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| Instructor | ***Luke Papademas*** | Due Date | **7/7** |

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| Part | **1** | **2** | **3** | **4** | Total |
| *Maximum Points* | **25** points | **25** points | **25** points | **25** points | **100**G101010 pointsG |
| ***Your Score*** |  |  |  |  |  |

**Textbook Reading Assignment**

Thoroughly read Chapter(s) 7 in your Computer Architecture and Organization textbook.

**Part 1 Glossary Terms - Input / Output and Storage Systems**

Define, in detail, each of these glossary terms from the realm of computer architecture and computer topics, in general. If applicable, use examples to support your definitions. Consult your notes

or course textbook(s) as references or the Internet by visiting Web sites such as:

[**http://www.ask.com**](http://www.ask.com) or [**http://www.webopedia.com**](http://www.webopedia.com/)

**(a) Amdahl’s Law**

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| Amdahl’s law states that the overall speedup of a computer depends on both the speedup in a particular component and how much that component is used by the system. |

**(b) Data Compression**

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| Data compression is the process of reducing the size of a data file to improve storage and transmission. |

**(c) I / O Architectures**

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| I/O architectures are defined through the subsystems of components that move data between external devices and a host system. These subsystems include:   * Blocks of main memory that are devoted to I/O functions * Buses that provide the means of moving data into and out of the system * Control modules in the host and in peripheral devices * Interfaces to external components such as keyboards and disks * Cabling or communications links between the host systems and its peripherals   There are 4 main control methods associated to architectures, including Programmed I/O, Interrupt-Driven I/O, Memory-Mapped I/O, and Direct Memory Access. |

**(d) RAID**

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| RAID is a disk structure that refers to a Redundant Array of Independent Disks. It is intended to provided reliability and performance improvement. There are 7 RAID levels:   * RAID Level 0 – places data in blocks across several disk surfaces * RAID Level 1 – each time data is written, it is mirrored onto a second set of drives called a mirror set * RAID Level 2 – writes one bit per strip to make the disk set act as one disk * RAID Level 3 – uses only one drive to hold a parity bit and uses only one drive for data protection * RAID Level 4 – writes data in strips of uniform size creating a stripe across all of the drives * RAID Level 5 – the parity disks exist throughout the array * RAID Level 6 – uses two sets of error-correction strips for every rank of drives * RAID DP – a single disk data block is protected by two linearly independent parity functions |

**(e) Transmission Modes**

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| There are two types of transmission modes – parallel and serial. Parallel transmission is transmission where an entire byte is transmitted at once. Serial transmission is transmission where a byte is sent one bit at a time. |

**Part 2 Exercises - Input / Output and Storage Systems**

For each of the following, enter True or False.

\_T\_\_\_\_ **(1)** A standard monitor is the only output device that presents results to the user.

\_T\_\_\_\_ **(2)** The simplest way for a CPU to communicate with an I / O device is through polled I / O .

\_F\_\_\_\_ **(3)** Channel I / O is a type of non - isolated I / O because the systems are equipped with separate I / O buses.

\_T\_\_\_\_ **(4)** Two types of transmission modes are serial and parallel transmission modes.

\_F\_\_\_\_ **(5)** Rewritable optical media replace the dye and reflective coating layers of a CD - R disk with a non - metallic alloy.

\_T\_\_\_\_ **(6)** The storage systems that are not protected by RAID are known as just a bunch of disks ( JBOD ) .

\_T\_\_\_\_ **(7)** RAID Level 1 , or RAID - 1 , is also known as disk mirroring.

\_T\_\_\_\_ **(8)** A hologram is a three - dimensional image rendered by the manipulation of laser beams.

\_F\_\_\_\_ **(9)** Memristor memories are a type of volatile RAM .

\_T\_\_\_\_ **(10)** The I / O modules take care of data movement between main memory and a particular device interface.

**Part 3 Exercises - Input / Output and Storage Systems**

**(1)** **( Amdahl’s Law )**

Amdahl’s Law is given by the equation:

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| *S* = | 1 |
| ( 1 − *f* ) + *f*  / *k* |

where

*S* is the overall speedup

*f* is the fraction of work performed by a faster component

*k* is the speedup of the faster component.

Calculate the overall speedup of a system that spends *f* = 65 % of its time on I / O with a disk upgrade that provides for 50 % greater throughput ( with *k* = 1.5 ) .

S = 1.27

**(2)** **( Amdahl’s Law )**

Calculate the overall speedup of a system that spends 40 % of its time in calculations with a processor upgrade that provides for 100 % greater throughput.

S = .86

**(3)** **( Amdahl’s Law )**

Suppose that you are designing a game system that responds to players' pressing buttons and toggling joysticks. The prototype system is failing to react in time to these input events, causing noticeable annoyance to the gamers. You have calculated that you need to improve overall system performance by 50 % . This is to say that the entire system needs to be 50 % faster than it is now. You know that these I / O events account for 75 % of the system workload. You figure that a new I / O interface card should do the trick. If the system's existing I / O card runs at 10 kHz ( pulses per second ) , what is the speed of the I / O card that you need to order from the supplier?

The speed of the I/O card should be 18 kHz (1.8 times faster than the current card).

**(4)** **( Amdahl’s Law )**

Your friend has just bought a new personal computer. She tells you that her new system runs at 1GHz , which makes it over three times faster than her old 300 MHz system. What would you tell her? ( Hint: Consider how Amdahl's Law applies. )

I would tell her that the system’s performance is constrained by the other components in the system. If the processor runs at 1 GHz, but other components run slow, she may not see a 1 GHz performance.

**(5)** **( I / O Architectures )**

Name the four types of I / O architectures. Where are each of these typically used and why are they used there?

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| **Programmed I/O – typically used in ATM machines and embedded systems that control or monitor environments.**  **Interrupt-driven I/O – typically used in personal computers**  **Direct Memory Access – typically used in smaller systems**  **Channel I/O – typically used on mainframe computers and file servers and storage networks** |

**Part 4 Exercises - Input / Output and Storage Systems**

Write a complete answer for each of these.

**(1) ( Seek Time, Rotational Delay, Transfer Time )**

Define the terms seek time, rotational delay and transfer time. Explain their relationship.

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| **Seek time is the time is takes for the disk arm to position itself over the required track. Rotational delay is the time it takes for the required sector to position itself under a read/write head. Transfer time is the access time plus the time it takes to read the data from the disk. These processes are related because they are all part of the process for accessing data on disk, and the performance of each of them impacts the performance of accessing the disk.** |

**(2) ( Random Access Device )**

Why do you think the term random access device is something of a misnomer for disk drives?

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| **This is not always correct because each unit of storage on a disk has a unique address that can be accessed independently of the sectors around it, indicating that the access is not random.** |

**(3) ( Disk Directories )**

Why do differing systems place disk directories in different track locations on the disk? What are the advantages of using each location that you cited?

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| **Systems place disk directories in different track locations for access time and data integrity. Placing directories on the inner track allows for faster access time, while placing directories on the outer track allows for increased data integrity but the performance is less.** |

**(4) ( Hard Disk Capacity )**

Suppose a disk drive has the following characteristics:

• 4 surfaces

• 1024 tracks per surface

• 128 sectors per track

• 512 bytes / sector

• track - to - track seek time of 5 milliseconds

• rotational speed of 5000 RPM

(a) What is the capacity of the drive? Hint: use this product.

? surfaces × ? tracks per surface × ? sectors per track × ? bytes / sector

(b) What is the access time? Hint: use this expression.

Rotational Delay = [ ( ? secs / ? rpm) × ( ? ms / second ) ] / 2 + ? ms seek time

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| 1. **268435456 bytes or about 256 MB.** 2. **11 ms** |

**(5) ( Hard Disk Capacity )**

Suppose a disk drive has the following characteristics:

• 5 surfaces

• 1024 tracks per surface

• 256 sectors per track

• 512 bytes / sector

• track - to - track seek time of 8 milliseconds

• rotational speed of 7500 rpm

(a) What is the capacity of the drive?

(b) What is the access time?

(c) Is this disk faster than the one described in question 17 ? Explain.

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| 1. **671088640 bytes or about 640 MB.** 2. **12 ms** 3. **It is slower because of the overall track to track seek time and access time.** |