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Activity 1

1. List at least four main differences between Von Neumann and Harvard architecture.

1. **Instruction and Data Storage:**

Von Neumann Architecture: Instructions and data are stored in the same memory space.
Harvard Architecture: Instructions and data are stored in separate memory spaces.

2. **Memory Access:**

Von Neumann Architecture: Shares a single data bus for accessing both instructions and data.
Harvard Architecture: Has separate data buses for accessing instructions and data, enhancing parallel processing capabilities.

3. **Performance:**

Von Neumann Architecture: May encounter the "Von Neumann bottleneck," where the speed is limited by the shared bus for instructions and data.
Harvard Architecture: Reduces bottlenecks by allowing simultaneous access to instructions and data, thus improving system performance.

4. **Complexity:**

Von Neumann Architecture: Simpler design as instructions and data share the same memory and bus.
Harvard Architecture: More complex design requiring separate management of instruction and data memory and their respective buses.

2. Discuss advantages and disadvantages of Harvard architecture.

- **Advantages:**

Enhances parallel processing capabilities by allowing simultaneous access to instructions and data without conflicts.
Reduces the performance limitations caused by the "Von Neumann bottleneck."
Allows for separate optimization of instruction and data storage, improving overall system performance.

- **Disadvantages:**

More complex design and implementation due to the need to manage two separate memory and bus systems.
Increases hardware costs and system complexity.
Less general-purpose compared to Von Neumann architecture, potentially unsuitable for some applications.

Activity 2

1. Based on the diagram, what architecture is used in the Arduino board? Justify your answer.

The Arduino board uses the Harvard architecture.
This is evident because the diagram shows separate pathways for instruction and data storage and access. The "Flash Program Memory" is distinct from "Data SRAM" and "EEPROM," indicating that instructions and data are stored in separate memory spaces.

2. Identify different types of memory in the Arduino architecture, discuss their usage, and sort them based on speed.

1. **Flash Program Memory:**
Usage: Stores the program code that is executed by the Arduino. This memory is non-volatile, meaning it retains its contents even when power is removed.

Speed: Flash memory is relatively fast for read operations but slower for write and erase operations compared to SRAM.

2. **SRAM :**
Usage: Used for storing temporary data and variables while the program is running. It is volatile memory, so it loses its contents when power is removed.

Speed: SRAM is faster than Flash and EEPROM for both read and write operations.

3. **EEPROM:**
Usage: Used for storing data that needs to be retained between power cycles, such as configuration settings or calibration data. It is non-volatile memory.

Speed: EEPROM is slower than both Flash and SRAM for read and write operations.

4. Registers:
Usage: These registers are used for temporary storage of data and instructions that the CPU processes. They are crucial for performing arithmetic and logical operations within the CPU.

Speed: Registers are the fastest type of memory because they are located within the CPU and accessed directly by the ALU (Arithmetic Logic Unit) without any delay.

Memory Speed (from fastest to slowest):

1. Registers
2. SRAM
3. Flash Program Memory
4. EEPROM