Aman Mangal

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Research Interests Network Function Virtualization, Distributed Systems, Cloud Computing
Software Defined Networking, Distributed Event Based Systems

Education

Georgia Institute of Technology, Atlanta, GA
Masters in Computer Science, GPA 4.0/4

Indian Institute of Technology, Bombay, India
Bachelor of Technology in Computer Science & Engineering with Honors, GPA: 8.54/10
Minor in Electrical Engineering, GPA: 8.06/10

Publications

1. **Aman Mangal**, Arun Mathew, Tanmay Randhavane and Umesh Bellur. "Predicting Power Needs in Smart Grids'. In Proceedings of the 8th ACM International Conference on *Distributed Event-Based Systems* (DEBS '14).

Research Experience

Raft Consensus Algorithm for Data Center Network [Sept 2015 - Dec 2015]
Guide: Greg Eisenhauer [`https://github.com/mangalaman93/etcd`]

- Analyzed the performance of Raft consensus algorithm in presence of heavy network load and improved it by co-designing the system with the network layer
- Showed that write performance of *etcd* degrades in presence of heavy network load
- Enhanced throughput by setting higher priority to *etcd* messages than congestion traffic
- Exposed the network layer priorities to the application in a transparent manner in order to simplify application development by modifying Golang *http* library
- Evaluated the idea on a 5 node cluster of *etcd* key-value store, setup on banana pi boards connected in a star topology using a 802.1p enabled L2 switch

Load-Based Server Selection for Containers (Bell Labs) [June 2015 - Aug 2015]
Mentors: Martin Carroll, Ilija Hadzic, Christian Hans Woithe

- Developed a monitoring infrastructure for Linux containers using collectd, influxdb (a time series database) and grafana (for visualization of various metrics)
- Analyzed workload of a specific set of containers streaming arbitrary number of pixel streams to remote displays using locally available GPUs
- Compared load prediction and container packing algorithms using Discrete Event Simulation technique for "streaming" containers assuming a exponentially distributed workload
- Demonstrated that real workload and generated workload is close enough to use the results for real world scenarios

Fault Tolerance in Software Defined Networks [Oct 2014 - Dec 2014]
Guide: Prof Nick Feamster [`https://github.com/mangalaman93/pyretic`]

- Proposed an algorithm for handling link failures in SDNs and implemented it in pyretic
- Performed reverse search by first selecting shortest paths in the network and then choosing links for which these paths can be used as back up paths
- Provided fine-grained control over the network by let the user specify flows and end nodes corresponding to which back up paths are to be installed
- Installed flow rules proactively to reduce downtime due to link failure

Optimizing Short Read Error Correction on GPU [Oct 2014 - Nov 2014]
Guide: Prof Richard Vuduc [https://bitbucket.org/cjain7/cse6230-project]

- Improved efficiency of GPU based state of the art error correction software CUDA-EC by 14.81% by increasing warp efficiency from 3.5% to 67.5% and other optimization
- Restructured the code by having one read processed by one warp and showed that *multiple-thread-one-read* model has enough task parallelism to exploit on GPU compared to the classical model of *one-thread-one-read* model
- Demonstrated that Bloom Filter access throughput cannot be further improved by showing that average bits accessed per query is only 1.25 bits

Dynamic Server Consolidation in Virtual Cluster [July 2013 - May 2014]
Guide: Prof Varsha Apte [https://github.com/mangalaman93/simcon]

- Leveraged cyclic workload of enterprise applications and formulated Dynamic Server Consolidation Problem (DSCP) as Finite Horizon Markov Decision Process (MDP)
- Reduced state space of MDP exploiting homogeneity of Physical Machines, therefore, reducing time complexity by a factor of $(\log N)^N$, N is number of applications (VMs)
- Compared with Dynamic Management Algorithm of Khanna and pMapper while providing the benefit of known cyclic workload, thus proving the optimality of MDP

Erlang Distributed File System (Undergraduate Thesis) [July 2013 - Dec 2013]
Guide: Prof G. Sivakumar [view report]

- Extensively surveyed existing Distributed File Systems and developed a taxonomy
- Inspired from Hadoop Distributed File System, highly concurrent & fault tolerant
- Implemented stateless worker nodes to achieve fault tolerance, event based protocol to detect component failures in the system
- Designed worker node as finite state machine with 4 different states- ReadWrite (normal state), ReadOnly, Distress and Unavailable

Work Experience

Erlang Package Manager (Google Summer of Code 2013) [June 2013 - Dec 2014]
Mentor: Eric Merritt & Jordan Wilberding [https://github.com/mangalaman93/epax]

- Built a command line interface(CLI) to create and maintain index of Erlang packages
- Solved the problem of dependency hell by retrieving OTP dependencies recursively
- Separated OS dependent and OS independent code, portable on Windows and Linux
- Provided support for various version control systems like git, bzr, svn where Erlang packages can be maintained
- Provided the concept of publisher so that fork/modified repositories of a package can be maintained as well as linked as a separate package

Unified Call Distributor (Novanet Ltd) [Dec 2012 - Dec 2013]

- Worked in a team of developers responsible for back end Erlang application (Call Distributor)
- Developed an algorithm to equally assign calls to agents by matching mandatory and desired skills to agent properties, considered idle time in case of a draw in properties
- Independent of channel (voice, chat, email etc.) of the request, hence unified
- Designed the OTP layout containing 14 different kinds of supervisors and workers
- Handled fail-over when master node dies, replicated database to backup node

Operation's Dashboard - opdash (Chronus Corporation) [May 2013 - June 2013]
Mentor: Murali Bhoopathy, Director of Operations & Co-founder

- Built dashboards as well as a command line tool (CLI) to visualize operation's performance for various production environments
- Used REST APIs to gather data from Pingdom, Newrelic, Amazon, Google spredsheets and pushed it on Geckoboard for visualization
- Deployed on Amazon servers and scheduled periodic updates using cron utility

Teaching Experience

Teaching Assistant

CS 3251 - Undergraduate Computer Networking [Spring 2015]
Instructor: Prof Russell J. Clark & Prof Matt Sanders, Georgia Tech

MA 214 - Introduction to Numerical Analysis [Spring 2012]
Instructor: Prof S. Sivaji Ganesh, IIT Bombay

Academic Achievements

- Secured All India Rank 70 in IIT JEE 2010 among 400,000 students
- Participated in Student Exchange Program and completed the spring semester 2011-12 in Nanyang Technological University (NTU), Singapore
- Secured All India Rank 256 in AIEEE 2010 among 800,000 students
- Awarded Narotam Sekhsaria Scholarship - 2010 for undergraduate studies in engineering
- Distinguished by Vasundhara Raje, Chief Minister of Rajasthan, India for 13^{th} merit in Secondary Board Examination 2010

Honors & Olympiads

- Stood amongst the top 1% students of the country in Indian National Physics Olympiad
- Secured 56^{th} position in the final round of 12th National Science Olympiad (NSO)
- Accomplished 7^{th} position in second round of Indian National Mathematics Olympiad
- Invited for the session of Council of Scientific and Industrial Research (CSIR) Programme on Youth for Leadership in Science (CPYLS) 2008 in CEERI Pilani, India
- Invited for Google Summer of Code (GSoC) Mentor Summit (Reunion), 2014 held at San Jose, CA, USA [23-26 Oct, 2014]

Key Projects Undertaken

Querifier (Implementation Techniques for Relational Databases) [Oct'12-Nov'12]
Guide: Prof. N. L. Sarda [`https://github.com/mangalaman93/querifier`]

- Designed an interface using JSP and Servlets for students to submit SQL queries, and verify the submitted queries with the desired result as per the query provided by instructor
- Used AJAX calls throughout the session of a user to minimize HTML traffic
- Implemented news forum where users can post questions and reply to the existing threads
- Provided updates and upcoming deadlines on the user's homepage

Click to Cheat (Hack U Competition by Yahoo) [Aug'12]
[`https://github.com/mangalaman93/click_to_cheat`]

- Developed an Android application that answers a natural-language fact based multiple choice question given a clicked image
- Developed a JNIWrapper to use OpenCV's Adaptive Thresholding functions in android for efficient text recognition (using Google's Tesseract OCR engine)

Singapore Mass Rapid Transit (Business Operations and Processes) [Feb'12-Apr'12]
Guide: Prof Liu Fang

- Studied behavior of SMRT, proposed possible improvements based on statistical analysis
- Conducted a survey focused on train efficiency, operations, service standards to support existence of problems in MRT (local train system of Singapore)
- Theoretically calculated the train inventory using Little's Law, compared it with the collected data thereby proving the optimality of the existing system

Steganography (Data Structures and Algorithms) [Sept'11-Nov'11]
Guide: Prof. Varsha Apte [`http://github.com/mangalaman93/steganography`]

- Developed using OpenCV to hide secret texts, files or small images in image files
- Implemented Least Significant Bit (LSB) Insertion algorithm to ensure invisibility of change in cover image
- Huffman Compression of the secret data is used to achieve high payload capacity

Voice Recognition System (Electronics Club Summer Project) [May'11-June'11]
[http://wiki.stab-iitb.org/wiki/Voice_Recognition_System]

- Implemented Discrete Wavelet Transform(DWT) using suitable mother wavelet to recognize voice commands independent of the characteristics of the speaker
- Prototyped in MATLAB and implemented it in C to run it onto ATMEGA-328 μC
- Solved the problem of small memory of μC by using external EEPROM (25LC1024) and designed a software cache to speed up writes and reads
- Developed a library to interface 7-seg LED Display to show static & dynamic text on it

Other Projects

- Developed a language processor CFGLP extending features of C++, generates assembly code (x84 architecture) from Control Flow Graph
- Designed virtual memory system with page in/out schemes, page fault handling, TLB, swap space management in OS/161 operating system
- Developed a prototype of electronic eyes for blinds to cross road on Atmega-32 platform using Ultrasound technology and Doppler effect
- Developed a strategy based 2-player game Connect-4 in MIT Scheme, implemented an AI player using minimax algorithm with alpha beta pruning
- Programmed Snake game having 10 levels of difficulty using EzWindows C++ library

Software & Programming Skills

- Proficient in C, C++, Golang, Erlang, Java, Python
- docker, Scilab, Xilinx(Verilog), Android
- Ruby on Rails (RoR), Java (JSP Servlets), AJAX, Javascript, PHP

Position of Responsibility

Convener of IIT Bombay Broadcasting Channel (IIT-BBC) [July'11-Dec'11]

- Founded first ever online broadcasting channel by an institute in India, with the help of Insight, IIT Bombay's Student Media Body and Newsletter
- Provides cultural, technical, sports and academic updates through videos
- Published over 50 videos in the first four months of the channel

ITSP Mentor (Institute Technical Summer Projects)

- Helped sophomore teams in their respective summer projects in 2012 and 2013
- Awarded for unprecedented mentorship by Student Technical Activities Body (STAB)

Extra Curriculars

- Contributed to spoken tutorial on Pre-Processor in GCC under Spoken Tutorial Project by testing the scripts as a novice (2011)
- Successfully completed the basic module in Japanese offered by Japanese Embassy (2012)
- Guided the under-privileged in regular doubt clearing classes organized by Abhyasika under Group for Rural Activities(GRA) (2011 - 2013)
- Secured first prize in short film making competition by Silverscreen club, IIT Bombay
- Designed a Wireless car using RF Module and an autonomous Line Follower on Arduino
- Successfully completed training in NSO Music(Keyboard) in 2010-11