

Solution 1

Module 1: How Computers Work?

1. Answer:

Input: Data enters via **hardware interfaces** (e.g., a GPIO sensor pin or a Wi-Fi network card).

Process: The **CPU** executes instructions on data currently in **RAM**.

Output: Processed data leaves via **hardware interfaces** (e.g., a GPIO output pin or an Ethernet packet).

Connection: All three must exist together, no computation happens without input data, the CPU can only work with data in RAM, and results are only useful when delivered as output.

2. Answer:

a) Before running: irrigation.py exists only on SSD as a static file. RAM: nothing from this program. CPU: idle for this program.

b) While running: A process is created (with a Process id - PID). The program's code + data is loaded into RAM. The CPU actively executes it. The file on the SSD is unchanged.

c) After finishing: The process ends. RAM that was allocated is freed (returned to the OS). The SSD still holds the original irrigation.py file unchanged.

3. Answer:

a) Path breakdown: /home/pi/data/ is the directory path, log.csv is the file name, .csv is the file extension indicating the format.

b) The file does not exist at that location, it may have been deleted, moved, or never created.

c) This is a file-system error (the path address points to a non-existent file). It is not a hardware failure and not a software logic bug in the code itself.

4. Answer:

Transistors/electrical signals → CPU instruction set (machine code) → Operating System (OS) → Process running in RAM → Python script. Each layer depends on the one below it.

5. Answer:

a) RAM (Random Access Memory) is exhausted, the running processes consumed all available volatile memory.

b) The CPU can ONLY work with data that is currently in RAM. SSD/flash storage is secondary storage, data there must first be loaded into RAM. The CPU has no direct fast path to execute from storage.

c) Possible solutions: reduce the number of simultaneous processes, optimise the flight software to use less memory, or upgrade the hardware module with more RAM.