DIMACS

Ramsey theory and rado's numbers

ADRIAN GALICIA

Objective

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- Create an algorithm to compute Rado numbers

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- Implement the algorithm in a web-friendly language (JavaScript, PHP, etc.)

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- Visualizing the computation

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- Implement the algorithm in a web-friendly language (JavaScript, PHP, etc.)
- Visualizing the computation
- Prove the output (Rado numbers) with certificates.

Ramsey Theorem

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- Given some edge-coloring of a complete graph, Ramsey's Theorem states that there exist monochromatic sub graphs (depending on how many colors are used).

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- If two colors are used (red & blue), for any positive integers (r,s), there exist a positive integer N=R(r,s) where a coloring of K[N] will give K[r] red or K[s] blue.

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Ramsey Theorem

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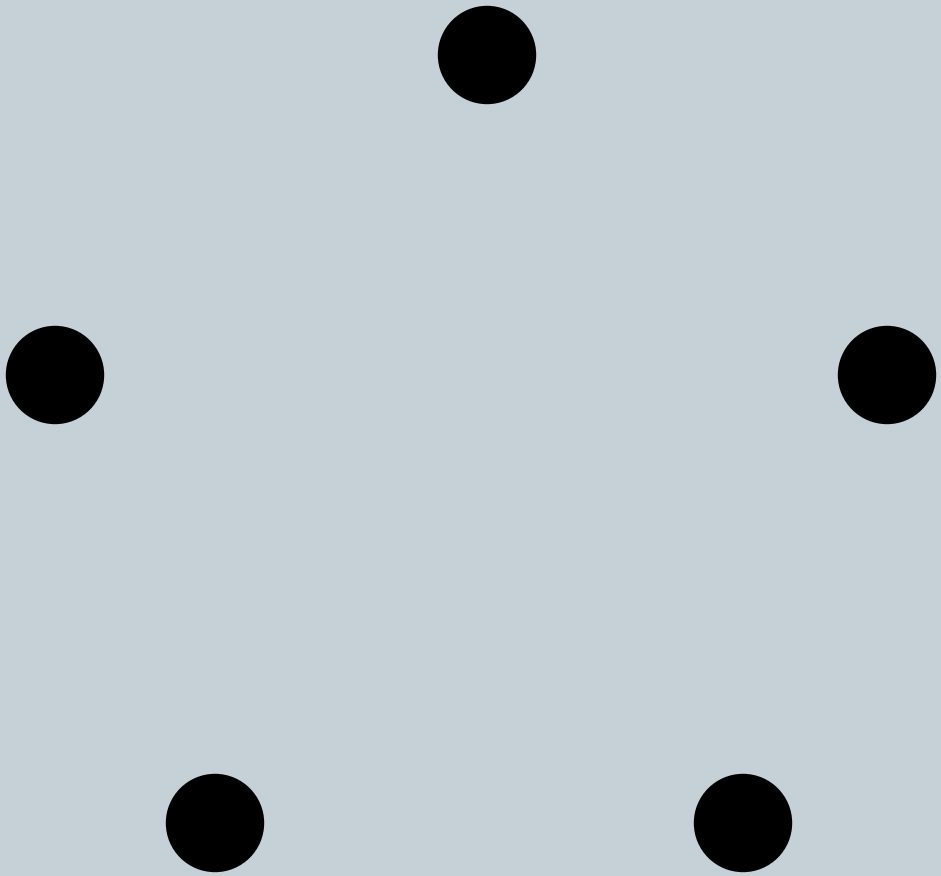
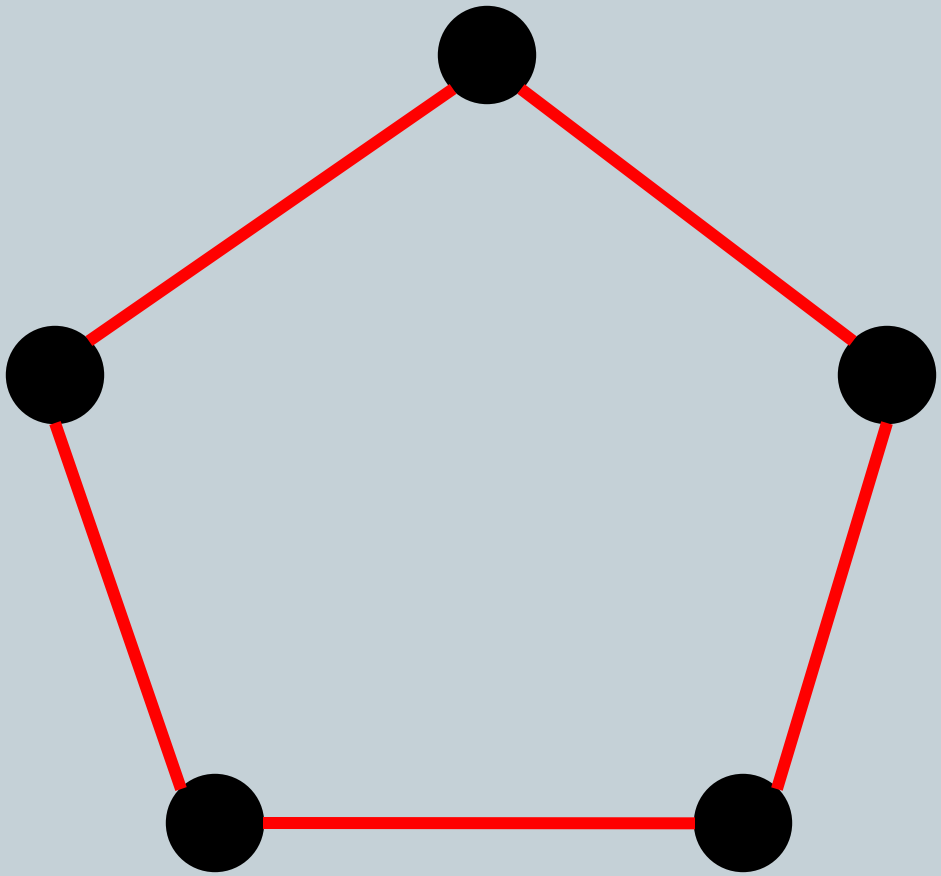
- If two colors are used (red & blue), for any positive integers (r,s), there exist a positive integer N=R(r,s) where a coloring of K[N] will give K[r] red or K[s] blue.
- The R(r,s) is smallest integer N for which the theorem holds.

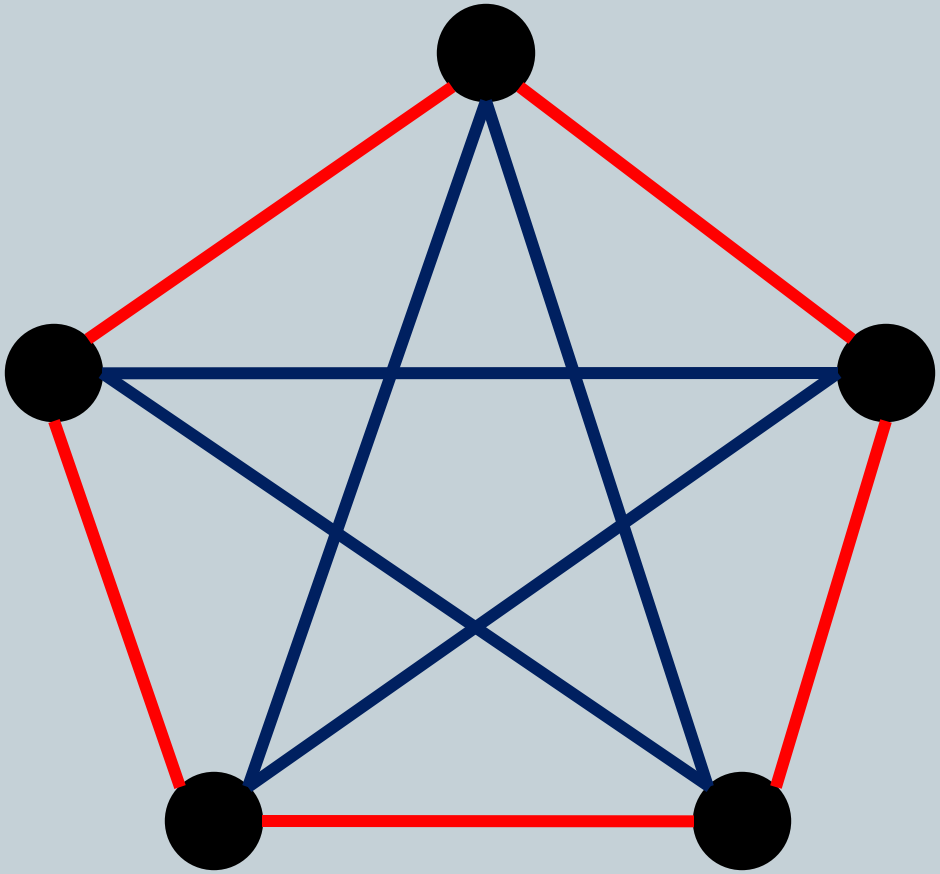
Ramsey's Theorem example



Ramsey's Theorem example



Ramsey's Theorem example



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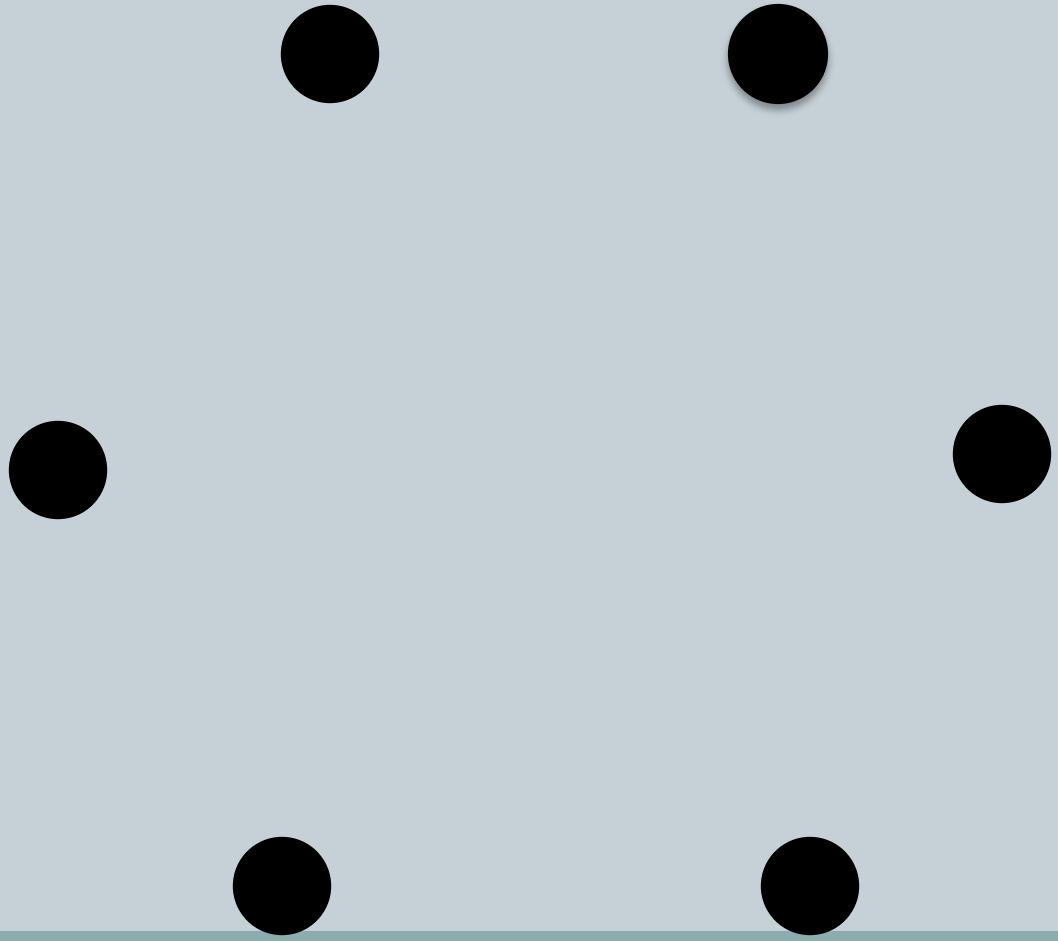
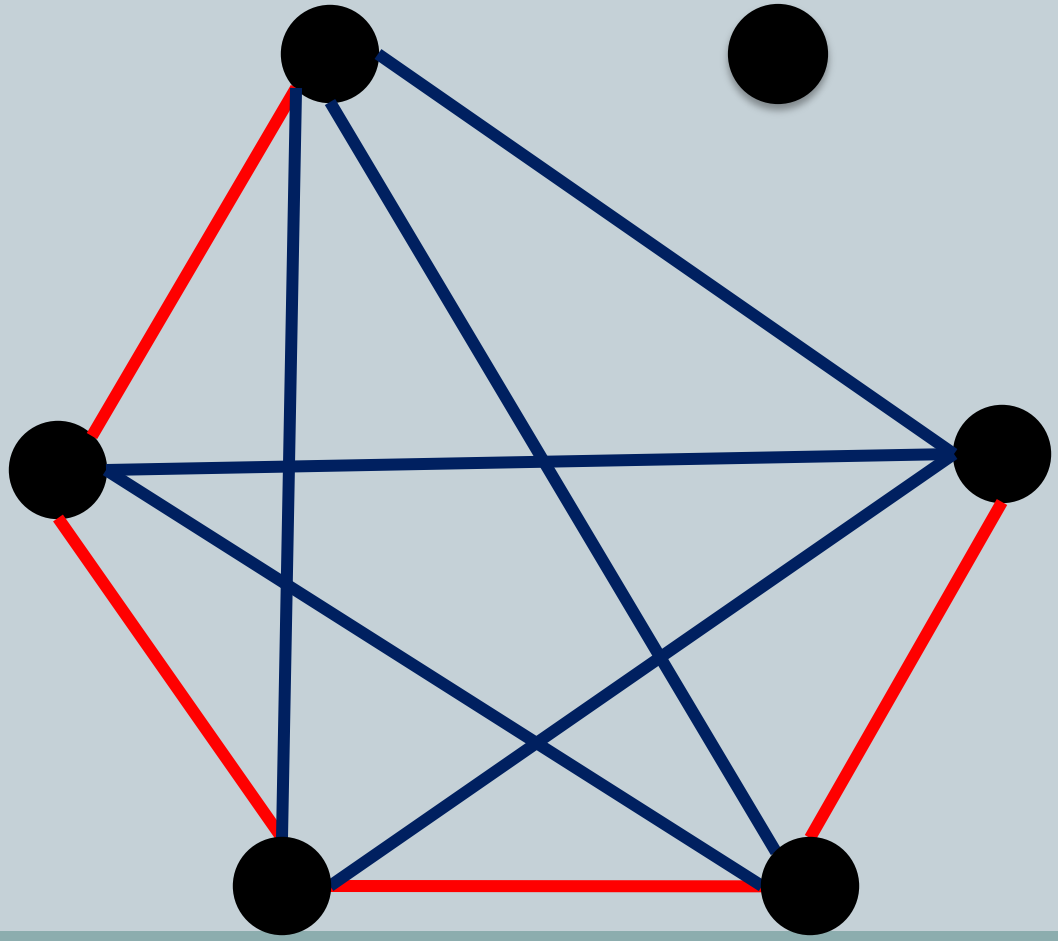


Ramsey's theorem example



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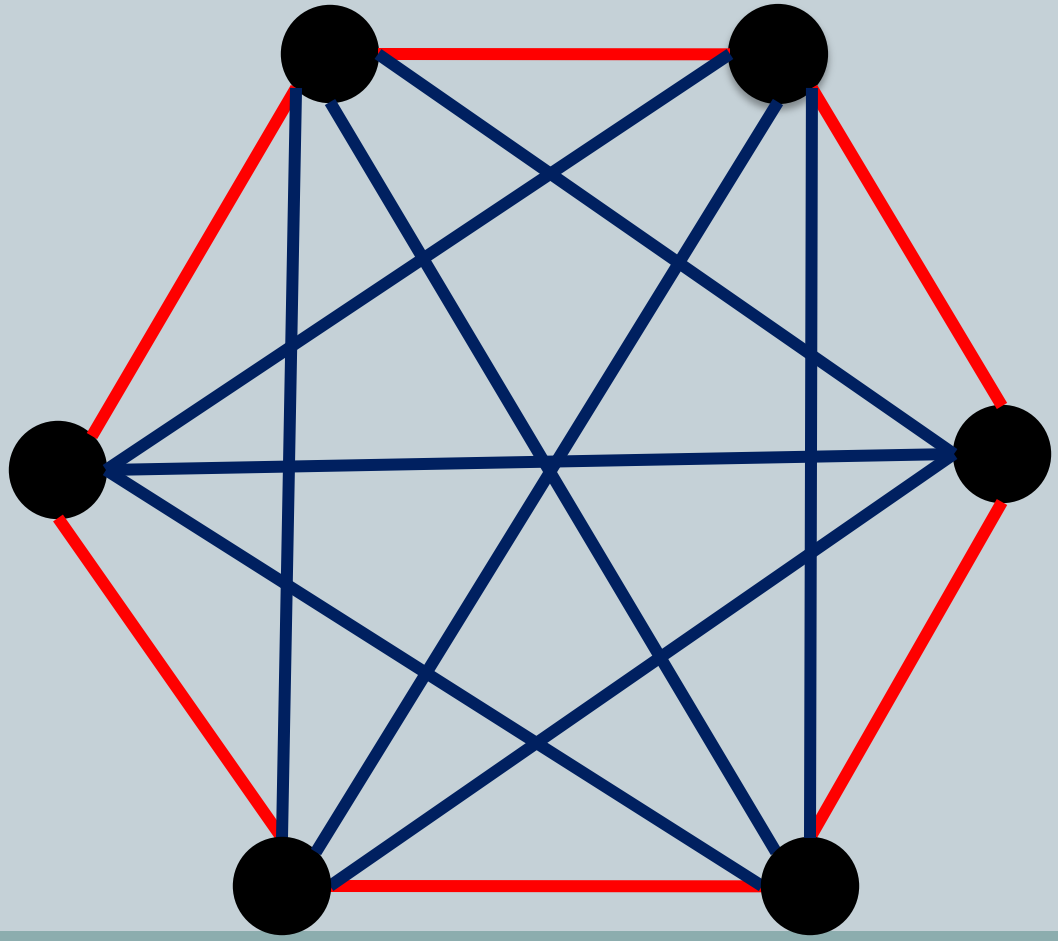
Ramsey's theorem example



Rado number

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Rado number

- Given some equation “E” such as x+y = z and some number of colors “r” (r=2, red and blue in this case), find the N so that there is no way to color 1 through N without a solution to the equation E of the same color.

Rado number

- Given some equation “E” such as x+y = z and some number of colors “r” (r=2, red and blue in this case), find the N so that there is no way to color 1 through N without a solution to the equation E of the same color.
- This is analogous to N=R(r,s), like R(3,3)=6. As showed in the graph, K[5] is the smallest number you can color and avoid monochromatic K[3].

Rado number example

$x+y = z$

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- N = 1 **1** **1**

Rado number example

x+y = z

- N = 1

~~1+1 = 2~~ 1 1+1 = 2

Rado number example

x+y = z

- N = 1 ~~1+1 = 2~~ 1 1 ~~1+1 = 2~~
- N = 2 1 2 1 2 1 2 1 2

Rado number example

x+y = z

- N = 1

1+1 = 2 1 1 1+1 = 2

- N = 2

1+1 = 2 1+1 = 2

1 2 1 2 1 2 1 2

Rado number example

x+y = z

- N = 1 — 1+1 = 2 — 1 — 1 — 1+1 = 2
- N = 2 — 1 2 — 1+1 = 2 — 1 2 — 1 2 — 1 2 — 1+1 = 2
- N = 3 — 1 2 3 — 1 2 3 — 1 23 — 1 2 3

Rado number example

x+y = z

- N = 1

1+1 = 2 1 1 1+1 = 2

- N = 2

1+1 = 2 1+1 = 2

1 2 1 2 1 2 1 2

- N = 3

1 2 3 1 2 3 1 23 1 2 3

- N = 4

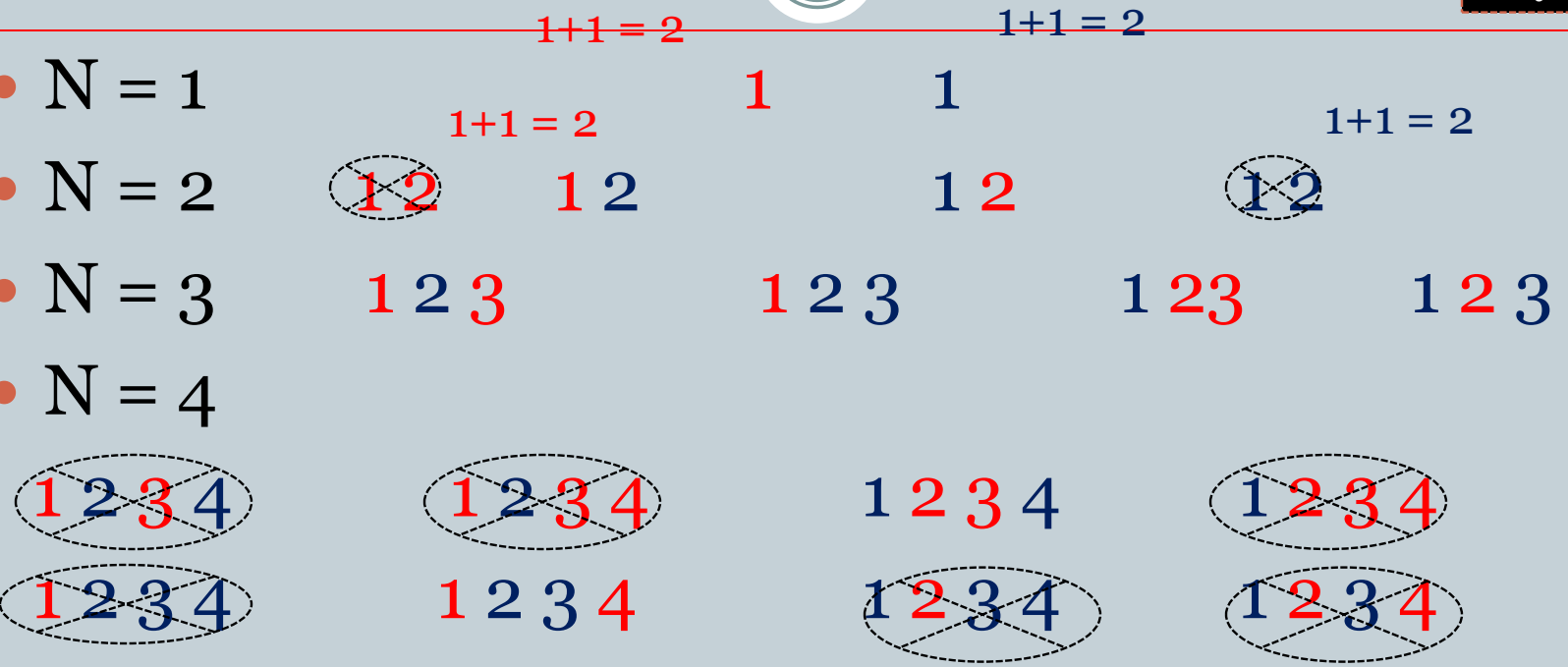
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4

1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4

Rado number example

x+y = z

- N = 1
- N = 2
- N = 3
- N = 4



Rado number example

x+y = z

- N = 1

1+1 = 2 1 1 1+1 = 2

- N = 2

1+1 = 2 1+1 = 2

1 2 1 2 1 2 1 2

- N = 3

1 2 3 1 2 3 1 2 3 1 2 3

- N = 4

1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4

1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4

- N = 5

1 2 3 4 5 1 2 3 4 5

1 2 3 4 5 1 2 3 4 5

Rado number example

x+y = z

- N = 1

1+1 = 2 1 1 1+1 = 2

- N = 2

1+1 = 2 1+1 = 2

1 2 1 2 1 2 1 2

- N = 3

1 2 3 1 2 3 1 23 1 2 3

- N = 4

1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4

1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4

- N = 5

1 2 3 4 5 1 2 3 4 5

1 2 3 4 5 1 2 3 4 5

Ultimate goal

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- Make a program that gives out the least Rado number given some equation taken from the user input.

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- If possible, it will not only work with 2 colors but with 3 or more colors.
- It will have a tree stylized output (certificate).

Tree output

Tree output

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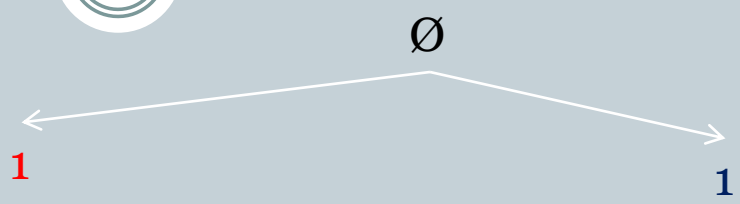
Tree output



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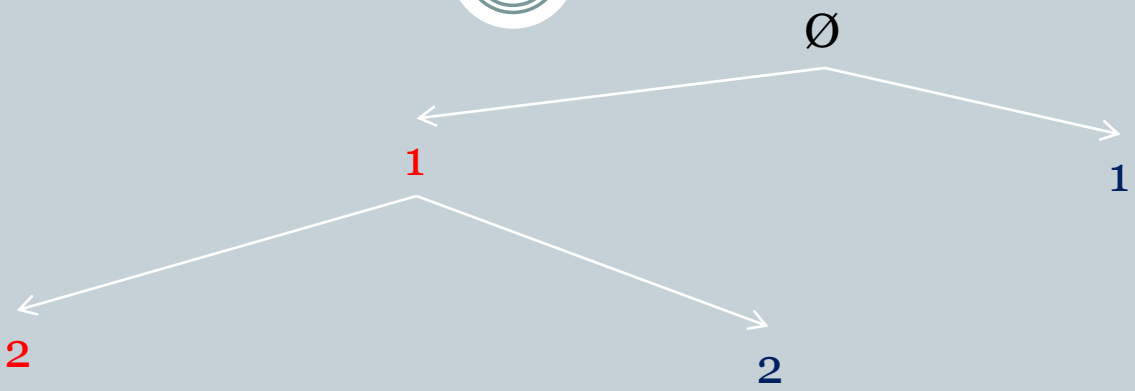
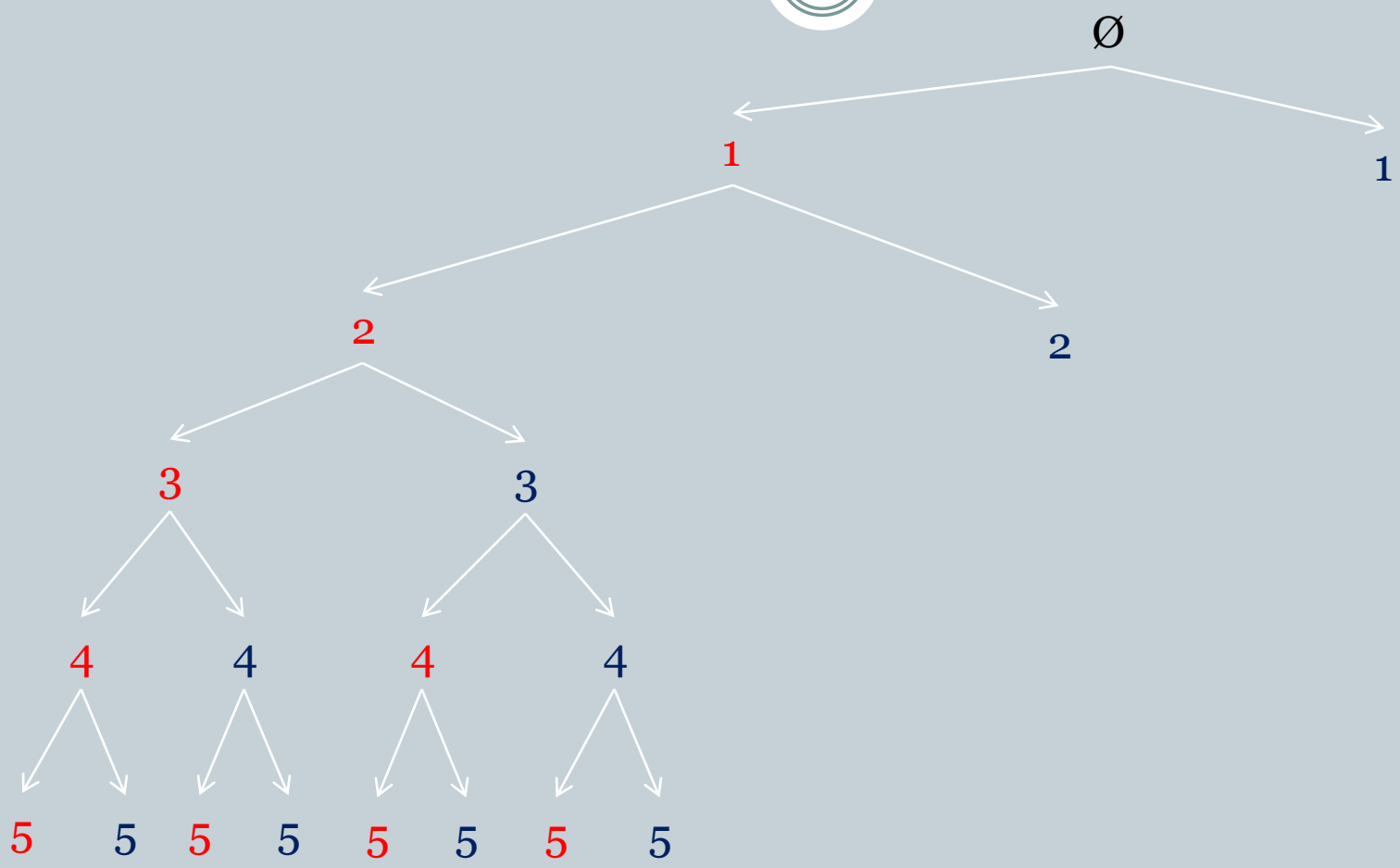
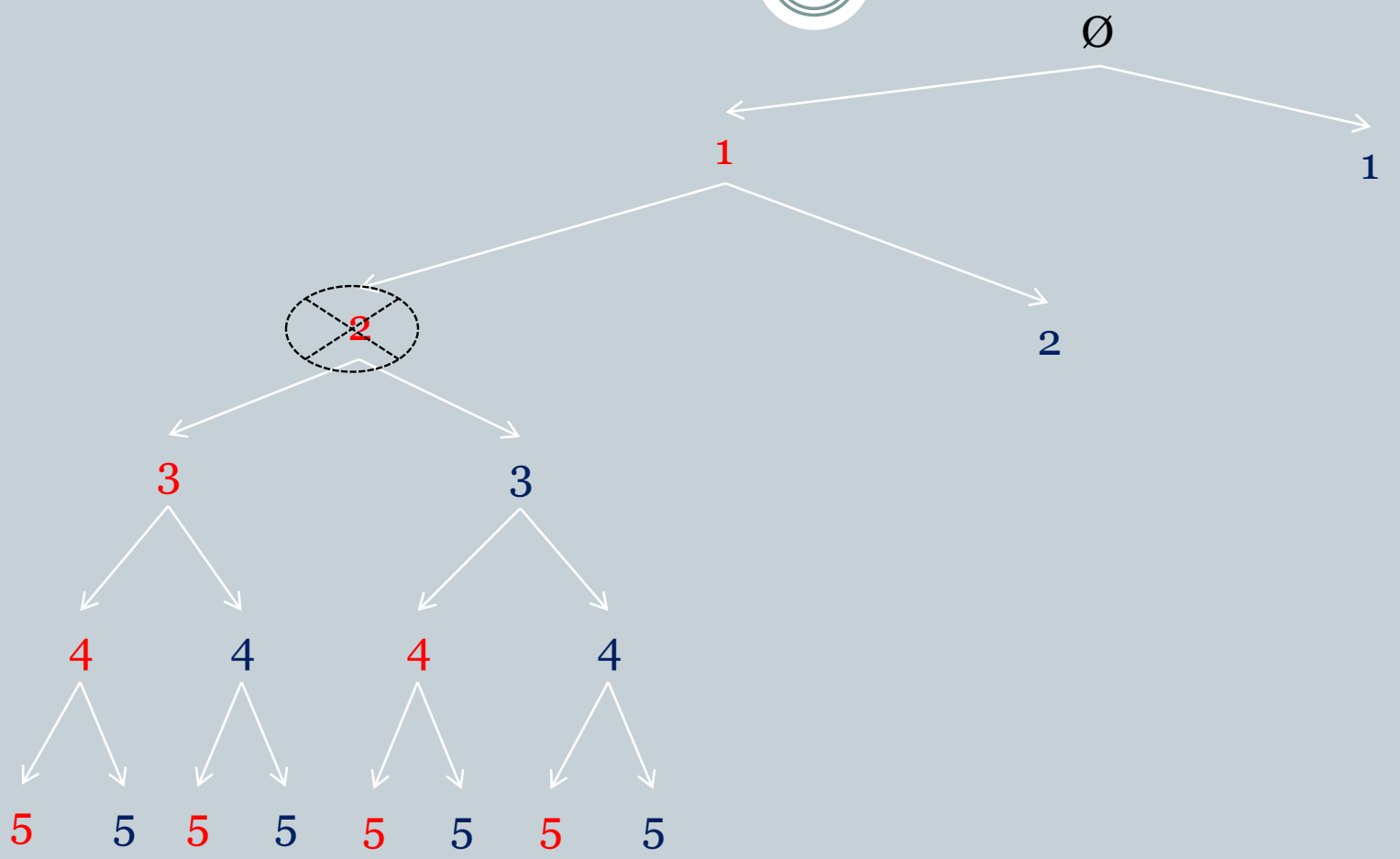
Tree output



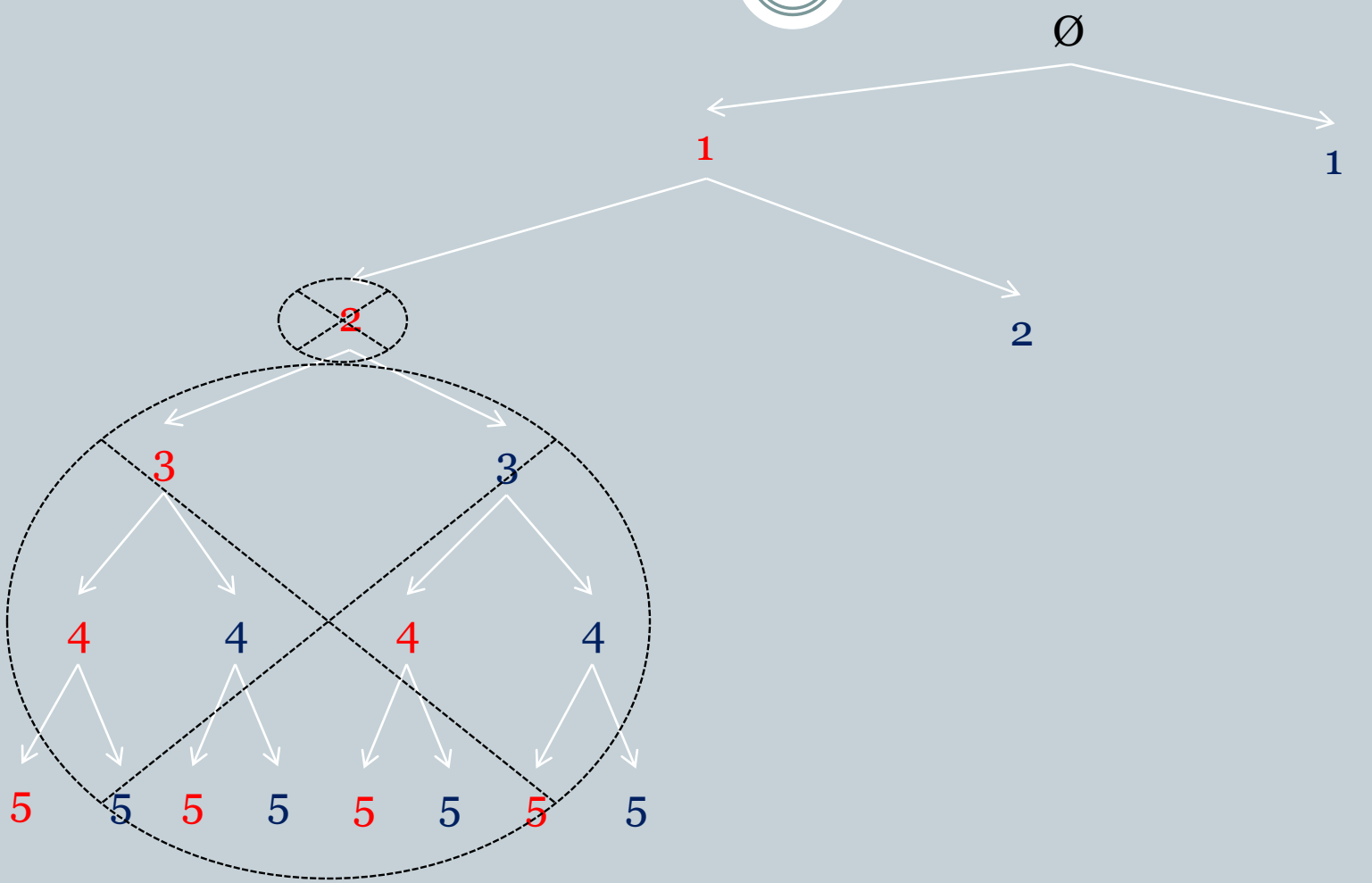
Tree output



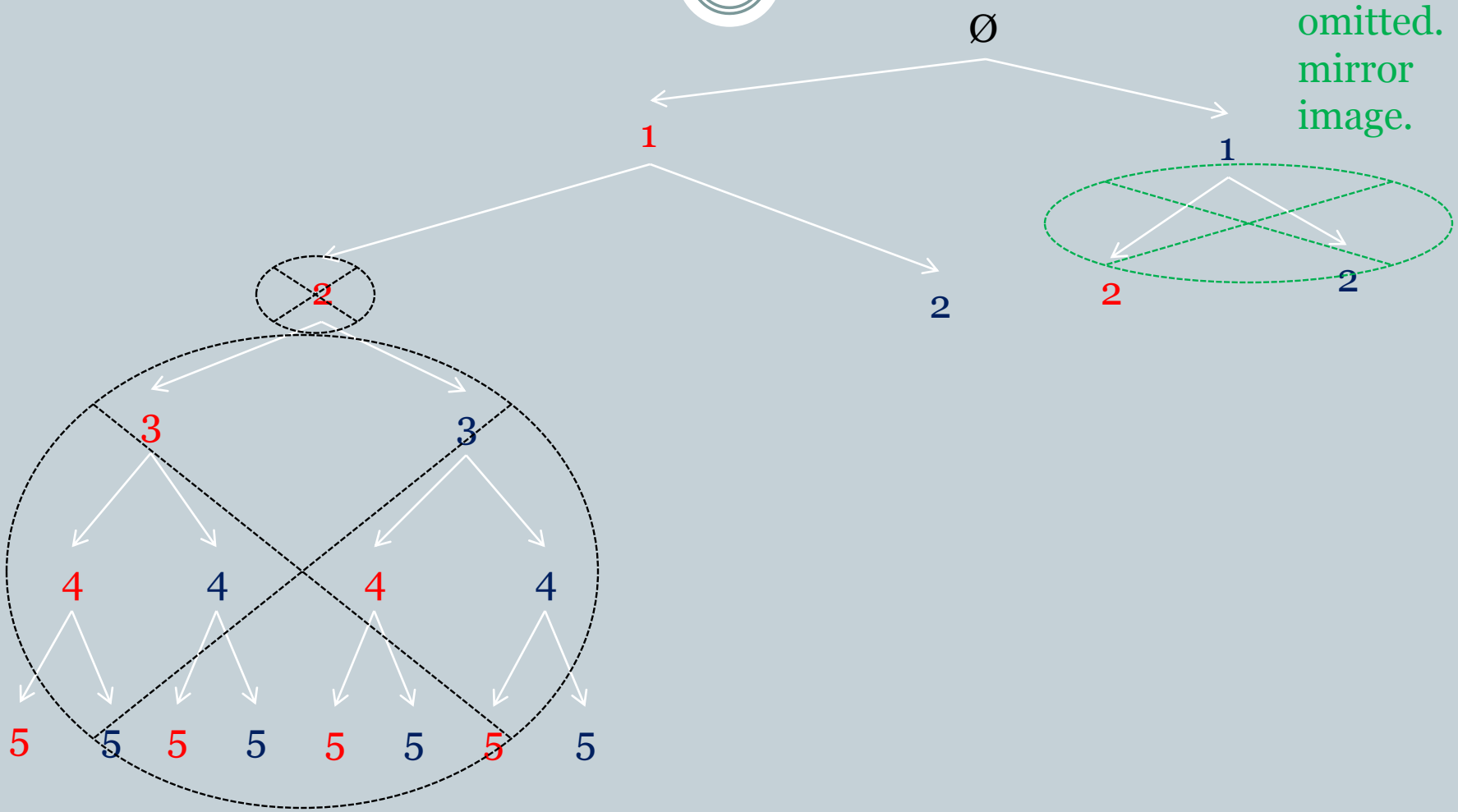
Tree output



Tree output

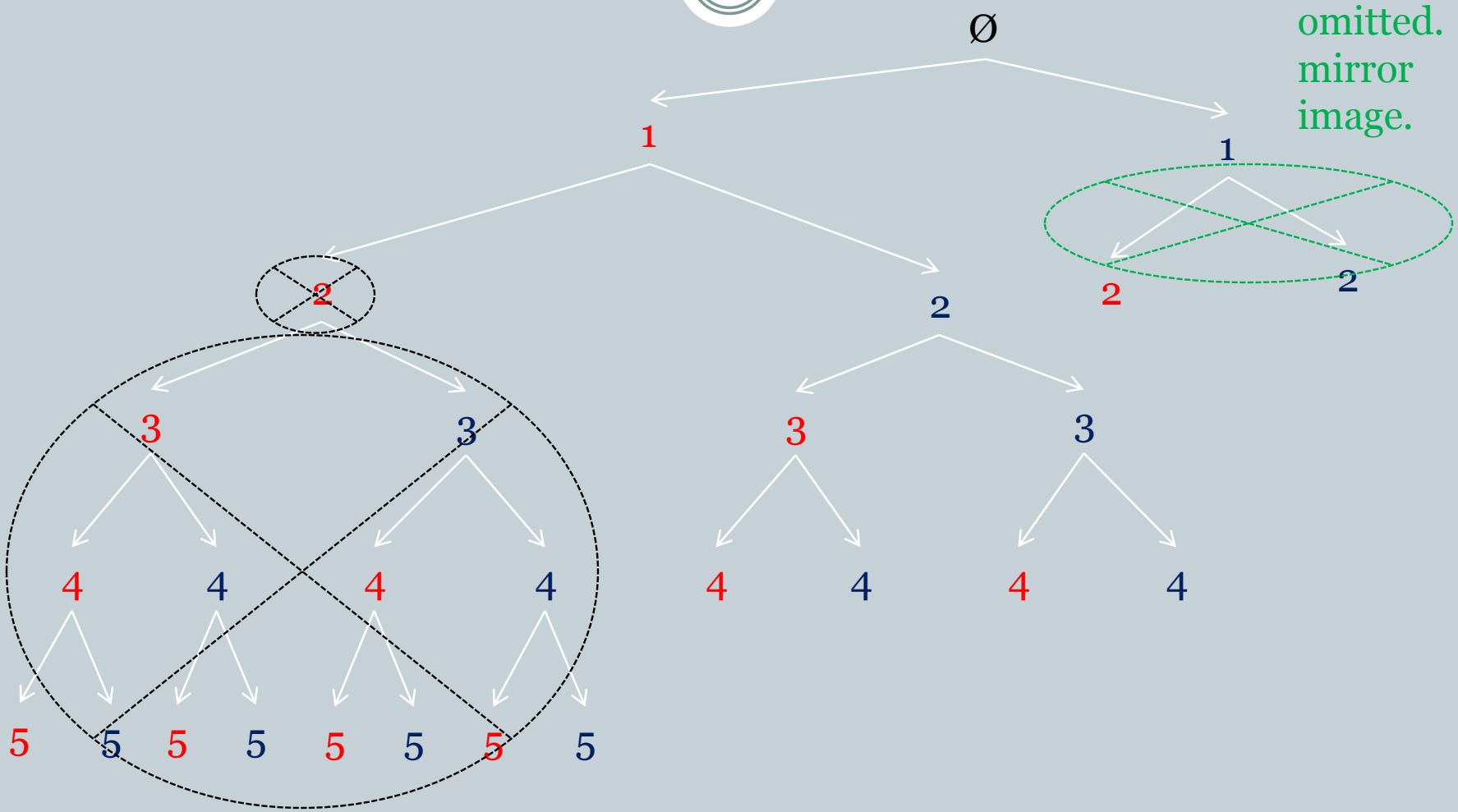


Tree output



Can be omitted. mirror image.

Tree output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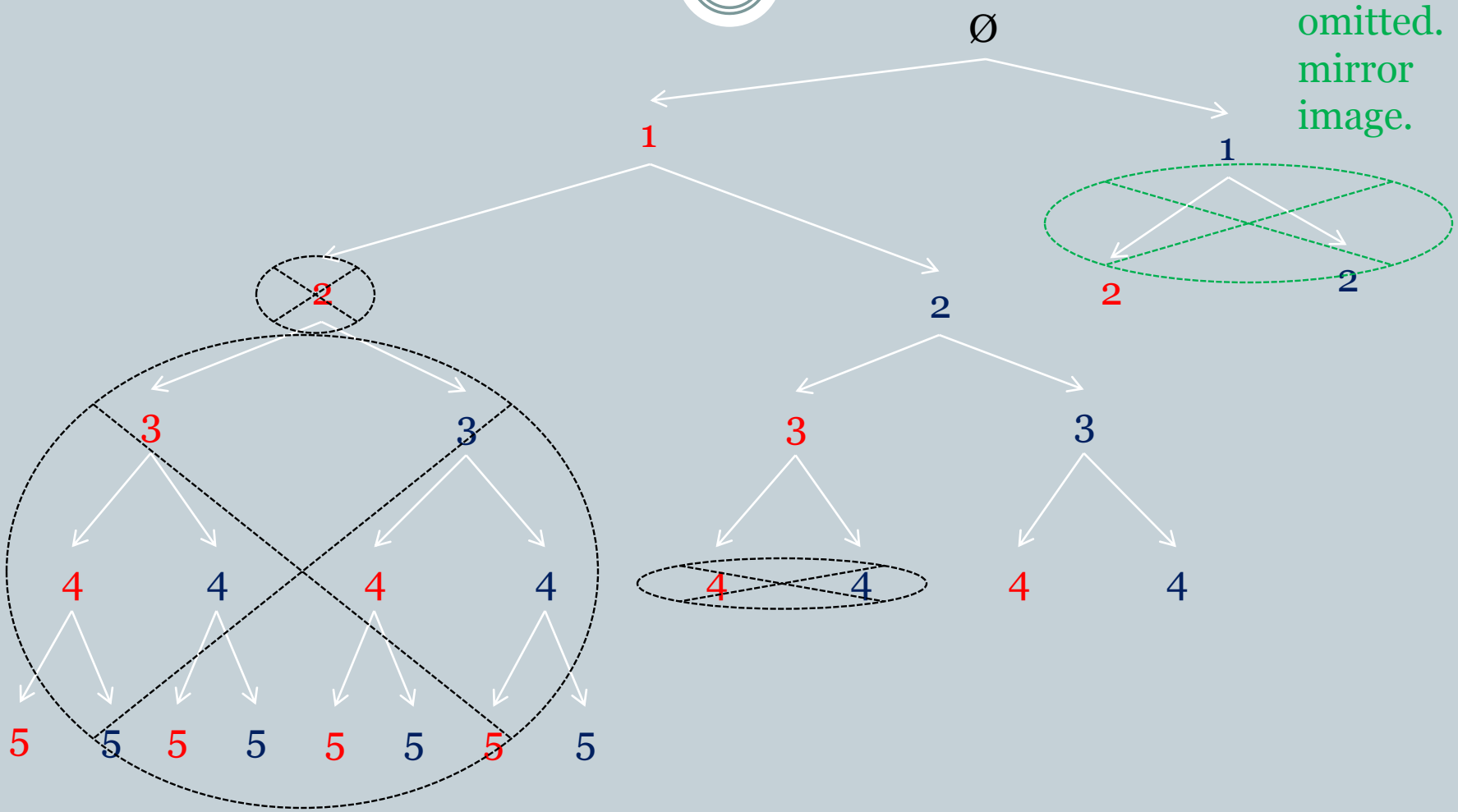

Can be omitted. mirror image.

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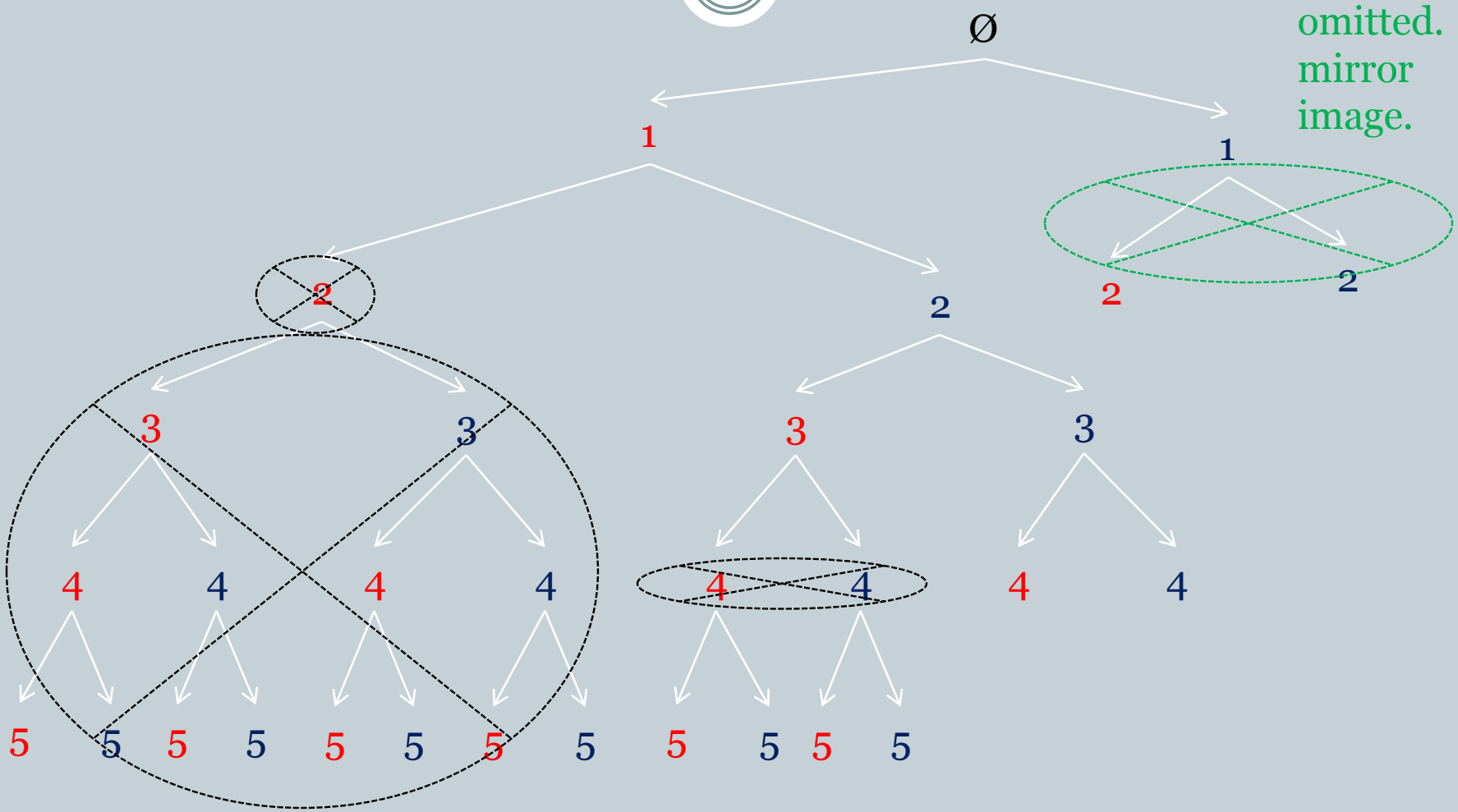

Can be omitted. mirror image.

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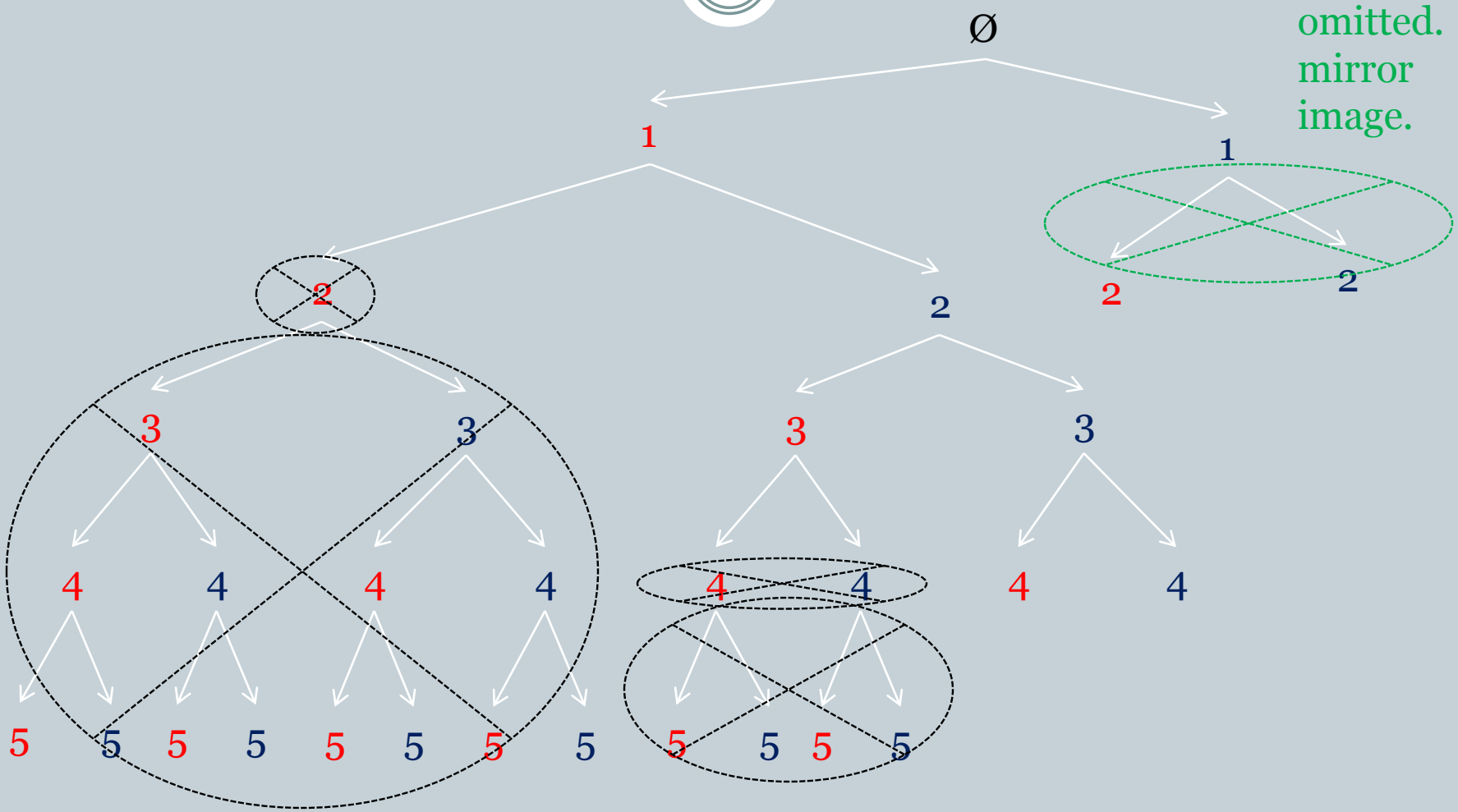

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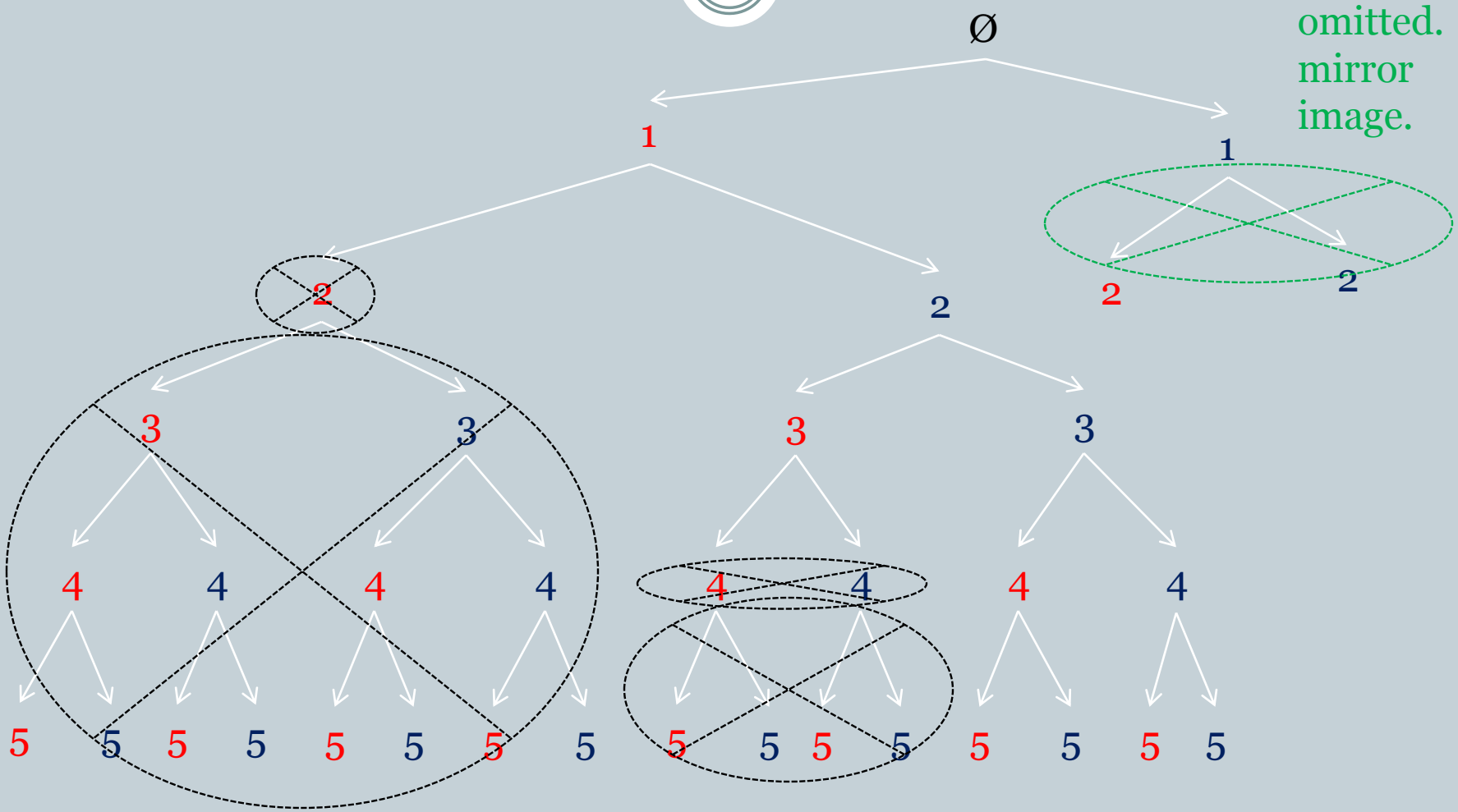

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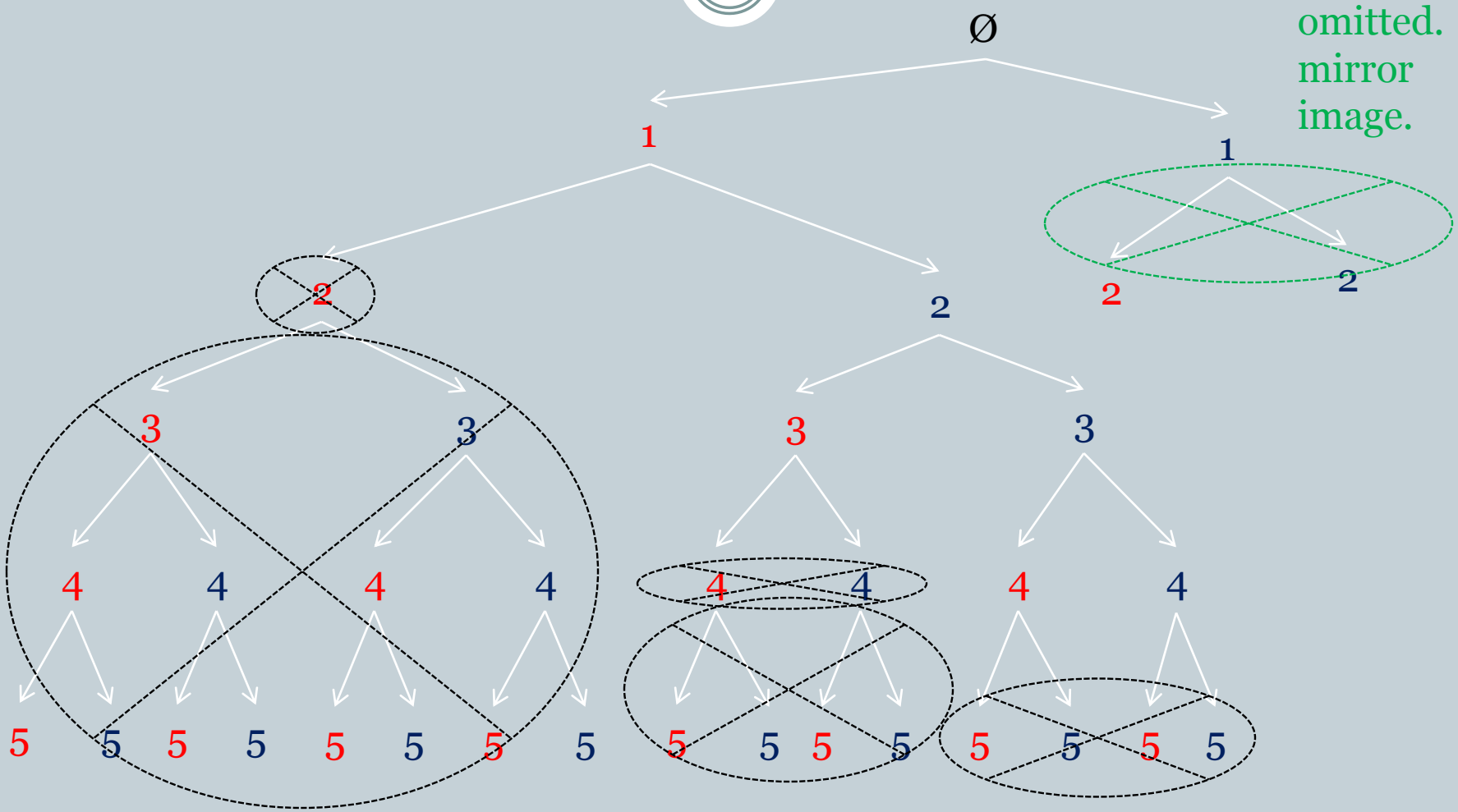

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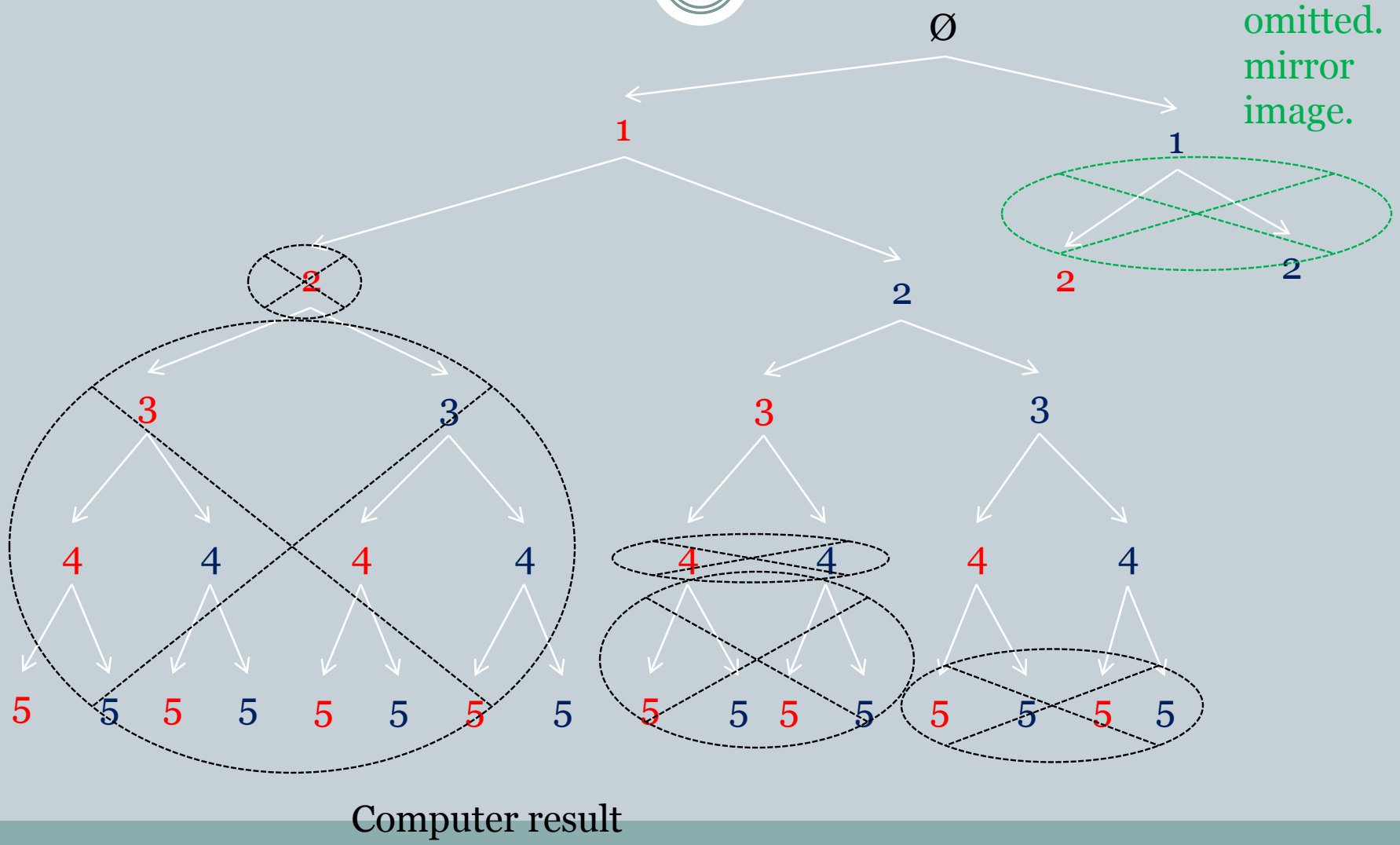

Computer result

Thanks for your attention.