

## TECHNOLOGY

# Computers Solve Puzzles

Digital computers that can be taught to solve jigsaw puzzles in essentially the same way humans do, will help man reduce waste in two-dimensional situations—By Ann Ewing

► **COMPUTERS** are being taught to solve jigsaw puzzles.

The reason is not at all frivolous. The methods used will help to solve such very practical problems as how to pack the highest possible number of cars into a parking lot, or how best to plot out a land development project.

The way in which digital computers solve jigsaw puzzles and how such solutions can be applied in everyday life were outlined in College Park, Md., by Dr. Herbert Freeman, an electrical engineer at New York University.

He said jigsaw puzzles were chosen as the basis for solving more practical problems because the difficulties involved are easy to understand.

Virtually everyone has done, or at least tried to do, a jigsaw. Some of the more ardent fans turn the pieces over, thus making the game more challenging by fitting them together by pattern alone, without the aid of color clues. This is how computers are being taught.

The computer solves the puzzle in essen-

tially the same way as humans. In its memory is a coded description of the shape of each piece. Starting with the first piece, the computer checks to find in its memory the five or seven other pieces that have indentations or projections most likely to fit.

It does not try to match each piece against every other—the number of combinations involved is so huge that even the biggest computers could not handle the calculations. From the general shape of the bays and peninsulas around the edge, it narrows down the five to seven likely pieces to the best-fitting one.

Dr. Freeman told **SCIENCE SERVICE** that the easiest jigsaw puzzles to solve were those made for adults. Such a seemingly simple jigsaw as one having a separate piece for each state of the contiguous United States is actually more difficult for the computer, as it would be for a human who did not recognize the states by their shapes.

The reason is that the adult puzzles are patterned in a certain way and have four corners to each piece. The United States, however, has only one point where four states count the same point as a border—the juncture of New Mexico, Arizona, Colorado and Utah.

Adult jigsaws are made by cutting a rectangular sheet into meandering strips, then cutting these strips in a wandering pattern in the crosswise direction.

Children's puzzles are cut to have easily identified pieces, such as states, animals or people.

Dr. Freeman said that one immediate application of the computer technique is in putting together the many fractured parts archaeologists find when they unearth the remains of ancient civilizations. Reshaping shattered pottery, for instance, is very much like solving a jigsaw puzzle.

Other practical applications include helping tailors or members of the garment industry make the most of a bolt of cloth, metal workers obtain the highest number of stampings from a metal sheet and shoemakers cut their leather to best advantage.

The technique applies, Dr. Freeman said, wherever it is helpful to minimize waste in a two-dimensional situation.

He also said there were plans to tackle the three-dimensional problem. This would occur, for instance, in packing shipping crates of different sizes in a railroad car in order to make the best use of the available space.

The digital computer method can also be used to handle such other graphical data processing problems as matching the photographs of the moon's surface sent back by Ranger lunar probes.

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## Questions

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