Key Definitions

- ☑ Architecture design
  - ➤ Plans for how the system will be distributed across computers and what hardware and software will be used for each computer
- ☑ Hardware and software specification
  - ➤ Describes the hardware/software components in detail to aid those responsible for purchasing those products.

- ☑ تصميم الهندسة المعمارية
  - ➤ خطط كيف سيتم توزيع النظام عبر أجهزة الكمبيوتر وما هي الأجهزة والبرمجيات وسوف تستخدم لكل كمبيوتر
- ☑ مواصفات الأجهزة والبرامج
  - ➤ يصف مكونات الأجهزة / البرمجيات في التفاصيل لمساعدة المسؤولين عن شراء تلك المنتجات.

ELEMENTS OF AN ARCHITECTURE DESIGN

ARCHITECTURAL COMPONENTS (FUNCTIONS) OF SOFTWARE:
- ☑ Data storage
- ☑ Data access logic
  - ➤ Processing required to access stored data
- ☑ Application logic
  - ➤ Processing logic of the application
- ☑ Presentation logic
  - ➤ Information display and user command processing

- ☑ مخزن البيانات
- ☑ منطق الوصول إلى البيانات
  - ➤ المعالجة المطلوبة للوصول إلى البيانات المخزنة
- ☑ منطق التطبيق
  - ➤ منطق معالجة الطلب
- ☑ منطق العرض
  - ➤ وعرض المعلومات ومعالجة الأمر المستخدم

ARCHITECTURAL DESIGN PURPOSE

- ☑ DETERMINE WHAT PARTS OF THE APPLICATION SOFTWARE WILL BE ASSIGNED TO WHAT HARDWARE.

- ☑ HARDWARE OPTIONS:

  - ➤ CLIENT COMPUTERS
    - ● INPUT/OUTPUT DEVICES EMPLOYED BY USERS
    - ● PCS, LAPTOPS, HANDHELD DEVICES, CELL PHONES

  - ➤ SERVERS
    - ● LARGER COMPUTERS STORING SOFTWARE AND DATA
    - ● ACCESSIBLE BY MANY USERS

  - ➤ NETWORK
    - ● CONNECTS THE COMPUTERS
    - ● VARY IN SPEED

- ☑ تحديد ما سيتم تعيين أجزاء من تطبيق البرمجيات لما هي الأجهزة.

- ☑ خيارات الأجهزة:

  - ➤ أجهزة الكمبيوتر العميل
    - ● أجهزة الإدخال / الإخراج المستخدمة من قبل المستخدمين
    - ● أجهزة الكمبيوتر وأجهزة الكمبيوتر المحمولة، الأجهزة المحمولة، والهواتف المحمولة

  - ➤ الخوادم
    - ● أجهزة الكمبيوتر الكبيرة تخزين البرامج والبيانات
    - ● يمكن الوصول إليها من قبل العديد من المستخدمين

  - ➤ شبكة الاتصال
    - ● يربط أجهزة الكمبيوتر
    - ● تختلف في سرعة

CLIENT-SERVER ARCHITECTURES

☑ SERVER-BASED ARCHITECTURE

☑ CLIENT-BASED ARCHITECTURE

☑ CLIENT-SERVER BASED ARCHITECTURE

CLIENT-SERVER BASED ARCHITECTURES

☑ ATTEMPT TO BALANCE THE PROCESSING BETWEEN CLIENT DEVICES AND ONE OR MORE SERVER DEVICES

➤ THE CLIENT IS RESPONSIBLE FOR THE PRESENTATION LOGIC

➤ THE SERVER IS RESPONSIBLE FOR THE DATA ACCESS LOGIC AND DATA STORAGE

➤ THE APPLICATION LOGIC MAY RESIDE ON THE CLIENT, RESIDE ON THE SERVER, OR BE SPLIT BETWEEN BOTH

☑ محاولة لتحقيق التوازن في معالجة بين الأجهزة العميلة واحد أو أكثر من أجهزة الخادم

➤ العميل هو المسؤول عن منطق العرض

➤ خادم هو المسؤول عن منطق الوصول إلى البيانات وتخزين البيانات

➤ يمكن أن يقيم منطق التطبيق على العميل، الموجودة على الخادم، أو أن تقسم بين البلدين
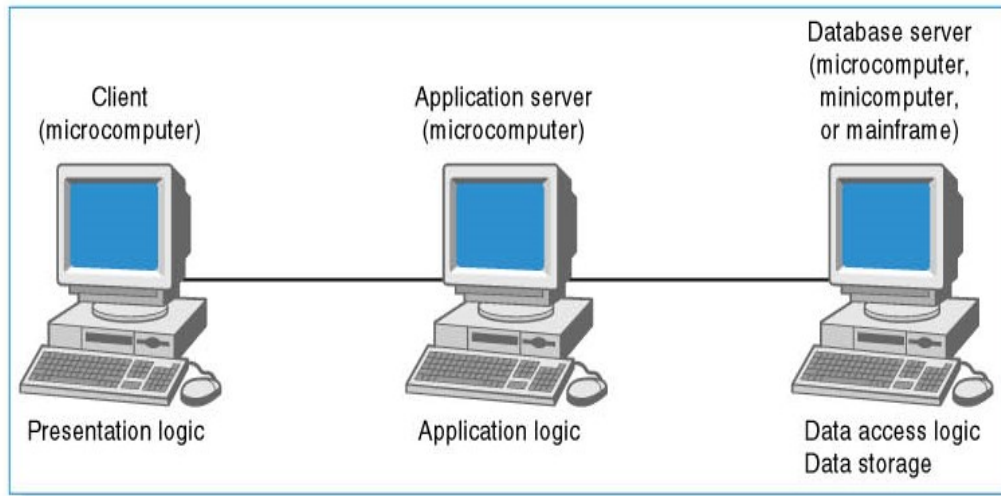
CLIENT-SERVER ATTRIBUTES

☑ Benefits	☑ Limitations
➤ **Scalable**	➤ Complexity
➤ **Works with multiple vendors/products through middleware**	➤ New programming languages and techniques (adds stress for personnel)
➤ **Improved modularity of web-based systems**	➤ More complex to update
➤ **No central point of failure**	

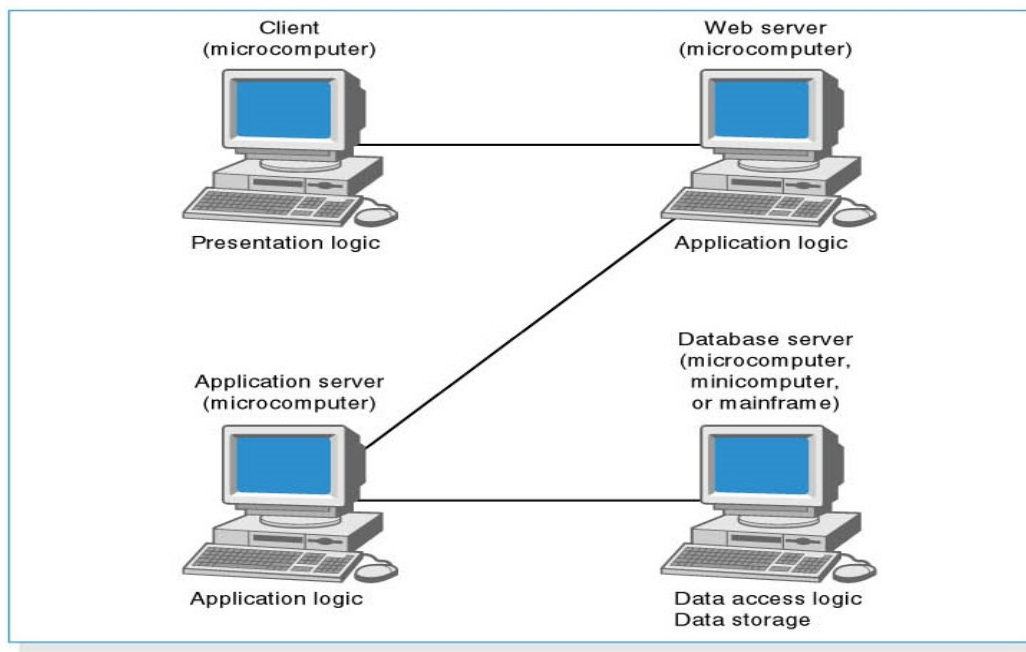| ☑ فوائد	☑ محددات
➤ **القابلة للتطوير**	➤ تعقيد
➤ **يعمل مع بائعين متعددين / المنتجات من خلال الوسيطة**	➤ لغات البرمجة وتقنيات جديدة (يضيف الإجهاد للموظفين)
➤ **تحسين نمطية من النظم القائمة على شبكة الإنترنت**	➤ أكثر تعقيدا لتحديث
➤ **لا نقطة مركزية للفشل**	

CLIENT-SERVER ARCHITECTURE (TWO-TIERED)
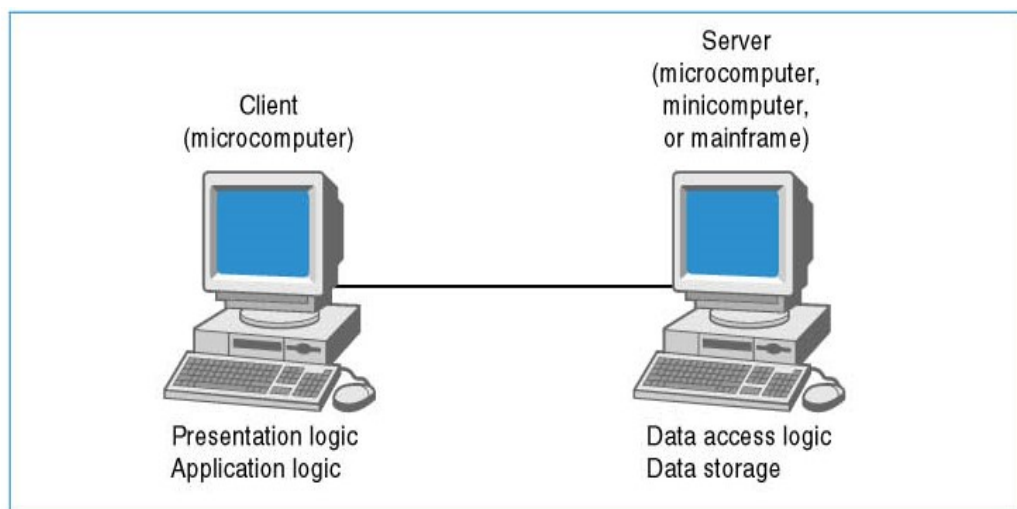
THREE-TIERED CLIENT-SERVER ARCHITECTURE

FOUR-TIERED CLIENT-SERVER ARCHITECTURE

N-Tiered versus 2-Tiered Client-Server Architectures

| ☑ Benefits	☑ Limitations
⇒ Separates processing to better balance load on different servers ⇒ More scalable	⇒ Greater load on the network ⇒ More difficult to program and test
☑ فوائد	☑ محددات
⇐ يفصل تجهيز لأفضل تحميل التوازن على ملقمات مختلفة ⇐ أكثر استيعابا	⇐ تحميل أكبر على شبكة ⇐ من الصعب برمجة واختبار

Server-Based Architecture
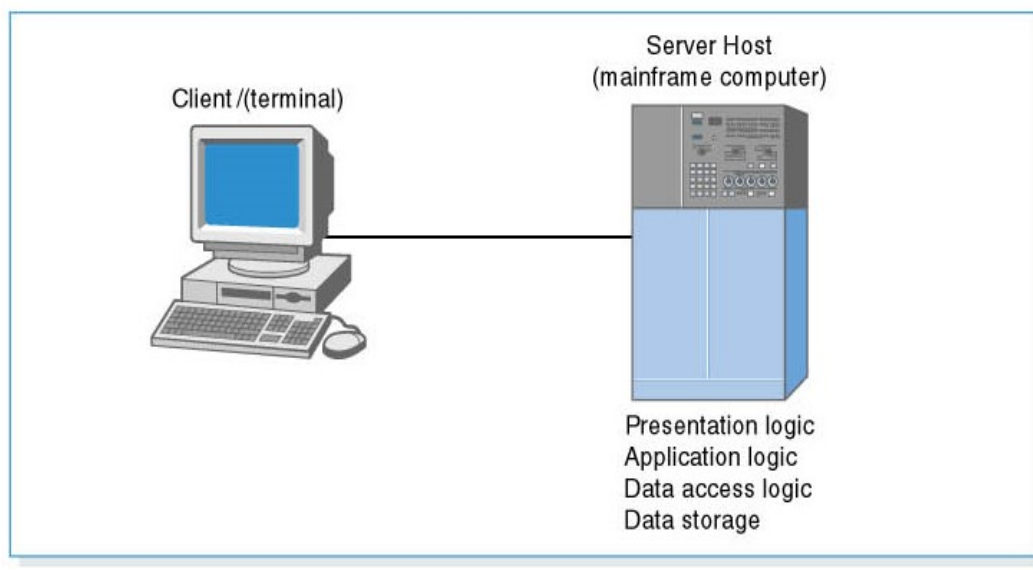
SERVER-BASED ARCHITECTURES

- ☑ Mainframe
- ☑ Minicomputer
- ☑ Microcomputer (personal computer)

CLIENT-BASED ARCHITECTURE
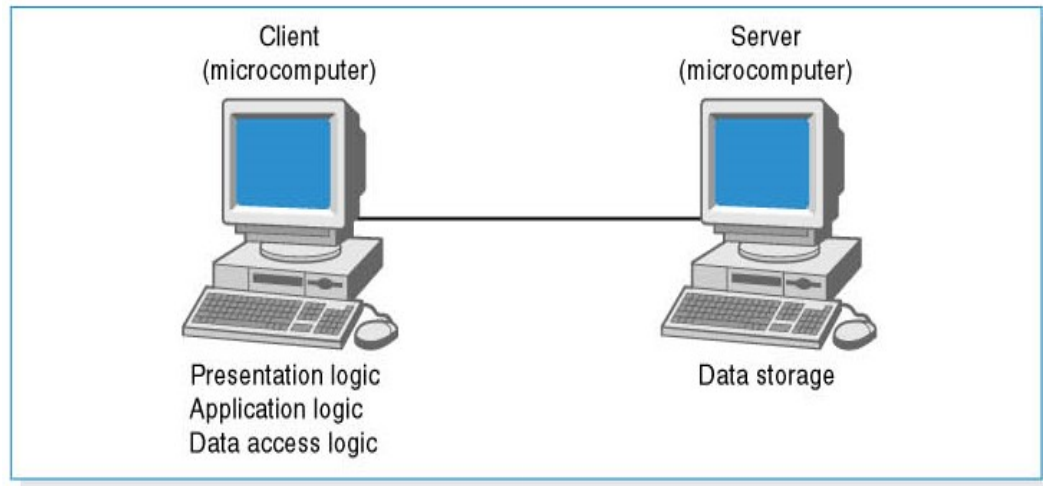
CLIENT-BASED ARCHITECTURES

- ☑ Terminals
- ☑ Microcomputer (personal computer)
- ☑ Special purpose terminals(ATMs, kiosks, Palm Pilots, and many others)

- ☑ محطات
- ☑ الحواسيب الصغيرة (الكمبيوتر الشخصي)
- ☑ محطات لأغراض خاصة (أجهزة الصراف الآلي، والأكشاك، والنخيل الطيارين، وكثير غيرها)

YOUR TURN

- ☑ Consider the course registration system at your university:

- ☑ What computing architecture does it use?

- ☑ What computing architecture would you use if you were replacing it today?

CREATING AN ARCHITECTURE DESIGN

SELECTING AN ARCHITECTURE DESIGN

☑ Lower costs often used to justify choice of client-server

☑ Recommended selection process:

➤ Expand nonfunctional requirement details

➤ Base architecture selection on the detailed nonfunctional requirements

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اختيار وتصميم الهندسة المعمارية:

☑ انخفاض التكاليف غالبا ما تستخدم لتبرير اختيار خدمة العملاء

☑ الموصي بها عملية الاختيار:

➤ توسيع تفاصيل الشرط غير وظيفي

➤ اختيار بنية قاعدة على متطلبات غير الوظيفية مفصلة

Operational Requirements

Type of Requirement	Definition	Examples
Technical Environment Requirements	Special hardware, software, and network requirements imposed by business requirements	• The system will work over the Web environment with Internet Explorer. • All office locations will have an always-on network connection to enable real-time database updates. • A version of the system will be provided for customers connecting over the Internet via a small-screen smartphone.
System Integration Requirements	The extent to which the system will operate with other systems	• The system must be able to import and export Excel spreadsheets. • The system will read and write to the main inventory database in the inventory system.
Portability Requirements	The extent to which the system will need to operate in other environments	• The system must be able to work with different operating systems (i.e., Linux; Windows 7). • The system may need to operate with handheld devices such as an iPad.
Maintainability Requirements	Expected business changes to which the system should be able to adapt	• The system will be able to support more than one manufacturing plant upon six months advance notice. • New versions of the system will be released every six months.

FIGURE 8-6
Operational Requirements

Performance Requirements

Type of Requirement	Definition	Examples
Speed Requirements	The time within which the system must perform its functions	• Response time must be less than 7 seconds for any transaction over the network • The inventory database must be updated in real time. • Orders will be transmitted to the factory floor every 30 minutes.
Capacity Requirements	The total and peak number of users and the volume of data expected	• There will be a maximum of 200 simultaneous users at peak use times. • A typical transaction will require the transmission of 10K of data. • The system will store data on approximately 5,000 customers for a total of about 2 MB of data.
Availability and Reliability Requirements	The extent to which the system will be available to the users and the permissible failure rate due to errors.	• The system should be available 24 × 7, with the exception of scheduled maintenance. • Scheduled maintenance shall not exceed one 6-hour period each month. • The system will have 99% uptime performance.

Security Requirements

Type of Requirement	Definition	Examples
System Value Estimates enue.	Estimated business value of the system and its data	• The system is not mission critical but a system outage is estimated to cost $50,000 per hour in lost rev- • A complete loss of all system data is estimated to cost $20 million.
Access Control Requirements	Limitations on who can access what data	• Only department managers will be able to change inventory items within their own department. • Telephone operators will be able to read and create items in the customer file, but cannot change or delete items.
Encryption and Authentication Requirements	Defines what data will be encrypted where and whether authentication will be needed for user access	• Data will be encrypted from the user's computer to the Web site to provide secure ordering. • Users logging in from outside the office will be required to authenticate.
Virus Control	Requirements to control the spread of viruses	• All uploaded files will be checked for viruses before

Type of Requirement	Definition	Examples
Multilingual Requirements	The language in which the system will need to operate	• The system will operate in English, French, and Spanish.
Customization Requirements	Specification of what aspects of the system can be changed by local users	• Country managers will be able to define new fields in the product database in order to capture country-specific information. • Country managers will be able to change the format of the telephone-number field in the customer database.
Making Unstated Norms Explicit	Explicitly stating assumptions that differ from country to country	• All date fields will be explicitly identified as using the month-day-year format. • All weight fields will be explicitly identified as being stated in kilograms.
Legal Requirements	The laws and regulations that impose requirements on the system	• Personal information about customers cannot be transferred out of European Union countries into the United States. • It is against U.S. federal law to divulge information on who rented what videotape, so access to a customer's rental history is permitted only to regional managers.

FIGURE 8-9
Cultural and Political Requirements

DESIGNING THE ARCHITECTURE

☑ **Technical environment requirements, driven by business requirements, often define the application architecture**

☑ **If not, other nonfunctional requirements become important**

☑ متطلبات البيئة التقنية، مدفوعا متطلبات العمل، وغالبا ما تحدد بنية التطبيق

☑ إذا لم يكن كذلك، تصبح متطلبات غير الوظيفية الهامة الأخرى

Requirements	Server-Based	Client-Based	Thin Client-Server	Thick Client-Server
Operational Requirements				
System Integration Requirements	✓		✓	✓
Portability Requirements			✓	
Maintainability Requirements	✓		✓	
Performance Requirements				
Speed Requirements			✓	✓
Capacity Requirements			✓	✓
Availability/Reliability Requirements	✓		✓	✓
Security Requirements				
High System Value	✓		✓	
Access Control Requirements	✓			
Encryption/Authentication Requirements			✓	✓
Virus Control Requirements	✓			
Cultural/Political Requirements				
Multilingual Requirements			✓	
Customization Requirements			✓	
Making Unstated Norms Explicit			✓	
Legal Requirements	✓		✓	✓

HARDWARE AND SOFTWARE SPECIFICATION

HARDWARE AND SOFTWARE SPECIFICATION

- Used if new hardware or software must be purchased
- Communicates project needs
- Actual acquisition of hardware and software usually left to a purchasing department -- especially in larger firms

> ☑ تستخدم إذا كان يجب شراء جهاز أو برنامج جديد
> ☑ يتصل احتياجات المشروع
> ☑ الاستحواذ الفعلي من الأجهزة والبرامج عادة غادر إلى إدارة المشتريات ـ وخاصة في الشركات الكبرى

HARDWARE AND SOFTWARE SPECIFICATION

- Determine software needs
  - OS, special purpose software
  - Training, warranty, maintenance, licensing needs
- Determine hardware needs
  - Server(s), clients, peripherals, backup devices, storage components
  - Minimum configuration needs

> ☑ تحديد احتياجات البرنامج
> - OS، والبرمجيات لأغراض خاصة
> - التدريب، والضمان والصيانة واحتياجات الترخيص
> ☑ تحديد احتياجات الأجهزة
> - الخادم (ق)، والعملاء، والأجهزة الطرفية، وأجهزة النسخ الاحتياطي، مكونات التخزين
> - احتياجات التكوين الأدنى

SAMPLE HARDWARE AND SOFTWARE SPECIFICATION

Operating System	• Windows	• Linux	• Linux	• Linux
	• Mozilla			
Special Software	• Real Audio	• Apache	• Java	• Oracle
	• Adobe Acrobat Reader			
Hardware	• 40-gig disk drive	• 80-gig disk drive	• 80-gig disk drive	• 200-gig disk drive
	• Pentium	• Pentium	• Pentium	• RAID
	• 17-inch Monitor			• Quad Pentium
Network	• Always-on Broadband preferred	• Dual 100 Mbps Ethernet	• Dual 100 Mbps Ethernet	• Dual 100 Mbps Ethernet
	• Dial-up at 56Kbps possible with some performance loss			

FACTORS IN HARDWARE AND SOFTWARE SELECTION

1. **Functions and Features** What specific functions and features are needed (e.g., size of monitor, software features)
2. **Performance** How fast the hardware and software operates (e.g., processor, number of database writes per second)
3. **Legacy Databases and Systems** How well the hardware and software interacts with legacy systems (e.g., can it write to this database)
4. **Hardware and OS Strategy** What are the future migration plans (e.g., the goal is to have all of one vendor's equipment)
5. **Cost of Ownership** What are the costs beyond purchase (e.g., incremental license costs, annual maintenance, training costs, salary costs)
6. **Political Preferences** People are creatures of habit and are resistant to change, so changes should be minimized
7. **Vendor Performance** Some vendors have reputations or future prospects that are different from those of a specific hardware or software system they currently sell

SUMMARY

☑ The three fundamental computing architectures are server-based, client-based, and client-server based.
☑ Select architecture design based on detailed nonfunctional requirements
☑ Hardware and software specification documents acquisition needs

☑ أبنية الحوسبة الأساسية الثلاثة هي يستند إلى ملقم، تستند إلى العميل، وخدمة العملاء القائمة.
☑ حدد تصميم الهندسة المعمارية على أساس متطلبات غير الوظيفية مفصلة
☑ احتياجات الوثائق مواصفات شراء المعدات والبرمجيات