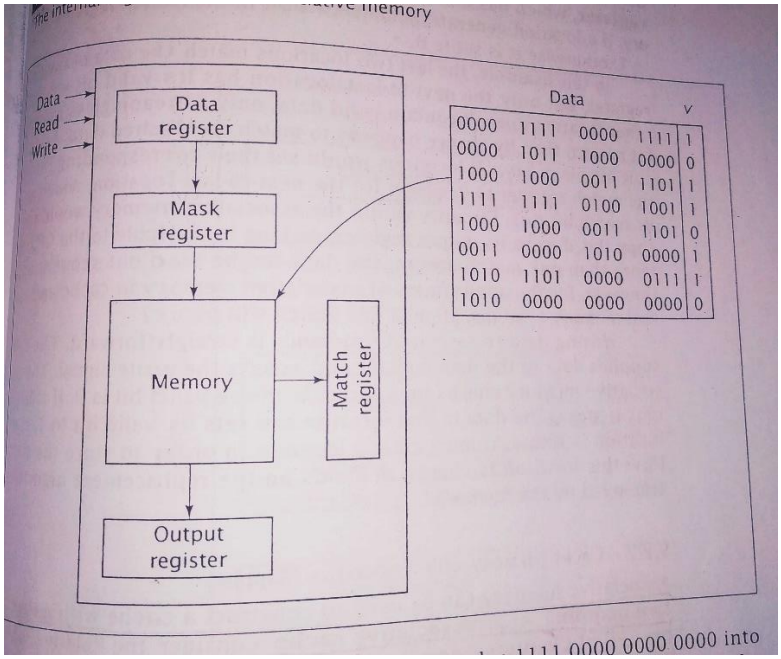
Cache memory: Associative Memory

- Cache memory can be constructed using either static RAM or associative memory (sometimes called content addressable memory), depending on the mapping scheme used.
- In static RAM implementation, it receives an address and accesses the data at that address.
- To access a data in associative memory a portion of the data is specified. The associative memory searches all of its locations in parallel and marks the location that match the specified data input. The matching data values are then read out sequentially.



- From figure above, each word has one additional bit labeled V (Valid bit). 1 indicates valid data and 0 indicates data is not valid.
- To read a value from associative memory, the CPU must specify the data value to be matched and the bits of this data value that are to be checked. The first value is the argument or data; the second is the mask or key.
- For example, assume that the CPU wishes to access data in the associative memory of figure above that has 1010 as its four high order bits. The CPU would load the value 1111

0000 0000 0000 into the mask register. Each bit that is to be checked regardless of the value it should have is set to 1; the other bits are set to zero. The CPU also loads the value 1010 XXXX XXXX XXXX into the data register. The four leading bits are the value to be matched, and the remaining 12 bits can have any value, since they will not be checked.

- At this point, the associative memory checks each location in parallel. A match occurs if case 1: for every bit position that has a value of 1 in the mask register, a location's bits are same as those in the data register and case 2: the locations' valid bit is set to 1.
- If a location generates a match, its bit in the match register is set to 1; otherwise it is set to 0.
- In the above example, the last two locations match the data in the data register, but only the next-to-last location has its valid bit set. The other location doesn't contain valid data, only a meaningless random bit pattern that by chance happens to match the desired data. As a result, all the locations would set their corresponding bits in the match register to 0, except the next-to-last location which sets its match bit to 1.
- Associative memory than copy its data to the output register making it available to the CPU.