CpE 213
Digital Systems Design

Lecture 2

Thursday 8/28/2003

Basic information

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- Office Hours: TR 1:30-3:00, or by appointment.
- Email is the best way to reach me.

Prerequisites by Topic

- Familiarity with C programming.
- Knowledge of the functions of NAND, NOR, decoders, multiplexers, and similar combinational logic elements.
- Knowledge of the functions of D flip-flops, registers, counters, and similar sequential logic elements.

Important reminder

- The course syllabus is a legally binding agreement between you and your instructor.
- Portions have been skipped in class.
- Please read it in its entirety.

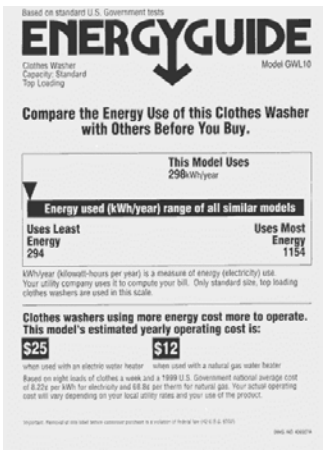
Application du jour

Fisher&Paykel innovative living

GWL11 Ecosmart Washer

- Brushless DC magnetic motor is directly connected to the agitator by a single stainless steel shaft.
- Agitator is directly in contact with electronics.
- Incorporates no belts, pulleys, or transmission, which are the first things to wear down and break in a conventional washer.
- Parts that aren't there can't fail.

Benefits of electronic controls



Based on standard U.S. Government tests

ENERGYGUIDE

Clothes Washer
Capacity: Standard
Top Loading

Model GWL10

Compare the Energy Use of this Clothes Washer with Others Before You Buy.

This Model Uses 298 kWh/year

Energy used (kWh/year) range of all similar models

Uses Least Energy	Uses Most Energy
294	1154

kWh/year (kilowatt-hours per year) is a measure of energy (electricity) use. Your utility company uses it to compute your bill. Only standard size, top loading clothes washers are used in this scale.

Clothes washers using more energy cost more to operate. This model's estimated yearly operating cost is:

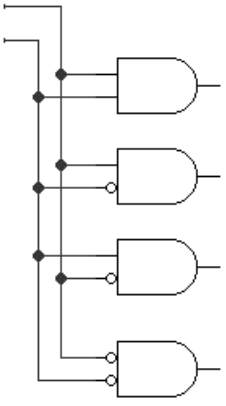
$25 when used with an electric water heater

$12 when used with a natural gas water heater

Based on eight loads of clothes a week and a 1999 U.S. Government national average cost of 8.22¢ per kWh for electricity and 68.8¢ per therm for natural gas. Your actual operating cost will vary depending on your local utility rates and your use of the product.

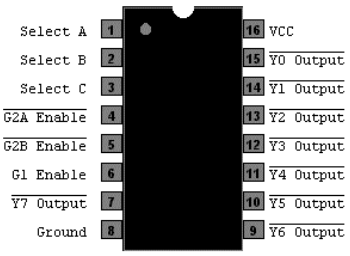
- Intelligent auto-water sensing uses only the amount of water needed for each individual load.
- Accurately controlled water temperatures ensure optimum wash performance.
- Delay start allows you to effortlessly wash during off-peak energy hours.
- Automatically balances the load.

Hardware review



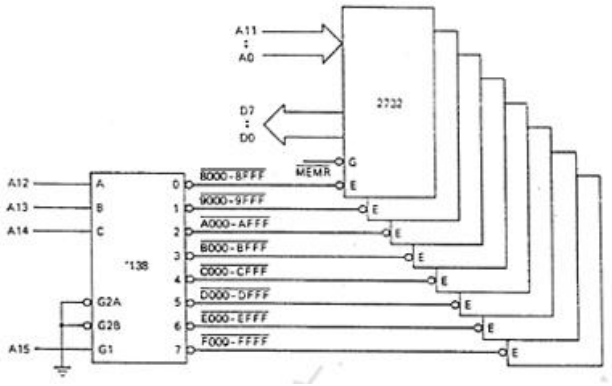
- What is it?
- What is it used for?

Address decoding



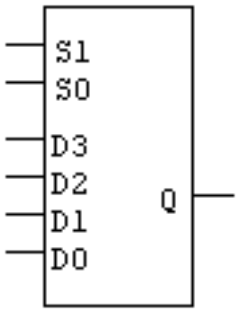
enable		select			output							
G1	G2	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	1	X	X	X	1	1	1	1	1	1	1	1
0	X	X	X	X	1	1	1	1	1	1	1	1
1	0	0	0	0	0	1	1	1	1	1	1	1
1	0	0	0	1	1	0	1	1	1	1	1	1
1	0	0	1	0	1	1	0	1	1	1	1	1
1	0	0	1	1	1	1	1	0	1	1	1	1
1	0	1	0	0	1	1	1	1	0	1	1	1
1	0	1	0	1	1	1	1	1	1	0	1	1
1	0	1	1	0	1	1	1	1	1	1	0	1
1	0	1	1	1	1	1	1	1	1	1	1	0

32K memory system

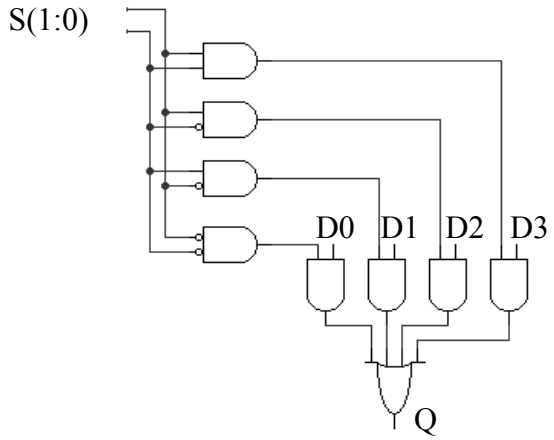


Hardware review

- What is it?
- What is it used for?

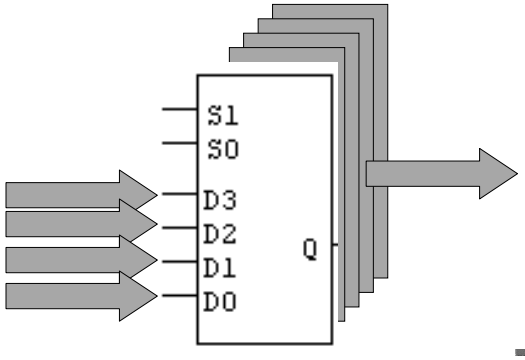


Mux = Decoder + Selector

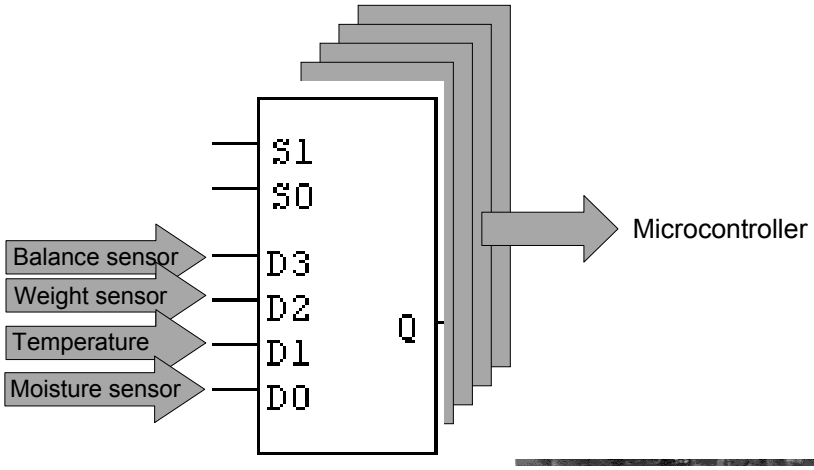


Buses = 3d muxes!

- Stack 8 muxes to get an 8 bit bus

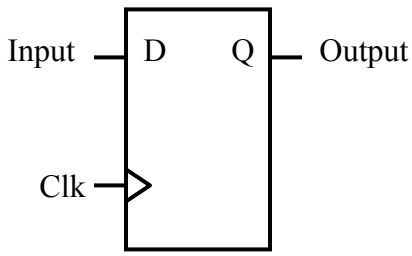


Washing machine example



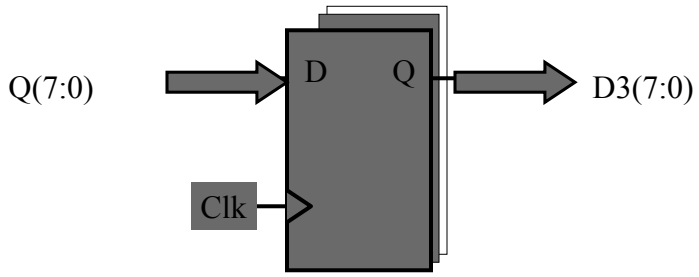
Flip flops

- D flip flops are important (forget JK)
- DFF = Primitive storage device



3d Flip Flops = register

- Stack 8 flip flops to get 8 bit data register
- Strobe Clk to get D3 <= Q;
- Set S=I then strobe Clk to get D3<= D[I]



Group activity

- Divide into groups of 5
- Introduce each other and select spokesperson
- Spokesperson reports after 5 min
- Include group members' names and date on report and hand it in.

Question 1

- Name the two types of semiconductor memory.
- Which type retains its contents when powered-off?
- What is the common term that describes this property?

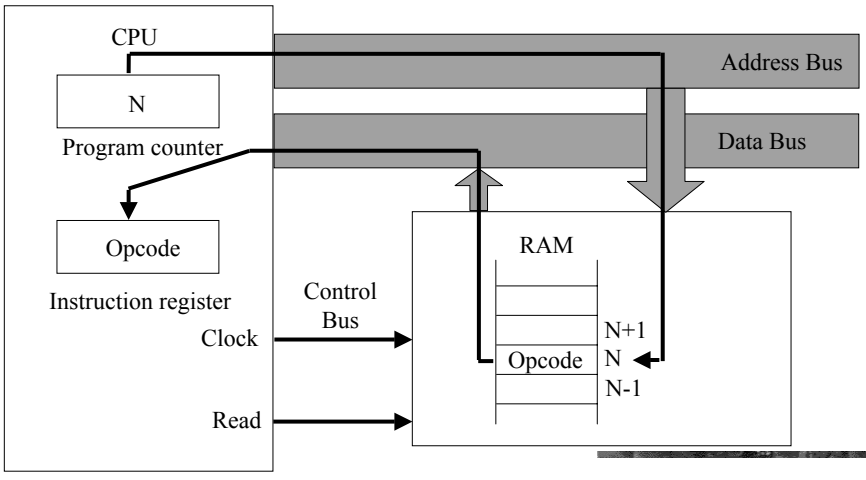
Question 2

- Which register in the CPU always contains an address?
- Which address is contained in this register?

Question 3 (See Fig 1-4 on pg. 5)

- During an Opcode fetch cycle, what is the information on the address and data buses?
- In which direction does the information flow during an Opcode fetch?

Bus activity for an opcode fetch cycle



Remember this program?

```
void main(){
unsigned int pc;
char rom[2048] = (0,1,2);
char ir;
pc = 0;
  while(1){
    ir= rom[++pc];
    switch (ir)
    {case 0: nop(); break;
     case 1: add(); break;
     /*...*/
    }}}
```

Question 4

- What is the usual meaning of “16-bit” in the phrase “16-bit computer”?

Question 5

- Classify the devices below as input or output devices.

  Joystick

  Monitor

  Mouse

  Microphone

  Loudspeaker

Question 6

- What is firmware?
- Is a microcontroller-based system more likely to use firmware or is a microprocessor system?
- Why?

Before the next lecture

- Review chapter 1 and lecture notes
- Download and read WIMP handout at:
  http://web.umr.edu/~daryl/classes/ee213/wimp_slides.pdf
- Find four partners that you will work with for the rest of the semester