

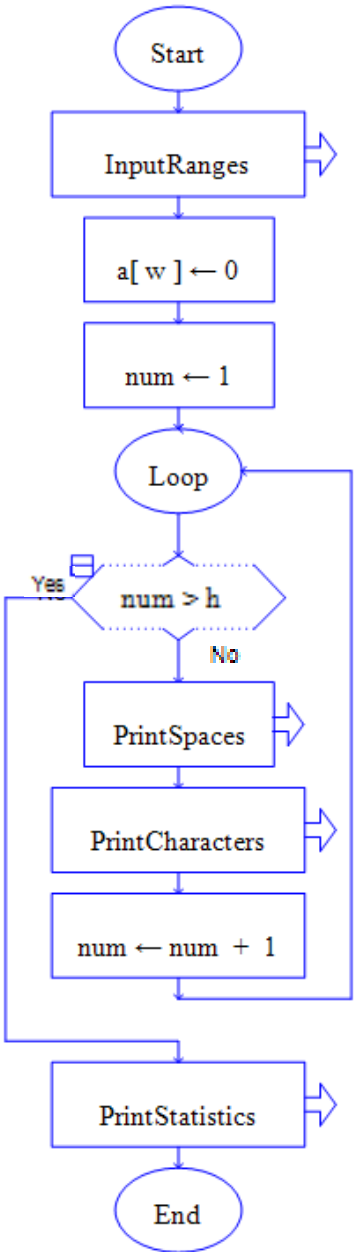
(60-140) Lab Exercises #8  
— Working with 1D arrays

November 13, 2017

1. Raptor: 1D array

- (a) Shown on the right is the main of a flowchart named “l8\_array.rap”, which is an enhanced version of “l6\_numbers.rap”. This enhanced flowchart takes two inputs  $w$  and  $h$ , for  $10 \leq w \leq 20$  and  $3 \leq h \leq 61$ . If both inputs are in range, the program prints  $h$  lines, each of which starts with a random number  $r_k$ ,  $k = 1, 2, \dots, h$ , in the range between 2 and  $w-1$ . If  $r_k$  is closer to 0 than  $w$ , the program prints  $r_k - 1$  number of characters  $c_k$ , and then ends the current line immediately. Otherwise, it prints  $r_k$  number of spaces first and then print  $w - r_k$  number of  $c_k$  before ending the current line. Depending on the value of  $k$ ,  $c_k$  is ‘1’–‘9’ for  $1 \leq k \leq 9$ , ‘a’–‘z’ for  $10 \leq k \leq 35$ , or ‘A’–‘Z’ otherwise. Before finishing, the flowchart also prints out the percentage of  $w/2$  among the total  $h$  random numbers. A typical example of running the program is shown below.

```
Enter width [10, 20]: 8
Enter height [3, 61]: 12
Enter width [10, 20]: 11
Enter height [3, 61]: 12
03: 11
08: ooooooooo222
03: 33
06: oooooo44444
05: 5555
08: ooooooooo666
10: oooooooooo7
08: ooooooooo888
05: 9999
09: oooooooooaa
04: bbb
02: c
Among 12 numbers, the percentage of 5 is 16.67%.
```



- (b) The main flowchart uses subchart **InputRanges** to obtain inputs for  $w$  and  $h$  after validation, subchart **PrintSpaces** to print the spaces when  $r_k$  is closer to  $w$ , subchart **PrintCharacters** to print either  $w - r_k$  or  $r_k - 1$  number of characters  $c_k$  as described above, and subchart **PrintStatistics** to print the last line of statistical information.

**Hint:** In subchart **PrintCharacters**, use “ $c \leftarrow \text{to\_character}(t)$ ” to assign the character as specified by ASCII code  $t$  to character  $c$  for printing.

- (c) Complete the flowchart with its four subcharts; save the file to “l8\_array.rap”; and submit it online.

2. Algorithm implementation with C programming languages:
- (a) Implement the algorithm as represented by “l8\_array.rap”, and write an equivalent C program that not only accomplishes what the flowchart does but also follows the structure of the flowchart when choosing C loop statements. The separate inputs of **w** and **h** of “l8\_array.rap”, however, need to be combined in a way as illustrated below:

```
Range: 9 < w < 21, 2 < h < 62
Enter width and height : 11 12
03: 11
05: 2222
02: 3
10:      4
06:      55555
10:      6
08:      777
04: 888
10:      9
06:      aaaaa
05: bbbb
08:      ccc
Among 12 numbers, the percentage of 5 is 16.67%.
```

```
Range: 9 < w < 21, 2 < h < 62
Enter width and height : 20 40
15:      11111
05: 2222      33
13:      4444444
19:      5
07: 666666
06: 77777
12:      88888888
08: 9999999
14:      aaaaaa
06: bbbbbb
15:      ccccc
09: dddddddd
08: eeeeeeee
03: ff
17:      ggg
05: hhhh
15:      iiiii
05: jjjj
12:      kkkkkkkk
09: 11111111
14:      mmmmmmm
04: nnn
04: ooo
04: ppp
11:      qqqqqqqqq
17:      rrr
10:      ssssssssss
16:      tttt
08: uuuuuuu
19:      v
14:      wwwwww
14:      xxxxxx
06: yyyyyy
03: zz
06: AAAAA
11:      BBBB88888
17:      CCC
14:      DDDDDDD
15:      EEEEE
Among 40 numbers, the percentage of 10 is 5.00%.
```

- (b) Save your program to a file named “l8\_array.c” in your working directory, and submit it online.

**Evaluation:** All online submissions must be completed before due time, which will be kept on record. In addition, every student is required to show/demonstrate his/her complete exercises to a GA/TA at the end of this lab, or at the beginning of the next lab after completing online submission. The demonstration includes showing the submitted C codes, compiling the C programs, and trying out the C programs with different input values. The maximum marks for this lab is 15, with 10 for the lab work (submission and demonstration) and 5 for lab attendance.