**CHAPTER-1: FUNDAMENTALS OF QUANTITATIVE DESIGN AND ANALYSIS**

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Case Studies and Exercises by Diana Franklin

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***1.2 Classes of Computers***

5 categories of Computers – Personal Mobile Device (PMD), Desktop, Server, Clusters/Warehouse-Scale Computer, Embedded

Personal Mobile Devices

They include cell phones, tablets, computers, and so on.

*Real-Time performance requirement*: A segment of the application has maximum execution time.

*Soft Real-Time*: The average time for a particular task is constrained as well as the number of instances when some maximum time is exceeded.

We need to minimize memory and use energy efficiently.

Desktop Computing

It is the largest market in terms of dollars.

The main aim is to optimize *price-performance*.

Servers

Availability is critical. Scalability is also needed. Efficient throughput is also essential – throughput is nothing but the overall performance of the server in terms of transactions per minute or web pages served per second. Also, responsiveness to an individual request remains important.

Clusters / Warehouse-Sale Computers

Clusters are collections of desktop computers or servers connected by local area networks to act as a single large computer. Each node runs its own operating system, and nodes communicate using a networking protocol.

The largest of these are called *warehouse-sale computers* – they are designed such that tens of thousands of servers can act as one. Due to their large size, *price-performance* and *power* are critical to WSCs.

*Supercomputers* are related to WSCs – they are equally expensive, costing hundreds of millions of dollars, but supercomputers differ by emphasizing floating point performance and by running large, communication intensive batch programs that can run for weeks at a time.

Embedded Computers

Embedded Computers are found in everyday machines: micro-waves, washing machines, most printers, most networking switches and all cars.

A close-up of a chart

Description automatically generated

**Classes of Parallelism**

There are basically two kinds of parallelism in applications:

1. *Data-Level Parallelism (DLP)*: It arises because there are many data items that can be operated on at the same time.

2. *Task-Level Parallelism (TLP)*: It arises because tasks of work are created that can operate independently and largely in parallel.

All computers fall into one of the following four categories:

1. *Single Instruction Stream, Single Data Stream (SISD)* – Uniprocessor.

2. *Single Instruction Stream, Multiple Data Stream (SIMD)* – The same instruction is executed by multiple processes using different data streams. SIMD computers exploit data level parallelism.

3. *Multiple Instruction Stream, Single Data Stream (MISD)* – No commercial multiprocessor of this type has been built till date.

4. *Multiple Instruction Stream, Multiple Data Stream (MIMD)* – Each processor fetches its own instructions and operates on its own data.

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**1.3 Defining Computer Architecture**

*Instruction Set Architecture*: The term instruction set architecture (ISA) is used to refer to the actual programmer-visible instruction set. The ISA serves as the boundary between the software and hardware.

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**1.4 Trends in Technology**