

The Art of Workload Selection

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These slides are available on-line at:

<http://www.cse.wustl.edu/~jain/cse567-06/>



- ❑ Services Exercised
 - Example: Timesharing Systems
 - Example: Networks
 - Example: Magnetic Tape Backup System
- ❑ Level of Detail
- ❑ Representativeness
- ❑ Timeliness
- ❑ Other Considerations in Workload Selection

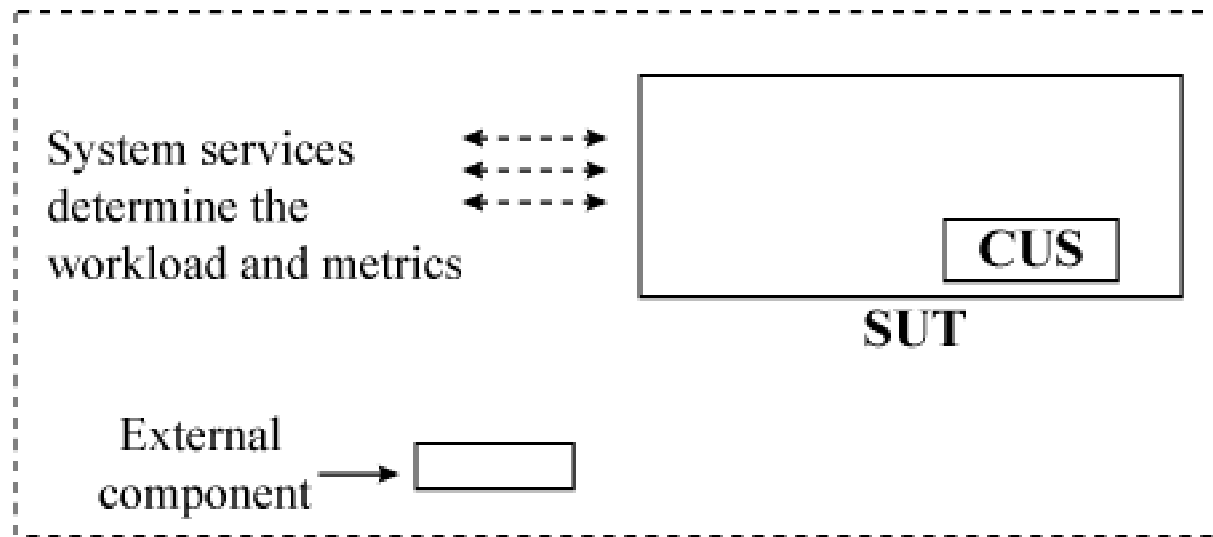
The Art of Workload Selection

Considerations:

- Services exercised
- Level of detail
- Loading level
- Impact of other components
- Timeliness

Services Exercised

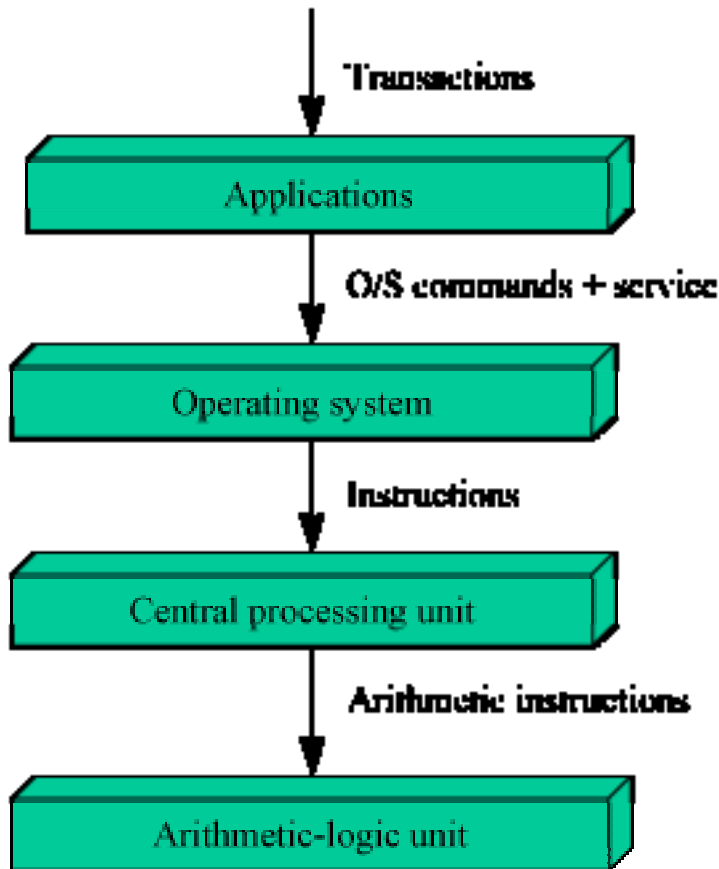
- ❑ SUT = System Under Test
- ❑ CUS = Component Under Study



Services Exercised (Cont)

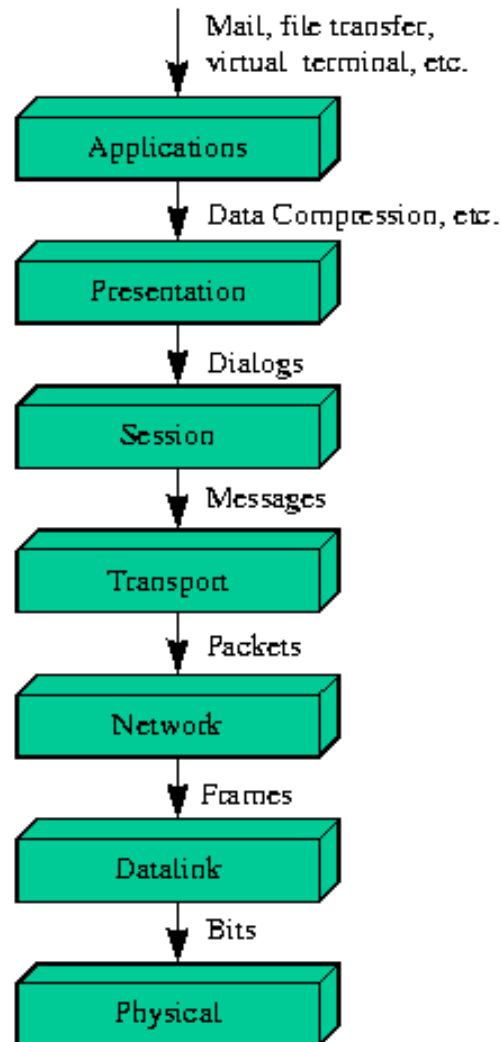
- ❑ Do not confuse SUT w CUS
- ❑ Metrics depend upon SUT: MIPS is ok for two CPUs but not for two timesharing systems.
- ❑ Workload: depends upon the system.
- ❑ Examples:
 - CPU: instructions
 - System: Transactions
 - Transactions not good for CPU and vice versa
 - Two systems identical except for CPU
 - ❑ Comparing Systems: Use transactions
 - ❑ Comparing CPUs: Use instructions
 - Multiple services: Exercise as complete a set of services as possible.

Example: Timesharing Systems



- Applications
⇒ Application benchmark
- Operating System
⇒ Synthetic Program
- Central Processing Unit
⇒ Instruction Mixes
- Arithmetic Logical Unit
⇒ Addition instruction

Example: Networks



Example: Magnetic Tape Backup System

□ Backup System:

- Services: Backup files, backup changed files, restore files, list backed-up files.
- Factors: File-system size, batch or background process, incremental or full backups.
- Metrics: Backup time, restore time.
- Workload: A computer system with files to be backed up. Vary frequency of backups.

□ Tape Data System:

- Services: Read/write to the tape, read tape label, auto load tapes.
- Factors: Type of tape drive.
- Metrics: Speed, reliability, time between failures.
- Workload: A synthetic program generating representative tape I/O requests.

Magnetic Tape System (Cont)

□ Tape Drives:

- Services: Read record, write record, rewind, find record, move to end of tape, move to beginning of tape.
- Factors: Cartridge or reel tapes, drive size.
- Metrics: Time for each type of service, for example, time to read record and to write record, speed (requests/time), noise, power dissipation.
- Workload: A synthetic program exerciser generating various types of requests in a representative manner.

□ Read/Write Subsystem:

- Services: Read data, write data (as digital signals).
- Factors: Data-encoding technique, implementation technology (CMOS, TTL, and so forth).
- Metrics: Coding density, I/O bandwidth (bits per second).

Magnetic Tape System (Cont)

- Workload: Read/write data streams with varying patterns of bits.

- Read/Write Heads:
 - Services: Read signal, write signal (electrical signals).
 - Factors: Composition, inter-head spacing, gap sizing, number of heads in parallel.
 - Metrics: Magnetic field strength, hysteresis.
 - Workload: Read/write currents of various amplitudes, tapes moving at various speeds.

Level of Detail

- ❑ Most frequent request:
 - Examples: Addition Instruction, Debit-Credit, Kernels
 - Valid if one service is much more frequent than others
- ❑ Frequency of request types
 - Examples: Instruction mixes
 - Context sensitivity \Rightarrow Use set of services
 - History-sensitive mechanisms (caching) \Rightarrow Context sensitivity
- ❑ Time-stamped sequence of requests
 - May be too detailed
 - Not convenient for analytical modeling
 - May require exact reproduction of component behavior

Level of Detail (Cont)

- ❑ Average resource demand
 - Used for analytical modeling
 - Grouped similar services in classes
- ❑ Distribution of resource demands
 - Used if variance is large
 - Used if the distribution impacts the performance
- ❑ Workload used in simulation and analytical modeling:
 - Non executable: Used in analytical/simulation modeling
 - Executable workload: can be executed directly on a system

Representativeness

The test workload and real workload should have the same:

- ❑ Elapsed Time
- ❑ Resource Demands
- ❑ Resource Usage Profile: Sequence and the amounts in which different resources are used.

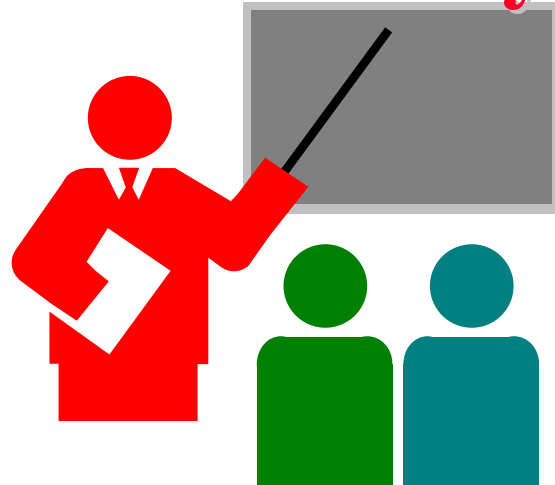
Timeliness

- ❑ Users are a moving target.
- ❑ New systems \Rightarrow new workloads
- ❑ Users tend to optimize the demand.
- ❑ Fast multiplication \Rightarrow Higher frequency of multiplication instructions.
- ❑ Important to monitor user behavior on an ongoing basis.

Other Considerations in Workload Selection

- ❑ Loading Level: A workload may exercise a system to its:
 - Full capacity (best case)
 - Beyond its capacity (worst case)
 - At the load level observed in real workload (typical case).
 - For procurement purposes \Rightarrow Typical
 - For design $\setminus R$ best to worst, all cases
- ❑ Impact of External Components:
 - Do not use a workload that makes external component a bottleneck \Rightarrow All alternatives in the system give equally good performance.
- ❑ Repeatability

Summary



- ❑ Services exercised determine the workload
- ❑ Level of detail of the workload should match that of the model being used
- ❑ Workload should be representative of the real systems usage in recent past
- ❑ Loading level, impact of external components, and repeatability or other criteria in workload selection

Exercise 5.1

- What metric and workload would you choose to compare:
 - a. Two systems with similar functionality: IBM PC versus DEC RainbowTM
 - b. Two systems for very different applications: IBM PC versus MACTM
 - c. Two systems with identical functionality: IBM PC versus Dell PC
 - d. Two versions of the same operating systems: MS-DOSTM V1 vs. MS-DOS V2
 - e. Two hardware components: Two floppy drives
 - f. Two languages: C vs. Pascal

Exercise 5.2

- Select an area of computer systems, for example, databases, networks, processors, and so on. Prepare a table identifying increasing levels of services, components, factors, and workloads.

Homework

- Read chapters 4 and 5
- Submit answer to Exercise 5.1