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Narayan Murthy

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Narayan Murthy

Department of Computer Science
School of Computer Science and Information Systems
Pace University
1 Martine Avenue
White Plains, NY 10606-1909

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Narayan Murthy is Professor of Computer Science. He came to Pace University in 1984 and very quickly won the Chairpersonship of the Department of Computer Science in Westchester, a position he continues to hold after fully ten years. Dr. Murthy's earned his Ph.D. in Mathematics from the University of Rhode Island.

Hot Java and Cool Applets

Narayan Murthy
Computer Science Department

Introduction

This monograph is an outcome of a Java discussion group the author coordinated this semester (Spring 1996). The group consisted of several graduate students and we met in Goldstein center on Pleasantville campus. Some of the group members, as a team, submitted an entry to a million dollar contest organized by Sun.

What is Java ?

Java is a new programming language closely related to C++. Java was originally called Oak and its development started in 1991 by James Gosling at Sun Microsystems, Inc. Small Java programs which are tagged from an HTML document are called applets. Sun describes Java as a simple, robust, object-oriented, platform-independent multi-threaded, dynamic general-purpose programming environment. It's best for creating applets and applications for the Internet, intranets and any other complex, distributed network [21]. Java is an interpreted language. The Java compiler, instead of generating the machine code, it generates intermediate byte-code. For a complete technical discussion on Java bytecode see [11]. Web browsers transport and interpret the byte code.

What is HotJava ?

HotJava, also developed by Sun, is a Web browser which can interpret Java byte code. To run Java 1.0 applets, you need the latest HotJava version. You can download this from [21].

Netscape Navigator 2.0 runs applets written in Java 1.0. Microsoft claims that their new Explorer is Java-enabled. Both of these browsers require Windows 95 (or NT). Mac and Unix versions of these browsers are also available. You can download both Netscape Navigator 2.0 and Microsoft Explorer 2.0, free from their respective home pages on the net (see [16] and [15]).

The Java Cup International

To encourage the development of applets in the public domain, Sun Microsystems recently sponsored a million dollar applet writing contest - the Java Cup International. Some of the members of our group joined together and submitted an entry. We entered in the category of educational tools. Our team implemented three famous computer science algorithms: The Towers of Hanoi Problem, The Eight Queens Problem and The Dijkstra's Shortest Path Problem. We are sure Sun will have received a large number of submissions from professional programmers. Just learning Java and sending a submission was a rewarding experience.

Members of the Java group

The following students participated in the discussion group.

John Ferretti, Anila Kodali, Carla Laffra, Chandra Manasa, Chitra Markale, Anita Mitra, Venu Pandya, Srini Rao, and Jeannie Song.

In addition to the applets submitted to Sun, the group has written several other applets. We have placed all these applet demos on the Web (see [7]). If you are interested, you can see the source code for these programs (these pages give links to the source code pages).

The following is a short description of the applets you will see in [7].

An Example of A* Search

One of the main search methods in AI is heuristics. The basic heuristic is called hill climbing. This follows the idea that if you wish to reach the top, always go up and choose the steepest paths. This basic thinking may lead into traps such as local maximum and plateaus where the search is stalled because it either reached a local peak where the next move will lead you down or in case of plateaus all the values of the next move do not advance search.

Another level of sophistication in the heuristic searches is the A* search. This search evaluates how far from the goal you are and how many steps it took to get to this node. This stops the search from being drawn to a false peak if the sofar number starts to grow.

The program displays how a mouse finds the cheese in a maze. You can click on any place in the maze and the cheese will be repositioned. The mouse will then remap the route and chase the cheese.

The program was written by John F. Ferretti.

Binary Search Tree

A binary search tree is a binary tree such that each node contains one key, the keys in the left subtree of a given node are less than the key in that node and the keys in the right subtree of a give node are greater than the key in that node. By definition, we do not place duplicate elements in the tree.

The program constructs a binary search tree from the integer data input by the user. The program can also add or delete specified nodes from the tree.

The program was written by Anila Kodali

The Dijkstra's Shortest Path Problem

Given a graph, the Dijkstra's Shortest Path Problem is to determine the shortest paths in the graph from a given start node to any other node. Most books on computer algorithms discuss this problem and Dijkstra's solution. An excellent treatment of the topic is in [11]. In [11], the author explains the algorithm by showing a sample graph where the nodes are colored differently at each step in the algorithm. Our Java program will make this explanation come alive through a user-controlled animation. Each step in the algorithm is explained with a short text shown in a special text area. The applet gives the following options: show an (editable) example graph, or let you create your own directed graph with weighted distances between the individual nodes. Then, you can either: look at an animation of Dijkstra's algorithm from start to end, or walk through the algorithm step by step.

The program was written by Carla Laffra.

The Eight Queens Problem

The eight queens problem is to place eight queens on a regular 8 by 8 chess board in such a way that no queen attacks any other queen on the board. Chess rules allow a queen to move an arbitrary number of squares in a horizontal, vertical, or diagonal direction.

There are many algorithm to solve the problem. The solution implemented by us is the straight forward method which involves trial and error, and backtracking. We keep the first queen in square (1,1). Our method places queen k, $(1 < k \leq 8)$, in the first possible square on row k, in such way that it is not in conflict with any of the earlier placed queens. This leads to a large number of trials and several backtrackings. In fact, the first solution is reached after 876 moves.

Our Java program displays, graphically, in slow motion, the attempts made and the final solution. There are all together 92 solutions. Our program displays the number of moves made and lets the user control the speed of the movements on the screen.

For an excellent discussion on the eight queens problem, see [9].

The program was written by Chandra Manasa.

The Towers of Hanoi Problem

There are three pegs: source, auxiliary and target and a specified number of disks are stacked on the source peg in the increasing order of size of the disks, with the smallest on the top. The problem involves moving the disks from the source peg to target peg under two conditions: (1) you can move only one disk at a time and (2) you can never keep a larger disk on a smaller one. You can, of course, use the empty auxiliary peg to hold disks in the intermediate stages.

This problem is discussed in most data structures books. Our Java program lets the user pick the number of disks (up to 10) and then displays, graphically, in slow motion, the actual moves and the final solution. The user can control the speed of moves.

The program was written by Chitra Markale.

A Ping Pong Game

This is not a computer science algorithm. A small ball game is implemented. The game is played between two players. There is a ball, there are walls on all sides, players have paddles. The paddles are controlled by the keys W and R. Other features of the game are self explanatory.

The program was written by Anitha Mitra.

Priority Queues

A list in which the header is always pointing to the element with highest priority. In our case we maintain a list of integers, and the smallest number has the highest priority. The program implements a simple priority queue, using elements provided by the user.

The program was written by Venu pandya.

Binary Tree Traversals

The famous binary traversals: preorder, inorder and postorder traversals are displayed. The program lets the user create a binary tree and then displays the specified traversal.

The program was written by Srini Rao

Magic Squares

A magic square of order n, is an n by n matrix which contain integers from 1 through n^2 such that the sum of numbers along any row, any column and any diagonal is the same.

The program asks the user to input a positive integer n (odd), and displays the magic square of order n.

The program was written by Jeannie Song.

Other matters and resources related to Java

- A Java applet has to be invoked from an HTML document using the APPLET tag.

- You can download Java free from Sun (see [21]). The development package is called Java Development Kit 1.0 (JDK 1.0). This kit comes with a program called Applet Viewer which will let you run applets directly without a browser.

- The absence of pointers (explicitly) in Java makes Java programs more robust and secure. It is said that Java is a better choice than C/C++ for application development. See Dr. Joe Bergin's "Java as Better C++" for a comprehensive summary of differences between Java and C++ (see [4]).

- Netscape has developed a programming language called JavaScript which is an extension to HTML. JavaScript is compatible with Java and JavaScript is embedded into HTML document directly.

- The 1.0 JDK is currently available on Solaris 2.3 or higher and Windows NT/95.

- Borland has released an integrated environment package to develop Java, which includes C++: "Borland C++ Development Suite Version 5.0 for Windows 95/NT/3.1/DOS." For details see [5].

- Symantec has also released an integrated package "Java Development Tools," which requires Windows95/NT. They claim their native compiler builds Java apps up to 13 times faster than Sun's compiler. For details see [20].

- Aimtech Corp. has developed a tool (to be released in June '96), Jamba, to create Java applets and applications. For details see [2].

- At least one school is using Java in the freshman CS major-oriented introductory programming course (CS1 and CS2). Prof. Doug Lea of SUNY at Oswego is teaching Java in CS1 and CS2. See [6] and [14] for details on how SUNY Oswego is handling it.

- One of the attractive features of Java is that using threads concurrent activities can be run within the same Java program. For an excellent introduction to this and general introduction to Java see Prof. Doug Lea's home page at [14].

- Two of the best places to start looking for Java resources, including latest information, tutorials, software etc., are Sun's Java home page [21] and Doug Lea's home page [14].

- The following Web sites provide several interesting Java demos: Gamelan home page [10], Sun's Java home page [21].

- Books on Java: In the last several weeks the number of books on Java has gone from 2-3 to 15-20. The following is a partial list of Java books currently available or available soon:

  The Java Programming Language by Ken Arnold and James Gosling, Addison-Wesley, [1].
  The Java Application Programming Interface, Volume 1 by James Gosling, Frank Yellin, Addison-Wesley, [1].
  The Java Language Specification by James Gosling, Bill Joy and Guy Steele, Addison-Wesley, [1].
  The Java Tutorial by Mary Campione and Kathy Walrath, Addison-Wesley, [1].
  The Java Machine by Tim Lindholn and Frank Yellin, Addison-Wesley, [1].
  The Java Class Libraries by Patrick Chan and Rosanna Lee, Addison-Wesley, [1].
  The Java FAQ by Jonni Kanerva, Addison-Wesley, [1].
  Instant Java by John Pew, Prentice-Hall, [18].
  Java by Example by Jerry Jackson and Alan McClellan, Prentice-Hall, [18].
 Core Java by Gary Cornell and Cay Horstmann, Prentice-Hall, [18].

- There is an online magazine, JavaWorld, devoted to java. See [12].

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Note: Citation of electronic documents (e-mail, online articles, Web pages, Usenet postings etc.,) are being standardized. Two places you get more information on this are [3] and [13].

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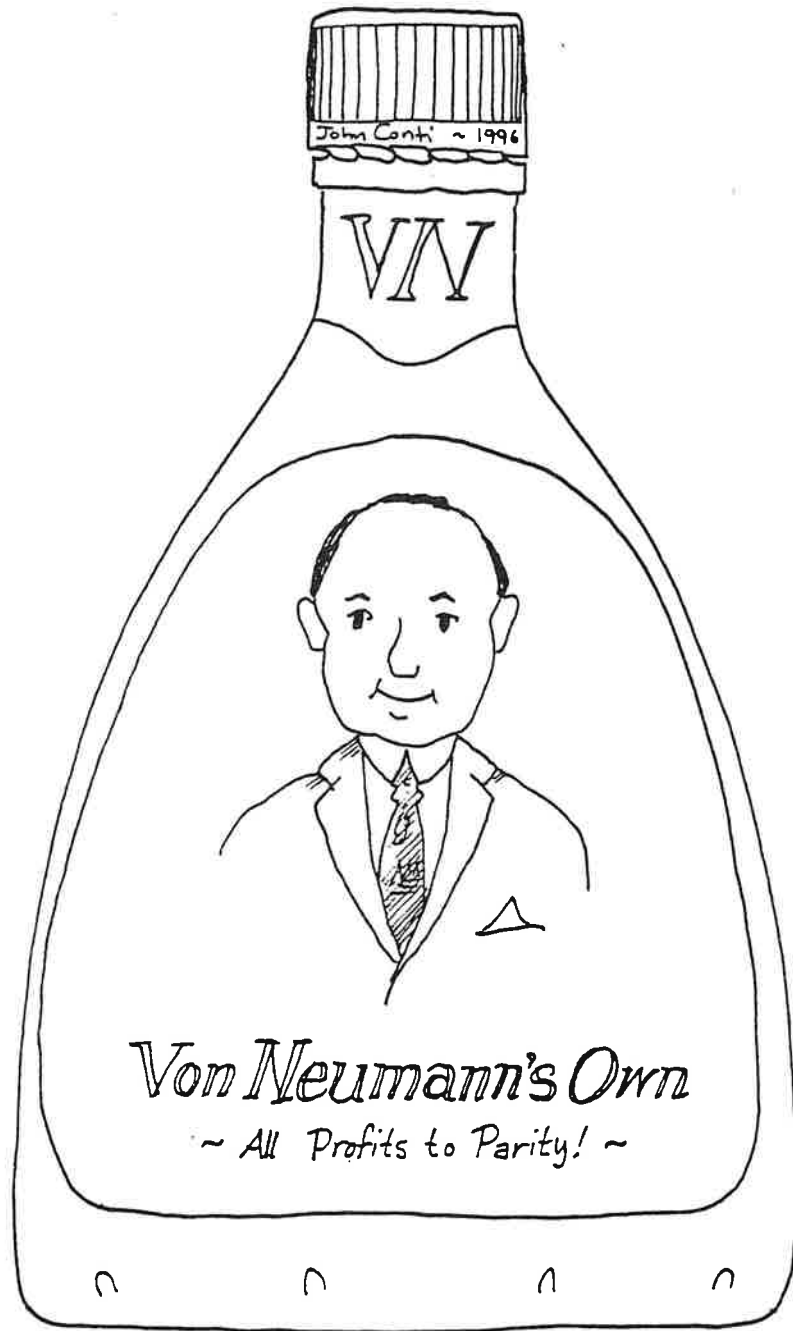
In later life, John Von Neumann became known as the man on the salad dressing jar.