COMP 428 Theory Assignment2

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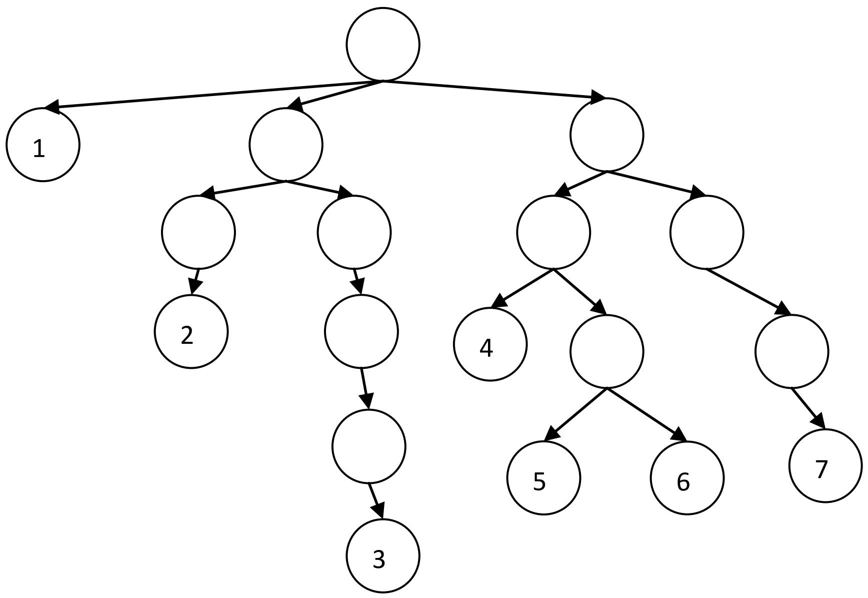
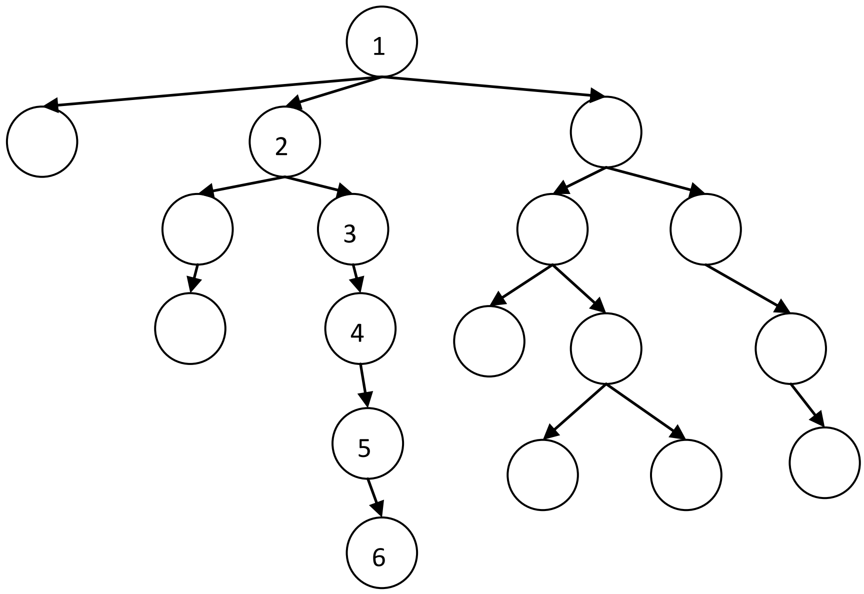
1.

(a). The maximum degree of concurrency is the maximum number of task that can be executed concurrently.



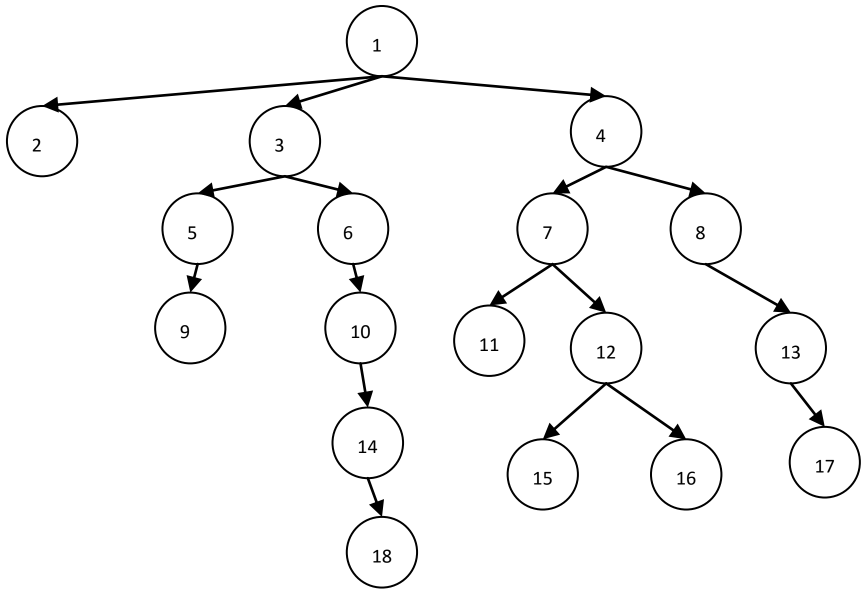
Answer: 7

(b). Critical path length is the longest directed path between start and finish nodes in the task dependency graph.



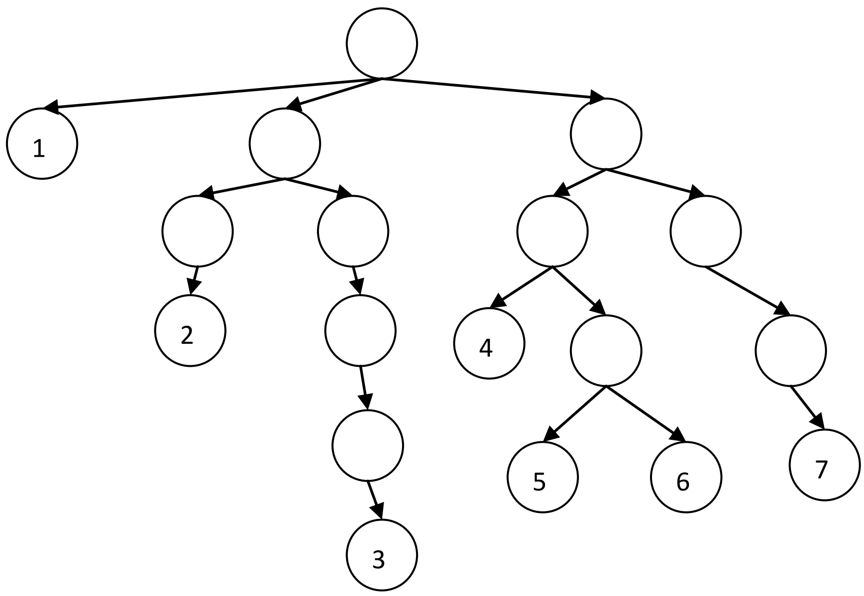
Answer: 6

(c). Maximum speedup relative to a single process is the ratio of the number of al tasks to the number of tasks in the critical path



Answer: 18/6=3

(d). The minimum number of processes needed to achieve the maximum possible speedup is the ratio of the number of all tasks to the maximum number of parallel tasks.



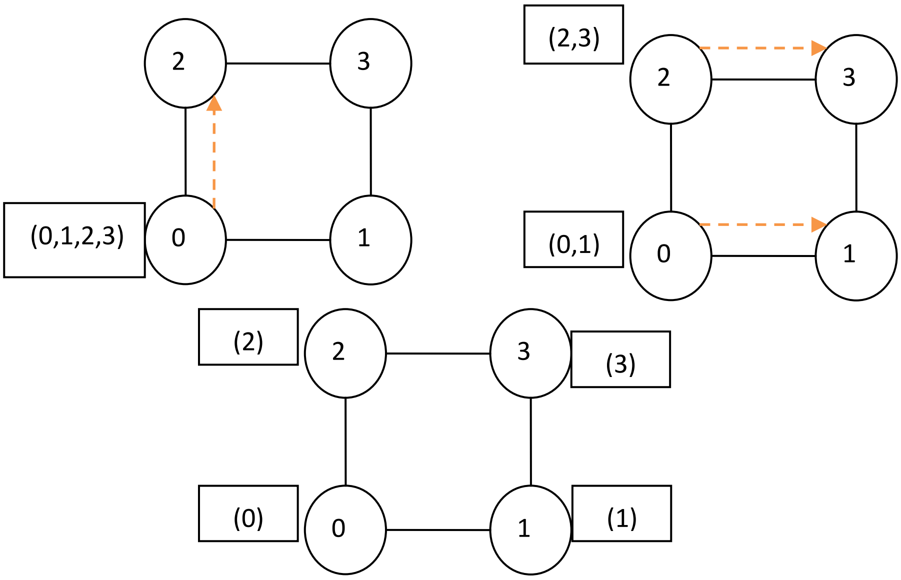
Answer: 7

2.

(a).

p=4,

sqrt(4)*sqrt(4) mesh



In first step, N0 sends half its message to N2

In next step, N2 sends half its message to N3

(b). The cost of this communication algorithm

Use all-to-all broadcast procedure with log(p) steps.

At each step, the nodes have data send a half of their data to a directly linked node.

Each step, the size of the messages communicated is halved.

Cost: T= $T_S \log(p) + T_w m(p-1)$

3.

$$T_s = \theta(n^3) = 8n^3$$

$$T_p = \theta(\frac{n^3}{p}) + \theta(n^2(\log p)^2) = \frac{8n^3}{p} + n^2(\log p)^2$$

(a). Speedup

$$S = \frac{T_s}{T_p} = \theta(\frac{n^3}{\frac{n^3}{p} + n^2(\log p)^2}) = \theta(\frac{np}{n + p(\log p)^2})$$

$$S = \frac{T_s}{T_p} = \frac{8n^3}{\frac{8n^3}{p} + n^2(\log p)^2} = \frac{8np}{8n + p(\log p)^2}$$

(b). Parallel Cost

$$pT_p = p*\theta(\frac{n^3}{p} + n^2(\log p)^2) = \theta(n^3 + pn^2(\log p)^2)$$

$$pT_p = p*(\frac{8n^3}{p} + n^2(\log p)^2) = 8n^3 + pn^2(\log p)^2$$

(c). Total Overhead

$$T_0 = pTp - Ts = \theta(n^3 + pn^2(\log p)^2) - \theta(n^3) = \theta(pn^2(\log p)^2)$$

$$T_0 = pTp - Ts = 8n^3 + pn^2(\log p)^2 - 8n^3 = pn^2(\log p)^2$$

(d). Efficiency

$$E = \frac{S}{p} = \frac{\theta(\frac{np}{n + p(\log p)^2})}{p} = \theta(\frac{n}{np + p^2(\log p)^2})s$$

$$E = \frac{S}{p} = \frac{\frac{8np}{8n + p(\log p)^2}}{p} = \frac{8n}{8n + p(\log p)^2}$$

(e).

$n = (2^5, 2^{10}, 2^{20}, 2^{32})$

$p = (4, 32, 128, 1024)$

$$E = \frac{8n}{8n + p(\log p)^2}$$

n	P=4	P=32	P=128	P=1024
2^5	0.9943682056	0.7793111244	0.3105429073	0.02684735054
2^{10}	0.999823041	0.9912281096	0.93105429073	0.4688807968
2^{20}	0.9999998272	0.999991358	0.9999322505	0.9988950326
2^{32}	1.0000000000	0.9999999979	0.9999999835	0.9999997299