8th World Computer Chess Championship

CUHK & ICCA

25-30 May 1995 Hong Kong

IBM, home
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system, is proud to
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8th World Computer
Chess Championship.

The 8th

World Computer Chess Championship

Hong Kong
May 25-30, 1995

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Hosted by The Chinese University of Hong Kong
Organized by International Computer Chess Association

Important Times and Places

Opening Reception and Lunch
Thursday 25 May 1995, 12 Noon - 2 pm
Royal Park Hotel, Shatin, New Territories.

Rules Meeting
Thursday 25 May 1995, 3 pm - 4 pm
Room 603, Ho Sin Hang Engineering Building, The Chinese University of Hong Kong.

Championship Rounds
Round 1   Thursday 25 May 1995, 4 pm-10 pm
Round 2   Friday   26 May 1995, 4 pm-10 pm
Round 3   Saturday 27 May 1995, 4 pm-10 pm
Round 4   Sunday   28 May 1995, 4 pm-10 pm
Round 5   Monday 29 May 1995, 4 pm-10 pm
(All rounds are in Room 603, Ho Sin Hang Engineering Building, The Chinese University of Hong Kong.)

The Saitek Challenge (Humans v Computers Match)
Sunday 28 May 1995, 10 am-3 pm,
Room 603, Ho Sin Hang Engineering Building, The Chinese University of Hong Kong.
(A match over 6 boards between a team of computers and a team of the best human chess players living in Hong Kong. The games will be played at the rate of 40 moves in two hours followed by either adjudication or the remainder of the moves in 30 minutes.)

Computer Strategy Games Programming Workshop
Friday 26 May 1995, 10 am - 3 pm
Room 503, Ho Sin Hang Engineering Building, The Chinese University of Hong Kong.

Awards Ceremony and Closing Lunch
Tuesday 30 May 1995, 12 noon - 2 pm
SCR Clubhouse, The Chinese University of Hong Kong.
(Trophies will be awarded to first, second and third places.)

ICCA Triennial Meeting
Saturday 27 May 1995, 3 pm - 4 pm
Room 603, Ho Sin Hang Engineering Building, The Chinese University of Hong Kong.

Other Information
Exhibits by Saitek and Novag will be in Room 601, H.S.H Building, CUHK.
Refreshments are available to participants & officials in Room 606, H.S.H Building, CUHK.

Officials
Tournament Director: Mike Valvo (IM)
Tournament Organizers: Monty Newborn, Tony Marsland and David Levy.
Local Arrangements: Hon Tsang (Tel. 2609-8254)

A Hong Kong Welcome
by Tony Marsland, ICCA President.

The International Computer Chess Association welcomes participants, guests and members of the public to the Eighth Triennial World Computer Chess Championship. For the first time the event is being held outside Europe or North America. This new development reflects not only the growing technical importance of the Orient in an increasingly interconnected world, but also the interest of our principal sponsor, the IBM Corporation, which is to open a research laboratory in China this year.

This championship brings together the strongest group of entrants ever assembled, and we can expect vigorous competition for the coveted Shannon Trophy. Amongst the competitors I am pleased to recognize first the six professionals: Chess Genius from England, Fritz from The Netherlands, the Deep Blue prototype—a reworked version of the 1989 world computer-chess champion—from IBM-America, W-chess and M-chess, also from the US; and a welcome newcomer, VirtuaChess from France. These professionals have their reputations on the line to compete against some very tough amateurs from major universities using powerful multiprocessor systems: Zugzwang from Paderborn, Hitech from CMU, Star-Socrates from MIT, Frenchess from Paris and Phoenix from Alberta. In addition, there are thirteen PC or SPARC based programs - dark horses that have no doubt been worked on for innumerable hours over the past three years, and that are likely to provide some strong challenges. Inevitably not all programs will fare as well as their designers would like—after all, in this field one has to run just to stand still! - but every one, I feel sure, will benefit from the experience.

We would not be here today without the help and co-operation of many people. Thanks, first, to the Chinese University of Hong Kong, which through its Dean of Engineering, Professor Omar Wing, greeted the initial proposal with enthusiasm and provided a beautiful tournament hall—the view from the window will be difficult to equal. Dr. Hon Tsang of the Department of Electronic Engineering, and the current Hong Kong chess champion, has given outstanding leadership in handling local arrangements, with the especially able assistance of Ms. Maxi Hui and Ms. Au Din Zee. Their efforts in locating and bringing together all the necessary computing and communication equipment, and in corresponding with local companies and the media, are to be highly commended.

Second, this event has been made possible by the support of our major financial sponsors, IBM, Compunetics and the Association for Computing Machinery, together with local sponsors including Sun Microsystems, Saitek, Varitronics, and Yorter Electronics. Saitek is also sponsoring today's reception and prizes for Sunday's match between computers and humans. Our thanks to all of them.

Last, but certainly not least, special thanks to my volunteer co-workers on the ICCA executive: Monty Newborn, who put in so much time negotiating with IBM, and David Levy who regularly shared with me his experience and who spent many hours coordinating with applicants. I must also add my thanks to the Computer Science Department at the University of Hong Kong, (the other one!), who made it possible for me to extend my stay and so take in this event.

Following the tradition of earlier championships we have invited an honoured guest. I welcome Robert Byrne, well-known chess correspondent for the New York Times. For nearly two decades Mr. Byrne has written about computer chess activities; he was one of the first reporters to recognize the growing strength of computer chess programs, and to perceive the contribution of computer chess to science and technology in general. We express our appreciation to him for this interest and enthusiasm for our endeavours.

The ICCA is pleased to secure once again the services of Mike Valvo as Tournament Director. Competitors always respect Mike for his experience and his calm manner, which give them confidence in his decisions. We can therefore, as always, look forward to a professionally run event under his direction.

Most participants here probably cherish a secret hope that theirs may be the first program to meet the human World Chess Champion for a regular match. Two competitors, Chess Genius and Fritz, have already won rapid-play games against Gary Kasparov, but it is still by no means certain that the occasional loss by the best human players in high-speed games represents the thin end of the wedge, the beginning of the end of human domination over computers in chess. By the end of this week, however, there may be concrete evidence to support the perennial prediction that within five years the human world champion will lose a match to a computer, and we may even know which computer that might be. Let the championship begin!

The Anatomy of Chess Programs

T.A. Marsland
Professor of Computing Science
University of Alberta
Edmonton, Canada

Introduction

Logically, chess is a trivial game: at every move, simply follow through each possible reply and its consequences until either a mate or a draw position is reached. In practical terms, however, this strategy is not workable, since an astronomically large number of chess positions would have to be examined. Thus both human players and computers rely on simplification to build an approximate model of the game. Human players have centuries of tradition and at least two hundred years of chess literature to draw on in building their personal model, but computer chess is less than fifty years old. Significant among the early ideas in computer chess is Claude Shannon's 1949-50 distinction between a brute force (type-A) strategy for looking at every combination of moves, and the use of chess knowledge to select and examine only a subset of the available moves (type-B strategy). Although some electro-mechanical systems to play a subset of chess had been built prior to Shannon's work, it was the programming of his ideas that led to the development of today's computer chess machines.

Current chess programs view the game as a tree search in which each position corresponds to a node in the game-tree, and each move is a branch (a transition from one node to the next). Thus the tree is made up of alternating layers or levels of moves for each side. (The term "ply" is used to denote each layer, and refers to one move by one player.) A three-stage tree model is popular with computer chess programmers. The first stage uses a brute force (Shannon type-A) approach, the second a selective (type-B) search, and the third a strategy known as a quiescence search, designed to resolve the problems and conflicts that remain. In this final stage the program evaluates sequences of capturing moves, assesses pawn promotion potentials, examines checking sequences and considers other highly constrained tactical issues. All programs use the same underlying depth-first alpha-beta search algorithm. What varies from program to program is the length (or "depth", to keep the layer analogy) of search assigned to each of these stages. Ultimately the stage length is not fixed, but varies by small amounts depending on the current sequence of moves being examined. For example, a search path may be locally lengthened because one side has attacked the King (given check), leaving the opponent with only a few alternatives to consider. There are so many options

here that even programs using the same basic model can achieve a radically different style and speed of play.
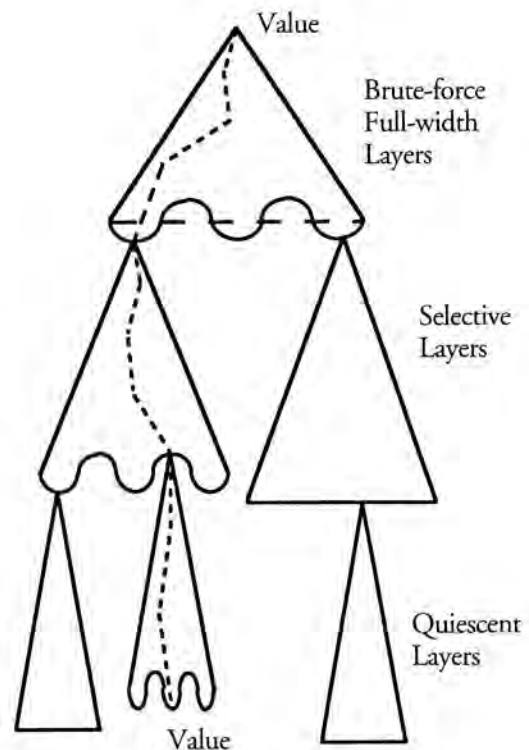
Tree Searching

While the human method of analyzing alternatives seems to involve selecting a few promising lines of play and exploring them, computers are necessarily exhaustive rather than selective, so refinement techniques have been developed. In a technique called "iterative deepening", instead of embarking on a single search of a certain ply (which might not be completed in the given time) the computer performs a series of increasingly deeper searches (N-ply, then N+1, then N+2, etc.) until the allotted time runs out. Thus it is able to produce the best move that the time constraint allows - a computer-chess situation that has many parallels in real-time applications. The computer can combine itera-

tive deepening with various memory functions, particularly refutation and transposition tables, to reorder moves, so that at the next iteration its selected "principal variation" (best sequence of moves found during the previous iteration) is explored first. Another move-reordering technique is to keep a short list of "killer" moves, which are tried first. Killer moves are those that have successfully "cut off" or pruned the search elsewhere. Often these killer moves are captures, so a simplification involves considering capture moves before all others. This technique is nicely generalized in the "history heuristic table" that many programs use. In its most elementary form a history table has 64x64 entries, each containing a value that measures the frequency with which the corresponding possible move has recently pruned the search.

Move-reordering mechanisms enhance the efficiency of the depth-first alpha-beta search algorithm. Three other improvements - Pearl's Scout algorithm and the related NegaScout and Principal Variation Search (PVS) methods - share a common theme: once a principal variation has been found it is sufficient to show that each alternative is inferior. Any that is not inferior must be re-searched, since it now constitutes the preferred path. Another technique for curtailing the search is called aspiration alpha-beta search. In this approach the value of the tree from the current position is estimated and a narrow search window (customarily plus and minus the value of half a pawn around that estimate) is used. Aspiration searching is a popular and better understood alternative to the Principal Variation Search method, although not as efficient.

It is difficult to be precise about the advantages that more searching provides. The size of the chess tree for any position is highly variable. In many endgames there are only about 8 moves for each side, while in complex middle game positions each side might have close to 80 moves. With today's technology programs exhaustively search 7 to 10 ply in the middle game, while at least one programmer claims to extend searches selectively to 40 ply! Selective extensions are based on heuristics devised by individual programmers to explore the sphere of influence associated with a key move: to examine the moves that might defend against a mate threat, or that might provide a counter attack and thus indirectly avoid some imminent loss. Selective extensions are not to be confused with singular extensions. The latter technique re-examines any move that looks singularly good relative to the others. The search depth is increased to determine whether the singular move remains best. In some sense this is a way of extending the principal variation in the small. It is a potentially costly but interesting method.

More popular and more widely used is the null move heuristic, where one side provisionally makes two successive moves. If the value of the position remains poor even with the benefit of two moves in a row, then the line of play is abandoned. This is one way to identify situations where an inevitable loss is otherwise being pushed out of sight beyond the search horizon. While many forward pruning methods fail too often to be useful, null move forward pruning is usually beneficial.

Transposition Table

A transposition table serves as a cache memory and is used to store information about positions that have been visited before, usually during an earlier part of an iterative deepening search. It is so called because it can be used to recognize transpositions in the order of moves. Stored in the entry associated with a position are important items like the "value" of the position, the best move from there, and the length of the previous search. "Value" is computed by applying an evaluation function at the terminal nodes of the tree (the nodes on the horizon where the search is stopping). This evaluation function often includes a quiescent search to help resolve existing capture sequences and other uncertainties in the position, such as pending pawn promotions. Transposition tables are also invaluable as a means of extending search in the endgame, where only a few new moves emerge at each node, the others leading through transposition to positions that have been seen before. These tables do not increase program size or complexity, since the total space allocated to them is simply a matter of cost. Each transposition-table entry requires about 10 bytes of memory, and most programs have tables in the range from 32 thousand to 1 million entries, though in 1993 one Supercomputer program boasted a table with a 1,000 million entries!. This wide range simply reflects the memory available to the programmer.

Program Performance and Rating

Despite the underlying similarity in methods there is wide variation in performance among the programs, even in machines using identical hardware. In some cases this merely reflects the effort put into the program's development. For example, although every program has an opening book, there is no basic book for them to use. Each team develops its own. At present these books vary in size from about 10,000 chess positions to about 500,000 positions, although one experimental program has 1.7 million book entries. Conversely, only a few people use Ken Thompson's CD-ROM database of 5 and 6-piece endgames. This is partly for technical reasons related to relatively slow access to the database, but also because most games finish before reaching these known endings. Perhaps programmers are just

being realistic about how to spend their time!

When it comes to speed of execution, contemporary programs examine between 3,000 and 500,000 positions per second on a single processor. Big differences in speed exist even for programs using identical machines. There are many explanations. Those who program in assembler tend to have faster programs, but even for the same programming language, not all compilers (translators) produce equally fast executable code. Much depends too on the relative sizes of the brute force, the selective and the quiescent search stages. Extra time is required in the selective stage to assess and identify which moves will be examined. The extent of this slow, knowledge-based process accounts for much of the speed difference. One other factor that influences the speed and strength of a program is the size of its transposition table.

Although many chess programs are similar to each other, their relative playing strength can still differ greatly. Determining that strength is no easy matter, since programs can be tuned to perform well on any standard test suite. For this reason the group who produce the Swedish Rating List use a more traditional approach. All commercially available programs continually and automatically play games against each other, leading to hundreds of statistically valid results. From these data an ELO rating is computed, much like the rating system used for chess-players in America and elsewhere. In the US the average club player has a rating over 1500, while experts are in the range 2000-2200 and masters are rated 2200-2400. Above that come the super elite players called Grand Masters, of whom about 300 are active worldwide. At the Eighth World Computer Chess Championships most programs have an ELO rating in the range 2100-2500. The current Swedish rating list is published in each issue of the International Computer Chess Association Journal.

The Future

These days the top chess machines are challenging the Grandmasters, especially in rapid play where the stand-alone PC-based machines have an advantage over multiprocessor-based systems. Stand-alone machines are especially fast, because they don't need the services of a computer network to transmit their moves. Multiprocessor machines using 10 to 100 processors are often better at the standard competition rate of play of 40 moves in 2 hours. Soon systems with 1000 processors, each as powerful as a high-performance PC, will be with us. Even if their efficiency is only at the 50% level, they will be able to search 2 or 3 ply deeper in a typical middle-game position than any single-processor system. By then computers will be clearly out-searching humans. Whether this will be enough to compensate for the human's proven strength in long-term planning remains to be seen. Human chess players are especially skilled at simplifying complex situations and identifying the fundamental issues. They are also adept at provoking long-term weaknesses in their opponent's position, until it becomes indefensible. Despite these advantages, each year we draw closer to realizing the perennial prediction that computers will beat the best humans at chess within 5 years. It could certainly take another decade to achieve that, but the inevitability is clear !

Reference Works about Chess Programs and Programming Techniques.

1. *Computer Chess Compendium*, edited by D.N.L. Levy, Springer-Verlag, 1988.
2. T.A. Marsland, "Computer Chess and Search," in *Encyclopedia of Artificial Intelligence*, S. Shapiro (editor), J. Wiley & Sons, 2nd edition, 1992, pages 224-241.
3. *International Computer Chess Association Journal*, 4 issues per year since 1983. Published by the ICCA Editor, Computer Science Department, University of Limburg, P.O. Box 616, 6200 MD Maastricht, The Netherlands.
4. *Computers, Chess, and Cognition*, edited by T.A. Marsland and J. Schaeffer, Springer-Verlag, 1990.
5. *Advances in Computer Chess*, Volumes 1 to 7, various editors and various publishers from 1977 to 1994.

Program Descriptions

Cheiron *by Ulf Lorenz (Germany)*
In Greek mythology, Cheiron was the wisest of all centaurs and the teacher of many heroes. The program Cheiron is written in C. It is an alpha-beta program using most of the known state-of-the-art heuristics including transposition table and selective deepening but not null moves. The quiescence search is quite large focusing on mating and promotion threats. The evaluation function examines the pawn structure, king's security, static positions of the pieces, everlasting knights etc. as well as special situations in the endgame. On a Pentium 90MHz the program will search about 10,000 nodes per second. Cheiron relies more on positional playing than tactics. The opening book contains about 12,000 positions. On a 50MHz 486 PC, Cheiron has an estimated rating of 2100 ELO based on tournament results against humans.

Chess Genius *by Richard Lang (UK)*
Chess Genius is an experimental development of the program that made history by defeating the World Champion Gary Kasparov in a rapid-play match at the Intel Grand Prix in London 1994. Its author, Richard Lang, has written programs which held the title of World Microcomputer Chess Champion in 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991 and 1993. Chess Genius is written in assembly language for the Intel Pentium microprocessor and is currently ranked top of the Swedish Computer Rating List.

Dark Thought *by Peter. W. Gillgasch, Markus Gille and Ernst Heinz (Germany)*
Dark Thought is a brute-force program employing sophisticated move ordering techniques and search extensions backed by a selective quiescence search. On a DEC 3000-600 (175Mhz Alpha 21064 CPU, 64MB RAM) Dark Thought visits up to 60,000 nodes per second and reaches a non-selective, brute-force search depth of at least 8 plies in 1 minute. Its opening book contains 250,000 positions. On-line access to Thompson's endgame databases is handled by a greatly enhanced version of the public domain software by Beuckens and Hoekstra. Peter Gillgasch, the main brain behind the chess engine, wrote a prototype version of Dark Thought in Pascal in 1992. Today the program compiles and runs from the same ANSI C source files on a variety of platforms. Markus Gille and Ernst Heinz are responsible for fine-tuning the evaluation function and databases and Peter Gillagasch still maintains the chess engine. During the World Championships, Darkthought will run on the most powerful DEC Alpha workstation available.

Deep Blue Prototype *by Feng-Hsiung Hsu, Murray Campbell and A.Joseph Hoane (USA)*
The Deep Blue Prototype consists of an IBM RS/6000 workstation with 14 chess search engines as slave processors. Each processor contains a VLSI chip for move generation, as well as additional hardware for search and evaluation. Each processor searches about 500,000 positions per second standalone, or about 400,000 positions per second as a slave processor. (This is about 1/10th of the projected speed of the Deep Blue single-processor currently in fabrication.) The 14-processor protoype typically searches between 3 and 5 million positions per second. When conducting a seach, the search tree near the root position is processed on the host workstation, and includes selective search extension alogorithms such as singular extensions. The deepest nodes in the search tree are handled by the slave search engines which usually do 4-ply alpha-beta searches.

Ferret *by Bruce Moreland and James Parker (USA)*
Ferret is a "normal" brute-force program that runs under Windows NT. Techniques and tools used by the program include alpha-beta pruning, selective search extensions, quiescence search limited by a static exchange evaluator, null-move forward pruning, a 50,000-positions opening book, several hash tables and a few simple endgame databases. The program consists of about 20,000 lines of C code and has been compiled using Microsoft Visual C 2.0. Ferret searches approximately 18,000-32,000 nodes per second on a Pentium 66. It was written during off-hours over a period of about 4 years, for fun. Ferret finished fifth in Don Beal's uniform platform tournament last September. It has also played several hundred games of blitz chess on the Internet Chess Server, where it has been shown to be competitive among strong human players and various commercial programs.

Frenchess *by M.F.Baudot, J.C.Weill, J.L.Seret (IM) and Michel Gondran (EDF) (France)*
Frenchess is a parallel chess program which runs on a CRAY T3D computer (128 Alpha processors, owned by the Commissariat a l'Energie Atomique located in Grenoble, France). It is written in C and is based on the parallel algorithm described by Jean Christophe Weill in his PhD thesis: Alpha-Beta Distribue Avec Droit d' Ainesse (ABDADA). The evaluation relies mostly on an Oracle approach, which introduces strategy and is designed to be

rewritten in the CHEVAL (CHess EVAluation Language) evaluation function description language currently under development (but CHEVAL will probably not be ready for the World Championships). Frenchess is written with the support of the "Direction des Etudes et Recherches (DER) d'Electrique de France (EDF)" as a research project on parallel computing.

Fritz *by Frans Morsch and Cok de Gorter (The Netherlands) and Mathias Feist (Germany)*
Fritz is built around a selective search technique known as null-move search. As part of its search, Fritz allows one side to move twice (the other side does a null-move). If the position after the null-move does not return a high value in the evaluation function, then clearly the first of the two moves did not contain a threat. This applies to 95% of the moves in a search. Detecting such moves before they are searched to the full depth is an excellent method to speed-up the search. In its latest version, Fritz manages a 10-times speed-up over a version without the null-move search. Selective search unavoidably introduces oversights, but these are few. In tournaments against humans and other programs, Fritz has proven to be a tough opponent when defending difficult positions.

Gandalf *by Steen Suurballe (Denmark)*
Gandalf is a PC program developed over the last ten years. The program performs highly selective searches, combining a one-ply brute-force search with selective search and search extensions. The search does not use standard techniques like the null-move method, but instead uses a rule-based method involving a calculation for every node to decide which moves are good. Development of the program was an extremely difficult and time consuming task. Gandalf searches about 1500 nodes per second on a 486/66. Gandalf has considerable chess knowledge and plays aggressively, which is unusual for a highly selective search program. Gandalf uses an opening book containing about 500,000 positions.

Junior *by Shay Bushinsky and Amir Ban (Israel)*
Junior is a leading Israeli chess playing PC program. It was developed as a hobby by Amir Ban and Shay Bushinsky. Junior's breakthrough occurred during August 1994: The program scored a remarkable equal fourth place (with GM Alon Greenfeld) in the Kfar-Saba Open national chess tournament. The games were conducted under normal tournament time control. In the final round, Junior amazingly defeated GM Leonid Gopstein. During November 1994, Junior participated in the strongest international blitz tournament ever held in Israel. It beat GM Ilya Smirin and drew with GM Lev Psakhis and GM Alon Greenfeld. Amongst others, Junior reached a completely won position against GM Judit Polgar. Since then Junior has established itself as a well respected player.

Hitech *by Hans Berliner, Chris McConnell et al.(USA)*
Hitech is a chess machine with special purpose hardware that is capable of evaluating 120,000 positions per second. The hardware is controlled by a SUN 4 workstation running either a brute force or selective search engine. Originally built in 1985 at Carnegie Mellon University, Hitech has since won several computer-compu ter and human-computer tournaments. Its primary purpose is supporting research into new search techniques. Active research includes a new selective search algorithm and techniques for automatically constructing better evaluation functions.

Lchess *by Lex Loep and Ger Neef (The Netherlands)*
The first version of LCHESS was written in 1987. In 1988 it participated for the first time in the Dutch Compu ter Chess Championship, ending 13th in a field of 16; the best result was in 1990 when it shared 3rd place. Lex Loep has steadily worked on the chess engine and the version which is playing in the WCCC has been ported to Windows NT. Techniques used by the chess engine include alpha-beta search, iterative deepening, PVS, null moves for pruning and threat detection, history tables, killer heuristics, transposition tables and refutation tables. Tactically the program plays very well, and is particularly good in finding mate threats. Positionally there is still a lot of work to do. On the Reinfeld test set it scores more than 80% with 1 minute CPU time on a Pentium 90. Search speed is 30,000-50,000 nodes/second. Ger Neef wrote the user interface.

M-Chess Pro *by Martin Hirsch (USA)*
M-Chess Professional is a chess program for PCs by Martin Hirsch. It won the title of ICCA's World Personal Computer Chess Champion 1991-2. Previous versions of M-Chess achieved numerous honours including Best Computer at AEGON 1991, second place in the ACM tournament in 1991 and first place in the Uniform Platform Tournament in 1992. M-Chess Professional has an unusual design that attempts to emulate the style of a strong human player by using complex pattern recognition, emphasizing positional aspects and having precise

knowledge of a number of endgame, while being tactically powerful. M-Chess Professional is commercially available with an excellent interface and an extensive set of features. It is currently ranked second in the Swedish Computers Rating List.

Nightmare *by Reinhold Gellner and Gaby von Rekowski (Germany)*
Completely written in C, work on Nightmare started in 1989 as a non-commercial project. It is a brute force program searching up to 7-ply in the middle-game with a selective search depth of up to 40 ply. Modified null-move searches, modified singular extensions, part-ply extensions and a new idea of hashing related meaningful subtrees are special features of Nightmare. The program also uses well known techniques like killer-moves, history heuristic, principal variation search and hash tables of 64,000 entries per side. The tournament opening book consists of about 40,000 moves. Endgame databases are NOT used. Last year, Nightmare was transferred to 32-bit under extended DOS and it can now search 12,000 moves per second. The program's rating is about 2000 ELO (German) on a 486-50.

Pandix *by Gyula Horvath, Szuzsa Horvath and Csaba Szues (Hungary)*
Gyula Horvath started writing chess programs in 1985. His program won the Amateur World Chess Championship in 1987 and the Personal Computer Chess Champion title in 1988 and 1989. His wife, Szuzsa, joined the development in 1986. She is mainly active in testing the program and in designing and programming the graphics of the commercial versions of the program. Both of them pursue chess programming as a hobby - Gyula works as a marketing researcher and Zsuzsa works as a telemarketing assistant. They have participated in various computer chess events since 1986. In 1993 their team increased to three members when Csaba Szues began to implement a new 100,000 moves opening book. The program is written in C and uses a 400KB hash table. It measures the move interestingness and incrementally updates the attack map. The program uses principal variation search, advanced time control and special limited quiescence search.

Phoenix *by Jonathan Schaeffer (Canada)*
The Phoenix program was an active participant in the 1980's computer chess tournaments and tied for first place in the 1986 World Championship. The program competing this year is essentially the same as that which competed in the 1989 World Computer Chess Championship. Phoenix's participation in the 1995 championship will serve as a benchmark for measuring improvements in the field. Phoenix will be running on a 20 processor SPARC 2000 server. Therefore the primary difference will be in the hardware. Expectations are that the software advances in the last 6 years will allow the other programs to move past Phoenix 89 in the final standings.

Schach 3 *by Matthias Engelbach (Germany) and Tom Kreitmeir (The Netherlands)*
Schach 3 is the PC version of Schach 2.x one of the earliest German chess programs. It is a non-commercial project developed and maintained by two former students. Work on Schach started in 1978 and after some surprisingly good results in computer chess tournaments, the authors could not stop working on the program. Even the distance - one of the programmers (Kreitmeir) lives in the Netherlands and the other in Germany - is no real handicap. The program is a more or less simple Shannon-A program with all the known extensions (the authors believe in the brute-force method for computer chess). The program is written in 486-assembler and can search nine or ten plies in the middle-game. Schach participated in the 1980, 1983 and 1986 World Championships, in the ACM events in the period 1981-1985 and in the German and Dutch Championships since 1992. Best results were a 6th place in Linz 1980 and New York 1983, a 3rd place in the 1994 Dutch Championship and a first place in the 1994 German Championship (Zugzwang was absent, but we all need some good luck!)

SOS *by Rudolf Huber (Germany)*
SOS is a conventional chess program. It uses depth first minimax tree search with quiescence search, alpha-beta enhancement, minimal window search and null-move pruning. To improve the search efficiency, the history heuristic and a transpositional table is used. The search is extended to deeper plies on those move sequences which have a high probability of being part of the principal variation. For SOS, those sequences are recaptures and check evasions. Leaf node evaluation considers only material, piece placement and pawn structure and only about 10% of the CPU time is spent on this (not including the quiescence search which is capture only, but extends on "losing" captures which are checks and on checking sequences). The evaluation parameters are dynamic and continuously updated during tree search. SOS's weakest part is probably endgame knowledge. SOS actively plays a wide range of openings, but most of those lines are not very deep. With autoplay games against itself, the opening book is tuned to favour those lines which harmonize with SOS's style of play.

StarSocrates *by D.Dailey, C.Joerg, B.Kuszmaul, C.Leiserson, R. Blumofe, M.Frigo, L.Kaufman (IM), K.Randall, Rolf Riesen and Yuli Zhou (USA)*
The Star Socrates 2.0 chess program developed at the MIT Laboratory for Computer Science, will be running on the 1824 node Intel Paragon parallel supercomputer located at Sandia National Laboratories. The lead programmers are Don Bailey and Christopher F.Joerg and the project team is lead by Prof. Leiserson. Heuristic Software provided the chess engine on which StarSocrates was originally based. The Paragon is about 50 feet long and weighs about 30,000 pounds. Each node consists of two 50MHz I860 processors with either 16 or 32MB of memory. The program currently runs on both the Connection Machine CM-5 and the Intel Paragon. More information about StarSocrates can be found on the web at http://theory.lcs.mit.edu/~cilk/starsoc.html.

Ulysses *by Ulf Lorenz and Valentin Rottmann (Germany)*
Ulysses was the legendary conqueror of Troy and on his adventurous journey home to Athens he made many wanderings. The program is written in C and uses a new searching technique called 'Controlled Conspiracy Number Search' (CCNS). The algorithm is described in Lorenz's and Rottmann's master thesis. CCNS takes up McAllester's 1988 Conspiracy Number scheme. Unlike Schaeffer's 1989 "Conspire" system , which was only a tactical player, Ulysses also exhibits good positional play. Conspiracy search achieves selectivity in the plain search algorithm without any domain dependent (i.e. chess specific) knowledge In the evaluation of leaf-nodes a CCNS algorithm is able to use quiescence searches with initial windows. Positional play thus becomes possible. The program's speed is attributed to the use of big memory tables, and from not wasting resources computing an upper bound for the value of the best move. All chess specific knowledge used is encoded in the static evaluation function which in turn uses a small quiescence search. Using a Sparc10 60MHz, UlyssesCCN searches about 8000 nodes per second, about 350 of them are Conspiracy Number nodes. The opening book consists of 11,000 positions. After 300 seconds at each position, Ulysses solves 281 positions of WinAtChess test set, consisting of 300 positions. To our knowledge, this is the first chess program based on Conspiracy Numbers which achieves acceptable results in computer chess competitions.

VirtuaChess *by M.F.Baudot and Jean Christophe Weill (France)*
VirtuaChess is the commercial version of the Ecume and Cumulus 2 chess programs (which finished second in the blitz tournament in Munich and which tied 2nd/3rd in the 7th World Championships in Madrid). It runs on a PC with MSDOS and can use all available memory for its hash tables. It has a splendid graphical interface written by the French firm Titus. Most of the chess engine is written in 32 bit assembler, and the program includes dynamic evaluation of king safety and pawn structure. It is based on PVS and uses null-move pruning. The program has perfect knowledge of KPK endgames. The evaluation function attempts to build plans whenever it recognizes important features in a position. VirtuaChess runs at 20,000 nodes per second on a Pentium 90.

WChess *by Dave Kittinger and James Parker (USA)*
WChess received world-wide attention after it scored 5 out of 6 against some of the strongest American grandmasters in the Intel Harvard Cup Man v Machine tournament held in October 1994. The program consolidated its position as one of the top micro-computer chess programs by winning the 1994 Uniform Platform Computer Chess Tournament held in London. WChess uses an iterative, depth first alpha-beta search with forward pruning and a tactical swap-off evaluation to limit the growth of the search tree. The evaluator is somewhat primitive and is not currently as dynamic as the author would like. Positional information is communicated to the search mainly by piece value tables. The current version only implements end game databases for KPK although the author is looking into adding more databases.

Woodpusher *by John Hamlen (UK)*
Woodpusher is a small chess program (<64K) of conventional design. It uses an iterative deepening alpha-beta search with PVS and aspiration window enhancements. The first version of Woodpusher was born in 1989 as part of a university project looking into null-move search techniques. True to it's origins, this new version of the program still uses the null-move throughout the search to recognize threats and to forward prune branches of the search tree. A database of attacks from and to all the squares on the board is maintained by using CHESS 4.5's bitboard implementation. These data structures are used for both generating moves and making positional evaluations. Woodpusher's position evaluation is maintained almost entirely incrementally while making and un-making moves during the search, with very little work done at the terminal nodes. The evaluation is therefore necessarily simple,but does include true measures of mobility rather than relying on piece-square evaluations.

Zeus 3.0 *by Gerardo Castano (Spain)*

Gerardo Castano works as a medical doctor and writes computer chess programs as a hobby. Zeus 1.0 was written in basic and finished fifth out of seven in the first Spanish Computer Chess Championships in 1993. The program was rewritten in C in 1994 and uses the standard techniques of alpha-beta search, selective extensions, minimal PVS, transposition tables, killer heuristic, history heuristic, null-move pruning and quiescence search. Capturing moves, checks, promotions, mate threats are all considered in the search. Zeus 2.0 used 256KB hash tables and searched 3000 nodes per second. It won the second Spanish Computer Chess Championships in 1994 with 7/7. Zeus 3.0 uses massive hash tables (32MB), and contains extensive chess knowledge (pawn structure, strong squares, bad bishop etc). The opening book contains about 300,000 positions and recognizes move and color transpositions. The endgame database is being developed and the evaluation function, although large, has produced good results.

Zugzwang *by R.Feldman and P.Mysliwietz (Germany)*

Zugzwang made its first moves in 1989. It won the bronze medal in the 1990 Computer Olympiad, and won the Paderborn (human) Championships in 1991. In the last Computer World Championships in Madrid 1992, Zugzwang, running on a system consisting of 1023 T800 transputers, finished second and was undefeated without playing the eventual Champion, Chess Machine Schroeder. In 1993 Zugzwang had its first victory over a grandmaster. In 1994 Zugzwang was completely rewritten from OCCAM to C (about 20,000 lines of code) and is now portable to a large spectrum of machines including SPARC, SGI, DEC Alpha, I860, 486 and PowerPC. In this year's Championships, Zugzwang will run on a GC-Powerplus distributed system (based on the Power PC) with at least 96 processors. The opening book contains about 130,000 moves and 1MB transposition tables are used per processor. Zugzwang uses bruteforce alpha-beta search with history tables and killer hruristics. The program searches about 3000 nodes per second per processors on a PowerPC. The search is performed by distributed processors using a distributed algorithm based on the Young Brothers Wait Concept, which gives good results even if as many as 1000 processors are used. In this case the machine calculates moves more than 400 times faster than a sequential system.

Recent Games of Note Played by the Top Programs
Monty Newborn and David Levy

In the last two years, the top programs have played some very strong games. We include here a sampling of seven of them. Six of them are computer versus human games. The remaining one is between two of the leading contenders here, Deep Blue and Star Socrates. The seven games thus cover five of the leading participants in the Eighth World Computer Chess Championship.

August 1993: Yorktown Heights, New York
The following two games were played at IBM's T.J. Watson Research Center in Yorktown Heights, New York on August 20, 1993. They were played at a speed of all moves in 30 minutes per player per games. IBM had invited Judit Polgar to their world-famous research center for the encounter.

Game 1: White: Deep Blue Prototype   Black: Judit Polgar [2630 FIDE]
1 e4 c5 2 Nf3 e6 3 d4 cd4 4 Nd4 Nc6 5 Nc3 Qc7 6 be2 a6 7 O-O Bb4 8 Nc6 bc6 9 Qd4 Bd6 10 Qg7 Bh2+ 11 Kh1 Be5 12 Bf4 Bg7 13 Bc7 d5 14 Rad1 Ne7 15 Na4 Ra7 16 Bb6 Ra8 17 c3 Ng6 18 Bc7 Ra7 19 Bb8 Rb7 20 Bg3 O-O 21 ed5 cd5 22 Rfe1 f5 23 Bd6 Rd8 24 Ba3 Rc7 25 Bb4 Rc6 26 Ba5 Rf8 27 Bb6 Rf7 28 Kg1 Bf8 29 b3 Bb7 30 Bh5 Re7 31 Kf1 Kf7 32 c4 Rc8 33 Ba5 dc4 34 Nb6 Rb8 35 Nd7 Rc8 36 Bb4 cb3 37 Nf8 Rf8 38 ab3 Rb8 39 Be7 Ke7 40 Rd4 a5 41 Ra4 Bc6 42 Ra5 Rb3 43 Ra7+ Kf6 44 Rh7 Nf4 45 g3 Bb5+ 46 Kg1 Nh3+ 47 Kg2 Ng5 48 Rh6+ Ke7 49 Re5 Bc6+ 50 Kf1 Rb1+ 51 Re1 Rb2 52 Be2 Ne4 53 Rd1 Bd5 54 Rc1 Nd2+ 55 Ke1 Ne4 56 Ra1 Nc3 57 Bd3 Na2 58 Kf1 Nb4 59 Bf5 Nc6 60 Rd1 Bc4 61 Bd3 Bb3 62 Rb1 Rb1 63 Bb1 Bd5 64 Rh7+ Kf6 65 Rh4 Ne5 66 Ke2 Bf3 67 Ke3 Bc6 68 f4 Nf7 69 g4 e5 70 g5+ Kg7 71 Rh7+ Kg8 72 g6 ef4 73 Kf4 1-0
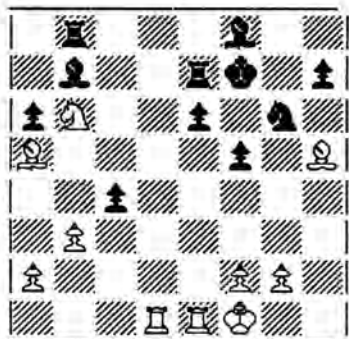
Figure 1. Position after 34. ... Rb8
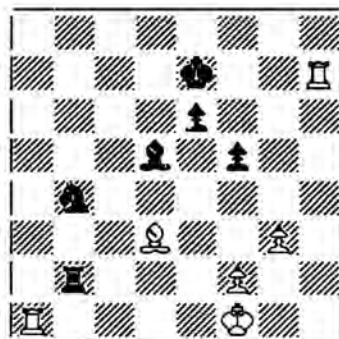
Figure 2. Position after 58. ...Nb4

Game 2: White: Judit Polgar   Black: Deep Blue Prototype
1 Nf3 Nf6 2 g3 d5 3 d3 Nbd7 4 Nbd2 e5 5 Bg2 c6 6 O-O Bd6 7 Nh4 O-O 8 e4 Nc5 9 Re1 Bg4 10 f3 Be6 11 Nf1 Qb6 12 Kh1 de4 13 de4 Rfd8 14 Qe2 Na4 15 g4 Bc5 16 Ne3 Bd4 17 c3 Nc3 18 bc3 Bc3 19 Nc2 Qa5 20 Bg5 h6 21 Be3 b6 22 Nf5 Qa4 23 g5 hg5 24 Bg5 Be1 25 Re1 Bf5 26 ef5 Rd6 27 Ne3 Re8 28 Rg1 Nh7 29 Bf1 Ng5 30 Rg5 Qf4 31 Rg4 Qh6 32 Rg1 Kf8 33 Qe1 Rd4 34 Bg2 Qf4 35 Ng4 Qf5 36 Qh4 Qg6 37 Qh8+ Ke7 38 Qh4+ Kd6 39 Qf2 c5 40 Ne3 Kc7 41 f4 ef4 42 Nd5+ Kd8 43 Nc3 Qd3 44 Qb2 Re3 45 Nb5 Rb4 46 Qg7 Qb5 47 Qf6+ Kc7 48 Qf7+ Qd7 49 Qf8 Ra4 50 Qa8 Ra2 51 Qb7+ Kd8 52 Qb8+ Ke7 53 Qf4 Qd4 54 Qc7+ Kf6 55 Rf1+ Kg5 56 Qf7 Ra1 57 Qf5+ Kh6 58 Qf8+ Kh5 59 Qf5+ Kh4 60 Qh7+ Kg5 61 Qf5+ 1/2 - 1/2

Hsu Observed that "17. c3 might be questionable, although White does have some compensation for the material deficit. At move 49, the machine had a completely winning position, but 49. ... Ra4? gave Judit some counterchances and 50....Ra2?? surrendered the win. It needed 10 seconds of thinking time, which it did not have to avoid the draw."
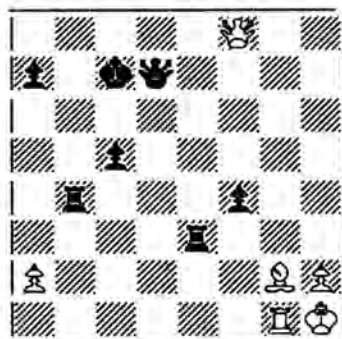
Figure 3. Position after 16. ...Bd4

Figure 4. Position after 49.Qf8

May 1994: Munich, Germany

The following game was played in the Intel World Chess Express Challenge tournament in Munich in May 1994. In this event the program was allowed five minutes per game for all of its moves while the 17 grandmasters each had six minutes. But the Grandmasters had to play the program from a PC screen, using a mouse to make the moves. The result of the tournament was a phenomenon! Fritz shared first place with Garry Kasparov, ahead of 16 top class Grandmasters. (In the play-off that followed Kasparov scored a convincing victory.) Kasparov errored on 35....e4 but nevertheless had the advantage when he lost on time.

White: Fritz   **Black: Garry Kasparov**

1 e3 d5 2 c4 dc 3 c4 e5 4 d4 ed4 5 ed4 Bb4+ 6 Nc3 Nf6 7 Nf3 O-O 8 O-O Bg4 9 h3 Bh5 10 g4 Bg6 11 Ne5 Nc6 12 Be3 Ne5 13 de5 Nd7 14 f4 Nb6 15 Bb3 Bd3 16 Qf3 Bf1 17 Rf1 c6 18 f5 Qe7 19 f6 Qe5 20 fg7 Kg7 21 Ne4 Nd5 22 Bd5 cd4 23 Ng3 Kg8 24 Nf5 Rac8 25 Qf2 Rc4 26 Nh6+ Kh8 27 Ba7 f6 28 Nf5 Re8 29 a3 Be1 30 Qg2 Re4 31 Nh6 Re7 32 Rf5 Re2 33 Re5 Rg2+ 34 Kg2 fe5 35 Bb8 e4 36 Be5+ Re5 37 Nf7+ Kg7 38 Ne5 Bd2 39 Kf1 Bc1 40 b3 Ba3 41 g5 d4 42 Ke2 d3+ 43 Kd2 Bd6 44 Nc4 Bf4+ 45 Kc3 b5 1-0
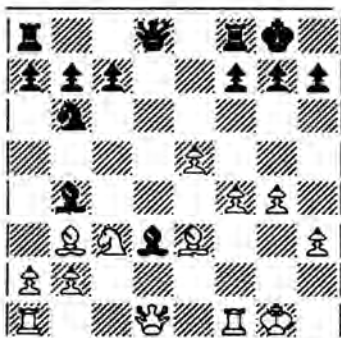
Figure 5. Position after 15. ... Bd3
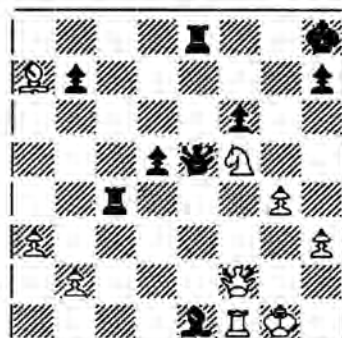
Figure 6. Position after 30. ...Be1

June 1994: Cape May, New Jersey

Deep Thought II played at the ACM's 24 International Computer Chess Championship at Cape May, New Jersey June 25-27, 1994. It won its first round game against Zarkov, but an electrical storm in Yorktown caused the program to default its second round game. In the third round, it bested WChess and then played the crucial game of the tournament in the next round against Star Socrates. Star Socrates castled long on move 8 and found itself on the defensive shortly thereafter. On move 40, Star Socrates went down an exchange, and with Deep Thought II keeping up the pressure, resigned twenty-one moves later. At the end of four rounds, Deep thought II and star Socrates each had three points. In the final round Deep Thought II defeated M-Chess Pro while Star Socrates was defeated by Sarkov. Despite forfeiting its first round game, Deep Thought II won the five-round event with a 4-1 score.

White: Star Socrates   **Black: Deep Thought II**

1 c4 c5 2 Nc3 Nc6 3 Nge2 Nf6 4 d4 cd4 d6 6 Bg5 e6 7 Qd2 a6 8 O-O-O h6 9 Bf4 Bd7 10 Nc6 Bc6 11 f3 d5 12 Qe1 Bb4 13 a3 Ba5 14 Bd2 O-O 15 ed5 ed5 16 Bd3 Re8 17 Oh4 d4 18 Na2 Bd2+ 19 Rd2 a5 20 Bc4 b5 21 Rd4 qc7 22 Bf1 Qe3+ 23 Rd2 b4 24 Qd4 ba3 25 Qe3 ab2+ 26 Kb2 Re3 27 Rd6 Rb8+ 28 Kc1 Ra3 29 Rc6 Ra2 30 g3 Ra1+ 31 Kd2 a4 32 Bg2 Rd8+ 33 Ke2 Rh1 34 Bh1 Ra8 35 Rb6 Nb5 36 Rb6 Nc3+ 37 Kd3 a3 38 Kc3 a2 39 Rd1 a1=Q+ 40 Ra1 Ra1 41 Bg2 Rg1 42 Bh3 Rh1 43 Bc8 Rh2 44 g4 Rf2 45 Bb7 g6 46 Kd3 h5 47 gh5 gh5

48 Be4 h4 49 Ke3 Rg2 50 Bf5 Rg5 51 Bh3 Rg3 52 Bf1 h3 53 Kf2 h2 54 Bg2 Rgh 55 f4 f5 56 Kf3 Kf7 57 Kf2 Rg4 58 Kf3 K27 59 Kf2 Rg8 60 Kf1 Kd6 61 Kf2 0-1
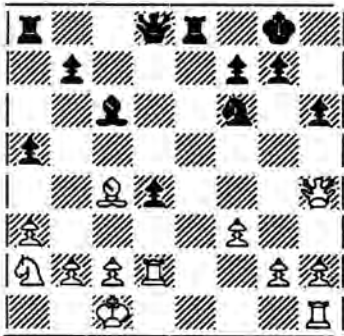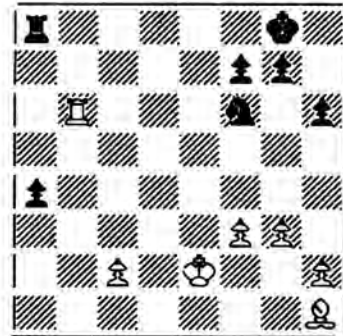

Figure 7. Position after 20. Bc4

Figure 8. Position after 35. Rb6

August 1994: London, England

On August 31, 1994 chess history was written when Pentium Genius defeated Gary Kasparov in a PCA Grand-Prix tournament in London. The games were played at a speed of all moves in 25 minutes per player per game. This event was a knock-out tournament involving many of the world's top grandmaster. Richard Lang's Pentium Genius program was paired against the World Champion in the first round and by winning the match 1.5-0.5 the program knocked Kasparov out of the tournament. In the second round Pentium Genius scored another dramatic victory, winning both games against Grandmaster Predrag Nikloc from Bosnia. It was only in the semi-final round that the program was to meet its match - the cool Vishy Anand of India who strategically outplayed it for a 2-0 victory.

Game 1:   **White: Garry Kasparov**   **Black: Pentium Genius**

1.c4 c6 2.d4 d5 3.Nf3 Nf6 4.Qc2 dc4 5.Qc4 Bf5 6.Nc3 Nbd7 7.g3 c6 8.Bg2 Be7 9.O-O O-O 10.c3 Ne4 11.Qe2 Qb6 12.Rd1 Rad8 13.Ne1 Ndf6 14.Ne4 Ne4 15.f3 Nd6 16.a4 Qb3 17.e4 Bg6 18.Rd3 Qb4 19.B3 Nc8 20.Nc2 Qb6 21.Bf4 c5 22.Be3 cd4 23.Nd4 Bc5 24.Rad1 e5 25.Nc2 Rd3 26.Qd3 Ne7 27.b4 Be3+ 28.Qe3 Rd8 29.Rd8+ Qd8 30.Bf1 b6 31.Qc3 f6 32.Bc4+ Bf7 33.Ne3 Qd4 34.Bf7+ Kf7 35.Qb3+ Kf8 36.Kg2 Qd2+ 37.Kh3 Qe2 38.Ng2 h5 39.Qc3 Qc4 40.Qd2 Qe6+ 41.g4 hg4+ 42.fg4 Qc4 43.Qe1 Qb3+ 44.Ne3 Qd3 45.Kg3 Qe4 46.Qd2 Qf4+ 47.Kg2 Qd4 48.Qd4 ed4 49.Nc4 Nc6 50.b5 Ne5 51.Nd6 d3 52.Kf2 Ng4+ 53.Ke1 Nh2 54.Kd2 Nf3+ 55.Kd3 Ke7 56.Nf5+ Kf7 57.Ke4 Nd2+ 58.Kd5 g5 59.Nd6+ Kg6 60.Kd4 Nb3+ 1-0
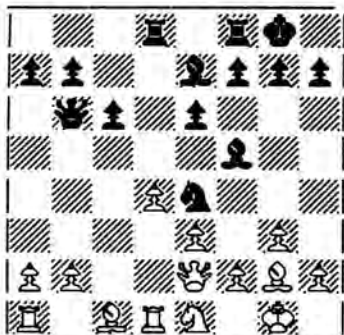
Figure 9. Position after 14. ... Ne4
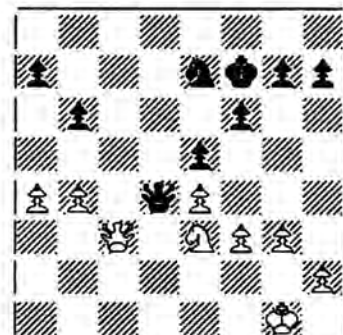
Figure 10. Position after 34. ... Kf7

By move 20, Kasparov had acquitted a strong position, but trades over the coming moves reduced his advantage. Frederic Friedel, when writing this match up in the September 1994 ICCA Journal, noted that "Instead of 35.Qd4 with an easy draw he played 35.Qb3+? for a win. The resulting position was one in which computers revel, and Genius had found all the tactical resources it required."

Friedel noted that "The second game saw Kasparov, playing Black, sacrifice a Pawn and then go on to entrap White positionally and gain a winning advantage. But the computer defended stubbornly and the inevitable moment of inattention came. 55....Qd4?? allows 56.Qd1 and the double threat 57.g4 and 57.Qb5, so that Black has lost the extra Pawn for nothing. A horrified Kasparov submitted to a draw."

Game2:   White: Pentium Genius   Black: Garry Kasparov
1 d4 Nf6 2 c4 e6 3 Nf3 b6 4 a3 Bb7 5 Nc3 d5 6 Bg5 Be7 7 e3 O-O 8 Bd3 Nbd7 9 cd5 ed5 10 O-O c5 11 Rc1
Ne4 12 Bf4 a6 13 Qc2 Ndf6 14 dc5 Bc5 15 Rfd1 Qe8 16 b4 Be7 17 Be2 Rc8 18 Qb2 b5 19 Nd4 Nd6 20 Bd3
Nc4 21 Qb3 Nh5 22 Bf5 Ra8 23 Nde2 Nf6 24 Bg5 Rd8 25 Nf4 d4 26 ed4 h6 27 Bf6 Bf6 28 Nce2 Bc4 29 Be4
Qe4 30 Qg3 Rfe8 31 Qc3 Rd6 32 Re1 Red8 33 Rcd1 Bd4 34 Nd4 Qf4 35 Ne2 Qe5 36 Rd6 Rd6 37 a4 Re6 38
Qc1 Qd6 39 ab5 ab5 40 Ng3 Qb4 41 Re6 fe6 42 h3 Qc5 43 Nf1 Qd5 44 Qa1 Qe5 45 Qa7 Kh7 46 Qd7 Qd5
47 Qe7 Qd6 48 Qb7 Qd5 49 Qe7 Qe5 50 Qd7 Nd6 51 Ne3 Nf5 52 Qd3 Kg8 53 Qd8+ Kf7 54 Qd7+ Kg6 55
Kd3 Qd4 56 Qb1 Draw
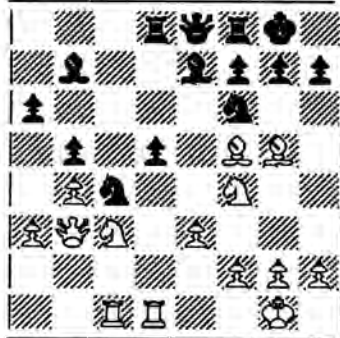
Figure 11. Position after 25.Nf4
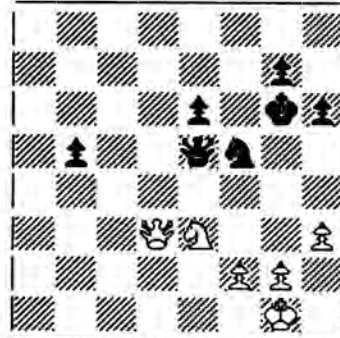
Figure 12. Position after 55.Qd3

October 1994: Boston, Massachusetts

Another startling result was achieved in the Fifth Harvard Cup tournament, played in Boston on October 1-2, 1994, which pitted six Grandmasters against eight computer programs, each grandmaster playing one game against each of the programs. The outstanding success of the event was WChess, which scored four wins and two draws, for a performance rating of 2895. WChess' success included victories over Alexander Yermolinsky, current US Co-champion and Patrick Wolff, former US Champion. The Yermolinsky versus WChess game follows.

White: Alexander Yermolinsky   Black:WChess
1 d4 d5 2 c4 dc4 3 Nf3 Nf6 4 e3 Bg4 5 Bc4 e6 6 Qb3 Bf3 7 gf3 Nbd7 8 Nc3 Nb6 9 Be2 Be7 10 Bd2 O-O 11
O-O-O c5 12 dc5 Bc5 13 Kb1 Qc7 14 Ne4 Ne4 15 fe4 Rfd8 16 Bc3 Rd1+ 17 Bd1 Rd8 18 h4 Be7 19 h5 Nc4
20 Qc2 Bf6 21 Bf6 Gf6 22 Ka1 Rd2 23 Qc3 Rf2 24 Bb3 b5 25 Rg1+ kh8 26 Qb4 Qd8 27 Qb5 Nb2 28 h6 Qc8
29 Kb1 a6 30 Qb6 Nd3 31 Qd4 Ne5 32 Rd1 Rg2 33 Qb6 Rg8 34 Qd6 Qa8 35 Qd4 Qf8 36 Rh1 Rg6 37 Qb6
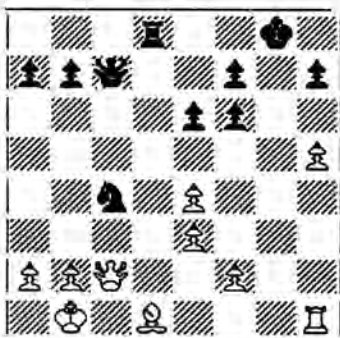Nf3 38 Qa6 Nd2+ 39 Ka1 Qc5 40 Qd3 Nb3+ 41 ab3 Qa5+ 42 Kb1 Rg2 0-1

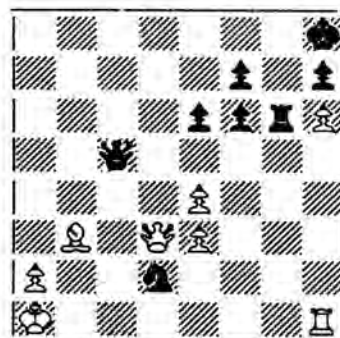
Figure 13. Position after 21. ...gf6

Figure 14. Position after 40. Qd3

Danny Kopec annotated the game in the December 1994 issue of the ICCA Journal and several of his comments are given here. Kopec observed that after 13....Qc7 "Rhg1 is still recommended [Kopec had earlier recommended this move instead of 10.Bd2]." White's 14.Ne4 "removes Black's only kingside defender — but with every exchange Black gets closer to his goal of exploiting White's doubled pawns and three pawn islands". After 21....gf6, Kopec said that "Black clearly has better pieces and central control. White's Bishop is a poor piece." He noted that 26....Qd8 prevents Qf8 mate and that after 27....Nb2, "white's King is now fully exposed." Following 31....Ne5, Kopec noted that "Black is still better centralised and co-ordinated. Here if 32.Rc1 then Qf8 defends and threatens the Pawn on h6." With 40....Nb3+, Kopec credits Black with simplifying because it evidently sees a forced win.

History of Major Tournaments

WORLD CHAMPIONS

Year	City	Winner	Runner-up
1974	Stockholm	KAISSA; Donskoy, Arlazarov, ICL 4/70	CHESS 4.0; Slate, Atkin, CDC 6600
1977	Toronto	CHESS 4.6; Slate, Atkin, CDC Cyber 176 IBM 370/165	DUCHESS; Truscott, Wright, Jensen,
1980	Linz	BELLE; Thompson, Condon, PDP 11/23 with chess circuitry	CHAOS; Alexander, Swartz, Berman O'Keefe, Amdahl 470/V8
1983	New York	CRAY BLITZ; Hyatt, Gower, Nelson Cray XMP/48	BEBE; Scherzer, Chess engine
1986	Cologne	CRAY BLITZ; Hyatt, Gower, Nelson, Cray XMP	HITECH; Berliner, et al., SUN workstation with chess circuitry
1989	Edmonton	DEEP THOUGHT; Hsu, Anantharaman Browne, Campbell, Jansen, Nowatzyk, SUN with VLSI chess hardware	BEBE; Scherzer, Scherzer, Chess Engine
1992	Madrid	CHESS MACHINE/SCHRÖDER, Schr^der, ARM2	ZUGZWANG; Feldman, Mysliwietz, Parsytec T-800

ACM INTERNATIONAL COMPUTER CHESS CHAMPIONSHIPS*

Year	City	Winner	Runner-up
1970	New York	CHESS 3.0; Slate, Atkin, Gorlen, CDC 6400	DALY CHESS PROGRAM; Daly, King, Varian 620/i
1971	Chicago	CHESS 3.5; Slate, Atkin, Gorlen, CDC 6400	TECH; Gillogly, PDP 10
1972	Boston	CHESS 3.6; Slate, Atkin, Gorlen, CDC 6400	OSTRICH; Arnold, Newborn, DG Supernova
1973	Atlanta	CHESS 4.0; Slate, Atkin, Gorlen, CDC 6400	TECH II; Baisley, PDP 10
1974	San Diego	RIBBIT; Hansen, Crook, Parry, H'well 6050	CHESS 4.0; Slate, Atkin, CDC 6400
1975	Minneapolis	CHESS 4.4; Slate, Atkin, CDC Cyber 175	TREEFROG; Hansen, Calnek, Crook, Honeywell 6080
1976	Houston	CHESS 4.5; Slate, Atkin, CDC Cyber 176	CHAOS; Swartz, Berman, Alexander Ruben, Toikka, Winograd, Amdahl 470
1977	Seattle	CHESS 4.6; Slate Atkin, CDC Cyber 176	DUCHESS; Truscott Wright, Jensen, IBM 370/168
1978	Washington	BELLE; Thompson, Condon, PDP 11/70 w/chess hardware	CHESS 4.7; Slate, Atkin, CDC Cyber 176
1979	Detroit	CHESS 4.9; Slate, Atkin, CDC Cyber 176	BELLE; Thompson, Condon, PDP 11/70 with chess hardware

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Called the ACM United States Computer Chess Championship from 1970-1974; renamed the ACM North American Computer Chess Champion in 1975; renamed the ACM International Computer Chess Championship in 1991.

1980	Nashville	BELLE; Thompson, Condon, PDP 11/70 w/chess hardware	CHAOS; Alexander, O'Keefe, Swartz, Berman, Amdahl 470
1981	Los Angeles	BELLE; Thompson, Condon, PDP 11/23 w/chess hardware	NUCHESS; Blanchard, Slate, CDC Cyber 176
1982	Dallas	BELLE; Thompson, Condon, PDP 11/23 w/chess hardware	CRAY BLITZ; Hyatt, Gower, Nelson, Cray 1

1983 Not held as the ACM NACCC that year but as the Fourth World Championship. See World Championships.

1984	San Fransisco	CRAY BLITZ; Hyatt Gower, Nelson, Cray XMP/4	BEBE; Slcherzer, Chess Engine and FIDELITY EXPERIMENTAL; Spracklen, Spracklen, Fidelity machine
1985	Denver	HITECH; Ebeling, Berliner, Goetsch, Palay Campbell, Slomer, SUN w/chess hardware	BEBE; Slcherzer, Chess engine
1986	Dallas	BELLE; Thompson, Condon, 11/23+c.h.	LACHEX; Wendroff, Cray X-MP
1987	Dallas	CHIPTEST-M; Anantharaman, Hsu Campbell, SUN 3 with VLSI chess hardware	CRAY BLITZ; Hyatt, Nelson, Gower Cray XMP 4/8
1988	Orlando	DEEP THOUGHT 0.02; Hsu, Anatharaman, Browne, Campbell, Nowatzyk, SUN 3 w/VLSI circuitry	CHESS CHALLENGER EXP; Spracklen, Spracklen, Nelson, Fidelity machine with Motorola 68030 microprocessor
1989	Reno	HITECH*; Ebeling, Berliner, Goetsch, Palay, Campbell, Slomer, SUN w/chess hardware (*denotes 1st-place tie)	DEEP THOUGHT*; Hsu, Anantharaman, Browne, Campbell, Nowatzyk, 3 SUN 4s w/VLSI chess hardware
1990	New York	DEEP THOUGHT/88; Hsu, Anantharaman, Jensen, Campbell, Nowatzyk, SUN 4 with two special VLSI chess circuits	MEPHISTO; Lang, 68030 microprocessor MEPHISTO machine
1991	Albuquerque	DEEP THOUGHT II, Hsu, Campbell, RS/6000 550 + 24 chess processors	M CHESS; Hirsch, IBM PC Clone/486
1993	Indianapolis	Socrates II, Dailey, Kaufmann, IBM PC	CRAY BLITZ; Hyatt, Gower, Nelson
1994	Cape May	DEEP THOUGHT II, Hsu, Campbell, Hoane, RS/6000 580 + 12 chess proc.	ZARKOV, Stanback, HP735

WORLD MICROCOMPUTER CHAMPIONS

Year	City	Winner	Runner-up
1980	London	CHESS CHALLENGER	BORIS EXPERIMENTAL
1981	Travemunde	FIDELITY X	CHESS CHAMPION MARK V
1983	Budapest	ELITE A/S	MEPHISTO X
1984	Glasgow	Four way tie: ELITE X, MEPHISTO S/X, PRINCHESS, PSION CHESS	
1985	Amsterdam	MEPHISTO AMSTERDAM I	MEPHISTO AMSTERDAM II
1986	Dallas	MEPHISTO DALLAS 3	FIDELITY "2533"
1987	Rome	MEPHISTO	CYRUS 68K
1988	Almeria	MEPHISTO	FIDELITY
1989	Portoroz	MEPHISTO	FIDELITY
1990	Lyons	MEPHISTO	Tie: ECHEC 1.9 & GIDEON
1991	Vancouver	Tie: MEPHISTO & GIDEON	
1992	Not held in 1992.		
1993	Munich	MEPHISTO GENIUS	HIARCS
1994	Not held in 1994.		

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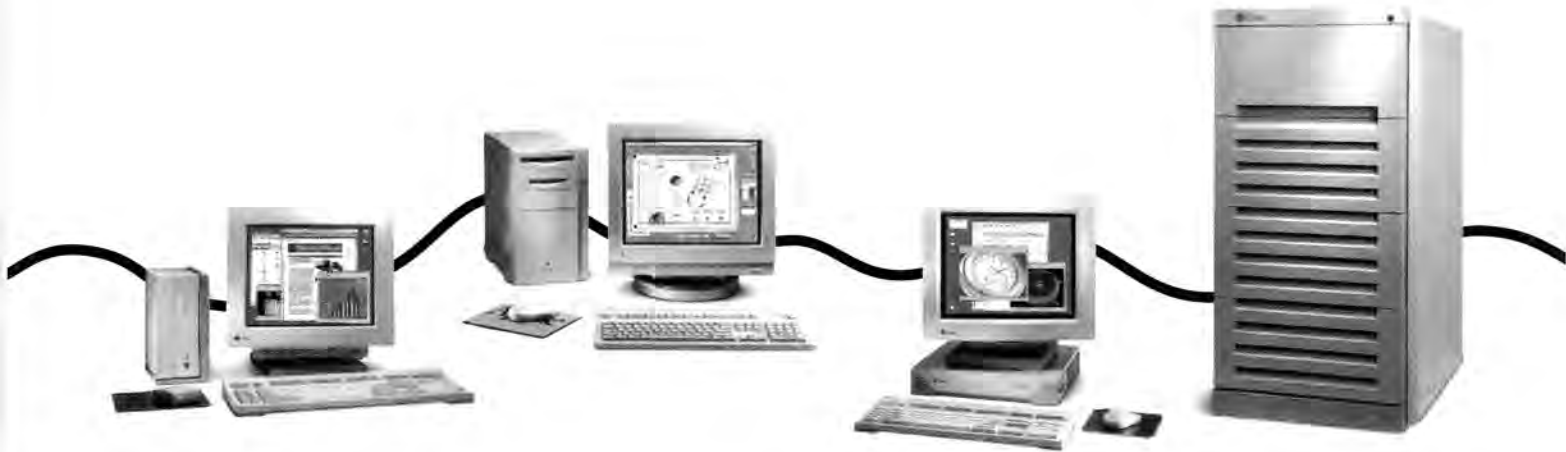
First the facts. Sun ships more UNIX systems worldwide than anyone, in terms of both dollars and units. Sun ships more workstations. More UNIX commercial desktop systems. And more UNIX technical systems. Solaris, Sun's UNIX operating environment, is the world's leading volume UNIX operating system. Not surprisingly, Sun is also the leading UNIX platform for relational database software*.

Now that you know the facts, the figures should prove especially meaningful. Consider that being number one means we have more than 16,000 UNIX experts ready to help you with service and support. More than 9,000 UNIX applications. And more UNIX know-how than any of our competitors. So why should you care? Because being number one means that when it comes to UNIX, nobody has more to offer you than Sun.

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Tournament Rules

1. Each entry is a computing system and one or more human operators. A listing of all chess-related programs running on the system must be available on demand to the Tournament Director, Mike Valvo. Each entry requires at least one full-time operator.

2. Participants must attend an organizational meeting at 15:00 in the tournament hall on May 25th for the purpose of officially registering for the tournament. Rules will be finalized at that meeting.

3. The tournament will be a 5 round Swiss system event.

4. Trophies will be awarded to the first three finishers. The winner of the tournament will be awarded the Shannon Trophy and the title of World Computer Chess Champion, both until 1998. The order of finish will be determined by the total number of points earned. If two or more teams have equal points, a tie-break system will be used. The first tie-break will be by sum of opponents' scores. If there is still a tie it will be broken on the basis of the sum of the respective programs' cumulative scores after each round (i.e. score after round 1 + score after round 2 + ... + score after round 5).

5. Unless otherwise specified, rules of play are identical to those of "human" tournament play. In disputes, the Tournament Director has the right to make the final decision.

6. Games are played at a rate of 40 moves per player in the first two hours and 40 moves/player per hour thereafter.

7. The Tournament Director has the right to adjudicate a game after six hours of total clock time. The adjudication will be made on the premise of perfect play by both sides from the final position.

8. An operator may ask the Tournament Director to stop clocks at most twice during a game because of technical problems. The operator can ask the Tournament Director for permission to restart the program. When restarting after a failure of any kind, the operator must reset all parameters to their values at the time the game was interrupted. Play must resume after at most a fifteen-minute delay. If an operator using a remote computer can clearly establish that the problems are in the communication network, the Tournament Director can permit additional time-outs.

9. An operator error made when starting a game or in the middle of a game can be corrected only with the approval of the Tournament Director. If an operator enters an incorrect move, the Tournament Director must be notified immediately. Both clocks will be stopped. The game must then be backed up to where the error occurred. Clocks will be backed up to their settings when the error occurred using whatever information is available. Both sides may then adjust program parameters with the approval of the Tournament Director. The Tournament Director may not allow certain parameters (eg contempt factor) to be changed.

10. Terminals at the tournament site must communicate directly with remote computers, i.e., there cannot be any human intermediary at the remote location.

11. Each team that uses a terminal must position the terminal in such a way that the opponent has a good view of it. An operator can only (1) type in moves and (2) respond to request from the computer for clock information. If an operator must type in any other information, it must be approved ahead of time by the Tournament Director. (This might happen if there is noise on the communication line and, for example, a CR must be typed to clear the line.) The operator cannot query the system to see if it alive without permission of the Tournament Director.

12. A team must receive the approval of the Tournament Director to change from one computing system to another.

13. Each game is played with a chess board and clock both provided by the Tournament Committee.

14. At the end of each game, each team must hand in a game listing to the Tournament Director.

8th ICCA World Computer Chess Championships
Tournament Results Table

Round	1		2		3		4		5		Final Score
Competitor	versus	result	versus	result	versus	result	versus	result	versus	result	
1 Cheiron											
2 Chess Genius											
3 Dark Thought											
4 Deep Blue Prototype											
5 Ferret											
6 Frenchess											
7 Fritz											
8 Gandalf											
9 Hitech											
10 Junior											
11 LChess											
12 M - Chess											
13 Nightmare											
14 Pandix											
15 Phoenix											
16 Schach 3											
17 SOS											
18 Star Socrates											
19 Ulzsses											
20 VirtuaChess											
21 W - Chess											
22 Woodpusher											
23 Zeus 3.0											
24 Zugzwang											

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International Computer Chess Association

Established at the Second World Computer Chess Championship in Toronto in 1977, this international association has about five hundred members from all over the world. Its journal is published four times a year. The International Computer Chess Association (ICCA) is an international organization that represents the computer chess world, not only to the computer science community (such as ACM, IEEE, and IFIP), but also to the world chess federation (FIDE). The most visible benefit of membership is the quarterly ICCA Journal. Each issue contains roughly 60 pages outlining the latest in computer chess research, news, tournament results, book reviews, conferences, games, etc.: something for researchers, chess program hobbyists, and chess players.

ICCA Journal Subscription

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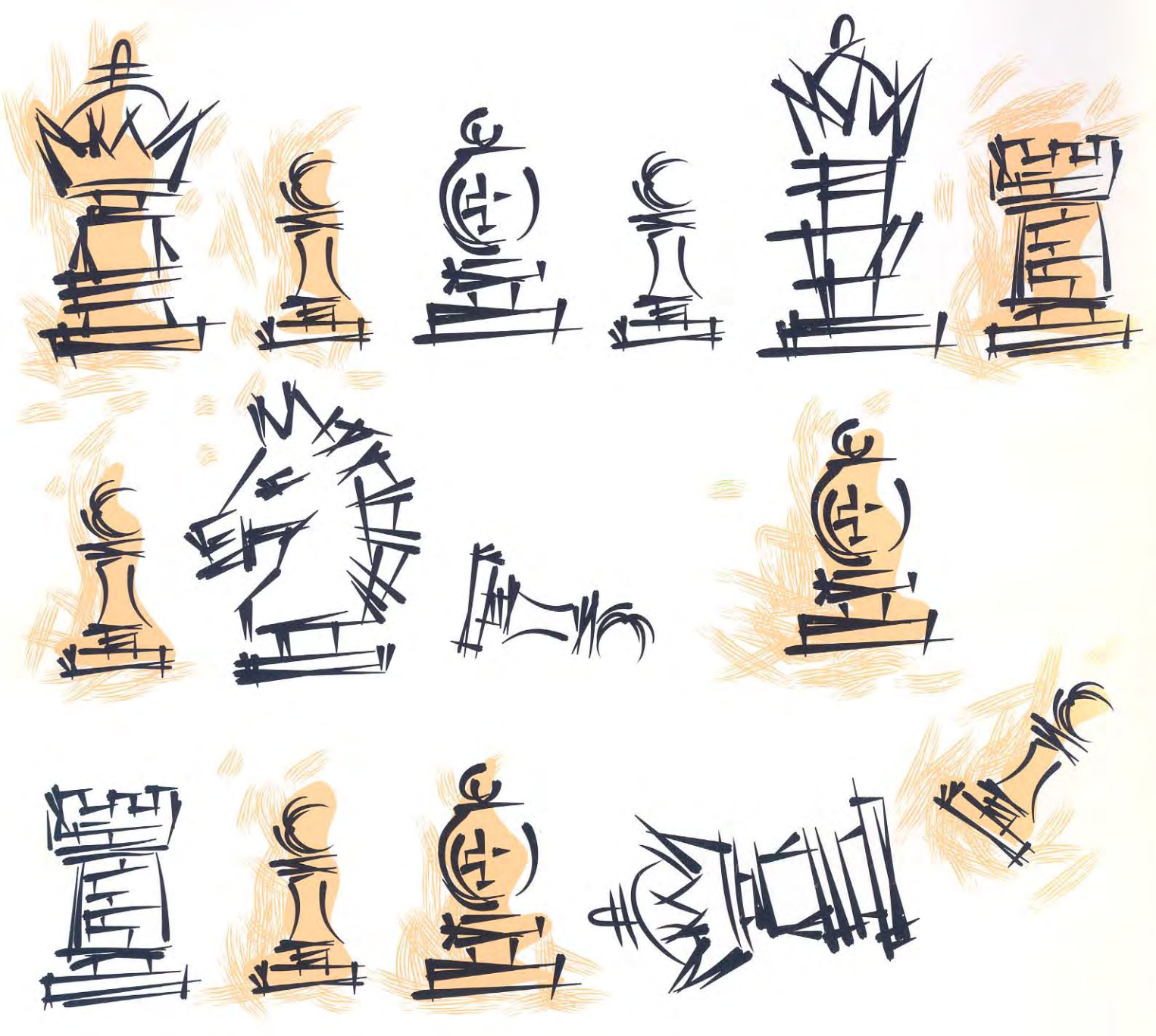Cost : $36 US per year, 24 UK pounds or 60 Dutch florins

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