Test 1 Study Guide

October 3, 2018

Direct Mapping Consider a machine with a byte addressable main memory of 2 24 bytes and a block size of 32 bytes. Assume that a direct mapped cache consisting of 64 lines is used with this machine. How is a 24-bit memory address divided into tag, line/set, and word/offset? How many total bytes of memory can be stored in the cache? Suppose the byte with address (1101 1011 0100 1110 1010 0111) 2 is stored in the cache. A number of other bytes are stored with this byte on the same line of cache. What is the highest address number in this group?

Solution Block size $= 32$ bytes
Size of Block/Word $= \log_2 32 = 5$ bytes
64 lines $\rightarrow \log_2 64 = 6 bytes$
# of lines $= \frac{Cachesize}{BlockSize} \rightarrow 64 = \frac{CacheSize}{32bytes}$
$\rightarrow 64 * 32bytes = CacheSize = 2KBytes$
Memory block $= 24 = tag + 6bytesline/set + 5word/offset$
$\rightarrow 24 - (6 + 5) = 13bytes = tag$
Dividing 110110110100111010100111

13Byte Tag	6Bytes Word	5 Bytes word
1101101101001	110101	00111

The highest addressable is $2^{blocksize} = 2^{32}$

Booths Method AKA multiplying Two's Compliment Binary Numbers If at first you don't get the same numbers switch the two numbers
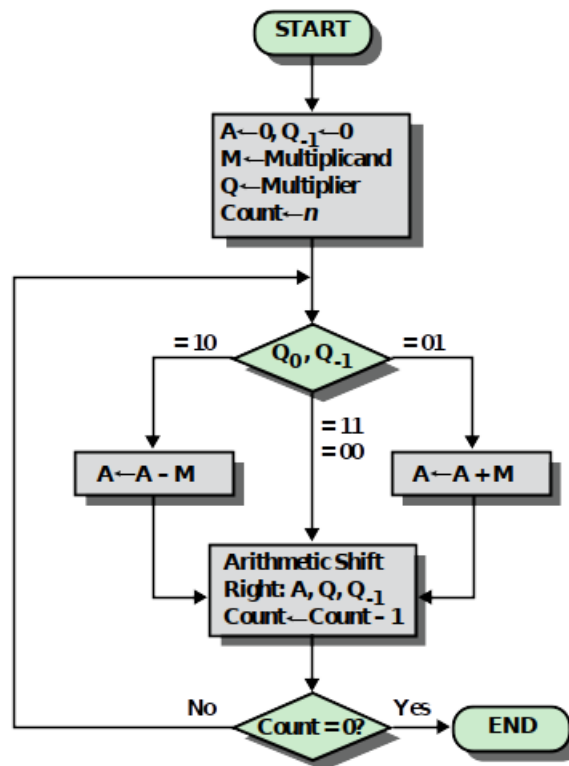
START

$A \leftarrow 0, Q_{-1} \leftarrow 0$
$M \leftarrow$ Multiplicand
$Q \leftarrow$ Multiplier
$Count \leftarrow n$

$= 10$ Q_0, Q_{-1} $= 01$

$= 11$
$= 00$

$A \leftarrow A - M$ $A \leftarrow A + M$

Arithmetic Shift
Right: A, Q, Q_{-1}
$Count \leftarrow Count - 1$

No $Count = 0?$ Yes   END

Figure 10.12 Booth's Algorithm for Twos Complement Multiplication

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Instructions Per Seconds Assume the following instruction mix for a given benchmark program: 1535million instructions and that load instructions require two cycles, branches require 4 cycles, integer addition and store instructions require 8 cycles and integer multiplies require 16 cycles, compute the overall cycles-per-instruction or CPI. Determine the Millions of Instructions per Second (MIPS) rate for a 3200-MHz processor. What is the execution time for this program?

Solution $CPI = \sum_{i=1}^{n} \frac{CPI_i x I_i}{I_c}$

Instruction Percentage * Inscrution # Cycles

$= .15 * 8 + .25 * 2 + .35 * 4 + .05 * 8 + .2 * 16 = 6.7$ cycles per second

$MIPS = \frac{Frequency}{CPI * 10^6} \rightarrow \frac{3200 * 10^6}{6.7 * 10^6} = \frac{3200}{6.7}$

$= 4.77.16$ Million Instructions Per Second

Total Execution Time $= I_c * CPI * \frac{1}{F}$

$10^6 * 6.7 * \frac{1}{3200 * 10^6}$

$= 2.1ms$

Sum of Products Stuff

A	B	C	F	SOP
0	0	0	0	0
0	0	1	0	0
0	1	0	1	$\overline{A}B\overline{C}$
0	1	1	1	$\overline{A}BC$
1	0	0	1	$A\overline{B} * \overline{C}$
1	0	1	1	$A\overline{B}C$
1	1	0	0	0
1	1	1	0	0

SOP $= \overline{A}B\overline{C} + \overline{A}BC + A\overline{B} * \overline{C} + A\overline{B}C$

POS $= (A + B + C) + (A + B + \overline{C}) + (A + \overline{B} + C) + (A + \overline{B} + \overline{C}) + (\overline{A} + B + C) + (\overline{A} + B + \overline{C}) + (\overline{A} + \overline{B} + C) + (\overline{A} + \overline{B} + \overline{C})$