Yang Cao

Curriculum Vitae – March 2018

IF5.37, Informatics Forum
University of Edinburgh
10 Crichton Street
Edinburgh, EH8 9AB, UK

Tel: +44 (0)754 241 5501
Email: yang.cao@ed.ac.uk
Web: http://homepages.inf.ed.ac.uk/ycao

Research Interests

Database systems and theory: query processing, approximation, data quality
Web data management: graph query languages, graph querying methods, parallelization

Education

University of Edinburgh — Edinburgh, UK
Ph.D.: Database, Computer Science and Informatics — February 2013 – August 2016
Supervisor: Prof. Wenfei Fan — (awarded on 29 Nov, 2016)

Beihang University — Beijing, China
B.S.: Computer Science and Technology — September 2006 – June 2010
Graduated from the **Shen-Yuan Honor School**.

Employment Record

University of Edinburgh — Edinburgh, UK
Research Associate, LFCS, School of Informatics — September 2016 – present

International Research Center on Big Data at Beihang — Beijing, China
Research Assistant (working remotely at Edinburgh, UK) — February 2014 – April 2016

Research Projects

I have been working on three projects described below.

(I) BEAS: Making Big Data Small

We develop BEAS, a new query evaluation paradigm to answer SQL queries under constrained resources, by reducing queries on big data to computation on small data. Underlying BEAS are two principled approaches:

- *bounded evaluation* that computes exact answers by accessing a bounded amount of data when possible [1, 3, 7, 8, 11, 12, 14], and
- *data-driven approximation scheme* that answers queries for which exact answers are beyond reach under bounded resources, and offers a deterministic accuracy bound [2].

[*Industrial evaluation.*] One of our industry collaborators (**Huawei Technologies Co., Ltd.**) has deployed and tested a prototype system of BEAS [3] using their real-life call-detailed-record (CDR) queries, and found that the performance of 90% of their CDR queries can be improved by 25 times to 5 orders of magnitude for exact answering with bounded evaluation, and data-driven approximation enables flexible trade-offs between query accuracy and evaluation time when approximate answers are allowed.

[*Publication.*] As my main Ph.D. thesis work, the project has produced 2 SIGMOD (one system demo), 2 PODS, 2 VLDB, 1 TODS, 1 ICDE papers and 3 filed US patents.

(II) Methods for Querying Big Graph Data

I have also worked on methods for querying big graph data, including

- scale independent graph pattern matching by making pattern queries bounded [12];

- parallelizing sequential graph algorithms via partial evaluation and incremental computation, without thinking like a vertex [4, 20, 21] (my contribution includes the characterization and correctness proofs of the auto-parallelization framework);
- trading off structural preservability and query complexity for querying graphs [15, 19];
- approximate graph querying using views [10]; and
- graph querying made easy by query relaxation and explanations [6].

[*Publication.*] This line of research has produced 1 SIGMOD (Best paper award), 1 VLDB, 1 ICDE, 2 CIKM, 1 WWW, 1 TODS, 1 BICOD and 1 Computer Journal (invited). Moreover, it has one invited TODS submission.

(III) Data quality: Data Accuracy and Information Completeness

I have worked also on two novel data quality problems and contribute to 1 SIGMOD and 1 Information Systems papers.

(1) *Data accuracy* belongs to the problem of entity resolution. Given a set I_e of tuples pertaining to an entity e, it aims to find the most accurate values for e from I_e (a target tuple t_e for e from I_e), such that for each attribute A of e, $t_e[A]$ is closest to the true A-value of e [17].

(2) *Relative information completeness* studies the following problem: for a given query Q, can its complete answer be found from an incomplete database D? That is, the answer to Q in D remains unchanged no matter how D is extended by adding new tuples [16].

Awards & Honors

- Selected for ACM SIGMOD Research Highlight Award 2017
- ACM SIGMOD **Best Paper Award** 2017
- Invited to publish in "Best of SIGMOD 2017" (TODS) 2017
- Invited to publish in "Best of PODS 2016" (TODS) 2016
- Invited to publish in "Best of BICOD 2015" (The Computer Journal) 2015
- Facebook Graduate Fellowship, finalist *(34 in total all over the wold)* 2014
- Microsoft Research Asia PhD Fellowship *(10 in Asia and part of US)* 2012
- International Mathematical Contest in Modeling, **FIRST Prize (International)** 2009
- China Mathematical Contest in Modeling, **(the ONLY) National NO.1** 2008
- "CASC Award" first prize, by China Aerospace Science and Technology 2013
- China National Scholarship for Graduates 2012
- Microsoft Research Asia Young Scholarship (*30 in total within China*) 2009

Publications & Patents

Published conference & journal papers

1. **Yang Cao**, Wenfei Fan, Floris Geerts, and Ping Lu "Bounded Query Rewriting Using Views". *ACM Transaction on Database Systems* (**TODS**) (**invited**), 2018.
2. **Yang Cao** and Wenfei Fan. "Data Driven Approximation with Bounded Resources". *International Conference on Very Large Data Bases* (**VLDB**), 2017.

3. **Yang Cao**, Wenfei Fan, Yanghao Wang, Tengfei Yuan, Yanchao Li and Laura Yu Chen. "BEAS: Bounded Evaluation of SQL Queries". *ACM SIGMOD Conference on Management of Data* (**SIGMOD**) (demo), 2017.
4. Wenfei Fan, Yinghui Wu, Jingbo Xu , Wenyuan Yu, Jiaxin Jiang, Zeyu Zheng, Bohan Zhang, **Yang Cao** and Chao Tian. "Parallelizing Sequential Graph Computations". *ACM SIGMOD Conference on Management of Data* (**SIGMOD**) (**Best paper award**), 2017.
5. **Yang Cao**, W. Fan, and T. Yuan. "Is Big Data Analytics Beyond the Reach of Small Companies?". *Data Analysis and Knowledge Discovery* (**invited**), 1(9), 2017
6. Jia Li, **Yang Cao**, Shuai Ma, "Relaxing Graph Pattern Matching With Explanations". *ACM International Conference on Information and Knowledge Management* (**CIKM**), 2017.
7. **Yang Cao** and Wenfei Fan "An Effective Syntax for Bounded Relational Queries". *ACM SIGMOD Conference on Management of Data* (**SIGMOD**), 2016
8. **Yang Cao**, Wenfei Fan, Floris Geerts, and Ping Lu "Bounded Query Rewriting Using Views". *ACM Symposium on Principles of Database Systems* (**PODS**), 2016
9. **Yang Cao**, Wenfei Fan and Shuai Ma "Virtual Network Mapping: A Graph Pattern Matching Approach". *The Computer Journal* (**invited**), 2016
10. Jia Li, **Yang Cao** and Xudong Liu "Approximating Graph Pattern Queries Using Views". *ACM International Conference on Information and Knowledge Management* (**CIKM**), 2016
11. Wenfei Fan, Floris Geerts, **Yang Cao**, Ting Deng and Ping Lu. "Querying Big Data by Accessing Small Data". *ACM Symposium on Principles of Database Systems* (**PODS**), 2015
12. **Yang Cao**, Wenfei Fan, Jinpeng Huai, Ruizhe Huang "Making Pattern Queries Bounded in Big Graphs". *International Conference on Data Engineering* (**ICDE**), 2015
13. **Yang Cao**, Wenfei Fan and Shuai Ma "Virtual Network Mapping: A Graph Pattern Matching Approach". *British International Conference on Databases* (**BICOD**), 2015
14. **Yang Cao**, Wenfei Fan, Wenyuan Yu "Bounded Conjunctive Queries". *International Conference on Very Large Data Bases* (**VLDB**), 2014
15. Shuai Ma, **Yang Cao**, Wenfei Fan, Jinpeng Huai, and Tianyu Wo. "Strong Simulation: Capturing Topology in Graph Pattern Matching". *ACM Transaction on Database Systems* (**TODS**), 2014
16. **Yang Cao**, Ting Deng, Wenfei Fan, Floris Geerts. "On the Data Complexity of Relative Information Completeness". *Information Systems*, 2014
17. **Yang Cao**, Ting Deng, Wenfei Fan, Floris Geerts. "Determining the Relative Accuracy of Attributes". *ACM SIGMOD Conference on Management of Data* (**SIGMOD**), 2013
18. Shuai Ma, **Yang Cao**, Jinpeng Huai, and Tianyu Wo. "Distributed Graph Pattern Matching". *International World Wide Web Conference* (**WWW**), 2012
19. Shuai Ma, **Yang Cao**, Wenfei Fan, Jinpeng Huai, and Tianyu Wo. "Capturing Topology in Graph Pattern Matching". *International Conference on Very Large Data Bases* (**VLDB**), 2012

Submissions under review

20. Wenfei Fan, **Yang Cao**, Jingbo Xu, Wenyuan Yu, Yinghui Wu, Chao Tian, Jiaxin Jiang, and Bohan Zhang "From Think Parallel to Think Sequential". *ACM SIGMOD Highlight* (**invited**), 2018. (Under review)
21. "Parallelizing Sequential Graph Computations". *ACM Transaction on Database Systems* (**TODS**) (**invited**), 2018. (Under review)

Ph.D dissertation

22. "Querying Big Data with Bounded Data Access". University of Edinburgh, 2016

U.S. patents

23. **Yang Cao**, Wenfei Fan, Jinpeng Huai. "Making Graph Pattern Queries Bounded in Big Graphs". U.S. patent (US20170308620A1), October 2017.
24. Wenfei Fan, **Yang Cao**, Floris Geerts, Ting Deng, Ping Lu. "Querying Big Data By Accessing Small Data" U.S. patent (US20170277750A1), September 2017.
25. Wenfei Fan, **Yang Cao**, Floris Geerts, Ping Lu, Yu Chen, Demai Ni "Bounded Query Rewriting Using Views" U.S. patent (pending), 2017

Professional Activities

Program Committee Member

- IEEE International Conference on Data Engineering (**ICDE**), 2019
- International Conference on Extending Database Technology (**EDBT**), 2018

Invited Journal Reviewer

- The International Journal on Very Large Data Bases (The **VLDB Journal**)
- ACM Journal of Data and Information Quality (**JDIQ**)

External Reviewer

- International Conference on Very Large Data Bases (**VLDB**), 2016; external reviewer
- International Conference on Very Large Data Bases (**VLDB**), 2015; external reviewer

Tutorials & Talks

Talks

- "Data Driven Approximation with Bounded Resources"
  VLDB Conference
  Munich, Germany, August 2017
- "BEAS: Bounded Evaluation of SQL Queries"
  Annual workshop of the National Basic Research Program of China (973 Program) on Fundamental theory of Big Data Computation in Cyberspace
  Beijing, China, January 2017
- "An Effective Syntax for Bounded Relational Queries"
  SIGMOD Conference
  San Francisco, USA, June 2016
- "Data Driven Approach to Querying Big Data"
  1st Microsoft Research Asia Ph.D Forum
  Beijing, China, September 2015

- "Querying Big Data by Accessing Small Data"
  PODS Conference
  Melbourne, Victoria, Australia, June 2015
- "Theory and Algorithms for Querying Big Relations"
  Beihang University
  Beijing, China, May 2015
- "Making Pattern Queries Bounded in Big Graphs"
  ICDE Conference
  Seoul, Korea (South), April, 2015
- "Bounded Conjunctive Queries"
  VLDB Conference
  Hangzhou, China, September 2014
- "Bounded Conjunctive Queries"
  Annual workshop of the National Basic Research Program of China (973 Program) on Fundamental theory of Big Data Computation in Cyberspace
  Beijing, China, April 2014
- "Determining the Relative Accuracy of Attributes"
  SIGMOD Conference
  New York, USA, June 2013
- "Virtual Machine Live-Migration and Virtual Network Mapping"
  Microsoft Research Asia Young Scholar Forum
  Beijing, China, September 2009
- "How to Do Mathematical Modeling?"
  "Higher Education Press" Cup Award Ceremony for National Mathematical Modeling
  Chongqing, China, December 2008

Tutorials

- "Mathematical Modeling" (Summer School Course)
  Beihang University, Beijing, China, Summer 2011/ Summer 2010/ Summer 2009

Students Mentoring

I have been mentoring and co-supervising the following students on a project basis:

- Yanghao Wang (MSc student, University of Edinburgh, supervisor: Wenfei Fan)
  [*My role.*] I co-supervised on Mr. Wang's master thesis project based on *Data-driven approximation* (see Project (I) "BEAS: Making Big Data Small").
  [*Outcome.*] Mr. Wang has been awarded an MSc by Research Degree *with Distinction.*
- Jia Li (PhD student, Beihang University, supervisor: Shuai Ma)
  [*My role.*] I co-supervised on Ms. Li's PhD thesis work on novel methods for querying big graphs (based on Project (II) "Methods for querying big data graphs").
  [*Outcome.*] 2 CIKM papers as a large part of Ms. Li's PhD thesis.
- Tengfei Yuan (PhD student, University of Edinburgh, supervisor Wenfei Fan)
  [*My role.*] I co-supervised Mr. Yuan on prototyping BEAS (see Project (I))
  [*Outcome.*] BEAS@PostgreSQL (one of the BEAS prototypes); 1 SIGMOD demo paper.