impossible for even the fastest of computers to examine all moves very deeply because of what is known as the exponential explosion," Berliner says. If, for example, 35 moves are possible at each turn for each opponent, then examining one move for each side involves searching through 35^2, or 1,225, terminal situations. Although computer scientists have improved the efficiency of these searches, the computers still are unable to make judgments about the ever-changing situation in complicated games such as backgammon.

Berliner set out to give his computer the ability to make those judgments by providing it with complex "real-world knowledge." All of the knowledge of artificial intelligence is stored in formulas. Sometimes the formulas are simple, linear functions: A=2B, for example, can represent, "Oranges are twice as valuable as apples." But simple, linear formulas rarely represent complex situations. (During a glut of oranges on the market, A=2B may no longer represent the orange-apple relationship.) Instead, Berliner says, the backgammon-playing computer needs SNAC: a Smooth, Non-linear function with Application Coefficients — the slowly varying items in each term of the formula that can represent subtle changes in a situation.

The equation "Value = $C_1A_1F_1 + C_2A_2F_2 + \ldots C_nA_nF_n$" illustrates some of the characteristics of a SNAC function. The F_i's (where i is 1 through n) represent the number of items of a certain type that exist in a particular situation, the C's represent their unit cost or value and the A's represent "the importance of the term i given certain global information about the present situation."

Using a modification of this SNAC program, a Berliner computer has retired from playing backgammon to coach — analyzing players' moves and explaining whether they are good. The general public "firmly believes" that it is impossible for a computer to conduct such analyses, Berliner says. "This is partly because no such machines have existed, and because it is generally thought that machines operate in an all-or-none mode where they can deal with black and white, but have trouble with shades of gray. However, this is a faulty view as this research demonstrates." □

Antiobesity drug may counter cancer, aging

A drug that counters obesity, prevents cancer and retards aging sounds too good to be true, but it just might become a reality if research reported at the AAAS meeting by Arthur Schwartz of Temple University Medical School in Philadelphia pans out. The wonder drug would be the adrenal gland product dehydroepiandrosterone (DHEA), or an analog thereof.

A great deal of animal and clinical studies have suggested that undereating can both prevent cancer and extend life span, the latter perhaps resulting from the former. Obesity, for instance, is believed to be a causative factor in certain types of cancers because it produces an increase in hormones known to be associated with those cancers. As for research on DHEA, it has been found that women who secrete subnormal levels of DHEA breakdown products are predisposed toward breast cancer. When DHEA was given to a genetically obese strain of mice, it kept them from becoming obese, and levels of DHEA have been found to drop off markedly when humans age. Pulling all this evidence together, Schwartz and his colleagues developed a fascinating hypothesis: DHEA might have not only an antiobesity effect but also anticancer and antiaging effects because it appears to counter cancer and aging just as caloric restriction does. They tested their hypothesis with two experiments.

The first was on mice of the same age with a genetic predisposition toward both breast cancer and obesity. Twenty-five mice got DHEA three times a week for a year; 25 did not. At the end of the year, the DHEA-treated mice had far fewer breast cancers than did the mice that did not get DHEA. What's more, the DHEA-treated mice looked younger — their coats were glossier and less gray than those of the control animals. The second experiment was conducted on mice of the same age with a genetic predisposition toward breast cancer but not obesity. Seventy-five mice got DHEA three times a week for a year; 75 did not. At the end of the year, the DHEA-treated mice had a much lower incidence of breast cancer than did the nontreated mice — even lower than for the DHEA-treated mice with a predisposition toward obesity. Once again, the DHEA-treated mice looked younger than did controls. The results of both studies, Schwartz and his colleagues conclude, "suggest that DHEA treatment may duplicate the antiaging and anticancer effects of caloric restriction."

Schwartz told SCIENCE NEWS that he and his team are now collaborating with a drug company to make DHEA analogs that are even more effective than DHEA. If they find an ideal one, they will attempt to get Food and Drug Administration clearance to test it in a clinical trial to see whether it can prevent breast cancer in women. The trial would probably be conducted on women at particularly high risk of breast cancer because of genes or other risk factors.

Schwartz is also optimistic that DHEA, or an analog thereof, might eventually be used as an antiaging drug in humans. He and his co-workers are now testing DHEA in rodents that are not predisposed to breast cancer or obesity to see whether it can extend their life spans. Preliminary results, he says, look promising. □

Proper diet saves lives, land, oil . . .

Eat more fruits, vegetables and whole grains and consume less animal fat, meat, cholesterol, salt, sugar and other highly refined foods. Nutritionists have been telling us this for years, and their major argument has been the beneficial health effects of a proper diet. At the AAAS meeting, a session titled "National Impacts of Recommended Dietary Changes" reviewed the health consequences of a good diet and then went on to conclude that changes in our eating habits can have significant beneficial effects on everything from land, water, fuel and mineral use to the cost of living, employment rates and the balance of international trade.

The session was arranged by Alex Hershaft of the MITRE Corp. in McLean, Va. He traced our current eating habits and tendency toward overconsumption of meat to the post-war economic situation that demanded that productivity (including farm productivity) be kept at a war-time level in order to forestall a major depression. Consequently, Hershaft explains, the U.S. Department of Agriculture found itself saddled with vast, perishable and costly stores of grain, legumes and other staple foods that had been purchased to support farm prices. To alleviate this storage problem, the USDA encouraged the expansion of animal agriculture and the establishment of feedlots where the grains and legumes could be used. The next step was a massive promotional campaign that eventually doubled the per capita consumption of beef—to about 95 pounds per year.

The well-known health effects of this increase in animal agriculture and increased consumption of beef, milk and eggs were discussed by J. A. Scharffenberger of the San Joaquin Community Hospital in Bakersfield, Calif. Citing a number of studies, he concluded, among other things, that: Elimination of animal products from the diet can reduce the rate of coronary heart disease by as much as 88 percent; dietary changes can possibly reduce the incidence of cancer by as much as 50 percent (the three major dietary factors in cancer causation are obesity, animal fat and lack of fiber, or whole grains); proper diet can help control weight and thus help reduce the risk of hypertension, coronary heat disease and cancer.

Going beyond the health effects, Georg A. Borgstrom of Michigan State University in East Lansing urged that the effects of land and water use be included in dietary debates. The United States, he says, has climbed to the pinnacle of the world in terms of per capita consumption of animal proteins and along the way has strained land and water resources to the point where we now hold the world record for the consumptive use of water for food