Network Cluster-GCN. Cluster-Graph Convolution Network D-MPNN. Directed Message Passing Neural Networks DCNN. Deep Convolutional Neural Networks DiffPool. Differentiable graph pooling DmoN. Deep Modularity Networks EXACT. Extreme Activation Compression (Scalable Graph Neural Networks Training via Extreme Activation Compression) (pression) FAGCN. Frequency Adaptation Graph Convolutional Networks FGNN. Factor Graph Neural Network GaAN. Graph Attention Network GAMLP. Graph Attention Multi-Layer Perceptron GAT. Graph Attention Networks GCN. Graph Convolutional Networks GCNII. Simple and Deep Graph Convolutional Networks GeomGCN. Geometric Graph Convolutional Networks GGNN. Gated Graph Neural Network GIN. Graph Isomorphism Network GINE. Graph Isomorphism Network with Edge Features GloGNN. Graph Neural Network with Global Information GMN. Graph Matching Networks GNN. Graph Neural Network GNN-LF/HF. Low-Frequency/High-Frequency Graph Neural Network (quency) GNN-SD. Graph Neural Network Self-Distillation (GNNSelf-Distilization) GPRGNN. Generalized PageRank Graph

Neural Network Neural Network GRACED. Graph Augmented MLPs via Customized Knowledge Distillation Knowledge Distilation) GRAN. Graph RecurrentAttention Networks GraIL. Graph Inductive Learning GraphGPS. Graph-based Progressive Propagation and Searching GraphSAGE. Graph Sampling and Graph Aggregation GraphSaint. Graph Sampling-Based Inductive Learning GTN. GraphTransformerNetwork HACUD. A Cash-Out User Detection Model Based on Attribute Heterogeneous Information Networks and Hierarchical Attention Mechanisms basedonAttributedHeterogeneousInformationNetworkwithaHierarchicalAttentionMechanism) HeCo. Self-Supervised Heterogeneous Graph Neural Network with Cooperative Comparative Learning NetworkwithCo-ContrastiveLearning) HERec. A recommendation method based on heterogeneous information network embedding. (ommendation) HGAT. Heterogeneous Graph Attention Network HGT. Heterogeneous Graph Transformer HIN. Heterogeneous Information Network HPN. Heterogeneous Graph Propagation Network IGSD. Iterative Graph Self-Distilization JKnet. Jumping Knowledge Networks LADIES. Layer-Dependent Importance Sampling Line. Large-scale Information Network Embedding LSP. Locality-Sensitive Pruning LSTM. Long Short-Term Memory Network LTD. Learning to Distil MCCF. Multi-Component Graph Convolutional Collaborative Filtering Model ring) MEIRec. Metapath-guided Embedding method for Intent recommendation Recommendation) MLP. Multilayer Perceptron molGAN. Molecular Generative Adversarial Network MPNN. Message Passing Graph Networks MPSN. Motion-aware PseudoSiamese Network NBFNet. Neural Belman-Ford Network Node2Vec. An algorithmic framework for learning continuous feature representations of nodes in a network (NodetoVector) PAGNN. Path-aware Graph Neural Network PPNP. Predict-then-Propagate. Graph Neural Network Prediction and Propagation Based on Personalized PageRank Algorithm NeuralNetworksmeetPersonalizedPageRank) ResGatedgraph. Residual Gated Graph Neural Network R-GCN. Relational Graph Convolutional Network ROD. Reception-aware Online Distilation for Sparse Graphs SAT. Simple Example Adaptive Self-Training Semi-Supervised Text Classification withSimpleInstance-AdaptiveSelf-Training) SEAL. Link Prediction from Subgraphs, Embeddings, and Attributes utesforLinkPrediction) SGC. Simple Graph Convolution SSP. Stale Synchronous Parallel VQ-GNN. Vector Quantization-Graph Neural Network

5 Overview of Graph Neural Network Representations and Model Compression

This document provides a unified reference specification for graph neural network representation and model compression, and its overall architecture is shown in Figure

1.This architecture... The standardization of the representation format, compression and acceleration methods, and computational framework of graph neural networks is beneficial for improving... The efficiency of developing and running graph neural network models on various devices. Figure

1.Overall architecture of graph neural network representation and model compression The overall architecture consists of the following three parts. Graph Neural Network Representation. This standardizes the representation methods of graph neural networks, including methods for representing graph data and graph neural network models. The method of representation. Graph data representation includes the definition of basic data types, the definition of graph data types, the definition of basic graph operations, and the definition of basic graph tasks. Definition. The graph neural network model representation covers the model structure and basic operator definitions, and standardizes the graph neural network points from the perspective of task partitioning. Operator interfaces for level-based, edge-based, and graph-based models. This section specifically corresponds to Chapters 6 and 7 of this document. Graph Neural Network Compression and Acceleration. This section standardizes graph neural network compression methods, model acceleration strategies, and their operator interfaces. Compression method package... This includes two parts. graph data compression and graph model compression. Graph data compression includes graph topology compression and graph feature data compression. And graph sampling. Graph model compression includes model quantization pruning and model distillation. For both graph data and model compression methods, definitions are provided. Metrics for measuring performance. Graph model acceleration includes parallel acceleration strategies, iterative acceleration strategies, graph partitioning strategies, and communication acceleration strategies. This part specifically corresponds to Chapter 8 of this document.

6.1 Basic Definitions

6.1.1 Overview This document defines the data structures and various basic data types.

6.1.2 Data Structure Definition This document defines a message as the basic unit of a data structure, and fields as the basic elements that constitute a message, as shown in Figure 2. As shown. Figure

2 Data Structure Definition Specification Messages consist of a series of fields with specific labels (fieldlabel), types (fieldtype), names (fieldname), and numbers (field). The data consists of fields (e.g., numbers). The message itself can be used as the field type to enable nested data structures.

a) Field Label. Field labels are used to define the attributes and usage rules of a field. By default, all fields are... It is considered optional and does not require explicit declaration. This approach aims to simplify the use of programming languages and ensure backward compatibility. When a field needs to represent multiple values, the "repeated" keyword should be used to indicate that the field can contain one or more values. The values above.

b) Field Type. The field type defines the data type that the field can store. This type includes int32, float, etc. Standard data types such as double, bool, and string, as well as composite data types such as enumerations, maps, and messages. type.

c) Field Name. The field name is a unique name specified for the field in the message definition, used to identify and access the message. The specific details of the information.

d) Field number. The field number is a positive integer used to uniquely identify a field in the binary format of the message. This number is crucial in the message serialization and deserialization process, ensuring that even if field names differ across languages... Similarly, the structure of the data can still be correctly understood.

6.2.4 Definition of Dynamic Graphs The definition of a dynamic graph is shown in Table 14.

6.2.5 Definition of Coordinate Graph The definition of a coordinate graph is shown in Table 15.

6.3 Basic Graph Operations The basic operation definitions for graph operations are shown in Tables 16 to 49. The definition of the degree operation is shown in Table 16.

7.1.1 Definition of Computational Graph

7.1.1.1 Defining the computation graph class The definition classes for computational graphs are shown in Table 50. Version Definition

7.1.1.3 The version definition is shown in Table 52.

7.1.1.4 Function Library Definition The function definition library (FunctionDefLibrary) is shown in Table 53.

7.1.1.5 Calculation Graph Debugging Information The definition of computation graph debugging information (GraphDebugInfo) is shown in Table 58.

7.1.2 Definition of Graph Neural Network Model Structure The graph neural network model structure definition (Model) is shown in Table 61.

7.2 Basic Operators

7.2.1 Overview Basic operators are the fundamental components for passing and aggregating messages in graph neural networks, and are divided into message passing operators (MessagePassingOperator-) The three operators are. pooling operator, normalization operator, and pooling operator.

7.2.2 Message Passing Operator

7.2.2.1 Overview The message passing operator is a core operation in graph neural networks, simulating the propagation and interaction of messages within a graph structure. Its computation... The process includes three sub-operators. message operator, aggregate operator, and update operator. (operator). Message-passing-based graph neural network convolution operators can be combined using message operators, aggregation operators, and update operators. accomplish.