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Information Retrieval: Recent Advances and Beyond

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ABSTRACT This paper provides an extensive and thorough overview of the models and techniques utilized in the first and second stages of the typical information retrieval processing chain. Our discussion encompasses the current state-of-the-art models, covering a wide range of methods and approaches in the field of information retrieval. We delve into the historical development of these models, analyze the key advancements and breakthroughs, and address the challenges and limitations faced by researchers and practitioners in the domain. By offering a comprehensive understanding of the field, this survey is a valuable resource for researchers, practitioners, and newcomers to the information retrieval domain, fostering knowledge growth, innovation, and the development of novel ideas and techniques.

INDEX TERMS First-stage retrieval, Information retrieval, Second-stage retrieval.

I. INTRODUCTION

CURRENTLY, Information Retrieval (IR) holds significant importance in people's daily lives due to its integration in various useful functions alike as internet browsing, question-answering systems, personal assistants, chatbots, and digital libraries. The primary objective is to recognize and retrieve information that is associated with the user's request. Since multiple records may be relevant, the results are frequently ranked according to their similarity score to the user's query. At the beginning of the IR field, traditional text retrieval systems predominantly rely on matching terms between documents and queries. However, these term-based retrieval systems have drawbacks, such as polysemy, synonymy, and lexical gaps, which can limit their effectiveness [1]. Recently, the field of Natural Language Processing (NLP) has undergone significant advancements due to the increased availability of large labeled datasets and enhanced computing power, which has allowed researchers to employ deep learning methods for various purposes. These techniques have been utilized to enhance traditional text retrieval systems and address the limitations of term-based retrieval techniques. However, applying these techniques requires substantial amounts of data and computational resources. As a result, researchers are constantly developing more advanced deep learning algorithms to meet these demands and achieve better results in NLP tasks [2]. With the use of these advanced

deep learning algorithms, the performance of IR systems has been significantly improved, leading to more precise and efficient retrieval of information for end-users. Some of the advancements in deep learning techniques that have been employed in IR include neural network architectures such as convolutional neural networks [3] and recurrent neural networks [4], in addition to transfer learning and pre-training techniques [5]. These methods have improved text data representation and enhanced the IR system's understanding of natural language queries. Moreover, attention-based mechanisms like the Transformer architecture [6] have been implemented to enhance the capability of IR systems to focus on critical parts of the query and documents for matching purposes. Further, adopting pre-trained language models, such as BERT [5] and GPT-2 [7], has demonstrated the ability to improve IR systems performance by providing superior cognition of the semantics and context of natural language queries and documents. Similarly, researchers also concentrated on integrating external knowledge to enhance the relevance of the retrieved information. One approach is to incorporate knowledge graph embeddings [8] into the IR process, which can aid in linking the query and documents to relevant entities and concepts, thereby producing more accurate results. Moreover, the use of multi-modal information retrieval, which involves combining text, image, and audio information, has demonstrated the ability to enhance

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Advances in Information Retrieval Paul Clough, Colum Foley, Cathal Gurrin, Gareth J. F. Jones, Wessel Kraaij, Hyowon Lee, Vanessa Murdock, 2011-04-06 This book constitutes the refereed proceedings of the 33rd annual European Conference on Information Retrieval Research ECIR 2011 held in Dublin Ireland in April 2010 The 45 revised full papers presented together with 24 poster papers 17 short papers and 6 tool demonstrations were carefully reviewed and selected from 223 full research paper submissions and 64 poster demo submissions The papers are organized in topical sections on text categorization recommender systems Web IR IR evaluation IR for Social Networks cross language IR IR theory multimedia IR IR applications interactive IR and question answering NLP

Advances in Information Retrieval Jaap Kamps, Lorraine Goeuriot, Fabio Crestani, Maria Maistro, Hideo Joho, Brian Davis, Cathal Gurrin, Udo Kruschwitz, Annalina Caputo, 2023-03-16 The three volume set LNCS 13980 13981 and 13982 constitutes the refereed proceedings of the 45th European Conference on IR Research ECIR 2023 held in Dublin Ireland during April 2 6 2023 The 65 full papers 41 short papers 19 demonstration papers 12 reproducibility papers consortium papers 7 tutorial papers and 10 doctoral consortium papers were carefully reviewed and selected from 489 submissions The book also contains 8 workshop summaries and 13 CLEF Lab descriptions The accepted papers cover the state of the art in information retrieval focusing on user aspects system and foundational aspects machine learning applications evaluation new social and technical challenges and other topics of direct or indirect relevance to search

Advances in Information Retrieval Mounia Lalmas, Andrew MacFarlane, Stefan Rüger, Anastasios Tombros, Theodora Tsikrika, Alexei Yavlinsky, 2006-04-05 This book constitutes the refereed proceedings of the 28th European Conference on Information Retrieval Research ECIR 2006 held in London April 2006 The 37 revised full papers and 28 revised poster papers presented are organized in topical sections on formal models document and query representation and text understanding topic identification and news retrieval clustering and classification refinement and feedback performance and peer to peer networks Web search cross language retrieval genomic IR and much more

Advances in Information Retrieval Craig Macdonald, Iadh Ounis, Vassilis Plachouras, Ian Ruthven, Ryan W. White, 2008-03-27 This book constitutes the refereed proceedings of the 30th annual European Conference on Information Retrieval Research ECIR 2008 held in Glasgow UK in March April 2008 The 33 revised full papers and 19 revised short papers presented together with the abstracts of 3 invited lectures and 32 poster papers were carefully reviewed and selected from 139 full article submissions The papers are organized in topical sections on evaluation Web IR social media cross lingual information retrieval theory video representation wikipedia and e books as well as expert search

Advances in Information Retrieval David E. Losada, Juan M. Fernández-Luna, 2005-04-01 Welcome to Santiago de Compostela We are pleased to host the 27th Annual European Conference on Information Retrieval Research ECIR 2005 on its first visit to Spain These proceedings contain the refereed full papers and poster abstracts presented at ECIR 2005 This conference was initially established by the Information

Retrieval Specialist Group of the British Computer Society BCS IRSG under the name Annual Colloquium on Information Retrieval Research The colloquium was held in the United Kingdom each year until 1998 when the event was organized in Grenoble France Since then the conference venue has alternated between the United Kingdom and Continental Europe reflecting the growing European orientation of ECIR For the same reason in 2001 the event was renamed European Conference on Information Retrieval Research In cent years ECIR has continued to grow and has become the major European forum for the discussion of research in the eld of information retrieval ECIR 2005 was held at the Technical School of Engineering of the University of Santiago de Compostela Spain In terms of submissions ECIR 2005 was a record breaking success since 124 full papers were submitted in response to the call for papers This was a sharp increase from the 101 submissions received for ECIR 2003 which was the most successful ECIR in terms of submissions ECIR 2005 established also a call for posters and 41 posters where submitted Paper and poster submissions were received from across Europe and further a eld including North America South America Asia and Australia which is a clear indication of the growing popularity and reputation of the conference

Advances in Information Retrieval Claudia Hauff, Craig Macdonald, Dietmar Jannach, Gabriella Kazai, Franco Maria Nardini, Fabio Pinelli, Fabrizio Silvestri, Nicola Tonellotto, 2025-04-02 The five volume set LNCS 15572 15573 15574 15575 and 15576 constitutes the refereed conference proceedings of the 47th European Conference on Information Retrieval ECIR 2025 held in Lucca Italy during April 6 10 2025 The 52 full papers 11 findings 42 short papers and 76 papers of other types presented in these proceedings were carefully reviewed and selected from 530 submissions The accepted papers cover the state of the art in information retrieval and recommender systems user aspects system and foundational aspects artificial intelligence and machine learning applications evaluation new social and technical challenges and other topics of direct or indirect relevance to search and recommendation Advances in Information Retrieval Pavel Serdyukov, Pavel

Braslavski, Sergei O. Kuznetsov, Jaap Kamps, Stefan Rüger, Eugene Agichtein, Ilya Segalovich, Emine Yilmaz, 2013-03-12 This book constitutes the proceedings of the 35th European Conference on IR Research ECIR 2013 held in Moscow Russia in March 2013 The 55 full papers 38 poster papers and 10 demonstrations presented in this volume were carefully reviewed and selected from 287 submissions The papers are organized in the following topical sections user aspects multimedia and cross media IR data mining IR theory and formal models IR system architectures classification Web event detection temporal IR and microblog search Also included are 4 tutorial and 2 workshop presentations *Advances in Information Retrieval*

Sharon McDonald, John Tait, 2004-03-01 These proceedings contain the refereed full technical papers presented at the 26th Annual European Conference on Information Retrieval ECIR 2004 ECIR is the annual conference of the British Computer Society's specialist group in Information Retrieval This year the conference was held at the School of Computing and Technology at the University of Sunderland ECIR began life as the nual Colloquium on Information Retrieval Research The colloquium was held in the UK each year until 1998 when the event was held in Grenoble France Since then the conference venue has alternated

between the United Kingdom and Continental Europe and the event was renamed the European Conference on Information Retrieval. In recent years ECIR has continued to grow and has become the major European forum for the discussion of research in the field of Information Retrieval. To mark this metamorphosis from a small informal colloquium to a major event in the IR research calendar the BCS IRSG decided to rename the event to the European Conference on Information Retrieval. ECIR2004 received 88 full paper submissions from across Europe and further afield including North America, China and Australia, a testament to the growing popularity and reputation of the conference. Out of the 88 submitted papers 28 were accepted for presentation. All papers were reviewed by at least three reviewers. Among the accepted papers 11 have a student as the primary author illustrating that the traditional student focus of the original colloquium is alive today.

Advances in Information Retrieval Fabio Crestani, Mark Girolami, C.J. van Rijsbergen, 2003-07-31. The annual colloquium on information retrieval research provides an opportunity for both new and established researchers to present papers describing work in progress or final results. This colloquium was established by the BCS IRSG British Computer Society Information Retrieval Specialist Group and named the Annual Colloquium on Information Retrieval Research. Recently the location of the colloquium has alternated between the United Kingdom and continental Europe. To reflect the growing European orientation of the event the colloquium was renamed European Annual Colloquium on Information Retrieval Research from 2001. Since the inception of the colloquium in 1979 the event has been hosted in the city of Glasgow on four separate occasions. However this was the first time that the organization of the colloquium had been jointly undertaken by three separate computer and information science departments, an indication of the collaborative nature and diversity of IR research within the universities of the West of Scotland. The organizers of ECIR 2002 saw a sharp increase in the number of good quality submissions in answer to the call for papers over previous years and as such 52 submitted papers were each allocated 3 members of the program committee for double blind review of the manuscripts. A total of 23 papers were eventually selected for oral presentation at the colloquium in Glasgow which gave an acceptance rate of less than 45% and ensured a very high standard of the papers presented.

Advances in Information Retrieval Theory Leif Azzopardi, Gabriella Kazai, Stephen Robertson, Stefan Rüger, Milad Shokouhi, Dawei Song, Emine Yilmaz, 2009-08-31. This book constitutes the refereed proceedings of the Second International Conference on the Theory of Information Retrieval ICTIR 2009 held in Cambridge UK in September 2009. The 18 revised full papers, 14 short papers and 11 posters presented together with one invited talk were carefully reviewed and selected from 82 submissions. The papers are categorized into four main themes: novel IR models, evaluation, efficiency and new perspectives in IR. Twenty one papers fall into the general theme of novel IR models ranging from various retrieval models, query and term selection models, Web IR models, developments in novelty and diversity to the modeling of user aspects. There are four papers on new evaluation methodologies, e.g. modeling score distributions, evaluation over sessions and an axiomatic framework for XML retrieval evaluation. Three papers focus on the issue of efficiency and offer solutions to

improve the tractability of PageRank data cleansing practices for training classifiers and approximate search for distributed IR Finally four papers look into new perspectives of IR and shed light on some new emerging areas of interest such as the application and adoption of quantum theory in IR *Advances in Information Retrieval* Joemon M Jose, Claudia Hauff, Ismail Sengor Altıngövd, Dawei Song, Dyaa Albakour, Stuart Watt, John Tait, 2017-04-07 This book constitutes the refereed proceedings of the 39th European Conference on IR Research ECIR 2017 held in Aberdeen UK in April 2017 The 36 full papers and 47 poster papers presented together with 5 Abstracts were carefully reviewed and selected from 248 submissions Being the premier European forum for the presentation of new research results in the field of Information Retrieval ECIR features a wide range of topics such as IR Theory and Practice Deep Learning and IR Web and Social Media IR User Aspects IR System Architectures Content Representation and Processing Evaluation Multimedia and Cross Media IR Applications

Advances in Information Retrieval Matthias Hagen, Suzan Verberne, Craig Macdonald, Christin Seifert, Krisztian Balog, Kjetil Nørvåg, Vinay Setty, 2022-04-05 This two volume set LNCS 13185 and 13186 constitutes the refereed proceedings of the 44th European Conference on IR Research ECIR 2022 held in April 2022 due to the COVID 19 pandemic The 35 full papers presented together with 11 reproducibility papers 13 CLEF lab descriptions papers 12 doctoral consortium papers 5 workshop abstracts and 4 tutorials abstracts were carefully reviewed and selected from 395 submissions Chapters Leveraging Customer Reviews for E commerce Query Generation and End to End Neural Retrieval for Patent Prior Art Search are available open access under a Creative Commons Attribution 4 0 International License via link [springer.com](https://www.springer.com)

Advances in Information Retrieval Center for Intelligent Information Retrieval, 2000-04-30 The NSF Center for Intelligent Information Retrieval CIIR was formed in the Computer Science Department of the University of Massachusetts Amherst in 1992 Through its efforts in basic research applied research and technology transfer the CIIR has become known internationally as one of the leading research groups in the area of information retrieval The CIIR focuses on research that results in more effective and efficient access and discovery in large heterogeneous distributed text and multimedia databases The scope of the work that is done in the CIIR is broad and goes significantly beyond traditional areas of information retrieval such as retrieval models cross lingual search and automatic query expansion The research includes both low level systems issues such as the design of protocols and architectures for distributed search as well as more human centered topics such as user interface design visualization and data mining with text and multimedia retrieval *Advances in Information Retrieval* Recent Research from the Center for Intelligent Information Retrieval is a collection of papers that covers a wide variety of topics in the general area of information retrieval Together they represent a snapshot of the state of the art in information retrieval at the turn of the century and at the end of a decade that has seen the advent of the World Wide Web The papers provide overviews and in depth analysis of theory and experimental results This book can be used as source material for graduate courses in information retrieval and as a reference for researchers and practitioners in industry **Advances in**

Information Retrieval W. Bruce Croft, 2006-04-11 The Center for Intelligent Information Retrieval CIIR was formed in the Computer Science Department of the University of Massachusetts Amherst in 1992 The core support for the Center came from a National Science Foundation State Industry University Cooperative Research Center S IUCRC grant although there had been a sizeable information retrieval IR research group for over 10 years prior to that grant The basic goal of these Centers is to combine basic research applied research and technology transfer The CIIR has been successful in each of these areas in that it has produced over 270 research papers has been involved in many successful government and industry collaborations and has had a significant role in high visibility Internet sites and start ups As a result of these efforts the CIIR has become known internationally as one of the leading research groups in the area of information retrieval The CIIR focuses on research that results in more effective and efficient access and discovery in large heterogeneous distributed text and multimedia databases The scope of the work that is done in the CIIR is broad and goes significantly beyond traditional areas of information retrieval such as retrieval models cross lingual search and automatic query expansion The research includes both low level systems issues such as the design of protocols and architectures for distributed search as well as more human centered topics such as user interface design visualization and data mining with text and multimedia retrieval **Advances in Information**

Retrieval Fabrizio Sebastiani, 2003-04-08 This book constitutes the refereed proceedings of the 25th European Conference on Information Retrieval Research ECIR 2003 held in Pisa Italy in April 2003 The 31 revised full papers and 16 short papers presented together with two invited papers were carefully reviewed and selected from 101 submissions The papers are organized in topical sections on IR and the Web retrieval of structured documents collaborative filtering and text mining text representation and natural language processing formal models and language models for IR machine learning and IR text categorization usability interactivity and visualization and architectural issues and efficiency **Advances in Information**

Retrieval Joemon M. Jose, Emine Yilmaz, João Magalhães, Pablo Castells, Nicola Ferro, Mário J. Silva, Flávio Martins, 2020-04-11 This two volume set LNCS 12035 and 12036 constitutes the refereed proceedings of the 42nd European Conference on Information Retrieval Research ECIR 2020 held in Lisbon Portugal in April 2020 The 55 full papers presented together with 8 reproducibility papers 46 short papers 10 demonstration papers 12 invited CLEF papers 7 doctoral consortium papers 4 workshop papers and 3 tutorials were carefully reviewed and selected from 457 submissions They were organized in topical sections named Part I deep learning I entities evaluation recommendation information extraction deep learning II retrieval multimedia deep learning III queries IR general question answering prediction and bias and deep learning IV Part II reproducibility papers short papers demonstration papers CLEF organizers lab track doctoral consortium papers workshops and tutorials Due to the COVID 19 pandemic this conference was held virtually *Advances in Information Retrieval* Sharon McDonald, John Tait, 2004-03-25 These proceedings contain the refereed full technical papers presented at the 26th Annual European Conference on Information Retrieval ECIR 2004 ECIR is the annual conference of the British Computer Society's specialist group in Information

Retrieval This year the conference was held at the School of Computing and Technology at the University of Sunderland

ECIR began life as the annual Colloquium on Information Retrieval Research The colloquium was held in the UK each year until 1998 when the event was held in Grenoble France Since then the conference venue has alternated between the United Kingdom and Continental Europe and the event was renamed the European Conference on Information Retrieval In recent years ECIR has continued to grow and has become the major European forum for the discussion of research in the field of Information Retrieval To mark this metamorphosis from a small informal colloquium to a major event in the IR research calendar the BCS IRSG decided to rename the event to the European Conference on Information Retrieval

ECIR2004 received 88 full paper submissions from across Europe and further afield including North America China and Australia a testament to the growing popularity and reputation of the conference Out of the 88 submitted papers 28 were accepted for presentation All papers were reviewed by at least three reviewers Among the accepted papers 11 have a student as the primary author illustrating that the traditional student focus of the original colloquium is alive today **Advances in Information Retrieval** Mounia Lalmas, Andrew MacFarlane, Stefan Rüger, Anastasios Tombros, Theodora Tsirikia, Alexei Yavlinsky, 2006-03-28 This book constitutes the refereed proceedings of the 28th European Conference on Information Retrieval Research ECIR 2006 held in London April 2006 The 37 revised full papers and 28 revised poster papers presented are organized in topical sections on formal models document and query representation and text understanding topic identification and news retrieval clustering and classification refinement and feedback performance and peer to peer networks Web search cross language retrieval genomic IR and much more **Advances in Information Retrieval** Craig Macdonald, 2008-03-18 This proceedings volume of the 30th annual European Conference on Information Retrieval Research covers evaluation Web IR social media cross lingual information retrieval theory video representation wikipedia and e books as well as expert search **Advances in Information Retrieval** Paul Clough, Colum Foley, Cathal Gurrin, Gareth Jones, Wessel Kraaij, Hyowon Lee, Vanessa Murdock, 2011-04-12 This book constitutes the refereed proceedings of the 33rd annual European Conference on Information Retrieval Research ECIR 2011 held in Dublin Ireland in April 2010 The 45 revised full papers presented together with 24 poster papers 17 short papers and 6 tool demonstrations were carefully reviewed and selected from 223 full research paper submissions and 64 poster demo submissions The papers are organized in topical sections on text categorization recommender systems Web IR IR evaluation IR for Social Networks cross language IR IR theory multimedia IR IR applications interactive IR and question answering NLP

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