

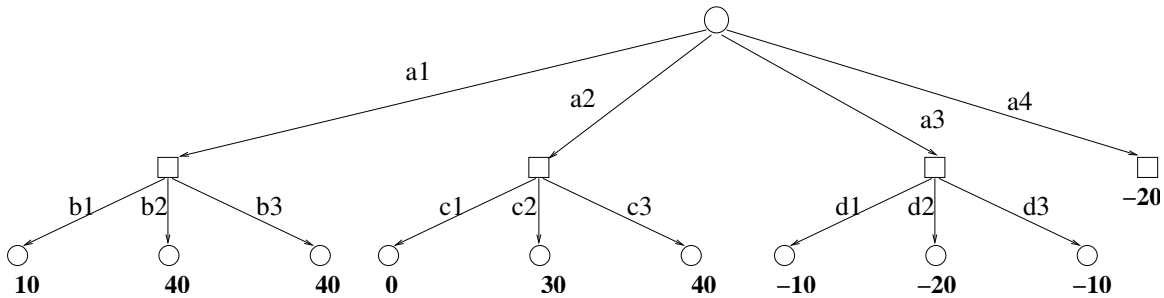
Agenda: Finish up pruning; discuss the history of chess programs, including Deep Blue.

Announcements:

- When you turn in Homework One at the beginning of class on Wednesday, there will be separate piles for each of the four parts. Therefore, remember to keep the different parts separate. Also, note that some subset of the TAs will pick up the homeworks at the beginning of class, take them away, and begin grading them. Thus, your homework must be in by (the stated deadline of) the beginning of lecture.
- Reminder: Prof. Lee will not be holding her regular office hours today; all other regular office hours are in effect.

Follow-ups: When we talked about bounded exploration in the last lecture, a much clearer description is to say that we cut off the search at some *time*, rather than some depth.

I. The pruning example from last time Here is what is either a full (small) game tree or the portion that would be explored using bounded exploration without any pruning (in which case the values at the leaves should properly be called “pseudo-minimax values”). The idea is to not have to look at all of the tree’s nodes. ○ and □ indicate player 1’s and player 2’s turn to move, respectively.



Pruning notation: Circle those leaf-node (pseudo-)minimax values that are consulted. Use hash marks to indicate pruning sites, below which we don’t bother searching. Write current constraints by nodes, and cross out out-dated constraints.

II. Selected highlights in the history of computer chess

1845: Babbage discusses getting a machine to play chess.

late 1800's: Torres y Quevedo builds a machine for three-piece (king and rook vs. king) endings.

1950's: Turing and Shannon (founders of computer science and information theory, respectively) propose searching path trees, elementary programs.

1957: Bernstein writes first program for full game.

1958: first documented human defeat (human taught rules just before the game).

The interim: Programmers and humans both confidently predict ultimate victory for their "sides".

Slow but steady progress in program development.

1988: Deep Thought defeats a human grandmaster in a match game, but world champion Kasparov defeats it easily.

1996: Kasparov vs. Deep Blue. Kasparov loses the first game, but wins the six-game match.

1997: Deep Blue wins the rematch, and subsequently is retired.

III. Some opinions on computer chess-playing

- Chess is the *Drosophila* [fruit fly] of artificial intelligence. — Alexander Kronrod, 1965.
- The Brain's Last Stand. — *Newsweek's* May 5, 1997 cover on the Kasparov/Deep Blue rematch.
- Deep Blue [had] ingenious counterattacks I.B.M.'s master plotter played the strongest purely positional game ever produced by computer....Deep Blue's defensive power was once more extraordinary: with great virtuosity, it fought through Deep Blue [engaged in] original play in the opening Deep Blue played as though virtuosity in difficult endgames was second nature. No one had foreseen its scintillating method of certifying the draw. — Robert Byrne (Grandmaster and NYT chess columnist), *New York Times*, May 13, 1997.
- The truth of the matter is that Deep Blue isn't so smart. It does not for a moment function in the manner of a human brain. It is just a brute-force computational device. Deep Blue is unaware that it is playing the game of chess. It is unconscious, unaware, literally thoughtless. It is not even stupid....¹

Machines aren't nearly as flexible and crafty as humans.

[Computers] never learn....

Deep Blue plays chess better ... but only because human beings have carefully programmed Deep Blue to play chess. Left on its own, Deep Blue wouldn't even know to come in out of the rain. — Joel Achenbach, *Washington Post*, May 10, 1997.

- The "skin-of-an-onion" analogy is also helpful. In considering the functions of the mind or the brain we find certain operations which we can explain in purely mechanical terms. This we say does not correspond to the real mind: it is a sort of skin which we must strip off if we are to find the real mind. But then in what remains we find a further skin to be stripped off, and so on. Proceeding in this way do we ever come to the "real" mind, or do we eventually come to the skin which has nothing in it? — Alan M. Turing, "Computing machinery and intelligence". *Mind* (59), pp. 433–460, 1950.

¹Colby Cosh remarked that "the media exuded a hysterical self-reassurance" ("Computer Bytes Man", *Alberta Report*, 1996).