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HiTech chess machine [\[1\]](#)

### **HiTech,**

a chess entity (special purpose hardware + software) by [Hans Berliner](#) and a crew of assorted experts at [Carnegie Mellon University](#) in [Pittsburgh](#) - [Carl Ebeling](#), [Murray Campbell](#), [Gordon Goetsch](#), [Andrew James Palay](#) and later [Andy Gruss](#), [Larry Slomer](#) and [Chris McConnell](#). [Move generation](#) and [pattern recognition](#) for [evaluation](#) purposes was done in [hardware](#) - With 64 chips in parallel. Search algorithm was either [alpha-beta](#) as well as [B\\*](#) ([ACM 1993](#)).

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## Photos



[Hans Berliner](#) and [Carl Ebeling](#), developers of [HiTech](#) at [Carnegie Mellon University](#) <sup>[2]</sup>

## Quotes

Hans Berliner on the HiTech team <sup>[3]</sup> :

- [Carl Ebeling](#) (now at University of Washington) built the special purpose hardware (Ebeling 1985), and a good deal of software relating to how to interface to the hardware and see what it is doing for debugging purposes.
- [Larry Slomer](#) (now at PPG Industries) helped to build the hardware and maintained it after Carl graduated.
- [Gordon Goetsch](#) wrote most of the system software that makes possible interfacing with the special purpose hardware, and has recently revised the software that supervises the search to make other searching disciplines possible. Gordon also maintains Hitech's statistics.
- [Murray Campbell](#) has helped with the opening book, and has now

implemented the [Singular Search](#) ([Anantharaman](#) 1988 <sup>[4]</sup>) algorithm on HiTech. He has been my alter-ego when it comes to discussion of chess ideas, and what can be done to allow HiTech to understand this or that.

- [Andrew James Palay](#) has been involved with early design issues, and recently had implemented the opening book in the form of a file system that allows greater ease of access, and modification.
- [Andy Gruss](#) has now taken over responsibility for the hardware and is designing some new units at the present time.
- I have been responsible for doing the pattern knowledge (Berliner 1988) and most of the opening book, and acting as moderator for the many fine discussions that we have about how to improve HiTech in the various areas that need work.

## Achievements

<sup>[5]</sup>

- In [1985](#) HiTech achieved a performance rating of 2530. It was the first computer to have a rating over 2400.  
In 1985 HiTech won the [ACM computer championship](#) in Denver <sup>[6]</sup>.
- In [1986](#) HiTech tied with [Cray Blitz](#) at the [WCCC 1986](#).  
In 1986 (June 17&18) HiTech beat the women grandmaster [Jana Miles](#) (2265), score: 2-0  
In 1986 (July 6), draw with black against [GM Michael Rohde](#) in the [Philadelphia World Open](#)
- In [1987](#) (February 23) HiTech beats the French chess prodigy [Joël Lautier](#) (14 y.o. and 2255 Elo) in [Cannes](#) <sup>[7]</sup>  
In 1987 HiTech won a match against IM [Laszlo Pirc](#) (2355) 1.5-0.5
- In [1988](#) HiTech won the Pennsylvania State Chess Championship after defeating IM [Ed Formanek](#) (2485)  
HiTech defeated Grandmaster [Arnold Denker](#) (74 years old) in a match (3.5-0.5)  
HiTech became the first chess computer to rated Grandmaster strength  
In 1988 (June 23) HiTech drew a 2 games match against [Manuel Apicella](#) (2370) in Royan ; both won with white pieces <sup>[8]</sup>
- In [1989](#) HiTech won the [ACM championship](#) in Reno
- In [1990](#) HiTech won the [Aegon](#) in [The Hague](#)

## Description

### 1987

given by [Hans Berliner](#) in *Some Innovations Introduced by HiTech* <sup>[9]</sup> :  
HiTech is a chess machine consisting of:

- A general purpose host computer ([SUN 3](#)) which provides a [user interface](#), does [search control](#), and has all the chess [knowledge](#) in the form of an [Oracle](#), and
  - A Searcher made up from specially designed and built hardware (about 5 boards) to do fast [searching](#) and [evaluation](#). HiTech can search about 175,000 [positions/second](#) and executes a [full-width depth-first alpha-beta search](#) using a [Trans/Ref table](#) ([Slate](#) and [Atkin](#), 1977). <sup>[10]</sup>

## 1995

given in 1995 from the [ICGA](#) tournament site <sup>[11]</sup> :

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

## See also

- [B\\*](#)
- [Carnegie Mellon University](#)
- [StarTech](#)
- [Tech](#)
- [The Fredkin Prize](#)

## Publications

- [Hans Berliner](#) (1985). *HiTech wins North American Computer-Chess Championship*. [ICCA Journal](#), Vol. 8, No. 4 » [ACM 1985](#)
- Carolyn Kelly (1986). [Chess Playing Computer Wins Championship](#). [The Tartan](#), [pdf](#) from [The Computer History Museum](#)
- [Carl Ebeling](#) (1986). [All the Right Moves: A VLSI Architecture for Chess](#). Ph.D. thesis, [Carnegie Mellon University](#), [MIT Press](#), ISBN 0-262-05035-8, [amazon.com](#)
- [Hans Berliner](#) (1987). *Some Innovations Introduced by Hitech*. [ICCA Journal](#), Vol. 10, No. 3
- [Hans Berliner](#) (1988). *Pennsylvania State Chess Championship - HiTech Becomes First Computer Senior Master*. AI Magazine Volume 9 Number 3 (© AAAI), [pdf](#)
- [Hans Berliner](#) (1989). *Some Innovations Introduced by Hitech*. [Advances in Computer Chess 5](#)
- [Hans Berliner](#), [Carl Ebeling](#) (1990). *Hitech*. [Computers, Chess, and Cognition](#), pp. 79-109

## Forum Posts

### 1990 ...

- [Hitech - Lautier](#) by [Hans Berliner](#), [rgc](#), April 19, 1990 <sup>[12]</sup>
- [HiTech, AEGON](#) by [Gordon Goetsch](#), [rgc](#), May 11, 1990 » [Aegon 1990](#)
- [Aegon Tournament 1990; Hitech best overall](#) by [Hans Berliner](#), [rgc](#), May 25, 1990 » [Aegon 1990, ACM 1989](#)
- [What happened to Hitech?](#) by Joshua Lee, [CCC](#), October 07, 1999

### 2000 ...

- [For collector : Hitech-Apicella games \(1988\)](#) by [Vincent Lejeune](#), [CCC](#), January 22, 2000
- [How would Hitech do against Crafty and others?](#) by Joshua Lee, [CCC](#), January 17, 2001
- [Hitech](#) by Joshua Lee, [CCC](#), July 08, 2004

### 2010 ...

- [Hitech-Lautier Cannes 1987 \(CC-History\)](#) by [Vincent Lejeune](#), [CCC](#), June 10, 2015

## External Links

### Chess Entity

- [HiTech from Wikipedia](#)
- [HiTech's ICGA Tournaments](#)
- [HiTech](#) from [The Computer History Museum](#)
- [60 games from HiTech on 365chess.com](#)

### Misc

- [High tech from Wikipedia](#)
- [High tech \(disambiguation\) from Wikipedia](#)
- [The Rolling Stones - Jumpin' Jack Flash](#) - Live On [Copacabana Beach](#), February 18, 2006, [YouTube](#) Video

## References

1. <sup>^</sup> [HiTech Photo](#), a Gift of [Feng-hsiung Hsu](#) from [History of Computer Chess](#) from [The Computer History Museum](#)
2. <sup>^</sup> Photo ca 1985, © Bill Redick, [History of Computer Chess](#) from [The Computer History Museum](#)
3. <sup>^</sup> [Hans Berliner](#) (1988). *Pennsylvania State Chess Championship - HiTech Becomes First Computer*

*Senior Master*. AI Magazine Volume 9 Number 3 (© AAAI), [pdf](#)

4. [^ Thomas Anantharaman](#), [Murray Campbell](#), [Feng-hsiung Hsu](#) (1988). *Singular extensions: Adding Selectivity to Brute-Force Searching*. AAAI Spring Symposium, Computer Game Playing, pp. 8-13. Also published in [ICCA Journal, Vol. 11, No. 4](#), republished (1990) in [Artificial Intelligence](#), Vol. 43, No. 1, pp. 99-109. ISSN 0004-3702
5. [^ Jean Paul Teyssier](#) (1991). *ECHECS A L'INFORMATIQUE*. [pdf](#) (French)
6. [^ Carolyn Kelly](#) (1986). [Chess Playing Computer Wins Championship](#). [The Tartan](#), [pdf](#) from [The Computer History Museum](#)
7. [^ Hitech - Lautier](#) by [Hans Berliner](#), [rgc](#), April 19, 1990
8. [^ For collector : Hitech-Apicella games \(1988\)](#) by [Vincent Lejeune](#), [CCC](#), January 22, 2000
9. [^ Hans Berliner](#) (1987). *Some Innovations Introduced by Hitech*. [ICCA Journal, Vol. 10, No. 3](#)
10. [^ David Slate](#) and [Larry Atkin](#) (1977). *CHESS 4.5 - The Northwestern University Chess Program*. [Chess Skill in Man and Machine](#), reprinted (1988) in [Computer Chess Compendium](#)
11. [^ HiTech's ICGA Tournaments](#)
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