

can gain here at the expense of absolute machine efficiency.

We hope to describe in a later paper how the programming system currently being designed at Cambridge for a new computer attempts to meet these requirements, and to describe some new facilities for error diagnosis which are being incorporated.

The techniques described in this paper are the result

of a continuous process of development in which many members of the Laboratory staff, past and present, have taken part. We wish to acknowledge these contributions: it is impossible to assign individual credit for all the ideas, but a large share must certainly go to Dr. D. J. Wheeler. One of us (D. F. H.) is indebted to the Department of Scientific and Industrial Research for a Research Studentship.

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# A convention to distinguish letter O from numeral zero

By H. McG. Ross

To avoid confusion when alpha-numeric data and programs are read into computers, a convention is suggested to distinguish between letter O and numeral zero.

For a considerable time difficulties have been experienced in computer work because of confusion between the letter O and numeral zero. With the increasing use of modern symbolic-programming methods, with their greater flexibility and increased opportunity to mix letters and numerals, the position has got worse and has now reached the stage when it is felt that something needs to be done about it.

A variety of suggestions on this point have been made from time to time, including the following.

1. Letter O should be "fatter" than zero.
2. Letter O should be a rectangular shape with rounded corners; this is quite widely used, particularly with ALGOL, but it is not easy to write.
3. There should be a dot in the middle of letter O; however, it is found that one's eye tends to halt at this when reading.
4. Zero may be split at the top, or at top and bottom (when it may be confused with two parentheses), or at the sides. Sometimes this has been used for letter O.
5. Zero should appear as Ø. This is widely used in meteorology and in British Government work, but a string of such zeros (as is common in data-processing work) is definitely unsightly, and there is confusion with phi, which is fairly widely used as a mathematical function or to mean figure-shift.
6. Letter O, or sometimes zero, has been like an inverted Q.

No one of these conventions has become widely accepted, and at the risk of another non-starter the following series of conventions is now put forward.

1. For printed documents (from typewriters, and line-at-a-time printers, etc.), letter O should appear **O** and zero 0.
2. For handwriting, if there is no possibility of confusion, do not bother to introduce any distinction.
3. For handwriting, if confusion might arise, write letter Ø and zero Ø.

Convention 1 has the advantages that the eye will run on for ordinary reading but the difference may be found on closer scrutiny; it is satisfactory for capital and small letters; it may be satisfactory for future alpha-numeric optical character-recognition systems.

Convention 3 is very easy to write, and the mark in zero hints at the oblique line of scheme 5 above.

A similar problem arises with confusion between capital letter I, lower-case letter *l* and numeral one. Here the solution is easier, and a corresponding set of conventions could be:

1. For printing, letter I, letter **I**, and numeral **1**, **1** or **1**.
2. For handwriting, letter I, letter *l* or *l*, numeral **1** or **1**.

(The only difficulty here is to write the serif of **1** small enough and at a slope, to avoid confusion with 7; some people might like to follow the Continental European practice of a small bar through the seven, 7.)

No difficulty has been found in following these conventions for all the printing machines used with Ferranti data-processing systems, which will in future be equipped as standard in this way.

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