

EECS 370 – Exam 1 – 13 Feb 2003

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1. Which of the following is not allocated to an activation record?
[5pts]

- A. Parameters to a function
- B. Registers saved by caller
- C. Registers saved by callee
- D. Return address
- E. Static local Variables

2. In which type of datapath does the instruction with the FASTEST
execution time determine the cycle time? [5 pts]

- A. Never
- B. All datapaths
- C. In single cycle datapath only
- D. In multi-cycle datapath only
- E. None of the above

3. Which addressing mode is most useful in referencing local variables?
[5 pts]

- A. Direct
- B. Base + Displacement
- C. Base Register
- D. PC-Relative
- E. Immediate

4. In the LC-2K3, we want to add a new instruction, without modifying the multicycle datapath (i.e. no more paths, registers or combinational logic). The new instruction is saveAll. It takes no arguments, but saves all the registers onto the stack, except R7, which is a pointer to the stack, and updates the stack pointer. What is the minimum number of cycles this will take on the unmodified datapath? [5 pts]

- A. 8
- B. 9
- C. 13
- D. 14
- E. This change cannot be made without modifying the datapath.

5. How many different numbers between 0 and 1.0 can be represented in the 32-bit IEEE 754 floating-point format? [5 pts]

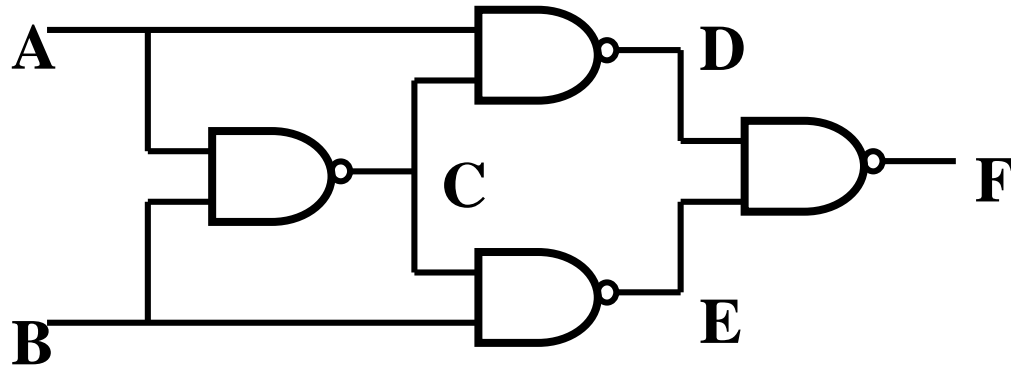
- A. About 16 million
- B. About 64 million
- C. About 256 million
- D. About 512 million
- E. About 1 billion

6. Write MIPS assembly code for the following C code fragment: [8 pts]

```
while (i > 0) {  
    sum = sum + list[i];  
    i--;  
}
```

Assume all variables are 32 bit integers.
Assume "i" is in \$1, "sum" is in \$2
and the array "list" starts at address 3700.

9. The following circuit with inputs A and B and output F has been constructed using four two-input NAND gates.



Construct a truth table that shows the values of C, D, E, and F for all inputs (A, B): [5 pts]

A	B	C	D	E	F
0	0				
0	1				
1	0				
1	1				

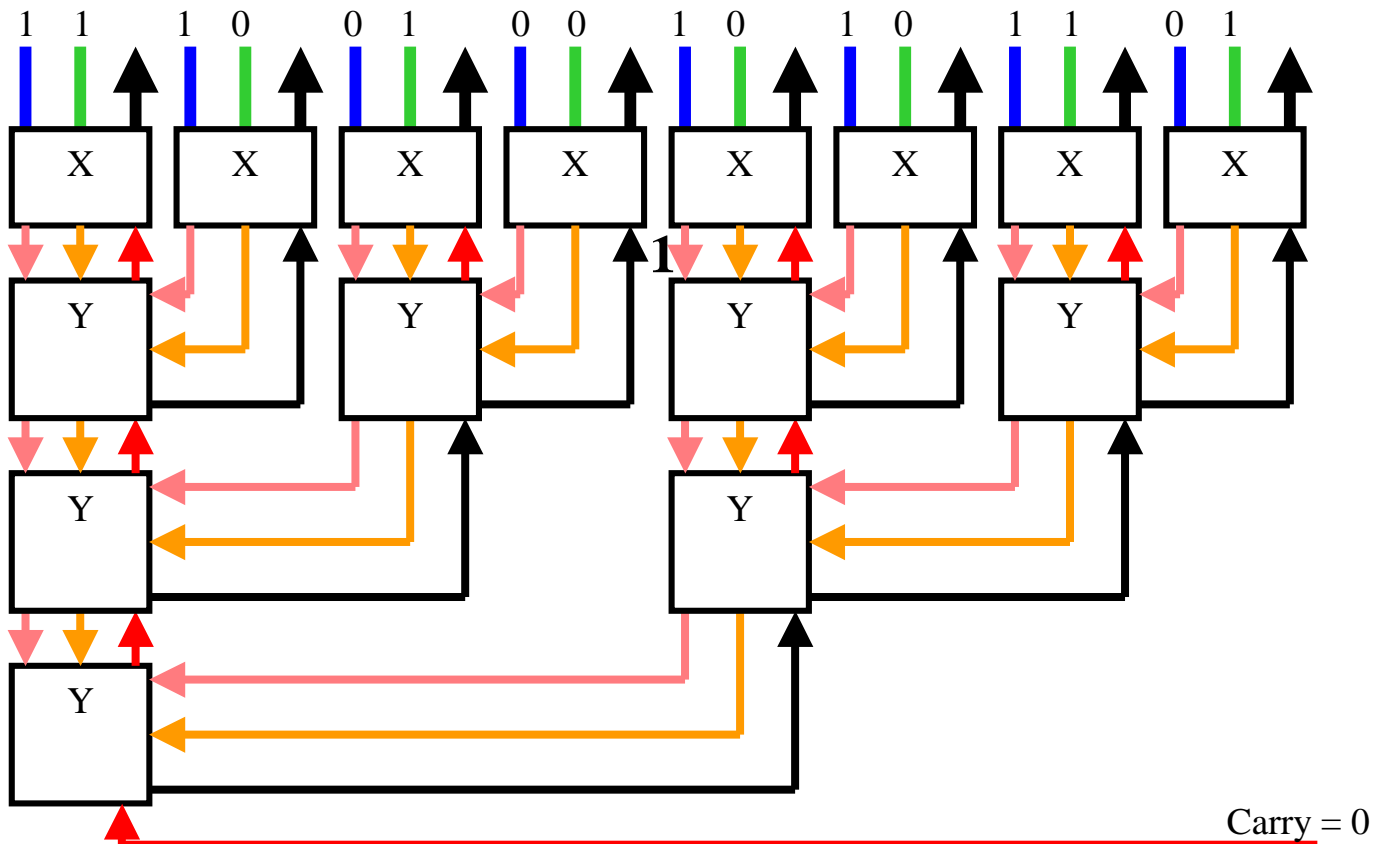
What is the name of the function $F(A,B)$ that this circuit implements?
[5 pts]

10. What does this sequence of LC2K3 instructions do? (Hint, what single MIPS instruction could be used to replace this sequence). [5 pts]

```
add 1 1 2
add 2 2 2
add 1 2 2
add 2 2 2
```

11. You are given an LC-2K3 simulator that appears to have a few bugs. It is rumored that it does not correctly sign-extend, but only on one of its instructions. Write an LC-2K3 assembly language test case that would expose defective sign-extension. For full credit, you must keep it as short as possible. [10 pts]

12. Show how a carry-lookahead adder would add the following two numbers $11001110 + 10100011$. Show your work by putting the correct value on each of the lines in the circuit below. [10 pts]



13. You are senior engineer for the LC-2 computer corporation. The decision has been made to provide upgraded instruction set architecture for the LC-2. It is desired to maintain as much compatibility as possible with previous versions. In particular, old LC-2 machine language programs should run correctly on the new ISA design without any modifications. You may assume that the old machine language programs correctly set all unused fields in their instructions to all 0; thus you have the opportunity to provide new features in a compatible way by specifying new functionality when these previously unused fields have nonzero values.

Several possible changes are up for consideration. Your hardware designers tell you that all of them would be straightforward to implement as long as you can specify a suitable change to the instruction set architecture; you need only concern yourself with defining suitable bit encodings for the new machine.

For each of the following changes, if it is possible, briefly explain how you might modify the LC-2 instruction set architecture to support it in a way that maintains compatibility with old machine code programs. If the change is not possible, explain why.

a) double the main memory size from 65536 to 131072 words [5 pts]

b) provide more arithmetic and logical operations; instead of only add and nand, all of the following will be provided at the instruction set level: [5 pts]

arithmetic: add, subtract, multiply, divide

logical: or, nor, and, nand, exclusive-or, exclusive-nor

c) double the number of registers from 8 to 16 [5 pts]

