Computer Networks

Homework 3

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1. What's a subnet? How does a network get IP address for itself (network part of address)?

Solution:

Subnetwork or Subnet

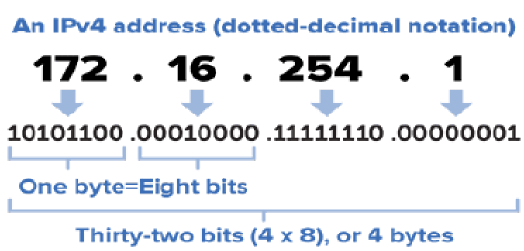
A subnetwork is a divided portion of a larger network. More specifically, subnets divide an IP network logically into several, smaller network pieces. Data is sent from one computer to another via the internet using the Internet Protocol (IP). Every machine, or host, on the internet is uniquely identified by at least one IP address.

A subnet, also known as a subnetwork, is a sectioned off area of a larger network. Subnets, in more precise terms, are the logical division of an IP network into several, smaller network pieces. The protocol used to transport data from one computer to another via the internet is called the Internet Protocol (IP). An IP address serves as a distinctive identification for every computer, or host, on the internet.

The division of a network address space by subnetting increases the effectiveness of address distribution. It is covered in detail in the official Request for Comments 950 document and is closely related to IP addresses, subnet masks, and Classless Inter-Domain Routing (CIDR) notation.

How does a network get IP address for itself: They're assigned by the Dynamic Host Configuration Protocol (DHCP), a service running on the network. DHCP typically runs on network hardware such as routers or dedicated DHCP servers. Dynamic IP addresses are issued using a leasing system, meaning that the IP address is only active for a limited time.

While routers are used to communicate inside subnets, each subnet enables communication amongst its linked devices. The connection needs and the network technology used determine a subnet's size. A data center subnet may be built to connect many more devices than a point-to-point subnet, which only allows two devices to connect.



An IP address is divided into two fields: a Network Prefix (also called the Network ID) and a Host ID. What separates the Network Prefix and the Host ID depends on whether the address is a Class A, B or C address. Figure shows an IPv4 Class B address, 172.16.254.1.

2. What is Border Gateway Protocol (**BGP**)? What are the guidelines for its selection of routes?

Solution:

The protocol that powers the internet's global routing system is called BGP (Border Gateway Protocol). By having edge routers trade routing and reachability data, it controls how packets are sent from one network to another. The autonomous systems (AS), which are networks managed by a single business or service provider, are connected by BGP.

BGP creates network stability by guaranteeing routers can adapt to route failures: when one path goes down, a new path is quickly found. BGP makes routing decisions based on paths, defined by rules or network policies set by network administrators.

BGP ROUTING: Only when something changes, and only the impacted information, does BGP deliver updated router table information. Due to the lack of an automated discovery mechanism in BGP, peer connections must be manually configured with peer addresses programmed at both ends. Based on current reachability, hop counts, and other network parameters, BGP determines the optimum way. BGP policies convey an organization's preferences for which path traffic should use when numerous pathways are available, such as inside a large hosting facility. BGP community tags can regulate peer-to-peer route advertising behavior.

BGP in networking is based on TCP/IP. It operates on the OSI Transport Layer (Layer 4) to control the Network Layer (Layer 3). As described in RFC4271 and ratified in 2006, the current version of BGP-4 supports both IPv6 and Classless Inter-Domain Routing (CIDR), which enables the continued viability of IPv4. Use of the CIDR is a way to have more addresses within the network than with the current IP address assignment scheme.

3. Assume that the routing table of Router B in the network has the following items (these three columns are represented as "destination network", "distance", and the next router, respectively):

N_1	7	A
N_2	2	C
N_6	8	F
N_8	4	E
N_9	4	F

Now B receives the routing information from C (these two columns are represented as "destination network" and "distance", respectively):

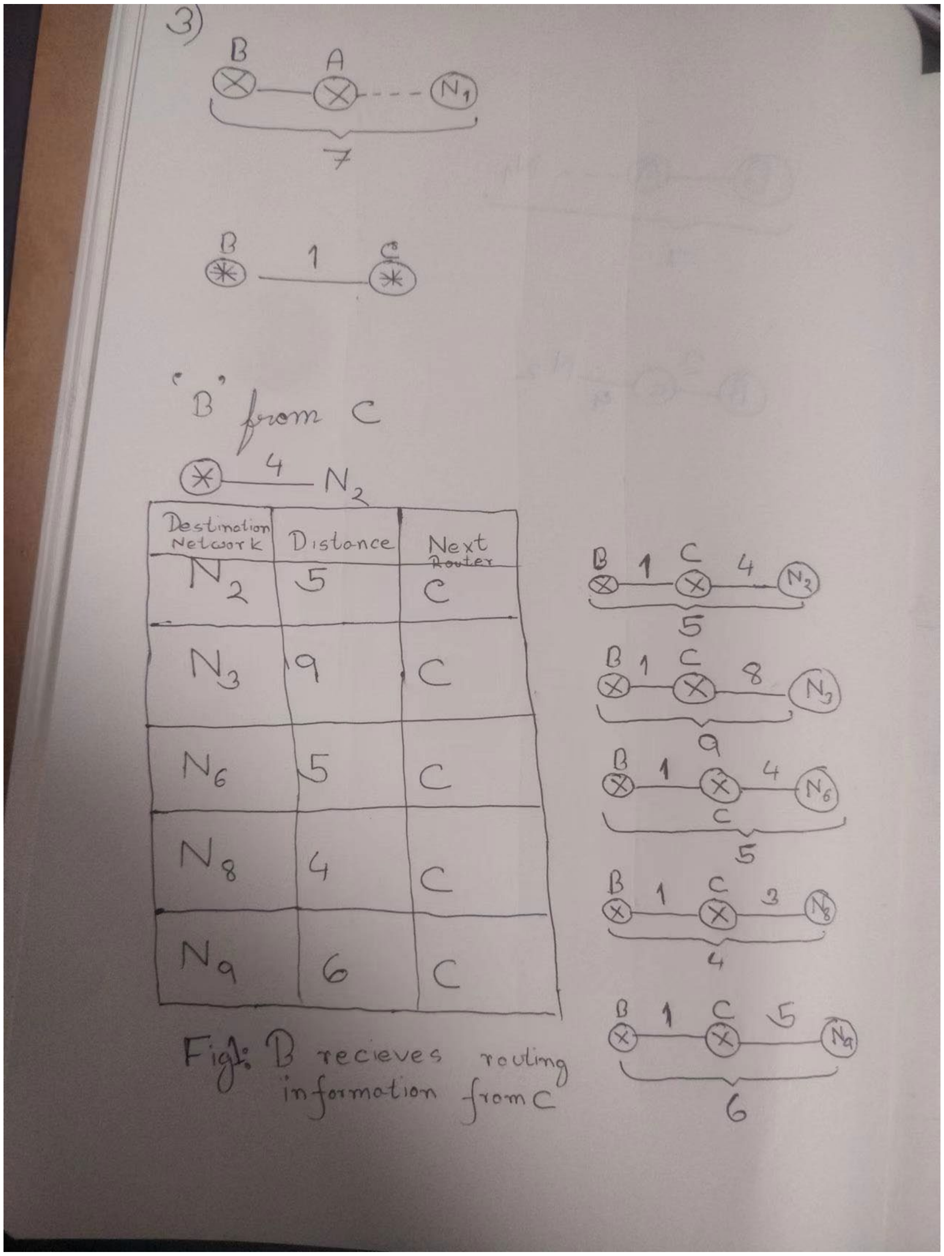
N_2	4
N_3	8
N_6	4
N_8	3
N_9	5

Please find the updated routing table of Router B according to the Distance vector algorithm:

$$D_x(y) = \min_v \{c_{x,v} + D_v(y)\}$$

(Please show the detailed description of each step).

Solution:



3)

'B' from C

Destination Network	Distance	Next Router
N_2	5	C
N_3	9	C
N_6	5	C
N_8	4	C
N_9	6	C

Fig: B recieves routing information from C

Rule:

B recieves routing information from C

1. If the next-hop router address is C then Replace the recieved item with the item in the original routing table (B table) (without comparing the size) with Fig 1

2. If the next-hop router address is not C, compare the distance 'd' with the distance in the routing table. of Fig 1

   i. If the distance 'd' in the recieved item is less than the distance in the routing table of router B then we update it

   ii. Otherwise we will not change the routing table of router B

Destination Network	Distance	Router	Reason
N_1	7	A	No new information, No change
N_2	5	C	Same Next Hop 'C' Update
N_3	9	C	New information, Add
N_6	5	C	Next hop is not C, distance is shorter 5>8 Update
N_8	4	E	Next hop is not C, distance is same, No update it means original routing table unchanged
N_9	4	F	Next hop is not C distance is greater 6>4

4. DIJKSTRA'S LINK-STATE ROUTING ALGORITHM:

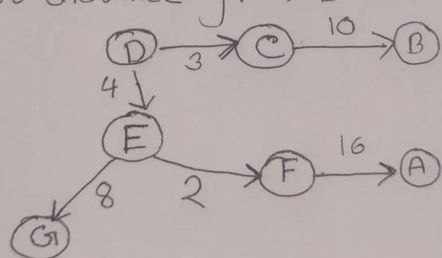
Consider the graph on the left and the use of Dijkstra's algorithm to compute a least cost path from D to all destinations. Suppose that nodes C and E have already been added to N' (Figure2).

Solution:

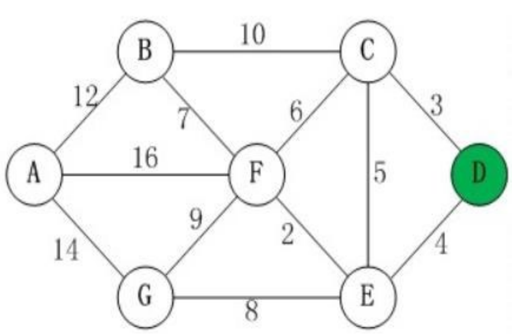
(4)

N'	D(C),p(C)	D(E),p(E)	D(B),p(B)	D(G),p(G)	D(A),p(A)	D(F),p(F)
D	3,D	4,D	∞	∞	∞	∞
DC	–	4,D	13,C	∞	∞	4,C
DCE	–	–	13,C	12,E	∞	6,E
DCEF	–	–	13,C	12,E	22,F	~~∞~~
DCEFG	–	–	13,C	–	22,F	–
DCEFGB	–	–	–	–	22,F	–
DCEFGBA						

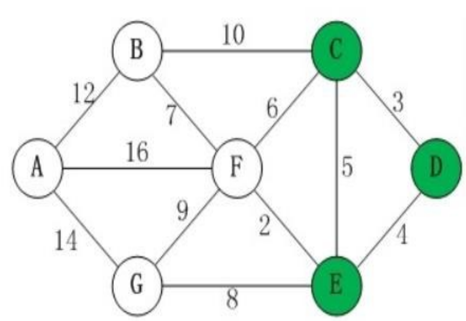
* The next node to be added to N' is F
* Shortest distance from D to A is DEFA



D →	D-C C	D-E E	D-F F	D-B B	D-G G	D-A A
Cost	3	4	6	13	12	22



(Figure1)



(Figure2)

What is the next node to be added to N'? (F, B or G?) What is the shortest distance from D to A? (Please use the Dijkstra algorithm according to the problem-solving steps taught by the teacher in class.)

*******Auxiliary information *******

Distance vector algorithm

Based on *Bellman-Ford* (BF) equation (dynamic programming):

Bellman-Ford equation

Let $D_x(y)$: cost of least-cost path from x to y.
Then:

$$D_x(y) = \min_v \{ c_{x,v} + D_v(y) \}$$

v's estimated least-cost-path cost to y

min taken over all neighbors v of x

direct cost of link from x to v

Dijkstra's link-state routing algorithm

Initialization:
  $N' = \{u\}$ /* compute least cost path from u to all other nodes */
  for all nodes v
    if v adjacent to u /* u initially knows direct-path-cost only to direct neighbors */
      then $D(v) = c_{u,v}$ /* but may not be *minimum* cost! */
    else $D(v) = \infty$

Loop
  find w not in N' such that $D(w)$ is a minimum
  add w to N'
  update $D(v)$ for all v adjacent to w and not in N' :
    $D(v) = \min (D(v),\ D(w) + c_{w,v})$
  /* new least-path-cost to v is either old least-cost-path to v or known
  least-cost-path to w plus direct-cost from w to v */
until all nodes in N'