



كلية الهندسة – جامعة المنصورة

**Lab**

**C1115**

**C 1115      معمل معمار الحاسب**

Computers and Control Systems Engineering Department

قسم هندسة الحاسبات ونظم التحكم

# Laboratory Book

Computers and Control Systems Engineering Department

2021

C1115      معمل معمار الحاسب

# **Laboratory Book**

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## 1: Laboratory Basic Information

أولا : البيانات الأساسية للمعمل

معمار الحاسب	إسم المعمل:
هندسة الحاسبات ونظم التحكم	القسم العلمي:
أ.م.د.ليب محمد ليب	المشرف :
م. ماري مينا فؤاد	مهندس المعمل:
م.أمل لطفى م.آيه كشك م.أحمد طارق	أعضاء الهيئة المعاونه :
داخلي 1279.	التليفون:
الناحية البحرية.	الموقع بالنسبة للكلية:
120 متر <sup>2</sup> .	مساحة المعمل:

## 2: Laboratory Instruments

ثانياً: قائمة بالأجهزة والمعدات الموجودة بالمعمل

Serial Number	العدد	إسم الجهاز	م
core i5, 4GB, 500GB	21	Dell optiplex 5050	1
MB Gigabyte H61	1	CPU Intel Pentium 2020	2
EWI-8084	1	Smart Board	3
CISCORouter 801	3	Cisco Routers	4
CiscoSwitch 801	3	Cisco Switches	5
Samsung	1	Projector	6

### 3: Laboratory Experimental List

ثالثاً: قائمة بالتجارب التي تؤدي داخل المعمل

م	التجربة	الغرض منها
1	التجارب العلمية الخاصة لمقرر شبكات الحاسب	مقرر شبكات الحاسب الفرقة الأولى - الفصل الدراسي الثاني.
2	Experiment: Lab 1: Experiment : Lab 2: Experiment : Lab 3: Experiment : Lab 4: Experiment : Lab 5: Experiment : Lab 6 Experiment: Lab7 Experiment : Lab8 Experiment Lab 10 Experiment : Lab11 Experiment : Lab12	PC To Lan Cofiguration Straight-Through Cable Construction Crossover Cable Construction Building a Peer-to-Peer Network Building a Switch-based Network IP Addressing Basics Basic Subnetting Establishing a Console Connection to a Router or Switch Connecting Router LAN Interfaces Creating a Small Lab Topology Basic Router Configuration
3	التجارب العلمية الخاصة لمقرر شبكات الحاسب	مقرر برمجة الشبكات الفرقة الرابعة - الفصل الدراسي الأول.
4	التجارب العلمية الخاصة لقواعد البيانات (1)	مقرر قواعد البيانات 1 الفرقة الثالثة - فصل الدراسي الأول

## 4: Laboratory Beneficiaries

رابعاً: الخدمات المجتمعية التي يؤديها المعمل:

- عدد المستفيدين من المعمل: 200 طالب (اسبوعيا)
- الجهات التي تتعاون مع المعمل: لا يوجد
- الدخل السنوي للمعمل: لا يوجد
- الجهات الممولة لأنشطة المعمل: لا يوجد
- المشاريع التنافسية التي يشارك فيها المعمل: مشاريع التخرج الخاصة بطلاب الصف الرابع – قسم هندسة الحاسبات و نظم التحكم.

## 5: Laboratory Student Beneficiaries

خامساً: الخدمات الطلابية التي يؤديها المعمل:

عدد الطلاب المستفيدين من المعمل	في خلال مده اسبوع 200 طالب
الأقسام العلمية المستفيدة من المعمل	قسم هندسة الحاسبات والنظم
الفرق الدراسيه المستفيدة من المعمل	الفرقه الاولى-الفرقه الثانيه-الفرقه الثالثه-الفرقه الرابعه من قسم هندسه الحاسبات ونظم التحكم
المقررات الدراسية التي تستفيد من المعمل	تصميم رقمى و منطقى 1 – تصميم رقمى و منطقى 2 – نظم تشغيل 1.
الأنشطة الطلابية داخل المعمل	ندوات طلابية – اجتماعات اللجنة العلمية للقسم – عقد جلسات مناقشة حلقات البحث لطلاب تمهيدى الماجستير و دبلومة الحاسبات – مناقشة مشاريع التخرج لطلاب قسم هندسة الحاسبات و نظم التحكم - عقد جلسات الامتحانات الشفوية لمادة نظم التشغيل – عقد الامتحانات العملية لمادة تصميم رقمى 1 و تصميم رقمى 2 – التدريب الصيفى لطلاب الصف الاول بقسم هندسة الحاسبات و نظم التحكم.
عدد طلاب الدراسات العليا المستفيدين من المعمل	80 طالب ضمن تمهيدى هندسة الحاسبات و دبلومة الحاسبات.
الرسائل العلميه التى تمت في المعمل	تطبيق الجزء العملى فى الرسائل العلميه الخاصه بالنظم الموزعه و انظمه المتشبتكات الحسايبه و نظم حمايه الشبكات و ذلك خلال (2011 الى 2020)
عدد الدورات التدريبية التي تمت في المعمل	عقد دورتين تدريبيتين لتدريب طلاب القسم فى انظمة قواعد البيانات Oracle و قام بالتدريس اعضاء الهيئة المعاونة و اعضاء هيئة التدريس بقسم هندسة الحاسبات ونظم التحكم.
المسابقات العملية التي شارك فيها طلاب من المستفيدين من المعمل	مسابقات خاصة بمشاريع التخرج الخاصة بطلاب القسم ضمن يوم المهندس المصرى – مؤسسة مصر المحروسة – ايتيدا _ ROV



## **6: Laboratory Experimental**

سادساً: التجارب المعملية

## التجربة الأولى

### ■ بيانات عامة:

### Experiment: Lab 1: PC Network TCP/IP Configuration.

الفرقة المقرر عليها التجربة: الفرقة الاولى

الفصل الدراسي: الثاني

■ الأدوات المطلوبة للتجربة: Set of workstation

■ الأساس النظري للتجربة:

### OBJECTIVE

- Identify tools used to discover a computer network configuration with various operating systems.
- Network address information.
- Compare network information to other PCs on the network

### BACKGROUND

This lab assumes the use of any version of Windows. This is a non-destructive lab and can be done on any machine without concern of changing the system configuration. Ideally, this lab is performed in a classroom or other LAN environment that connects to the Internet.

### ■ خطوات تنفيذ التجربة:

**Note:** All users complete Step 1

#### STEP 1: Gather TCP/IP configuration information

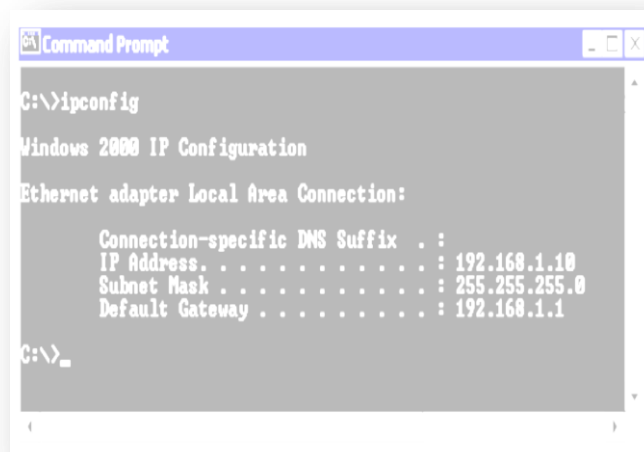
Use the Start menu to open the Command Prompt, an MS-DOS-like window. Press:

**Start > Programs > Accessories >**

**Command Prompt** or

**Start > Programs > Command Prompt.**

The following figure shows the Command screen. Type **ipconfig** and press the **Enter** key. The spelling of **ipconfig** is critical while case is not. It is short for IP Configuration.



This first screen shows the IP address, subnet mask, and default gateway. The IP address and the default gateway should be in the same network or subnet, otherwise this host would not be able to communicate outside the network. In the figure the subnet mask tells us that the first three octets must be the same to be in the same network.

#### STEP 2: Record the following TCP/IP information for this computer




IP address: \_\_\_\_\_

Subnet Mask: \_\_\_\_\_

Default Gateway: \_\_\_\_\_

### STEP 3: Compare the TCP/IP configuration of this computer to others on the LAN

If this computer is on a LAN, compare the information of several machines.

-  Are there any similarities? \_\_\_\_\_
-  What is similar about the IP addresses? \_\_\_\_\_
-  What is similar about the default gateways? \_\_\_\_\_

The IP addresses should share the same network portion. All machines in the LAN should share the same default gateway.

**Record a couple of the IP Addresses:**

\_\_\_\_\_

### STEP 10: Check additional TCP/IP configuration information

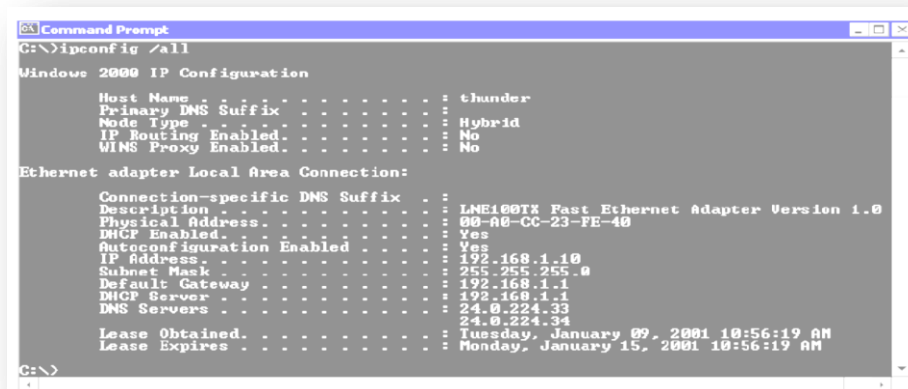
To see detailed information, type **ipconfig /all** and press **Enter**. The figure shows the detailed IP configuration screen.

**Notice** the Physical Address (MAC) and the NIC model (Description). In the LAN, what similarities about the Physical (MAC) Addresses are seen?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



While \_\_\_\_\_ not \_\_\_\_\_ a \_\_\_\_\_ requirement, most LAN administrators try to standardize components like NICs. Therefore, it would not be surprising to find all machines share the first three Hex pairs in the adapter address. These three pairs identify the manufacturer of the adapter.

**Write down the IP addresses of any servers listed:**

\_\_\_\_\_

**Write down the computer Host Name:**

\_\_\_\_\_

**Write down the Host Names of a couple other computers:**


\_\_\_\_\_


Do all of the servers and workstations share the same network portion of the IP address as the student workstation? \_\_\_\_\_

## التجربة الثانية

### ■ بيانات عامة:

## Experiment : Lab 2: Straight-Through Cable Construction

الفرقة المقرر عليها التجربة: الفرقة الاولى 

الفصل الدراسي: الثاني 

○ الأدوات المطلوبة للتجربة:

The following resources will be required:

- One 0.6 to .9 m (2 to 3 ft) length of Cat 5 cabling per person or team
- Four RJ-45 connectors, two are extra for spares
- RJ-45 crimping tools to attach the RJ-45 connectors to the cable ends
- Ethernet cabling continuity tester which can test straight-thru or crossover type cables, T568-A or T568-B
- Wire cutters

### ■ الأساس النظري للتجربة:

## OBJECTIVE

- Build a Category 5 or Category 5e (CAT 5 or 5e) Unshielded Twisted Pair (UTP) Ethernet network patch cable or patch cord.
- Test the cable for continuity and correct **pinouts**, the correct color of wire on the right pin.

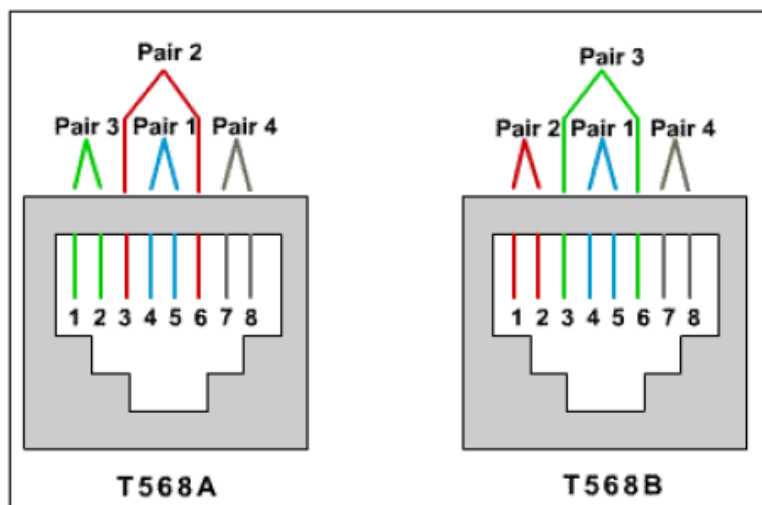
## BACKGROUND

The cable constructed will be a four-pair, eight-wire, straight-through cable, which means that the color of wire on Pin 1 on one end of the cable will be the same as that of Pin 1 on the other end. Pin 2 will be the same as Pin 2, and so on. The cable will be wired to either *TIA/EIA T568B* or *T568A* standards for 10BASE-T Ethernet, which determines what color wire is on each pin. T568-B, also called AT&T specification, is more common in the U.S., but many installations are also wired to T568-A, also called ISDN.

Prior to starting the lab, the teacher or lab assistant should have a spool of Cat 5 Unshielded Twisted Pair (UTP) cable, RJ-45 (8-pin) connectors, an RJ-45 crimping tool and an Ethernet / RJ-45 continuity tester available. Work individually or in teams.

### ☞ CABLING PIN-OUT INFORMATION FOR T568-B

Diagram showing both T568-A and T568-B cabling wire colors



Pin #	Pair #	Function	Wire Color	Used with 10/100 BASE-T Ethernet?	Used with 100 BASE-T4 and 1000 BASE-T Ethernet?
1	2	Transmit	White/Orange	Yes	Yes
2	2	Transmit	Orange	Yes	Yes
3	3	Receive	White/Green	Yes	Yes
4	1	Not used	Blue	No	Yes
5	1	Not used	White/Blue	No	Yes
6	3	Receive	Green	Yes	Yes
7	4	Not used	White/Brown	No	Yes
8	4	Not used	Brown	No	Yes

Use the preceding table and diagram to create a T568-B patch panel cable. Both cable ends should be wired the same when looking at the conductors.

### STEP 1

Determine the distance between devices or device and plug. Add at least 30.48 cm (12 in.) to the distance. The maximum length for this cable, according to TIA/EIA structured wiring standards is 3 m (9.84 ft), although this can vary. Standard lengths are 1.83 m (6ft) and 3.05 m (10 ft).

### STEP 2

Cut a piece of stranded Cat UTP cable to the desired length. Use stranded cable for patch cables because it is more durable when bent repeatedly. Solid wire is used for cable runs that are punched down into jacks.

### STEP 3

Strip 5.08 cm (2 in.) of jacket off of one end of the cable.

#### **STEP 4**

Hold the four pairs of twisted cables tightly where jacket was cut away. Reorganize the cable pairs into the order of the T568-B wiring standard. Take care to maintain as much of the twists as possible since this provides noise cancellation.

#### **STEP 5**

Hold the jacket and cable in one hand and untwist a short length of the green and blue pairs. Reorder the pairs to reflect the T568-B wiring color scheme. Untwist and order the rest of the wire pairs according to the color scheme.

#### **STEP 6**

Flatten, straighten, and line up the wires. Trim them in a straight line to within 1.25 to 1.9 cm (1/2 to 3/4 in.) from the edge of the jacket. Be sure not to let go of the jacket and the wires, which are now in the proper order. Minimize the length of untwisted wires because sections that are too long and near connectors are a primary source of electrical noise.

#### **STEP 7**

Place an RJ-45 plug on the end of the cable, with the prong on the underside and the orange pair to the left side of the connector.

#### **STEP 8**

Gently push the plug onto wires until the copper ends of the wires can be seen through the end of the plug. Make sure the end of the jacket is inside the plug. This provides for stress relief and to ensure that all wires are in the correct order. If the jacket is not inside the plug, the plug will not be properly gripped and will eventually cause problems. If everything is correct, crimp the plug hard enough to force the contacts through the insulation on the wires, completing the conducting path.

#### **STEP 9**

Repeat Steps 3 through 8 to terminate the other end of the cable. Use the same scheme to finish the straight through cable.

#### **STEP 10**

Test the finished cable. Have the instructor check the finished cable. How is it possible to tell if the cable is functioning properly?

## التجربة الثالثة

■ بيانات عامة:

### Experiment : Lab 3: Crossover Cable Construction

الفرقة المقرر عليها التجربة: الفرقة الاولى

الفصل الدراسي: الثاني

الأدوات المطلوبة للتجربة:

- ☐ Set of workstation.
- ☐ One 0.6 to .9 m (2 to 3 ft) length of Cat 5 cabling per person or team.
- ☐ Four RJ-45 connectors, two are extra for spares.
- ☐ RJ-45 crimping tools to attach the RJ-45 connectors to the cable ends.
- ☐ Ethernet cabling continuity tester which can test crossover type cables, T568-A to T568-B.
- ☐ Wire cutters.

#### OBJECTIVE

- Build a Category 5 or Category 5e (CAT 5 or 5e) Unshielded Twisted Pair (UTP) Ethernet crossover cable to T568-B and T-568-A standards.
- Test the cable for continuity and correct pin-outs, correct wire on the right pin.

#### BACKGROUND.

This will be a 4-pair "crossover" cable. A crossover cable means that the second and third pairs on one end of the cable will be reversed on the other end. The pin-outs will be T568-A on one end and T568-B on the other end. All 8 conductors (wires) should be terminated with RJ-45 modular connectors.

This patch cable will conform to the structured cabling standards. If the patch cable is used between hubs or switches, it is considered to be part of the "vertical" cabling. Vertical cabling is also called backbone cabling. A crossover cable can be used as a backbone cable to connect two or more hubs or switches in a LAN, or to connect two isolated workstations to create a mini-LAN. This will allow the connection of two workstations or a server and a workstation without the need for a hub between them. This can be very helpful for training and testing. To connect more than two workstations, a hub or a switch will be needed.

Prior to starting the lab, the teacher or lab assistant should have a spool of Cat 5 or Cat 5e UTP cable, RJ-45 (8-pin) connectors, a RJ-45 crimping tool and an Ethernet / RJ-45 continuity tester available. Work individually or in teams. The following resources will be required:

#### STEP 1

Create a crossover cable using the following tables and diagrams. One end of the cable should be wired to the T568-A standard. The other end should be wired to the T568-B standard. This crosses the transmit pairs and the receive pairs, the second and third pair, to allow communication to take place. Only four wires are used with 10BASE-T or 100BASE-TX Ethernet.

T568-A Cabling					
Pin #	Pair #	Function	Wire Color	Used with 10/100 BASE-T Ethernet?	Used with 100 BASE-T4 and 1000 BASE-T Ethernet?
1	3	Transmit	White/Green	Yes	Yes
2	3	Transmit	Green	Yes	Yes
3	2	Receive	White/Orange	Yes	Yes
4	1	Not used	Blue	No	Yes
5	1	Not used	White/Blue	No	Yes
6	2	Receive	Orange	Yes	Yes
7	4	Not used	White/Brown	No	Yes
8	4	Not used	Brown	No	Yes

T568-B Cabling					
Pin #	Pair #	Function	Wire Color	Used with 10/100 BASE-T Ethernet?	Used with 100 BASE-T4 and 1000 BASE-T Ethernet?
1	2	Transmit	White/Orange	Yes	Yes
2	2	Transmit	Orange/White	Yes	Yes
3	3	Receive	White/Green	Yes	Yes
4	1	Not used	Blue/White	No	Yes
5	1	Not used	White/Blue	No	Yes
6	3	Receive	Green/White	Yes	Yes
7	4	Not used	White/Brown	No	Yes
8	4	Not used	Brown/White	No	Yes

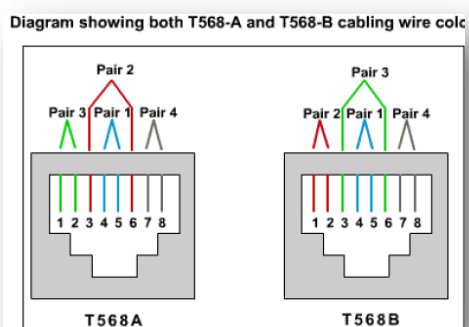
## STEP 2

Determine the distance between devices, or device and plug, and then add at least 30.48 cm (12 in.) to it. Standard lengths for this cable are 1.83 m (6 ft) and 3.05 m (10 ft).

## STEP 3

Determine the distance between devices, or device and plug, and then add at least 30.48 cm (12 in.) to it. Standard lengths for this cable are 1.83 m (6 ft) and 3.05 m (10 ft).

**STEP 4 :**Strip 5.08 cm 9 (2in.) of jacket off one end of the cable.



## STEP 5

Hold the four pairs of twisted cables tightly where the jacket was cut away. Reorganize the cable pairs into the order of the 568-B wiring standard. Take care to maintain the twists since this provides noise cancellation.

## STEP 6



Hold the jacket and cable in one hand. Untwist a short length of the green and blue pairs, and reorder them to reflect the 568-B wiring color scheme. Untwist and order the rest of the wire pairs according to the color scheme.

#### **STEP 7**

Hold the jacket and cable in one hand. Untwist a short length of the green and blue pairs, and reorder them to reflect the 568-B wiring color scheme. Untwist and order the rest of the wire pairs according to the color scheme.

#### **STEP 8**

Place an RJ-45 plug on the end of the cable with the prong on the underside and the orange pair, green pair on the 586-A end, to the left side of the connector.

#### **STEP 9**

Gently push the plug onto wires until the copper ends of the wires can be seen through the end of the plug. Make sure the end of the jacket is inside the plug and all wires are in the correct order. If the jacket is not inside the plug, the plug will not be properly gripped and will eventually cause problems. If everything is correct, crimp the plug hard enough to force the contacts through the insulation on the wires, thus completing the conducting path.

#### **STEP 10**

Repeat steps 4-8 to terminate the other end of the cable using the 568-A scheme to finish the crossover cable.

## التجربة الرابعة

■ بيانات عامة:

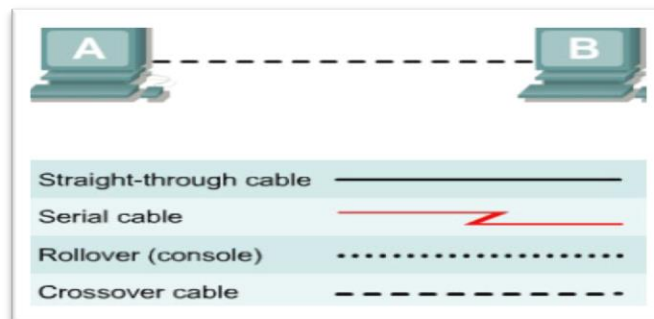
### Experiment : Lab 4: Building a Peer-to-Peer Network

الفرقة المقرر عليها التجربة: الفرقة الاولى

الفصل الدراسي: الثاني

الأدوات المطلوبة للتجربة:

- Set of workstation.
- One 0.6 to .9 m (2 to 3 ft) length of Cat 5 cabling per person or team.
- Four RJ-45 connectors, two are extra for spares.
- RJ-45 crimping tools to attach the RJ-45 connectors to the cable ends.
- Ethernet cabling continuity tester which can test crossover type cables, T568-A to T568-B.
- Wire cutters.



### OBJECTIVE

- Create a simple peer-to-peer network between two PCs.
- Identify the proper cable to connect the two PCs.
- Configure workstation IP address information.
- Test connectivity using the `ping` command.

### BACKGROUND.

This lab focuses on the ability to connect two PCs to create a simple peer-to-peer Ethernet LAN between two workstations. The workstations will be directly connected

to each other without using a hub or switch. In addition to the Layer 1 physical and Layer 2 data link connections, the computers must also be configured with the correct IP network settings, which is Layer 3, so that they can communicate. A basic CAT 5/5e UTP crossover cable is all that is needed. A crossover cable is the same type that would be used as backbone or vertical cabling to connect switches together. Connecting the PCs in this manner can be very useful for transferring files at high speed and for troubleshooting interconnecting devices between PCs. If the two PCs can be connected with a single cable and are able to communicate, then any networking problems are not with the PCs themselves. Start this lab with the equipment turned off and with cabling disconnected. Work in teams of two with one person per PC. The following resources will be required:

- Two workstations with an Ethernet 10/100 NIC installed.
- Several Ethernet cables, which are both straight-through and crossover, to choose from for connecting the two workstations.

### **STEP 1: Identify the proper Ethernet cable and connect the two PCs**

a) The connection between the two PCs will be accomplished using a Category 5 or 5e crossover cable. Locate a cable that is long enough to reach from one PC to the other, and attach one end to the NIC in each of the PCs. Be sure to examine the cable ends carefully and select only a crossover cable.

b) What kind of cable is required to connect from NIC to NIC?

---

c) What is the category rating of the cable?

---

d) What is the AWG wire size designation of the cable?

---

### **STEP 2: Verify the physical connection**

a. The connection between the two PCs will be accomplished using a Category 5 or 5e crossover cable. Locate a cable that is long enough to reach from one PC to the other, and attach one end.

### **STEP 3:**

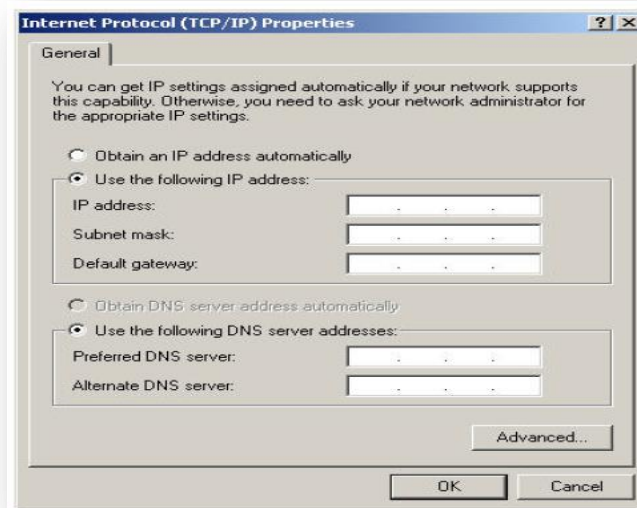
**Note:** Be sure to write down the existing IP settings, so that they can be restored at the end of the lab. These include IP address, subnet mask, default gateway, and DNS servers. If the workstation is a DHCP client, it is not necessary to record this information.

### **Windows XP users should do the following:**

- Click on Start > Settings > Control Panel and then click the Network Connection icon.
- Select the Local Area Network Connection and click on Change settings of this connection.

- Select the TCP/IP protocol icon that is associated with the NIC in this PC.
- Click on Properties and click on Use the following IP address.

**See the following example:**



#### **STEP 4: Configure TCP/IP settings for the two PCs**

- Set the IP address information for each PC according to the information in the table.
- Note that the default gateway IP address is not required, since these computers are directly connected. The default gateway is only required on local area networks that are connected to a router.

Computer	IP Address	Subnet mask	Default Gateway
PC – A	192.168.1.1	255.255.255.0	Not Required
PC – B	192.168.1.2	255.255.255.0	Not Required

#### **STEP 5: Access the Command or MS-DOS prompt**

Windows XP users should do the following:

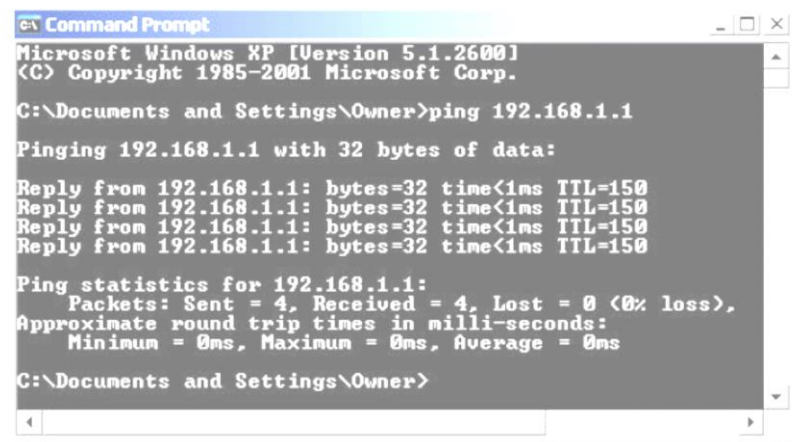
**Start > Programs > Accessories > Command Prompt**

#### **STEP 6 :Verify that the PCs can communicate**

- Test connectivity from one PC to the other by pinging the IP address of the opposite computer. Use the following command at the command prompt.

**C:>ping 192.168.1.1 (or 192.168.1.2)**

- Look for results similar to those shown below. If not, check the PC connections and TCP/IP settings for both PCs. What was the ping result?



```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Owner>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:

Reply from 192.168.1.1: bytes=32 time<1ms TTL=150
Reply from 192.168.1.1: bytes=32 time<1ms TTL=150
Reply from 192.168.1.1: bytes=32 time<1ms TTL=150
Reply from 192.168.1.1: bytes=32 time<1ms TTL=150

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Documents and Settings\Owner>
```

---

## STEP 7: Confirm the TCP/IP network settings

Type the `ipconfig` command from the Command Prompt. Record the results:

---

---

---

---

## التجربة الخامسة

### ■ بيانات عامة:

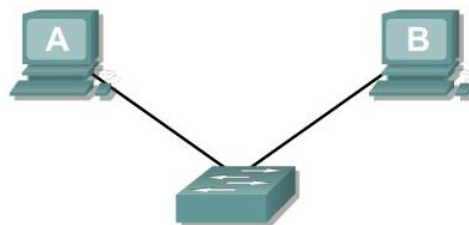
## Experiment : Lab 5: Building a Switch-based Network

الفرقة المقرر عليها التجربة: الفرقة الاولى

الفرقة المقرر عليها التجربة: الفرقة الاولى

الأدوات المطلوبة للتجربة:

- Set of workstation.
- Switches (minimal 4 Ports).
- One 0.6 to .9 m (2 to 3 ft) length of Cat 5 cabling per person or team.
- Four RJ-45 connectors, two are extra for spares.
- RJ-45 crimping tools to attach the RJ-45 connectors to the cable ends.
- Ethernet cabling continuity tester which can test crossover type cables, T568-A to T568-B.
- Wire cutters.



Straight-through cable	—————
Serial cable	————— ⚡
Rollover (console)	.....
Crossover cable	- - - - -

### OBJECTIVE

- Create a simple network with two PCs using a switch.
- Identify the proper cable to connect the PCs to the switch.
- Configure workstation IP address information.
- Test connectivity using the `ping` command.

### BACKGROUND.

This lab focuses on the ability to connect two PCs to create a simple switch-based Ethernet LAN using two workstations. A switch is a networking concentration device sometimes referred to as a

multiport bridge. Switches are relatively inexpensive and easy to install. When operating in full-duplex mode, they provide dedicated bandwidth to workstations. Switches eliminate collisions by creating microsegments between ports to which the two workstations are attached. They are appropriate for small to large LANs with moderate to heavy traffic.

In addition to the physical and data link connections, which are Layers 1 and 2, the computers must also be configured with the correct IP network settings, which is Layer 3, so that they can communicate. Since this lab uses a switch, a basic Category 5/5e UTP straight-through cable is needed to connect each PC to the switch. This is referred to as a patch cable or horizontal cabling, which is used to connect workstations and a typical LAN. Start this lab with the equipment turned off and with cabling disconnected. Work in teams of two with one person per PC. The following resources will be required:

- Two workstations with an Ethernet 10/100 NIC installed.
- Ethernet 10BaseT or Fast Ethernet switch.
- Several Ethernet cables, which are straight-through and crossover, to choose from for connecting the two workstations.

### **STEP 1: Identify the proper Ethernet cable and connect the two PCs to the switch**

- a) The connection between the two PCs and the switch will be accomplished using a Category 5 or 5e straight-through patch cable. Locate two cables that are long enough to reach from each PC to the switch. Attach one end to the NIC and the other end to a port on the switch. Be sure to examine the cable ends carefully and select only a straight-through cable.

What kind of cable is required to connect from NIC to switch?

---

- b) What is the category rating of the cable?
- 

- c) What is the AWG wire size designation of the cable?
- 

### **STEP 2: Verify the physical connection**

- a. Plug in and turn on the computers. To verify the computer connections, insure that the link lights on the both PC NICs and the switch interfaces are lit. Are all link lights lit?
- 

### **STEP 3: Access the IP settings window**

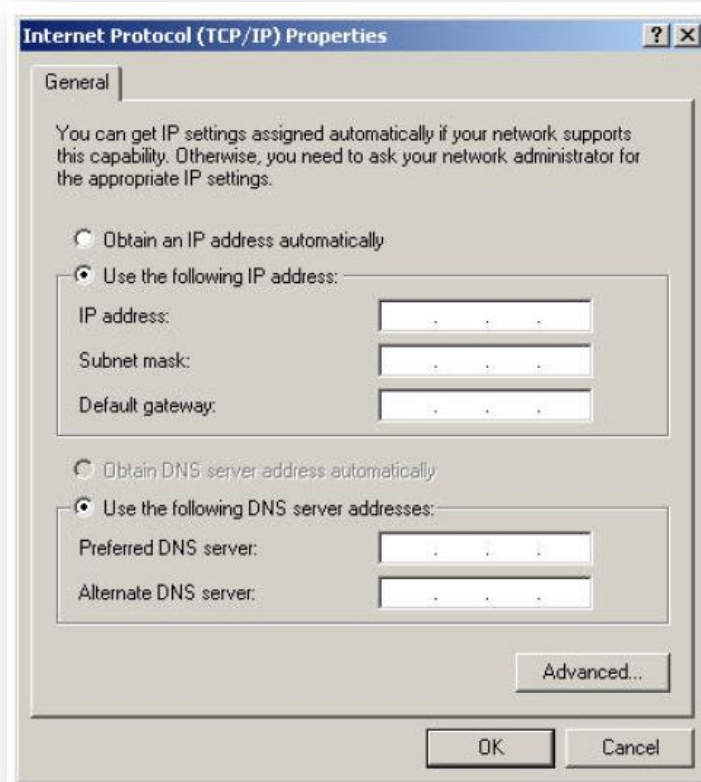
Note: Be sure to write down the existing IP settings, so that they can be restored at the end of the lab. These include IP address, subnet mask, default gateway, and DNS servers. If the workstation is a DHCP client, it is not necessary to record this information.

#### **Windows XP users should do the following:**

- Click on Start > Settings > Control Panel and then click the Network Connection icon.
- Select the Local Area Network Connection and click on Change settings of this connection.
- Select the TCP/IP protocol icon that is associated with the NIC on this PC.

- Click on Properties and click on Use the following IP address.

See the following example:



#### STEP 4: Configure TCP/IP settings for the two PCs

- Set the IP address information for each PC according to the information in the table.
- Note that the default gateway IP address is not required, since these computers are directly connected. The default gateway is only required on local area networks that are connected to a router.

Computer	IP Address	Subnet mask	Default Gateway
PC – A	192.168.1.1	255.255.255.0	Not Required
PC – B	192.168.1.2	255.255.255.0	Not Required

#### STEP 5: Access the Command or MS-DOS prompt

Windows XP users should do the following:

**Start > Programs > Accessories > Command Prompt**

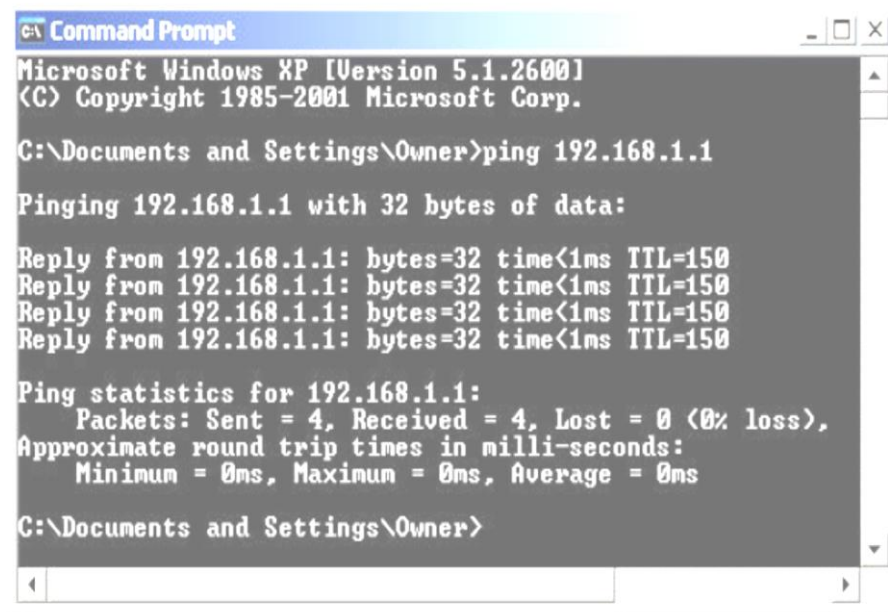
#### STEP 6: VERIFY that the PCs can communicate



a. Test connectivity from one PC to the other by pinging the IP address of the opposite computer. Use the following command at the command prompt.

**C:>ping 192.168.1.1 (or 192.168.1.2)**

b. Look for results similar to those shown below. If not, check the PC connections and TCP/IP settings for both PCs. What was the ping result?



```
C:\ Command Prompt
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Owner>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:

Reply from 192.168.1.1: bytes=32 time<1ms TTL=150
Reply from 192.168.1.1: bytes=32 time<1ms TTL=150
Reply from 192.168.1.1: bytes=32 time<1ms TTL=150
Reply from 192.168.1.1: bytes=32 time<1ms TTL=150

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Documents and Settings\Owner>
```

## STEP 7: Confirm the TCP/IP network settings


Type the **ipconfig** command from the Command Prompt. Record the results:


## التجربة السادسة

■ بيانات عامة:

### Experiment : Lab 6: IP Addressing Basics

الفرقة المقرر عليها التجربة: الفرقة الاولى

الفصل الدراسي: الثاني 

الأدوات المطلوبة للتجربة: 

 Exercise Sheet

### OBJECTIVE

- Name the five different classes of IP addresses.
- Describe the characteristics and use of the different IP address classes.
- Identify the class of an IP address based on the network number.
- Determine which part, or octet, of an IP address is the network ID and which part is the host ID.
- Identify valid and invalid IP host addresses based on the rules of IP addressing.
- Define the range of addresses and default subnet mask for each class.

### BACKGROUND.

This lab exercise helps develop an understanding of IP addresses and how TCP/IP networks operate. It is primarily a written lab exercise. However, it would be worthwhile to review some real network IP addresses using the command line utilities **ipconfig** for Windows NT/2000/XP or **winiipcfg** for Windows 9x/ME. IP addresses are used to uniquely identify individual TCP/IP networks and hosts, such as computers and printers, on those networks in order for devices to communicate. Workstations and servers on a TCP/IP network are called hosts and each has a unique IP address. This address is referred to as its host address. TCP/IP is the most widely used protocol in the world. The Internet or World Wide Web only uses IP addressing. In order for a host to access the Internet, it must have an IP address.

**In its basic form, the IP address has two parts:**

- A network address.
- A host address.

The network portion of the IP address is assigned to a company or organization by the Internet Network Information Center (InterNIC). Routers use the IP address to move data packets between networks. IP addresses are 32 bits long according to the current version IPv4 and are divided into 4 octets of 8 bits each. They operate at the network layer (Layer 3)

of the Open System Interconnection (OSI) model, which is the Internet layer of the TCP/IP model. IP addresses are assigned in the following ways:

- **Statically** – manually, by a network administrator.
- **Dynamically** – automatically, by a Dynamic Host Configuration Protocol (DHCP) server.

The IP address of a workstation, or host is a logical address, meaning it can be changed. The Media Access Control (MAC) address of the workstation is a 48-bit physical address. This address is burned into the network interface card (NIC) and cannot change unless the NIC is replaced. The combination of the logical IP address and the physical MAC address helps route packets to their proper destination.

There are five different classes of IP addresses, and depending on the class, the network and host part of the address will use a different number of bits. In this lab, different classes of IP addresses will be worked with and to help become familiar with the characteristics of each. The understanding of IP addresses is critical to the understanding of TCP/IP and internetworks in general. The following resources are required:

- PC workstation with Windows 9x/NT/2000/XP installed.
- Access to the Windows Calculator.

## STEP 1: Review IP address classes and their characteristics

**Address classes** There are five classes of IP addresses, A through E. Only the first three classes are used commercially. A Class A network address is discussed in the table to get started. The first column is the class of IP address. The second column is the first octet, which must fall within the range shown for a given class of addresses. The Class A address must start with a number between 1 and 126. The first bit of a Class A address is always a zero, meaning the High Order Bit (HOB) or the 128 bit cannot be used. 127 is reserved for loopback testing. The first octet alone defines the network ID for a Class A network address.

**Default subnet mask** The default subnet mask uses all binary ones, decimal 255, to mask the first 8 bits of the Class A address. The default subnet mask helps routers and hosts determine if the destination host is on this network or another one. Because there are only 126 Class A networks, the remaining 24 bits, or 3 octets, can be used for hosts. Each Class A network can have  $2^{24}$ , or over 16 million hosts. It is common to subdivide the network into smaller groupings called subnets by using a custom subnet mask, which is discussed in the next lab.

**Network and host address** The network or host portion of the address cannot be all ones or all zeros. As an example, the Class A address of 118.0.0.5 is a valid IP address. The network portion, or first 8 bits, which are equal to 118, is not all zeros and the host portion, or last 24 bits, is not all zeros or all ones. If the host portion were all zeros, it would be the network address itself. If the host portion were all ones, it would be a broadcast for the network address. The value of any octet can never be greater than decimal 255 or binary 11111111.

**Note:** Class A address 127 cannot be used and is reserved for loopback and diagnostic

Class	1 <sup>st</sup> Octet Decimal Range	1 <sup>st</sup> Octet High Order Bits	Network/Host ID (N=Network, H=Host)	Default Subnet Mask	Number of Networks	Hosts per Network (Usable Addresses)
<b>A</b>	1 – 126 *	0	N.H.H.H	255.0.0.0	126 ( $2^7 - 2$ )	16,777,214 ( $2^{24} - 2$ )
<b>B</b>	128 – 191	10	N.N.H.H	255.255.0.0	16,382 ( $2^{14} - 2$ )	65,534 ( $2^{16} - 2$ )
<b>C</b>	192 – 223	110	N.N.N.H	255.255.255.0	2,097,150 ( $2^{21} - 2$ )	254 ( $2^8 - 2$ )
<b>D</b>	224 – 239	1110	Reserved for Multicasting			
<b>E</b>	240 – 254	11110	Experimental; used for research			

functions.

## STEP 2: Determine basic IP addressing

Use the IP address chart and your knowledge of IP address classes to answer the following questions:

- 1) What is the decimal and binary range of the first octet of all possible Class B IP addresses?
  - a) **Decimal:** From: \_\_\_\_\_ To: \_\_\_\_\_
  - b) **Binary:** From: \_\_\_\_\_ To: \_\_\_\_\_
- 2) Which octet(s) represent the network portion of a Class C IP address?  
\_\_\_\_\_
- 3) Which octet(s) represent the host portion of a Class A IP address?  
\_\_\_\_\_
- 4) What is the maximum number of useable hosts with a Class C network address?  
\_\_\_\_\_
- 5) How many Class B networks are there? \_\_\_\_\_
- 6) How many hosts can each Class B network have?  
\_\_\_\_\_
- 7) How many octets are there in an IP address? \_\_\_\_\_
- 8) How many bits per octet? \_\_\_\_\_

## STEP 3: Determine the host and network portions of the IP address

With the following IP host addresses, indicate the following:

- Class of each address.
- Network address or ID.
- Host portion.
- Broadcast address for this network.
- Default subnet mask.

The host portion will be all zeros for the network ID. Enter just the octets that make up the host. The host portion will be all ones for a broadcast. The network portion of the address will be all ones for the subnet mask. Fill in the following table:

Host IP Address	Address Class	Network Address	Host Address	Network Broadcast Address	Default Subnet Mask
216.14.55.137					
123.1.1.15					
150.127.221.244					
194.125.35.199					
175.12.239.244					

**STEP 4: Given an IP address of 142.226.0.15 and a subnet mask of 255.255.255.0, answer the following questions:**

- What is the binary equivalent of the second octet?

\_\_\_\_\_

- What is the class of the address?

\_\_\_\_\_

- What is the network address of this IP address?

\_\_\_\_\_

- Is this a valid IP host address (Y/N)?

\_\_\_\_\_

- Why or why not?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Step 5: Determine which IP host addresses are valid for commercial networks

For the following IP host addresses, determine which are valid for commercial networks and indicate why or why not. Valid means it could be assigned to any of the following:

- Workstation.
- Server.
- Printer.
- Router interface.
- Any other compatible device.

**Fill in the following table:**


IP Host Address	Valid Address? (Yes/No)	Why or Why Not
150.100.255.255		
175.100.255.18		
195.234.253.0		
100.0.0.23		
188.258.221.176		
127.34.25.189		
224.156.217.73		


## التجربة السابعة


### ■ بيانات عامة:

#### Experiment: Lab7 Basic Subnetting

الفرقة المقرر عليها التجربة: الفرقة الاولى

الفصل الدراسي: الثاني 

الأدوات المطلوبة للتجربة: 

 Exercise Sheet

### OBJECTIVE

- How to identify reasons to use a subnet mask.
- How to distinguish between a default subnet mask and a custom subnet mask.
- What given requirements determine the subnet mask, number of subnets, and hosts per subnet.
- What needs to be understood about useable subnets and useable numbers of hosts.
- How to use the ANDing process to determine if a destination IP address is local or remote.
- How to identify valid and invalid IP host addresses based on a network number and subnet mask.

### BACKGROUND.

This lab exercise focuses on the basics of IP subnet masks and their use with TCP/IP networks. The subnet mask can be used to split up an existing network into subnetworks, or subnets. Some of the primary reasons for subnetting are the following:

- Reduce the size of the broadcast domains, which creates smaller networks with less traffic.
- Allow LANs in different geographical locations to communicate through routers.
- Provide improved security by separating one LAN from another.

Routers separate subnets, and determine when a packet can go from one subnet to another. Each router a packet goes through is considered a hop. Subnet masks help workstations, servers, and routers in an IP network determine if the destination host for the packet they want to send is on their own network or another network. This lab reviews the default subnet mask and then focuses on custom subnet masks. Custom subnet masks use more bits than the default subnet masks by borrowing these bits from the host portion of the IP address. This creates a three-part address:

- The original network address.
- The subnet address made up of the bits borrowed.
- The host address made up of the bits left after borrowing some for subnets.

## STEP 1: Review the structure of IP addresses

If an organization has a Class A IP network address, the first octet, or 8 bits, is assigned and does not change. The organization can use the remaining 24 bits to define up to **16,777,214** hosts on its network. This is a lot of hosts. It is not possible to put all of these hosts on one physical network without separating them with routers and subnets.

It is common for a workstation to be on one network or subnet and a server to be on another. When the workstation needs to retrieve a file from the server it will need to use its subnet mask to determine the network or subnet that the server is on. The purpose of a subnet mask is to help hosts and routers determine the network location where a destination host can be found. Refer to the table below to review the following information:

- The IP address classes.
- The default subnet masks.
- The number of networks that can be created with each class of network address.
- The number of hosts that can be created with each class of network address.

\* Class A address 127 cannot be used and is reserved for loopback and diagnostic functions.

## STEP 2: Review the ANDing process

Hosts and routers use the ANDing process to determine if a destination host is on the same network or not. The ANDing process is done each time a host wants to send a packet to another host on an IP network. In order to connect

to a server, the IP address of the server or the host name, such as, **<http://www.cisco.com>**, must be known. If the host name is used a Domain Name Server (DNS) will convert it to an IP address.

Address Class	1 <sup>st</sup> Octet Decimal Range	1 <sup>st</sup> Octet High Order Bits	Network/Host ID (N=Network, H=Host)	Default Subnet Mask	Number of Networks	Hosts per Network (Usable Addresses)
A	1 – 126 *	0	N.H.H.H	255.0.0.0	126 ( $2^7 - 2$ )	16,777,214 ( $2^{24} - 2$ )
B	128 – 191	10	N.N.H.H	255.255.0.0	16,382 ( $2^{14} - 2$ )	65,534 ( $2^{16} - 2$ )
C	192 – 223	110	N.N.N.H	255.255.255.0	2,097,150 ( $2^{21} - 2$ )	254 ( $2^8 - 2$ )
D	224 – 239	1110	Reserved for Multicasting			
E	240 – 254	11110	Experimental; used for research			

First, the source host will compare, or AND, its own IP address to its own subnet mask. The result of the ANDing is to identify the network where the source host resides. It will then compare the destination IP address to its own subnet mask. The result of the 2<sup>nd</sup> ANDing will be the network that the destination host is on. If the source network address and the destination network address are the same, they can communicate directly. If the results are



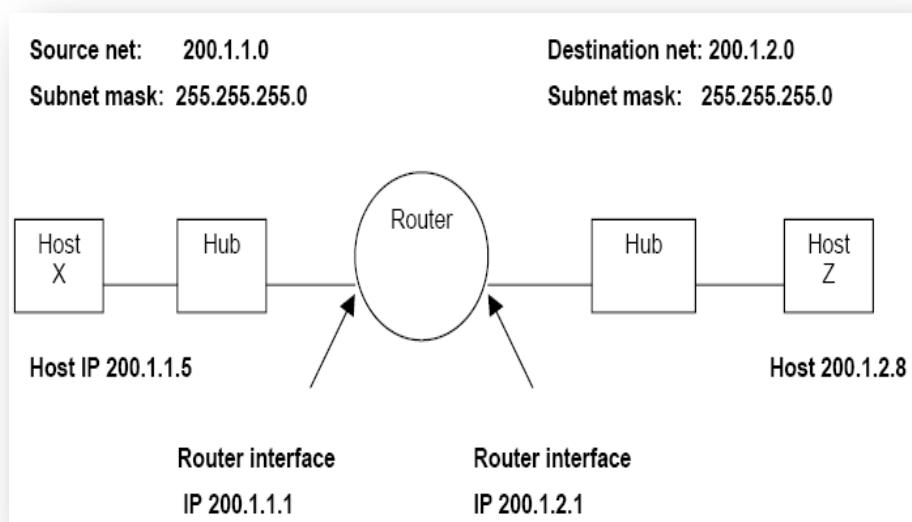
different, they are on different networks or subnets. If this is the case, the source host and the destination host will need to communicate through routers or might not be able to communicate at all.

ANDing depends on the subnet mask. Subnet masks are always all ones. A default subnet mask for a Class C network is **255.255.255.0** or **11111111.11111111.11111111.00000000**. This is compared to the source IP address bit for bit. The first bit of the IP address is compared to the first bit of the subnet mask, the second bit to the second, and so on. If the two bits are both ones, the ANDing result is a one. If the two bits are a zero and a one, or two zeros, the ANDing result is a zero. Basically, this means that a combination of 2 ones results in a one, anything else is a zero. The result of the ANDing process is the identification of the network or subnet number that the source or destination address is on.

### STEP 3: Two Class C networks using the default subnet mask

This example shows how a Class C default subnet mask can be used to determine which network a host is on. A default subnet mask does not break an address into subnets. If the default subnet mask is used, the network is not being subnetted. **Host X**, the source on network 200.1.1.0 has an IP address of 200.1.1.5. It wants to send a packet to **Host Z**, the destination on network 200.1.2.0 and has an IP address of 200.1.2.8. All hosts on each network are connected to hubs or switches and then to a router. Remember that with a Class C network address, the first 3 octets, or 24 bits, are assigned as the network address. So, these are two different Class C networks. This leaves one octet, or 8 bits for hosts, so each Class C network could have up to 254 hosts:

$$2^8 = 256 - 2 = 254$$



The ANDing process helps the packet get from Host 200.1.1.5 on network 200.1.1.0 to Host 200.1.2.8 on network 200.1.2.0 by using the following steps:

- 1) Host X compares its own IP address to its own subnet mask using the ANDing process.

Host X IP address 200.1.1.5	11001000.00000001.00000001.00000101
Subnet Mask 255.255.255.0	11111111.11111111.11111111.00000000
ANDing Result (200.1.1.0)	11001000.00000001.00000001.00000000

Note: The result of the ANDing process is the network address of Host X, which is 200.1.1.0.

- 2) Next, Host X compares the IP address of the Host Z destination to its own subnet mask using the ANDing process.

Host Z IP address 200.1.2.8	11001000.00000001.00000010.00001000
Subnet Mask 255.255.255.0	11111111.11111111.11111111.00000000
ANDing Result (200.1.2.0)	11001000.00000001.00000010.00000000

Note: The result of the ANDing process is the network address of Host Z, which is 200.1.2.0.

Host X compares the ANDing results from Step 1 and the ANDing results from Step 2, and notes they are different. Host X now knows that Host Z is not in its local-area network (LAN). Therefore, it must send the packet to its default gateway, which is the IP address of the router interface of 200.1.1.1 on network 200.1.1.0. The router then repeats the ANDing process to determine which router interface to send the packet out to.

#### STEP 4: One Class C network with subnets using a custom subnet mask

This example uses a single Class C network address (200.1.1.0) and shows how a Class C custom subnet mask can be used to determine which subnetwork (or subnet) a host is on and to route packets from one subnetwork to another. Remember that with a Class C network address, the first 3 octets, or 24 bits are assigned as the network address. This leaves one octet, or 8 bits, for hosts. So, each Class C network could have up to 254 hosts:

$$2^8 = 256 - 2 = 254$$

Perhaps less than 254 hosts, workstations and servers combined, are desired on one network. This could be for security reasons or to reduce traffic. It can be done by creating two subnetworks and separating them with a router. This will create smaller independent broadcast domains and can improve network performance and increase security. This is possible because these subnetworks will be separated by one or more router. Assume at least two subnetworks will be needed and that there will be at least 50 hosts per subnetwork. Because there is only one Class C network address, only 8 bits in the fourth octet are available for a total of 254 possible hosts. Therefore, a custom subnet mask must be created. The custom subnet mask will be used to borrow bits from the host portion of the address. The following steps help accomplish this:

- 1) The first step to subnetting is to determine how many subnets are needed. In this case, its two subnetworks. To see how many bits should be borrowed from the host portion of

the network address, add the bit values from right to left until the total is equal to or greater than the number of subnets needed. Because two subnets are needed, add the one bit and the two bit, which equals three. This is greater than the number of subnets needed. To remedy this, borrow at least two bits from the host address starting from the left side of the octet that contains the host address.

Network address: 200.1.1.0								
4 <sup>th</sup> octet Host address bits:	1	1	1	1	1	1	1	1
Host address bit values (from right)	128	64	32	16	8	4	<u>2</u>	<u>1</u>

Add bits starting from the right side, the 1 and the 2, until the sum is greater than the number of subnets needed.

**Note:** An alternate way to calculate the number bits to be borrowed for subnets is to take the number of bits borrowed to the power of 2. The result must be greater than the number of subnets needed. As an example if 2 bits are borrowed the calculation is two to the second power, which equals four. Since the number of subnets needed is two this should be adequate.

2) After we know how many bits to borrow, we take them from the left side of the of the host address, the 4th octet. Every bit borrowed from the host address bit leaves fewer bits for the hosts. Even though the number of subnets is increased, the number of hosts per subnet is decreased. Because two bits need to be borrowed from the left side, that new value must be shown in the subnet mask. The existing default subnet mask was 255.255.255.0 and the new custom subnet mask is 255.255.255.192. The 192 results from adding the first two bits from the left, 128 + 64 = 192. These bits now become 1s and are part of the overall subnet mask. This leaves 6 bits for host IP addresses or 2<sup>6</sup>= 64 hosts per subnet.

4 <sup>th</sup> Octet borrowed bits for subnet:	<u>1</u>	<u>1</u>	0	0	0	0	0	0
Subnet bit values: (from left side)	<u>128</u>	<u>64</u>	32	16	8	4	2	1

With this information, the following table can be built. The first two bits are the subnet binary value.

The last 6 bits are the host bits. By borrowing 2 bits from the 8 bits of the host address 4 subnets, 2<sup>2</sup>, with 64 hosts each, can be created. The 4 networks created are as follows:

- The 200.1.1.0 network.
- The 200.1.1.64 network.
- The 200.1.1.128 network.
- The 200.1.1.192 network.

The 200.1.1.0 network is considered unusable, unless the networking device supports the IOS command **ip subnet-zero**, which allows using the first subnet.

Subnet No.	Subnet Bits Borrowed Binary Value	Subnet Bits Decimal Value	Host Bits Possible Binary Values (Range) (6 Bits)	Subnet/Host Decimal Range	Useable?
0 Subnet	00	0	000000–111111	0–63	No
1 <sup>st</sup> Subnet	01	64	000000–111111	64–127	Yes
2 <sup>nd</sup> Subnet	10	128	000000–111111	128–191	Yes
3 <sup>rd</sup> Subnet	11	192	000000–111111	192–254	No

Another common way to represent a subnet mask, is the use of the “slash/number” (/#) where the # following the slash is the number of bits used in the mask (network and subnet combined). As an example, a Class C network address such as 200.1.1.0 with a standard subnet mask (255.255.255.0) would be written as 200.1.1.0 /24, indicating that 24 bits are used for the mask. The same network, when subnetted by using two host bits for subnets, would be written as 200.1.1.0 /26. This indicates that 24 bits are used for the network and 2 bits for the subnet. This would represent a custom subnet mask of 255.255.255.192 in dotted decimal format.

A Class A network of 10.0.0.0 with a standard mask (255.0.0.0) would be written as 10.0.0.0 /8. If 8 bits (the next octet) were being used for subnets it would be written as 10.0.0.0 /16. This would represent a custom subnet mask of 255.255.0.0 in dotted decimal format. The “slash” number after the network number is an abbreviated method of indicating the subnet mask being used.

#### **STEP 5: Use the following information and the previous examples to answer the following subnet-related questions**

A company has applied for and received a Class C network address of 197.15.22.0. The physical network is to be divided into 4 subnets, which will be interconnected by routers. At least 25 hosts will be needed per subnet. A Class C custom subnet mask needs to be used and a router is needed between the subnets to route packets from one subnet to another. Determine the number of bits that need to be borrowed from the host portion of the network address and the number of bits that will be left for host addresses.

**Note:** There will be 8 possible subnets, of which 6 can be used.

**Fill in the following table and answer the following questions:**

Subnet No.	Subnet Bits Borrowed Binary Value	Subnet Bits Decimal and Subnet No.	Host Bits Possible Binary Values (Range) (5 Bits)	Subnet/Host Decimal Range	Use?
0 Subnet					
1 <sup>st</sup> Subnet					
2 <sup>nd</sup> Subnet					
3 <sup>rd</sup> Subnet					
4 <sup>th</sup> Subnet					
5 <sup>th</sup> Subnet					
6 <sup>th</sup> Subnet					
7 <sup>th</sup> Subnet					

**Use the table just developed to help answer the following questions:**

1) Which octet(s) represent the network portion of a Class C IP address?

---

---

2) Which octet(s) represent the host portion of a Class C IP address?

---

---

3) What is the binary equivalent of the Class C network address in the scenario?  
197.15.22.0

Decimal network address: \_\_\_\_\_

Binary network address: \_\_\_\_\_

4) How many high-order bits were borrowed from the host bits in the fourth octet?

---

5) What subnet mask must be used? Show the subnet mask in decimal and binary.

Decimal subnet mask: \_\_\_\_\_

Binary subnet mask: \_\_\_\_\_

6) What is the maximum number of subnets that can be created with this subnet mask?

---

7) What is the maximum number of useable subnets that can be created with this mask?

---

8) How many bits were left in the fourth octet for host IDs?

---

9) How many hosts per subnet can be defined with this subnet mask?

---

10) What is the maximum number of hosts that can be defined for all subnets with this scenario? Assume the lowest and highest subnet numbers and the lowest and highest host ID on each subnet cannot be used.

---

11) 11. Is 197.15.22.63 a valid host IP address with this scenario?

---

12) 12. Why or why not? \_\_\_\_\_

13) 13. Is 197.15.22.160 a valid host IP address with this scenario?

---

## التجربة الثامنة

### ■ بيانات عامة:

#### Experiment : Lab8 Establishing a Console Connection to a Router or Switch


الفرقة المقرر عليها التجربة: الفرقة الاولى

الفرقة الدراسي: الثاني

الأدوات المطلوبة للتجربة:

- PC
- Router
- Switch



Straight-through cable	—————
Serial cable	———  ———
Rollover (console)	.....
Crossover cable	-----

### OBJECTIVE

- Create a console connection from a PC to a router and switch using the proper cable.
- Configure HyperTerminal on the PC.
- Observe the router and switch user interface.

### BACKGROUND.

This lab will focus on the ability to connect a PC to a router or a switch in order to establish a console session and observe the user interface. A console session allows the user to check

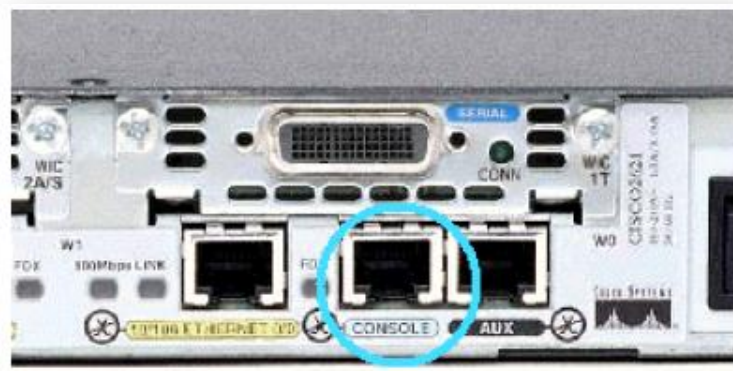
or change the configuration of the switch or router and is the simplest method of connecting to one of these devices.

This lab should be performed twice, once with a router and once with a switch to see the differences between the user interfaces. Start this lab with the equipment turned off and with cabling disconnected. Work in teams of two with one for the router and one for the switch. The following resources will be required:

- Workstation with a serial interface and HyperTerminal installed.
- Ethernet 10BASE-T or Fast Ethernet switch.
- Cisco Router.
- Rollover or console cable for connecting the workstation to the router or switch.

### STEP 1: Identify the Router/Switch console connectors

a. Examine the router or switch and locate the RJ-45 connector labeled “Console”.



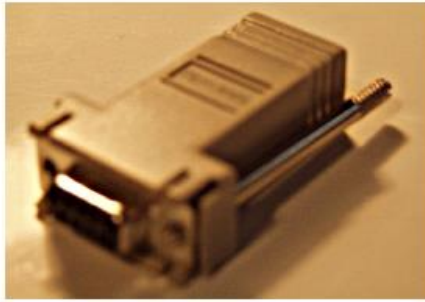
### STEP 2: Identify the computer serial interface, which is COM 1 or 2

a. It should be a 9 or 25-pin male connector labeled serial or COM1. It may or may not be identified.



### STEP 3: Locate the RJ-45 to DB-9 adapter

One side of the adapter connects to the PC's serial interface and the other to the RJ-45 rollover cable connector. If the serial interface on the PC or dumb terminal is a DB-25, an RJ-45 to DB-25 adapter will be needed. Both of these adapters typically come with a Cisco router or switch.

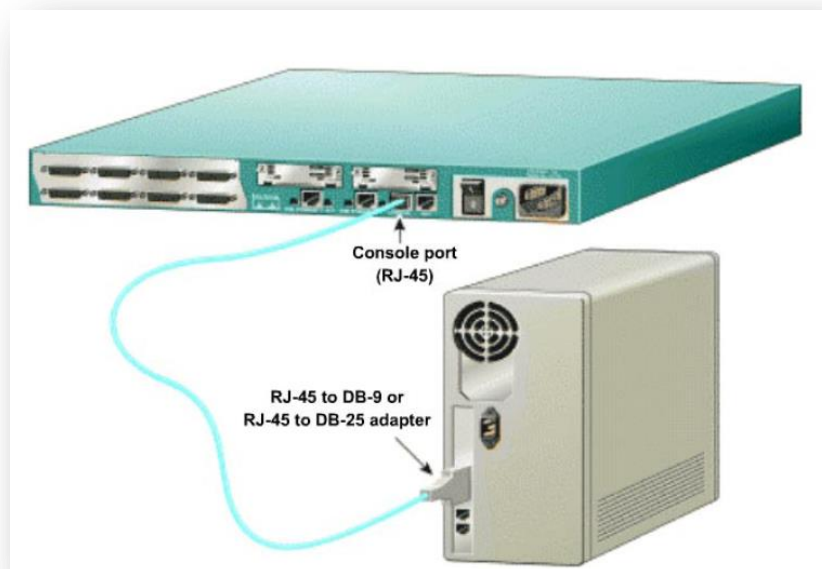


#### STEP 4: Locate or build a rollover cable

Use a rollover cable. If necessary, make one of adequate length to connect the router or switch to a workstation.

#### STEP 5: Connect the cabling components

Connect the rollover cable to the router or switch console port RJ-45 connector. Next, connect the other end of the rollover cable to the RJ-45 to DB-9 or DB-25 adapter. Finally, attach the adapter to a PC serial port, either DB-9 or DB-25, depending on the computer.



#### STEP 6: Start the PC HyperTerminal program

- a. Turn on the computer.
- b. From the Windows taskbar, locate the **HyperTerminal** program:

**Start > Programs > Accessories > Communications > Hyper Terminal**

#### STEP 7: Name the HyperTerminal Session



At the “Connection Description” popup enter a name in the connection Name field and select **OK**.



## STEP 8: Specify the computer connecting interface

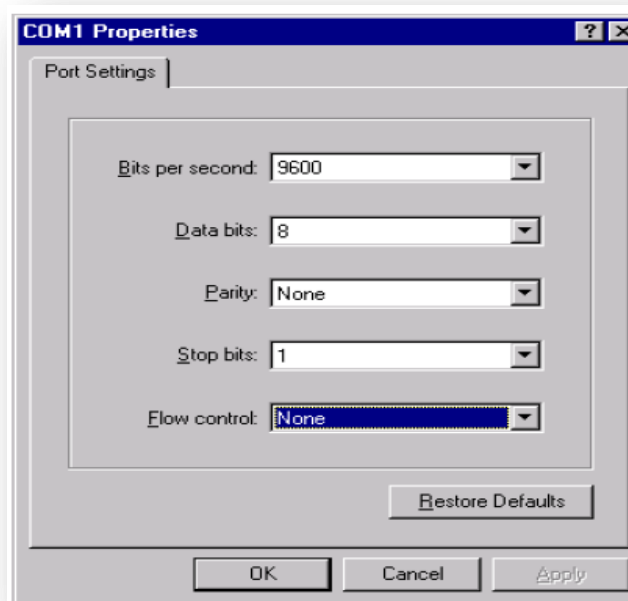
At the “Connect To” popup, use the drop down arrow in the Connect using: field to select **COM1** and select **OK**.

**Note:** Depending on which serial port was used on the PC, it may be necessary to set this to **COM2**.



## STEP 9: Specify the interface connection properties

- a. At the “COM1 Properties” popup use the drop down arrows to select the following:
  - Bits per second = **9600**.
  - Data bits = **8**.
  - Parity = **None**.
  - Stop bits = **1**.
  - Flow control = **None**.
- b. Then select **OK**.



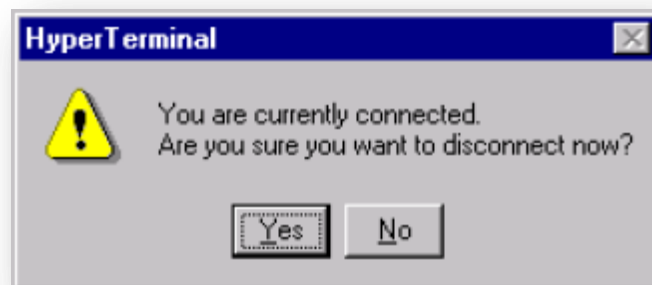
- c. When the HyperTerminal session window comes up, turn on the router or switch. If the router or switch is already on, press the **Enter** key. There should be a response from the router or switch. If there is, then the connection has been successfully completed.

## STEP 10: Observe the router or switch user interface

- a. Observe the user interface.
- b. If this is a router, what is the prompt? \_\_\_\_\_
- c. If this is a switch, what is the prompt? \_\_\_\_\_

## STEP 11: Close the Session

- a. To end the console session from a HyperTerminal session, select the following:  
**File > Exit**
- b. When the HyperTerminal disconnect warning popup appears, select **Yes**.



c. The computer will then ask if the session is to be saved. Select **No**.

#### STEP 12:

**Shut down the router or switch and store the cables**

## التجربة العاشرة

### ■ بيانات عامة:

### Experiment Lab 10 : Connecting Router LAN Interfaces

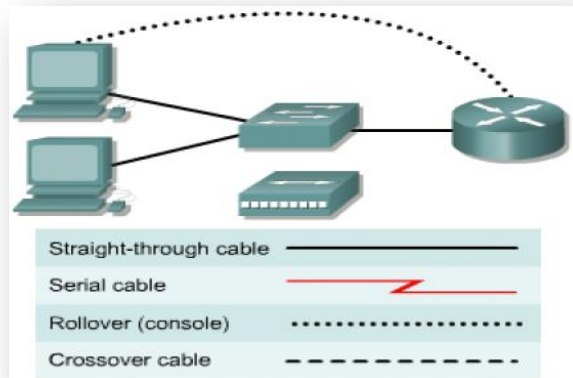
الفرقة المقرر عليها التجربة: الفرقة الاولى

الفصل الدراسي: الثاني

الأدوات المطلوبة للتجربة:

PC

Router



### OBJECTIVE

- Identify the Ethernet or Fast Ethernet interfaces on the router.
- Identify and locate the proper cables to connect the router and PC to a hub or switch.
- Use the cables to connect the router and PC to the hub or switch.

### BACKGROUND.

This lab focuses on the ability to connect the physical cabling between Ethernet LAN devices such as hubs and switches and the appropriate Ethernet interface on a router. The computer(s) and router should be preconfigured with the correct IP network settings. Start this lab with the computer(s), router, and the hub or switch all turned off and unplugged. The following resources will be required:

- At least one workstation with an Ethernet 10/100 NIC installed.
- One Ethernet switch or hub.
- One router with an RJ-45 Ethernet or Fast Ethernet interface or an AUI interface.

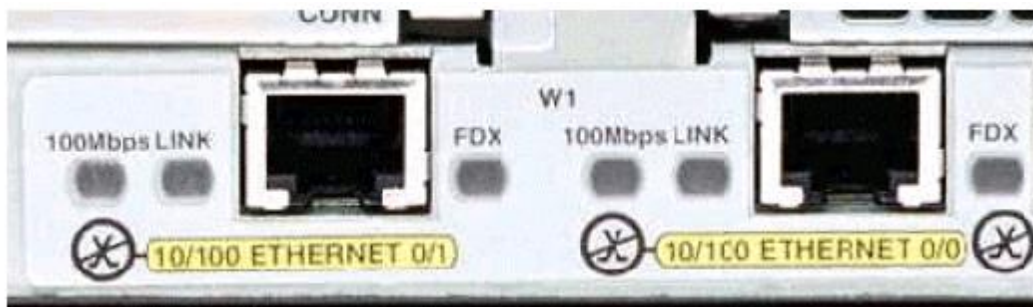
- 10BASE-T AUI transceiver (DB-15 to RJ-45) for a router with an AUI Ethernet interface (2500 Series).
- Several Ethernet cables, which are straight-through and crossover, to choose from for connecting the workstation and router to the hub or switch.

### STEP 1: Identify the Ethernet or Fast Ethernet interfaces on the router

- a) Examine the router.

What is the model number of the router?

- b) Locate one or more RJ-45 connectors on the router labeled “Ethernet0” or “Ethernet1”. This identifier may vary depending on the type of router used; a 2600 series router is shown. A 2500 series router will have an AUI DB-15 Ethernet port labeled AUI 0. These will require a 10BASE-T transceiver to connect to the RJ-45 cable.



- c) Identify the Ethernet ports shown that could be used for connecting the routers. Record the information below. Record the AUI port numbers if a Cisco 2500 series router is being used.

Router	Port	Port

### STEP 2: Identify the proper cables and connect router

- a) The connection between the router and the hub or switch will be accomplished using a Category 5 straight-through patch cable. Locate a patch cable that is long enough to reach from the router to the hub. Be sure to examine the cable ends carefully and select only straight-through cables.
- b) Use a cable to connect the Ethernet interface that uses zero designation on the router to a port on the hub or switch. This identifier may vary depending on the type of router used; a 2600 series router is shown.

### STEP 3: Connect the workstation Ethernet cabling

- a) The computer(s) will also connect to the hub using a straight-through patch cable. Run Category 5 patch cables from each PC to where the switch or hub is located. Connect one end of these cables to the RJ-45 connector on the computer NIC and connect the other end to a port on the hub or switch. Be sure to examine the cable ends carefully and select only straight-through cables.

#### **STEP 4: Verifying the connection**

- a) Plug in and turn on the routers, computers, and hub or switch.
- b) To verify the router connections, insure that the link light on the router interface and the hub or switch interface are both lit.
- c) To verify the computer connections, insure that the link light on the NIC and the hub or switch interface are both lit.

## التجربة الحادية عشر

### ■ بيانات عامة:

#### Experiment : Lab11 Creating a Small Lab Topology

الفرقة المقرر عليها التجربة: الفرقة الاولى

الفرقة المقرر الدراسي: الثاني

الأدوات المطلوبة للتجربة:

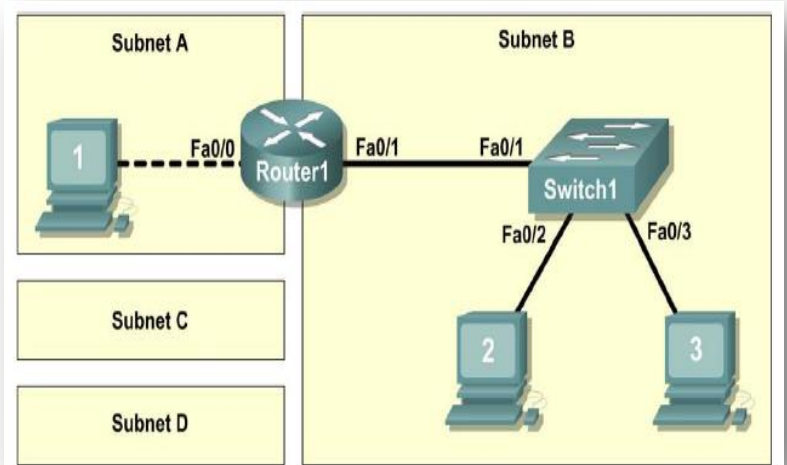
- PCs
- Switch.
- Router

### OBJECTIVE

Upon completion of this lab, you will be able to:

- Design the logical network.
- Configure the physical lab topology.
- Configure the logical LAN topology.
- Verify LAN connectivity.

### DEVICES SPECIFICATION:



Hardware	Qty	Description
Cisco Router	1	Part of CCNA Lab bundle
Cisco Switch	1	Part of CCNA Lab bundle
*Computer (host)	3	Lab computer
Cat-5 or better straight-through UTP cables	3	Connects Router1 and computers Host1 and Host2 to Switch1
Cat-5 crossover UTP cable	1	Connects computer Host1 to Router1

Table 1. Equipment and Hardware for Lab

Gather the necessary equipment and cables. To configure the lab, refer to the equipment and hardware listed in Table 1.

## SCENARIO

In this lab you will create a small network that requires connecting network devices and configuring host computers for basic network connectivity. **SubnetA** and **SubnetB** are subnets that are currently needed. **SubnetC** and **SubnetD** are anticipated subnets, not yet connected to the network. The **0<sup>th</sup>** subnet will be used.

### TASK 1: Design the Logical Network.

Given an IP address and mask of 172.20.0.0 / 24 (address / mask), design an IP addressing scheme that satisfies the following requirements:

Subnet	Number of Hosts
SubnetA	2
SubnetB	6
SubnetC	47
SubnetD	125

Host computers from each subnet will use the first available IP address in the address block. Router interfaces will use the last available IP address in the address block.

### STEP 1: Design SubnetD address block.

Begin the logical network design by satisfying the requirement of SubnetD, which requires the largest block of IP addresses. Refer to the subnet chart, and pick the first address block that will support SubnetD.

Fill in the following table with IP address information for SubnetD:

Network Address	Mask	First Host Address	Last Host Address	Broadcast

What is the bit mask in binary?

---

### STEP 2: Design SubnetC address block.

Satisfy the requirement of SubnetC, the next largest IP address block. Refer to the subnet chart, and pick the next available address block that will support SubnetC.

Fill in the following table with IP address information for SubnetC:

Network Address	Mask	First Host Address	Last Host Address	Broadcast



What is the bit mask in binary?

---

**STEP 3: Design SubnetB address block.**

Satisfy the requirement of SubnetB, the next largest IP address block. Refer to the subnet chart, and pick the next available address block that will support SubnetB.

Fill in the following table with IP address information for SubnetB:

Network Address	Mask	First Host Address	Last Host Address	Broadcast

What is the bit mask in binary?

---

**STEP 4: Design Subnet address block.**

Satisfy the requirement of SubnetA. Refer to the subnet chart, and pick the next available address block that will support SubnetA.

Fill in the following table with IP address information for SubnetA:

Network Address	Mask	First Host Address	Last Host Address	Broadcast

What is the bit mask in binary?

---

**TASK 2: Configure the Physical Lab Topology.**

**STEP 1: Physically connect devices.**

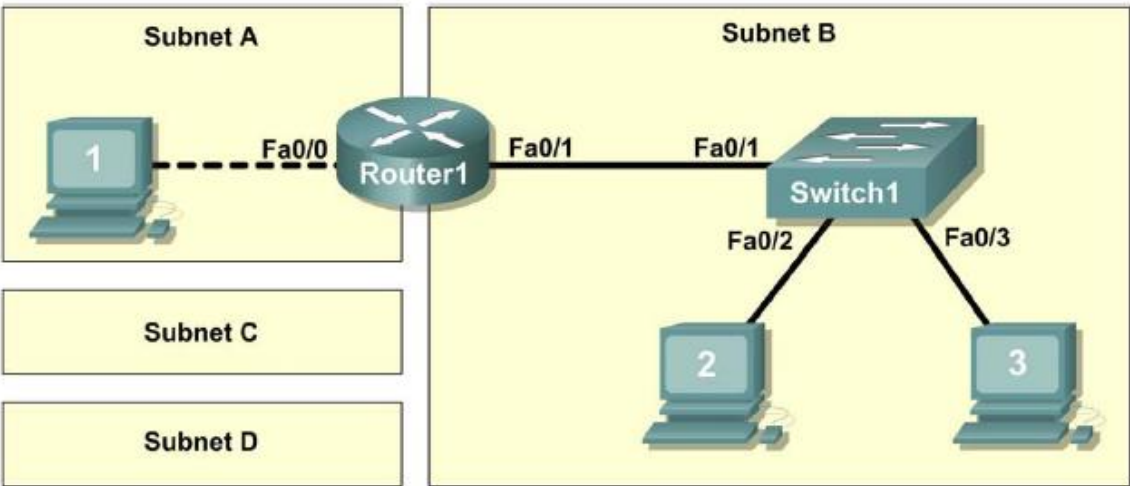


Figure 1. Cabling the Network

Cable the network devices as shown in Figure 1.

What cable type is needed to connect Host1 to Router1, and why?

---

---

What cable type is needed to connect Host1, Host2, and Router1 to Switch1, and why?

---

---

---

If not already enabled, turn power on to all devices.

### **STEP 2: Visually inspect network connections.**

After cabling the network devices, take a moment to verify the connections. Attention to detail now will minimize the time required to troubleshoot network connectivity issues later. Ensure that all switch connections show green. Any switch connection that does not transition from amber to green should be investigated. Is the power applied to the connected device? Is the correct cable used? Is the correct cable good?

What type of cable connects Router1 interface Fa0/0 to Host1?

---

What type of cable connects Router1 interface Fa0/1 to Switch1?

---

What type of cable connects Host2 to Switch1?

---

What type of cable connects Host3 to Switch1?

---

Is all equipment turned on?

---

### **TASK 3: Configure the Logical Topology.**

#### **STEP 1: Document logical network settings.**

The host computer Gateway IP address is used to send IP packets to other networks. Therefore, the Gateway address is the IP address assigned to the router interface for that subnet.

From the IP address information recorded in Task 1, write down the IP address information for each computer:

Host1	
IP Address	
IP Mask	
Gateway Address	

Host2	
IP Address	
IP Mask	
Gateway Address	

Host3	
IP Address	
IP Mask	
Gateway Address	

## STEP 2: Configure Host1 computer.

On Host1, click **Start > Control Panel > Network Connections**. Right-click the **Local Area Connection** device icon and choose **Properties**.

On the **General** tab, select **Internet Protocol (TCP/IP)**, and then click the **Properties** button.

**Internet Protocol (TCP/IP) Properties**

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

☐ Obtain an IP address automatically

☒ Use the following IP address:

IP address:

Subnet mask:

Default gateway:

☐ Obtain DNS server address automatically

☒ Use the following DNS server addresses:

Preferred DNS server:

Alternate DNS server:

Advanced...

OK Cancel

Figure 2. Host1 IP Address and Gateway Settings

Refer to Figure 2 for Host1 IP address and gateway settings. Manually enter the following information, recorded in Step 1, above:

```
IP address: Host1 IP address
Subnet mask: Host1 subnet mask
Default gateway: Gateway IP address
```

When finished, close the Internet Protocols (TCP/IP) Properties window by clicking **OK**. Close the Local Area Connection window. Depending on the Windows operating system, the computer may require a reboot for changes to be effective.

### STEP 3: Configure Host2 and Host3 computers.

Repeat Step 2 for computers Host2 and Host3, using the IP address information for those computers.

### TASK 4: Verify Network Connectivity.

Verify with your instructor that Router1 has been configured. Otherwise, connectivity will be broken between LANs. Switch1 should have a default configuration.

Network connectivity can be verified with the Windows **ping** command. Open a windows terminal by clicking **Start > Run**. Type **cmd** and press **Enter**.

Use the following table to methodically verify and record connectivity with each network device. Take corrective action to establish connectivity if a test fails:

From	To	IP Address	Ping Results
Host1	Gateway (Router1, Fa0/0)		
Host1	Router1, Fa0/1		
Host1	Host2		
Host1	Host3		
Host2	Host3		
Host2	Gateway (Router1, Fa0/1)		
Host2	Router1, Fa0/0		
Host2	Host1		
Host3	Host2		
Host3	Gateway (Router1, Fa0/1)		
Host3	Router1, Fa0/0		
Host3	Host1		

Note any break in connectivity. When troubleshooting connectivity issues, the topology diagram can be extremely helpful.

In the above scenario, how can a malfunctioning Gateway be detected?

---

---

### **TASK 5: Reflection**

Review any physical or logical configuration problems encountered during this lab. Be sure that you have a thorough understanding of the procedures used to verify network connectivity.

This is a particularly important lab. In addition to practicing IP subnetting, you configured host computers with network addresses and tested them for connectivity.

It is best to practice host computer configuration and verification several times. This will reinforce the skills you learned in this lab and make you a better network technician.

### **TASK 6: CHALLENGE**

Ask your instructor or another student to introduce one or two problems in your network when you aren't looking or are out of the lab room. Problems can be either physical (wrong UTP cable) or logical (wrong IP address or gateway). To fix the problems:

1. Perform a good visual inspection. Look for green link lights on Switch1.

2. Use the table provided in Task 3 to identify failed connectivity. List the problems:

---

---

3. Write down your proposed solution(s):

---

---

4. Test your solution. If the solution fixed the problem, document the solution. If the solution did not fix the problem, continue troubleshooting.

---

---

### **Task 7: Clean Up.**

Unless directed otherwise by the instructor, restore host computer network connectivity, and then turn off power to the host computers.

## التجربة الثانية عشر




■ بيانات عامة:

### Experiment : Lab12 Basic Router Configuration

الفرقة المقرر عليها التجربة: الفرقة الاولى

الفصل الدراسي: الثاني

الأدوات المطلوبة للتجربة:

-  PCs
-  Switch.
-  Router

### OBJECTIVE

Upon completion of this lab, you will be able to:

- Cable a network according to the Topology Diagram.
- Erase the startup configuration and reload a router to the default state.
- Perform basic configuration tasks on a router.
- Configure and activate Ethernet interfaces.
- Test and verify configurations.
- Reflect upon and document the network implementation.

### SCENARIO

In this lab activity, you will create a network that is similar to the one shown in the Topology Diagram. Begin by cabling the network as shown in the Topology Diagram. You will then perform the initial router configurations required for connectivity. Use the IP addresses that are provided in the Topology Diagram to apply an addressing scheme to the network devices. When the network configuration is complete, examine the routing tables to verify that the network is operating properly.

### TASK 1: CABLE THE NETWORK.

Cable a network that is similar to the one in the Topology Diagram. The output used in this lab is from 1841 routers. You can use any current router in your lab as long as it has the required interfaces as shown in the topology. Be sure to use the appropriate type of Ethernet cable to connect from host to switch, switch to router, and host to router. Be sure to connect the serial DCE cable to router R1 and the serial DTE cable to router R2.

### ANSWER THE FOLLOWING QUESTIONS:

What type of cable is used to connect the Ethernet interface on a host PC to the Ethernet interface on a switch? \_\_\_\_\_

What type of cable is used to connect the Ethernet interface on a switch to the Ethernet interface on a router? \_\_\_\_\_

What type of cable is used to connect the Ethernet interface on a router to the Ethernet interface on a host PC? \_\_\_\_\_

## **TASK 2: ERASE AND RELOAD THE ROUTERS.**

- **STEP 1:** Establish a terminal session to router R1.

- **STEP 2:** Enter privileged EXEC mode.

Router>enable

Router#

- **STEP 3:** Clear the configuration. To clear the configuration, issue the erase startup-config command. Press Enter when prompted to [confirm] that you really do want to erase the configuration currently stored in NVRAM.

Router#erase

startup-config Erasing the nvram filesystem will remove all files! Continue?  
[confirm]

[OK] Erase of nvram: complete

Router#

- **STEP 4:** Reload configuration. When the prompt returns, issue the reload command. Answer no if asked to save changes.

What would happen if you answered yes to the question, "System configuration has been modified. Save?"

---

The result should look something like this:

Router#reload

System configuration has been modified. Save? [yes/no]: no

Proceed with reload? [confirm]

Press Enter when prompted to [confirm] that you really do want to reload the router. After the router finishes the boot process, choose not to use the AutoInstall facility, as shown:

Would you like to enter the initial configuration dialog? [yes/no]: no

Would you like to terminate autoinstall? [yes]: [Press Return]

Press Enter to accept default. Press RETURN to get started!

**STEP5:** Repeat Steps 1 through 4 on router R2 to remove any startup configuration file that may be present.

## **TASK 3: PERFORM BASIC CONFIGURATION OF ROUTER R1.**

**STEP 1:** Establish a HyperTerminal session to router R1.

**STEP 2:** Enter privileged EXEC mode.

Router>enable

Router#

**STEP 3:** Enter global configuration mode.

Router#configure terminal

Enter configuration commands, one per line. End with CNTL/Z. Router(config)#

**STEP 4:** Configure the router name as R1. Enter the command hostname R1 at the prompt.

Router(config)#hostname R1

R1(config)#

**STEP 5:** Disable DNS lookup. Disable DNS lookup with the no ip domain-lookup command.

R1(config)#no ip domain-lookup

R1(config)#

Why would you want to disable DNS lookup in a lab environment?

---

What would happen if you disabled DNS lookup in a production environment?

---

**STEP 6:** Configure the EXEC mode password. Configure the EXEC mode password using the enable secret password command. Use class for the password.

R1(config)#enable secret class

R1(config)#

Why is it not necessary to use the enable password password command?

---

**STEP 7:** Configure a message-of-the-day banner. Configure a message-of-the-day banner using the banner motd command.

R1(config)#banner motd &

Enter TEXT message. End with the character '&'.

\*\*\*\*\*

!!!AUTHORIZED ACCESS ONLY!!!

\*\*\*\*\*

&

R1(config)#

When does this banner display?

---

Why should every router have a message-of-the-day banner?

---



**STEP 8:** Configure the console password on the router. Use cisco as the password. When you are finished, exit from line configuration mode.

```
R1(config)#line console 0
R1(config-line)#password cisco
R1(config-line)#login R1
(config-line)#exit
R1(config)#
```

**STEP 9:** Configure the password for the virtual terminal lines. Use cisco as the password. When you are finished, exit from line configuration mode.

```
R1(config)#line vty 0 4
R1(config-line)#password cisco
R1(config-line)#login
R1(config-line)#exit
R1(config)#
```

**STEP 10:** Configure the FastEthernet0/0 interface. Configure the FastEthernet0/0 interface with the IP address 192.168.1.1/24.

```
R1(config)#interface fastethernet 0/0
R1(config-if)#ip address 192.168.1.1 255.255.255.0
R1(config-if)#no shutdown
```

```
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R1(config-if)#
```

**STEP 11:** Configure the Serial0/0/0 interface. Configure the Serial0/0/0 interface with the IP address 192.168.2.1/24. Set the clock rate to 64000.

**NOTE:** The purpose of the clock rate command is explained in Chapter 2: Static Routes.

```
R1(config-if)#interface serial 0/0/0
R1(config-if)#ip address 192.168.2.1 255.255.255.0
R1(config-if)#clock rate 64000
R1(config-if)#no shutdown
R1(config-if)#
```

Note: The interface will not be activated until the serial interface on R2 is configured and activated

**STEP 12:** Return to privileged EXEC mode. Use the end command to return to privileged EXEC mode.

```
R1(config-if)#end
R1#
```

**STEP 13:** Save the R1 configuration. Save the R1 configuration using the copy running-config startup-config command.

```
R1#copy running-config startup-config
Building configuration... [OK]
R1#
```

What is a shorter version of this command?

#### **TASK 4: PERFORM BASIC CONFIGURATION OF ROUTER R2.**

**STEP 1:** For R2, repeat Steps 1 through 9 from Task 3.

**STEP 2:** Configure the Serial 0/0/0 interface. Configure the Serial 0/0/0 interface with the IP address 192.168.2.2/24.

```
R2(config)#interface serial 0/0/0
R2(config-if)#ip address 192.168.2.2 255.255.255.0
R2(config-if)#no shutdown %LINK-5-CHANGED: Interface Serial0/0/0, changed
state to up %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0,
changed state to up R2(config-if)#
```

#### **STEP 3: CONFIGURE THE FASTETHERNET0/0 INTERFACE.**

Configure the FastEthernet0/0 interface with the IP address 192.168.3.1/24.

```
R2(config-if)#interface fastethernet 0/0
R2(config-if)#ip address 192.168.3.1 255.255.255.0
R2(config-if)#no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up %LINEPROTO-5-
UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R2(config-if)#
```

**STEP 4:** Return to privileged EXEC mode. Use the end command to return to privileged EXEC mode.

```
R2(config-if)#end
R2#
```

**STEP 5:** Save the R2 configuration. Save the R2 configuration using the copy running-config startup-config command.

```
R2#copy running-config startup-config
Building configuration... [OK]
R2#
```

## TASK 5: CONFIGURE IP ADDRESSING ON THE HOST PCS.

**STEP 1:** Configure the host PC1. Configure the host PC1 that is attached to R1 with an IP address of 192.168.1.10/24 and a default gateway of 192.168.1.1. **STEP 2:** Configure the host PC2. Configure the host PC2 that is attached to R2 with an IP address of 192.168.3.10/24 and a default gateway of 192.168.3.1.

## TASK 6: VERIFY AND TEST THE CONFIGURATIONS

**STEP 1:** Verify that routing tables have the following routes using the show ip route command. The show ip route command and output will be thoroughly explored in upcoming chapters. For now, you are interested in seeing that both R1 and R2 have two routes. Both routes are designated with a C. These are the directly connected networks that were activated when you configured the interfaces on each router. If you do not see two routes for each router as shown in the following output, proceed to Step 2.

```
R1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.1.0/24 is directly connected, FastEthernet0/0
C    192.168.2.0/24 is directly connected, Serial0/0/0

-----
```

```
R2#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set
```

```
C    192.168.2.0/24 is directly connected, Serial0/0/0
C    192.168.3.0/24 is directly connected, FastEthernet0/0
```

## Database Design Exercise Lab 1

- Before you come to lab, you need to know the followings:
  - Read text book Chapter 7 and 8: ER and EER modeling.
  - Read ERwin documents at
  - Valid UB account and Oracle Database account

### A. ER Diagrams using ERwin

ERwin is one of the most popular software applications for data modeling worldwide. ERwin, manufactured by CA (Computer Associates), supports many database related functions including database design, logical data modeling, physical data modeling, and reverse engineering for a variety of DBMS such as Oracle, DB2, Sybase, SQL Server and others. ERwin is not free software, but commercial product. ERwin is installed on computers in Tech 113 lab under University Associate program with CA.

First, look at the description of SALES database and try to understand it. This includes entities, their attributes and data types, key attribute (underlined), and some constraints. Look at the following description of SALES database. Notice that the key attributes CANNOT be null.

SALES database:

```
Customers
(
  cust_id      varchar (10)  NOT NULL ,
  cust_name    varchar (50)  NOT NULL ,
  cust_address varchar (50),
  cust_city    varchar (50),
  cust_state   varchar (5) ,
  cust_zip     varchar (10),
  cust_country varchar (50),
  cust_contact varchar (50),
  cust_email   varchar (255)
)

Vendors
(
  vend_id      varchar (10) NOT NULL ,
  vend_name    varchar (50) NOT NULL ,
  vend_address varchar (50),
  vend_city    varchar (50),
  vend_state   varchar (5) ,
  vend_zip     varchar (10),
  vend_country varchar (50),
)
```

```
Products
(
  prod_id      varchar (10)  NOT NULL ,
  vend_id      varchar (10)  NOT NULL ,
  prod_name    varchar (255) NOT NULL ,
  prod_price   number (8,2)  NOT NULL ,
  prod_desc    varchar (255)
)

Orders
(
  order_num     number      NOT NULL ,
  order_date    date        NOT NULL ,
  cust_id       varchar (10) NOT NULL ,
)

OrderItems
(
  order_item    number      NOT NULL ,
  order_num     number      NOT NULL ,
  prod_id       varchar (10) NOT NULL ,
  quantity      number      NOT NULL ,
  item_price    number (8,2) NOT NULL
)
```

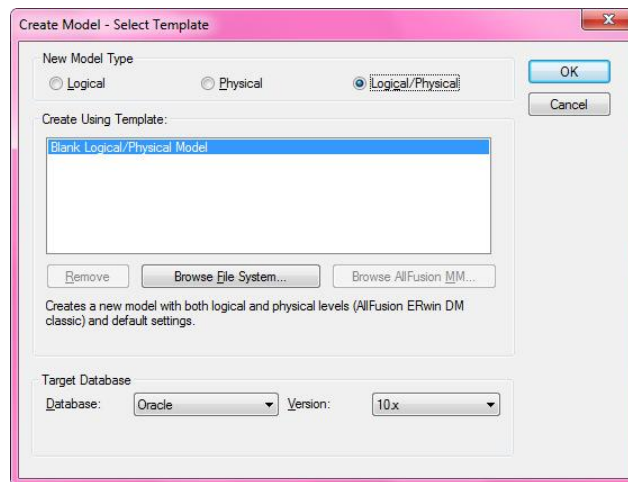
You are going to create ER diagram using ERwin from the SALES database. There is an example ER diagram at the end of this exercise, please only look at it if you are stuck! If you just copy it in you will learn nothing!

To start ERwin: “Start →All Programs →CA →AllFusion →ERwin Data Modeler r7 →ERwin Data Modeler r7”

Start ERwin Data Modeler r7.

## A1. Setup design environment

1. Create a new model with “File →New”



Select “Logical/Physical” for New Model Type  
Select “Oracle” and “10.x” for Target Database

2. Select the level of detail in the display as follows:

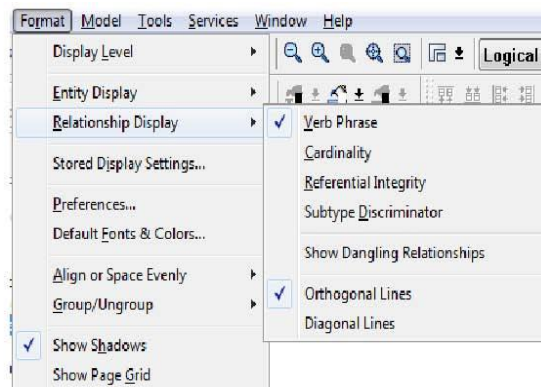
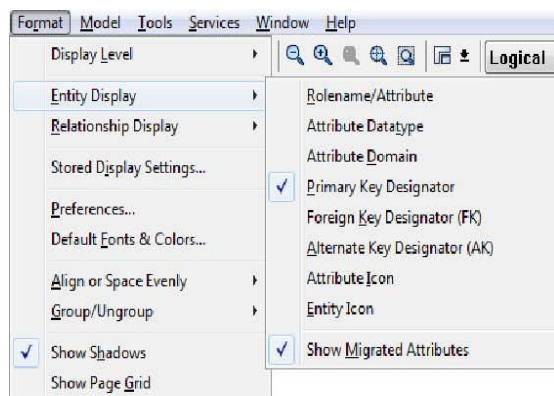
From the Format Menu

Choose Entity Display and uncheck “Foreign Key Designator (FK)”

Choose Entity Display again and check “Primary Key Designator”

Choose Entity Display again and check “Show Migrated Attributes”

Choose Relationship Display and check “Verb Phrase”



Format →Entity Display menu    Format →Relationship Display menu

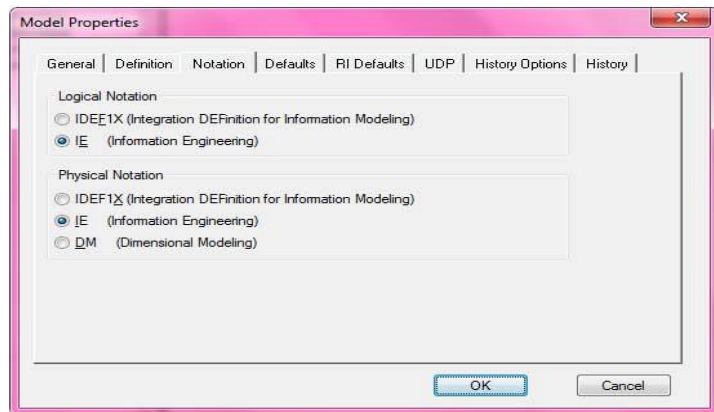
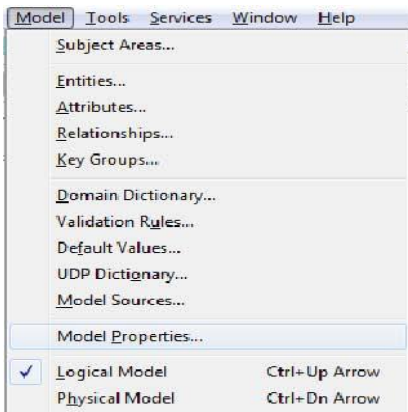
3. Choose the ER diagram notation

From the Model Menu

Select “Model Properties...”

When the Model Properties window opens, click on the “Notation” tab

Select “IE (Information Engineering)” under “Logical Notation” and “Physical Notation”



## A2. Create a new Entity

1. Place a new entity representing CUSTOMERS on the screen

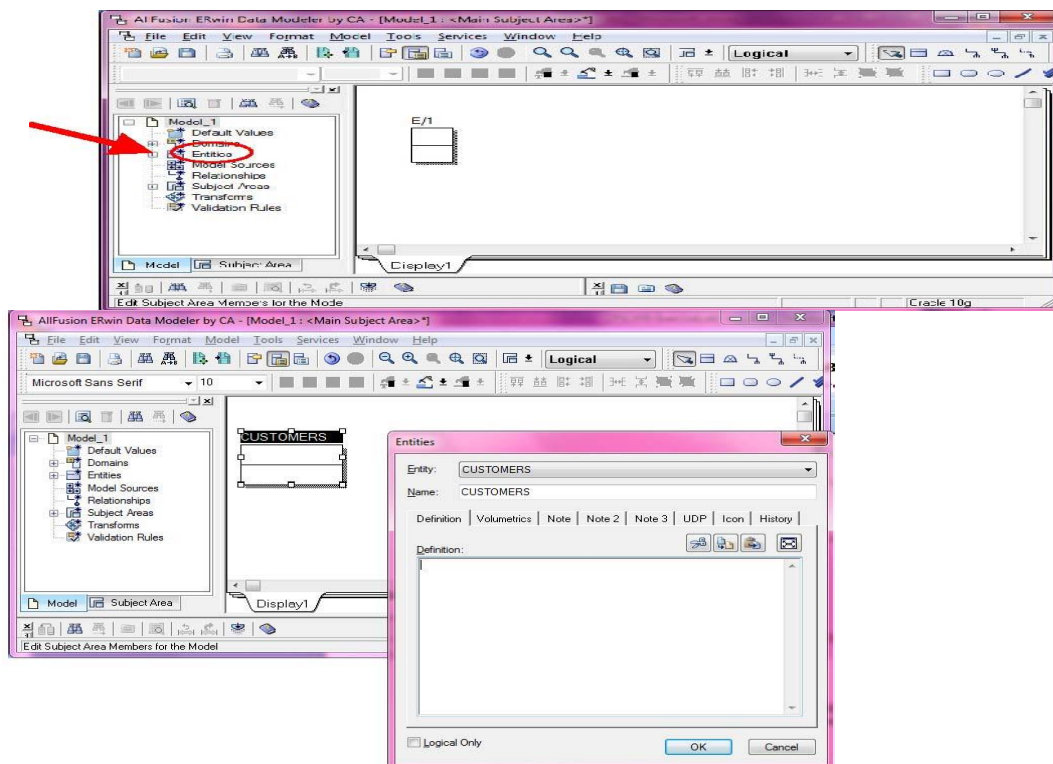


To a new entity onto the model, click the entity icon ( ) on the tool bar (the entity to appear. NOTE: An alternate method is to right-click on the word “Entities” in the Model Navigator.

The default name will be [E/X] where ‘X’ is sequence number, e.g. ‘1’ in this example. The entity consists of three parts, “Entity Name”, “Primary Key Attribute(s)” and “Non-Primary Key Attribute(s)”. You can move to each part by pressing ‘TAB’ key.

Press tab key until the entity name is highlighted, and then enter the entity name, CUSTOMERS.

To edit an existing entity, right-click on the entity and select ‘Entity Properties....’. Then, double click on the entity. The Entity Editor will be shown.

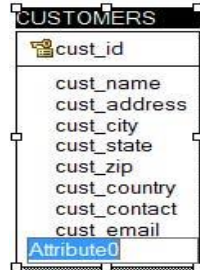


2. Add Attributes to the CUSTOMER entity

Press the tab key to highlight the primary key box, enter the name of the primary key attribute (i.e.,

cust\_id).

To add non-primary keys, press the tab key to highlight attribute box, where you can add non-primary key attributes. Type the attribute name and enter, continuously, until all attributes for CUSTOMERS are entered (i.e., cust\_name, cust\_address, ... , cust\_email). Then ESC to exit the entity.



Press ESC to quit adding attributes

3. Edit the Datatype for each attribute of the CUSTOMER entity

Right-click on the entity and select “Attributes ...” .

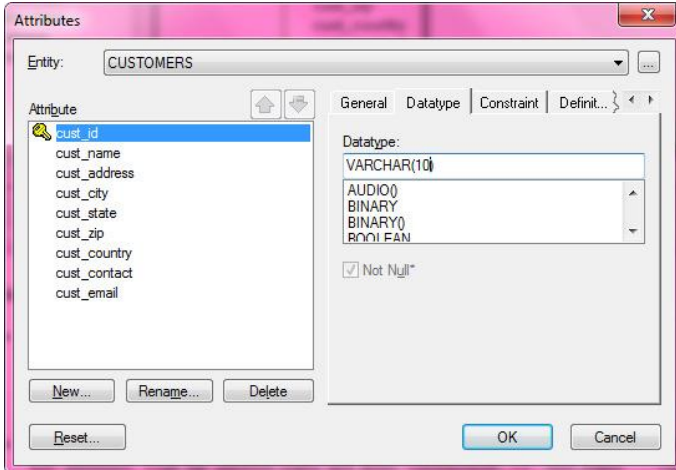
When the Attributes window opens, select the attribute to edit and choose the “Datatype” tab.

Select the appropriate Datatype from the list. If the assigned datatype has parameters (e.g.

VARCHAR(10)) enter the wanted value between ( ). Repeat this step for all attributes.

Check 'Not Null' if the attribute should not be null.

Once you have created the 'CUSTOMERS' entity, save the file in your home directory, and then define all the other entities. (You need to save your file frequently)



4. Repeat steps 1, 2, and 3 for all entities

### A3. Make relationships

Once the entities have been designed, the relationships between them must be defined. We must link primary and foreign keys, and link the relations together using the correct cardinality. Here are the relationships (you can give them your own names):

#### Relationships for CUSTOMER database

ORDERS has a 1..N relationship with ORDERITEMS FK\_OrderItems\_Orders FOREIGN KEY (order\_num) REFERENCES Orders (order\_num)

ORDERITEMS has a 1..N relationship with PRODUCTS FOREIGN KEY (OrderItems\_order\_item) in Products REFERENCES OrderItems (Order\_order\_item)

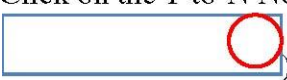
CUSTOMERS has a 0..N relationship with ORDERS FOREIGN KEY (Customers\_cust\_id) in Orders REFERENCES Customers (cust\_id)

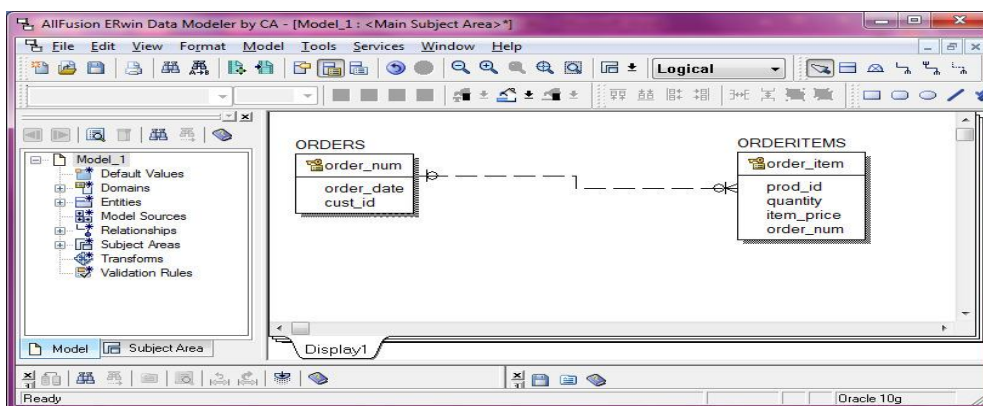


VENDORS has a 1..N relationship with PRODUCTSFK\_Products\_Vendors REFERENCES Vendors (vend\_id)

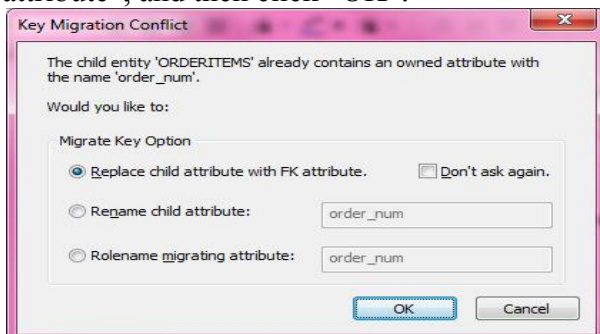
1. Add a relationship between ORDERS and ORDERITEMS entities

The Parent Entity is the entity you want to be on the “1” side of the relationship (i.e., parent), and the entity you want to be on the “N” side is the Child Entity.

- Click on the 1-to-N Non-identifying relationship icon (  ).
- ) on the toolbar ( Select the Parent Entity first (click on ORDERS)
- Then select the Child Entity (click on ORDERITEMS). A relationship line will be drawn between the two entites.



NOTE: If the child entity has an attribute with the same name as an attribute of parent entity (i.e., order\_num) you will see the following pop-up window. Select “Replace child attribute with FK attribute”, and then click “OK”.



2. Name the relationship and change the cardinality

Double-click the relationship. The “Relationship” window will open.

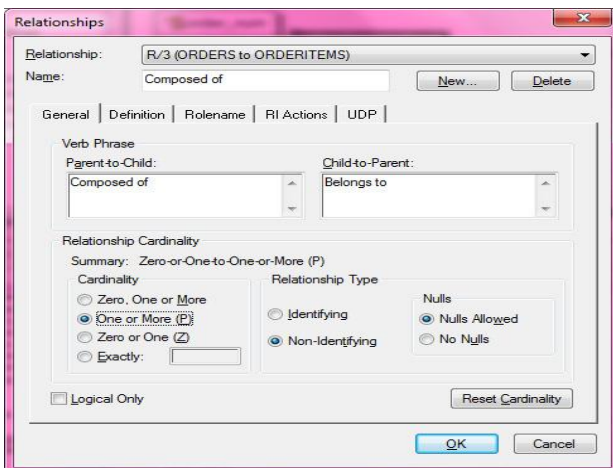
Enter a name in the “Name” textbox (i.e., Composed of).

Enter a Verb Phrase in the “Parent-to-Child” textbox (i.e., Composed of)

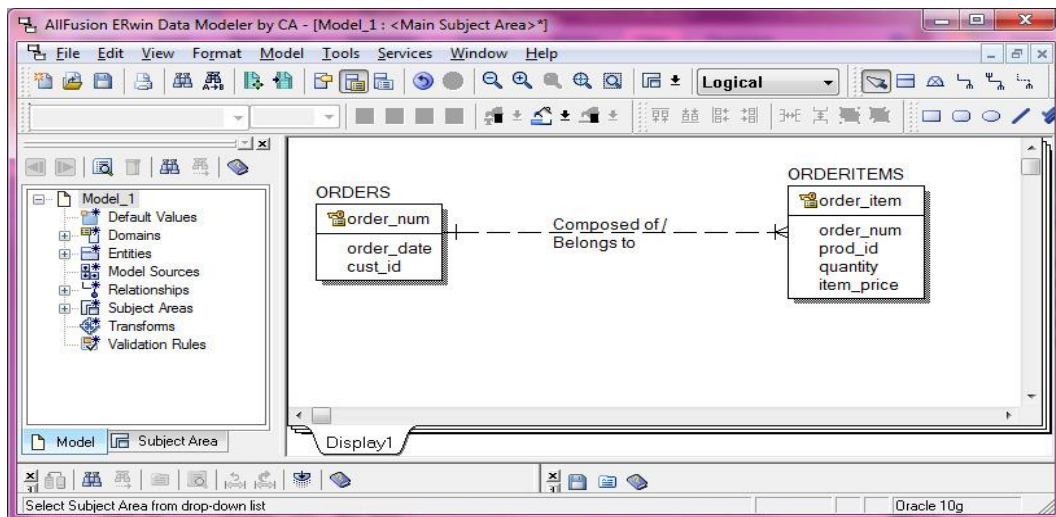
Enter a Verb Phrase in the “Child-to-Parent” textbox (i.e., Belongs to)

For the 1-to-many relationship select the “One or More (P)” option under “Cardinality”.



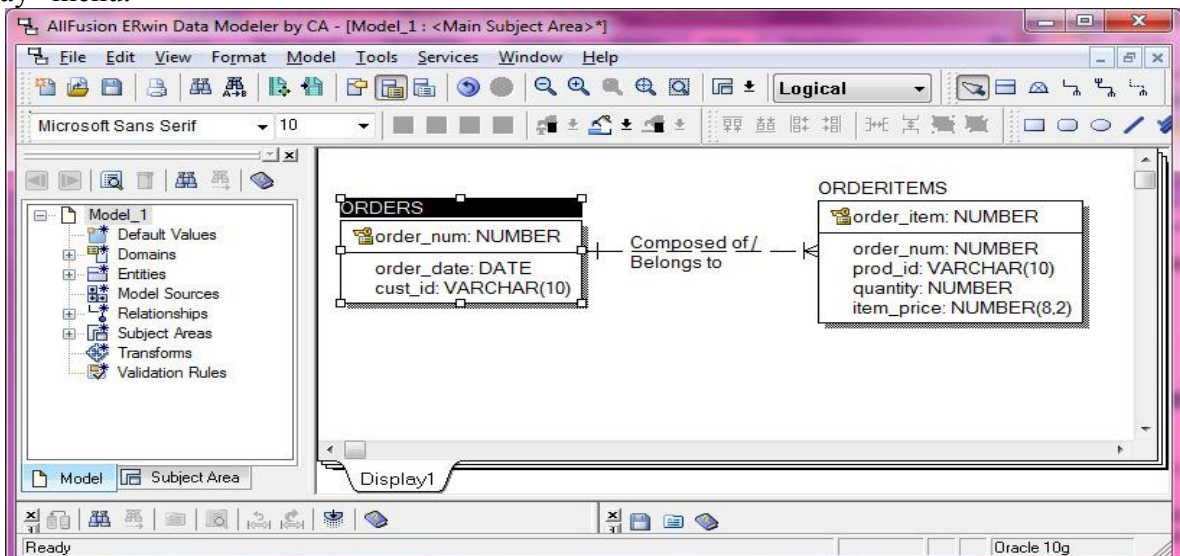


The following figure is for the 1-to-N relationship between ORDERS and ORDERITEMS.



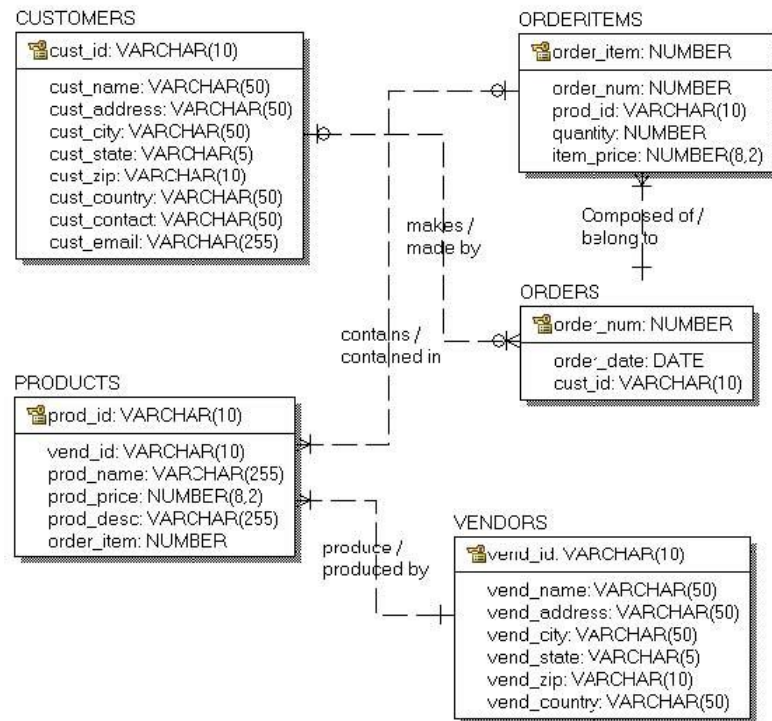
3. Repeat steps 1 and 2 for the remaining relationships

NOTE: To display Datatype for each attribute, select “Attribute Datatype” from the “Format →Entity Display” menu.



#### A4. Save File

When have defined all the relationships save the file. The completed diagram should look something like this when you are finished:



#### B. EER Diagrams using ERwin

The following steps will help you to complete the EER diagram for your homework.

##### B1. Setup design environment

1. Create a new model with "File → New"

Select "Logical/Physical" for New Model Type  
Select "Oracle" and "10.x" for Target Database

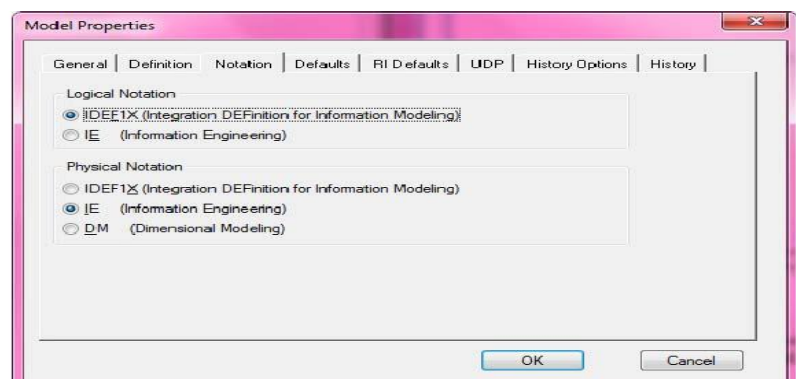
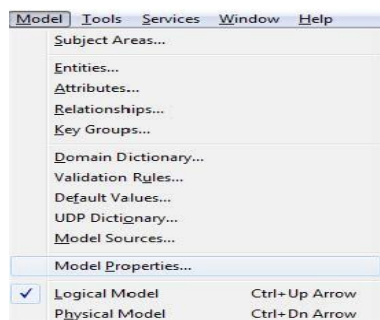
2. Modify the Model Properties as follows:

From the Model Menu

Choose "Model Properties..."

When the Model Properties window opens click on the "Notation" tab

In the "Logical Notation" section select "IDEF1X (Integration DEFINition for Information Modeling)"



**B2. Create entities (use the diagram below and follow procedure outlined in section A)**

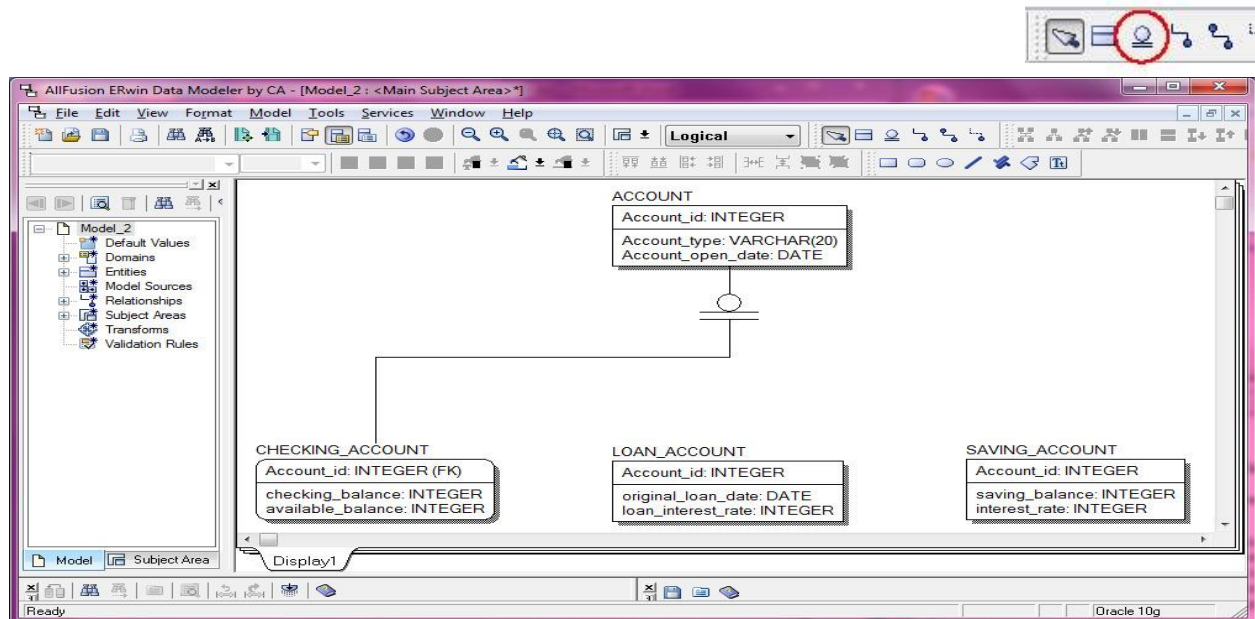
**B3. Join the Super and Sub Classes**

1. Create the relationship between the Parent Entity and the first Child Entity

- Click on the “complete sub-category” icon ( ) on the toolbar ( ). The mouse cursor will change to resemble the icon.

Select the Parent Entity (click on ACCOUNT)

Select one of the Child Entities (click on CHECKING\_ACCOUNT) A relationship line will appear, joining the two entities



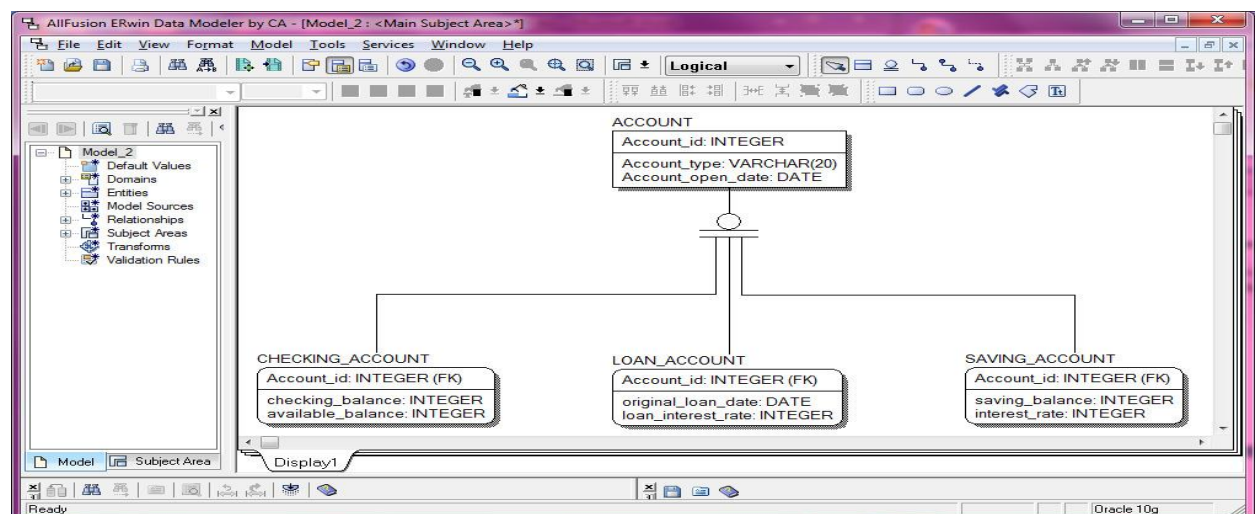
2. Create the relationship between the Parent Entity and the remaining Child Entities

Make sure the “complete sub-category” icon is selected on the toolbar.

Click on the Subtype symbol in the Display area.

Click on the Child Entity.

Repeat for all Child Entities.

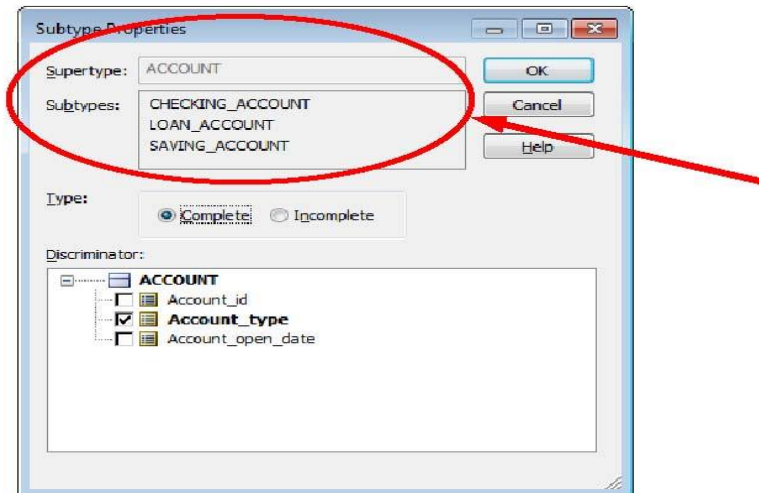


3. Name the relationship

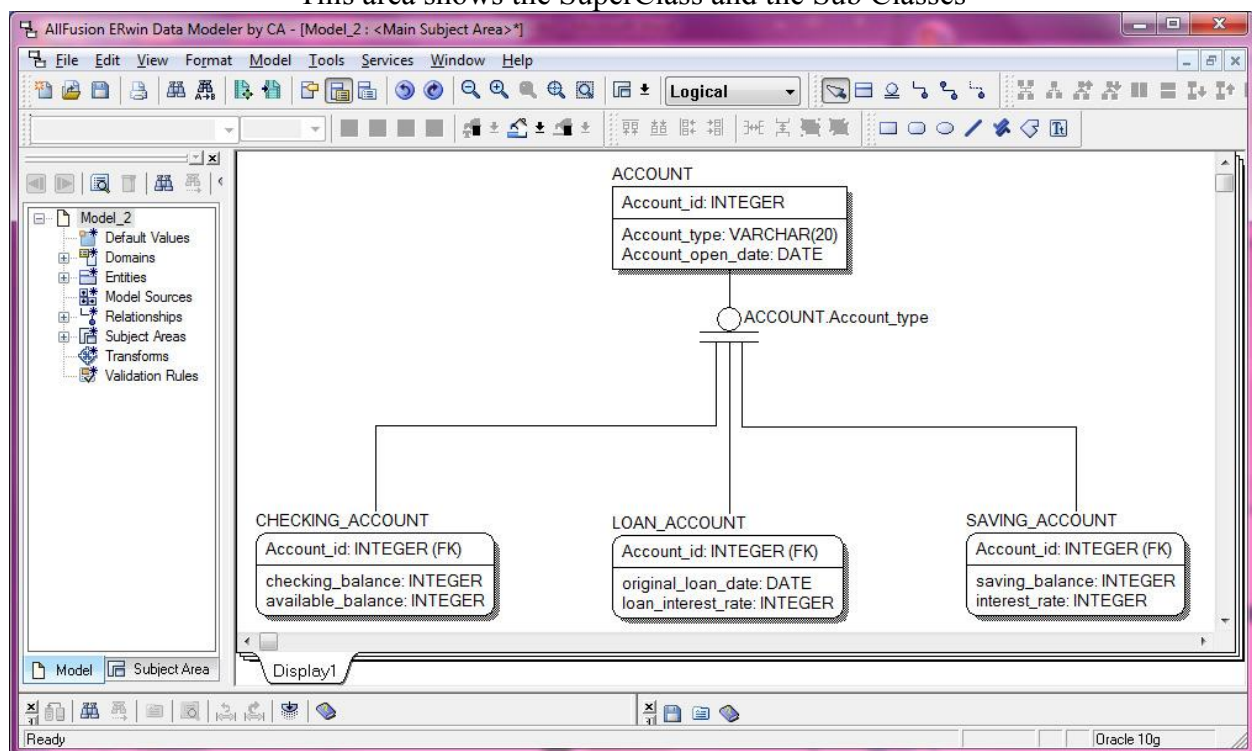
Right-click on the Subtype symbol in the Display area.

Select “Subtype properties...” from the menu.

In the Subtype Properties window, select the properties on which the Specialization/Generalization has been done. In this case the Specialization/Generalization was done on Account\_type, so put a check in the Account\_type checkbox.



This area shows the SuperClass and the Sub Classes



### Exercise 1: ER Diagram for COMPANY database

Use COMPANY database. (Figure 5.6, Figure 5.7, and Figure 8.2) You have to create a Crow's Foot diagram using ERwin for the COMPANY database that you have used for lab exercises as follows:

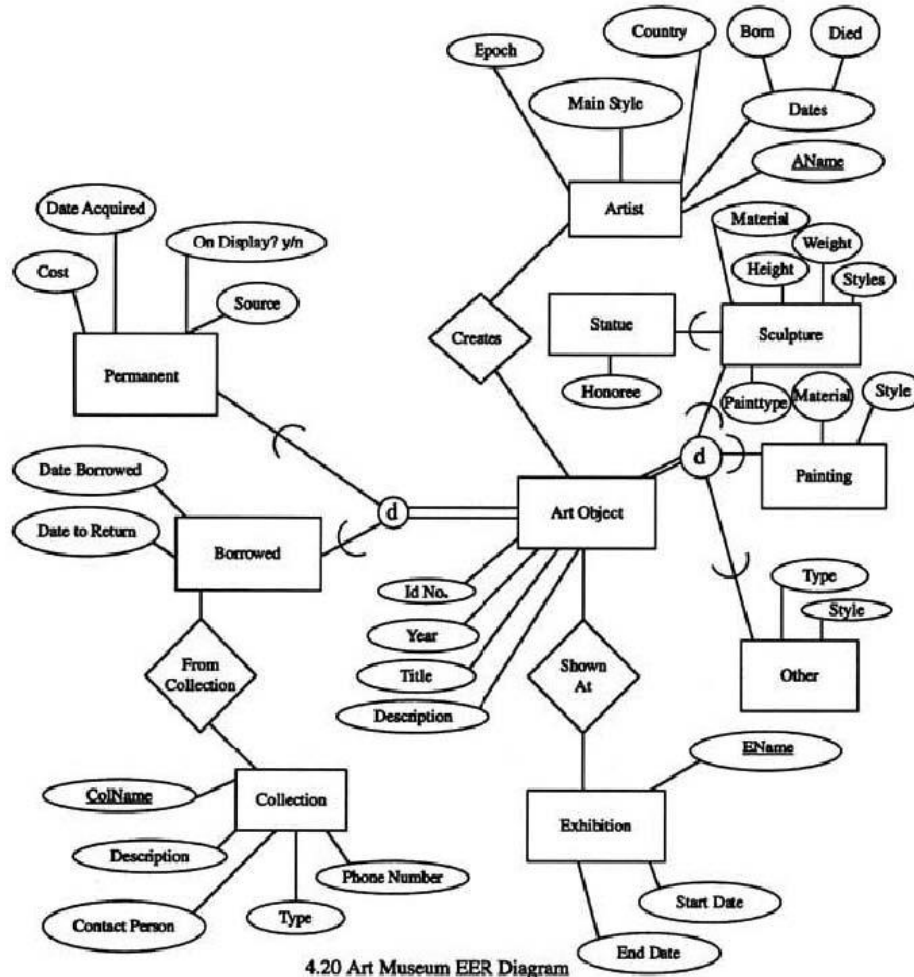
- Create all entities.
- Change entity names.
- Create all attributes.
- Modify appropriate data types, primary key, foreign key, and not null constraints.
- Define the relationships in the COMPANY database.
- Create relations, and give the names.



## Exercise 2: EER Diagram for Art Museum database

This is the EER diagram for Art Museum database. From the diagram, create EER diagram using ERwin.

- You need to study by yourself how to generate EER diagram using ERwin.



## Exercise 3: ER modeling

Design an ER schema for keeping track of information about vote taken in the U.S. House of Representatives during the current two-year congressional session. The database needs to keep track of each U.S. STATE's Name (e.g., 'Texas', 'New York', 'Connecticut') and include the Region of the state (whose domain is {'Northeast', 'Midwest', 'Southeast', 'Southwest', 'West'}). Each CONGRESS\_PERSON in the House of Representatives is described by his or her Name, plus the District represented, the Start\_date when the congressperson was first elected, and the political Party to which he or she belongs (whose domain is {"Republican", 'Democrat', 'Independent', 'Other'}). The database keeps track of each BILL (i.e., proposed law), including the Bill\_name, the Date\_of\_vote on the bill, whether the bill Passed\_or\_failed (whose domain is {'Yes', 'No'}, and the Sponsor (the congressperson(s) who sponsored-that is, proposed-the bill). The database keeps track of how each congressperson voted on each bill (domain of Vote attribute is {'Yes', 'No', 'Abstain', 'Absent'}).

Find Entities.

Find Relationships.

Draw an ER schema diagram using ERwin with appropriate options.

State clearly any assumptions you make.

Exercise: 1

1. Save your model into ERwin type (file name: “Your Last Name”\_“UB ID”\_e1.erwin). For example, in case of “John Smith” and “1234567”, the file names are smith\_1234567\_e1.erwin.

Exercise: 2

1. Save your file into ERwin type (file name: “Your Last Name”\_“UB ID”\_e2.erwin). For example, in case of “John Smith” and “1234567”, the file names are smith\_1234567\_e2.erwin.

Exercise: 3

1. Save your file into ERwin type (file name: “Your Last Name”\_“UB ID”\_e3.erwin). For example, in case of “John Smith” and “1234567”, the file names are smith\_1234567\_e3.erwin.

After you create three files, you must make one zip file, “Your Last Name”\_”UB\_ID”\_LAB1.zip.

Then, you will submit your program using blackboard digital drop-box (<http://bridgeport.ctdlc.org/>).

If you have any trouble to use blackboard, you can contact GA or instructor.