IELM 231 IT for Logistics and Manufacturing
Lab 2-4. Client-Server Application

Objectives:

1. Set up a web server (IIS)
2. Create a simple Database (using MS Access)
3. Create a simple CGI program that allows data entry and retrieval from the DB via a web client (using VB 6.0)

Introduction:

Modern logistics/manufacturing systems use IT in many different ways, including accounting, personnel records, order records, forecasting, purchasing, shipment tracking etc. Typically, different tasks are handled by separate programs. However, decision support systems often require collecting some data from several such systems and using it to make decisions about some aspect. In the following labs, we will construct such a computer program: to ***design a scheduling system based on existing job orders***.

This lab is the first step of this program (sort of a mini-project).

The tasks for this lab:

Task 1. Create a simple database that stores job orders of a company. For this project, we will assume that our job data is stored in a *single table*, called *JOBS*. The data stored for each job is:

> *JobID* (should be a unique integer),
> *ProcessTime* (a floating point number denoting number of days this task will use up the company’s production capacity),
> *DueDate* (a Date when the job must be completed), and
> *LateCost* (a floating point number indicating $-penalty per day of tardiness in completion of the job.

For this lab, we shall use MS Access.

Task 2. Create a *single web page* (using HTML) that has the following *four forms*, all used for managing the Job list:
[You only need to create the forms for now, the CGI programs will be written later].

Form 1 (add a new job): will allow the user to input the data for a new Job.

Form 2 (show current jobs): allows the user to display (in a web-page) all the data for the Jobs currently in the database.

Form 3 (delete job(s)): allows the user to enter a JobID, and deletes the record of that job from the Database.

Form 4 (make schedule): when this form is submitted, a VB function will create a schedule that minimizes the total tardiness cost for all Jobs currently in the Database.

For all forms, please use: method=post. Do not fill the cgi-program-location in the action=[cgi-program-location] field for now.

Task 3. Set up the web server: IIS

The functions that must be done by the forms in Task 2 must be provided by computer programs (these programs are called CGI programs). As the application developer, you must write these functions. Also, the functions are executed when the form is submitted from a remote client (that is, some other computer on the internet). In this task, you will learn how to set up a web server, so that you can store these programs on the web server.

For the course, we use an internet server built into Windows: the IIS (Internet Information Services). IIS has multiple server programs: web-pages, email, and ftp. We will only use the web-pages for now.

Step 3.1. Start up IIS on your computer:

In Windows: Start → Control Panel (on the left, click on 'Switch to classic view', if required) → Administrative Tools → Internet Information Services → (+) IECXXX(local computer) → (+) web sites → (+) Default Web site → Right-Click → Start item

The web server program does mainly two things: (i) if a remote computer, namely a web client, requests a file, the server sends this file to the client computer, (ii) if the remote client sends a request through a form, then the server executes a CGI program; the output of the CGI program, usually in HTML or XML format, is sent back to the remote client computer.

Since remote clients will now have access to your computer (the server), therefore security is potentially an issue. To improve security, the server enforces that the client can only request for files (or CGI programs) that are located inside a nominated folder on the server hard disk. It is convenient to give this folder an alias name, for easy reference.

So, we need to tell IIS (i) in which folder we will store all our web-files, and (ii) what is its alias name:

Step 3.2. Set up a Virtual Directory:

In Windows: Set up a folder where you will keep all your web files. For this course, please create a folder: C:\ielm231\lab

In IIS: Right-Click 'Default Web Site' → New… → Virtual Directory → click 'Next'
→ In the Dialog box, enter the name of the Virtual folder. Any name is OK, but I suggest that you use Name = *ielm231*
→ Click 'Select Folder' → browse the File open dialog box and select C:\ielm231\lab
→ in the 'Access Permissions', enable (check) (i) Read, (ii) Run scripts, (iii) Execute.
→ Hit 'Next', or 'Finish' until the dialog box closes.

If all is working well, any file, e.g. *xyz.html* inside your Virtual Web Folder can now be accessed by any computer in the world, using the following address (called its ***URL***):

http://IECxxx.ielm.ust.hk/ielm231/lab/xyz.html

or, if you're sitting on the web server computer, you can type the URL:

http://localhost/ielm231/lab/xyz.html

Step 3.3: Organize all your files in subfolders

Inside the folder C:\ielm231\lab, I suggest that you create three separate folders:
(i) html, (ii) cgi (iii) db

For all labs, place all your html files in the html folder; place all your cgi files inside the cgi folder, and place all your Database files (*.mdb) inside the db folder.

Task 4. Allowing your CGI program to communicate with your Database

When your CGI program executes, it will need to access/modify data in your database. Such tasks can only be performed by the DB server program (in our case, MS Access). Therefore our CGI program needs some method to (i) start up MS Access, and (ii) Communicate the DB commands, which are themselves written in SQL language, to MS Access, (iii) receive the response from MS Access, and process this information to send back to the web client.

We need to first make sure that our CGI program to communicate with MS Access. This communication is done by a special program called an ODBC. The following steps will allow your CGI program to make a connection to MS Access and use the Database you created in Task 1.

4.1. Set up the ODBC

In Windows: The DB you will use was created in Task 1; please put the DB file inside the folder C:\ielm231\lab\db\

In Windows: Start → Control Panel → Administrative Tools → Data Sources (ODBC) → select the tab for 'System DSN' → click 'Add…' → select 'Driver do Microsoft Access (*.mdb) → click 'Finish'
→ enter a 'Data Source Name': ielm_231_lab
→ link the DB file(s) you will use: in the Database box, click 'Select…' → in the File open dialog box, browse till you locate your Database file, and select it → 'OK'

Task 5. Writing the CGI programs

Any programming language can be used to write CGI programs. In our case, we will use VB. Since CGI programs must be executable, you will need to *compile your VB programs* (in Windows, this means you should get an exe-file), and put them in the appropriate web folder on the web server.

Tasks 5.1.-5.4. Write the CGI programs for Form 1,, Form 4.

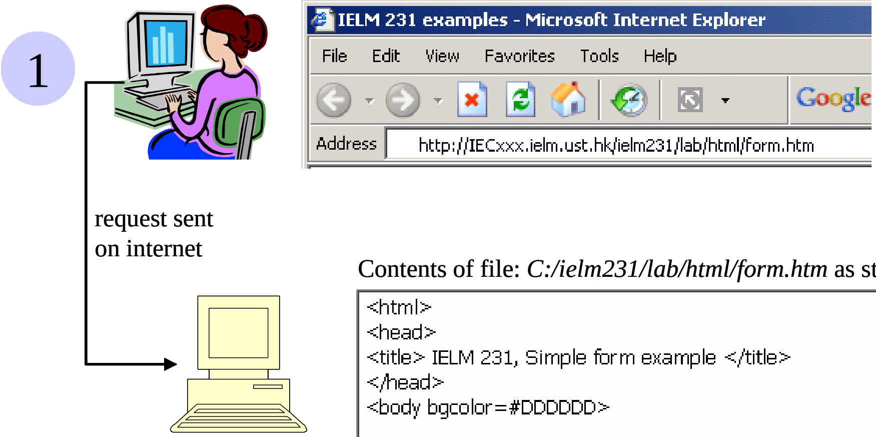
We shall use Visual Basic 6.0 to write the CGI programs in this course. It is possible to use VB.net, VB2003, Perl, php, C, C++, asp, or any other programming language, but VB6.0 is commonly available and used in many companies locally, so it's a good platform.

Before you begin to write CGI programs, please make sure you understand the different software programs and libraries that are working together. The following figure(s) may help you to get the high level idea.

Basics of Client-server applications on the web

We assume you are familiar with basic web operations, including terms such as URL, web client (e.g. Internet explorer), and web server (e.g. IIS). Let's look at a common, simple architecture for DB-backed web applications.

A simple model for web forms: The web server is the DB client

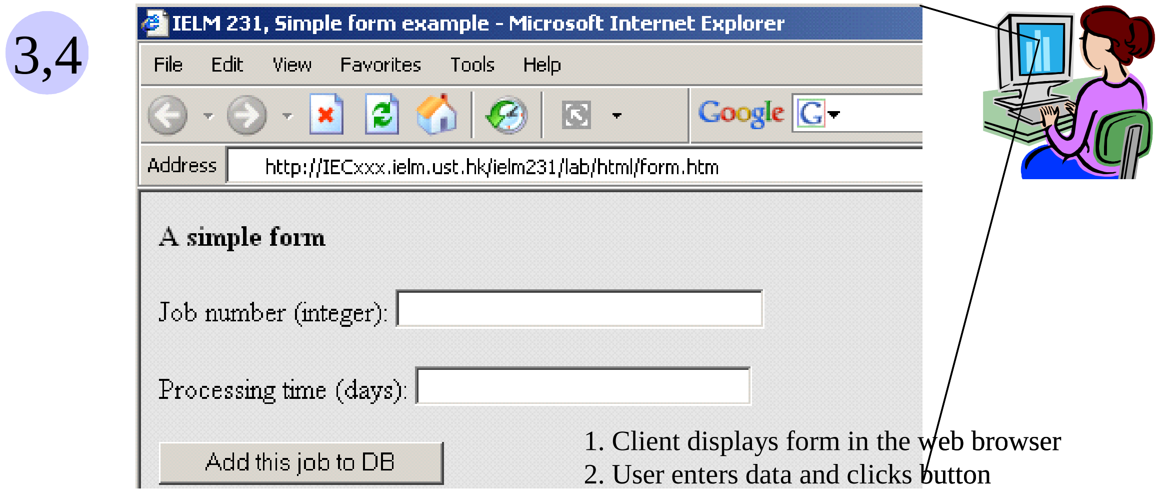

1
IELM 231 examples - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Google
Address
request sent
on internet

Address: http://IECxxx.ielm.ust.hk/ielm231/lab/html/form.htm

Contents of file: *C:/ielm231/lab/html/form.htm* as stored on the server

```
<html>
<head>
<title> IELM 231, Simple form example </title>
</head>
<body bgcolor=#DDDDDD>

<b> A simple form </b>

<form method=POST action="http://IECxxx.ielm.ust.hk/ielm330/cgi/CGI-FILENAME.exe" >

    <p> Job number (integer): <input type=text size=30 name=JobNum>
    <p> Processing time (days): <input type=text size=27 name=ProcessTime>
    <p> <input type=submit value="Add this job to DB">
</form>

</body>
</html>
```

2
file sent to client


3,4
IELM 231, Simple form example - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Google
Address
Add this job to DB

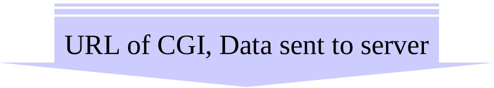
Address: http://IECxxx.ielm.ust.hk/ielm231/lab/html/form.htm

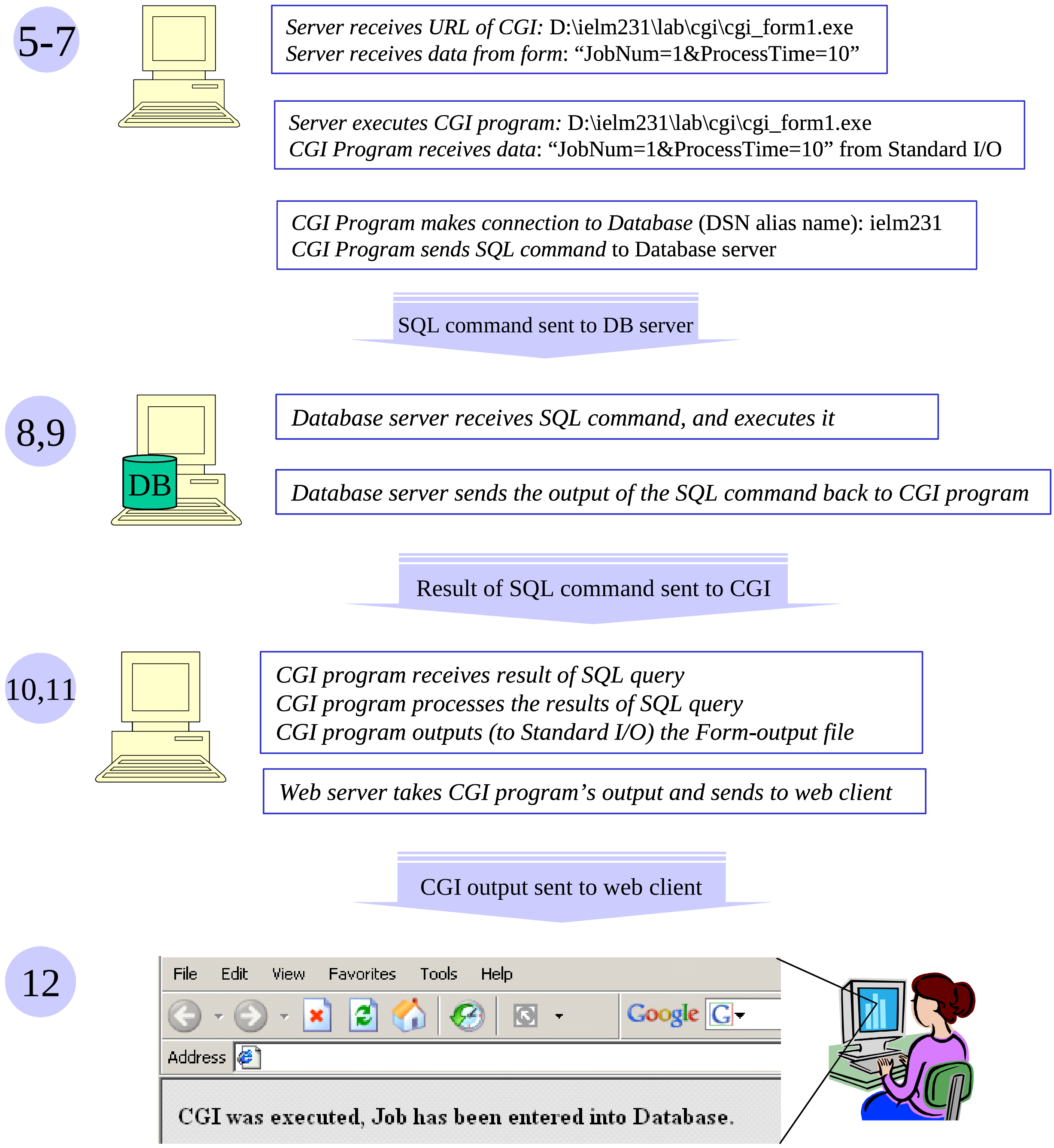
A simple form

Job number (integer):

Processing time (days):

1. Client displays form in the web browser
2. User enters data and clicks button





5-7

Server receives URL of CGI: D:\ielm231\lab\cgi\cgi_form1.exe
Server receives data from form: “JobNum=1&ProcessTime=10”

Server executes CGI program: D:\ielm231\lab\cgi\cgi_form1.exe
CGI Program receives data: “JobNum=1&ProcessTime=10” from Standard I/O

CGI Program makes connection to Database (DSN alias name): ielm231
CGI Program sends SQL command to Database server

SQL command sent to DB server

8,9

Database server receives SQL command, and executes it

Database server sends the output of the SQL command back to CGI program

Result of SQL command sent to CGI

10,11

CGI program receives result of SQL query
CGI program processes the results of SQL query
CGI program outputs (to Standard I/O) the Form-output file

Web server takes CGI program’s output and sends to web client

CGI output sent to web client

12

CGI was executed, Job has been entered into Database.

Notice here that in steps 5-11, I draw a different image for the Web server and the Database server. In our labs, in fact we shall run the DB server on the same computer as the web server, but in practice, the CGI program can connect to any DB server that is on the internet.

~~~~~~~~~

Finally, let’s take a brief look at how the actual communications between the different programs/libraries take place. The best way to do so is to read carefully and modify the sample VB program file (it has many comments to help you to understand it). Initially, please
~~~~~~~~~

use the simple VB code file and modify it for your use. Later, we will give a longer VB file, but with several useful functions to help you write better CGI's.

Some other comments:

1. The connection from any VB program to MS Access is managed by a library called ***ADO*** (**A**ctive **D**ata **O**bject). Therefore your VB program will refer to an ***adodb*** object.

2. If your form uses ***method=post***, then the web server will present the data sent by the form to your CGI program as if it is being typed into the standard i/o (thus, the CGI program is written pretending that the input is coming from the keyboard).

3. The data received by the CGI program (from the form, and from the Database server) is formatted in special way; it is tedious to write your own functions to extract this data, it is easier to just use some functions already written by others to handle this data. That is what we shall do.

~~~~~~~~
~~~~~~~~