CHW 469 : Embedded Systems

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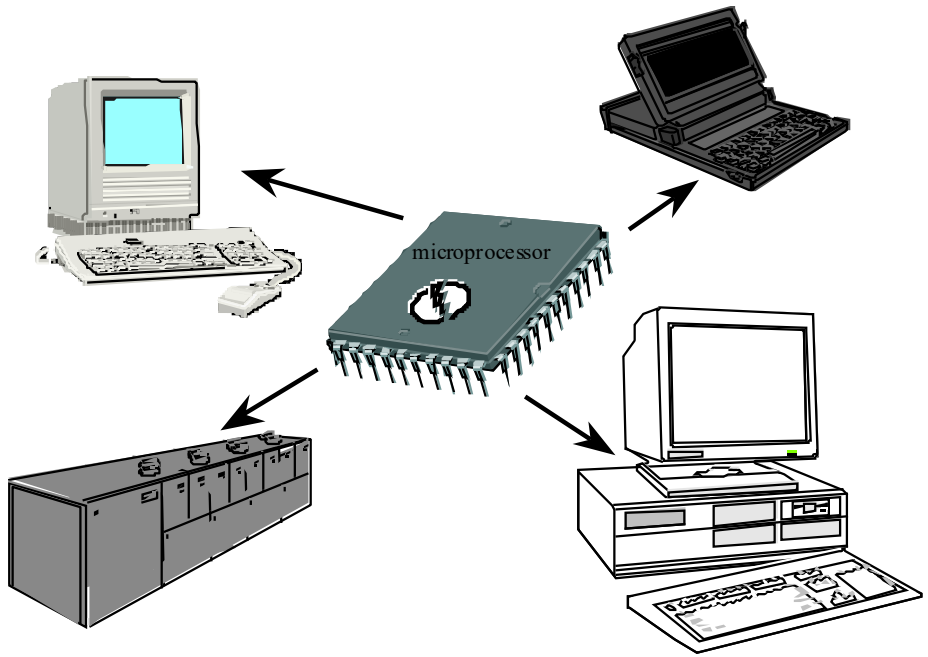
https://piazza.com/fci.bu.edu.eg/spring2017/chw469/home

What ? Embedded Systems

- **An embedded system is an electronic system that:**
  - includes a microcomputer embedded or hidden inside.
  - has software programmed into ROM.
  - has software that is not accessible to the user of the device
  - is configured to perform a specific dedicated application (software solves only a limited range of problems)

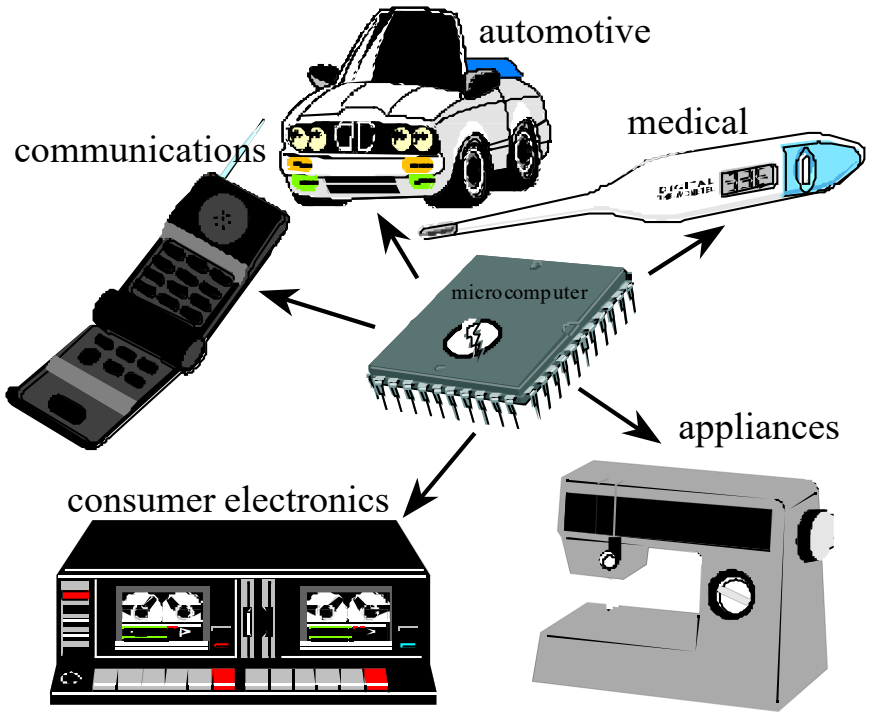
General Purpose System

- keyboard
- disk
- graphics display
- software useful for a wide variety of purposes
- software that can be changed by user



Embedded System

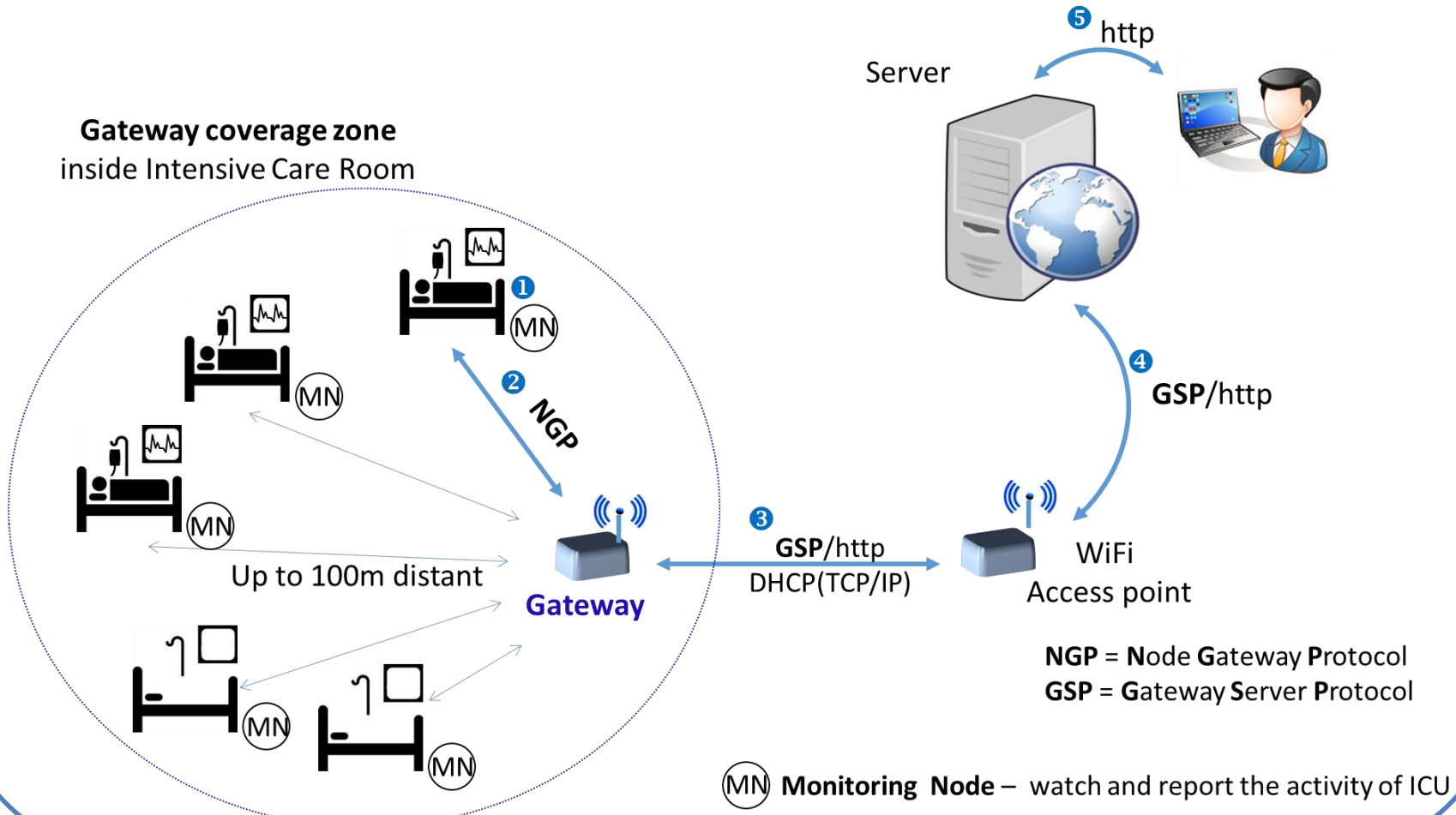
- Accepts inputs,
- Performs calculations
- Generates outputs
- Runs in “real time.”



The **internet of things** (IoT)

- Embedded systems (sensors and actuators).
- Internet.

ICU Utilization System



Embedded Systems “Big Ideas”

- **HW/SW Architecture**
  - Non processor centric view of architecture
  - Microcontroller, FPGA, analog circuits
- **Bowels of the “operating system”**
  - Specifically, the lower half of the OS
  - Concurrency, parallelism, synchronization
- **Real world design**
  - performance vs. cost tradeoffs, constraints
- **Analyzability**
  - how do you “know” that your drive-by-wire system will function correctly?
- **Application-level techniques**
  - Power Aware Programming

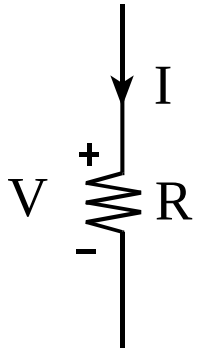
Review of Electronics

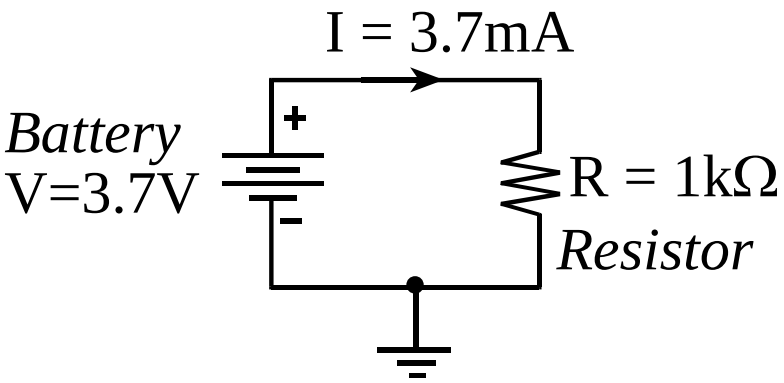
Ohm's Law

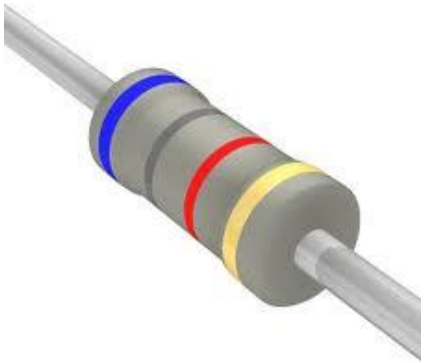
*V = I * R* *Voltage = Current * Resistance*

I = V / R Current = Voltage / Resistance

R = V / I Resistance = Voltage / Current







*P = V * I* *Power = Voltage * Current*

P = V2 / R *Power = Voltage^2 / Resistance*

*P = I2 * R* *Power = Current^2 * Resistance*

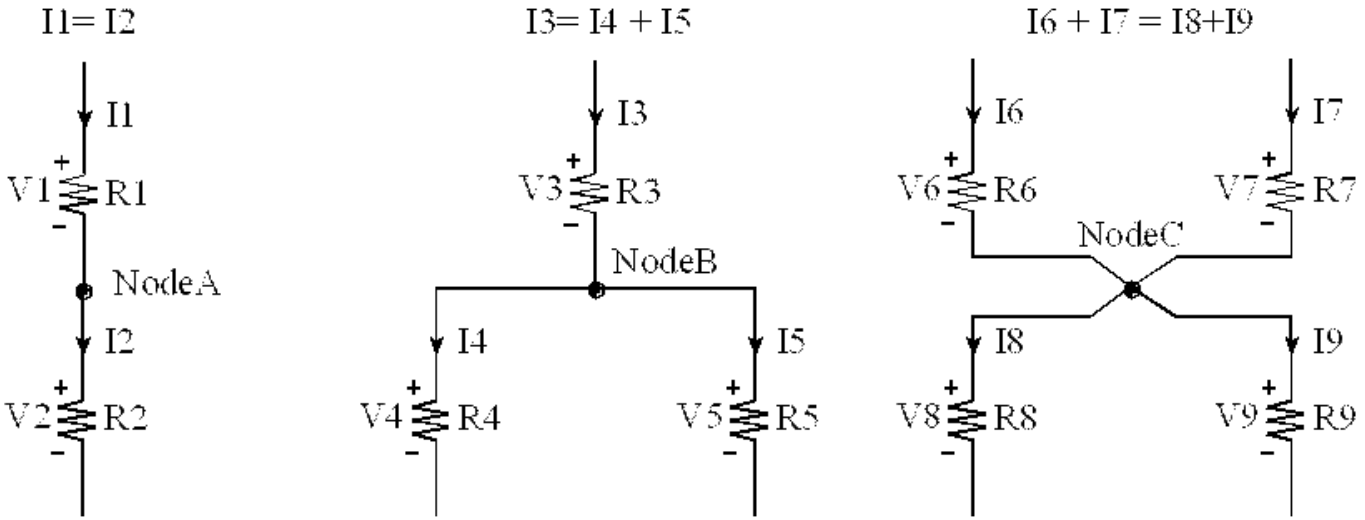
Review of Electronics (Cont...)

- Voltage: an electrical potential.
- Current: the flow of charge (electrons)
- Power: the rate of energy change.
- Energy: defines the amount of work that can be done
- Resistance: potential divided by flow

Review of Electronics (Cont...)

Kirchhoff's Current Law (KCL).

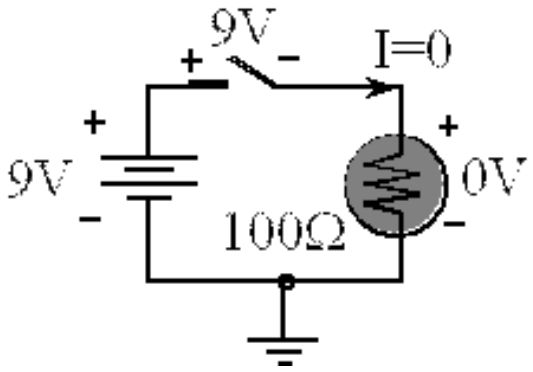
The sum of the currents **into a node** equal the sum of the currents **leaving the node**.

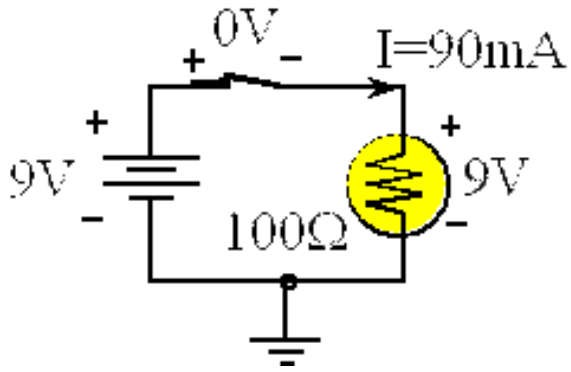


Review of Electronics (Cont...)

Kirchhoff's Voltage Law (KVL).

The sum of the voltages **around the loop is zero**.





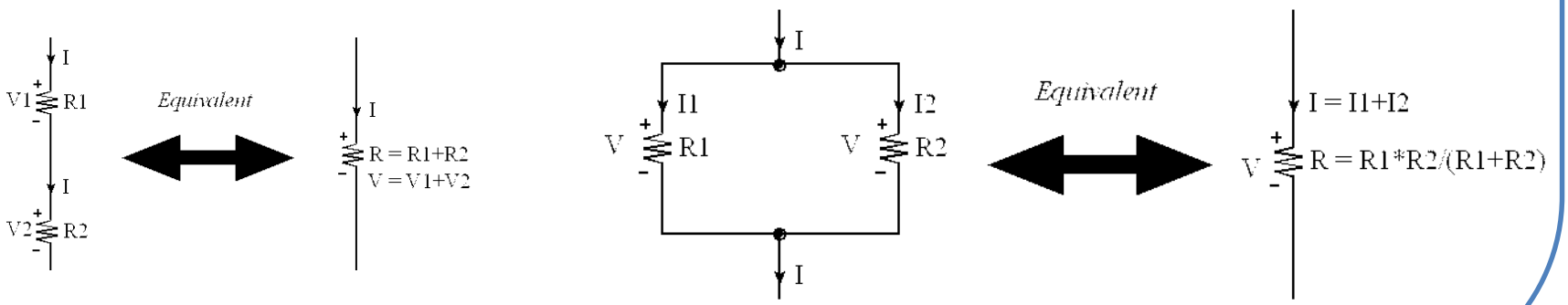
Review of Electronics (Cont...)

Series resistance

If resistor R1 is **in series** with resistor R2, this combination behaves like one resistor with a value **equal** to R1+R2

Parallel resistance

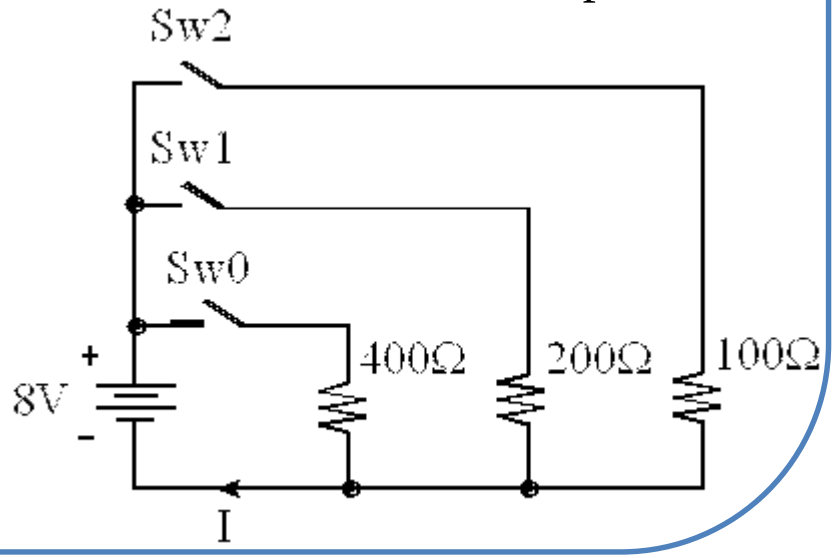
If resistor R1 is **in parallel** with resistor R2, this combination behaves like one resistor with a value **equal** to R1*R2/(R1+R2)



Review of Electronics (Cont...)

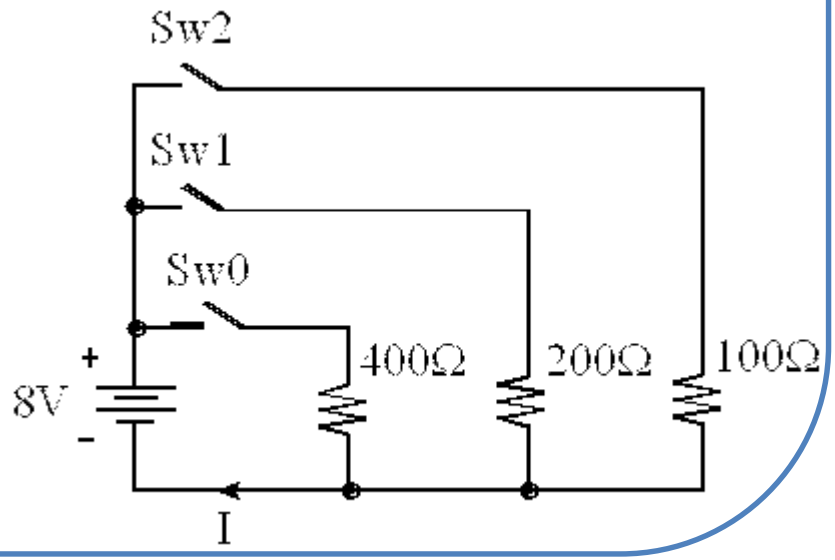
Consider this 3-bit digital to analog converter. Define a 3-bit number *n* (0 to 7) which specifies the three switch positions. *n* = 0 means none are pushed. *n* = 1 means Sw0 is pushed. *n* = 2 means Sw1 is pushed. *n* = 3 means Sw1 and Sw0 are pushed. *n* = 4 means Sw2 is pushed. *n* = 5 means Sw2 and Sw0 are pushed. *n* = 6 means Sw2 and Sw1 are pushed. *n* = 7 means all are pushed.

Derive a relationship between the current *I* and the number *n*. Multiple choice



Review of Electronics (Cont...)

400	200	100	0	0	0	0	0	0	0	No- Current
400	200	100	1	0	0	400	0	0	400	0.02
400	200	100	0	1	0	0	200	0	200	0.04
400	200	100	1	1	0	400	200	0	133.3333	0.06
400	200	100	0	0	1	0	0	100	100	0.08
400	200	100	1	0	1	400	0	100	80	0.1
400	200	100	0	1	1	0	200	100	66.66667	0.12
400	200	100	1	1	1	400	200	100	57.14286	0.14



Review of Electronics (Cont...)

EXAMPLE : ANALOG INPUT = 6.428V, REFERENCE = 10.000V