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The state of the art in advanced computer games

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Games such as chess and checkers have always been considered an excellent testbed for developments in computer science, particularly artificial intelligence. At the New York City College of Technology (a section of CUNY) in Brooklyn, a Department of Math Center for Logic, Algebra and Computation-sponsored presentation by Dr. Daniel Kopec (an international chess master, author, and computer science professor at Brooklyn College) was held on the 25th of October 2011 on *The state of the art in advanced computer games*. The meeting was part of the C-LAC Seminar.

Kopec started with the case of checkers, mentioning the studies of Arthur Samuel who was a pioneer in the field of artificial intelligence and machine learning and who studied about 50 heuristics. Checkers has proven to be a good test for machine learning and Kopec gave a typical standard representation of the board and the possible positions for the analysis, trying to figure out what is the best move among the possible ones. He showed a sophisticated diagram with a tree of combination of possible moves, that represents the moves' sequence in a MiniMax with Alpha-Beta analysis, that can eliminates about 99% of the possible moves. Jumping to the 1990s, he mentioned the program called CHINOOK developed at the University of Alberta by Jonathan Schaeffer, that was the first computer program to win the world champion title, beating Marion Tinsley. From 1994 to 1996 computer scientists tried to develop a complete solution for checkers. Checkers is about 10^{10} possible positions, while Chess at good play is 10^{120} (more than the atoms in the universe). In order to solve the checkers, Schaeffer and his team did what Kopec called a "sandwich approach" in 3 steps. In the beginning, they tried with 10 pieces and studied what humans did, discovering that some moves were good and others not. Then they chose the openings that quickly reduce the complexity of the problem. The central part of the "sandwich approach" is the heuristicand the calculation. The final step is building a database.

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Kopec moved then to the case of chess that, according to the speaker, are based essentially on equality: when you loose the equality you start to loose pieces quickly. There is also an issue of time and organization, plus a sense of space. He gave a typical board representation of a chess starting theme, based on numbers and then explained the structure in terms of mobility and connectivity. While traditionally the central concept is mobility, the speaker stressed the connectivity that is good for protection and showed some of the players on a scale of mobility *vs* connectivity scale.

The second part of the presentation was devoted to the history of computer chess from the "Mechanical Turk", a fake chess-playing machine constructed in the late XVIII Century to the pioneers such as Alan Turing and Claude Shannon, that in 1948 independently developed the basic algorithms still employed by chess programs today. Kopec gave a quick but comprehensive history of the programs: the Mac Hack written by Richard D. Greenblatt, the Ostrich developed by George Arnold and Monroe Newborn at the Columbia University, Chess 3.x and 4.x developed at the Northwestern University which uses the Alpha-Beta algorithm and which dominated the North American Computer Chess Championship, Belle developed by Joe Condon and Ken Thompson at Bell Labs and that was the first program to officially break the USCF master barrier, HiTech built at Carnegie Mellon University under the direction of Hans J. Berliner, Deep Thought developed at Carnegie Mellon University and later at IBM.

Having seen all those programs at work, people started to assume that chess has been solved, that it is not true. Kopec's idea is that humans make mistakes because they get tired, while machines don't. And that is not a fair match because involves a physical affair and it's not just about the human intelligence *vs* the artificial intelligence. And this seems confirmed by what happened in 2005 to the Hydra, the most powerful chess supercomputer in the world at that time, that was beaten twice by Arno Nickel in two correspondence games, since Nickel had more time available.

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