

Introduction to Information and Communication Technology

CS202 Lecture # 3

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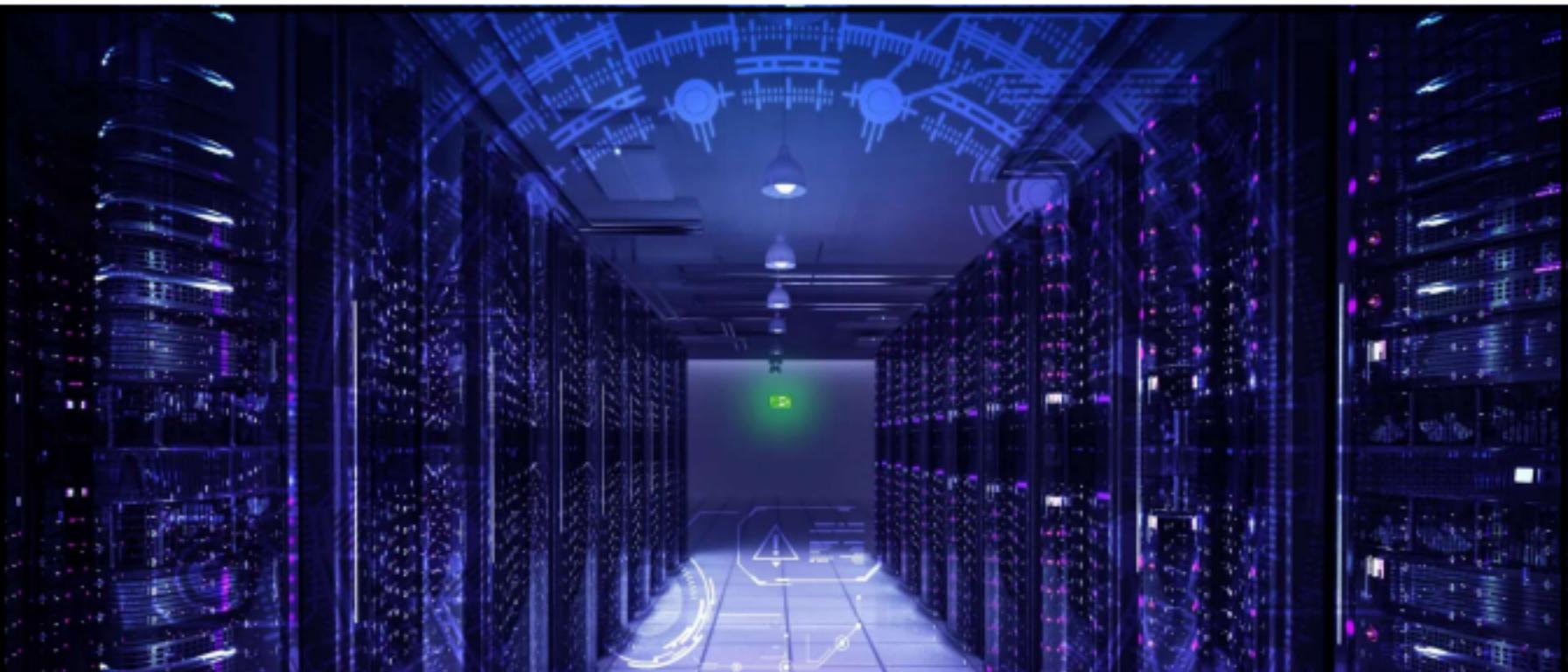


Topics Covered in Last Week

- Introduction of Course Instructor/Students and Objectives
- Introduction to ICT and Latest Advancements
- Introduction to Computing, History and Key Concepts
- Communication Technology
- Programming Languages
- Career Paths / Getting Started

Today's Topics

- Classification of Computers by Size
- Classification of Computers by Purpose
- Algorithms
- Data Structures
- Software Engineering
- Network Engineering



Classification of Computers by Size

A photograph showing a long, narrow corridor in a data center. Both sides of the corridor are filled with tall, dark server racks. The ceiling is blue with a grid of rectangular light fixtures. The floor is made of grey tiles. The perspective of the corridor creates a sense of depth.

Classification of Computers by Size

1. Supercomputers

- **Size:** Very large, often occupying entire rooms or buildings.
- **Power:** Extremely powerful, capable of performing billions to trillions of calculations per second.
- **Usage:** Used for complex scientific computations, weather forecasting, nuclear simulations, large-scale data analysis, and advanced research.
- **Example:** IBM Summit, Cray Titan.

Fastest Supercomputer



EL CAPITAN

- At Lawrence Livermore National Laboratory, USA

▪ Performance:

1.742 exaFLOPS

- **exa-(E):** 10^{18} or one quintillion



Classification of Computers by Size

2. Mainframe Computers

- **Size:** Large, though typically smaller than supercomputers, usually housed in dedicated rooms.
- **Power:** Highly powerful, capable of handling and processing large amounts of data simultaneously.
- **Usage:** Used by large organizations for critical applications, bulk data processing, transaction processing, enterprise resource planning, and large-scale database management.
- **Example:** IBM Z series, Unisys ClearPath.

A photograph of a man in a dark suit and blue shirt, smiling and waving his right hand. He is standing next to a large, dark grey IBM z17 mainframe server. The server has the word "IBM" at the top and a stylized "Z" logo on the left side. The background features a large screen displaying the text "IBM z17".

IBM z17

**Fastest
Mainframe
Computer**

IBM z17



Classification of Computers by Size

3. Minicomputers (Mid-Range Computers)

- **Size:** Smaller than mainframes, typically about the size of a large cabinet.
- **Power:** Less powerful than mainframes but capable of supporting multiple users simultaneously.
- **Usage:** Used by small to medium-sized businesses for tasks like database management, enterprise resource planning, and industrial control.
- **Example:** DEC PDP-11, IBM AS/400.



Classification of Computers by Size

4. Workstations

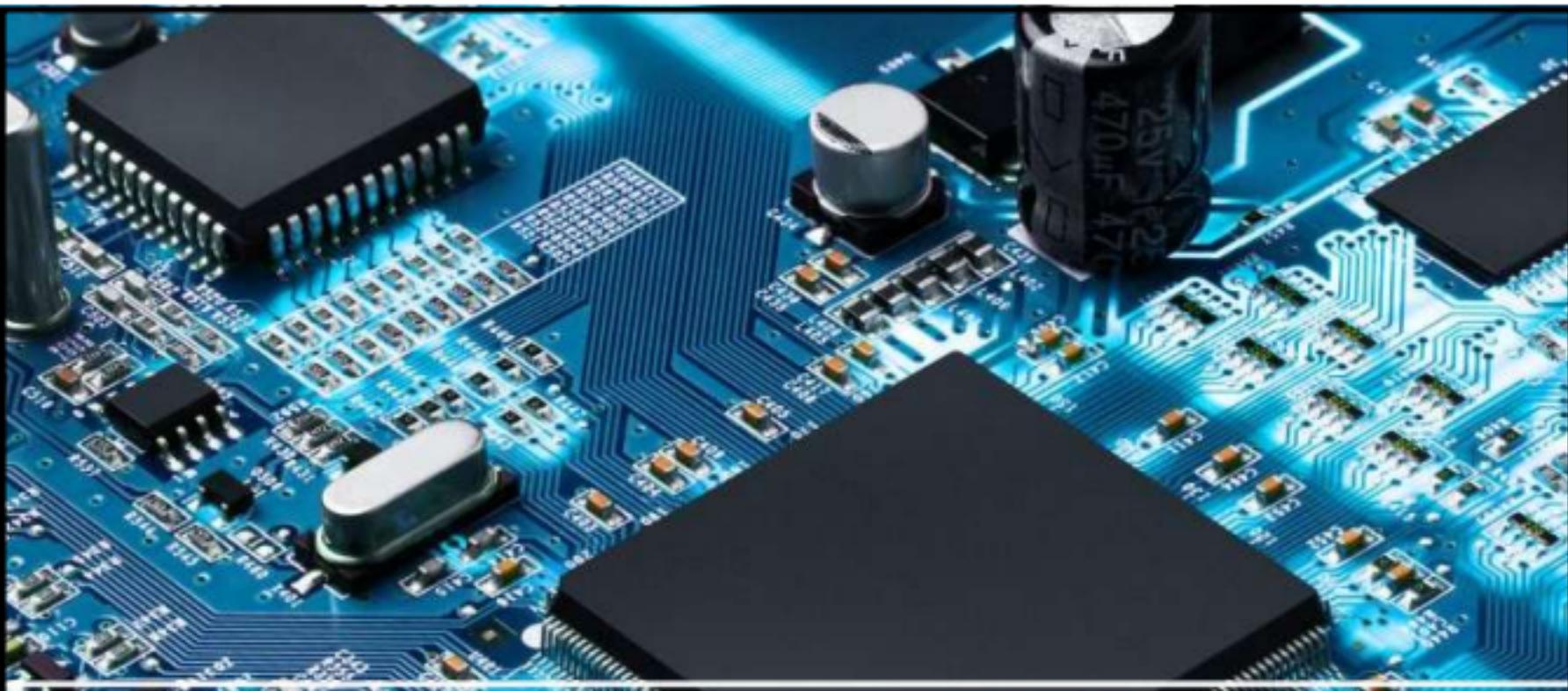
- **Size:** Similar to or slightly larger than desktop computers.
- **Power:** More powerful than standard personal computers, designed for technical or scientific applications.
- **Usage:** Used by engineers, graphic designers, and professionals requiring high processing power for tasks like 3D rendering, video editing, and complex simulations.
- **Example:** Dell Precision, HP Z Workstations.

Classification of Computers by Size



5. Microcomputers (Personal Computers)

- **Size:** Small, designed to fit on a desk or be portable.
- **Power:** Sufficient for individual use, including tasks like word processing, internet browsing, gaming, and software development.
- **Types:**
 - **Desktop Computers:** Stationary, with separate monitor, keyboard, and CPU.
 - **Laptop Computers:** Portable, with integrated screen, keyboard, and CPU.
 - **Notebooks:** Smaller and less powerful than laptops, designed for basic tasks like web browsing.
- **Usage:** Used by individuals, students, and professionals for personal and business tasks.
- **Example:** Apple MacBook, Dell Inspiron, HP Pavilion.



Microcontrollers and Embedded Systems

Classification of Computers by Size



6. Microcontrollers and Embedded Systems

- **Size:** Very small, often embedded within other devices.
- **Power:** Limited, designed for specific control tasks rather than general computing.
- **Usage:** Used in embedded systems for controlling machines, appliances, cars, and other electronics.
- **Example:** Arduino, Raspberry Pi (although Raspberry Pi can also be considered a microcomputer).

Classification of Computers by Size



7. Servers

- **Size:** Varies, can be as small as a desktop computer or as large as a mainframe.
- **Power:** Varies based on the type and purpose, typically more powerful than personal computers.
- **Usage:** Used to manage network resources, host websites, manage databases, and provide services to other computers (clients) in a network.
- **Example:** Dell PowerEdge, HPE ProLiant.



Classification of Computers by Purpose

Classification of Computers by Purpose

1. General-Purpose Computers

- **Definition:** Computers designed to perform a wide variety of tasks and run various types of applications. They can handle general computing tasks, including word processing, internet browsing, gaming, and more.
- **Usage:** Used in homes, offices, schools, and businesses.
- **Examples:**
 - **Personal Computers (PCs):** Laptops, desktops, and tablets used by individuals for everyday tasks.
 - **Workstations:** Powerful computers used by professionals for tasks like graphic design, software development, and 3D modeling.



Classification of Computers by Purpose

2. Special-Purpose Computers

- **Definition:** Computers designed to perform a specific task or a limited range of tasks. They are optimized for particular applications and often lack the flexibility of general-purpose computers.
- **Usage:** Used in industries, scientific research, and specific applications where specialized computing is required.
- **Examples:**
 - **Embedded Systems:** Found in appliances, automobiles, medical devices, and industrial machines to control specific functions.
 - **Gaming Consoles:** Designed specifically for playing video games, with hardware optimized for rendering graphics and processing game logic.
 - **Digital Signal Processors (DSPs):** Used in audio, video, and communication devices to process real-time data signals.



Classification of Computers by Purpose

3. Scientific Computers

- **Definition:** Computers designed to perform complex scientific calculations and simulations. They are optimized for tasks that require high processing power and large amounts of data.
 - **Usage:** Used in research institutions, laboratories, and industries that require modeling, simulation, and data analysis.
 - **Examples:**
 - **Supercomputers:** Used for tasks like climate modeling, molecular simulations, and astrophysics.
 - **Mainframes:** Employed in large-scale data processing, such as in government agencies and financial institutions.



Classification of Computers by Purpose

4. Business Computers

- **Definition:** Computers designed specifically for business applications, such as managing data, transactions, and communications. They are optimized for reliability, security, and efficiency in handling business operations.
- **Usage:** Used in offices, enterprises, and financial institutions.
- **Examples:**
 - **Servers:** Manage network resources, host websites, and handle databases.
 - **Mainframes:** Used by large organizations for critical business applications like transaction processing and enterprise resource planning (ERP).



Classification of Computers by Purpose

5. Real-Time Computers

- **Definition:** Computers designed to process data in real-time, meaning they provide immediate responses to input and are often used in systems where timing is critical.
- **Usage:** Used in environments where immediate processing and response are crucial, such as industrial control, aviation, and telecommunications.
- **Examples:**
 - **Industrial Control Systems:** Manage and control machinery in factories and production lines.
 - **Flight Control Systems:** Used in aircraft to manage and process data from sensors in real-time for navigation and control.



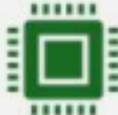


Algorithms and Data Structures

Algorithms



A step-by-step procedure or set of rules designed to solve a specific problem or perform a task



In computer science, algorithms are essential in the design and analysis of programs and systems, aiming for both correctness (solving the problem as intended) and efficiency (optimizing resource use such as time and memory)

Algorithms

Sorting and Searching

Essential for efficient data management in software applications.

Graph Algorithms

Crucial for network analysis and optimizing communication routes

More Algorithms

Dynamic Programming

Optimizing problem-solving in software development.

Cryptographic Algorithms

Securing communication and data storage.

Data Structures



Systematic way of organizing, managing, and storing data, so that it can be efficiently accessed and modified



Provide a means of organizing large amounts of data in a way that facilitates operations such as searching, sorting, insertion, deletion, and traversal



They can be categorized into various types, depending on how they organize data and the operations they support

Data Structures

- **Arrays and Linked Lists:** Fundamental for data organization and access in software.
- **Trees and Graphs:** Used in databases, networking, and AI applications.



More Data Structures

- **Hash Tables:** Enabling fast data retrieval in systems and applications.
- **Queues and Stacks:** Managing tasks and processes efficiently in computing.





Software and Network Engineering

PORT	CATEGORY	SERVICE	VERSION
22/tcp	open	ssh	OpeUSSH 5.Mpl DeZian 3ubuntu7 (protooco0 2.0)
			ssh-hos3key: 1024 8d:6Y:f106c0ca:b5:3d:PaVd6:67:54:96:69:WC:b9:d0 (DSA) 28

Software Engineering

Definition:

- Systematic, Disciplined, and Quantifiable Approach to the Design, Development, Testing, Deployment, and Maintenance of Software Systems
- Applies Principles of Computer Science, Engineering & Project Management
- Ensures Reliability, Efficiency, Scalability, and Cost-Effectiveness of Software

Salients of Software Engineering

- 1. Systematic Approach** – Ensures structured, predictable, and disciplined development.
- 2. Requirement Analysis** – Foundation for building software that truly meets user needs.
- 3. Design and Modularity** – Supports scalability, reusability, and long-term maintainability.
- 4. Quality Assurance** – Guarantees correctness, reliability, and user satisfaction.
- 5. Security and Reliability** – Critical for trust, safety, and system dependability.

Network Engineering

Definition:

- Design, Implementation, Management, and Optimization of Computer Networks
- Enable Communication Between Devices, Systems, and Users
- Ensures that Data can be Transmitted Efficiently, Securely, and Reliably across Local and Global Networks

Salients of Network Engineering

- 1. Network Design and Architecture** – Choosing topologies (star, mesh, hybrid) and planning scalable networks
- 2. Connectivity and Communication** – Ensuring smooth, reliable data transfer across wired and wireless networks
- 3. Security and Access Control** – Protecting networks with firewalls, encryption, VPNs, and authentication
- 4. Performance and Reliability** – Monitoring, load balancing, and fault tolerance to keep networks efficient and always available
- 5. Protocols and Standards Compliance** – Following TCP/IP, Ethernet, Wi-Fi, and global standards (IEEE, IETF) for interoperability



Case Studies

Case Study: ICT for a Weather Forecasting Center

Background:

A national weather forecasting center is planning to upgrade its computing infrastructure. The center must:

- Process **terabytes of satellite and sensor data** every day.
- Run **complex mathematical models** for predicting storms, rainfall, and heatwaves.
- Deliver results **quickly and accurately** so early warnings can be issued.
- Ensure the system can handle **large-scale simulations** and remain reliable.

The IT team is considering the following computer types:

- Microcomputers
- Workstations
- Mainframe Computers
- Supercomputers

Case Study: ICT for a Weather Forecasting Center

Question:

If you were part of the IT team, which type of computer would you recommend for the weather forecasting center? Explain your answer by comparing the strengths and limitations of each option and then justify why your chosen option is the most suitable.

Case Study: ICT for a Weather Forecasting Center

Answer:

To select the right type of computer for a weather forecasting center, we need to evaluate the requirements carefully. The system must process terabytes of satellite and sensor data daily, run highly complex mathematical models, and deliver results in real time so that early warnings can be issued. This means the solution must provide very high computational power, speed, and reliability.

Let us compare the available options.

Case Study: ICT for a Weather Forecasting Center

Answer:

1. Microcomputers (PCs/Laptops):

Microcomputers are affordable and widely available, but their processing capacity is far too limited for the needs of a weather forecasting center. They are designed for individual users and basic applications such as word processing, browsing, or simple simulations. Even a network of microcomputers would not achieve the scale of computation needed for large scientific models.

Case Study: ICT for a Weather Forecasting Center

Answer:

2. Workstations:

Workstations are more powerful than standard PCs and are suitable for tasks such as graphic design, CAD, or engineering projects. However, they are not optimized for handling massive scientific simulations or processing terabytes of data simultaneously. While they could help with smaller tasks within the center, they cannot be the primary computing infrastructure for large-scale weather prediction.

Case Study: ICT for a Weather Forecasting Center

Answer:

3. Mainframe Computers:

Mainframes are highly reliable and capable of handling large databases and transaction processing. They are commonly used in banking, government, and business environments where reliability and transaction throughput matter more than raw computational power. For a weather forecasting center, where the challenge is running highly complex mathematical models rather than storing and processing customer records, mainframes are not the best fit.

Case Study: ICT for a Weather Forecasting Center

Answer:

4. Supercomputers:

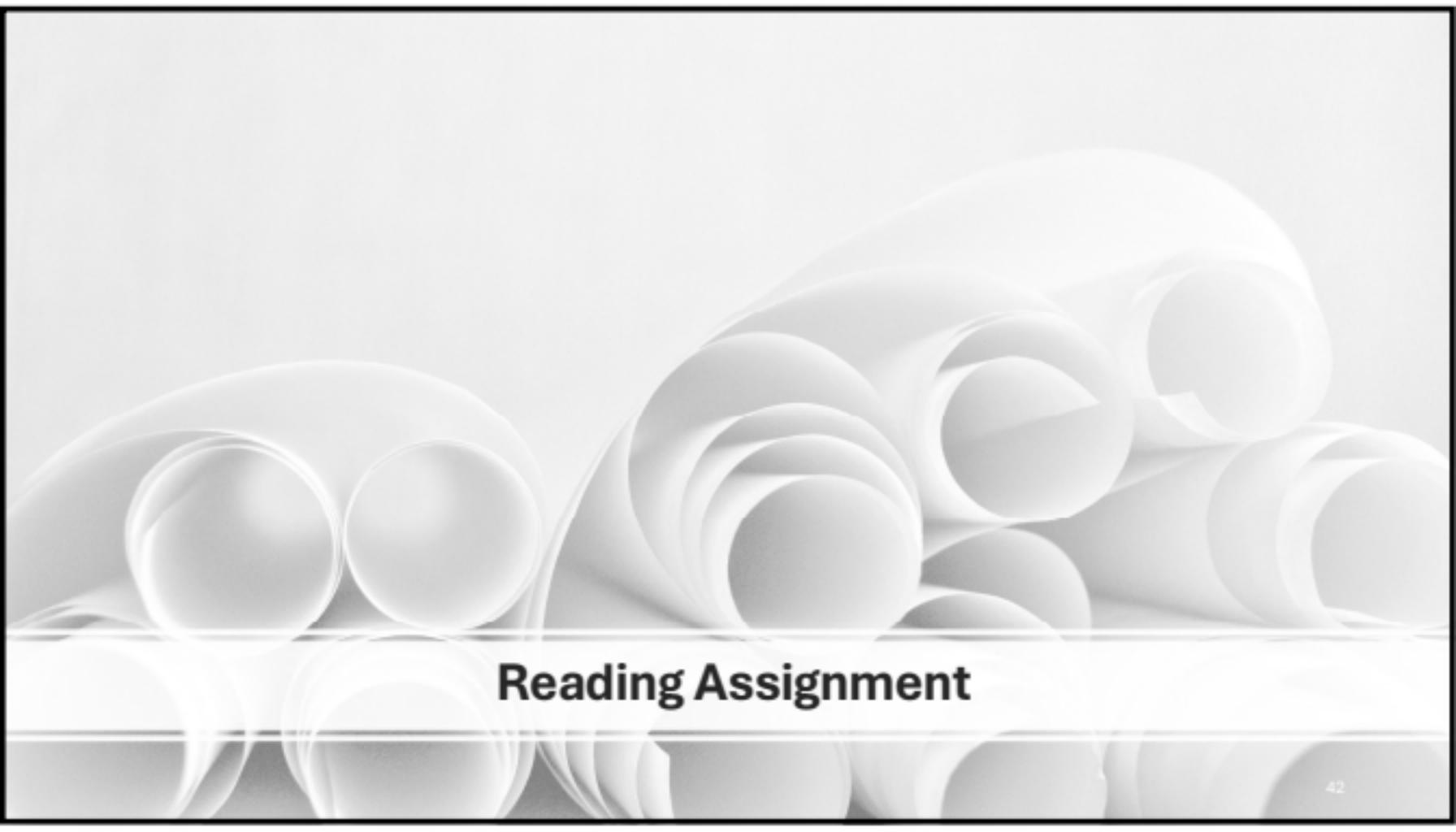
Supercomputers are specifically designed for performing trillions of calculations per second and are the standard choice for scientific research, climate modeling, and weather forecasting. They can process huge datasets, run simulations of natural phenomena, and provide results within the timeframes required to issue warnings. They are also optimized for parallel processing, which is critical when working with models that involve many variables and equations simultaneously.

Case Study: ICT for a Weather Forecasting Center

Answer:

Conclusion:

After comparing all four options, it is clear that only **Supercomputers** meet the needs of a weather forecasting center. PCs, workstations, and mainframes each have strengths in their own domains, but they cannot provide the combination of speed, scale, and scientific modeling capacity required here. Therefore, a Supercomputer is the most suitable choice, as it is purpose-built for large-scale simulations, real-time data processing, and accurate forecasting.

A grayscale photograph showing a large stack of rolled-up documents or blueprints. The rolls are tightly wound and stacked in a somewhat haphazard pile, creating a sense of depth and texture. The lighting is soft, highlighting the edges of the paper.

Reading Assignment

Reading Assignment

Book: Understanding Computers: Today and Tomorrow. Comprehensive by Deborah Morley, Charles S. Parker (16th Edition), Cengage Learning, 2017

Read:

- Chapter 1 Introduction to the World of Technology – 4
 - Computers to Fit Every Need 19
 - Embedded Computers 19
 - Mobile Devices 20
 - Personal Computers (PCs) 21
 - Servers 24
 - Mainframe Computers 26
 - Supercomputers 26

Thank You !

