Assignment 4

Alex Bartella
400308868

April 12, 2023 1:08 PM

1. Consider the system on slide 20 of the lecture slides `hwsw1.pdf`, with a latency constraint of 30.

   (a) In addition to processors $P1$ and $P2$, there is a third component available, processor $P3$. $P3$ has execution times $t_A = 22$, $t_B = 2$, $t_C = 8$ and $t_D = 9$. The corresponding energy consumptions are $e_A = 3$, $e_B = 6$, $e_C = 6$, and $e_D = 2$. You can replace one of $P1$ or $P2$ with $P3$ if you desire. Would you make a change? Justify your answer.

P3: $t_A = 22$ $t_B = 2$ $t_C = 8$ $t_D = 9$
$e_A = 3$ $e_B = 6$ $e_C = 6$ $e_D = 2$

	t_A	t_B	t_C	t_D
P_1	5	15	10	30
P_2	10	20	10	10

	e_A	e_B	e_C	e_D
P_1	10	6	3	1
P_2	3	8	3	3

latency constraint = 30, energy constraint = 15

try: replacing P_1

	e_A	e_B	e_C	e_D
P_3	3	6	6	2
P_2	3	8	3	3

min = 14
max = 20
3+6+3+2 = 14 ✓

	t_A	t_B	t_C	t_D
P_3	22	2	8	9
P_2	10	20	10	10

$t_3 = 2+9 = 11 < 30$ ✓
$t_2 = 10+10 = 20 < 30$ ✓

try: replace P_2

	e_A	e_B	e_C	e_D

infeasible

	e_A	e_B	e_C	e_D
P_1	10	6	3	1
P_3	3	6	6	2

tradeoff

min = 13

max = 24

3+6+3+2 = 14 ✓

	t_A	t_B	t_C	t_D
P_1	5	15	10	30
P_3	22	2	8	9

$t_1 = 10 < 30$ ✓

$t_2 = 33 \not< 30$ ×

No replacement

	e_A	e_B	e_C	e_D
P_1	10	6	3	1
P_2	3	8	3	3

tradeoff

3+6+3+3 = 15 ✓

	t_A	t_B	t_C	t_D
P_1	5	15	10	30
P_2	10	20	10	10

$t_1 = 25$ ✓

$t_2 = 20$ ✓

∴ should replace P_1 w/ P_3

b/c would minimize energy consumption (14 < 15) & latency (11 < 25 & 20 = 20)

(b) Suppose that you could replace either P_1 or P_2 with a specialized low-energy processor that has execution time of 30 and energy consumption of 1 for one task and is incapable of executing the other tasks. Would you make the switch? Justify your answer.

assuming no tradeoff for P_1 & P_2

	e_A	e_B	e_C	e_D
P_1	10	6	3	1
P_2	3	8	3	3

$= 13$

	t_A	t_B	t_C	t_D
P_1	5	15	10	30
P_2	10	20	10	10

$t_1 = 15 + 30 = 45$ ~~$t_1 + t_2 = 65$~~

$t_2 = 10 + 10 = 20$

---

	e_A	e_B	e_C	e_D
P_2	3	8	3	3
$P_{special}$	X	1	X	X

$= 10 < 13$ ✓

	t_A	t_B	t_C	t_D
P_2	10	20	10	10
$P_{special}$	X	30	X	X

$t_1 = 30 < 45$

$t_2 = 30 \not< 20$

~~$t_1 + t_2 = 60 < 65$~~

∴ we should replace P_1 w/ $P_{special}$ for task B, since energy consumption

For task B, since energy consumption is reduced, latency at P_2 is reduced, & total latency is reduced

2. This was not covered in lecture, but it is a simple but important point to keep in mind. Suppose that we were considering the following eight processors for a design with three different performance metrics:

	Cost	Power (mW)	Execution Time (ms)
$P1$	20	450	800
~~$P2$~~	~~70~~	~~300~~	~~500~~
$P3$	80	150	300
$P4$	40	100	400
$P5$	90	50	200
~~$P6$~~	~~50~~	~~300~~	~~700~~
~~$P7$~~	~~40~~	~~350~~	~~900~~
~~$P8$~~	~~70~~	~~200~~	~~500~~

If we are interested in all three metrics, which processors could we immediately discard? Why?

P8 & P2 cost the same
→ same execution time
→ P8 has lower power
→ ∴ discard P2

P7 & P4 cost the same
→ P4 has lower power & execution time
→ ∴ discard P7

P4 & P6
→ P4 is cheaper, lower power, & lower exec time
→ ∴ discard P6

→ ∴ discard P6

P4 & P8
→ P4 is cheaper, lower power, & lower exec time
→ ∴ discard P8

so, keep P_1, P_3, P_4, P_5, discard else because they are clearly sub optimal