Ch P K S Sampath Kumar

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EDUCATION

Degree/ Certificate	Institution	Year	CPI/Percentage	Rank
M.tech	Indian Institute of Technology, Kanpur, India	2015*	8/10**	
B.tech	Indian Institute of Technology, Kanpur, India	2015*	6.6/10**	
Class12 : State Board	Prathibha Junior College, Hyderabad, India	2009	88.7%	
Class10:State Board	Richmonds High School, Hyderabad, India	2007	85.0%	

*expected year of graduation ** after completion of 8th semester

Research Interests

Computer Architecture, parallel programming, Parallel Processing, Parallel Algorithms, Machine Translation, Compilers, Program Analysis and Optimizations, Functional programming, Artificial Intelligence, Geometric Modelling, Robotics, Logic in Computer Science, Databases, Data Mining, Sensor Networks, Bioinformatics, Computer Networks, Protocols, IPv6, Telecom Regulation, Automated & Common sense Reasoning, AI, Programming Languages, Computational Complexity Theory, Algebra, Algebraic Geometry, Sequential and Parallel Algorithms, Image Processing, Software Architecture, Knowledge Engineering, Web 2.0, Compilers, Program Analysis & Code Optimization, Databases, Game Theory, Distributed Systems, Temporal Logics and Verification, Graph algorithms, Dynamic algorithms and Randomized algorithms.

ACADEMIC PROJECTS

Visual Saliency of Building *Dec'12 – Apr'13*

(Mentor: Dr. Amitabha Mukerjee in Artificial intelligence, Department of CSE, IIT Kanpur)

- Predicted the landmarks primarily man-made which are used by the humans while describing a route to someone whose not familiar with the surrounding
- Involved detection of building in the scene using with a cascade of boosted classifiers based on haar-like features.
- Estimated the visual saliency using Itti and Koch algorithm
- Final scores were verified with gaze tracking

C# Compiler *Dec'12 – Apr'13*

(Mentor: Dr.Sanjeev K Aggarwal in compilers course, Department of CSE, IIT Kanpur)

- Build a compiler which generates the code for SPIM architecture.
- The compiler has object oriented features such as inheritance(Multilevel), Access modifiers
- Built a C# compiler in C, which generates code for SPIM architecture.
- The final compiler had support for **basic data types, composite date** types like multi-dimensional arrays, **operators, statements, functions (pass by reference and value, recursion)**, and **object-oriented features** like **classes, namespaces, constructors, access modifiers and inheritance (multi-level)**.
- Provided for functions (both pass by reference and value, recursion)
- Provided for object-oriented features like classes, constructors, access modifiers, polymorphism and inheritance (multi-level).
- Input programs passes through four analysis stages (**lexical analysis, syntax analysis, semantic analysis, and code generation**) to give assembly code for SPIM.
- Developed in four stages viz. lexical analysis, syntax analysis, semantic analysis, and code generation
- Graded as the best project of the course among 30 projects

Aadhaar Database Dec*'12 – Apr'13*

(Mentor: Dr.Harish Karnick in Database course, Department of CSE, IIT Kanpur)

- Built the Database for 50 users, and a web application which connects to this database and get required information such as the ration details, families getting benefitted by Govt. schemes, students receiving scholarships etc
- Built a web application that connects to mysql data base on background.
- User can type the details which are required in the web application, which queries to the data base and show the result to user
- The database is designed efficiently which has undergone stages of Entity Relationship model design and appropriate normalization.

Library Management on Android Platform *Aug'13 – Nov'13*

(Mentor: Dr. T.V. Prabhakar in software Engineering course, Department of CSE, IIT Kanpur)

- Aim : To build a Library Management System which provides easy issue and submission of book which helps in reducing manual work, the number of paper and PC's currently used in IITK library
- Developed an android application for IIT Kanpur library which helps in issuing, searching and renewing book using mobile devices
- Application uses barcode scanner API to scan barcode on books and helps in issuing or searching
- Problem is when handling traffic which may lead to crash
- Whenever user want to issue a book he scans the barcode on the book and request for issue, then a secure number is sent to his device, while leaving library he shows that number to guard uses another devices and sends the number to the server which send back with his roll number seeing the secure number and book is issued to the student

Nachos Operating System *Aug'13 – Nov'13*

(Mentor: Dr Mainak Chaudhuri in Operating System course, Department of CSE, IIT Kanpur)

- Implemented several features on nachos, which is a operating systems simulator/framework for 80x86 architecture.
- Nachos support light-weight user level threads and a few system calls that helps user program to print outputs in stdout but crashes with an exception because certain system call are not been implemented, we added the system calls to the simulator so that user programs terminate properly
- There are certain system calls like exec, fork, exit which operating system handles for running any user programs on command line, these system calls are not present in nachos, we Implemented those system calls on nachos which helped user to run his programs successfully
- Nachos natively runs round robin with a time limit of 100 clock cycles, we extended nachos to support various scheduling algorithms like first come first serve, round robin(for various clock cycles) and Unix scheduling algorithms and compared the result by running some of user defined programs which increase CPU usage time
- Added semaphores to the nachos which help simulator to use shared memory feature
- Added virtual memory and demand paging feature to nachos so that multiple process can run at a time also added page replacement policies and page fault to handle what page to be replaced

Indirect branch prediction using Virtual Program Counter (VPC) and Conditional branch predictor *Jan'14 – May'14*

(Mentor: Dr Mainak Chaudhuri in Computer Architecture course, Department of CSE, IIT Kanpur)

- Aim: Object oriented languages support polymorphism i.e. functions to be called is known only at run time. For implementing these instruction indirect calls of ISA are used. Predicting the correct target of indirect branch is necessary for better performance of processor
- We proposed a virtual program counter(VPC) [an idea from chang and hao] which treats each indirect branch as a sequence of conditional branches
- Target address of indirect branch is predicted by conditional branch predictor and branch target buffer(BTB) already present in system which helps in predicting conditional branches
- Whenever direction predictor predicts the virtual branch has not-taken, vpc predictor is updated to next vpc and when direction predictor predicts virtual branch as taken, BTB is indexed with that VPC to fetch next address
- Main advantage is no need of extra hardware for predictor but problem with the approach is we don't know what is upper limit on virtual branches
- Results for various iteration of VPC are compared to PC with GHR and only PC for different limit on virtual branches and found that there is certain limit i.e. 16 virtual branches after which misprediction almost becomes constant

Pipelining of unpipelined MIPS *Jan'14 – May'14*

(Mentor: Dr Mainak Chaudhuri in Computer Architecture course, Department of CSE, IIT Kanpur)

- Successfully able converted a unpipelined version of MIPS simulator with 5 stages in C++ to a pipelined MIPS simulator
- Data hazards and control hazards has been dealt successfully
- Tested successfully for about 15 programs

Operator overloading for java *Jan'14-May'14*

(Mentor: Dr. Rajiv kumar in object oriented language and implementation course, Department of CSE, IIT Kanpur)

- Operator overloading helps the programs to be concise, more readable and more template friendly, but operator overloading make the language more complicated also definition of operators will be in the hands of user, so we have studied the intricacies of operator overload in c++ and found when used properly operator overloading is a useful feature
- Extended Java language to support operator overloading. Done by using lexical analysis and examined the code to see what are the operator needed to be overloaded and correspondingly changed the operator to method call using a data structure.
- Lexical analysis is done using python language
- Program in java is sent to other python program and all operators are examined and operators needed to be overloaded are changed to corresponding method calls

Goeprofiling an android application *Jan'14-May'14*

(Mentor: Dr. T.V. Prabhakar in Software Architecture course, Department of CSE, IIT Kanpur)

- Aim: This application provides the user a complete solution for call management based on time and location(i.e keeping phone in silent mode etc.). The user can manage whitelist and blacklist of contacts and can send customized messages to the caller and application also allows user to find location where the user was at a given time
- Multiple user can access the application from same device which can help in tracking the phone and but multiple login from same device at one time is not allowed
- Server helps maintaining a log, when the user is connected to the server, user profile gets synchronised helping us to maintain multiple devices
- The UI has registration to server (which is made optional after the suggestion of professor), login page, profile creation page
- In this application we used client server architecture for implementation

Mtech Thesis

Cache Block prediction *Jan'14-May'15**

(Mentor: Prof. Dr.Mainak Chaudhuri, Department of CSE, IIT Kanpur)

- Aim is to predict the incoming/evicting cache block to be placed in the cache hierarchy
- Problem is to predict the incoming/evicting cache block to be placed in cache hierarchy
- Uses belady's optimal page replacement policy as a base limit

Internship/Work Experience/Positions of responsibility

Technoserve INDIA *May'12-July'12*

- Customer profiling for the two Agri Tech Service Providers (ATSPs) in two different districts of Haryana namely Karnal and kurukshetra and to develop an operational manual for technologies being used in the pilot project, namely Laser Leveller and Direct Seeded Rice machine
- 140 farmers survey has been conducted in kurukshetra covering over an area of 300 acre of land which helped me to analyse the data, which helped researchers to take above mentioned techniques more nearer to the farmers

Teaching Assistant at IIT Kanpur *Aug'14-Dec'14*

- Teaching Assistant for distributed system course
- Designed assignments and sample project ideas for registered student to works

RELEVANT COURSES AND TECHNICAL SKILLS

Computer Science Courses:

- Data Structure and Algorithms
- Computer Architecture
- Discrete Mathematics
- Software Architecture
- Operating System
- Algorithms-II

- Introduction to computer organization
- Artificial Intelligence Programming
- Computer Networks
- Fundamentals of computing(C)
- Programming Tools and Technique
- Principle of Database system
- Introduction to Software Engineering
- Tools of object oriented language and implementation
- Introduction to mathematical Logic
- Compiler Design
- Game Theory and Its Application in Computer Science
- Topics in Linear programming

Mathematics Courses:

Probability and Statistics, Non-linear Analysis, Real Analysis and Multi-variable Calculus, Complex Analysis, Linear Algebra, Fourier Analysis and Differential Equations

Physics Courses:

Order and Chaos, Electro dynamics, Thermodynamics, Mechanics

Technical Skills

- **Programming Skills** : Expert: C, Java, python, C++, Assembly Language, Python, Blue Spec Verilog, shell scripting
- **OS Platforms** : Windows, Linux, Unix, Android SDK, Nachos
- **Tools** : PIN, Latex, gdb, make, sed, Lex, Yacc, GNU Plot, Matlab, AutoCAD, Eclipse, postgresql, mysql, octave, Django
- **Web Developments** : PHP, Html, JavaScript, MYSQL, CSS

Extra-Curricular & Achievements

- Participated in wild soccer in takneek'10
- Placed 2nd in Battle City (AI competition) among over 300 competitors in Techkriti'13
- Runner up in technical arts course (TA201-2011-12/II)
- Awarded Merit-cum-Means Scholarship for past four years
- Achieved an All India Rank 2835 (AIR) in IIT-JEE'10 in which more than 600,000 students appeared
- Secured a percentile of 99.93 in IIT-JEE'10 in which more than 600,000 students appeared
- 2^{nd} in class for Mathematics Olympiad
- **Secretary,** Take-off, Techkriti'11, technical fest of IIT Kanpur
- **Secretary,** Show Management, Antaragni'11, annual cultural festival of IIT Kanpur
- Completed a trek to Jalori in May'14
- **Yellow Belt** in Tae-kwon do from Kanpur Tae-kwon do association
- **'A'** Certificate in NCC 2007 from Hyderabad
- **"2nd place** in battle city, an event in techkriti – 2014
- Graded as best project in CS335: Compiler Design among 30 projects
- Graded among best project in CS365: Introduction to Artificial Intelligence among over 40 projects