



A9.1 Hardware, software and the stored program

Computer architecture · A level · OCR H446 1.1.1, AQA 7517 4.6.1.1,
Eduqas A500QS 2.1 · about 20 min

Name _____

Class _____

Date _____

What this lesson is about

Internal components, the three buses and their widths, I/O controllers, the stored program concept, and von Neumann against Harvard.

- Hardware and software
- The internal components
- The stored program concept
- Von Neumann and Harvard
- The robot's processor

Questions

6 marks in all

-
- Which bus is unidirectional, carrying signals only from the processor? [1 mark]
☐ A Address bus
☐ B Data bus
☐ C Control bus
☐ D All three
 - A processor has a 20-bit address bus. How many different memory addresses can it use? [1 mark]

 - Which statement is the stored program concept? [1 mark]
☐ A Machine code instructions are stored in main memory and fetched and executed serially by the processor
☐ B Programs are stored on secondary storage so they survive power loss
☐ C Instructions and data are kept in separate memories
☐ D A program is set up by wiring the processor for each job
 - Where is the Harvard architecture typically used? [1 mark]
☐ A Embedded systems and digital signal processors
☐ B Desktop PCs running many applications
☐ C Web servers
☐ D Spreadsheet software
 - What is the job of an I/O controller? [1 mark]
☐ A To connect a device to the buses and translate between the processor's signals and the device's
☐ B To store the program while it runs
☐ C To decode instructions
☐ D To add numbers for the processor

6. How does hardware relate to software?

[1 mark]

- ☐ A Software is instructions that only do something when run on hardware, and hardware needs software to tell it what to do
- ☐ B Software is the physical parts and hardware is the programs
- ☐ C Hardware can do useful work without any software
- ☐ D Software is only the operating system

The task: bus widths

Work out what a bus of a given width can carry. - For each address bus width in [12, 16, 24, 32] bits, print how many different addresses it can make, as a whole number with no commas, in the form `address bus 16 bits: 65536 addresses`. - For each data bus width in [8, 16, 32] bits, print the smallest and largest unsigned whole number it can carry, in the form `data bus 8 bits: 0 to 255`. Print the seven lines in that order. The robot does not move.

```
# the two lines every program starts with: the commands, then the robot
from bugbot import *
connect()

address_widths = [12, 16, 24, 32]
data_widths = [8, 16, 32]
```

Plan your program here, then type it in and press Run.



Do it on the robot

www.bugbotlab.com/learn/a9-1-hardware-software-and-the-stored-program/

The simulator checks it and tells you when it passes. Nothing to install, no account.

Challenges

1. A processor has a 20-bit address bus and each address holds one byte. How many MiB can it address?
2. Give two reasons a washing machine controller would use Harvard architecture.
3. Explain why the data bus must be bidirectional but the address bus need not be.