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# CMPE 300 ANALYSIS OF ALGORITHMS

# PROJECT 3 - ANSWERS

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# PART 1

## d) (You can adjust the length of the tables)

*Success, n=6*

| Step | Columns | Available |
|---|---|---|
| **1** | [2] | [0, 4, 5] |
| **2** | [2, 5] | [1, 3] |
| **3** | [2, 5, 1] | [4] |
| **4** | [2, 5, 1, 4] | [0] |
| **5** | [2, 5, 1, 4, 0] | [3] |
| **6** | [2, 5, 1, 4, 0, 3] | [] |

*Visualization of the table*

| | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **0** | | | Q | | | |
| **1** | | | | | | **Q** |
| **2** | | **Q** | | | | |
| **3** | | | | | **Q** | |
| **4** | Q | | | | | |
| **5** | | | | **Q** | | |

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*Success, n=6*

| Step | Columns | Available |
|---|---|---|
| **1** | [3] | [0, 1, 5] |
| **2** | [3, 0] | [2, 4] |
| **3** | [3, 0, 4] | [1] |
| **4** | [3, 0, 4, 1] | [5] |
| **5** | [3, 0, 4, 1, 5] | [2] |
| **6** | [3, 0, 4, 1, 5, 2] | [] |

*Visualization of the table*

| | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **0** | | | | Q | | |
| **1** | Q | | | | | |
| **2** | | | | | Q | |
| **3** | | Q | | | | |
| **4** | | | | | | Q |
| **5** | | | Q | | | |

*Failure, n=6*

| Step | Columns | Available |
|---|---|---|
| **1** | [0] | [2, 3, 4, 5] |
| **2** | [0, 4] | [1] |
| **3** | [0, 4, 1] | [5] |
| **4** | [0, 4, 1, 5] | [2] |
| **5** | [0, 4, 1, 5, 2] | [] |
| | | |
| | | |

*Failure, n=6*

| Step | Columns | Available |
|---|---|---|
| **1** | [3] | [0, 1, 5] |
| **2** | [3, 0] | [2, 4] |
| **3** | [3, 0, 2] | [4, 5] |
| **4** | [3, 0, 2, 5] | [1] |
| **5** | [3, 0, 2, 5, 1] | [] |
| | | |
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*Success, n=8*

| Step | Columns | Available |
|---|---|---|
| **1** | [4] | [0, 1, 2, 6, 7] |
| **2** | [4, 7] | [0, 1, 3, 5] |
| **3** | [4, 7, 3] | [0, 6] |
| **4** | [4, 7, 3, 0] | [2, 6] |
| **5** | [4, 7, 3, 0, 2] | [5] |
| **6** | [4, 7, 3, 0, 2, 5] | [1] |
| **7** | [4, 7, 3, 0, 2, 5, 1] | [6] |
| **8** | [4, 7, 3, 0, 2, 5, 1, 6] | [] |

*Visualization of the table*

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| **0** | | | | | Q | | | |
| **1** | | | | | | | | **Q** |
| **2** | | | | **Q** | | | | |
| **3** | Q | | | | | | | |
| **4** | | | **Q** | | | | | |
| **5** | | | | | | **Q** | | |
| **6** | | **Q** | | | | | | |
| **7** | | | | | | | **Q** | |

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*Success, n=8*

| Step | Columns | Available |
|---|---|---|
| **1** | [2] | [0, 4, 5, 6, 7] |
| **2** | [2, 5] | [1, 3, 7] |
| **3** | [2, 5, 1] | [4, 6] |
| **4** | [2, 5, 1, 6] | [0, 4] |
| **5** | [2, 5, 1, 6, 4] | [0] |
| **6** | [2, 5, 1, 6, 4, 0] | [7] |
| **7** | [2, 5, 1, 6, 4, 0, 7] | [3] |
| **8** | [2, 5, 1, 6, 4, 0, 7, 3] | [] |

*Visualization of the table*

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| **0** | | | Q | | | | | |
| **1** | | | | | | **Q** | | |
| **2** | | **Q** | | | | | | |
| **3** | | | | | | | **Q** | |
| **4** | | | | | **Q** | | | |
| **5** | Q | | | | | | | |
| **6** | | | | | | | | **Q** |
| **7** | | | | **Q** | | | | |

*Failure, n=8*

| Step | Columns | Available |
|---|---|---|
| **1** | [2] | [0, 4, 5, 6, 7] |
| **2** | [2, 0] | [3, 5, 6, 7] |
| **3** | [2, 0, 6] | [1, 3, 4] |
| **4** | [2, 0, 6, 4] | [1, 7] |
| **5** | [2, 0, 6, 4, 1] | [5] |
| **6** | [2, 0, 6, 4, 1, 5] | [] |
| | | |

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*Failure, n=8*

| Step | Columns | Available |
|---|---|---|
| **1** | [5] | [0, 1, 2, 3, 7] |
| **2** | [5, 0] | [2, 4, 6] |
| **3** | [5, 0, 4] | [1, 6, 7] |
| **4** | [5, 0, 4, 7] | [] |
| | | |
| | | |
| | | |

*Success, n=10*

| Step | Columns | Available |
|---|---|---|
| **1** | [6] | [0, 1, 2, 3, 4, 8, 9] |
| **2** | [6, 4] | [0, 1, 2, 7, 9] |
| **3** | [6, 4, 7] | [0, 1, 5] |
| **4** | [6, 4, 7, 0] | [3, 8] |
| **5** | [6, 4, 7, 0, 3] | [5, 9] |
| **6** | [6, 4, 7, 0, 3, 9] | [2] |
| **7** | [6, 4, 7, 0, 3, 9, 2] | [5, 8] |
| **8** | [6, 4, 7, 0, 3, 9, 2, 5] | [8] |
| **9** | [6, 4, 7, 0, 3, 9, 2, 5, 8] | [1] |
| **10** | [6, 4, 7, 0, 3, 9, 2, 5, 8, 1] | [] |

*Visualization of the table*

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | | | | | | | Q | | | |
| **1** | | | | | **Q** | | | | | |
| **2** | | | | | | | | **Q** | | |
| **3** | Q | | | | | | | | | |
| **4** | | | | **Q** | | | | | | |
| **5** | | | | | | | | | | **Q** |
| **6** | | | **Q** | | | | | | | |
| **7** | | | | | | **Q** | | | | |
| **8** | | | | | | | | | **Q** | |
| **9** | | **Q** | | | | | | | | |

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*Success, n=10*

| Step | Columns | Available |
|---|---|---|
| **1** | [5] | [0, 1, 2, 3, 7, 8, 9] |
| **2** | [5, 3] | [0, 1, 6, 8, 9] |
| **3** | [5, 3, 0] | [4, 6, 7, 9] |
| **4** | [5, 3, 0, 6] | [4, 8] |
| **5** | [5, 3, 0, 6, 8] | [1, 2] |
| **6** | [5, 3, 0, 6, 8, 1] | [7] |
| **7** | [5, 3, 0, 6, 8, 1, 7] | [4] |
| **8** | [5, 3, 0, 6, 8, 1, 7, 4] | [2] |
| **9** | [5, 3, 0, 6, 8, 1, 7, 4, 2] | [9] |
| **10** | [5, 3, 0, 6, 8, 1, 7, 4, 2, 9] | [] |

*Visualization of the table*

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | | | | | | Q | | | | |
| **1** | | | | **Q** | | | | | | |
| **2** | Q | | | | | | | | | |
| **3** | | | | | | | **Q** | | | |
| **4** | | | | | | | | | **Q** | |
| **5** | | **Q** | | | | | | | | |
| **6** | | | | | | | | **Q** | | |
| **7** | | | | | **Q** | | | | | |
| **8** | | | **Q** | | | | | | | |
| **9** | | | | | | | | | | **Q** |

*Failure, n=10*

| Step | Columns | Available |
|---|---|---|
| **1** | [1] | [3, 4, 5, 6, 7, 8, 9] |
| **2** | [1, 6] | [0, 2, 4, 8, 9] |
| **3** | [1, 6, 4] | [0, 2, 7, 9] |
| **4** | [1, 6, 4, 0] | [7, 8] |
| **5** | [1, 6, 4, 0, 7] | [3, 5, 9] |
| **6** | [1, 6, 4, 0, 7, 9] | [2] |
| **7** | [1, 6, 4, 0, 7, 9, 2] | [5] |
| **8** | [1, 6, 4, 0, 7, 9, 2, 5] | [8] |
| **9** | [1, 6, 4, 0, 7, 9, 2, 5, 8] | [] |

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*Failure, n=10*

| Step | Columns | Available |
|---|---|---|
| **1** | [8] | [0, 1, 2, 3, 4, 5, 6] |
| **2** | [8, 0] | [2, 3, 4, 5, 7, 9] |
| **3** | [8, 0, 5] | [1, 3, 7, 9] |
| **4** | [8, 0, 5, 9] | [1, 2, 6] |
| **5** | [8, 0, 5, 9, 6] | [1] |
| **6** | [8, 0, 5, 9, 6, 1] | [3, 7] |
| **7** | [8, 0, 5, 9, 6, 1, 7] | [2, 4] |
| **8** | [8, 0, 5, 9, 6, 1, 7, 4] | [] |

## d)

| n | Number of Success | Number of Trials | Probability |
|---|---|---|---|
| **6** | 711 | 10000 | 0.0711 |
| **8** | 1273 | 10000 | 0.1273 |
| **10** | 565 | 10000 | 0.0565 |

# PART 2

## c)

*n = 6*

| k | Number of Success | Number of Trials | Probability |
|---|---|---|---|
| **0** | 10000 | 10000 | 1.0 |
| **1** | 6697 | 10000 | 0.6664 |
| **2** | 2251 | 10000 | 0.2114 |
| **3** | 1132 | 10000 | 0.1185 |
| **4** | 843 | 10000 | 0.0832 |
| **5** | 680 | 10000 | 0.0857 |

*n = 8*

| k | Number of Success | Number of Trials | Probability |
|---|---|---|---|
| **0** | 10000 | 10000 | 1.0 |
| **1** | 10000 | 10000 | 1.0 |
| **2** | 8730 | 10000 | 0.8705 |
| **3** | 4946 | 10000 | 0.4885 |
| **4** | 2626 | 10000 | 0.2575 |
| **5** | 1625 | 10000 | 0.1682 |
| **6** | 1345 | 10000 | 0.1863 |
| **7** | 1303 | 10000 | 0.2981 |

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*n = 10*

| k | Number of Success | Number of Trials | Probability |
|---|---|---|---|
| **0** | 10000 | 10000 | 1.0 |
| **1** | 10000 | 10000 | 1.0 |
| **2** | 10000 | 10000 | 1.0 |
| **3** | 7943 | 10000 | 0.8035 |
| **4** | 4182 | 10000 | 0.4202 |
| **5** | 1968 | 10000 | 0.2073 |
| **6** | 1059 | 10000 | 0.1185 |
| **7** | 736 | 10000 | 0.0924 |
| **8** | 662 | 10000 | 0.1194 |
| **9** | 595 | 10000 | 0.2017 |

## d) Comments

The success rates are increased in the second part in all cases because in the second part we decreased the number of probabilistic tries and leave this parts responsibility to the deterministic algorithm. Increasing success rate is a good thing, however in our project, deterministic algorithm is much more costly than the probabilistic algorithm. Consequently, this high success rate comes with a cost. I would prefer to use probabilistic algorithm with multiple runs in a real-life project. Because deterministic algorithm isn't a feasible time algorithm (it is exponential time) and it won't be suitable for scalable projects.

In the second part, when we increase k, generally success rate is increased. However, this correlation is broken if k value is close to n (see the cases n=10 and k=6,7,8,9). This is because we repeat the probabilistic algorithm till, we find a feasible k queen placements. If k is very close to n, then there are a few queens that must be placed, so it is higher probability to be able to successfully place them.