1. Distinguish between switching, forwarding and routing.

   - Switching

     Switching is the method Switches use to determine where to send frames.

     The switching table is a mapping from MAC addresses to output ports on a switch.

     The algorithm for switching is as follows:

     – On receipt of a packet from MAC address x on port y add an entry into the switching table to send packets for MAC address x out on port y.

     – On receipt of a packet destined for MAC address x, search for it in the switching table. If there is an entry saying which port it should be sent on, send it on that port.

       Otherwise, flood the network asking if any nodes *have* MAC address x or have an entry for x in their switching table. If no response is received, x is not on the network so the packet is dropped. If a response is received, the entry is input into the forwarding table and x is sent out on the correct link.

   - Routing

     Routing is a network-wide operation which is done every time the network changes. Routing is done in the control plane and is used to construct the forwarding table.

   - Forwarding

     Forwarding is a per-packet operation performed by Routers in the data plane. The Forwarding Table is a mapping from ranges of IP addresses to output ports. A copy of this is stored on the Input Linecard. For each packet, the Input Linecard finds finds the longest prefix match (the most specific destination) in the forwarding table and sends the packet to the corresponding output port.

2. Describe the Link State and Distance Vector routing algorithms.

   - Link State Routing

     In Link State routing, each node is given total information about the whole network then computes the shortest path to the destination and stores the first-hop in the routing table. Initially, each node knows only its local link state (information about links it is directly connected to). Each node floods the network with this information (using eager reliable broadcast). Every node on the network now has the global link state.

     Each node now has a copy of the global link state. Every node then independently uses Dijkstra's Algorithm to work out a least-cost path to every router.

   - Distance Vector Routing

     In Distance Vector Routing, each node maintains a Distance Vector D, containing a triple of $(\text{address prefix}, \text{subnet mask}, \text{distance}, \text{router})$ where $(a, s, d, r) \in D$ means the subnet a/s can be reached in distance d through router r.

     Nodes continuously broadcast their distance vector to their neighbours. They then update their distance vectors to the elementwise minimum.

3. What are RIP, OSPF and BGP?

   RIP is "Router Information Protocol" – the most common implementation of Distance Vector Routing.

   OSPF is "Open Shortest Path First Protocol" – a common implementation of link-state routing.

BGP is "Border Gateway Protocol" – an inter-domain routing protocol which uses a variant of of Distance Vector Routing and is designed to allow border routers to hide what goes on inside their networks.