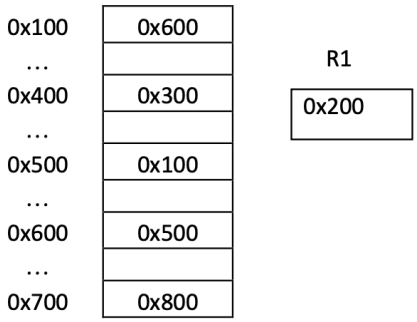
1.)

22. Suppose we have the instruction Load 500. Given memory and register R1 contain the values below:



and assuming R1 is implied in the indexed addressing mode, determine the actual value loaded into the accumulator and fill in the table below:

Mode	Value Loaded into AC
Immediate	
Direct	
Indirect	
Indexed	

Ans

Immediate: 0x500
Direct: 0x100
Indirect: 0x600
Indexed: 0x800

2.) A nonpipelined system takes 200ns to process a task. The same task can be processed in a 5-segment pipeline with a clock cycle of 40ns. Determine the speedup ratio of the pipeline for 200 tasks. What is the maximum speedup that could be achieved with the pipeline unit over the nonpipelined unit?

Ans

$S = nt_n / (k + n - 1)t_p$
$= (200 * 200) / (5 + 200 - 1) * 40$
$= 1000 / 204$
$= 4.901$

Maximum Speedup (k) = 5

3.) Assume the pipelining of 4 stages, explain the potential pipeline hazards (if any) in each of the code segments in a) and b).

Suppose we have a four-stage pipeline, where:

- S1 = fetch instruction
- S2 = decode and calculate effective address
- S3 = fetch operand
- S4 = execute instruction and store results

a) X=R2+Y
R4= R2+X

Ans

The first instruction, X = R2 + Y, can be executed in stages S1, S2, S3 and S4, The second instruction, R4 = R2 + X, can be fetched in stage S1 while the first instruction is being executed in stage S2, S3, and S4. Therefore, there are no potential pipeline hazards in the instructions.

b) R1=R2+X
X =R3+Y
Z =R1+X

Ans

The first instruction, R1 = R2 + X, requires the value of X, which is calculated in the second instruction, X = R3 + Y. However, the second instruction has not yet completed when the first instruction is being executed, so there is a data dependency between the two instructions. The third instruction, Z = R1 + X, requires the value of R1, which is calculated in the first instruction. However, the first instruction is not complete when the third instruction is being executed, so there is a data dependency between the two instructions. Therefore, to avoid these pipeline hazards, two pipeline stalls are required, one after the first instruction and one after the second instruction.

R1 = R2 + x
STALL
X = R3 + Y
STALL
Z = R1 + X

Using two stalls will ensure the instructions are executed in the correct order however, it will also reduce the performance and efficiency of the pipeline.

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