Example 7: How many counties in the US have a higher population
density than the state of New Jersey?

Of course this question is contrived so that the solution will illustrate a 3-level nesting of structures – in this case, a conditional statement inside a While inside a For loop. It will also illustrate a simple use of an array. We will use the divide-and-conquer method to break the problem into three relatively simple parts, which we will then combine. We will assume that some clerk has access to data on all 50 states, showing the population and area of each county in the state.

For the convenience of the clerk, it would be good to refer to states by name, so we will start by building the names of the states into the program:

> Declare String Array StateNames[51] // We will only use entries numbered 1 through 50
> Set StateNames[1] = "Alabama"   //Note 1
> Set StateNames[2] = "Alaska"
> ……………….
> Set StateNames[49] = "Wisconsin"
> Set StateNames[50] = "Wyoming"

Our strategy is to go through the states, and for each state go through its list of counties. In each county, we have to divide the population by the area to get the density, then compare the quotient with the population density of New Jersey, which is 1012.1 persons per square mile. (Note 2)

At this point, we can develop an initial Variables Table:

Name	Data Type	Usage
StateNames	Array[51] of String	Names of US States
J	Integer	Used for counting states
Dense CountiesCount	Integer	Number of high-density counties found
Population	Integer	Population of one county
Area	Float	Area of one county
Density	Float	Density of one county
JerseyDensity	Float Constant	1020.1 prsons/Sq.Mi. in New Jersey

Step 1: Deal with the States

Since we know already how many states there are, we will use a For loop

> Begin Program
> Declare J as Integer
> Declare DenseCountiesCount as Integer
> Set DenseCountiesCount = 0 // Every time we fine a high-density county, we add 1 to this.
> For (J = 1; J <= 50; J = J + 1)
> 		*Instruct the clerk to enter data for state StateNames[j] and process it*
> End For

Write "There are " + DenseCountiesCount + " counties with population densities greater than that of New Jersey."
End Program

Step 2: Deal with one State

We have to go through the list of counties, but we don't know how many there are (most likely, no two states are the same) so we will use a While loop with a sentinel, as we have done before. Here is what we need in the yellow area:

Declare Population as Integer
Declare Area, Density as Float
Write "Enter the population and area of a " + StateNames[J] + " county"
Input Population, Area
While (Population > 0)
        Deal with the data for this county
        Write "Enter the population and area of a county, or zero and zero if finished"
        Input Population, Area
End While

Step 3: Deal with one County

Now we forget about loops for a while, and just deal with the data we have for some unknown county.

Set Density = Population/Area
If (Density > JerseyDensity)
        Set DenseCountiesCount = DenseCountiesCount + 1
End If

Step 5: Assemble the Program

First, we insert the results of Step 3 in place of the blue-highlighted line in Step 2:

Declare Population as Integer
Declare Area, Density as Float
Write "Enter the population and area of a county, or zero and zero if finished"
Input Population, Area
While (Population > 0)
        Set Density = Population/Area
        If (Density > 1210.1)
                Set DenseCountiesCount = DenseCountiesCount + 1
                EndIf
        Write "Enter the population and area of a county, or zero and zero if finished"
        Input Population, Area
End While

Then, we insert all of the above in place of the yellow line in Step 1, and pick up the initial declarations:

```
Declare String Array StateNames[51] // We will only use entries numbered 1 through 50
Set StateNames[1] = "Alabama"    //Note  1
Set StateNames[2] = "Alaska"
……………….
Set StateNames[49] = "Wisconsin"
Set StateNames[50] = "Wyoming"

Declare JerseyDensity as Float
Set JerseyDensity = 1210.1

Declare J as Integer
Declare DenseCountiesCount as Integer
Set DenseCountiesCount = 0 // Every time we fine a high-density county, we add 1 to this.
For (J = 1; J <= 50; J = J + 1)
        Declare Population as Integer
        Declare Area, Density as Float
Write "Enter the population and area of a " + StateNames[J] + " county"
        Input Population, Area
        While (Population > 0)
                Set Density = Population/Area
                If (Density > 1210.1)
                        Set DenseCountiesCount = DenseCountiesCount + 1
                        EndIf
                Write "Enter the population and area of a county, or zero and zero if finished"
                Input Population, Area
        End While
End for
Write "There are " + DenseCountiesCount + " counties with population densities greater than
that of New Jersey."
End Program
```

Note 1: This is a very common use of arrays. For instance, any program that has to deal with calendar issues would contain an array of month names, and another array containing the number of days in each month.

Note 2: Source: Wikipedia article "List_of_U.S._states_by_population_density"