

# Fundamentals of Software Engineering

## Week 7 Lab Exercise: Computer Systems Architecture

The Objective for this activity is to investigate the use of Tiers in computer systems architecture and to consider how this approach may be used in an information systems application. This activity also considers the idea of virtualization. To try and put the ideas discussed in perspective you are provided with some links to videos on YouTube. You should watch these videos and make some notes on the main points that are being discussed.

This activity is more of a reading activity than a doing activity.

### **Virtualization**

Virtualization is the situation where you try and utilize a bigger proportion of the resources that a computer has available by “turning” it into a number of virtual computers each with its own operating system.

The video in the link below outlines these ideas in details. Please watch the video carefully and make your own notes.

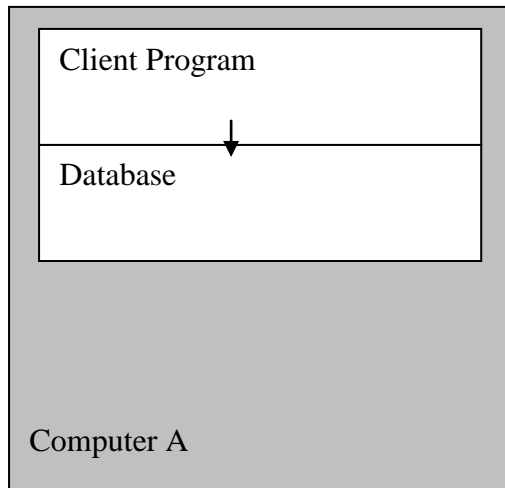
<https://www.youtube.com/watch?v=MnNX13yBzAU>

The presenter Dan Chu that is given the overview of virtualization works for one of the biggest vendors of virtualization software. The company is called VMware. The lab machines that we use at the GCU Glasgow campus all make use of VMware images to provide students with access to a range of specialist applications.

## Tiered Database Architectures

### Scenario 1 Single Tier Application

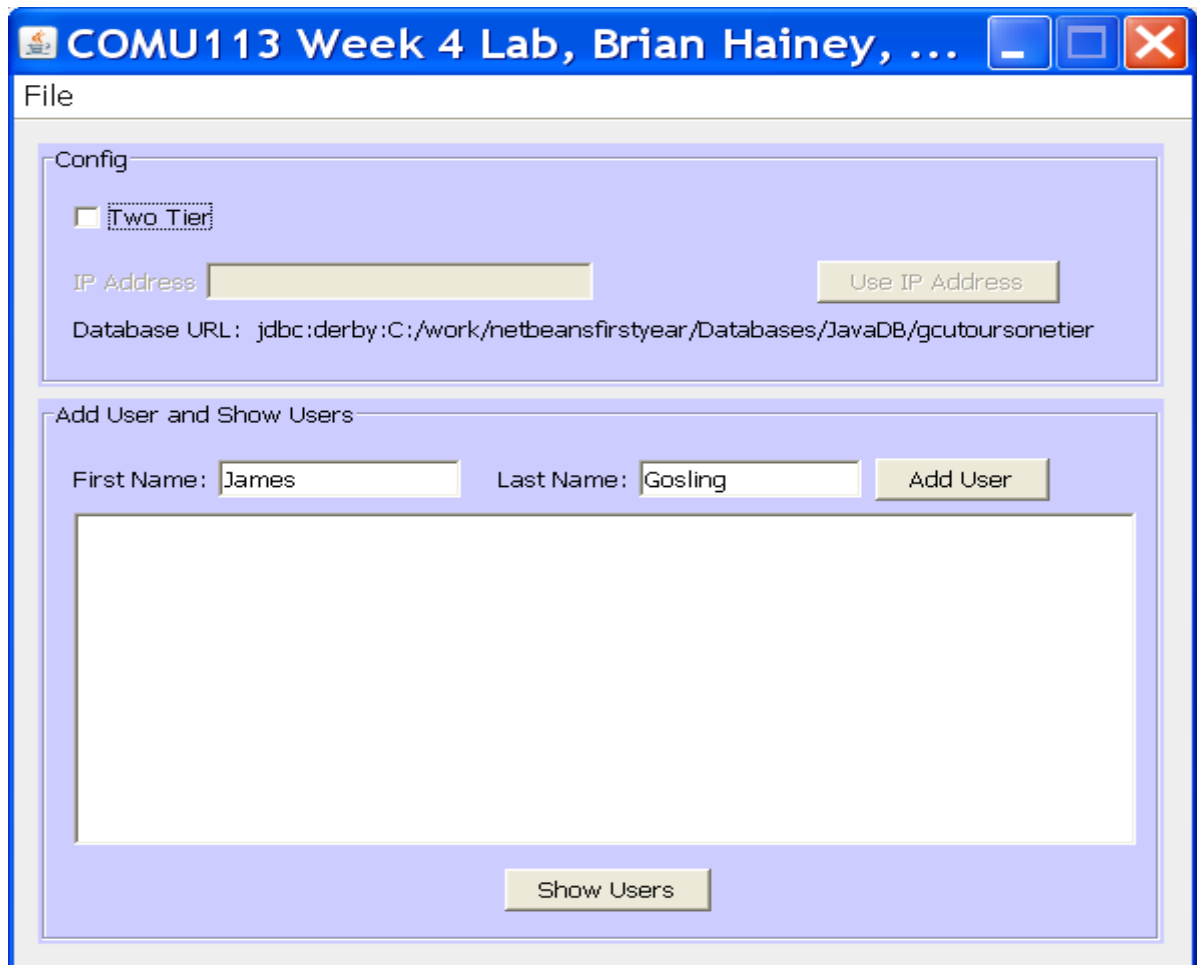
The diagram below illustrates the simplest application set up for an information system. In this set up we have an application running on a single computer. In the application the Database and the code accessing the Data are contained in a single application. This is referred to as a single tier application.



### Single Tier

**In this example the database is private.  
It is used only by this client program.**

The screen capture below illustrates the interface of a simple Java application which implements this application.



**Figure 1**

The application has 2 functions:

You can

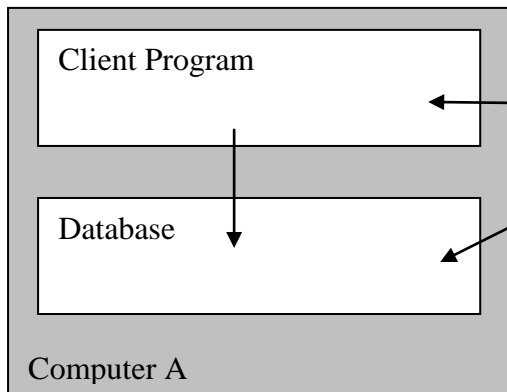
- Click show users and a list of users in the database will be displayed
- Enter a First Name and Last Name in the boxes provided and then Add the entry to the database.

Questions

What do you think some of the drawbacks to this approach are?

## Scenario 2 Two Tier Application where the Tiers are physically separated on the same computer

In this arrangement we still have a single computer but the Client Program accessing the Database is now physically separated from the Database



### Two Tier – *Logically Separated*

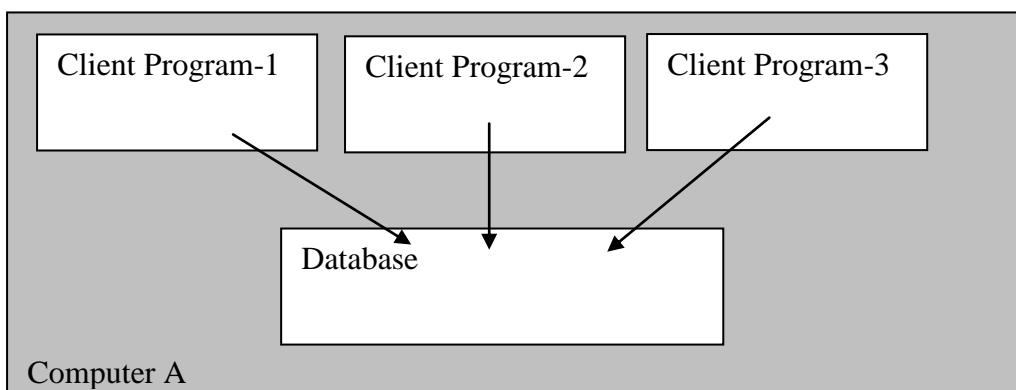
Client Tier

Server Tier

The tiers are *logically* separated since they run under the same computer. The database is a separate entity, accessed by the client program through some communications mechanism.

In the application that was illustrated in Figure 1 there was a check box to allow the application to run in 2 tier mode. Clicking on this box make a box labelled IP address to become active. The IP address is a way of uniquely identifying a computer. When you are trying to access an application on the same computer you can utilise a special IP address to do this. This IP address is 127.0.0.1. If you enter this value and then press Use IP address the Java app will access the separate Database running on the same machine rather than the build in database to the application.

The diagram which follows shows the Database being accessed by several client applications.



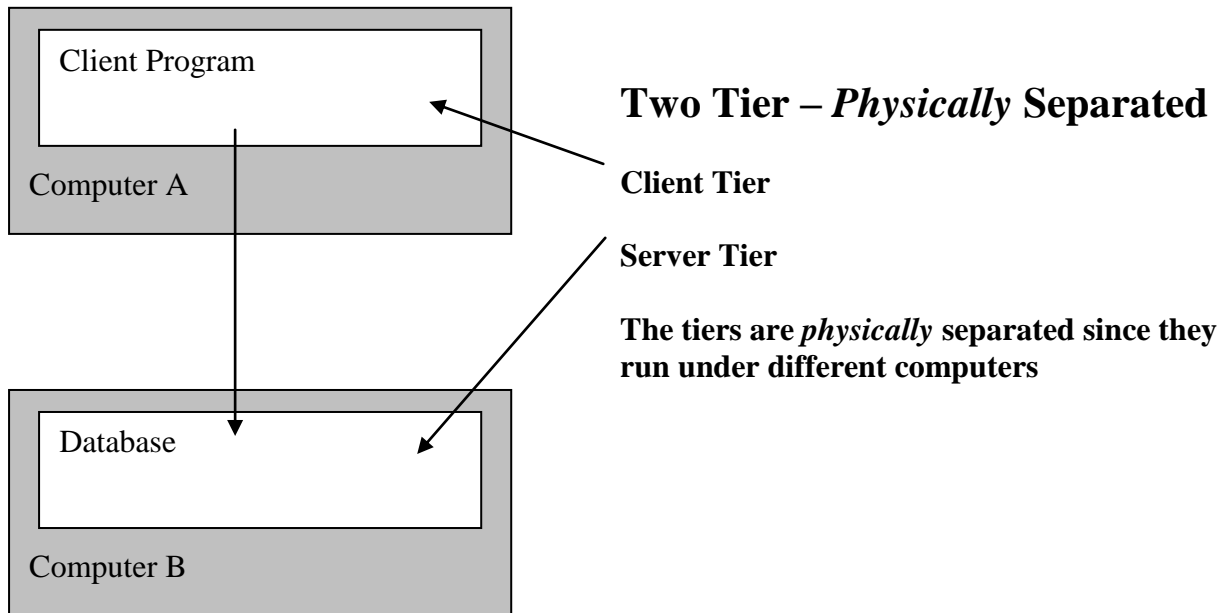
### Question

What are the drawbacks to this arrangement?

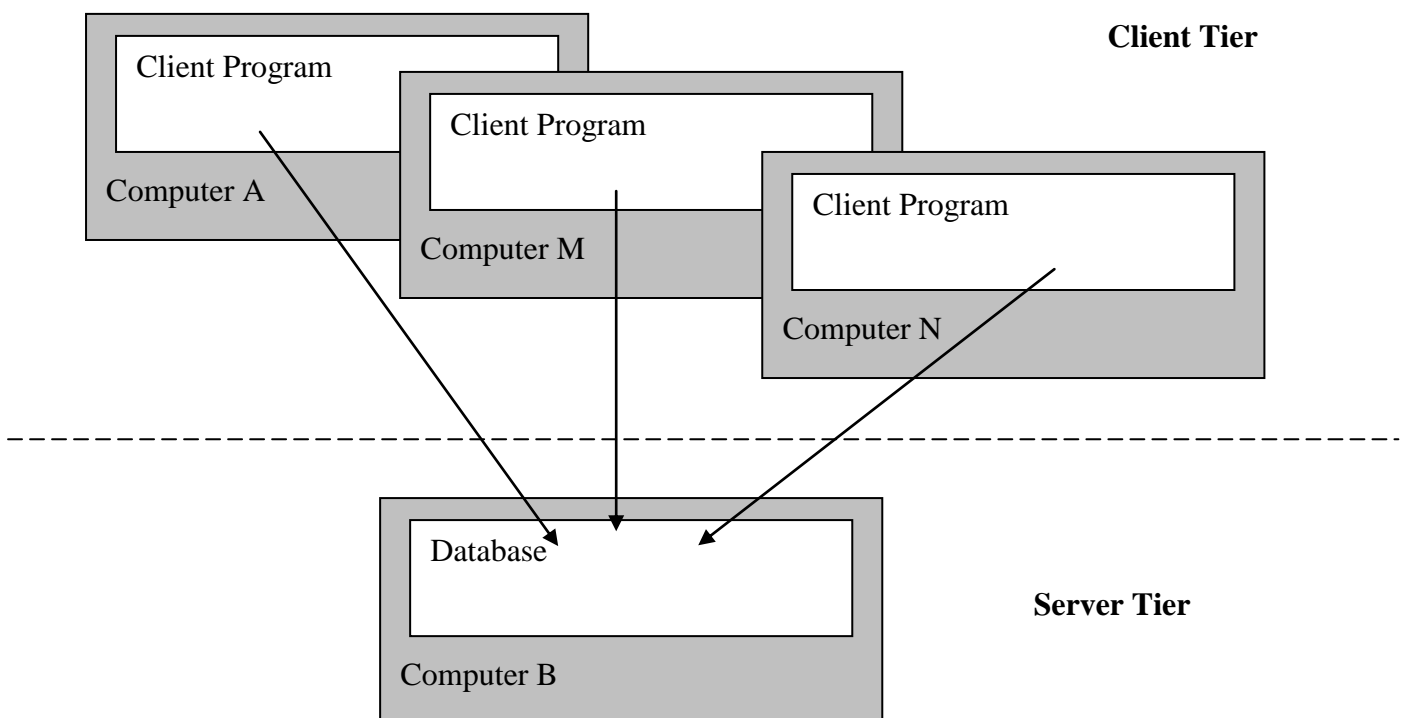
What do you think the logical development of this set up is?

### Scenario 3 Two Tier Application where the Tiers are physically separated on the same computer

The next logical development is to separate the machines that the client and the database run on. This is shown in the diagram below.



In order to this the Client app needs to know the IP address of the computer on which the database is running. This value is used as part of the request to access data on the database running on a machine with that specific IP address.

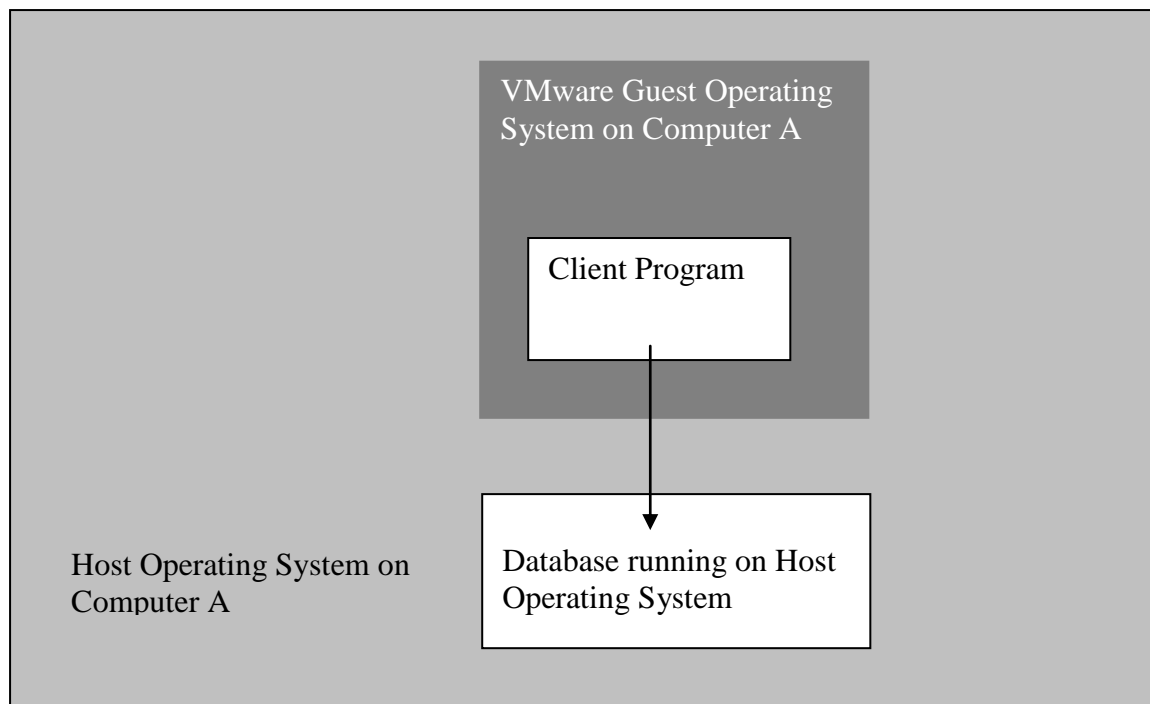


This is a typical use of a 2 tier architecture. The database runs on a separate machine and multiple computers run a client application that allows each one to access the information in the Database. A typical use of this set up would be some form of inventory control system. The database could store information about car parts, electronic parts etc. This allows multiple people in an organisation to access the information held in the database. The client application may implement different roles. Some users will only be able to view the date which other may be able to view update, add and delete entries in the Database.

## Virtualisation

So what does Virtualisation bring to this mix? If you have viewed the VMware YouTube video on virtualization you will have learned that Virtualization involves running a “virtual operating system” within a host operating system.

The diagram below illustrates one set up where virtualisation is used.



In this situation the client application is running in a virtual machine and the Database is running on a host computer. Again the key to achieving this set up is knowing the IP address of the host machine.

So there is scope for generalising this now.

In the diagram below we now have the set up where we have 4 VMware images running on a single computer. In this case I have chosen to show each virtual machine running a single application which just happens to be a Database. Each Database can be accessed by multiple clients literally from anywhere in the world.

Note that when we use the term Database we are referring to an application with a significant amount of functionality (Add, Delete, Update etc.) not just a simple file.



Where do you think the computer that is running GCULearn is situated?

### **Virtualization and Data Centers**

To further explore this topic you should watch the following videos on YouTube. The videos will give you some idea of the enormity of the Google Empire but will probably not answer the question of where your emails in your Gmail accounts are held! The virtualization Technology that was previously discussed will be utilized in the Google Data Centers.

Google container Data Centre <https://www.youtube.com/watch?v=zRwPSFpLX8I>

Google Data Centre in South Carolina  
<https://www.youtube.com/watch?v=XZmGGAbHqa0>

Where is your nearest Google Data Centre? See the link below if you are not sure.

<https://www.google.com/about/datacenters/inside/locations/index.html>

Companies such as Amazon, Ebay etc. will utilise virtualisation technology in their Data Centres. Amazon also provides a lot of software to allow developers to utilise the services that it provides. You will learn more about this type of technology in other modules on your programme of study.