ON THE SCREEN

MAN-MACHINE INTERACTION


by

Chandler Harrison Stevens


Visiting Social Scientist
Center for International Studies
Massachusetts Institute of Technology

Member, House of Representatives
Commonwealth of Massachusetts


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There is an <u>art</u> as well as a <u>science</u> to drawing election districts. Since I come from Massachusetts, some of you might guess that the "art" I speak of is the variety practiced by the famed artist Gilbert Stuart back in 1812 in a Boston newspaper office. There he sketched the wings, teeth and claws onto the newly drawn state senatorial district which was then to become dubbed as the original Gerrymander, named after then Governor Gerry and the salemander, a beast of similar shape. The not so fine art of Gerrymandering to serve individual and partisan ambitions is <u>still</u> practiced in Massachusetts as a recently-drawn, buzzard-shaped congressional district clearly demonstrates.

I'm not talking about the districting art which was developed in Massachusetts a century and a half ago. I'm referring to one which just a few months ago was developed in a computer laboratory at M.I.T. In M.I.T.'s computer labs, and particularly in a research program known as Project MAC, there has been developing a healthy respect for the art of decision making, for the qualitative as opposed to the quantitative, for human judgement—particularly when it is placed in tandem with the computational speed of computers.

A little more than a year ago I began investigating the possibility of doing computer districting on, what they call in the computer field, a real-time basis. I wanted to use a time-shared computer to display maps and calculations on a cathode-ray tube or TV screen and to receive intermitted commands through a manual keyboard. This would allow for the instantaneous man-machine interaction, the immediate coupling of human judgement with the computer, which I felt the districting problem required.

To let human judgement creep into the field of computer districting may at first seem like an unnecessary risking of computer-aided gerry-mandering, especially if you view gerrymandering as I do to be an unnecessary political evil—an underlying cause of voter alienation. But that risk is definitely worth taking for four reasons. First, there are certain legitimate districting criteria which may well be constitutional

and which can not be readily quantified for purely computerized, non-human evaluation--such as how well do election districts correspond to various regional development and planning patterns?  Secondly, human judgement such as contained in the subjective weights applied to conflicting criteria can never be completely eliminated.  Thirdly, a computer districting system which does not allow for the rapid interplay of human judgement, will, in my opinion, go largely unused.  Finally and most importantly, such a man-machine system will for the first time allow the anti-gerrymanderers to rapidly challenge and expose the faults of districts drawn by the gerrymanderers.  In other words, the computer-aided anti-gerrymanderers will have the relative advantage, for they were previously barred from the smoke-filled room, if for no other reason than the fact that the districting issue was too complex for the political outsider of the pre-computer era.

Further general remarks concerning the philosophy behind this man-machine system, which I have labeled Geodata, should be saved until after I first give a specific description of how the Geodata system works. I'll do this with the aid of three slides.

Please understand that what you're about to see is a hastily developed version of Geodata, which we had no intention of applying to a real districting problem so soon.  But, last February 15, a federal

[W SLIDE 1]  court in Massachusetts declared Massachusetts Congressional districts to be invalid.  Just four months later, this slide was taken of an operational version of Geodata.  The man shown standing in the slide is William Finnegan, who was the chief staff man on our state's Legislative Committee on Congressional Redistricting.  Not shown in the slide are the amazing number of volunteers who helped prepare the data and the programs to make this demonstration possible in so short a time.

Mr. Finnegan is looking over my shoulder at a districting plan which his committee had prepared.  This plan had been prepared without the aid of Geodata, which had just become operational on the very day this slide was taken.  I had however previously appeared before the

districting committee with results of a preliminary run of CROND's
redistricting program. With these results, I tried to explain to the
committee two points--first, that population equality of as little as
1% deviation could be easily achieved, and, secondly and more importantly,
that even within such limits, great variations in compactness were
possible. The committee seemed to understand the first point, for every
districting plan which they subsequently considered had population
deviations of 1% or less. But they ignored the second point, for their
final plan was clearly the least compact plan of all the districting
plans which they considered. Geodata analysis of the Legislature's
districting effort made transparent the fact that within the limits of
the court-imposed criteria of population equality, the second criteria
of traditional Gerrymandering had plenty of room in which to operate.

Before showing you a close-up slide of the map and table of data
which appear on the display scope, let me point out a few pieces of
computer hardware visible in this slide. In the background are various
units of the IBM 360 computer to which this display scope is connected.
Specifically, you can see the card-reader, through which the basic
population, geographic and political data had been entered into the
computer along with CROND's redistricting program modified to contain
Geodata scope output and keyboard input routines. In the standard
CROND program, computer input is through the card reader and computer
output is through a high-speed printer, a corner of which is also visible
in this slide. The Geodata system does little to modify this basic input
and output system. Instead Geodata supplements this system in two ways.
First, on the input side, the districting analyst may type in instructions
through the typewriter-like keyboard. For example the instruction,
"MOVE LEXINGTON FROM DISTRICT 5 TO DISTRICT 3" might be typed in, displayed
on the screen, and then executed. Upon execution of this instruction,
CROND's REDIST program will produce its approximately ten page description
and evaluation of the modified districting plan. Geodata then supplements
this permanent printed record with its output display of the same

[SHOW SLIDE 2]
information in map and tabular form, as shown on this second slide.

Let me briefly review what is shown in this display, which is quite easy to see when you're in the computer room, but which is unfortunately out of focus on this slide. First, the state of Massachusetts and an enlarged section of the metropolitan Boston area are outlined by the scope's beam of light which repetitively scans the screen under control of positioning commands generated by the Geodata program.

What you can hardly see on this slide is that the boundaries of each city and town and each Boston ward--the basic building blocks for this districting problem--are also shown in black on a plastic overlay which has been taped to the face of the scope. It would be relatively inefficient to have the computer store community boundary descriptions and repetitively draw these unchanging community boundaries with the scope's beam of light. The computer controlled beam of light should be reserved primarily for the display of dynamic information, that is, mapping and data characteristics which change with modifications in the districting plan. Ideally, static mapping information such as community boundaries could best be displayed by slides or microflim being projected upon the scope's screen rather than by using plasitc overlays as in this experimental version of Geodata. This projection system, which I have just suggested, would be needed in order to realize the full potential of the Geodata system. For imagine how useful it would be to the districting analyst if he could call forth slides of regional planning districts, of newspaper reading patterns, of commuting patterns, of transportation networks and of other already available mappings which would help him judge how closely various communities are tied together.

While the boundaries of cities and towns go unchanged the boundaries of Congressional districts are, of course, for this problem the primary variable. The computer calls the viewer's attention to each community along a district's boundary by displaying that district's identification number in the center of each border community. Thus, the rectangular shaped district number two in south central Massachusetts is outlined on three sides by a string of twos which appear in the centers of the district's perimeter communities.

Each of the twelve congressional districts thus outlined on the map are further described in the table on the lower half of the screen. Columns one and two show, respectively, the districts' identification numbers and populations. Columns four, five, and six evaluate the districts according to the three previously discussed criteria--population equality, contiguity and compactness. In column three, population deviation is shown; in column four, the letter C is displayed if the district is contiguous, the letters NC if noncontiguous; and in column five, the district's moment of inertia or what I call the Gerry Index is given.

The remaining columns can be used to display any district characteristics, which the districting analyst considers relevant and for which there is sufficient data. We might have here shown average income, total property valuation, average age or other social or economic data. There might be considerable justification for the display of such information if we were using the Geodata technique for drawing service or planning districts rather than election districts. Moreover, I personally feel that we need much better correspondence between election districts and other districts used for regional planning, mass transportation, mental health, pollution control, welfare and employment services and a myriad of other programs. It's gotten to be almost impossible for a citizen to keep track of his political address of criss-crossing districts. It's no wonder that the alienated voter feels that he is losing control of his government.

However, since gerrymandering presently overrides most other rational districting criteria, we have shown in these last three columns of our table the numbers of Democrats, Republicans, and Independents in each district. During the recent course of debate on Massachusetts Congressional districts, Geodata was used to demonstrate to legislators and newsmen that the districting committee was guilty of gerrymandering in favor of incumbent congressmen and in favor of at least one potential challenger who sat on the districting committee. This was done on the screen by [ОW SLIDE 3] making rapid comparisons of the committee's plan against alternative plans which various persons had put forth. It was possible to take any

plan displayed and to modify it according to suggestions made by on-the-scene observers. And here you see several on-the-scene observers making suggestions, one which caused Geodata to produce a noncontiguous district in this particular side. Geodata has an additional feature designed to give the observer a quick feeling for qualitative differences among plans. It displays a plus or minus sign to the right of each number in the table, whenever that particular number has gone up or down relative to the number previously displayed.

At the last minute before one of our Geodata demonstrations, we got word that the House Rules Committee was planning to switch certain towns among districts along the border of a district where the incumbent reportedly felt he was in trouble. So during our demonstration, we showed how this interchanging of towns clearly made the districts involved less compact while making it safer for that particular incumbent. The proportion of voters in his party went up considerably in his district. Needless to say, gerrymandering won out over compactness this time. But this type of public exposure should help hasten the day when state constitutions will be revised and courts will be armed to force fairer districting.

Geodata can be used not only to compare districting plans visually and to modify them on the spot by moving border communities from one district to another. But also there is a function key which the districting analyst can push to cause whatever districting plan is on the screen to be made more compact. This is done by calling upon CROND's very powerful iterative process which redraws the districts right before the Geodata viewers' eyes.

Since Geodata is meant to be an open-ended system, I would like in the future to be able to use CROND's basic routine in other ways besides minimizing the weighted sum of squared geographical distances from district population centers. For instance, I might initially consider transportation patterns qualitatively by flashing highway maps on the screen. But in a more sophisticated system, I might want to replace geographical distance with the time required to travel between communities.

For instance, in my own legislative district, one town next to my home-town takes me quite a while to get to because I have to go around an Air Force Base, parts of which are located in each of the two towns. CROND's routine could be used to minimize not only such "time distance" but also various economic and social "distances" in the study of various patterns of homogeneity.

I realize that this opens up many controversial questions, but in the interest of basic science--basic social science--these questions demand exploration.

Now to summarize the Geodata philosophy, if it can be called that. Since a brewery in Massachusetts advertises its "beer philosophy," I guess it's okay if I speak about the "Geodata philosophy." This philosophy advocates:

1) an OPEN-ENDED SYSTEM to allow for the progressive development of the districting science and the districting art;

2) use of COMPUTER GRAPHICS to directly facilitate communication within the districting discipline and with the outside world;

3) MAN-MACHINE INTERACTION to allow the computer to do that part of districting which is well-defined and to allow man to handle the ever changing but always remaining ill-defined portion; and finally

4) UNIVERSAL ACCESSIBILITY of the system so that the full weight of the democratic process might be applied to bring about districts which are more meaningful to citizens.

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