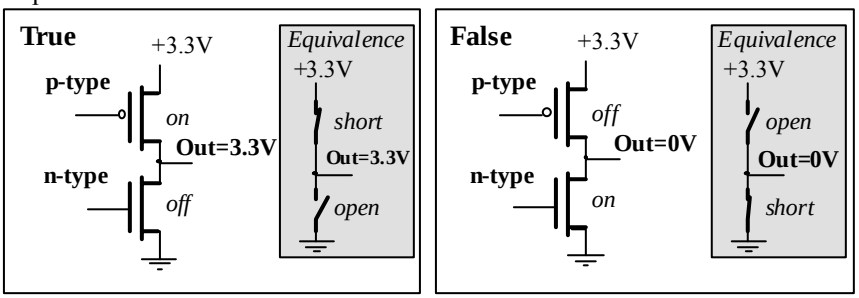
Chapter 1 Homework Solutions

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*5V/R, which equals 25/R. The +3.3V logic has a power of 3.3V*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.

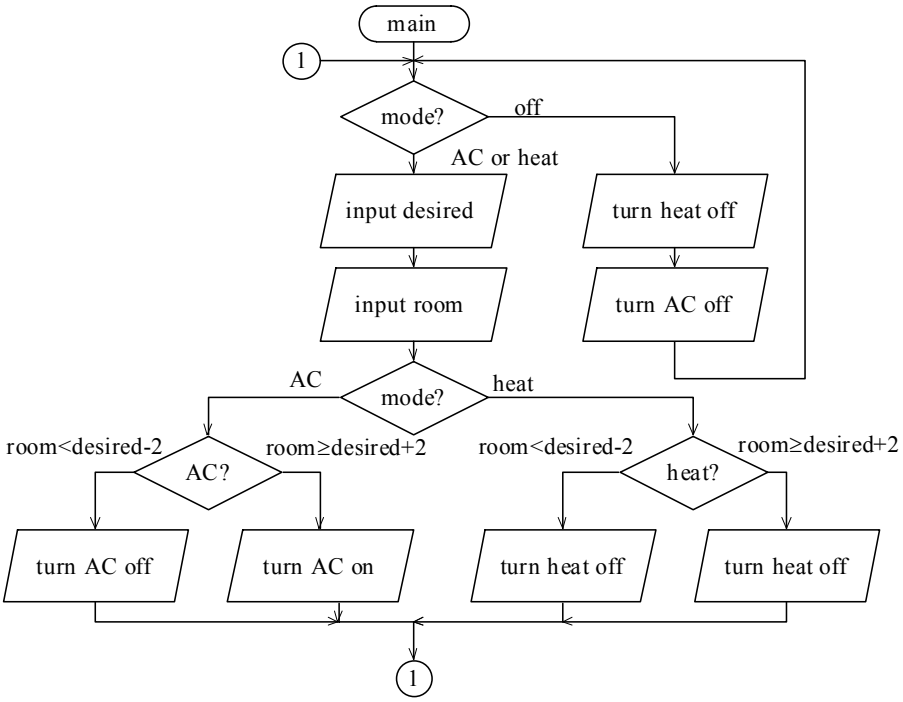
Solution 1.3: A port is a physical connection between the computer and its outside world. It allows information to enter and exit the system.

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

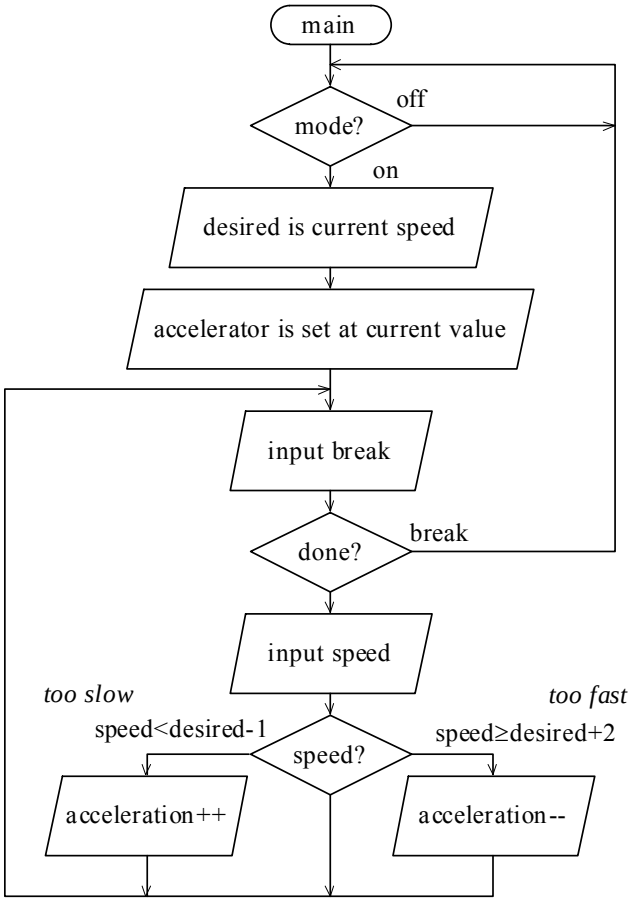
Solution 1.5: RAM refers to Random Access Memory. ROM refers to Read Only Memory. I/O refers to input/output. ALU refers to arithmetic logic unit. ADC refers to analog to digital converter.

Solution 1.6: A microcontroller is a microcomputer that incorporates the processor, RAM, ROM and I/O devices into a single package.

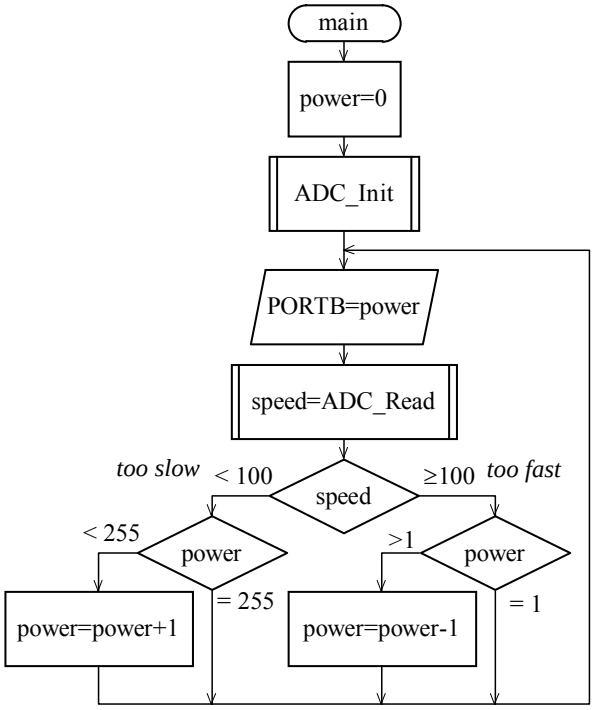
Solution 1.7: The flowchart describes the control algorithm of a thermostat.



Solution 1.8: A cruise control algorithm maintains constant speed.



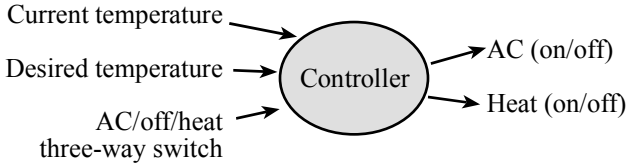
Solution 1.9: The flowchart is.



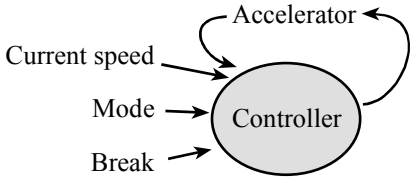
Solution 1.10: Write C code for the flowchart.

```
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 */
  }
}
```

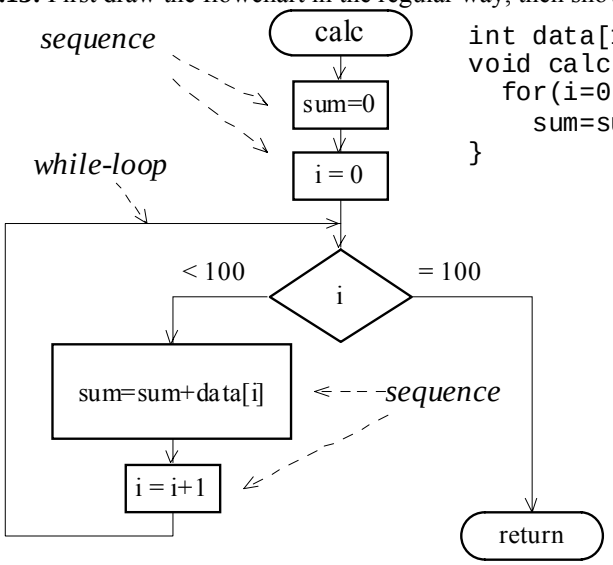
Solution 1.11: Draw a data flow graph of the thermostat algorithm developed in Homework 1.7.



Solution 1.12: Draw a data flow graph of the cruise control algorithm developed in Homework 1.8.

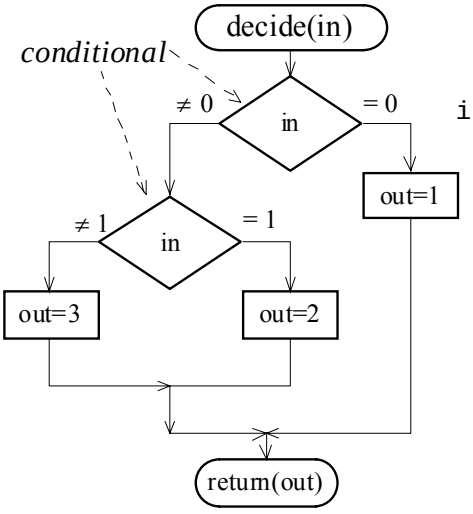


Solution 1.13: First draw the flowchart in the regular way, then show the groupings



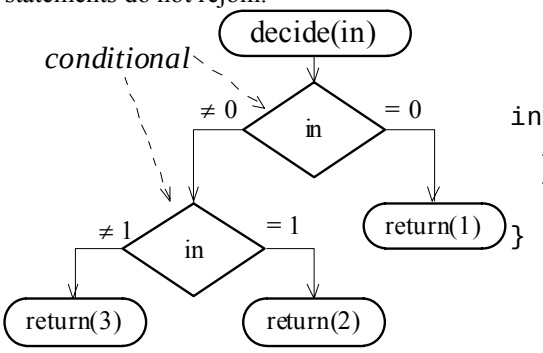

```
int data[100],sum;
void calc(void){int i; sum=0;
  for(i=0;i<100;i++)
    sum=sum+data[i];
}
```

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;
  }
```

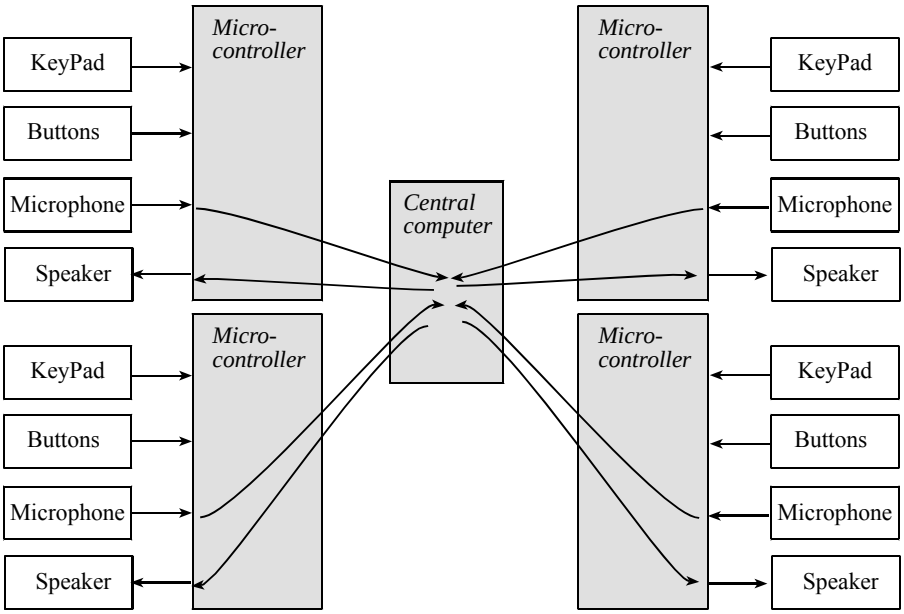
Solution 1.15: First draw the flowchart in the regular way. This flowchart is not technically structured, because the *if* statements do not rejoin.



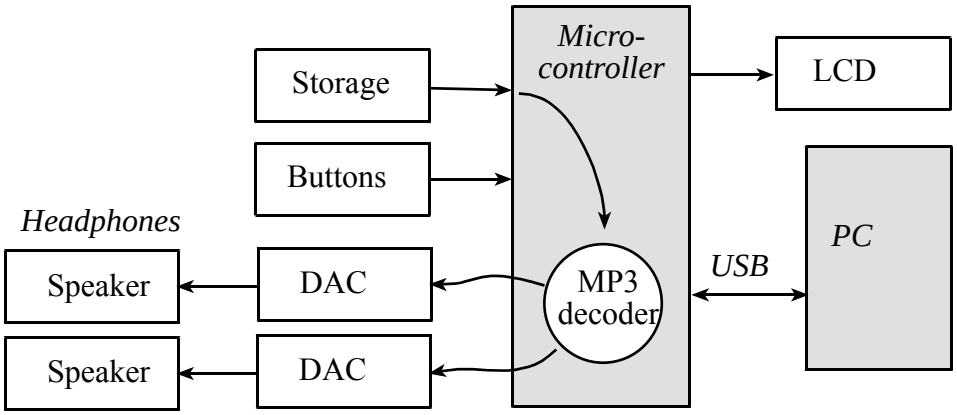

```
int decide(int in){
  if(in==0) return 1;
  if(in==1) return 2;
  return 3;
}
```

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

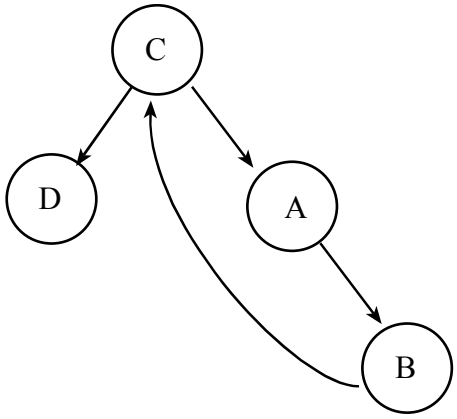
Solution 1.17.



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