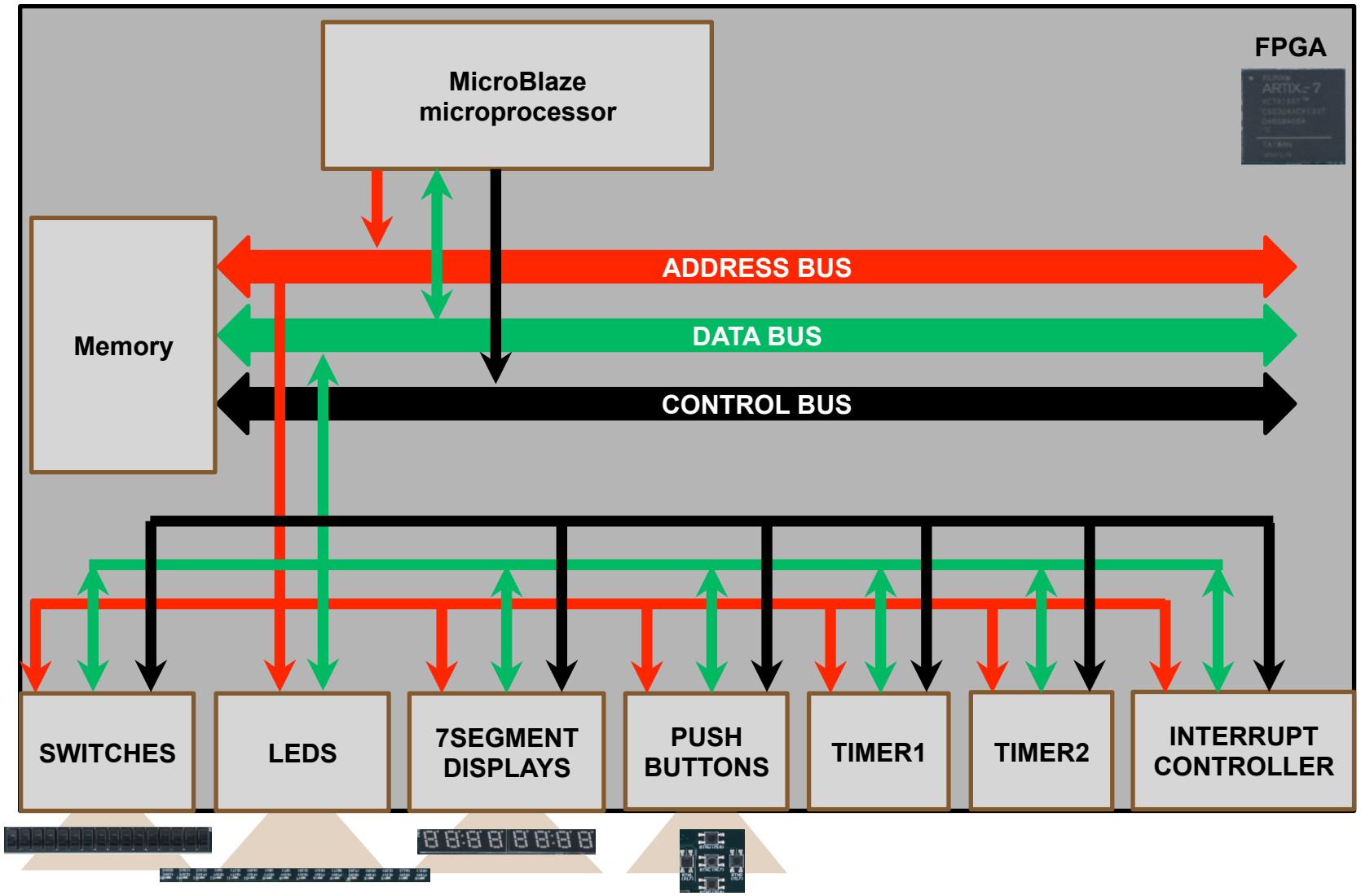
Lab2: I/O Handling

Goal

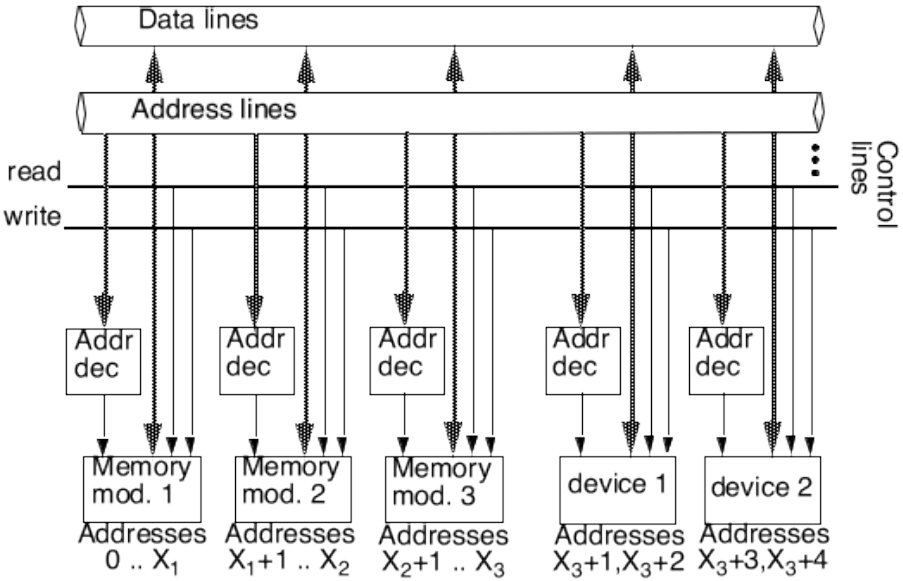
- Learn how to access different I/O devices
- Write programs that interact with I/O devices
- Write driver routines

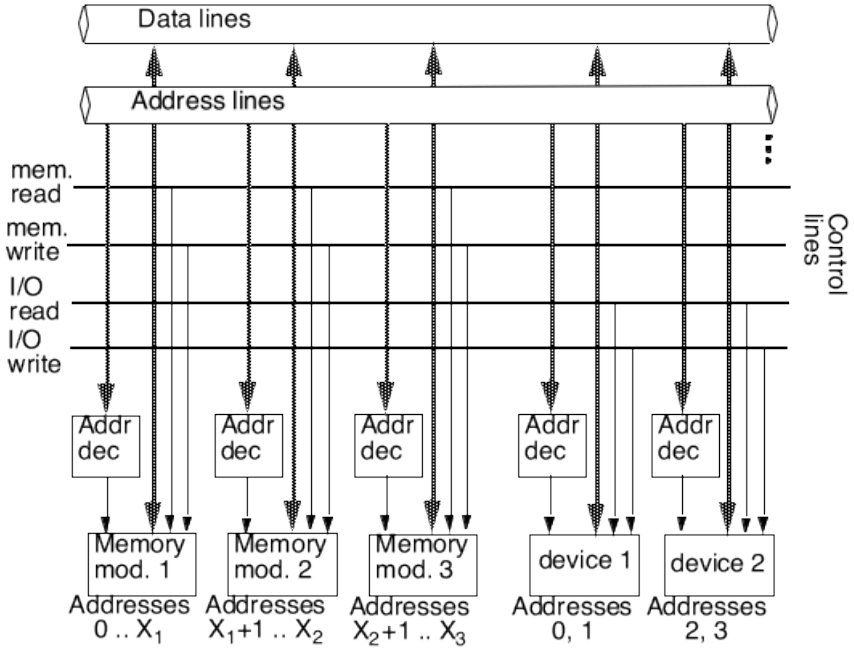
Computer system

Computer System



Minnesmappad och isolerad I/O





Memory mapped vs. Isolated I/O

- Memory mapped
  - Same address space shared among memory and I/O
  - Same instructions used to access memory and I/O
- Isolated I/O
  - Different address space for memory and I/O
  - Different instructions
  - More control signals

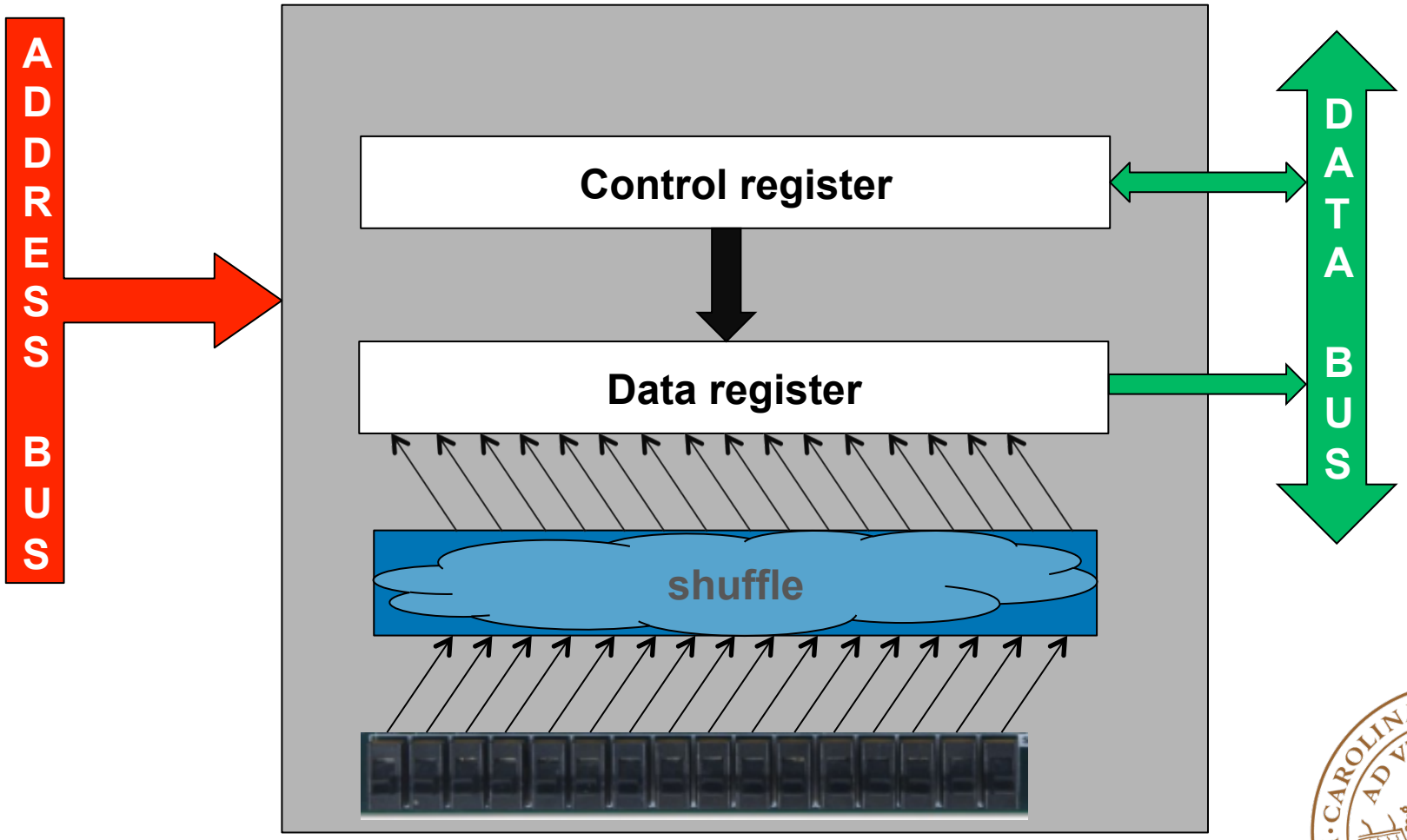
I/O devices

- Contain a set of registers
- Status/Control registers
- Data registers

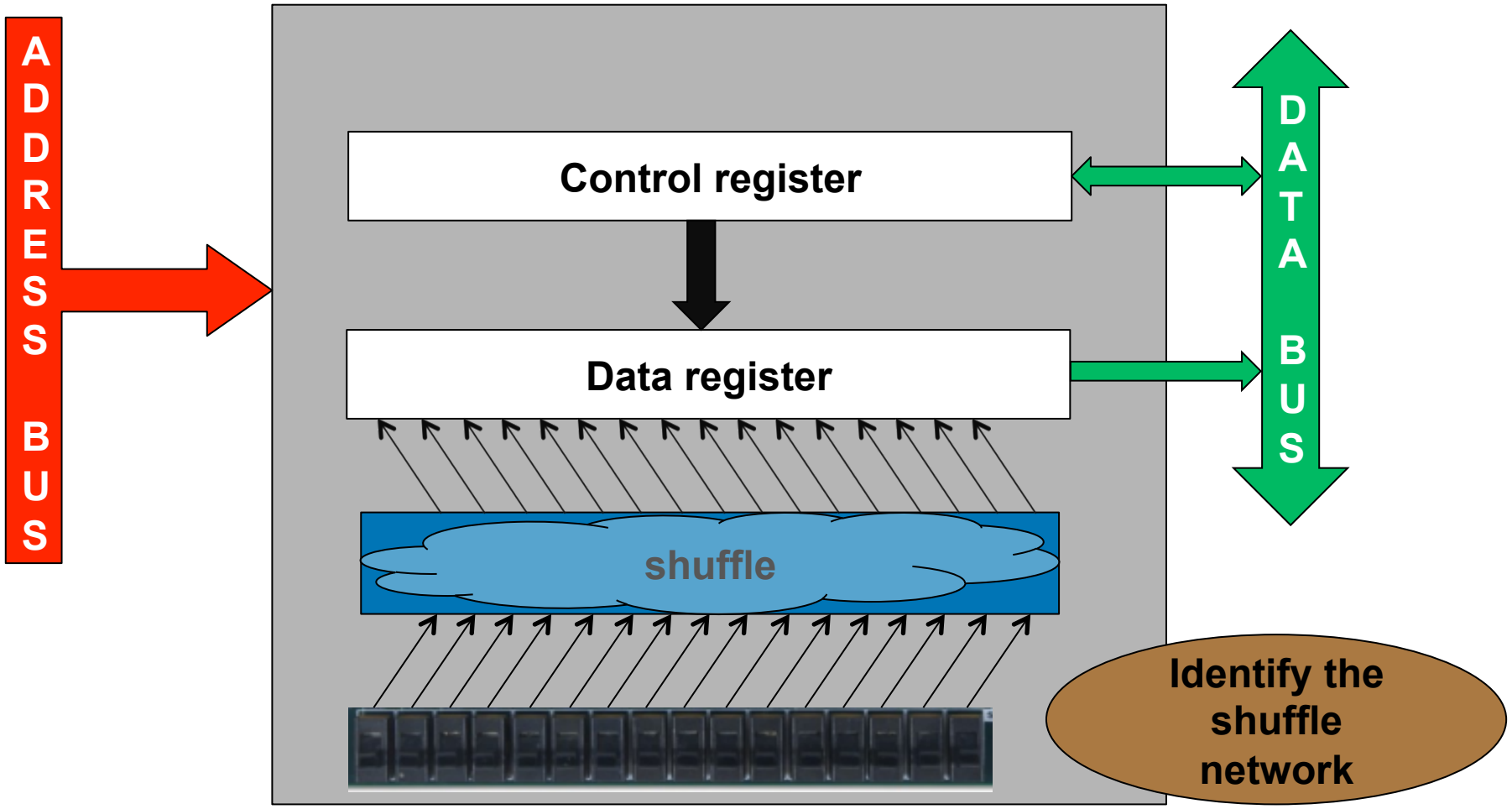
SWITCHES

- 16 switches are interfacing the microprocessor through an I/O module
- The I/O module has one control and one data register
- Both registers are 32bit wide
- Control register gives a bit level control for the data flow direction of each of the bits of the data registers
- Data register stores the state of the switches
- Input device

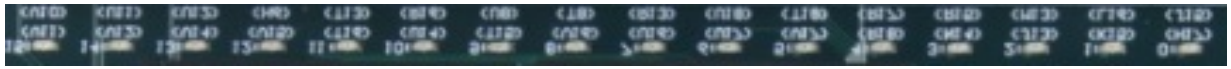
SWITCHES


ADDRESS BUS
Control register
Data register
shuffle
DATA BUS

SWITCHES

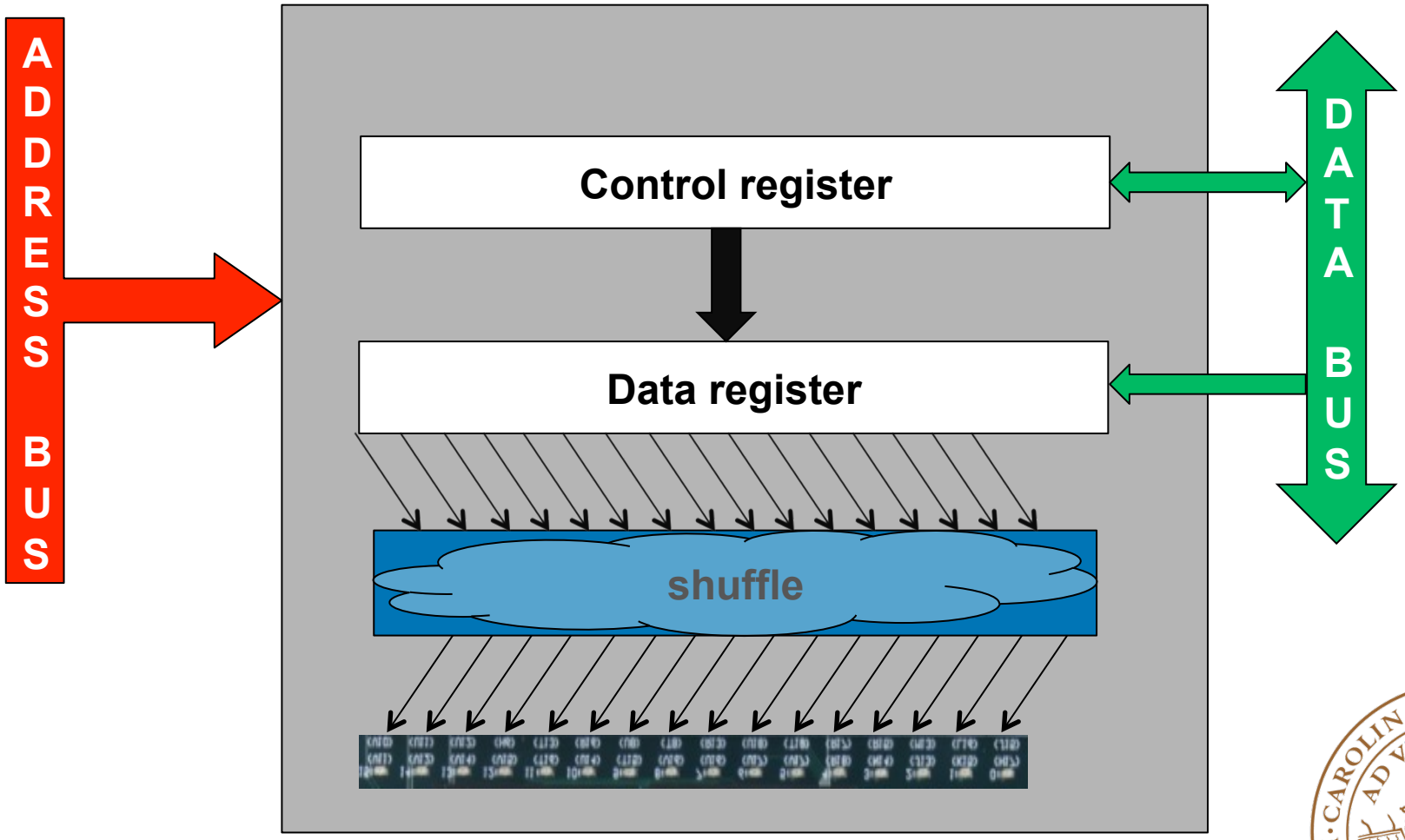

ADDRESS BUS
Control register
Data register
shuffle
DATA BUS
Identify the shuffle network

LEDS

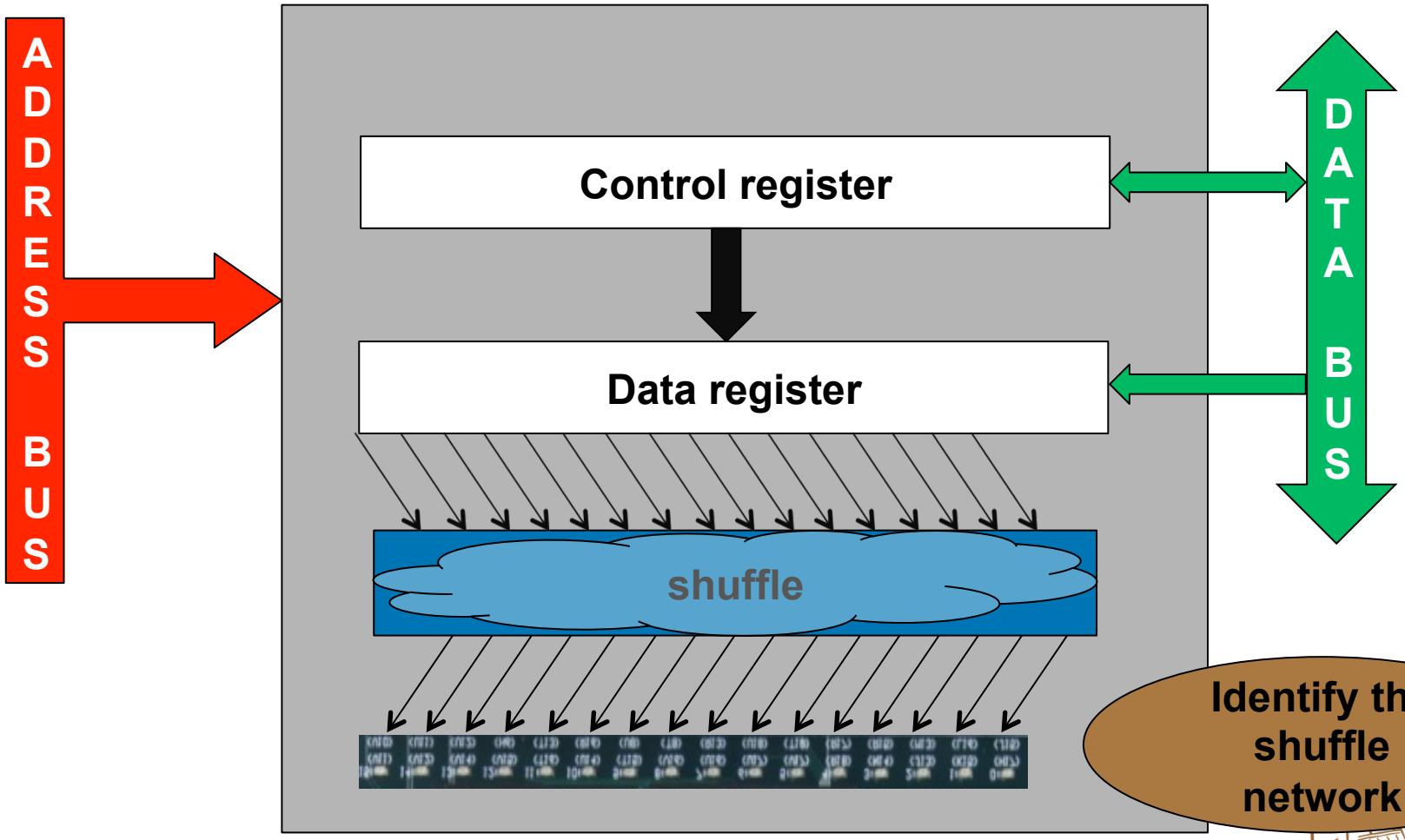


- 16 LEDs are interfacing the microprocessor through an I/O module
- The I/O module has one control and one data register
- Both registers are 32bit wide
- Control register gives a bit level control for the data flow direction of each of the bits of the data registers
- Data register controls the state of the LEDs
- Output device

LEDS

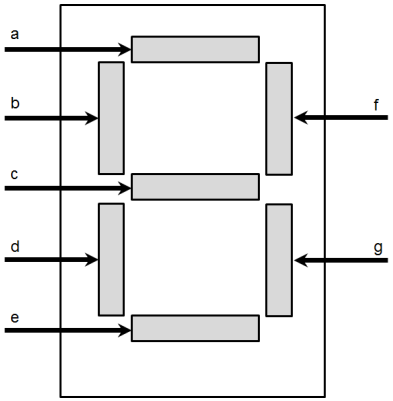

ADDRESS BUS
Control register
Data register
shuffle
DATA BUS

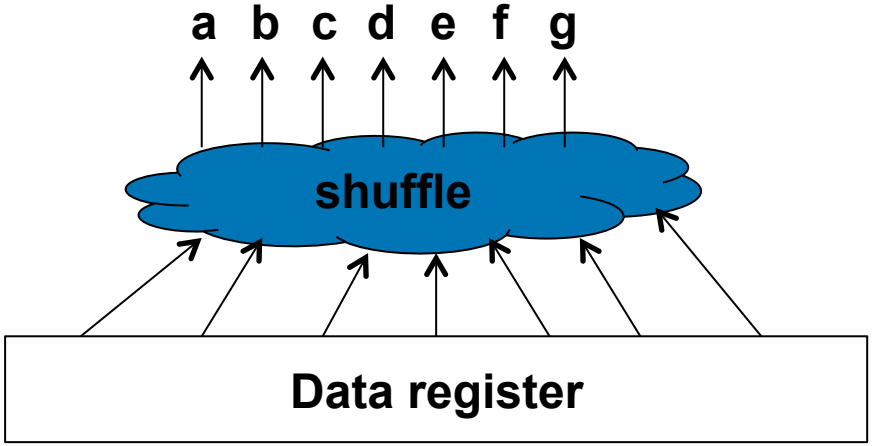
LEDS


ADDRESS BUS
Control register
Data register
shuffle
DATA BUS
Identify the shuffle network

Seven segment display

- 7 input signals
- One signal controls the state of one segment

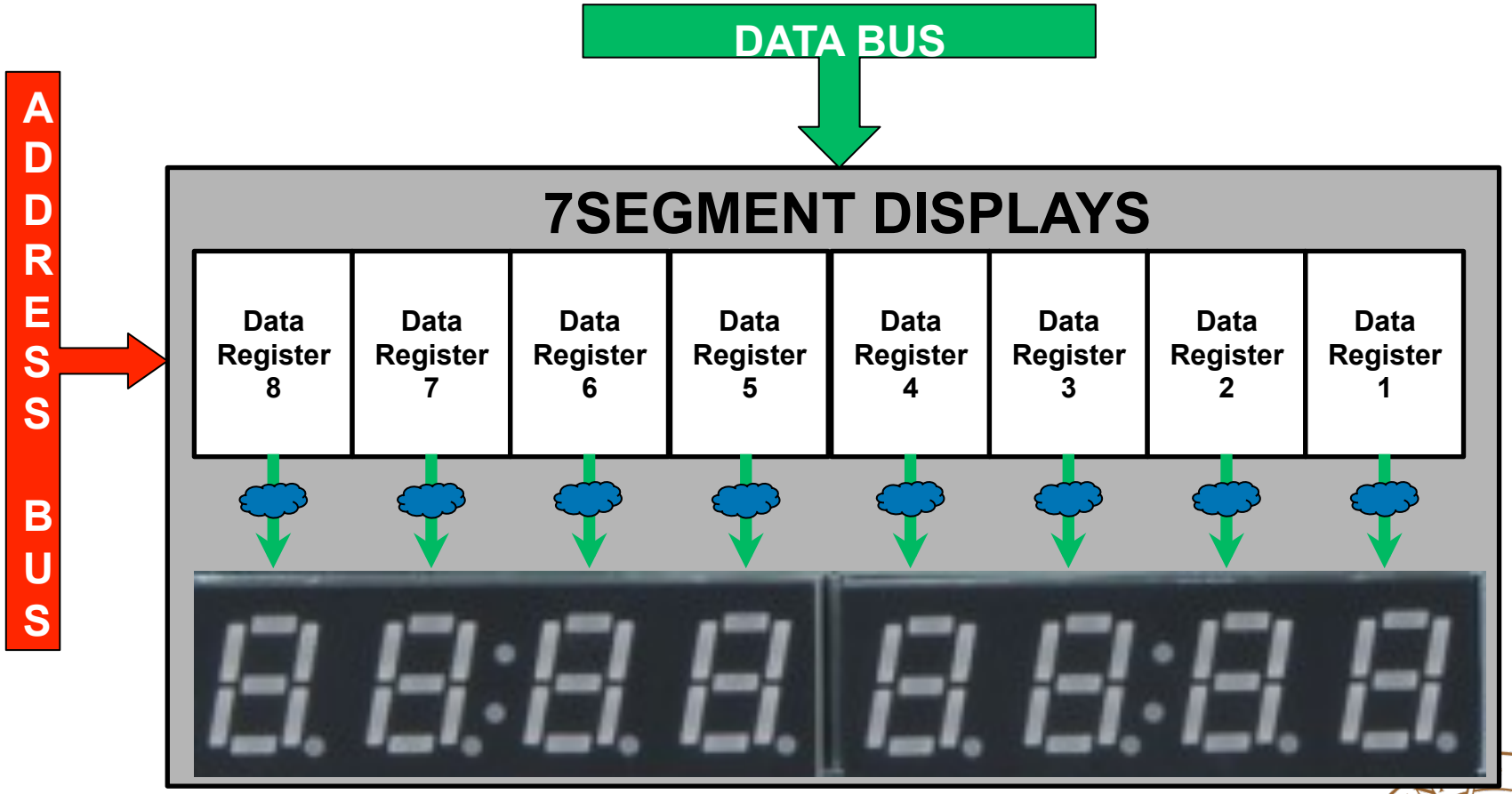




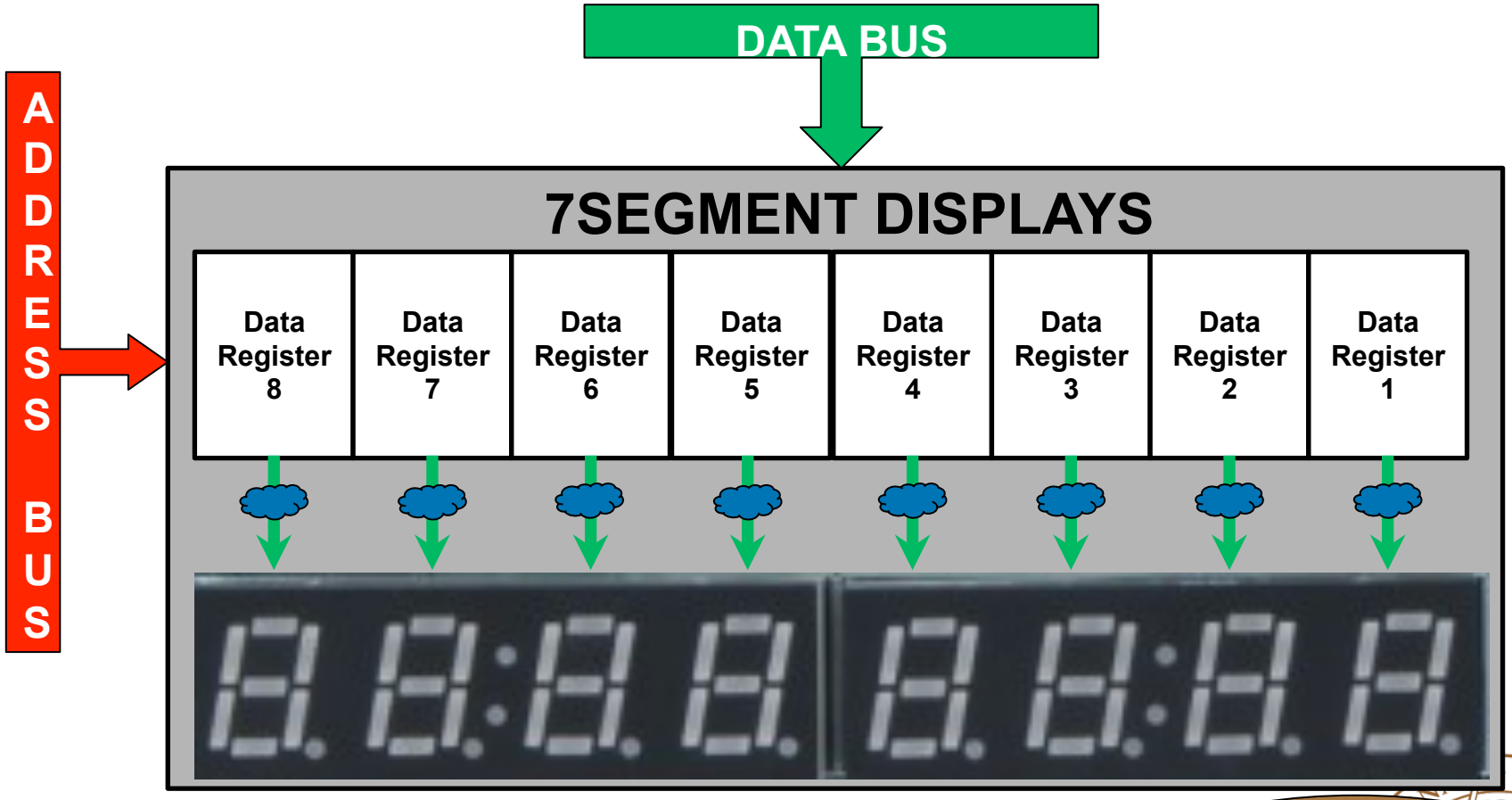
7SEGMENT DISPLAYS

- Output device
- Contains 8 data registers
- Each data register is 32bit wide
- One data register keeps the data to be displayed on one of the 8 seven segment displays

7SEGMENT DISPLAYS



7SEGMENT DISPLAYS



Identify the shuffle network

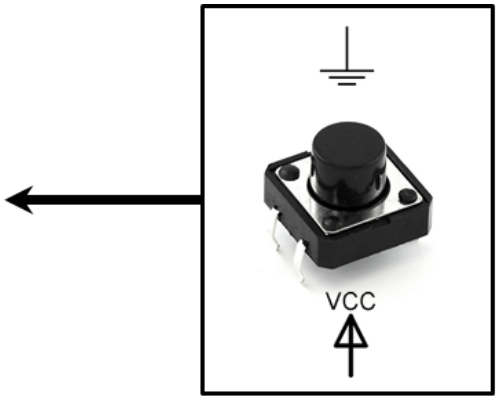
Driver routines

- Software interface to hardware devices
- Operating system can invoke driver routines
- Programmers can invoke driver routines without needing to know precise details of the hardware being used

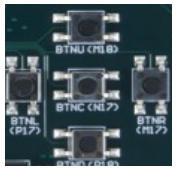
Write driver routines for the 7SEGMENT DISPLAYS device

Pushbutton

- Produces a logic ‘1’ when pressed
- Produces a logic ’0’ when released

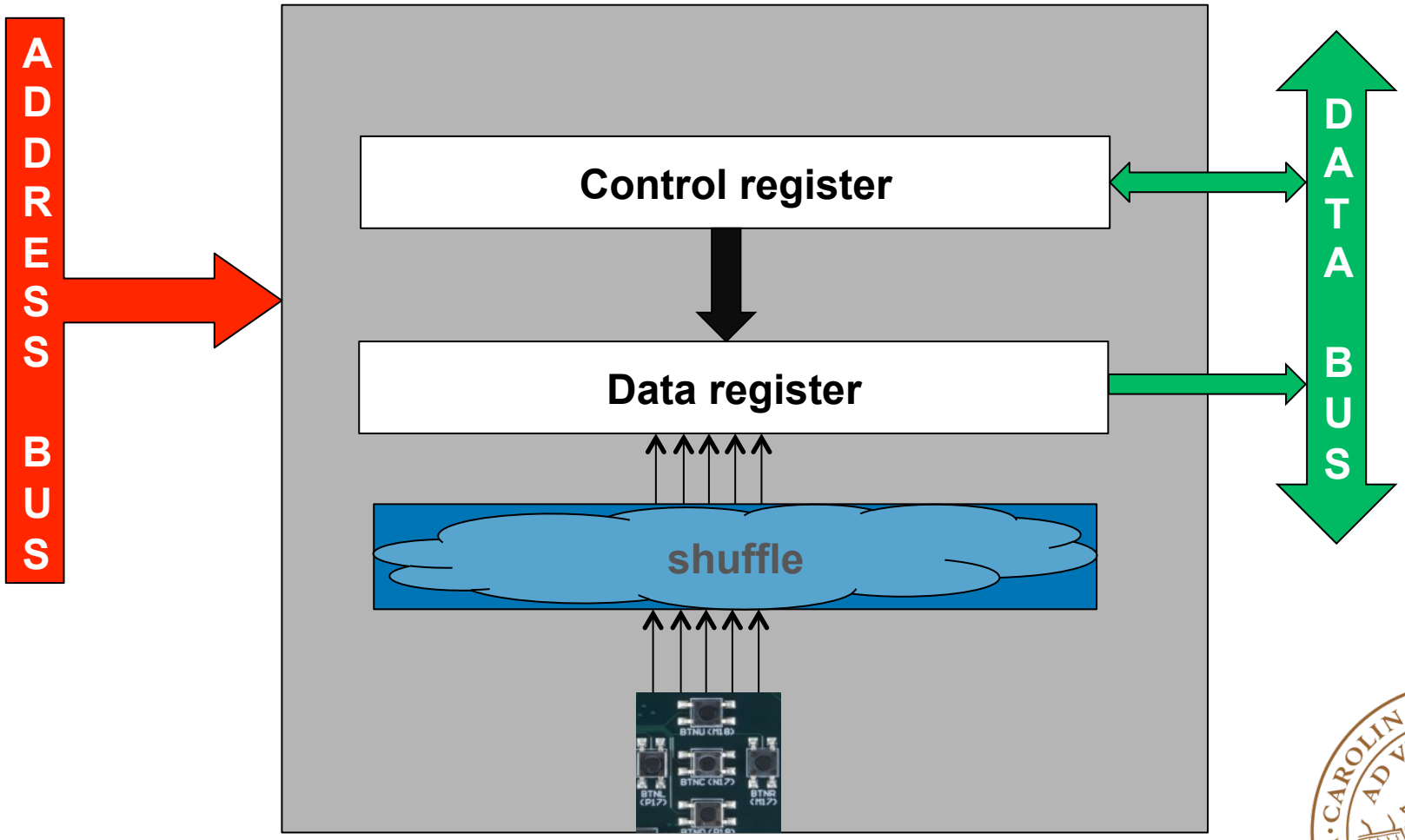


PUSH BUTTONS

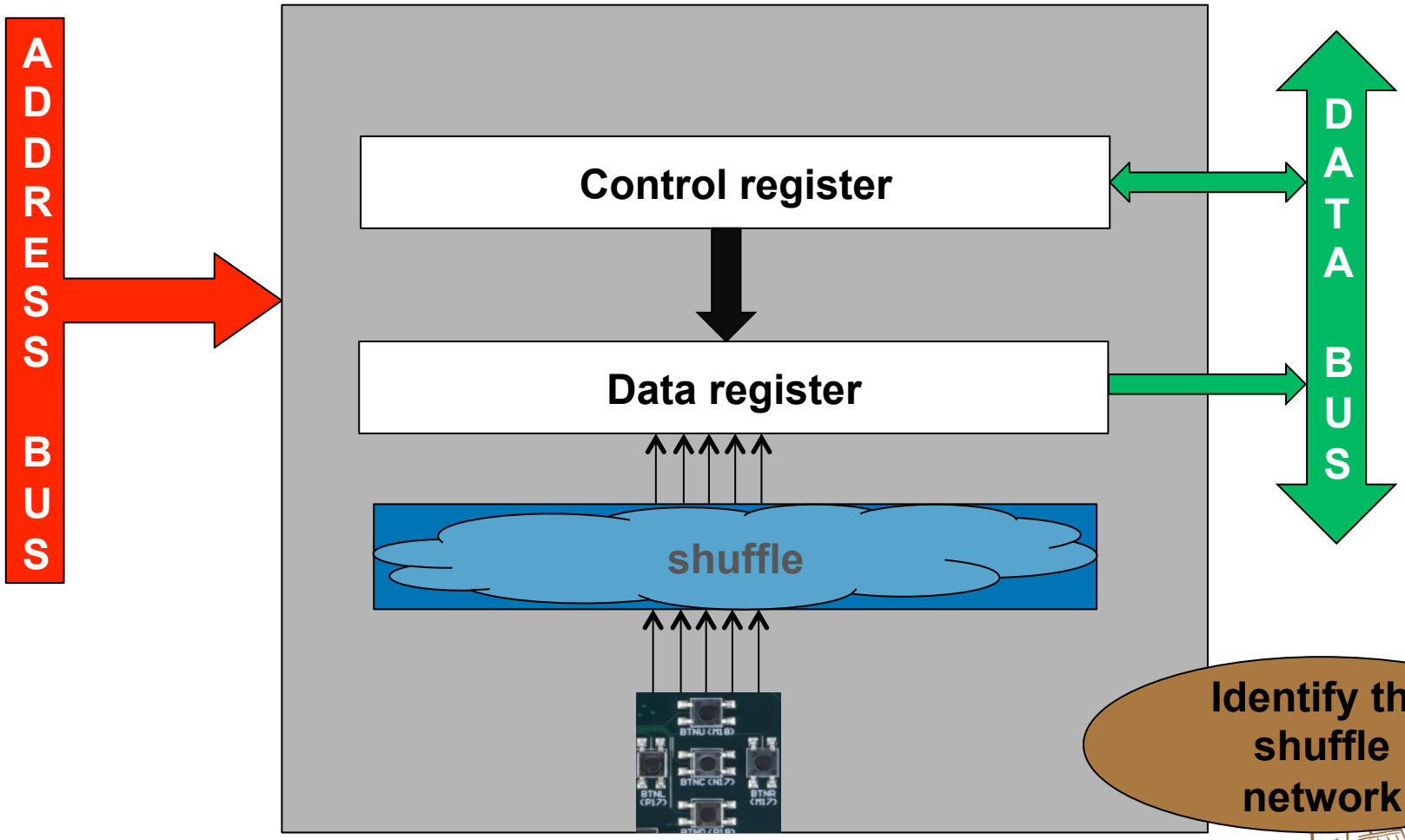


- 5 pushbuttons are interfacing the microprocessor through an I/O module
- The I/O module has one control and one data register
- Both registers are 32bit wide
- Control register gives a bit level control for the data flow direction of each of the bits of the data registers
- Data register stores the state of the pushbuttons
- Input device

PUSH BUTTONS



PUSH BUTTONS



CPU - I/O communication

- Programmed I/O
  - CPU has to wait for completion of each I/O operation
- Interrupt-driven I/O
  - CPU can execute other code during I/O operation

Programmed I/O

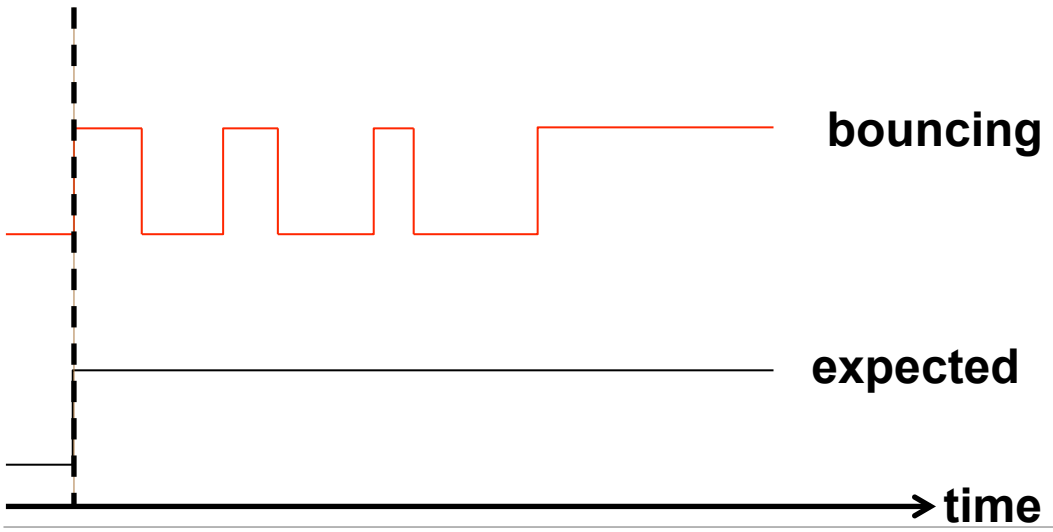
- Polling
  - CPU repeatedly checks if the device I/O is ready
  - Many clock cycles are wasted

Check if any of the pushbuttons are pressed or released

Bouncing

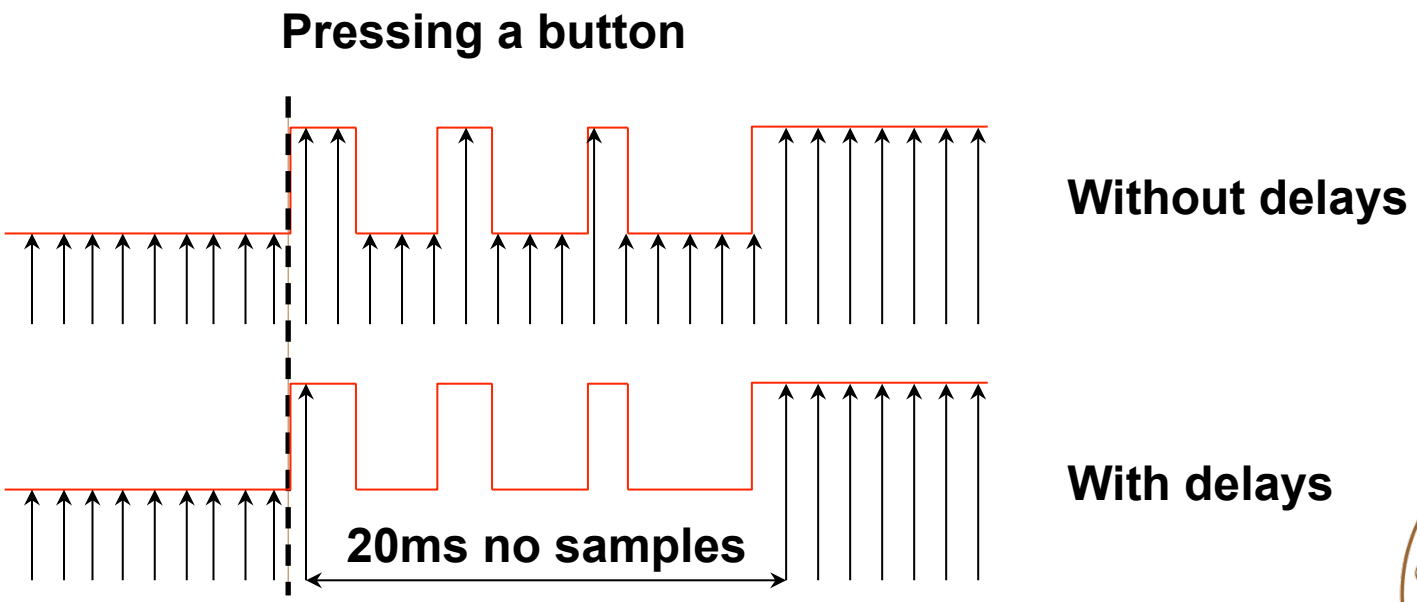
- Problem with the pushbuttons
- Tendency of any two metal contacts in an electronic device to generate multiple signals as the contacts close or open

Pressing a button



Debouncing

- Delays
- If the state has changed, read the state after some delay
- The delay is of order of milliseconds



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