

# FYSS 385 Computer-based data acquisition and control

## Mid-term examination

Monday 14 March 2011 1615-1715

### Instructions:

1. Write your name on the answer sheet.
2. For each question the statements a), b), c) d) e) etc are either correct or false. Mark on your answer sheet the correct statements. Eg. For Q. 3 if statements b) and d) are correct and a) c) e) false, then write: "3. b), d)"
3. There are twenty questions. This means you have three minutes to answer each question. You should attempt to answer all questions.

Good luck!

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### Q. 1

- a) a CPU has a word length of 64 bits can be written as a CPU with 6-byte word length.
- b) Concurrent processing means the program strings are tied together to make a longer program string.
- c) Unsigned integer representation negative numbers are not stored as two's compliment.
- d) In the IEEE 744 standard for floating point representation as 32-bit and 64-bit floating point numbers the floating-point words contain only the exponent and significand.
- e) Text strings may be represented by one byte containing the number of characters in the string followed the sequence of 8-bit ASCII characters or a string terminator e.g. "return". Using these schemes, the following string can be completely represented using 13 bytes of memory.

### String:

It's Sunday.

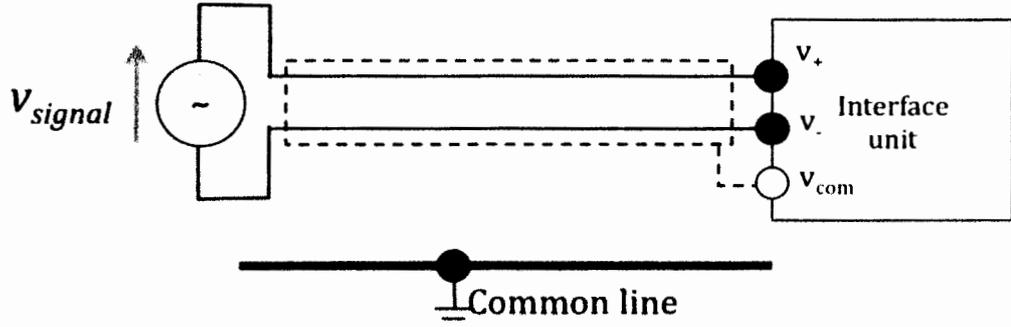
### Q. 2

- a) A I/O register is a special type of memory cell that can be written and/or read by the computer and passes the data in and out of the computer.
- b) An analogue to digital converter takes a set of binary values arranged as a word and converts this to analogue signal.
- c) PIC is an acronym that is generally taken to mean "Pulse Input to Computer"
- d) A peripheral interface controller must always be used in conjunction with a computer.
- e) A reason you may want to implement data acquisition using a computer are to improve archiving and tractability.

### Q.3

- a) It is generally essential in developing computer-based experiments for school use that they can handle the CAMAC standard.
- b) The MatLab programming environment has a toolbox that enables some instruments to be controlled.
- c) A good way to write software for data acquisition and control is to build up complex tasks of many simple functions.
- d) Implementation of measurement systems based on peripheral interface controllers generally does not need any programming skills.
- e) System lifetime and expandability generally are not important issues when developing computer based data acquisition systems.

Q. 4



- a) The circuit above shows represents a single-ended voltage measurement.
- b) The circuit above measures the voltage relative to the earthed common line.
- c) The circuit above is very susceptible to earth leakage currents circulating in the common line.
- d) Earth (ground) loops are caused by voltages originating from currents flowing in the earth (common) line.
- e) Parallel data communication the data is transmitted on many signal lines in parallel.

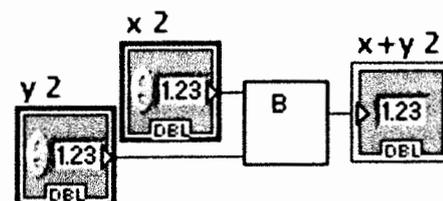
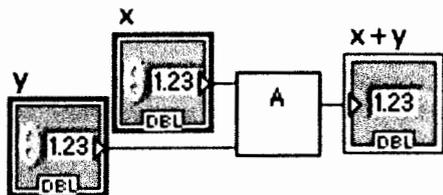
Q.5

- a) In data transmission with RS232 the data is transferred in parallel by the many signal lines
- b) RS232 and the USB are different names for the same standard.
- c) RS-232 defines the signal levels, transmission rates and bits per frame.
- d) GPIB and IEEE 488 are different names for the same standard.
- e) The Nuclear Instrumentation Module standard has a built-in data bus

Q. 6

- a) LabVIEW is a proprietary program and you must have a license to develop data acquisition and control systems using it.
- b) LabView is a conventional programming language where the program is are written line by line.
- c) The PXI interface standard is based on the USB serial bus,
- d) LabVIEW and DAQmx are different names for the same software package.
- e) LabVIEW can only be used with National Instruments hardware.

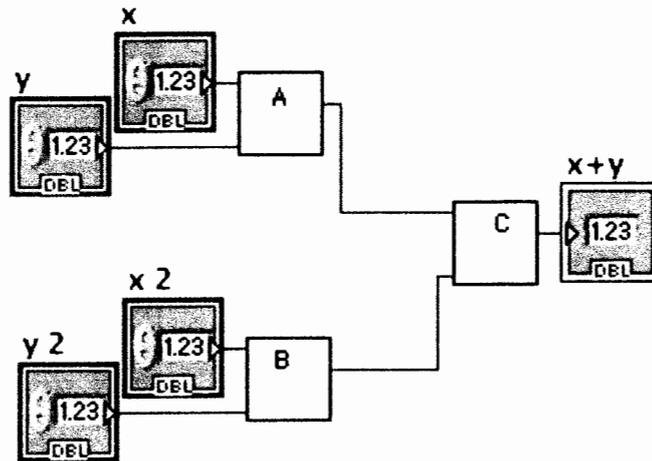
Q. 7



- a) In the block diagram above A and B are controls.

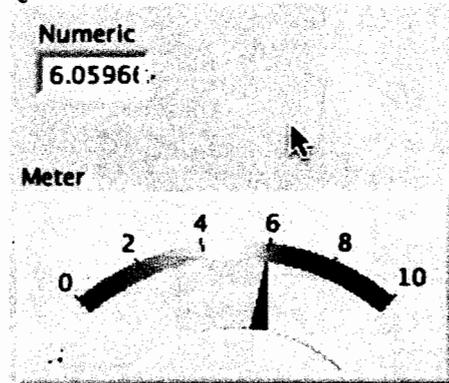
- b) In the block diagram "x+y" and "x+y 2" are controls.
- c) A executes before B
- d) A and B execute concurrently.
- e) The signal lines carry 32-bit floating point numbers.

Q. 8



- a) In the block diagram above C executes as soon as A or B has finished execution.
- b) In the block diagram above C executes first.
- c) In the block diagram above C executes as soon as A and B has finished execution.
- d) In the VI A, B and C are indicators.
- e) If C is a while-loop A and B are repeatedly executed because they are within the loop structure.

Q.9



On the control panel above the numeric and meter indicators indicate the value of the same signal.

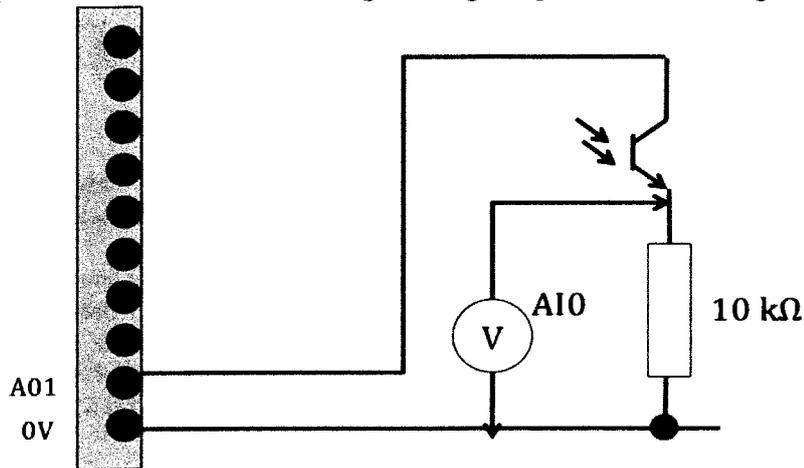
- a) The meter display is more precise.
- b) The accuracy of the reading is determined only by the precision of the indicator
- c) The numeric indicator is showing a double precision integer signal
- d) The numeric indicator is showing an array
- e) The numeric display is more precise than the meter, but the accuracy may not be better for the numeric display.

Q. 10

- a) In LabVIEW the VI always has a control panel and a block diagram.
- b) LabVIEW is best described a graphic dataflow programming environment.
- c) Signals are connected to and from sub-Vis by means of a terminal block.
- d) Execution of Vis in labVIEW is always left to right.
- e) Express Vis are Vis that execute faster than normal Vis

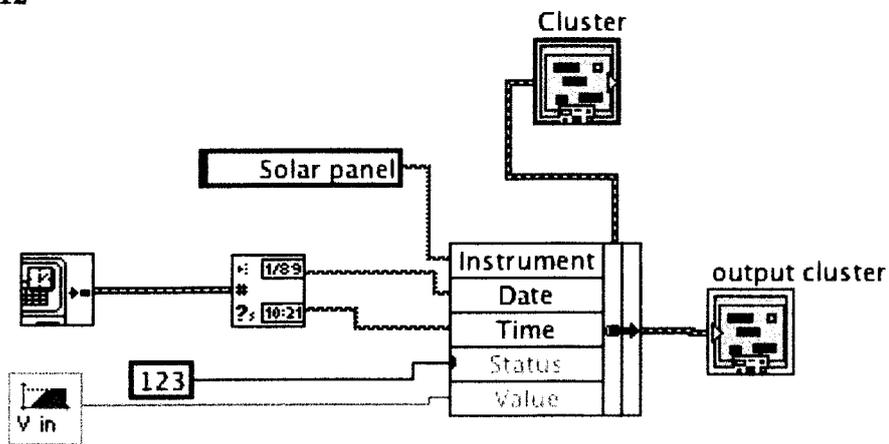
Q. 11

The figure shows a circuit for an USB-6009 interface to measure light intensity using a phototransistor. A01 is an analogue voltage output. AIO is an analogue voltage input.



- A01 is used to sense the current through the phototransistor
- AIO is used to measure the voltage across the shunt resistor.
- The sensitivity of the shunt resistor is such that when A01 is 2 V, 0.2 mA flows through the shunt resistance.
- Two terminal characteristics of  $I_c$  vs voltage  $V_{ce}$  can be measured with this circuit.
- The measurement of AIO can be a single-ended voltage measurement.

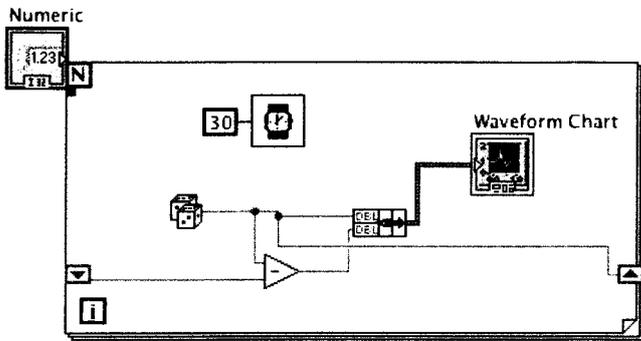
Q. 12



The block diagram above shows where data, about a solar energy system is bundled into a cluster.

- A cluster can only contain one type of data.
- A cluster can be like an array but the elements contain different types of data such as string, floating point numbers, unsigned integers, Boolean and floating point data.
- Clusters cannot contain arrays
- Five types of data are bundled into a cluster in the above figure.
- Only numerical values are bundled into the cluster.

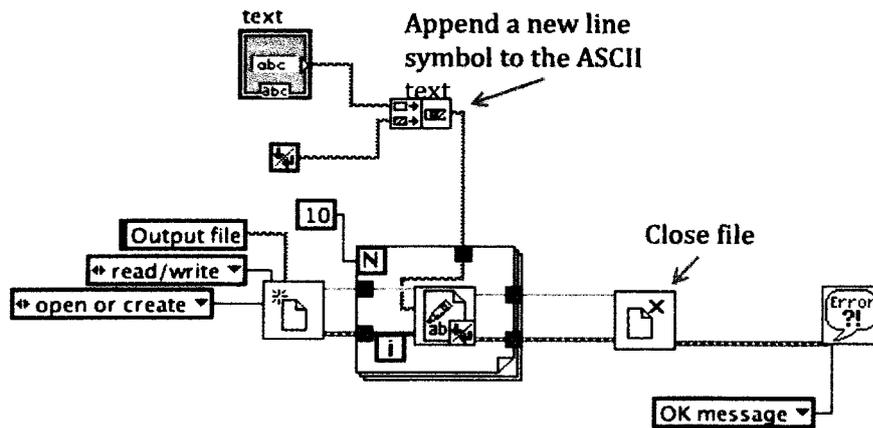
Q. 13



- In the above block diagram an array of double precision numbers is plotted as a 2D image.
- To append to the array a shift register is used.
- The number of times the loop will be executed is set using the loop counter "i" in the bottom left.
- The clock waveform chart has a cluster variable as input.
- The data is plotted as an x,y plot.

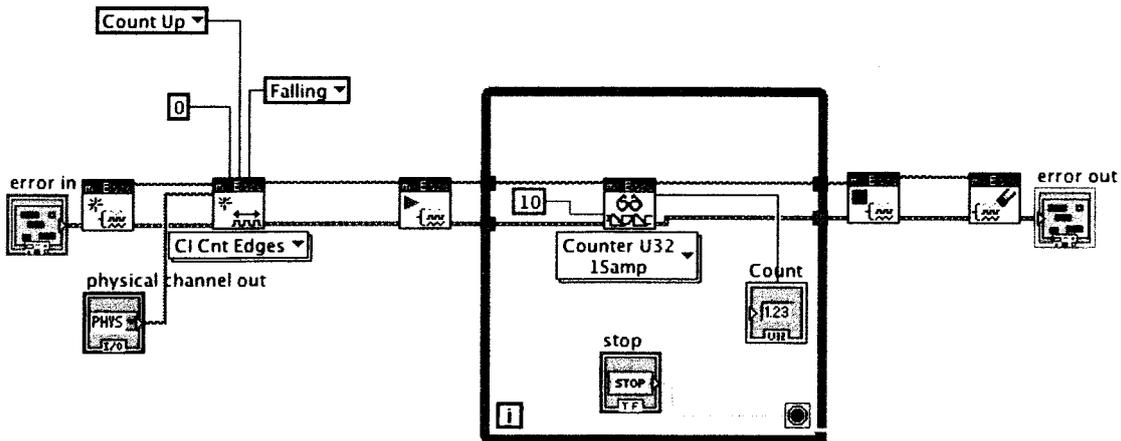
Q. 14

- Array and matrices in LabVIEW are identical.
- The LabVIEW standard simple error handler uses an array variable
- The Block Diagram below opens a new file file and writes 10 lines of text to



- it.
- A while loop can never be used to replace a For-loop.
- Tunnels are used to carry the signals in and out of the For-loop

Q. 15



- a) The Block diagram of a VI to read a counter using DAQmx is shown above. The first DAQmx VI to be executed defines a new DAQmx task.
- b) The DAQmx configure channel and DAQmx read VIs are polymorphic and can handle different input and output signals.
- c) DAQmx is intended to be used to read serial ports.
- d) Virtual Instrument Software Architecture, (VISA) is a standard for computer control of musical instruments and not intended for use in the laboratory.
- e) A single DAQmx task can perform many functions such as reading analogue voltages and writing digital outputs.

**Q. 16**

- a) A parametric analyser measures the characterises a device by using the device to generate signals without any input and recording these signals vs. time in an spreadsheet file.
- b) A PNP bipolar transistor is a 4-terminal device.
- c) a light switch can be considered as a 3-terminal device.
- d) In parametric analysis the computer generates signal(s) and the response(s) to those signals is recorded.
- e) In parametric analysis we determine the behaviour of the device in terms of the input signal characteristics

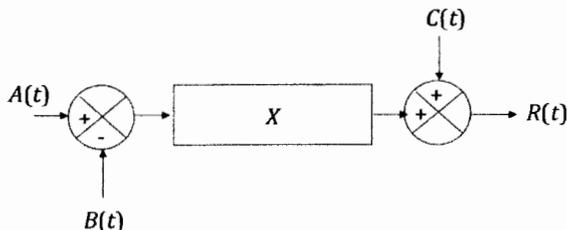
**Q. 17**

- a) In control technology the set point is the value the measured variable is compared with in order to determine the controlled variable.
- b) In open-loop control the measured value is compared with the set point.
- c) A water tap is an example of open-loop control.
- d) A car cruise-control (constant speed controller) is a good example of an open-loop control.
- e) Open loop control cannot be used to control variables such as flow rate – only variables that are on or off.

**Q18.**

- (a) A controller is always a part of a control loop.
- (b) An example of a self-actuating controller is the air pressure regulator on the air tanks used by divers.
- (c) The term “plant” is used to describe physical equipment, or parts that function together that is to be controlled.
- (d) A proportional controller gets its name because it provides a control signal to the plant that is inversely proportional to the difference between the set value and the measured output of the plant.
- (e) Hysteresis in an on/off controller is always undesirable.

**Q. 19**



The figure above shows a standard block diagram for a control system.

- (a) The control system is single input, with multiple inputs.
- (b) The control system has multiple inputs and a single output
- (c) The control system is a closed-loop control

(d) The function can be written:  $R(t) = [A(t) - B(t)]X - C(t)$

(e) Threshold controllers often have a hysteresis built-in to reduce the number of on-off switching that would cause damage to frequent start-stopping of plant.

**Q. 20**

(a) A servo-system is used to control transfer a changing set-point faithfully to a large plant. E.g. a ship's rudder or an aircraft control surfaces.

(b) A controller with a fixed set point maintains a constant value against disturbances.

(c) In all control systems; overshoot must always be completely avoided.

(d) A PID controller uses only the rate of change of the error signal (difference between the set-point and measured value) to control the system.

(e) A proportional controller (P-controller) does not oscillate because the controlled variable is always the set-point.