

Kasdi Merbah University – OUARGLA  
Faculty of New Information and Communication Technologies (FNTIC)  
Department of Computer Science and Information Technologies



**Exam (Semester 1)**  
**-MASTER 2 - Fundamental Computer Science**

Course: Parallel Algorithms  
Duration: 1 hour and 30 minutes  
(No authorized documents)

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- 1) What is multithreading?
  1. A way to parallelize code execution using multiple processes
  - 2. A way to parallelize code execution using multiple threads within a process**
  3. A way to distribute code execution across multiple machines
  4. A way to serialize code execution for better performance
  
- 2) Which of the following is an advantage of multithreading over multiprocessing?
  - 1. Better utilization of multiple processors**
  2. Easier to implement
  3. Improved fault isolation
  4. Increased memory space
  
- 3) What is a message in the context of the message-passing paradigm?
  1. A system call
  2. A lightweight process
  - 3. A unit of data sent from one process to another**
  4. A separate program
  
- 4) What is distributed memory in parallel architecture?
  - 1. Memory that is distributed across multiple computers**
  2. Memory that is distributed among multiple processes within the same system
  3. Memory that is distributed among multiple cores on a single processor
  4. Memory that is private to each processor
  
- 5) What is dynamic balancing in parallel architectures?
  - 1. Adjusting the distribution of tasks during runtime**
  2. Balancing tasks at the beginning of program execution
  3. Allocating tasks based on a fixed schedule
  4. Prioritizing tasks based on their complexity
  
- 6) What is loop parallelization in the context of parallel computing?
  1. Executing loops sequentially
  - 2. Dividing a loop into parallel tasks**
  3. Skipping loops for faster execution
  4. Transforming loops into recursive functions

7) In loop parallelization, what is a reduction operation?

1. An operation that increases loop iteration count
2. **An operation that combines results from multiple iterations into a single value**
3. An operation that skips certain loop iterations
4. An operation that reduces the number of loop iterations

8) What is "embarrassingly parallel" computing?

1. Computing that is overly complex and difficult to parallelize
2. **Computing tasks that can be parallelized with minimal effort and coordination**
3. The inability of a method to scale efficiently
4. A type of parallel algorithm with high task dependency

### Exercise 1

1. Provide the 'sequential' set of instructions to calculate the expression  $Y = x^3 + 2x^2 - 3x$

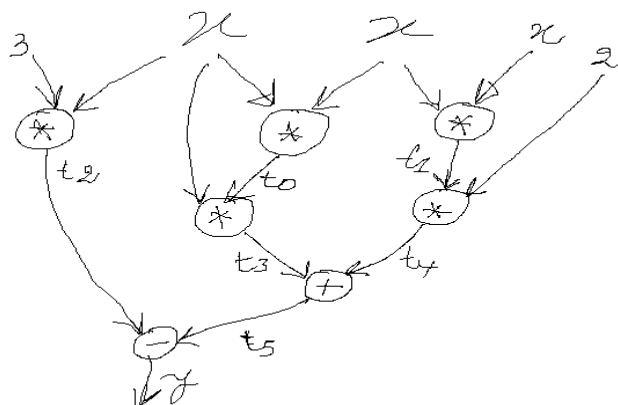
$t_0 = x * x$
$t_1 = x * x$
$t_2 = 3 * x$
$t_3 = t_0 * x$
$t_4 = 2 * t_1$
$t_5 = t_3 + t_4$
$y = t_5 - t_2$

2. How many time units are required to perform this calculation?

**Answer : 7**

3. Provide the data flow graph (or the task dependency graph) for a parallel algorithm calculating the expression Y?

**Answer :**



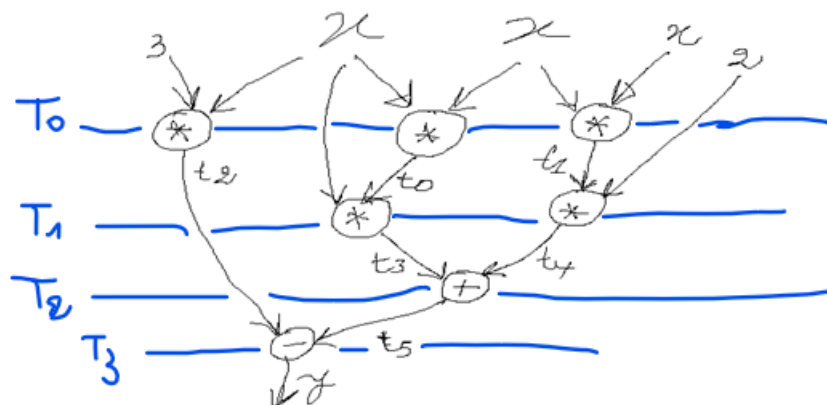
4. How many time units are required to perform this parallel algorithm?

**Answer : 4**

5. Evaluate the degree of parallelism of this parallel algorithm?

**Answer :**

Times	PD
T0	3
T1	2
T2	1
T3	1



6. Evaluate the average degree of parallelism of this parallel algorithm?

**Answer : ADP = (3+2+1+1)/4**

7. Find the length of the critical path of this parallel algorithm?

**Answer : The length of the CP =3**

8. Determine the ideal parallel execution time of this parallel algorithm ?

**Answer : The Ideal Parallel Execution Time = 4 (3+1)**

Number of execution units	Minimum time
1	7
2	5
3	4
4	4
5	4

**Exercise 2**

Perform the Odd-Even Sort of the following data on a 5-processor machine.

15, 15, 13, 10, 7, 9, 11, 2, 1, 4, 12, 14, 3, 6, 7, 8, 3

**Answer :**

Processor	P1	P2	P3	P4	P5
Initial state	15, 15, 13, 10	7, 9, 11, 2	1, 4, 12	14, 3, 6	7, 8, 3
Local sort	10, 13, 15, 15	2, 7, 9, 11	1, 4, 12	3, 6, 14	3, 7, 8
Odd	2, 7, 9,10	11, 13, 15, 15	1, 3, 4	6, 12, 14	3, 7, 8
Even	2, 7, 9,10	1, 3, 4, 11	13, 15, 15	3, 6, 7	8, 12, 14
Odd	1,2,3,4	7,9,10,11	3, 6, 7	13, 15, 15	8, 12, 14
Even	1,2,3,4	3, 6, 7,7	9,10,11	8,12,13	14,15,15
Odd	1,2,3,3	4,6,7,7	8,9,10	11,12,13	14,15,15