

## MATH 495R, HOMEWORK 10 FINDING MAXIMUM PATHS

In this lab, we will write programs to find paths through arrays of numbers that maximize certain sums. As an example, we present the triangle below:

```

      19
     41 30
    28 39 62
   96 42 43 19
  56 31 09 14 22
 81 87 72 25 44 98
 08 40 15 08 49 98 27
69 02 23 79 26 34 67 41
72 57 06 29 63 39 57 58 76
64 11 39 82 97 61 83 82 53 97

```

Our goal is to move downward from the top entry of the triangle to the bottom, choosing to go left or right as we go from each row to the next, and maximize the sum of the numbers on our path. For instance, the path going 19-41-39-43-14-44-98-67-58-82 (indicated in boldface above) has a sum of 505. It is not, however the path having the highest sum.

Triangles like the one above with 10, 15, 20, 25, 30, 100, and 200 rows are available online, at

<http://math.byu.edu/~doud/Math495R/Triangles>

These files consist of  $n$  rows of positive numbers, each two digits, with a space between the numbers.

1. Write a Python program that will read in the file for a 10 row triangle and print a list of all the sums obtained by valid paths (sorted in increasing order, without repetition).
2. Write a Python program that will read in the file for any of the triangles given, and print the largest sum of a valid path.
3. Write a Python program that will read in the file for a triangle and find the largest even/odd sum of a path from the top to the bottom of the triangle. Note that the largest even sum and the largest odd sum will be different—one of them will be the actual maximum, and the other will not.
4. Modify your program so that it will work to find the path with largest sum for a rectangular array of numbers, where you wish to go from the upper left to the lower right corner, and you can only move right or down. Test your program on the squares of various sizes found at

<http://math.byu.edu/~doud/Math495R/Rectangles>

(See the back of the page for an example of a path through a rectangle.)

|           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>47</b> | 54        | 58        | 48        | 66        | 30        | 06        | 06        | 33        | 76        | 22        | 35        | 77        | 22        | 01        | 26        |
| <b>56</b> | 31        | 22        | 31        | 74        | 98        | 39        | 67        | 21        | 58        | 71        | 90        | 74        | 80        | 63        | 85        |
| <b>36</b> | 27        | 70        | 06        | 50        | 58        | 62        | 88        | 58        | 13        | 25        | 80        | 13        | 36        | 14        | 51        |
| <b>40</b> | <b>89</b> | <b>57</b> | <b>75</b> | <b>76</b> | 55        | 78        | 71        | 35        | 20        | 64        | 23        | 35        | 60        | 82        | 10        |
| 62        | 21        | 95        | 58        | <b>69</b> | <b>53</b> | 81        | 63        | 52        | 75        | 82        | 65        | 58        | 66        | 49        | 47        |
| 79        | 82        | 29        | 03        | 37        | <b>87</b> | 15        | 93        | 48        | 50        | 49        | 91        | 92        | 18        | 39        | 02        |
| 35        | 35        | 77        | 10        | 30        | <b>43</b> | 45        | 46        | 85        | 42        | 25        | 80        | 10        | 55        | 71        | 01        |
| 75        | 19        | 63        | 56        | 10        | <b>82</b> | 56        | 19        | 48        | 58        | 48        | 20        | 83        | 93        | 89        | 50        |
| 18        | 01        | 95        | 10        | 14        | <b>69</b> | <b>53</b> | 40        | 28        | 34        | 41        | 24        | 26        | 60        | 23        | 59        |
| 13        | 73        | 56        | 07        | 49        | 05        | <b>99</b> | 27        | 16        | 11        | 79        | 53        | 48        | 47        | 44        | 45        |
| 61        | 17        | 40        | 63        | 15        | 49        | <b>92</b> | 06        | 68        | 11        | 21        | 68        | 55        | 65        | 97        | 08        |
| 56        | 54        | 41        | 75        | 02        | 74        | <b>32</b> | 70        | 85        | 39        | 83        | 51        | 21        | 29        | 89        | 17        |
| 78        | 05        | 89        | 45        | 66        | 19        | <b>75</b> | 53        | 55        | 54        | 84        | 57        | 18        | 19        | 80        | 85        |
| 68        | 74        | 54        | 41        | 95        | 79        | <b>74</b> | <b>76</b> | 30        | 83        | 88        | 16        | 52        | 54        | 90        | 75        |
| 71        | 34        | 83        | 38        | 91        | 81        | 34        | <b>66</b> | 39        | 68        | 38        | 74        | 46        | 47        | 42        | 94        |
| 63        | 62        | 33        | 37        | 77        | 52        | 08        | <b>42</b> | <b>22</b> | <b>65</b> | <b>36</b> | <b>80</b> | <b>17</b> | <b>54</b> | <b>25</b> | <b>98</b> |

The path above:

47-56-36-40-89-57-75-76-69-53-87-43-82-69-53-99-  
 -92-32-75-74-76-66-42-22-65-36-80-17-54-25-98

has sum 1885.