THE CONDITIONAL PROBABILITY COMPUTER

by

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THE Conditional Probability Computer constitutes a versatile "learning machine". It simulates certain features of animal learning and embodies principles which are important in the development of adaptive control mechanisms for industrial applications. A brief account of the operation of the computer is given below, followed by descriptions of the particular applications demonstrated.

Conditional Probability Computer

The computer shown has five input channels labelled j,k,l,m,n, but computers with any number of input channels are possible in principle. It consists of 31 similar units which count the number of occurrences of the patterns of input activity presented in these channels. When some statistical data has been accumulated, and when one or a group of the input channels is activated, the computer determines, on the basis of its stored statistical information, whether this group is usually accompanied by activity in another channel or channels. If it is, the computer makes an *inference* of activity in the other channels (shown by *red* illumination of the panel above the computer). The precise conditions for an inference are described below.

The 31 units are essentially counters; five of them count the numbers of occurrences of activity in the respective input channels, while a further ten units count the numbers of occurrences of simultaneous activity in each of the ten possible pairs of input channels, and so on for groups of 3, 4 and 5 channels. The counts are represented in the units by the amount of charge on a capacitor, which is deliberately made to leak towards the level corresponding to zero count. The introduction of leakage ensures that the inferences made by the computer are governed more by recent events than by less recent events.

The conditional probability of activity in the l channel, given that there is activity in the j and k channels, is given by:

$$p_{jk}(l) = \frac{\text{count stored in } (jkl) \text{ unit}}{\text{count stored in } (jk) \text{ unit}}$$

Whenever the j and k inputs of the computer are activated simultaneously, it computes the quantities $p_{jk}(l)$, $p_{jk}(m)$ and $p_{jk}(n)$. If any of these exceeds a predetermined threshold value, an inference is made of activity in the l, m or n channel. The operation is similar when other groups of input channels are activated.