

ISyE 3103 Introduction to Supply Chain Modeling: Logistics
Summer 2011
Homework 8
Issued: July 11, 2011
Due: July 15, 2011

**Single-Vehicle, Multiple-Destination Transportation Routing
(Traveling Salesman Problem)**

[50 points]

Logistics is important not only for providers of goods, but also for providers of services. Transportation is often the primary concern for companies that provide on-site or in-person services. One such example is a traveling circus like Ringling Brothers and Barnum & Bailey, “The Greatest Show On Earth”.

The Ringling Brothers and Barnum & Bailey circus “cheats” by actually having two touring circuses, the “red” circus and the “blue” circus, which tour the country simultaneously and thus are able to cover more cities.

In this homework, we will be looking at the travels of a fictional circus with just a single touring unit. This Atlanta-based circus plans to visit 16 cities, listed in the table below:

Atlanta GA	Des Moines IA	Kansas City MO	Nashville TN
Birmingham AL	Dubuque IA	Little Rock AR	Oklahoma Cit OK
Columbus OH	Indianapolis IN	Louisville KY	Saint Louis MO
Dallas TX	Jackson MS	Memphis TN	Springfield IL

After visiting all of the cities, the circus will return to Atlanta.

As one might imagine, the travel costs associated with a circus are quite high. Special vehicles, equipment, foods, etc. are needed to transport the tigers, elephants and other circus animals. Other equipment, such as high-wire apparatus and set construction materials, are also expensive to transport. Therefore, the circus would like to minimize its transportation costs during its national tour.

Of course, a benefit of minimizing travel time is that the circus will have more time to perform, and thus generate more revenue.

Since the special circus vehicles can only travel on major highways, we can assume a constant speed for every highway. Therefore, minimizing travel time is equivalent to minimizing travel distance in this case.

The goal of the circus is to find a good tour of all the cities; that is, to find a path that visits each city and then returns to its starting point. Of course, some tours are shorter than others, and the optimal tour is the one which covers the least total distance.

The raw city-to-city distance data can be found on t-square in the file hw8data.xls and are listed later in this document. All distances are symmetric; the distance from city A to city B is the same as the distance from city B to city A.

Deliverable:

Please hand in the tour maps for all parts and for part V a discussion of any methods you used to find better tours.

Part I (5 points)

Use your own intuition to get the shortest-distance circus tour you can find. Do not use any of the algorithms from class – don't worry, you'll have plenty of opportunity for that in the rest of the homework, and your grades will not depend on the quality of the solution you find in this part. For now, just try using your intuition and logic. Draw your best answer clearly on the attached map, and give the total distance.

Part II (10 points)

Using the distances provided on t-square or in this document (do not just go by eye, as the graphical plot is not to scale), use the Nearest Neighbor heuristic from class starting from Atlanta to find the best route for the circus to take. Draw your answer clearly on the attached map, number the edges in the sequence that you choose them, and give the total distance.

Part III (15 points)

Repeat Part II, but use the Nearest Insertion heuristic instead of Nearest Neighbor. By the nature of the method, your tour should never contain any edge crossings. Start your tour by choosing first the arc with minimum cost. Draw your answer clearly on the attached map, number the nodes in the sequence that you insert them, and give the total distance.

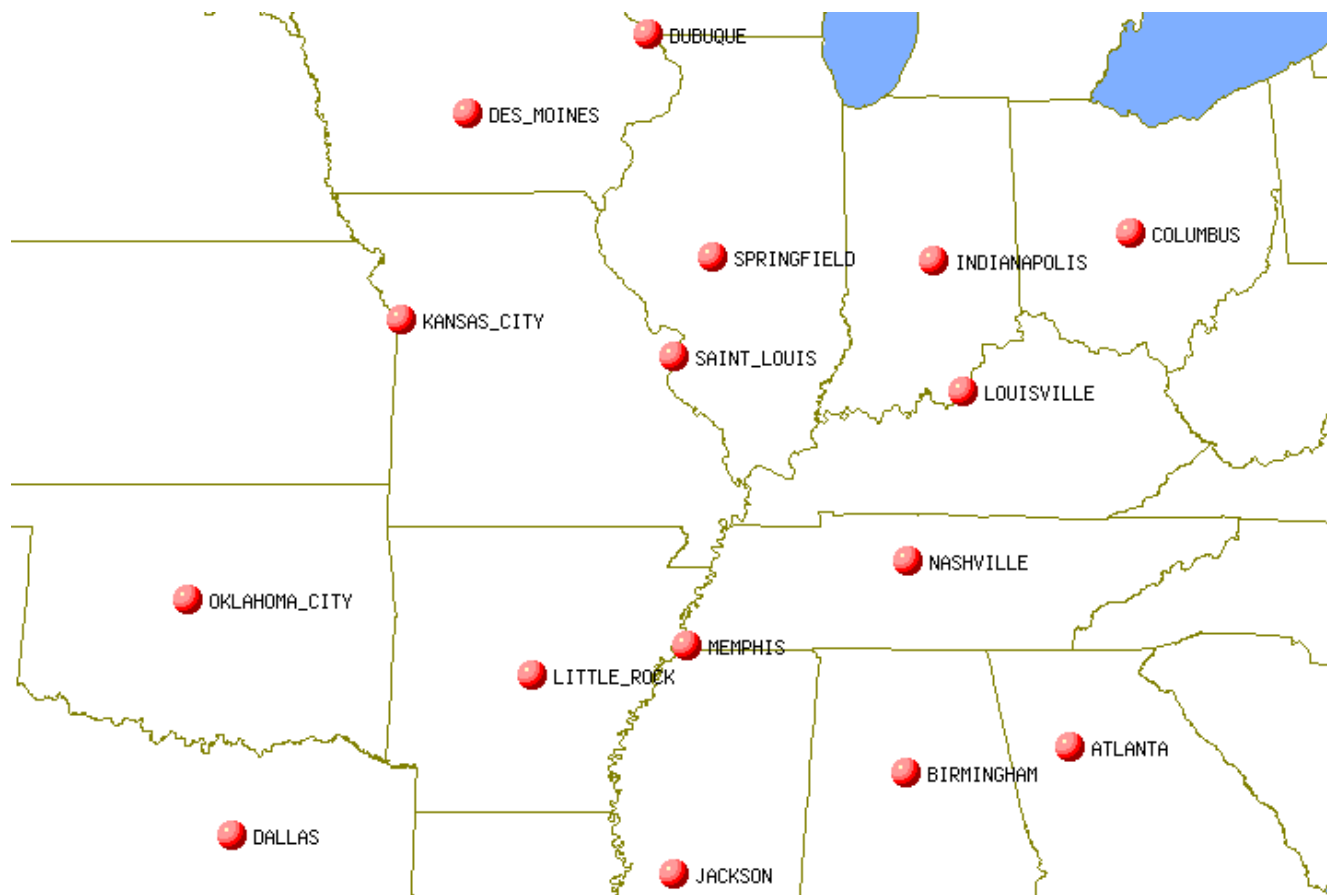
Part IV (15 points)

Repeat Part II, but use the Twice Around Minimum Spanning Tree heuristic instead of Nearest Neighbor. Use Prim's algorithm to find the Minimum Spanning Tree, and number the edges clearly on the map in the sequence that you choose them. Then start in Atlanta, go to its closest neighbor in the Minimum Spanning Tree, and continue onwards around the Minimum Spanning Tree, always going to the closest unvisited neighbor next when you have a choice, to construct a tour. Draw your answer clearly on the attached map, and give the total length of the Minimum Spanning Tree as well as the total distance of your tour.

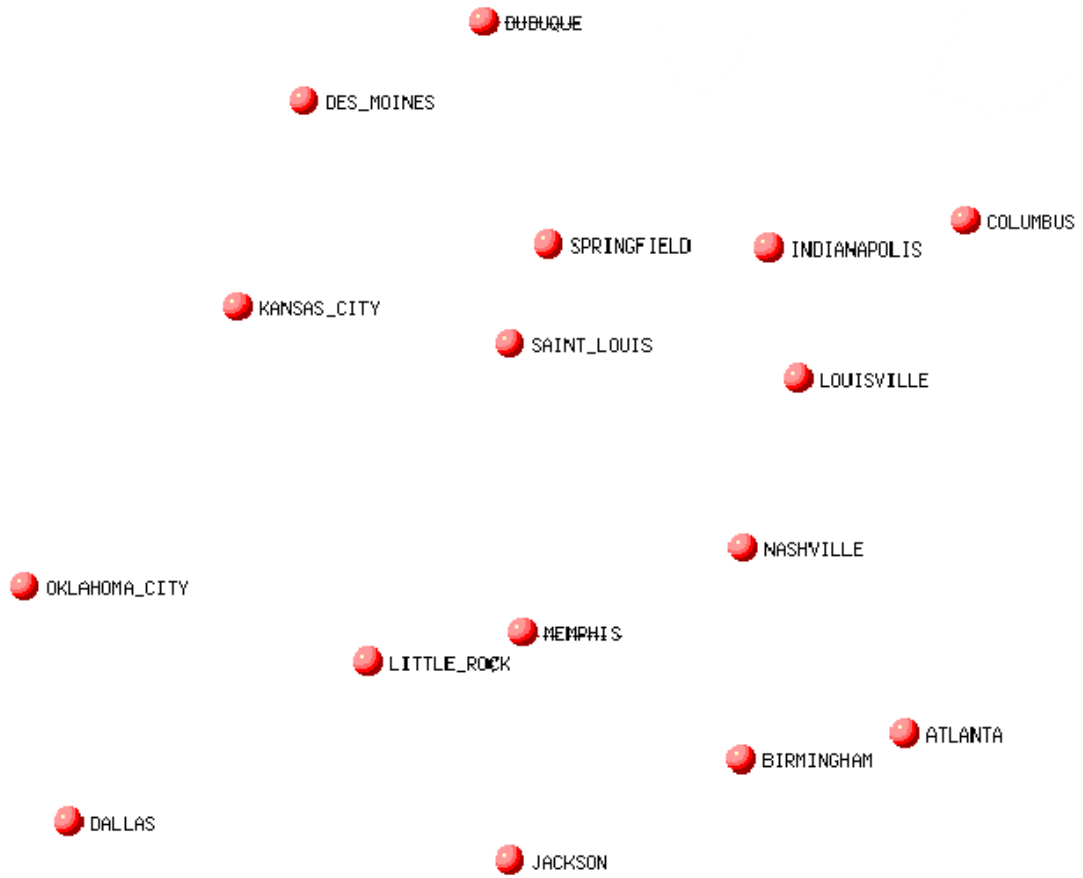
Part V (5 points)

Use an improvement algorithm to improve your solutions from I-IV. You may also develop any new solution method you think is appropriate.

Make a recommendation to the circus as to the sequence of cities it should visit on its national tour.



Part I – “Human Algorithm” Tour

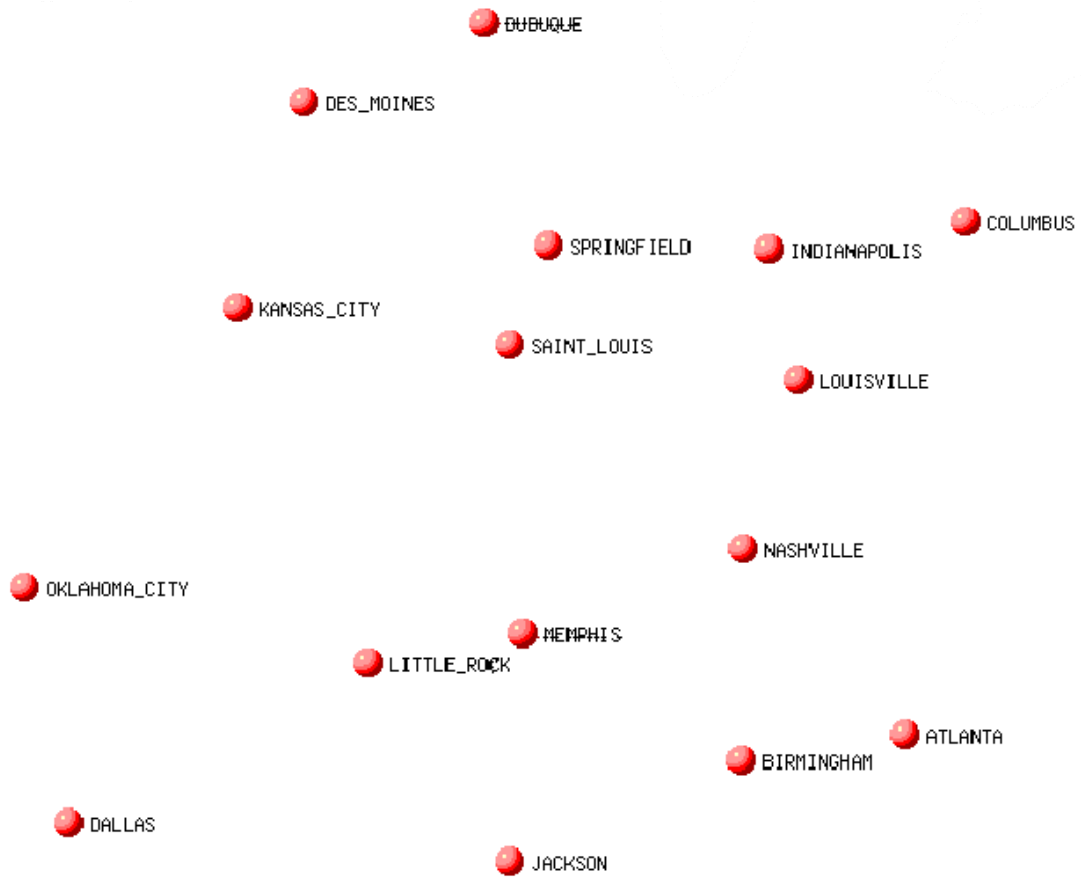


Total Distance: _____

CITY-TO-CITY DISTANCES

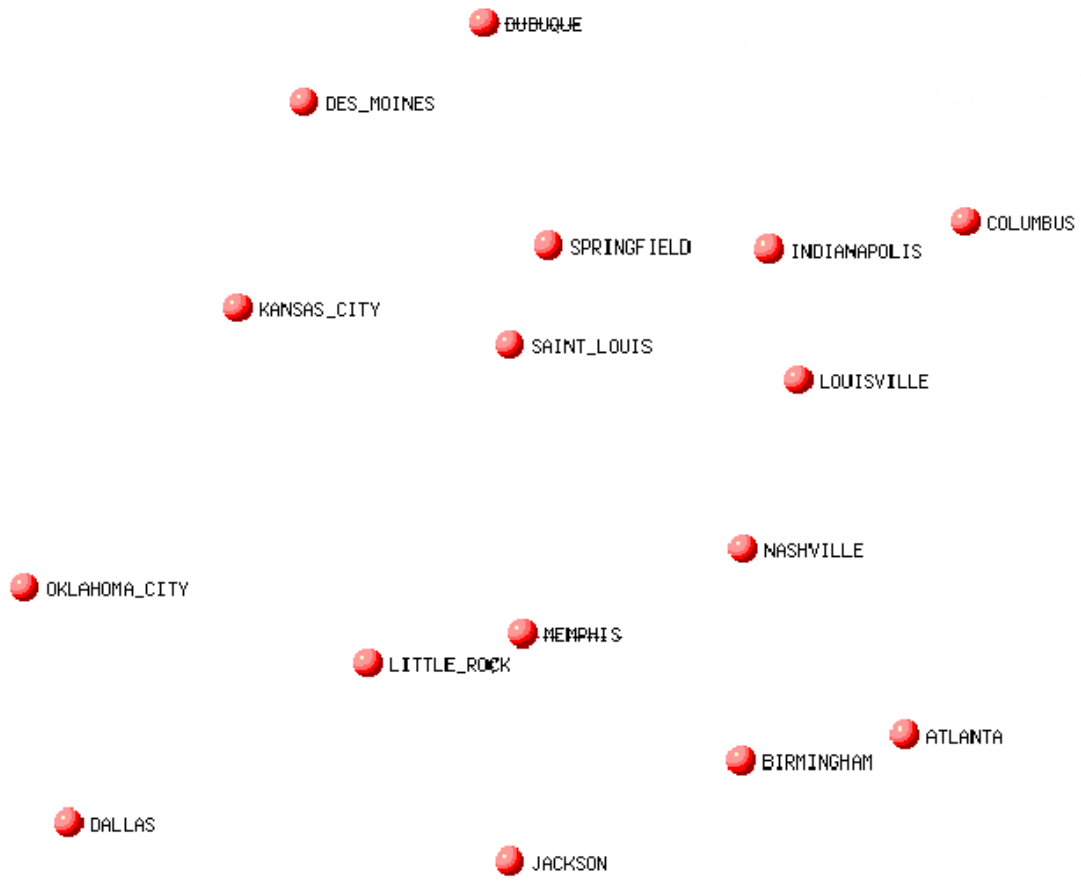
	LiR	Nas	OkC	KCy	Dub	Ind	Bir	Lou	Atl	Mem	StL	Jax	Col	Dal	Spr	DeM
Little Rock AR	0	331	299	332	539	486	333	454	469	157	297	215	634	282	379	472
Nashville TN	331	0	611	471	481	248	183	151	212	189	257	331	336	612	294	523
Oklahoma Cit OK	299	611	0	321	614	697	632	701	768	442	468	480	866	174	533	475
Kansas City MO	332	471	321	0	294	444	584	489	676	391	231	541	619	456	259	155
Dubuque IA	539	481	614	294	0	302	652	399	685	517	260	704	443	735	192	166
Indianapolis IN	486	248	697	444	302	0	431	108	415	384	230	562	175	755	186	413
Birmingham AL	333	183	632	584	652	431	0	335	158	202	406	214	493	581	461	669
Louisville KY	454	151	701	489	399	108	335	0	307	330	259	491	191	734	248	489
Atlanta GA	469	212	768	676	685	415	158	307	0	327	468	361	421	727	503	735
Memphis TN	157	189	442	391	517	384	202	330	327	0	256	189	511	424	331	496
Saint Louis MO	297	257	468	231	260	230	406	259	468	256	0	444	403	541	81	267
Jackson MS	215	331	480	541	704	562	214	491	361	189	444	0	667	390	520	668
Columbus OH	634	336	866	619	443	175	493	191	421	511	403	667	0	911	360	576
Dallas TX	282	612	174	456	735	755	581	734	727	424	541	390	911	0	617	616
Springfield IL	379	294	533	259	192	186	461	248	503	331	81	520	360	617	0	243
Des Moines IA	472	523	475	155	166	413	669	489	735	496	267	668	576	616	243	0

Part II – Nearest Neighbor Tour



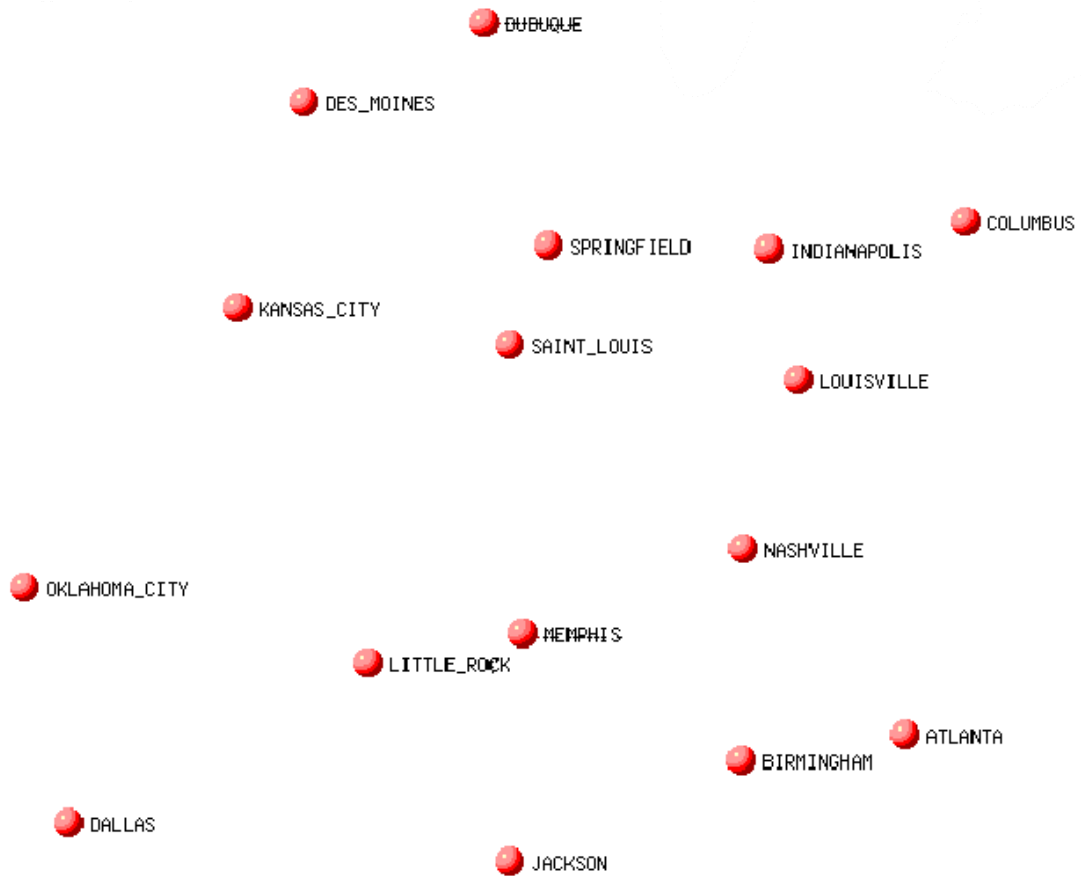
Total Distance: _____

Part III – Nearest Insertion Tour



Total Distance: _____

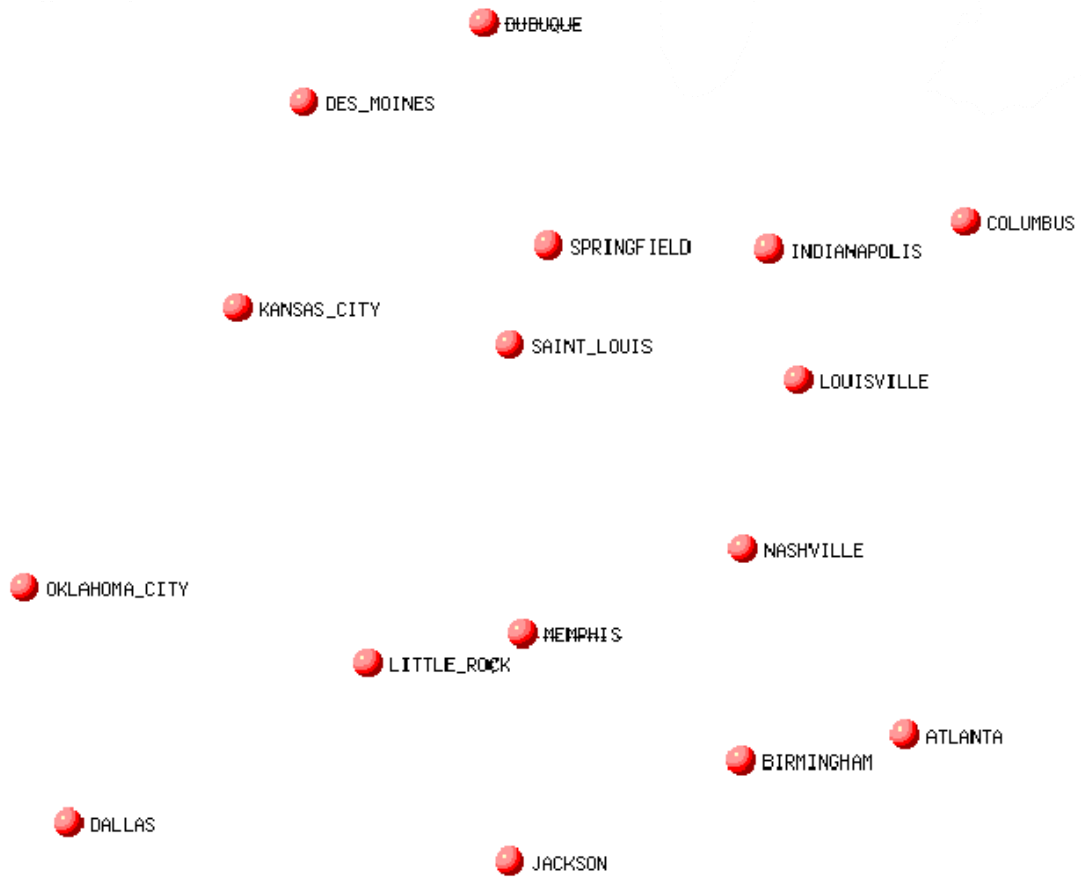
Part IV – Twice Around Minimum Spanning Tree Tour



Total Distance: _____

Minimum Spanning Tree Cost: _____

Part V – Recommended Circus Tour (Overall Best)



Total Distance: _____