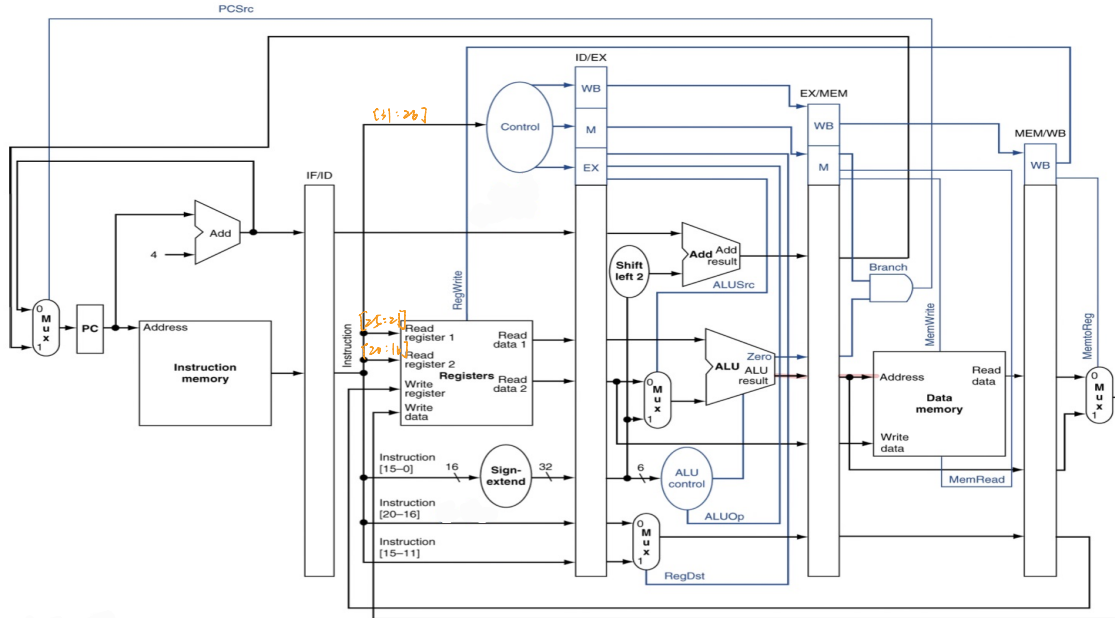


Computer Organization Lab3

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Architecture diagrams:



Hardware module analysis:

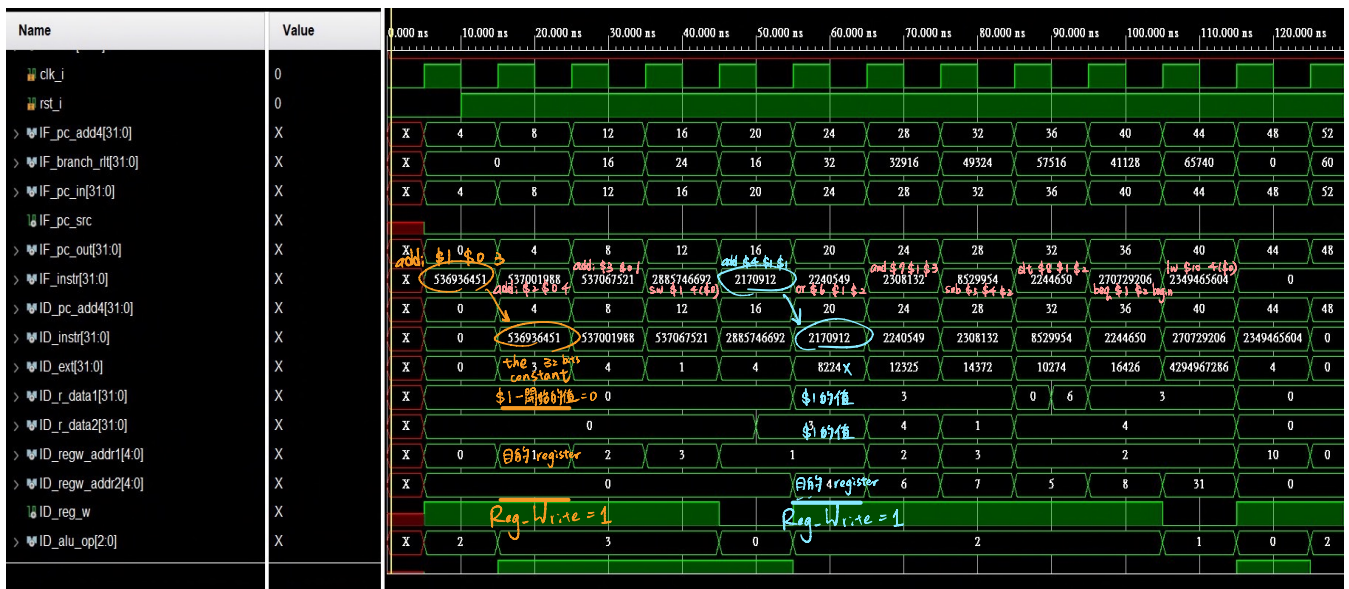
優:

1. 可以同時執行許多指令，善用硬體資源
2. 可增加throughput
3. 相較於single cycle CPU，儘管比單個指令有可能速度較慢，但絕大部分時候都比較省時

缺:

1. 需要額外的flip flop儲存每個stage的結果
2. 實作時比single cycle CPU還複雜
3. 需要處理hazard的問題

Finished part:



Problems you met and solutions:

因為都是照著課本的架構圖實作，所以沒有遇到甚麼太大的困難，只有太粗心大意導致浪費很多時間debug的問題。XD

在想bonus的部分時，因為誤解題目的意思，所以一直在想到底有什麼解決data hazard的方法不會需要用到hazard detection unit和forwarding unit，我想來想去都覺得需要。後來我才看懂題目的意思，原來可以直接改machine code。以後我會好好看題目的每一個字的！

Summary:

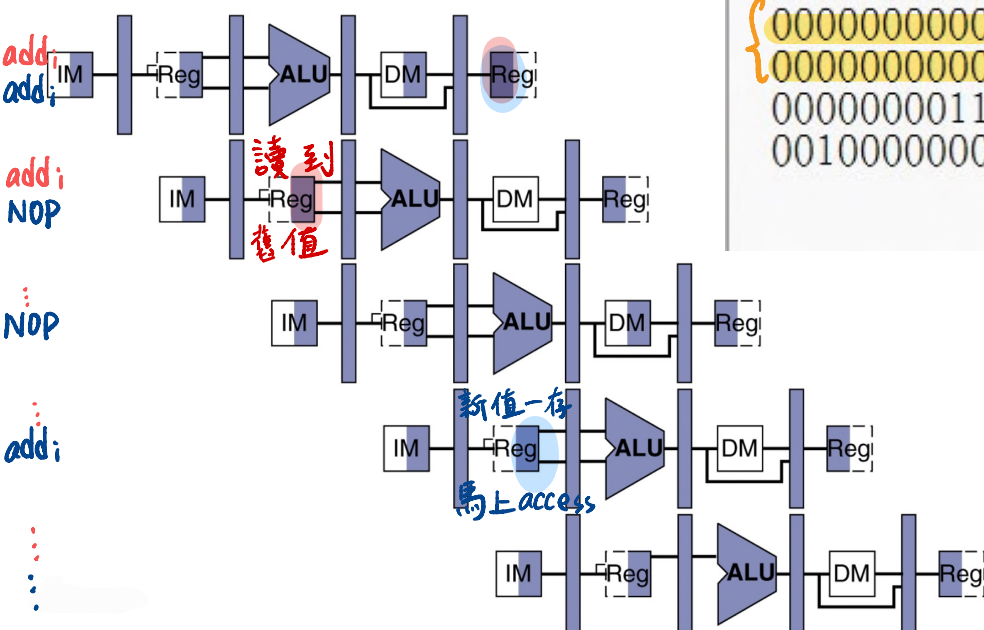
管線化處理器是個聰明的設計，可以提高Instruction-Level Parallelism，大幅提升處理器的效能。

Bonus:

ex:

紅色是原本 data hazard 的情況

藍色是 insert NOP 後的情況



NOP

```
CO_P4_test_2.txt - Notepad
File Edit View

001000000000000010000000000010000
00000000000000000000000000000000
00000000000000000000000000000000
00100000001000100000000000000100
00100000000000110000000000001000
10101100000000010000000000000100
10001100000000100000000000000100
00000000000000000000000000000000
00000000000000000000000000000000
00000000100000110010100000100010
0000000011000010011000000100000
00100000001001110000000000001010
00000000000000000000000000000000
00000000000000000000000000000000
00000000111000110100000000100100
00100000000010010000000001100100
```

my result :

```
Register=====
r0=      0, r1=      16, r2=      20, r3=      8, r4=      16, r5=      8, r6=      24, r7=      26
r8=      8, r9=     100, r10=     0, r11=     0, r12=     0, r13=     0, r14=     0, r15=     0
r16=     0, r17=     0, r18=     0, r19=     0, r20=     0, r21=     0, r22=     0, r23=     0
r24=     0, r25=     0, r26=     0, r27=     0, r28=     0, r29=     0, r30=     0, r31=     0
```

```
Memory=====
m0=      0, m1=      16, m2=      0, m3=      0, m4=      0, m5=      0, m6=      0, m7=      0
m8=      0, m9=      0, m10=     0, m11=     0, m12=     0, m13=     0, m14=     0, m15=     0
r16=     0, m17=     0, m18=     0, m19=     0, m20=     0, m21=     0, m22=     0, m23=     0
m24=     0, m25=     0, m26=     0, m27=     0, m28=     0, m29=     0, m30=     0, m31=     0
```

answer :

```
CO_P4_test_2_result.txt - Notepad

File Edit View

Register=====
r0= 0, r1= 16, r2= 20, r3= 8, r4= 16, r5= 8, r6= 24, r7= 26
r8= 8, r9= 100, r10= 0, r11= 0, r12= 0, r13= 0, r14= 0, r15= 0
r16= 0, r17= 0, r18= 0, r19= 0, r20= 0, r21= 0, r22= 0, r23= 0
r24= 0, r25= 0, r26= 0, r27= 0, r28= 0, r29= 0, r30= 0, r31= 0

Memory=====
m0= 0, m1= 16, m2= 0, m3= 0, m4= 0, m5= 0, m6= 0, m7= 0
m8= 0, m9= 0, m10= 0, m11= 0, m12= 0, m13= 0, m14= 0, m15= 0
r16= 0, m17= 0, m18= 0, m19= 0, m20= 0, m21= 0, m22= 0, m23= 0
m24= 0, m25= 0, m26= 0, m27= 0, m28= 0, m29= 0, m30= 0, m31= 0
```

Wave form :

