

CS3000

Computer
Organization/Architecture Review

Two Tests

- CS2550 or ECE2700 (Before Fall 2008)
- CS2810 (Fall 2008)

Differences

- <Fall 2008 (40 quest's)
 - Number systems & Conversions 12.5%
 - Boolean Algebra 12.5%
 - K-Maps 10%
 - Comb. Logic 12.5%
 - MSI Devices 12.5%
 - Flip Flops 10%
 - Seq. Cir. 10%
 - State Diagrams & Tables 12.5%
 - General Know. 7.5%
- >=Fall 2008 (34 quest's)
 - Boolean Algebra
 - Comb. Logic
 - Seq. Logic
 - General Know.
 - Quant's& Notation
 - Number Systems
 - Quant. – Base
 - Codes
 - Conversion
 - Float. Pt.
 - CPU Basics
 - ISA
 - Pipelining
 - Memory
 - Cache
 - Virt. Mem

Text/Class <Fall 08

- The Computer Organization review covers material in
 - CS2550 or
 - ECE2530 (it is now numbered ECE2700)
- The basic text for both classes has been
 - Logic Design – by Roth

Text/Class \geq Fall 08

- CS2810
- Computer Organization and Architecture – Null
- Could also use Patterson and Hennessey book from old CS2810

Thoughts about two tests

- A person who took CS2550 and then CS2810 would do ok with new test
- A person in the ECE2700 class should take the old test.

Old Test (<Fall 2008)

Number Systems and Conversions

- *What does BCD stand for?*
 - *Binary coded decimal*
 - *Before carry drop*
 - *Before combination done*
 - *Before coding digit*
 - *Binary converted to decimal*

Number Systems and Conversions

- *What does BCD stand for?*
 - *Binary coded decimal* 86%
 - *Before carry drop* 0%
 - *Before combination done* 0%
 - *Before coding digit* 0%
 - *Binary converted to decimal* 10%

 - *NOT ANSWERED* 3%

Number Systems and Conversions

- Number systems & Complement number systems
 - What are they?
 - Why have them?
 - Carry and overflow
 - Base R, Base R-1 convert to
 - What is the ?'s complement of N?
 - Sign magnitude representation
 - Excess representation

What are they

- Different bases 10, 2, 8 (octal), 16 (hexadecimal), BCD, and anything else
- Any number in any base can be converted to an equivalent number in another base?
 - Not exactly
 - Show how to convert
- What are complement number systems?
 - Radix and radix -1

Efficiency and Accuracy of Representation

- 8 & 16 are more compact schemes for numbers in binary
- What happens when convert decimal to binary?
- Why have sign magnitude representation?
- What does unsigned mean and why have it.
- Is there a problem(s) in comparing numbers in complement form?

Why have them?

- Computers are discrete systems and hence they use discrete number systems
- Basic unit (hardware) of a computer systems is binary, hence a binary system
- Complement system allows for subtraction by addition
 - Means an adder can add and subtract

Carry & Overflow

- Max & min
 - Especially in 2's complement system
- When does overflow occur and what does it mean?
 - How can we detect overflow?
- In a complement system, what are the ranges of representable values?
- What systems have multiple 0's?

Number Systems and Conversions

- Conversion
 - Convert base R to base S
 - How many digits are required to represent N in base R?
 - 10.5 base 10 is represented as ? Base 2?
 - Especially, binary, BCD, octal, hexadecimal, and decimal
- What is the largest/smallest decimal equivalent for a n-bit 2's complement number?

Boolean Algebra

- 5 questions 12.5%
- T/F – In Boolean algebra, $x+1=1$

Boolean Algebra

- T/F – In Boolean algebra, $x+1=1$
- 58 % correct
- 34% incorrect
- 7% not answered

Boolean Algebra

- DeMorgan's law
- Law of Duality
- $F(A,B,C)$ will have how many inputs and how many outputs?
- $F(A,B,C)$ will have how many possible different output values?
- Truth Table
 - Size (number of rows and columns)

DeMorgan's Law

- Go from $F(\dots)$ to $F'(\dots)$
 - Need to represent as AND's, OR's, and Not's
 - AND \Rightarrow OR
 - OR \Rightarrow AND
 - Complement variables and constants

Duality

- Same as DeMorgan EXCEPT
 - Complement constants, but don't complement variables

Boolean Algebra

- Boolean functions
 - Simplification
 - And, Or, Not, Nand, Nor, exclusive-or
 - SOP, POS, canonical, minimum POS, minimum SOP, minterm, maxterm
 - Given a Boolean expression ---- convert it to its minimal SOP/POS
 - How many Boolean functions of N variables are there?

Karnaugh Maps

- 4 questions 10%
- The Boolean expression $A'B'C'D + A'B'D + A'CD$ when represented as a sum of minterms is:
 - a. $m_1 + m_3 + m_7$
 - b. $m_0 + m_1 + m_2 + m_3$
 - c. $m_1 + m_3 + m_2 + m_7$
 - d. $m_2 + m_3 + m_7 + m_8$
 - e. None of the above

Karnaugh Maps

- 4 questions 10%
- The Boolean expression $A'B'C'D + A'B'D + A'CD$ when represented as a sum of minterms is:

| | |
|----------------------|---------------|
| a. $m_1+m_3+m_7$ | 40% (correct) |
| b. $m_0+m_1+m_2+m_3$ | 10% |
| c. $m_1+m_3+m_2+m_7$ | 0% |
| d. $m_2+m_3+m_7+m_8$ | 0% |
| e. None of the above | 50% |

Karnaugh Maps

- 3, 4, or 5 variable maps (size and organization)
- Why K-maps
- What basic rule does a K-map rely on?
- How many adjacencies are needed for a simplification?
- What are the minterms and maxterms in a K-map?

Combinational Logic

- 5 questions 12.5%
- How many input variables are needed to design a 1-bit full subtractor?
 - 1
 - 2
 - 3
 - 4
 - 5

Combinational Logic

- 5 questions 12.5%
- How many input variables are needed to design a 1-bit full subtractor?
 - 1 3%
 - 2 46%
 - 3 37% (correct)
 - 4 8%
 - 5 3%
 - Not Answered 3%

Combinational Logic

- Logical completeness and how does that affect the kinds of gates required for a CLC
- What distinguishes CLC's from sequential logic circuits?
- How does one implement a subtractor in today's digital computers?

Combinational Logic

- What is a static hazard
 - E.g. a 1-hazard means if the input changes while the output should stay at a 1, it may go momentarily to a 0
- Can a two-level AND-OR circuit be implemented using only NAND's?

MSI Devices

- 5 questions 12.5%
- Any logic function can be implemented by a decoder – T/F

MSI Devices

- 5 questions 12.5%
- Any logic function can be implemented by a decoder – T/F

53% True (correct)

43% False

4% Not answered

MSI Devices

- Decoders –
 - Accepts n inputs and asserts one of 2^n outputs
- Multiplexer – a switch
 - 2^n data input and n control inputs, with one output, i.e. selects one of 2^n inputs
- ROM – implement a CLC
- RAM
- PLA

Flip-Flops

- 4 questions 10%
- Flip-Flops are used for the design of combinational logic circuits? T/F

56% True

36% False (correct)

8% Not Answered

Flip-Flops

- Flip-Flop types
 - JK, RS or SR, D, T
 - These are the standards
 - You need to know how each of these operate
- What's the relation between the number of states and the number of required flip-flops?
- Next state equation $Q(t+1) = JQ' + KQ$

Sequential Circuits

- 4 questions 10%
- Sequential circuits are of two types. They are _____ and _____ (FIB – fill-in-the-blank(s))
 - Clocked or synchronous (distance = 2)
 - Unclocked or asynchronous (distance=2)

Sequential Circuits

- 4 questions 10%
- Sequential circuits are of two types. They are _____ and _____ (FIB – fill-in-the-blank(s))

40% correct

51% incorrect

9% not answered

Sequential Circuits

- Tables, etc. associated with a sequential machine
 - Characteristic table
 - Characteristic equation
 - State diagram
 - Moore (machine)
 - Mealy (machine)
 - Excitation table

Sequential Circuits

- Characteristic table
 - Specifies how the state changes as a function of the current state and the input
- Characteristic equation
 - Derived from the characteristic table is a Boolean expression for the table
- State diagram
 - A graph (picture) with nodes and edges

Sequential Circuits

- State diagram
 - Moore (machine)
 - A machine/state diagram in which the output is a function only of the current state
 - Mealy (machine)
 - A machine/state diagram in which the output is a function of the current state and the input
 - How will the diagrams of these two machines differ?

Sequential Circuits

- Excitation table
 - Specifies what input for a given state is needed to get a desired next state and output
- Excitation vs Characteristic Table
 - In the ET, the inputs are the current state and the desired next state, and the output is the required input
 - In the CT, the inputs are the current state and input and the outputs are the next state and the output

Sequential Circuits

- FSM=Sequential Machine = Sequential Machine
- MSI => counter
- MSI=> sequence detector

State Diagrams and Tables

- 5 questions 12.5%
- The main difference between Equivalence Partition (EP) and Implication Chart (IC) approaches in sequential machine design is:
 - a. An IC is more powerful
 - b. An EP is simpler to build
 - c. An EP can be used to handle a state table with don't cares
 - d. The EP approach require compatible relations between inputs
 - e. None of the above

State Diagrams and Tables

- The main difference between Equivalence Partition (EP) and Implication Chart (IC) approaches in sequential machine design is:
 - a. An IC is more powerful 67% (correct)
 - b. An EP is simpler to build 0%
 - c. An EP can be used to handle a state table with don't cares 7%
 - d. The EP approach require compatible relations between inputs 13%
 - e. None of the above 0%
- Not answered 13%

State Diagrams and Tables

- Implication table/chart and Equivalence Partition are used to find equivalent sequential machine states, and thus reduce the number of required states

State Reduction

(Characteristic Table below)

| Current State | Next State | | Present Output |
|---------------|------------|---|----------------|
| | x=0 | 1 | |
| a | d | c | 0 |
| b | f | h | 0 |
| c | e | d | 1 |
| d | a | e | 0 |
| e | c | a | 1 |
| f | f | b | 1 |
| g | b | h | 0 |
| h | c | g | 1 |

Implication Chart

b d-f/c-h means $a=b$ iff $d=f$ and $c=h$

c X means a and c have different outputs
so can't be eq

d

e etc.

f

g

h

a b c d e f g h

Equivalence Partition

(a,b,d,g) (c,e,f,h)

General Knowledge

- 3 questions 7.5%
- A digital circuit can be classified
 - a. Combinational or sequential
 - b. CPU or memory
 - c. Adder or subtractor
 - d. Register or memory
 - e. none of the above

General Knowledge

- A digital circuit can be classified
 - a. Combinational or sequential 64% (correct)
 - b. CPU or memory 4%
 - c. Adder or subtractor 12%
 - d. Register or memory 0%
 - e. none of the above 8%

- Not answered 12%

General Knowledge

- SSI, VLSI, CPU, ALU, lots of acronyms
- How does a binary integer multiplier(divider) work?
- What's a don't care and how are they used?
- Incompletely specified machine
- What is a tri-state device and why use one?

New Test \geq Fall 2008

Boolean Algebra

- There are how many distinct functions of 4 variables?

Combinational Logic Circuits

- Adders, decoders, half-adders, multiplexers
- A half-adder will have ? inputs

Sequential Logic

- Kinds of sequential logic circuits
- If memory is byte addressable, how many bits are required to address a 4Mx64 memory?

General

- Abstraction, Moore's Law, IC yield,
- Compressing a digital signal in a channel has an effect similar to reducing the channel's capacity.

Quantities/Notation

- Match the quantities on the left with those on the right
- $1\text{GHz} = ???$

Number Systems

- Base 10, base 2, base 8, base 16

Quantities - Base

- Under what circumstances can overflow occur in a 2's complement system?

Codes

- The excess-3 code word for octal digit 5 is

Conversion

- Convert A to B

Floating Point

- A 15 bit floating point value,..... The hexadecimal for Is ?

CPU Basics

- CISC vs RISC Processors
- Registers
- The major components of a computer system are:

ISA

- Stack, two-address, ...
- Most computer architectures today are accumulator based.

Pipelining

- Given segment speeds, what is the max speed of the pipeline?

Memory

- How many bits are required to address ...?

Cache Memory

- Direct mapped, set associative, fully associative

Virtual Memory

- Given memory set-up, how long to read
....

Quantities – Base Comprehension