

applications they become more difficult to update or maintain. A change requires updating the complete application rather than just a module. At some point, an expanding application that has not been created with modules has to be redesigned from the ground up into modules for better maintenance and reliability.

As discussed in Chapter 1, a search engine can display a web page interface in a browser on the user's PC. Once the user enters the search request, the information can be transmitted across the Internet to a remote server (we don't know where), which executes a search application (we don't know what program language was used to create it). The application then searches a database (we don't know what DBMS or where it is located) for the requested information. The results are sent back to the application, which in turn, sends the information back to the browser (via the web server) on the user's PC.



Figure 2-12. Three-tier modular application design

The flow of information in this process causes the design of this type of web application to naturally fall into (at least) three tiers (modules); interface tier, business rules tier, and data tier. One advantage of breaking code into different tiers is the ability to reuse tiers with multiple applications. For example, our search engine could use the same business rules tier and data tier for multiple devices while using a different interface (PC app or smart phone app). Distinct tiers can also be updated without affecting other tiers. The smart phone app interface could be updated to use the latest features of the newest operating system without changes to the business rules or data tiers. Code within the business rules tier could be updated to fix logical bugs without requiring changes to the interface or data tiers. Let's take a look at what typically occurs in each tier.

Modular Three-Tier Applications, Design, Programming—Three-tier design provides the ability to create programs that can be separated into an interface tier, business rules tier, and data tier. The interface tier contains all graphics and program code related to displaying information to the user. The business rules tier does not contain an interface. However, it processes any information submitted from the interface tier and can then submit information to the data tier to be stored. The data tier is the primary storage location for the application, which may include the use of a database. Each tier can be independently changed and built (compiled) without affecting the other tiers.

Do It

1. What are the name of the three tiers of modular design?
2. How is modular design similar to designing a building?
3. How does modular programming make coding more efficient?