INTRODUCTION TO MULTIMEDIA SYSTEMS

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EXERCISE #2

COMPUTER ARCHITECTURE

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Exercises in digital logic

Problem 1:

Make truth tables for AND and OR.

Both members of this group knows their boolean logics and the below tables were therefore constructed without any further research.

A	B	AND
0	0	0
0	1	0
1	0	0
1	1	1

Fig.1 AND table

A	B	OR
0	0	0
0	1	1
1	0	1
1	1	1

Fig.2 OR table

Problem 2:

Construct a circuit which computes AND by only using NAND gates.

Using three NAND gates a AND gate was constructed. This was accomplished by using table notations as in "problem 1". See Fig. 3 for Circuit Diagram.

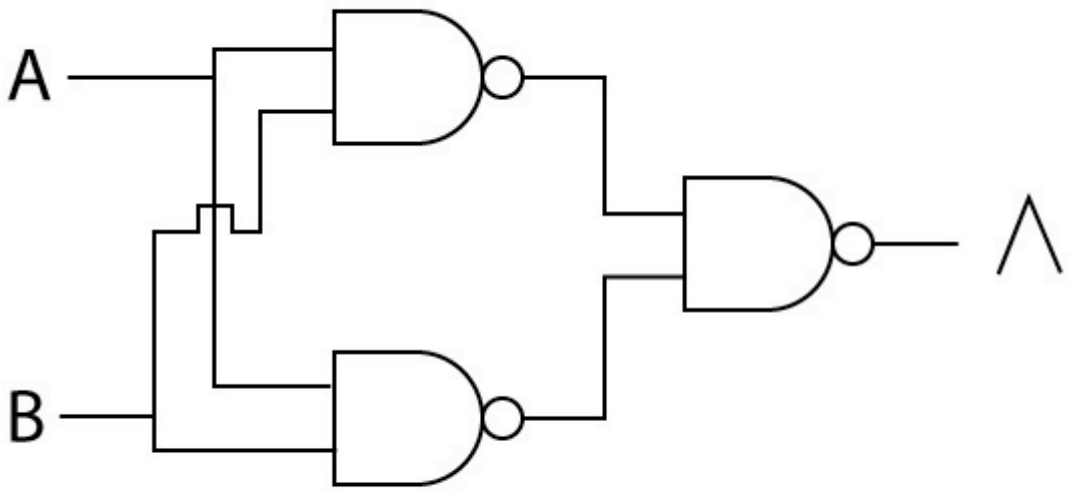

Fig.3 A AND circuit using only NAND gates

Problem 3:

Construct a circuit which computes the XOR of two input signals A and B. You may use any number and type of the gates you have seen so far, i.e. NOT, NAND, NOR, AND, OR.

This group decided to solve this problem using only the three gate primitives NOT, NAND and NOR as described in the exercise handout. This choice was taken based on the fact that it would simply give us a better picture of what goes on inside a CPU. The circuit diagram of the obtained XOR gate can be seen in fig.4.

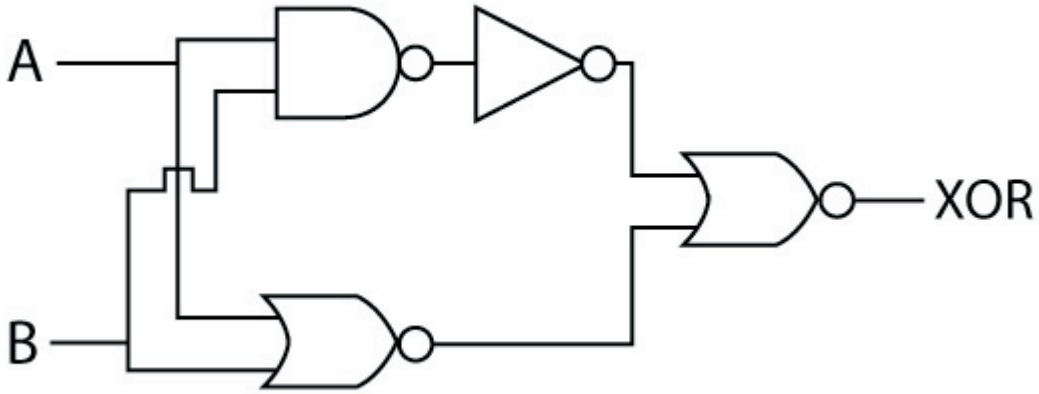

Fig.4 A XOR constructed using gate primitives only.

Systems architecture

Problem 1:

Instructions for the CPU have to be fetched from main memory. Assuming the above is all there is to memory and programs, can you say anything about such a system's performance?

The speed of the CPU is 500MHz and the RAM is 100MHz. This means that they don't run in a 1/1 ratio. Instead the CPU is about 5 times faster, hence a 1/5 speed relationship exists. In a perfect computer system the CPU and RAM would have the same speeds hence removing the need for cache RAM.
But why is the primary RAM even necessary? We know that the L1 cache is in fact running in same clock frequency as the CPU. SO why not simply make the cache RAM larger? Here the restriction is economics as well as technology. Larger caches cost quite a lot and it wouldn't be possible to make a cache the same size as the Primary memory today. Hence the RAM is the limiting factor in this computer system.
As a final comment it should be noted that today's RAM run at speeds far faster than the one in this example. Top of the line personal computer RAMs today run at speed up to 1066Mhz (RDRAM), which makes a 1/1 ration possible. The DDR SDRAM has reaches speeds of 666MHz this year and will reach 700+ before new years.