Kadir Emre Oto
150140032

BLG 322E - Computer Architecture
Assignment 2

Due Date: 14.03.2018, Wednesday, 22:00

a) Draw the space-time diagram for the given program. Solve all data and branch conflicts using NOOP instructions. What is the total amount of penalty in clock cycles caused by conflicts for the given piece of code?

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
LD 0(R5), R1	FR	EX	MW											
LD 0(R6), R2		FR	EX	MW										
LD 0(R7), R3			FR	EX	MW									
NOOP				FR	EX									
ADD R3, R2, R3					FR	EX	MW							
NOOP						FR	EX							
SUB R3, R1, R3							FR	EX	MW					
BNX EX								FR	EX	MW				
NOOP									FR	EX				
ADD R0, 0, R3										FR	EX	MW		
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
NEG R3										FR	EX	MW		
NOOP											FR	EX		
ADD R3, R2, R2												FR	EX	MW

To solve all conflicts, **4** NOOP instructions are used and it causes 4 clock penalties if brach, otherwise **3**.

Kadir Emre Oto
150140032

b) To minimize the amount of penalty, find an optimized software solution to all conflicts, if it is possible. (Do not change the algorithm and be sure that the results generated by the program are still the same.) What is the total amount of penalty in clock cycles with the new solutions?

	1	2	3	4	5	6	7	8	9	10	11	12	13
LD 0(R6), R2	FR	EX	MW										
LD 0(R7), R3		FR	EX	MW									
LD 0(R5), R1			FR	EX	MW								
ADD R3, R2, R3				FR	EX	MW							
NOOP					FR	EX							
SUB R3, R1, R3						FR	EX	MW					
BNX EX							FR	EX	MW				
NOOP								FR	EX				
ADD R0, 0, R3									FR	EX	MW		
…	…	…	…	…	…	…	…	…	…	…	…	…	…
NEG R3									FR	EX	MW		
NOOP										FR	EX		
ADD R3, R2, R2											FR	EX	MW

For given piece of code, the first NOOP operation is not necessary indeed because we can reorder the first three lines such like the table above. By this way the new clock penalty is reduced to **3** if branch, otherwise **2.**