Using Lists for Tabulation

Using Arrays for Tabulation

• Arrays turn out to be useful when you have a set of data values and need to count how many values fall into each of a set of ranges. This process is called tabulation.

• Tabulation uses arrays in a different way from applications that use them to store a list of data. When you implement a tabulation program, you use each data value to compute an index into an array of integers that keeps track of how many values fall into that category.

• The example of tabulation used in the text is a program that counts how many times each of the 26 letters appears in a sequence of text lines. Such a program is useful in decoding letter-substitution ciphers, which is one aspect of the topic of cryptography you’ll be working with on Project #4.

Cryptograms

• A cryptogram is a puzzle in which a message is encoded by replacing each letter in the original text with some other letter. The substitution pattern remains the same throughout the message. Your job in solving a cryptogram is to figure out this correspondence.

• One of the most famous cryptograms was written by Edgar Allan Poe in his short story “The Gold Bug.”

• In this story, Poe describes the technique of assuming that the most common letters in the coded message correspond to the most common letters in English, which are E, T, A, O, I, N, S, H, R, D, L, and U.

Implementation Strategy

• The basic idea behind the program to count letter frequencies is to use an array with 26 elements to keep track of how many times each letter appears. As the program reads the text, it increments the array element that corresponds to each letter.

Edgar Allan Poe (1809-1849)

Poe’s Cryptogram Puzzle

AGOODGLASSINTHEBISHOPSHOSTELINTHEDEVILSESSTHADYBYBORDMAINSBRANCHEVENTSIBLEJUINSHOOTFROMTHELEFTYEESCOPETHESHOTFIFTYFOOTOUT
Program to Count Letter Frequencies

```python
# File: CountLetterFrequencies.py

'''
This program counts the frequencies of letters in a sequence of lines
that the user enters on the console.
'''

def CountLetterFrequencies():
    counts = createFrequencyTable()
    print("Enter input lines, ending with a blank line."
    while True:
        line = input("")
        if line == "":
            break
    updateFrequencyTable(counts, line)
    printFrequencyTable(counts)

def createFrequencyTable():
    """
    Creates an empty frequency table, which is a list of 26 elements
    indicating the counts for each letter of the alphabet.
    """
    return [0] * 26
```

Exercise: Display a Histogram

- Write a function `showHistogram(scores)` that takes a list of
  scores in the range 0 to 100 and then displays on the console a
  histogram of those scores divided into ranges 0-9, 10-19, and
  so on.

  ```
  +-------------------+-------------------+-------------------+-------------------+
  | 0 - 9             | 10 - 19           | 20 - 29           | 30 - 39           |
  +-------------------+-------------------+-------------------+-------------------+
  | 0                 | 1                 | 2                 | 3                 |
  +-------------------+-------------------+-------------------+-------------------+
  | 4                 | 5                 | 6                 | 7                 |
  +-------------------+-------------------+-------------------+-------------------+
  | 8                 | 9                 | 10                | 11                |
  +-------------------+-------------------+-------------------+-------------------+
  | 12                | 13                | 14                | 15                |
  +-------------------+-------------------+-------------------+-------------------+
  | 16                | 17                | 18                | 19                |
  +-------------------+-------------------+-------------------+-------------------+
  | 20                | 21                | 22                | 23                |
  +-------------------+-------------------+-------------------+-------------------+
  | 24                | 25                | 26                | 27                |
  +-------------------+-------------------+-------------------+-------------------+
  ```

- Histograms are usually presented vertically. The one in this
  exercise is drawn horizontally because that program is so
  much easier to write.

Image Histograms

- The statistical notions behind the histogram program are
  important in image processing of the sort you’ll undertake in
  Project #3.

- One part of the ImageShop program uses histograms to adjust
  a photograph with insufficient contrast, as illustrated below:

  ```
  | low-contrast image | the same image after equalization |
  —— | —— | —— |
  | standard histogram | cumulative histogram |
  —— | —— | —— |
  ```

- The steps in the process are are illustrated on the next slide.