



Merge Sort

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*A ideia é dividir a lista ao meio,
recursivamente, até aparecer
sub-listas com um único elemento.
O outro passo é combinar cada par
(esquerda e direita) de sub-listas em
uma sequência ordenada.*

Intuição

▷ Dividir

- Se a sequência (lista) de entrada tiver mais de um elemento, divida em duas;

▷ Conquistar

- Chame o método (mergesort) para cada subsequência (sub-lista), recursivamente;

▷ Combinar

- Junte as subsequências em uma sequência ordenada;

Exemplo

5	3	1	6	4	2
----------	----------	----------	----------	----------	----------

Iteração 1

5	3	1	6	4	2
---	---	---	---	---	---

p

m

r

5	3	1	6	4	2
---	---	---	---	---	---

Iteração 2

5	3	1	6	4	2
<i>p</i>	<i>m</i>	<i>r</i>			

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

Iteração 3

5	3	1	6	4	2
---	---	---	---	---	---

p, m

r

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3
---	---

1

Iteração 4

5	3	1	6	4	2
---	---	---	---	---	---

p, r

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

5	3
---	---

Iteração 5

5	3	1	6	4	2
---	---	---	---	---	---

p, r

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

5	3
---	---

Iteração 3

3	5	1	6	4	2
---	---	---	---	---	---

p, m

r

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3
---	---

1

5

3

3	5
---	---

Iteração 6

3	5	1	6	4	2
---	---	---	---	---	---

p, r

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

5	3
---	---

3	5
---	---

Iteração 2

1	3	5	6	4	2
<i>p</i>	<i>m</i>	<i>r</i>			

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

5	3
---	---

3	5
---	---

1	3	5
---	---	---

Iteração 7

1	3	5	6	4	2
			<i>p</i>	<i>m</i>	<i>r</i>

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

5	3
---	---

3	5
---	---

1	3	5
---	---	---

Iteração 8

1	3	5	6	4	2
---	---	---	---	---	---

p, m

r

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3
---	---

3	5
---	---

1	3	5
---	---	---

Iteração 9

1	3	5	6	4	2
---	---	---	---	---	---

p, r

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3
---	---

6	4
---	---

3	5
---	---

1	3	5
---	---	---

Iteração 10

1	3	5	6	4	2
---	---	---	---	---	---

p, r

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3
---	---

6	4
---	---

3	5
---	---

1	3	5
---	---	---

Iteração 8

1	3	5	4	6	2
---	---	---	---	---	---

p, m

r

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3
---	---

6	4
---	---

3	5
---	---

4	6
---	---

1	3	5
---	---	---

Iteração 9

1	3	5	4	6	2
---	---	---	---	---	---

p, r

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3
---	---

6	4
---	---

3	5
---	---

4	6
---	---

1	3	5
---	---	---

Iteração 7

1	3	5	2	4	6
			<i>p</i>	<i>m</i>	<i>r</i>

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3
---	---

6	4
---	---

3	5
---	---

4	6
---	---

1	3	5
---	---	---

2	4	6
---	---	---

Iteração 1

1	3	5	2	4	6
<i>p</i>		<i>m</i>			<i>r</i>

5	3	1	6	4	2
---	---	---	---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3	1
---	---	---

6	4	2
---	---	---

5	3
---	---

6	4
---	---

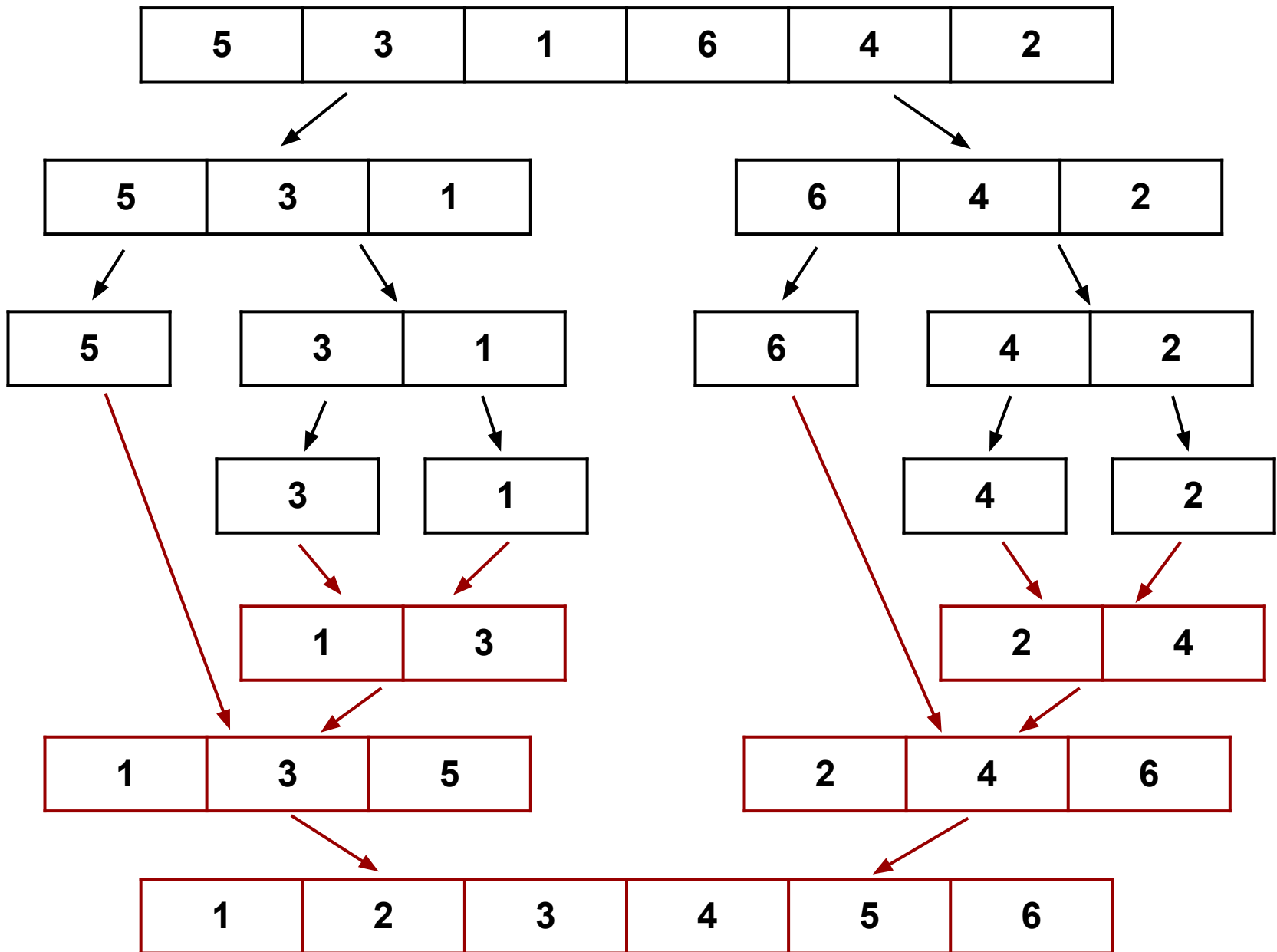
3	5
---	---

4	6
---	---

1	3	5
---	---	---

2	4	6
---	---	---

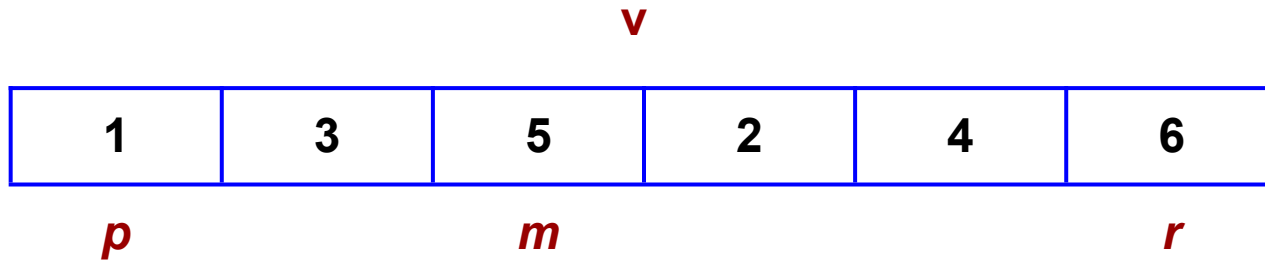
1	2	3	4	5	6
---	---	---	---	---	---



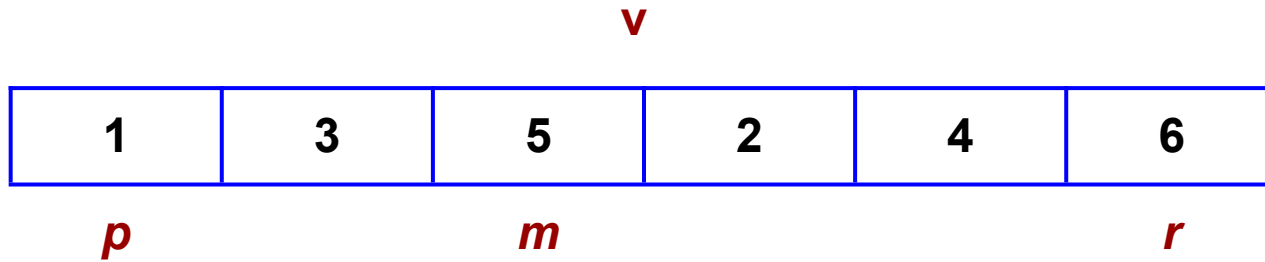


*Se a sub-lista (esquerda ou direita)
tiver um elemento, considera-se já
ordenada.*

Merge entre duas metades



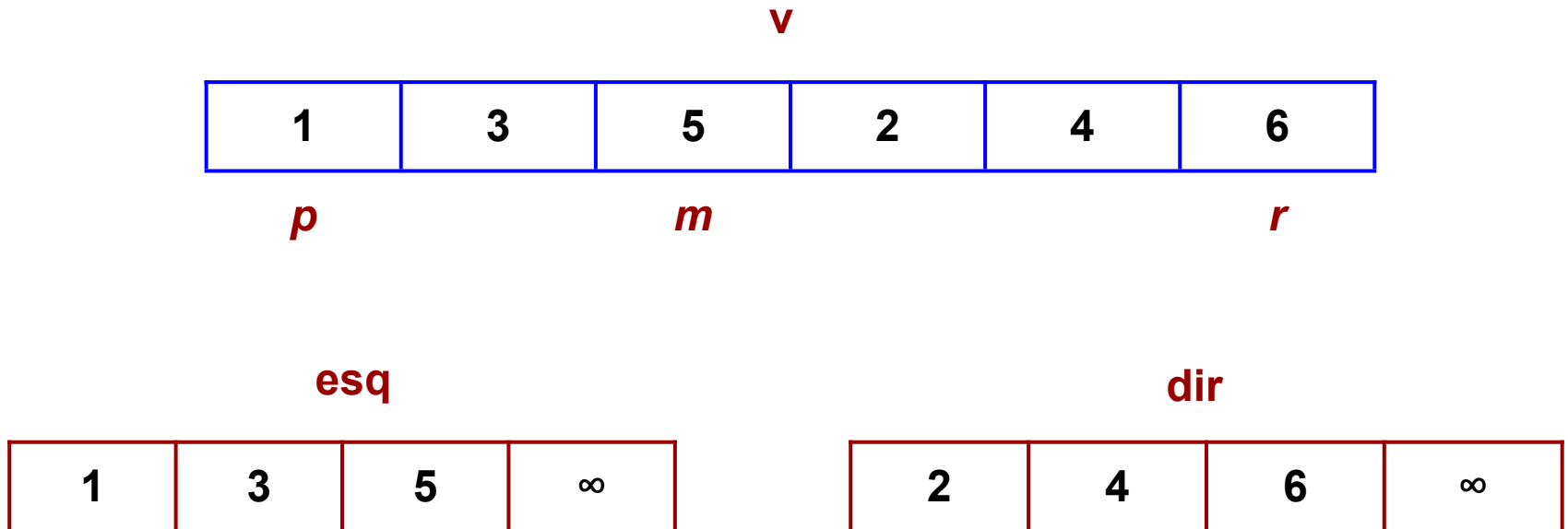
Merge entre duas metades



esq



Merge entre duas metades



Merge entre duas metades

v

1	3	5	2	4	6
---	---	---	---	---	---

p, k

r

esq

1	3	5	∞
---	---	---	----------

i

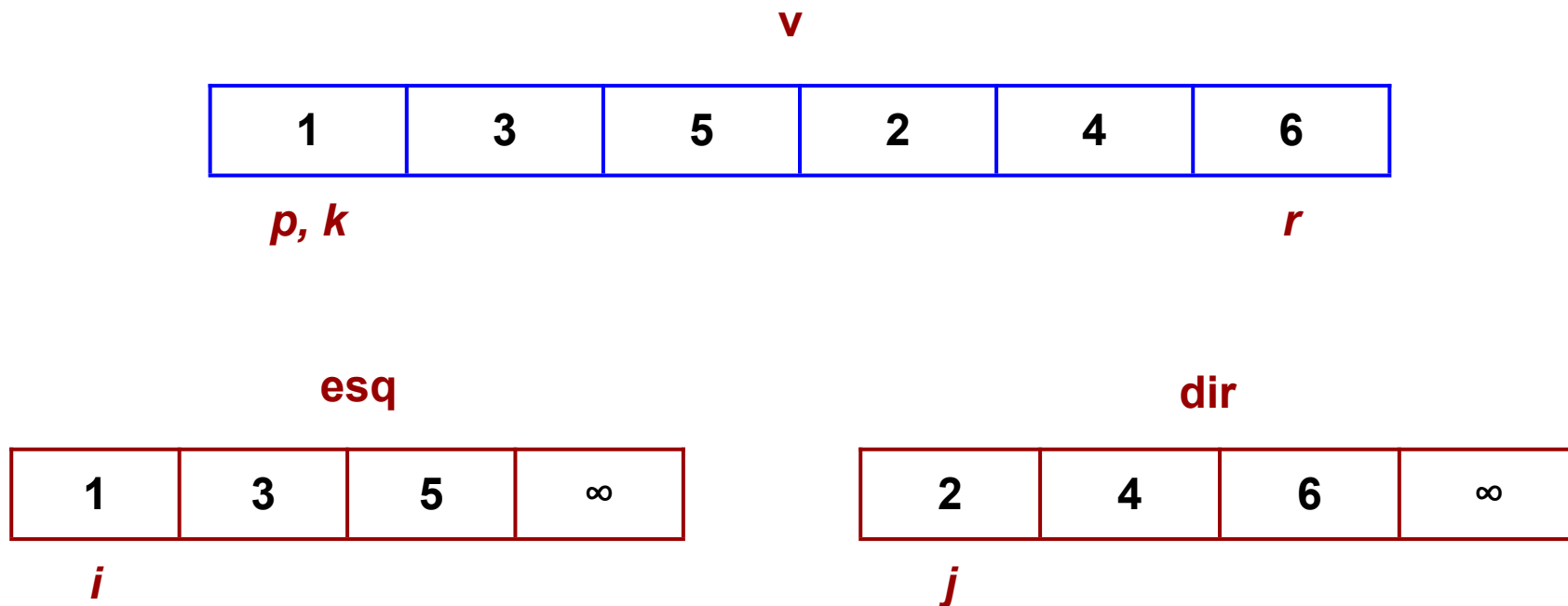
dir

2	4	6	∞
---	---	---	----------

j

1 <= 2 ?

Merge entre duas metades



Coloca esq[i] em v[k]

Merge entre duas metades

v

1	3	5	2	4	6
---	---	---	---	---	---

p, k

r

esq

1	3	5	∞
---	---	---	----------

i

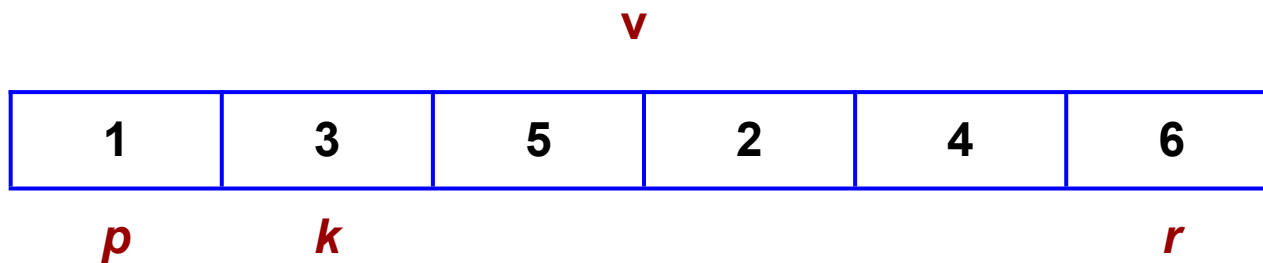
dir

2	4	6	∞
---	---	---	----------

j

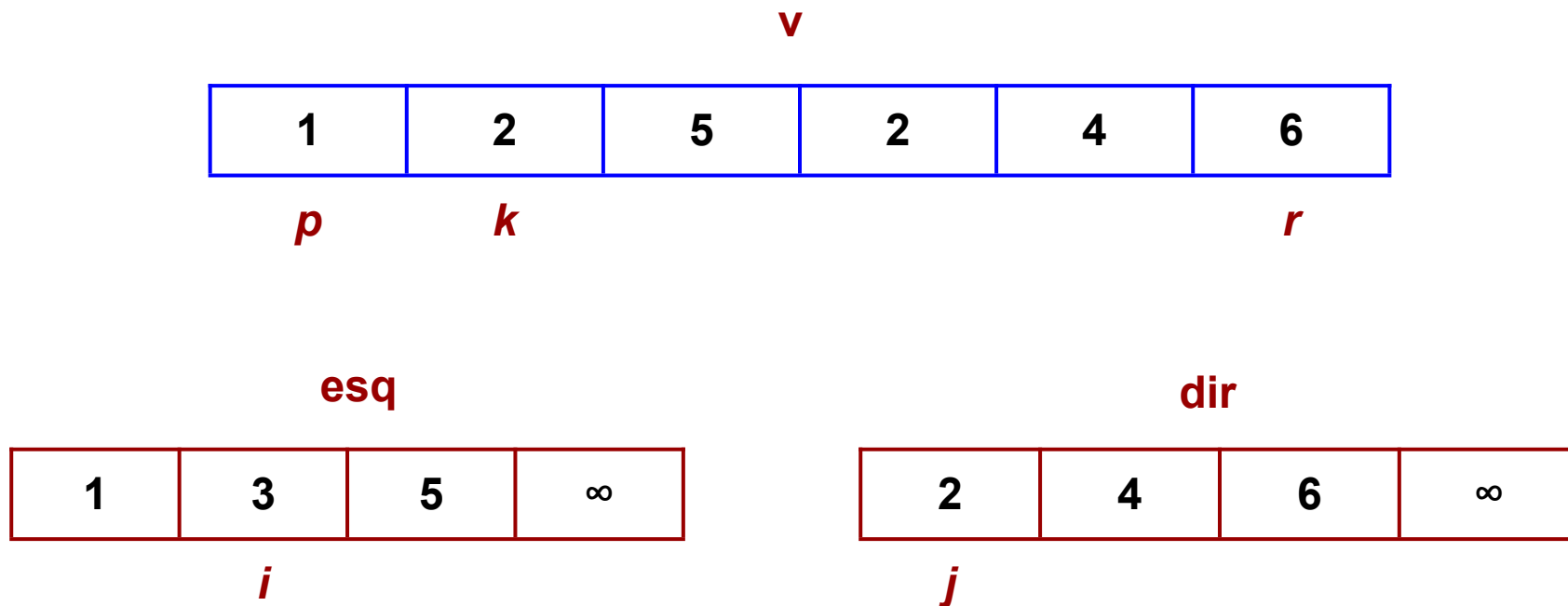
Incrementa i

Merge entre duas metades



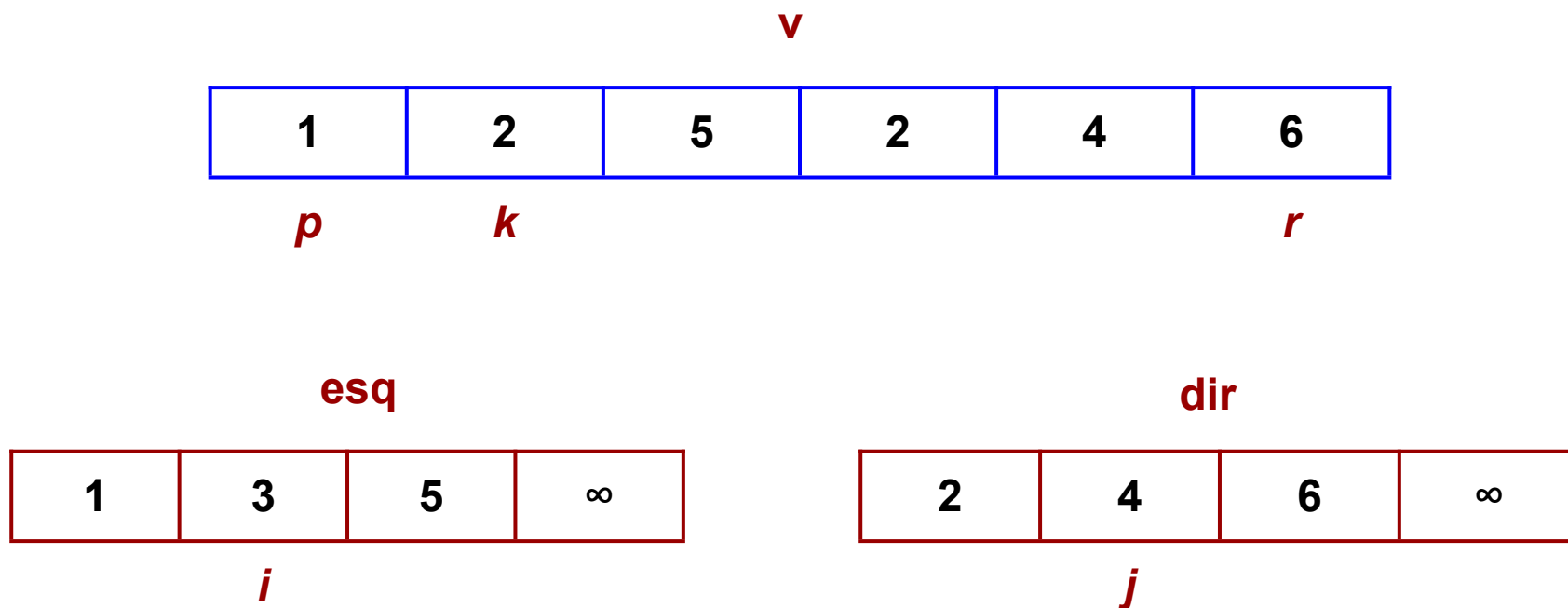
3 ≤ 2 ?

Merge entre duas metades



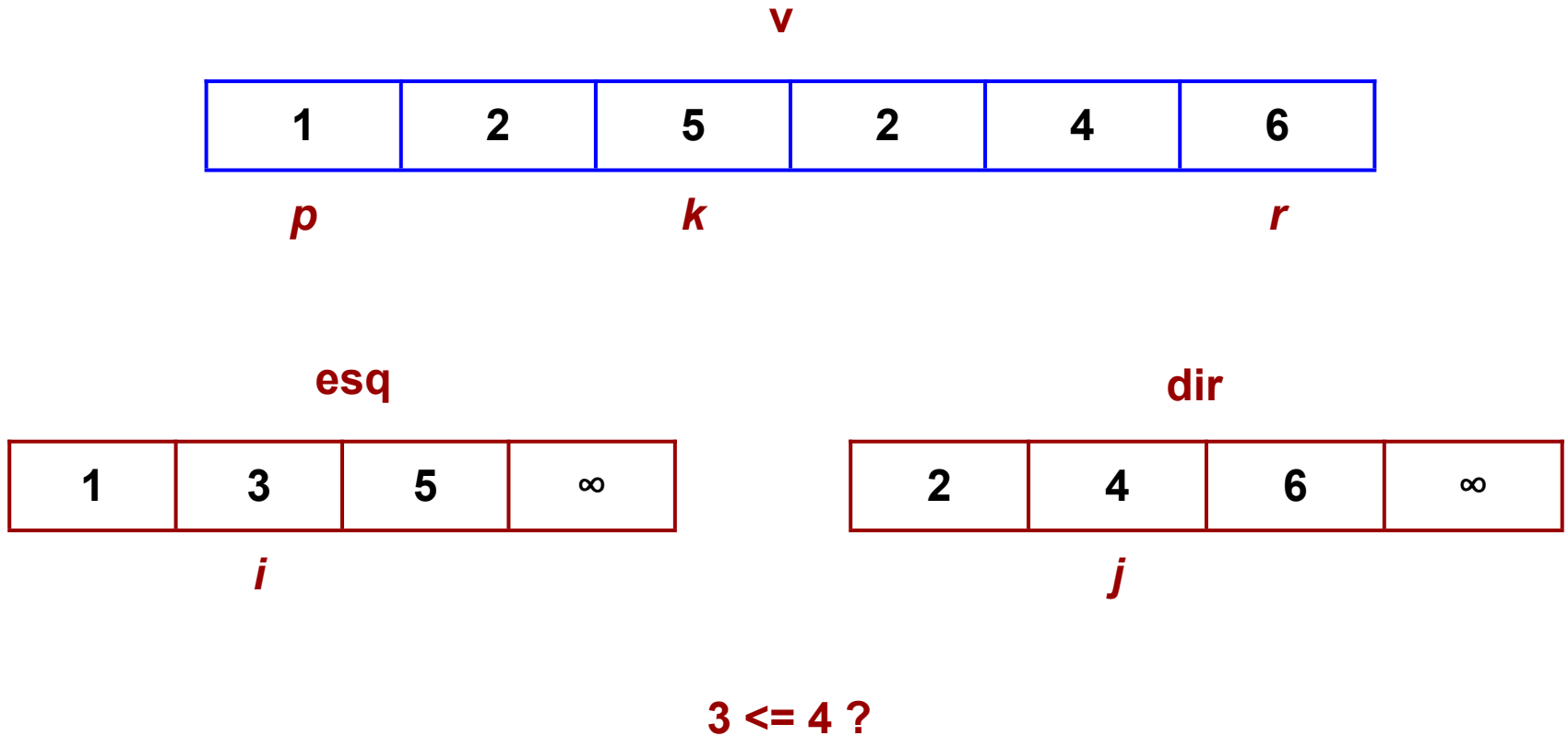
Coloca dir[j] em v[k]

Merge entre duas metades

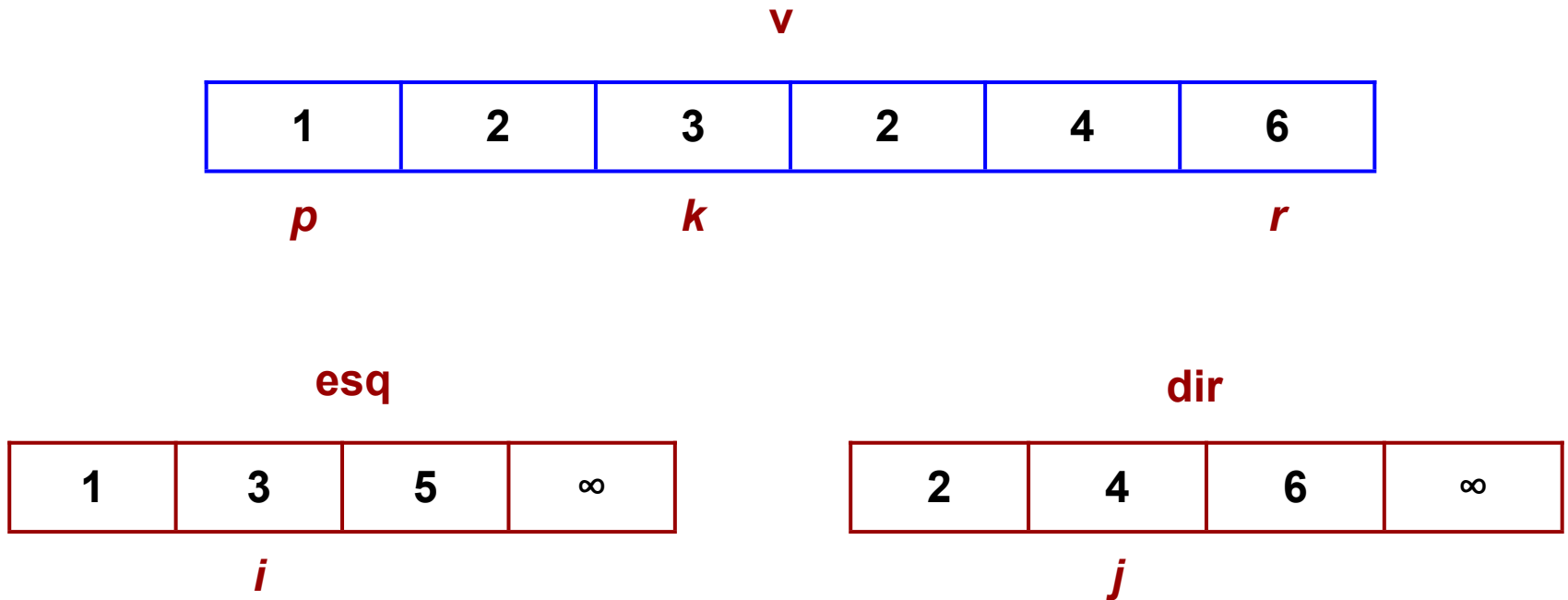


Incrementa j

Merge entre duas metades

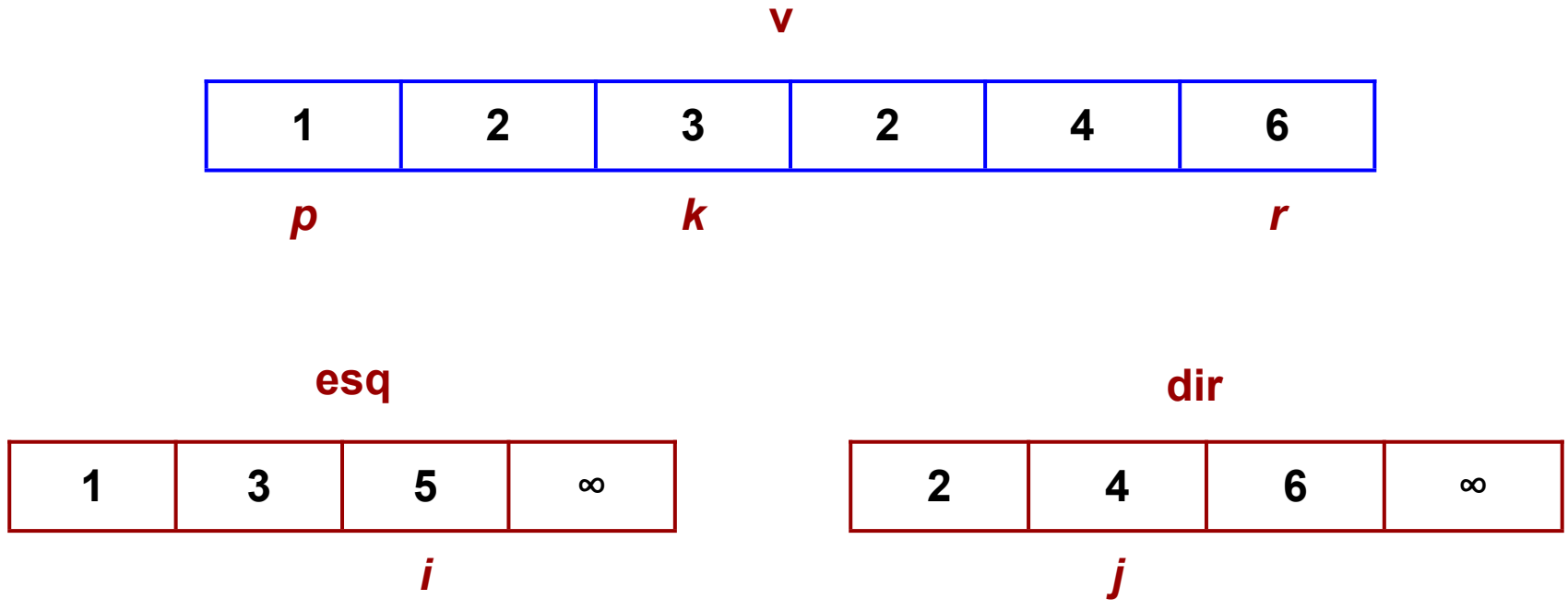


Merge entre duas metades



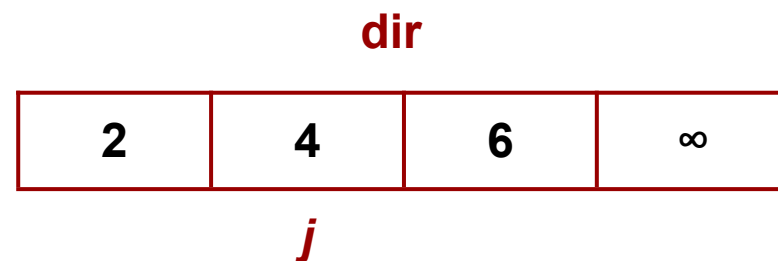
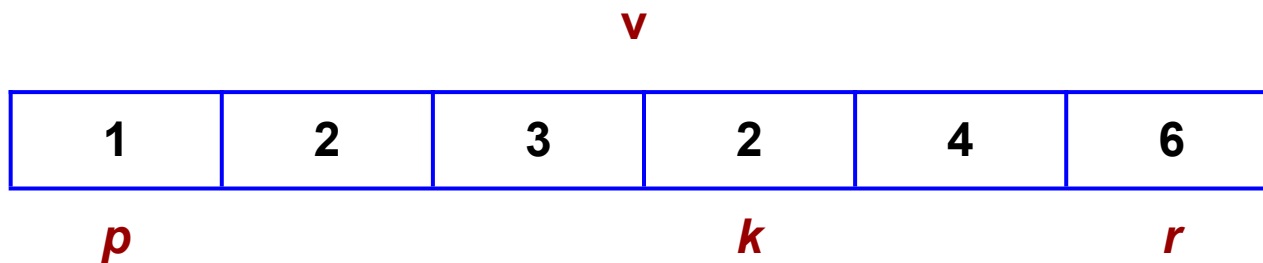
Coloca esq[i] em v[k]

Merge entre duas metades



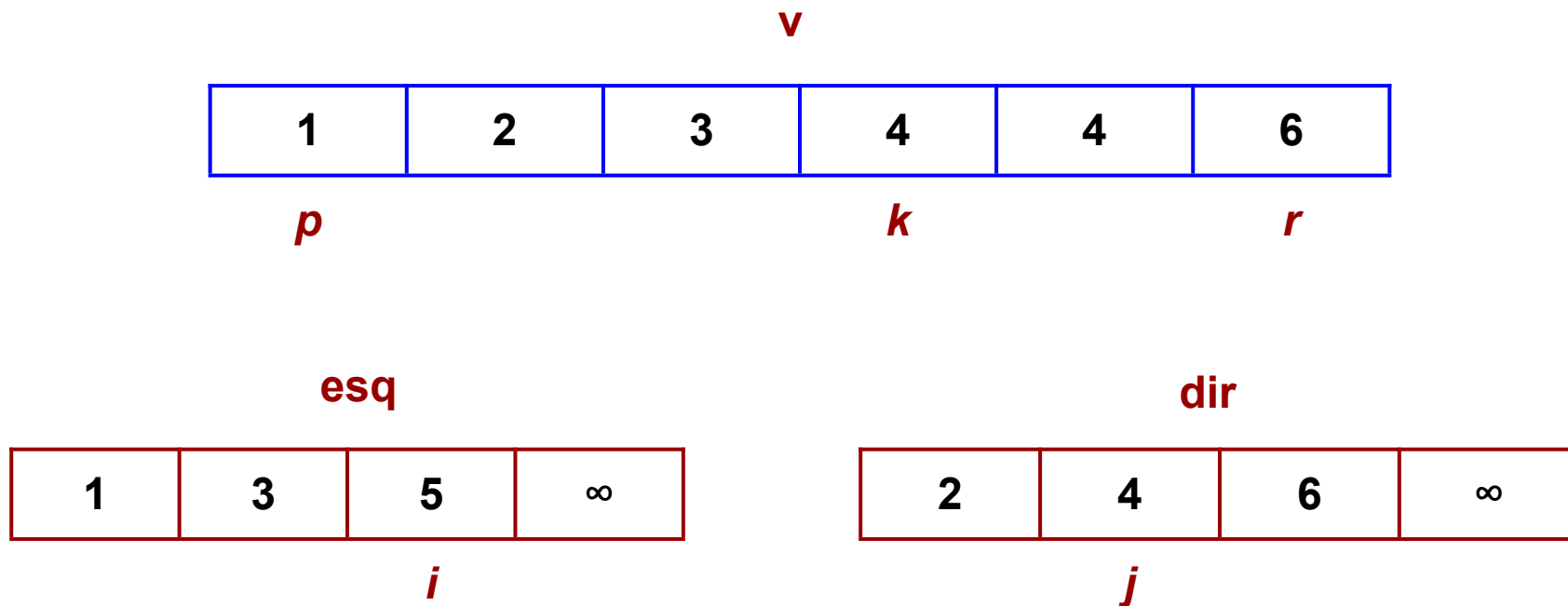
Incrementa i

Merge entre duas metades



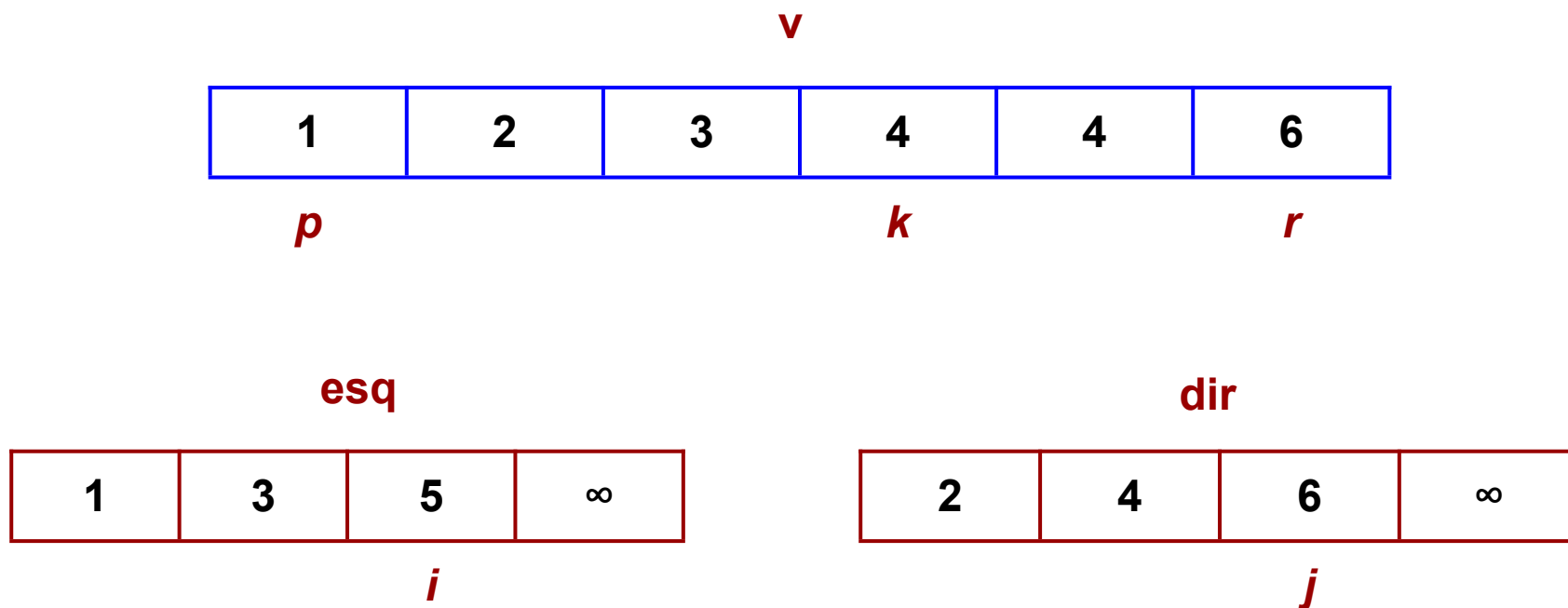
5 ≤ 4 ?

Merge entre duas metades



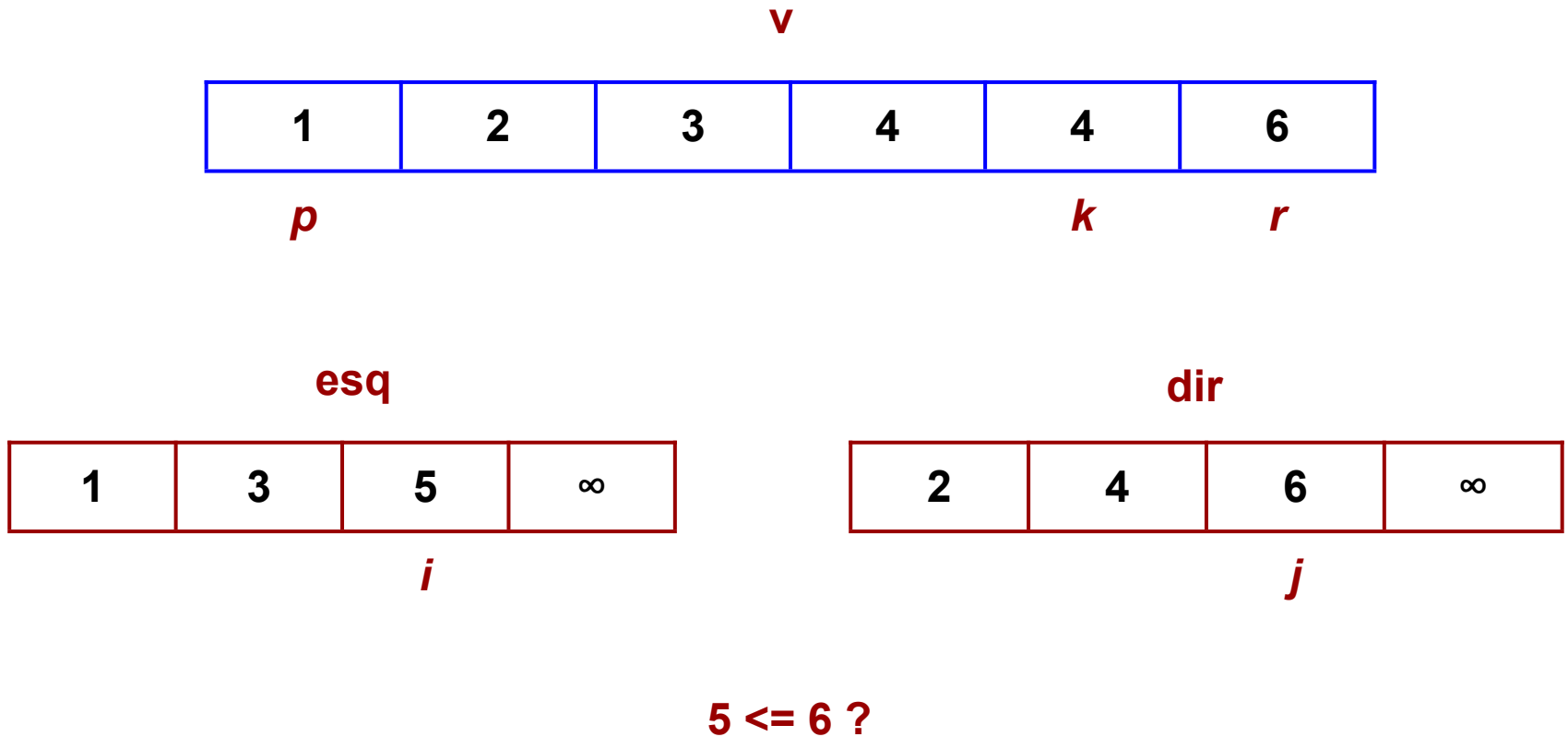
Coloca dir[j] em v[k]

Merge entre duas metades

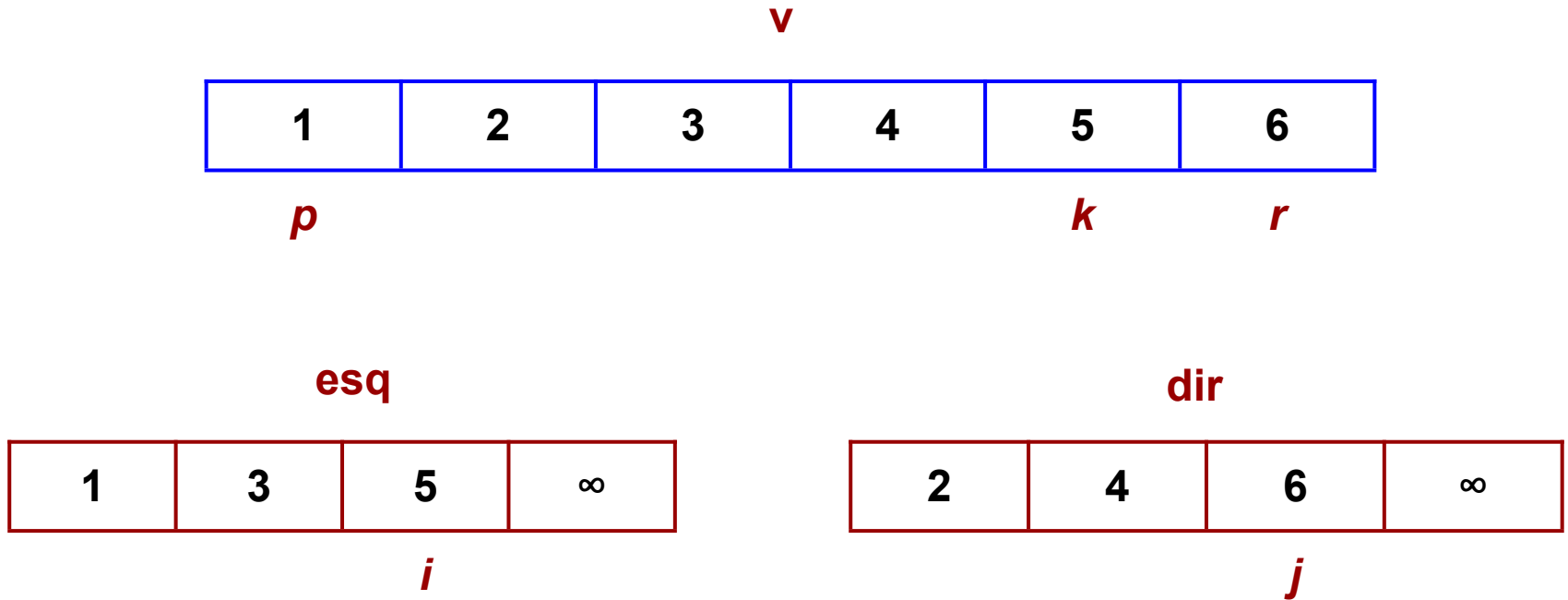


Incrementa j

Merge entre duas metades

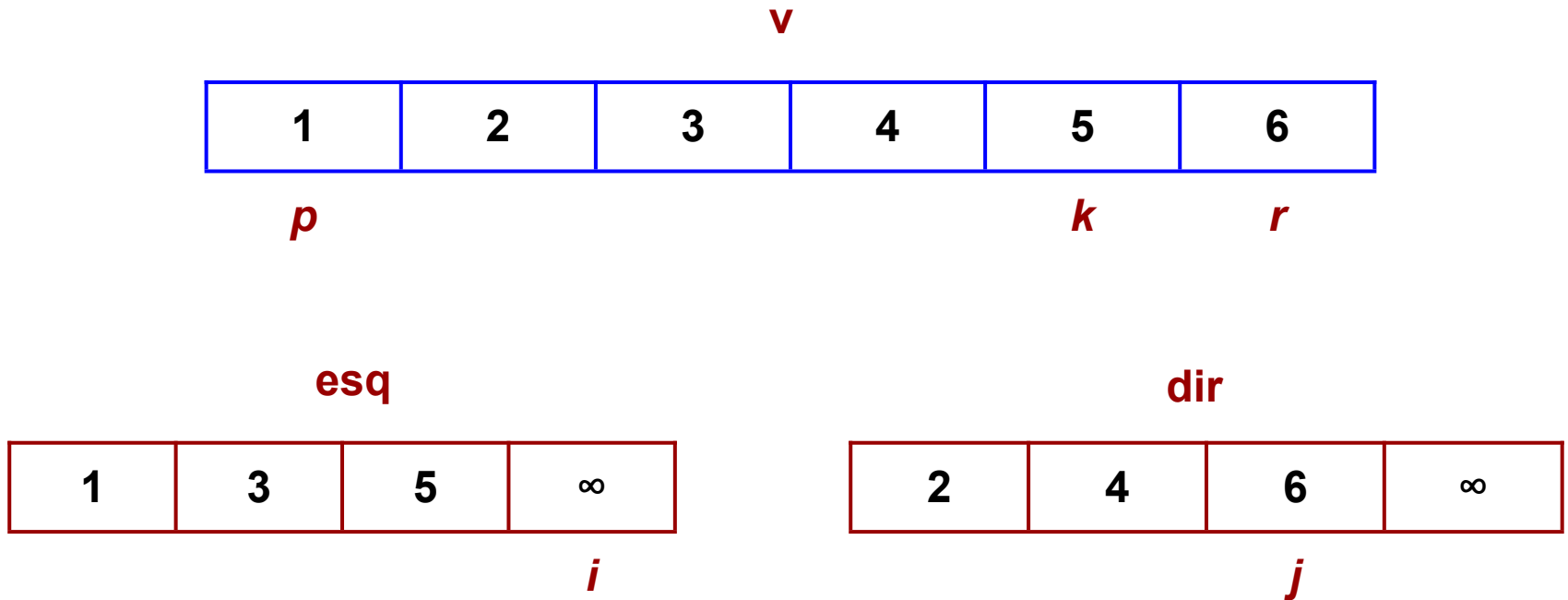


Merge entre duas metades



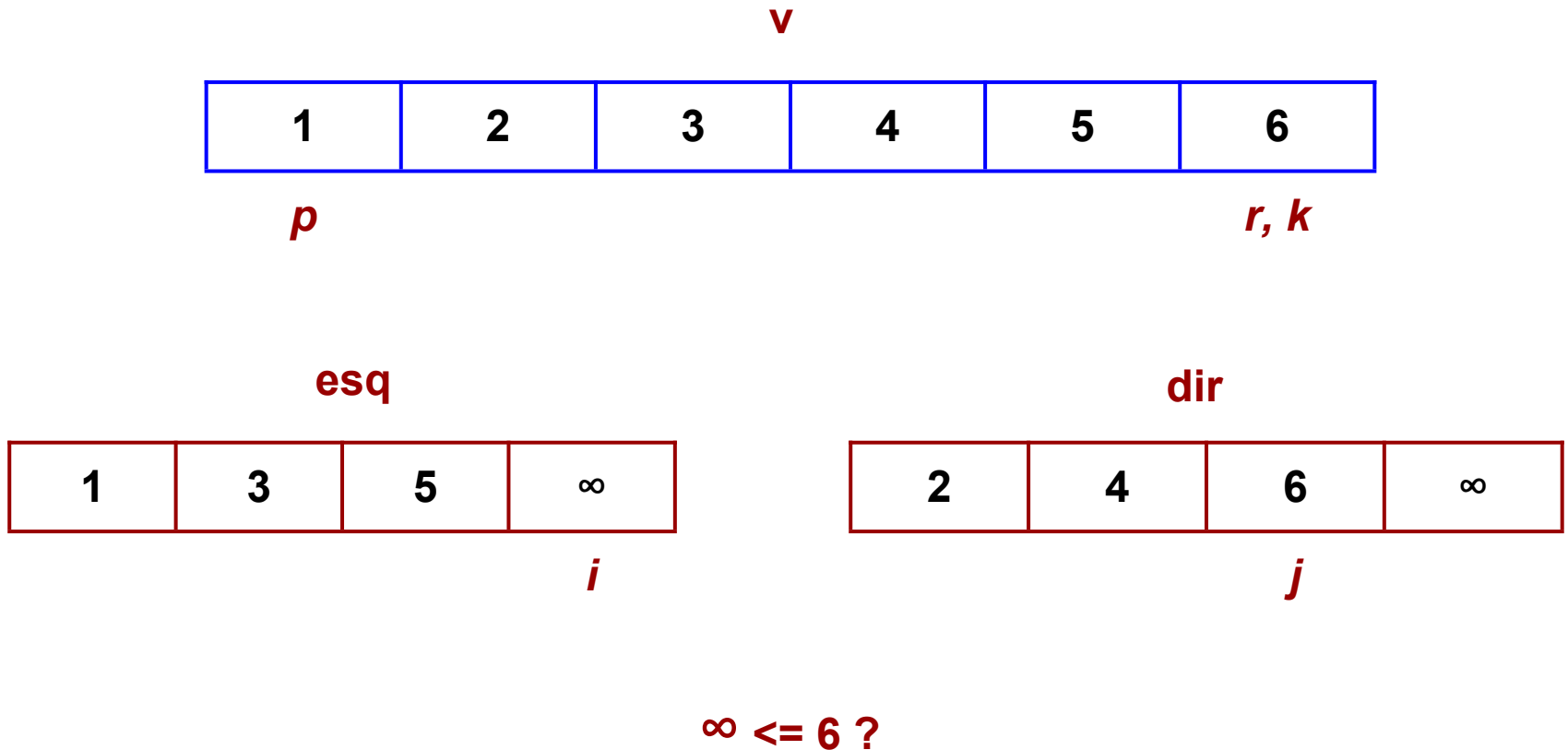
Coloca esq[i] em v[k]

Merge entre duas metades

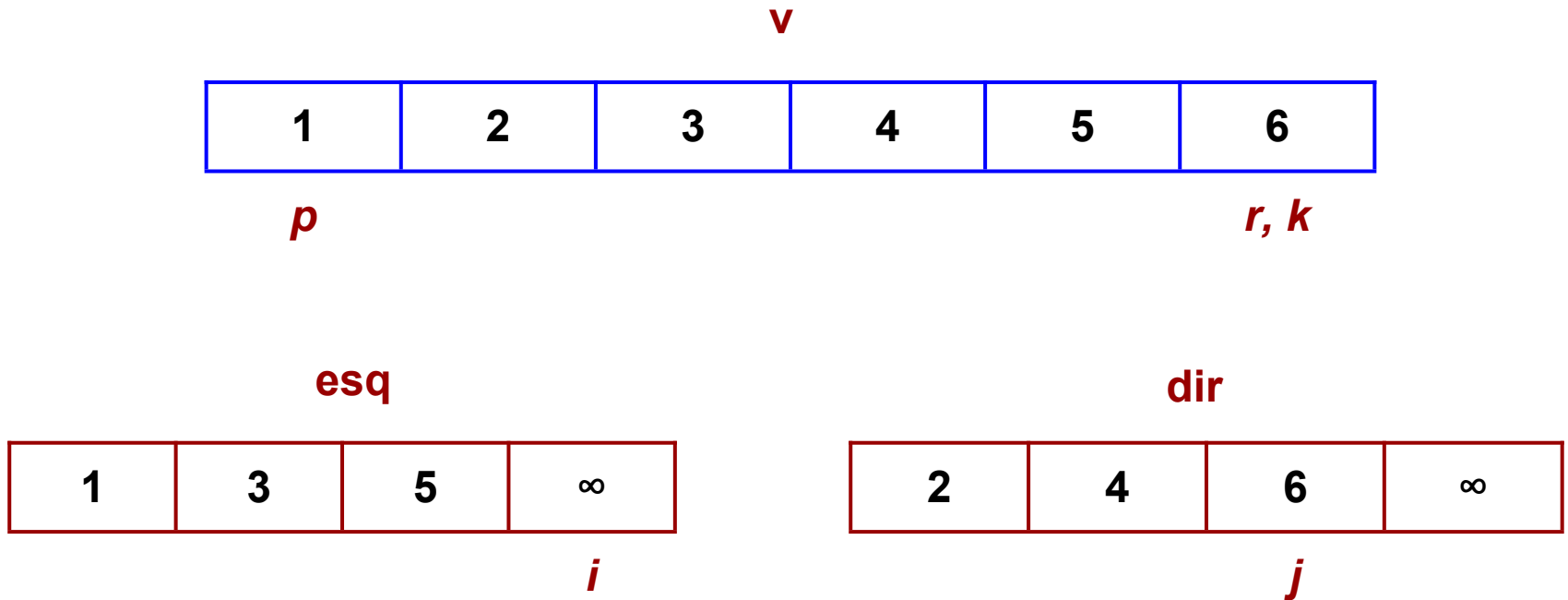


Incrementa i

Merge entre duas metades

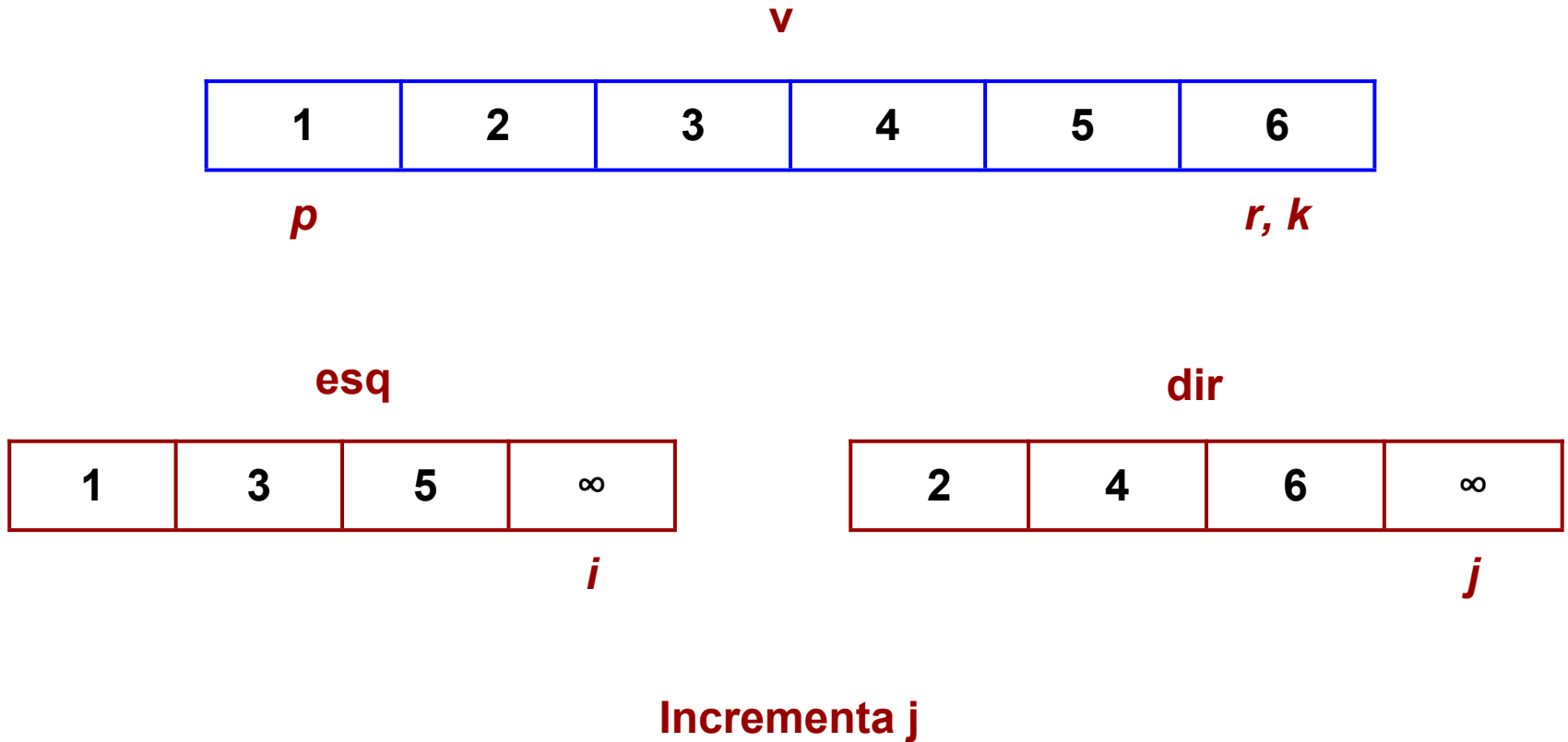


Merge entre duas metades

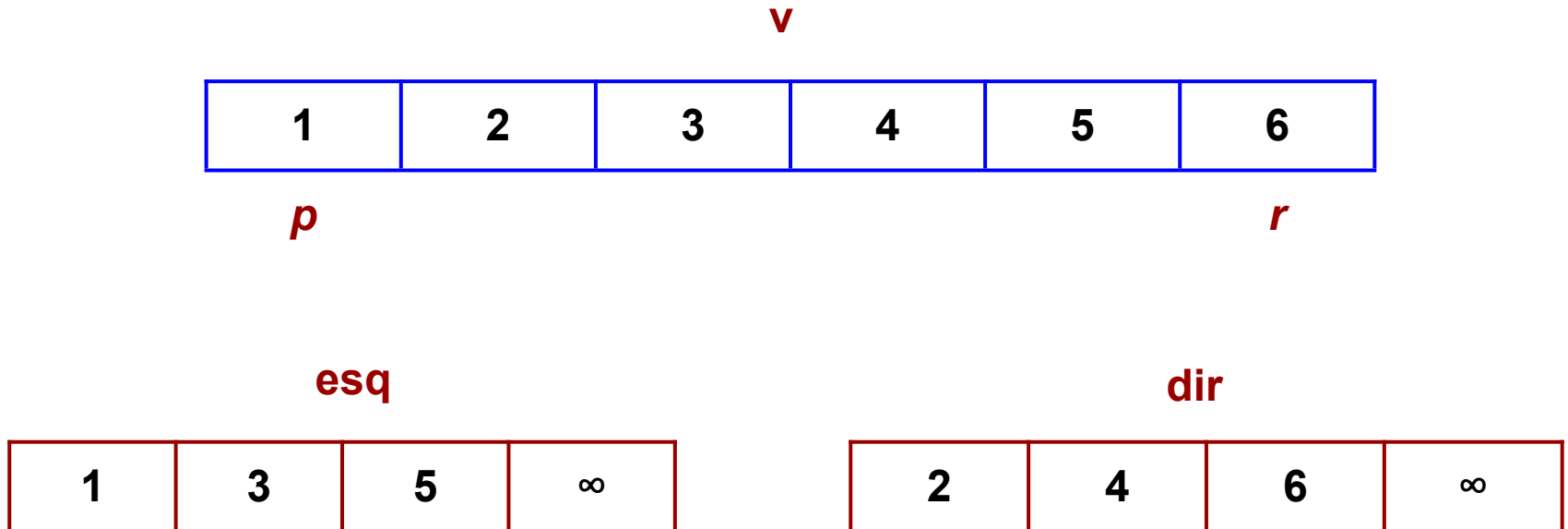


Coloca dir[j] em v[k]

Merge entre duas metades



Merge entre duas metades



Fim do merge

Implementação em sala



Características

- ▷ Algoritmo do tipo dividir para conquistar;
- ▷ Bom desempenho;
- ▷ Não é In place
 - Requer espaço extra;
- ▷ Stable;
- ▷ Muito usado na prática;