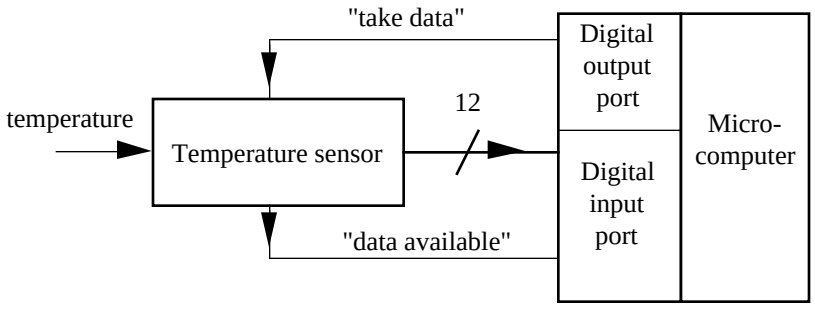
Solutions for Midterm #1 - EECS 145M Spring 1998

1a

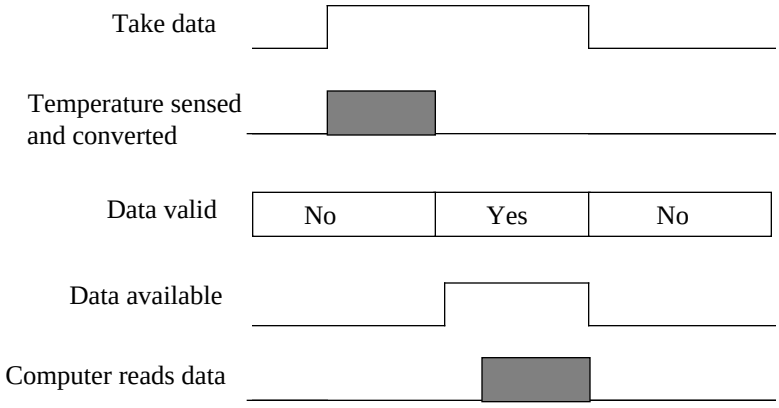


1b

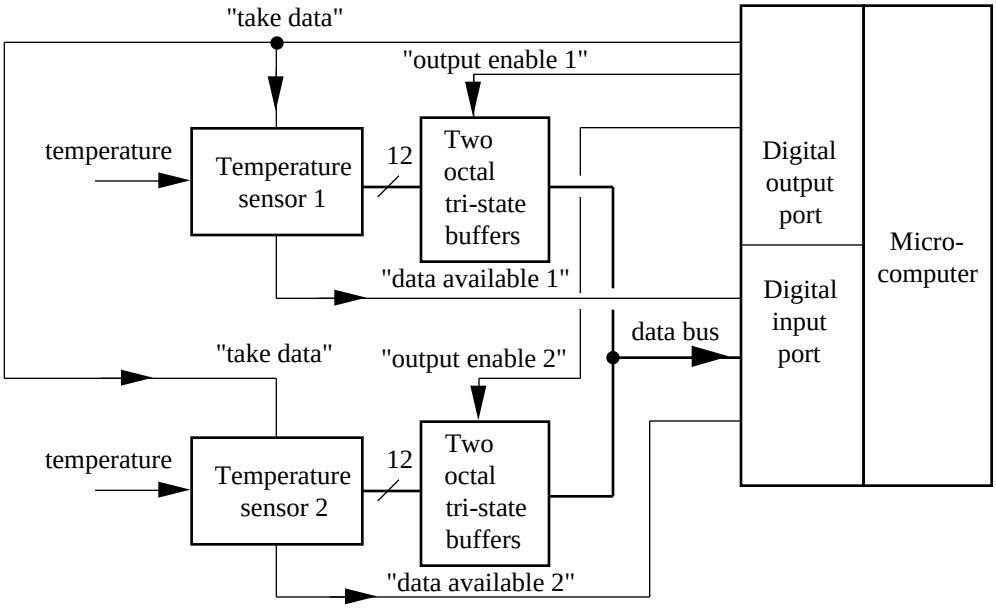
1 The program outputs a one to the digital output port, which makes “take data” high
2 The program starts a loop that continuously reads the 16 bits of data and exits when the “output data available” line goes high.
3 The temperature sensor detects a one on “take data”, senses the temperature, converts to into a 12-bit number
4 The temperature sensor asserts the 12-bit number on the 12 output lines
5 The temperature sensor makes the “output data available” line high
6 The program detects the “output data available” signal, and exits the loop
7 The program masks the 12-bit number from the 16 bit data
8 The program makes “take data” low
9 The sensor makes “output data available” low

[4 points off if the computer never reads “output data available”]
[2 points off if computer makes “take data” low before reading data]

1c



2a

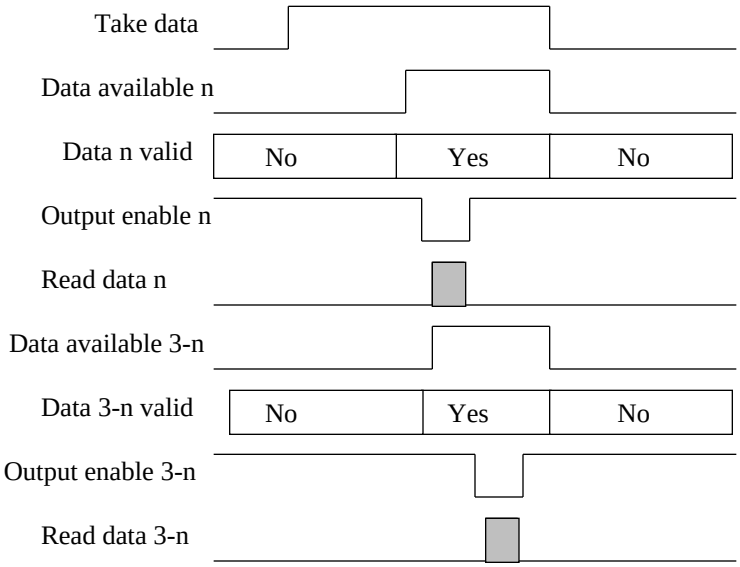


2b

1 The program outputs a word to the digital output port that has a one on the “take data” bit, and ones on both output enable 1 and 2 to ignore the sensors.
2 The two temperature sensors simultaneously start producing a digital output
3 The program reads the digital input port in a loop waiting for “output data available n”, n = 1 or 2 to go high (Note that these two signals do not need tri-state buffers and can be read directly to constantly monitor both temperature sensors)
4 If sensor n (n = 1 or 2) is ready first, it makes “output data available n” high
5 The program detects the "output data available n" signal and writes a word to the digital output port with one on the “take data” bit, a zero on the “output enable n” bit to select sensor n, and a one on the “output enable 3-n” bit to ignore sensor 3-n.
(Note: If n = 1, 3-n = 2. If n = 2, 3-n = 1.)
6 The program reads the input port for the sensor n data
7 The program masks the data to produce the 12-bit value from temperature sensor n
8 The program continues to read the digital input port in a loop waiting for the “output data available 3-n” bit to go high
9 When sensor 3-n is ready, it brings “output data available 3-n” high
10 The program detects the “output data available 3-n” and writes a word to the digital output port that has a one on the “take data” bit, a one on the “output enable n” bit to ignore sensor n, and a zero on the “output enable 3-n” bit to select sensor 3-n.
11 The program reads the input port for the sensor n data
12 The program masks the data to produce the 12-bit value from temperature sensor n
13 The program writes a word to the digital output port that brings “take data” low

[4 points off if the computer does not read the “output data available” signals
[4 points off if the computer does not selectively enable the two tri-states before reading data]

2c



[2 points off if data valid or data read process not shown (data lines are signals!!)]
[2 points off if output enable lines not shown]

3a

$$G = R_1 / R_2 \qquad \sigma_G^2 = \left(\frac{\partial G}{\partial R_1}\right)^2 \sigma_{R_1}^2 + \left(\frac{\partial G}{\partial R_2}\right)^2 \sigma_{R_2}^2 = \left(\frac{1}{R_2}\right)^2 \sigma_{R_1}^2 + \left(\frac{-R_1}{R_2^2}\right)^2 \sigma_{R_2}^2$$

$$\frac{\sigma_G^2}{G^2} = \left(\frac{R_2}{R_1}\right)^2 \frac{\sigma_{R_1}^2}{R_2^2} + \left(\frac{R_2}{R_1}\right)^2 \left(\frac{R_1}{R_2^2}\right)^2 \sigma_{R_2}^2 = \frac{\sigma_{R_1}^2}{R_1^2} + \frac{\sigma_{R_2}^2}{R_2^2} = (0.01)^2 + (0.01)^2 = 0.0002$$

$$\frac{\sigma_G}{G} = \sqrt{0.0002} = 0.01414$$

Midterm #1 class statistics:

Problem	max	average	rms
1	30	28.2	2.6
2	50	44.9	6.8
3	20	16.9	3.5
total	100	90.0	10.6

Grade distribution:

Range	number	*approximate* letter grade
61-65	1	C
66-70	0	C+
71-75	0	B-
76-80	0	B
81-85	3	B+
86-90	3	A
91-95	0	A
96-100	7	A+