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Komodo logo ^[4]

Komodo,

a chess engine by primary author [Don Dailey](#) (died at the age of 57 on November 22, 2013) and since October 2013, by [Mark Lefler](#), supported by chess advisor and evaluation expert and Don's long time collaborator [Larry Kaufman](#). In [July 2016](#), [Komodo 10.x](#) won the [Shannon Trophy](#).

Komodo appeared in January 2010 derived from Don's former engine [Doch](#). It uses [bitboards](#) as internal board representation, and has a sophisticated [search](#) and a knowledge based, balanced [evaluation](#). Komodo is a standalone chess engine supporting the [UCI](#) protocol and is available for multiple platforms and [operating systems](#), and is therefore compatible with free and commercial UCI compliant chess [graphical user interfaces](#) and [database](#) front ends.

As of December 2011, Komodo became commercial with version [4](#), earlier versions running under [Windows](#), [Linux](#), [Mac OS](#) and [Android](#) are available from the Komodo download site, free for non-commercial use ^[2]. Next release date was May 2013, with [CCT15](#) winner Komodo **CCT** ^[3].

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Further Versions

Komodo 5

Komodo **5.1 MP**, released in June 2013, was a major rewrite in [C++11](#), able to perform a [parallel search](#) to run on multiple processors ^[5].

Komodo 6

In October 2013, Don Dailey announced the release of Komodo **6** and also bad news concerning the future status of Komodo due to his fatal illness of a acute form of [Leukemia](#) ^[6]. He introduced [Mark Lefler](#) as new member of the Komodo team ^{[7] [8]}. Don Dailey died November 22, 2013 at age 57, just about the same time that Komodo pulled ahead of [Stockfish](#) by winning game 2 in the [TCEC Season 5 final](#) ^{[9] [10]}.

Komodo TCEC and 7

As winner of the TCEC 5 final, Komodo **TCEC** was released on December 04, 2013 ^[11], the further improved Komodo **7** on May 21, 2014, during the [TCEC Season 6 final](#) versus [Stockfish](#) again, now supporting [Syzygy Bases](#) ^[12], probing code interface implementation by [Jeremy Bernstein](#) ^[13].

Komodo 8

Komodo **8**, released on September 05, 2014, is a substantial improvement over Komodo 7a, which was already rated among the top three chess engines on almost all rating lists ^[14]. Komodo 8 supports [Syzygy Bases](#) and is available for [Windows](#), [Linux](#), [Mac OS](#) and [Android](#), the latter immediately available for import in [Chess for Android](#) and in [Chess for Glass](#) ^[15]. Since mid September 2014, Komodo 8 for Windows is available as [ChessBase](#) engine, bundled with the [Deep Fritz interface](#), Syzygy bases not included ^[16].

Komodo 9

Komodo **9**, released on April 28, 2015, continues the progress with approximately +50 Elo over Komodo 8 due to improved [search](#), [evaluation](#), and [time management](#), as well as more efficient use of multiprocessing ^[17]. Most noticeable is the increase in [search depth](#) reached in a given amount of time, which is due to better [extension](#), [reduction](#), and [pruning](#) rules ^[18]. Further, Komodo 9 now features [Chess960](#) and a [persistant hash](#) to save and restore analysis.

Komodo 10

On May 23, 2016, Komodo **10** came with revised and improved [king safety](#), [pawn storm](#) and [passed pawn evaluation](#), as well with revised [LMR](#), [NMP](#), [IID](#) and [history heuristic](#) concerning [search](#), and is about 60 Elo stronger than Komodo 9 ^[19]. In [July 2016](#), **Komodo 10.x** won the [Shannon Trophy](#).

Komodo 11

On May 23, 2017, Komodo **11.01** was released, which corrected some minor issues of Komodo 11, which was already released by [ChessBase](#) a few days before. It is estimated about 55 Elo stronger than Komodo 10 at intermediate time controls, gains related to [evaluation](#) ^[20], revised [quiescence search](#), [singular extensions](#), [LMR](#), and [parallel search](#) ^[21]. Komodo **11.2**, released on July 17, 2017, was the version which won the [WCCC 2017](#) ^[22]. Komodo **11.3** was released on March 04, 2018 with subsequent improvements ^[23]. It also comes with a [BMI2](#) compile for compatible [x86-64](#) processors - so far not recommend for [AMD Ryzen](#) due to its slow [PEXT](#) implementation ^[24].

Tournament Play

Komodo played the [ICT 2010](#) in [Leiden](#) over the board, and further the [CCT12](#) and [CCT14](#).

CCT 15/16 and TCEC 5-7

Komodo had its first tournament success in 2013, when it won the [CCT15](#) with 6½/7, and later that year the [TCEC Season 5](#) after qualifying for the [Superfinal](#) and 48 thrilling games versus [Stockfish](#) by a margin of 25 - 23. In 2014, Komodo won the [CCT16](#) with 5½/6. In May 2014, at [TCEC Season 6](#), Komodo **7** qualified for the [Superfinal](#) - again versus Stockfish - both engines further improved and supporting [Syzygy Bases](#). This time, Stockfish won the 64 game match 35½ - 28½. Again, the other way around at [TCEC Season 7 - Superfinal](#) in December 2014 - version 8 successor [Komodo 1333](#) won from Stockfish 141214 with 33½ - 30½.

WCCC / WCSC / WCRCC 2015

At the [WCCC 2015](#) in [Leiden](#), Komodo 9.x won the Blitz tournament, and became runner-up behind and losing from the massively parallel and distributed [Jonny](#) which played on a cluster of 100x24 cores. After the revenge winning against Jonny at the equal hardware [WCSC 2015](#) a few days later, Komodo was unlucky and made too many draws against apparently weaker opponents ^[25], to became third behind [Shredder](#) and [Ginkgo](#). Two weeks later, Komodo won the [WCRCC 2015](#) convincingly with 9/9!



Komodo team [Erdogan Günes](#) and [Mark Lefler](#) during the [WCCC 2015](#) in [Leiden](#) ^[26]

TCEC Season 8

In Fall 2015, Komodo 9.3x dominated the [TCEC Season 8](#) and won the [Superfinal](#) again versus Stockfish, this time 100 games with +9, =89, -2, that is $53\frac{1}{2}$ - $46\frac{1}{2}$ ^[27].

WCCC / WCSC / WCRCC 2016

The [2016 ICGA tournaments](#) in [Leiden](#) were a huge success for **Komodo 10.x**, which did not only won the [Shannon Trophy](#) in the open hardware [World Computer Chess Championship](#) after a nerve-racking six games play-off versus defending champion [Jonny](#) - Komodo with 48 [threads](#) on 60 core [Intel](#) i7 versus Jonny's cluster of 100x24 [AMD](#) cores, but also the equal hardware [World Chess Software Championship](#) with $5/6$ - $1\frac{1}{2}$ points ahead of runner-up Jonny and [Shredder](#). Two weeks later Komodo defended its [ACCA](#) title in rapid chess at the [WCRCC 2016](#) with 14 wins and one draw versus runner-up [Andscacs](#), that is $14\frac{1}{2}$ out of 15.



[WCCC 2016](#), Komodo team [Erdogan Günes](#) and [Mark Lefler](#) with [Shannon Trophy](#) ^[28]

WCCC / WCSC / WCRCC 2017

In [2017](#), Komodo could defend its titles at the [WCRCC 2017](#) online, and the soon later released [Komodo 11.2](#) the [ICGA WCCC 2017](#) over the board, again in a play-off versus [Jonny](#). Komodo further became runner-up at the uniform hardware [WCSC 2017](#) behind [Shredder](#).



[WCCC 2017](#), Komodo opening book author and operator [Erdogan Günes](#) with the [Shannon Trophy](#) ^[29]

Quotes

Promotions

[Don Dailey](#) on [Minor Promotions](#) ^[30] :

Komodo never looks at rook or bishop under promotions and only looks at knight under promotions when it gives check. But even for the knight case there are positions where my rule won't find the right move.

Evaluation

Centered Point Values

In 2012, [Don Dailey](#) gave following [point values](#) in a kind of [millipawn scale](#), [tapered](#) between [opening](#) and [endgame](#) phase with [knight](#) and [bishop](#) values constant - positional scores from [mobility](#) and [piece square tables](#) centered around zero ^[31] :

	Pawn	Knight	Bishop	Rook	Queen
Opening	600	3100	3225	4350	9100
Ending	925	3100	3225	5475	9700

Quality of Knowledge

[Don Dailey](#) in a reply to [Vincent Diepeveen](#) ^[32]:

Don, Your program is kind of a beancounter that relies heavily positional upon [piece square tables](#).

You could not be more incorrect. We have piece square tables in Komodo that are a very minor part of Komodo and get very small weights but Komodo puts a huge emphasis on getting the [evaluation](#) right with hundreds of evaluation terms that are carefully balanced to produce a find positional chess program. I personally believe that Komodo has the best evaluation function of any chess program in the world.

...

Total amount of [knowledge](#) is not what is important, it's the QUALITY of the knowledge that is. Komodo tries to have the most balanced evaluation function possible, and probably much more knowledge than most programs. I don't believe in quantity but Komodo evolved to have a lot of knowledge anyway - probably because every piece of knowledge in Komodo is needed. I tried removing knowledge in Komodo to get speed and we were not able to remove ANYTHING without noticing that it weakened Komodo, at least slightly.

Lazy Evaluation

[Don Dailey](#) on [Selectivity](#) and [Lazy Evaluation](#) ^[33]:

Komodo pushes the selectivity pretty hard and we DO get a decent [nodes per second](#) increase with Lazy evaluation but the problem is that we get a big increase in [nodes](#). It is this way because we assume we will not make scout if the guesstimate is too low. So we miss some of the [beta cutoffs](#), you cannot have your cake and eat it too. Komodo's positional component can vary enormously so we do take a lot of damage positionally when we use lazy margins.

Node Counting

[Don Dailey](#) on counting [nodes](#) in Komodo 4 ^[34]:

As Larry mentioned we are counting nodes differently. More specifically, both versions have always counted a node when a [move is made](#), but Komodo 3 would count nodes that were [forward pruned](#) (if the

move was actually executed) and Komodo 4 does not. In Komodo 3 I figured that if any work was done (such as attack testing after making the move) it should count as a node. But in Komodo 4 we changed this because the move is technically being pruned (even if we had to check it out a bit first.) Of course if a move is searched or [reduced](#) it is counted in both versions.

It's mostly semantics, but we get more stable node counts and this works better for fixed node testing which we sometimes do.

I have several things in mind for getting serious speedups in future versions of Komodo which will bring the speed of Komodo back up to that of other programs, or at least not as far away. I believe Komodo is one of the slower programs in terms of raw search speed as we have put a really heavy focus on having a smart program and little on heavy optimization. The reasoning is the same for delaying the MP stuff too, we want to start with a really strong program before we play the optimization games.

Parallel Search

[Don Dailey](#) about aspects of [parallel search](#) in Komodo 5.1 MP ^[35]

How you approach a problem is strongly related to how you DEFINE a problem or task. The goal of MP is to make the program play as well as possible using more cores, to take advantage of the hardware as fully as possible and the only measure that really matters (at least to us) is [playing strength](#). We ALL wish that our program played as if it they were 4x faster when playing on 4 cores - but nobody gets that kind of efficiency.

Some have implied that we search wider because we don't get quite the same increase in depth and that this is a horrible thing. The intuition is that if that if it works you could do it on 1 thread too. However I do not think that follows. The problem is that 4 threads is just not 4x better than 1 thread no matter how good your MP implementation, so it always comes down to how to best utilize what you have. Anything goes in my opinion if it gets more out of extra cores in terms of ELO.

It is well known that programs do not scale well beyond a few processors. Going from 128 to 256 processors gives you very little. One of the things Larry and I want to do is to explore how to better exploit more and more cores and hopefully what we learn will translate to better performance on few cores. It is unlikely to be minor

refinements to what we already do.

I'm not breaking new ground as this has been studied for decades and lots of ideas have been tried - I'm not pretending otherwise. But we will look at new original ideas we come up with and revisit old-fashioned ideas that have been tried in the past. A lot of the old ideas which have been rejected have later come back to life, so there is no idea that is off-limits.

As far as whether searching "wider" is a bad thing and isn't real parallelism, I disagree with that. If 4 cores were 4 times better than one I probably would agree but since it isn't, we have to determine where the effort is best spent. If you have 11 people in the room and 10 are doctors and the one who isn't has a heart attack, what is the best use of the doctors time? Not all 10 doctors can give CPR even though normally that would be very best use of their talent, but surely one of them will be calling for an ambulance while another will be doing CPR and the rest will be doing whatever they can to assist, even in little ways.

So if you are getting very little benefit out of additional processors you need to figure out if there is something else they can do to be more useful. Perhaps one thing is to deal with the lines that are severely reduced in the single core program?

See also

- [Doch](#)
- [Dragon](#)
- [Occam](#)
- [Reptile](#)

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- [Arno Nickel](#) (2012). [Die schöne neue Welt der Schachengines](#). [SCHACH](#) 2,3,5,6 2012, [pdf](#) (German) ^[36]
- [Tamal T. Biswas](#), [Kenneth W. Regan](#) (2015). *Measuring Level-K Reasoning, Satisficing, and Human Error in Game-Play Data*. [IEEE ICMLA 2015](#), [pdf preprint](#)

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- [Komodo Coasts To Victory Over Benjamin](#) by [Sam Copeland](#), [Chess.com](#), March 31, 2016

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