ANSWERS

F9.6 Memory

Logic and computer systems · GCSE · OCR J277 1.2.1, AQA 8525 3.4.5, Edexcel 1CP2 3.1.1 · about 15 min

BugBotLab

What this lesson is about

RAM, ROM, cache and virtual memory.

- RAM
- ROM
- Cache
- Virtual memory

Questions

5 marks in all

1. What does volatile mean? [1 mark]

- ☐ **A** The contents are lost when the power is off
- ☐ **B** It can only be read
- ☐ **C** It is very fast
- ☐ **D** It is stored on a disk

> **Answer:** A. RAM is volatile; ROM is not.

2. What is ROM used for? [1 mark]

- ☐ **A** Holding the boot program that starts the computer
- ☐ **B** Holding the programs currently running
- ☐ **C** Storing a user's files
- ☐ **D** Speeding up the CPU with copies of data

> **Answer:** A. The boot instructions must be there when the power comes on.

3. What is virtual memory? [1 mark]

- ☐ **A** Part of secondary storage used as extra RAM when RAM is full
- ☐ **B** Memory inside the CPU
- ☐ **C** RAM that keeps its contents without power
- ☐ **D** Memory on another computer

> **Answer:** A. The OS moves data not in use out to storage.

4. Why does a computer slow down when it uses virtual memory a lot? [1 mark]

- ☐ **A** Secondary storage is much slower than RAM
- ☐ **B** Virtual memory uses more power
- ☐ **C** The CPU stops while it is used
- ☐ **D** Virtual memory is smaller than RAM

> **Answer:** A. Moving data back and forth to storage takes time. More RAM is the fix.

5. Put these in order from fastest to slowest. [1 mark]

Number the lines 1 to 4 to put them in the right order.

___ `Registers`

___ `Cache`

___ `Secondary storage`

___ `RAM`

> **Answer:**
>
> ```
> Registers
> Cache
> RAM
> Secondary storage
> ```
>
> Faster memory is smaller and costs more per gigabyte.

The task: out of RAM

A computer has 4 GB of RAM, and the operating system always uses 1 GB. The apps in `apps` are opened in order. For each one, while it does not fit, move the app that has been in RAM longest to virtual memory and print `moved <name> to virtual memory`. Then load it and print `<name> -> RAM`. At the end, print `RAM used: <n> GB` and `in virtual memory: <names>`, the names joined with `, `.

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

ram_size = 4
os_size = 1
apps = [("browser", 1.5), ("game", 2.0), ("music", 0.5), ("editor", 1.0)]
```

The hint students can ask for: Keep a list of what is in RAM, oldest first, and a list of what has been moved out. Before loading an app, keep moving the oldest out while it still does not fit, remembering the operating system's share.

A solution

```
from bugbot import *
connect()
ram_size = 4
os_size = 1
apps = [("browser", 1.5), ("game", 2.0), ("music", 0.5), ("editor", 1.0)]
in_ram = []
virtual = []

def used():
    return os_size + sum(size for name, size in in_ram)

for name, size in apps:
    while used() + size > ram_size:
        old = in_ram.pop(0)
        virtual.append(old[0])
        print("moved", old[0], "to virtual memory")
    in_ram.append((name, size))
    print(name, "-> RAM")
print("RAM used:", used(), "GB")
print("in virtual memory:", ", ".join(virtual))
```

Any program that meets the task's checks is marked correct in the simulator; this is one way, not the only way.