Discussion Section 4

- HW2 comments/HW3 questions
- Edit graph optimization
- Useful data structures

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      - Iteratively remove nodes without parents except for the start node
      - Give each node a flag indicating if the path to it includes the start node

HW 4: Edit graph

- Create an edit graph for 3 sequences using the BLOSUM62 score matrix
- Output in the same format as HW2
- Run your highest-weight path program on the edit graph to find the highest scoring path (local alignment)

HW 4: Edit graph

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Protein 2: M L V V L A N ...

Protein 3: M Y V I L V Y ...
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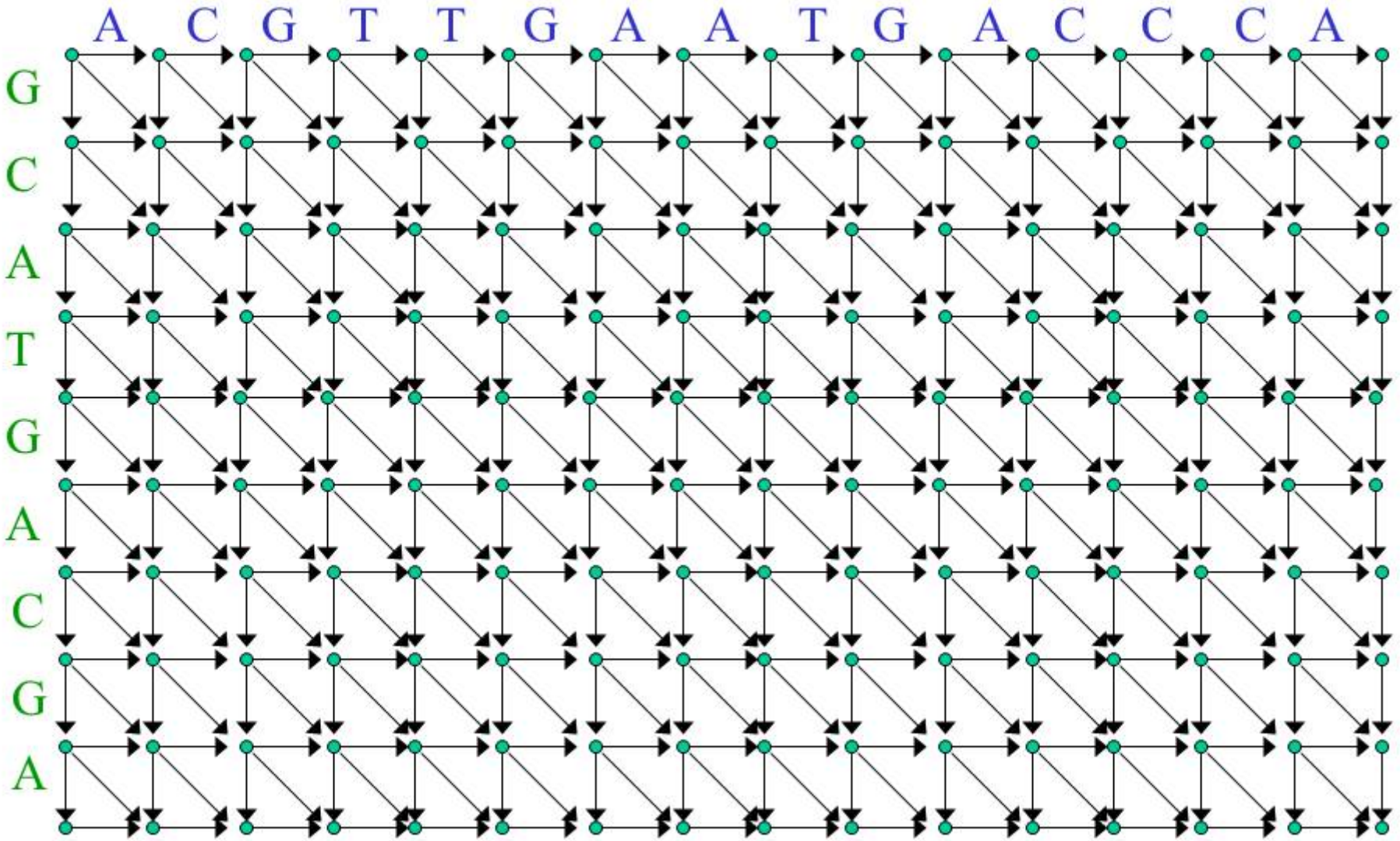

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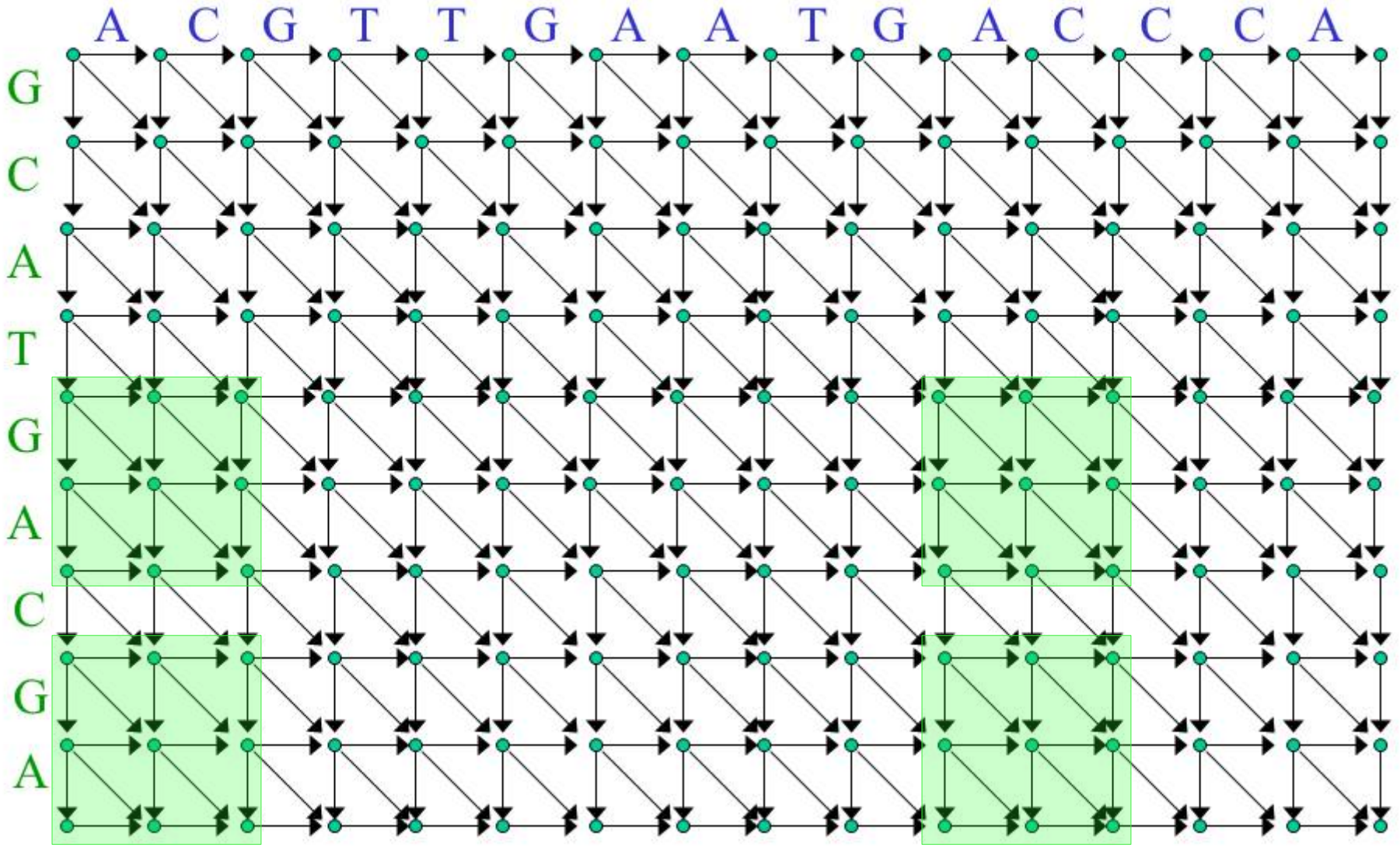
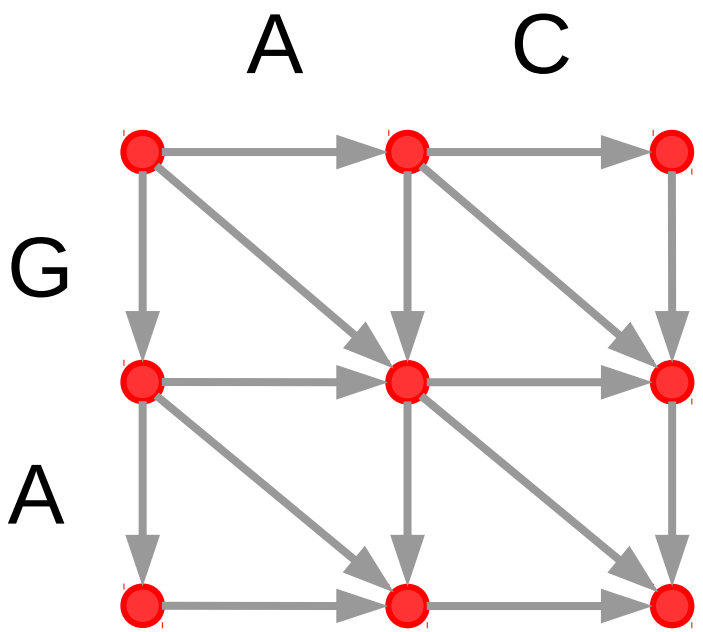


Method of Four Russians



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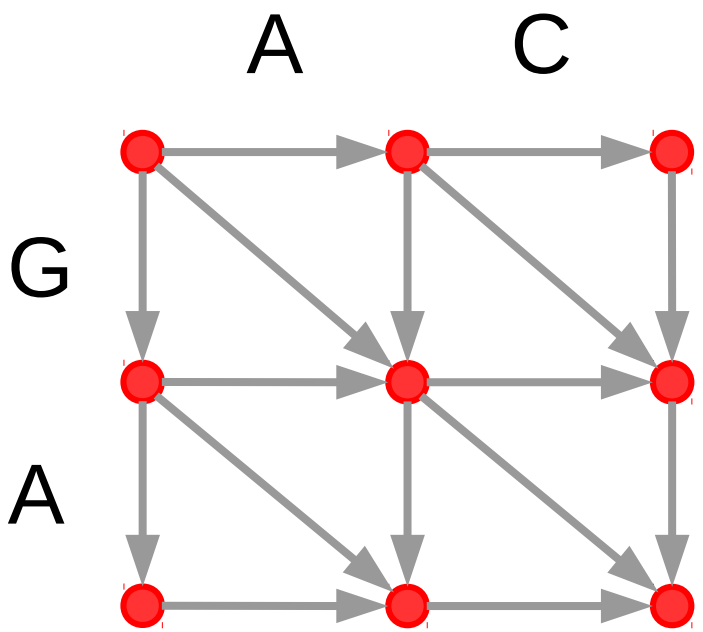

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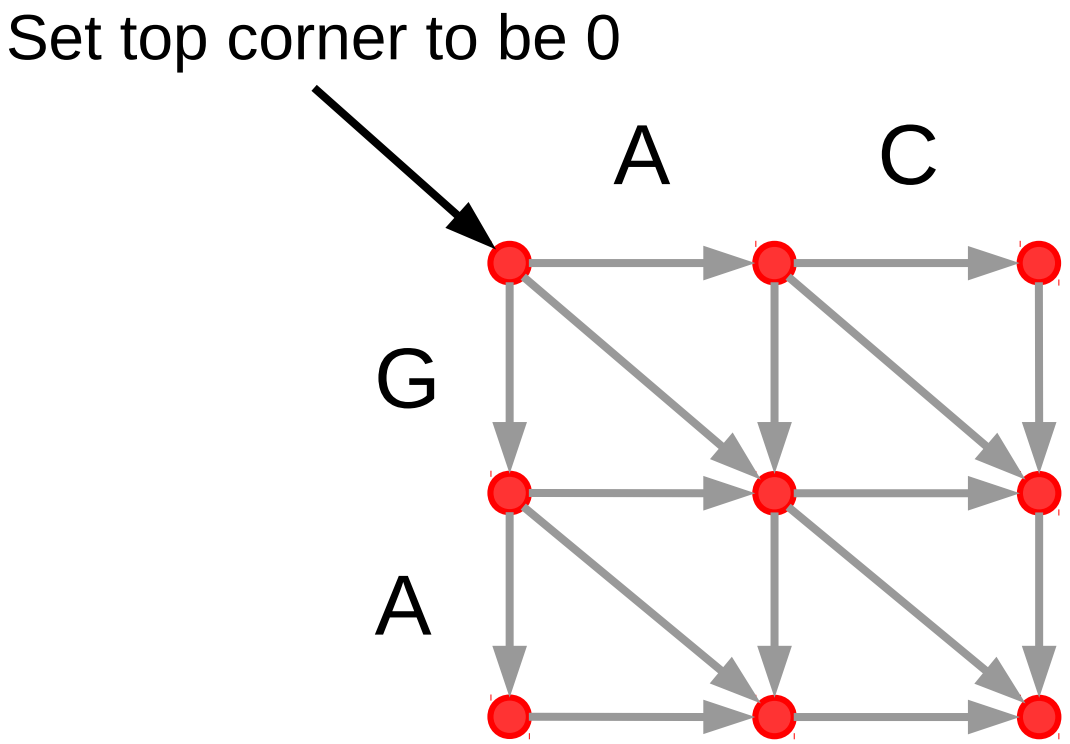

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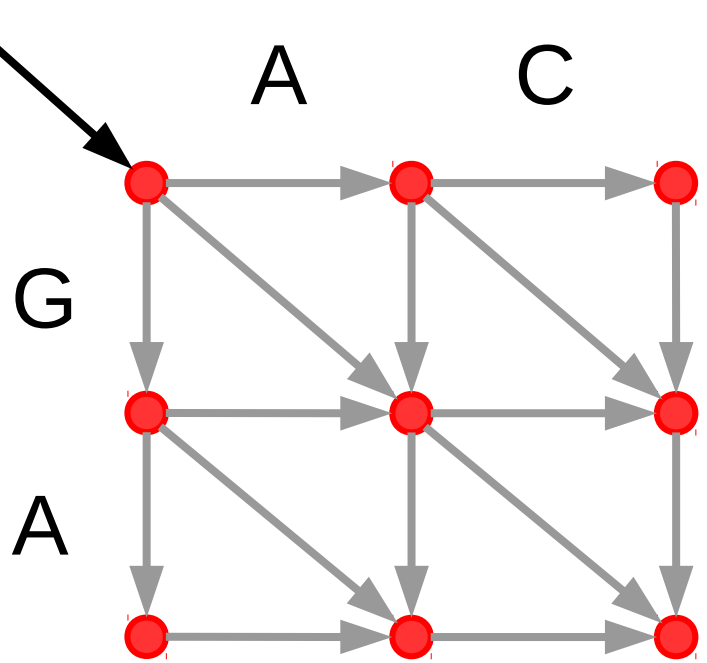

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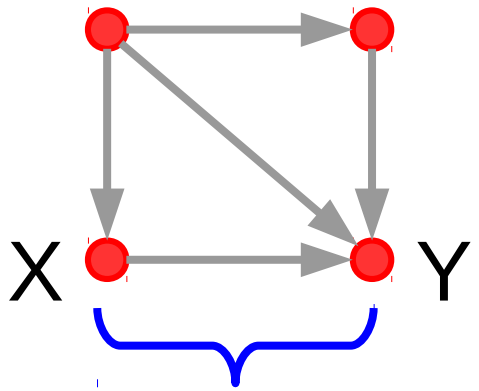

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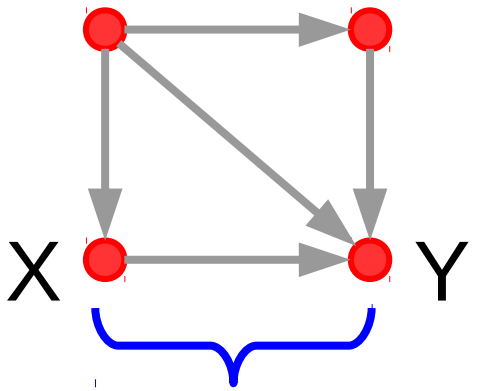

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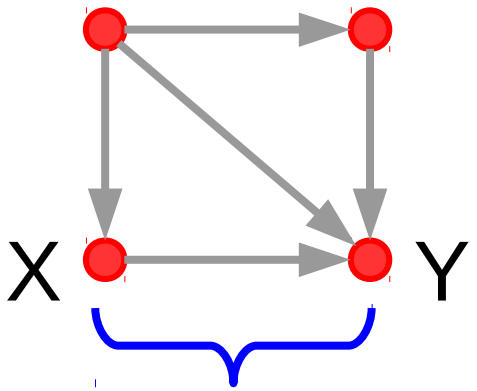

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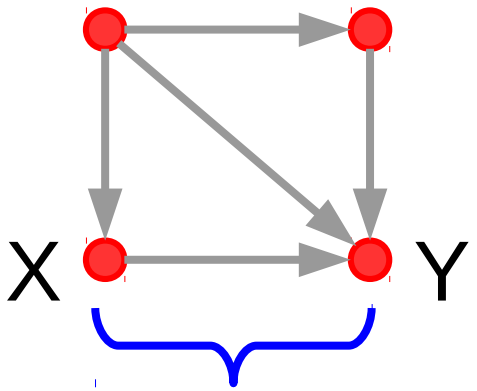

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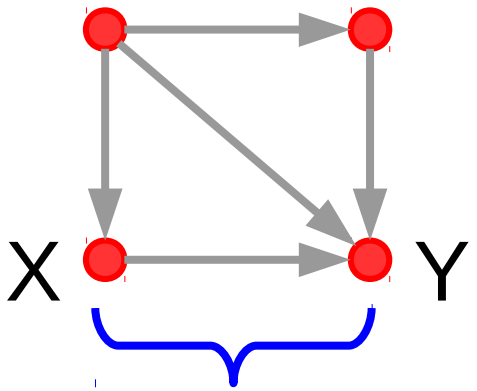

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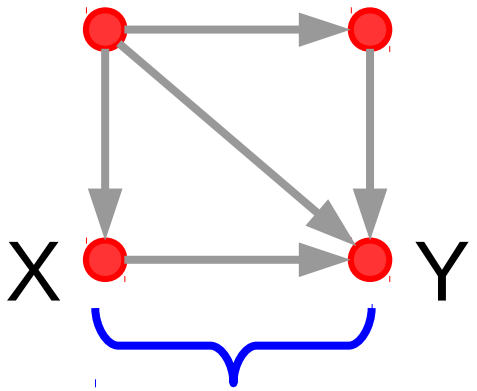

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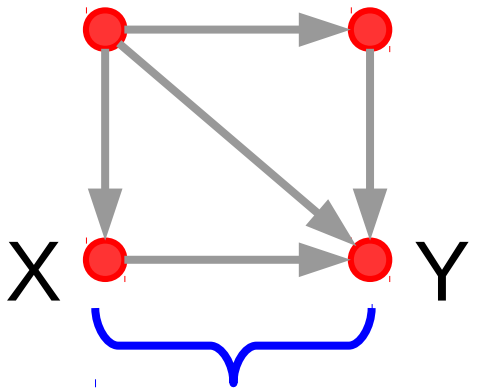

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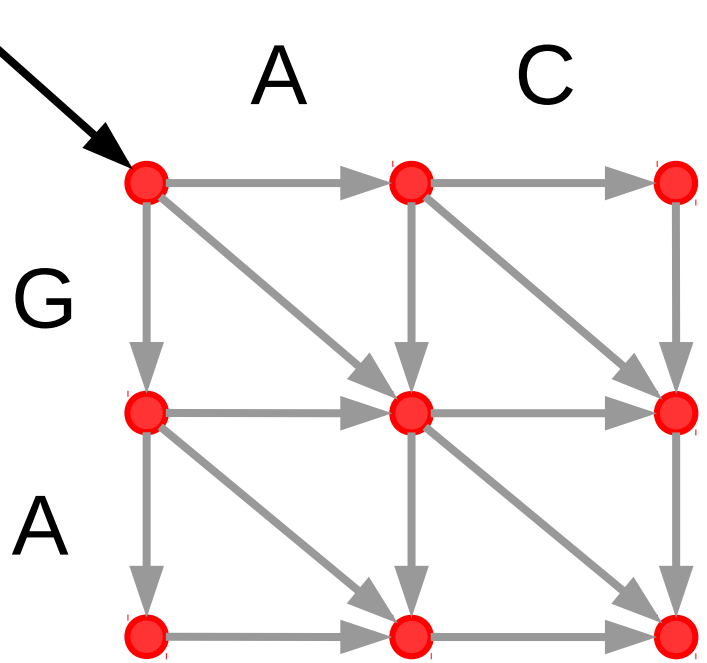

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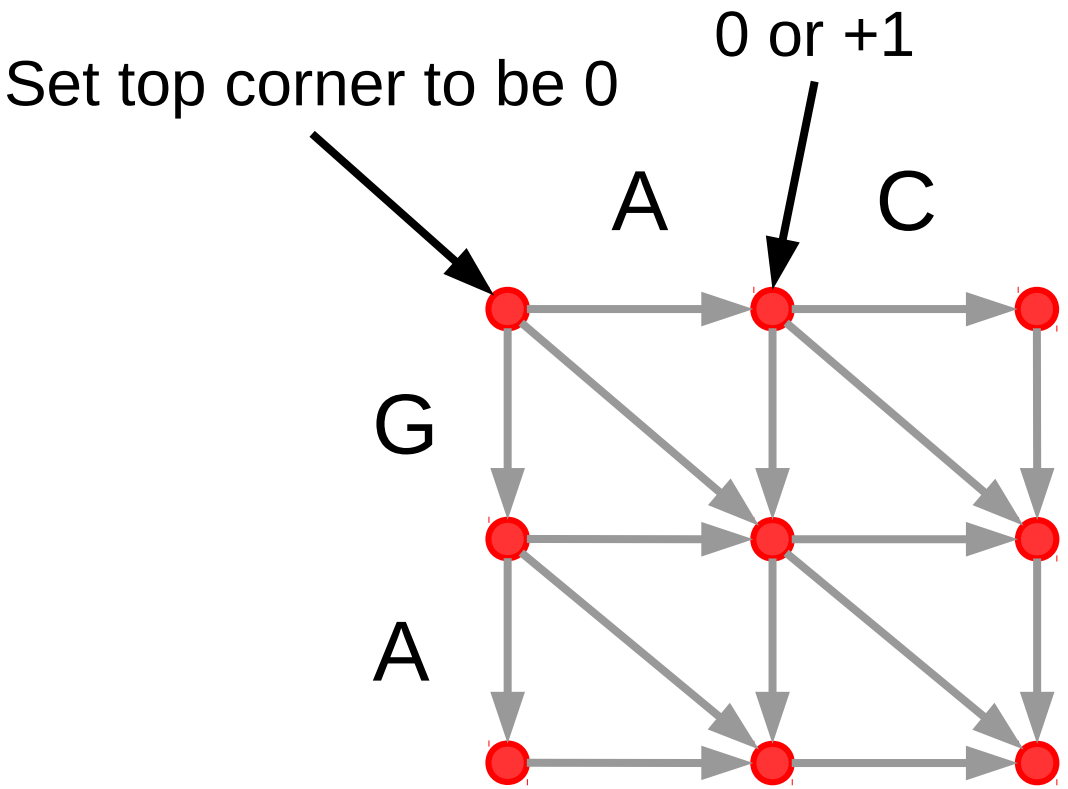

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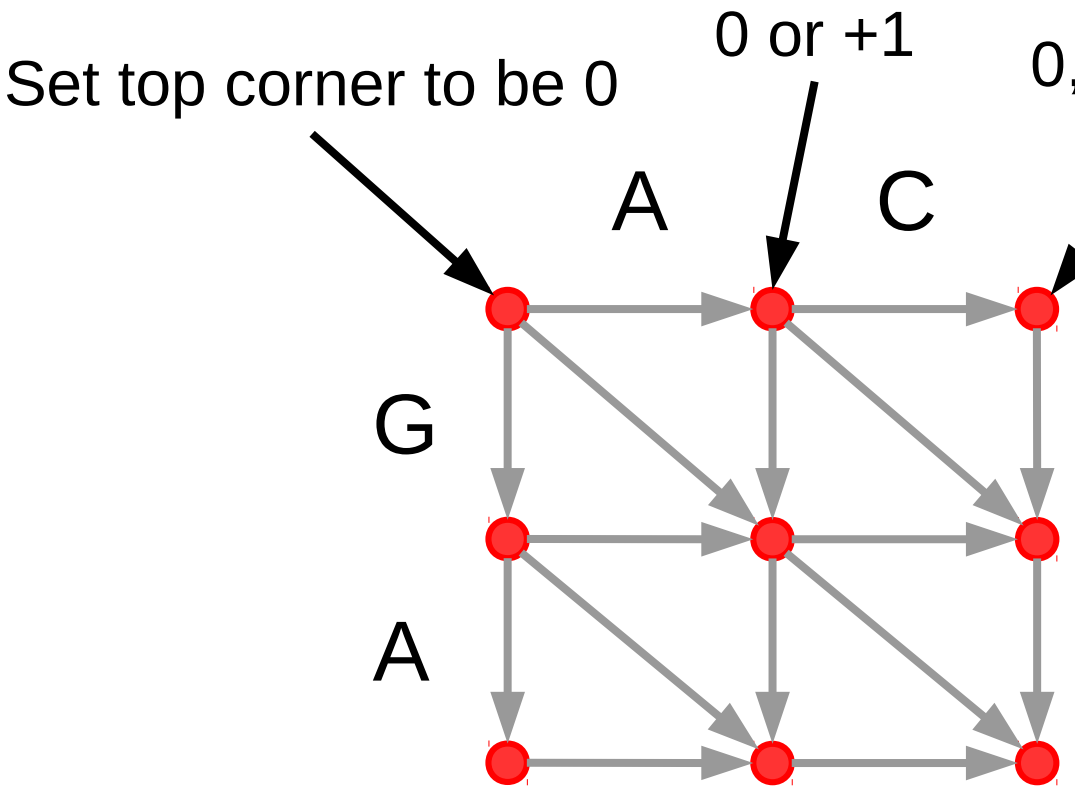

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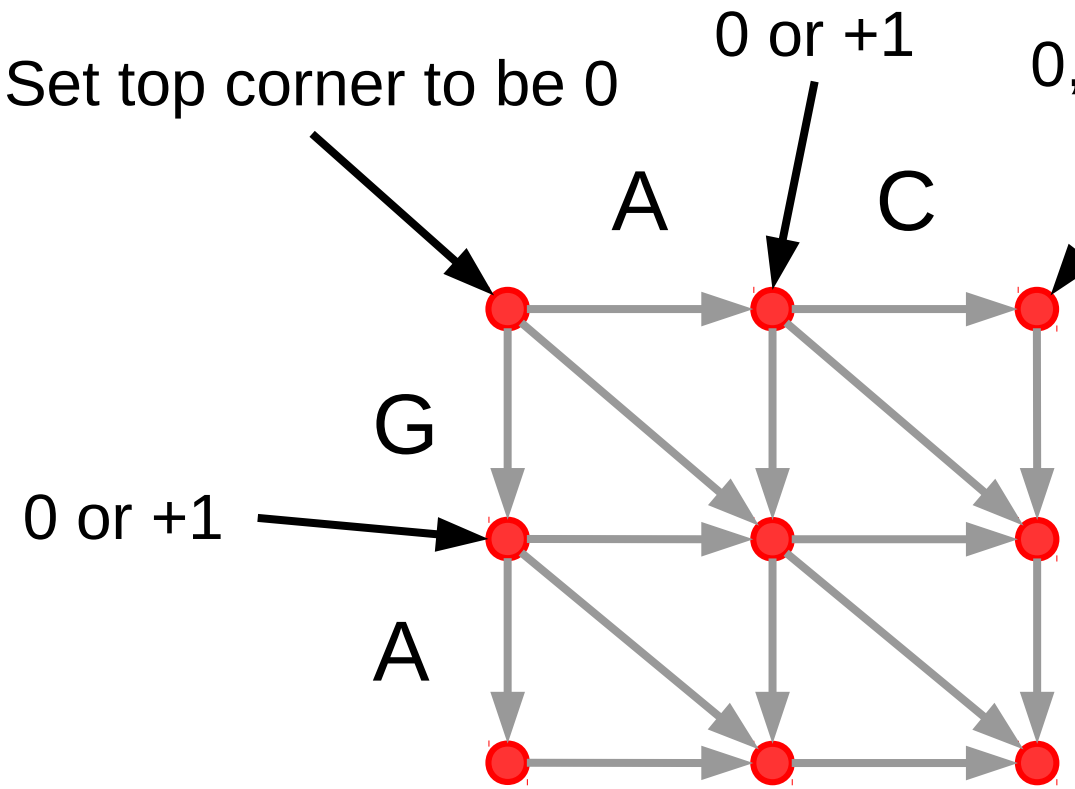

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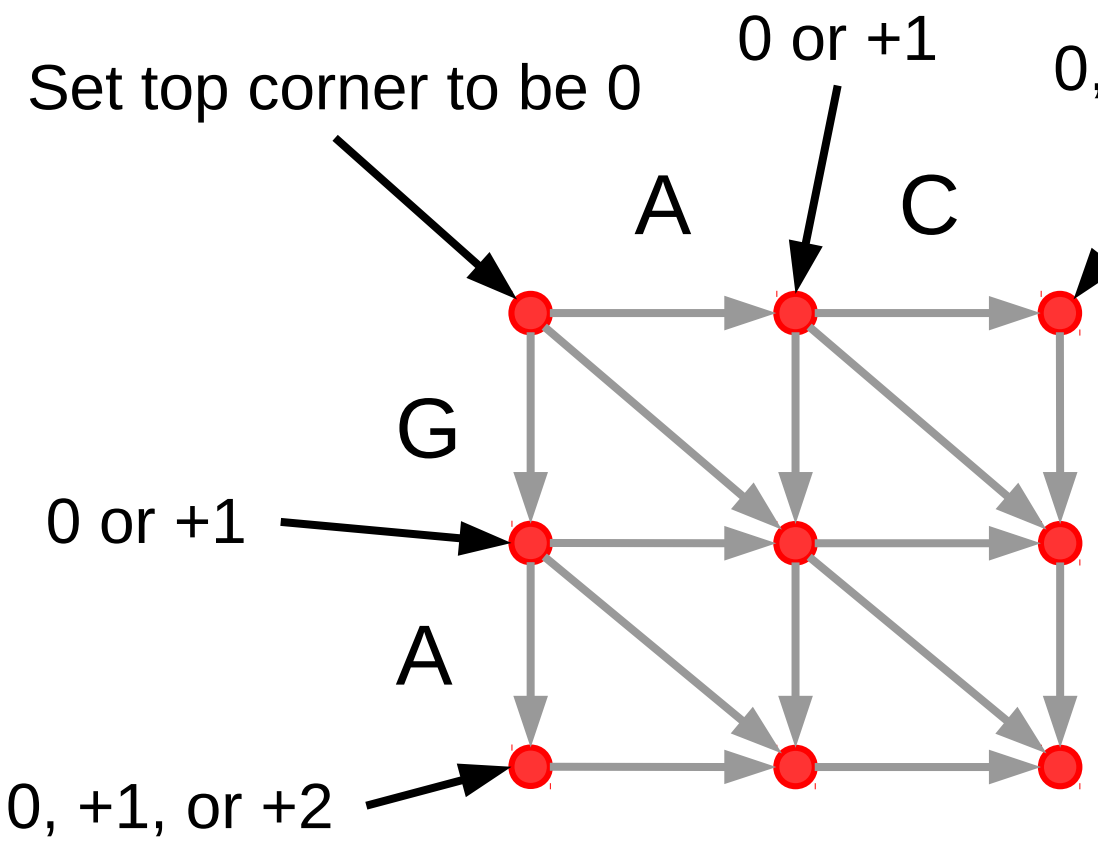

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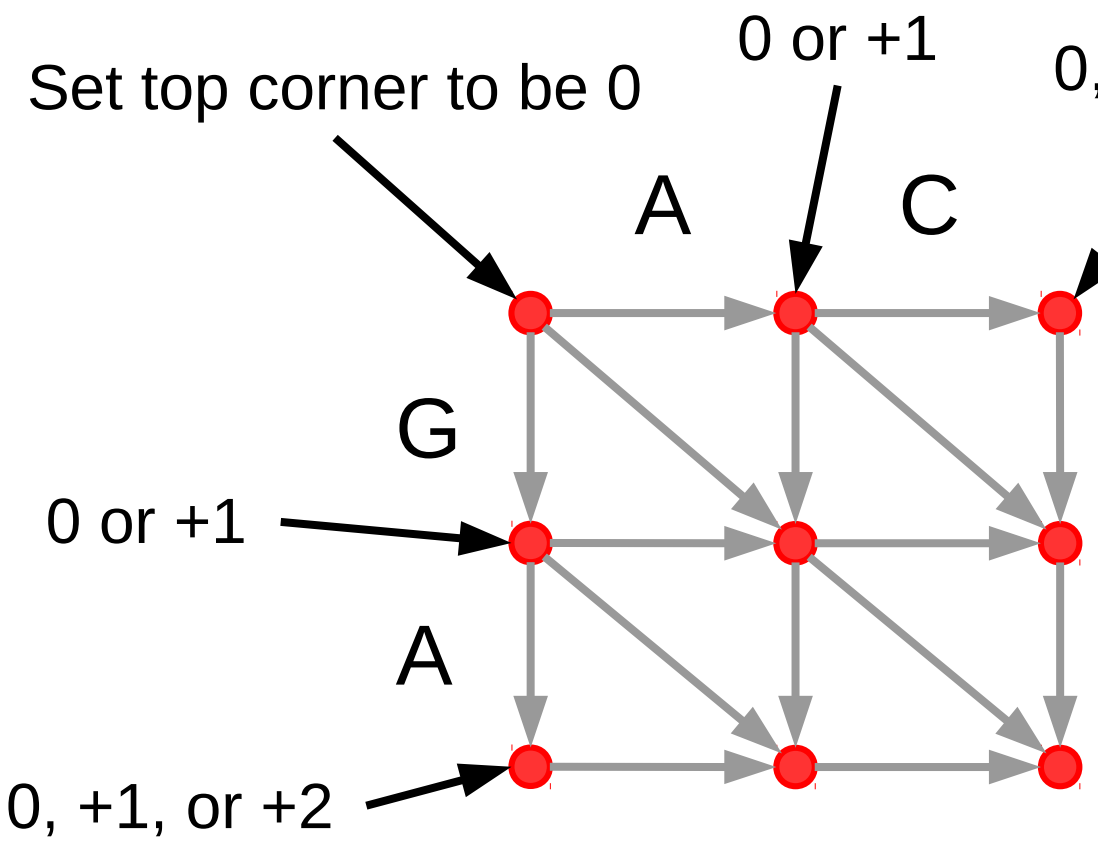

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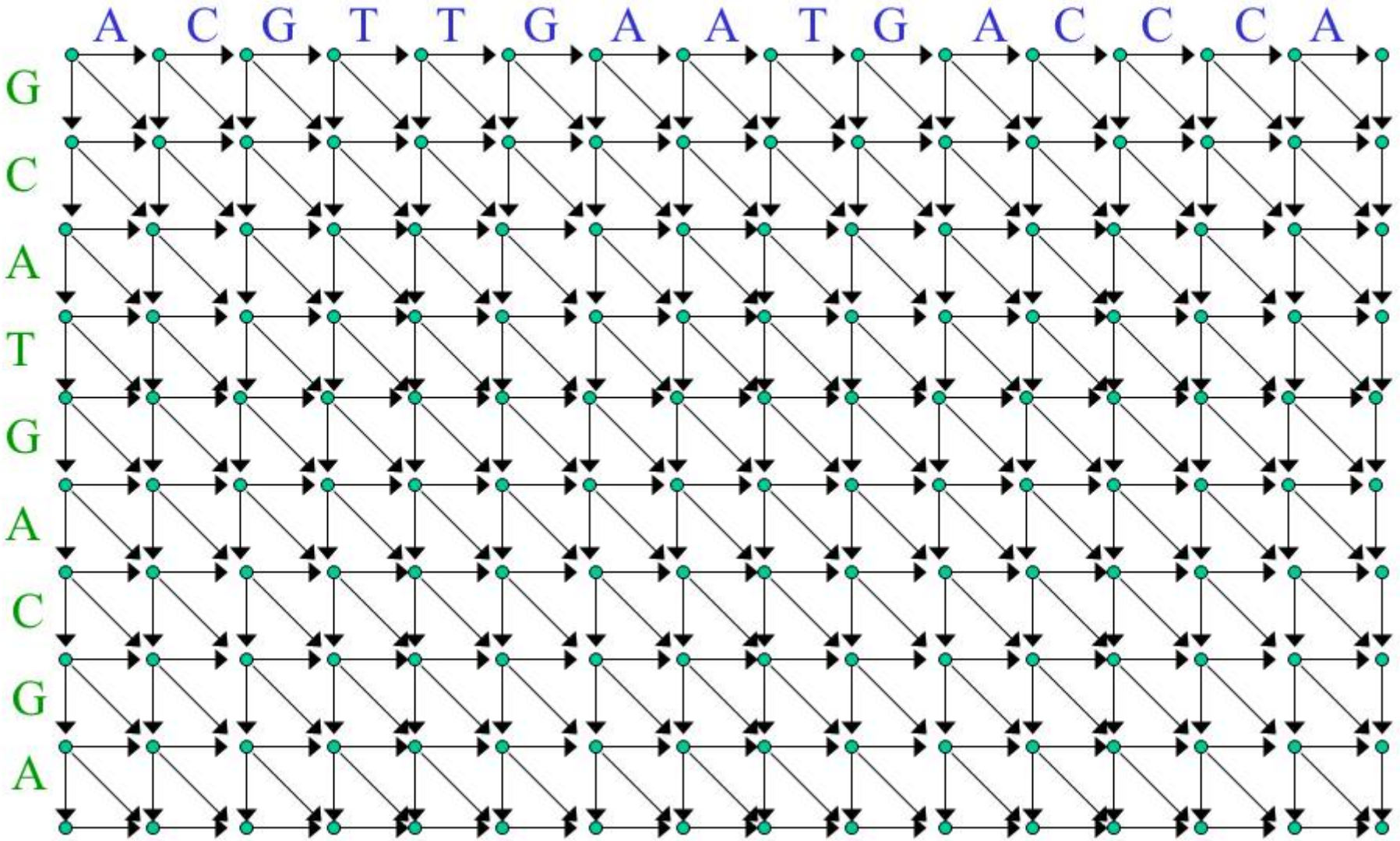

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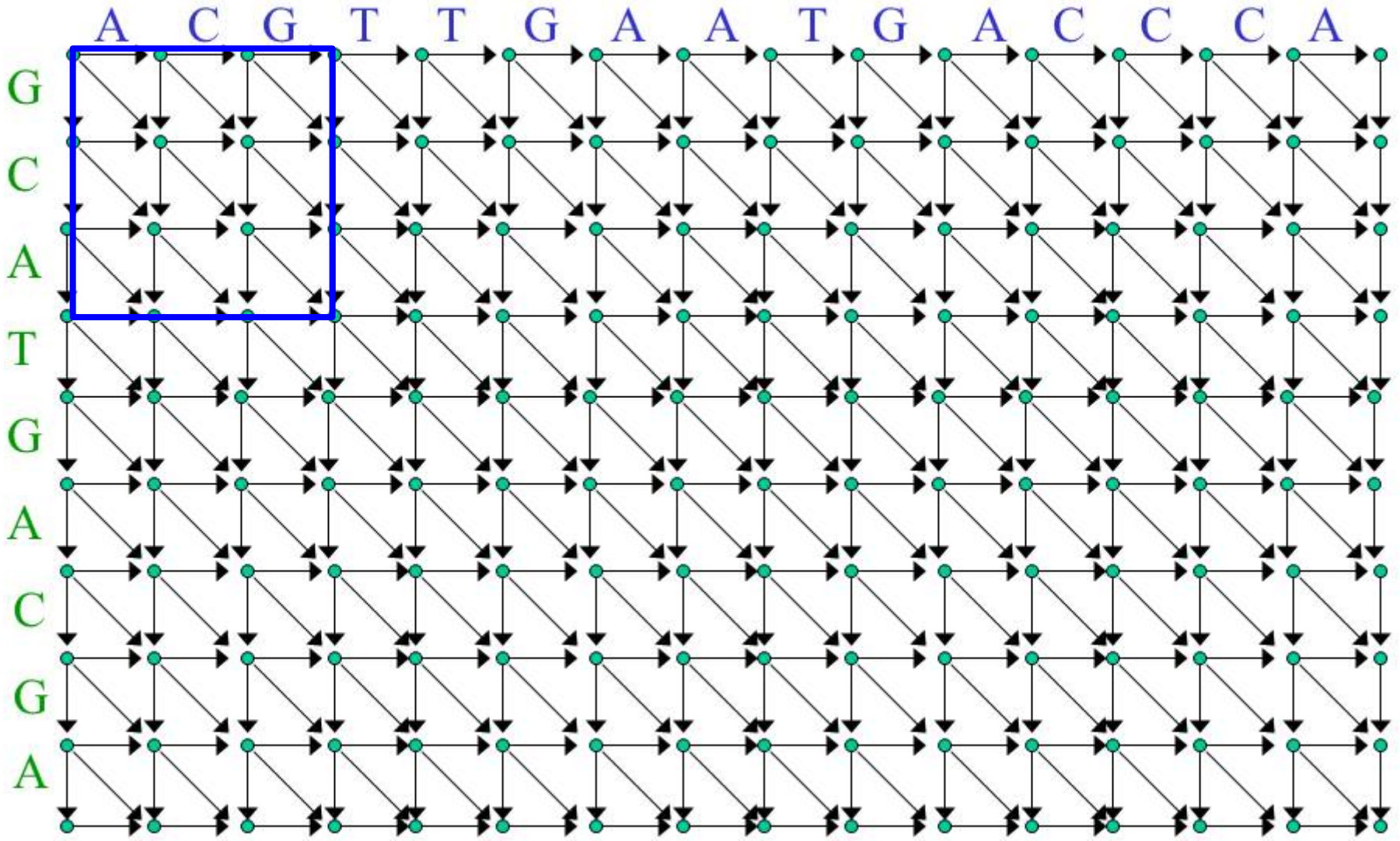

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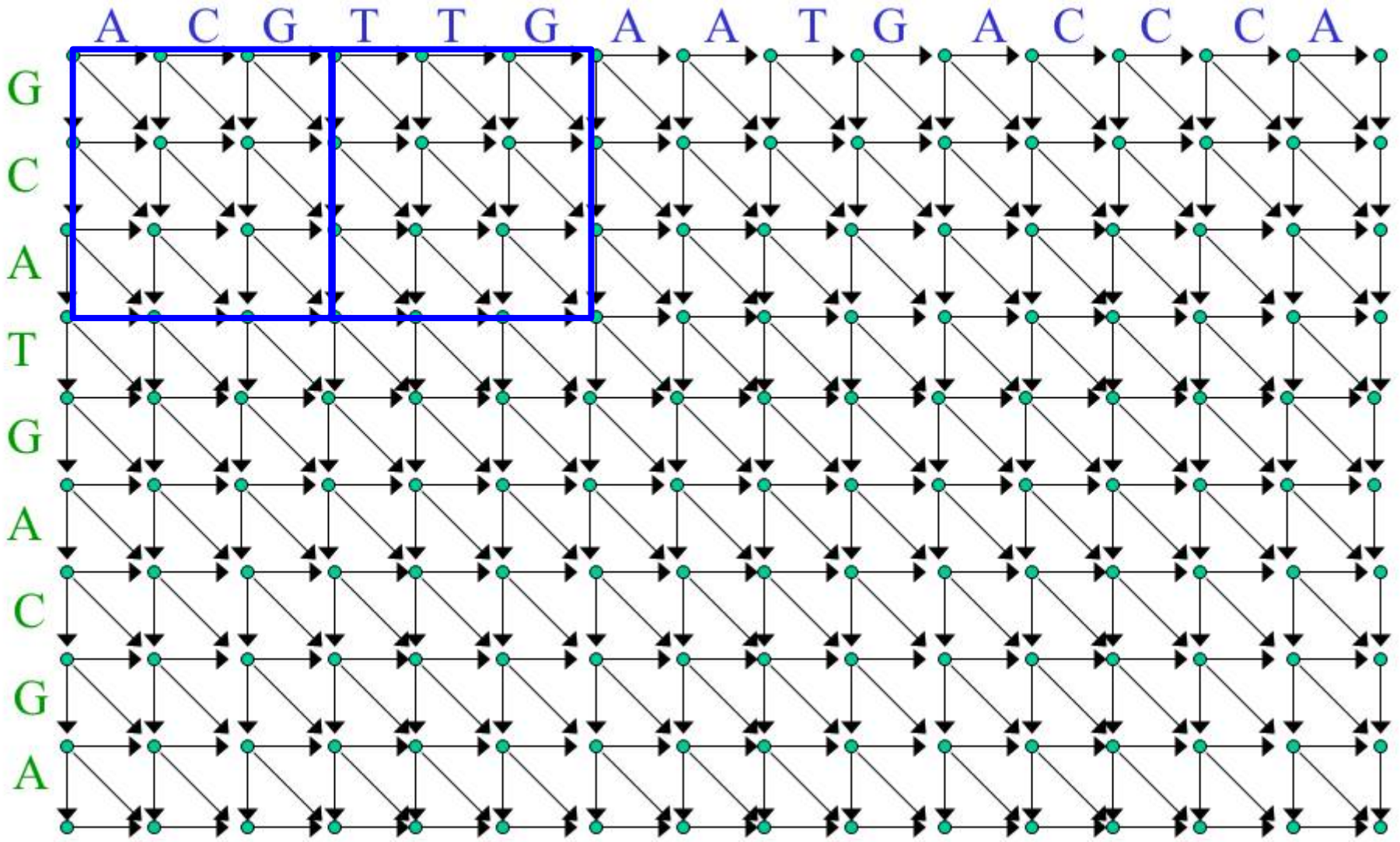

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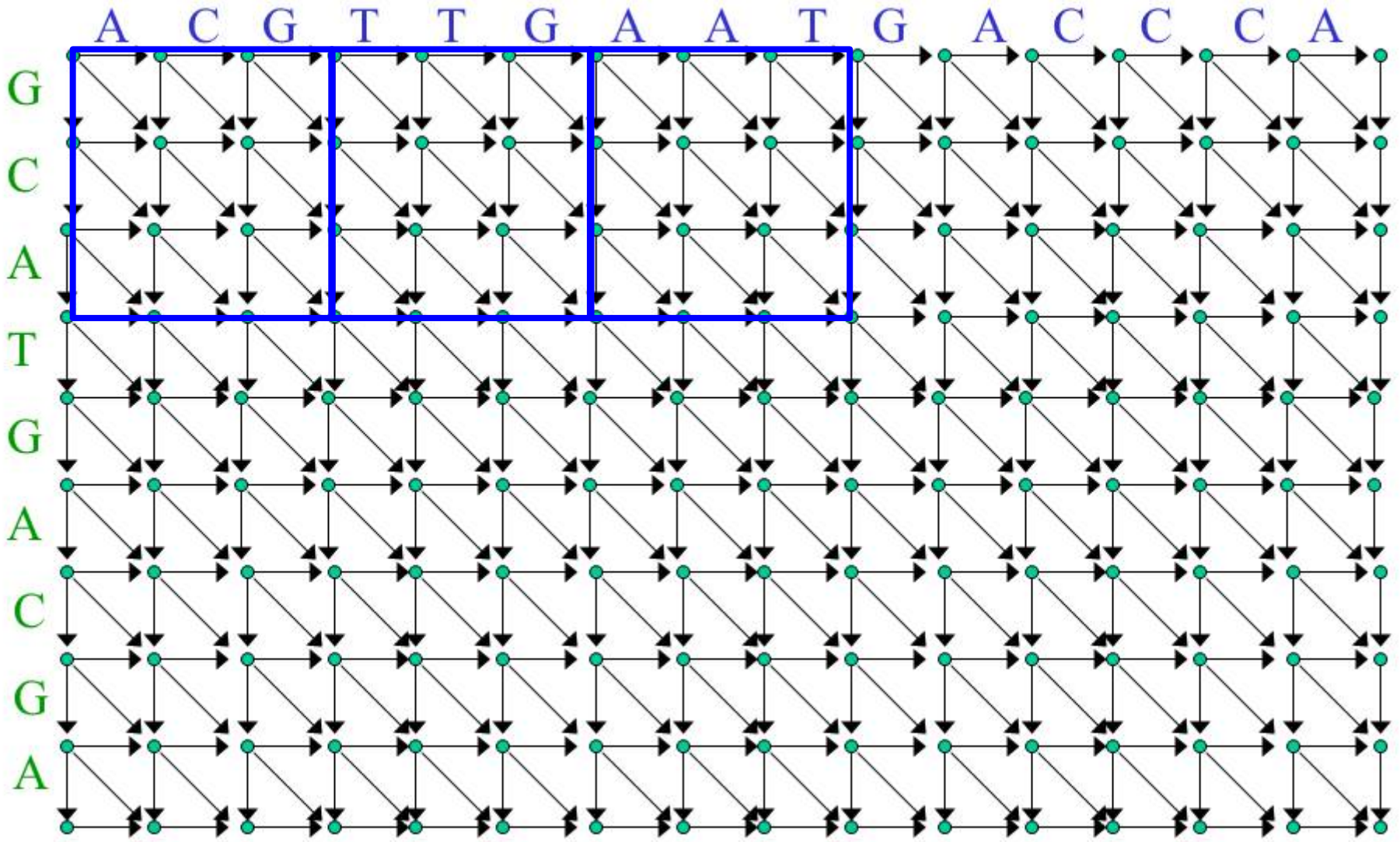

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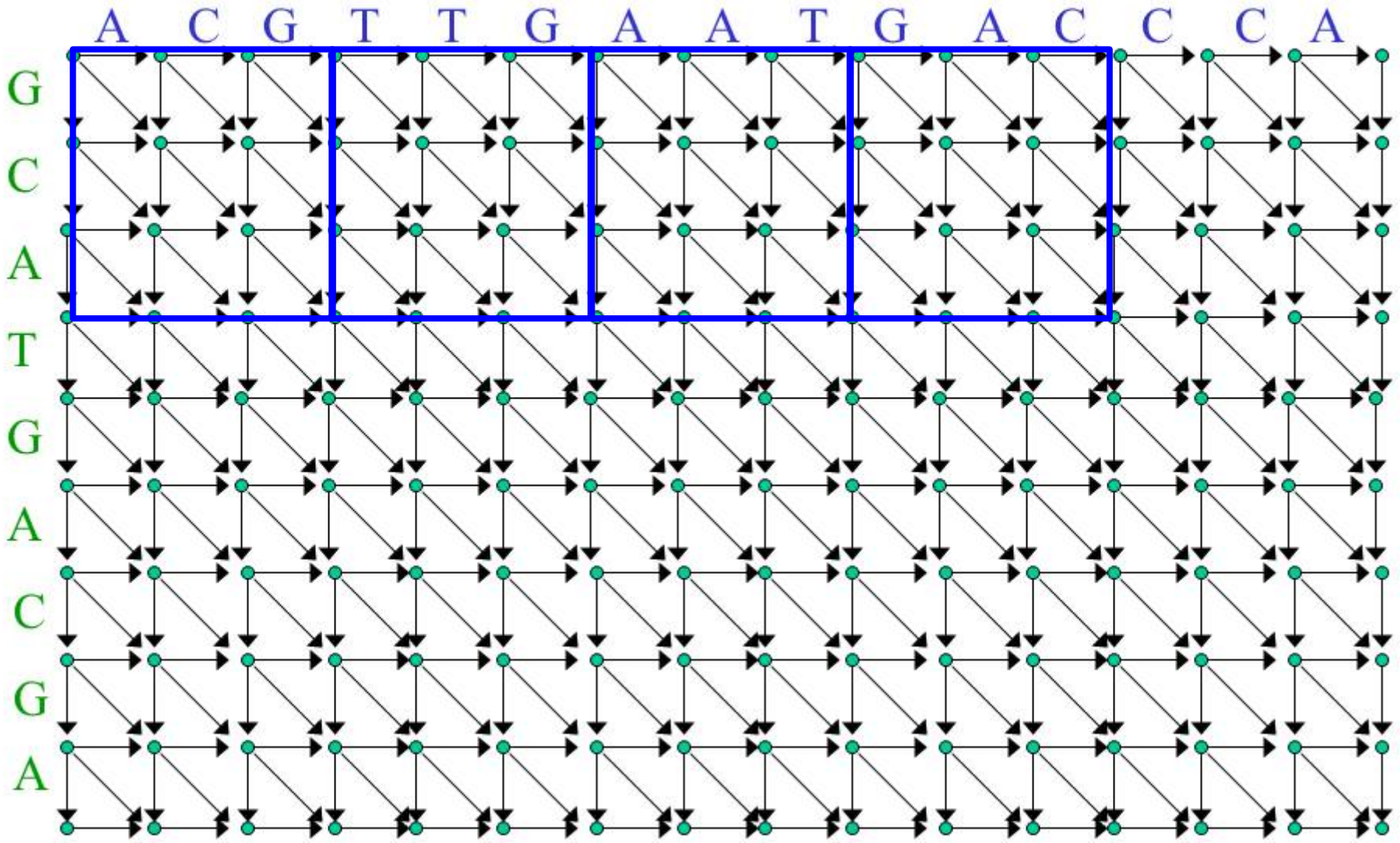

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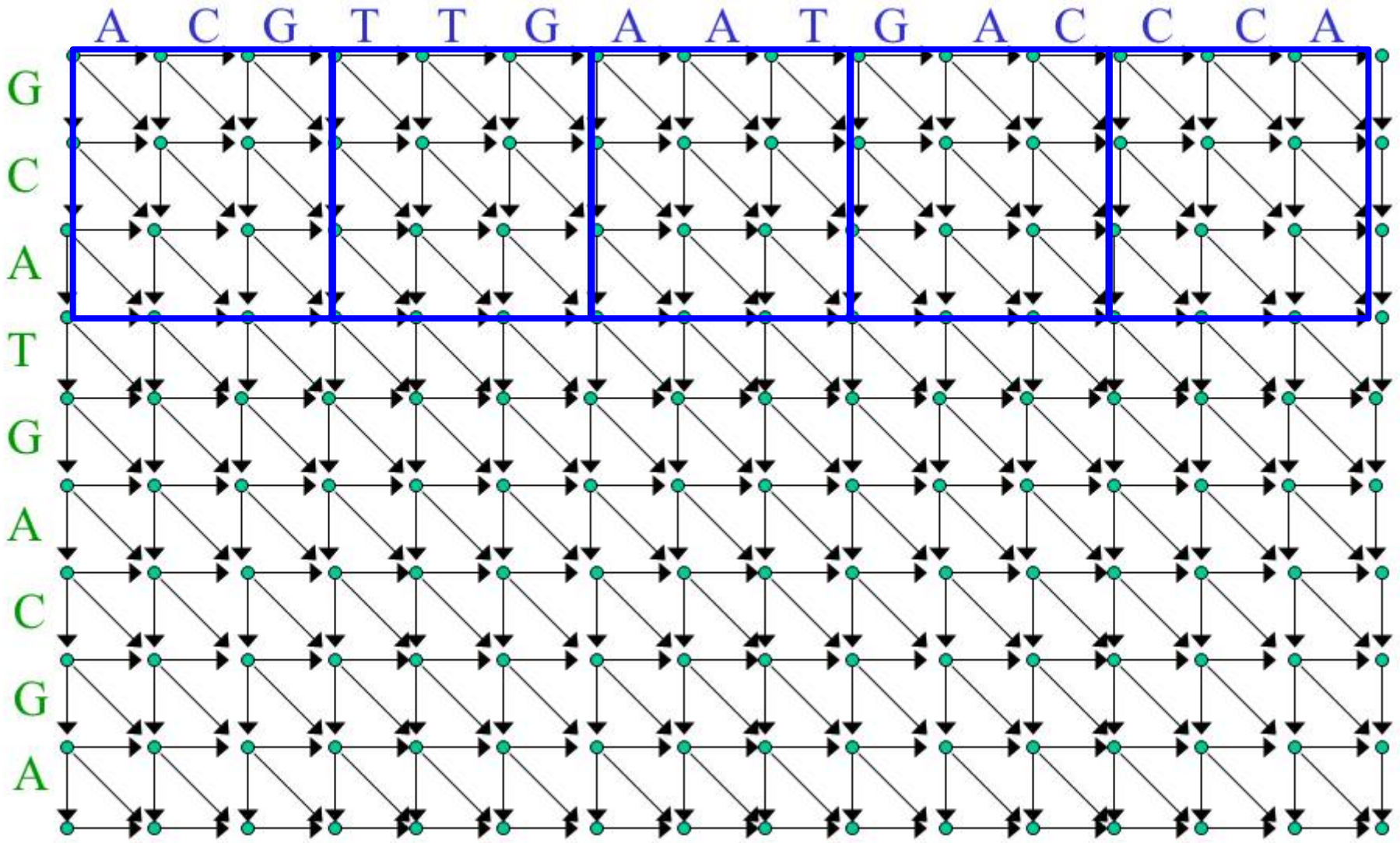

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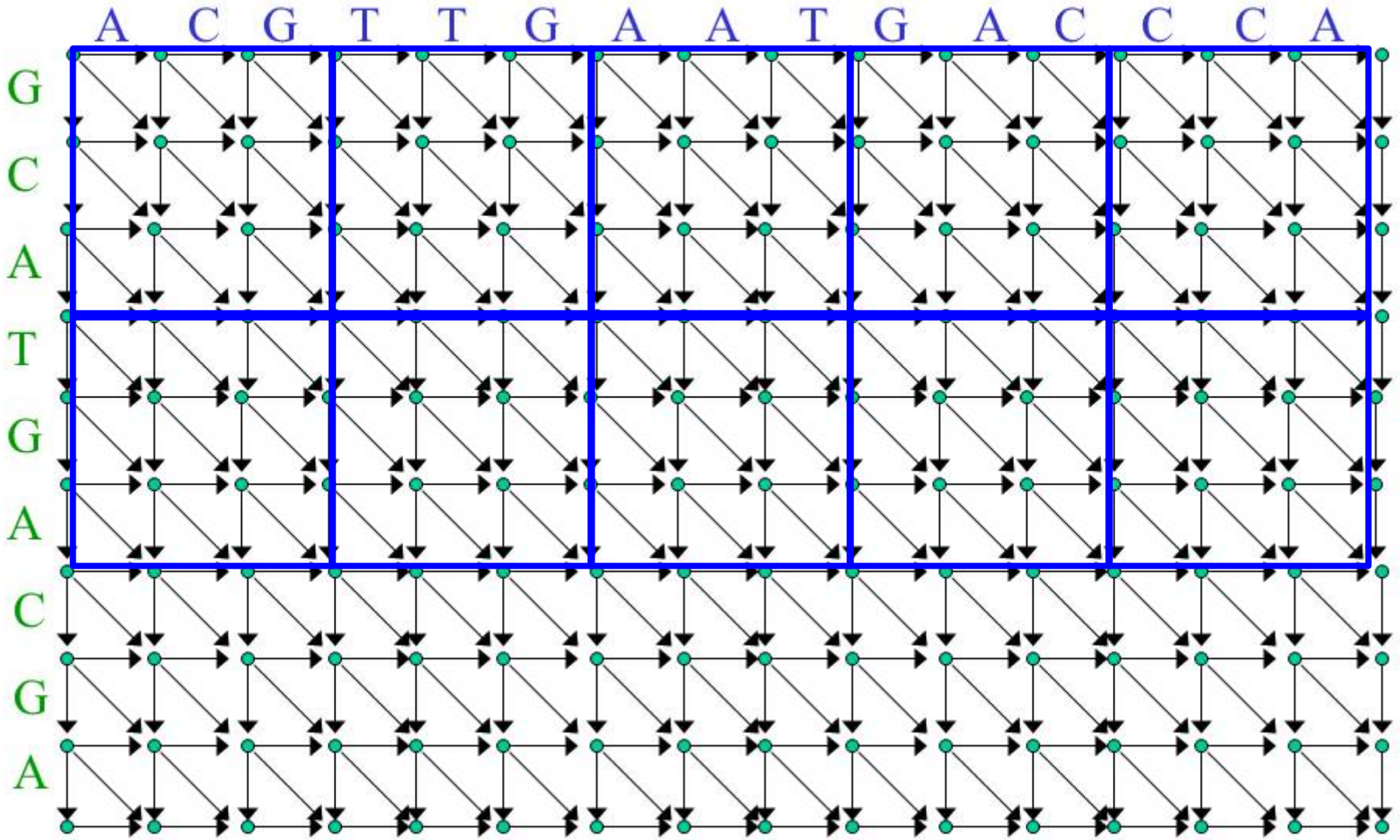

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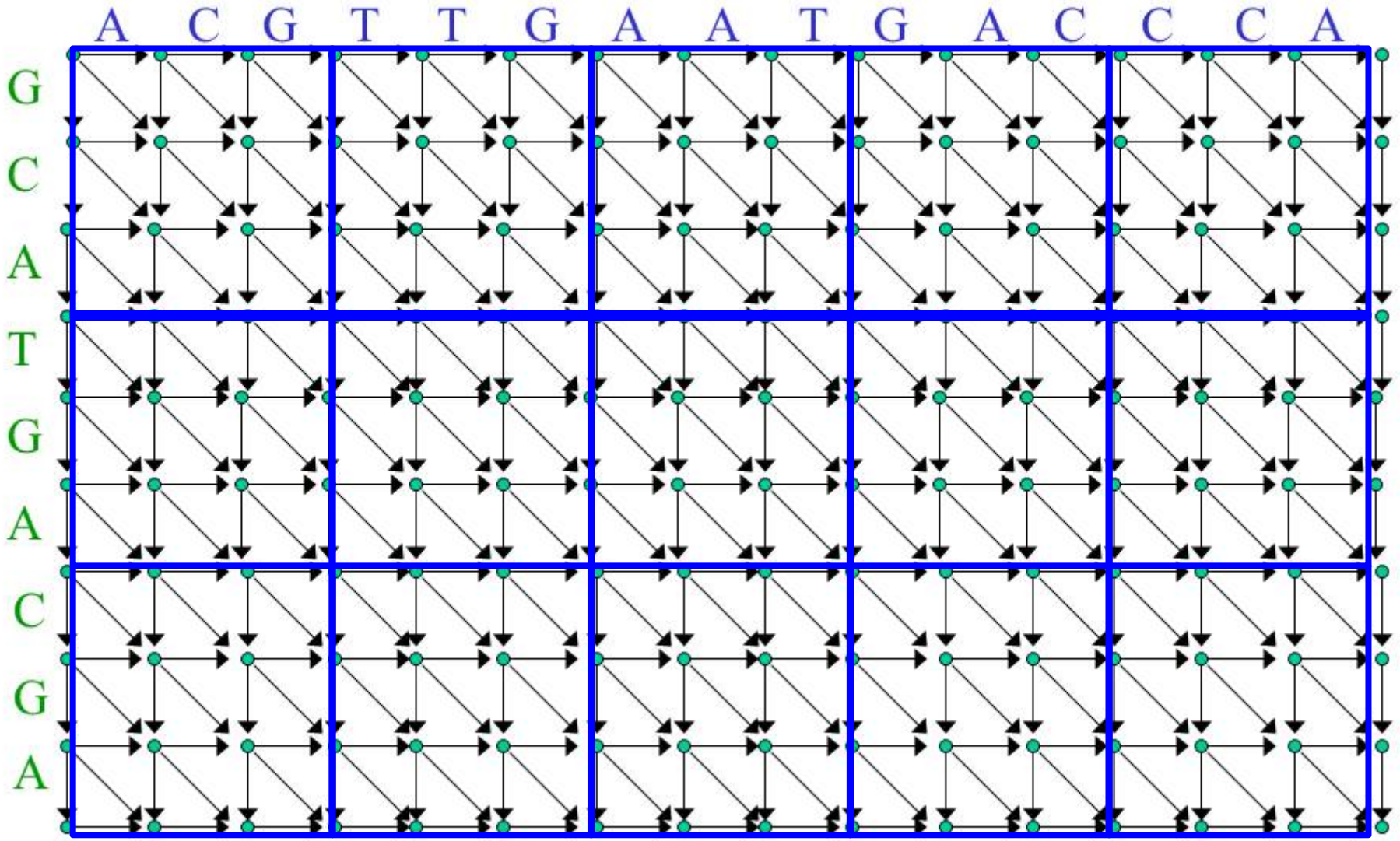

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  - Constructing a minimum spanning tree (Monocle does this, not sure if it uses a heap though)

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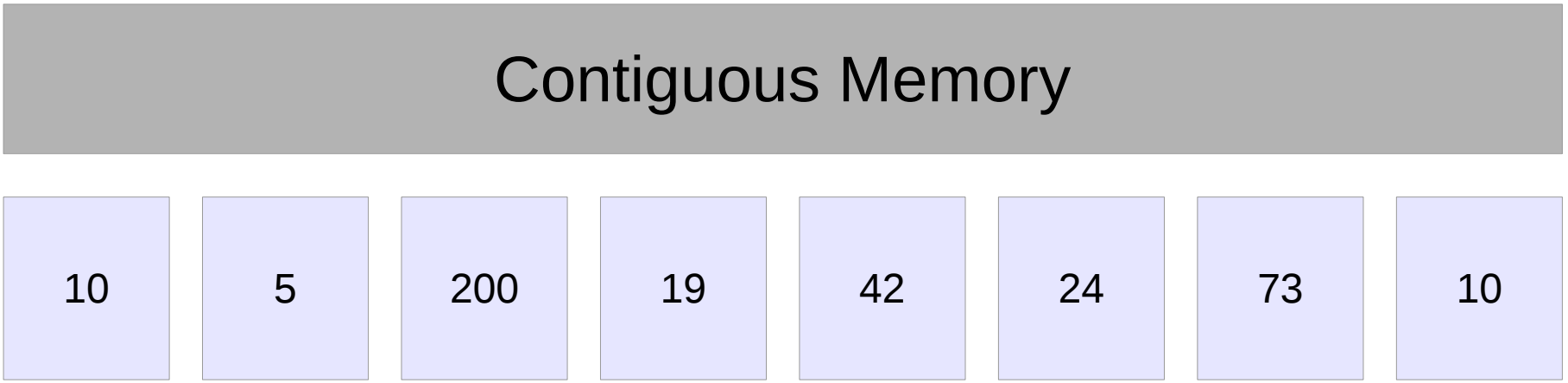

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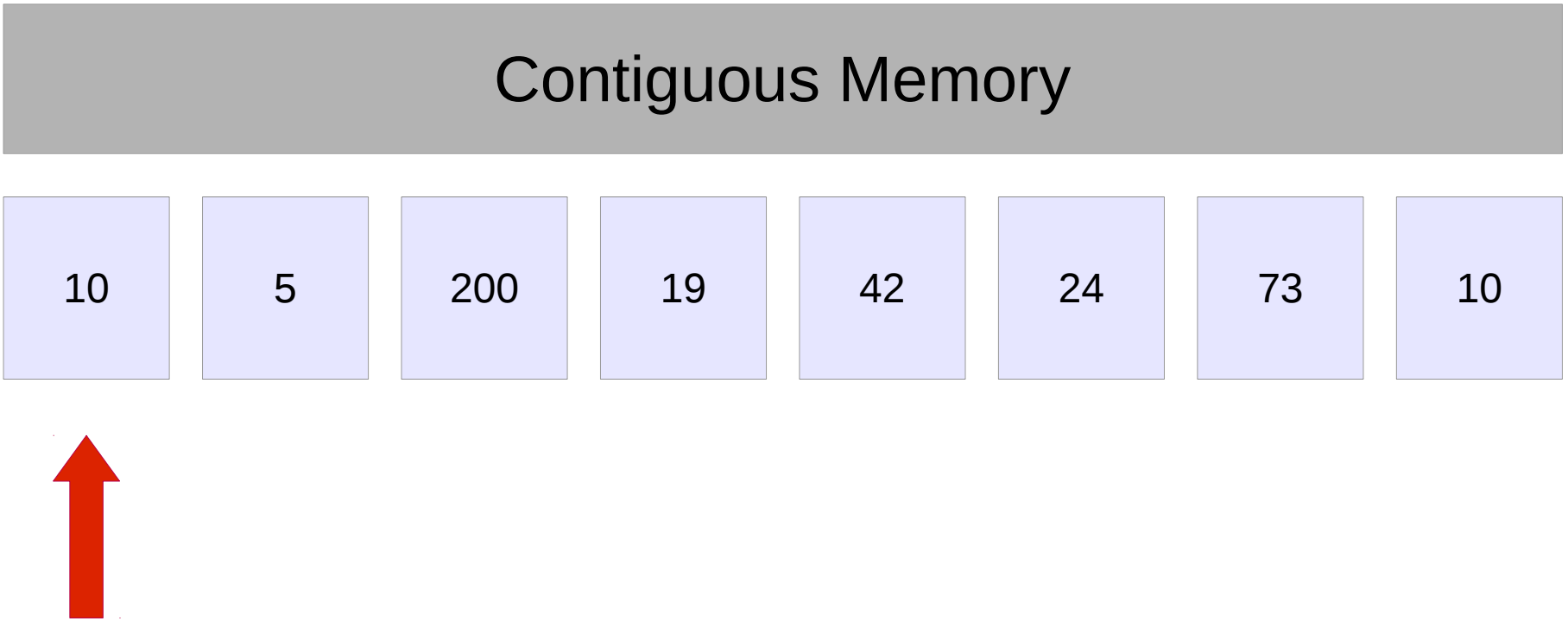

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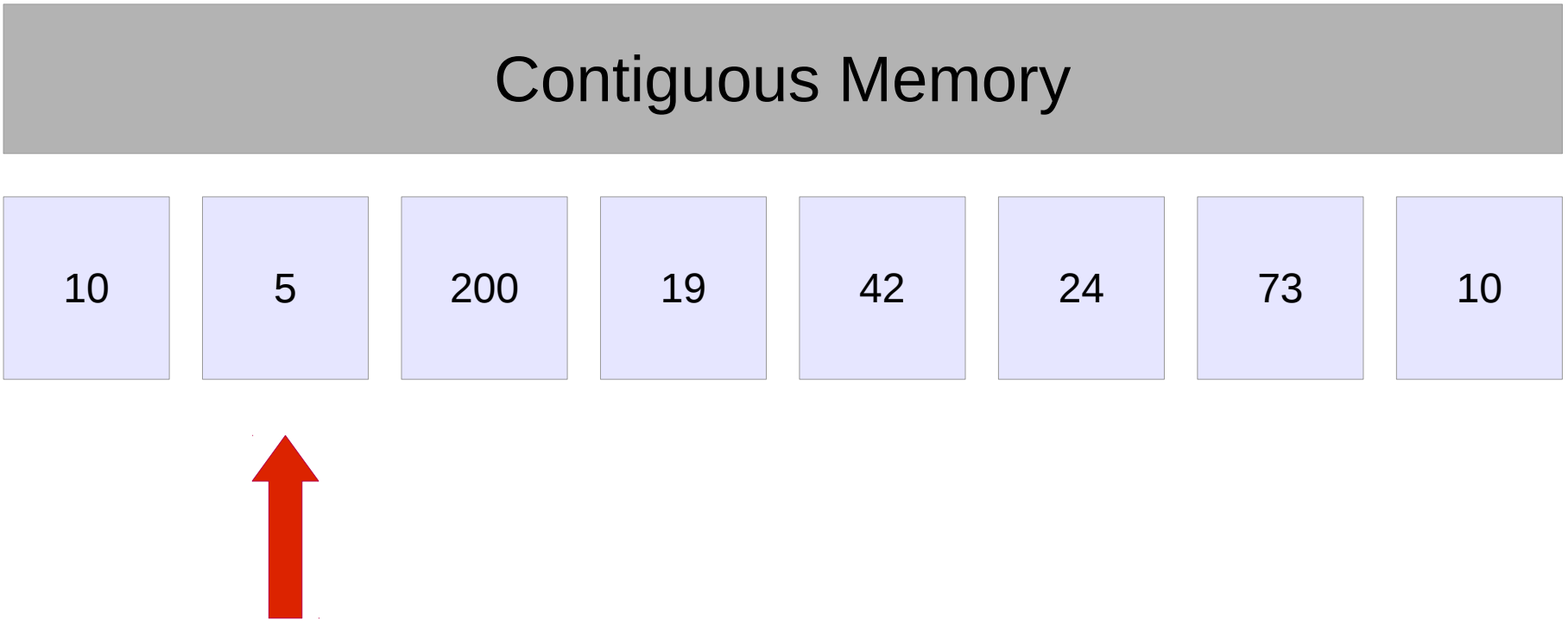

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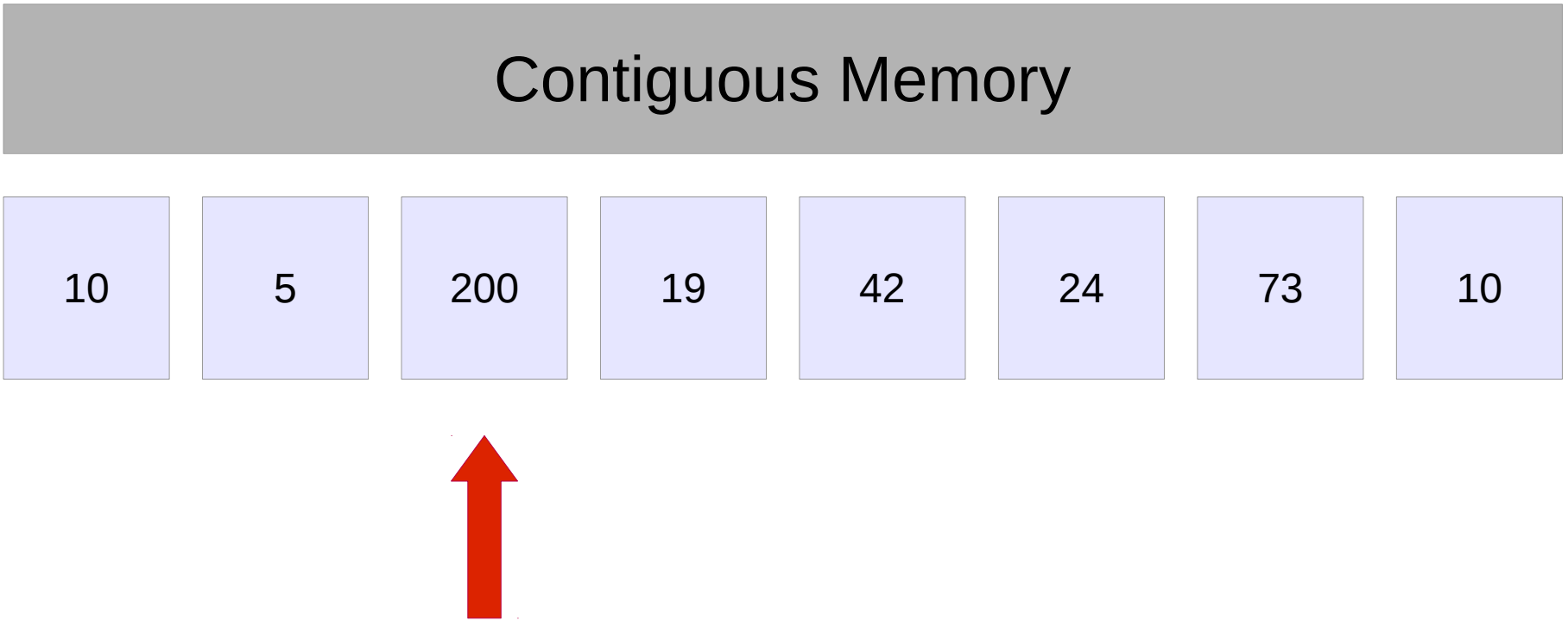

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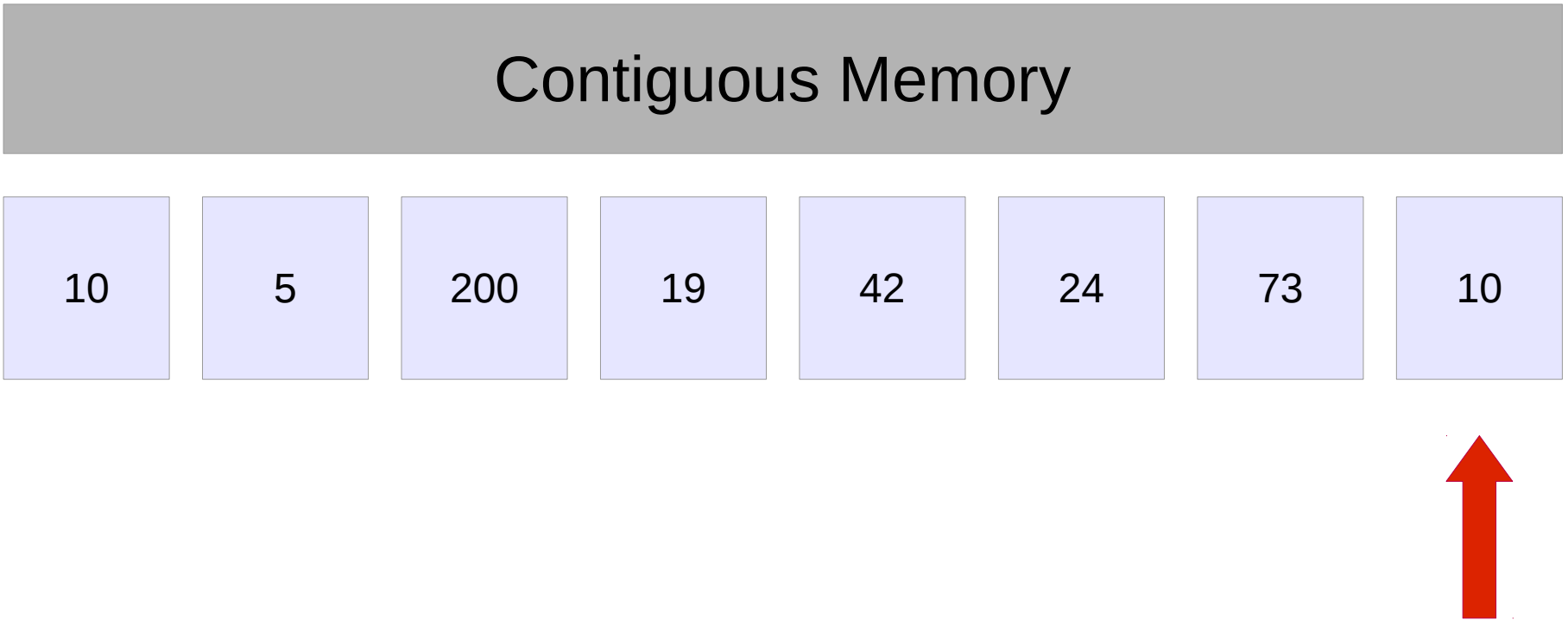

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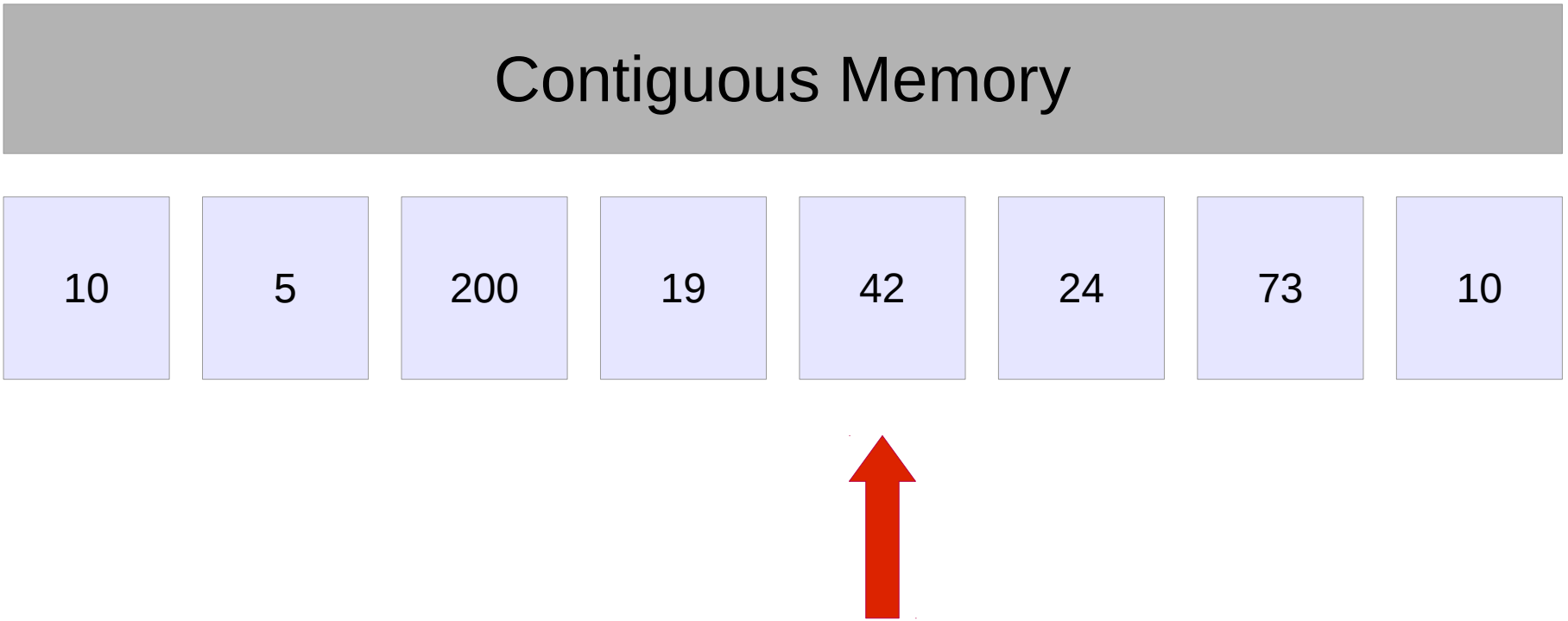

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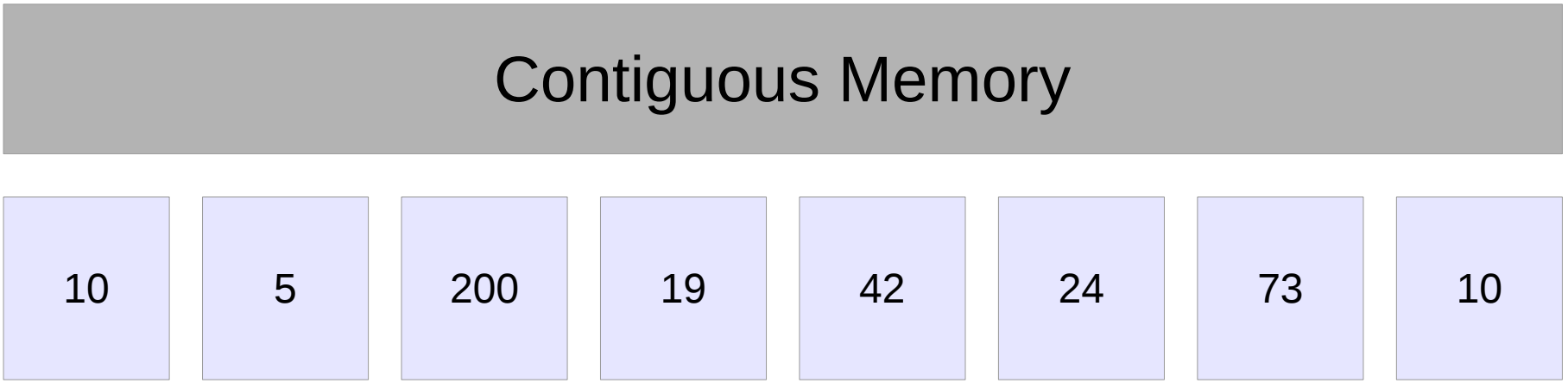

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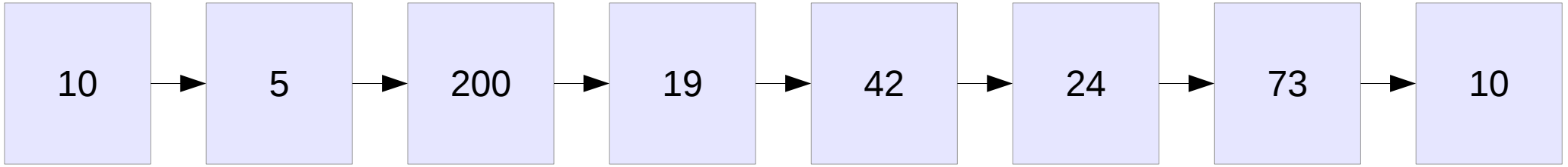

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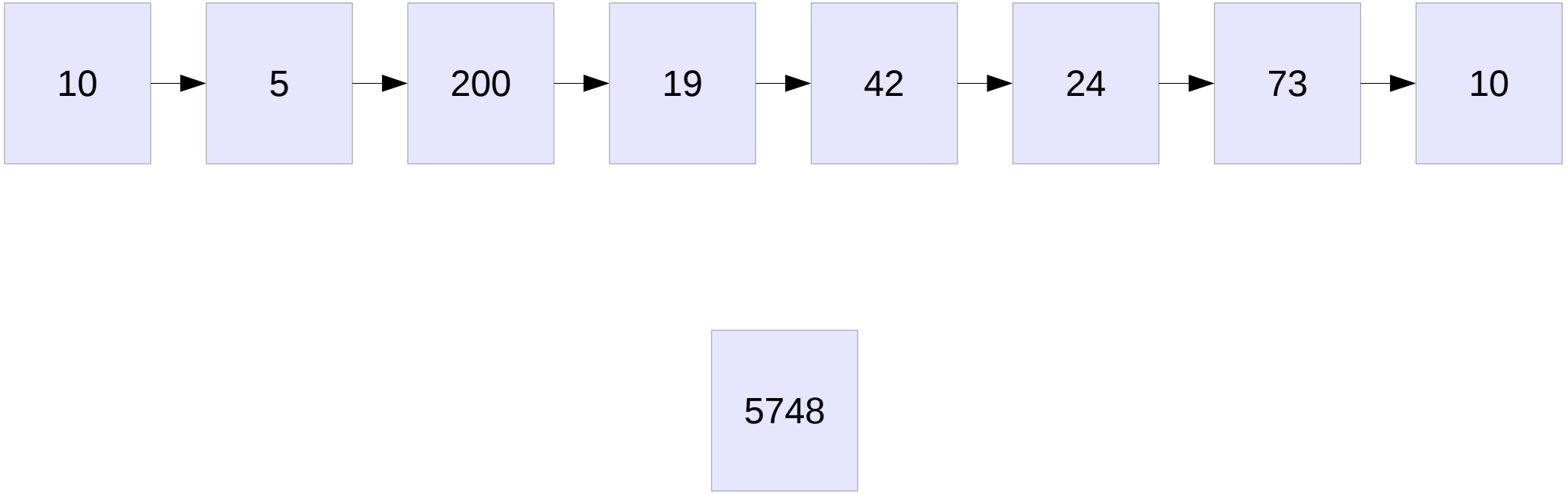

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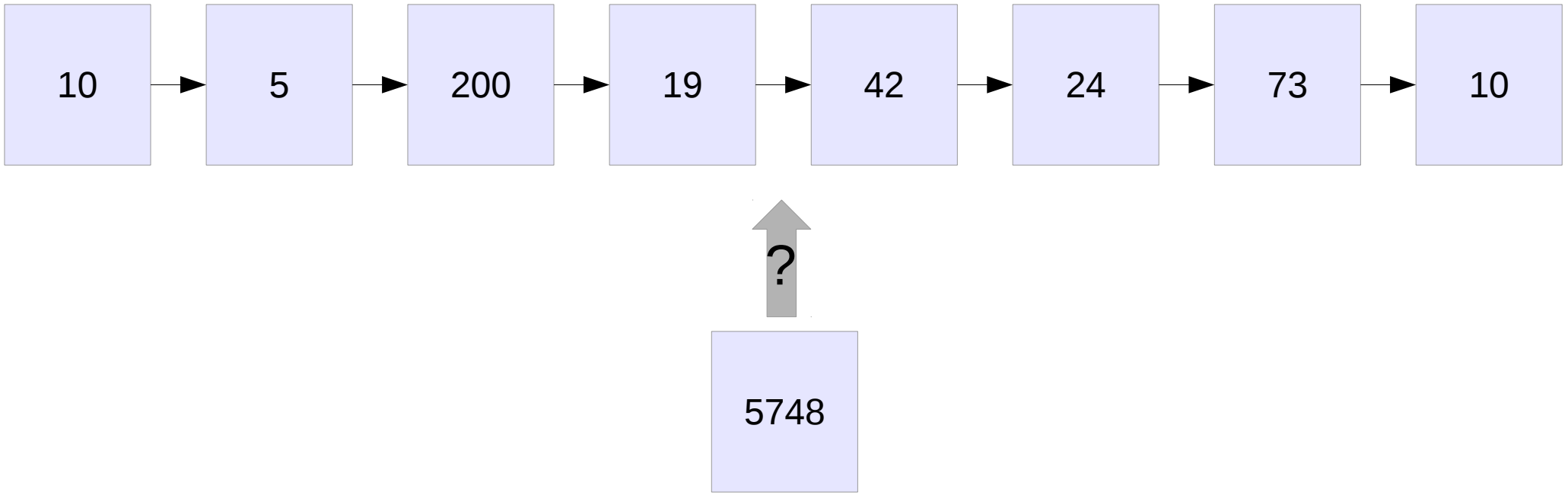

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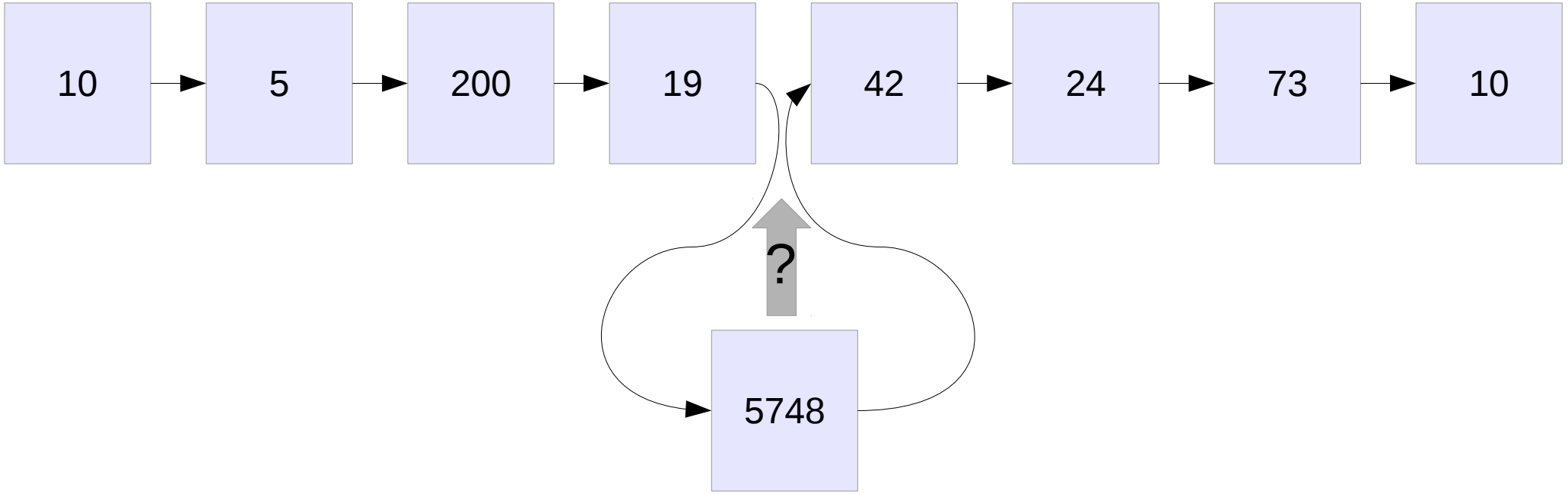

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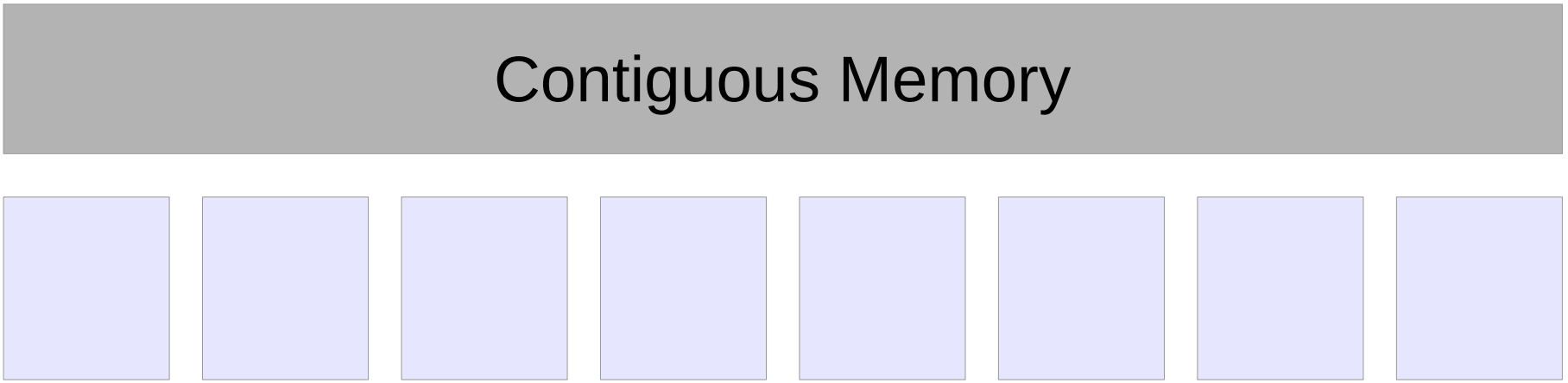

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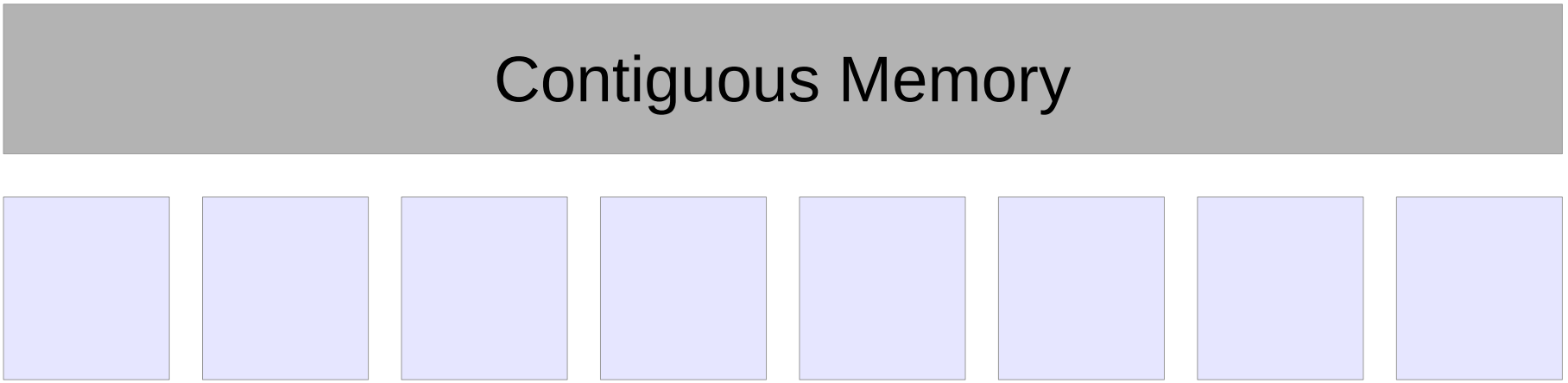

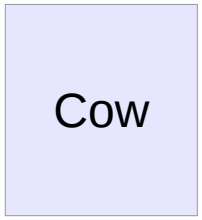

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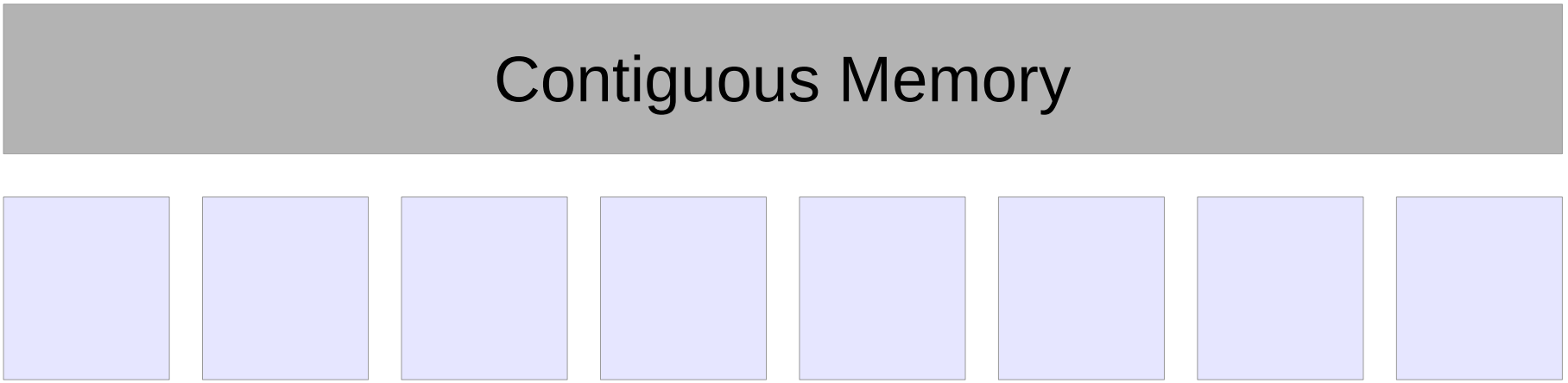

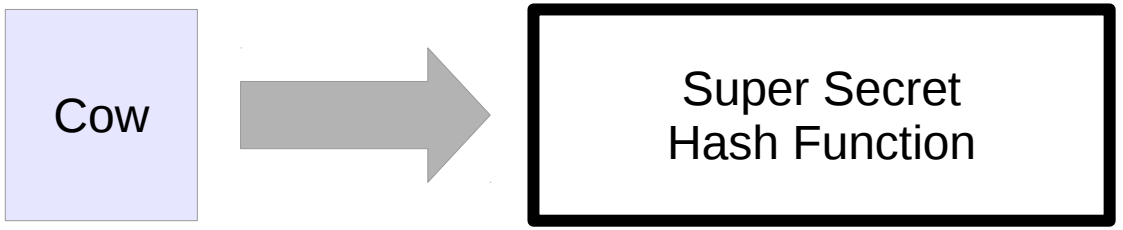

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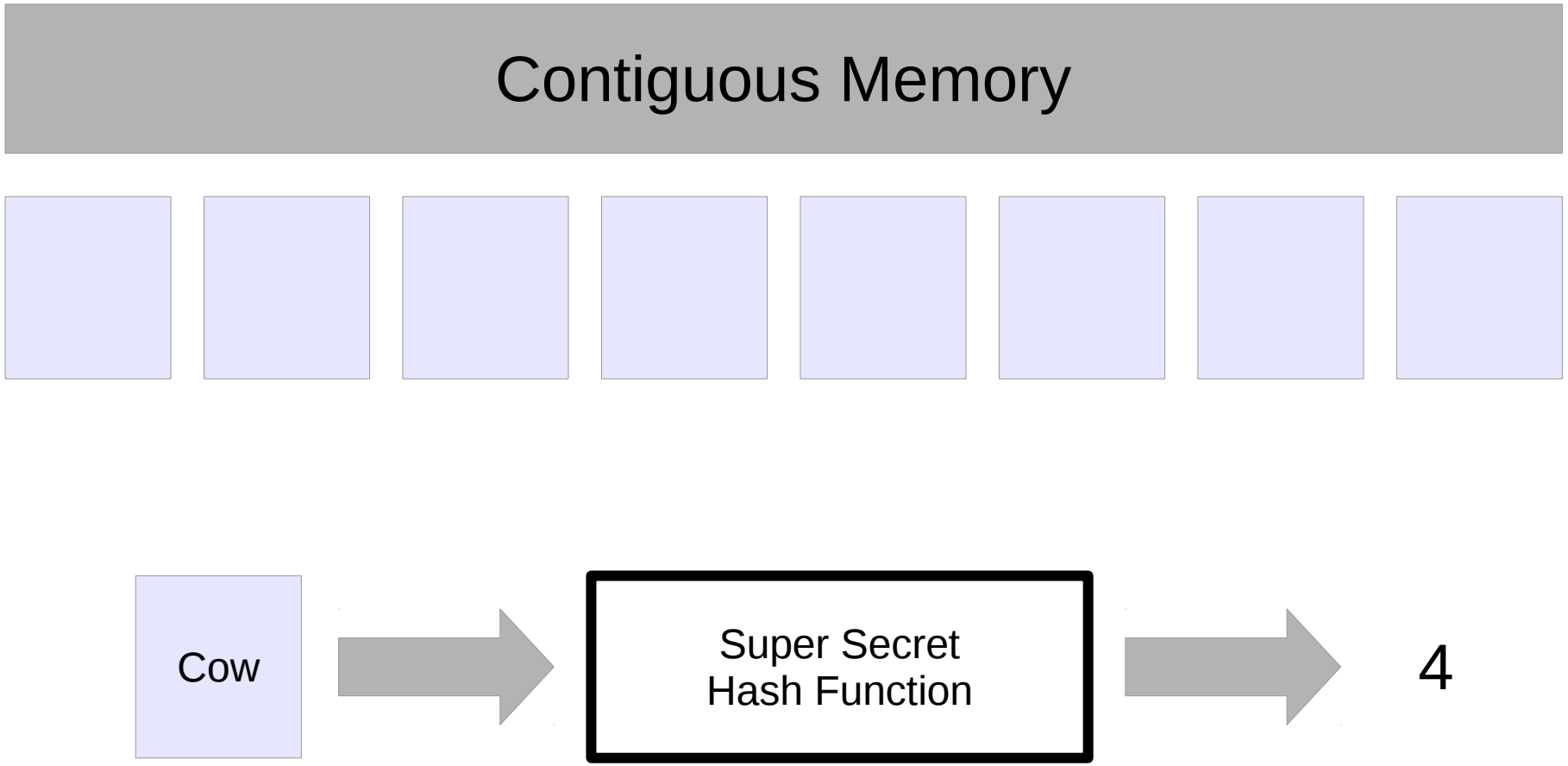

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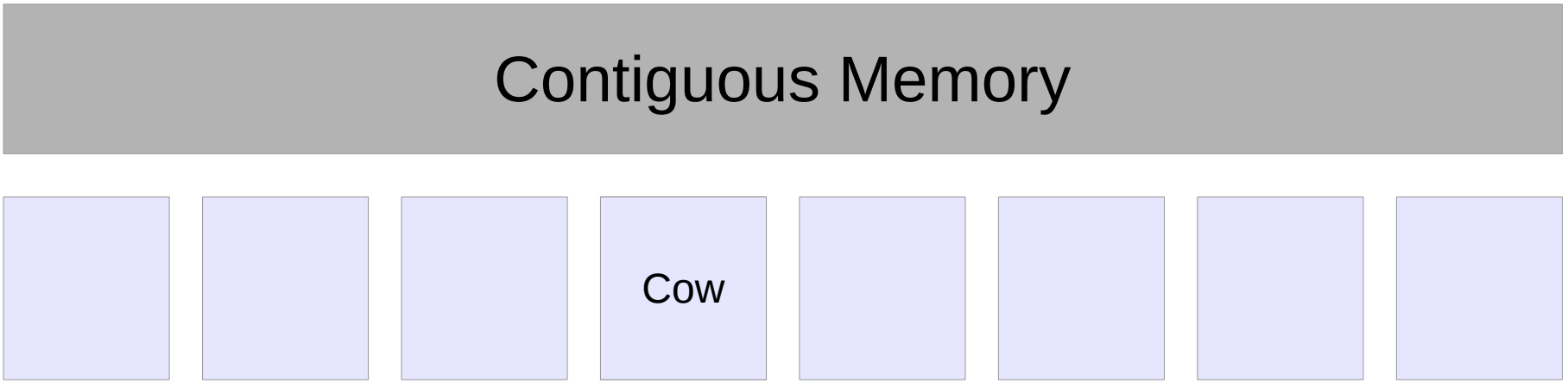

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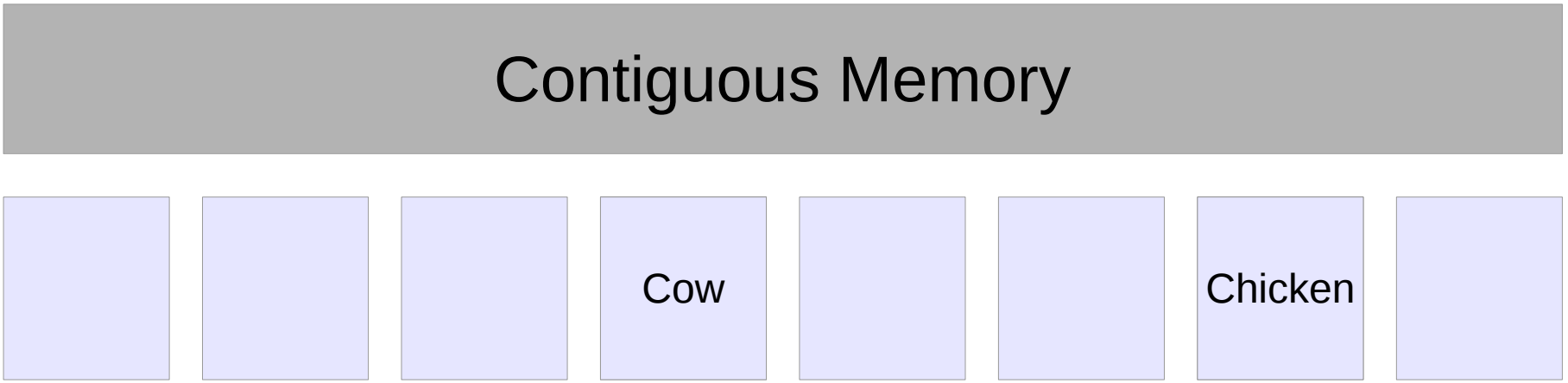

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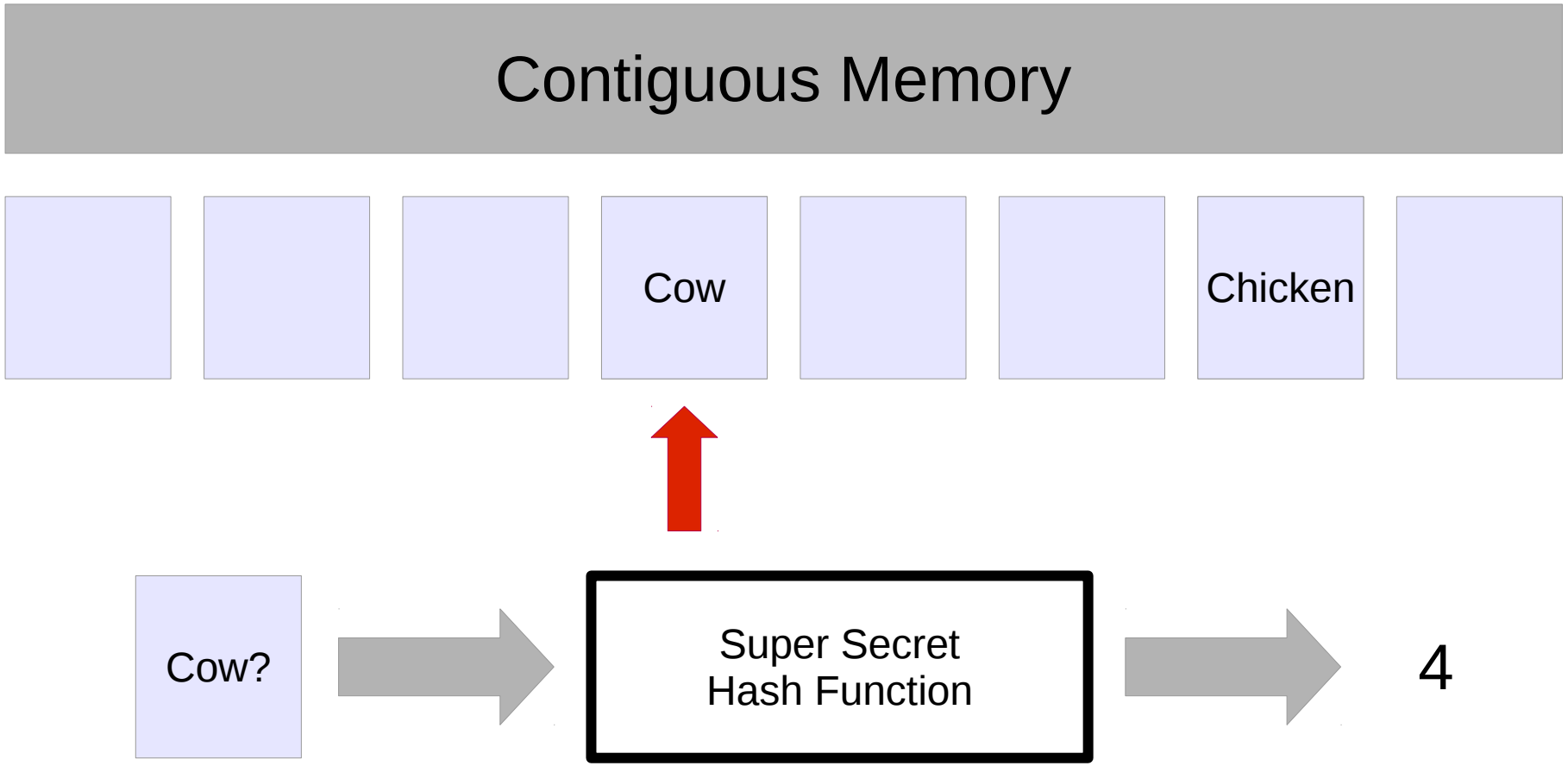

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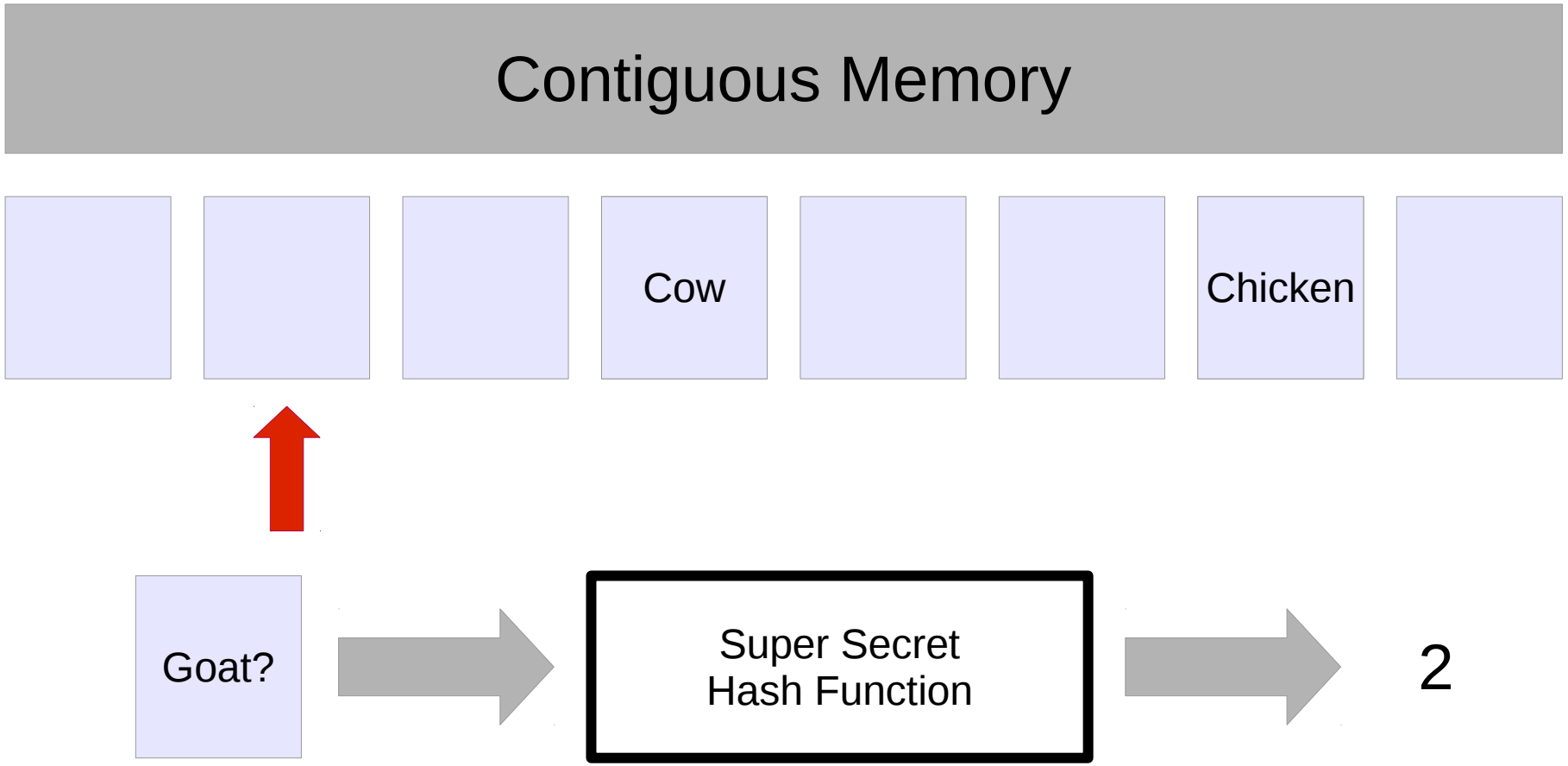

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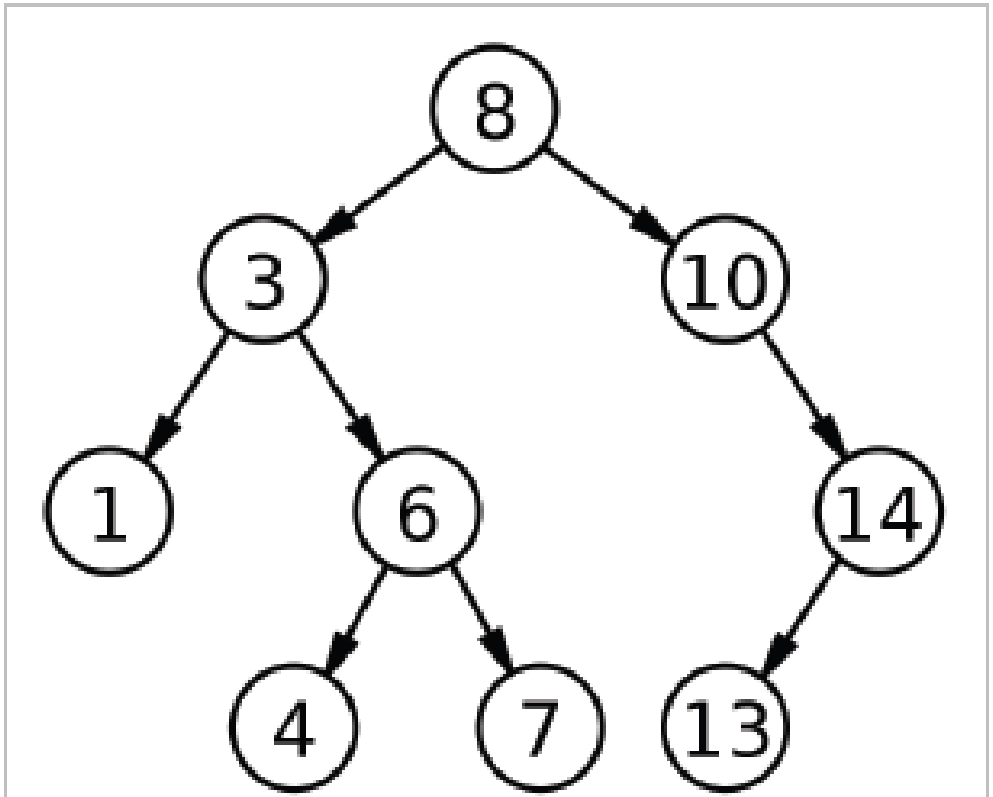
```
size_t myhash(const string& s)
{
    // Inspired by xkcd comic 153 and the Cha Cha slide

    size_t hash = 0;

    // This time we're gonna get funky
    // (Convert the string to a number and do some strange things
    to it)
    // (Inspired by Jenkins one-at-a-time hash function (found on
    Wikipedia))
    for (size_t i = 0; i < s.size(); ++i) {
        hash += s[i];
        hash += (hash << 8); // Two measure of 4 is 8 beats
        hash ^= (hash >> 5); // Funky has 5 letters
    }

    // Everybody clap your hands
    // Clap clap clap clap your hands
    // Clap clap clap clap your hands
    // (Flip the bits)
    hash = ~hash;

    // Alright we gonna do the basic steps
    // Slide to the left
    // (The Cha Cha slide is in 4)
    hash = hash << (hash % 4);

    // Slide to the right
    // (But it really should be in 3)
    hash = hash >> (hash % 3);

    // Take it back now y'all
    // (Subtract - No one wants to walk back that far, so 1)
    hash -= (hash >> 1);

    // One hop this time
    // (Bunnies hop and bunnies eat carrots. Some bunnies can hop
    5 feet)
    hash ^= (hash % 5);

    // Right foot lets stomp
    // (Add, make it dependent on the hash function for more
    randomness
```

Trees

- Good for searching ranges



A binary search tree of size 9 and depth 3, with root 8 and leaves 1, 4, 7 and 13

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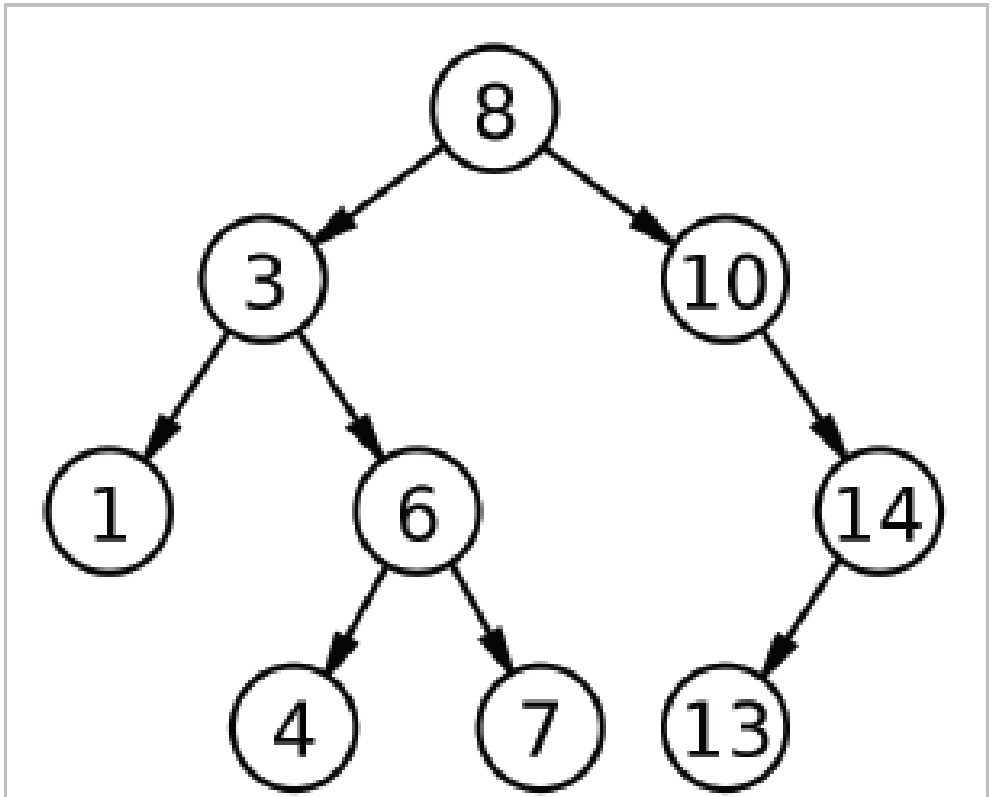

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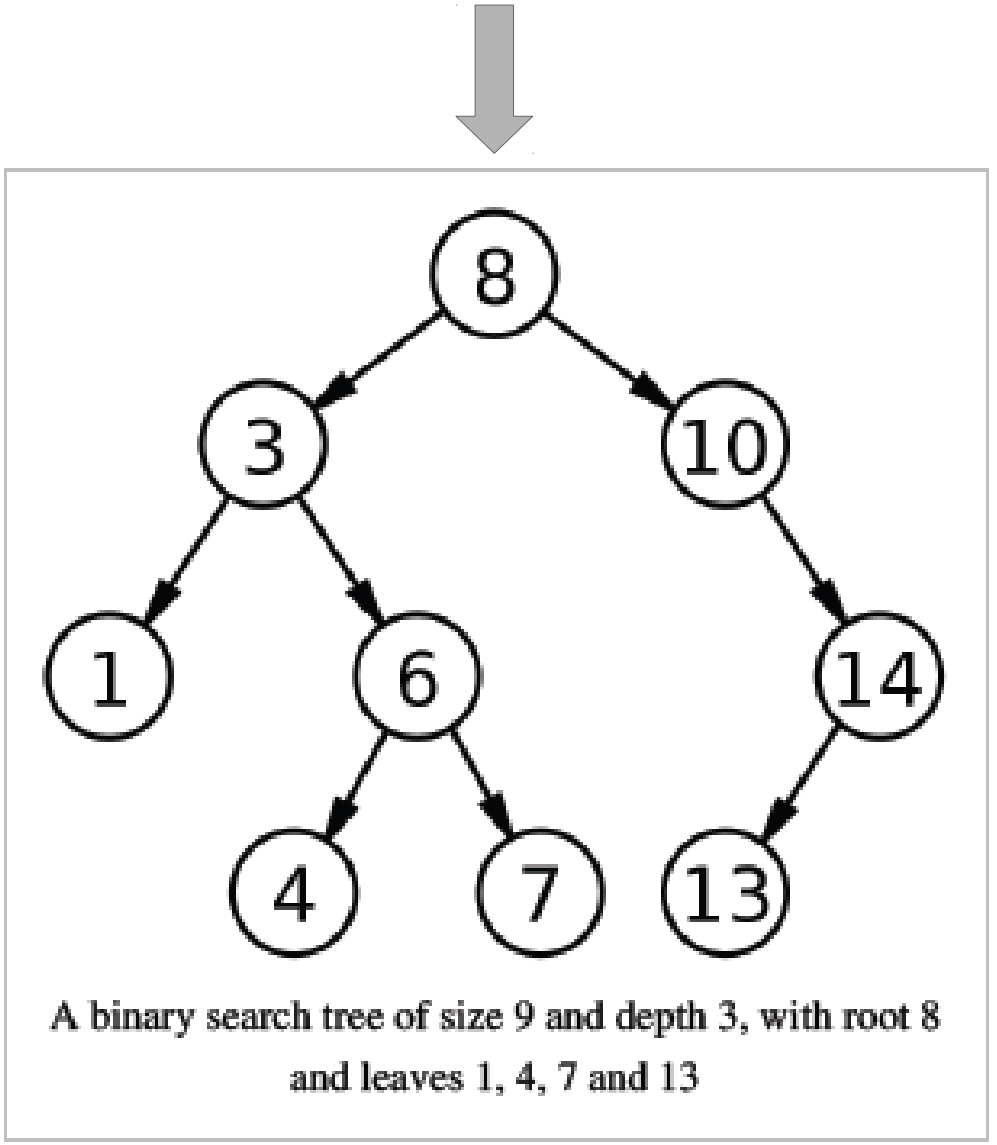

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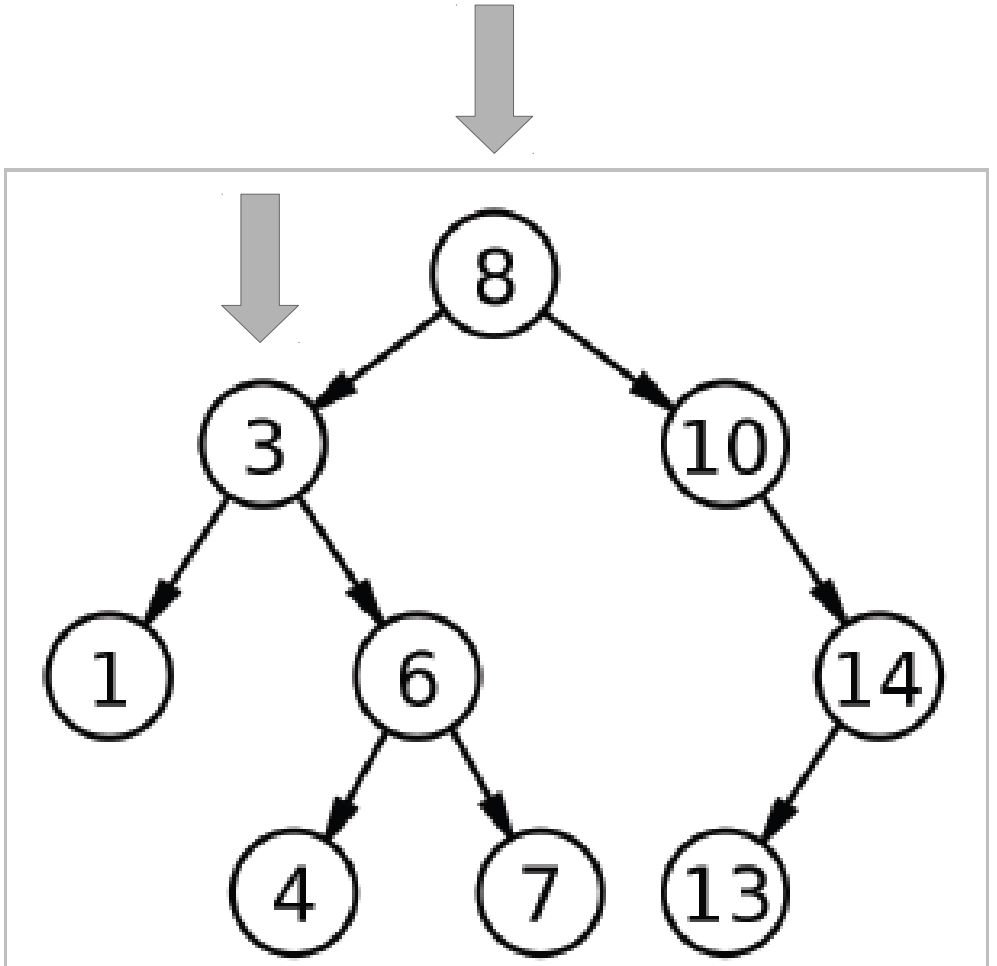

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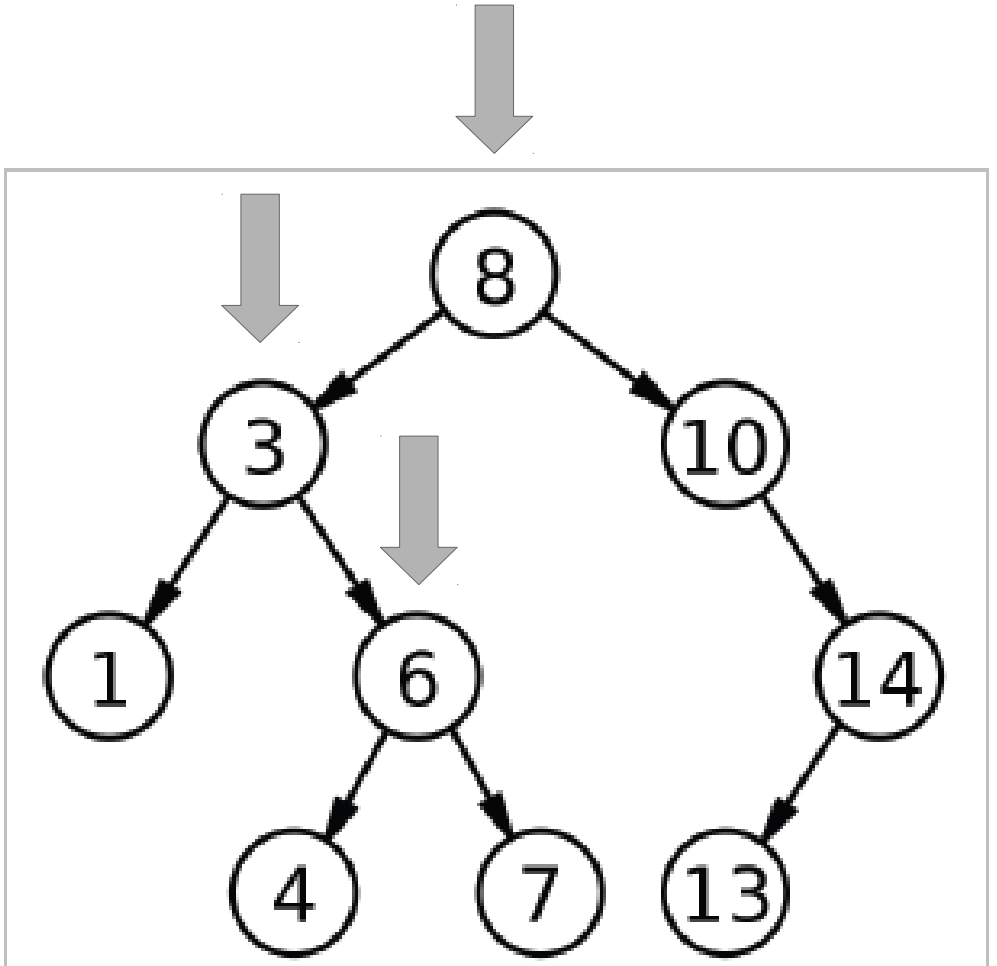

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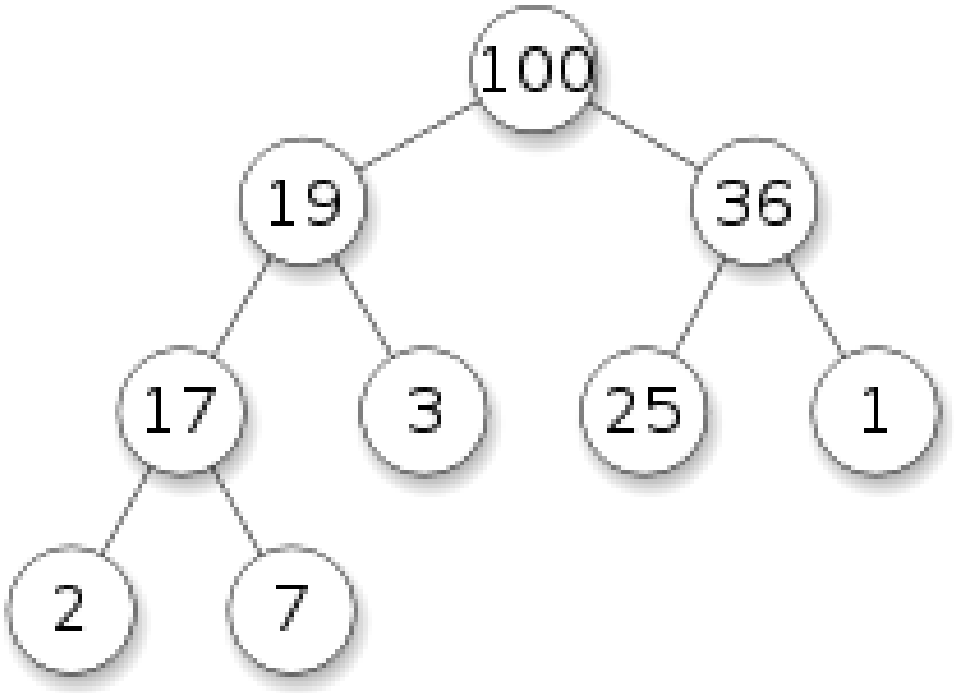

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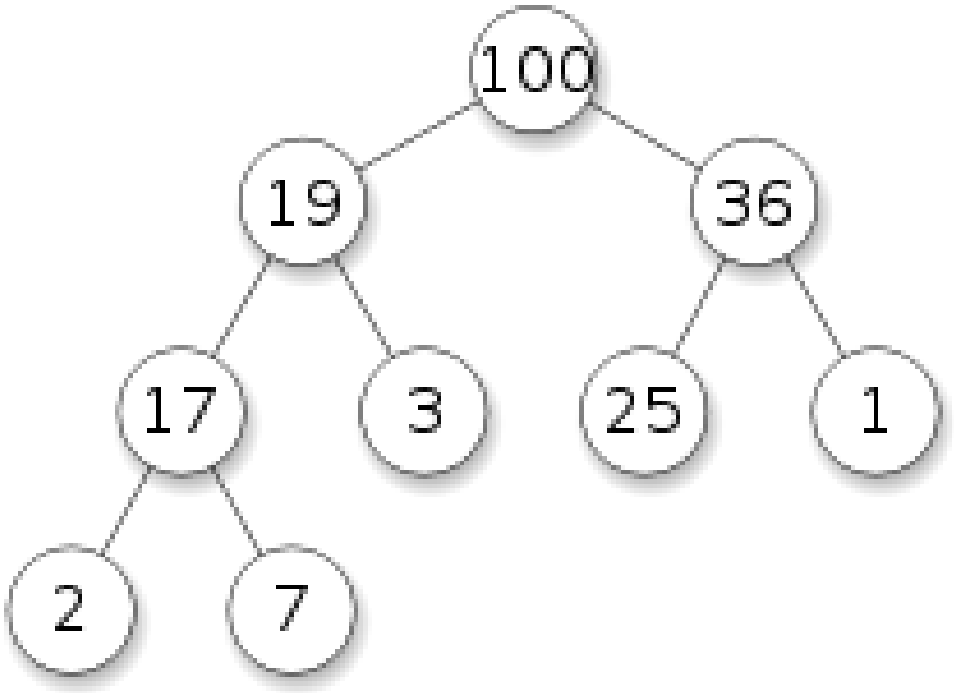
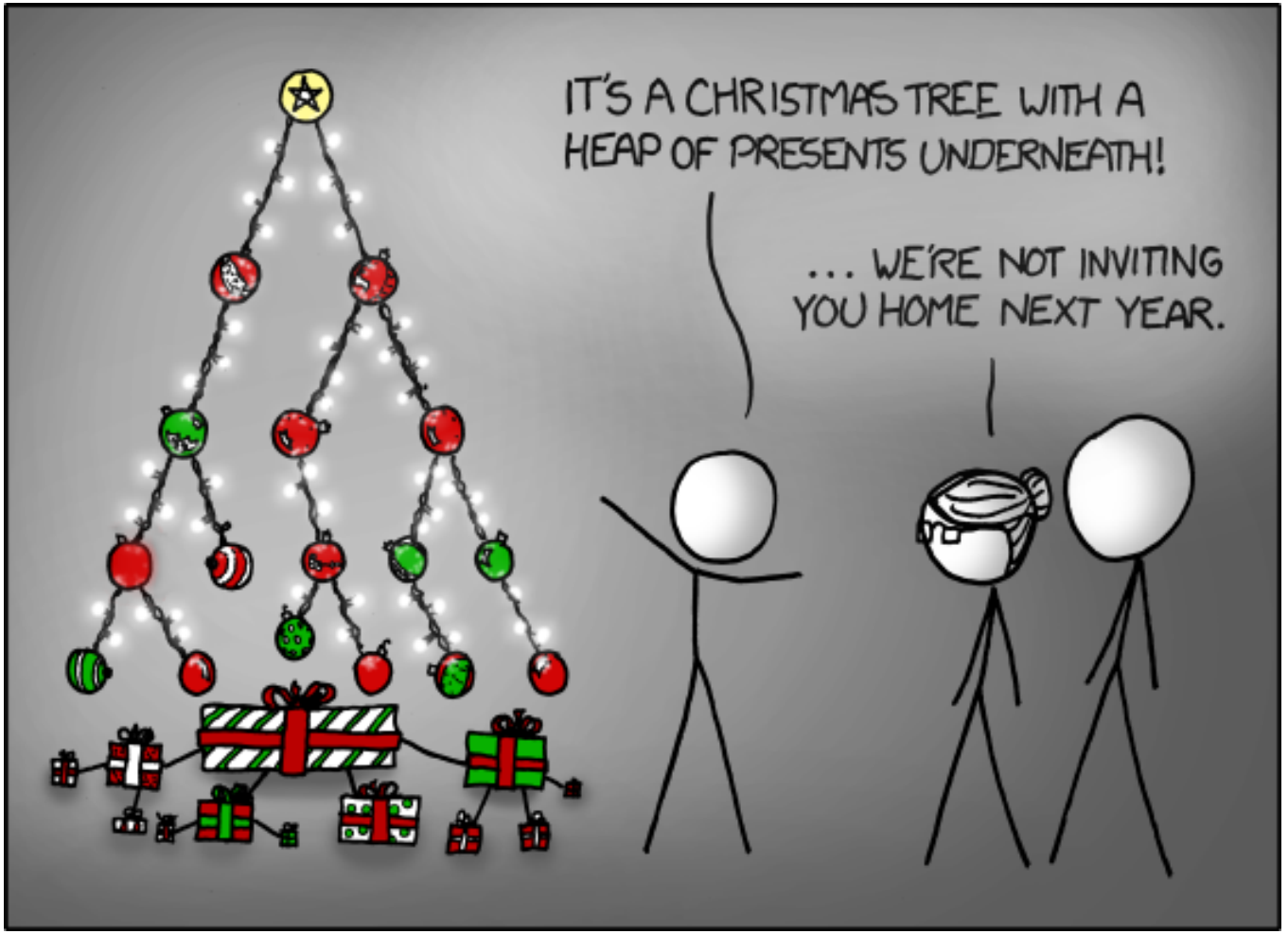
What's the largest value?



Trees and Heaps

- Similar in structure, but different rules



Operation

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Array	O(1)	O(N)	O(1) or O(N)	O(1) or O(N)
Linked List	O(N)	O(N)	O(1) or O(N)	O(1) or O(N)
Hash Map	N/A	O(1)	O(1)*	O(1)*
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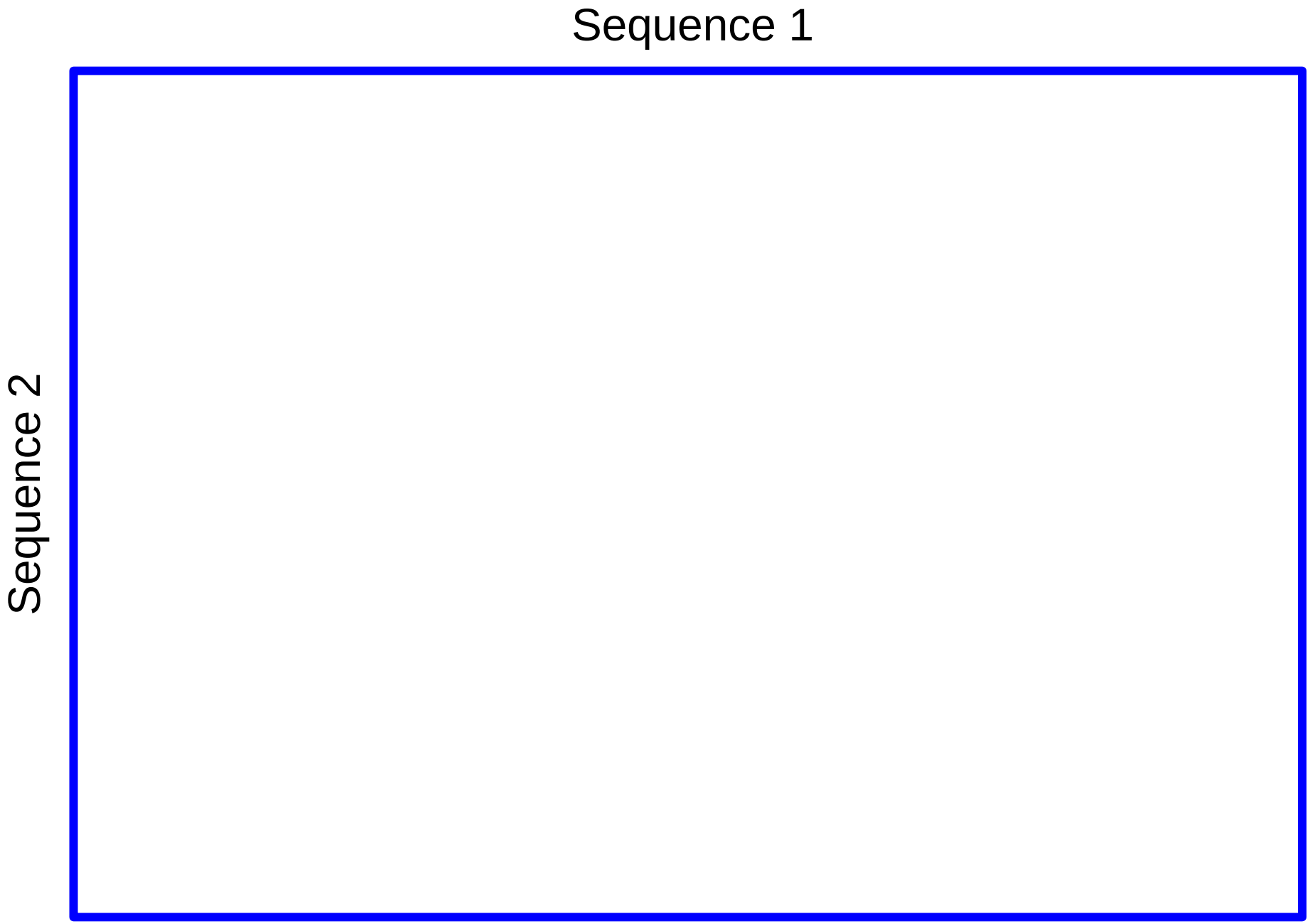
Heaps are specialized for find-min/max = O(1), delete-min/max = O(log N), and insert = O(log N)

Optimizing for space efficiency



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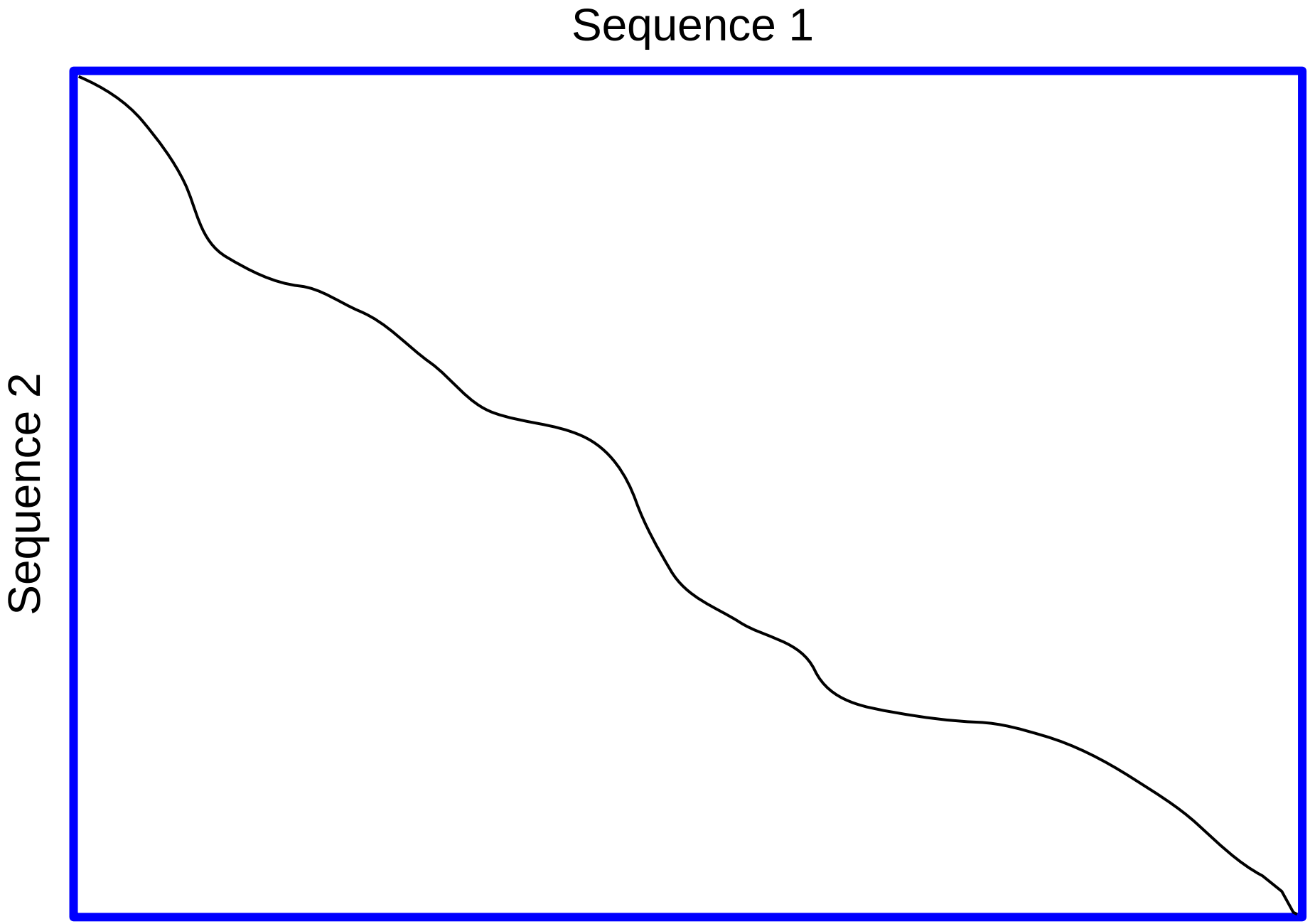

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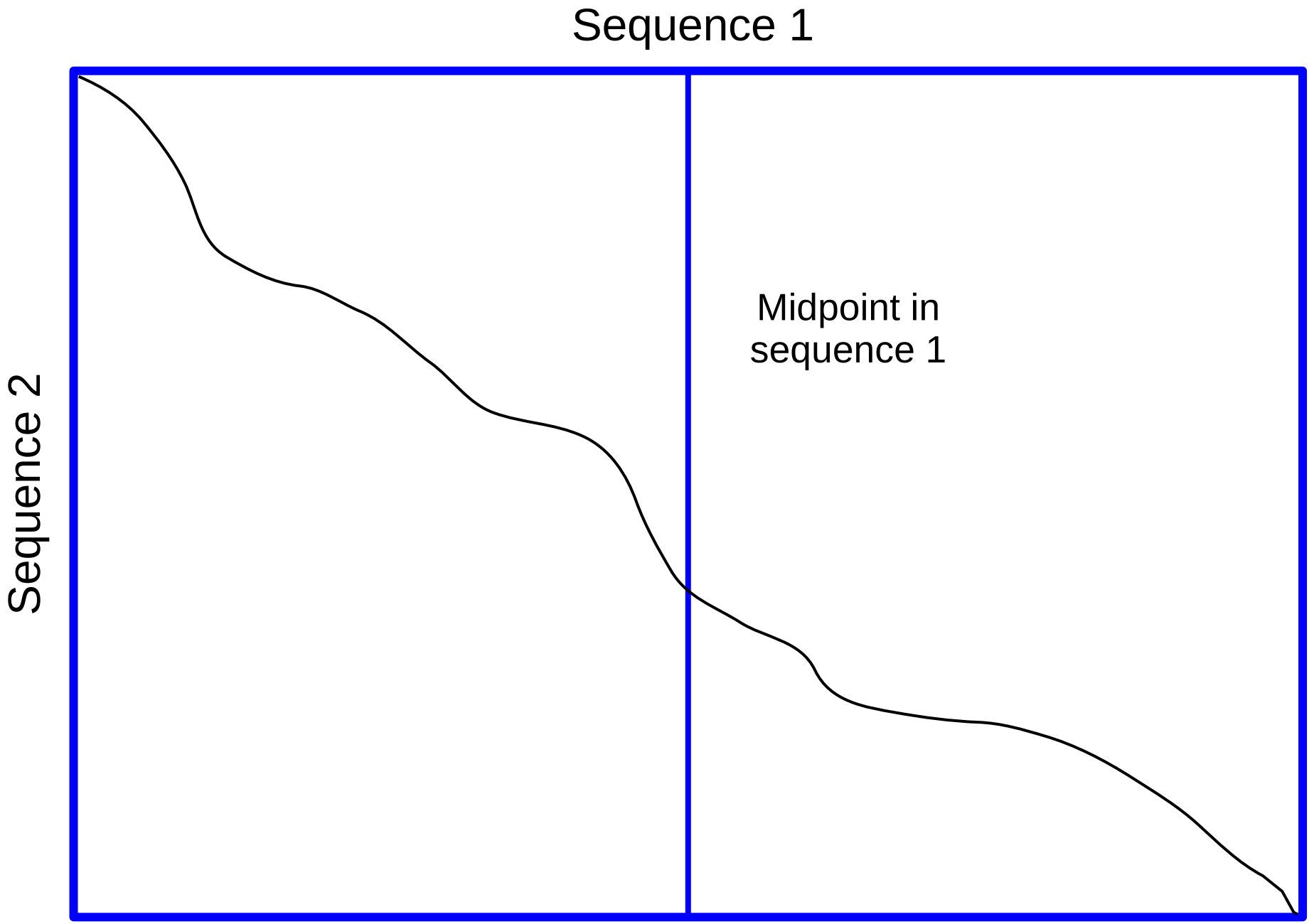

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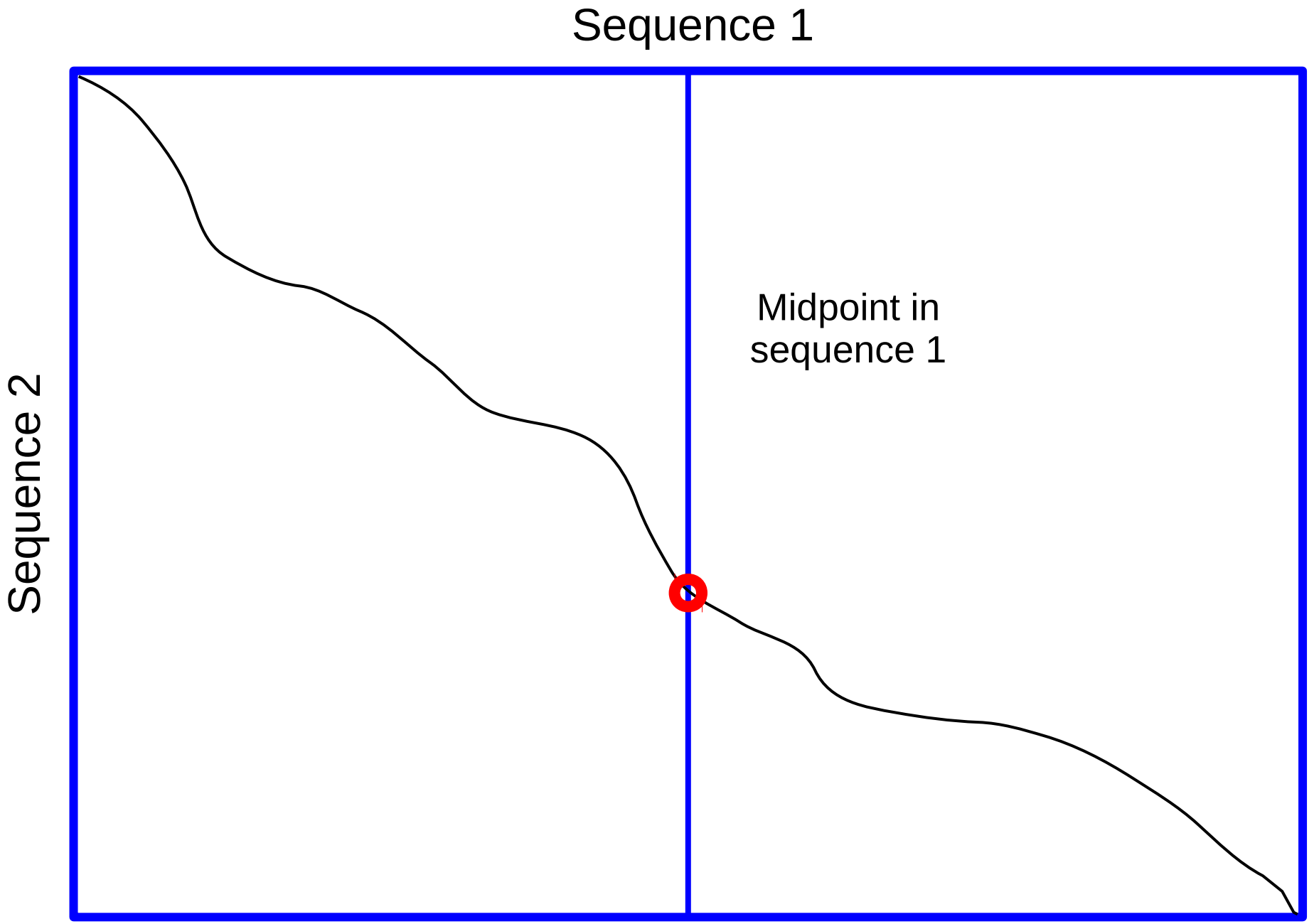

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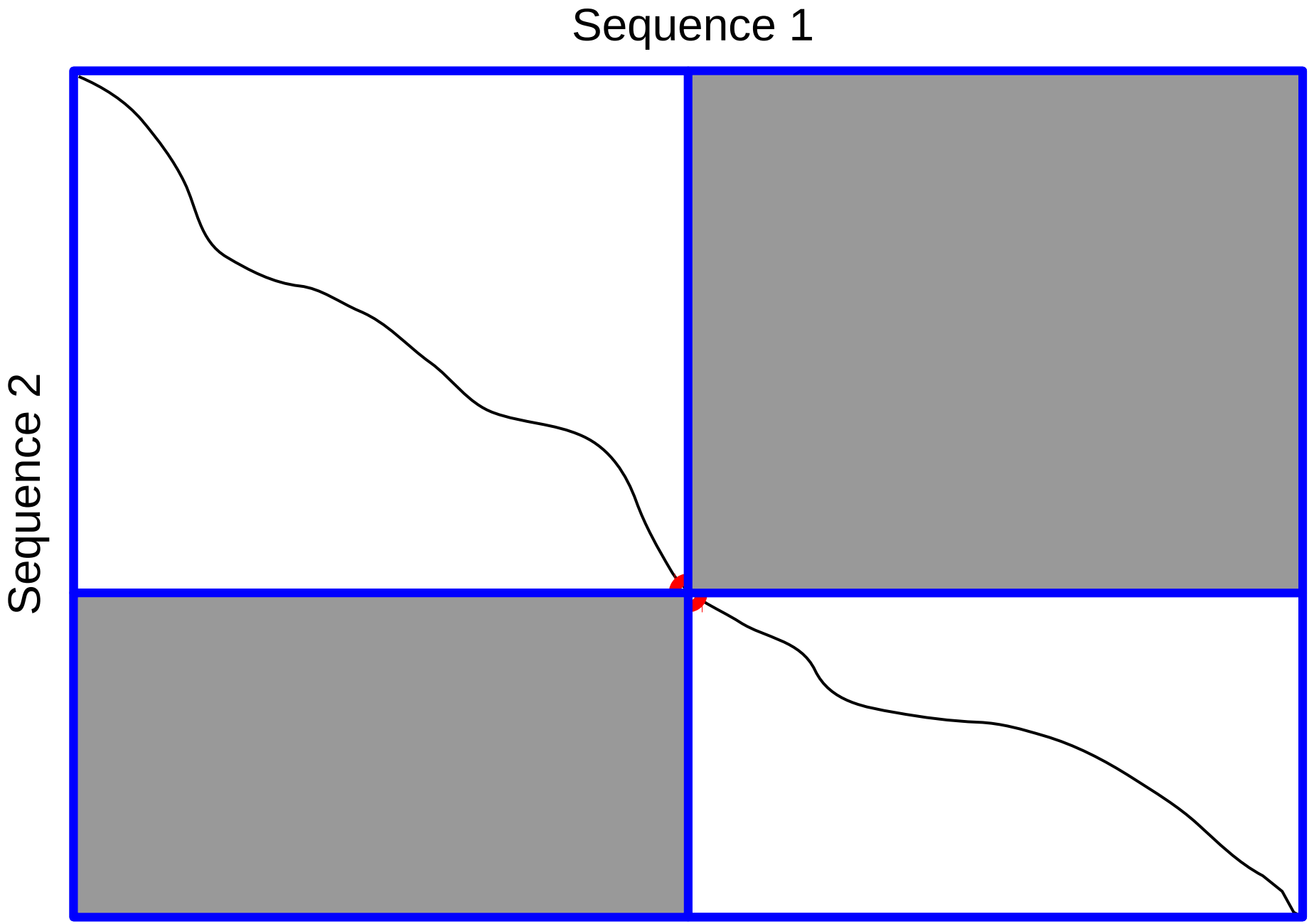

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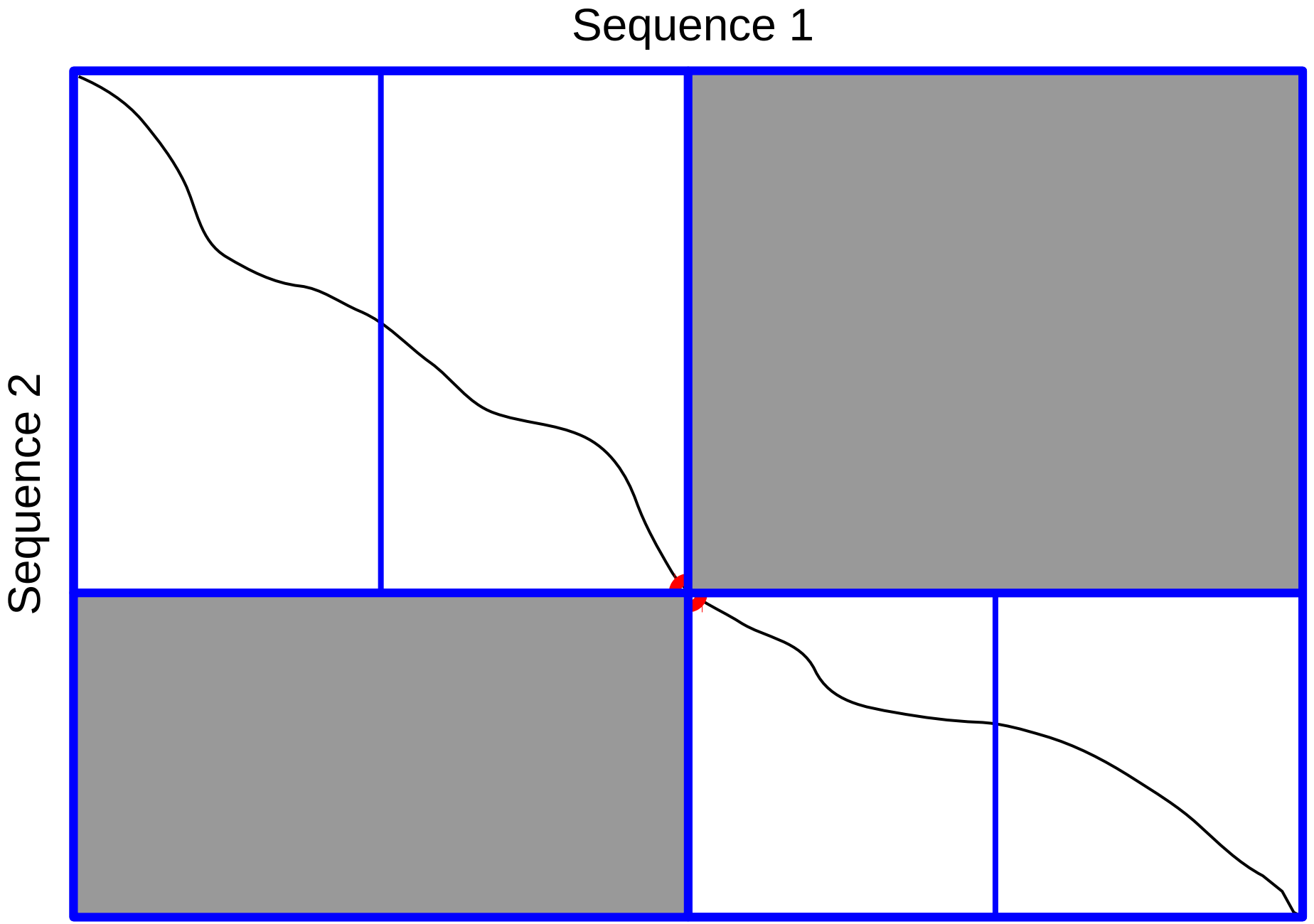

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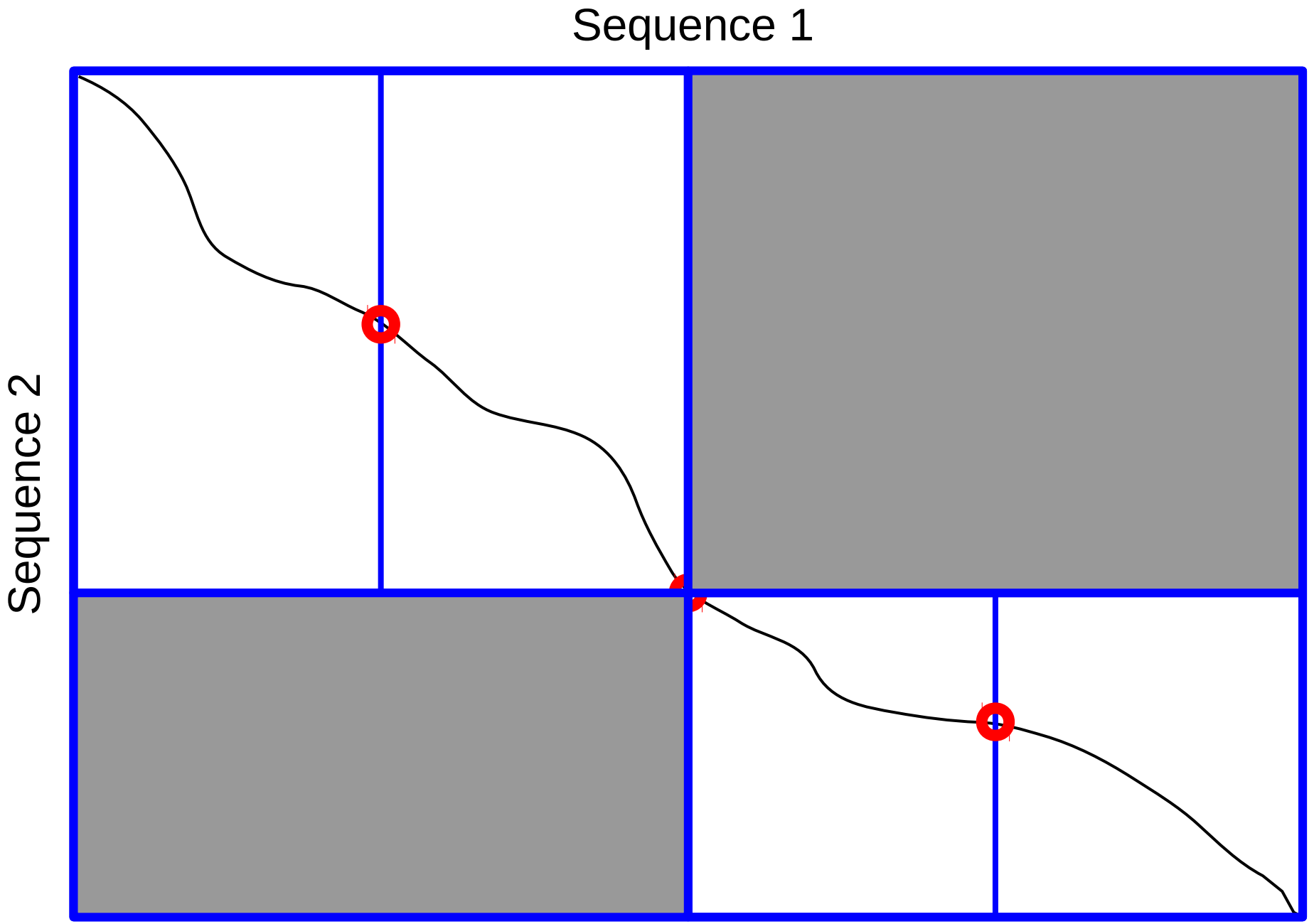

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