7.   num = 0

    repeat:

    if (num is Odd)

    print (num is Odd)

    num = num + 1

    until (num < 50)

11. Suppose N is the given integer. Then the following will work. You may want to ask your students how this solution could be made more efficient.

X = 1

while (X ≤ N):

    if (X divides N):

        print(X)

    X = X + 1

13. Pseudocode is a relaxed version of a programming language used to jot down ideas. A formal programming language prescribes strict rules of grammar that must be obeyed.

20.   Approximately 122 meters. Let the distance between the hives be y. Since each bee flies at a constant speed, the ratio of the distances traveled must be the same each time the meet. Therefore, $50/(y - 50) = (y + 20)/(2y - 20)$. Solving for y implies that y is approximately 7.5 meters or 122 meters.

22. Body: Everything indented below the while

    Initialization: The first two assignment statements

    Modification: The last assignment statement (Some could argue that it is the last three assignment statements.)

    Test: while (Current < 100)

    The output will be 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89.

23. It prints all prime numbers from 1 to 100 as shown below:

1

2

3

5

7

11

13

17

19

23

29

31

37

41

43

47

53

59

61

67

71

73

79

83

89

97

25. When searching for J: H, L, J
    When searching for Z: H, L, N, 0
26. Sequential search: 3000
    Binary search: at least 13
37. a. binary   b. sequential   c. binary   d. binary
    e. 4 for the sequential search; 3 for the binary search.
38. Armstrong (num, digits)
    n = num
    while (num > 0) do
    digit = n % 10;
          sum = sum + pow (digit, digits)
                n = n / 10;
    if (sum = num)
    print it is an Armstrong number
    else
    print it is not an Armstrong number

46. alphabeticalsorting (char a[m][n])
    {
    char temp[100];
    int i, j;

```
for (i =0; i < m; i++)
    for (j = i+1; j < m+1; j++)
    {
        if (stringcompare(a[i], a[j]) > 0)
        {
            stringcopy (temp, a[i]);
            stringcopy (a[i], a[j]);
            stringcopy (a[j], temp);
        }
    }
print ("Sorted strings are : ");
for (i = 0; i < m+1; i++)
print (a[i]);
}

int stringcompare (char s1[], char s2[])
{
  int i = 0;
    while ( s1[i] != '\0' )
    {
        if ( s2[i] == '\0' ) { return 1; }
        else if ( s1[i] < s2[i] ) { return -1; }
        else if ( s1[i] > s2[i] ) { return 1; }
            i++;
    }
        return 0;
}
stringcopy (char dest[], char src[])
{
for (i=0; src[i] != '\0'; ++i)
        dest[i] = src[i];
        dest[i] = '\0';
}
```

53. No. The algorithm will not compute the correct answer when $X = 0$.

56. a. Preconditions: The input list is arranged in ascending order.

Loop invariant: The target value is not equal to any list entry preceding the current entry.

b. Since the input list can contain only a finite number of entries and each time

through the body of the loop the current entry is advanced by one, at some point there will no longer remain entries to be considered.

Chapter 6

2. Suppose the value of x is stored in the memory cell whose address is XY and the program begins at address 00.

    2100

    31XY

    2003

    B110

    2201

    5112

    31XY

    B006

23.   `if (X > 5):`

        X = X + 2

    else:

        X = X + 1

29. When passing by value, the sequence 7, 5 would be printed. When passing by reference the sequence 7, 7 would be printed.
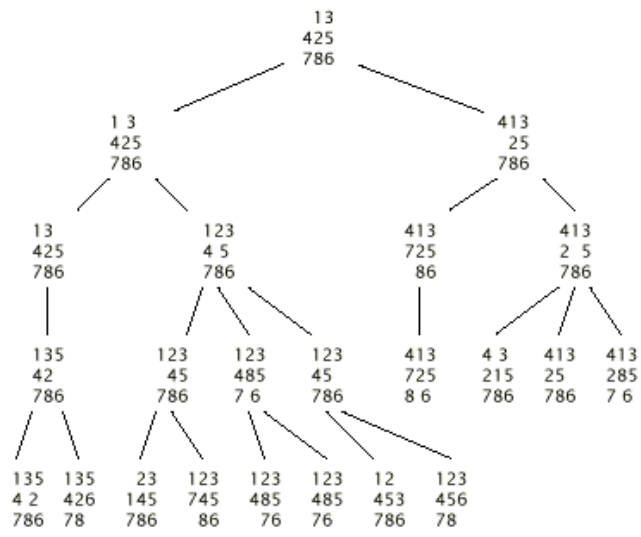
42. Any string of the form $x^n y x^n$, where n is a nonnegative integer.

45. When performing either assignment statement, the value of X will already be in a register as a result of the comparison performed earlier. Thus, it need not be retrieved from memory.
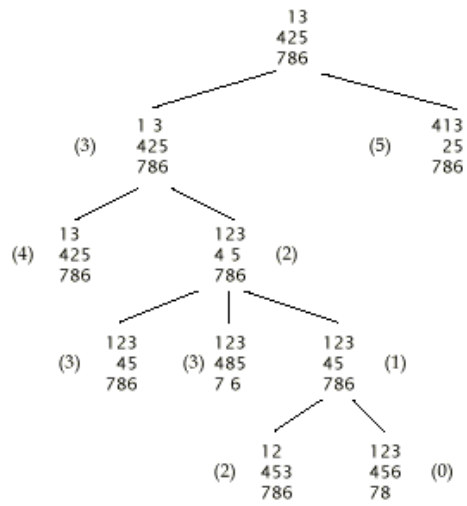
51. Answers will vary.

Chapter 11

28.

```
                            13
                            425
                            786
                  ┌──────────┴──────────┐
                 1 3                    413
                 425                     25
                 786                    786
           ┌──────┴──────┐        ┌──────┴──────┐
          13            123      413            413
          425           4 5      725            2 5
          786           786       86            786
           │      ┌───┬──┴──┐      │        ┌───┬─┴──┐
          135    123  123  123    413      4 3  413  413
          42      45  485   45    725      215   25  285
          786    786  7 6   786    8 6     786  786  7 6
        ┌──┴─┐  ┌─┴─┐ ┌─┴─┐ ┌─┴──┐
       135  135 23 123 123 123  12  123
       4 2  426 145 745 485 485 453 456
       786  78  786  86  76  76 786  78
```

29.

```
                    13
                    425
                    786
          ┌──────────┴──────────┐
         1 3                    413
    (3)  425              (5)    25
         786                    786
     ┌────┴────┐
    13        123
(4) 425  (2)  4 5
    786        786
          ┌────┬──┴──┐
         123  123   123
    (3)   45 (3) 485  45    (1)
         786    7 6  786
                     ┌───┴───┐
                    12       123
               (2)  453      456  (0)
                    786       78
```

30.

```
                        123
                        576
                        4 8
          ┌──────────────┼──────────────┐
         123            123            123
(6)      576      (4)   5 6      (4)    576
          48            478             48
                ┌────────┼────────┐
               1 3      123      123
         (5)   526  (5) 56       56   (3)
               478      478      478
                          ┌────────┬────────┐
                         23                123
                   (4)   156        (2)    456
                         478                78
                                            │
                                           123
                                     (1)   456
                                           7 8
                                    ┌───────┴───────┐
                                   123            123
                             (2)   456      (0)   456
                                   7 8            7 8
```
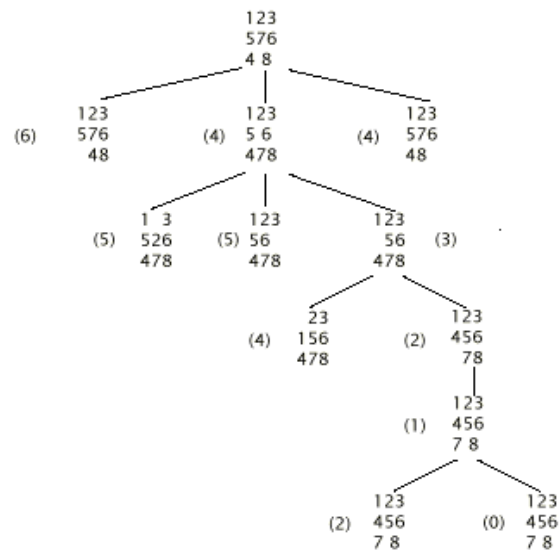
31.   It does not distinguish between different states as well.

Chapter 12

5. The following routine places the quotient of X and Y in Z:

```
clear Z
copy X to XX
while XX not 0:
    copy Y to YY
    while YY not 0:
        decr XX
        decr YY
    incr Z
copy X to XX
while XX not 0:
    decr Z
    clear XX
```

6. It computes X − Y when X ≥ Y.

10. One approach would be

```
    incr name1
    clear name2
    repeat:
        incr name2
        decr name1
        until (name1 equals 0)
    decr name2
```

26. Yes, searching through a binary tree for a particular value is a polynomial problem. Its time complexity is O(nlogn) and nlogn is equals to n ^ m.

27.
```
def fib( n):
  if (n <= 1)
    return n
  return fib(n-1) + fib(n-2)
```

Time Complexity: T(n) = T(n-1) + T(n-2) which is exponential (non polynomial).

34. Yes, it is deterministic. The person following the directions never has to make a choice. At each step, that person merely does what he or she is told.

42. The merge sort would perform 4 name comparisons when sorting the list Alice, Bob, Carol, and David. The precise number performed when sorting the list Alice, Bob, Carol, David, and Elaine depends on the point at which the odd entry is considered.

47. $(n - 1) + (n - 2) + ... + 1$