ECE 6101 HW1.

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Question 1:

First, just to label the instructions with: "A B C D E F G H I J K"

time-	1	2	1	3	1	1	5	5	2	3	1
depen-	X	X	A① B①	C① A①	C① A① B②	X	X	X	E①	F① B①	A①

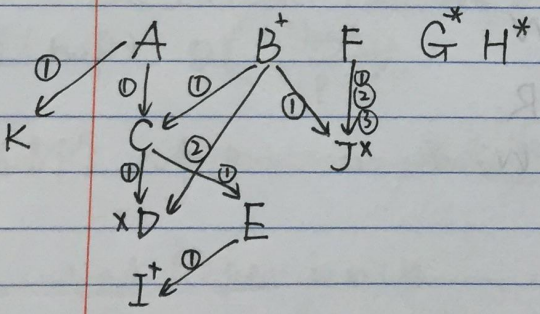
A LUI R_0, 25
B LW R_1, R_2
C ADD R_3, R_0, R_1
D MUL R_2, R_3, R_0
E AND R_4, R_3, R_0
F NOT R_6, R_6
G FMUL F_4, F_5, F_6
H FMUL F_1 F_2 F_3
I SW ADDR, R_4
J MUL R_6 R_6 R_1
K SUBI R_7, R_5, R_0

① means true dependency - RAW

② means anti - WAR

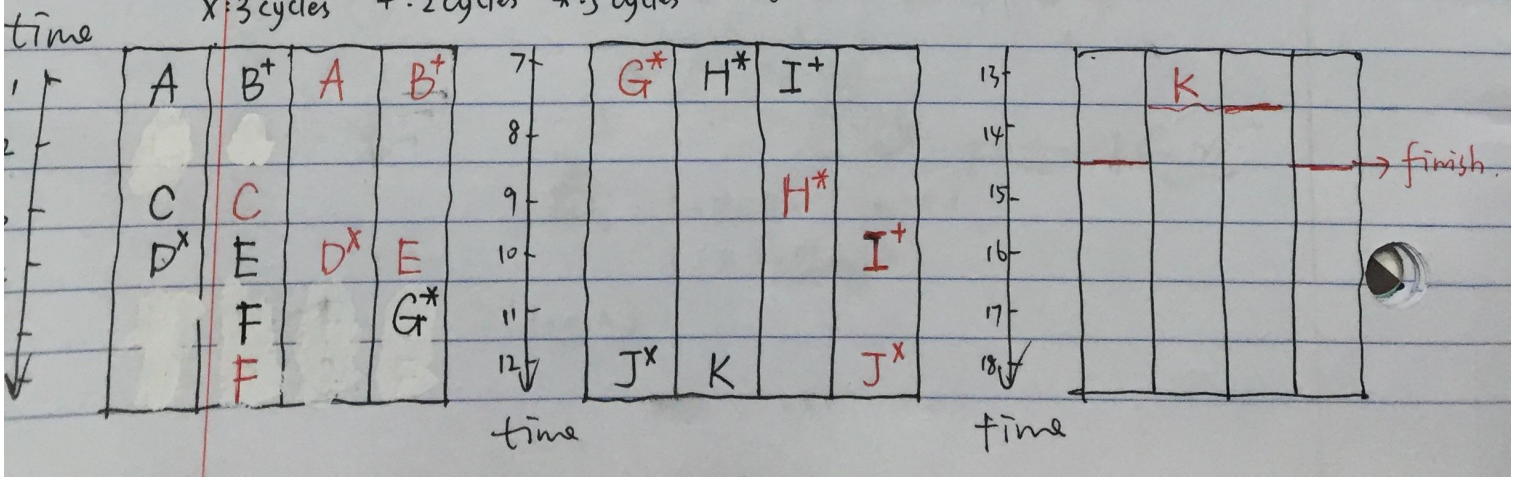
③ means output - WAW.

dependency graph:



1. when scheduling, only true dependency should be taken into consideration.
2. D depends on Both A and C. while C depends on A. So just consider that D → C.

X: 3 cycles +: 2 cycles *: 5 cycles



So, in all, it takes 14 cycles to finish the two threads.

Question 2:

(a) Speed up of parallelizable region : $100 - 1.04^{(P-118.5)}$

Over all time spent now = $10\%t + 90\%t / (100 - 1.04^{(118.5-P)})$.

$$\text{over all speed up} = \frac{1}{0.1 + 0.9/(100 - 1.04^{(118.5-P)})}$$

$$= \frac{1}{0.1 + \frac{0.9}{f(p)}}, \quad f(p) = 100 - 1.04^{(118.5-P)}$$

$$f(p) = \begin{cases} 10.84, & P=4 \\ 23.76, & P=8 \\ 44.29, & P=16 \end{cases} \quad \text{So, the speed up} = \begin{cases} 5.46 & , P=4 \\ 7.2527 & , P=8 \\ 8.3112 & , P=16 \end{cases}$$

(b) $\frac{1}{0.1 + \frac{0.9}{f(p)}} = 9$, $f(p) = 81.0811$.

then $118.5 - P = \log_{1.04}^{(100-81.0811)} = 74.96$

$P \approx 44$.

You will need 44 processors.

Question 3: when there is N processors, the problem size of the parallel part increases to NX_1.

Suppose that with one processor and problem size of X_1, the sequential time is T and the parallel time is 9T.

then with N processors and NX_1 input:

overall time = $T + \left(\frac{NX_1}{N}\right)/X_1 \times 9T = 10T$. (remains unchanged)

However if you deal with NX_1 input with a single processor

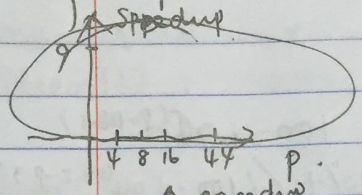
time = $T + (NX_1)/X_1 \cdot 9T = (9N+1)T$.

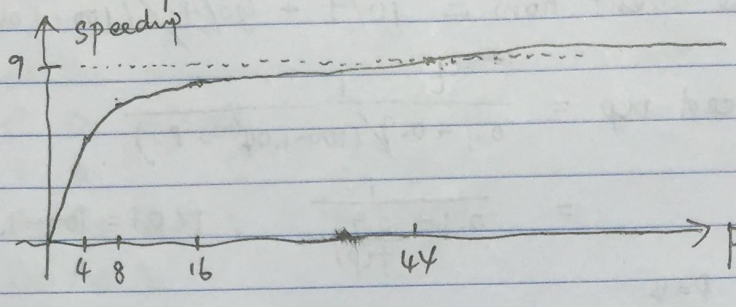
$$\text{Speedup} = \frac{9N+1}{10} = \frac{9}{10}N + 1.$$

(b) for problem 2 : Speedup = $\frac{1}{0.1 + 0.9/[100 - 1.04(118.5 - p)]}$

$p \to \infty$.

Speedup $\to \frac{1}{0.1 + 0.009} = 9.17$





for problem 3 :