Briefly explain the following interconnection networks:

1. The Crossbar Network

2. Cube Interconnection Network

3.  Fat Tree Connection

Solution

Crossbar network: A crossbar is a non-blocking switching element with *N* inputs and *M* outputs used for connecting multiple components of a computer where, typically, *N* = *M*. The crossbar can simultaneously transport signals on any of the *N* inputs to any of the *M* outputs as long as multiple signals do not compete for the same input or output port. Crossbars are commonly used as basic switching elements in switched-media network.



Cube interconnection network: An cube network, also called hypercube, consists of N=2n nodes; n is called the dimension of the n-cube network. When the node addresses are considered as the corners of an n-dimensional cube, the network connects each node to its n neighbors. In an n-cube, individual nodes are uniquely identified by n-bit addresses ranging from 0 to N-1. Given a node with binary address d, this node is connected to all nodes whose binary addresses differ from d in exactly 1 bit. For example, in a 3- cube, in which there are eight nodes, node 7 (111) is connected to nodes 6 (110), 5 (101), and 3 (011).



Fat tree connection: The **fat tree network** is a universal [network](https://en.wikipedia.org/wiki/Network_theory%22%20%5Co%20%22Network%20theory) for provably efficient communication. It was invented by [Charles E. Leiserson](https://en.wikipedia.org/wiki/Charles_E._Leiserson%22%20%5Co%20%22Charles%20E.%20Leiserson) of the [Massachusetts Institute of Technology](https://en.wikipedia.org/wiki/Massachusetts_Institute_of_Technology%22%20%5Co%20%22Massachusetts%20Institute%20of%20Technology) in 1985. In a [tree](https://en.wikipedia.org/wiki/Tree_%28data_structure%29%22%20%5Co%20%22Tree%20%28data%20structure%29) [data structure](https://en.wikipedia.org/wiki/Data_structure%22%20%5Co%20%22Data%20structure), every branch has the same thickness, regardless of their place in the hierarchy—they are all "skinny" (*skinny* in this context means low-[bandwidth](https://en.wikipedia.org/wiki/Bandwidth_%28computing%29%22%20%5Co%20%22Bandwidth%20%28computing%29)). In a fat tree, branches nearer the top of the hierarchy are "fatter" (thicker) than branches further down the hierarchy. In a [telecommunications network](https://en.wikipedia.org/wiki/Telecommunications_network%22%20%5Co%20%22Telecommunications%20network), the branches are [data links](https://en.wikipedia.org/wiki/Data_link%22%20%5Co%20%22Data%20link); the varied thickness (bandwidth) of the data links allows for more efficient and technology-specific use.

