Tutorial 2

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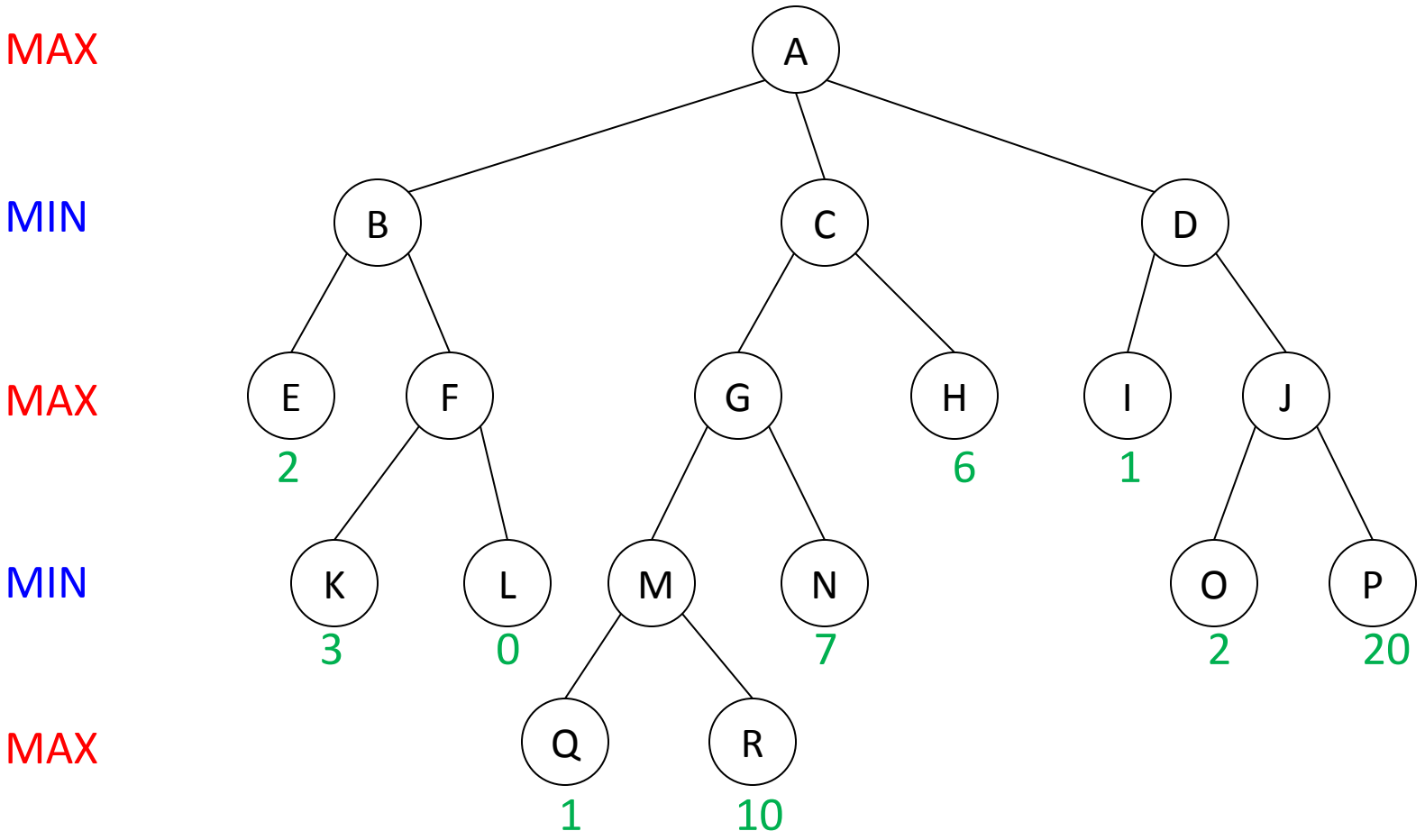
Overview

- alpha-beta pruning (a step-by-step example)
- miniproject: Othello

Example: alpha-beta pruning for Minimax

Start : $\alpha = -\infty$, $\beta = +\infty$.



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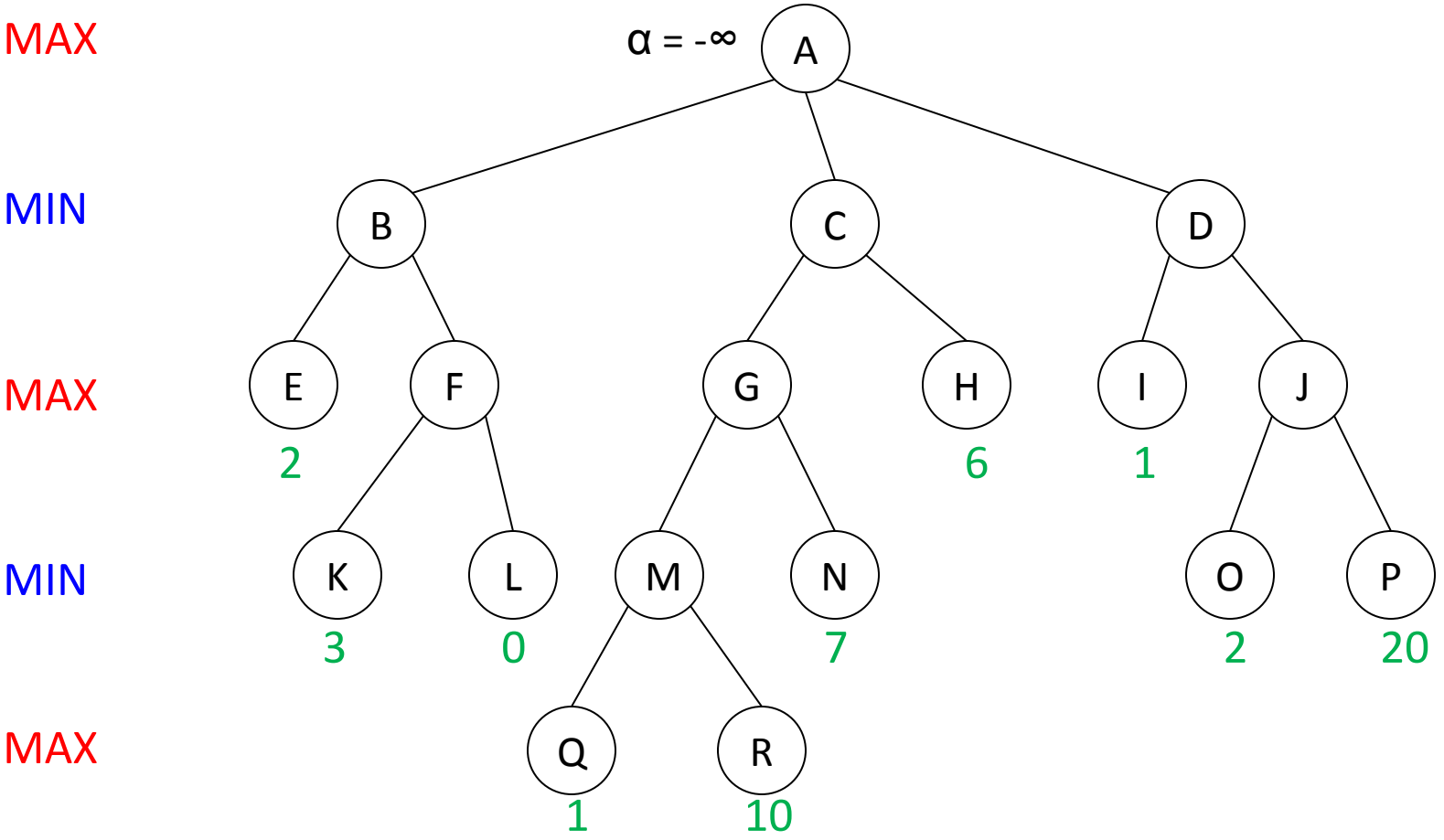

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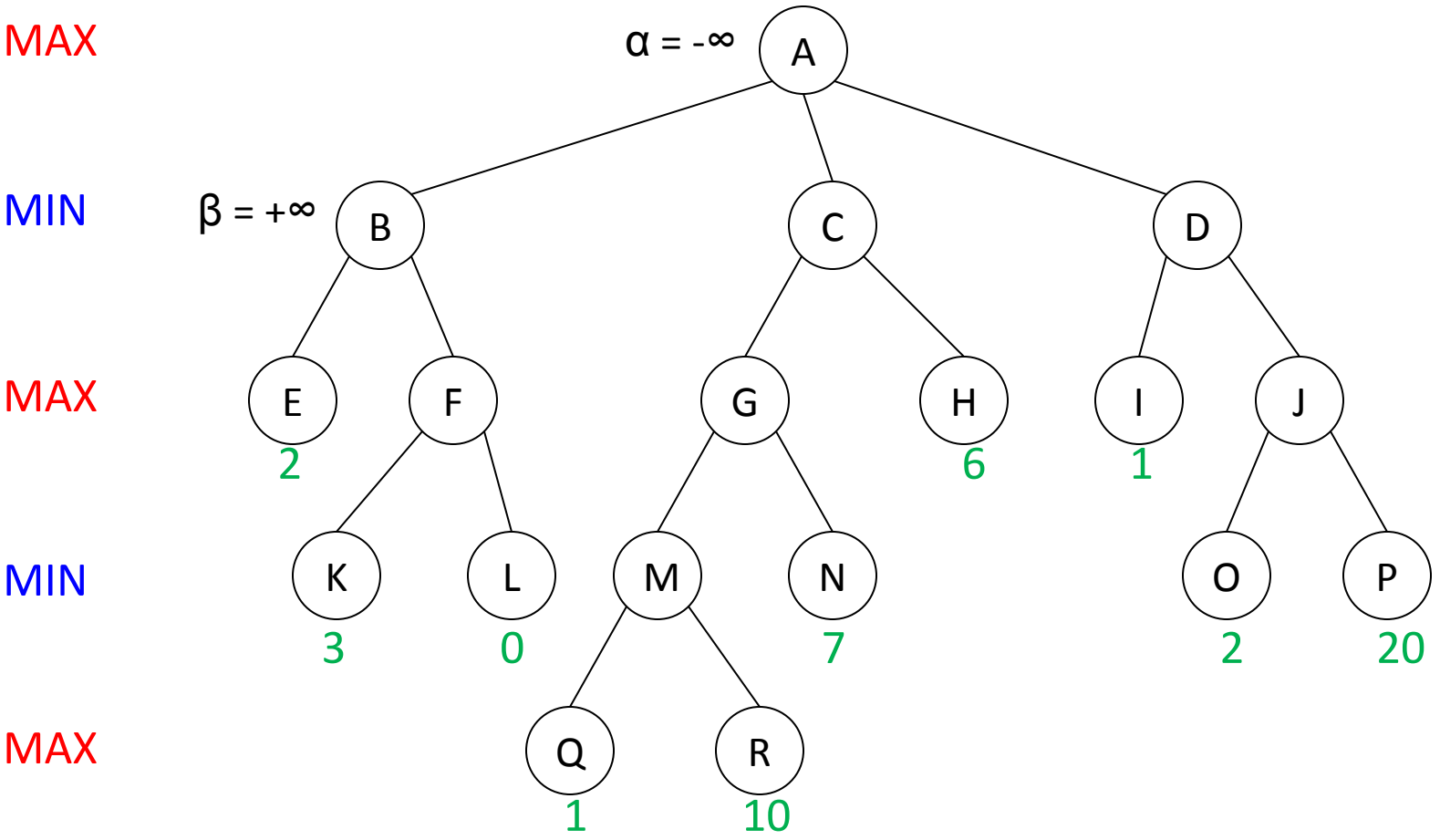

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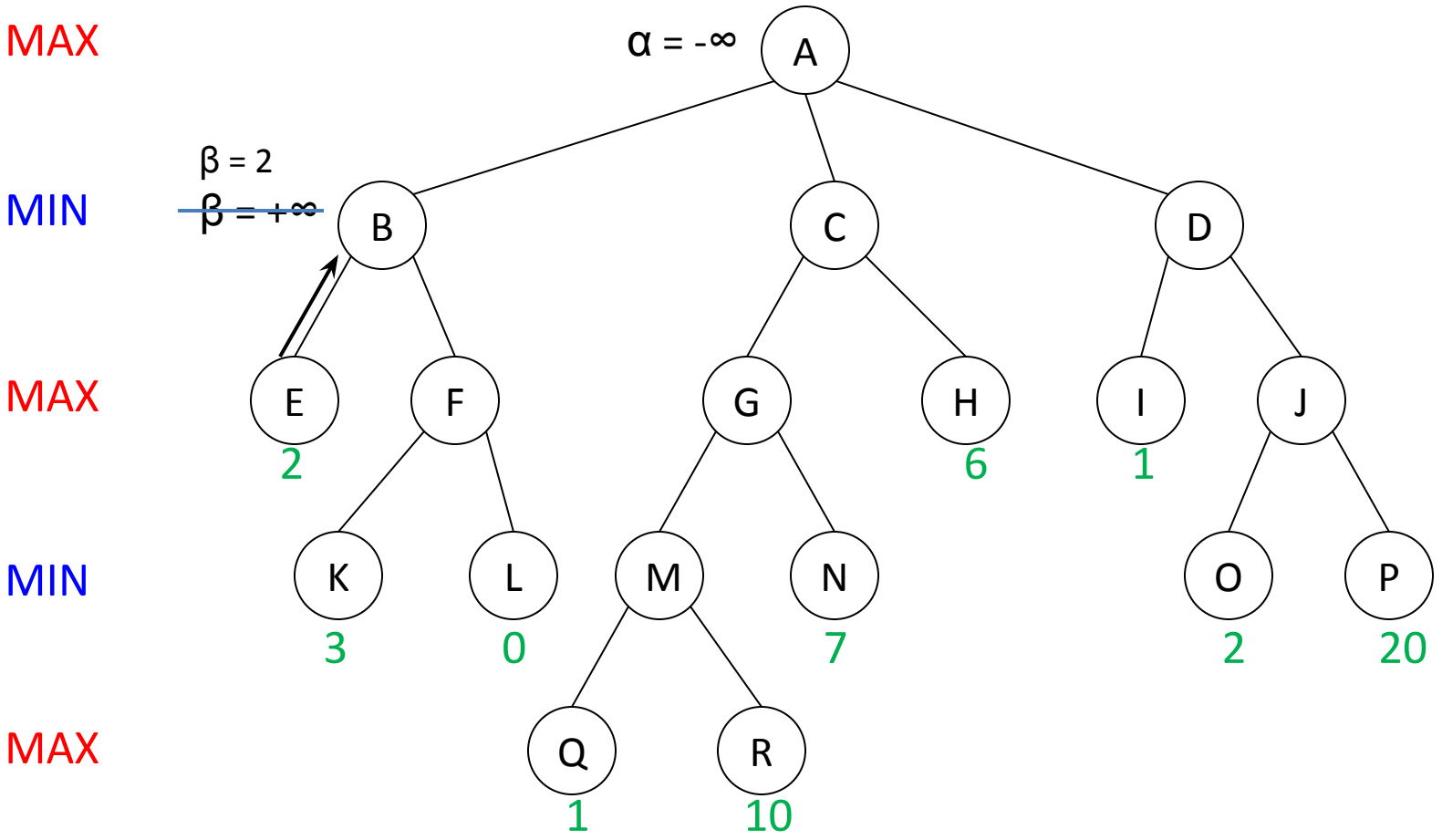

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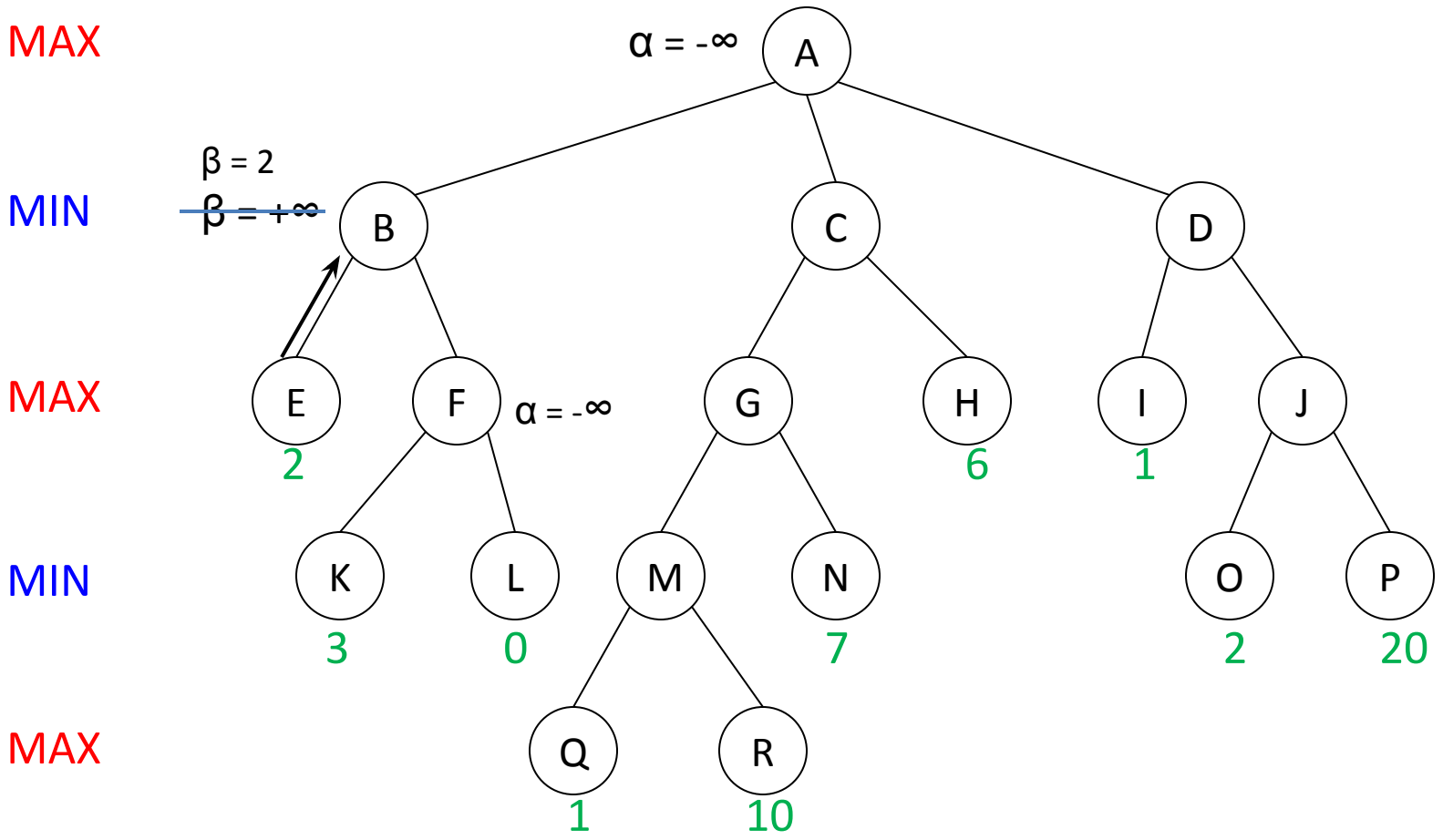

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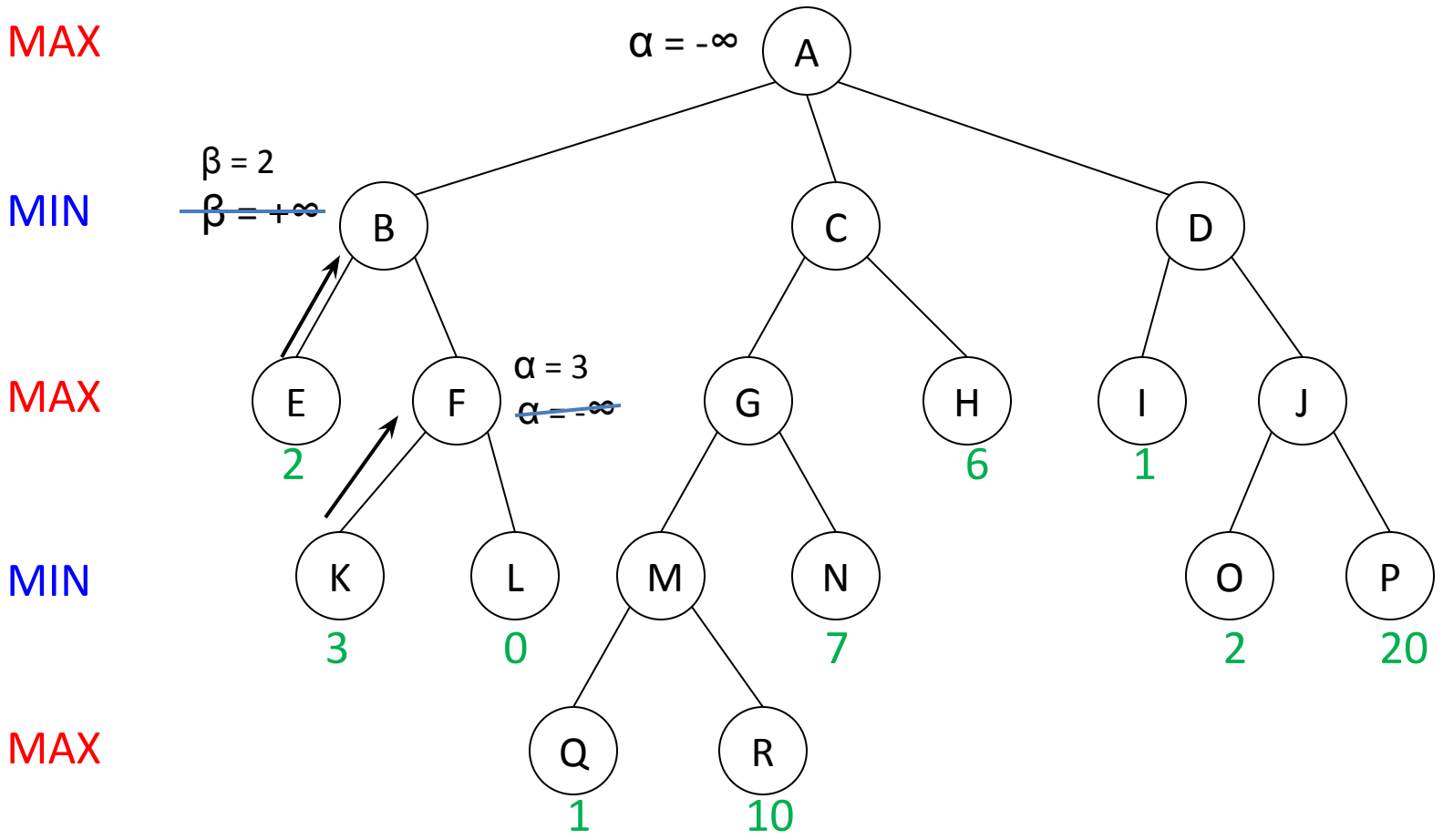

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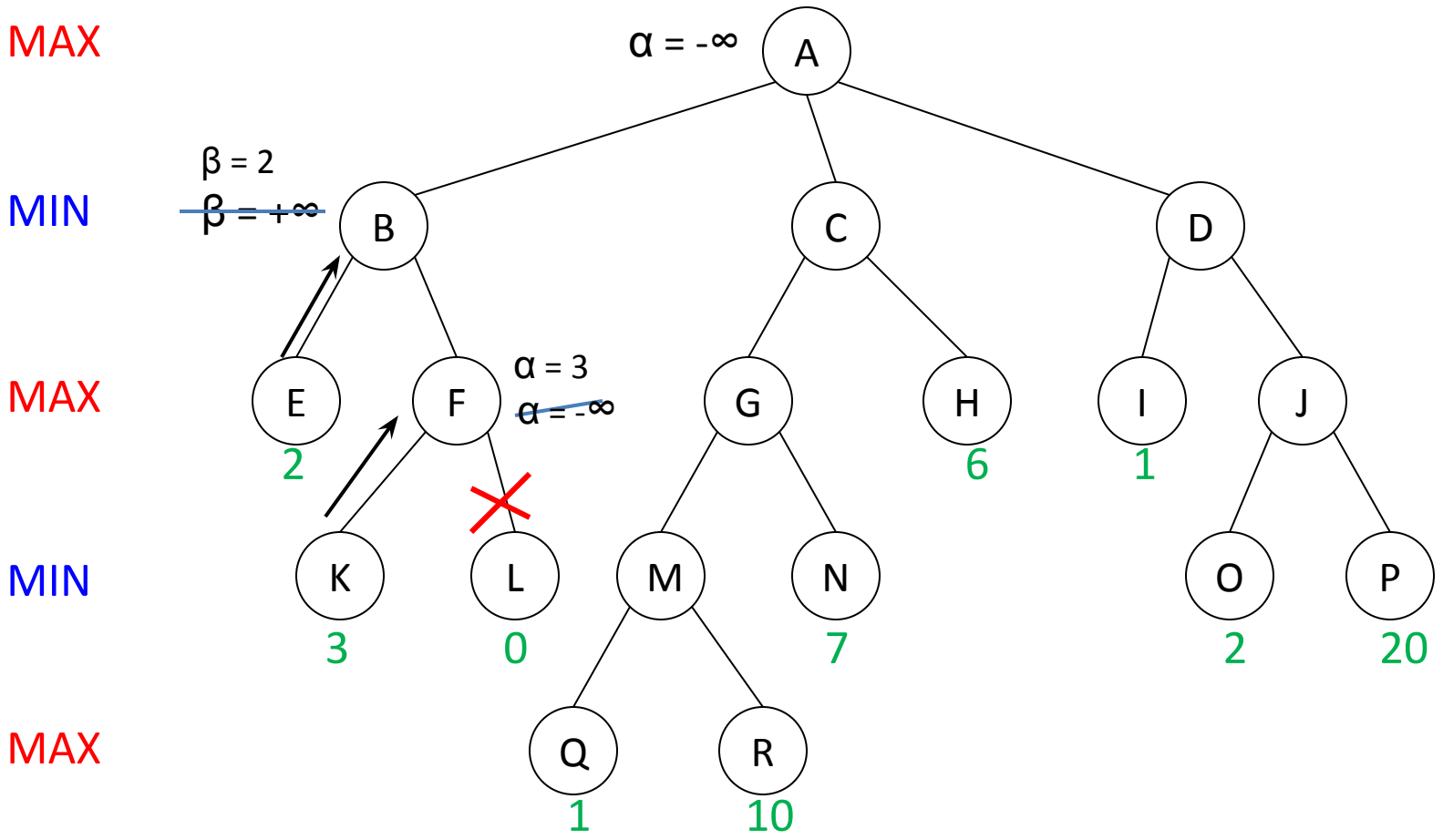

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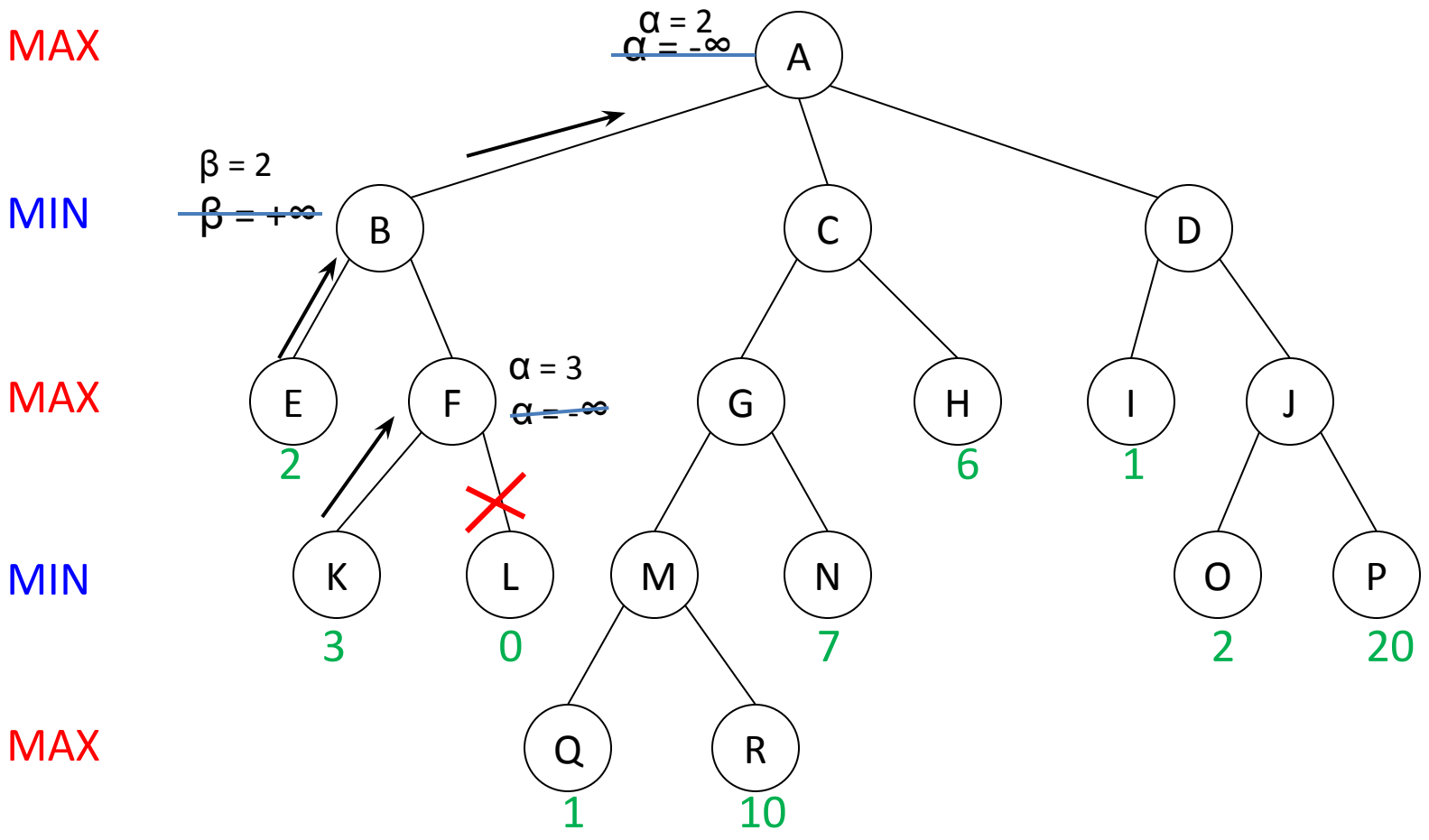

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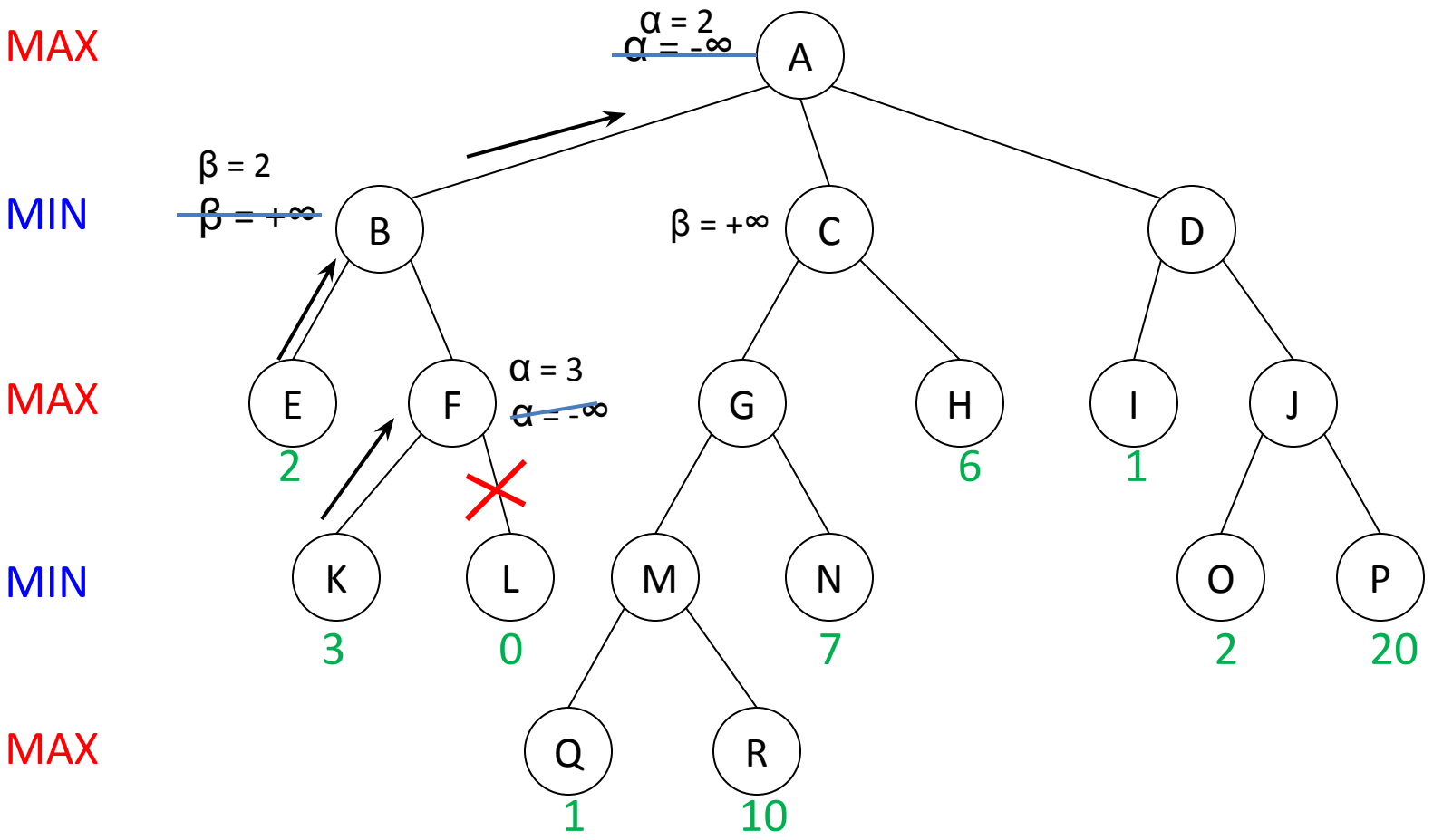

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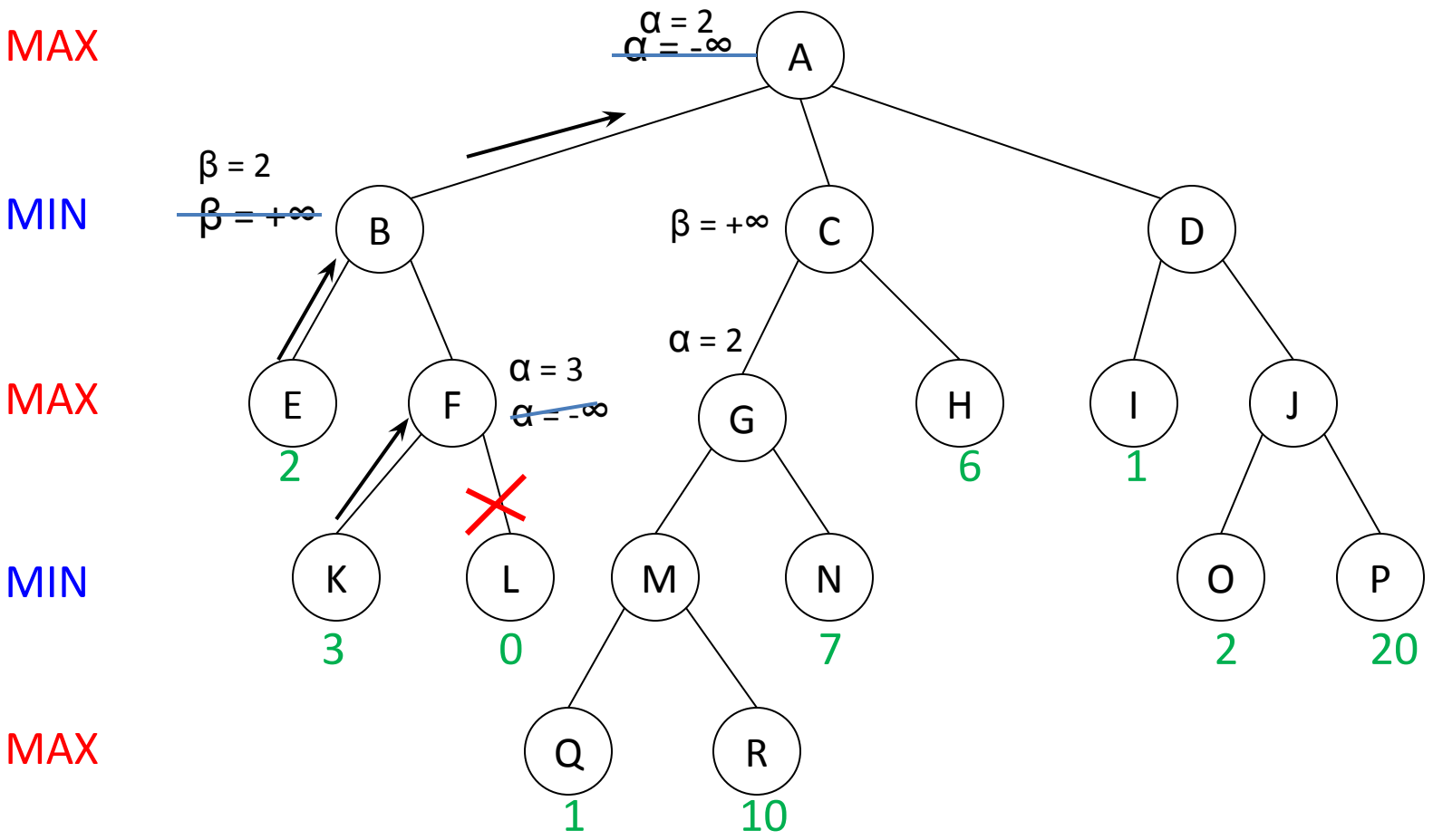

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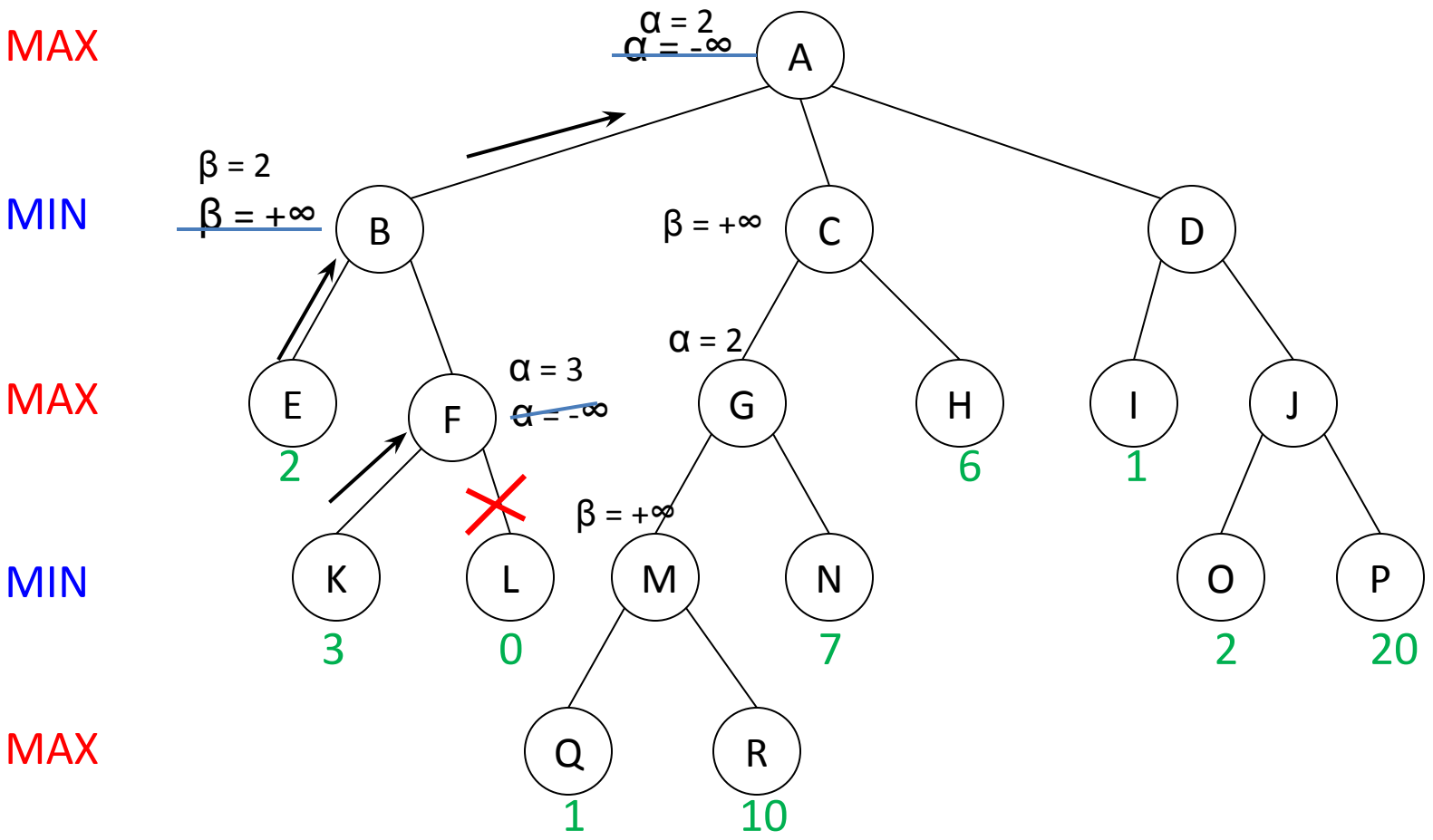

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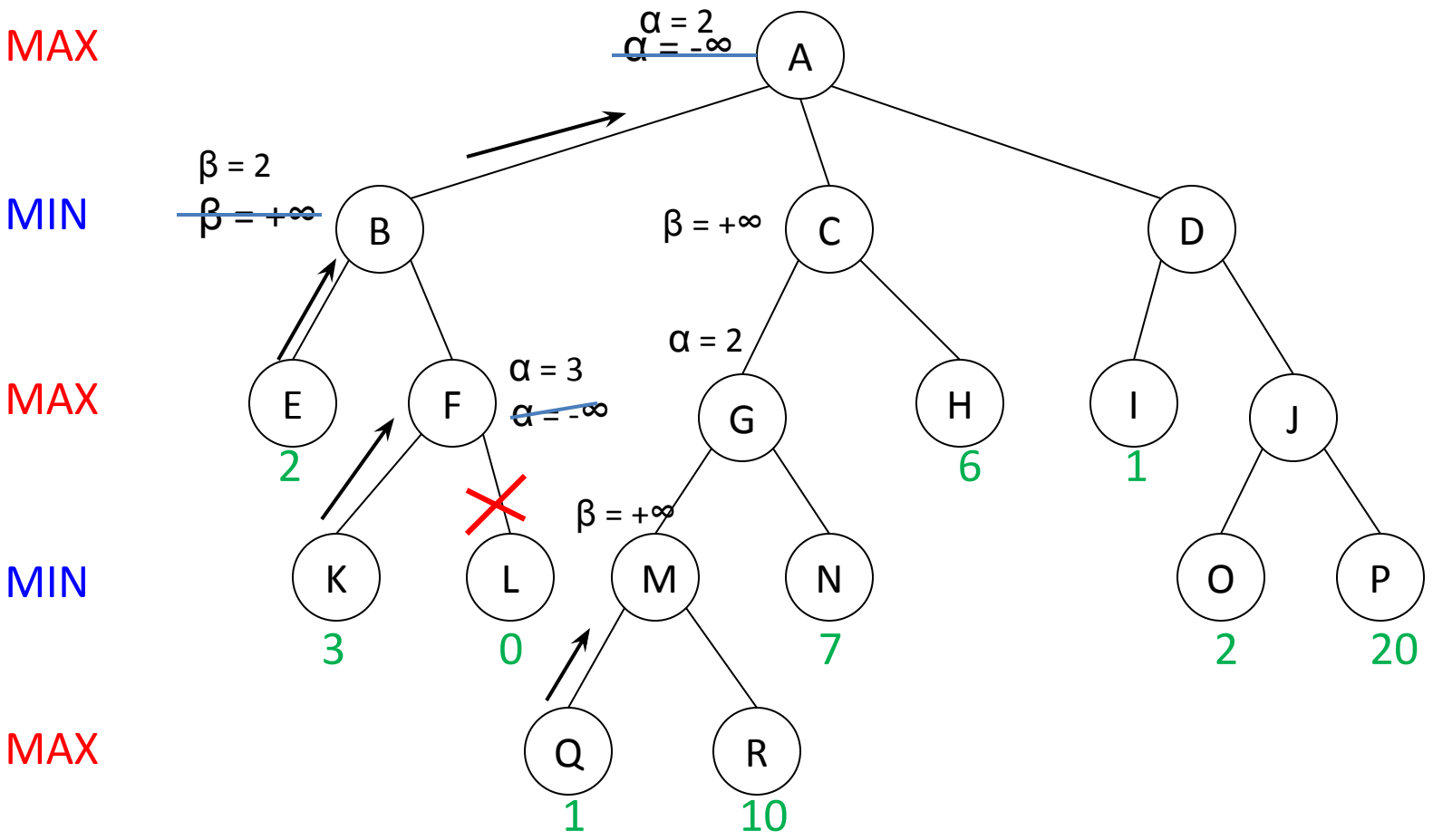

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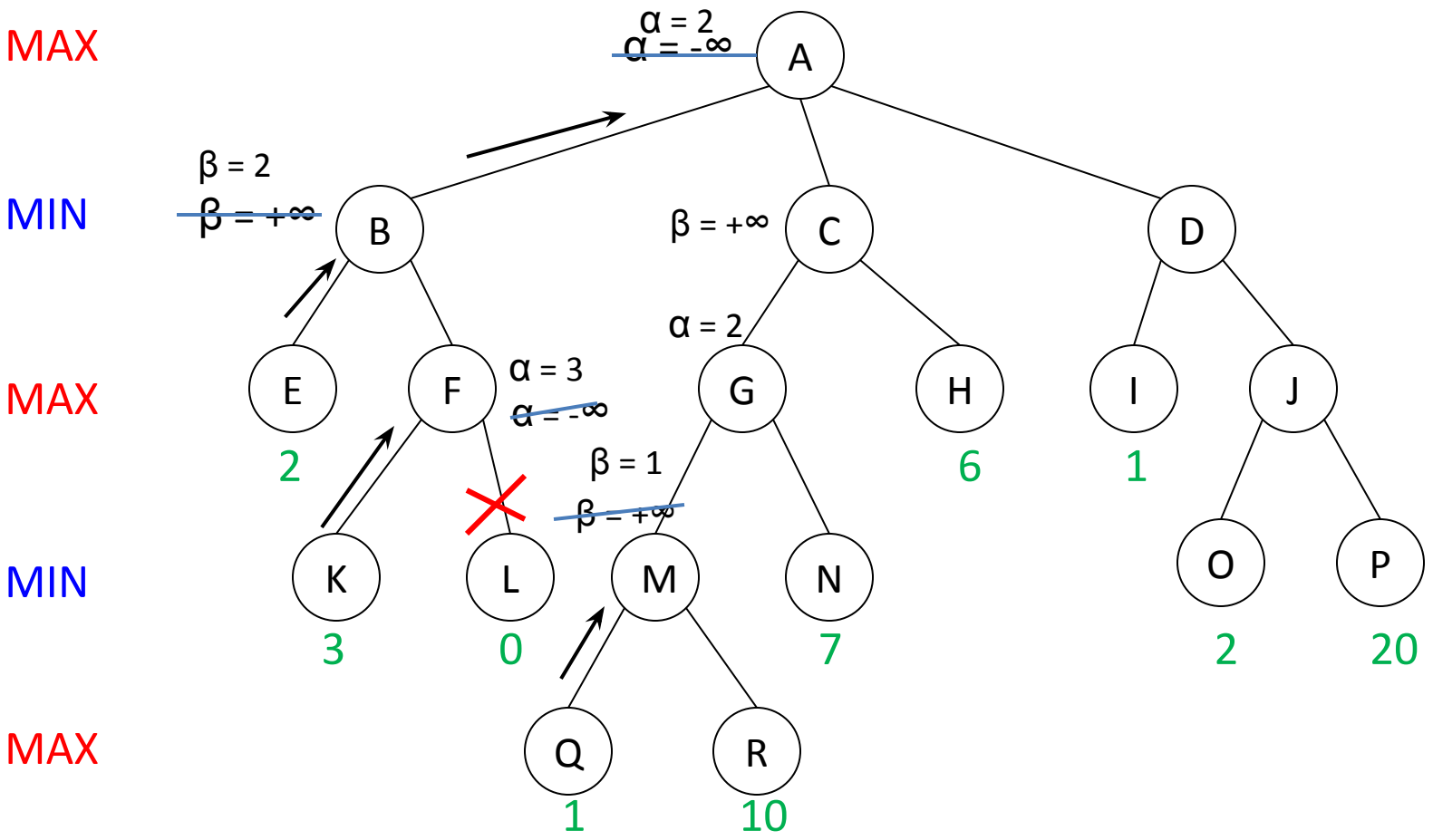

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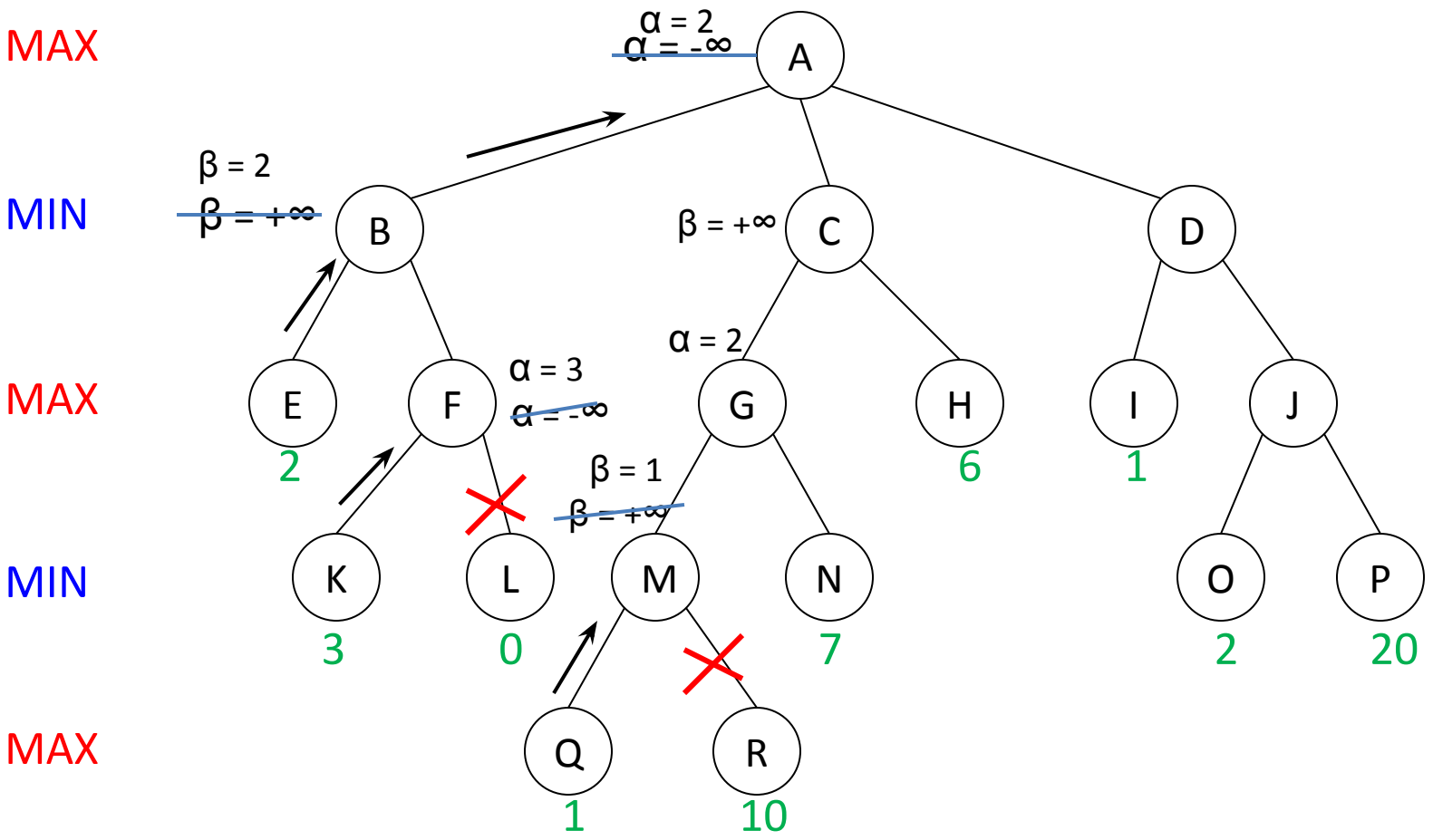

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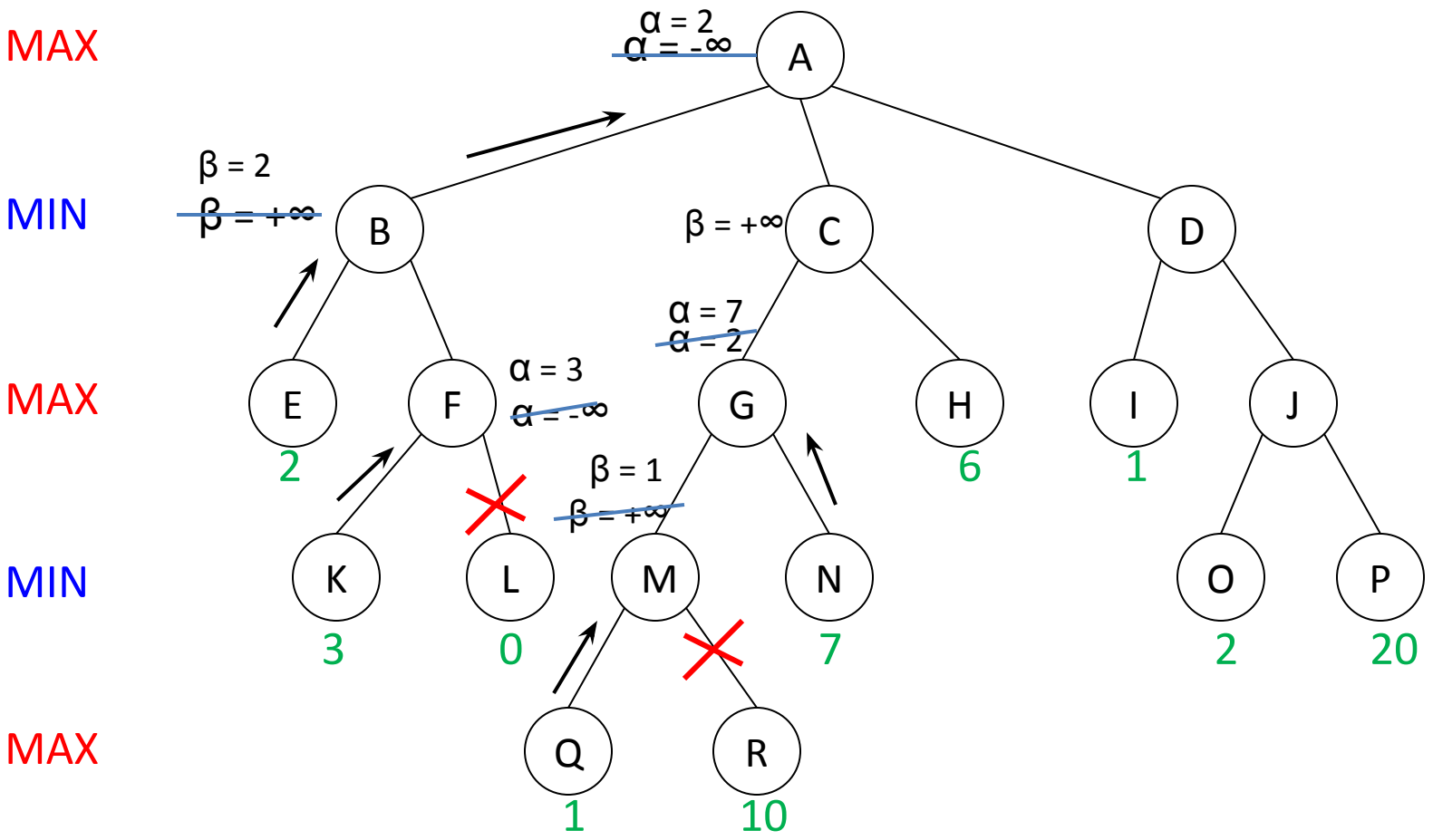

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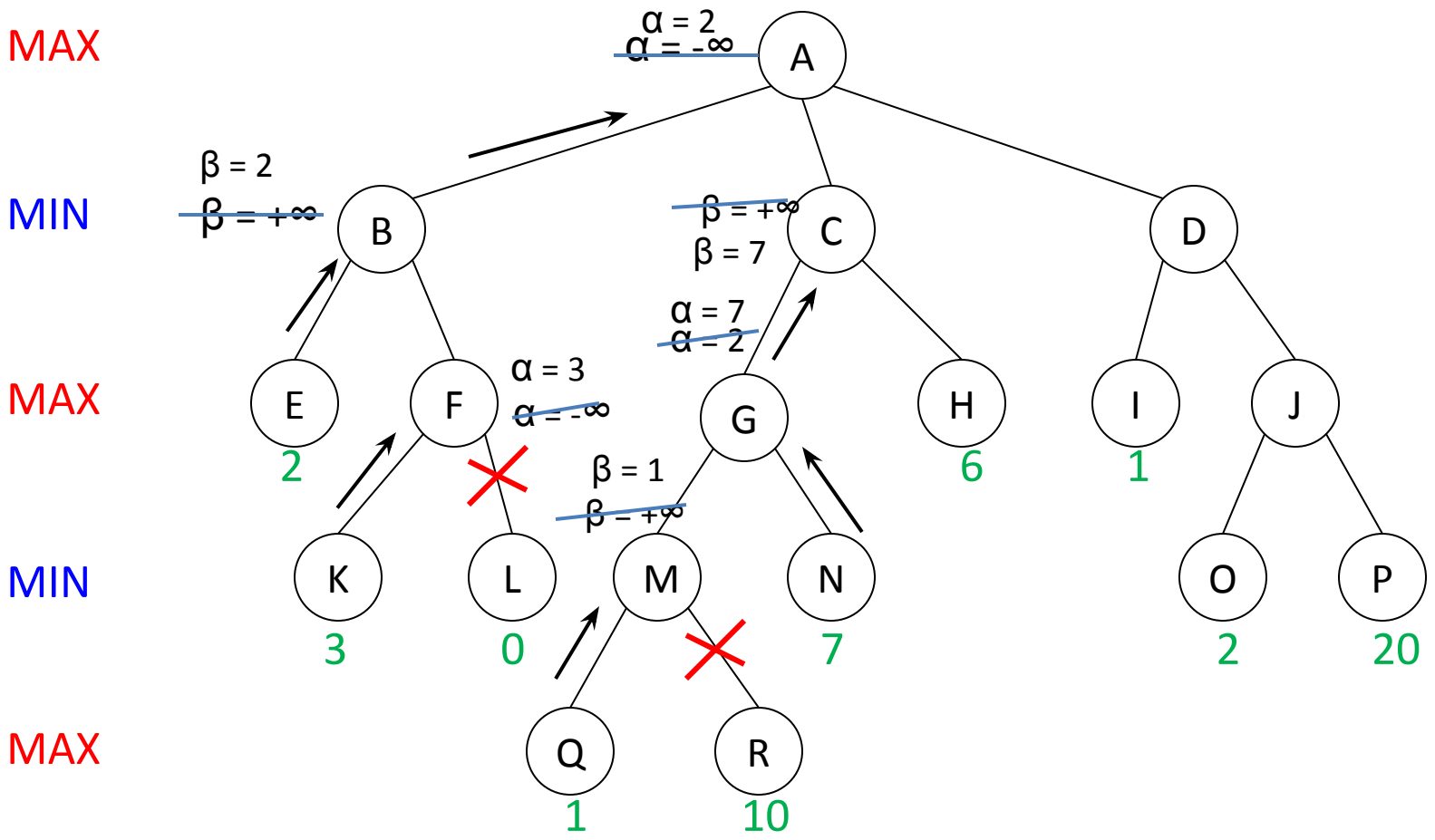

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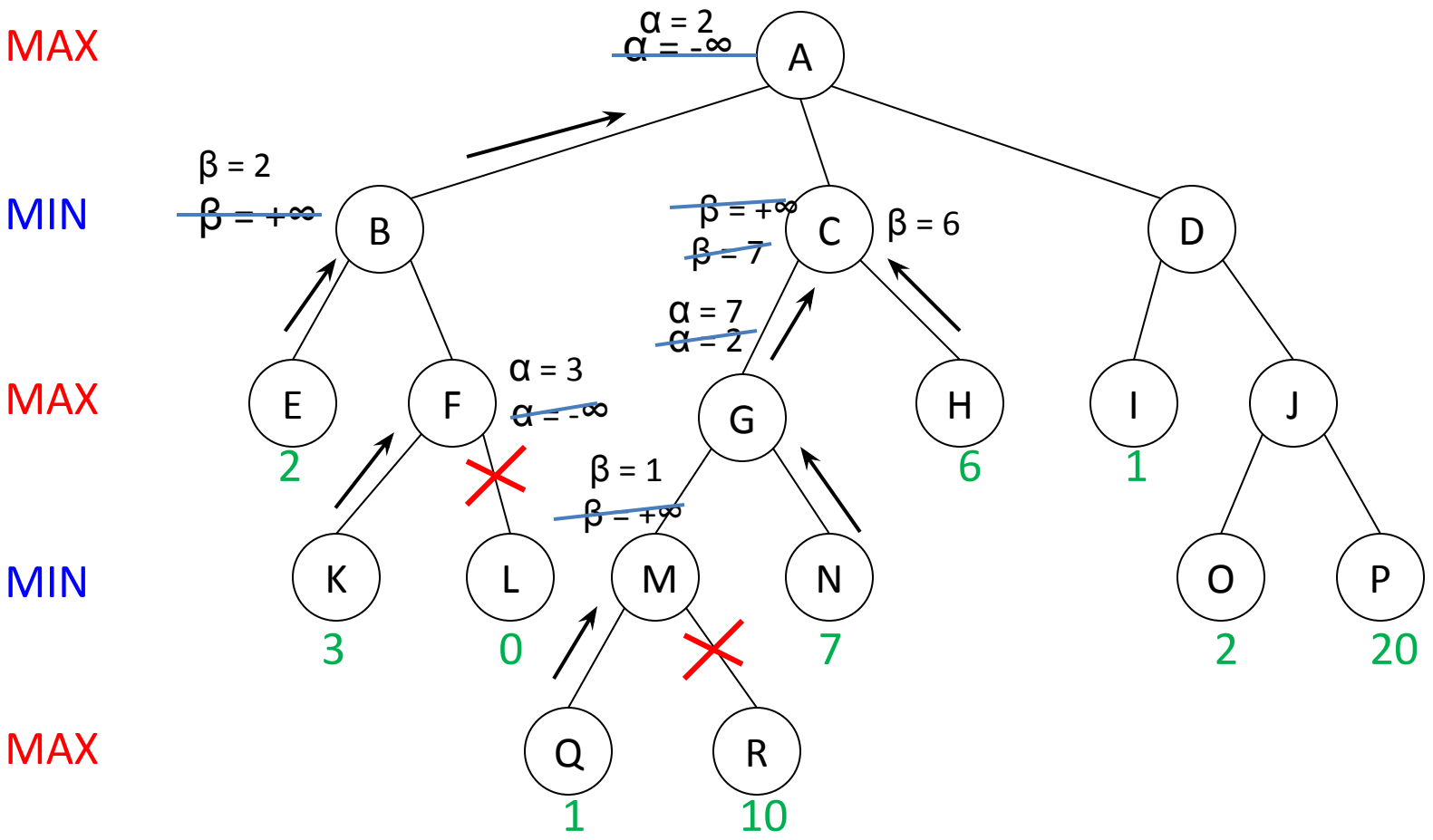

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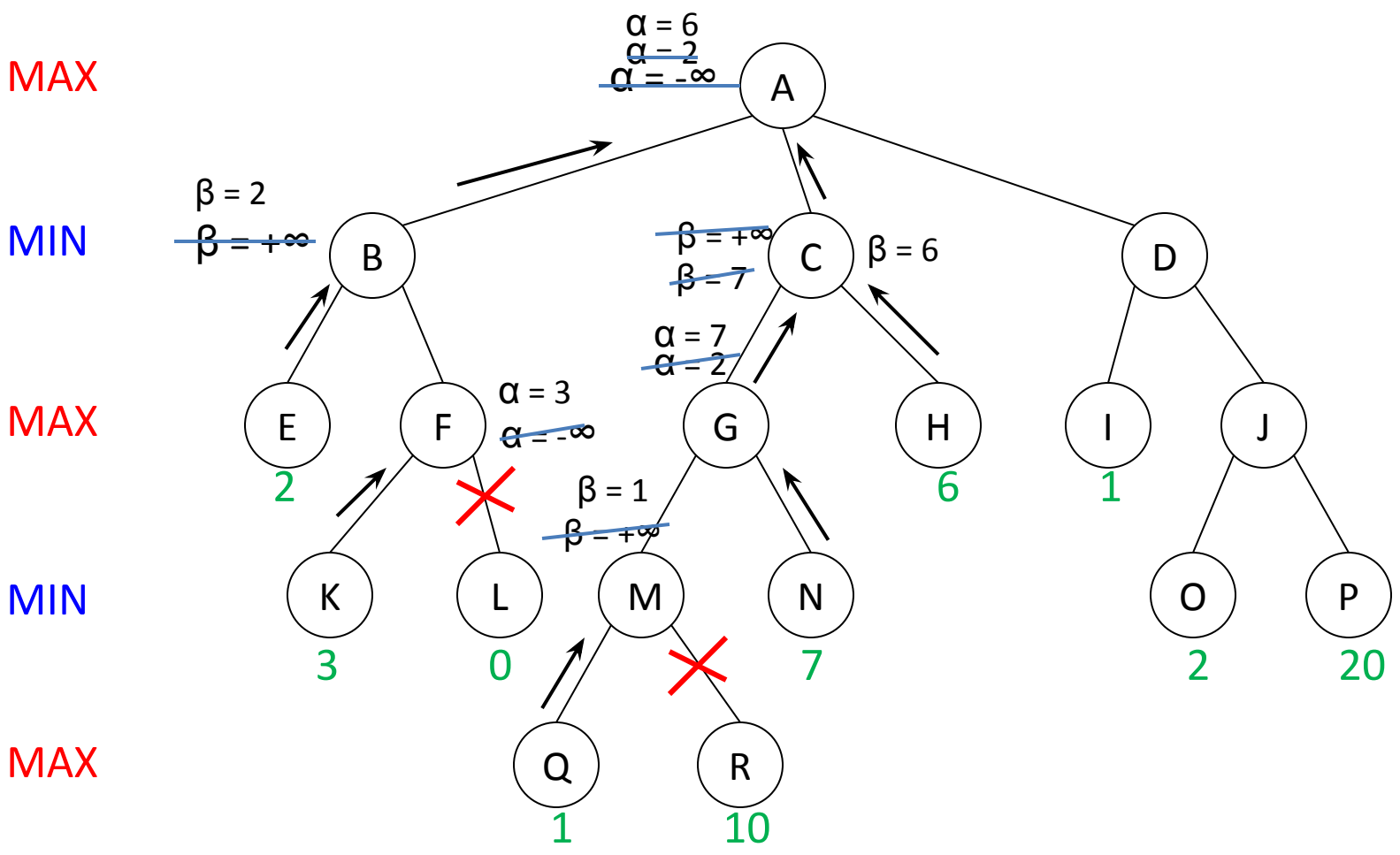

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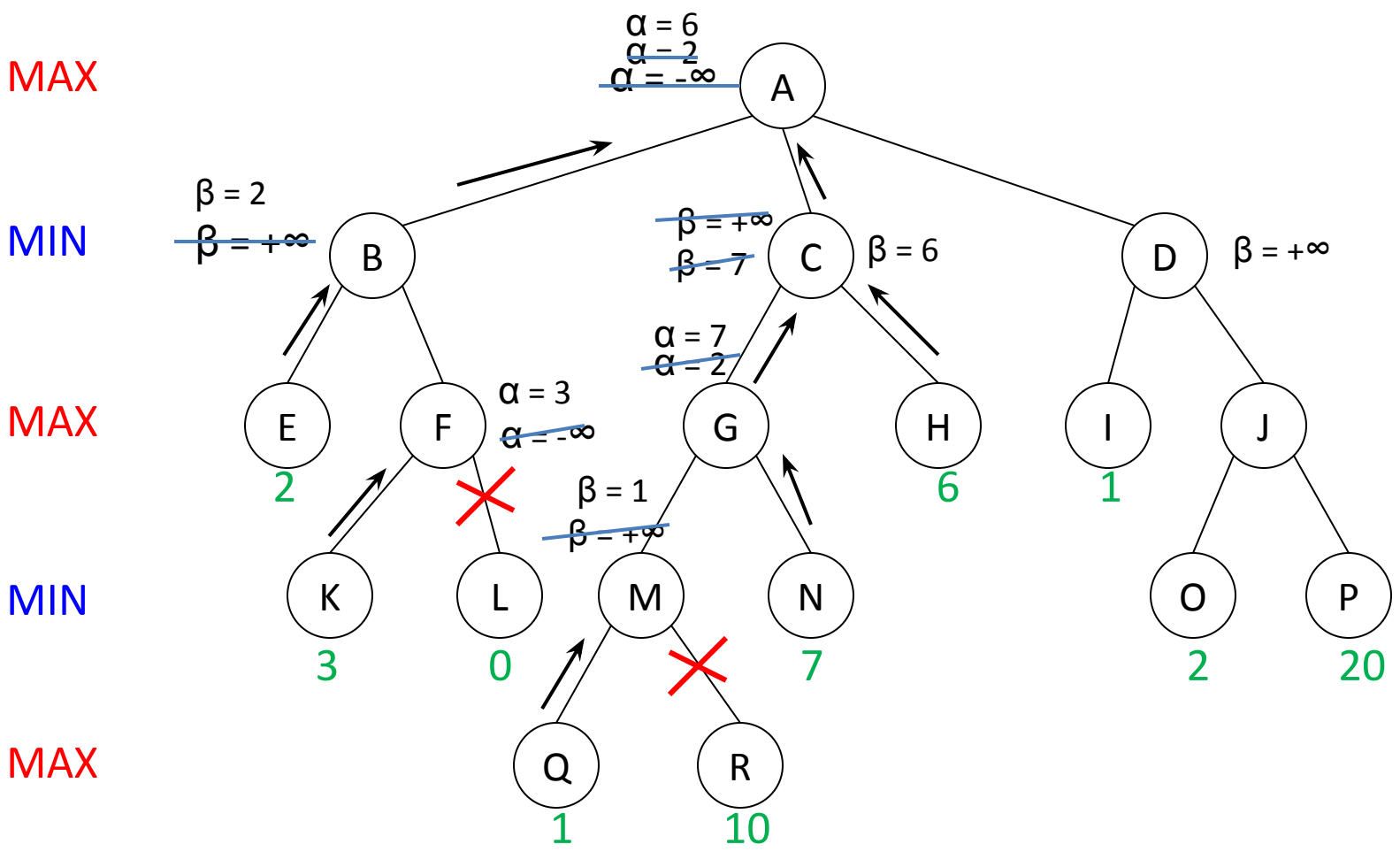

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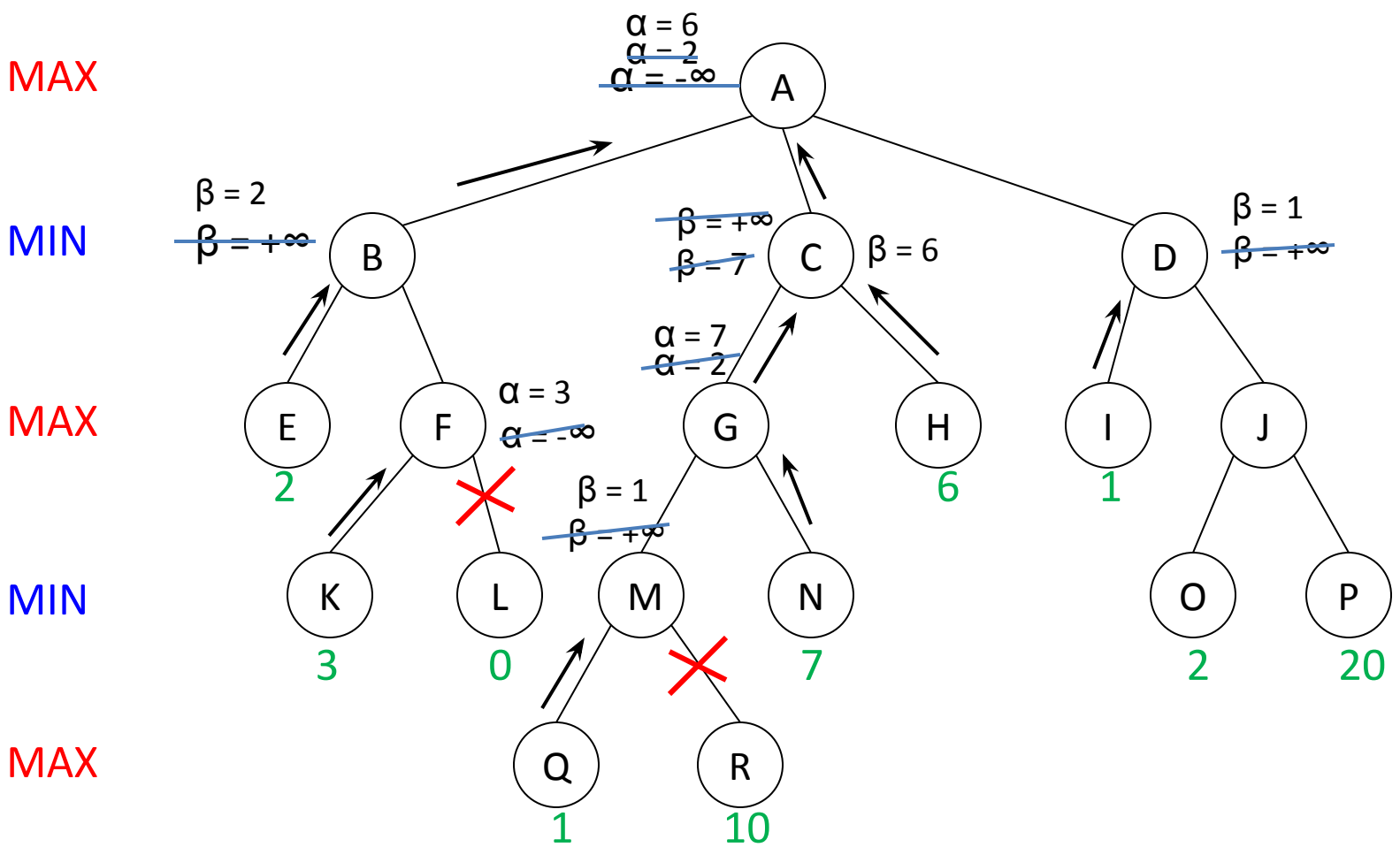

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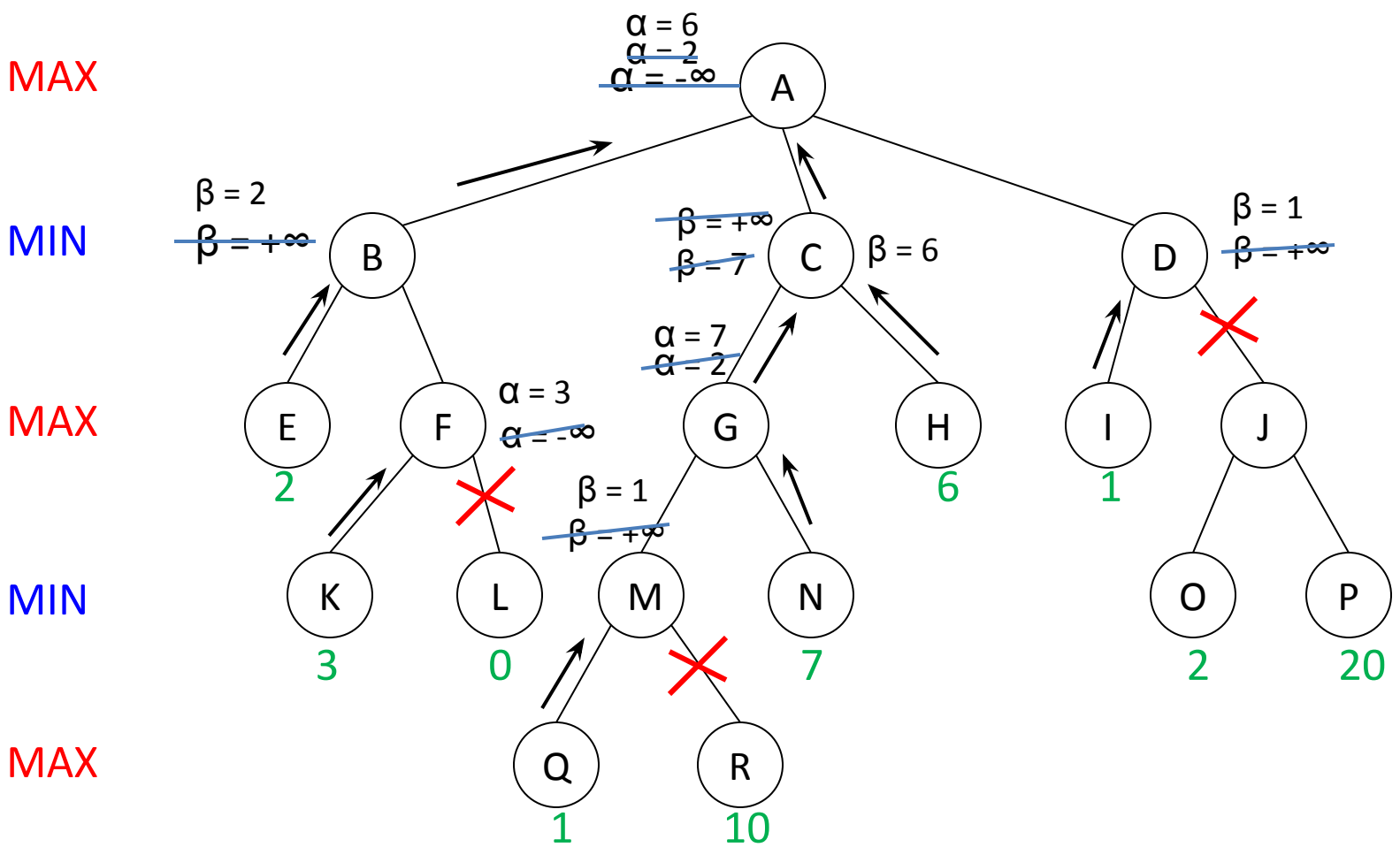

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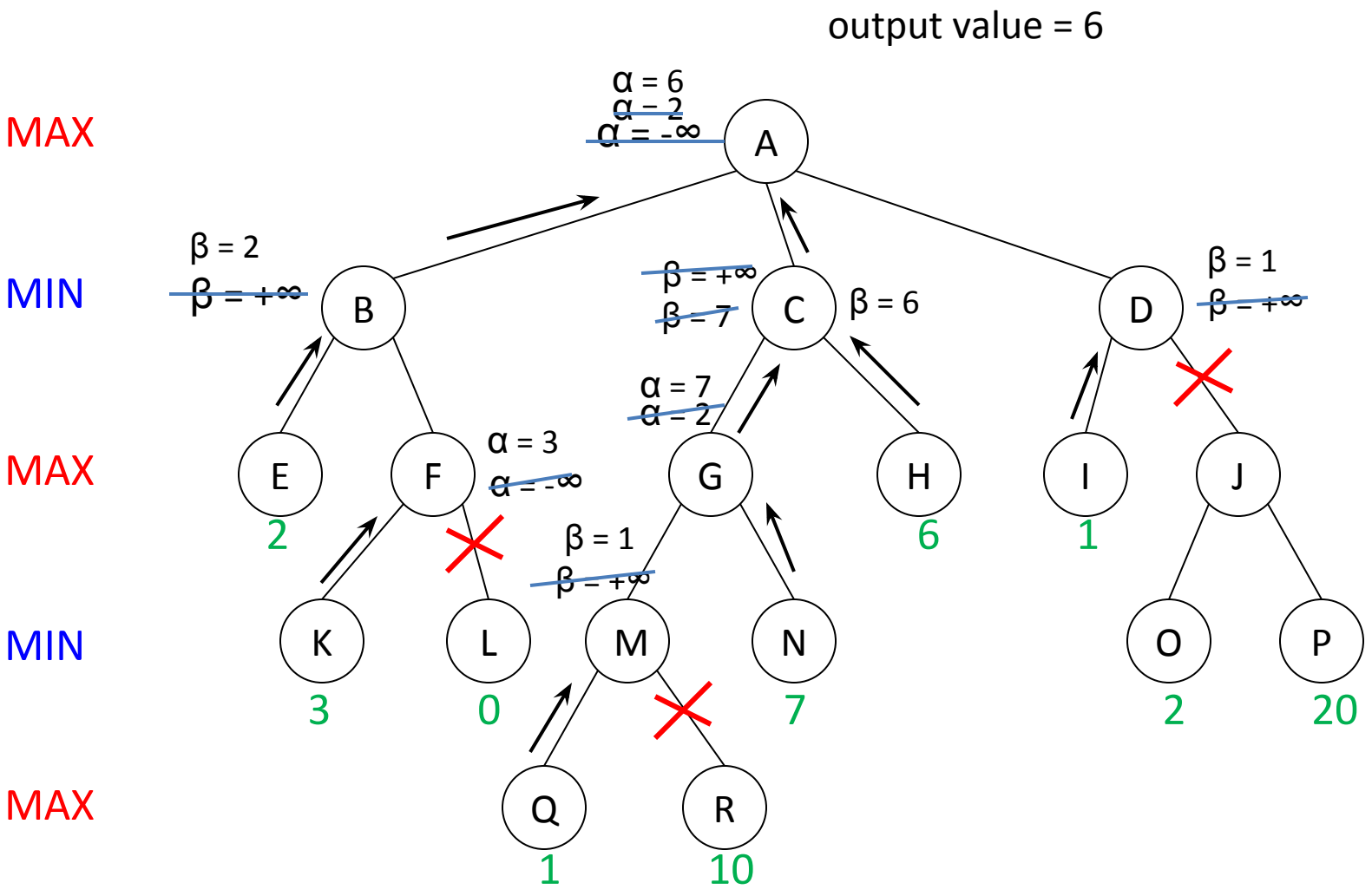
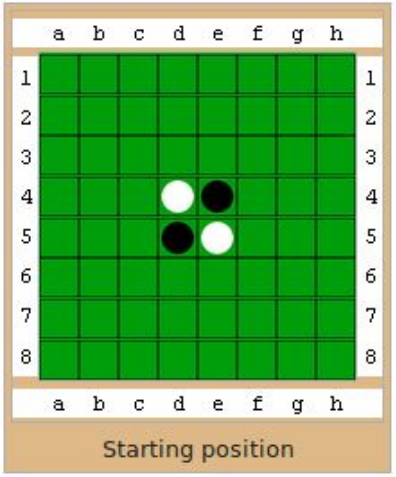


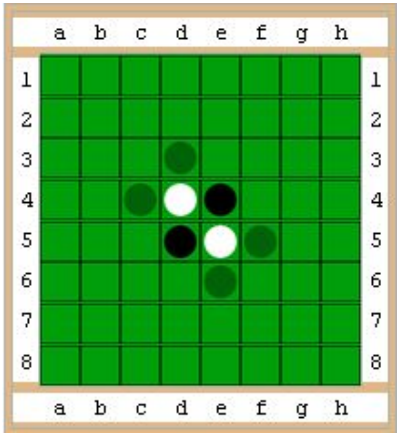
Othello



- Othello is a game for two players, played on an **8×8** board.
- There are total 64 identical pieces, which are **WHITE** on one side and **BLACK** on the other.

Rules

- starting position is fixed; BLACK piece first
- legal move: a piece can be placed in a empty square and the player can turn over opponent's >=1 pieces
- situations that pieces can be turned over: any pieces of the opponent's color that are in a straight (horizontal, vertical and diagonal) line and bounded by the piece just placed and another piece of the current player's color
- If one player can not make a valid move, play passes back to the other player. When neither player can move, the game ends (when the board has filled up or when neither player can legally place a piece in any of the remaining squares)
- how to determine one player is win: the player with the most pieces on the board at the end of the game wins.



Othello with AI

- Search methods: BFS, IDS, ...
- Minimax, alpha-beta pruning
- **GUI**: an **8×8** board; black and white pieces; each move can be controlled by the keyboard or the mouse.

- Evaluation (based on the rules and strategies):

• assign scores for the leaves of the tree, the evaluation function **Score = p + c + l + m**

1. **Piece difference (p)**: measures how many pieces of each color on the board

   B and **W** represent the numbers of black and white pieces on the board, respectively.

   if **B** > **W**, the score **p** = B / (B + W) * 100;

   if **B** < **W**, the score **p** = - W / (B + W) * 100;

   if **B** = **W**, **p** = 0.

2. **Corner occupation (c)**: measures how many corners are owned by each player

   B is the number of black pieces in corners; **W** is the number of white pieces in corners.

   Then the score **c** = 25 * (B - W).

3. **Corner closeness (l)**: measures the pieces adjacent to empty corners

   B and **W** represent the numbers of black and white pieces adjacent to empty corners, respectively.

   Then the score **l** = 12.5 * (W - B).

4. **Mobility (m)**: measures how many legal moves each player has

   B and **W** represent the numbers of all possible legal black and white moves, respectively.

   if **B** > **W**, then the score **m** = B / (B + W) * 100;

   if **B** < **W**, then **m** = - W / (B + W) * 100;

   if **B** = **W**, then **m** = 0.

More on evaluation functions:

- Estimation of the current state of the game: who is most likely to win.
- Search through moves and pick the “best” one.
- Evaluations based on the board positions.
- The evaluation function should take into account the "long term" advantages and disadvantages of a position.