

About Me

I earned both my Bachelor's and Doctoral degrees in computer science from Zhejiang University, with the former being awarded in 2011 and the latter in 2016. Throughout my doctoral studies, I was honored with China's most prestigious fellowships and scholarships, namely the "Microsoft Research Asia Fellowship" and the "Baidu Scholarship." Subsequently, I continued my academic journey as a postdoctoral scholar at the Department of Statistics, University of California, Berkeley, between 2016 and 2018. I then served as a tenure-track Assistant Professor at the Department of Computer Science, Stevens Institute of Technology, from 2018 to 2021. In late 2021, I transitioned my career to the industry, joining Xiaohongshu (Shanghai) as an ML Engineer and Manager.

I possess a wide range of expertise encompassing search engines, machine learning, reinforcement learning, and numerical algorithms. Additionally, I also have experience in working with natural language processing (NLP) and recommender systems. While active in academia, my research focused on machine learning, numerical optimization, and parallel computing, among other areas. In my leisure time, I authored a book titled *Deep Reinforcement Learning (in Chinese)* and created an open course called *Industrial Recommender System (in Chinese)*.

Within the industry, my primary experience lies in search engines and natural language processing (NLP). From Dec 2021 to Sep 2022, I led the model team responsible for Xiaohongshu's search engine. During this time, my team successfully launched 14 experiments that positively impacted key performance indicators such as DAU, retention, and CTR, while also reducing CPU/GPU costs. Since Oct 2022, I have been leading the NLP team, which supports various areas including search, recommendation, e-commerce, and user growth. Currently, my team is actively involved in the development and practical applications of large language models (LLMs).

Work Experience

- 2021 – now Xiaohongshu (Shanghai, China), machine learning engineer & manager
- 2018 – 2021 Stevens Institute of Technology (NJ, USA), Assistant Professor in Computer Science
- 2016 – 2018 UC Berkeley (CA, USA), Postdoc
- 2014 – 2015 Baidu Big Data Lab (Beijing, China), intern
- 2012 – 2012 Google (Beijing, China), intern
- 2011 – 2012 Microsoft Research Asia (Beijing, China), intern

Education

- 2011 – 2016 Zhejiang University (Hangzhou, China), Ph.D. in Computer Science
- 2007 – 2011 Zhejiang University (Hangzhou, China), B.Eng. in Computer Science

Industry Projects

- 2022 Improving CTR model for search ranking
 - My team focused on enhancing the click-through rate (CTR) model for search ranking. We introduced several improvements to the neural network architecture and feature selection, resulting in significant increases in query CTR, document CTR, and overall user engagement.
 - My team transitioned from CPU-based training and inference to GPU-based training and inference, consequently reducing costs and response times.
- 2022 Locality-sensitive search intents
 - Over 1% of queries on Xiaohongshu were aimed at discovering nearby points of interest (POIs). However, our search engine seemed to be overlooking such queries and not catering to this specific user intent.
 - In response to the issue, I initiated a project to address the needs of users searching for nearby POIs. I took the lead in designing the project pipeline, encompassing query understanding, retrieval, and ranking processes.

- As a result, we achieved a substantial increase in query CTR for searches with nearby intent. Due to its success, the project was recognized with the 2022 Q3 ExtraMile Prize, standing out as one of the top five projects within the company.

2022-2023 NLP techniques for search retrieval

- I conceptualized an innovative *inverse retrieval* method, which generates highly relevant queries offline and constructs an index to map queries to lists of related documents. My team implemented and launched this inverse retrieval strategy, leading to a notable 0.1% increase in both the app's daily active users (DAU) and user retention.
- My team used the inverse retrieval method to enhance the retrieval of newly published documents. When a new document is published, our nearline pipeline generates relevant queries for it and adds the corresponding (query, doc) pair to the index of query \rightarrow List (doc). This project significantly improved the 24-hour new document impression ratio and led to a slight increase in both query and document click-through rates (CTR).

2022-2023 Offline search retrieval pipelines

- My team developed and implemented an innovative *cached retrieval* method. We maintain a table consisting of the top 5 million queries, and for each of these queries, we perform an offline analysis of the search log to extract highly relevant documents with impressive content quality, freshness, and substantial click numbers. The index for query \rightarrow List (doc) is updated daily, serving as a retrieval channel. As a result of this project, we increased query click-through rates (CTRs).
- I proposed an offline search pipeline that targets top queries and initiates proactive, non-personalized retrieval and ranking during nighttime. This process establishes a key-value (KV) index for query \rightarrow List (doc). In the online stage, the offline computation results replace the non-personalized retrieval channel. The project further reduced the GPU costs related to relevance by 21%, as well as improving click-through rates and other key performance indicators.

2022-2023 NLP models

- Pretrained NLP models: My team pretrained both 12-layer and 48-layer BERT models on a combination of public data and proprietary Xiaohongshu data. These pretrained models have been applied to various use cases, including search relevance and search queries, exhibiting significant enhancements in performance across the board.
- Utilizing the open-source BLOOM model as a foundation, we fine-tuned Chinese GPT models specifically to cater to various application requirements. In addition, we invented RefGPT that generates multi-turn dialogues, and we use the dialogues for finetuning GPT models.

Book

- Deep Reinforcement Learning (in Chinese).
Shusen Wang, Yujun Li, and Zhihua Zhang.
Posts & Telecom Press Co., Ltd, 2022.

Journal Papers

- Fast Randomized-MUSIC for Mm-Wave Massive MIMO Radars.
Bin Li, **Shusen Wang**, Jun Zhang, Xianbin Cao, and Chenglin Zhao.
IEEE Transactions on Vehicular Technology, 70(2):1952-1956, 2021.
- Fast Pseudo-spectrum Estimation for Automotive Massive MIMO Radar.
Bin Li, **Shusen Wang**, Zhiyong Feng, Jun Zhang, Xianbin Cao, and Chenglin Zhao.
IEEE Internet of Things Journal, 2021.
- Randomized Approximate Channel Estimator in Massive-MIMO Communication.
Bin Li, **Shusen Wang**, Xianbin Cao, Jun Zhang, and Chenglin Zhao.
IEEE Communications Letters, 24(10):2314 - 2318, 2020.
- A Bootstrap Method for Error Estimation in Randomized Matrix Multiplication.
Miles E. Lopes, **Shusen Wang**, Michael W. Mahoney.
Journal of Machine Learning Research (JMLR), 20(39):1-40, 2019.

- Scalable Kernel K-Means Clustering with Nystrom Approximation: Relative-Error Bounds.
Shusen Wang, Alex Gittens, and Michael W. Mahoney.
Journal of Machine Learning Research (JMLR), 20(12):1-49, 2019.
- Sketched Ridge Regression: Optimization Perspective, Statistical Perspective, and Model Averaging.
Shusen Wang, Alex Gittens, and Michael W. Mahoney.
Journal of Machine Learning Research (JMLR), 18:1-50, 2018.
- Efficient Data-Driven Geologic Feature Characterization from Pre-stack Seismic Measurements using Randomized Machine-Learning Algorithm.
Youzuo Lin, **Shusen Wang**, Jayaraman Thiagarajan, George Guthrie, and David Coblenz.
Geophysical Journal International, ggy385, 2018.
- Alchemist: An Apache Spark \Leftrightarrow MPI Interface.
Alex Gittens, Kai Rothauge, Michael W. Mahoney, **Shusen Wang**, Lisa Gerhardt, Prabhat, Jey Kottalam, Michael Ringenburt, and Kristyn Maschhoff.
Concurrency and Computation Practice and Experience, Special Issue on the Cray User Group, 2018.
- Towards More Efficient SPSP Matrix Approximation and CUR Matrix Decomposition.
Shusen Wang, Zhihua Zhang, and Tong Zhang.
Journal of Machine Learning Research (JMLR), 17(210):1-49, 2016.
- SPSP Matrix Approximation via Column Selection: Theories, Algorithms, and Extensions.
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- EP-GIG Priors and Applications in Bayesian Sparse Learning.
Zhihua Zhang, **Shusen Wang**, Dehua Liu, and Michael I. Jordan.
Journal of Machine Learning Research (JMLR), 13: 2031-2061, 2012.

Conference Papers

- Federated Reinforcement Learning with Environment Heterogeneity.
Hao Jin, Yang Peng, Wenhao Yang, **Shusen Wang**, and Zhihua Zhang.
In *Artificial Intelligence and Statistics (AISTATS)*, 2022.
- Learning by Interpreting.
Xuting Tang, Abdul Rafae Khan, **Shusen Wang**, and Jia Xu.
In *International Joint Conference on Artificial Intelligence (IJCAI)*, 2022.
- Matrix Sketching for Secure Collaborative Machine Learning.
Mengjiao Zhang and **Shusen Wang**.
In *International Conference on Machine Learning (ICML)*, 2021.
- Communication-Efficient Distributed SVD via Local Power Iterations.
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- Cola-GNN: Cross-Location Attention based Graph Neural Networks for Long-term ILI Prediction.
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In *Conference on Information and Knowledge Management (CIKM)*, 2020.

- Sharper Generalization Bound for the Divide-and-Conquer Ridge Regression.
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 In *AAAI Conference on Artificial Intelligence (AAAI)*, 2019.
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- Towards Real-Time Geologic Feature Detection from Seismic Measurements using a Randomized Machine-Learning Algorithm.
 Youzuo Lin, **Shusen Wang**, Jayaraman Thiagarajan, George Guthrie, and David Coblenz.
 In *Proceeding of Society of Exploration Geophysics (SEG)*, 2017.
- Open Domain Short Text Conceptualization: A Generative + Descriptive Modeling Approach.
 Yangqiu Song, **Shusen Wang**, and Haixun Wang.
 In *International Joint Conference on Artificial Intelligence (IJCAI)*, 2015.
- Improving the Modified Nystrom Method Using Spectral Shifting.
Shusen Wang, Chao Zhang, Hui Qian, and Zhihua Zhang.
 In *ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD)*, 2014.
- Efficient Algorithms and Error Analysis for the Modified Nystrom Method.
Shusen Wang and Zhihua Zhang.
 In *International Conference on Artificial Intelligence and Statistics, (AISTATS)*, 2014.
- Making Fisher Discriminant Analysis Scalable.
 Bojun Tu, Zhihua Zhang, **Shusen Wang**, and Hui Qian.
 In *International Conference on Machine Learning (ICML)*, 2014.
- Exact Subspace Clustering in Linear Time.
Shusen Wang, Bojun Tu, Congfu Xu, and Zhihua Zhang.
 In *the 28th AAAI Conference on Artificial Intelligence (AAAI)*, 2014.
- Using The Matrix Ridge Approximation to Speedup Determinantal Point Processes Sampling Algorithms.
Shusen Wang, Chao Zhang, Hui Qian, and Zhihua Zhang.
 In *the 28th AAAI Conference on Artificial Intelligence (AAAI)*, 2014.
- Transfer Understanding from Head Queries to Tail Queries.
 Yangqiu Song, Haixun Wang, Weizhu Chen, and **Shusen Wang**.
 In *ACM International Conference on Information and Knowledge Management (CIKM)*, 2014.
- Nonconvex Relaxation Approaches to Robust Matrix Recovery.
Shusen Wang, Dehua Liu, and Zhihua Zhang.
 In *International Joint Conference on Artificial Intelligence (IJCAI)*, 2013.
- A Scalable CUR Matrix Decomposition Algorithm: Lower Time Complexity and Tighter Bound.
Shusen Wang and Zhihua Zhang.
 In *Advances in Neural Information Processing Systems (NIPS)*, 2012.

- Colorization by Matrix Completion.
Shusen Wang and Zhihua Zhang.
In *AAAI Conference on Artificial Intelligence (AAAI)*, 2012.
- Efficient Subspace Segmentation via Quadratic Programming.
Shusen Wang, Xiaotong Yuan, Tiansheng Yao, Shuicheng Yan, and Jialie Shen.
In *AAAI Conference on Artificial Intelligence (AAAI)*, 2011.

Teaching

- 2021 Fall CS600: Advanced Algorithms
- 2021 Spring CS583: Deep Learning (remote)
- 2020 Fall CS600: Advanced Algorithms (remote), with students' rating of 3.90/4.0
- 2020 Spring CS583: Deep Learning, with students' rating of 3.89/4.0
- 2019 Fall CS583: Deep Learning, with students' rating of 3.83/4.0
- 2021 Spring CS583: Deep Learning, with students' rating of 3.71/4.0
- Open Course YouTube Chinese Channel: <https://www.youtube.com/c/ShusenWang>
YouTube English Channel: <https://www.youtube.com/c/ShusenWangEng>
Bilibili Chinese Channel: <https://space.bilibili.com/1369507485>

Honors & Awards

- 2014 Baidu Scholarship, awarded to 8 Chinese students in the world, US\$30,000
- 2013 Microsoft Research Asia Fellow, awarded to 10 students in Asia Pacific, US\$10,000
- 2012 Scholarship Award for Excellent Doctoral Student Granted by Ministry of Education, US\$5,000
- 2012 – 2014 National Scholarship for Graduate Students, 3 times, each time US\$5,000

Academic Service

Journal Reviewer

- Journal of Machine Learning Research, 2015 – 2021
- SIAM Journal on Scientific Computing, 2017
- ACM Transactions on Mathematical Software, 2017
- Journal of Econometrics, 2017
- SIAM Journal on Matrix Analysis and Applications, 2017, 2019
- International Journal of Data Science and Analytics, 2018
- IEEE Transactions on Signal Processing, 2018
- IEEE Transactions on Information Theory, 2019
- IEEE Transactions on Pattern Analysis and Machine Intelligence, 2019, 2020

Conference Committee Member

- NIPS 2014, 2015, 2017, 2018, 2020
- ICML 2017, 2018, 2019
- IJCAI 2015, 2017, 2018, 2019, 2020
- AAAI 2017, 2018, 2020
- AISTATS 2019, 2020
- UAI 2019, 2020
- Supercomputing 2019
- KDD 2020
- ICLR 2021

Conference Senior Committee Member

- AAAI 2021
- IJCAI 2021

个人简介

我于 2011 年、2016 年取得浙江大学计算机本科、博士学位。读博期间从事人工智能领域研究工作，因学术成果突出，获得百度奖学金、微软学者奖学金、教育部学术新人奖。在 2016 至 2018 年期间任美国加州大学伯克利分校统计系博士后，在 2018 至 2021 年期间任美国史蒂文斯理工学院计算机系助理教授、博导。从 2021 年底至今在小红书（上海）任算法工程师、团队负责人。

我精通搜索引擎、机器学习、强化学习、数值计算，熟悉 NLP、推荐系统。在学术界期间，在人工智能相关的国际顶级期刊、国际顶级会议上发表超过 30 篇论文，并担任多个国际期刊、国际会议的评审、组委会成员。我在业余时间著书《深度强化学习》，开设公开课《工业界的推荐系统》。

在小红书期间，我的主要经验是搜索引擎、NLP 技术和业务。12/2021 至 09/2022 期间负责小红书搜索的基础模型，团队推全 14 个实验，均显著提升搜索大盘指标或降低机器成本。10/2022 至今负责小红书社区 NLP 团队，对接搜索、推荐、电商、增长等多条业务线，并参与 LLM 的研发和落地应用。此外，我短暂负责过推荐系统新内容冷启。

教育经历

- 2011 – 2016 浙江大学计算机学院，博士
- 2007 – 2011 浙江大学计算机学院、竺可桢学院，本科

工作经历

- 2021 – 现在 小红书（中国上海），算法工程师、团队负责人
- 2018 – 2021 史蒂文斯理工学院（美国新泽西州），助理教授、博导
- 2016 – 2018 加州大学伯克利分校（美国加州），博士后
- 2014 – 2015 百度研究院（中国北京），实习
- 2012 – 2012 谷歌研究院（中国北京），实习
- 2011 – 2012 微软亚洲研究院（中国北京），实习

工业界项目

2022 搜索排序的 CTR 模型

- 我的团队推全多个模型结构、特征工程实验，均显著提升 query 有点比。
- 我的团队将 CPU 推理切换成 GPU 推理，降低成本和 RT。

2022 本地内容搜索

- 背景：我发现小红书上有一定比例的 query 的意图是寻找本地生活内容，但是搜索引擎没有相应的承接，这类 query 的有点比等指标很差。
- 我提出了本地内容搜索项目，设计了独立的链路（包括意图理解、召回、排序策略），作为项目 PL 推进项目从零到一落地。对于几类本地意图的 query，有点比有巨大提升。
- 项目获得公司 2022 Q3 ExtraMile 奖（公司共有 5 个项目，其中 2 个为技术项目）。

2022-2023 NLP 技术在搜索召回的应用

- 我设计了“反向召回”技术，用文档生成高相关性查询词，建立 query → List (doc) 的 KV 索引。我的团队落地该技术，小幅提升有点比，大幅提升大盘 DAU 和留存指标。
- 我们团队将反向召回技术用于新文档召回，在文档发布之后，近线生成 query，接入 query → List (doc) 实时流 KV 索引。该技术小幅提升有点比，大幅提升 24 小时新文档占比。

2022-2023 离线搜索链路

- 我的团队设计并实现了“缓存召回通道”，原理是圈定头部 query，离线统计每条 query 的曝光、点击、交互，并融合相关性、内容质量、时效性分数，根据融合分数做离线排序，作为一条召回通道。两期项目均提升了有点比等业务指标。
- 我提出了离线搜索链路，即圈定头部 query，在夜间发起主动的非个性化召回和排序，建立 query → List (doc) 的 KV 索引。在线上，用离线计算结果代替非个性化召回通道。项目降低相关性 GPU 成本 21%（在已有 Redis 缓存的前提下进一步降本），而且提升有点比等指标。

- 预训练技术：我们团队利用小红书数据与公开数据，用多机多卡预训练 12 层和 48 层 BERT 模型。将模型在搜索、电商等业务中落地，比公开中文 BERT 有大幅提升。
- GPT 模型：我们团队基于 BLOOM 等预训练基座，做 finetuning 训练中文 GPT。我们设计的RefGPT技术自动生成大量多轮问答数据，用于 finetuning。

著书

- 深度强化学习（中文）。
王树森，黎彧君，张志华。
人民邮电出版社，2022。
初稿下载地址：https://github.com/wangshusen/DRL/tree/master/Notes_CN

期刊论文

- Fast Randomized-MUSIC for Mm-Wave Massive MIMO Radars.
Bin Li, **Shusen Wang**, Jun Zhang, Xianbin Cao, and Chenglin Zhao.
IEEE Transactions on Vehicular Technology, 70(2):1952-1956, 2021.
- Fast Pseudo-spectrum Estimation for Automotive Massive MIMO Radar.
Bin Li, **Shusen Wang**, Zhiyong Feng, Jun Zhang, Xianbin Cao, and Chenglin Zhao.
IEEE Internet of Things Journal, 2021.
- Randomized Approximate Channel Estimator in Massive-MIMO Communication.
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IEEE Communications Letters, 24(10):2314 - 2318, 2020.
- A Bootstrap Method for Error Estimation in Randomized Matrix Multiplication.
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- Scalable Kernel K-Means Clustering with Nystrom Approximation: Relative-Error Bounds.
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Geophysical Journal International, ggy385, 2018.
- Alchemist: An Apache Spark \leftrightarrow MPI Interface.
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In *International Conference on Machine Learning (ICML)*, 2014.
- Exact Subspace Clustering in Linear Time.
Shusen Wang, Bojun Tu, Congfu Xu, and Zhihua Zhang.
In *the 28th AAAI Conference on Artificial Intelligence (AAAI)*, 2014.
- Using The Matrix Ridge Approximation to Speedup Determinantal Point Processes Sampling Algorithms.
Shusen Wang, Chao Zhang, Hui Qian, and Zhihua Zhang.
In *the 28th AAAI Conference on Artificial Intelligence (AAAI)*, 2014.
- Transfer Understanding from Head Queries to Tail Queries.
Yangqiu Song, Haixun Wang, Weizhu Chen, and **Shusen Wang**.
In *ACM International Conference on Information and Knowledge Management (CIKM)*, 2014.
- Nonconvex Relaxation Approaches to Robust Matrix Recovery.
Shusen Wang, Dehua Liu, and Zhihua Zhang.
In *International Joint Conference on Artificial Intelligence (IJCAI)*, 2013.
- A Scalable CUR Matrix Decomposition Algorithm: Lower Time Complexity and Tighter Bound.
Shusen Wang and Zhihua Zhang.
In *Advances in Neural Information Processing Systems (NIPS)*, 2012.
- Colorization by Matrix Completion.
Shusen Wang and Zhihua Zhang.
In *AAAI Conference on Artificial Intelligence (AAAI)*, 2012.
- Efficient Subspace Segmentation via Quadratic Programming.
Shusen Wang, Xiaotong Yuan, Tiansheng Yao, Shuicheng Yan, and Jialie Shen.
In *AAAI Conference on Artificial Intelligence (AAAI)*, 2011.

教学

- 2021 秋 CS600: Advanced Algorithms
- 2021 春 CS583: Deep Learning (网课)
- 2020 秋 CS600: Advanced Algorithms (网课)
- 2020 春 CS583: Deep Learning
- 2019 秋 CS583: Deep Learning
- 2021 春 CS583: Deep Learning
- 公开课 YouTube 中文频道: <https://www.youtube.com/c/ShusenWang>
- YouTube 英文频道: <https://www.youtube.com/c/ShusenWangEng>
- Bilibili 中文频道: <https://space.bilibili.com/1369507485>

获奖

- 2014 百度奖学金, 全球 8 人获奖, 奖金 20 万人民币
- 2013 微软学者奖学金, 亚太地区 10 人获奖, 奖金 1 万美元
- 2012 教育部学术新人奖学金, 奖金 3 万人民币
- 2012 – 2014 三次获得国家奖学金, 每次奖金 3 万人民币

期刊、会议评审

期刊审稿

- Journal of Machine Learning Research, 2015 – 2021
- SIAM Journal on Scientific Computing, 2017
- ACM Transactions on Mathematical Software, 2017
- Journal of Econometrics, 2017
- SIAM Journal on Matrix Analysis and Applications, 2017, 2019
- International Journal of Data Science and Analytics, 2018
- IEEE Transactions on Signal Processing, 2018
- IEEE Transactions on Information Theory, 2019
- IEEE Transactions on Pattern Analysis and Machine Intelligence, 2019, 2020

会议 Committe Member

- NIPS 2014, 2015, 2017, 2018, 2020
- ICML 2017, 2018, 2019
- IJCAI 2015, 2017, 2018, 2019, 2020
- AAAI 2017, 2018, 2020
- AISTATS 2019, 2020
- UAI 2019, 2020
- Supercomputing 2019
- KDD 2020
- ICLR 2021

会议 Senior Committe Member

- AAAI 2021, 2022
- IJCAI 2021