

A Traveling Salesman Solution For The Capitals of All African Nations

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Abstract

A Traveling Salesman Problem is the task of finding the shortest round trip path a traveling salesperson can take to visit each vertex of a given graph. They are usually implemented using a genetic algorithm. Our salesperson happens to be traveling to the capitals of every country in Africa that is a recognized member of the United Nations.

1 The Problem

- | | | |
|--|--------------------------------|------------------------------|
| 1. Algeria - Algiers | 17. Equatorial Guinea - Malabo | 36. Namibia - Windhoek |
| 2. Angola - Luanda | 18. Eritrea - Asmara | 37. Niger - Niamey |
| 3. Benin - Porto-Novo | 19. Ethiopia - Addis Ababa | 38. Nigeria - Abuja |
| 4. Botswana - Gaborone | 20. Gabon - Libreville | 39. Rwanda - Kigali |
| 5. Burkina Faso - Ouagadougou | 21. The Gambia - Banjul | 40. Senegal - Dakar |
| 6. Burundi - Bujumbura | 22. Ghana - Accra | 41. Seychelles - Victoria |
| 7. Cameroon - Yaounde | 23. Guinea - Conakry | 42. Sierra Leone - Freetown |
| 8. Cape Verde - Praia | 24. Guinea-Bissau - Bissau | 43. Somalia - Mogadishu |
| 9. Central African Republic - Bangui | 25. Kenya - Nairobi | 44. South Africa - Pretoria |
| 10. Chad - N'Djamena | 26. Lesotho - Maseru | 45. Sudan - Khartoum |
| 11. Comoros - Moroni | 27. Liberia - Monrovia | 46. Swaziland - Mbabane |
| 12. Congo, Republic of the - Brazzaville | 28. Libya - Tripoli | 47. Tanzania - Dar es Salaam |
| 13. Congo, Democratic Republic of the - Kinshasa | 29. Madagascar - Antananarivo | 48. Togo - Lome |
| 14. Cote d'Ivoire - Yamoussoukro | 30. Malawi - Lilongwe | 49. Tunisia - Tunis |
| 15. Djibouti - Djibouti | 31. Mali - Bamako | 50. Uganda - Kampala |
| 16. Egypt - Cairo | 32. Mauritania - Nouakchott | 51. Zambia - Lusaka |
| | 33. Mauritius - Port Louis | 52. Zimbabwe - Harare |
| | 34. Morocco - Rabat | |
| | 35. Mozambique - Maputo | |



Figure 1: Capitals of African Nations

2 Overview

The remainder of this article is organized as follows. Section gives account of previous work. Our new and exciting results are described in Section . Finally, Section gives the conclusions.

3 Programs

The TSP was solved using the Python 2.6 programming language.

I leveraged software written by John Montgomery [?]

The results were then visualized using Google maps mapping API.

Two methods were used a **hillclimb** and

4 Solution

$$yDis = (lat2 - lat1) * NauticalMilesPerLatitude \quad (1)$$

$$xDis = (\cos(lat1 - \frac{\pi}{180}) + \cos(lat2 - \frac{\pi}{180})) * (lon2 - lon1) * \frac{NauticalMilesPerLongitude}{2} \quad (2)$$

$$tDistance = \sqrt{yDis^2 + xDis^2} * MilesperNauticalMiles \quad (3)$$

$$(4)$$

Final Order:

- | | | |
|---|-------------------------------|---------------------------------------|
| 1. Congo, Republic of the - Brazzaville | 19. Madagascar - Antananarivo | 38. Sierra Leone - Freetown |
| 2. Congo, Democratic Republic of the - Kinshasa | 20. Mauritius - Port Louis | 39. Liberia - Monrovia |
| 3. Angola - Luanda | 21. Seychelles - Victoria | 40. Cote d'Ivoire - Yamoussoukro |
| 4. Namibia - Windhoek | 22. Somalia - Mogadishu | 41. Mali - Bamako |
| 5. Botswana - Gaborone | 23. Ethiopia - Addis Ababa | 42. Burkina Faso - Ouagadougou |
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| 7. Lesotho - Maseru | 25. Eritrea - Asmara | 44. Ghana - Accra |
| 8. Swaziland - Mbabane | 26. Sudan - Khartoum | 45. Togo - Lome |
| 9. Mozambique - Maputo | 27. Egypt - Cairo | 46. Benin - Porto-Novo |
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| 15. Uganda - Kampala | 33. Cape Verde - Praia | 52. Gabon - Libreville |
| 16. Kenya - Nairobi | 34. Senegal - Dakar | |
| 17. Tanzania - Dar es Salaam | 35. The Gambia - Banjul | |
| 18. Comoros - Moroni | 36. Guinea-Bissau - Bissau | |
| | 37. Guinea - Conakry | |



Figure 2: Final Path Through Africa

In this section we describe the results.

5 Runtime

We worked hard, and achieved very little.

6 Analysis

References

- [1] Montgomery, John *Tackling The Travelling Salesman Problem*<http://www.psychicorigami.com/category/tsp/> , 2007
- [2] Mead, C. A.; Truhlar, D. G. *J. Chem. Phys.* **1983**, 78, 6344.