Operating System Fundamentals

Module 6:

Processes and Services

Agenda

- Application-Process-Thread
- Multi-tasking
- Scheduling
- Useful Tools
- Services

Application

- Often called a program
- Set of logical conditions that perform some function, or meaningfully grouped set of functions
- Made up of one or more processes

Process

- Often called a Task
- Set of physical conditions for the environment necessary to run an application
- Made up of one or more Threads

Processes

- Attributes include:
  - Virtual Address Space information
  - Executable code
  - Handles to System Objects
  - Security Context
  - Unique Process Identifier (PID)
  - Environment Variables
  - Priority Class
  - Minimum and Maximum working set sizes
- At least one thread is necessary, called the Primary Thread

Threads

- Entity in a process that can be scheduled for execution (in Windows)
- Share process's virtual space and system resources
- Each thread maintains:
  - Exception Handlers
  - Scheduling Priority
  - Thread Local Storage (TLS)
  - Structures to manage context
    - Machine Registers
    - Kernel Stack
    - Thread environment block
    - User stack in process's address space
- Can have own security context

Multi-Tasking

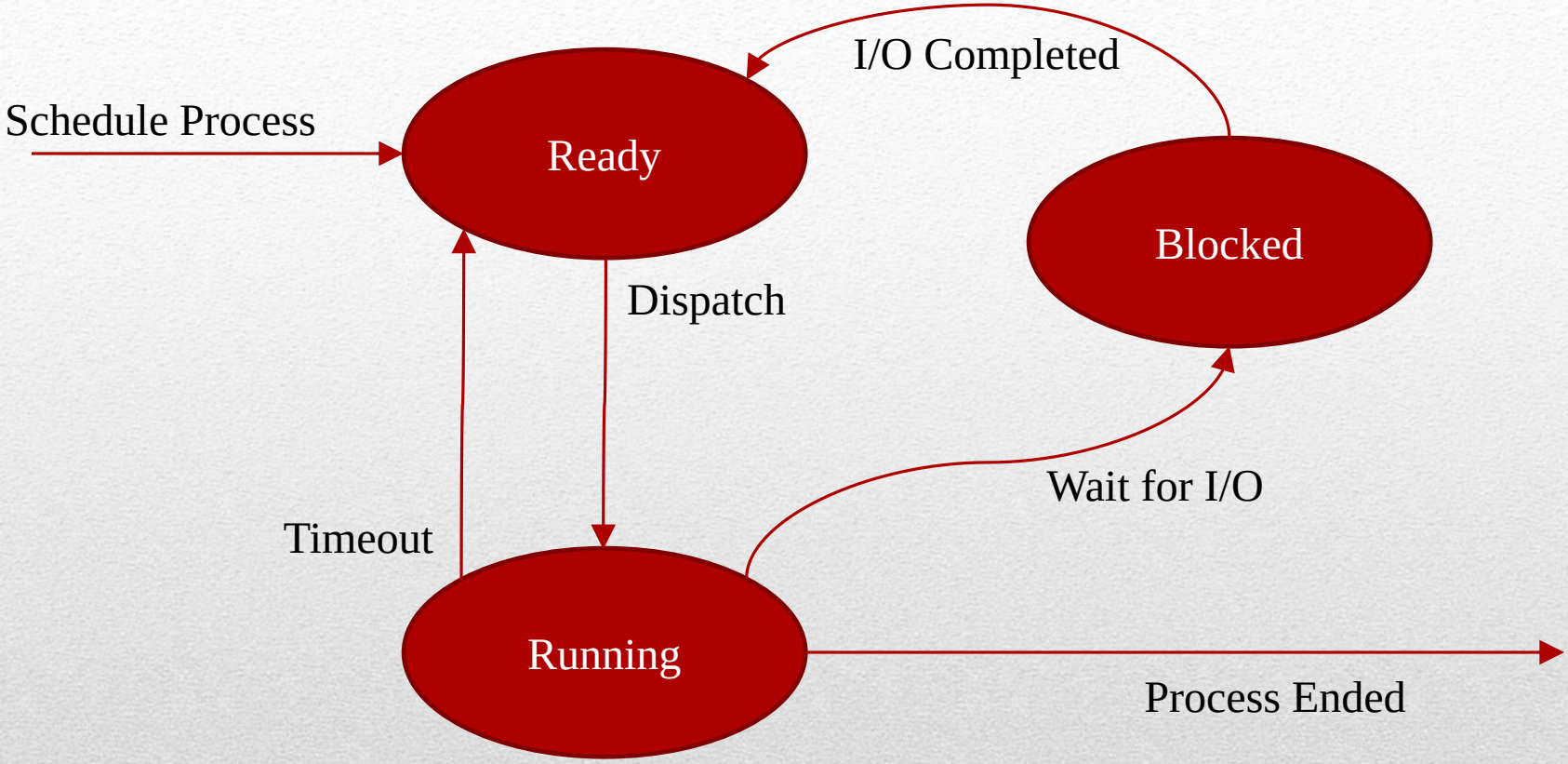
- Let's user appear to have multiple applications running at one time
- Can improve utilization of system resources
- Two general categories:
  - Cooperative
  - Preemptive
- Generally, each task runs for a short period of time, switching context as they all run

Cooperative Multitasking

- Task voluntarily gives up its CPU/resources to another task
- Need to be conscious of the resources it is consuming, and that other tasks might need them
- Good for highly deterministic applications like space flight
- Bad if consuming resources causes other tasks to be starved
- Used in early general purpose operating systems:
  - Pre-Windows 95
  - Pre-Mac OS X

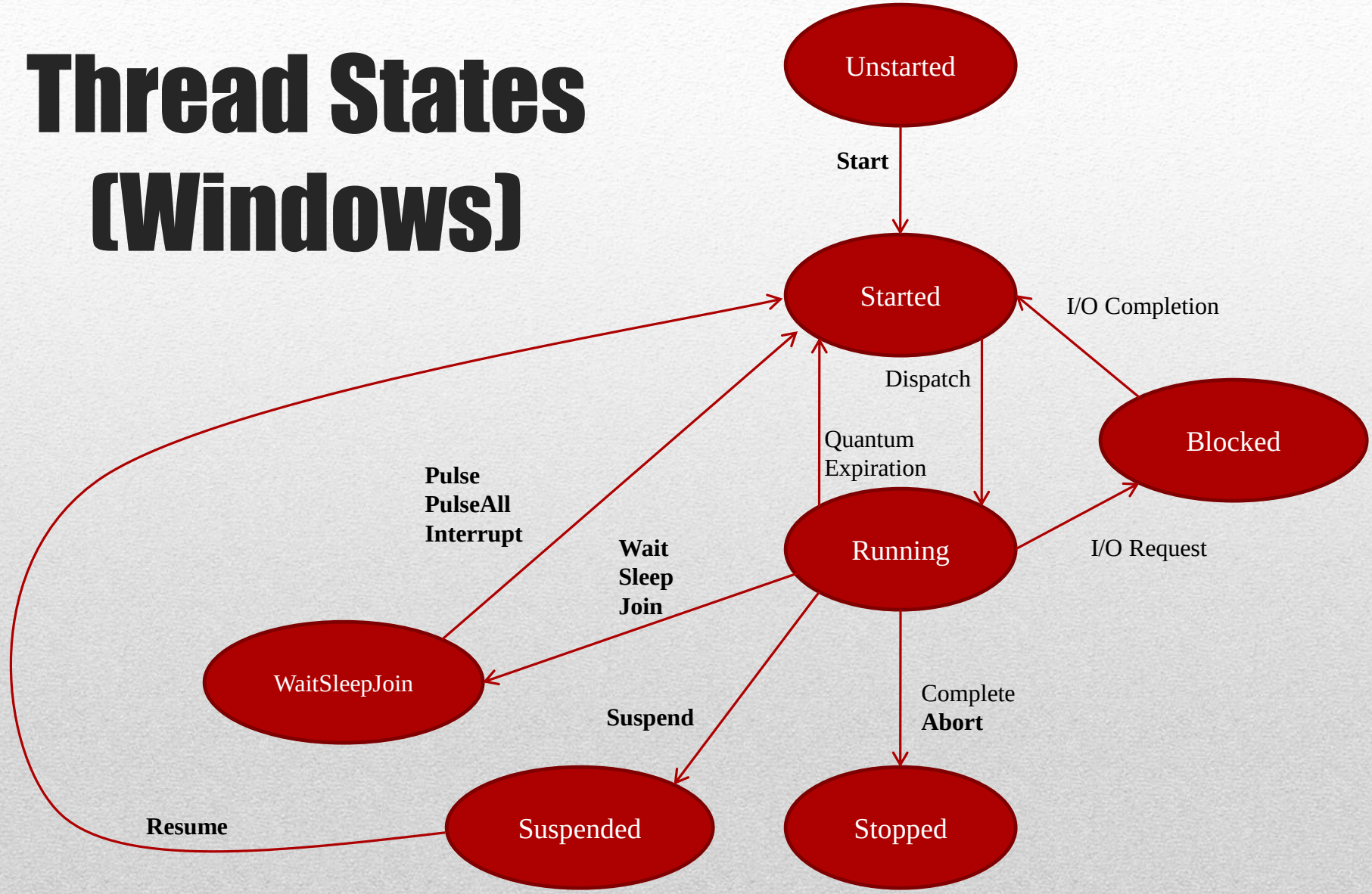
- Task allocated a maximum time slice (~20 ms in Windows)
- Task can give itself up prior to slice expiration
- If task consumes full time slice, Scheduler in OS will "preempt" the operation and switch to another task
- Task switch involves saving the context of the preempted thread, and loading the context of the new one
- Used in UNIX and its derivatives (like Linux)
- Used in Mac OS X
- Using in Windows NT and Windows 95 (and up)

Preemptive Multitasking



Process State Diagram

Thread States (Windows)



Scheduling

- Part of the OS that decides what to run next
- Several algorithms exist for different OS's; some OS's support multiple algorithms
- Generally follow a Round Robin approach, with (dynamic) priorities to ensure all tasks execute

Scheduling Concepts

- Priority
  - Most OS's have multiple priorities
    - Used to separate system and user tasks
- Blocking
  - To prevent a task from being run, it may be blocked waiting for something to occur (like a timer countdown, callback, etc.)
- I/O Bound Process
  - Mostly communicating with something, and waits most of the time – priority is often dynamically bumped up to allow it to be run
  - While waiting, it is Blocked
- Processor-Bound Process
  - Mostly consuming CPU – priority is often dynamically dropped to allow other tasks to run

Useful Tools

- Task Manager
- Performance Monitor
- Process Explorer (and anything from Sysinternals)
- Visual Studio

- No User Interface (directly)
- Automatically started at boot, using a control applet, or application
- Can execute without user logged on
- Needs credentials to start

Services

Services

- Service Control Manager
  - Maintains database of services
  - Controls services
- Examples of Services
  - File System Services (Encryption, Indexing)
  - Server (Web Server, File Server, Print Server)
  - Database (SQL Server, MySQL)
  - Network (Firewall, Anti-Virus, Message Queues)
  - Security (Encryption, Certificate, Group Policy)
- In Linux, services are Daemons

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