

# AFTAB HUSSAIN

PhD Candidate

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## RESEARCH INTERESTS

My research interests are in the areas of programming languages, systems, and security. I enjoy the design of interface description languages that can generate secure code for inter-module interactions of large code systems like Linux. I also enjoy developing scalable systems that can support static analysis applications, such as bug detection, on very large codebases. Currently, I am working in a project on light-weight capability domains in Linux at the MARS Systems Research Group with my advisor, Professor Anton Burtsev.

## EDUCATION

- 2015 - present    PhD Candidate in COMPUTER SCIENCE,  
**University of California, Irvine (UCI)**, United States  
Focus: "Programming Languages and Systems" | Advisor: Prof. Anton BURTSEV  
GPA: 3.82/4
- 2013 - 2015    M.Sc. in SOFTWARE ENGINEERING,  
**University of California, Irvine**, United States  
GPA: 3.74/4
- 2010 - 2012    M.Sc. Engg. in COMPUTER SCIENCE AND ENGINEERING,  
**Bangladesh University of Engineering and Technology (BUET)**, Dhaka, Bangladesh  
Thesis: "Software Restructuring using Hierarchical Clustering"  
Advisor: Prof. Md. Saidur RAHMAN  
GPA: 3.83/4
- 2005 - 2009    B.Tech. in COMPUTER SCIENCE AND ENGINEERING,  
**Institute of Engineering and Management (IEM)**, Kolkata, India  
Thesis: "Steganography" | Advisor: Prof. Himadri Nath SAHA  
GPA: 8.01/10

## EXPERIENCE

RESEARCH	<b>Graduate Researcher</b> at DEPARTMENT OF COMPUTER SCIENCE, UNIVERSITY OF CALIFORNIA, IRVINE <i>Areas:</i> Scalable static program analysis, graph processing, cyber security <i>Labs:</i> Mars Systems Research Group, PLSys Group	MAR 2015 to <i>present</i>
	<b>Graduate Researcher</b> at DEPARTMENT OF INFORMATICS, UNIVERSITY OF CALIFORNIA, IRVINE <i>Areas:</i> Big data analytics, software repository mining <i>Lab:</i> Big Data Mondego Lab	SEP 2013 to MAR 2015
	<b>Research Associate</b> at DEPARTMENT OF COMPUTER SCIENCE, BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY <i>Areas:</i> Graph clustering, software visualization <i>Labs:</i> Graph Drawing and Info Visualization Lab, Samsung Innovation Lab	DEC 2012 to AUG 2013
	<b>Research Assistant</b> at DEPARTMENT OF COMPUTER SCIENCE, BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY <i>Areas:</i> Planar graph drawing, wireless sensor networks <i>Lab:</i> Graph Drawing and Info Visualization Lab	SEP 2010 to JUN 2011

TEACHING	<b>Teaching Assistant</b> at BREN SCHOOL OF INFORMATION AND COMPUTER SCIENCES, UNIVERSITY OF CALIFORNIA, IRVINE	JAN 2014 to <i>present</i>
	<b>Reader</b> at BREN SCHOOL OF INFORMATION AND COMPUTER SCIENCES, UNIVERSITY OF CALIFORNIA, IRVINE	SEP 2013 to DEC 2013
INDUSTRY	<b>Software Engineering Intern</b> at NEXTTEL COMMUNICATION, DHAKA, BANGLADESH <i>Project:</i> GUI design of pharmaceutical mobile application	MAR 2010 to APR 2010
	<b>Software Engineering Trainee</b> at CMC KOLKATA, (A TATA ENTERPRISE), KOLKATA, INDIA <i>Project:</i> Design of hospital database management system	JUL 2008

## PUBLICATIONS

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### CONFERENCE PUBLICATIONS

- C.4. K. Wang, A. Hussain, Z. Zuo, G. Xu, and A. A. Sani. Graspan: A single-machine disk-based graph system for interprocedural static analyses of large-scale systems code. In *22nd ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS '17)*, Xi'an, China, 2017 ([paper](#))
- C.3. D. Yang, A. Hussain, and C. V. Lopes. From query to usable code: An analysis of stack overflow code snippets. In *13th International Conference on Mining Software Repositories (MSR '16, Co-located with ICSE '16)*, Austin, Texas, US, 2016 ([paper](#))
- C.2. I. Hossain, S. Sultana, A. Hussain, N. N. Moon, and M. S. Rahman. L-shaped drawings of series-parallel graphs. In *International Mathematics Conference*, Dhaka, Bangladesh, 2013 ([paper](#))
- C.1. A. Hussain and M. S. Rahman. A new hierarchical clustering technique for restructuring software at the function level. In *6th India Software Engineering Conference (ISEC '13)*, New Delhi, India, 2013 ([paper](#))

### WORKSHOP PUBLICATIONS

- W.2 A. Hussain. Graspan: A single-machine disk-based graph system for interprocedural static analyses of large-scale systems code. In *17th Southern California Workshop on Programming Languages and Systems (SoCal PLS '16)*, Irvine, California, US, 2016
- W.1 A. Hussain and M. S. Rahman. A new clustering technique using (k,w)-core decomposition for restructuring software functions. In *Workshop on Graph Drawing and Graph Algorithms (GDGA '13)*, Dhaka, Bangladesh, 2013

### POSTERS

- P.3 K. Wang, A. Hussain, Z. Zuo, G. Xu, and A. A. Sani. Graspan: A single-machine disk-based graph system for interprocedural static analyses of large-scale systems code. In *22nd ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS '17)*, Xi'an, China, 2017 ([poster](#))
- P.2 A. Hussain. Graspan: A single-machine disk-based graph system for interprocedural static analyses of large-scale systems code. In *Student Research Competition, 37th ACM SIGPLAN conference on Programming Language Design and Implementation (PLDI '16)*, Santa Barbara, California, US, 2016
- P.1 A. Hussain. Graspan: A single-machine disk-based graph system for interprocedural static analyses of large-scale systems code. In *Computer Science Research Showcase, University of California, Irvine*, Irvine, California, US, 2016

## TECHNICAL REPORTS

- T.6 A. Hussain, V. Narayanan, and A. Burtsev. An implementation overview of an idl generation framework based on dsa. Technical report, Department of Computer Science, University of California, Irvine, 2018
- T.5 H. Xu, Z. Zuo, K. Wang, A. Hussain, and K. Nguyen. Systemized program analyses: A big data perspective on scaling large-scale code analyses. Technical report, Department of Computer Science, University of California, Irvine, 2017 ([report](#))
- T.4 A. Hussain and I. Scherson. A study on memory consistency approaches in distributed shared memory systems. Technical report, Department of Computer Science, University of California, Irvine, 2016
- T.3 A. Hussain and G. Xu. Graphdttc: A graph processing system for scalable and precise program analysis. Technical report, Department of Computer Science, University of California, Irvine, 2015 ([report](#))
- T.2 A. Hussain, O. Asadi, and D. Richardson. A holistic look at requirements engineering practices in the gaming industry. Technical report, Department of Informatics, University of California, Irvine, 2015 ([report](#))
- T.1 D. Yang, A. Hussain, and C. V. Lopes. Effect of follow and watch relationships in pull requests (in github). Technical report, Department of Informatics, University of California, Irvine, 2014 ([report](#))

## UNDER PREPARATION

- U.1 A. Hussain and A. Burtsev. Common vulnerabilities and exposures in the cloud (under preparation). Technical report, Department of Computer Science, University of California, Irvine, 2018

## SELECTED PROJECTS

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### IDL Compilation for generating Glue Code for isolating Linux Drivers

2018-present

Design and compilation of an interface definition language to generate glue code that helps to isolate Linux drivers.

› Resources: [Source code](#), [IDL compiler documentation](#)

### IDL Generation for Linux Kernel Security

2017-present

Static analysis of Linux kernel to automatically generate interface definition language (IDL) code for isolating kernel modules for enhancing security.

› Resources: [Source code](#)

### Graspan: Parallel Graphs System for Big Code Analysis

2015-2017

We built a disk-based parallel graph system, Graspan, that uses a novel edge-pair centric computation model to compute dynamic transitive closures on very large program graphs. We implement context-sensitive pointer/alias and dataflow analyses on Graspan. An evaluation of these analyses on program graphs of large codebases such as Linux shows that their Graspan implementations scale to millions of lines of code. **(Computations in Graspan took 2 to less than 12 hrs, and the largest graph generated had 1.1 billion edges).**

Graspan implementations are also much simpler to implement than their original implementations. After augmenting existing checkers with these analyses, the checkers **uncovered 132 new NULL pointer bugs and 1308 unnecessary NULL tests in Linux 4.4.0-rc5, PostgreSQL 8.3.9, and Apache httpd 2.2.18.**

› Accepted in [ASPLOS '17](#), Xi'an, China.

› Featured in the tutorial, [Systemized Program Analyses](#) at ASPLOS '17.

› Invited for presentation at [SoCal PLS '16](#).

- › Invited for poster presentation at [PLDI SRC '16](#).
- › Resources: [Source code](#), [paper](#), [poster](#), [tutorial](#)

## Analysis of Usability of Stack Overflow Code Snippets

2013-2014

Besides being useful for software developers, annotated Stack Overflow snippets can potentially serve as the basis for automated tools that provide working code solutions to specific natural language queries. Towards this goal, we investigated the compilability of Stack Overflow code snippets. **A total of 3 million code snippets were analyzed across four languages: C#, Java, JavaScript, and Python.** Python and JavaScript proved to be the languages for which the most code snippets are usable. Conversely, Java and C# proved to be the languages with the lowest usability rate.

- › Accepted in [MSR '16](#).
- › Resources: [Paper](#)

## Software Restructuring using Hierarchical Clustering

2011-2013

Software restructuring techniques based on hierarchical agglomerative clustering (HAC) algorithms have been widely used to restructure large modules with low cohesion into smaller modules with high cohesion, without changing the overall behaviour of the software. These techniques generate clustering trees, of modules, that are sliced at different cut-points to obtain desired restructurings. Choosing appropriate cut-points has always been a difficult problem in clustering. Previous HAC techniques generate clustering trees that have large number of cut-points. Moreover, many of those cut-points return clusters of which only a few lead to a meaningful restructuring of the software.

In this work, we develop a new hierarchical clustering technique for restructuring software that **improves refactoring visualization by at least 30% over 3 widely popular clustering algorithms, is 60% faster, and yields the same code quality improvements on Java functions extracted from real-life industrial programs.**

- › Accepted in [ISEC '13](#).
- › Invited for presentation in GDGA (Graph Drawing and Graph Algorithms) '13.
- › Resources: [Paper](#), [thesis](#)

## PRESENTATIONS

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- P.5 Graspan: A Single-machine Disk-based Graph System for Interprocedural Static Analyses of Large-scale Systems Code, SoCalPLS, November 2016, Irvine, California, US
- P.4 Graspan: A Single-machine Disk-based Graph System for Interprocedural Static Analyses of Large-scale Systems Code, PLDI SRC, (poster), June 2016, Santa Barbara, California, US
- P.3 Graspan: A Single-machine Disk-based Graph System for Interprocedural Static Analyses of Large-scale Systems Code, UCI CS Research Showcase, (poster), June 2016, Irvine, California, US
- P.2 A New Hierarchical Clustering Technique for Restructuring Software at the Function level, ISEC, February 2013, New Delhi, India
- P.1 A New Clustering Technique using (k,w)-Core Decomposition for Restructuring Software Functions, GDGA, January 2013, Dhaka, Bangladesh

## TEACHING

COURSES	<i>Served as Teaching Assistant (TA), University of California, Irvine:</i>	
	Computer Systems Architecture (CS 250P), graduate level	WINTER 2019
	Operating Systems (CS 238P), graduate level	FALL 2018
	Concepts in Programming Languages (CS 141), undergraduate level	SUMMER 2018
	Principles of System Design (ICS 53), undergraduate level	SPRING 2018
	Compilers and Interpreters (CS 142), undergraduate level	WINTER 2018
	Concepts in Programming Languages (CS 141), undergraduate level	FALL 2017
	Compilers and Interpreters (CS 142), undergraduate level	WINTER 2017
	Introduction to Programming (ICS 31), undergraduate level	WINTER 2014
	Requirements Analysis and Engineering (INF 113), undergraduate level	WINTER 2014
SELECTED LECTURES	<i>Served as Reader, University of California, Irvine:</i>	
	Introduction to Software Engineering (INF 43), undergraduate level	FALL 2013
	<i>Operating Systems (CS 238P):</i>	
	<a href="#">Basic UNIX shell commands, VIM</a>	FALL 2018
	<a href="#">C basics, arrays, pointers (code)</a>	FALL 2018
	<a href="#">C string manipulation, structures, function pointers (code)</a>	FALL 2018
	<a href="#">C bitfields, xv6 setup, GDB (video)</a>	FALL 2018
	<a href="#">xv6 booting: Transitioning from 16 to 32 bit mode (video)</a>	FALL 2018
	<a href="#">ELF header, real mode segmentation, paging (video)</a>	FALL 2018
	<a href="#">Threads, locks (video, code)</a>	FALL 2018
STUDY MATERIAL	<a href="#">xv6 review, system call chain (video)</a>	FALL 2018
	<i>Compilers and Interpreters (CS 142):</i>	
	<a href="#">Bottom-up parsing (LR(0), LR(1))</a>	WINTER 2018
	Top-down parsing (LL(1)), handles	WINTER 2018
	Global optimization	WINTER 2017
	<i>Operating Systems (CS 238P):</i>	
	<a href="#">Memory layout after booting xv6</a>	FALL 2018
	<a href="#">Counting semaphores</a>	FALL 2018
	<i>Concepts in Programming Languages (CS 141):</i>	
	<a href="#">Memory layout of struct and union in C</a>	FALL 2017
TOOLS	<i>Compilers and Interpreters (CS 142):</i>	
	<a href="#">Crux Compiler Project Autograder</a>	WINTER 2018

## MENTORING

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PROJECTS	<i>University of California, Irvine:</i>	
	4. Efficient Software Infrastructure for Non-Uniform Memory Machines	AUG 2018 - JAN 2019
	3. Grasp Migration from Java to C++	JUN 2016 - DEC 2016
	2. Automatic Comment Generator for Java Code	SEP 2015 - DEC 2015
	<i>Bangladesh University of Engineering and Technology:</i>	
1.	Improving Code Testing Environments	DEC 2012 - AUG 2013
STUDENTS	<i>I-Surf Fellows at University of California, Irvine:</i>	[Project #]
	Jeonghoon Lee, Undergraduate, HANYANG UNIVERSITY, SEOUL	4
	Jiwon Jeon, Undergraduate, AJOU UNIVERSITY, SUWON	4
	Minjun Cha, Undergraduate, KOOKMIN UNIVERSITY, SEOUL	4
	Yealynn Kim, Undergraduate, KOOKMIN UNIVERSITY, SEOUL	4
	Sungsoo Son, Undergraduate, KOOKMIN UNIVERSITY, SEOUL	3
	Hansem Jeon, Undergraduate, KOOKMIN UNIVERSITY, SEOUL	3
	Soyeong Park, Undergraduate, KOOKMIN UNIVERSITY, SEOUL	2
	John Vincent Thorpe, Undergraduate, UCI	3
	Md. Khaled Hussain, Graduate, BUET	1

## SERVICE

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ISSTA 2018 Amsterdam, Netherlands	Artifact Evaluation Committee Member INTERNATIONAL SYMPOSIUM ON SOFTWARE TESTING AND ANALYSIS
ISSTA 2017 Santa Barbara, California, US	Artifact Evaluation Committee Member INTERNATIONAL SYMPOSIUM ON SOFTWARE TESTING AND ANALYSIS
WADM 2013 Dhaka, Bangladesh	Reviewer WORKSHOP ON ADVANCES IN DATA MANAGEMENT
BWTCSE 2013 Dhaka, Bangladesh	Organizing Committee Member BRAIN STORMING WORKSHOP ON THEORETICAL COMPUTER SCIENCE AND ENGINEERING
GDGA 2013 Dhaka, Bangladesh	Organizing Committee Member WORKSHOP ON GRAPH DRAWING AND GRAPH ALGORITHMS
WALCOM 2012 Dhaka, Bangladesh	Organizing Committee Member and Reviewer WORKSHOP ON ALGORITHMS AND COMPUTATION

## HONORS

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### GRANTS

- MAR 2017**    **ACM Professional Activities Grant**  
For paper presentation in 22nd ACM International Conference on Architectural Support for Programming Languages and Operating Systems, (ASPLOS '17).
- MAY 2016**    **ACM Travel Award**  
For poster presentation in Student Research Competition at Programming Languages Design and Implementation Conference (PLDI '16)
- FEB 2013**    **Chair's Award**  
Department of Informatics, University of California, Irvine
- DEC 2012**    **CodeCrafters-Investor Tools Research Grant**  
For paper presentation in ACM Indian Software Engineering Conference (ISEC '12)
- SEP 2010**    **Research Assistantship Grant**  
Committee of Advanced Studies and Research,  
Bangladesh University of Engineering and Technology

### OFFERS

- MAR 2017**    Invited to present tutorial on "Systemized Program Analyses - A Big Data Perspective on Static Analysis Scalability" at ASPLOS '17
- APR 2013**    **Graduate Admission Offer**  
Department of Computer Science, University of California, Davis
- FEB 2013**    **PhD Admission Offer with Full Scholarship**  
School of Computing, Queen's University, Canada
- JUL 2009**    **Associate System Engineer Position Offer**  
IBM-India

### CERTIFICATIONS

- MAY 2008**    **DELTA A2 Diploma in French Language**  
Alliance Française, Ministère de l'Éducation Nationale, République Française
- NOV 2007**    **DELTA A1 Diploma in French Language**  
Alliance Française, Ministère de l'Éducation Nationale, République Française

### OTHERS

- FEB 2010**    **Selection in National ICT Internship Program**  
Bangladesh Computer Council,  
Ministry of Science and ICT, Dhaka, Bangladesh
- OCT 2009**    **Top 22 of 152 test takers**  
Master's Program Admission Test, Bangladesh University of Engineering and Technology