MONASH University


# Lecture Revision

## OBJECTIVES

- Revise the materials and deepen the understanding of Week 1 to 3 lectures.

## MARKS

- The applied session is worthed 3 of the unit final mark.

## INSTRUCTIONS

1. **Preparation is required for this Applied session.** Please do NOT plan to complete the Applied preparation during the Applied as this is not compatible with a flipped Applied format.
2. The purpose of these **flipped Applieds** is for students to get an opportunity to test their understanding of lecture/pre-reading material with a low cost in lost marks if they have not understood the material, rather than not understanding the material.
3. Students should produce **written answers** to the Applied questions prior to starting the Applied.
4. Students must submit their answers via Moodle in **PDF format** before their allocated class.
5. Students' answers will be reviewed in a question and answer format during the Applied. Each student will explain their answer.
6. For many of the questions, marks will be allocated for **both the correctness of the written answer and the correctness & clarity of the verbal answer.** Therefore, plan also for a brief 60 seconds summary explanation of each question. Try to focus on the most important and critical idea in the answer. Marks will be awarded on the student's ability to explain their submitted answers in the PDF: concise, focused and accurate answers will earn full marks, answers with errors and lengthy explanations will lose marks. Read the marking rubric for detailed instructions.
7. All questions are based on lecture/pre-reading slides, and lecture/pre-reading slides are in effect the answer sheets for these Applieds.
8. Worked answers will not be posted after Applieds as most of the answers are already in the lecture/pre-reading slides and discussed in the class.
9. Marks will not be awarded if you skip the class, or do not make any submissions, or make an empty submission to Moodle (unless a special consideration extension has been approved).
10. You are allowed to use search engines or AI tools to search for information and resources during pre-class preparation. However, search engines and AI tools are not allowed during the class.

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## Questions

Answer all the following questions.

**Question 1 [Flynn's taxonomy]:**

A. Discuss the types of parallel systems based on the number of independent instruction and data streams.
B. For each type of parallel system, name one example of a machine found in human's history and describe a real-life application that can be solved by the machine.

**Question 2 [Processes, Threads, and IPC]:**

A. Explain the composition of a process. Name at least 7 attributes that must exist for a process so that it can be identified with its state known.
B. Name two resources that are shared between threads within a process, but not shared between processes.
C. Explain three IPC mechanisms applicable to the same host operating system.
D. Name one IPC mechanism that is applicable for a network of computers (potentially with different operating systems).
E. Explain the two aspects of performance for such a mechanism.

**Question 3 [Shared Memory Communication]:**

With reference to the following sample code:

```
#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>

void *print_message_function( void *ptr )
{
     char *message;
     message = (char *) ptr;
     printf("%s \n", message);
}

int main()
{
     pthread_t thread1, thread2;
     char *message1 = "Thread 1";
     char *message2 = "Thread 2";
     int  iret1, iret2;

    /* Create independent threads each of which will execute function */

     iret1 = pthread_create( &thread1, NULL, print_message_function,
                             (void*) message1);
     iret2 = pthread_create( &thread2, NULL, print_message_function,
                             (void*) message2);

     printf("Thread 1 returns: %d\n",iret1);
     printf("Thread 2 returns: %d\n",iret2);
     return;
}
```

A. Discuss the possible outcomes of the code above.
B. Explain the reasoning behind your outcomes.

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**Question 4 [Pipelining]:**

A. Assume a time phase duration of 1 nanosecond and 4 stages to execute an instruction. Draw two diagrams, one without pipelining and one with pipelining, to explain why pipelining would increase the throughput.
B. What is the throughput speedup and the pipeline latency for such a pipeline system?
C. Name two reasons for pipeline stalls.

**Question 5 [Superscalar processing]:**

A. Assume a time phase duration of 1 nanosecond and 4 stages to execute an integer instruction. Assume a 8-way superscalar CPU core has 2 integer Execution Units (EU), 4 floating point (FP) EUs, and 2 Address Arithmetic EUs. Given 4 integer instructions, draw a time-phase diagram to explain how the superscalar CPU can speed-up the throughput.
B. Explain how anti-dependency can slow down superscalar CPU, and give a brief (max 7 coding lines) example in C/C++ to illustrate the idea.