Topic 17 Hardware: Memory Hierarchy – Worksheet

1. Research and Present

a. Draw a diagram of the components of the memory hierarchy for a dual-core processor. Include all levels from internal general-purpose registers through local secondary storage to cloud storage (tertiary storage). As in your textbook (and in current common practice), use a *Harvard architecture* for the level 1 cache, and a *von Neumann* architecture for the remaining levels. Do not include other processor components such as the ALU or registers other than the general-purpose registers. **(10)**

b. What is the purpose of secondary storage? Give **two** examples of what is frequently stored in secondary storage. **(4)**

The primary purpose of secondary storage is to provide permanent (1), non-volatile storage (1)

for he entire system when the power is off.

Stores OS, applications, user data (2)

c. List the advantages and disadvantages of SRAM over DRAM **(4)**

Advantages:

Faster and lower latency (1); simpler operation because it does not require a refresh cycle (2)

Disadvantages:

More transistors means: higher cost (1) and greater area (1) per bit of storage.

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d. Describe the three ways memory can be accessed, and give an example of each. **(6)**

(i) Sequential – data must be accessed in a fixed, linear sequence. (1) ie: tape drive

(ii) Random – any storage location can be accessed directly and in approximately the same amount of time (1) ie: RAM, Flash, (1)

(iii) Direct – access is not sequential, but time to access is based on the current state of the device ie: magnetic or optical disk (time to position head and rotate disk).

e. Describe the three categories of secondary storage and give an example of each. **(6)**

(i) Magnetic – uses the magnetic orientation of particles on the surface to store bits (1) ie: hard drive or tape drive (1)

(ii) Optical – uses light reflection to represent bits (1) ie: CD, DVD, BlueRay (1)

(iii) Solid-state – uses an integrated circuit (logic or capacitive) to stored bits (1) ie: Flash, NVMe (1)

f. Give an example of digital ***convergence*** and say in why it is an example. **(3)**

Digital convergence is when functions originally implemented in separate devices are implemented n a single device (1). Examples: smart phone, smart watch, smart TV, … (1)

Smart phone implements not only a phone but also camera, calculator, GPS device, etc. (1)

g. In Pearson A-Level IT, electrical devices are categorized into: computers, mobile phones, embedded systems, peripheral devices, and storage devices. Argue for or against a separate category for mobile phones. **(3)**