Chess by Vincent Diepeveen
Chess History

- Chess found its origin in India well over 1500 years ago
- Most sources quote the 6th century A.D.
  and even before that..
- From India it reaches Persia (Iran)
- The rules gradually change; the queen and bishop become more powerful and the pawn can move two squares
- The name Chess comes from the Persian word for king: Shah
Chess

- Some centuries later, Muslim rulers who conquer Persia spread the game of chess to Europe
- Around the 15th century the rules start to be similar to today's chess rules
- Where rules are pretty much the same since then, the way the pieces look like definitely isn't, not even today!
- Most western tournaments the standard is Staunton, from 19th century UK
Original Staunton 1849

- Replica's are already around $2000 a set
Russian Chess pieces (modern)

- Actually similar (cheaper) sets you can encounter in the east in tournaments; the below set is already a couple of hundreds of dollars in the stores – note shape similar to Staunton
Renaissance Style Chess pieces

- Please note that there is no cross on the king
- It's possible Staunton gets that credit...
Most chessplayers find this easier
Blindfolded Chess

• Actually chess players don't need to see the chess pieces at all

• Nearly all titled chess players can play blindfolded

• Question for the audience: How strong do titled chess players play blindfolded?
Blindfolded Strength

- Playing regularly blindfolded hardly loses strength to OTB (over the board)
- Own experience: The first few moves after opening are actually the hardest moves to make, because of complicated tactics
- The more pieces get captured, the easier it is
- So unlike what some guess, “playing for a long time”, that doesn't increase the chances against a titled player playing blindfolded, instead it reduces it!
The first Chess Machine?

- It is the year 1770, roughly 340 years ago, computers are not invented yet, quite some toys were getting built called 'automatons' that entertained the audience.
- Suddenly a German Inventor Wolfgang von Kempelen shows up with a Chess Automaton.
- He calls it: The Turk.
- The original was destroyed in a fire in 1854, here shown is a replica built a few decades ago.
The Turk impressed

- The turk, originally designed for an Austrian Empress, Maria Theresa of Austria, was a slamming success.
- Not only did it know how to play; it somehow knew which move was played, it also could execute its own moves mechanical.
- Before the game Von Kempelen opened the 3 doors and showed clearly no one was inside the box.
- All this **without electricity**, it operated purely mechanical.
The world tour of The Turk

- In 1781 Von Kempelen, who had assured everyone that The Turk had been disassembled by him, was ordered to rebuild The Turk and start a world tour with The Turk, by Emperor Joseph II.
- This was much against the wish of Von Kempelen who reluctantly obeyed.
- In 1783 Von Kempelen started the tour. First through Europe; After death of Von Kempelen (1804), it kept playing; in 1809 Napoleon Bonaparte, later on it moved to USA also playing one of the founding fathers there.
1854 the truth gets published

- Obviously a human chess player was hidden in the Turk playing there blindfolded; it must have been a strong player with a very good condition!
- Cheating in this manner is actually not so easy
- First of all the demonstration is in a crowded place and takes a long time, with an important person playing a game against the turk; also some of the spectators trying to discover how 'the trick' worked, they all guessed wrong...
- You need light inside the box, candles from back then burned oxygen
The Turk quickly explained

- An ingenious air refreshing system was in the turk, breathing through the turk, solving the candle problem
- A real sophisticated mechanism had been designed to play moves mechanically
- Communication system to outside the box
- The secret was kept until its destruction in 1854
- Even in the 1980s chess computer manufacturers struggled recognizing moves played on chessboards. That's 210 years later!
Rules of mass production

- It's not easy to give rules for mass production, as it is different for each industry.
- As for toys (and for example clothes) like chess computers which can get produced for example for $25 each.
- Assuming you need to compete, the profit you want to make on that is also $25, so 100%.
- Then the shops selling it usually also want to make 100% profit.
- So a production price of $25 to result in $100 in the store, factor four higher.
Exporting to 105 countries

- In the 80s the chess computers were exported to 105+ countries
- Most models not seldom were produced in volumes of 100,000 at a time and sold quickly
- Main problem to solve is recognizing moves
- As for chess players they don't like to play on cheap plastic boards, they prefer wood
- In this speech we focus upon quality solutions, engineering the best is the focus, not cheap plastic solutions
Chess Computer?

- Now as in most parts of my daily writing I've been using the terminology 'chess computer' to describe 'the cheap plastic solutions'. In fact they are formally not true chess computers.

- In computer chess we tend to call a chessboard with a SoC (system on chip) carrying a cheap CPU, a dedicated chess computer.

- With today's equipment a dedicated chess computer is rather easy to build, yet some 100 years ago there were no CPU's yet...

- The first chess machine saw life start of 20th century in Spain.
Finally electricity...

- Leonardo Torres y Quevedo has claimed the honor of building the first chess machine, exactly 100 years ago, in 1912
- Torres demonstrates publicly the Chess Player (El Ajedrecista) at the Paris World Fair 1914
- [http://nathanbauman.com/seoulhero/nfblog/?p=317](http://nathanbauman.com/seoulhero/nfblog/?p=317) There is a wonderful picture in colors from it and a good description
- The machine still exists, also the later improved version built by his son in 1920, in a Madrid Museum called: “Colegio de Ingenieros de Caminos, Canales y Puertos”
The 1920 machine has a chessboard
The Chess Player

- As a game engineering challenge The Chess Player (1914) is the biggest achievement of the 20th century.
- Basically new technology gets used to construct an analogue computer which follows an exact algorithm that manages to mate.
- The outbreak of world war 1914 in combination with the fact that it “just could play out an endgame” are probably the two reasons Torres didn't get the credit he so much deserved.
A detailed (algorithmic) explanation on how The Chessplayer mates you can find at chessprogramming.wikispaces.com

The method (algorithm) to mate basically produces moves

When the first generic programmable computers start to arrive, which is short after world war II, then several pioneers write the first chess programs that split the problem of playing chess into a searching algorithm and an evaluation function
Paper Chessprograms

- There are confusing historic sources quoting what actually happened short after world war 2
- One of them mentions several authors, under which Alan Turing, playing his chessprogram on paper against that of other programs
- Relevant is that there is a clear split in the move getting played (search algorithm) and the chessknowledge used to evaluate how well the position is after making those moves (evaluation)
Money Progress

- Initially computerchess advances rather slow, that soon changes in 70s and 80s when there is cheap single chips that can get used to build dedicated chess computers, allowing money to get made with it.

- Initially the supercomputers, not surprisingly, win all contests, that suddenly changes at the end 80s, though they still get massive publicity especially deep thought later deep blue.

- With 1 or 2 algorithms excepted, the next sheet shows the scientific contribution of supercomputers from the 80s until 2000.
Scientific contribution to computer chess from supercomputers
Let's keep positive

- So we praise the microprogrammers who program in assembler
- They single handed outgunned supercomputer university teams
- Zugzwang (university paderborn) at a 512 transputer @ 1Mhz gets in total 200 nodes (positions) per second (according to Ulf Lorenz). That's probably true, as the published results show 5 ply searches, so it looks ahead 5 chess moves (half moves in fact not full moves which is 2 ply), programmed in C
Again those cheap plastic solutions

- “Our big secret was our speed” Frans Morsch
- On a pentium each chess position is under 1000 cycles. Schach achieved a tad over 600 cycles per node. So on the same transputer they probably would have achieved hands down 200 nodes per second at a single 1Mhz transputer
- A single person's program was roughly a factor of 500+ faster than the 'supercomputer' team of university scientists, not seldom under supervision of professors
- Now where Zugzwang still has some knowledge in its evaluation, Cilkchess didn't...
Leierson & Dailey joined under different names under which Cilkchess

Don visited me at home and we played some matches Cilkchess at 1 cpu (Sun 300Mhz) against a pentiumpro 200Mhz with Diep

Diep was a pretty young program back then

After being hammered, Don says: “let's use my laptop without parallel Cilk framework”

Suddenly the MiT program is factor 40 faster
“All these supercomputer programs from the past, they first slowed them down 50 times in order to claim a better speedup” Rudolf Huber

How efficient was Deep Blue?

Basically Deep Blue is a program from the 80s, it was very strong back then.

By 1996, Kasparov is doing nothing and suddenly loses a game. BIG UPSET. Then to not lose the match, Kasparov plays a very convincing game and wins, showing clearly how weak deep blue is

The improved 1997 Deep Blue that wins from Kasparov, how efficient is it?
What is deep blue?

- In 80s an academic project called Deep Thought was taken over by IBM, then it was called deep blue
- Deep Bue is a real chess computer
- From what I understand is that by 1997 it was a RS/6000 workstation with 30 processors, with each processor controller 16 hardware, self produced processors
- Just short before the match the machine was upgraded to 480 processors, seemingly it had less than half that amount before the match
The logfiles

- By the year 2000 all logfiles get published from Deep Blue.
- Shows the cleaned up logfile of game 1
- The first thing we notice in the logfiles, is that they don't log the nodes (chess positions) per second anywhere nor how many searches per second get carried out
The marketing department

- The marketing department from IBM hammered onto the fact that this machine was the fastest chess computer ever built, getting on average 200 million positions per second.
- First 2 facts are correct, in later scientific publications (2001) that number gets corrected by the original programmers to 133 million chess positions per second.
- Impressive facts, even today at a single socket you won't even remotely get so much.
First move out of book game 1

- That seems to be the move played Nb8-d7

10(6) #[e6](19)#[TIMEOUT] 2126 sec]#[Nd7](26) 26  T=167

Nb8d7 bc1a3 Pe7e6 ba3f8B Nd7f8b bf1g2 Ng8f6 pd2d4 Nf8d7 nb1d2

3. .. Nd7 <-- 37/116:40

- Comparing a 1997 with a 2012 program is not very fair. I turned off all algorithms that Deep Blue did not use either and use Diep

- Of course I am using hashtables (transpositiontables – caching what we already searched to not search it again) everywhere, as in 1997...
Diep at the same position (fullwidth)

- 00:07 2085135 15304893 10 0.272 Bg4xf3 e2xf3 e7-e6 Bf1-b5 c7-c6 Bb5-e2 Ng8-f6
- 00:23 2320374 55433743 11 0.474 Bg4xf3 e2xf3 e7-e6 d2-d4 Qd8-d7 Bf1-d3 Nb8-c6 c2-c3 ++ b8-c6 procnr=3 terug=475 org=[474;475]
- 00:42 2440249 104271871 11 0.542 Nb8-c6 Bc1-b2 Ng8-f6 Bf1-g2 e7-e6 O-O Bf8-c5 d2-d4
- 02:32 2596370 396336006 12 0.129 Nb8-c6 Bf1-g2 Ng8-f6 Bc1-b2 e7-e6 c2-c4 Bf8-c5
- ++ g4-f3 procnr=13 terug=130 org=[129;130]
- 02:48 2600780 436957175 12 0.305 Bg4xf3 e2xf3 e7-e6 d2-d4 c7-c5 Bf1-b5 Nb8-c6 O-O
Why no nullmove?

- Early in the 90s, Chrilly Donninger writes about nullmove. In 1995, 2 years before the match, Frans Morsch becomes world champion in Hong Kong and explains this is because of nullmove. Start 1995 I'm trying to get nullmove to work for Diep. There were zero secrets around nullmove

- In 1997 deep blue still is not using it, despite that it is a big winner for everyone, publicly posted. Mid 90s already very few chess programs do without, years before deep blue plays matches
Diep with nullmove and hashtables

- 00:01 1261629 1299478 10 0.298 Bg4xf3 e2xf3 Nb8-c6 d2-d4 e7-e6 Bf1-b5
- 00:01 1406473 2095645 11 0.262 Bg4xf3 e2xf3 e7-e6 Bc1-b2 Ng8-f6 Nb1-
  + b8-c6 procnr=11 terug=263 org=[262;263]
- 00:02 1618166 4142505 11 0.542 Nb8-c6 Bc1-b2 Ng8-f6 Nb1-c3 d5-d4 Nc3-b5 Bg4xf3 e2xf3
- 00:05 1694842 9355529 12 0.129 Nb8-c6 Bf1-g2 Ng8-f6 Bc1-b2 e7-e6 c2-c4 Bf8-c5 c4xd5
  + g4-f3 procnr=15 terug=130 org=[129;130]
It no longer fits at 1 sheet...

- 00:06 1744467 10937814 12 0.305 Bg4xf3
- 00:11 1939529 22149430 13 0.447 Bg4xf3
- 00:16 2057147 33737213 14 0.250 Bg4xf3
- 00:41 2176473 90214840 15 0.503 Bg4xf3
- 00:59 2169611 128050494 0 16 0.314 Bg4xf3
- 03:42 2232131 496805587 0 17 (29080,579800) 0.268 Bg4xf3 e2xf3 e7-e6 Bc1-b2 Ng8-f6 Bf1-g2 Nb8-c6 f3-f4 Bf8-d6 O-O O-O
- A full 5 ply (moves) deeper with nullmove
- 1 second vs 167, and Diep 100x slower in nps, that's making Deep Blue lose factor 16700?
Kasparov-Karpov
How to play the opening?

- Start playing a pawn to the center
- Kasparov played hyperaggressive chess in 80s and 90s
- Nearly always opening thereby with a pawn to the center
- The opening is a crucial and dominating aspect in the preparation and today (2012) the only area where Grandmasters are convincingly stronger than computers
- Why give up this huge advantage?
Kasparov – Deep Blue

- b3 (in the blue) is not a good move here...
Chessplayers and seeing the future

- Where most scientists realized the progress chess programs were making, even the most genius chess players total underestimated them and simply did not believe it was possible that programs would play very strong

- They all too well realized the reasons, sometimes also contractual reasons, causing players to lose from computers, long before the program in question achieved that strength

- Short term thinking then total overrules any reality sense on what's about to happen
Computer chess experts predicting the future

- Public posts from my hand end 90s, indicating that with 'the nodes per second of deep blue it would be possible to easily search 18-20 ply
- That was laughed away, except by Frans Morsch. His program already would achieve this, if he extrapolated... ...no public support though
- Practical with a 10 million nps now, chess programs easily achieve 20 ply and reach 30 ply and well beyond that
- That is far beyond ANYONES expectation
Progress in the 21\textsuperscript{th} century

- Diep progressed fast and became 3d in worldchamps 2004, despite that it was outsearched by nearly every opponent, clearly showing chess knowledge was working.
- Then suddenly a new generation software is there which hammered everyone, what happened?
- The new software sure had more knowledge but not that much more than the past...
- A new trick?
1. The testing problem

- Sometimes it takes a few years to publicly understand what happened behind closed doors
- Software in 90s suffered from small tiny mistakes everywhere
- Accurate testing at many cores helps to fix that
- It appears however that you need to play many games for that. The old fashioned 2SD testing giving 95% confidence just isn't enough
- Instead of 200 games the standard now is 10000-40000 for real accurate measurement
2. Parameter tuning

- Now this is something typical specific to computer chess, as not in every science parameter tuning plays a role. Obviously it matters a lot what value you give to what parameter.

- For example historically most gave weight 3.5 pawns to a chesspiece. In Diep I used 3.625 pawns for a piece historically. When I put that (by hand) up to nearly 3.9 pawns Diep really played a lot better, much to my surprise.

- Doing all this requires huge computational power, explaining why most of the 90s experiments there completely failed.
The most surprising progress is the evaluation functions improvements of past few years thanks to the improved testing and tuning.

If we look back to the models that extrapolated strength of chess engines, the hardware progress was *somewhat* factored in. Where a handful factored also in algorithmic progress, no one had factored in the evaluation progress!

Progressing today without serious testing is nearly unthinkable, clusters are ideal for this!
Comparison to other fields

- Pharmaceuticals need to go through a big process (3 phases) to introduce new medicines, yet majority of that is lobbying and talking.
- They just look at the short term effects.
- And need a 200 cases (95% confidence) to introduce a new medicine and sell for billions.
- Not surprisingly the latest psychological drugs, such as some new generation ADHD medicines for children now are frightening similar to some hard drugs (cocain).
- Do they need to fix the testing?
Thank you

- I'd like to thank Mellanox for providing me a network and Nvidia for providing Tesla GPU's
- The many authors who collected all material on wiki about the chess history and computer chess history, it's really a superior way of dealing with information. If I compare my book collection there to the progress made by many contributors on the internet, it's really a helpful source of information!
- The interesting historic pictures I took from there! The openings page shows 12th century 'Lewis' chess pieces found in Scotland...