

Class Diagram: Exercise & Solution

Question 1:

A company consists of departments. Departments are located in one or more offices. One office acts as a headquarter. Each department has a manager who is recruited from the set of employees. Your task is to model the system for the company.

Task:

Draw a class diagram which consists of all the classes in your system their attributes and operations, relationships between the classes, multiplicity specifications, and other model elements that you find appropriate.

Solution:

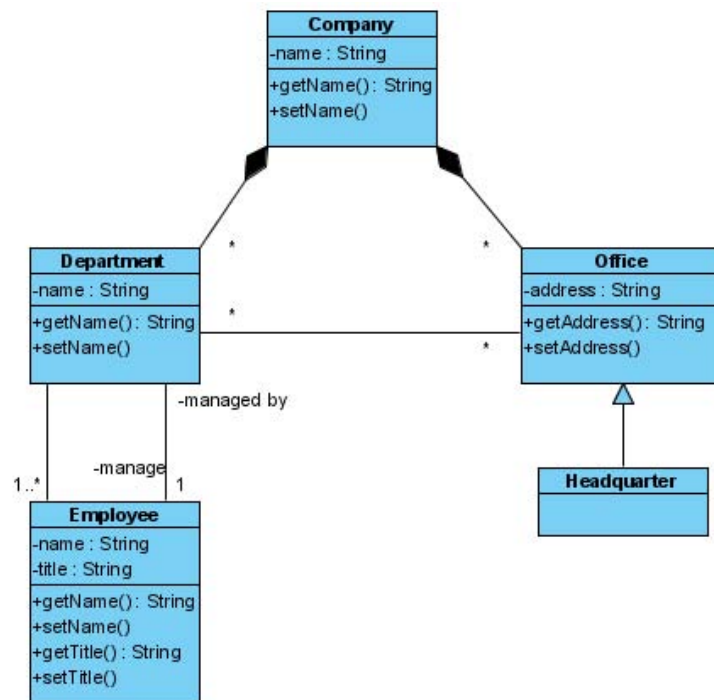


Figure 1 – Company consists of Departments Class Diagram

Question 2:

A token-ring based local-area-network (LAN) is a network consisting of nodes, in which network packets are sent around. Every node has a unique name within the network, and refers to its next node. Different kinds of nodes exist: workstations are originators of messages; servers and printers are network nodes that can receive messages. Packets contain an originator, a destination and content, and are sent around on a network. A LAN is a circular configuration of nodes.

Task:

Draw a class diagram which consists of all the classes in your system their attributes and operations, relationships between the classes, multiplicity specifications, and other model elements that you find appropriate.

Solution:

The class diagram is shown below. Note that the packet uses names for the originator and destination nodes. An alternative model would be to remove the instance variables from Packet, and to add two associations: one to Workstation (originator), and one to Server (destination). However, that solution is very hard to implement.

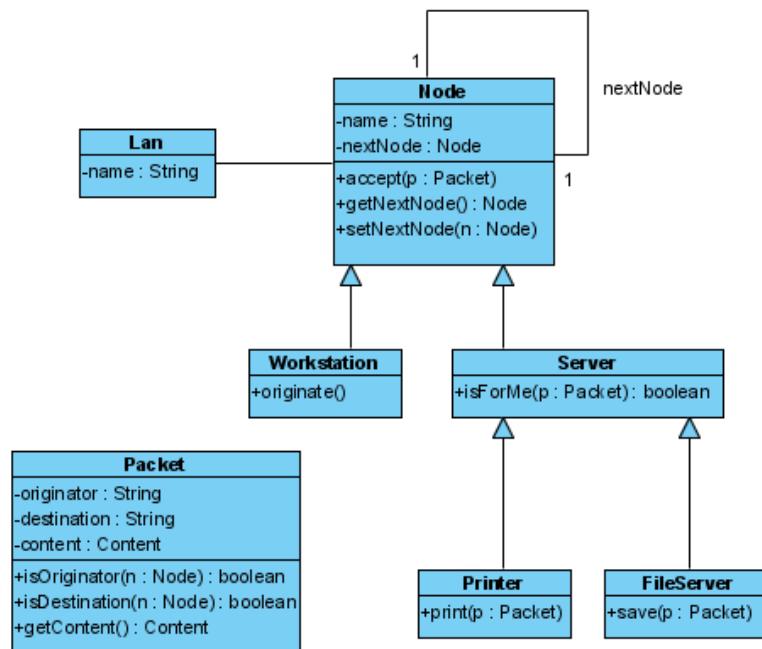


Figure 2 – A token-ring based local-area-network Class Diagram

Question 3:

Model a LAN in which we find two kinds of printers: ASCII printers can only print ASCII documents. PostScript printers can print either ASCII or Postscript documents. The documents are sent around as content of packets.

Task:

Adapt the class diagram from the previous example to support this behavior. Don't forget attributes and operations, relationships between the classes, multiplicity specifications, and other model elements that you find appropriate.

Solution

Figure 3 shows the class diagram in considering additional printing requirements. Note that no case statements or explicit checks are needed when printing documents: the double dispatch mechanism takes care of that. The pieces of code illustrate the mechanism. Figure 4 shows the double dispatch mechanism in action using a sequence diagram. Sophie sends a packet on the network, with as destination the laser printer. The printer is the next node, so it immediately arrives at the destination. The double dispatch mechanism is highlighted.

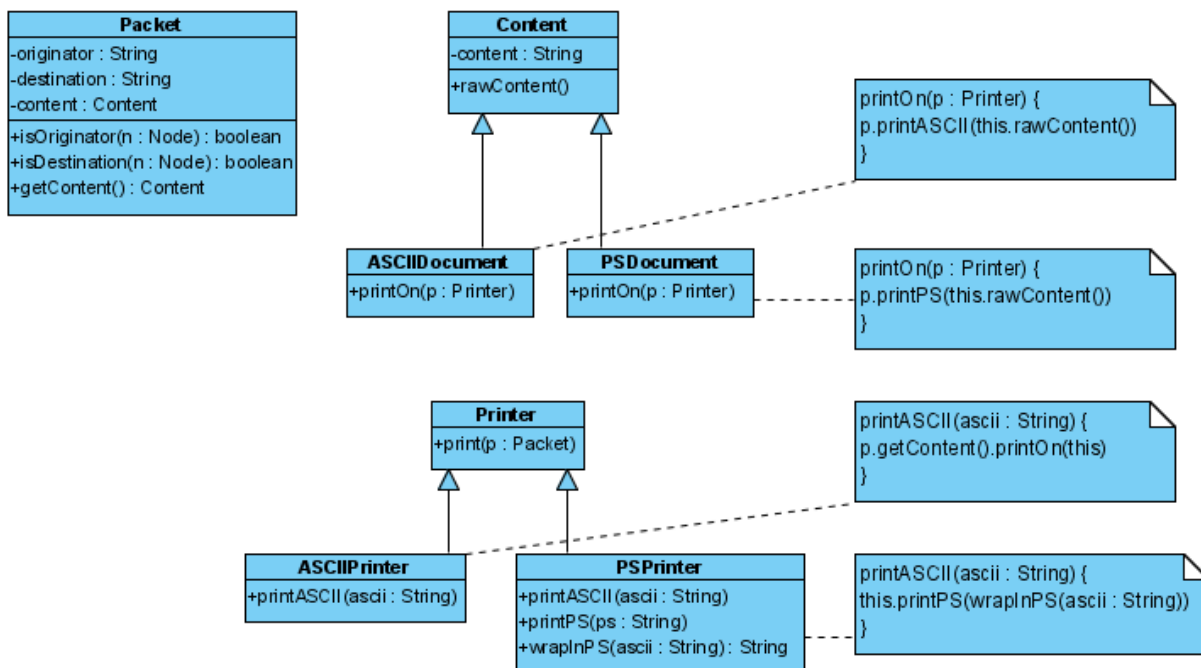


Figure 3 – Printing Refined Class Diagram

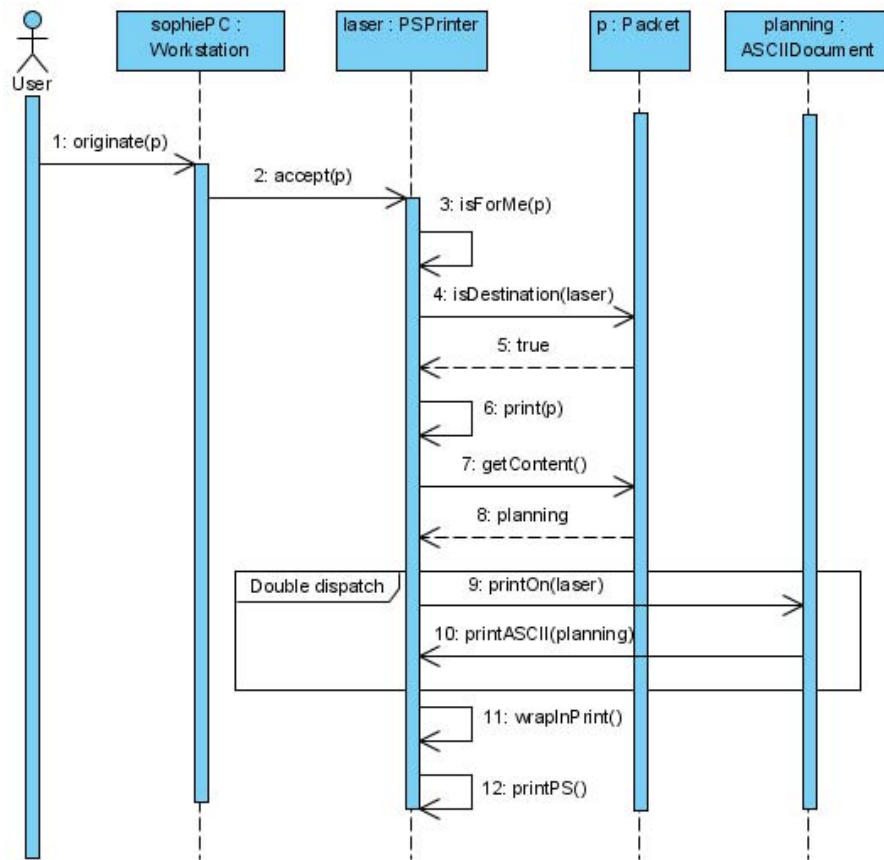


Figure 4 - The interaction diagrams shows the printing of an ASCII document on a postscript printer. The double dispatch mechanism is highlighted.

Question 4:

Token-ring LANs form a (closed) ring. Star-based networks, as commonly used with UTP based solutions, feature a central node to which all other nodes are connected (the "hub"). Apart from this topological change there is no difference in behavior between token-ring and star-based networks.

Task:

Adapt your class diagram to support Star-based networks. Don't forget attributes and operations, relationships between the classes, multiplicity specifications, and other model elements that you find appropriate.

Solution:

It is only needed to add the hub node. Every node can then with its next node point to the hub. The hub contains all its nodes. That way the hub can also do basic routing tasks, immediately passing the packet to the right node in the network.

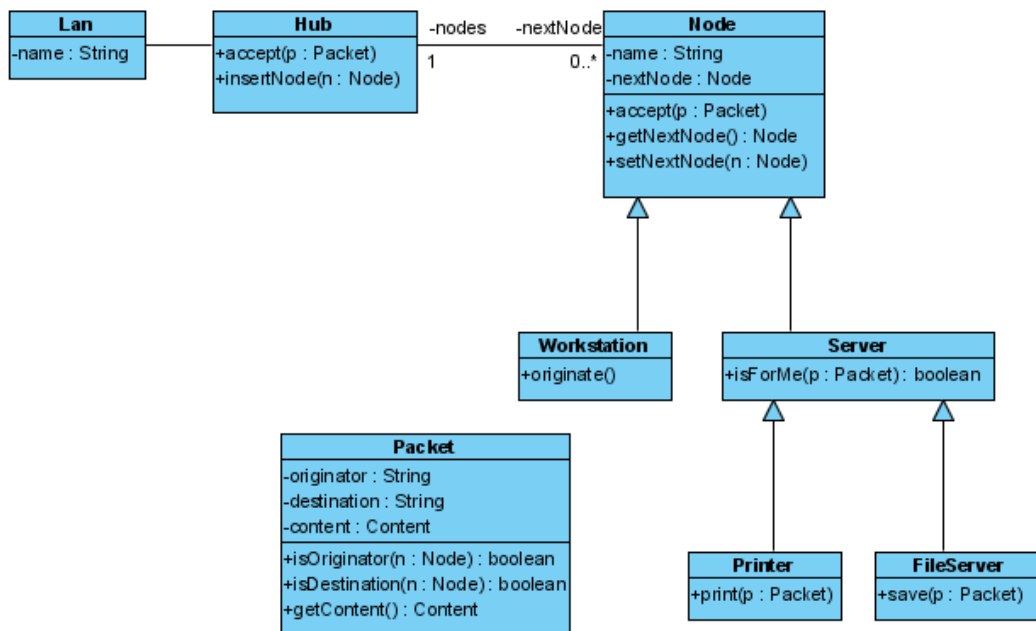


Figure 5 – A Star-based local-area-network Class Diagram