

**Armstrong State University**  
**Engineering Studies**  
**MATLAB Marina – Structures Exercises**

1. Answer the following questions for MATLAB structures:
  - a) How can structures be created?
  - b) How can one extract the data from fields of a structure?
  - c) How can one pre-allocate space for a structure?
  - d) What operations can be done on structures?
2. Answer the following questions for MATLAB structure arrays:
  - a) How can structure arrays be created?
  - b) How can one extract the data from the fields of a structure array?
  - c) How can one pre-allocate space for a structure array?
  - d) What operations can be done on structure arrays?
  - e) What do the MATLAB functions `disp`, `length`, and `size` return for structure arrays?
3. Run the MATLAB program of Figure 1 that creates two `workerData` structures consisting of names (string), time to complete items (vector of numbers), and if the items passed quality control (vector of Booleans).

```
clear;
clc;
close all;
worker1Data.name = 'Bob';
worker1Data.time = [15.7, 12.2, 16.0, 14.8, 19.5, 9.8, 10.1, 20.2];
worker1Data.quality = [true, false, true, true, true, true, false, true];
worker2Data.name = 'Joe';
worker2Data.time = [18.7, 19.9, 23.4, 18.0, 18.7, 20.0];
worker2Data.quality = [false, true, true, false, true, false];
```

Figure 1, MATLAB Program to Create Two `workerData` Structures

Add code to the program to:

- Display the each `workerData` structure using the MATLAB `disp` function. How is the data in structures displayed?
- Display each `workerData` structure using the MATLAB `fprintf` function.
- Extract the time to complete items vector from each structure and store each of them in a separate row vector. Why can't these be stored in a 2D array with two rows?
- Extract the quality control vector from each structure and store each of them in a separate row vector.
- Compute the average time to complete an item for each worker.
- Compute the average time to complete an item that passed quality control for each worker.

- Compute the number and percentage of items completed that passed quality control for each worker.
4. Write a `createWorkerData` constructor (function). The `createWorkerData` constructor should take a name (string), an 1D array of times (row vector of real numbers), and an 1D array of quality control pass/fail (row vector of Booleans) and should return a structure containing name, time, and quality fields. Test the constructor function for the structure data: Bernard, [25.8, 34.6, 22.9, 33.3], [true, true, true, true].
  5. Complete the MATLAB program of Figure 1 that will create a `workerData` structure array. Use the constructor written for problem 2 to create the individual structures.

```

% create workerData structure array
numberWorkers = input('Enter number of workers: ');

% pre-allocate space for the workerData structure array
workerData = struct('name', cell(1,numberWorkers), 'time', ...
    cell(1,numberWorkers), 'quality', cell(1,numberWorkers));

% read in workerData info and save in structure array
for k = 1:1:numberWorkers

end

```

Figure 1, Program to Create workerData Structure Array

6. Write a MATLAB function that will display a `workerData` structure in the following format:  
 Name: worker's name  
 Times: vector of times  
 For example, a `workerData` structure containing the data: Bernard, [25.8, 34.6, 22.9, 33.3], [true, true, true, true], should be displayed as:  
 Name: Bernard  
 Times: 25.8 34.6 22.9 33.3.
7. Write a MATLAB program that will:
  - Load a `workerData` structure array from the MATLAB file `workerdata.mat`
  - Compute the average time to complete an item that passed quality control for each worker. Save these values in a 1D array.
  - Determine the number of items completed that passed quality control for each worker. Save these values in a 1D array.
  - Determine the number of items completed that passed quality control for all workers (total number).

- Determine the average worker time to complete an item that passed quality control for all workers.
8. Modify your `createWorkerData` constructor so that the `workerData` structure also has a field `itemsCompleted` that will hold a number corresponding to the items completed that passed quality control. Test the modified constructor from the command line for the data: `'Bob', [15.7, 12.2, 16.0, 14.8, 19.5, 9.8, 10.1, 20.2], [true, false, true, true, true, true, false, true], 0`.

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