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**Date of Birth: 20th Jan 1971**

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| **Education**: | Indian Institute of Science, | Bangalore, India. |
| | M.E. in Systems Science and Automation | CGPA 6.2/8.0 |
| | Dept. of Computer Science and Automation | (Aug 92-Jan 94). |
| | Indian Institute of Technology, | Bombay, India. |
| | B.Tech. in Aerospace Engineering.(Aug 88-April 92). | CGPA 7.5/10.0 |

**Additional courses:**
- Machine Learning: https://www.coursera.org/learn/machine-learning (Andrew Ng)
- deeplearning.ai: 5 courses (Andrew Ng)
- Heterogeneous Parallel Programming GPUs CUDA/OpenCL (Wen-Mei Hwu)
- Neural Networks for Machine Learning:  https://www.coursera.org/learn/neural-networks (Geoffrey Hinton)
- Statistics One (Assignments in R)

**Software Skills:**  Computer Languages:  C, C++, Java, Objective C, JavaScript (in browser and NodeJs), Python, Scala, OpenCL (GPU), CUDA (GPU).
Operating Systems/Platforms:  AWS, Azure, GCP, UNIX, Linux, Mac OSX, iOS, Android, OSE, pSOS, QNX, Windows 95/NT.
Specialized Knowledge/Skills:  Gstreamer, DeepStream SDK (Deep Learning based Video Processing pipeline for Nvidia GPUs) Different Machine Learning Algorithms, Deep Learning Algorithms, Parallel Computing on GPU in OpenCL and CUDA.

**Softwares**:  Apache Spark, Flink, Reddis, Zeppelin notebook, XCode, Android SDK, MATLAB, MATHEMATICA 2.0.

**Experience Summary**: 25+ years of designing and developing application software on various flavors of UNIX, Linux, parallel computing on GPUs, Mac OSX, mobile platforms iOS, Android, and other platforms in Java, J2EE/EJB3, C and C++, Objective C including cross-platform development. Out of this, 7 years was in USA, and 1 year in Germany.

**Technical (Hands On) Experience:**
- Deep Learning: Training models using different libraries, model deploying using different inferencing libraries.
- Big Data Analytics and Machine Learning in Spark for different projects
- Involved in research/exploratory projects involving Machine Learning, Spark and GPUs.
- Mobile apps development using native Android and iOS platforms/SDKs as well as hybrid JavaScript apps using Cordova, with deep insights in user interaction through innovative use of sensors on the mobile devices.    **Work has resulted in 2 patent applications in mobile advertising (Yahoo!).**
- In depth experience in the design and development of distributed multithreaded and asynchronous enterprise applications, code generators, interpreters in various environments and programming languages.

- Extensive experience in software performance analysis using performance analysis/profiling tools like Rational Purify, and CodeCoverage, valgrind, jConsole, VisualVM, jhat etc. Devising various strategies for performance enhancement using application specific memory management, minimizing memory allocations, thread pools, thread specific buffers, and code optimization.

**Leadership Experience:**
- Successfully lead different teams to develop software from scratch to scalable, stable and successful deployment.
- Team lead and architect for development of software applications. This involved preparing architecture and design documents, architecting the overall application, guiding team members for technical help, helping them understand the overall application and project, version control, quality control, documentation, assigning work and schedules to team members and making sure everyone meets deadlines, interacting with third party vendor for getting fixes of the problems and new features.
- Worked on developing coding guidelines and standards and code review practices across teams in the organization.

**Functional Experience:**
- Video Analytics using deep learning
- Application of Machine Learning to Natural Language Processing, Text and Image Classification, and Predicting Virtual Machine (VM) performance characteristics.
- Experience in developing front-end user interface (web and mobile) and backend server applications for various domains (telecom, banking, internet).

**Work History**
**Employer: Huawei Technologies India Pvt Ltd**                    **April 2020 – Present**
**Project: HoloSens**
**Environment: HiSilicon ARM chip based Software Defined Camera (Embedded Device), Embedded Python, C++, Different types of neural networks, Distributed Computing**
**Description:**
 HoloSens is a platform for developing and deploying Deep Learning based computer vision applications. It enables third party developers to train and evaluate models using transfer learning for tasks like classification, object detection, segmentation, action recognition and convert them to deploy on Software Defined Cameras (SDCs) which uses specialized neural network accelerators for real time inference. For easily building more complex applications, a set of gstreamer plugins were developed. These plugins, part of a gstreamer pipeline, can perform model inference on a series of models for the complex application. The platform was developed from scratch, and using the platform, an industrial application was developed and deployed for monitoring worker sanitization at the worker entry points.
**Project: Time Series prediction for Ad Requests and Impressions**
**Environment: TensorFlow2, PySpark, cloud based model training and deployment platform**
**Description:**
 Based on historical data for user impressions, and Ad requests on different mobile apps, for different user profiles (age, gender, network type) on different days, a recurrent neural networks (RNN/GRU) model was developed to predict future user impressions and Ad requests. Multiple strategies for filling missing data were developed and evaluated, and finally rolling medians based strategy was adopted in the preprocessing step. This and other pre-processing steps resulted in a low prediction error for the final deployed model.

**Project: Data Driven Attribution for Ads-Media events**
**Environment: TensorFlow2, PySpark, cloud based model training and deployment platform**
**Description:**

In simple attribution models, credits for Ad conversions (downloads/purchases/installs) or attributions are given to first click, last click, or descending/ascending weights. This does not result in correct attribution and often results in losses for advertisers either due to low attribution or incorrect picture of the campaigns. Data driven models on the other hand learn the attribution based on patterns in the data, for example campaigns which have been more effective for a particular product during a particular time and for some user profiles. A classification model based on the past dataset for campaigns and conversions was trained to predict conversion probability for every media event (click/impression) and normalized conversion probability across events is taken as attribution of the event towards conversion.

**Project: Conversion Modeling to mine media events leading to conversion**
**Environment: TensorFlow2, PySpark, cloud based model training and deployment platform**
**Description:**

Its important for advertisers to know which Ads are getting converted to downloads/purchases/installs. When device ids or user ids are available in conversion and media event logs, its a trivial job of joining the two logs using the ids. When users apply privacy protection, the ids are not available. An RNN based model was designed to predict which of the media events in a sequence of events lead to the given conversion event. In this model, a novel way to conditionally propagate RNN hidden state was designed where the hidden state is propagated to the next time step only if the current event is predicted to lead to conversion. This sequence model leads to better accuracy compared to individual events prediction model.

**Employer: AllGoVision Technologies, India.**                               **Oct 2017** – Jan 2020.
**Project: Video Analytics (Principal Software Architect)**
**Environment:** Python, TensorFlow and Caffe for deep learning, NodeJS, Cassandra, Elastic Search, AWS, Azure, and GCP.
**Description:**

- Building a Gstreamer+Nvidia DeepStream SDK based Edge+Cloud based Video Analytics Architecture. This architecture resulted in at-least **50 times speed improvement** over existing client-server based implementation, consequently resulting much trimmed down hardware requirement. As part of this architecture, Python DeepStream Gstreamer Metadata bindings have been implemented which along with DeepStream plugins are used in building DeepStream based video inferencing pipeline which can be configured through REST APIs. The product is deployed through Docker and Kubernetes on AWS cloud. The inferencing happens on the edge devices and inference results are sent to cloud through Kafka messaging. The annotated images and videos clips are stored in S3. The edge devices fetch configuration data in the cloud DB through REST APIs running in AWS. The cloud hosted REST APIs use Redis Cache for faster servicing. The cluster of edge devices use Redis Cache (on-premises) for state management needed during object/face tracking/alarm processing.
- Built smart face and object search application which allows users to search using image content (url or image file). It is based on computing distance between image features of the given image against features of large number of images in a database. It has a wide number of use cases include suspect search, missing object detection, people and other moving objects tracking, video indexing etc. The application has a web interface with web-server implemented in Python and uses TensorFlow *Simple Online and Realtime Tracking with a Deep Association Metric* (Deep SORT) object detection model and triplet

loss based face model. It uses Cassandra for large scale storage and image search using distance metric computation using UDFs, and Elastic Search for metadata search. It was deployed on Azure cloud with hosted Cassandra and elastic search.

- o Architected and helped build multi-tenant NodeJS based Web UI (web-server) to configure video analytics for different cameras and recorded videos. The application has REST APIs for adding/deleting cameras, configure various video analytics parameters (for e.g. to perform face recognition, vehicle recognition, people/vehicle counting, vehicle number plate recognition), managing execution of analytics for different cameras on different machines, license management, reports like heatmap/flowmap/sitemap, viewing of Alarms, integration with various VMS solutions etc. The same REST APIs are used by the Web UI and integrations with third party Video Management Systems (VMS), devices such as boom barriers to open/close for registered faces/number plates. The application is designed to be horizontally scalable, secure (through NGinx) and cloud ready with full multi-tenancy and multi-site support. It has been integrated with multiple third party VMSs, entry-exit management systems and embedded devices, and sends autonomous events to management systems.  It is deployed as a multi-tenant application on the AWS platform with hosted database and uses cloud managed Kafka to communicate with other components of the application.

**Employer: HP Enterprise Software, India.**                                    **Dec 2015 – Oct 2017.**
**Project: Cloud Optimizer**
**Environment: Java, Spark, Kafka, Scala.**
**Description:**
- o Cloud Optimizer product is about monitoring virtual machines in a cloud environment and optimal placement on physical hosts in different clusters based on the forecasted CPU, memory and disk utilization. Forecasting of these metrics is based on building a statistical model using periodicity and trend analysis. The optimal placement is based on a computed metric "days to capacity" which itself is based on forecasted CPU, memory and disk utilization.
- o My work was about re-architecting the product to meet the increasing requirements of scaling to much larger cloud deployments and be able to quickly develop new features, based on fast changing analytics requirements.
- o This was done by breaking up the monolithic product into microservices which communicate through REST endpoints and Kafka, and the use of the big data analytics framework Apache Spark (Scala APIs) for core algorithms.    Highlight of the effort: Re-implementation of the VM Placement algorithm in Scala/Spark resulted in 100 times less lines of code.

**Employer: Informatica Business Solutions, India.**                          **Dec 2013** – Dec 2015.
**Project: Core Data Integration Module (part of Informatica ETL solution)**
**Environment: C++, CUDA, OpenCL, Spark, Scala**
**Description:**
- o Adding the capability to have scalar and vector custom data types in the data transformation engine. This involved changing the core to invoke operation functions of the custom data type instances in addition to the ones pre-defined for builtin types.
- o Working on core data engine module with special focus on incorporating GPU based data parallelism using OpenCL/CUDA. The work involves building core data integration transformations like sort, join (different join algorithms), aggregation, filter to exploit parallelism of GPUs.

**Project: Accelerating Machine Learning algorithms on Spark using GPUs**

**Environment: Aparapi, JavaCL, OpenCL, Scala, Spark**
**Description:**
The Global Customer Support (GCS) receives hundreds of support cases from customers everyday. There is a business need to decide in advance whether a case needs to be escalated or not based on various fields in the case like title, description, priority, customer etc. This involves NLP using machine learning algorithms. This an exploratory work being done with the chief architect of the CTO office.
   o The work involved feature extraction (TF/IDF) from text description, entropy computation for text document classification, implementation of Logistic Regression (LR) (to enable automated escalation of support cases for the Global Customer Support ). The Entropy computation on various terms was used to decide whether to use the term as a feature in LR. These were implemented using Spark's Scala APIs for instead of the existing MLib on spark for better understanding of the algorithms to be able to later efficiently implement them using GPUs.
   o The algorithms are now being converted to exploit GPUs on an RDD partition basis. The idea is to let spark perform partitions of data across machines in a cluster and use GPUs for computations within a partition.
   o Eventually this may lead to new Spark RDD APIs like filterPartitions, reducePartitions on the lines of the existing mapPartitions.

**Employer: Yahoo! Inc India.**                                    **Feb 2011** – Dec 2013.
**Project: Advanced User Interactions in Yahoo Mobile Apps**
**Environment: XCode iOS, Android, iPhone, iPad, Android mobile devices**
**Description:**
   o Research in various Yahoo apps and corresponding competitor apps (for example yahoo native mail app and gmail app) for the features they support
   o Designing and developing generic components for adding user interactions like following:
   1. scribble attachment to mail or scribble upload to Flickr,
   2. QR code, barcode recognition, Optical Character Recognition (OCR) and feeding the extracted QR code/barcode/text to text fields for search, sharing on mail, messenger etc.,
   3. carousel/cover flow style presentations of content like mails, news
   4. Tilt scroll for easier browsing of content
   5. 2 patents in mobile advertising

**Project: Performance Instrumentation, analytics platform (web, mobile)**
**Environment: javascript, XCode iOS, Android, Hadoop, (possibly splunk, Esper or Storm)**
**Description:**
   o Developing instrumentation libraries for web front ends, and native mobile apps based on user timing and navigation timing w3c standards. Proposed changes to user timing draft with w3c-perf group for handling race condition issues in draft implementation.
   o Part of decision making group for deciding on tools to be used for analytics platform for real time and on demand analytics.

**Project: Network infrastructure Provisioning Yahoo data centers (Nextgen network)**
**Environment: Java, hibernate, javascript, HTML5, RHEL linux,**
**Description:** The project involves automated provisioning the network devices to establish network connectivity in data centers for use in cloud computing platform and Hadoop Grid. The work involved architecting the software in consultation with other architects in Yahoo, defining

and implementing rest web service interfaces, web front end, and server for 3 stage CLOS network configuration generation, and pushing configuration to network devices.

**Other Activities:**

- o Patents applied for 2 ideas in mobile advertising
- o Interests in machine learning, processing Wikipedia data for better visualization, YQL, RDF, geo tagging.
- o Participation in internal hack days, id8 contests,
- o Wrote technical blogs on multi-lingual input methods and implemented some ideas for web front ends and mobile-based remote keyboard apps for iOS and Android.
- o Mobile app for creating notes from OCR of printed material, reading them out using Text to Speech on Android and iOS, Facebook integration to share notes with friends.

**Employer: Goldman Sachs Services Pvt Ltd.**          Aug 2005 – Feb 2011.

**Project: In house ORM tools MITHRA and MOJO**
**Platform: Java 6, Linux, freemarker templates, various databases**
**Role: Technical Architect, Contributor**
**Team Size: 5**
**Description:** These in house tools are used in many business applications in the firm. They have been designed to have type safe, declarative queries on the object model rather than string based unsafe queries. They have distinct advantages over the open source tools such as hibernate in terms of ease of use, compile time error detection and seamlessly working across multiple data sources. While MITHRA can be used for relational databases, MOJO can be used against a variety of data sources like files, LDAP, including relational DBs.

My role involved developing template based code generators for these ORM tools. The code generators automate the process of defining MITHRA/MOJO object models for a given database schema by using the DB schema metadata like table and foreign key definitions. The generated code can serve as the final domain model or as the starting point for defining domain model in a manner specific to these tools.

**Project: Knowledge Management for Business Intelligence**
**Platform: Java 6, Linux, junit, in house ORM tool MITHRA**
**Role: Technical Architect, Contributor**
**Team Size: 5**
**Description:** This is an application to be used by legal business teams to under the risk profiles of the business deals in various countries, and industry sectors. My role involved developing the data model for the application in consultation with managers and users, come up with use cases, design document, a large part of implementation and testing.

**Project: Cloud Computing**
**Platform: Google AppEngine, Amazon EC2, GWT and its extensions**
**Role: Contributor**
**Team Size: 5**
Description: The project involves investigating the use of cloud computing in the infrastructure division. It is thought that many IT projects in the firm can benefit through the use of a shared infrastructure during the development and final deployment phases. "Platform as a Service" (Paas) (version control/issue tracker, workflow of some business units, intra-office business communication systems etc) is being investigated and the need for proper security to isolate various business users from each other is also being studied.

**Project: Messaging Tools for managing messaging infrastructure**

**Role: Senior Team Lead/Development Manager**
**Team Size: 8**
Platform: Redhat Linux, Windows, Sybase DB, Eclipse.
Environment: Java 1.5/1.6, J2EE-EJB 3, JSF-Richfaces, Hibernate, Tibco EMS and RV, LDAP.
Profiling tools: VisualVM, jConsole, jhat.
Description: The project involved developing enterprise level tools for configuring, and monitoring Goldman's messaging infrastructure consisting of Tibco's EMS servers and RV routing daemons (RVRD). The tools consist of various GUIs, and a middle tier application layer comunicating with database, LDAP, and the EMS/RV servers.

- Leading the team in the development effort. It involved considerable hands on effort (design, implementation, profiling using performance analysis tools).
- Interacting with user community and management for requirements, priorities, deadlines.
- Helping users with messaging topologies for their message flows.
- Monitoring development process through code reviews, and guiding team to appropriate usage of design patterns and frameworks.
- Active contribution in architecting, designing, developing, testing, and deploying the releases.
- Profiling the applications using jconsole/VisualVM/JHAT and using the data/observations for performance enhancement.
- Key modifications for performance enhancement through EJB transactions finetuning and multithreading.

**Project: Cross platform database abstraction library**
**Role: Senior Team Lead/Development Manager**
**Team Size: 5.**
Platform: Linux, Solaris, Windows (32 and 64 bit).
Environment: GNU C++, Sparc C++, Solaris Forte C++, Sun Studio C++, Microsoft Visual C++ 6.x and 7.x, Sybase 12.x, DB2 (UDB), MS-SQL server, DataDirect ODBC, Sybase CTLIB.
Description:
The DB abstraction library ObjetClient (OC) is used by almost all the C++ based business applications in Goldman to communicate with databases. This library also functions as a commit agent for Goldman's XA compliant transaction management layer. The project involved rewriting the legacy Sybase DB abstraction layer using ODBC, earlier developed in Sybase CTLIB. The rewritten library now supports many new platforms including the 64 bit variants, multiple databases, many new features including prepared statements and batched execution, at the same time maintaining **backwards binary compatibility** and **backwards compatibility for error codes** despite the underlying library being different.
← It involved considerable hands on effort (design, implementation, profiling using performance analysis tools).
← Working with teams in Bangalore and NY for specifications and implementation.
← Working with application teams in Bangalore, NY, London for resolving their issues.
← Documentation and helping other teams come to speed on using the new features of prepared statements and batched execution.
← *This effort was much appreciated in many business teams and management.*

**Employer: Infinera India Pvt Ltd.**                                          May 2003 – July 2005.
**Project: Digital Optical Network (DON)**
**Position: Team Lead, Team Members: 5.**
Platform: Linux, QNX.
Environment: GNU C++, Remote debugging environment using GDB, Open Secure Shell (Open

SSH), Adventnet TL1 toolkit, Expect, Perforce (Version management).
Description:
The project consists of developing application software for managing and configuring a network element. The development and initial testing platform is Linux, the target platform being QNX RTOS running on PPC.
←  Functioning as a team leader of the TL1 agent (management interface), and embedded database server modules. This involved writing design documents, guiding team members for understanding TL1 commands, database server (RDBMS) and in-memory database development issues, related software development and ensuring quality assurance through code reviews, and basic testing of the software modules.
←  Lead the team to stable and successful deployment of these modules at customer sites.
←  Involved in the entire development cycles of various phases of the software lifecycle.
←  Involved in developing the TL1 commands, autonomous messages as per the specifications and Telecordia standards. Devised a scheme to use OpenSSH for secure TL1 and XML management interfaces with minimal software changes.
←  Involved in developing redundancy related software modules for highly available database server and management interfaces TL1 and XML.
  ←  Interacting with third party vendor Adventnet for problems fixes, and new feature releases. Inhouse fixing of many issues in the third party Adventnet TL1 library and their Java based code generator.

**Employer: Xtera Communications Inc., USA**                    Aug 2001 - Jan 2003.
**Project: NuWave (All Band Amplifier)**
Platform: Sun Solaris (UNIX), OSE RTOS.
Environment: Vertel eOrb for CORBA, GNU C++, GHS 4.3 compiler, Multi debugging environment, Expect, Clearcase.
Description:
NuWave system is an optical amplifier network element operating on the entire 100nm DWDM spectrum. The project consisted of developing application software for managing and configuring the NuWave network elements. The embedded software for the NuWave comprises network management interfaces TL1 and CORBA, application software, equipment control software, embedded DB manager, and hardware interface software. The development and initial testing platform is Sun Solaris, the target platform being OSE RTOS running on PPC.
←  Involved in the entire development cycles of two major releases of the system.
←  Designed, developed and tested features for Optical Channel, and OC192 facilities, Channel Turnup/Turndown state machine, Transient Control for line fiber-cut scenario.
←  Designed, developed and tested the various features from top to bottom: TL1 and CORBA interface definition, CORBA test client for text interface, TL1 and CORBA implementation, application software for validating request/responses, Database definition and interface, equipment control software and hardware interface.
←  Developed a number of Expect test scripts for automated testing of different features via TL1 and CORBA interfaces, automated sanity testing of the system via TL1 and CORBA interfaces.
←  Fixing of many issues in the third party library Vertel eOrb like Async I/O on TCP/IP sockets, handling of special messages like GIOP_CloseConnection message, receiving incomplete data in buffers.
  ←  Fixing of many issues across all features and all layers in the software during the SVT phase.

**Employer: Sycamore Networks Inc., USA**                    May 2000 - July 2001.
**Project: SilvxManager**

Platform: Sun Solaris, and Windows NT 4.0.
Environment: JDK1.2, Linux, and GNU C++.
Description:
SilvxManager is the network management and element management platform for Sycamore's network elements. It is an important element of Sycamore's Intelligent Optical Network framework. It is based on the metadata architecture, which makes it easily scaleable for any of the Sycamore's network element. Extended the SilvxManager to support the ultra-long haul product SN10000:

    a) Participating in the project level meetings from the beginning of the project, discussing the project level issues like complex turn-up procedures of the Raman and EDFA amplifiers, and user interfaces/procedures for optical power balancing with the optics group and providing ways to support them through the NMS/EMS,

    b) Communicating project level issues to NMS group, discussing and implementing the enhancements of the NMS/EMS platforms to support various features and procedures of SN10000.

    c) Enhancement of the embedded software architecture for incorporating the factory design pattern. This enhancement enables the embedded software to load, use, and manipulate card and port objects without even knowing them at the development/compile time. This feature makes the architecture very flexible and scaleable to incorporate any new card/port object. Also, this avoids the need of linking unwanted card/port objects to the software as these objects are loaded dynamically at runtime.

**Employer: Tellabs Operations Inc., USA**                12/97 - May 2000.
**Project: Optical Transport System (OTS)**
Platform: Sun Solaris, and Windows NT 4.0.
Environment: DSET CMIP agent development toolkit, Sun workshop for C/C++, gnu C++, BSD Sockets, clearcase, Java JDK1.1 and JDK1.2, Symantec Visual Café.
Description:
OTS is a Dense Wavelength Division Multiplexing Equipment which is capable of optical mux/demux of 32 wavelengths (optical signals), with each wavelength carrying OC-3, OC-12, or OC-48 SONET signals. The product, which has flexible add/drop and passthrough capabilities, is aimed at the metro DWDM market.
Role:

1. Acquired knowledge of the telecom standards such as M3100, G774, X721 (SMI), X722 (GDMO), X208 (ASN.1) etc.
2. Designed and developed the managedEquipment and diagnostic fragments managed objects (MOs) using the DSET's agent development toolkit on Sun in ASN.C/C++. These fragments are part of the embedded CMIP agent on the Tellabs Wavelength Division Multiplexing (WDM) Network Element.
3. Was involved in the cross-compilation/porting of the agent to pSOS. Involved in the setup of development environment.
4. Conceptualized, and developed an application to emulate the backend hardware and software. This application is an interactive GUI written in Java based on Symantec Visual Café and Java beans. Developed mechanism for transfer of information from the gateway worker to this backend simulator in Java, and vice versa. It is used extensively in testing the agent without the presence of backend hardware and software.
5. Played a key role in setting up the OSI stack and the agent on the admin card, and facilitating communication of EMS and the agent over the OSI stack. This involved setting up various OSI stack parameters as well as extensive debugging.
6. Played a key role in system integration and basic provisioning efforts. Streamlined procedures for loading the software on various cards from the admin card.

**Other Significant achievements:**

1. Involved in doing a feature by feature comparison of the products of the competitors, Nortel and Ciena, and working on new features to be implemented in the future releases of the product.

2. Developed a CMIP manager toolkit for developing a CMIP manager in Java. The toolkit's compilers are also in Java. Built a demo Java CMIP manager application for the OTS agent. The toolkit involves:

   **a)** ASN.1 to Java Compiler. Developed using JaCC 1.0, which a yacc/lex equivalent for Java (although it uses LL-k grammar as opposed to LALR grammar of yacc). Since the compiler itself is in Java, it is platform independent.

   **b)** GDMO to Java Compiler. Developed using JaCC 1.0.

   **c)** ASN.1 Java class library, which involves BER encoding/decoding methods, and built-in debugging facilities.

   **d)** GDMO Java Class library, which involves MIT maintenance classes for Java.

   **e)** Interface classes for transporting CMIP PDUs over TCP/IP stack. This is for communicating with DSET's agent on TCP/IP (not a standard CMOT implementation). This is pure Java implementation.

   **f)** Interface classes for transporting CMIP PDUs over marben OSI stack. This uses Java Native Interface C functions, since Java does have built-in OSI stack support.

   **g)** TL1 request, response, and autonomous message parser in JaCC.


**Employer: Network Programs Network Machines, USA**                     03/97 - 12/97.
**Project: Virtual View**
Platform: Sun Solaris, HP-UX 9.x, 10.20, and Windows NT 4.0.
Environment: Java JDK1.02, JDK1.1, Java Workshop, Softbench C++, BSD Sockets, Distributed Applications architecture, multithreading, and TL1 (for communicating with Fujitsu SONET Network Elements).
Description:
The application provides Network and Service management for a network comprising of ATM and SONET equipment. The client application facilitates dynamic setup of Permanent Virtual Circuits (PVCs) on broadband multivendor networks.  The application allows Network Administrator and customers to view the network topology, view/modify device configurations, and subscribe to services (PVCs), depending on the user privilege levels.

The application comprises of various distributed components, which interact with each other through IDLs. The Local Domain Manager (LDM) manages the end to end service provisioning. The Element Access Module accepts requests from LDM and converts them into device specific commands (such as TL1 and SNMP) for device configuration.

Developed algorithms for low speed (DS1/T1, DS3) and high speed (OC-3, OC-12) service provisioning on SONET rings with UPSR, BLSR ring configurations (OC-3, OC-12, OC-48), and various kinds of ring interconnections. Also worked for service provisioning on networks using ATMs over SONET layer.

Analyzed and developed alarm handling strategies, and their effects on services.  Designed and developed the user interface objects in Java using Java Workshop 1.0. This comprised of defining communication protocols between Java and C++ objects and was implemented using sockets and multithreading.

Also involved in quality control of the developed software and to ensure the adherence of the

development efforts to object oriented methodologies. Helped in configuration of the SONET equipment for development and testing environment using FLEXR and FLEXR+.

**Employer: IBSS Inc. ADP, USA**                                                     10/96 - 01/97.
Designed and developed platform independent class libraries in C++.  These include the following:
1. Abstract classes for performing network I/O. These classes hide the actual communication protocol being used. These classes currently implement TCP/IP (using BSD sockets) and NetBios protocol functionality. Abstract classes for transferring various kinds of objects between two communicating processes are also provided.
2. Abstract classes for supporting devices like various printers, terminals, and windowed environments. These classes have functions for drawing basic objects like strings, lines, arcs, and images on the abstract devices. Using this functionality, more advanced objects which consist of these basic objects define methods for drawing themselves on the devices.
3. Designed and developed application design framework for loading and accessing classes created at runtime using dynamic inheritance. These classes are derived from a base class (which defines the application framework), and reside in dynamically linked libraries or shared libraries.

**Employer: Deutsche Software (India), Deutsche Bank, Frankfurt, Germany**.    02/95 - 09/96.
Designed and developed a network application on Unix, Tandem, and OS/2 LAN in C++. The application is for the Configuration Management of the DB-Internet NT project of Deutsche Bank. The users of the application are screen developers for GUI screens on OS/2. They invoke the client utilities of the application for performing various version control operations (such as checking in and checking out the related set of files). The client utilities in turn communicate with the OS/2 LAN based server using Named Pipes of OS/2. The server, after checking the user authentication, performs the requested operation, and returns the error code of the operation to the client. It communicates with the servers on Tandem and Unix for database updates and file transfers for automated dispatch management using TCP/IP sockets interface for communication with Unix servers, and Remote Server Call for communication with Tandem servers. The OS/2 LAN based server is a multithreaded application written in C++, and the client utilities are OS/2 PM applications in C++ (which use IBM Open Class Library for GUI, multithreading, and DLL loading). The servers on Tandem are written in C++ and use the native IPC techniques. The daemon programs on Unix are written in C++, and use Unix Domain Stream Sockets for IPC. Developed Unix shell scripts for running application specific servers through the main server. The main server handles the communication with the OS/2 based server, and executes the shell scripts depending on request in the message from the network.  The shell scripts execute the application specific servers passing them necessary parameters.

Environment: Gnu C++, Visual Age C++, Open Class Library, OS/2 PM and LAN, PVCS, Tandem, Unix.

**Defence Research and Development Laboratory, Hyderabad**.                    04/94-02/95.
The project involved development of an Object Oriented missile simulation package in the Windows 3.1 environment for the Surface to Air missile arconymed AKASH. The intended use of the package was to study various Kalman filter algorithms for target tracking and other subsystems of the missile.  Designed, developed and tested all the modules, developed related class libraries like matrix class libraries, studied and implemented various Kalman filter algorithms in C++.
Environment: Windows 3.1, Borland C++ 4.0.

**Indian Institute of Science, Bangalore**. 08/92-12/92.
Developed Lisp interpreter on CD4360 (Unix) with full Lisp functionality including user defined functions (defun). It was developed as part of the course on data structures and algorithms. Developed a Prolog interpreter on CD4360 with a minimal Prolog functionality, as part of the same course. Environment: CD4360 (Unix), C.