Probabilistic Approaches to Recommendations

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Probabilistic Approaches to Recommendations Nicola Barbieri,Giuseppe Manco,Ettore Ritacco,2022-05-31 The importance of accurate recommender systems has been widely recognized by academia and industry and recommendation is rapidly becoming one of the most successful applications of data mining and machine learning Understanding and predicting the choices and preferences of users is a challenging task real world scenarios involve users behaving in complex situations where prior beliefs specific tendencies and reciprocal influences jointly contribute to determining the preferences of users toward huge amounts of information services and products Probabilistic modeling represents a robust formal mathematical framework to model these assumptions and study their effects in the recommendation process This book starts with a brief summary of the recommendation problem and its challenges and a review of some widely used techniques Next we introduce and discuss probabilistic approaches for modeling preference data We focus our attention on methods based on latent factors such as mixture models probabilistic matrix factorization and topic models for explicit and implicit preference data These methods represent a significant advance in the research and technology of recommendation The resulting models allow us to identify complex patterns in preference data which can be exploited to predict future purchases effectively The extreme sparsity of preference data poses serious challenges to the modeling of user preferences especially in the cases where few observations are available Bayesian inference techniques elegantly address the need for regularization and their integration with latent factor modeling helps to boost the performances of the basic techniques We summarize the strengths and weakness of several approaches by considering two different but related evaluation perspectives namely rating prediction and recommendation accuracy Furthermore we describe how probabilistic methods based on latent factors enable the exploitation of preference patterns in novel applications beyond rating prediction or recommendation accuracy We finally discuss the application of probabilistic techniques in two additional scenarios characterized by the availability of side information besides preference data In summary the book categorizes the myriad probabilistic approaches to recommendations and provides guidelines for their adoption in real world situations **Mining Structures of Factual Knowledge from Text** Xiang Ren,Jiawei Han,2022-05-31 The real world data though massive is largely unstructured in the form of natural language text It is challenging but highly desirable to mine structures from massive text data without extensive human annotation and labeling In this book we investigate the principles and methodologies of mining structures of factual knowledge e g entities and their relationships from massive unstructured text corpora Departing from many existing structure extraction methods that have heavy reliance on human annotated data for model training our effort light approach leverages human curated facts stored in external knowledge bases as distant supervision and exploits rich data redundancy in large text corpora for context understanding This effort light mining approach leads to a series of new principles and powerful methodologies for structuring text corpora including 1 entity recognition typing and synonym discovery 2 entity

relation extraction and 3 open domain attribute valuemining and information extraction This book introduces this new research frontier and points out some promising research directions **Multidimensional Mining of Massive Text Data** Chao Zhang,Jiawei Han,2022-06-01 Unstructured text as one of the most important data forms plays a crucial role in data driven decision making in domains ranging from social networking and information retrieval to scientific research and healthcare informatics In many emerging applications people s information need from text data is becoming multidimensional they demand useful insights along multiple aspects from a text corpus However acquiring such multidimensional knowledge from massive text data remains a challenging task This book presents data mining techniques that turn unstructured text data into multidimensional knowledge We investigate two core questions 1 How does one identify task relevant text data with declarative queries in multiple dimensions 2 How does one distill knowledge from text data in a multidimensional space To address the above questions we develop a text cube framework First we develop a cube construction module that organizes unstructured data into a cube structure by discovering latent multidimensional and multi granular structure from the unstructured text corpus and allocating documents into the structure Second we develop a cube exploitation module that models multiple dimensions in the cube space thereby distilling from user selected data multidimensional knowledge Together these two modules constitute an integrated pipeline leveraging the cube structure users can perform multidimensional multigranular data selection with declarative queries and with cube exploitation algorithms users can extract multidimensional patterns from the selected data for decision making The proposed framework has two distinctive advantages when turning text data into multidimensional knowledge flexibility and label efficiency First it enables acquiring multidimensional knowledge flexibly as the cube structure allows users to easily identify task relevant data along multiple dimensions at varied granularities and further distill multidimensional knowledge Second the algorithms for cube construction and exploitation require little supervision this makes the framework appealing for many applications where labeled data are expensive to obtain *Exploiting the Power of Group Differences* Guozhu Dong,2022-05-31 This book presents pattern based problem solving methods for a variety of machine learning and data analysis problems The methods are all based on techniques that exploit the power of group differences They make use of group differences represented using emerging patterns aka contrast patterns which are patterns that match significantly different numbers of instances in different data groups A large number of applications outside of the computing discipline are also included Emerging patterns EPs are useful in many ways EPs can be used as features as simple classifiers as subpopulation signatures characterizations and as triggering conditions for alerts EPs can be used in gene ranking for complex diseases since they capture multi factor interactions The length of EPs can be used to detect anomalies outliers and novelties Emerging contrast pattern based methods for clustering analysis and outlier detection do not need distance metrics avoiding pitfalls of the latter in exploratory analysis of high dimensional data EP based classifiers can achieve good accuracy even when the training

datasets are tiny making them useful for exploratory compound selection in drug design EPs can serve as opportunities in opportunity focused boosting and are useful for constructing powerful conditional ensembles EP based methods often produce interpretable models and results In general EPs are useful for classification clustering outlier detection gene ranking for complex diseases prediction model analysis and improvement and so on EPs are useful for many tasks because they represent group differences which have extraordinary power Moreover EPs represent multi factor interactions whose effective handling is of vital importance and is a major challenge in many disciplines Based on the results presented in this book one can clearly say that patterns are useful especially when they are linked to issues of interest We believe that many effective ways to exploit group differences power still remain to be discovered Hopefully this book will inspire readers to discover such new ways besides showing them existing ways to solve various challenging problems   **Mining Human Mobility in Location-Based Social Networks** Huiji Gao,Huan Liu,2022-06-01 In recent years there has been a rapid growth of location based social networking services such as Foursquare and Facebook Places which have attracted an increasing number of users and greatly enriched their urban experience Typical location based social networking sites allow a user to check in at a real world POI point of interest e g a hotel restaurant theater etc leave tips toward the POI and share the check in with their online friends The check in action bridges the gap between real world and online social networks resulting in a new type of social networks namely location based social networks LBSNs Compared to traditional GPS data location based social networks data contains unique properties with abundant heterogeneous information to reveal human mobility i e when and where a user who has been to for what corresponding to an unprecedented opportunity to better understand human mobility from spatial temporal social and content aspects The mining and understanding of human mobility can further lead to effective approaches to improve current location based services from mobile marketing to recommender systems providing users more convenient life experience than before This book takes a data mining perspective to offer an overview of studying human mobility in location based social networks and illuminate a wide range of related computational tasks It introduces basic concepts elaborates associated challenges reviews state of the art algorithms with illustrative examples and real world LBSN datasets and discusses effective evaluation methods in mining human mobility In particular we illustrate unique characteristics and research opportunities of LBSN data present representative tasks of mining human mobility on location based social networks including capturing user mobility patterns to understand when and where a user commonly goes location prediction and exploiting user preferences and location profiles to investigate where and when a user wants to explore location recommendation along with studying a user s check in activity in terms of why a user goes to a certain location   *Detecting Fake News on Social Media* Kai Shu,Huan Liu,2022-05-31 In the past decade social media has become increasingly popular for news consumption due to its easy access fast dissemination and low cost However social media also enables the wide propagation of fake news i e news with intentionally false

information Fake news on social media can have significant negative societal effects Therefore fake news detection on social media has recently become an emerging research area that is attracting tremendous attention This book from a data mining perspective introduces the basic concepts and characteristics of fake news across disciplines reviews representative fake news detection methods in a principled way and illustrates challenging issues of fake news detection on social media In particular we discussed the value of news content and social context and important extensions to handle early detection weakly supervised detection and explainable detection The concepts algorithms and methods described in this lecture can help harness the power of social media to build effective and intelligent fake news detection systems This book is an accessible introduction to the study of detecting fake news on social media It is an essential reading for students researchers and practitioners to understand manage and excel in this area This book is supported by additional materials including lecture slides the complete set of figures key references datasets tools used in this book and the source code of representative algorithms The readers are encouraged to visit the book website for the latest information http dmml asu edu dfn **Individual and Collective Graph Mining** Danai Koutra,Christos Faloutsos,2022-06-01 Graphs naturally represent information ranging from links between web pages to communication in email networks to connections between neurons in our brains These graphs often span billions of nodes and interactions between them Within this deluge of interconnected data how can we find the most important structures and summarize them How can we efficiently visualize them How can we detect anomalies that indicate critical events such as an attack on a computer system disease formation in the human brain or the fall of a company This book presents scalable principled discovery algorithms that combine globality with locality to make sense of one or more graphs In addition to fast algorithmic methodologies we also contribute graph theoretical ideas and models and real world applications in two main areas Individual Graph Mining We show how to interpretably summarize a single graph by identifying its important graph structures We complement summarization with inference which leverages information about few entities obtained via summarization or other methods and the network structure to efficiently and effectively learn information about the unknown entities Collective Graph Mining We extend the idea of individual graph summarization to time evolving graphs and show how to scalably discover temporal patterns Apart from summarization we claim that graph similarity is often the underlying problem in a host of applications where multiple graphs occur e g temporal anomaly detection discovery of behavioral patterns and we present principled scalable algorithms for aligning networks and measuring their similarity The methods that we present in this book leverage techniques from diverse areas such as matrix algebra graph theory optimization information theory machine learning finance and social science to solve real world problems We present applications of our exploration algorithms to massive datasets including a Web graph of 6 6 billion edges a Twitter graph of 1 8 billion edges brain graphs with up to 90 million edges collaboration peer to peer networks browser logs all spanning millions of users and interactions **Exploratory Causal Analysis with Time Series Data**

James M. McCracken,2022-06-01 Many scientific disciplines rely on observational data of systems for which it is difficult or impossible to implement controlled experiments Data analysis techniques are required for identifying causal information and relationships directly from such observational data This need has led to the development of many different time series causality approaches and tools including transfer entropy convergent cross mapping CCM and Granger causality statistics A practicing analyst can explore the literature to find many proposals for identifying drivers and causal connections in time series data sets Exploratory causal analysis ECA provides a framework for exploring potential causal structures in time series data sets and is characterized by a myopic goal to determine which data series from a given set of series might be seen as the primary driver In this work ECA is used on several synthetic and empirical data sets and it is found that all of the tested time series causality tools agree with each other and intuitive notions of causality for many simple systems but can provide conflicting causal inferences for more complicated systems It is proposed that such disagreements between different time series causality tools during ECA might provide deeper insight into the data than could be found otherwise   Phrase Mining from Massive Text and Its Applications Jialu Liu,Jingbo Shang,Jiawei Han,2022-06-01 A lot of digital ink has been spilled on big data over the past few years Most of this surge owes its origin to the various types of unstructured data in the wild among which the proliferation of text heavy data is particularly overwhelming attributed to the daily use of web documents business reviews news social posts etc by so many people worldwide A core challenge presents itself How can one efficiently and effectively turn massive unstructured text into structured representation so as to further lay the foundation for many other downstream text mining applications In this book we investigated one promising paradigm for representing unstructured text that is through automatically identifying high quality phrases from innumerable documents In contrast to a list of frequent n grams without proper filtering users are often more interested in results based on variable length phrases with certain semantics such as scientific concepts organizations slogans and so on We propose new principles and powerful methodologies to achieve this goal from the scenario where a user can provide meaningful guidance to a fully automated setting through distant learning This book also introduces applications enabled by the mined phrases and points out some promising research directions   *Mining Latent Entity Structures* Chi Wang,Jiawei Han,2022-05-31 The big data era is characterized by an explosion of information in the form of digital data collections ranging from scientific knowledge to social media news and everyone s daily life Examples of such collections include scientific publications enterprise logs news articles social media and general web pages Valuable knowledge about multi typed entities is often hidden in the unstructured or loosely structured interconnected data Mining latent structures around entities uncovers hidden knowledge such as implicit topics phrases entity roles and relationships In this monograph we investigate the principles and methodologies of mining latent entity structures from massive unstructured and interconnected data We propose a text rich information network model for modeling data in many different domains This leads to a series of new principles and powerful methodologies for

mining latent structures including 1 latent topical hierarchy 2 quality topical phrases 3 entity roles in hierarchical topical communities and 4 entity relations This book also introduces applications enabled by the mined structures and points out some promising research directions **Correlation Clustering** Francesco Bonchi,David García-Soriano,Francesco Gullo,2022-05-31 Given a set of objects and a pairwise similarity measure between them the goal of correlation clustering is to partition the objects in a set of clusters to maximize the similarity of the objects within the same cluster and minimize the similarity of the objects in different clusters In most of the variants of correlation clustering the number of clusters is not a given parameter instead the optimal number of clusters is automatically determined Correlation clustering is perhaps the most natural formulation of clustering as it just needs a definition of similarity its broad generality makes it applicable to a wide range of problems in different contexts and particularly makes it naturally suitable to clustering structured objects for which feature vectors can be difficult to obtain Despite its simplicity generality and wide applicability correlation clustering has so far received much more attention from an algorithmic theory perspective than from the data mining community The goal of this lecture is to show how correlation clustering can be a powerful addition to the toolkit of a data mining researcher and practitioner and to encourage further research in the area **Machine Learning and Knowledge Discovery in Databases** Paolo Frasconi,Niels Landwehr,Giuseppe Manco,Jilles Vreeken,2016-09-03 The three volume set LNAI 9851 LNAI 9852 and LNAI 9853 constitutes the refereed proceedings of the European Conference on Machine Learning and Knowledge Discovery in Databases ECML PKDD 2016 held in Riva del Garda Italy in September 2016 The 123 full papers and 16 short papers presented were carefully reviewed and selected from a total of 460 submissions The papers presented focus on practical and real world studies of machine learning knowledge discovery data mining innovative prototype implementations or mature systems that use machine learning techniques and knowledge discovery processes in a real setting recent advances at the frontier of machine learning and data mining with other disciplines Part I and Part II of the proceedings contain the full papers of the contributions presented in the scientific track and abstracts of the scientific plenary talks Part III contains the full papers of the contributions presented in the industrial track short papers describing demonstration the nectar papers and the abstracts of the industrial plenary talks *Machine Learning and Knowledge Discovery in Databases* Dimitrios Gunopulos,Thomas Hofmann,Donato Malerba,Michalis Vazirgiannis,2011-09-06 This three volume set LNAI 6911 LNAI 6912 and LNAI 6913 constitutes the refereed proceedings of the European conference on Machine Learning and Knowledge Discovery in Databases ECML PKDD 2011 held in Athens Greece in September 2011 The 121 revised full papers presented together with 10 invited talks and 11 demos in the three volumes were carefully reviewed and selected from about 600 paper submissions The papers address all areas related to machine learning and knowledge discovery in databases as well as other innovative application domains such as supervised and unsupervised learning with some innovative contributions in fundamental issues dimensionality reduction distance and similarity learning model learning and matrix tensor analysis

graph mining graphical models hidden markov models kernel methods active and ensemble learning semi supervised and transductive learning mining sparse representations model learning inductive logic programming and statistical learning a significant part of the papers covers novel and timely applications of data mining and machine learning in industrial domains

New Frontiers in Mining Complex Patterns Annalisa Appice,Michelangelo Ceci,Corrado Loglisci,Giuseppe Manco,Elio Masciari,Zbigniew Ras,2013-03-25 This book constitutes the thoroughly refereed conference proceedings of the First International Workshop on New Frontiers in Mining Complex Patterns NFMCP 2012 held in conjunction with ECML PKDD 2012 in Bristol UK in September 2012 The 15 revised full papers were carefully reviewed and selected from numerous submissions The papers are organized in topical sections on mining rich relational datasets mining complex patterns from miscellaneous data mining complex patterns from trajectory and sequence data and mining complex patterns from graphs and networks **New Frontiers in Mining Complex Patterns** Michelangelo Ceci,Corrado Loglisci,Giuseppe Manco,Elio Masciari,Zbigniew W. Ras,2016-05-17 This book constitutes the thoroughly refereed post conference proceedings of the 4th International Workshop on New Frontiers in Mining Complex Patterns NFMCP 2015 held in conjunction with ECML PKDD 2015 in Porto Portugal in September 2015 The 15 revised full papers presented together with one invited talk were carefully reviewed and selected from 19 submissions They illustrate advanced data mining techniques which preserve the informative richness of complex data and allow for efficient and effective identification of complex information units present in such data The papers are organized in the following sections data stream mining classification mining complex data and sequences

Advanced Techniques in Computing Sciences and Software Engineering Khaled Elleithy,2010-03-10 Advanced Techniques in Computing Sciences and Software Engineering includes a set of rigorously reviewed world class manuscripts addressing and detailing state of the art research projects in the areas of Computer Science Software Engineering Computer Engineering and Systems Engineering and Sciences Advanced Techniques in Computing Sciences and Software Engineering includes selected papers form the conference proceedings of the International Conference on Systems Computing Sciences and Software Engineering SCSS 2008 which was part of the International Joint Conferences on Computer Information and Systems Sciences and Engineering CISSE 2008 **Data Warehousing and Knowledge Discovery** Torben Bach Pedersen,Mukesh K. Mohania,A Min Tjoa,2009-08-17 This book constitutes the refereed proceedings of the 11th International Conference on Data Warehousing and Knowledge Discovery DaWak 2009 held in Linz Austria in August September 2009 The 36 revised full papers presented were carefully reviewed and selected from 124 submissions The papers are organized in topical sections on data warehouse modeling data streams physical design pattern mining data cubes data mining applications analytics data mining clustering spatio temporal mining rule mining and OLAP recommendation

Efficient Frequent Subtree Mining Beyond Forests Pascal Welke,2020-06-15 A common paradigm in distance based learning is to embed the instance space into a feature space equipped with a metric and define the dissimilarity between

instances by the distance of their images in the feature space Frequent connected subgraphs are sometimes used to define such feature spaces if the instances are graphs but identifying the set of frequent connected subgraphs and subsequently computing embeddings for graph instances is computationally intractable As a result existing frequent subgraph mining algorithms either restrict the structural complexity of the instance graphs or require exponential delay between the output of subsequent patterns meaning that distance based learners lack an efficient way to operate on arbitrary graph data This book presents a mining system that gives up the demand on the completeness of the pattern set and instead guarantees a polynomial delay between subsequent patterns To complement this efficient methods devised to compute the embedding of arbitrary graphs into the Hamming space spanned by the pattern set are described As a result a system is proposed that allows the efficient application of distance based learning methods to arbitrary graph databases In addition to an introduction and conclusion the book is divided into chapters covering preliminaries related work probabilistic frequent subtrees boosted probabilistic frequent subtrees and fast computation with a further two chapters on Hamiltonian path for cactus graphs and Poisson binomial distribution **Machine Learning and Knowledge Discovery in Databases** Toon Calders,Floriana Esposito,Eyke Hüllermeier,Rosa Meo,2014-09-01 This three volume set LNAI 8724 8725 and 8726 constitutes the refereed proceedings of the European Conference on Machine Learning and Knowledge Discovery in Databases ECML PKDD 2014 held in Nancy France in September 2014 The 115 revised research papers presented together with 13 demo track papers 10 nectar track papers 8 PhD track papers and 9 invited talks were carefully reviewed and selected from 550 submissions The papers cover the latest high quality interdisciplinary research results in all areas related to machine learning and knowledge discovery in databases **Machine Learning and Knowledge Discovery in Databases** Hendrik Blockeel,Kristian Kersting,Siegfried Nijssen,Filip Železný,2013-08-28 This three volume set LNAI 8188 8189 and 8190 constitutes the refereed proceedings of the European Conference on Machine Learning and Knowledge Discovery in Databases ECML PKDD 2013 held in Prague Czech Republic in September 2013 The 111 revised research papers presented together with 5 invited talks were carefully reviewed and selected from 447 submissions The papers are organized in topical sections on reinforcement learning Markov decision processes active learning and optimization learning from sequences time series and spatio temporal data data streams graphs and networks social network analysis natural language processing and information extraction ranking and recommender systems matrix and tensor analysis structured output prediction multi label and multi task learning transfer learning bayesian learning graphical models nearest neighbor methods ensembles statistical learning semi supervised learning unsupervised learning subgroup discovery outlier detection and anomaly detection privacy and security evaluation applications and medical applications

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