# COMS 4701 - Homework 2 - Written

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## Question 1

| Advantages | Disadvantages |
|---|---|
| 1.   No Need to maintain a search tree<br>Only need to store the current state or several current states.<br><br>2.   Use very little memory<br>Not having to store a search tree keeps the memory requirements very low.<br><br>3.   Can often find good enough solutions in continuous or large spaces<br>Local searches can yield adequate solutions while many other searches would either take too long or cannot find any solution. | 1.   They are not definitively optimal<br>Since they are local, it may not find the best solution for the entire problem.<br><br>2.   Their use involves substantial parameter tuning<br>While trying to get the optimal solution, the algorithm often requires many different features.<br><br>3.   They lack strong terminating conditions.<br>Since they do not always terminate on the optimal answer, weaker conditions must be set for the program to terminate. |

## Question 2

a) $6^6$ = 46,656 total states
b) 6*5 = 30 successor states for each for each state
c) 3 + 3 + 3 = 9
d) Mutation—randomly change one queen position on the board

# Question 3

a) MinSupp = 50%

| $C_1$ | | $F_1$ | |
|---|---|---|---|
| **Itemset** | **Support** | **Itemset** | **Support** |
| diapers | 4/6 = 67% | diapers | 4/6 = 67% |
| beer | 5/6 = 83% | beer | 5/6 = 83% |
| water | 2/6 = 33% | coffee | 4/6 = 67% |
| coffee | 4/6 = 67% | milk | 6/6 = 100% |
| milk | 6/6 = 100% | | |

| $C_2$ | | $F_2$ | |
|---|---|---|---|
| **Itemset** | **Support** | **Itemset** | **Support** |
| diapers, beer | 4/6 = 67% | diapers, beer | 4/6 = 67% |
| diapers, coffee | 3/6 = 50% | diapers, coffee | 3/6 = 50% |
| diapers, milk | 4/6 = 67% | diapers, milk | 4/6 = 67% |
| beer, coffee | 3/6 = 50% | beer, coffee | 3/6 = 50% |
| beer, milk | 5/6 = 83% | beer, milk | 5/6 = 83% |
| coffee, milk | 4/6 = 67% | coffee, milk | 4/6 = 67% |

| $C_3$ | | $F_3$ | |
|---|---|---|---|
| **Itemset** | **Support** | **Itemset** | **Support** |
| diapers, beer, coffee | 3/6 = 50% | diapers, beer, coffee | 3/6 = 50% |
| diapers, beer, milk | 4/6 = 67% | diapers, beer, milk | 4/6 = 67% |
| diapers, coffee, milk | 3/6 = 50% | diapers, coffee, milk | 3/6 = 50% |
| beer, coffee, milk | 3/6 = 50% | beer, coffee, milk | 3/6 = 50% |

| $C_4$ | | $F_4$ | |
|---|---|---|---|
| **Itemset** | **Support** | **Itemset** | **Support** |
| diapers, beer, coffee, milk | 3/6 = 50% | diapers, beer, coffee, milk | 3/6 = 50% |

b) MinConf = 80%

| Itemset | Rule # | Rule | Confidence | Strong? |
|---|---|---|---|---|
| diapers, beer | 1 | d -> b | 4/4 = 100% | yes |
| | 2 | b -> d | 4/5 = 80% | yes |
| diapers, coffee | 3 | d -> c | 3/4 = 75% | no |
| | 4 | c -> d | 3/4 = 75% | no |
| diapers, milk | 5 | d -> m | 4/4 = 100% | yes |
| | 6 | m -> d | 4/6 = 67% | no |
| beer, coffee | 7 | b -> c | 3/5 = 60% | no |
| | 8 | c -> b | 3/4 = 75% | no |
| beer, milk | 9 | b -> m | 5/5 = 100% | yes |
| | 10 | m -> b | 5/6 = 83% | yes |
| coffee, milk | 11 | c -> m | 4/4 = 100% | yes |
| | 12 | m -> c | 4/6 = 67% | no |

| Itemset | Rule # | Rule | Confidence | Strong? |
|---|---|---|---|---|
| diapers, beer, coffee | 13 | db -> c | 3/4 = 75% | no |
| | 14 | dc -> b | 3/3 = 100% | yes |
| | 15 | bc -> d | 3/3 = 100% | yes |
| diapers, beer, coffee | 16 | d -> bc | 3/4 = 75% | no |
| | 17 | b -> dc | 3/5 = 60% | no |
| | 18 | c -> db | 3/4 = 75% | no |
| diapers, coffee, milk | 19 | dc -> m | 3/3 = 100% | yes |
| | 20 | dm -> c | 3/4 = 75% | no |
| | 21 | cm -> d | 3/4 = 75% | no |
| diapers, coffee, milk | 22 | d -> cm | 3/4 = 75% | no |
| | 23 | c -> dm | 3/4 = 75% | no |
| | 24 | m -> dc | 3/6 = 50% | no |
| diapers, beer, milk | 25 | db -> m | 4/4 = 100% | yes |
| | 26 | dm -> b | 4/4 = 100% | yes |
| | 27 | mb -> d | 4/5 = 80% | yes |
| diapers, beer, milk | 28 | d -> bm | 4/4 = 100% | yes |
| | 29 | b -> dm | 4/5 = 80% | yes |
| | 30 | m -> db | 4/6 = 67% | no |
| beer, coffee, milk | 31 | bc -> m | 3/3 = 100% | yes |
| | 32 | bm -> c | 3/5 = 60% | no |
| | 33 | cm -> b | 3/4 = 75% | no |
| beer, coffee, milk | 34 | b -> cm | 3/5 = 60% | no |
| | 35 | c -> bm | 3/4 =75% | no |
| | 36 | m -> bc | 3/6 = 50% | no |

| Itemset | Rule # | Rule | Confidence | Strong? |
|---|---|---|---|---|
| diapers, beer, coffee, milk | 37 | dbc -> m | 3/3 = 100% | yes |
| | 38 | dbm -> c | 3/4 = 75% | no |
| | 39 | dcm -> b | 3/3 = 100% | yes |
| | 40 | bcm -> d | 3/3 = 100% | yes |
| diapers, beer, coffee, milk | 40 | db -> cm | 3/4 = 75% | no |
| | 41 | dc -> bm | 3/3 = 100% | yes |
| | 42 | dm -> bc | 3/4 = 75% | no |
| | 43 | bc -> dm | 3/3 = 100% | yes |
| | 44 | bm -> dc | 3/5 = 60% | no |
| | 45 | cm -> db | 3/4 = 75% | no |
| diapers, beer, coffee, milk | 46 | d -> bcm | 3/4 = 75% | no |
| | 47 | b -> dcm | 3/5 = 60% | no |
| | 48 | c -> dbm | 3/4 = 75% | no |
| | 49 | m -> dbc | 3/6 = 50% | no |

Question 4.

a) $4^{12}$ = 16777216

   Each of the 12 variable squares has the number 1, 2, 3, or 4.
   (Note: This is the state space where every variable contains a value that is not empty. If we include blanks before a variable is filled in, then the state space is $5^{12}$).

b) Any Square must equal either 1, 2, 3, or 4
c) I, J
d)

| A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1, 3 | 1, 2 | 1, 2, 3 | 1, 2, 3 | 1, 3 | 1, 2 | 1, 3 | 1, 4 | 1 | 1 | 1, 4 | 1, 2 |
| 1, 3 | 1, 2 | 2, 3 | 2, 3 | 1, 3 | 1, 2 | 3 | 4 | 1 | 1 | 4 | 2 |
| 1, 3 | 1, 2 | 3 | 2 | 1, 3 | 1, 2 | 3 | 4 | 1 | 1 | 4 | 2 |
| 1 | 1, 2 | 3 | 2 | 1, 3 | 1 | 3 | 4 | 1 | 1 | 4 | 2 |
| 1 | 2 | 3 | 2 | 3 | 1 | 3 | 4 | 1 | 1 | 4 | 2 |