Lecture 04 (Identifying and Solving Issues with OOO)

1 Nature of Dependence

1. Program Order Dependence
   - instructions dependent because of program order (kinda irrelevant)
2. Read after Write (RAW)
3. Write after Write (WAW)
4. Write after Read (WAR)
5. Control dependency

OOO processors respect only data and control dependency

1.1 Claims

1. Some dependencies are anti-dependencies (WAW, WAR)
2. They are present only because we have finite registers

1.2 Solution

$$r_x \rightarrow p_{xa}$$
$$a = avatar$$

hardware is very simple, we only have logic gates, registers and wires :)

2 Issues with Write-Back

1. These updates should appear to happen in-order
2. Interrupt or exception handler will see incorrect state otherwise - **precise exceptions**
3. Treated the same as branch failures

3 Branch Predictor

3.1 Predicting Whether Branch

1. Remember the branch status of PC

2. Store it in a Instruction Status Table (IST)
3. Indexing is done using $PC \mod n$ (n is typically 10)
4. Can have destructive interference (branch-brach or non branch-branch collision)
5. To solve this, store $32 - n$ bits or its subset (helps solve non branch-branch collision)

3.2 Predicting Whether Taken

1. Approach 1 - predict the same as last outcome
2. Approach 2 - use 2 bits to predict (saturating counter)

3.2.0.1 DisCo Stories

(context: history decides what level of DisCo to be given)

DisCo levels: - Department level - Dean level - HIGH Alert

History:

1. Sir was warden and his hostel's mess secy provided food and powder - level 2; misdeed repeated - level 3; he has enjoyed sitting in all 3 levels of DisCo
2. Sir was TnP department head, some kids did no work in intern but stole accessories, given level 2 DisCo

DisCo committees are very busy throughout the year - 20-30 DisCo's per year