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605.411 Problem Set 6

1. `lwc1 $f2, x`
`lwc1 $f4, y`
`c.lt.s $f2, $f4 //Set condition if f2 < f4`
`movt.s $f3, $f4 //If condition is set mov f4 into f3`
`movf.s $f3, $f2 //If condition is not set mov f2 into f3`
`swc1 $f3, z //f3 now contains either x or y, mov that into z`

2. This suffers from resource conflicts, since both instructions use the same register operands, and use the ALU.

3. (a) There are $4! = 24$ possible orders.
 (b) It would require 2 bits to identify which of the 4 ways is the least recently used.
 (c) This could be done with five bits
 (d) A Pseudo-LRU could be done with only three bits.

4. (a) Fully Associative
`|25 Bit Tag | 7 Bit Offset |`
 The tag is used to see if any line in cache has already stored that line in memory. The offset identifies the byte we are interested in.

- Direct Mapped
`|20 Bit Tag| 5 Bit Line | 7 Bit Offset |`
 Here we have a match if the line number identified by the middle 5 bits matches the tags on one of the lines in the cache. If it does we can use the 7 bit offset to get the byte we are interested in.

- Set Associative
`| 22 Bit Tag | 3 Bit Set | 7 Bit Offset |`
 We try to match on of the 4 lines in the set identified by the middle 3 bits to see if any of them match the 22 bit tag. If they do we use the 7 bit offset to obtain the byte of interest.

- (b) Fully Associative
 2 Matches (293824 and 293764) (3072 and 3184)

Direct Mapped

- 1 Match (3072 and 2184)
 Set Associative
 2 Matches (293824 and 293764) (3072 and 3184)
- (c) Fully Associative - No line replacements necessary
 Direct Mapped - 2 Line replacements 2948 replaces 293824, then
 293764 replaces 2948
 Set Associative - 1 Line replacement, 4088 replaces 2948.
- (d) Fully Associative 25 bit Tag for 32 lines = 800 bits
 1 bit modify per line = 32 bits
 832 Bits of overhead
- Direct Mapping 20 bit tag for 32 lines = 640 bits
 1 bit modify per line = 32 bits
 672 bits
- Set Associative
 3 bit psuedo lru for 8 sets = 24 bits
 22 bit tag for 32 lines = 704
 1 bit modify per line = 32 bits
 760 bits