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Problem 1

11 : $z = (b*d) / b+d$
12 : $X = z*Z + (c*a)$
13 : $y = (e+a)*d$
14 : $Z = x+d / (b+c)$

F.d : output$(I_1) \cap$ Input(I_2)
A.d : Input$(I_1) \cap$ output(I_2)
O.d : Output$(I_1) \cap$ output(I_2)

$I_1 \| I_2$? NO, F.d
$= \{z\} \cap \{z, c, a\} \neq \emptyset$
$= \{b, d\} \cap \{x\} = \emptyset$
$= \{z\} \cap \{x\} = \emptyset$

$I_1 \| I_3$? yes
$= \{z\} \cap \{e, a, d\} = 0$
$= \{b, d\} \cap \{y\} = 0$
$= \{z\} \cap \{y\} = 0$

$I_1 \| I_4$? NO, O.d
$= \{z\} \cap \{x, d, b, c\} = 0$
$= \{b, d\} \cap \{z\} = 0$
$= \{z\} \cap \{z\} \neq 0$

$I_2 \| I_3$? yes
$= \{x\} \cap \{c, a, d\} = 0$
$= \{z, c, a\} \cap \{x\} = 0$
$= \{x\} \cap \{y\} = 0$

$I_2 \| I_4$? NO - F.d and A.d
$= \{X\} \cap \{x, d, b, C\} \neq \emptyset$
$= \{Z, C, a\} \cap \{z\} \neq \emptyset$
$= \{X\} \cap \{z\} = \emptyset$

$I_3 \| I_4$? yes
$= \{y\} \cap \{x, d, b, c\} = 0$
$= \{e, a, d\} \cap \{z\} = 0$
$= \{y\} \cap \{Z\} = 0$

a) I_1 and I_3, I_2 and I_3, I_3 and I_4 can parallelize
I_1 and I_2, I_1 and I_4, I_2 and I_4 can't parallelize

$Proc_1$	$Proc_2$
I_1	I_3
I_2	
I_4	

b) NO, as we just show, some programs need to wait due to dependencies.

Problem 2

I_1 $X[0] = 1$
I_2 $x[1] = x[0] + 2$
I_3 $x[2] = X[1] + 3$
I_4 $x[3] = 3$
I_5 $X[4] = X[2] + 3$
I_6 $X[5] = X[1] + 2$

F.d : $output(I_1) \cap Input(I_2)$
A.d : $Input(I_1) \cap output(I_2)$
O.d : $Output(I_1) \cap output(I_2)$

$I_1 \| I_2$? No
$= output(I_1) \cap Input(I_2) \neq 0$
$Input(I_1) \cap output(I_2) = 0$
$Output(I_1) \cap output(I_2) = 0$

$I_1 \| I_3$? yes
$= output(I_1) \cap Input(I_3) = 0$
$Input(I_1) \cap output(I_3) = 0$
$Output(I_1) \cap output(I_3) = 0$

$I_1 \| I_4$? yes
$= output(I_1) \cap Input(I_4) = 0$
$Input(I_1) \cap output(I_4) = 0$
$Output(I_1) \cap output(I_4) = 0$

$I_1 \| I_5$? yes
$= output(I_1) \cap Input(I_5) = 0$
$Input(I_1) \cap output(I_5) = 0$
$Output(I_1) \cap output(I_5) = 0$

$I_1 \| I_6$? yes
$= output(I_1) \cap Input(I_6) = 0$
$Input(I_1) \cap output(I_6) = 0$
$Output(I_1) \cap output(I_6) = 0$

$I_2 \| I_3$? No
$I_2 \| I_4$? yes
$I_2 \| I_5$? yes
$I_2 \| I_6$? No

$I_3 \| I_4$? yes
$I_3 \| I_5$? No
$I_3 \| I_6$? yes

$I_4 \| I_5$? yes
$I_4 \| I_6$? yes

$I_5 \| I_6$? yes

$Proc_1$	$Proc_2$	$Proc_3$	$Proc_4$
I_1	I_3	I_4	I_6
I_2	I_5		

4 Processors

Problem 3

1) Baking cookies. when baking cookies, you can involve more friends to help with baking process. Each person can take on a specific task, like mixing the daugh, shaping cookies, etc. with more helpers you can bake more without significantly increasing the time it takes to finish.

2) Copying files. Imagine you want to copy a text book if you divide the task and use more scanner/printer, you can decrease the time it takes to copy the text book.