CPS 104 Midterm Exam
Prof. Gershon Kedem
Spring 1999

Closed Book, 1 hour.
Answer all questions:
Please make sure that your exam has all 6 pages
Put your name on each page.

Your Name: _____________________________

Student ID: _____________________________

Problem 1: (20 pt) _______
Problem 2: (20 pt) _______
Problem 3: (20 pt) _______
Problem 4: (20 pt) _______
Problem 5: (20 pt) _______
Total: _______

Your Name: _____________________________

Student ID: _____________________________

Problem 1: (20 pt) _______
Problem 2: (20 pt) _______
Problem 3: (20 pt) _______
Problem 4: (20 pt) _______
Problem 5: (20 pt) _______
Total: _______
1. a. (6 pt) Show the truth table for a three-input one-output GTE5 function. The function value is 1 if the 3-digit number \(<\text{In2, In1, In0}>_2\) is greater or equal to \(5_{10}\), otherwise the value is 0.

<table>
<thead>
<tr>
<th>In2</th>
<th>In1</th>
<th>In0</th>
<th>GTE5</th>
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b. (8 pt) Write down Boolean expression for the GTE5 function. Simplify the expression as much as you can.

c. (6 pt) Draw a circuit diagram for the Boolean function GTE5. Use only AND, OR and NOT (Inverter) gates.
2. a. (15 pt) Construct a truth table for the following circuit:

b. (5 pt) What does the circuit do?
3. The following are two 12-bit two's complement numbers:

\[ A = 011101011010 \]
\[ B = 111000110101 \]

a. (7 pt) Compute \( A + B \) and \( B - A \) in 12-bit two’s complement.

\[ A + B = \quad \]  
\[ B - A = \quad \]

b. (7 pt) Convert \( A \) and \( B \) to 16-bit two's complement numbers and compute \( A + B \) and \( B - A \) in 16-bit two’s complement.

\[ A + B = \quad \]  
\[ B - A = \quad \]

c. (6 pt) Write the results in part b. as HEX numbers

\[ A + B = 0x\quad \]  
\[ B - A = 0x\quad \]
4. (20 pt) Consider the following C++ code fragments for a 32-bit machine:

```cpp
class List_node {
public:
    int Key;
    int Value;
    List_node *previous;
    List_node *next;
};

List_node* p = new List_node;

The value of \texttt{p} is: \texttt{0x0042a282}. What is the address of \texttt{p->previous}? That is, what is the value of \texttt{&(p->previous)}?

\texttt{&(p->previous) = ________________}
```
5. (20 pt) Consider the following C++ code fragments:

```cpp
int sum, i, Array_A[100];
...
sum = 0;
for( i=0; i<100; i++)
    sum = sum + Array_A[i];
cout << sum;
```

Write a MIPS assembly code fragment that accomplishes the same task. Assume that the space for the integer array `Array_A` was already allocated and it was labeled `Array_A`. Comment your code!