

# Contemporary System Choices



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# Introduction

Some of you have expressed a wish to have an article written on setup of a computer system for chess play and analysis. I can understand the concern for the computer novice who is not that au fait with computers in general or the contemporary chess software scene in particular. Indeed, all aspects of computing are constantly changing and improving so the contemporary chess computer scene is a constantly moving target to try and keep abreast of current trends. Therefore, any attempt to write about it will become a snapshot at that time and subject to change and update within days or weeks of writing. The market has four main categories of hardware platform for the home user to run chess software: desktops, laptops, tablets and mobile/smart phones (i.e., smart phones have a larger screen and can download and run programs or applications often called apps.). Each can have a part to play in the chess software scene and some players utilise more than one platform for speed, portability and budget considerations.

As this document is mainly for the readership of chess players at all levels of technical ability, it is very likely that some of the ideas and techniques asserted in this article could be challenged by an individual's own experiences. The intention is that the information provided will inform those who can adopt and benefit, allow comparison for those who have established techniques through experience to fine tune their approach, and confirm for those who feel their experience is superior for their needs than is presented here.

## Anti-computer Diehards

It is first worth considering whether to move towards computer assistance for your chess play or stay as you are. There are those that prefer not to use digital assistance. Naturally it is an individual's choice on how they approach their chess. Factors worthy of consideration when considering the pros and cons are:

- Existing without a computer  
If you don't have an email address and play all your correspondence chess by post, then it is perfectly feasible to utilise physical books or your memory for your openings and maintain a paper database (perhaps a chess games score book) to review your opponent's games scores before commencing a game. Unfortunately, this category of chess player would not have access to endgame tablebases which are part and parcel of the correspondence game now and rule changes have been adopted to accommodate use of these tablebases on some chess servers, like the ICCF for example. By electing not to use a computer a chess player must face up to the fact that their opponent may well use a computer to assist their play and that may place the non-computer user at a disadvantage. At a very basic level humans can and do make mistakes during play, whereas basic mistakes like leaving a piece en-prise has been eliminated from strong chess computer play unless there is suitable compensation to do so. This could lead to the non-computer chess player losing a match and his/her grade being adversely affected by the lower graded player win.
- Non-ownership Computer use  
Most players use computer assistance. Even if just to access a webserver for play and to access email chess correspondence. For those not wishing to own a computer in the house they can access internet facilities at their local library (usually for free) or visit an Internet Cafe where they can rent computer time, often by the hour. Obviously, the downside is that access to these facilities are at restricted times and you have to leave the house to access the facility, coupled with the fact you cannot install your own software on this class of computer service. Alternatively, internet access can also be achieved by utilisation of apps on a smart phone or tablet to enable receipt and reply of emails, notification of opponent move on chess servers and chess apps to aid game analysis. Effectiveness of chess analysis being restricted by the abilities of the phone or tablet specification and the inherent dumbing down of features and facilities in these apps to enable compatibility with phone or tablet.

- Extending Computer Usage for chess  
Computers can also be well employed to maintain an openings database, and a games database. Endgame tablebases are now available online, such as at the ICCF website. This aspect of computer use during chess play is no different to using manual procedures for storage and recall of games and openings, except speed of data access will be faster, and data is extensible, what-ifs are significantly easier to implement and searches are quicker and a lot more versatile. Something new, and a little out of the ordinary, is to maintain a player database which would hold a thumbprint image of the player and statistics about their chess history which would enable opponent research before commencing a game. Where chess playing websites prohibit the use of computer assistance for chess play the computer use described in this paragraph will not contravene those rules, as the computer is not being used to generate a reply move. However, some unscrupulous chess players still use computer software to assist their play despite the practice being banned on those sites.
- Legacy Computer systems  
Where chess players have existing computers, which are employed for general purpose use these could be adopted to run computer software. However, older computer systems or systems not purchased with chess or gaming in mind are unlikely to be ideal for running chess software. They may be running an old or out of date operating system, perhaps even no longer supported for updates, fixes etc. Many older system hardware will not be compatible with the requirements to install Windows 10 or Windows 11 (which will be with us soon). With unswerving regularity new generations of software applications become more sophisticated and demand faster and higher capacity hardware to function at reasonable speeds. Older generation hardware is often slower to process at reasonable speeds or has not got the capacity or capability to accommodate new generation software.
- Inadequate Resources  
The CPU architecture may not be up to date; 8 and 16 bit systems are now out of date and 32bit systems are also now being replaced with 64bit. The central processor may only run single core or two cores (dual core) and the speed at which it runs could prohibit effective move analysis to any significant depth or require longer run times (perhaps overnight) to reach a reasonable depth of search.
- Insufficient RAM is disastrous  
For a few years 4 Gigabytes (GB) of computer memory (RAM for Random Access Memory) was considered adequate for most regular users. Whereas nowadays current software can be significantly more demanding of RAM requirements. From start-up modern day systems may demand 2Gb or more of RAM. Then with several pages open in an internet browser that could easily exceed 1Gb leaving 1Gb or less to start the chess GUI and commence an analysis task. Any further background tasks that may start automatically could easily request RAM that is not available. The system will then slow down, often ignoring any further user requests, whilst it attempts to save any non-critical current task's memory to disc, thereby freeing up often small portions of RAM. Only when sufficient RAM has been freed-up will the system start the new task and the system will then respond to further user requests. Occasionally sufficient free RAM is not found and the system is stuck in this mode, unresponsive to requests. Often the only resort is to turn off the machine (by depressing the start button for 5 seconds) and restart the system, at the risk of corrupting any open files that didn't close properly on power down. 8Gb should be considered a minimum to run chess software. 16Gb or 32Gb being much safer to run in and is offered on many machines nowadays. Usually, two or three RAM memory slots are built on the motherboard with current systems. So, 8Gb would normally be installed as 2 x 4Gb chips. These chips are often easily upgraded with larger capacity chips. The superseded chips sometimes can be part exchanged for an upgrade.

- New Revolution in Mass Storage

Remaining free hard drive storage may be insufficient for contemporary databases, bearing in mind it is always wise to leave at least 10% of disc space free and unused for defragmentation purposes. There is also a new generation of mass storage device which is superior to the magnetic head disc drives that have been used in computers for many years now. Solid State is the new 'kid on the block' and improved reliability and access times for reading and writing data are the characteristics of this new storage. For many years storage memory was known as either volatile or non-volatile. Volatile memory held information stored there until power was switched off; computer RAM being an example of this. In contrast, non-volatile memory or storage can retain information even after power is removed. The term non-volatile memory can also refer to read-only memory (ROM), flash memory, and most types of magnetic computer storage devices. It is Solid State, non-volatile memory that retains contents when power is removed that has now largely replaced magnetic head disc drives. These legacy drives were always known as the drives that will always eventually fail either with a head crash or corrupted areas of the disk that cannot be read. There is a much-reduced risk of read/write problems with Solid State memory. However, Solid State memory is still quite expensive in comparison with the mature conventional magnetic head storage. Where a legacy system has acceptable CPU speed but low disc space adding a 1Tb disc drive could be the cost effective answer. Externally placed for laptops and internally mounted for desktops.

## Defragmentation Explained.

Modern file saving techniques include saving a larger file in several smaller disc gaps, where previous files have been deleted, rendering the file saved in several fragments. The system keeps tabs on where all fragments of each file are. This ensures that very little disc space is wasted but, renders file retrieval more complicated and takes more time for the system to locate all fragments of one file (all this being invisible to the computer user). This is remedied by running a defragmentation job which collates all fragments for one file together in one place on the disc, rendering a more efficient file retrieval system.

## Dedicated Chess Machine.

Dedicated chess playing machines with electronic board and integral computer program, with or without a display window, are also available but are not at the leading edge of the market anymore. The outer casings are usually manufactured from plastic at the budget end of the market, with press sensitive squares and sometimes an LED light on each square. At the more expensive end of the market luxury polished wood replaces plastic casings, and magnetic switches detect the presence or absence of a chess piece. Leading edge dedicated chess computer machines are rare or do not exist due to the rate of improvement of the chess computer scene, and the price will be prohibitively expensive. This aspect of computer chess is still of interest to those requiring an instant chess sparring partner, to mimic closely OTB play. Unfortunately, the benefits are fewer to the titled or advanced chess player who may easily beat the computer most of the time and upgradeability is rare because the customer base is too small for profit making. In the majority of cases, except with modular high-end (read expensive) systems, hardware is not usually upgradeable. This category of the computer chess market is not recommended for the aspiring chess player who wishes to utilise a computer to assist their chess play. The higher price of the stronger dedicated versions can be better utilised to purchase a desktop or laptop machine and thereby gain access to much stronger free programs available on the market, and of course you would still have use of a computer for many other tasks which a dedicated chess machine is obviously not capable of.

## Electronic board Accessory

Some chess players prefer to analyse a position on an actual chessboard. Electronic boards with pieces are available to attach to a PC or laptop allowing the computer to play one side whilst the chess player can analyse or play through a game. Corresponding software will be required to interface with the external board.

## Client Server

For those not familiar with the term client server, this refers to a managed computer system where the host machine or server runs application programs and the remotely situated user or client accesses the resources remotely from their own computers. For chess these are usually referred to as chess webserver and allow chess players to login to the website and access all aspects of chess play provided by the server machine.

The logged in chess player is called the client and is accessing all chess facilities on the server via the internet. Server machines vary in capacity and resources from those capable of perhaps handling a membership of around 300 users to bigger, faster machines that are capable of managing thousands of players simultaneously logged on.

Chess servers usually have sufficient hardware resource to store endgame tablebases up to 6 or 7 men and these are available for enquiry purposes on each game played on the server. A chess player's client system may not have the storage capability to hold the tablebases individually on their machine. Currently 128Gb is sufficient for the main six-man tablebases, and these can be held on a memory stick plugged into a USB port on the home machine. It is worth bearing in mind that memory sticks of 128Gb do not always have 128Gb free storage (some storage being taken up with manufacturers housekeeping utilities) and therefore some 128Gb USB sticks would not be suitable to hold 6-man tablebases.

Typical examples of chess webserver are the ICCF site, Schemingmind, Chessworld.net and Gameknot.com sites, although many more do exist. ICCF differs from the others quoted here as the website hosts many different organisation/clubs/countries that run their own competitions whereas the other two sites are subscription based with a trial period to assess likeability and convenience of site for a player's needs. The ICCF site only caters for standard chess and Fisher random (also known as 960 chess, so called as the rearrangement of the back rank can be in 960 different positions, and still fit within the requirements that the king must be placed between the two rooks and bishops must be on separate colours). Chessworld and Gameknot cater for standard chess only. Schemingmind caters for a significant number of variations on standard chess. For the curious standard chess player, it is a veritable education to learn of the chess variants able to be played on this site.

## Hardware Choice

Cost can be a major consideration when dipping a toe into the computer hardware market. Once the total spend has been budgeted for, we need to decide whether to go for a desktop or a laptop or keep costs down by opting for a tablet or smartphone. They each have their advantages and disadvantages:

### Desktop

- More affordable cost of ownership when comparing with a similarly specified laptop.
- A main consideration is placement and airflow around the unit. Desktops often run faster/hotter CPUs and therefore require superior ventilation methods
- Ultimately the fastest machines are desktops due to the more efficient cooling systems built into the main CPU casing which allows faster CPUs to operate at lower operating temperatures, sometimes even offering water cooling. As laptops are portable there is the temptation to sit them on your lap, but in so doing it is easy to

block the cooling vents, leading to overheating and eventual forced shutdown by the system. This problem is less likely on an Apple laptop as the main heat disperser is often the extruded aluminium casing which wicks the heat away. Desktops and laptops should, on a periodic basis, have their vents cleared of dust to ensure efficient airflow or they will overheat and in a forced shut down when a critical temperature is detected by the sensors; risking corrupted files and sometimes an operating system repair or restore in worst case scenarios, especially if an update is in progress.

- Will take up more space in the house than a laptop when catering for CPU box, Screen, keyboard and mouse. If using a wireless mouse periodic battery replacement will be required although batteries usually last a year and sometimes two years in the case of some models.
- Once setup they are not easily portable and are best left on their own computer table. If the dedicated table has wheels, then some portability can be afforded. However, for obvious reasons transport outside of the house is not very practical on a regular basis.
- It is my experience that the majority of desktop users do not consider reserve or backup power supplies, so when the power is discontinued or the CPU reaches a critical operating temperature the desktop system immediately powers down, potentially losing unsaved data and corrupting open files that had no time to close down safely. Corrupted files of several gigabytes or terabytes could be an expensive loss especially if the owner did not undertake a periodic secure backup routine to allow for a file or system restore following system corruption due to power supply outage.
- Ultimately desktops allow hardware upgradeability. This enables the owner to keep up to date with current hardware trends (usually to increase speed of processing), although there is a limit at which it may well be cheaper to buy a replacement CPU unit. As CPU units are highly dependent on the ancillary support circuitry to function effectively, often near complete systems can be purchased on one circuit board called a motherboard, contemporary designs of chip now integrate graphics within the CPU. Upgradeability is particularly important as graphics cards have become of major importance to leading edge chess software and extra advantages can be gained by using the most up to date graphics cards (although as of September 2021 the chess software development market appears to be moving away from the requirement for expensive graphic cards to run the top chess software). The existing screen, keyboard and mouse may still work with the new base unit, but interfaces between accessories and computer should be checked as older interfaces have now been superseded. This is far superior to the equivalent laptop that has very little scope for hardware upgrade.

It is worth noting here that Desktops can be built, and home assembled for those with that interest and capability but purchasing components individually is not a cost-effective approach to obtaining a computer and usually the cost of ownership will increase for a bespoke home assembled unit. It is always worth comparing costs with an advertised model bought, 'off the shelf'. Considerable savings can be made in this way and it is feasible to secure a higher specification desktop than could be purchased for home assembly, plus of course you have the manufacturers guarantee on the whole assembled unit rather than individual guarantees on each purchased component.

- Desktops usually will run any of the three main operating systems: Microsoft's Windows, Apple's MacOs and Linux. Windows being the preferred option here if the widest choice of chess software is desired.
- Desktops allow convenient upgrade of graphics systems. Graphics cards tend to be upgraded on a reasonably prolific basis, though the need to do so for chess software is becoming less necessary nowadays.
- Both the keyboard and mouse can either be connected via a separate cable to the CPU unit or more conveniently connected wirelessly to the base unit with a Bluetooth connection.
- Most desktops come with an internal network adaptor card which means it can connect wirelessly to the internet, or alternatively for a more secure connection a network cable will plug into the network card usually at the back of the CPU case. The



alternative is to attach a wireless dongle to a usb port to achieve the same where a network card is not installed.

- Screens or monitors come in various sizes 17" or larger is better to fit more windows on the screen at once without the text in each window being too small to read. LED screens are the most popular and widely available, Liquid Crystal Display (LCD) and Cathode Ray Tubes (CRT) are from past generations and inferior to current Light Emitting Diodes (LEDs). Resolution minimum should be 1366 x 768 which is HD ready resolution. Full HD resolution of 1920 x 1080 is much sharper but still old technology. Nowadays 4k ultra-HD monitors are readily available at very reasonable prices. Gaming monitors are better as their refresh rates are higher which helps avoid eyestrain for extended viewing (at lower screen refresh rates of less than 80 Hertz screen flicker can be detected which can lead to eyestrain. Connections on modern systems can be either HDMI, DisplayPort, USB-C or Thunderbolt. HDMI is the most popular, but DisplayPort is the higher performer. Any new purchasers should ensure connections match between CPU unit and monitor. If you buy your desktop from one supplier as a system everything should match.
- Memory requirements for a desktop running chess software should be a minimum of 8Gb. 4Gb leaves inadequate remaining memory to run applications as the system grabs the majority of the first 4Gb of memory. 16Gb is ideal for a games machine and 32Gb and 64Gb machines are available on the market. With greater ram capacity comes the flexibility to run several chess applications at the same time. With a fast CPU good response would still be possible from each application, but a larger monitor would probably be necessary. There are utilities now where the complete desktop can be spread over two screens which enables two independent chess programs to run on two separate monitors from the one computer system (notably Apple's sidecar facility can easily achieve this by wirelessly linking an iPad for the second screen). Windows can also achieve this but will require cabled access to two different video ports.
- Mass storage has undergone a significant change over the last decade. A hard drive has traditionally been built into most desktops and laptops except Chromebooks which rely on cloud mass storage, see Wikipedia for details. The nature of hard drives has changed, and solid-state non-volatile memory is now becoming common place though still expensive when compared with traditional hard disk drives. The advantages of solid-state drives include ultimate reliability and IO (input/output) speeds have significantly improved, over the traditional hard drive technology. They also utilise less physical space and are therefore better suited to use in laptops. Capacities have crept up over the years and 1 or 2 Terabytes (one Tb is approximately 1000 Gb) are quite common on gaming machines. 500Gb being a regular minimum for the cost conscious purchaser.

## Laptop

- Screen requirements  
The four main screen sizes for laptops are 11", 13", 15" and 17". 17" screens often give you a wider keyboard (the screens are wider therefore the keyboard is also wider) with a separate numeric keypad and more readable on-screen text. 11" and 13" are a little small for most users when multiple windows are opened. A 15" monitor is practical for everyday use and keeps the laptop workspace compact. Overall the bigger the screen then the more windows can be opened simultaneously on screen, with readable text, or you can switch between windows with larger text in each window.
- Battery advantages  
One of the big advantages of a laptop is the capability to take it with you when you leave home and wish to utilise whilst on the move, without needing an external power supply. It is also convenient to use on battery power within the home, away from an external power source The battery backup gives extra security in a mains power cut situation. Many users may setup their laptop in one place in the home and leave it connected to the mains supply permanently. The software in some systems is sophisticated enough to adjust charging levels to extend battery life. Start-up times



can be speeded up by placing the laptop in sleep mode rather than a complete close down after each session. On restart the system switches on the screen and the last used window layout is displayed. Users can invoke a sleep session by just closing the screen. Sleep mode switches the screen off and stops most processes from running to preserve battery charge. (note: battery power will slowly reduce on sleep mode if not connected to a mains power supply). Where battery levels are low and on battery power, at a determined critical remaining power level, the laptop will perform an orderly shutdown so as not to lose any data due to unclosed files.

- Memory considerations

Random Access Memory (RAM) is critical for a chess computer system. 4Gb is inadequate for current systems and current applications. 8Gb is the minimum and better is 16Gb or 32Gb. The more sophisticated operating systems now running on modern computers leave little RAM remaining for applications on a 4Gb machine. 8Gb eases this memory bottleneck but with a few web pages open on a browser, mail or Outlook open and other apps running 8Gb is soon swallowed up. Therefore, 16Gb or 32Gb is a better RAM size to leave sufficient memory for one or maybe two chess systems to run on the one machine. This higher-level memory is only addressable in 64bit operating systems (16 bit machines could only address 16 kilobytes of memory, 32bit machines could access a minimum of 4 gigabytes, hence the 4Gb still offered at the budget end of the market). There were techniques to address more memory, at a cost. Current 64 bit systems can access up to 16 Exabytes (one exabyte being approximately 1 million gigabytes) The greater the amount of ram installed the better the capability to store essential data such as tablebases in ram speeding up data access and thereby allowing greater search depths to be achieved. Regardless of your machines RAM capacity it is still possible to utilise all available ram if you have several memory dependent apps. Running at once. At this point the machine becomes unresponsive to mouse or keyboard commands. The only way to overcome this is to force a system shutdown by holding down the on/off button for at least 5 seconds. Open files may be corrupted, even the operating system may become corrupted if an update was underway. It is therefore good practice to always know the quantity of RAM utilisation at any time. This can easily be achieved by using CTRL-SHIFT-ESC to start the Task Manager where all pertinent info. can be assessed, and compensated for, before disaster strikes. This caters for a windows laptop Other operating systems will have different access to monitoring software.

- Laptop accessories

Most accessories can be connected by USB to the laptop, external to the laptop casing itself and starting to extend the workspace that the laptop now takes up. However, the more accessories connected then the more items to trail around when transporting the laptop.

- Laptop ergonomics

Laptops rely on a touch pad, usually situated at the bottom centre of the keyboard area to enable control of the on-screen pointer. An external mouse and/or a larger area touchpad can be attached to the laptop via USB cable or wireless to assist/ enhance control of pointer direction and to better allow gestures like expanding a window with the use of two fingers, the same as is normal practice on a tablet or smartphone. Touchpads in current generation machines are bigger in area than previous generations.

- Case design

Solid state memory is quite prolific in laptops which tends to reduce the thickness of the casing. However, reducing casing thickness also reduces the effectiveness of airflow for cooling purposes so there are diminishing returns on thin cased laptops. Apple have managed to build a reasonably high-performance chip (Intel 9900 series with 8 cores) into a slim casing. The aluminium casing is very effective at helping to keep the processor at reasonable operating temperatures and an efficient fan starts up if the cpu temperature exceeds the threshold for case only cooling. The processor rarely runs at its maximum theoretical clock speed and naturally overclocking (where

frequency of chip operation is boosted) is not incorporated to help control operating temperatures. Although there are one of two larger cased laptops on the market that allow overclocking as a feature of the system. Heavier duty fans are installed to counter the extra heat generated and these fans can tend to encroach on a room's quietness, and are therefore not everybody's choice.

- DVD drive redundancy

Many laptops do not come with a DVD reader or writer. Download speeds are quite adequate for the majority of software and an external DVD or Blue-ray drive can be added via a USB socket.

## Tablet and Smart Phone

- For greater portability an Android tablet or Apple tablet (iPad) can be used to run chess software. In the case of the higher performing iPads cost will be over £1000 per iPad usually incorporating 512Gb or 1Tb of memory and incorporating a reasonably fast multi-core processor, which will compare favourably with some laptops.

In general tablet software is not as flexible as that running on a desktop or laptop. Chess software is reasonably plentiful with a lot of free software available but there is little leading edge chess software available for use on a Tablet. Tablet chess software costs range from free to a few pounds at most. One of the better exceptions to purchased software is an app from the Apple App Store called BanksiaGUI which is a reasonably polished piece of software. The app includes a very capable Chess GUI and integrates 6 strong engines over 3200 elo including a NNUE version of Stockfish (Stockfish 14 which is a third generation NNUE version) and LC0 v0.27.0, the current latest version (although LC0 v0.28.0 is currently in beta). These are two of the leading-edge chess programs on the market at the present time.

The app can play, analyse and also paste games or positions into the GUI. Game navigation forward and back and to start or end of games are easily achieved. The number of cores can be set in options. There is also the option to select between classic, Hybrid and NNUE for the evaluation function of the engine. This is probably one of the best applications for strength and versatile chess playing actions that any chess player can utilise for an iPad. Other sound and reliable applications are implementations of Hiarcs and Shredder. Often, free chess software comes with in-app advertising, the oblique price to be paid for 'free' software. Stockfish is available in its own user interface, is very fast and utilises Stockfish version 14. It will allow a pgn file to be 'pasted' in and then analyse the position. Setup is very straightforward and the latest Neural Net processing is incorporated.

- For the cost conscious where they are using a smartphone for their everyday use free chess programs can be downloaded to play chess and analyse positions., thereby incurring no additional costs except that of download charges. However, speed of CPU will not compare with better laptop or desktop systems. A range of increasing CPU speeds persists in Tablets and Smart phones from budget through to the high-end models; higher costs of ownership usually determine the faster units with greater onboard memory. In general tablets are often faster than smart phones and this determines the depth of search for any given time. But it is worth taking into account that the fastest smartphones execute faster than Deep Blue's hardware did in February 1996, when it beat Kasparov in a match, and the available software is significantly more capable than that available in 1996.

The faster smartphones are able to reach a greater depth of search which potentially can give a wider range of analysis results with greater accuracy before the horizon effect kicks in. The maximum depth that a machine analyses to is its horizon beyond which it has no assessment and is effectively blind beyond that point. It should be noted that the deeper the search reaches away from the candidate move the less accurate the line becomes. Programs adopting the Monte Carlo search technique avoid the horizon limitation, as they analyse each line to game end.

## GUI environments

Communication between computer and user is usually managed by a GUI interface. GUI is short for Graphic User Interface, so called due to the use of a WIMP environment. For the sake of completion, a WIMP environment is an acronym recognised by having Windows, Icons, a Mouse and a Pointer. Visit WIMP in Wikipedia for more details. The alternative to a WIMP environment is a Command Line Interpreter (CLI). Pre-WIMP environments used a terminal window which enabled commands to be typed in and results were relayed via text in the same window. It is one of the most flexible ways to communicate with a computer but slow and often laborious to type each command with the correct syntax each time. It only required one character to be mistyped and the command was errored and had to be retyped again. Hence the reason WIMP came about. The terminal window is still available for those that wish to use it.

## Computer Chip Development

The nature of the processing unit in a computer system has a significant bearing on the effectiveness of the system to run chess computer programs. Originally computer chips had one single core and therefore executed one instruction at a time. Current systems are now built with several cores and are significantly more efficient at running these chess computer programs. This efficiency of speed does come at a cost; the chips run hot and need significant cooling and extra logic to monitor chip running temperature, the higher the temperature, the faster the cooling fan runs and when the cooling fan cannot cope and temperature continues to rise, the system shuts down before damage occurs.

Usually, systems are designed to allow the chip to run at full speed all day. However, if air vents get blocked with collected dust, fans become less effective as air flow is hampered. It is wise to ensure all air vents are cleared on a regular basis. When fans run at full speed all the time, whether heavily loaded or not then there is a good chance that vents are blocked, and the cooling system is compromised. This problem is more prevalent on laptops than desktops. One notable exception is some of the Apple laptops which use an extruded aluminium casing which acts as the heatsink to counter overheating. Current high-end generation of Apple machines do however use fans to assist the aluminium case heatsink.

The more high-end the CPU the faster the processor will run and the hotter it will operate and therefore the more aggressive will be the cooling strategy designed for that machine; this often leads to faster fan speeds and therefore a more invasive fan noise will be experienced. So, you may find running a high-end system in a crowded living room may encroach on others in the room; something to consider when deciding placement of the machine, whether laptop or desktop.

There are two main chip developers, that are used in machines purchased for running chess computer programs namely Intel and AMD. Other processor manufacturers do exist but not usually employed for high-end chess systems. Intel have been very successful with their Core i3, i5 and i7 and now i9 range of processors. They are at their 10<sup>th</sup> generation now and this enables more cores to be run from the one processor. Looking at the last 10 years of development AMD appear to have been playing catch-up with Intel for most of that time as Intel has a greater market share. Currently AMD have multi core processors that compete very favourably with Intel's products and at very competitive prices. It is worth surveying the market before purchase. AMDs Ryzen 5 and 7 chips are available in laptops and are some of the fastest on the market as of August 2021, at very reasonable costs. Presently AMD have a Ryzen 9 5950x CPU with 16 cores, and therefore 32 threads with a max boost of 4.9Ghz. With these specifications, CPUs can only be employed for desktop processing due to the stringent cooling facilities required. However, AMD have laptops targeted with slower and therefore cooler CPUs, that may still be competitive with Intel's range.

For those who are curious but not yet informed: on a Windows system by pressing CTRL-ALT-DEL and selecting Task Manager from the mini menu that appears, selecting the performance tab will display information about the nature of the CPU and number of cores



and speed of processing. The task manager can also be accessed within Windows directly by depressing CTRL-SHFT-ESC. On Apple click the Apple logo, in the top LH corner, select, 'About This Mac' for a summary of the CPU specification. For those running a Linux system by typing, 'how to enquire on a CPU in Linux' in an internet browser search field will display a series of websites presenting techniques to find similar information on Linux based CPU stats.

## Chess Program Interface

Development of digital chess systems has historically tended to fall into three categories.

- Chess programs run from a CLI with no GUI but usually with the capability to interface with a chess GUI.
- Integrated Chess GUIs that manage the interface between chess program and chess player are usually supplied with a resident chess program but allow additional chess programs to be added as required. (for instance; Arena, BanksiaGui, Cutchess, Nibbler, Chessbase, Hiarcs Chess Explorer and Shredder, the first four being free to download) there are others on the market which can be searched for.
- Integrated Chess GUIs that have the chess program embedded in the system but are not extensible with other chess programs. (Stockfish for Mac from <https://stockfishchess.org/mac/> is probably the strongest program freely available for Apple machines)

There are significantly more chess programs on the market than there are chess GUIs. Many of these chess programs are written by talented amateurs that freely make their creations available for general use, such as LC0 (short for Leela Chess Zero). Some of these are open source, whereby the source code is available to amend and recompile for those who feel adept enough to do so, such as Stockfish, so long as the GPL licence is adhered to. The GPL or GNU licence is a series of widely used free software licences that guarantee end users the freedom to run, study, share and modify the software, providing licensed conditions are met.

A common practice is for commercial enterprises to offer a free version of their program for assessment, but these are usually several years old and lack current development techniques or have been sufficiently handicapped so as not to interfere with sales of their top program. Commercial programs often, but not always come with a chess GUI too. Notable examples are **Fritz by Chessbase**, **Hiarcs HCE** and **Shredder**. **Komodo** is another commercial chess program that sits at or near the top of the chess software ladder but does not have its own chess GUI, being UCI compliant it will integrate with most if not all UCI compatible GUIs on the market.

To ensure most if not all programs will interface with a chess GUI a standard interface was devised called Winboard which existed alone for a few years until Stefan Meyer Kahlen, author of Shredder, devised a more flexible and comprehensive chess interface called 'Unified Chess Interface' or UCI for short. All Chess GUI interfaces should adopt this standard, and most do, to enable the majority of chess programs to integrate seamlessly with the current range of GUIs on the market.

In the case of the Chessbase GUI they have a habit of purchasing a licence to the new strongest programs, wrapping a Fritz GUI around it, and marketing the package for sale by advertising the new top of the range program they have integrated. Hiarcs, Junior, Rybka, Houdini and Komodo have all been marketed in the past wrapped in a Fritz GUI. Chessbase often update the version of Fritz released in the package at the same time to take advantage of new high-end programs which they rename to Fritz. So, the Fritz engine has seen many significant changes over the years but has rarely been the leading-edge program on the market. Marketing an inclusive Fritz package like this has the benefit for those who do not want to understand about downloading GUIs and linking downloaded chess engines via a UCI link. The Chessbase installation process takes care of all that for you. Chessbase

provide DVD versions of their software and straight download. Downloaded versions remain in your account on the Chessbase server for download in the future, if required.

One other feature of the Chessbase software is that it has a Lets Check feature, unique to the Fritz interface. With Lets check the current position being analysed in the GUI is compared with an online database of positions and where the position matches, a maximum of the three highest scoring analysis lines are displayed depicting the three programs that have already analysed the position giving the move, score in centipawns, depth, the engine that performed the analysis and the date the analysis was submitted to the online database. This has the benefit of enabling the CC player to take advantage of other analyses on the position they are considering at no extra cost to themselves, especially if the program stated is superior to theirs, analyses to a greater depth and displays a better score.

The extra quirk that can be gleaned from this window is if the entry shows the same current date for the current position on the board, there is a good chance that the entry is from the opponent on the other side of the board to you and subsequently gives a player an indication of what their opponent is using for a chess engine in the match. Naturally, your opponent can learn your use of chess engines in a Fritz GUI too. Switch Lets Play off to hide this information from your opponent.

**Shane's Chess Information Database** or 'SCID vs. PC' is a powerful chess toolkit, able to manage large databases, run chess engines for play or analysis.

**Arena Chess GUI** is another free chess interface. It enables the chess player to analyse games, play against engines, maintain a database of games and unusually the interface supports the Chessbase .ctg opening book format. It supports UCI and Winboard for GUI/Eng. communication. Arena comes with a selection of free programs already built into the system. During analysis comprehensive search information is displayed. Another feature which very few GUIs manage is to support the use of an external analogue chess board with an electronic interface between board and pieces. This external board is called the DGT Chessboard. Arena is also 960 compliant.

**Tarrasch** is another chess GUI worthy of consideration. It comes with a free chess database of games and comes already supplied with a full version of Stockfish and demo versions of Houdini and Komodo.

## Analysis versus Play

Most chess programs have the majority of the following features:

- varying strengths to suit different levels of play. Restriction of playing strength can be enacted by reducing the time for play, reducing the depth of search ply or programming weaknesses into the program directly which can be selected prior to the game commencing. On a multi core machine restricting the search to a single core will also weaken its play. If all else fails handicaps can be set by editing the board position, to place the program at a disadvantage from the start. Reducing time of reflection for the computer doesn't always work to weaken the program as if the program is set to permanent brain on then the chess engine is still calculating during your thinking time.
- Play personalities can be switched in to mimic particular styles of play.
- Training modes can be switched in. Mate problems and positional problems can also be provided.
- An edit mode to allow setup of any legal position.
- Ability to store chess games in a database.
- Access to an opening book.
- Access to endgame tablebases.
- Enable computer v computer tournaments – this can be useful to determine the strength of a new program in comparison with existing engines.

- Voice actuation to enable visually challenged chess players to easily operate the software.

## Windows vs Apple vs Linux.

There are more commercial and free chess programs available for the Windows operating system than for either Apple or Linux. Unfortunately, that severely restricts the choice open to Apple and Linux users. Some commercial chess programs have a special compile for Apple machines, such as Komodo. Stockfish, one of, if not the, strongest commercial free chess program provides, in their annual release, versions for Windows and separate compiled versions for Apple and Linux. Stockfish being open source is under continual development and there is a development site that automatically provides compiled programs for Windows and Linux following successful testing of a program change.

However, they are essentially beta test programs which means they can produce errors as comprehensive testing has not been undertaken. But, by downloading development versions you have the opportunity to try the new versions for yourself and take advantage of any increases in strength or facilities the new version offers. Unfortunately, Apple users must rely on the annual release of Stockfish although the Apple app store currently has an application called small fish which has its own GUI and integrates a very strong version of Stockfish which incorporates many current advances which is free and a very fast implementation. By using this application, the beginner to chess computing does not need to find a UCI version of Stockfish and doesn't need to understand how to incorporate a UCI engine into a chess GUI.

Several compiled versions are available in the stockfish development environment for each new release. If you are not sure which version to use, start with the vertically highest in the list, for your operating system and if you need to, work your way down until you find a working program.

## Chess 960 or Fisher Random Chess.

Not all chess engines on the market are Chess 960 compliant. Likewise, fewer Chess GUIs are 960 compliant. It is possible to run a 960 compliant program in a non 960 compliant GUI which should not affect analysis but actuating non-standard 960 castling would require editing the position and that will normally delete the previous moves from the game score. Shredder 13 engine and GUI are 960 compliant. Fat Fritz and its Fritz17 GUI are also 960 compliant although there are some reports that there are problems with the implementation. The program Fritz17 is not 960 compliant. LC0 and Stockfish engines are not 960 compliant. 960 compliant GUIs include: Cutchess, ChessGUI, WinBoard, BanksiaGUI, the Hiarcs 14 supports 960 but the HCE GUI does not. Dragon by Komodo is 960 compliant but it doesn't have its own GUI so needs a 960 compliant GUI such as Shredder, Fritz, BanksiaGui or Arena.

## The pros and cons of cores and threads.

No primer on chess computers would be complete without a short section on cores and threads. Essentially most CPUs nowadays, to be commercially competitive, must run several cores from one chip. So, a four-core system can execute four lines of search simultaneously. This is obviously faster than a single core system, which therefore enables the program to search deeper for any given position, making the search more effective for any given duration.

Contemporary systems have a facility called multi-threading; this effectively enables the program to run multiple threads, in excess of the number of cores present. Therefore, a four-core system would have eight threads available to be switched in giving the program the impression it was working with 8 cores if all were switched in at once. Effectively each core



alternates between two search lines very very quickly, giving the impression that up to double the number of physical cores is being used.

Different chess programs respond with varying degrees of success to the utilisation of multiple threads. Usually, a program manual or run instructions will determine the best configuration for a program. This configuration will also manage the amount of Hash ram to be assigned to a program for a given time limit. Not all programs benefit from using all available threads and there is a case for ensuring at least one or two threads less than maximum are used to leave threads available for other tasks like the chess players interface with the system. Some chess programs perform worse if assigned the maximum number of threads, whilst others will only work at their best with the maximum number of cores assigned. If the user guide is not explicit on this some experimentation will be required.

Typically, on a four-core system, setting a thread level of six appears to work reasonably well for most chess programs. Setting the maximum number of threads could have the side effect of making it extremely difficult to break into the processing to have the computer do anything else, as it is 'locked' into the one chess program. Apple is a lot more forgiving on this one, but Windows can be stubborn at times. It is recommended therefore, to never use all available threads for a chess program. On initial start-up following installation it is always wise to check assigned RAM and number of cores before commencing play.

## Monte Carlo Tree Search (MCTS)

Chess program development appears to progress in fits and starts. New ideas come along and if successful are adopted by the chess programming community in general. Brute force search gave way to Alpha-beta, minimax pruning then singular extensions helped depth of analysis. Many other new programming ideas have been implemented through the years. More recently MCTS processing has experienced renewed interest, where each line of search is taken through to a game result, very quickly. Completed lines are scored and reported back to adjust the move order priority.

One big advantage of the Monte Carlo (MC) search is the ability to output many lines of analysis without any penalty to the search progress this is called MPV. PV is principal variation and obviously multi-PV displays several principal variations scored according to the search criteria. A MCTS search is significantly more likely to find difficult or puzzle-like moves that would perhaps be dropped under move pruning. Three of the top programs that can manage MC mode are Fat Fritz, LC0 and Dragon by Komodo has an MCTS option within the main Komodo program.

With normal non monte carlo search criteria multiple lines (or MPV) slows the search process down and therefore is not recommended if speed of search is critical to the analysis.

## Neural Net Processing

The most recent development in chess programming is the adoption of Neural Net (NN) processing. This is a series of algorithms modelled after the neural networks that make up the human brain and nervous system. These algorithms learn using mathematical logic. It would not be exaggerating to suggest that the chess program community has been shaken to its roots by a program called AlphaZero, created by DeepMind. AlphaZero developed from AlphaGo which was written to play the game Go. This developed into AlphaGo Zero which easily surpassed its predecessor by teaching itself to play better by playing against itself.

So instead of ploughing through billions of positions applying human knowledge it creates its own knowledge first and uses that for its search. Based on results the knowledge it

generates for itself is unique and superior. Despite its play being dynamic and sacrificial, this approach enabled it to beat accurate elite programs like Stockfish 8 at the time. Its style of play prefers piece activity and attacking chances. The concept of AlphaZero was carried through into LC0 v0.27.0 which is a free program available for all to download.

The strength of NN programs is due to the weights file which it generates through self-learning. In the case of AlphaZero significantly advanced hardware was used called a Tensor Processing Unit (TPU) to achieve the self-learning process. 5000 of these TPUs were employed to produce the 44 million self-play games of chess in approximately 9 hours. LC0, on the other hand is using much slower hardware often adopting distributed processing (where many owners volunteer their machines remotely over the internet to progress learning and at 1.5 million games per day it will take a month to achieve what DeepMind produced in 9 hours. AlphaZero played and beat Stockfish 8 by +155 -6 =839 in a thousand game match. LC0 is a significant step forward for chess programming but it is still a work in progress subject to future development.

A derivative of LC0 (or Leela Chess zero) is Leelastein 925 which uses the same chess engine binary as LC0 but instead of using self-play to produce its NN weights file it is trained on selected high-level engine games, and the term, 'supervised learning' is given to this approach to generation of the NN weights file. Current thinking is that pure self-learning has the edge over supervised learning. Experimental methods to produce NN weights files is likely to continue for some time as the technology is really quite new.

One particular trap that a user can fall into whilst running some NN chess programs is not to restrict the amount of available RAM to the program. Unchecked these chess programs will happily utilise all RAM eventually and lock your system up with potential catastrophic damage to open files. To counter this for each NN program the parameter, RamLimitMb must be set to something like half the available RAM on the system to prevent all RAM being used. Reference to the user guideline for the software may well give better advice on the total RAM to be assigned. Note as the parameter is in Mb then 1000 Mb will just assign 1Gb of available memory, normally your system may have 8, 16, or 32Gb available.

## Graphics Processor

Alongside NN processing another development is the employment of the graphics processor to assist with the running of chess programs. Access to the large weights file is managed by the graphics processor whilst other processing is undertaken by just 2 cores of CPU.

Originally during download the learning file was a separate download and had to be placed in a specific directory and the file name must be known to the chess program in order to be used correctly. Failure to find the file meant the chess program did nothing. Alongside this the cost of a system using a dedicated graphics processor was expensive and very few laptops had this capability. These two factors may have influenced the decision of Stockfish and Dragon by Komodo to undertake all their NN processing on the CPU, thereby not utilising a GPU. The chess programming community also found it convenient to adopt the Efficiently Updateable Neural Network (NNUE) which was built into Stockfish and made Stockfish 12 near if not the pre-eminent program on the market, now at version 14 at the present time, and of course the big bonus is that it's free to download.

The graphics processors that are key in the NN revolution are the NVIDIA RTX 2060 RTX 2070 RTX 2080 and RTX 2080 ti family which have now been succeeded by the next generation 30nn range. Acer and Hewlett Packard are two examples of manufacturers that are producing laptops with the specialised graphics cards integrated into the build. It is not just for chess; they are advantageous for gaming too. It is possible to purchase a separate independently enclosed graphics processor and connect via USB to a laptop socket. Price is high and cheaper integrated solutions are available on the market.

## Chess Program Market Leaders

**Stockfish 16** is considered to be one of the strongest free chess programs on the market and is a good starter for any chess player to setup on their system and experiment with for analysis and play. It is based on the NNUE model and does not need a graphics processor. The unique weights file is incorporated into the compiled version of the program. This is the third generation of NN superseding the last version that did not incorporate NN processing, Stockfish 11.

Development versions that are improving Stockfish 16 are consistently being produced and made available for download differentiated by date and time in the file name. These development versions have had a series of tests to ensure there are no immediate problems but do not have the thorough testing that the annual release has had and therefore problems may crop up, and that is the last thing a chess programmer needs when analysing a chess position.

It should be noted that I personally have never had a problem in running these development versions. However, being cautious, I tend to run Stockfish 16 (the last fully tested version) on one machine and the latest development version on another and then I can compare the two outputs. The website is [ebrok.eu/stockfish/](http://ebrok.eu/stockfish/) and the latest version is at the top of the page. It is worth checking at least daily for new versions, if you are interested in using the very latest version. The MPV value should be set to one if you want the program to run at its fastest.

**Leela Chess zero or LC0** is a leading edge NN chess program that requires a graphics processor preferably from those listed in previous sections of this article.

Leela Chess Zero consists of an executable to play or analyse games. It was initially dubbed LCZero, soon rewritten by a team around Alexander Lyashuk for better performance and then called LC0. This executable, the actual chess engine, performs the MCTS and reads the self-taught CNN (Convolutional Neural Network) or weights file. LC0 is written in C++14 and may be compiled for various platforms and backends. For more background information browse the Wiki for LC0.

The weights file is a separate download which must be placed in the same folder as the LC0.exe program file. The website to download and get some installation help is [lczero.org](http://lczero.org). The latest version is v0.28.0. Setting number of lines to be displayed (MPV mode) is advantageous and does not affect the processing of the program.

**Fat Fritz (FF) by Chessbase** is supplied in the same bundle as the Fritz 17 engine which is not as strong. Chessbase have used one of their developers (Albert Silver) to copy and amend LC0, add some coding to make it Chess 960 compliant and give it a new Weights file and call it FF. The result is an interesting chess program that often produces a different move to other NN and non-NN programs. Whether its suggested move is stronger or better than other chess programs is down to the chess player to determine for themselves. Interestingly the output from FF displays a series of percentages of win draw and lose for the side to play rather than the more normal centipawn 'score' assessment of the current position.

Chessbase has provided a different compile of FF and LC0 to cater for different hardware configurations. Initially a FF RTX was available which was obviously to be used for those machines incorporating use of an NVIDIA RTX graphics processor. With release of version 1.1 of FF Chessbase also produced a CPU version for those systems not having the required graphics processing, but this version runs quite slowly. A further update version 1.2 has now been released; compiles have been supplied for different configurations of hardware. Unfortunately, version 1.2 of FF RTX will not work on my RTX 2080 system, but another version (1.2 dx12) appears to work but does not appear to run as fast. This paragraph has



been left in to cater for those who have the original FF. However time has moved on and FF2 has been on the market for some months now.

Chessbase have upgraded their FF program with FF2 which uses the Shredder chess engine as its basis and then Albert Silver has utilised LC0 to produce an advanced weights file. A fundamental change has also been addressed with a change to the hardware requirements to run FF2, which is now NNUE compliant and not requiring an expensive graphics card. FF2 will now run purely using the CPU and no graphics utilisation is required. There is some controversy over the licensing of this product, which is currently being settled in the courts. It is thought FF2 is based around Stockfish 12. However, Stockfish 14 has now been released so FF2 is behind the times.

Bundled in with FF/FF2 is the standard LC0 program and a Chessbase version which presumably runs a different weights file. These LC0 engines do not appear to be Chess 960 compliant. By searching through the folders, a UCI executable of FF/FF2 can be found enabling this version of the engine to be executed in an alternative GUI environment, however, the executable appears to run quite slowly, so crawls through the plies on its search.

It should be noted FF does not handle the endgame so well. Where a short mate is found FF does not announce the mate and does not always order the candidate moves in the correct order, it also tends to restrict its search to less than 10 plies.

Chessbase market a chess database management system that is one of the market leaders. Comprehensive search criteria can be readily used for sophisticated enquiries. Chessbase 16 is the latest version of the package and comes with a choice of three different database sizes with corresponding pricing to suit.

### **Komodo and Dragon by Komodo**

The last Komodo chess program pre-NNUE processing is currently running at version 14. The program does not come with a chess GUI and relies on other GUIs available on the market. A few versions ago the development team introduced a parameter into the UCI run file which enabled a Monte Carlo search to be actuated. This was determined to be a little behind the strength of the non-MC version but with MPV set to greater than one it became the better option for analysis where several alternative principal moves could be viewed during the search process. After several months following the release of version 14 the Komodo team announced their version of a NNUE Komodo on 10-09-20 which utilised a specially built weights file but deviates from other NNUE implementations in relying more on existing coding rather than a special routine written specifically for NNUE systems. This version superseded version 14 and is much stronger, approaching the strength of Stockfish 12. Komodo Dragon 2 came along as an upgrade and is not far behind Stockfish 14 in strength. As of late September the Komodo team have released Komodo Dragon 2.5 which appears to at least equal, if not exceed, the strongest Stockfish on the market at the present time. Note: with progressive releases of a program previous generations are eventually made available for free. So, Komodo 14 may soon be available free of charge. However, free versions are made available because they are not leading edge and will not perform at the same level as the current latest release.

**Houdini** has been on the market at version 6.03 for several years now and no further development has been undertaken. It is a commercial engine that utilises code from Stockfish along with original code provided by the author. It is notable because I have found the mate search to be particularly efficient in comparison with Stockfish and Dragon by Komodo. It is a little behind the other top programs in strength, not having a NN version, but a worthwhile alternative for comparison with the other top engines. There is not a monte carlo version of this program. Houdini comes in two versions; one can utilise up to six cores, the Pro version can access more than six. Unless you have one of the latest multicore machines the non-pro version is cheaper, and still utilise a multi-core facility. Unfortunately Houdini was found to be a Stockfish clone with some changes and has largely been shunned by the chess community as this flagrantly defied the GPL licence upon which Stockfish is tied to.

**Shredder** is a commercial program that has been around for many years at version 12. A couple of years ago a version 13 was released which was at least 100 elo stronger. It comes with its own GUI and has an additional facility called a triple brain built into the GUI that allows three chess engines to assess a position and the GUI determines the overall best move from the three engines. It is fully 960 compliant. Along with Hiarcs the engines come in two versions. The deep version will use multiple cores, the basic version uses one core only. The majority of the market has now made their chess programs multi-core compliant, so the higher cost for the deep shredder version does not represent such good value for money when compared with Fritz versions. It is now falling behind the status quo as no new versions have been forthcoming for some years now.

Shredder has its own version of a database management system. It can manage '.pgn' formats. The enquiry/search facilities are a little more sophisticated than those utilised in the HCE.

**Hiarcs** has also been on the market for several years without any updates to the engine. However, it comes with the Hiarcs Chess Explorer (HCE) which has been constantly updated throughout the years. The Hiarcs team have voiced their intention to release a significantly better version of their HCE with an upgraded Chess engine, but no firm release date has been given and they keep missing their suggested release windows. Now with the release of NN processing I suspect they may well have to revisit the program for update.

However, there is no reason why they cannot release a new improved HCE and the program can follow later. The reason for mentioning this program here is because it is one of the most knowledgeable of the chess programs with one of the best GUIs on the market and the Hiarcs team provide another service to update, on a regular basis, a very large opening book available to all who would like to subscribe.

The HCE incorporates management of a pgn games database facility where all games can be stored and recalled with simplified search criteria. One advantage of this database version is the convenience of games management able to be actuated in the same view as all other windows instead of switching to a new window for database access alone.

At the present time a known bug in the Software Development Kit used to compile the HCE for Apple MacOS has resulted in a quirk when using the HCE. The GUI can still perform perfectly ok with this bug, but drop-down lists do not work correctly on the Save dialogue. I suspect the Hiarcs team will await a new debugged version of their SDK before further changes are released.

**Aquarium by ChessOk** developed by Convetka Ltd, is a flexible chess GUI that is UCI compliant and has many other features and therefore is a contender in the current Chess GUI market. It offers advanced analysis methods including analysis presets, and blunder discovery. One nice feature is the ability for ChessOk Aquarium 2021 to auto-find chess programs (including the strong Stockfish 12 engine) from the internet, download and install them, with just a couple of mouse clicks, without needing to know where the program website is or how to incorporate a UCI engine into a compatible chess GUI. The GUI enables storage of the infinite analysis results, for future recall.

Where multiple chess engines are used for analysis, the analysis results and trees can be stored separately for each engine. The chess package comes with a 7.5 million games database (freely extensible on a weekly basis) and one year's access to Lomonosov endgame Tablebases. The 2020 version of the program integrates most of the advantages of the 2021 version without the Stockfish 12 automated install with a 50% cost saving at the current time (18-01-2021).

Convetka has built rudimentary chess game database facilities into the ChessOk package but they also produce a separate application called Chess Assistant which is more database oriented. However, the package can also manage engines, initiate chess games, undertake game analysis and manage opening books.

## Openings Book Use

Chess programs may come with just the engine or usually with a GUI and supplied with an opening book. Fritz, Hiarcs and Shredder all come with their own proprietary opening books. There is no secret to the benefits of a strong wide opening book, but a big problem is that if the opponent is using the same book and players play from this book only, then these games may well end with a similar result to the original game. Naturally the big drawback of an online opening book file is they cannot present reasons as to why a particular line is preferential to other candidate moves. However, the opening display presents question marks and exclamation marks to indicate the superiority over other opening moves in the list.

Openings study is still beneficial, but study of openings can be supplemented by the use of electronic opening databases. It is often good practice to find the first safe deviation to get your opponent out of book and make them rely on their own resources in conjunction with their preferred portfolio of engines to prevent potential draws from book play. Usually where the opening book offers perhaps one or two candidate replies only and the number of games supporting these candidates is one or very few this is an opportunity to break out of the book line hopefully placing the opponent in unfamiliar territory, just don't handicap your play by doing so. Of course, where the opponent has a much higher grade it may be beneficial to play through the opening book as far as possible, perhaps securing a draw in the game which may increase your grading slightly. This is the reason why higher graded chess players are very careful, if they wish to protect the higher grading, to play against similar or higher graded players.

Most free engines do not have an openings book, though sometimes a small openings book will be provided in the program compilation, or in conjunction with the right GUI an external opening book can be allocated. Where a chess engine is supplied with its own openings book the programmer has usually optimized the book to maintain compatibility with the playing style of the engine. Where external books are attached there is no guarantee they will work in harmony with the chess engine.

The Chessbase version of opening book format (.ctg) is perhaps the most popular and common commercial version. Good free opening books are provided on the market, but they are not .ctg formats. At present I believe the only way to utilise the .ctg format is to use the Fritz, Chessbase or Arena GUI Interfaces. The Hiarcs opening book service is probably one of the best opening books on the market being described by Larry Kaufman, Grandmaster and World Senior Chess Champion and significant author of Dragon by Komodo, 'the best publicly available book', updated approximately on a quarterly basis.

They produce this book in three formats. ctg .hce and .hbg (hbg for iPad and iPhone use with the corresponding Hiarcs app). So, anyone with a Fritz GUI or Arena or iPad or iPhone running Hiarcs HCE can use the superior .ctg Hiarcs opening book in their own GUI interface, but no other GUI interface is using this format at present.

Hiarcs also supply a slightly cheaper service which gives you almost the same opening book service streamed directly from their server to their HCE uniquely, and these are updated once or twice each month. There are three versions Human, GM++ and Tournament with each having its specific uses. I have found that where the online streamed books may show two or three moves of equal value in a line, the .ctg version of Hiarcs opening book tends to show what has been determined to be the strongest choice in that same line.

Polyglot is a popular free openings book which can be switched into those chess GUIs that are compatible with the format.



## Contemporary Running Approach

The current suite of contemporary chess programs on the market are considerably stronger than most chess players but when used for analysis they must be used with caution. There is no guarantee bugs do not exist in the code which may produce a response which is flawed and on slow hardware with a short analysis time the depth of search may not be sufficient to see a mating net if it is beyond the horizon for that search.

Of course, the astute chess player will use a chess engine to advise on available lines but at the end of the day the player has to determine if the proposed move or line of play is what he would like to play or whether he sees a better move that fits in with a preferred plan the computer has not considered.

A belt and braces technique to help avoid bugs and restricting horizon effect is to run at least two chess engines on any given position. This can be done directly in the Fritz interface for instance where a Kibitzer is setup to run with the main selected engine. This will unfortunately slow down the main engine slightly and consequently brings the horizon effect in earlier for the given time used on both engines. Alternatively, it is perfectly feasible to run two GUI interfaces at the same time on the one machine. If you open Hiarcs HCE to run the latest version of Stockfish and leave three cores or three threads, depending how you configure the engines, then you can setup the Fritz GUI to run say Fat Fritz or LC0 using two threads and still leaving one thread free to break in and perform other functions. This would only be feasible on those machines that are running the advanced graphics processors discussed earlier in this article.

Another alternative, where no special graphics card is installed, is to run two separate GUIs on the same machine running two programs independently, one in each GUI. The penalty here is that the number of cores or threads will be less than half that available on the machine and the ram assigned will perhaps be less than optimal for each program. The ideal situation is to have a separate machine to run each engine, but that can prove expensive both in monetary terms and space in the home.

A technique adopted by one of two chess players is to run several computers, each running a different chess program and where they all correlate on one reply it may be worth considering looking more closely at that reply to see the benefits and if those benefits agree with the chess players direction in which he wishes to play. Alternatively look for the highest consensus between the programs. Adopting Monte Carlo techniques for suitable chess programs may give an idea as to how different candidate moves are graded.

## Licence Limits

All free programs have unlimited installs. Commercial versions of chess programs often have a limit on the number of installs. As mentioned earlier Hiarcs does not appear to have a limit on the number of installs. Houdini is restricted to four installs, but the author seems open to extending that on request. Shredder appears quite restrictive on number of installs per licence. Chessbase is also restrictive on number of installs. This is obviously not a problem if you are only running one machine.