Lecture 21

GProlog
Announcements

- Problems with Homework 7?
- Quiz 2 in class next Monday
  - GProlog
8 Queen Puzzle

1) How do we represent a solution (output)?

2) How do we iterate all candidate solutions?

3) How do we check candidate solutions?

Materials adapted from John Fisher
1) How do we represent a solution (output)?

1.a) How do we represent a queen?

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8 Queen Puzzle

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Qi = [Ri, Ci]

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1.b) What about n queens?

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1.a) How do we represent a queen?

Qi = [Ri, Ci]

1.b) What about n queens?

Row = [R1, R2, R3, R4, R5, R6, R7, R8]
Col = [C1, C2, C3, C4, C5, C6, C7, C8]

Materials adapted from John Fisher
8 Queen Puzzle

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1.a) How do we represent a queen?

Qi = [Ri, Ci]

1.b) What about n queens?

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1.c) Domain of Row and Col

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1.c) Domain of Row and Col

? - queen([1, 2, 3, 4], Col).
Col = [3, 1, 4, 2]?

Materials adapted from John Fisher
8 Queen Puzzle

How do we iterate all candidate solutions

\[ \text{queen}([1, 2, 3, 4], \text{Col}). \]
\[ \text{Col} = [3, 1, 4, 2]? \]

Materials adapted from John Fisher
2) How do we iterate all candidate solutions

\[
\text{permutation}([1, 2, 3, 4], \text{Col})
\]

\?

Materials adapted from John Fisher
8 Queen Puzzle

3) How do we check candidate solutions

Constraints: no two queens on the same row, col, or diagonal

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3) How do we check candidate solutions

Constraints: no two queens on the same row, col, or diagonal

\[ R_i - R_j = C_i - C_j \Rightarrow R_i - C_i = R_j - C_j \]
\[ R_i - R_j = C_j - C_i \Rightarrow R_i + C_i = R_j + C_j \]

Materials adapted from John Fisher

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\[ R_i - R_j = C_i - C_j \]
\[ R_i - C_i = R_j - C_j \]
\[ R_i + C_i = R_j + C_j \]

\[
\text{sumanddiff}([X1|X], [Y1|Y], [S1|S], [D1|D]) :- \\
\quad S1 \text{ is } X1 + Y1, \\
\quad D1 \text{ is } X1 - Y1, \\
\quad \text{sumanddiff} (X, Y, S, D). \\
\text{sumanddiff}([], [], [], []). \\
\]

\(? - \text{queen}([1, 2, 3, 4], \text{Col}). \\
\text{Col} = [3, 1, 4, 2]?

Materials adapted from John Fisher
3) How do we check candidate solutions

Constraints: no two queens on the same row, col, or diagonal

\[
\begin{align*}
R_i - R_j &= C_i - C_j \rightarrow R_i - C_i = R_j - C_j \\
R_i - R_j &= C_j - C_i \rightarrow R_i + C_i = R_j + C_j
\end{align*}
\]

all_diff([X|Y]) :- \+member(X, Y), all_diff(Y).
all_diff([X]).

\(? - queen([1, 2, 3, 4], \text{Col}).
\text{Col} = [3, 1, 4, 2]?\)
8 Queen Puzzle

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queen(Row, Col) :-
    permutation(Row, Col),
    sumanddiff(Row, Col, Sum, Diff),
    all_diff(Sum),
    all_diff(Diff).

sumanddiff([X1|X], [Y1|Y], [S1|S], [D1|D]) :-
    S1 is X1 + Y1,
    D1 is X1 - Y1,
    sumanddiff(X, Y, S, D).

all_diff([X|Y]) :- \+ member(X, Y), all_diff(Y).

all_diff([X]).
```

Materials adapted from John Fisher