國立高雄大學資訊工程學系 計算機結構第一次小考考卷

姓名： 學號：

1. Please explain the three kinds of hazards：
   A. Structural hazards
   B. Data hazards
   C. Control hazards

   - **Structural hazards: HW cannot support this combination of instructions (single person to fold and put clothes away)**
   - **Data hazards: Instruction depends on result of prior instruction still in the pipeline (missing sock)**
   - **Control hazards: Caused by delay between the fetching of instructions and decisions about changes in control flow (branches and jumps).**

2. Please explain the three kinds of data hazards and give some examples：
   A. RAW
   B. WAR
   C. WAW

Read After Write (RAW)
InstrJ tries to read operand before InstrI writes it
I: add r1,r2,r3
J: sub r4,r1,r3

- Caused by a "Dependence" (in compiler nomenclature). This hazard results from an actual need for communication.

Write After Read (WAR)
InstrJ writes operand *before* InstrI reads it
I: sub r4,r1,r3
J: add r1,r2,r3
K: mul r6,r1,r7

- Called an "anti-dependence" by compiler writers.

This results from reuse of the name “r1”.

- WAR hazards can happen if instructions execute out of order or access data late

Write After Write (WAW)

InstrJ writes operand *before* InstrI writes it.

I: sub r1,r4,r3

J: add r1,r2,r3

K: mul r6,r1,r7

- Called an “output dependence” by compiler writers

  This also results from the reuse of name “r1”.

3. Please what kinds of data hazards in the following instruction. (20%)

DIV.D	**F0, F2, F4**
ADD.D	**F6, F0, F8**
S.D.	**F6, 0(R1)**
SUB.D	**F8, F10, F14**
MUL.D	**F6, F10, F8**

RAW:

DIV.D and ADD.D

S.D and ADD.D

SUB.D and MUL.D

WAW:

ADD.D and MUL.D

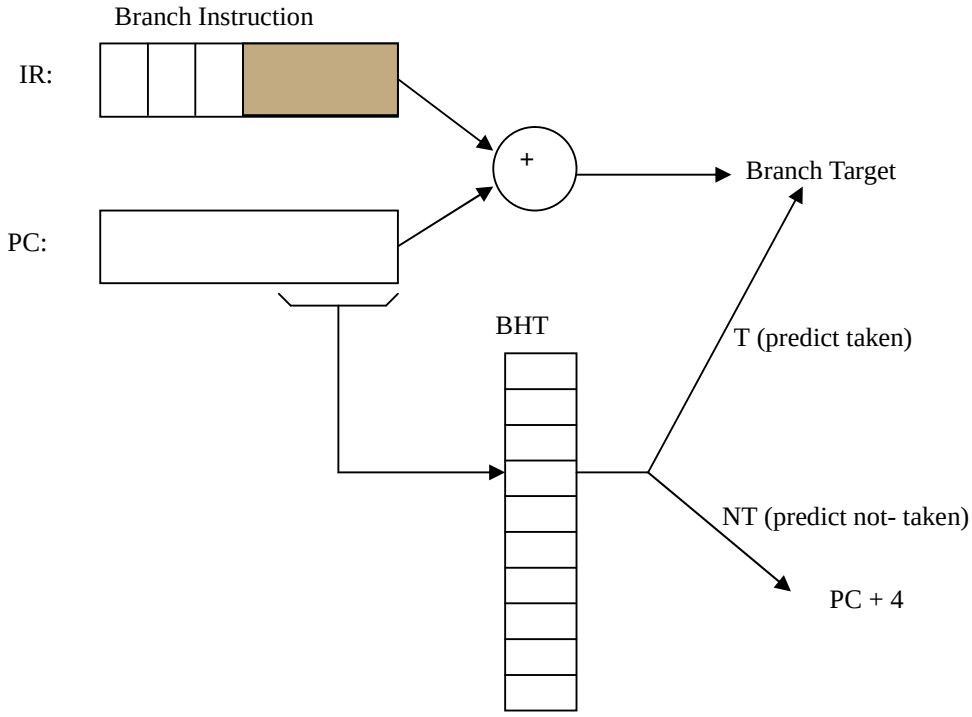
WAR:

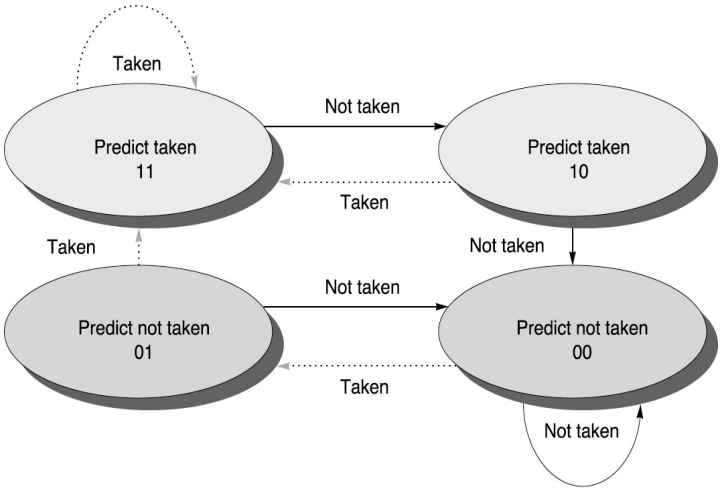
ADD.D and SUB.D

4. Please explain what is register renaming in Tomasulo. (10%)

Registers in instructions replaced by values or pointers to reservation stations

5. Please describe what is the2-bit Basic Branch Prediction Buffer. Explain how to predict that the branch instruction is taken or untaken. What stage is the branch buffer accessed during?





IF stage