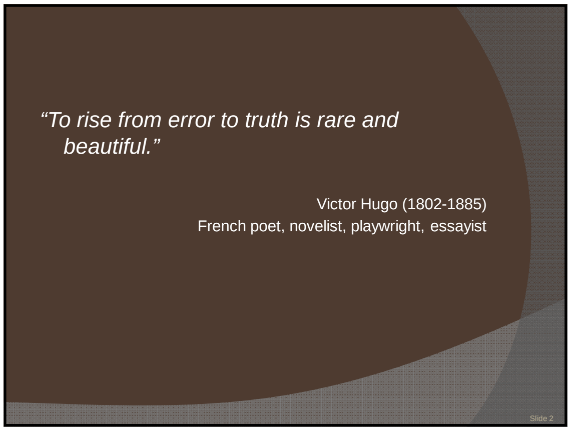
The Heart & Brains of Your Web Site

WEB & DATABASE SERVERS



"To rise from error to truth is rare and beautiful."

Victor Hugo (1802-1885)
French poet, novelist, playwright, essayist

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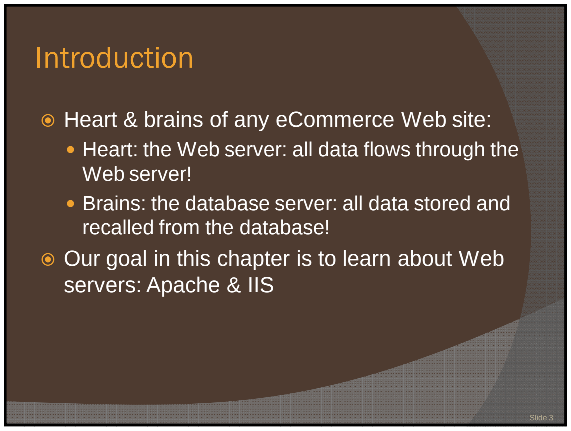

Introduction

- Heart & brains of any eCommerce Web site:
  - Heart: the Web server: all data flows through the Web server!
  - Brains: the database server: all data stored and recalled from the database!
- Our goal in this chapter is to learn about Web servers: Apache & IIS

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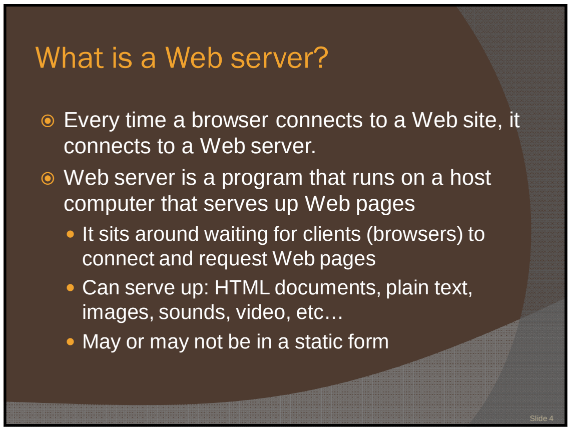

What is a Web server?

- Every time a browser connects to a Web site, it connects to a Web server.
- Web server is a program that runs on a host computer that serves up Web pages
  - It sits around waiting for clients (browsers) to connect and request Web pages
  - Can serve up: HTML documents, plain text, images, sounds, video, etc…
  - May or may not be in a static form

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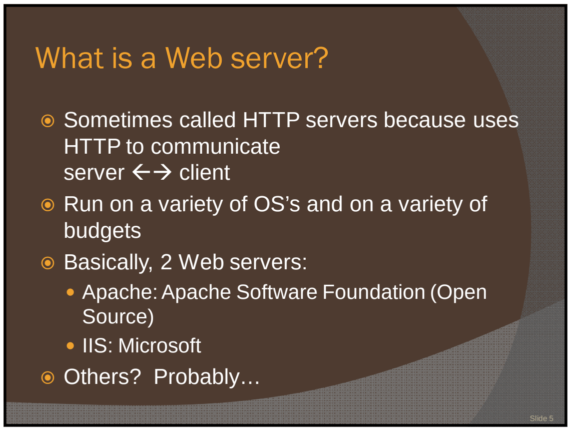

What is a Web server?

- Sometimes called HTTP servers because uses HTTP to communicate
  server ←→ client
- Run on a variety of OS's and on a variety of budgets
- Basically, 2 Web servers:
  - Apache: Apache Software Foundation (Open Source)
  - IIS: Microsoft
- Others? Probably…

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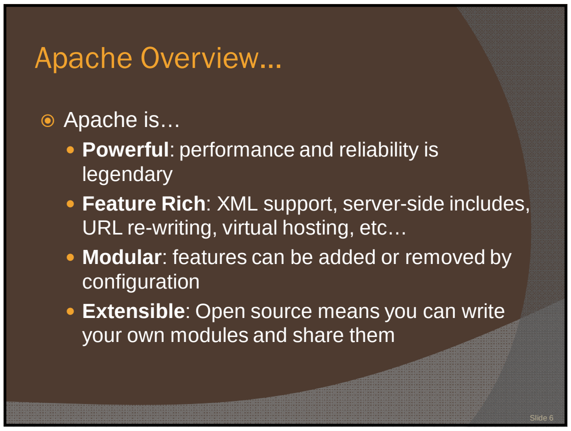

Apache Overview…

- Apache is…
  - **Powerful**: performance and reliability is legendary
  - **Feature Rich**: XML support, server-side includes, URL re-writing, virtual hosting, etc…
  - **Modular**: features can be added or removed by configuration
  - **Extensible**: Open source means you can write your own modules and share them

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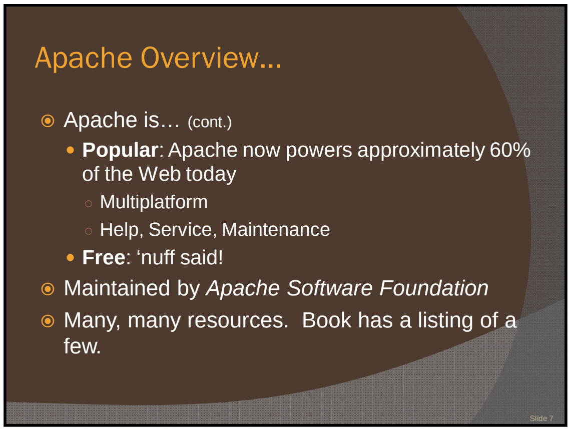

Apache Overview…

- Apache is… (cont.)
  - **Popular**: Apache now powers approximately 60% of the Web today
    - Multiplatform
    - Help, Service, Maintenance
  - **Free**: 'nuff said!
- Maintained by *Apache Software Foundation*
- Many, many resources. Book has a listing of a few.

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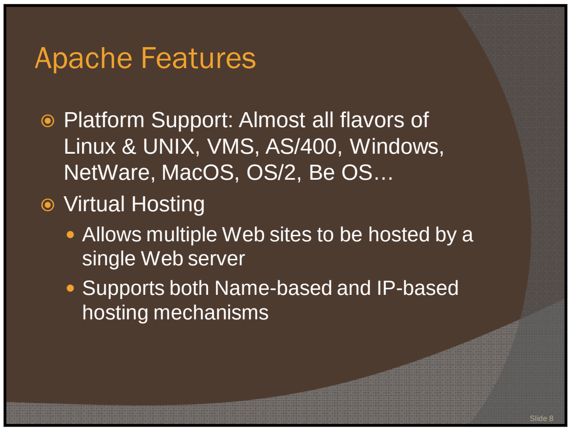

Apache Features

- Platform Support: Almost all flavors of Linux & UNIX, VMS, AS/400, Windows, NetWare, MacOS, OS/2, Be OS…
- Virtual Hosting
  - Allows multiple Web sites to be hosted by a single Web server
  - Supports both Name-based and IP-based hosting mechanisms

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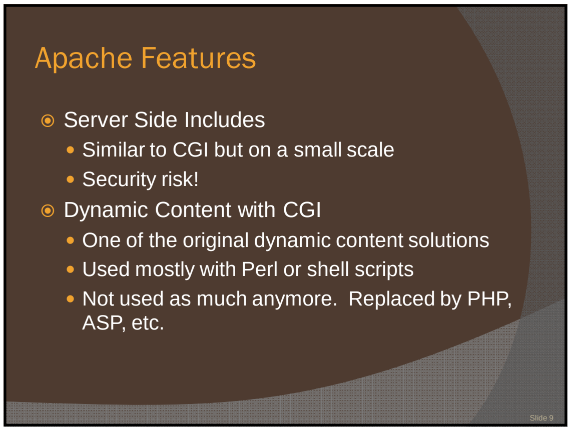

Apache Features

- Server Side Includes
  - Similar to CGI but on a small scale
  - Security risk!
- Dynamic Content with CGI
  - One of the original dynamic content solutions
  - Used mostly with Perl or shell scripts
  - Not used as much anymore. Replaced by PHP, ASP, etc.

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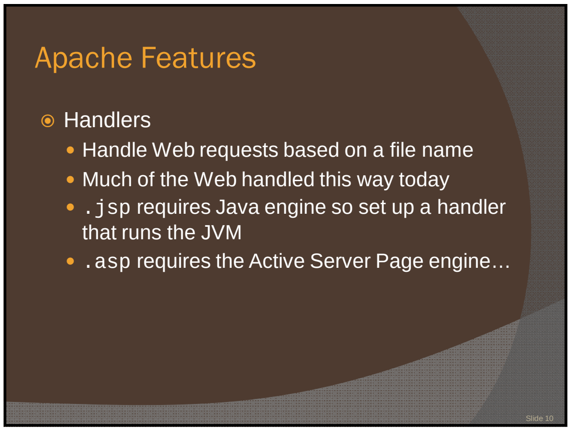

Apache Features

- Handlers
  - Handle Web requests based on a file name
  - Much of the Web handled this way today
  - `.jsp` requires Java engine so set up a handler that runs the JVM
  - `.asp` requires the Active Server Page engine…

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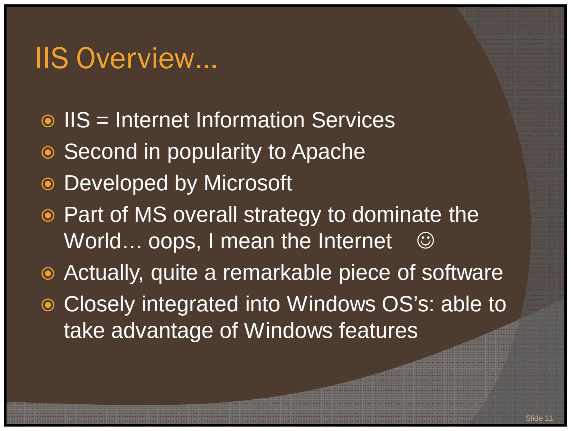

IIS Overview…

- IIS = Internet Information Services
- Second in popularity to Apache
- Developed by Microsoft
- Part of MS overall strategy to dominate the World… oops, I mean the Internet ☺
- Actually, quite a remarkable piece of software
- Closely integrated into Windows OS's: able to take advantage of Windows features

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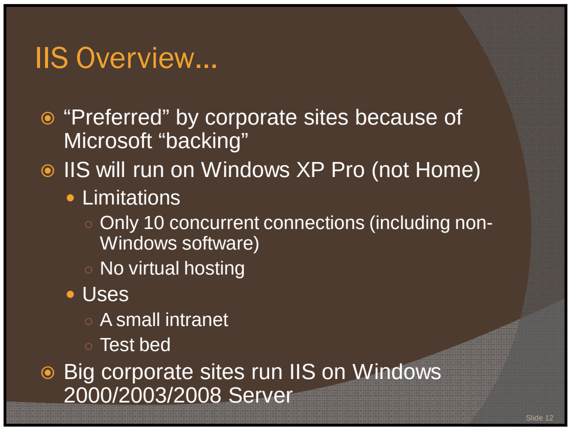

IIS Overview…

- "Preferred" by corporate sites because of Microsoft "backing"
- IIS will run on Windows XP Pro (not Home)
  - Limitations
    - Only 10 concurrent connections (including non-Windows software)
    - No virtual hosting
  - Uses
    - A small intranet
    - Test bed
- Big corporate sites run IIS on Windows 2000/2003/2008 Server

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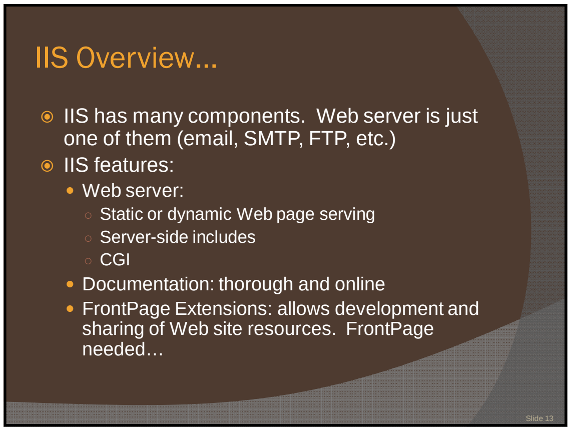
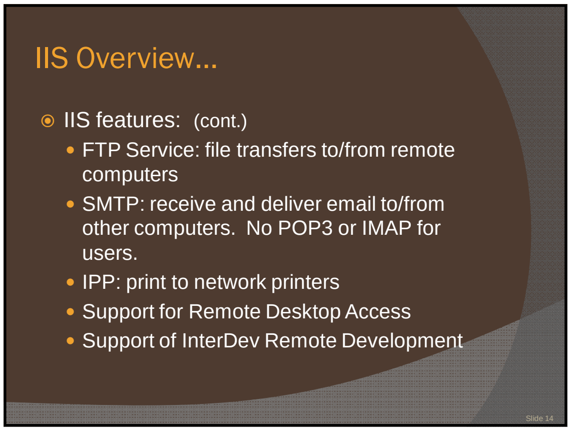


IIS Overview…

- IIS has many components. Web server is just one of them (email, SMTP, FTP, etc.)
- IIS features:
  - Web server:
    - Static or dynamic Web page serving
    - Server-side includes
    - CGI
  - Documentation: thorough and online
  - FrontPage Extensions: allows development and sharing of Web site resources. FrontPage needed…

Slide 13



IIS Overview…

- IIS features: (cont.)
  - FTP Service: file transfers to/from remote computers
  - SMTP: receive and deliver email to/from other computers. No POP3 or IMAP for users.
  - IPP: print to network printers
  - Support for Remote Desktop Access
  - Support of InterDev Remote Development

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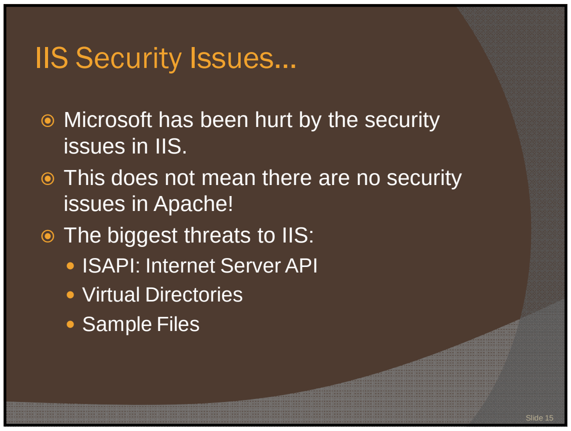
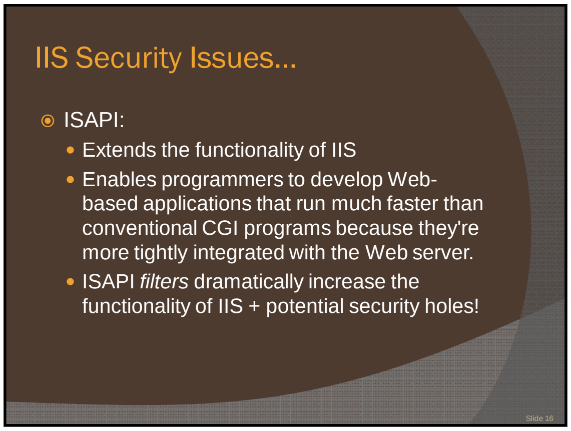


IIS Security Issues…

- Microsoft has been hurt by the security issues in IIS.
- This does not mean there are no security issues in Apache!
- The biggest threats to IIS:
  - ISAPI: Internet Server API
  - Virtual Directories
  - Sample Files

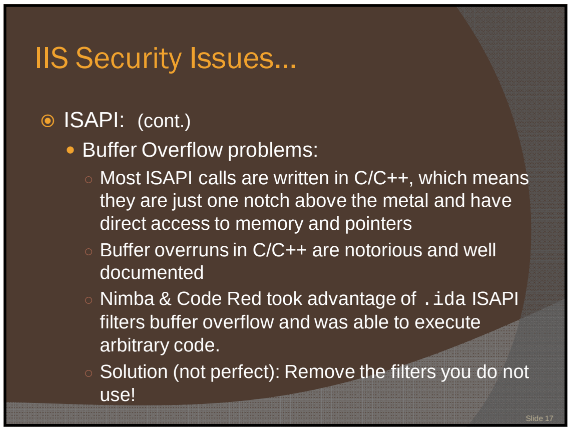
Slide 15



IIS Security Issues…

- ISAPI:
  - Extends the functionality of IIS
  - Enables programmers to develop Web-based applications that run much faster than conventional CGI programs because they're more tightly integrated with the Web server.
  - ISAPI *filters* dramatically increase the functionality of IIS + potential security holes!

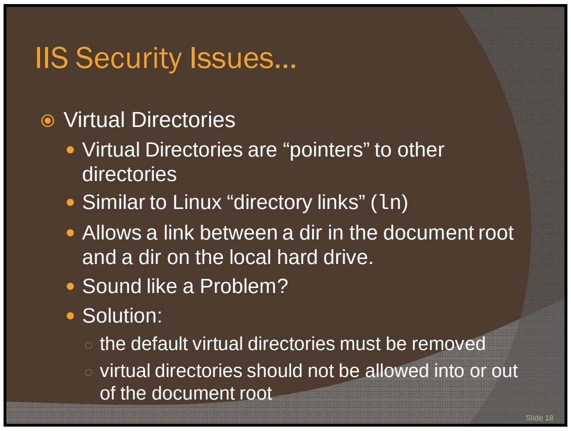
Slide 16



IIS Security Issues…

- ISAPI: (cont.)
  - Buffer Overflow problems:
    - Most ISAPI calls are written in C/C++, which means they are just one notch above the metal and have direct access to memory and pointers
    - Buffer overruns in C/C++ are notorious and well documented
    - Nimba & Code Red took advantage of `.ida` ISAPI filters buffer overflow and was able to execute arbitrary code.
    - Solution (not perfect): Remove the filters you do not use!

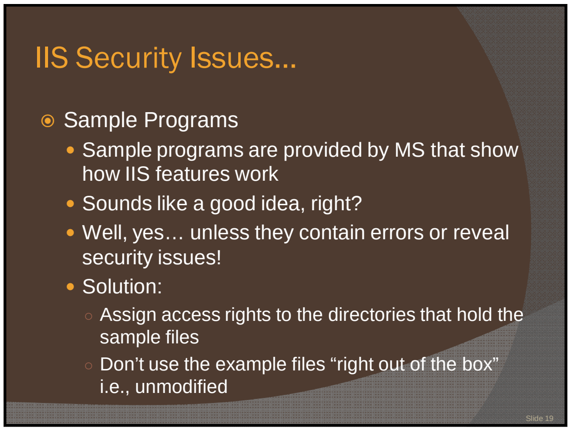
Slide 17



IIS Security Issues…

- Virtual Directories
  - Virtual Directories are "pointers" to other directories
  - Similar to Linux "directory links" (`ln`)
  - Allows a link between a dir in the document root and a dir on the local hard drive.
  - Sound like a Problem?
  - Solution:
    - the default virtual directories must be removed
    - virtual directories should not be allowed into or out of the document root

Slide 18



IIS Security Issues…

- Sample Programs
  - Sample programs are provided by MS that show how IIS features work
  - Sounds like a good idea, right?
  - Well, yes… unless they contain errors or reveal security issues!
  - Solution:
    - Assign access rights to the directories that hold the sample files
    - Don't use the example files "right out of the box" i.e., unmodified

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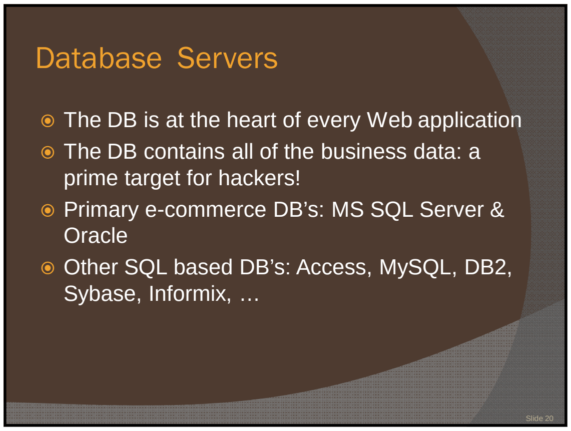

Database Servers

- The DB is at the heart of every Web application
- The DB contains all of the business data: a prime target for hackers!
- Primary e-commerce DB's: MS SQL Server & Oracle
- Other SQL based DB's: Access, MySQL, DB2, Sybase, Informix, …

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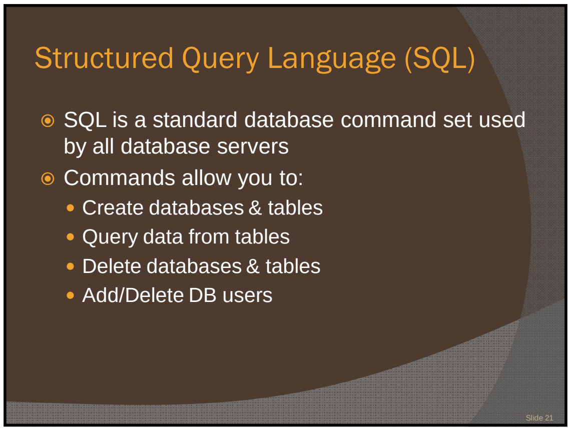
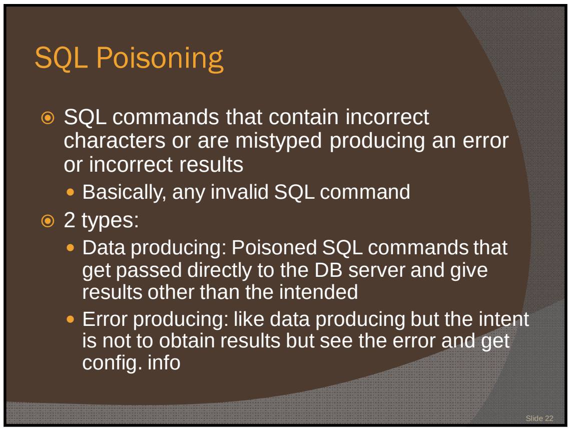


Structured Query Language (SQL)

- SQL is a standard database command set used by all database servers
- Commands allow you to:
  - Create databases & tables
  - Query data from tables
  - Delete databases & tables
  - Add/Delete DB users

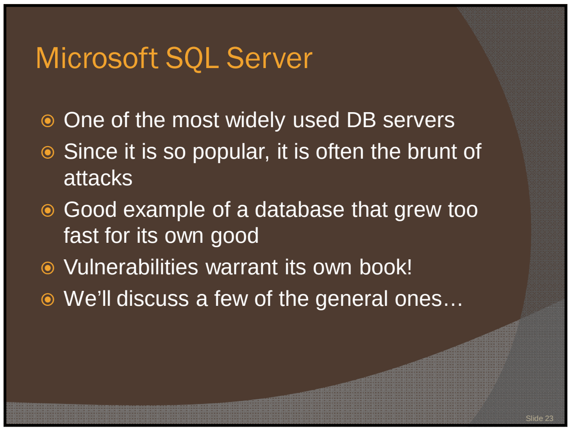
Slide 21



SQL Poisoning

- SQL commands that contain incorrect characters or are mistyped producing an error or incorrect results
  - Basically, any invalid SQL command
- 2 types:
  - Data producing: Poisoned SQL commands that get passed directly to the DB server and give results other than the intended
  - Error producing: like data producing but the intent is not to obtain results but see the error and get config. info

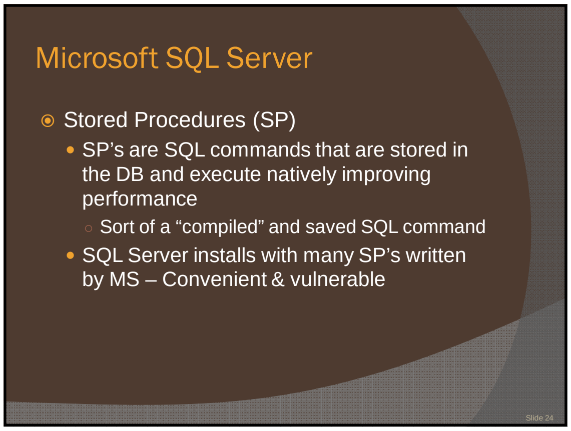
Slide 22



Microsoft SQL Server

- One of the most widely used DB servers
- Since it is so popular, it is often the brunt of attacks
- Good example of a database that grew too fast for its own good
- Vulnerabilities warrant its own book!
- We'll discuss a few of the general ones…

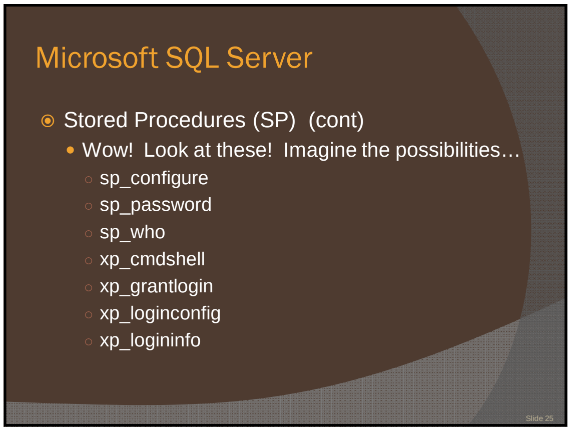
Slide 23



Microsoft SQL Server

- Stored Procedures (SP)
  - SP's are SQL commands that are stored in the DB and execute natively improving performance
    - Sort of a "compiled" and saved SQL command
  - SQL Server installs with many SP's written by MS – Convenient & vulnerable

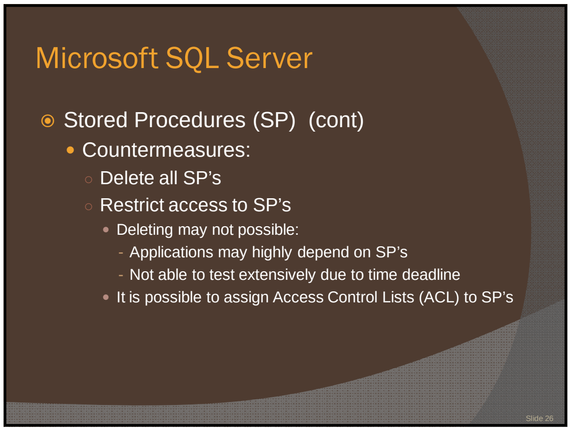
Slide 24



Microsoft SQL Server

- Stored Procedures (SP) (cont)
  - Wow! Look at these! Imagine the possibilities…
    - sp_configure
    - sp_password
    - sp_who
    - xp_cmdshell
    - xp_grantlogin
    - xp_loginconfig
    - xp_loginfo

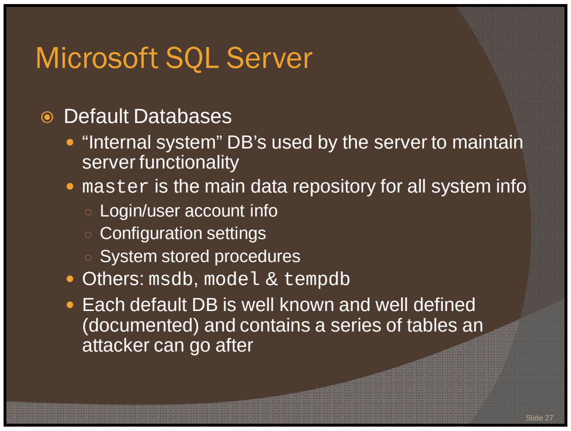
Slide 25



Microsoft SQL Server

- Stored Procedures (SP) (cont)
  - Countermeasures:
    - Delete all SP's
    - Restrict access to SP's
      - Deleting may not possible:
        - Applications may highly depend on SP's
        - Not able to test extensively due to time deadline
      - It is possible to assign Access Control Lists (ACL) to SP's

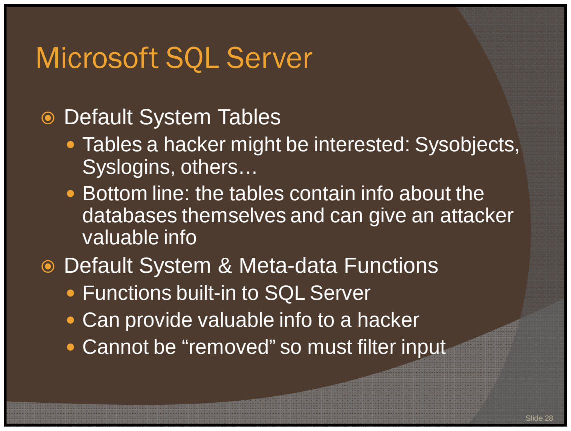
Slide 26



Microsoft SQL Server

- Default Databases
  - "Internal system" DB's used by the server to maintain server functionality
  - `master` is the main data repository for all system info
    - Login/user account info
    - Configuration settings
    - System stored procedures
  - Others: `msdb`, `model` & `tempdb`
  - Each default DB is well known and well defined (documented) and contains a series of tables an attacker can go after

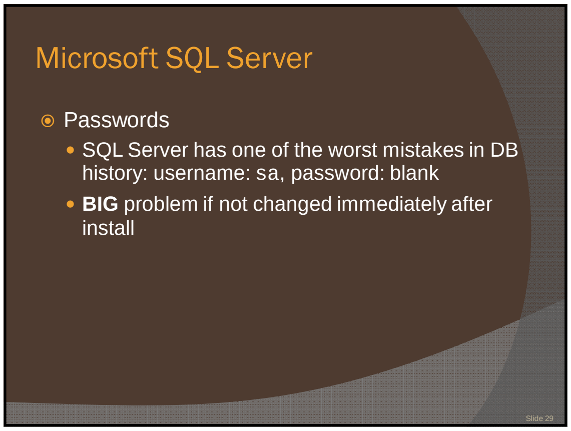
Slide 27



Microsoft SQL Server

- Default System Tables
  - Tables a hacker might be interested: Sysobjects, Syslogins, others…
  - Bottom line: the tables contain info about the databases themselves and can give an attacker valuable info
- Default System & Meta-data Functions
  - Functions built-in to SQL Server
  - Can provide valuable info to a hacker
  - Cannot be “removed” so must filter input

Slide 28



Microsoft SQL Server

- Passwords
  - SQL Server has one of the worst mistakes in DB history: username: sa, password: blank
  - **BIG** problem if not changed immediately after install

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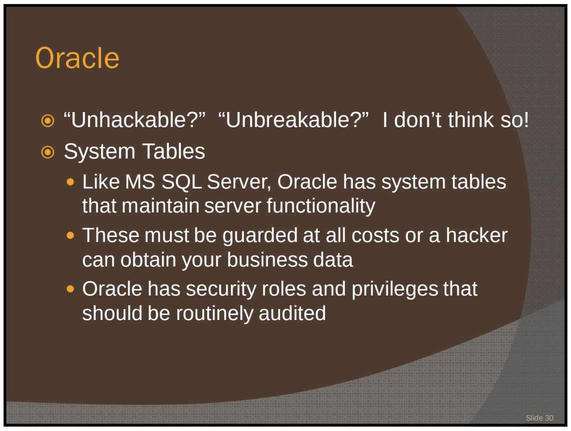

Oracle

- “Unhackable?” “Unbreakable?” I don’t think so!
- System Tables
  - Like MS SQL Server, Oracle has system tables that maintain server functionality
  - These must be guarded at all costs or a hacker can obtain your business data
  - Oracle has security roles and privileges that should be routinely audited

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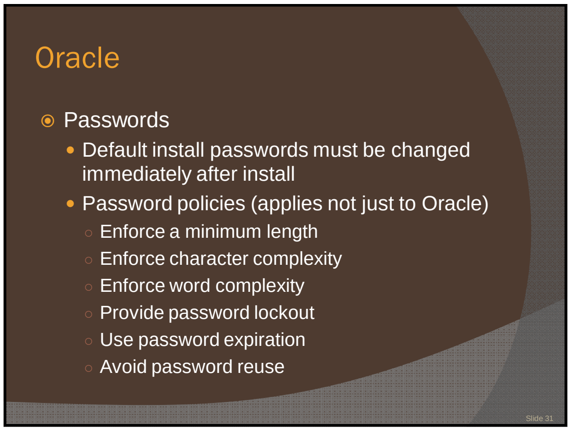
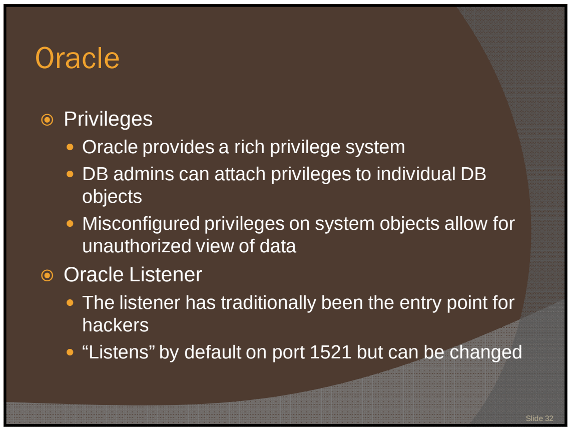


Oracle

- Passwords
  - Default install passwords must be changed immediately after install
  - Password policies (applies not just to Oracle)
    - Enforce a minimum length
    - Enforce character complexity
    - Enforce word complexity
    - Provide password lockout
    - Use password expiration
    - Avoid password reuse

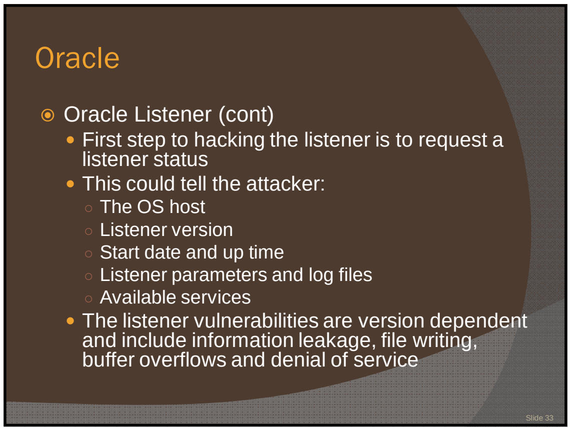
Slide 31



Oracle

- Privileges
  - Oracle provides a rich privilege system
  - DB admins can attach privileges to individual DB objects
  - Misconfigured privileges on system objects allow for unauthorized view of data
- Oracle Listener
  - The listener has traditionally been the entry point for hackers
  - “Listens” by default on port 1521 but can be changed

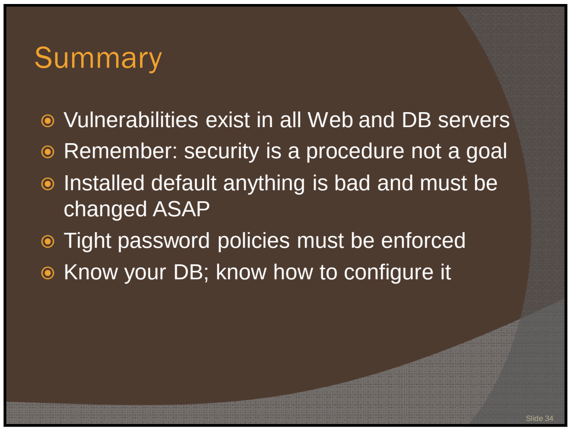
Slide 32



Oracle

- Oracle Listener (cont)
  - First step to hacking the listener is to request a listener status
  - This could tell the attacker:
    - The OS host
    - Listener version
    - Start date and up time
    - Listener parameters and log files
    - Available services
  - The listener vulnerabilities are version dependent and include information leakage, file writing, buffer overflows and denial of service

Slide 33



Summary

- Vulnerabilities exist in all Web and DB servers
- Remember: security is a procedure not a goal
- Installed default anything is bad and must be changed ASAP
- Tight password policies must be enforced
- Know your DB; know how to configure it

Slide 34