Let's suppose the DHCP server allocates address 68.85.2.101 to Bob's laptop. The DHCP server creates a **DHCP ACK message** (Section 4.4.2) containing this IP address, as well as the IP address of the DNS server (68.87.71.226), the IP address for the default gateway router (68.85.2.1), and the subnet block (68.85.2.0/24) (equivalently, the "network mask"). The DHCP message is put inside a UDP segment, which is put inside an IP datagram, which is put inside an Ethernet frame. The Ethernet frame has a source MAC address of the router's interface to the home network (00:22:6B:45:1F:1B) and a destination MAC address of Bob's laptop (00:16:D3:23:68:8A).

6. The Ethernet frame containing the DHCP ACK is sent (unicast) by the router to the switch. Because the switch is **self-learning** (Section 5.4.3) and previously received an Ethernet frame (containing the DHCP request) from Bob's laptop, the switch knows to forward a frame addressed to 00:16:D3:23:68:8A only to the output port leading to Bob's laptop.
7. Bob's laptop receives the Ethernet frame containing the DHCP ACK, extracts the IP datagram from the Ethernet frame, extracts the UDP segment from the IP datagram, and extracts the DHCP ACK message from the UDP segment. Bob's DHCP client then records its IP address and the IP address of its DNS server. It also installs the address of the default gateway into its **IP forwarding table** (Section 4.1). Bob's laptop will send all datagrams with destination address outside of its subnet 68.85.2.0/24 to the default gateway. At this point, Bob's laptop has initialized its networking components and is ready to begin processing the Web page fetch. (Note that only the last two DHCP steps of the four presented in Chapter 4 are actually necessary.)

5.7.2 Still Getting Started: DNS and ARP

When Bob types the URL for www.google.com into his Web browser, he begins the long chain of events that will eventually result in Google's home page being displayed by his Web browser. Bob's Web browser begins the process by creating a **TCP socket** (Section 2.7) that will be used to send the **HTTP request** (Section 2.2) to www.google.com. In order to create the socket, Bob's laptop will need to know the IP address of www.google.com. We learned in Section 2.5, that the **DNS protocol** is used to provide this name-to-IP-address translation service.

8. The operating system on Bob's laptop thus creates a **DNS query message** (Section 2.5.3), putting the string "www.google.com" in the question section of the DNS message. This DNS message is then placed within a UDP segment with a destination port of 53 (DNS server). The UDP segment is then placed within an IP datagram with an IP destination address of 68.87.71.226 (the address of the DNS server returned in the DHCP ACK in step 5) and a source IP address of 68.85.2.101.
9. Bob's laptop then places the datagram containing the DNS query message in an Ethernet frame. This frame will be sent (addressed, at the link layer) to the gateway router in Bob's school's network. However, even though Bob's laptop