Chess Software And Its Impact On Chess Players

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ABSTRACT

Computer-aided chess is an important teaching method, as it allows a student to play under every condition possible, and regulates the speed of his/her development at an incremental pace, measured against actual players in the rated chess community. It is also relatively inexpensive, and pervasive, and allows players to match themselves against competitors from across the world. The learning process extends beyond games, as interactive software has shown; it teaches several skills, such as opening, strategy, tactics, and chess-problem solving. Furthermore, current applications allow chess players to establish rankings via online chess tournaments, meet international grandmasters, and have access to training tools based on strategies from chess masters. Using 250 chess software packages, this research classifies them into distinct categories based mainly on the Gobet and Jansen's organization of the chess knowledge [4]. This is followed by extensive discussion that analyzes these training tools, in order to identify the best training techniques available building on a research on human computer interaction, cognitive psychology, and chess theory.

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Introduction

If learning chess were that easy, everybody would be good.

– Dan Heisman

Though chess exact origins are unknown, scholars believe that its history dates to the seventh century. Chess is a mental game that requires a keen mental acuity; a successful player is able to quickly assess and analyze both the current situation and future permutations of his and his opponent's options. Now a universal game, it is taught in many public schools, including those in Iceland, Russia, and Venezuela [1].

The World Chess Federation, FIDE (Fédération Internationale des Échecs) rates a player's ability, according to "the history of a player's performance — and a statistical prediction of his/her near-future performance among other players in the same rating community," [2] which is re-assessed after a player participates in a rated chess tournament. The highest achievement is the title of grandmaster. Slightly lower, is International Master. While still lower, is FIDE Master — a title awarded when a player earns a 2300 rating or higher through tournaments administered by the FIDE.

In 1958, the chess legend Bobby Fischer earned the title grandmaster at the age of 15, marking the youngest grandmaster in the history's rankings. This was especially significant, as teenage grandmasters were extremely uncommon at the time. In 1991, Judit Polgar broke the record of Fischer by roughly one month. From there, the record was broken several times. In 2002, Surgey Karjakin became the youngest chess grandmaster at only 12 years, 7 months. It is not only that it became common to see teenage grandmasters, but there is also a notable increase on the average ratings of the

top100 players in the World according to the statistics of the World Chess Federation (Table I).

Why did such young players begin to dominate the upper echelon of chess? Why are the average ratings of the top 100 players in the world increasing year after year? We believe that the Internet, chess computers and advanced software packages contributed to both the popularity of chess and its players' rapid improvement. In support of this claim, Jacobs *et al* posit that "[a]ccess to such packages must inevitably speed up the process by which chess knowledge is gained" [3]. Additionally, such packages offer tools that make learning easy for all types of chess players, from novices to top international grandmasters. Gobet and Jansen [4] "believe that the best way to achieve this [optimizing learning so that key aspects of the position are recognized rapidly, and so that methods are applied efficiently] is by using computer technology to display positions and games, or, even better, to teach concepts". The authors also state that technology not only decreases the time spent in searching games, variants, and the way one chooses to move pieces throughout the game, but also affords one to more easily consider variations and sub-variations of play, which is traditionally taught and realized in one's imagination.

In this research project, we present theory on human computer interaction related to chess player's memories and perceptions, and we discuss how chess software applications can be used as a tool for teaching chess and its accompanying strategies building on a chess theory and the theory we presented on human computer interaction. The discussion is supported by real examples of software packages involved in creating virtual chess environments, classified into different categories based mainly on our understanding to the Gobet and Jansen's chess knowledge organization [4]. To this end, the paper will

sketch a historical background in Chapter 2; review published work regarding computer chess and use the body of work to classify chess into different categories in Chapter 3; present concepts on human computer interaction such as memory, perception, and thinking so that to show where our work fits in computer science research in Chapter 4; review Gobet and Jansen's chess knowledge organization [4] in Chapter 5, which is utilized again in Chapter 6 to classify a group of 250 chess software applications into different categories; Chapter 7 begins with a discussion regarding the use of software as a tool for chess training, thus building on a theory based on human computer interaction, cognitive psychology, and chess theory. Chapter 8 provides conclusions.

TABLE I
AVERAGE CHESS RATING FOR THE TOP 100 PLAYERS FROM JULY 2001 TO APRIL 2008 [5]

Period	Average Rating
Top 100 Players April 2008	2677
Top 100 Players January 2008	2675
Top 100 Players October 2007	2672
Top 100 Players July 2007	2671
Top 100 Players April 2007	2669
Top 100 Players January 2007	2666
Top 100 Players October 2006	2666
Top 100 Players July 2006	2665
Top 100 Players April 2006	2664
Top 100 Players January 2006	2664
Top 100 Players October 2005	2663
Top 100 Players July 2005	2662
Top 100 Players April 2005	2661
Top 100 Players January 2005	2658
Top 100 Players October 2004	2657
Top 100 Players July 2004	2658
Top 100 Players April 2004	2656
Top 100 Players January 2004	2654
Top 100 Players October 2003	2654
Top 100 Players July 2003	2653
Top 100 Players April 2003	2651
Top 100 Players January 2003	2650
Top 100 Players October 2002	2649
Top 100 Players July 2002	2649
Top 100 Players April 2002	2645
Top 100 Players January 2002	2645
Top 100 Players October 2001	2646
Top 100 Players July 2001	2645

- Chapter 2 -

Historical Background [1]

The history of computer chess was first discussed in academia by Claude Shannon, a researcher at MIT and Bell Laboratories who in 1950 was "concerned with the problem of constructing a computing routine or "program" for a modern general purpose computer which will enable it to play chess" [6]. A year later, professor Dietrich Prinz created a simple chess program that served a single purpose: to determine the best move in a situation where checkmate is only two moves removed. In 1958, the chess player and programmer Alex Bernstein wrote a program to function on the IBM 707. It was a simple application — so simple, in fact, that it was easily defeated by a novice chess player, but significant because it was the first fully-automated chess program to be created on a computer. In 1959, the field saw a significant advancement when a group of freshmen at MIT began work on a chess playing program for IBM 7090 that was dependent on the artificial intelligence. Richard GreenBlatt enhanced this work, thus creating the first computer able to competitively play against humans in actual chess tournaments. Though the work was groundbreaking, the ability of the program was average-player strength, at best.

The divergence between the early programmers and the new programmers was simple: the former utilized knowledge-based searches, while the latter added the 'brute force' method in order to calculate millions of possible moves in a very short amount of time. The change in technique was made possible by a move forward in programming

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methodology, but also significant advances in computing power. For instance, in 1977 Ken Thompson and Joe Condon developed a chess program, `Belle`, able to search 16,000 positions per second. At the same time, the programs `KAISSA` and `CHESS` introduced several novel features, among them 'iterative deepening', that is, gradually increasing the search depth. In the mid 1980s, the `Hitech` and `ChipTest` chess computers were developed and they were able to apply the 'brute force' method in the hardware instead of in software, which yielded faster calculation.

The year 1989 saw a leap in ability. The program `Deep Thought` was developed, allowing computers to play at grandmaster level. When used, it regularly defeated grandmasters. Meanwhile, there was an advancement in microcomputers, and `WChess` — a microprocessor-based chess playing program–began to defeat American grandmasters. In 1989, IBM hired the key members of `Deep Thought` to develop a chess program that could defeat the World Champion, Gary Kasparov. In the first trial, Kasparov beat the machine; however, the development team spent the next seven years refining the program. In 1996, the machine was renamed `Deep Blue` and played six games against Kasparov, and though he won by 4–2 (3 wins, 1 loss and 2 draws), Kasparov lost the first match to `Deep Blue`, marking the first time a world champion lost a game to a computer. In the following year, `Deep Blue` defeated Kasparov in a six-game match in Manhattan by 3.5–2.5 (2 wins, 1 loss and 3 draws). Today, chess-playing programs are able to play at the same level as `Deep Blue` and are widely available at low cost.

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[1] The information in Chapter 2 is mainly taken from [7].

- Chapter 3 -

Previous Work

Since Shannon's research [6], computer chess has been an active topic for research and development, yielding various perspectives and solutions. The body of computer chess literature is both sizable and dynamic, the majority of which can be classified in five topics: computer chess methods, chess tutoring, improving and developing chess software and hardware, analysis, and accessibility. The following graphic represents exemplary pieces of chess literature and their corresponding classification. Each category will be expanded upon in the following pages.

TABLE II
CLASSIFICATION OF PUBLICATIONS ON CHESS RESEARCH

Topic	Publications
Computer Chess Methods	[8], [9], [10]
Chess Tutoring	[3], [4], [11], [12], [13]
Improving and Developing Chess Software and Hardware	[7], [14], [15], [16], [17]
Analysis	[18], [19], [20], [21], [22], [23], [24], [25], [26]
Accessibility	[27], [28]

3.1. Computer Chess Methods

Chess programs depend mainly on search methods and to follow strategies defined by the programmer. These chess programs depend mainly on the 'chunking theory', first developed by de Groot in 1965, a researcher who studied chess players of various skills. First, players were asked to look at meaningful chess positions for a certain amount of time and, after the period was over, reconstruct them from memory. As expected, chess

masters were much more accurate in reconstructing the positions than beginners. De Groot then repeated the experiment with the same subjects, but instead placed the pieces on the board at random. Each player's memory was affected in the same way — all players were accurate to roughly the 20% mark. Part of the strength observed within a chess master's ability is his relational ability, which is strengthened by his experience with common chess placement and order. Building on this observation, George and Schaeffer [9] discuss enhancing a chess program in such a way that it will be able to discover and extract an implicit knowledge from grandmaster games that have already been played. The authors describe the design of '**MACH'** (Master Advisor for Chess) as one that depends on a pre-existing knowledge, defined by grandmasters, in order to enhance the performance of the system. Similar to '**MACH'**, Caulifield [8] "examines the use of knowledge in chess by both humans and existing computer programs" and added an implementation to enable "both the chunking of existing master games and also the analysis of the game in progress" [8, *p*. 21] in '**GNU Chess'**, that is, an old computer program for playing chess on Unix computers.

3.2. Chess Tutoring

Recently, chess software application packages, chess computers, and the Internet have made it possible to provide chess tutoring and many other useful services for chess players. The academic response followed suit, as with Jacobs *et al* [3], who attempt to answer questions about the efficacy of these programs, like "What is the best way to manage this tsunami of information without becoming completely bewildered and feeling swamped? How best to use chess-playing software? What is the best way to study middlegames and endgames?" ('endgame' NOT 'end game' is always the spelling found

in the literature). In turn, Garcia *et al* [11] create `'Chess Tutor'`, a web-based solution that brings chess students together to play, all under the remote eyes of a Chess Master. Furthermore, Gobet and Jason [4] build upon their research of teaching tools by showing "how recent findinds [*sic*] in cognitive psychology can be applied to improve techniques of chess training, teaching, and learning". The authors review different ways for chess training and discuss the advantages and the disadvantages of each building on a psychological theory. Baena *et al* [12] "provide [provides] details on the analysis, design and implementation of" a web-based ITS (Intelligent Tutoring System), that is, `'STIA'` (Sistema Tutor en Internet de Ajedrez) which is "a fully implemented Web-based tool developed to provide adaptive guidance and help while learning chess basics". In `'STIA'`, the program uses a pre-defined tutoring strategy, which is compiled by the courses' authors. The student's knowledge is evaluated through a set of problems, and based on that knowledge the student can access level-appropriate chess tutoring resources, thus eliminating extraneous tutoring materials.

3.3. Improving and Developing Chess Software and Hardware

Fogel *et al* [14] made advancements by using an evolutionary algorithm to make a computer program learn how to play chess via playing chess games against itself. This fact is important, as it was one of the first programs that became better as it played more matches, thus building the knowledge base from which is worked. Essentially, "[t]he program learned to evaluate chessboard configurations by using the positions of pieces, material and positional values, and neural networks to access specific sections of the chessboard" [14]. The next major leap in interactive, online chess-playing applications was in 1992, when a Carnegie Melon professor Danny Sleator discovered the

'Internet Chess Club' (ICC) [29], which became one of the most famous places to play chess on the Internet. The ICC not only hosts tournaments, but also lessons, lectures, and grandmaster-grandmaster matches. Black *et al* [15] showed the security problems in the security protocol that occur during the communication between the ICC server and the users.

3.4. Analysis

Some researchers focused on the inherent worth, or value, of the chess moves themselves, thus rating each in relation to the board. For instance, a former World Champion, Bobby Fischer, accused Gary Kasparov and Anatoly Karpov of prearranging the moves in their games in 1985 World Chess Championship before. In academic research, Segal employs embedded finite Markov chains as a way to observe the "run of particular moves" [22, *p.* 98], and also demonstrates how chess programs and searching game databases can be used to pass judgment on this problem. A Markov chain is defined as a "collection of random variables $\{X_t\}$ (where the index t runs through 0, 1, …) having the property that, given the present, the future is conditionally independent of the past" [30]. The chess program 'Fritz', capable of playing at a world class level was used to make judgments on the moves, as it gives a score for each move. Game databases were used to search for games based on certain parameters.

In a similar, yet different vein, Harreveld *et al* [20] study the psychological effect that the game and its balance of power exerted on players, the end goal of which is to discover the effect, if any, it has on play. They "study the effect of time pressure on expert chess performance in order to test the hypothesis that compared to weak players, strong players depend relatively heavily on fast processes," such as pattern recognition of meaningful

patterns. The authors perform two studies. In the first study, they examine the effect of time pressure on the performance of a group of chess players of different strength levels on the online chess server. In the second study, they examine the effect of fast and slow time controls on the performance of chess players in world championship matches. According to the authors, the "data suggests that once players are forced to play faster, their ability during regular play under normal time controls becomes less predictive of their performance" [20, *p*. 595]. Levene and Bar-Ilan [21] analyze chess positions using statistics from two opening books: one compiled from human games, the other compiled from games played by machines. The intention of this research was to examine the moves made in human games and moves made in machine versus machine games. The authors show that there was a strong association between both types of moves when using a book as guidance for the move choices. Guid and Bratko [18] attempt to compare chess players who lived in different eras based on an evaluation of a chess-playing program of the games played during their world championships. The "analysis also takes into account the differences in players' styles to account for the fact that calm positional players have in their typical games less chance to commit gross tactical errors than aggressive tactical players" [18, *p*. 65].

3.5. Accessibility

Computer Accessibility is a term used to describe "access to interactive computer-based systems by people with disabilities" [27, *p*. 1]. "Although there is no single universally accepted classification," [27, *p*. 2] there are many types of disabilities such as motor impairments, vision impairments, hearing impairments, and cognitive impairments. 'UA-Chess' is a fully functional web-based chess game that is designed to be concurrently

played between users either offline on the same computer or on the Internet including people with disabilities [27]. Grammenos *et al* [27] describe a software implementation of 'UA-Chess' and "discuss [discusses] how accessibility is supported in UA-Chess for different user categories through the game's interface, its adaptation capabilities and the available alternative input and output modalities". Storey [28] "offers [offer] guidelines for teachers who wish to teach beginning chess skills to students with disabilities." For example, the author considers "[u]sing a [v]ariety of [i]nstructional [m]odalities" such as software and chess computers that "offer an assortment of instructional methodologies for teaching chess skills based on student interest and learning strategies" [28, *p.* 46].

- Chapter 4 -

Where is Computer Science Work Relevant?

Human computer interaction (HCI) is an area of research that studies the interaction between the user and the computer. The Association for Computing Machinery defines the HCI as "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" [31]. As an intersection between many areas of research, such as computer science, cognitive psychology, and the social sciences, HCI is an amalgamation of sub-disciplines, assembled to tackle an elusive topic: the inner workings of cognitive thought and learning. HCI seeks to use "experimental laboratory methods that externalize as much of the mental behavior as possible and analytical methods based on representations of the system's functioning and the user's underlying mental processes" [32, *p.* 260]. Analytical methods "are based on theories of the interaction, including how computer systems work; how computer users perceive, remember, plan and act; and how humans' cognitive strengths and limitations affect their behavior with the system" [32, *p.* 260]. To this end, HCI research not only focuses on the best teaching techniques, but also the best human machine interface, via programming methodology. It is very important to design computer applications that are easy to be used and learned by end-users.

Human Memory is an important aspect of the game, given that many complex computations need to be made very quickly, the results of which must be analyzed against each other. Memory itself is a complex cognitive system that consists of several components the most important of which are Sensory Information Storage (SIS), short-

term memory (STM) and long-term memory (LTM). The first (SIS) is a buffer for holding the sensory image for a very short amount of time after it is received so that the brain can process the sensory event for longer time than the time of the event itself. In STM, the information is held temporarily for a short period of time for processing which includes "judgments concerning meaning, relevance, and significance, as well as the mental actions necessary to integrate selected portions of the information into long-term memory" [33, *p.* 18]. The STM is characterized by its direct access and retrieval of the stored information; while its main limitation lies in its storage capacity, which is a physiological issue. Rehearsal can be used to keep the information in the STM for a short period of time; however, it is impossible to add new items during the process of rehearsal. While it is quick to retrieve the information from the STM, retrieving and processing the information from the LTM is sometimes difficult. LTM is characterized by its ability to store large amounts of information. There are mental processes to decide what information is passed from SIS into STM and from STM into LTM, and how to search the LTM and assess the relevance of the retrieved information.

The brain consists of many different types of cells of which the most involved in learning are neurons and glial cells [34]. The neuron is a nerve cell that consists of the cell body, the dendrites, and the axon. Dendrites are located at the top of the neuron and they are the locations from which the information enters the cell body of the neuron. Messages can be sent to other neurons via the axon through the space between them (synapse). Learning occurs when two neurons communicate with each other in this way; in actuality a thought stimulates thousands of neurons at a time. The larger, biological neural network consists of a chain of neurons, which are interconnected in the human brain. The connections

between the neurons get stronger, as they are used more frequently. To support such active electro-neural activity, glial cells are used to nourish and support the neurons.

To take full advantage of human brain chemistry, memorization techniques have been created and refined over the years. For example, a schema is a concept used for memory organization, defined as "any pattern of relationships among data stored in memory" [33, *p.* 22]. Schema "shows that how knowledge is connected in memory is critically important in determining what information is retrieved in response to any stimulus and how that information is used in reasoning" [33, *p.* 22]. We can imagine the schemata (plural of schema) as concepts that are interconnected by relationships between them. The content of schemata is a main measurement for the analytical ability for that person. For example, the chess master has many schemata in his mind that enables him to perceive chess patterns via pattern recognition that are undetected by the average player, which is one of the reasons that a grandmaster is much more likely to make successful, strong moves more quickly than a beginner.
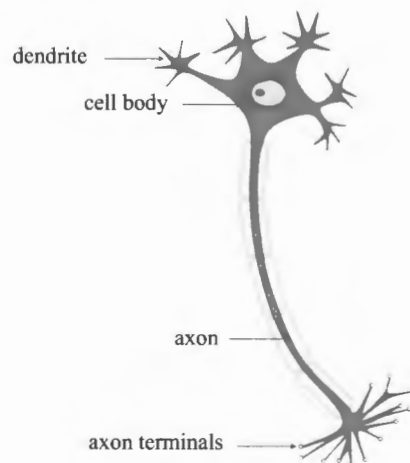
Figure 4-1: Neuron [35]

The following points are key findings on chess expertise summarized by Gobet and Jansen [4, *p.* 3]:

1. Chess players have a highly efficient mode of (high-level) perception. They can access the key elements of a position rapidly.
2. Chess players show a remarkable memory for chess positions and games. This ability typically does not extend beyond chess.
3. Chess knowledge is encoded at several levels, in particular at a low, *perceptual level*, where patterns of pieces are stored, and at a high, *conceptual level*, where information about plans, evaluation, etc., is stored. These various types of encoding, with rich indexing and a high level of cross-referencing, account for chess players' excellent professional memory.
4. Chess players search highly selectively. It is rare that they analyze more than one hundred positions in the search tree before choosing a move.
5. There is no difference between the search algorithm of class A players (ELO 1800–2000) and that of Grandmasters.
6. Masters lose relatively little of their skill when they play simultaneous games or speed chess.

The template theory postulates that human cognitive system consists of three modules: a visuo-spatial imagery system, a short-term memory, and a long-term memory [4]. The visuo-spatial imagery system describes the ability of the user to visually perceive the spatial relationships between the objects in the space. LTM consists of "structures indexing the information and the information itself" [4, *p.* 4]. It consists of "declarative knowledge" "encoded as schemata" and "procedural knowledge" "encoded as productions" [4, *p.* 4]. The declarative knowledge "states relations between concepts" and the procedural knowledge "encodes action(s) to carry out given a set of conditions" [4, *p.* 7]. Productions can be defined as "knowledge units made up from a set of conditions and actions" [4, *p.* 5]. For instance, "IF you have a passed Pawn X" (condition), "THEN push X" (action) [4, *p.* 5]. Productions allow chess players to use what they call it 'intuition' when they choose their moves [4, *p.* 5]. For example, in Figure 4-2 chess experts will choose Qh8+ move as shown in Figure 4-3 (b) since it leads to checkmate. Figure 4-3

illustrates the series of moves after the white chooses Qh8+ leading to checkmating the Black's king. 'Chunks' are the main blocks of knowledge defined as "the key features of a position indicating a combination or a strategic theme" [4, *p.* 14]. When the chess player is familiar with a position, templates (large chunks) are activated; these templates are described as "patterns of the chess board found in familiar openings and lines of play" whose function is to "specify the locations of perhaps a dozen pieces in the position" [36, *p.* 40]. According to the Chunking Model, the skill of the chess player is based on two factors: first, the ability to search in the tree of moves for a strong move (whose success is rated against the subsequent moves derived from it), and second, the ability to recognize chess positions quickly and to discover the strong moves [36, *p.* 4]. The recognition of chess positions through pattern recognition saves the time searching for the best move, which is important in play, given the limited time available and the number of relevant permutations through the game. When a chess master encounters a chess position over the board, he recognizes the familiar patterns of pieces as chunks and a pointer will be placed in the STM for these chunks; since a chess master typically has a huge quantity of large chunks in his LTM, he is able to detect and make strong moves based on the positions he sees on the chess board [36, *p.* 5].

Figure 4-2: Production Example
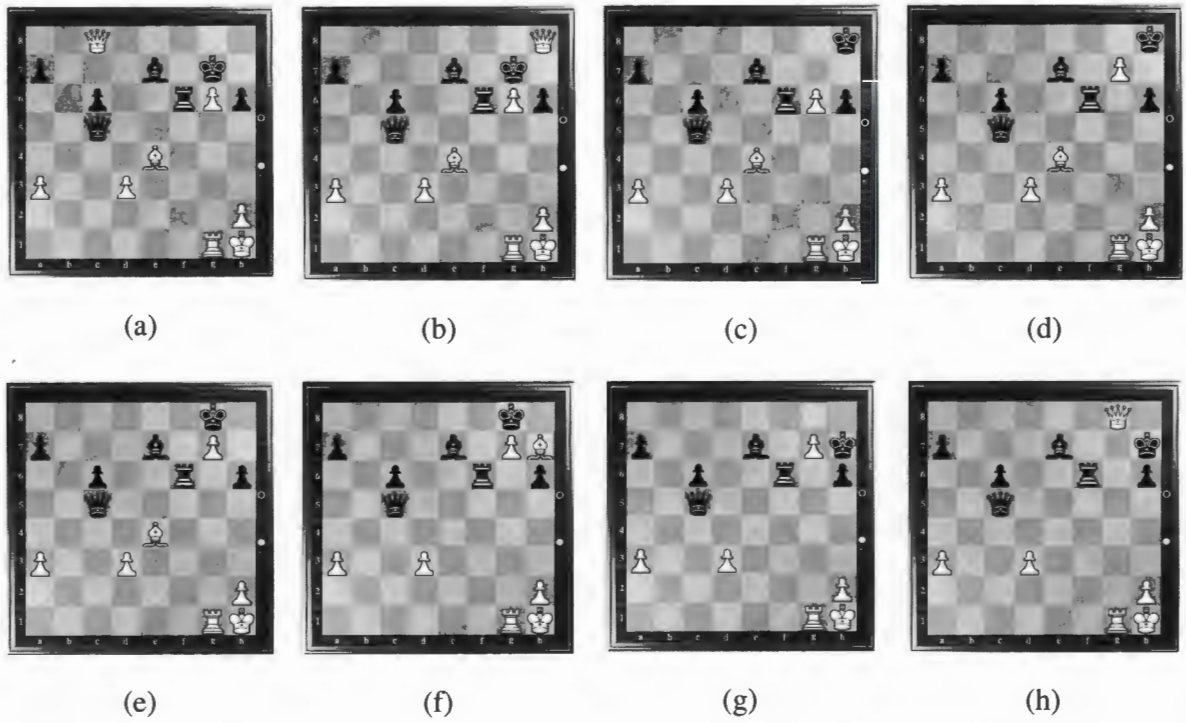
(a)   (b)   (c)   (d)

(e)   (f)   (g)   (h)

Figure 4-3: Illustrative example of productions showing how Qh8+ leads to checkmate
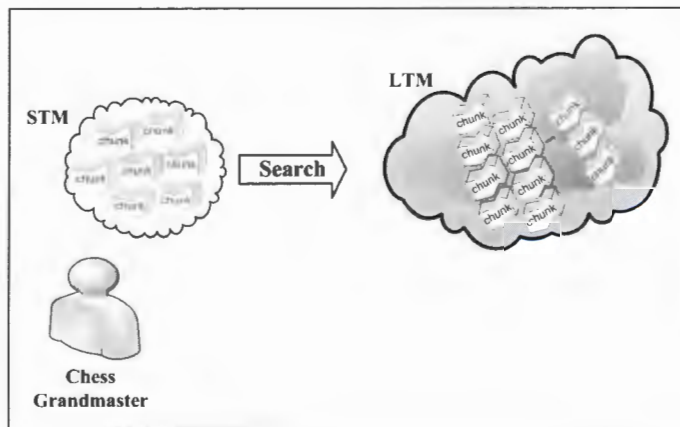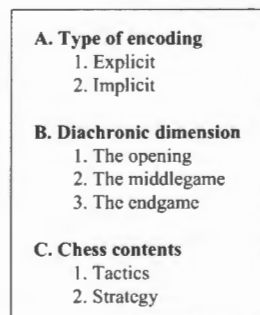

Figure 4-4: Searching for a good move in a grandmaster's memory

- Chapter 5 -

Overview of Gobet and Jansen's Chess Knowledge Organization

Gobet and Jansen [4] "employ the conceptual framework offered by the template theory to review various chess training techniques" the organization of which is found directly below (Figure 5-1):

```
A. Type of encoding
    1. Explicit
    2. Implicit

B. Diachronic dimension
    1. The opening
    2. The middlegame
    3. The endgame

C. Chess contents
    1. Tactics
    2. Strategy
```

Figure 5-1: Gobet and Jansen's organization of the chess knowledge [4]

In the next section, the Gobet and Jansen's chess knowledge organization is reviewed, in the order presented in Figure 5-1.

5.1. Type of Knowledge

The authors "propose [proposed] that (chess) knowledge is encoded with one of two types of data structures: *declarative*, which states relations between concepts, and *procedural*, which encodes action(s) to carry out given a set of conditions" [4, *p.* 7]. While part of each is comprised of explicit knowledge, both types are dominated by implicit knowledge. Examples of the former are easier to come by, described by the authors as "the theory of openings," "the theory of endgames, and by various types of methods to apply in particular types of positions" [4, *p.* 8]. Implicit knowledge, however, is harder to describe because "players are themselves unaware of the details of its

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encoding" [4, *p*. 10]. This is not to say that it cannot be described, but rather that the way that players utilize this type of knowledge is largely a function of subconscious processes.

5.2. Diachronic Dimension

The chess match can be divided into three parts: chess opening, middle game, and endgame. This division is theoretical, as it is actually quite difficult to draw a line between the three stages.

A chess opening is a set of moves played at the beginning of the game, the aim of which is to develop pieces and gain control of the board's centre. Of course, there are hundreds of standard openings and variations. Figure 5-2 (a) shows one of the most famous traditional openings, Italian Game. Figure 5-2 (b) shows Italian Game — Evans Gambit as an attempt to achieve rapid development and control of the centre at a cost of pawn.

Figure 5-2: (a) Italian Game (b) Italian Game — Evans Gambit

The middle game is the part of a chess game that follows the opening and comes before the endgame. It is after each player develops his own pieces. The middle game phase has many more variations than the opening phase, and that makes studying the middle game harder than studying the opening.

Figure 5-3: Middle game position after move 19 taken from Kasparov (White) vs. Anand (Black)

Game in PCA World Championship, Round 10, 1995 [37]

The endgame is the stage that follows the middle game and it is usually when there are few pieces left on the board. There are many types of endgames such as Pawn endgames, Rook endgames, Queen endgames, and general endgames.

Figure 5-4: Endgame position taken from Karpov (White) vs. Anand (Black) Game in FIDE World

Championship, Round 1, Switzerland, 1998 [37]

5.3. Chess Contents (Strategy and Tactics)

In chess, 'strategy' refers to long-term plans achieved via proper development of the chess pieces in which the whole set of problems to checkmate the opponent's king are to be addressed and solved. Methods called 'tactics' are short-term plans that either lead to checkmate or result in a tangible gain are used as tools to solve such big problems.

- Chapter 6 -

Chess Software Applications Classification

6.1. Chess Software Applications Data

Chess software applications are diverse, providing many services for chess players, coaches and tournament organizers. Using chess software applications allows chess players to test their chess skills via playing against human and computer opponents, solve chess problems, play in rated tournaments, analyze their games, ask the computer for advice, and have access to chess databases, among other things. In this research, the software applications used were obtained from Wholesale Chess [38] — a highly praised website. Wholesale Chess provides a description for each of the software applications. In order to simply search processes for future researchers, chess software was organized and categorized. All the software applications available on Wholesale Chess website were retrieved on December 13, 2007 and are listed in Appendix A.

6.2. Classification Methodology

The classification of the chess software applications listed in Appendix A is mainly based on the relevance to the Gobet and Jansen's chess knowledge organization [4], overviewed in Chapter 5. Chess categories also came out from the extensive review of chess theory and the author's chess experience.

a. First, chess applications were divided into the following categories: openings, middle games, endgames, chess-playing programs, strategy and tactics, chess attack, game study, chess problems (puzzles) and game databases.

b. Next, openings, middle games, endgames, strategy and tactics, chess attack, game study, and chess problems (puzzles) were grouped in one group called 'chess tutoring'.

c. Game databases, and chess-playing programs were separated into two distinct groups.

d. We started assigning software applications in Appendix A into the three groups (chess tutoring, game databases, and chess-playing programs) according to our best knowledge based on the description provided by Wholesale Chess. Two applications did not fit into one of the three groups (software 55 and software 66). So, 'tournament organization' group was added (fourth group) (See table III).

TABLE III
CLASSIFICATION OF CHESS SOFTWARE APPLICATIONS IN APPENDIX A

Category	Software
Chess Tutoring	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 42, 43, 44, 45, 46, 47, 48, 50, 51, 52, 53, 54, 56, 57, 58, 59, 60, 62, 64, 65, 66, 67, 68, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 181, 183, 184, 185, 186, 187, 188, 190, 191, 192, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 209, 210, 211, 212, 213, 214, 215, 216, 217, 219, 220, 222, 224, 225, 226, 227, 228, 230, 231, 232, 234, 235, 236, 237, 238, 239, 242, 243, 244, 245, 246, 249, 250
Databases	2, 3, 7, 9, 10, 11, 16, 17, 18, 27, 31, 34, 35, 48, 53, 56, 57, 58, 59, 64, 65, 66, 68, 72, 86, 88, 91, 92, 94, 95, 96, 98, 99, 100, 101, 103, 104, 105, 106, 107, 108, 109, 110, 112, 115, 117, 118, 119, 122, 123, 124, 125, 127, 128, 130, 131, 132, 134, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 152, 167, 168, 179, 180, 203, 204, 207, 216, 218, 221, 226, 228, 233, 246, 248, 249
Chess Playing Software	8, 25, 30, 40, 41, 48, 49, 63, 69, 94, 111, 153, 181, 182, 187, 189, 192, 193, 194, 196, 208, 214, 220, 221, 222, 223, 229, 240, 241, 247
Tournament Organization	55, 61

Table III shows the classification of the 250 applications. Chess tutoring applications can be used to train chess players on many chess aspects such as openings, middle games, endgames, game study, strategy and tactics, basics, attack and exercises. Table IV shows the further classification of chess tutoring applications.

TABLE IV
CLASSIFICATION OF CHESS TUTORING APPLICATIONS [2]

Category	Software
Openings	1, 2, 3, 12, 13, 14, 15, 16, 17, 19, 20, 24, 26, 27, 29, 31, 33, 34, 35, 42, 43, 45, 47, 51, 52, 53, 56, 57, 58, 60, 64, 66, 68, 77, 90, 94, 95, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 112, 119, 120, 121, 123, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 157, 158, 162, 163, 165, 166, 167, 169, 170, 171, 172, 173, 174, 178, 181, 184, 185, 186, 187, 190, 191, 192, 194, 195, 196, 197, 198, 199, 200, 201, 202, 206, 207, 210, 211, 212, 213, 214, 216, 217, 222, 224, 225, 226, 228, 230, 231, 232, 235, 237, 238, 242, 244, 245, 246
Middle games	1, 26, 29, 37, 46, 57, 71, 73, 74, 75, 76, 77, 78, 79, 90, 102, 103, 137, 157, 158, 165, 197, 209, 222, 227, 242
Endgames	1, 9, 11, 18, 21, 28, 44, 48, 57, 70, 79, 81, 88, 89, 90, 97, 102, 103, 116, 118, 126, 155, 159, 160, 161, 175, 184, 188, 197, 203, 215, 219, 222, 232, 234, 236, 242, 244, 250
Game study	7, 9, 11, 12, 13, 14, 15, 16, 17, 19, 26, 27, 29, 31, 33, 34, 35, 37, 39, 43, 44, 48, 51, 53, 54, 56, 57, 58, 59, 60, 62, 64, 65, 66, 68, 72, 77, 78, 79, 86, 87, 90, 91, 92, 94, 95, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 112, 113, 115, 117, 118, 119, 120, 122, 123, 124, 125, 126, 127, 128, 130, 131, 132, 134, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 158, 160, 165, 167, 168, 178, 185, 186, 187, 203, 204, 205, 207, 216, 220, 224, 225, 226, 228, 231, 232, 242, 245, 246
Strategy and tactics	4, 11, 21, 23, 30, 32, 36, 50, 76, 77, 78, 79, 80, 82, 83, 84, 85, 86, 87, 93, 96, 102, 103, 114, 116, 121, 124, 128, 138, 154, 155, 156, 161, 163, 164, 166, 167, 174, 176, 177, 183, 184, 185, 186, 197, 200, 210, 215, 219, 220, 222, 227, 235, 242, 243, 249
Basics	4, 21, 30, 153, 183, 187, 220, 222, 243
Exercises	4, 5, 6, 17, 21, 22, 23, 24, 26, 27, 29, 31, 32, 36, 37, 38, 42, 43, 44, 46, 50, 53, 59, 60, 64, 65, 66, 67, 71, 75, 79, 80, 81, 82, 83, 84, 85, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 112, 114, 115, 116, 118, 119, 121, 122, 123, 126, 128, 130, 132, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 145, 146, 147, 148, 149, 150, 151, 152, 154, 155, 156, 157, 158, 159, 160, 162, 165, 166, 167, 176, 177, 183, 190, 217, 226, 236, 239, 242, 243, 249
Chess attack	38, 67, 73, 74, 83, 116, 123, 148, 154, 176, 177, 184, 185, 186, 187, 197, 217, 226, 230, 235, 242

[2] Assigning software applications to the groups in the table is to the best of our knowledge based on the description provided by Wholesale Chess.

In summary, as has been demonstrated, a group of 250 distinct chess software applications was classified into four categories: chess tutoring, game databases, chess playing software, and tournament organization. Chess tutoring is the largest group, and it includes software applications that cover openings, middle games, endgames, game study, strategy and tactics, basics, exercises and chess attack. Although the classification was mainly based on Gobet and Jansen's chess knowledge organization [4], the categories came also from extensive review of chess literature and the chess experience of the author.

- Chapter 7 -

Chess Training Using Chess Software

As a matter of fact, the fight for initiative is the basic law of the chess game!

–Vlastimil Hort

Using chess software offers chess training in many ways. This section discusses some ways in which chess software can be used to teach many chess skills.

7.1. The Chess Opening

Play the opening like a book, the middle game like a magician, and the endgame like a machine.

– Rudolf Spielmann

Chess opening books can be thought of as databases that contain every relevant possible opening move. Such books are of a worthwhile value, especially if one is to commit the most valuable moves to memory. 'ChessBase' is one of the most famous of these applications. It (from version 7 onwards) has an opening report function, that is, a 'comprehensive account' "generated on any critical position in a specific opening, using the games in the reference database" [3, *p.* 36]. The report includes useful information, such as the games that have been played using certain types of opening, main lines of that opening, players who played this opening, their ratings and the percentage of their success, and moves and plans for each side [3, *p.* 36–44]. In addition, 'ChessBase' allows chess players to have their own games, which stem from their opening repertoire [3]. Practising openings is very important, as the players get a chance to try their openings in real games, played against either a human or a computer opponent. Gobet

and Jansen [4, *p.* 10] recommend that the chess player should focus on a small set of chess openings that, after mastery, should be expanded and to have "a balance between rote learning and understanding". The student should study chess openings from more than a point of view, such as studying middle games and endgames that stem from certain openings, store the information in a "central filing system" (`ChessBase` can serve for that purpose), and repeat [4, *p.* 11]. The authors also mentioned what they called the "decomposition method", that is, studying and playing the basic endgames stemming from certain opening positions by removing all the pieces from the chessboard (except nights and pawns) and then "gradually adding pieces of various sorts or varying aspects of the pawn structure" [4, *p.* 11]. All chess software applications that we are aware of allow chess players to use this method: the player simply creates the chess position that he desires, and plays against a human or a computer opponent. A good example of this type of software is the `Chessmaster`, which allows players to compete against computer representations of real Grandmasters, such as Anand and Polgar. Each chess player has his openings and the trainer can select the chess player based on the opening he is interested to learn. For example, Grandmaster Adolf Anderssen is an early attacker chess player. The playing style of Anderssen in the `Chessmaster` Grandmaster edition is "the epitome of attacking chess" who "prefers to go after the enemy king, and will generally surprise you with its lively style of play and inventive ideas" [37]. The chess player who is interested in this style of play finds Anderson a suitable and formidable computer opponent, from which he can learn chess openings that lead to an early-attack in the chess game. Grandmaster Chris Ward "emphasizes the need to understand the key elements of each opening rather than simply memorise a series of

complicated variations which leave you stranded if the opponent varies from the expected route" [39]. Grandmaster Josh Waitzkin supports this style of instruction stating that "the most common error that chess teachers and players make is to spend the beginning of their chess lives memorizing opening variations with which they think they can win lots of quick games" [37].

Playing 'blitz' or speedy chess is a very important aspect for the chess player, and there are many free software applications that allow chess players to meet with real people online in speedy chess matches. Jacobs *et al* [3, *p.* 40] recommend playing lots of speedy chess games "in the same opening line in order to build up familiarity". The authors also state that it is "worth briefly going through each game afterwards to identify the critical points in the opening" [3, *p.* 40–41]. To our knowledge, all chess-playing software has the game analysis option. In fact, playing many blitz games is probably a very good way to improve as the player gets exposed to many chess positions in a short amount of time, which in turn, makes him acquire many schemata of chess positions in his mind.

Databases of chess openings taken from grandmaster games are currently available with annotation. Such databases make it easier for the chess player to find any type of opening for which he is looking. In addition, the user can find the opening he is interested to study in a grandmaster game. For example, the following is part of the description of `Chess Databases DVD'` (software 10) [38]:

> … The database `HugeBase` includes 3,002,000 games from the beginning of the chess history till the 1st of April 2006…. The players' library consists of more than 200,000 chess players with unique names, and more than 50,000 of them are included into the rating list of FIDE. Each game has exhaustive information:

participants, date of the game, place, tournament class, opening index. The database HugeBase in **Chess Assistant** format includes 36,000 commented games.

Chess openings are very important for those who want to play at the highest level. Grandmaster Nigel Short states that "[i]f you want to get to the very highest level, then you have to study openings, there is no question about that, but if you want to reach a certain level in chess, try to study a top player's games" [40, *p*. 44].

By reviewing chess opening applications in Table IV, we can see that the chess software applications in the opening category teach the opening in many ways: games, opening traps, exercises and training, and lectures and videos. Table V shows the four groups.

Table VI shows one example for each of the groups.

TABLE V
CLASSIFICATION OF CHESS OPENING APPLICATIONS [3]

Category	Software
Games	2, 3, 12, 13, 16, 17, 19, 20, 26, 27, 29, 31, 34, 35, 43, 45, 51, 52, 53, 56, 57, 58, 64, 66, 68, 77, 90, 94, 95, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 112, 119, 120, 123, 127, 128, 130, 131, 132, 134, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 158, 163, 165, 166, 167, 169, 170, 171, 172, 173, 174, 178, 185, 187, 197, 207, 210, 214, 216, 222, 225, 226, 228, 231, 232, 242, 246
Opening Traps	24, 42, 90, 103, 138
Exercises and Training	1, 16, 17, 20, 24, 26, 27, 29, 31, 42, 43, 60, 64, 66, 77, 94, 95, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 112, 119, 121, 123, 128, 130, 131, 132, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 145, 146, 147, 148, 149, 150, 151, 152, 157, 158, 162, 165, 166, 167, 190, 197, 217, 226
Lectures and Videos	1, 12, 13, 14, 15, 19, 26, 29, 33, 34, 35, 45, 47, 51, 52, 53, 56, 57, 58, 68, 90, 102, 120, 158, 165, 178, 184, 185, 186, 190, 191, 195, 198, 199, 198, 201, 202, 206, 207, 210, 211, 212, 213, 217, 224, 225, 230, 231, 232, 237, 238, 245

[3] Assigning software applications to the groups in the table is to the best of our knowledge based on the description provided by Wholesale Chess

TABLE VI
EXAMPLES OF SOFTWARE APPLICATIONS FOR TEACHING OPENINGS [38] [4]

Category	Software
Games	`'Trompowsky Attack'` (software 128): The Trompowsky attack, which arises after 1.d4 Nf6, Bg5 has matured into a fullblooded opening. On this CD a repertoire from White's point of view is given. Database texts give you explanations of the important and critical position. Just playing trough some of the key game will enable you to understand the main points of the variation. Apart from that there is a large reference database with over 6,000 games on the CD, as well as a smaller Database with trainings questions.
Opening Traps	`'Encyclopedia of Opening Blunders'` (software 42): Instead of only learning what you must play in the opening, learn what not to play by learning the opening mistakes and traps that have been discovered over time. The chess material was prepared by IM Yaroslav Ulko and IM Aleksey Mitenkov, both of whom are experienced coaches and players in Russia. This program is designed for studying the blunders in different openings (more than 40 openings), so be ready to trap and avoid being trapped with the Encyclopedia of Opening Blunders.
Exercises and Training	`'Modern Chess Openings: 1… Nc6!?'` (software 60): - More than 300 commented instructive examples plus 50 tasks for solving and 5000 additional games - Opening theory worked out and analyzed as well as key positions evaluated - Using the Opening Table mode it is quite convenient to look through the theory and insert either new moves or games - All the work you've made about the opening can be both saved and printed - Languages: English, German, French, Spanish and Italian After studying the program you will better understand and be able to implement methods of play in this opening.
Lectures and Videos	`'Fritz Trainer — The ABC of the Benko Gambit by Andrew Martin'` (Software 14): Martin describes the main themes and ideas of the Gambit and gives sound guide lines, so that any one who wants to play for the initiative with Black and play the Benko Gambit, will be very well equipped. Do you want to play for the initiative with Black? Then the Benko Gambit is surely for you. The DVD contains more than 4 hours video lessons, the latest `ChessBase` 9.0 Reader as well as an unannotated database of the contents.

[4] The entries on the table are either paraphrased or quoted as they are

7.2. Middle Game, Strategy and Tactics

To study opening variations without reference to the strategy that applies to the middle game is, in effect, to separate the head from the body.

– Tigran Petrosian

Chess middle game software applications teach middle games in many ways: games, exercises and training, lectures and videos, traps, and plans and methods for certain

openings (Please refer to Table VII). Table VIII shows one example for each one of those categories.

TABLE VII
CLASSIFICATION OF CHESS MIDDLE GAME APPLICATIONS [5]

Category	Software
Games	37, 77, 79, 90, 102, 103, 158, 165, 197
Tests, exercises and training databases	1, 26, 29, 37, 46, 71, 75, 90, 102, 103, 157, 158, 165
Lectures/Videos	1, 26, 29, 71, 74, 75, 76, 90, 102, 165, 227
Traps	90
Plans and methods for certain openings	1, 26, 29, 46, 77, 102, 157, 158, 165

TABLE VIII
EXAMPLES OF CHESS MIDDLE GAME APPLICATIONS [38] [6]

Category	Software
Games	`The Basic Principles of Chess Strategy Vol. 1` (software 77): A comprehensive introduction to the secrets of chess strategy…. The software covers fast piece development, safety of the king and fighting for the center, learning how to assess positions and how to find promising plans, and pros and cons of all pawn formations.
Tests, exercises and training databases	`The ABC of Chess Middlegames` (software 1): Gary Gauthier explains all the basics themes with the help of selected master games. The games are annotated and explained in a way that makes it possible for even the rank amateur to follow, while graphic commentary enables you to grasp the main ideas at a glance…. The chess player can solve practical positions and get scores for correct answers in a training database. Each chapter has a video clip with an introduction by GM Daniel King.
Lectures/Videos	`Encyclopedia of Middlegame IV` (software 29): Composed by GM Kalinin and it is aimed at teaching a student much of the middlegame methods and intricacies through a theoretical section which includes over 560 games/lectures, each of them illustrating typical plans and methods in certain openings.
Traps	`Winning in 20 moves` (software 90): Lubomir Ftacnik shows typical traps and mistakes in the opening phase in 333 very instructive short games.
Plans and methods for certain openings	`Encyclopedia of Middlegame, Vol. II` (software 102): A program for studying middlegame opening plans and playing techniques. The theoretical section includes over 600 games/lectures, each of them illustrating the popular openings' typical plans and methods.

[5] Assigning software applications to the groups in the table is to the best of our knowledge based on the description provided by Wholesale Chess

[6] The entries on the table are either paraphrased or quoted as they are

The most common way to improve a chess player's ability in a Russian chess school, is through solving chess problems; essentially thinking of complex chess positions and comparing solutions with the original annotations [3, *p.* 119]. This is probably a good way to get a chess player exposed to many chess positions and variations, which in turn, helps him to find good moves in his games through pattern recognition. Additionally, playing with strong computer opponents is an excellent way to improve strategy and tactics in the middle game: numerous software applications are available for this purpose. Jacobs *et al* [3, *p.* 119] suggest some methods for middle game training:

a. … [T]ake some positions which are deeply complicated, set the clock for 15 to 20 minutes, and take good time to work out what is going on. After this, you enter everything you have seen into **ChessBase** and go over your own analysis first with your own eyes. Then take the advanced you (you + computer) and go through the lines again to see if there was anything you missed.

b. … [P]lay attacking or defensive positions against **Fritz** and afterwards analyze the games and see what you missed.

In fact, the chess player can use the '**Chessmaster**' Grandmaster Edition software to play against simulated human opponents each of which is characterized by a certain playing style. For example, a chess player can choose to play against Judit Polgar, whose typical technique is aggressive which can also help the chess player practise his openings in real games against computer opponents, as "most of the strategic education can be gained by building one's own opening repertoire" [4, *p.* 15]. Perhaps most importantly, the software also allows the chess player to analyze the game.

The number of positions in the middle game is much larger than that in the openings and thus the job of the chess player is more difficult. For effectiveness, the chess player should start with positions that stem from his openings' repertoire [4, *p.* 13]. There are software applications that cover plans and methods behind certain types of chess

openings. For example, '`Chess Middle Game Collection: Encyclopedia of Middlegame`' (1–4), is a good example of software to be used for that purpose (software 26). It covers "the theory and practice of the middlegame for each of the openings" and "includes detailed theoretical material for the corresponding openings and variations, positions for solving and special learning positions to play against with the built-in game engine" [38].

7.3. The Endgame

If you want to win at chess, begin with the ending

- Irving Chernev

Chess endgame study is very important as without its "practical skill, you won't be able to realize the opening or middlegame advantage you fought so hard to achieve" [41, *p.* 12].

Chess software applications intended for endgame study teach the endgame strategies in many ways: exercise and training — in which the chess player is exposed to chess puzzles and problems and he is asked to solve them; endgame themes and patterns — such as Pawn endgames and Rook endgames; games and lectures; traps; and endgame studies.

The Danielsen Method is a good way to study the endgames, and is best learned by frequently using a database that has been loaded with endgame positions [3, *p.* 109]. Grandmaster Henrik Danielsen explained "that this would help the brain to adapt patterns and later put them into use via an improved intuition" [3, *p.* 109]. Chess software applications made it easy to use that method, as the chess player can use one of the chess database programs to enter the positions and use that database for repetition later. For

example, Figure 7-1 is an example of an endgame position and the sequence of moves leading to checkmating the black's king.

(a) (b) (c)

(d) (e) (f)
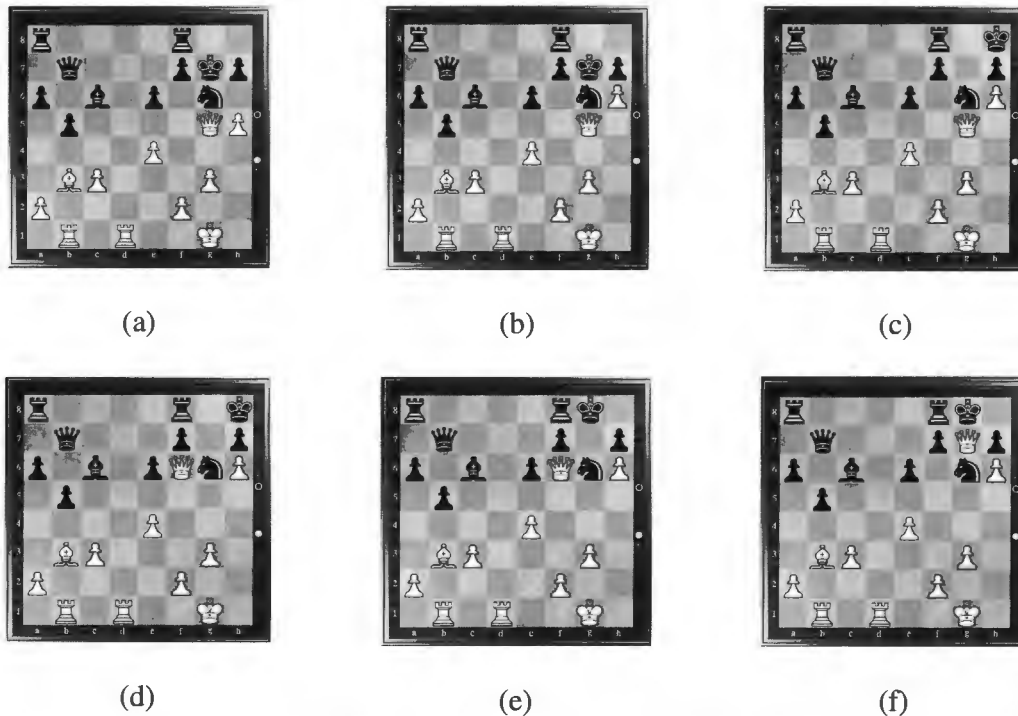
Figure 7-1: Endgame position leads to checkmating the black's king

Besides the Danielsen Method, Gobet and Jansen [4, *p*. 13] propose three lines of study for the endgames:

a. Applying the concept of an improving spiral in which the student starts by acquiring basic knowledge in all domains of endgames with "special emphasis" given "to Pawn and Rook endgames". "It is important to pay attention to *typical positions*, and avoid all arcane knowledge, however exciting it may be. In further cycles, attention should be directed to slightly more complex endgames, with a constant check that knowledge acquired in previous cycles is still there. Only in later cycles of the spiral can you start spending time on more exotic endgames."

b. "… [O]ne should study well-commented endgames played by strong players".

c. "… [O]ne should study typical endgames resulting from the openings belonging to one's repertoire."

We can see that the currently available chess software applications can be used for studying chess endgames according to the study lines proposed above, as the following:

a. The chess player can use `Dvoretsky's Endgame manual for PC'` (software 28) that "covers all of the most important positions required for endgame mastery, from elementary kind-and-pawn [*sic*] endings to complex rook or queen endgames that have baffled even top grandmasters".

b. `'Comprehensive Chess Endings'` (software 97) can be used for studying games as it has "4182 theoretically important games and examples thoroughly analyzed and classified into 500 themes".

c. Studying typical endgames that result from openings stemming from the players' repertoire can be done via using game databases where the chess player can search for certain openings and then study and read the annotations of the games stemming from that opening.

Moreover, "[s]tudying endgame studies with few pieces is probably excellent practice and may help develop imaginative and original ideas, but should come only when the basics on practical endgames have been covered" [4, *p.* 15].

Table IX shows the classification of chess endgame applications into exercises and training, endgame themes and patterns, games and lectures, traps and endgame studies.

TABLE IX
CLASSIFICATION OF CHESS ENDGAME APPLICATIONS [7]

Category	Software
Exercises and Training	44, 79, 81, 88, 89, 97, 102, 103, 118, 126, 155, 160, 203, 222, 236, 250
Endgame themes and patterns	1, 18, 28, 70, 81, 88, 89, 97, 102, 118, 126, 159, 161, 175, 203, 215, 219, 222, 236, 250, 244
Games and lectures	44, 81, 90, 97, 102, 103, 118, 126, 160, 203, 215, 219, 250, 244
Traps	90, 161
Endgame studies	102, 118, 155, 159, 160, 188, 203, 236, 244

[7] Assigning software applications to the groups in the table is to the best of our knowledge based on the description provided by Wholesale Chess

7.4. Tournament organization

If you are in a tournament, you have to think of yourself — you can't think of your wife or children — only about yourself.

– Judit Polgar

In chess there are three types of tournaments: Match Competition, Round Robin, and the Swiss System. In Match Competition, two chess players meet head-to-head and play a pre-determined number of games as in the World Championship matches. In Round Robin play, every chess player plays against every other chess player in that tournament. A chess player receives one point each time he wins, half a point each time he draws a game and zero point when he loses. The Swiss System is the most common system used in chess tournaments. In the Swiss system, a chess player is paired with stronger opponents in the successive rounds, as long as he continues to win games. In the Swiss system chess players are paired according to the following rules [42, *p*. 26]:

a. The chess player is not paired with the same player twice in the same tournament.

b. To the possible extent, players with the same number of points are paired together.

c. Colours for each are selected by the director as fairly as possible.

At the beginning of the tournament, chess players are sorted in a list based on their rankings (or alphabetically if not ranked). The list is then divided into two halves, and the pairing is done as the following: the first player on the first half plays the first player on the second half; the second player on the first half plays the second player on the next half and so on. After the first round, every player gets one point for winning a game, half a point for drawing a game, and zero point for losing. On the successive rounds, chess players are matched against others with similar point totals.

Some chess software applications are intended to manage tournaments. For example, `WinTD Chess Tournament Pairing Management Software'` (software 55) provides "[o]perations such as pairing rounds, entering game results, and printing charts" [38]. Moreover, it gives "a great deal of control over all aspects of the pairing process, including drop/raise decisions, interchanges of players to improve color assignments, and more" [38].

7.5. Game Databases

You learn what to do from studying GM games; and what you've been doing wrong —
and thus what to correct — from studying your own games.

– Kelly Atkins

Chess database programs, such as `ChessBase'`, allow users to enter games in a database, view them, classify each, and write notes. In Grandmaster John Emms's opinion, "they are at least partly responsible for the growing number of young world-class players" [3, *p.* 8]. In addition, using chess database programs is a good way for a

student to study and analyze his own games. For example, using 'Fritz', the player can have a chess engine running on the background to point to the obvious tactical mistakes, and 'Fritz' can perform a blunder check by looking to the moves and notes and suggest to both sides other moves if it believes they are stronger [3, *p.* 9]. In addition, 'Fritz' can tell if there are mistakes in the moves and offer guidance based on that [3, *p.* 13]. One point to mention here, is that 'Fritz' may pass easily over a critical position, especially if there is not enough time allocated for 'Fritz' to analyze [3, *p.* 13].

In 'ChessBase', games can be classified by opening moves; this, in turn, makes it easier for the chess player to study the games stemming from certain types of openings [3, *p.* 13]. Large databases allow the chess player to study different opening variations so that he gets familiar with many possibilities and can compare the openings played by different players. Commercial offerings include 'Big Database' (software 180) and 'Mega Database' (software 179). The following is part of the description of 'Mega Database' [38]:

> The exclusive annotated database. Contains more than 3.75 millions games from 1560 to 2007 in the highest ChessBase quality standard. 61,000 games contain commentary from top players, with ChessBase opening classification with more than 100,000 key positions, direct access to players, tournaments, middlegame themes, endgames. The largest topclass annotated database in the world. The most recent games of the database are from the middle of November 2007.

Chess database files come in certain formats the most important of which are CBH ('ChessBase' format) and PGN (Portable Game Notation). CBH format consists of many separate files, the most important of which is .cbh. The PGN is a text file format that can be virtually read by any software, text editor and word processor.

7.6. Chess playing programs

Live, lose, and learn — by observing your opponent — how to win.

– Amber Steenbok

Chess playing programs are widely available at low cost and can be used by chess players of all levels. Such programs not only allow chess players to play against human or computer opponents, but they also provide useful services, including hints, analyzing games, opening training, and having access to game archives. Some software applications allow chess players to play online against other players, live. A chess player can use these applications for playing different types of chess, such as speed chess. Although the chess player loses part of his chess ability during the speed chess games, playing speed chess is probably a good way to improve the chess player's performance. In support of that, this chapter concludes with some questions taken from an interview with Alex Lenderman, the World Under-16 Champion in 2005 [43]:

Question: How often do you work on chess and what materials do you use when you do?

Alex: I don't really work that much on chess. I play in many over-the-board tournaments and also a lot of on-line blitz.

Question: What about individual work and study?

Alex: Well, only when I want to research an opening, I will look it up.

Question: I noticed you play a lot of chess on-line, when you also play a lot of over-the-board chess. How come?

Alex: Well, playing online allows you to try out lines and pick up ideas for openings you could later apply in tournament chess, so it helps.

- Chapter 8 -

Summaries and Conclusions

In this project, we reviewed research in the area of computer chess, and presented theory in human computer interaction related to chess players' memories and perceptions. We also discussed how chess software can be used as a tool for chess training purposes building on this theory and chess theory. Furthermore, we classified the chess software application packages available on Wholesale Chess into different categories based mainly on our understanding to the Gobet and Jansen's chess knowledge organization [4], as follows: chess tutoring, databases, chess playing programs and tournament organization software. Chess tutoring applications include software applications intended to teach chess players many skills including openings, middle game, endgame, strategy and tactics, chess attack and basics in many ways such as game study and chess exercises. Databases are software packages that include millions of chess games and provide many services for chess players and coaches such as searching, classification and storing game information.

The significance of this work is that it takes 250 distinct chess software applications as a large body of information, and synthesizes it in such a way that makes it useful for researchers, and uses that to support the discussion on how chess software can be used as a tool for chess-training building on human computer interaction, cognitive psychology and chess theory. This project can be used as a starting point for computer science researchers from many areas including network security, human computer interaction,

computer-aided learning, and artificial intelligence interested in doing research in computer chess in many ways, as it shows the latest trends in chess software, reviews research articles in different areas in the computer chess field, and discusses how chess software can be used as a tool for training chess players. For instance, computer-aided learning researchers can build on our classification of chess software applications to design chess software to be used for training chess players on many chess skills and teach them chess concepts. Furthermore, designing chess software can be based on concepts related to chess players' memories and perceptions to maximize the benefit for a chess player. Similarly, HCI researchers can conduct further research on Section 3.5 on accessibility to design chess software applications to teach people with disabilities different chess skills and concepts. We reviewed research related to improving and developing chess programs in Section 3.3 including the security issues in the ICC which can be further researched to improve chess servers such as the `**Free Internet Chess Server**' (FICS) and the `**Internet Chess Club**' (ICC). In short, we hope that readers find this work useful.

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Appendix A

1. ABC OF CHESS OPENING, MIDDLEGAME & ENDGAME - COMBO

2. CHESS ASSISTANT 9 - PROFESSIONAL PACKAGE (2 DISCS)

3. CHESS ASSISTANT 9 - STARTER PACKAGE

4. CHESS MENTOR 3 - BASIC EDITION

5. CHESS MENTOR 3 - COMPREHENSIVE EDITION

6. CHESS MENTOR 3 - SCHOLASTIC EDITION

7. SIX WORLD CHAMPIONS

8. ZAP!CHESS - WORLD COMPUTER CHESS CHAMPION

9. ADVANCED CHESS DATA

10. CHESS DATABASES

11. CHESSBASE MONOGRAPH: WORLD CHAMPION CAPABLANCA

12. FRITZ TRAINER OPENING: MY BEST GAMES IN THE SICILIAN-NAJDORF (ALEXEI SHIROV)

13. FRITZ TRAINER OPENING: MY BEST GAMES IN THE SICILIAN (ALEXEI SHIROV)

14. FRITZ TRAINER - THE ABC OF THE BENKO GAMBIT (ANDREW MARTIN)

15. FRITZ TRAINER OPENING: MY BEST GAMES IN THE SPANISH (ALEXEI SHIROV)

16. SICILIAN ALAPIN SYSTEM

17. AN OPENING REPERTOIRE FOR BLACK

18. ENDGAME TURBO 3 ON DVD - NALIMOV TABLEBASES

19. MR. KASPAROV - HOW TO PLAY THE NAJDORF (VOLUME 2)

20. OPENING INSTRUCTOR

21. POCKET CHESS BASICS

22. POCKET CHESS COMBINATIONS

23. POCKET TACTICS FOR BEGINNERS

24. 1000 OPENING TRAPS

25. CHESS CHAMP 3D SOFTWARE FOR PC

26. CHESS MIDDLEGAME COLLECTION: ENCYCLOPEDIA OF MIDDLEGAME 1–4

27. DUTCH A80-A85

28. DVORETSKY'S ENDGAME MANUAL FOR PC

29. ENCYCLOPEDIA OF MIDDLEGAME IV

30. LEGO CHESS SOFTWARE FOR PC

31. THE VIENNA GAME C23-C29

32. CHESS COMBINATIONS ENCYCLOPEDIA

33. FRITZ TRAINER - THE ABC OF CHESS OPENINGS

34. GAMBIT LEXIKON

35. MR. KASPAROV - HOW TO PLAY THE NAJDORF (VOLUME 1)

36. POCKET CHESS STRATEGY

37. SQUARES STRATEGY 3: THE MIDDLEGAME

38. TEST YOUR CHESS TRAINING CD

39. VIKTOR KORTCHNOI: MY LIFE FOR CHESS VOL. 1

40. CHESS GENIUS CLASSIC FOR PC

41. CHESS GENIUS FOR PALM OS

42. ENCYCLOPEDIA OF OPENING BLUNDERS

43. MODERN CHESS OPENINGS: SLAV DEFENCE

44. POCKET CHESS ENDINGS

159. MATE STUDIES

160. THEORY AND PRACTICE OF CHESS ENDINGS

161. CD: STARTING OUT CHESS TACTICS AND CHECKMATES

162. CD: STARTING OUT THE KING'S INDIAN

163. CD: THE FRENCH ADVANCE

164. CHESS TACTICS ART 3.0

165. ENCYCLOPEDIA OF MIDDLE GAME

166. SQUARES STRATEGY 2

167. THE DUTCH DEFENCE: LENINGRAD SYSTEM

168. THE GREATEST TOURNAMENTS IN THE HISTORY OF CHESS (1851–1986)

169. CD: PLAY 1 E4 E5!

170. CD: PLAY THE QUEEN'S GAMBIT

171. CD: STARTING OUT THE CLOSED SICILIAN

172. CD: STARTING OUT SICILIAN NAJDORF

173. CD: STARTING OUT THE SCOTCH GAME

174. CD: STARTING OUT THE SICILIAN DRAGON

175. FRITZ TRAINER: POWER PLAY 1 (MATING PATTERNS)

176. FRITZ TRAINER: POWER PLAY 2 (ATTACKING THE KING)

177. FRITZ TRAINER: POWER PLAY 3 (PAWN STORM)

178. SHIROV: MY BEST GAMES IN THE SPANISH 2

179. MEGA DATABASE 2008

180. BIG DATABASE 2008

181. DEEP RYBKA 2.3.2A & CHESS OPENINGS 2007

225. FRITZ TRAINER OPENING: ALEXEI SHIROV: MY BEST GAMES IN THE NIMZO-INDIAN

226. WHITE REPERTOIRE FOR 1.E4

227. FRITZ TRAINER MIDDLEGAME: THE PATH TO TACTICAL STRENGTH

228. FRITZ POWERBOOK 2007 ON DVD

229. CHAMPIONSHIP CHESS SOFTWARE FOR PC

230. FRITZ TRAINER OPENING: A WORLD CHAMPIONS GUIDE TO THE KINGS INDIAN

231. FRITZ TRAINER OPENING: THE BOTVINNIK & MOSCOW VARIATION

232. ALEXEJ SHIROV: MY BEST GAMES IN THE PETROFF DEFENCE

233. MEGA DATABASE 2007

234. NALIMOV ENDING TABLEBASES ON DVD

235. FRITZ TRAINER OPENING: THE FRENCH DEFENCE

236. CHESS ENDGAMES 3: MAJOR PIECE ENGAMES

237. FRITZ TRAINER: QUEENS INDIAN DEFENCE - THE EASY WAY

238. FRITZ TRAINER: THE ABC OF THE CARO KANN

239. CHESS MENTOR 3 - DELUXE EDITION

240. JUNIOR 10 CHESS SOFTWARE FOR PC

241. DEEP JUNIOR 10 FOR PC (MULTIPROCESSOR VERSION)

242. FRITZ AND CHESSTER LEARN TO PLAY CHESS PART 2

243. FRITZ AND CHESSTER LEARN TO PLAY CHESS SOFTWARE

244. CHESS ENDGAMES 1: BASIC KNOWLEDGE FOR BEGINNERS

245. FRITZ TRAINER: ALEXEI SHIROV: MY BEST GAMES IN THE SLAV AND SEMI-SLAV

246. CHESS ASSISTANT 9 - MEGA PACKAGE (3 DISCS)

247. DEEP SHREDDER 10 FOR PC (MULTIPROCESSOR VERSION)

248. CORR DATABASE 2006

249. THE GREAT ABC OF CHESS TACTICS

250. CHESS ENDGAMES 2: ROOK ENDGAMES