Chapter 1 Homework Solutions

Solution 1.1: Replace all +5V with +3.3V

Logic high is 3.3V, logic low is 0V. Assuming a fixed resistance R, the +5V logic has a power of $5V \cdot 5V/R$, which equals $25/R$. The +3.3V logic has a power of $3.3V \cdot 3.3V/R$, which equals $11/R$. This is a reduction in power by a factor of $11/25 = 44\%$.

Solution 1.2: The software in a vending machine must maintain accept money, issue product based on user selection, maintain inventory, control temperature, and issue change.

Solution 1.3: A port is a physical connection between the computer and its outside world. It allows information to enter and exit the system.

Solution 1.4: It refers to a memory where its contents are not lost when power is removed.

Solution 1.5: RAM refers to Random Access Memory. ROM refers to Read Only Memory. I/O refers to input/output. ALU refers to arithmetic logic unit. ADC refers to analog to digital converter.

Solution 1.6: A microcontroller is a microcomputer that incorporates the processor, RAM, ROM and I/O devices into a single package.
**Solution 1.7**: The flowchart describes the control algorithm of a thermostat.

```
main

1

mode?

off

AC or heat

input desired

input room

room ≥ desired + 2

mode? heat

AC

mode? heat

AC

room < desired - 2

room ≥ desired + 2

room < desired - 2

room ≥ desired + 2

AC?

mode?

turn heat off

turn AC off

turn AC off

turn heat off

turn heat off

1
```

**Solution 1.8**: A cruise control algorithm maintains constant speed.

```
main

mode?

off

AC or heat

desired is current speed

accelerator is set at current value

input break

done?

break

input speed

too slow

speed < desired - 1

acceleration ++

too fast

speed ≥ desired + 2

acceleration --
```

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**Solution 1.9:** The flowchart is.

```
Solution 1.10: Write C code for the flowchart.

```void step(unsigned char value){unsigned short cnt;
while((PORTA&0x01)==0){}; /* stop if PA0=0, continue if PA0=1 */
PORTB = value;              /* output to stepper */
for(cnt==0;cnt<10000;cnt++){}; /* wait */
}
```void main(void){
while(1){
step(5);   /* rotate stepper motor */
step(9);   /* rotate stepper motor */
step(10);  /* rotate stepper motor */
step(6);   /* rotate stepper motor */
}
}
```

**Solution 1.11:** Draw a data flow graph of the thermostat algorithm developed in Homework 1.7.

```
Solution 1.12:** Draw a data flow graph of the cruise control algorithm developed in Homework 1.8.
Solution 1.13: First draw the flowchart in the regular way, then show the groupings

```
int data[100], sum;
void calc(void){
    int i;
    sum = 0;
    for(i=0; i<100; i++)
        sum = sum + data[i];
}
```

Solution 1.14: First draw the flowchart in the regular way, then show the groupings that define each basic block. This flowchart is already structured into two conditional (basic) blocks.

```
int decide(int in){
    int out;
    switch(in){
        case 0:  out = 1; break;
        case 1:  out = 2; break;
        default: out = 3;
    }
    return out;
}
```
**Solution 1.15:** First draw the flowchart in the regular way. This flowchart is not technically structured, because the *if* statements do not rejoin.

It can be converted to a structured flowchart by rejoining each conditional. \texttt{Out} is a hidden local variable. The answer is the same as Homework 1.14 solution.

**Solution 1.17.**

**Solution 1.18.**
**Solution 1.19.** A calls B means an arrow from A to B. C calls A means an arrow from C to A. B calls C means an arrow from B to C. These three arrows create a loop, so A, B, C must be tested together. D could be independently tested.

**Solution 1.20.** List 3 factors that we can use to evaluate the “goodness” of a program.
- Dynamic efficiency is the execution speed
- Static efficiency is the memory needed (ROM and RAM)
- Style defines how easy it is to understand, debug, or modify