Welcome to CPS 210

Theme for Spring 2001:
Energy-aware OS for mobile/embedded computing

- Graduate Level Operating Systems
  - *readings, discussions, and programming projects*
- Systems Quals course
  - *midterm and final exams*
- Gateway to systems research
  - *E-track term project*

Logistics

//www.cs.duke.edu education/courses/spring01/cps210 /

- What, no book?
  The course will be based on readings from the literature.
  Background: *any* undergraduate introduction to OS textbook.
- Discussion, in class / collaboration, outside of class.

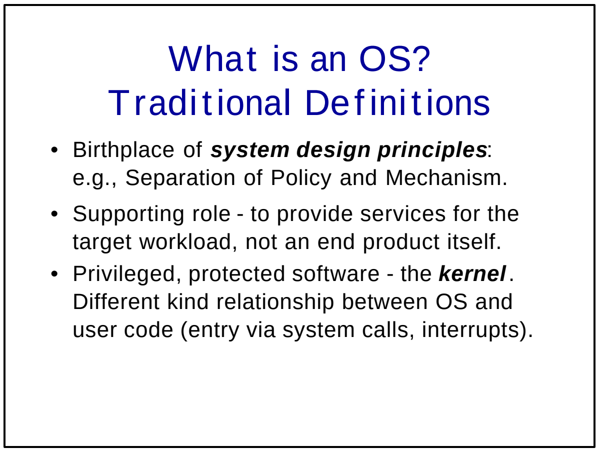
E- and G- Tracks

E-track project:

- Possibility 1:
  SOSP contribution March 26
- Possibility 2: Project of your choice
- Mini-conference during reading period.
- Milestones:
  - February 1 - 1 page proposal.

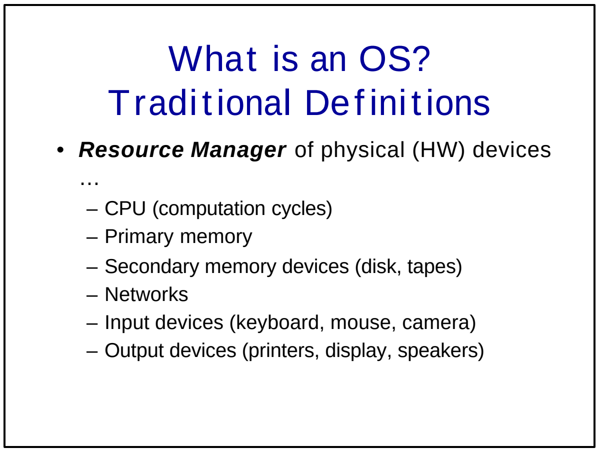
What is an OS? Traditional Definitions

- ***Resource Manager*** of physical (HW) devices ...
- ***Abstract machine*** environment. The OS defines a set of logical resources (objects) and operations on those objects (an interface on the use of those objects).
- Allows ***sharing*** of resources. Controls interactions among different users.



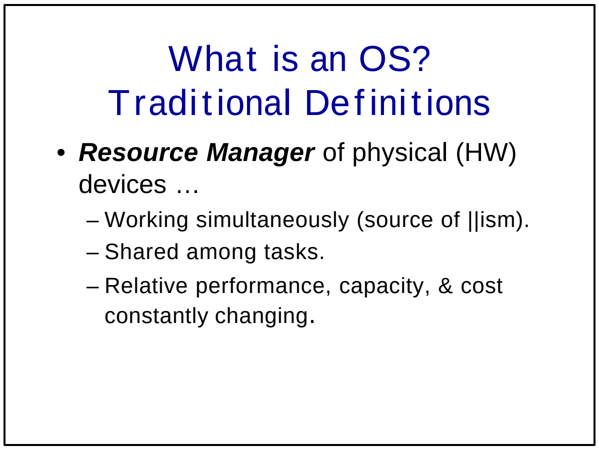
What is an OS? Traditional Definitions

- Birthplace of ***system design principles***: e.g., Separation of Policy and Mechanism.
- Supporting role - to provide services for the target workload, not an end product itself.
- Privileged, protected software - the ***kernel***. Different kind relationship between OS and user code (entry via system calls, interrupts).



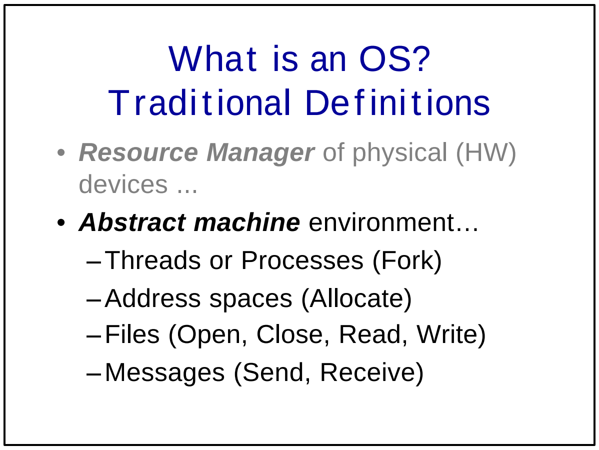
What is an OS? Traditional Definitions

- ***Resource Manager*** of physical (HW) devices …
  - CPU (computation cycles)
  - Primary memory
  - Secondary memory devices (disk, tapes)
  - Networks
  - Input devices (keyboard, mouse, camera)
  - Output devices (printers, display, speakers)



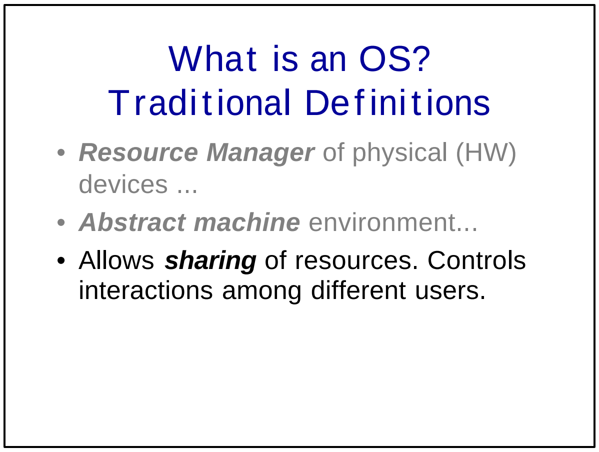
What is an OS? Traditional Definitions

- ***Resource Manager*** of physical (HW) devices …
  - Working simultaneously (source of ||ism).
  - Shared among tasks.
  - Relative performance, capacity, & cost constantly changing.



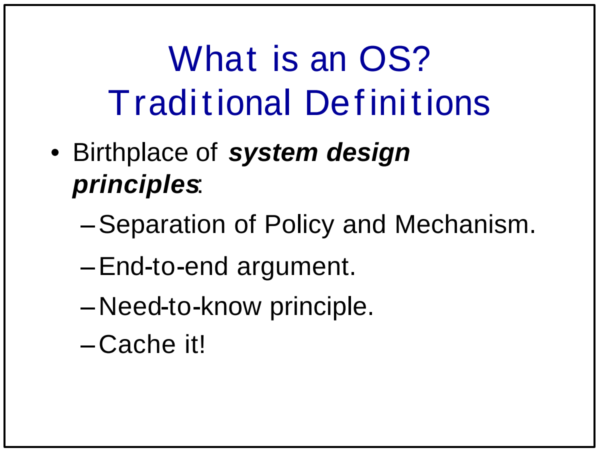
What is an OS? Traditional Definitions

- ***Resource Manager*** of physical (HW) devices ...
- ***Abstract machine*** environment…
  - Threads or Processes (Fork)
  - Address spaces (Allocate)
  - Files (Open, Close, Read, Write)
  - Messages (Send, Receive)



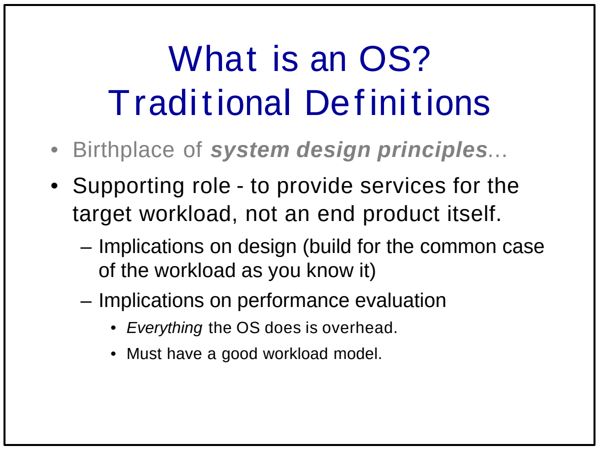
What is an OS? Traditional Definitions

- ***Resource Manager*** of physical (HW) devices ...
- ***Abstract machine*** environment...
- Allows ***sharing*** of resources. Controls interactions among different users.



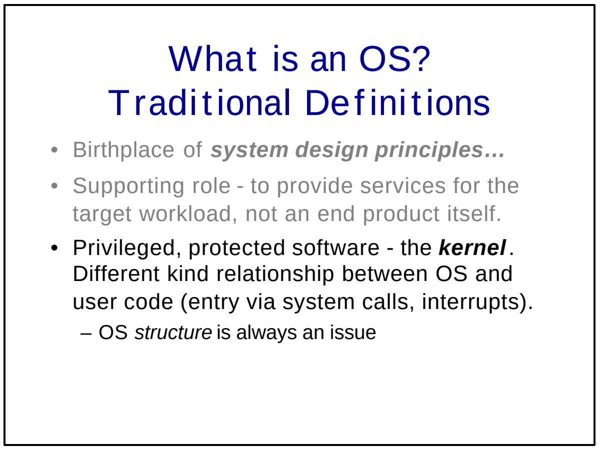
What is an OS? Traditional Definitions

- Birthplace of ***system design principles***:
  - Separation of Policy and Mechanism.
  - End-to-end argument.
  - Need-to-know principle.
  - Cache it!



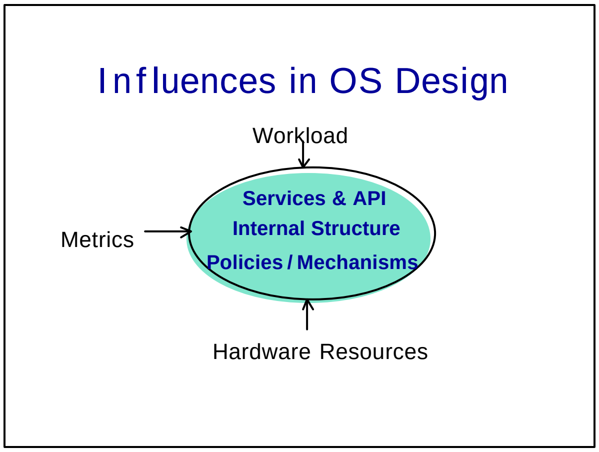
What is an OS? Traditional Definitions

- Birthplace of ***system design principles***...
- Supporting role - to provide services for the target workload, not an end product itself.
  - Implications on design (build for the common case of the workload as you know it)
  - Implications on performance evaluation
    - *Everything* the OS does is overhead.
    - Must have a good workload model.



What is an OS? Traditional Definitions

- Birthplace of ***system design principles...***
- Supporting role - to provide services for the target workload, not an end product itself.
- Privileged, protected software - the ***kernel***. Different kind relationship between OS and user code (entry via system calls, interrupts).
  - OS *structure* is always an issue



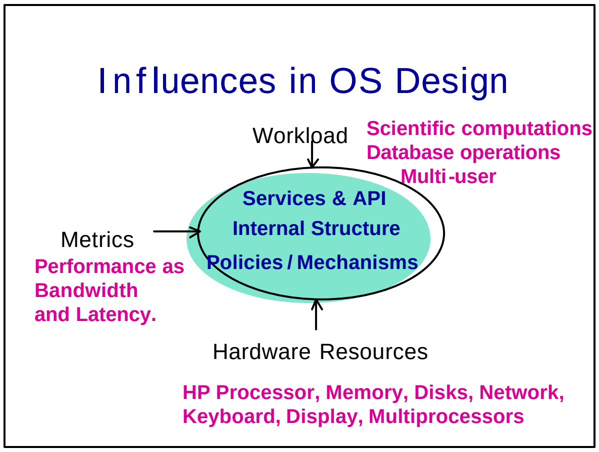
Influences in OS Design

Workload

Metrics

Services & API
Internal Structure
Policies / Mechanisms

Hardware Resources



Influences in OS Design

Workload

Scientific computations
Database operations
Multi-user

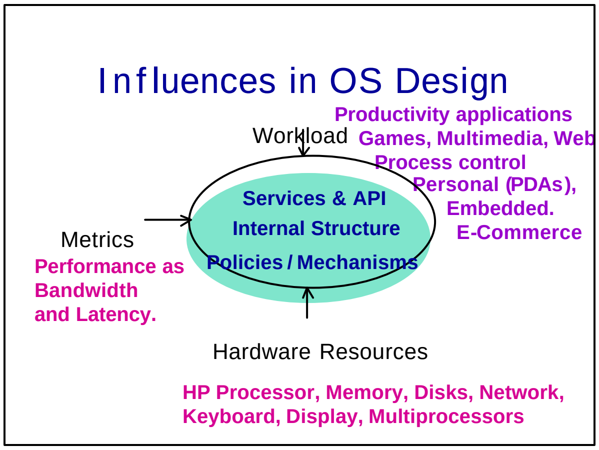
Metrics

Performance as
Bandwidth
and Latency.

Services & API
Internal Structure
Policies / Mechanisms

Hardware Resources

HP Processor, Memory, Disks, Network,
Keyboard, Display, Multiprocessors



Influences in OS Design

Workload

Productivity applications
Games, Multimedia, Web
Process control
Personal (PDAs),
Embedded.
E-Commerce

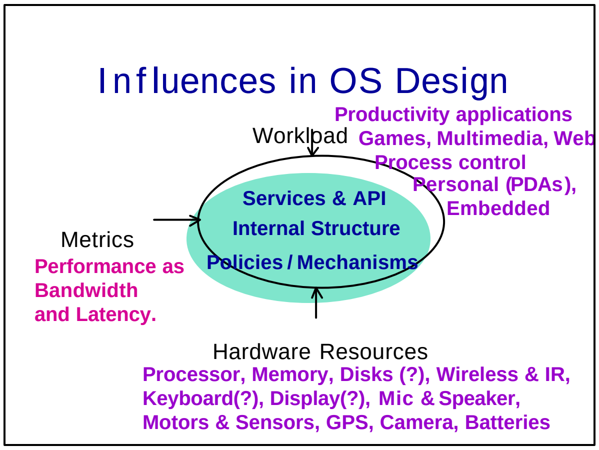
Metrics

Performance as
Bandwidth
and Latency.

Services & API
Internal Structure
Policies / Mechanisms

Hardware Resources

HP Processor, Memory, Disks, Network,
Keyboard, Display, Multiprocessors



Influences in OS Design

Workload

Productivity applications
Games, Multimedia, Web
Process control
Personal (PDAs),
Embedded

Metrics

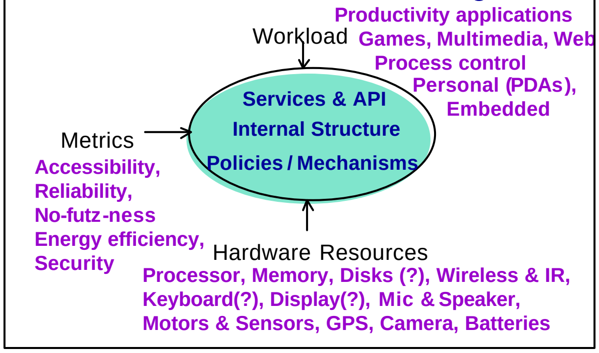
Performance as
Bandwidth
and Latency.

Services & API
Internal Structure
Policies / Mechanisms

Hardware Resources

Processor, Memory, Disks (?), Wireless & IR,
Keyboard(?), Display(?), Mic & Speaker,
Motors & Sensors, GPS, Camera, Batteries

Influences in OS Design



Workload

Productivity applications

Games, Multimedia, Web

Process control

Personal (PDAs),

Embedded

Services & API

Internal Structure

Policies / Mechanisms

Metrics

Accessibility,

Reliability,

No-futz-ness

Energy efficiency,

Security

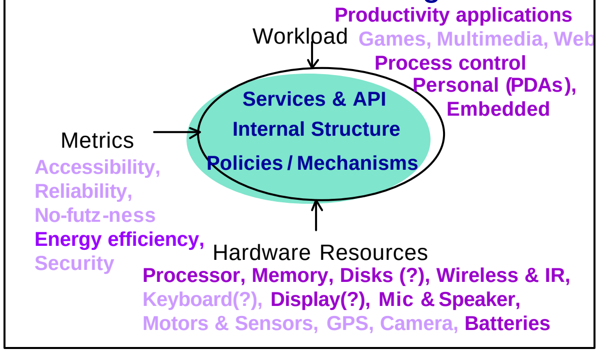
Hardware Resources

Processor, Memory, Disks (?), Wireless & IR,

Keyboard(?), Display(?), Mic & Speaker,

Motors & Sensors, GPS, Camera, Batteries

What is Impact?
Rethink OS Design



Workload

Productivity applications

Games, Multimedia, Web

Process control

Personal (PDAs),

Embedded

Services & API

Internal Structure

Policies / Mechanisms

Metrics

Accessibility,

Reliability,

No-futz-ness

Energy efficiency,

Security

Hardware Resources

Processor, Memory, Disks (?), Wireless & IR,

Keyboard(?), Display(?), Mic & Speaker,

Motors & Sensors, GPS, Camera, Batteries

Gee Toto, I don't think we're in Unix* anymore…

*substitute Windows NT, Intel Pentium, Computin