Discussion Session 5
CSE 141

Material in the lecture:
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Problem 7, Swap

- swap $3, $4, $3
- swap rd, rs, rt
- rd = rs or rt = rs
- rs = rd or rs = rt
5. Single cycle (10ns CT)

<table>
<thead>
<tr>
<th>(ns)</th>
<th>IF</th>
<th>ID</th>
<th>EX</th>
<th>MEM</th>
<th>WB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>2</td>
<td>2</td>
<td>1.5</td>
<td>2.5</td>
<td>2</td>
</tr>
</tbody>
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Part A) How long will it take to run a program with 100 dynamic inst.

Part B) If you make each column a cycle of a multi-cycle design, what would be the new cycle length?
### Part C)
How long will 100 load instructions take to run on the multicycle machine?

### Part D)
Describe a 100 instruction program that will execute just barely faster on multi-cycle than single cycle.

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<th>ID</th>
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**Single/Multi vs. Pipelined**

- **Single cycle**
  - $CPI =$
  - $CT =$

- **Multi-Cycle**
  - $CPI =$
  - $CT =$

- **Pipelined**
  - $CPI =$
  - $CT =$

Add r1, r2, r3
lw r2, 0(r2) Add r1, r2, r3lw r2, 0(r2) Add r1, r2, r3
sub r4, r2, r3 lw r2, 0(r2) Add r1, r2, r3
 sub r4, r2, r3 lw r2, 0(r2) Add r1, r2, r3
sw r5, 0(r1) lw r2, 0(r2) Add r1, r2, r3
sw r5, 0(r1) lw r2, 0(r2) Add r1, r2, r3
bne r1, r2, label
sub r4, r3, r3
lw r2, 0(r2)
sw r5, 0(r1)
bne r1, r2, lable

sw r5, 0(r1)
bne r1, r2, lable