Segmenttipuista

DT-valmennusleiri, maaliskuu 2017

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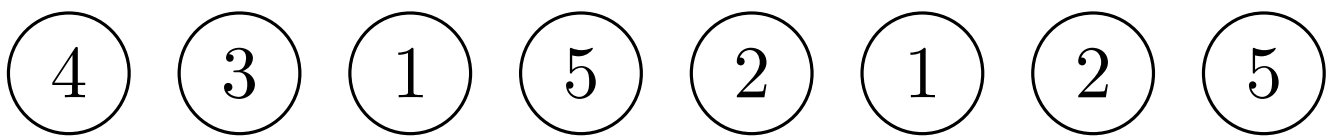

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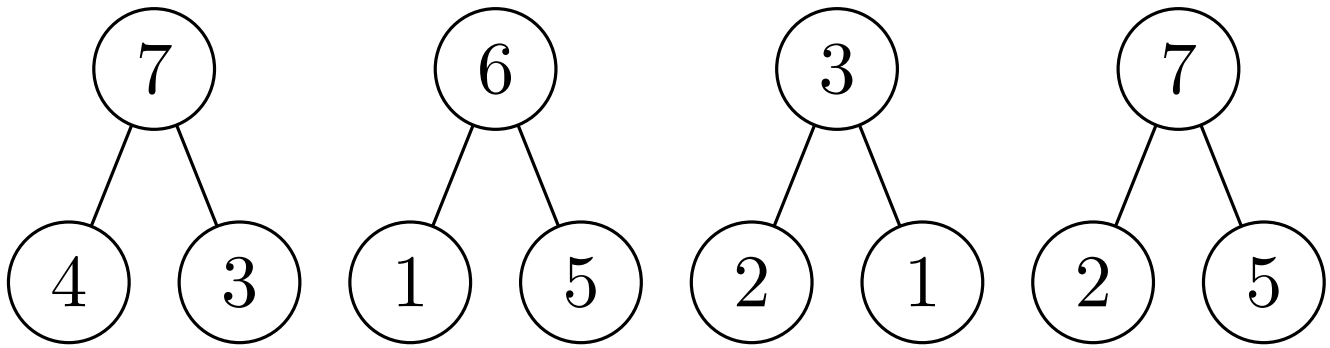

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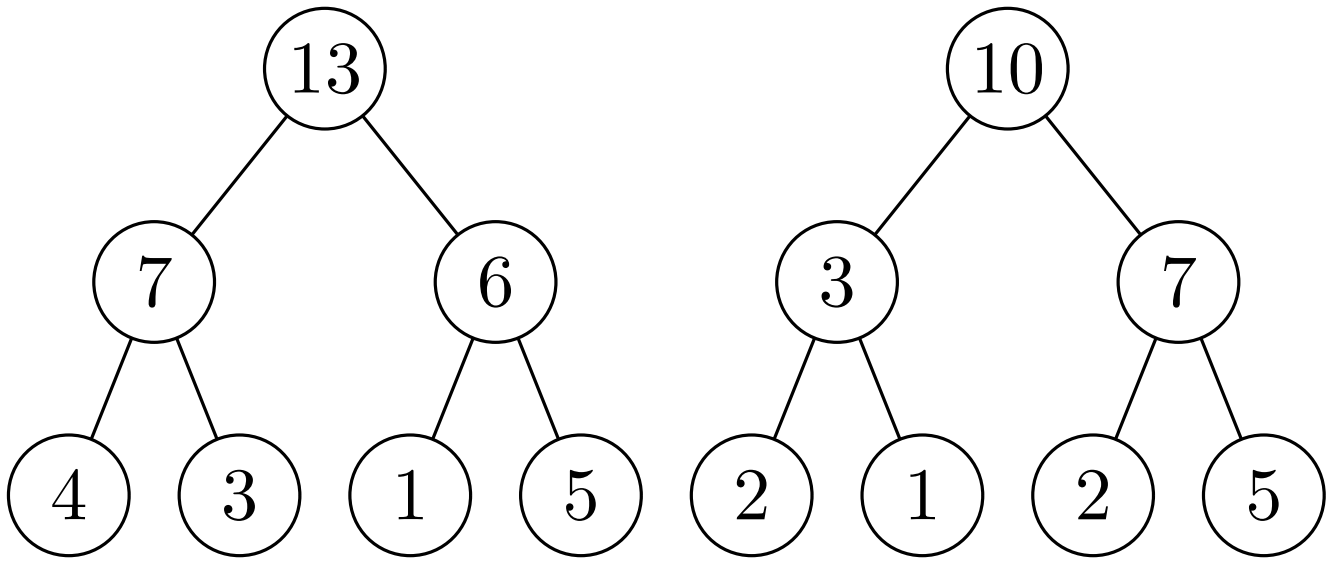

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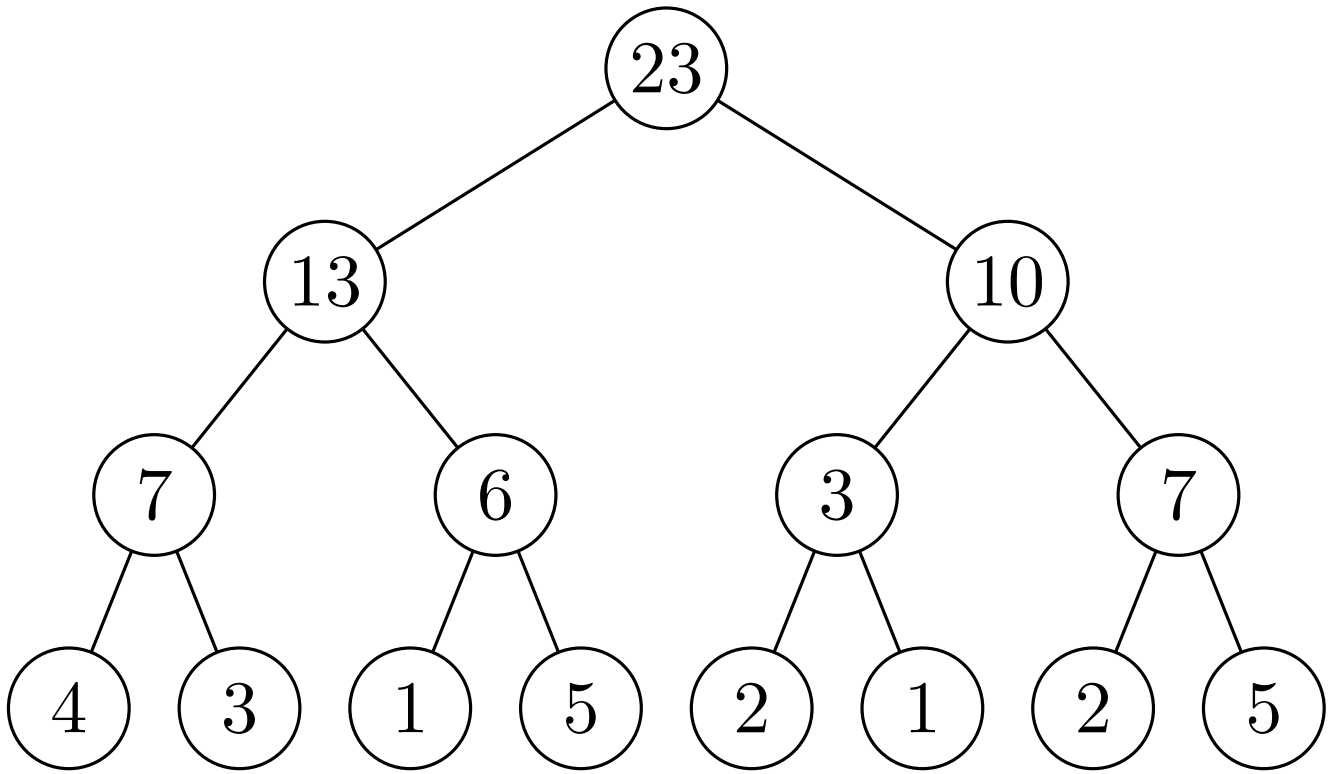

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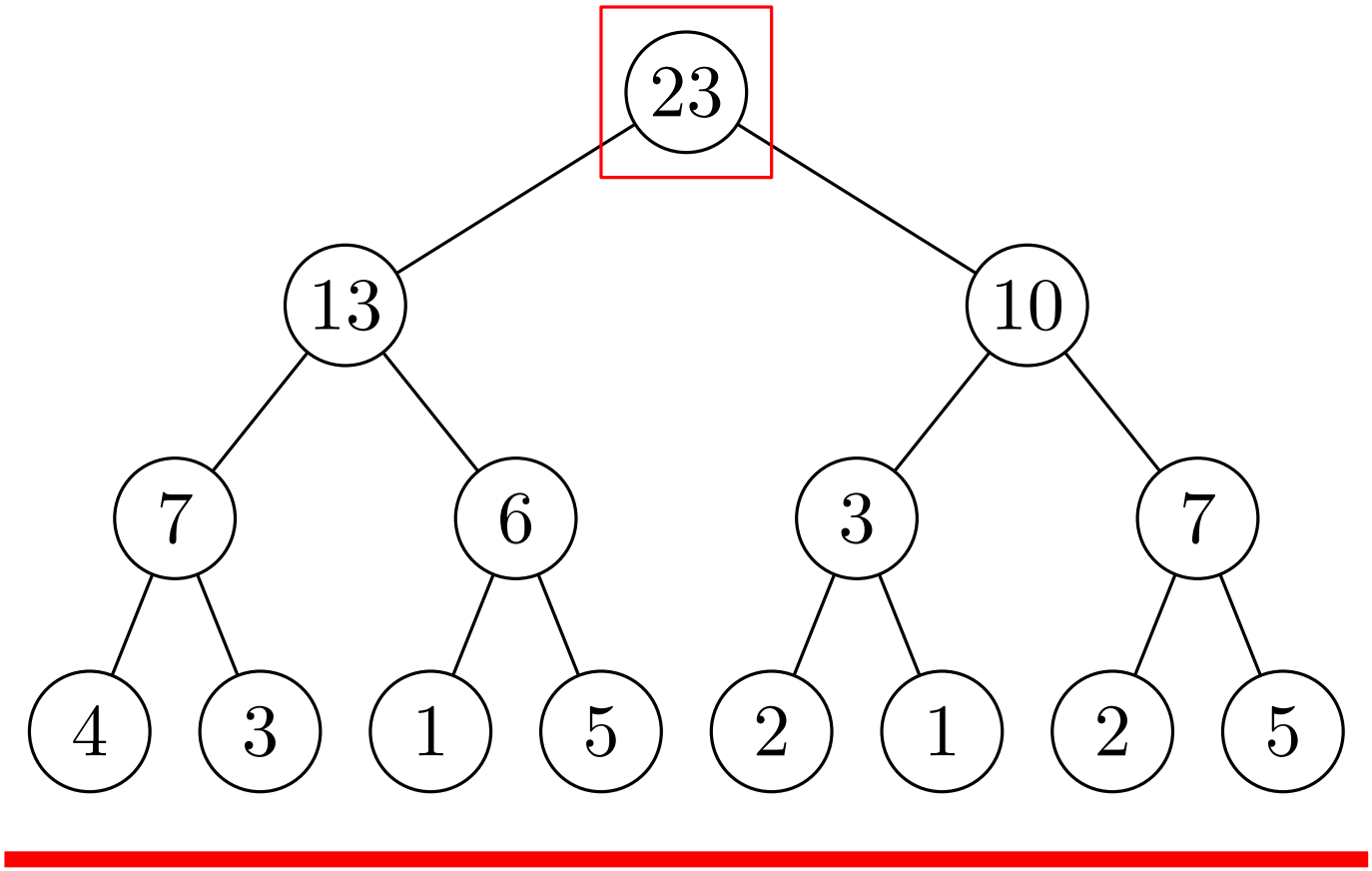

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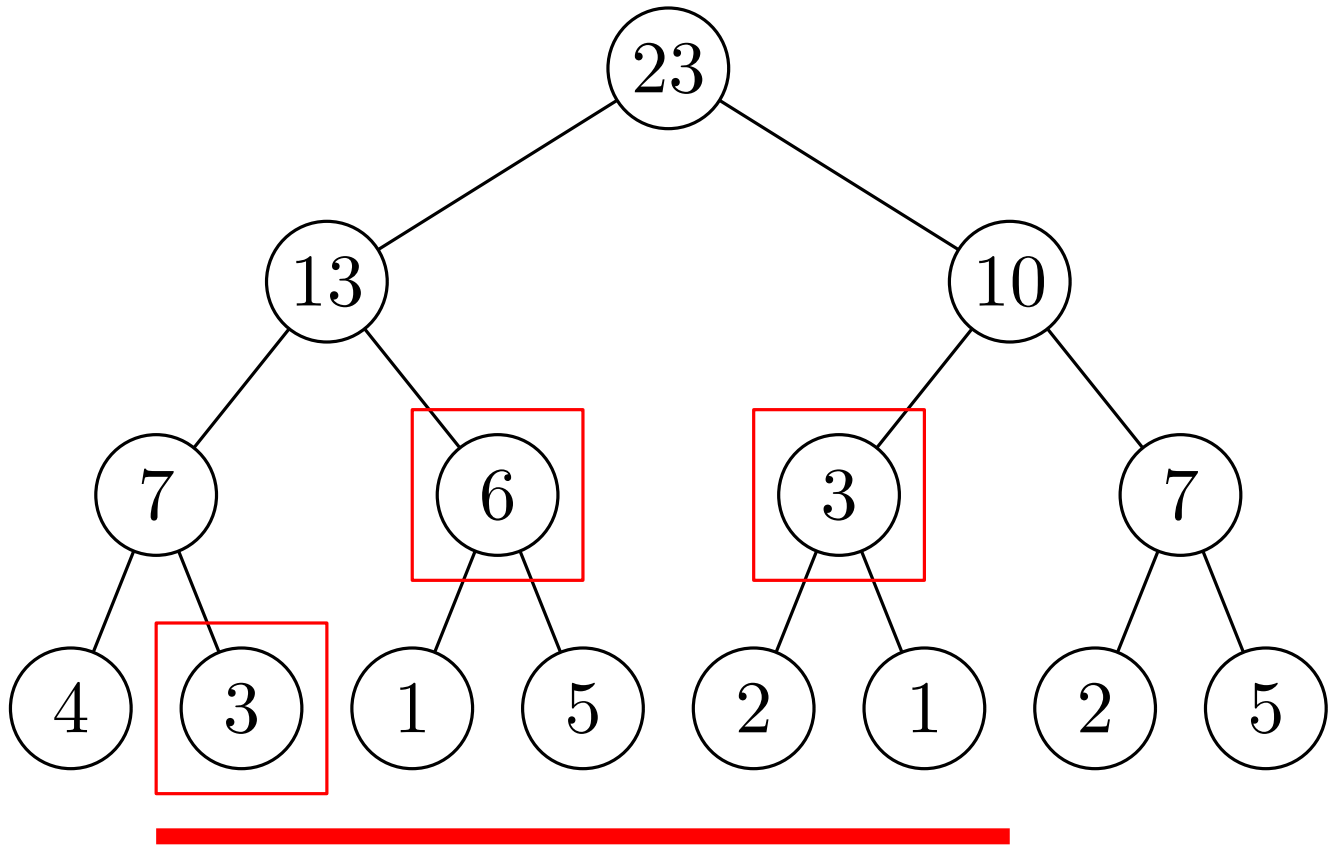

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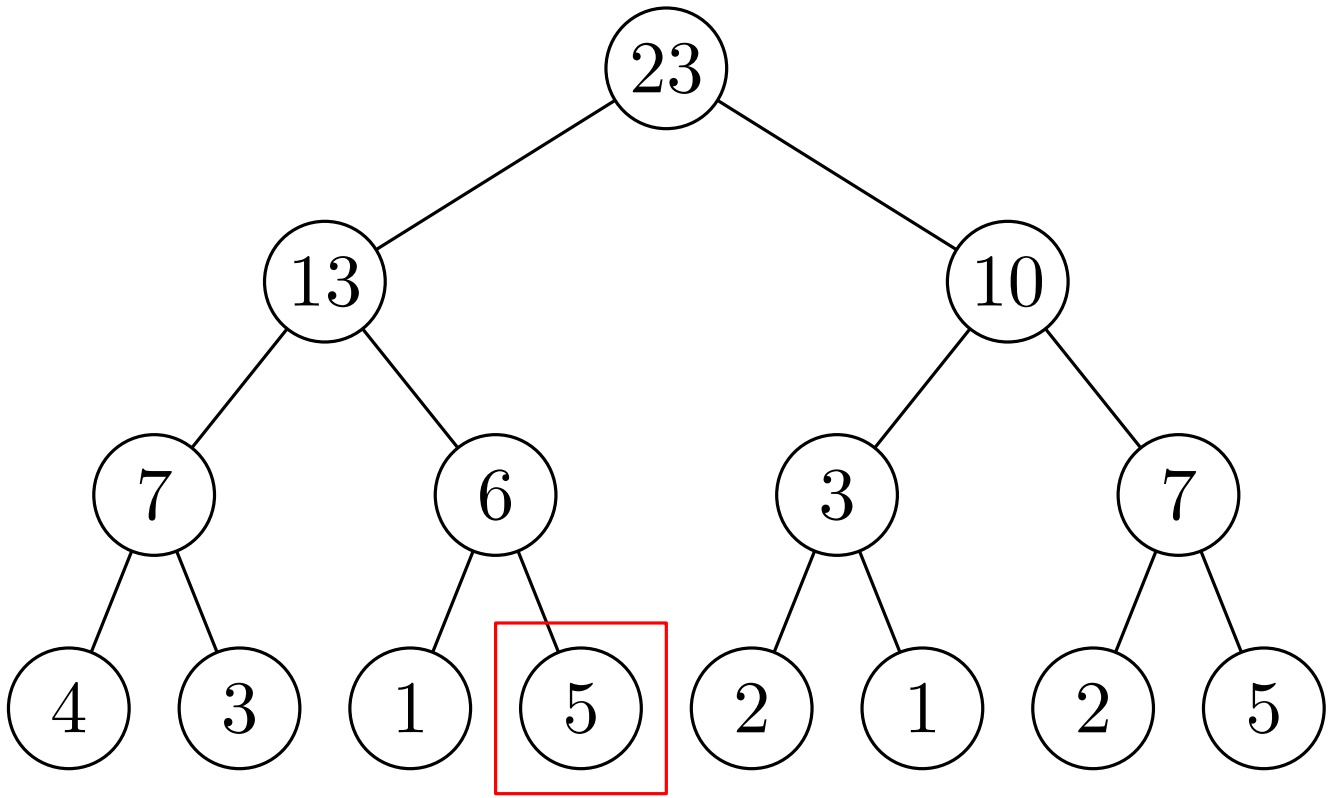

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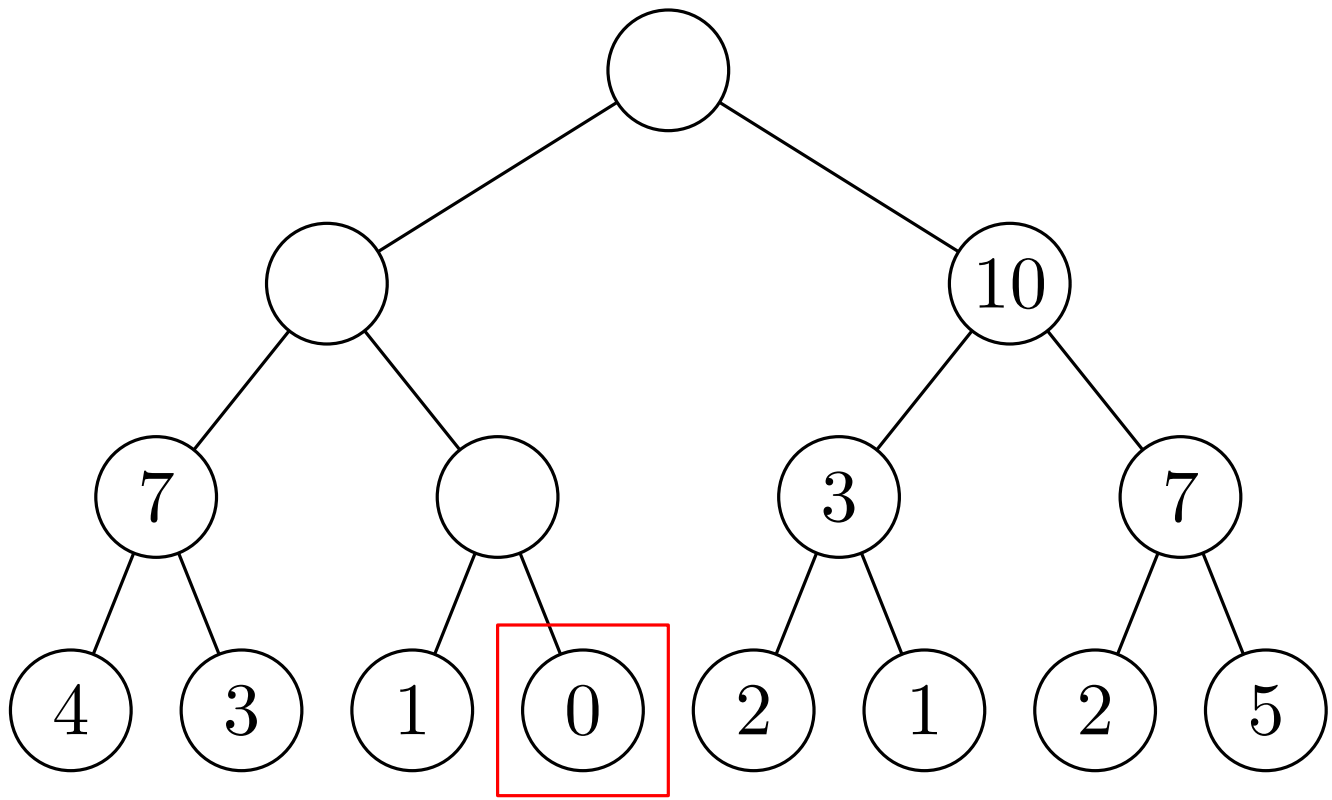

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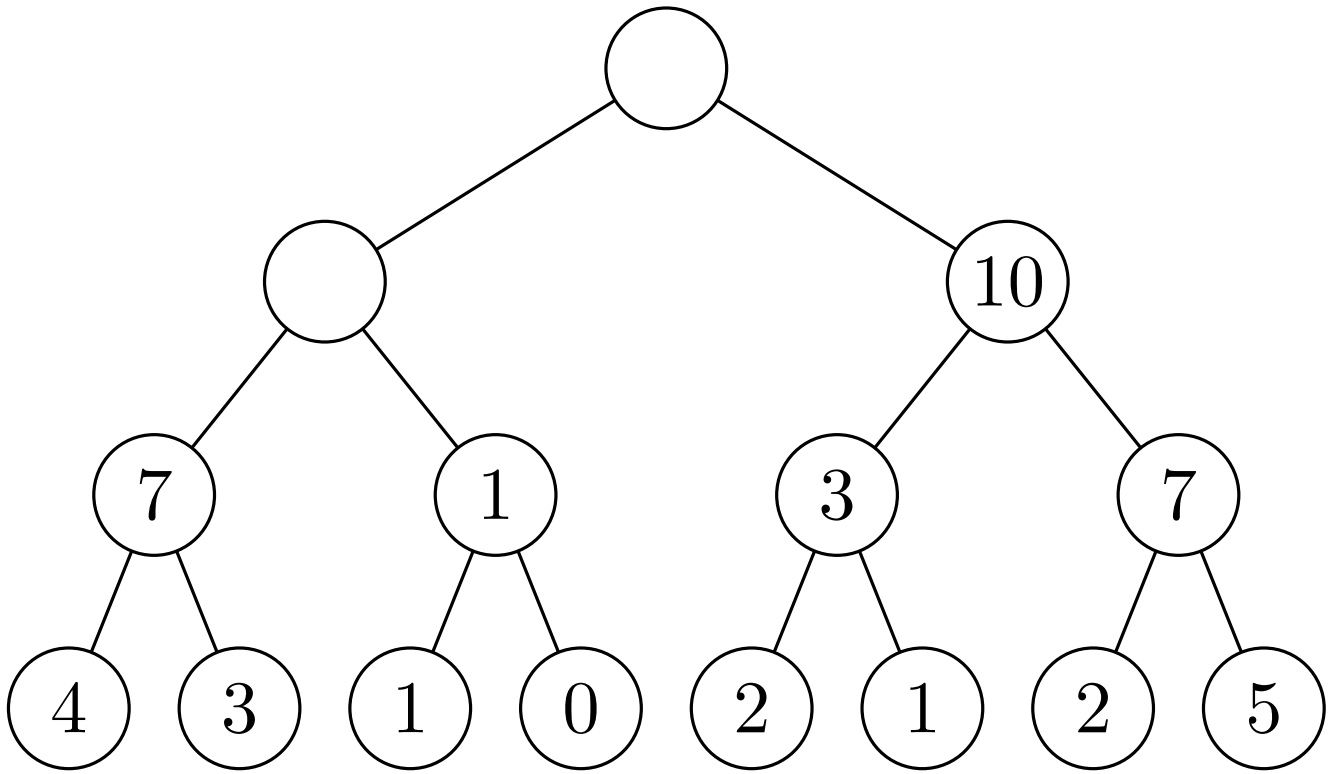

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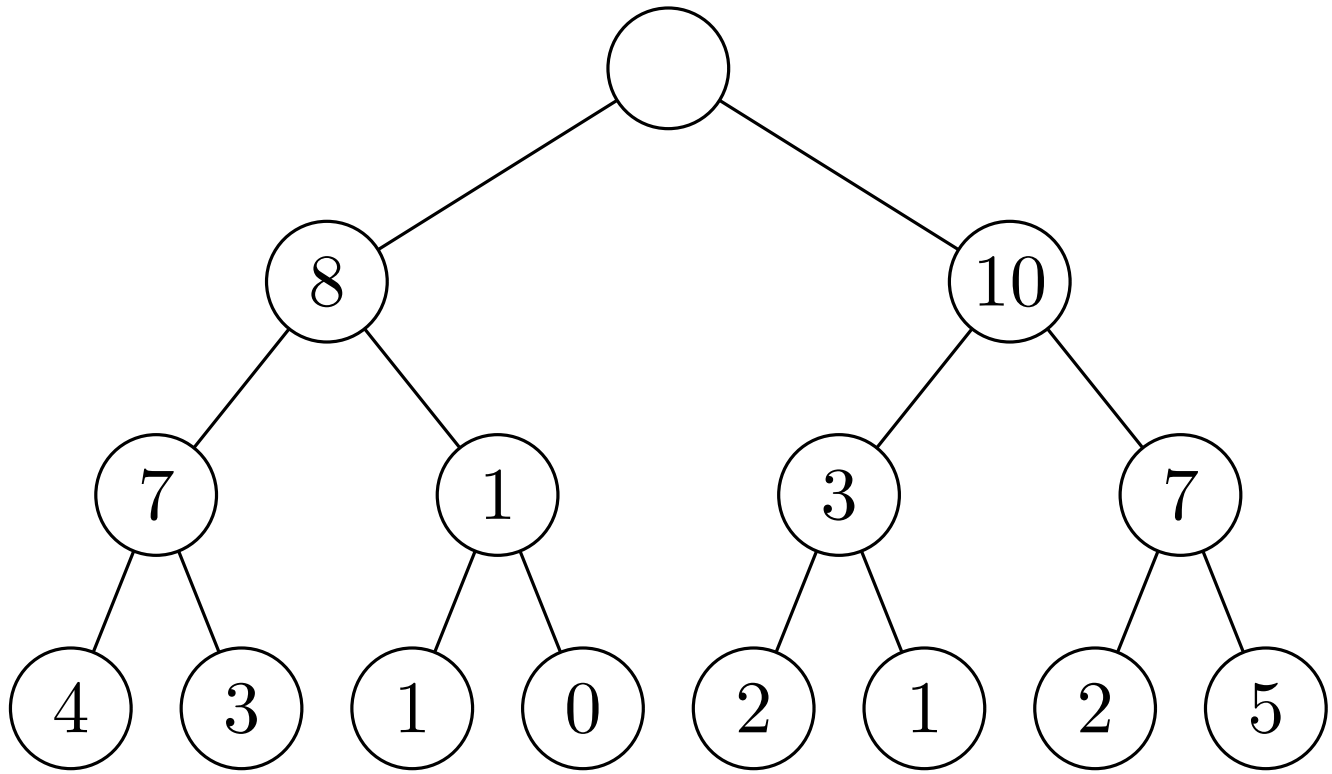

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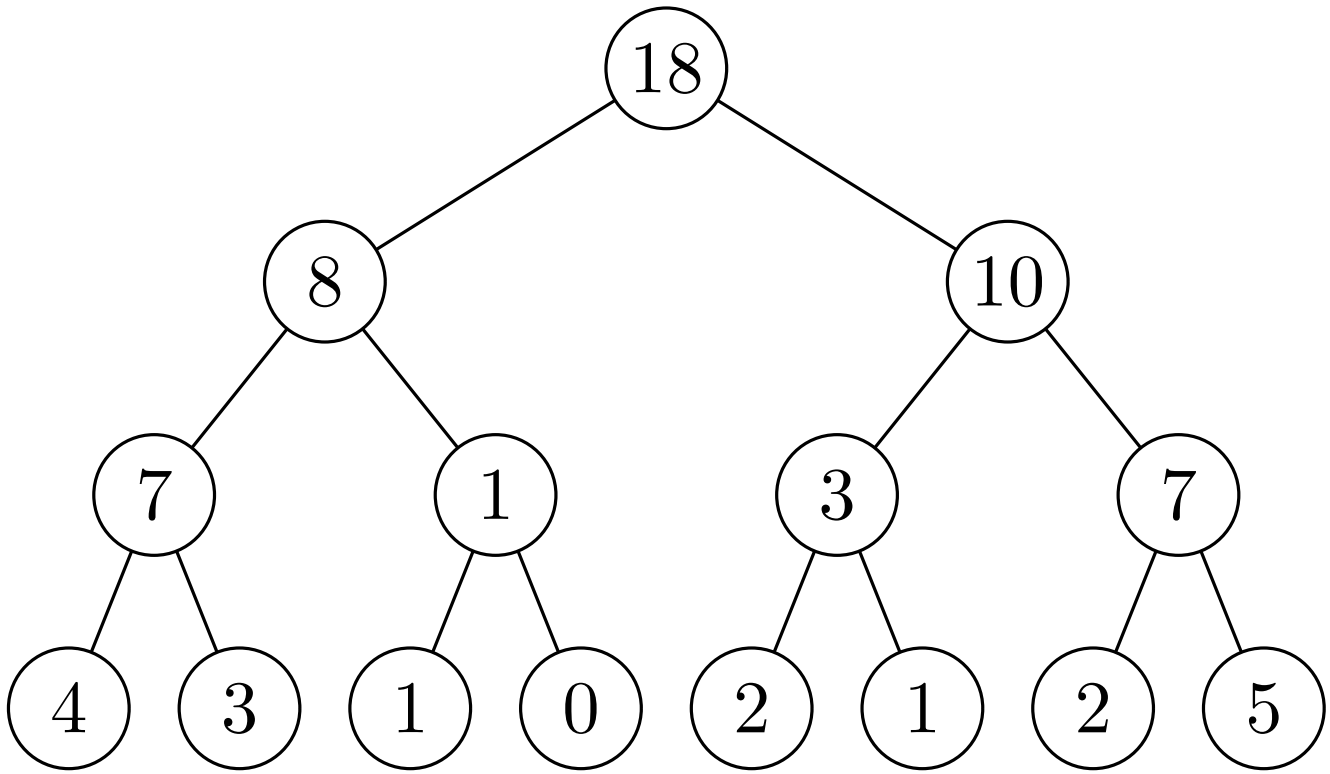

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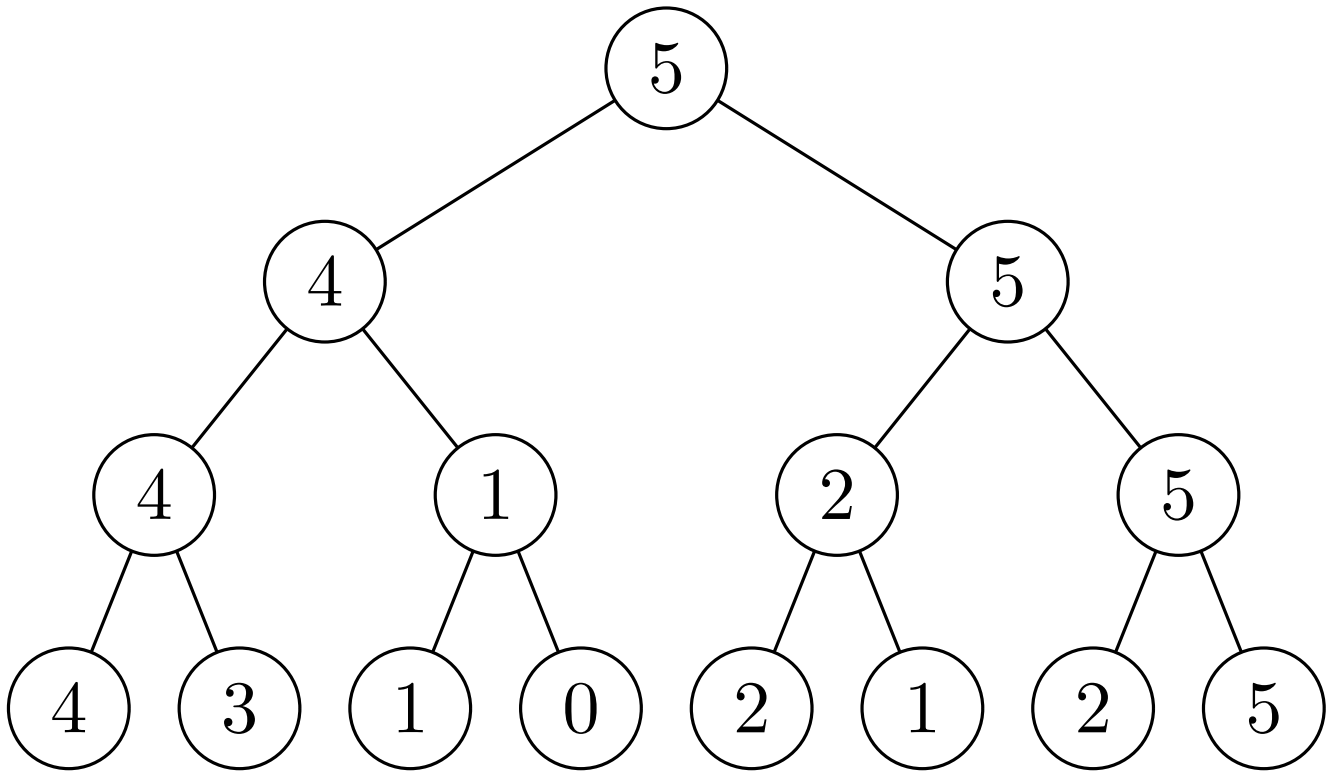

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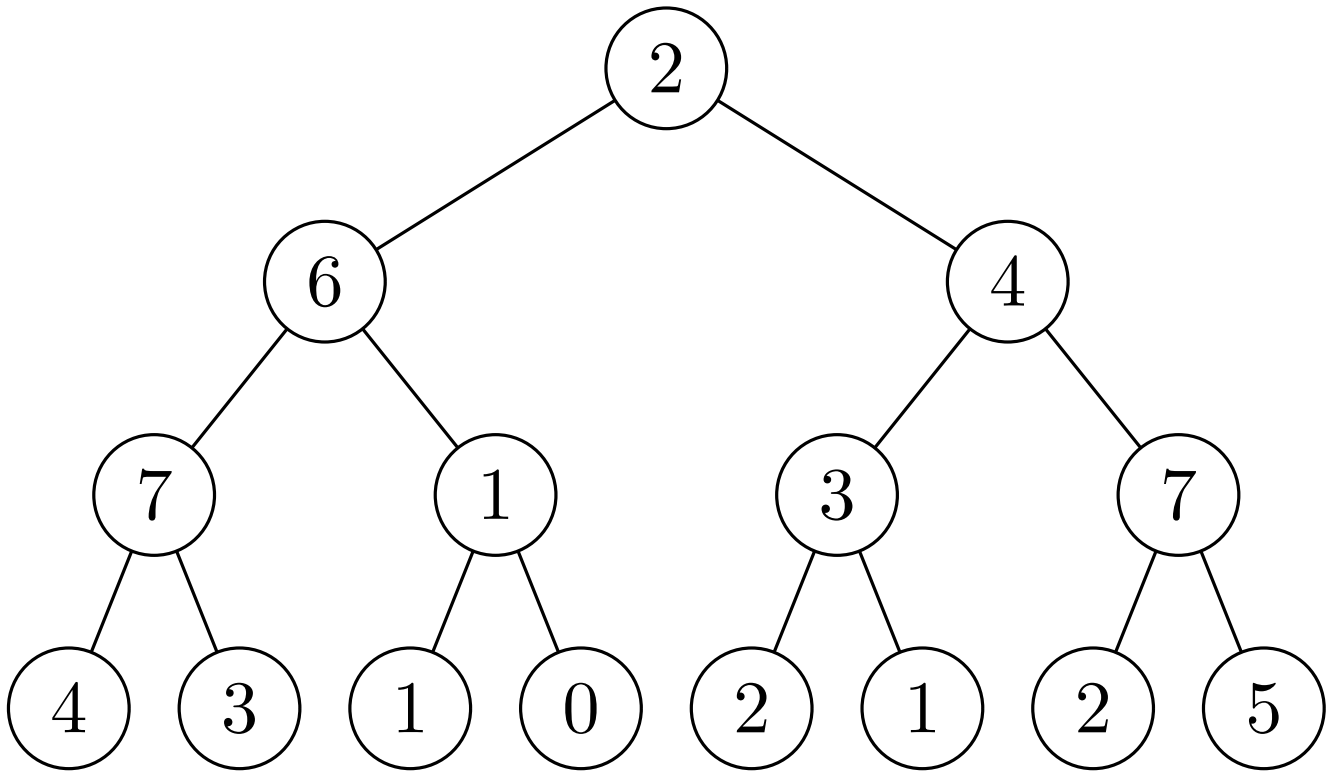

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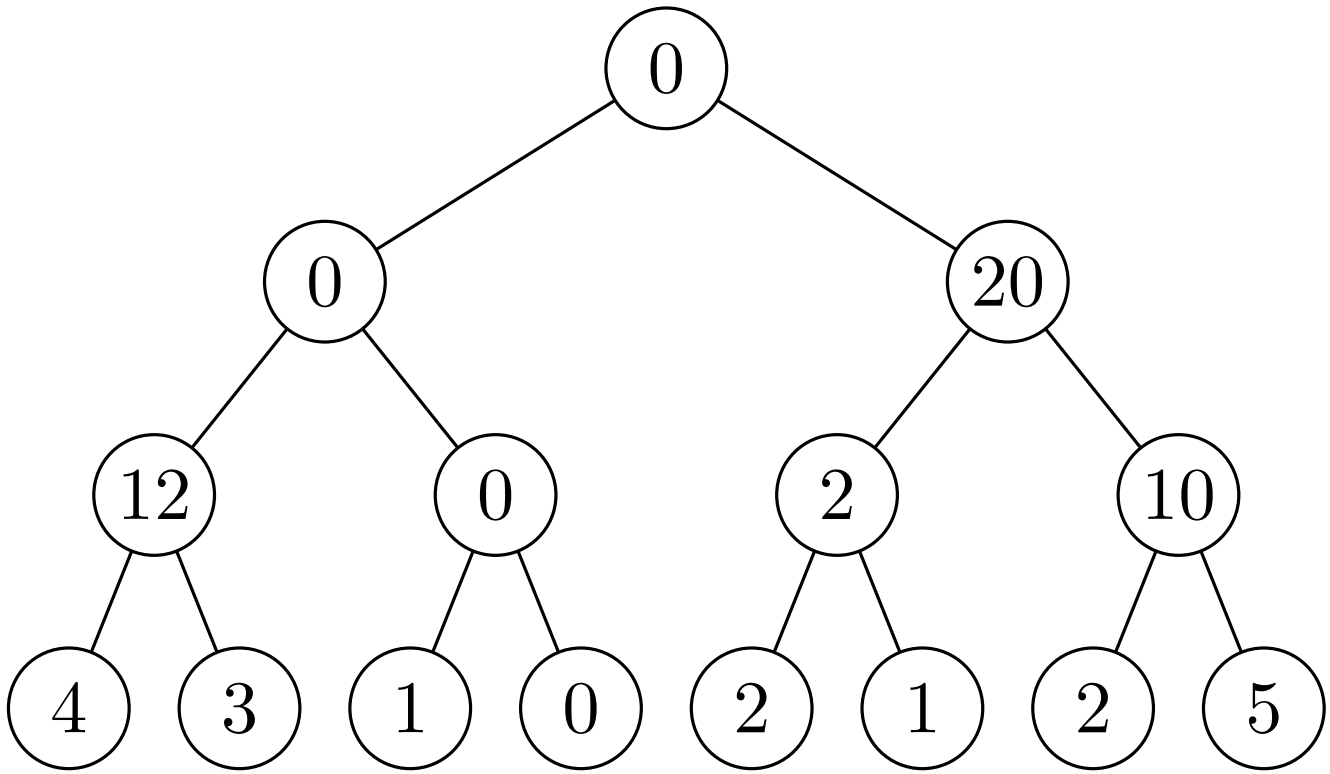
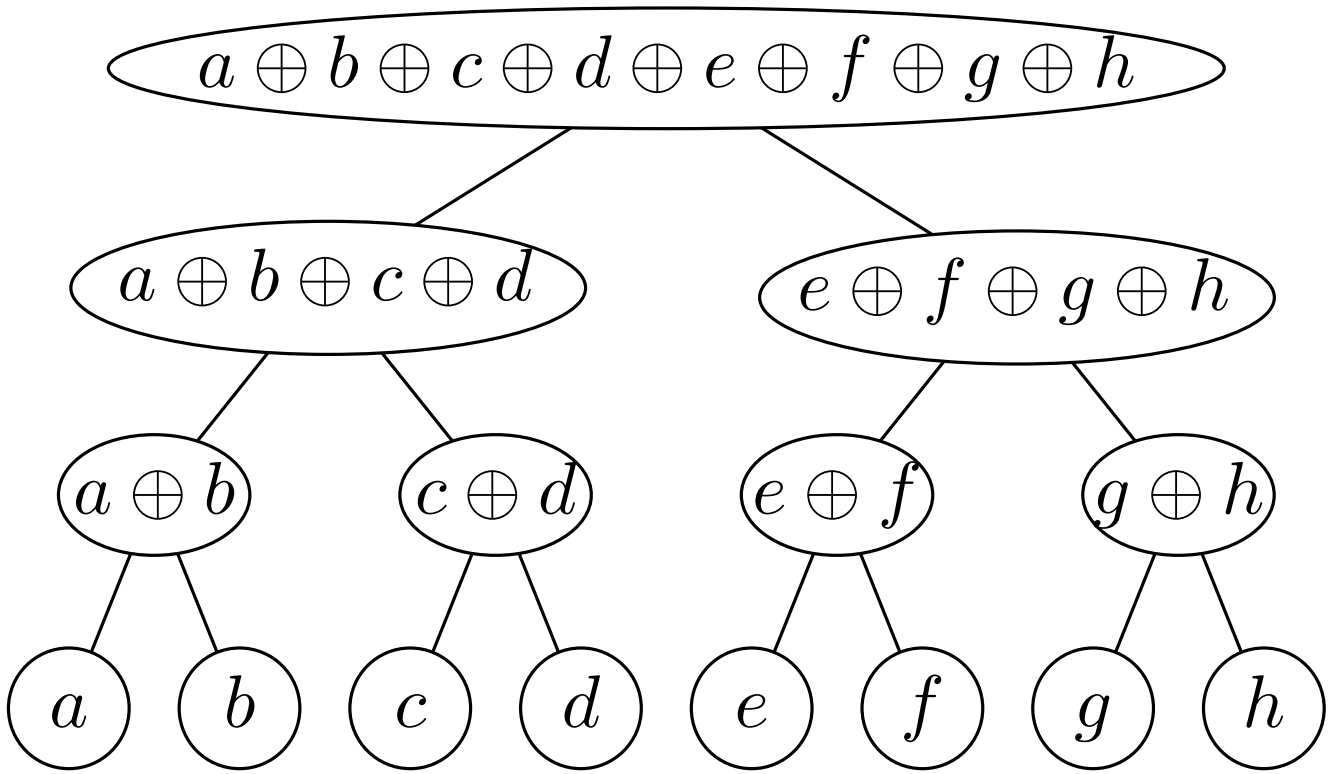


Välikyselysegmenttipuu: ???



Välikyselysegmenttipuu: pisin musta ketju

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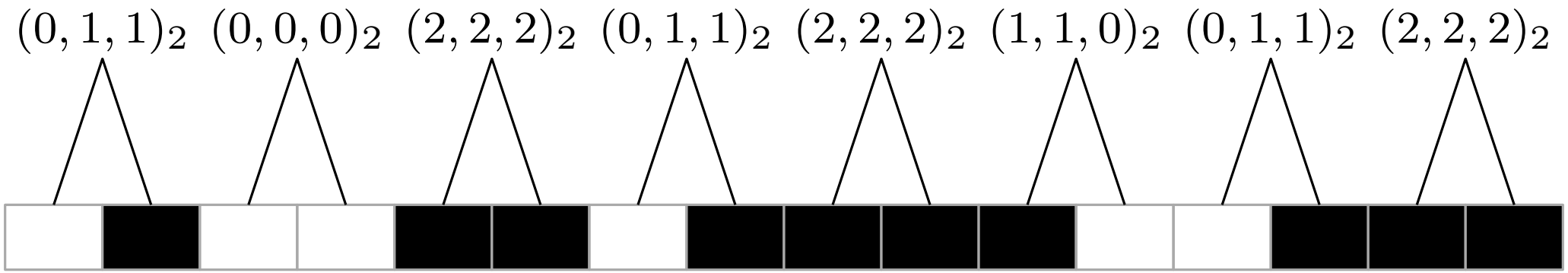

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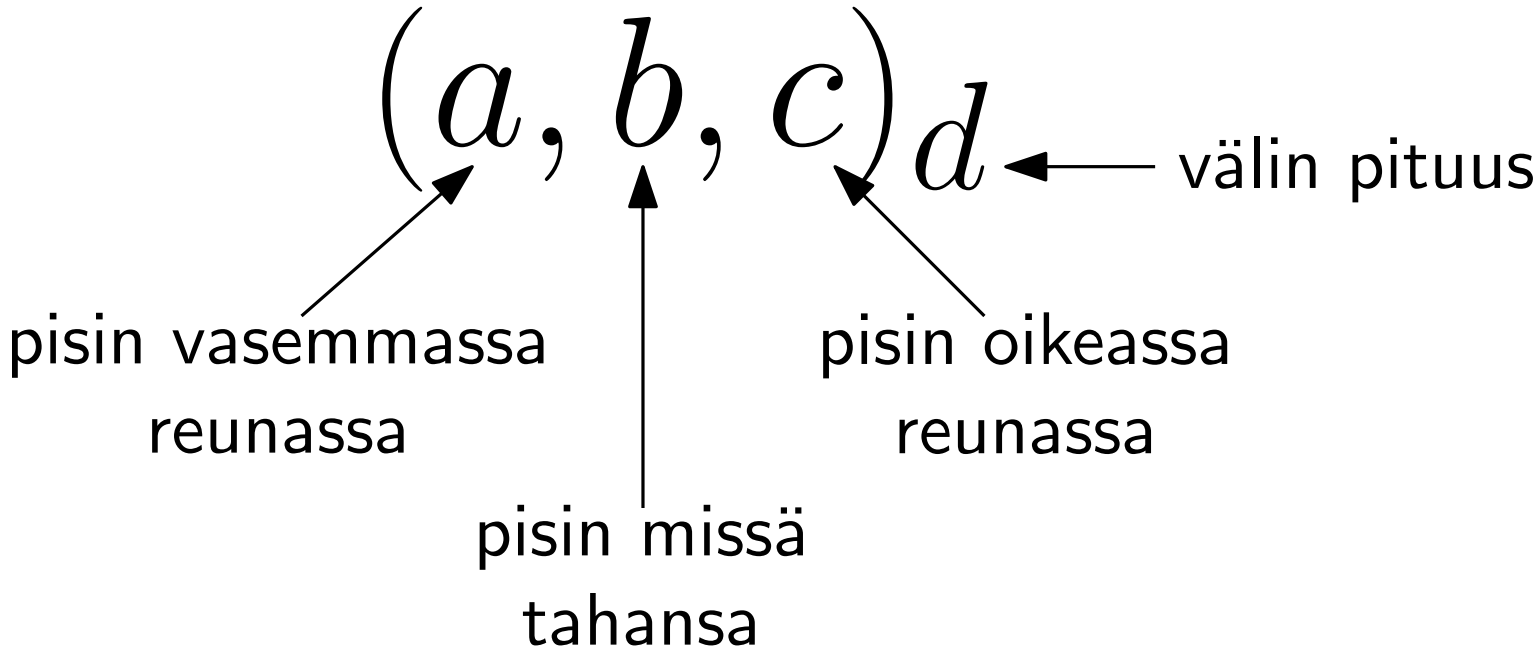

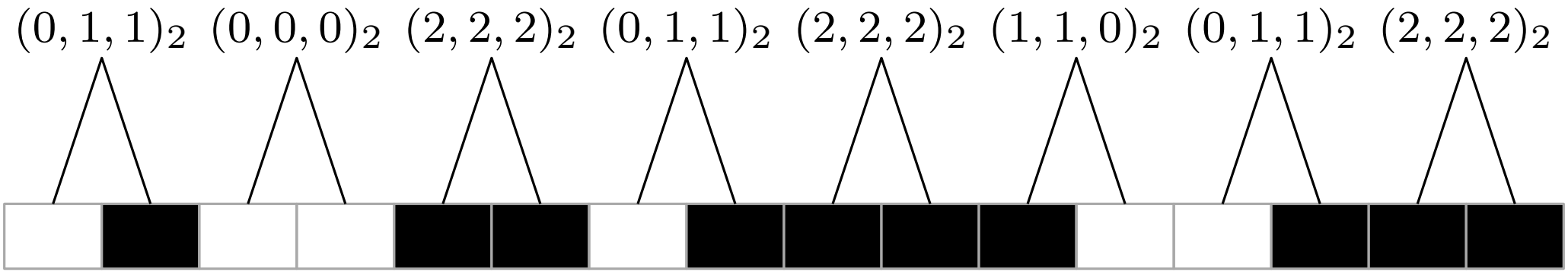

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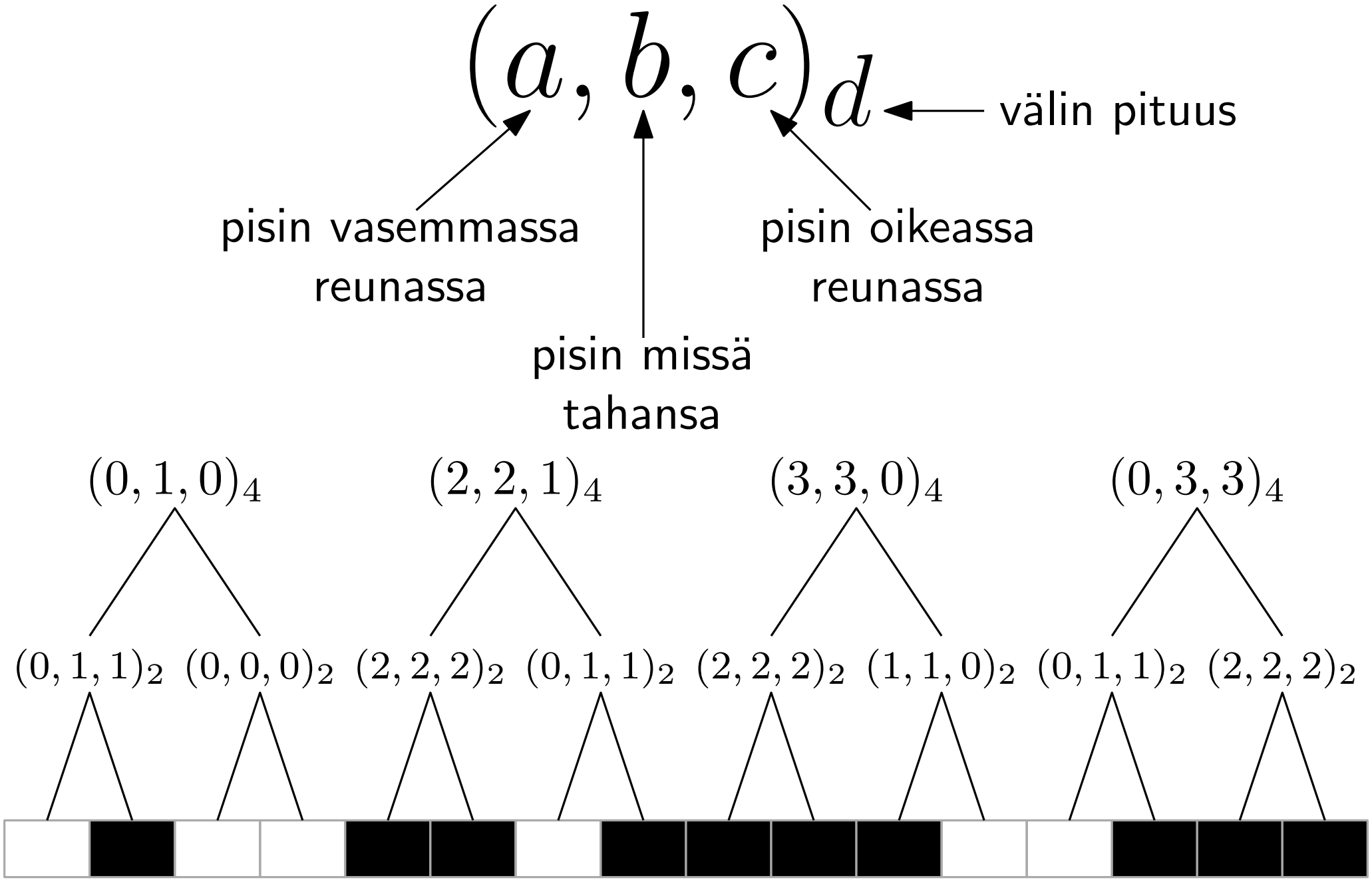

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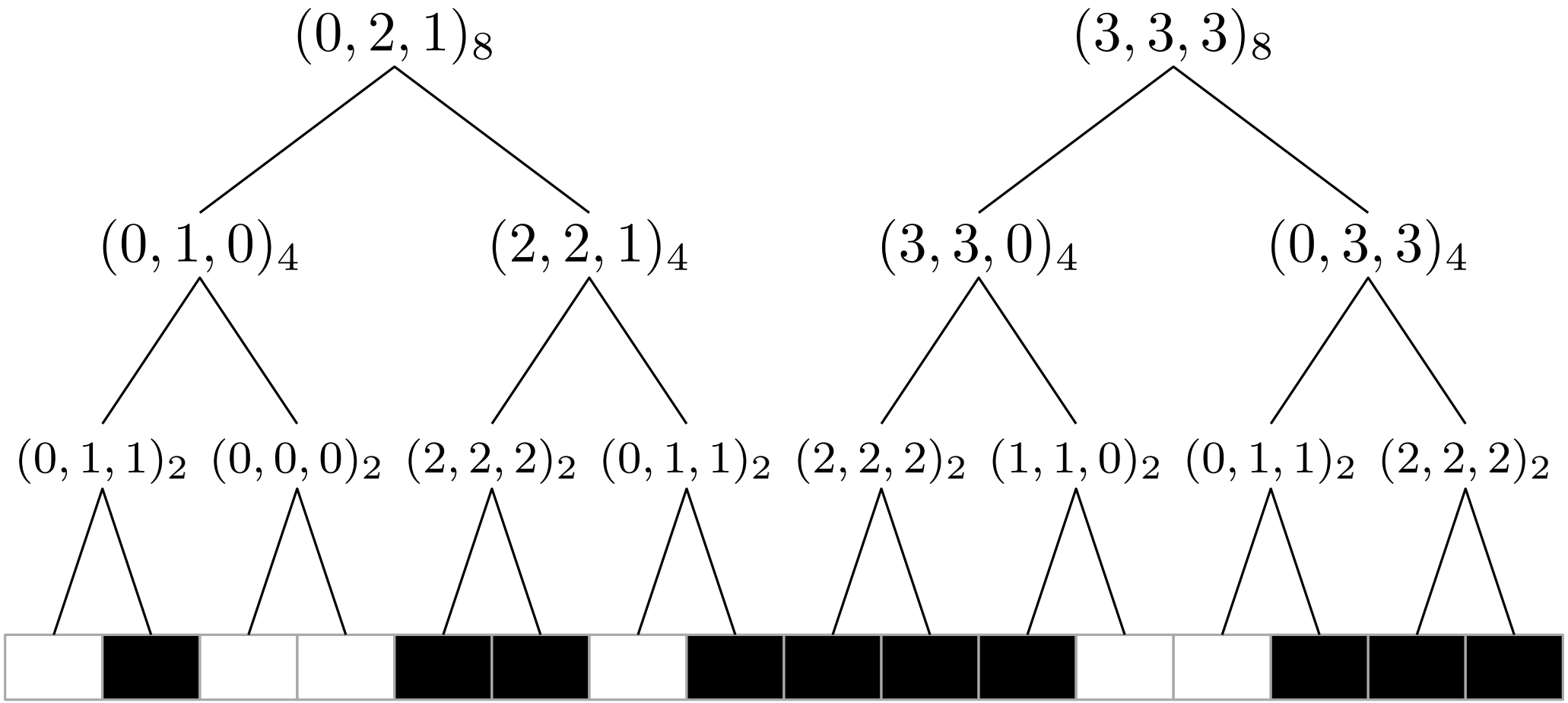
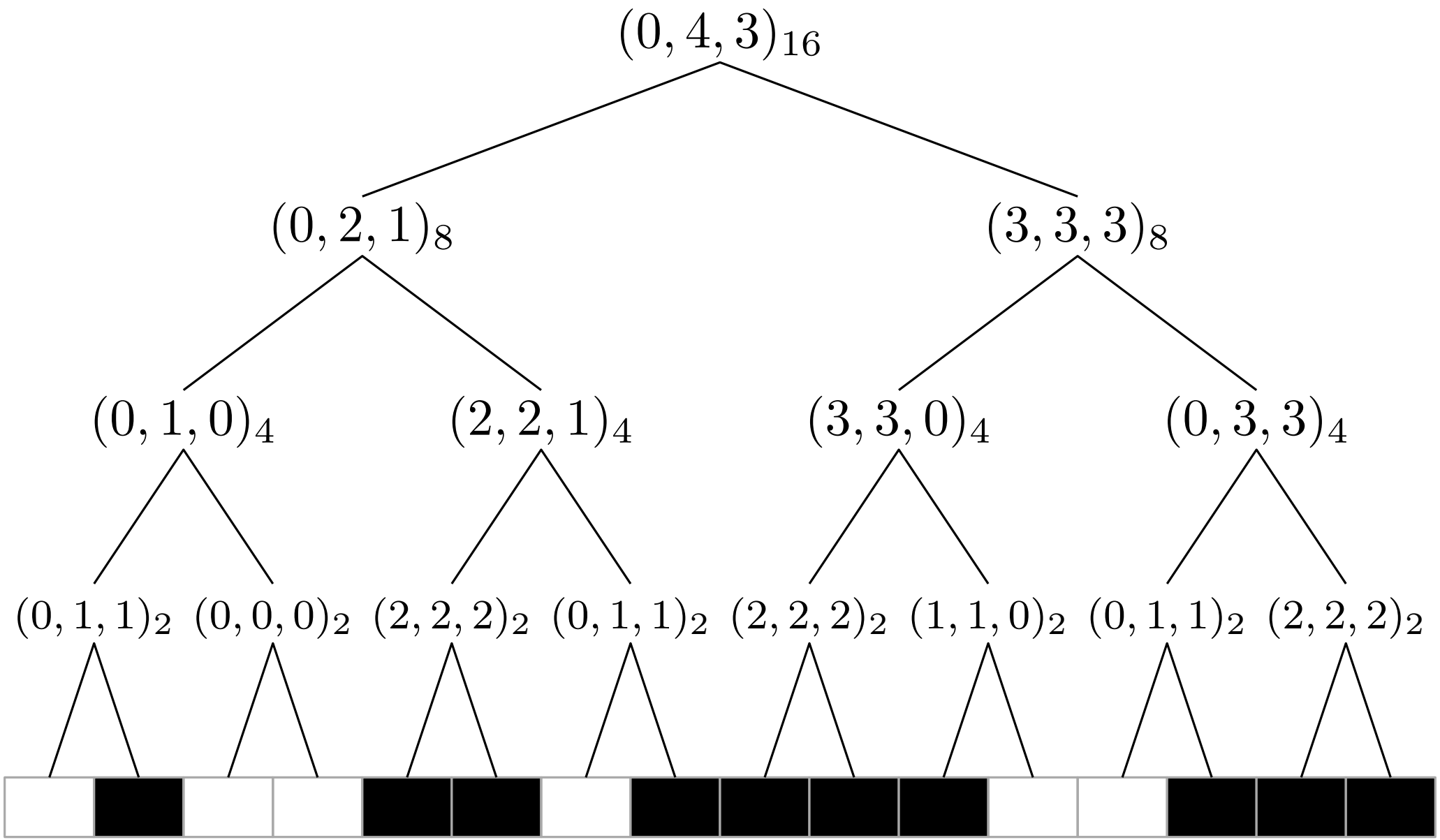
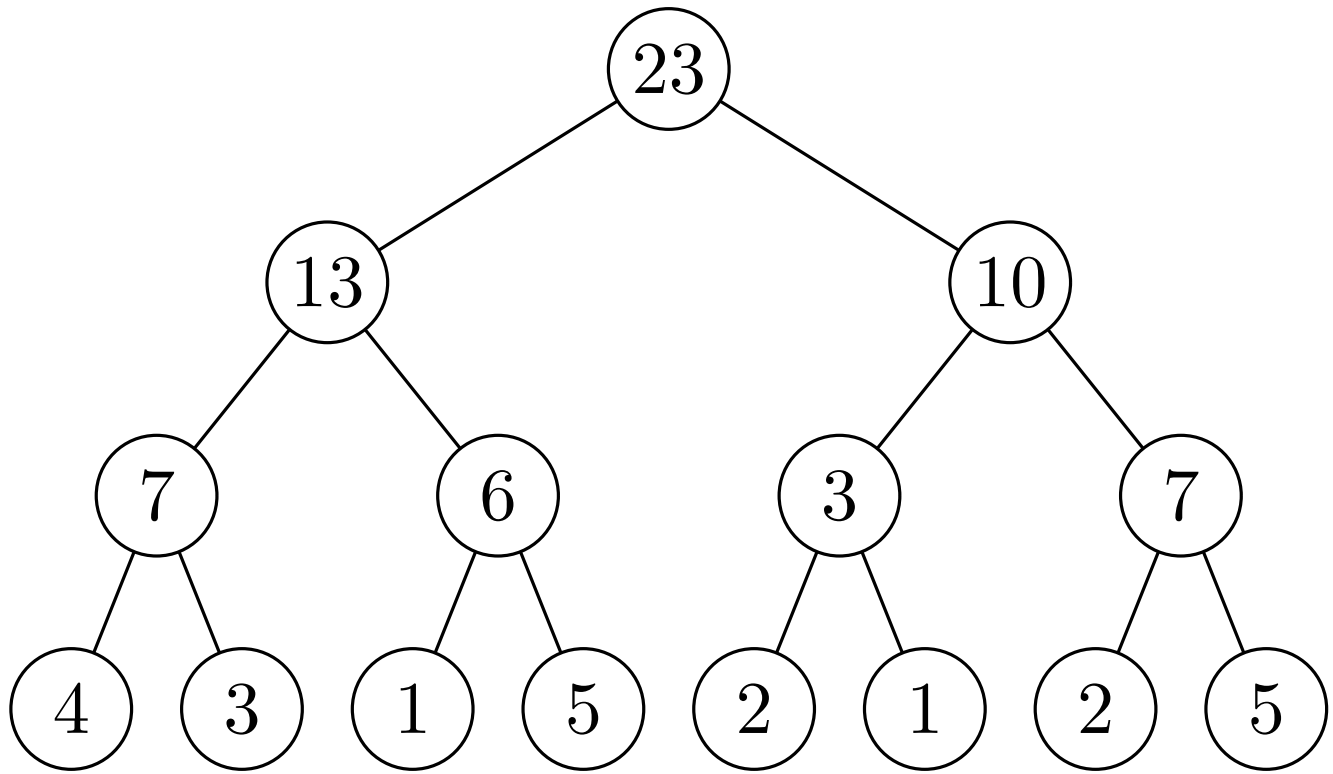


Välikyselysegmenttipuu: pisin musta ketju

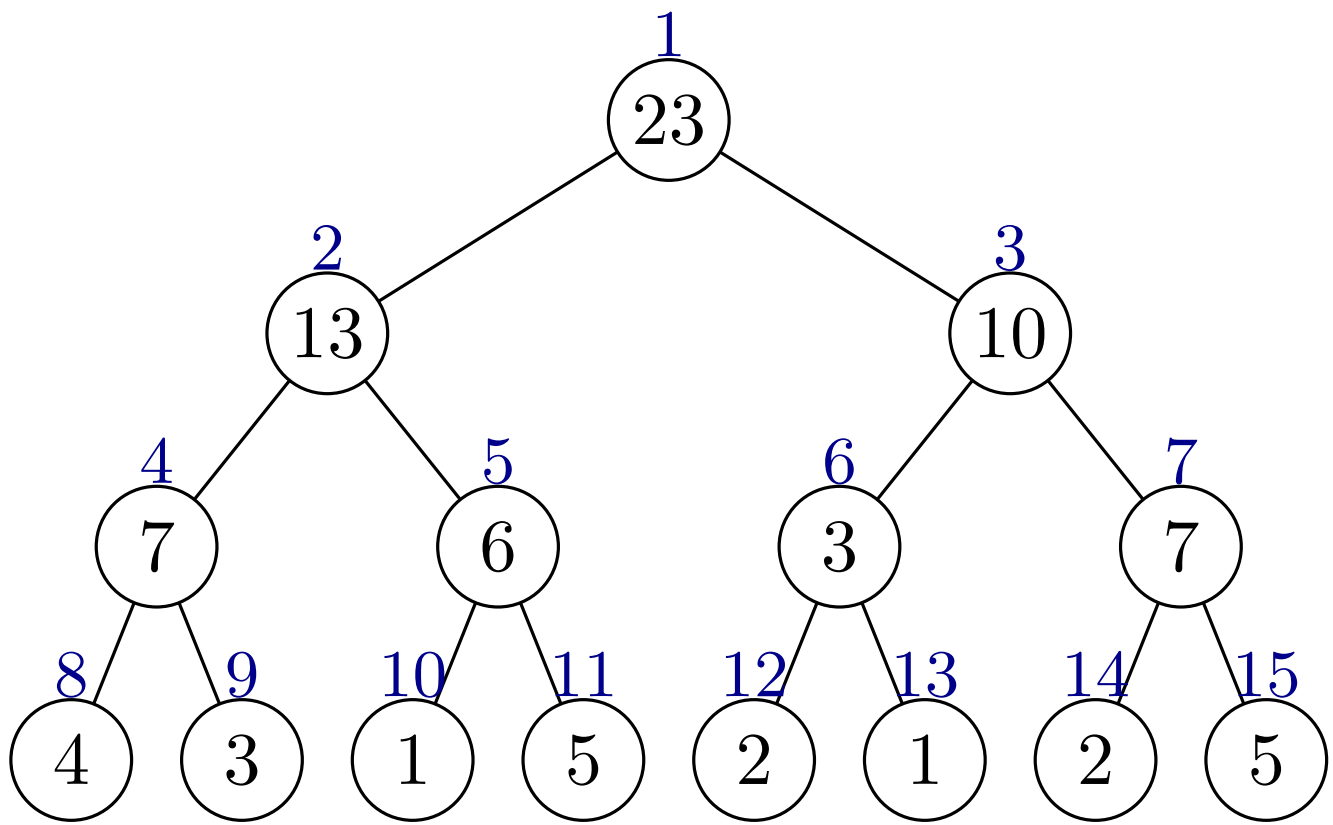


Välikyselysegmenttipuu – perinteinen toteutus



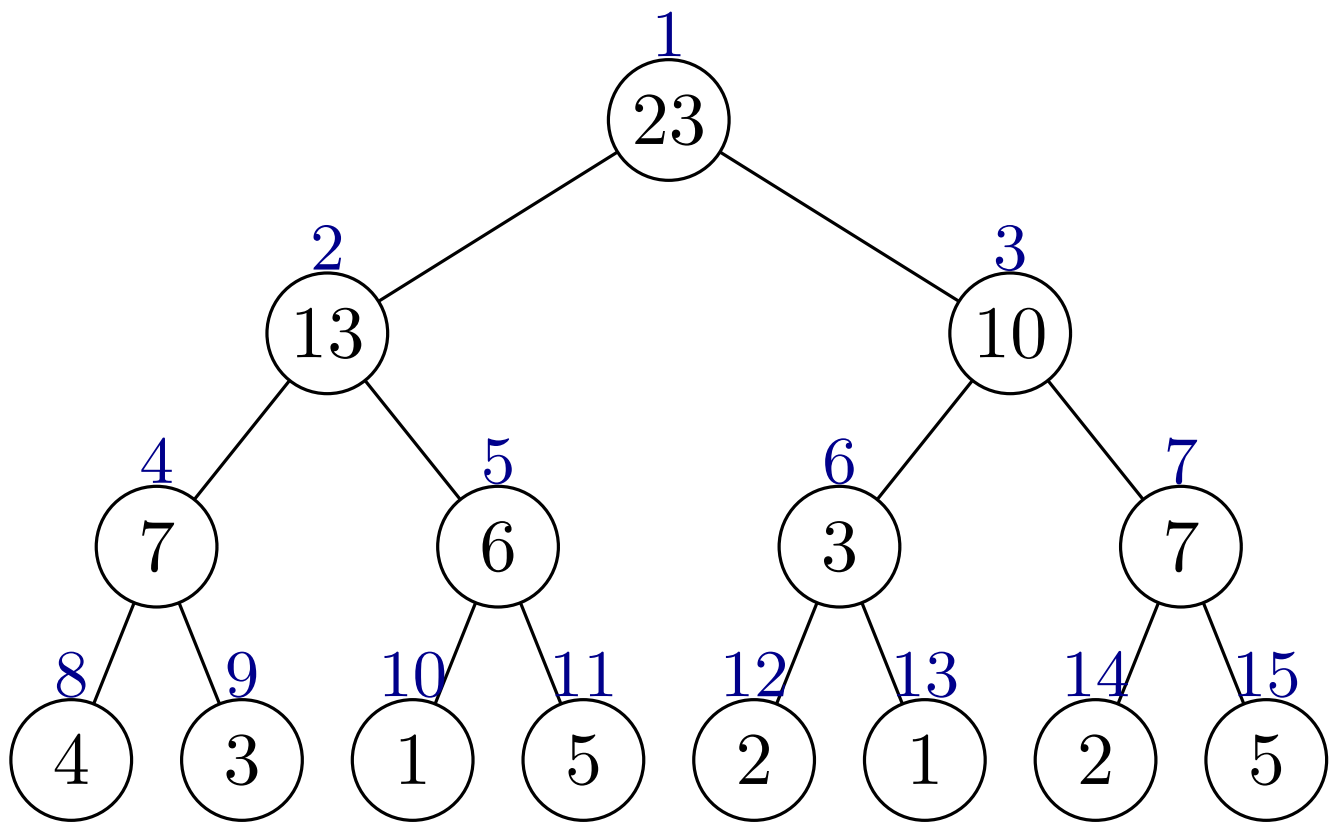
Välikyselysegmenttipuu – perinteinen toteutus

```
void muuta(int i, int val) {
        i += N;
        T[i] = val;
        i /= 2;
        while(i) {
                T[i] = T[2 * i] + T[2 * i + 1];
                i /= 2;
        }
}
```



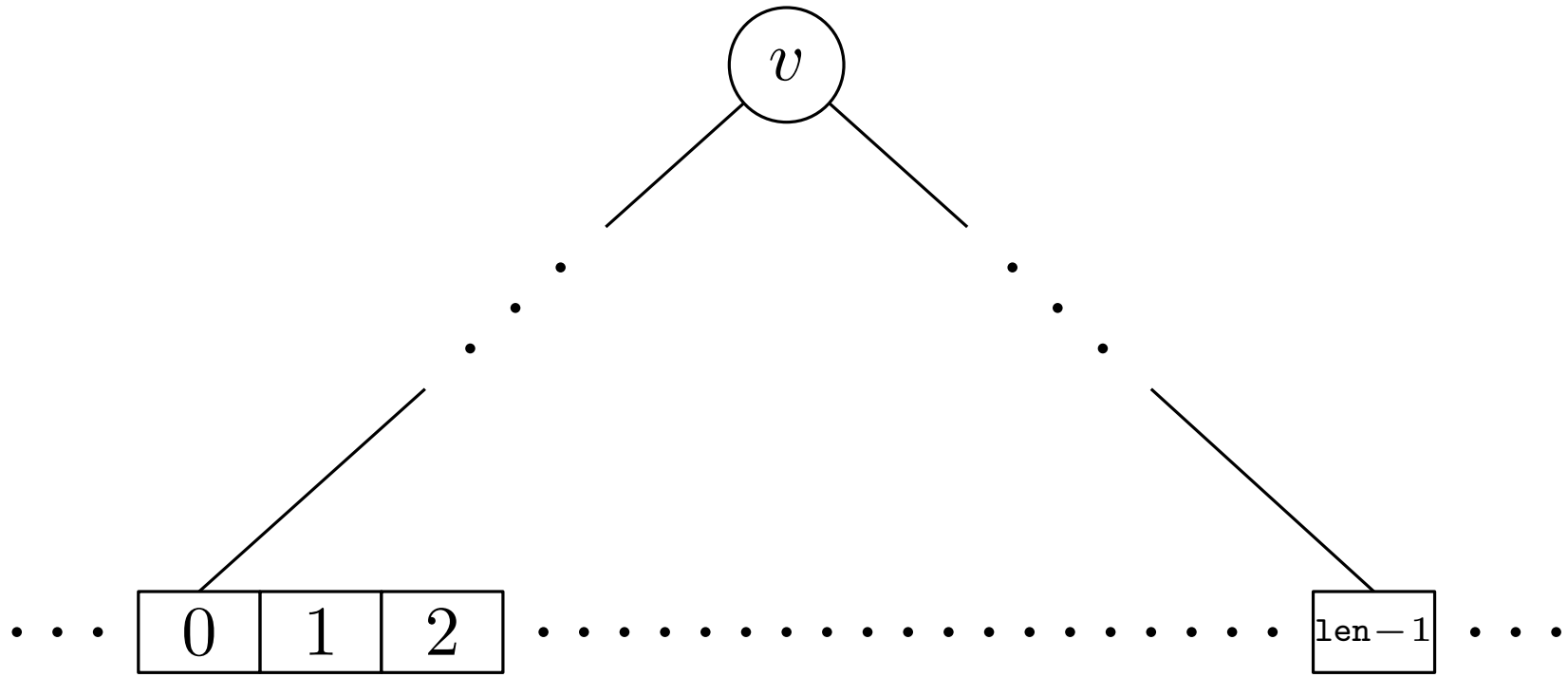
Välikyselysegmenttipuu – perinteinen toteutus

```
int valisumma(int i, int j) {
        i += N; j += N;
        int ret = 0;
        while(i <= j) {
                if(i & 1) ret += T[i++];
                if(!(j & 1)) ret += T[j--];
                i /= 2; j /= 2;
        }
}
```



Välikyselysegmenttipuu – rekursiivinen toteutus

```
int valisumma(int i, int j, int v = 1, int len = N) {
        if(i <= 0 && j >= len) return T[v];
        if(j <= 0 || i >= len) return 0;
        return valisumma(i, j, 2 * v, len / 2) +
               valisumma(i - len / 2, j - len / 2, 2 * v + 1, len / 2);
}
```



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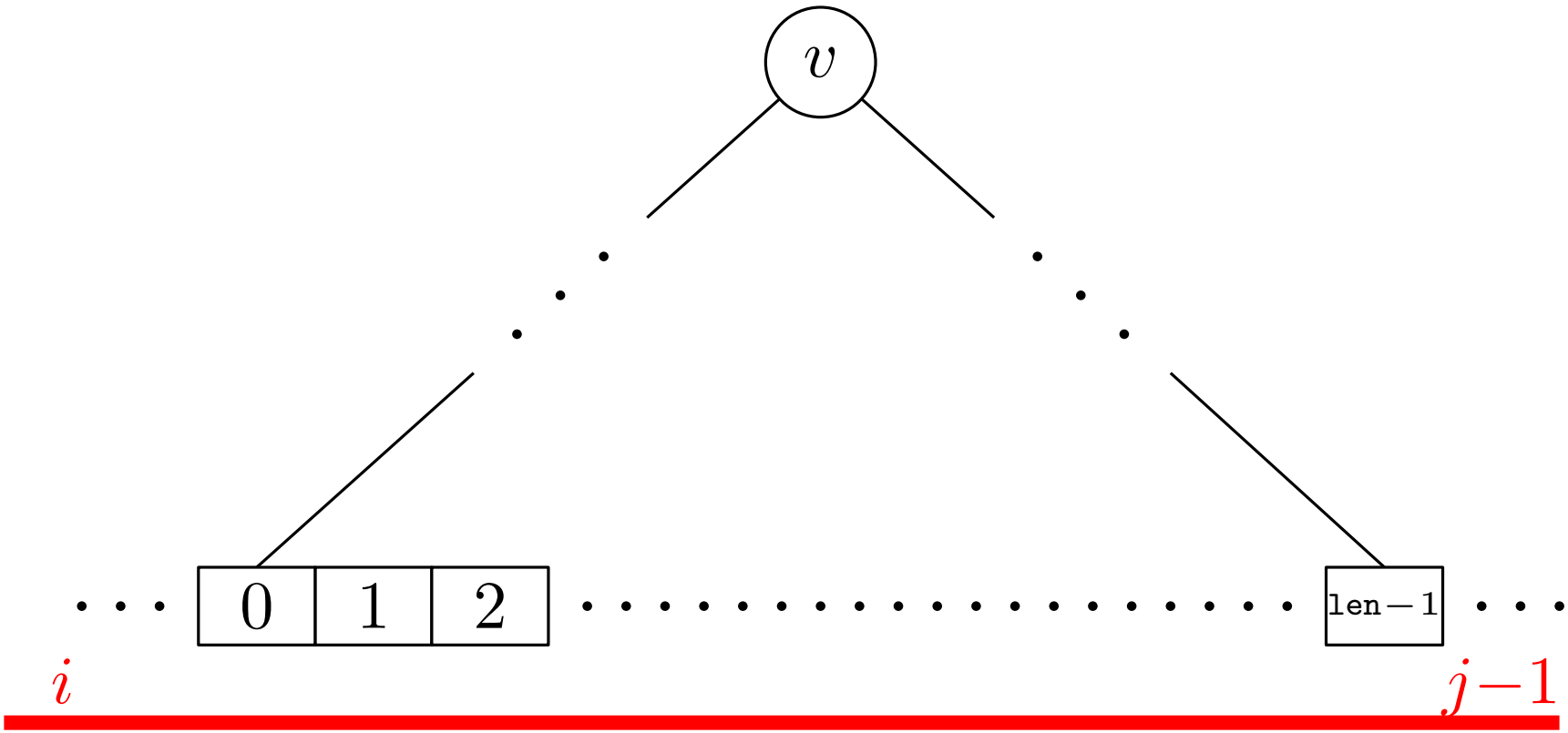
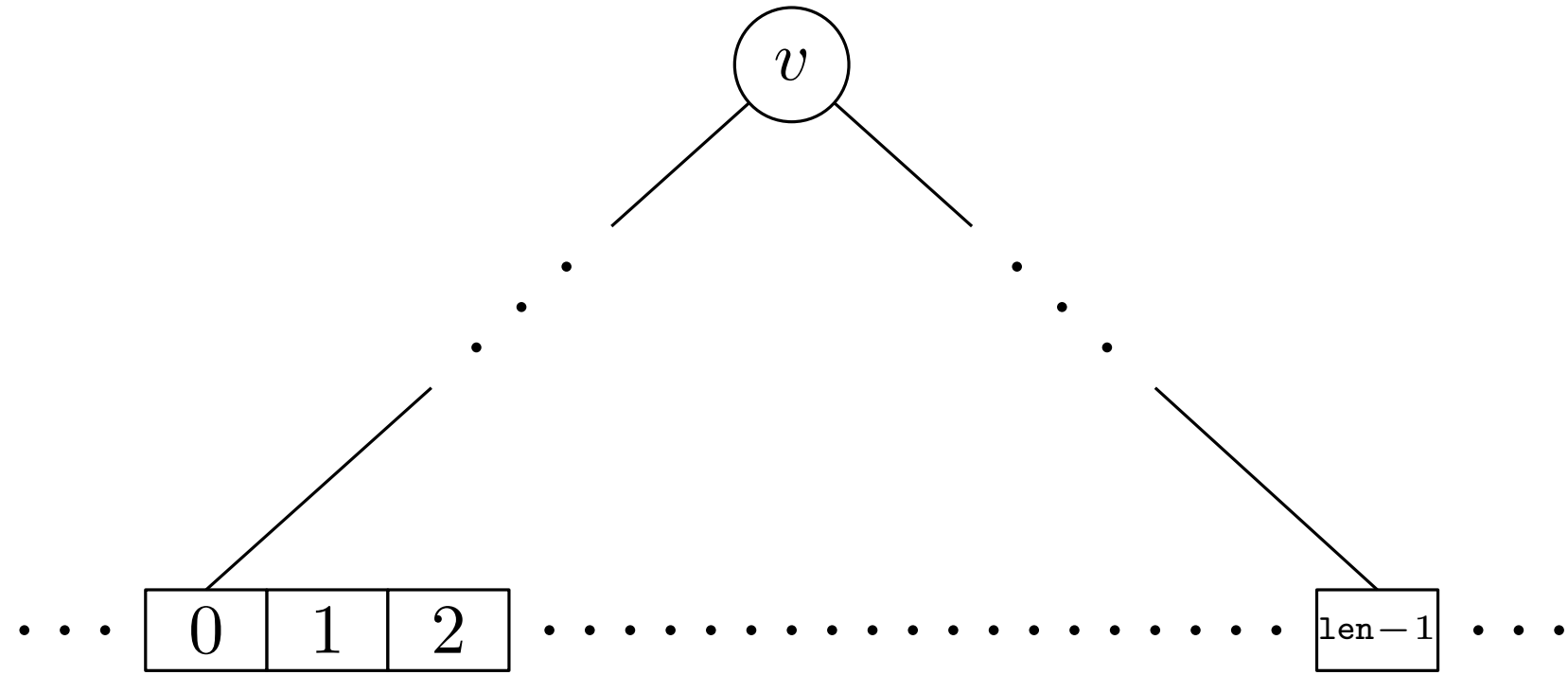
        return valisumma(i, j, 2 * v, len / 2) +
               valisumma(i - len / 2, j - len / 2, 2 * v + 1, len / 2);
}
```



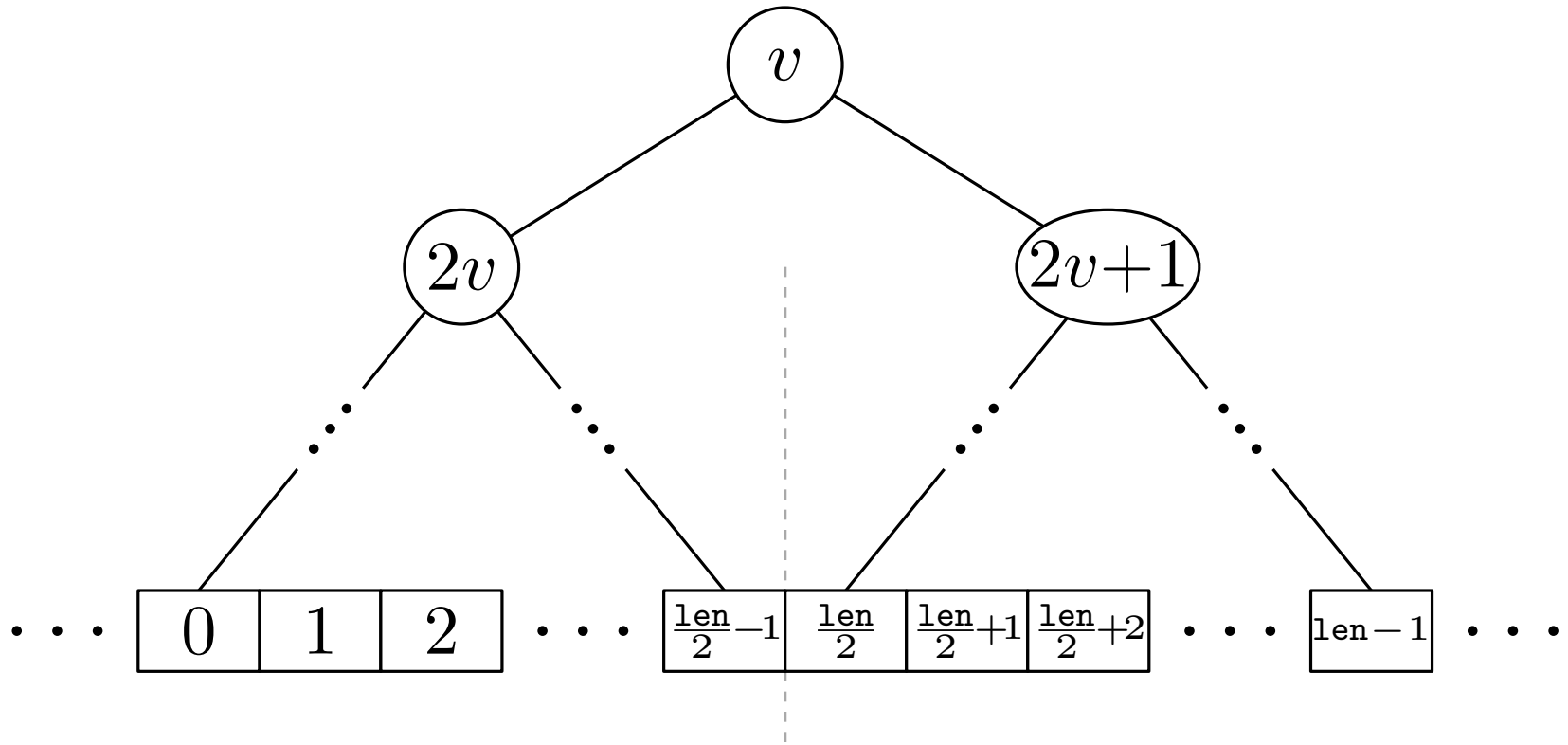
Välikyselysegmenttipuu – rekursiivinen toteutus

```
int valisumma(int i, int j, int v = 1, int len = N) {
        if(i <= 0 && j >= len) return T[v];
        if(j <= 0 || i >= len) return 0;
        return valisumma(i, j, 2 * v, len / 2) +
               valisumma(i - len / 2, j - len / 2, 2 * v + 1, len / 2);
}
```



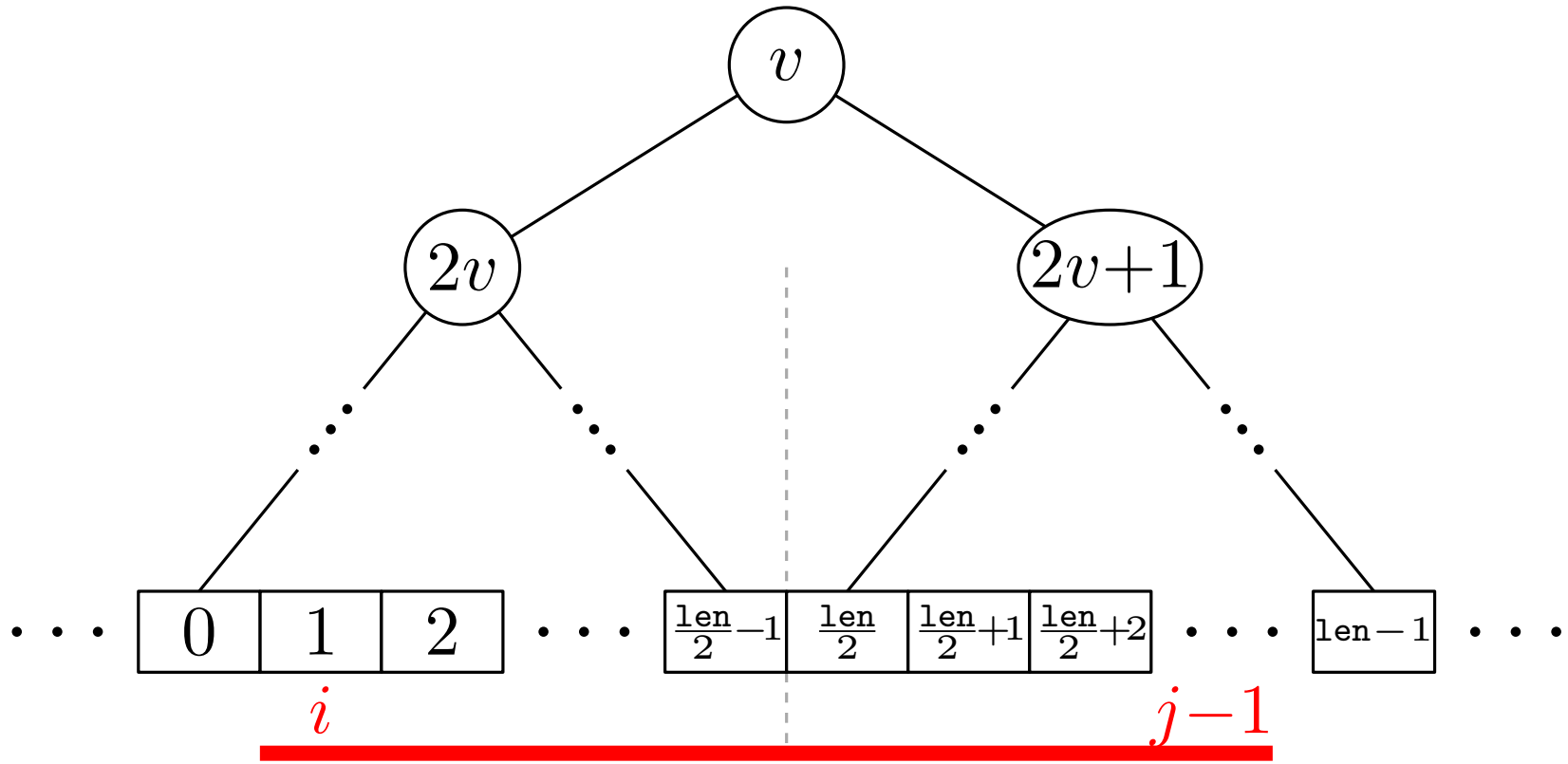
Välikyselysegmenttipuu – rekursiivinen toteutus

```
int valisumma(int i, int j, int v = 1, int len = N) {
        if(i <= 0 && j >= len) return T[v];
        if(j <= 0 || i >= len) return 0;
        return valisumma(i, j, 2 * v, len / 2) +
               valisumma(i - len / 2, j - len / 2, 2 * v + 1, len / 2);
}
```



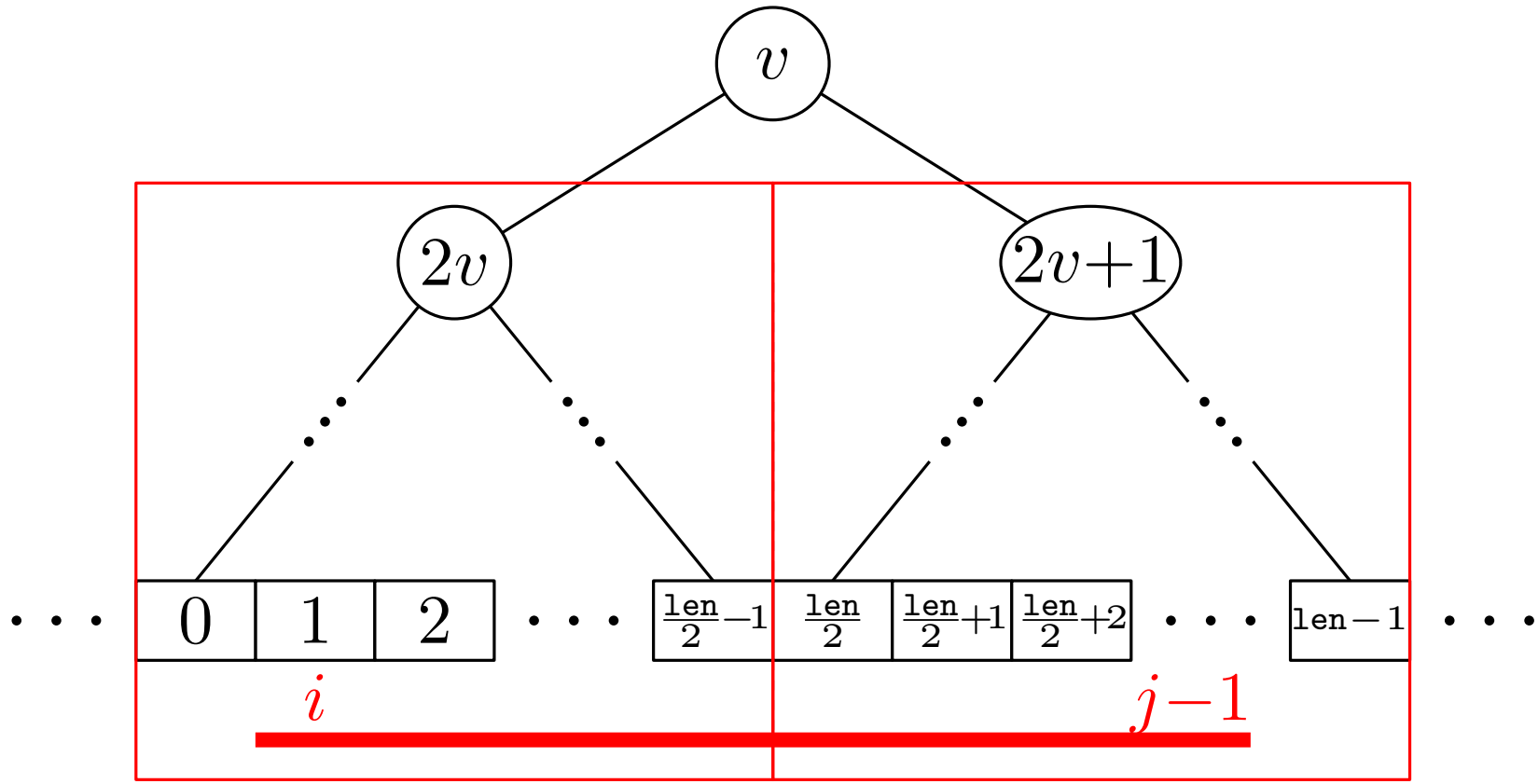
Välikyselysegmenttipuu – rekursiivinen toteutus

```
int valisumma(int i, int j, int v = 1, int len = N) {
        if(i <= 0 && j >= len) return T[v];
        if(j <= 0 || i >= len) return 0;
        return valisumma(i, j, 2 * v, len / 2) +
               valisumma(i - len / 2, j - len / 2, 2 * v + 1, len / 2);
}
```



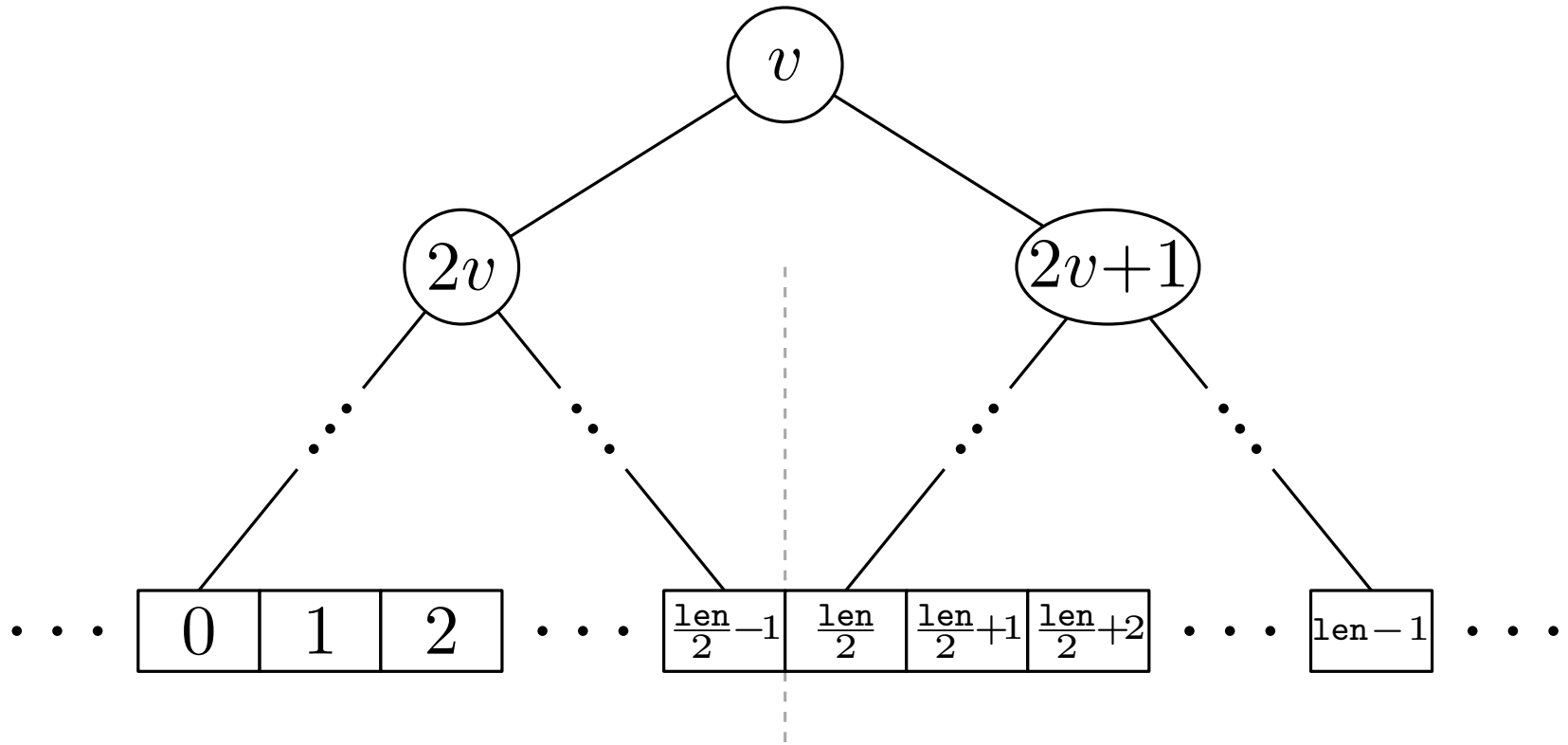
Välikyselysegmenttipuu – rekursiivinen toteutus

```
int valisumma(int i, int j, int v = 1, int len = N) {
        if(i <= 0 && j >= len) return T[v];
        if(j <= 0 || i >= len) return 0;
        return valisumma(i, j, 2 * v, len / 2) +
               valisumma(i - len / 2, j - len / 2, 2 * v + 1, len / 2);
}
```

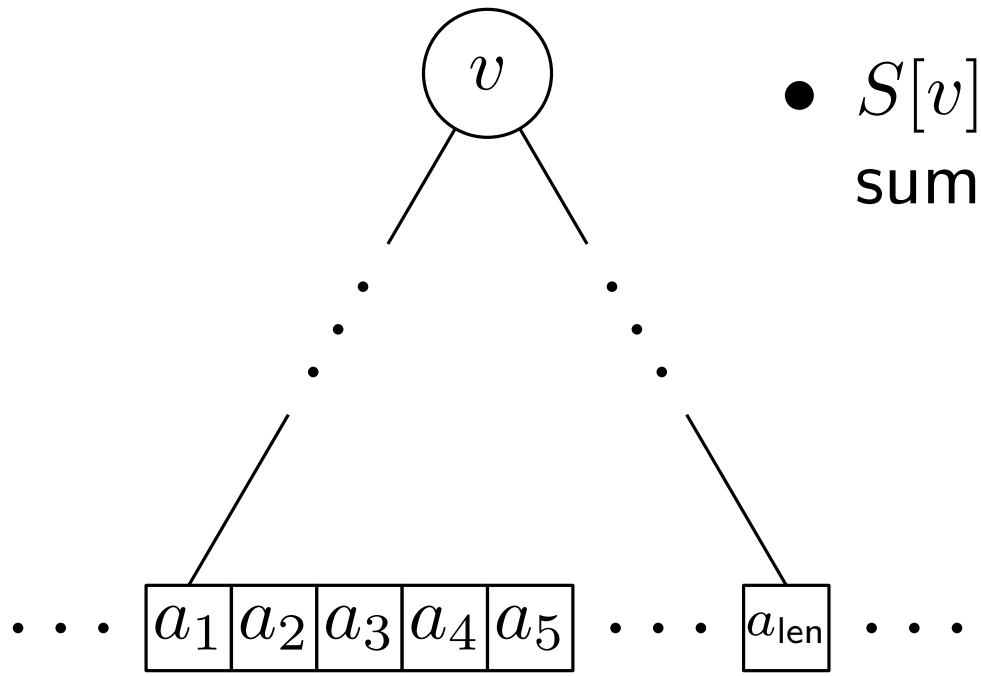


Välikyselysegmenttipuu – rekursiivinen toteutus

```
int valisumma(int i, int j, int v = 1, int len = N) {
        if(i <= 0 && j >= len) return T[v];
        if(j <= 0 || i >= len) return 0;
        return valisumma(i, j, 2 * v, len / 2) +
               valisumma(i - len / 2, j - len / 2, 2 * v + 1, len / 2);
}
```

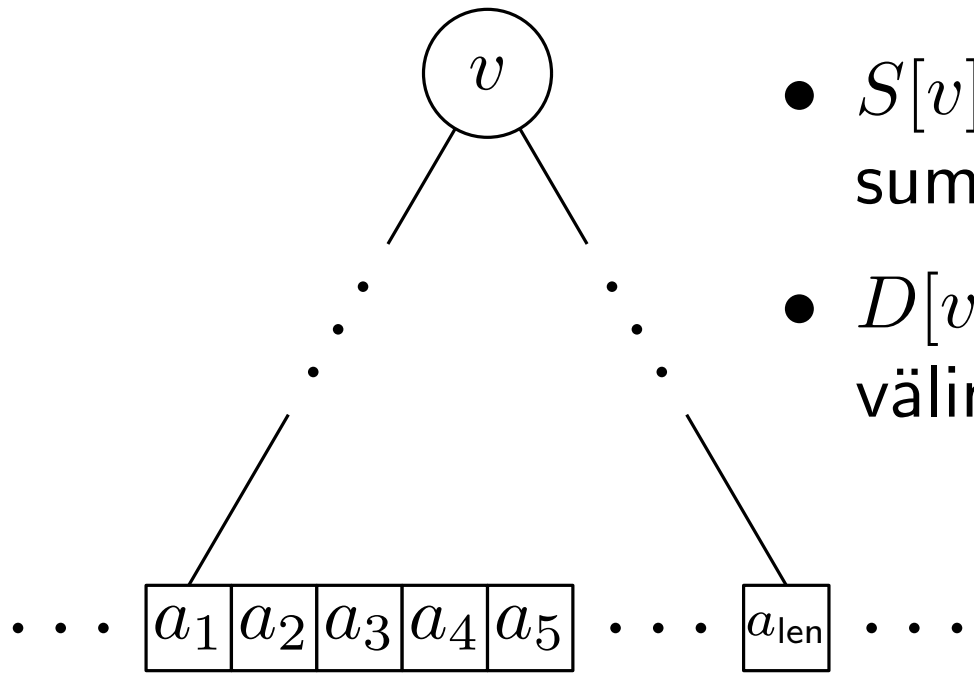


Välikyselyt ja välimuutokset: sisupuu



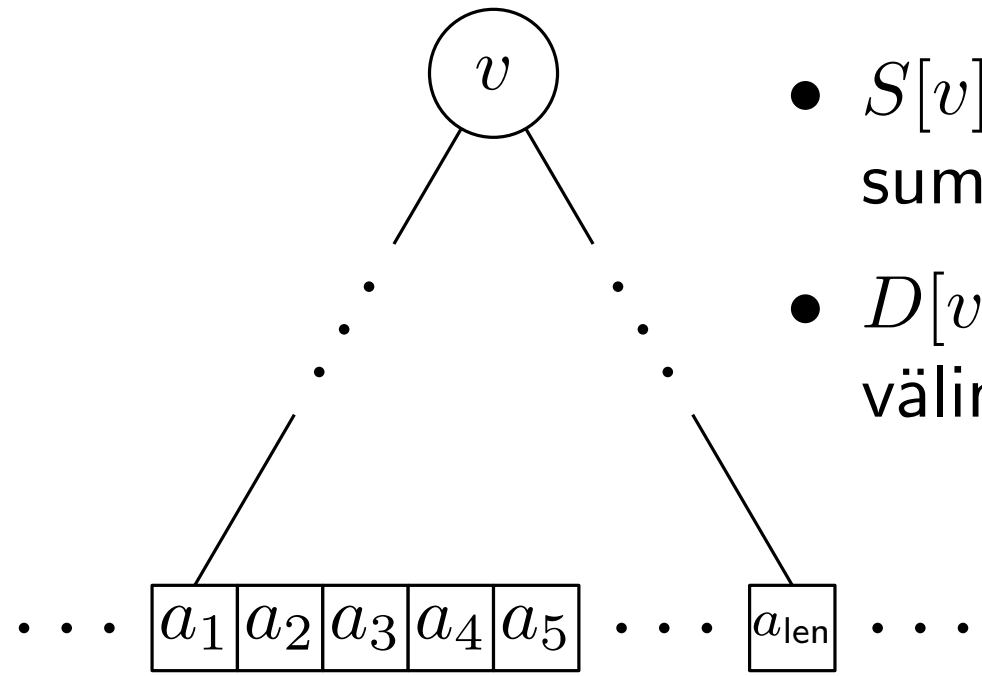
- $S[v]$: solmua v vastaavan välin summa on $S[v]$

Välikyselyt ja välimuutokset: sisupuu



- $S[v]$: solmua v vastaavan välin summa on $S[v]$
- $D[v]$: kaikkiin solmua v vastaavan välin alkioihin on lisättävä $D[v]$

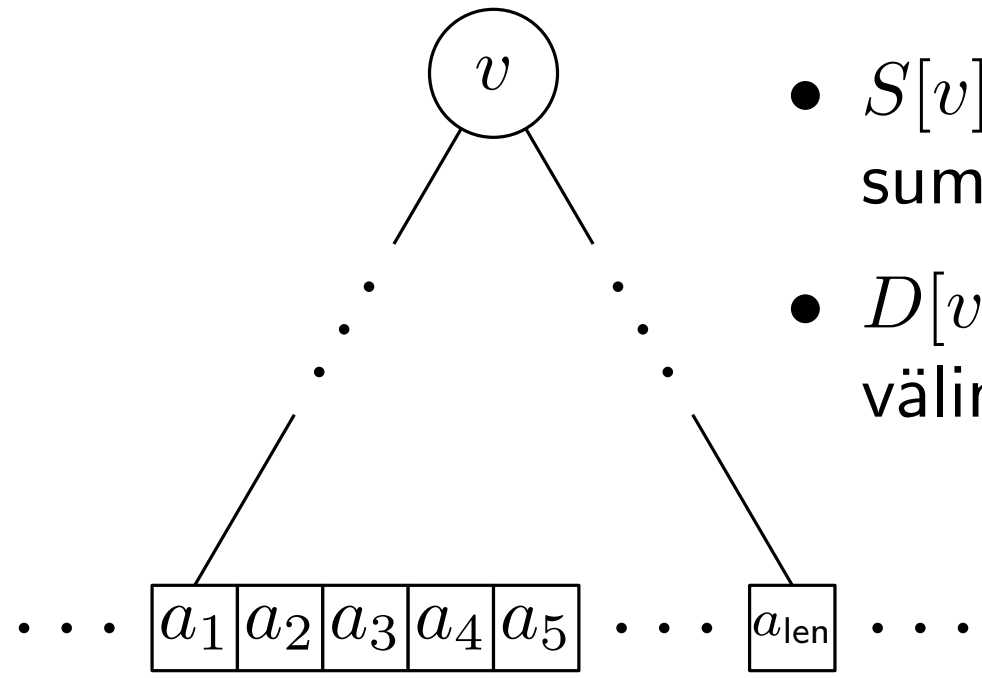
Välikyselyt ja välimuutokset: sisupuu



- $S[v]$: solmua v vastaavan välin summa on $S[v]$
- $D[v]$: kaikkiin solmua v vastaavan välin alkioihin on lisättävä $D[v]$

```
void valimuutos(int i, int j, int d, int v = 1, int len = N) {
        if(j <= 0 || i >= len) return;
        if(i <= 0 && j >= len) {
                D[v] += d;
                S[v] += len * d;
        } else {
                valimuutos(i, j, d, 2 * v, len/2);
                valimuutos(i - len/2, j - len/2, d, 2 * v + 1, len/2);
                S[v] = S[2 * v] + S[2 * v + 1] + len * D[v];
        }
}
```

Välikyselyt ja välimuutokset: sisupuu



- $S[v]$: solmua v vastaavan välin summa on $S[v]$
- $D[v]$: kaikkiin solmua v vastaavan välin alkioihin on lisättävä $D[v]$

```
int valikysely(int i, int j, int v = 1, int len = N) {
        if(i <= 0 && j >= len) return S[v];
        if(j <= 0 || i >= len) return 0;
        return valikysely(i, j, 2 * v, len/2) +
               valikysely(i - len/2, j - len/2, 2 * v + 1, len/2) +
               D[v] * (min(j, len) - max(i, 0));
}
```

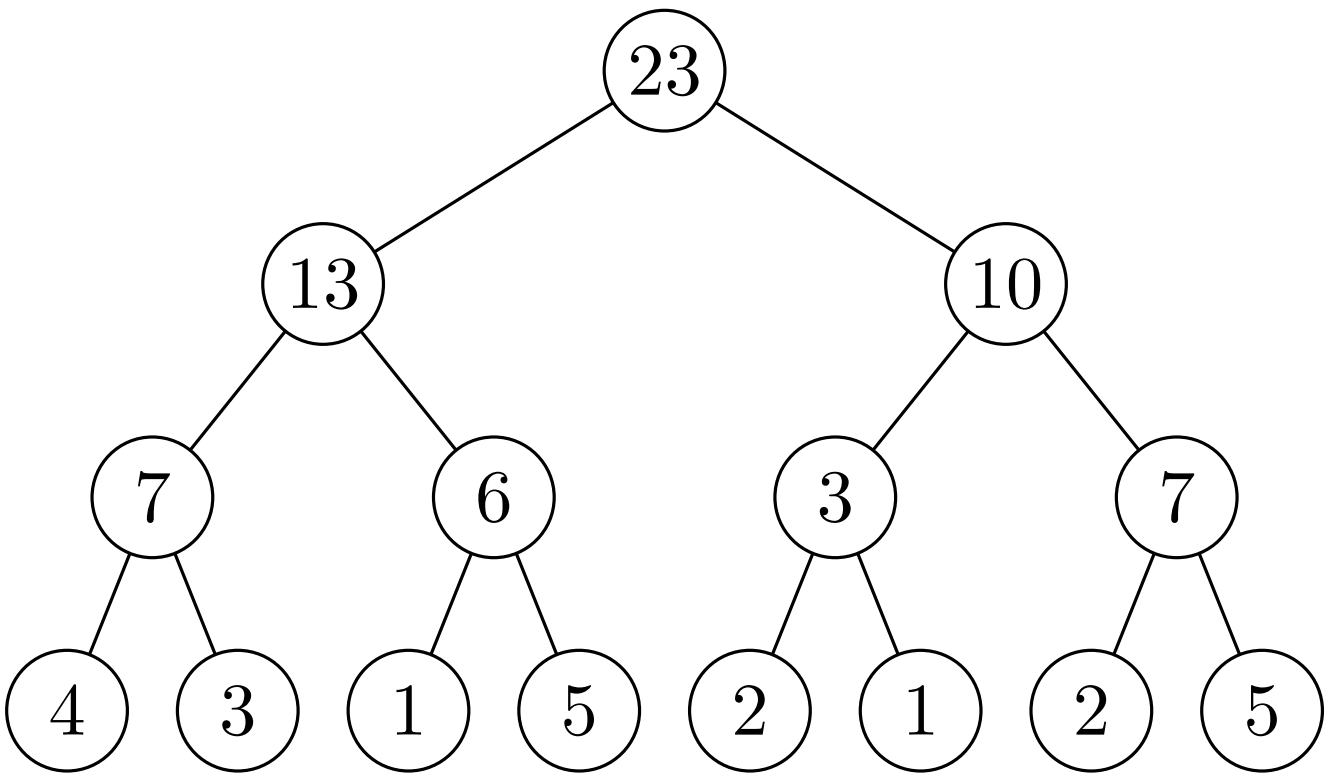
Harvat segmenttipuut

- Tallennetaan v:n vasemman lapsen indeksi `L[v]` ja oikean lapsen indeksi `R[v]`.
- Jos indeksi on 0, solmua ei vielä ole.

```
int idx = 1;
int left(int v) {
        if(!L[v]) {
                L[v] = idx++;
        }
        return L[v];
}
int right(int v) {
        if(!R[v]) {
                R[v] = idx++;
        }
        return R[v];
}
```

- Korvaa `2*v` $\rightarrow$ `left(v)` ja `2*v+1` $\rightarrow$ `right(v)`

Persistentit segmenttipuut



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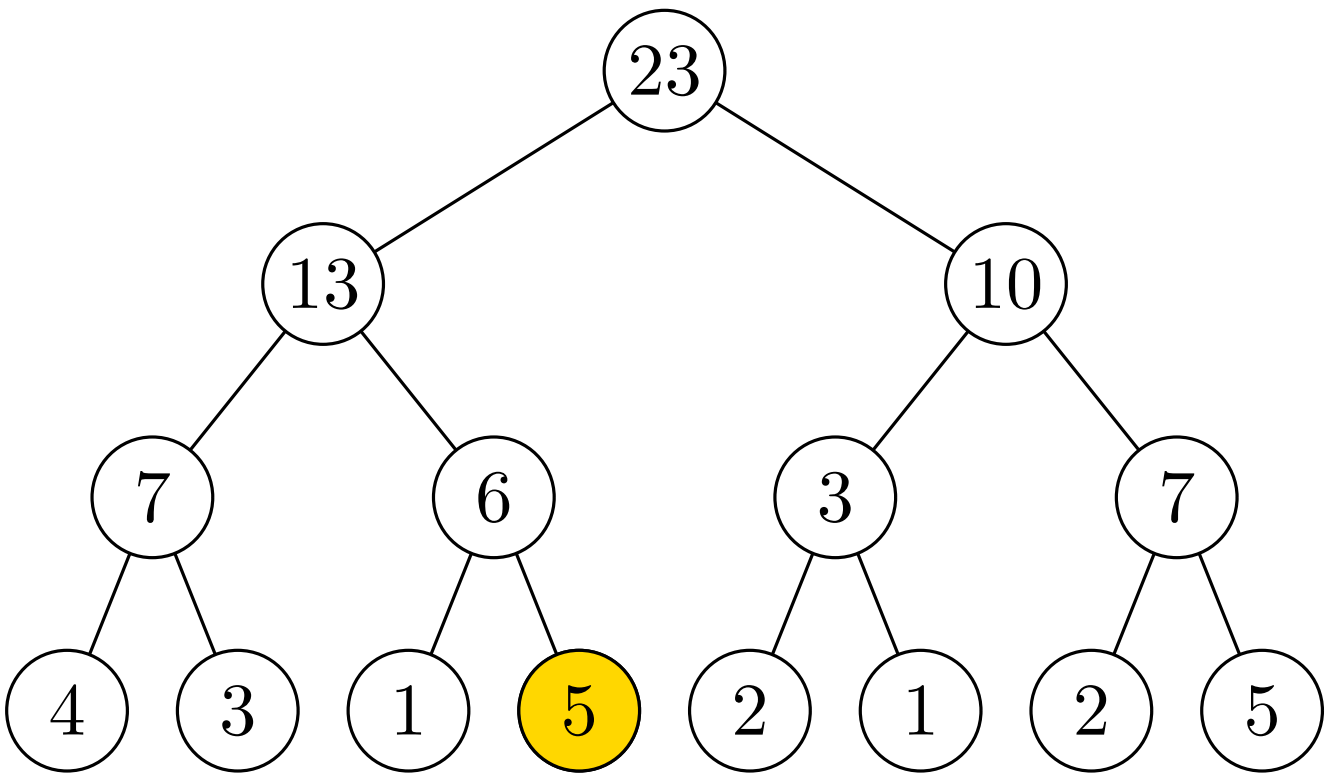
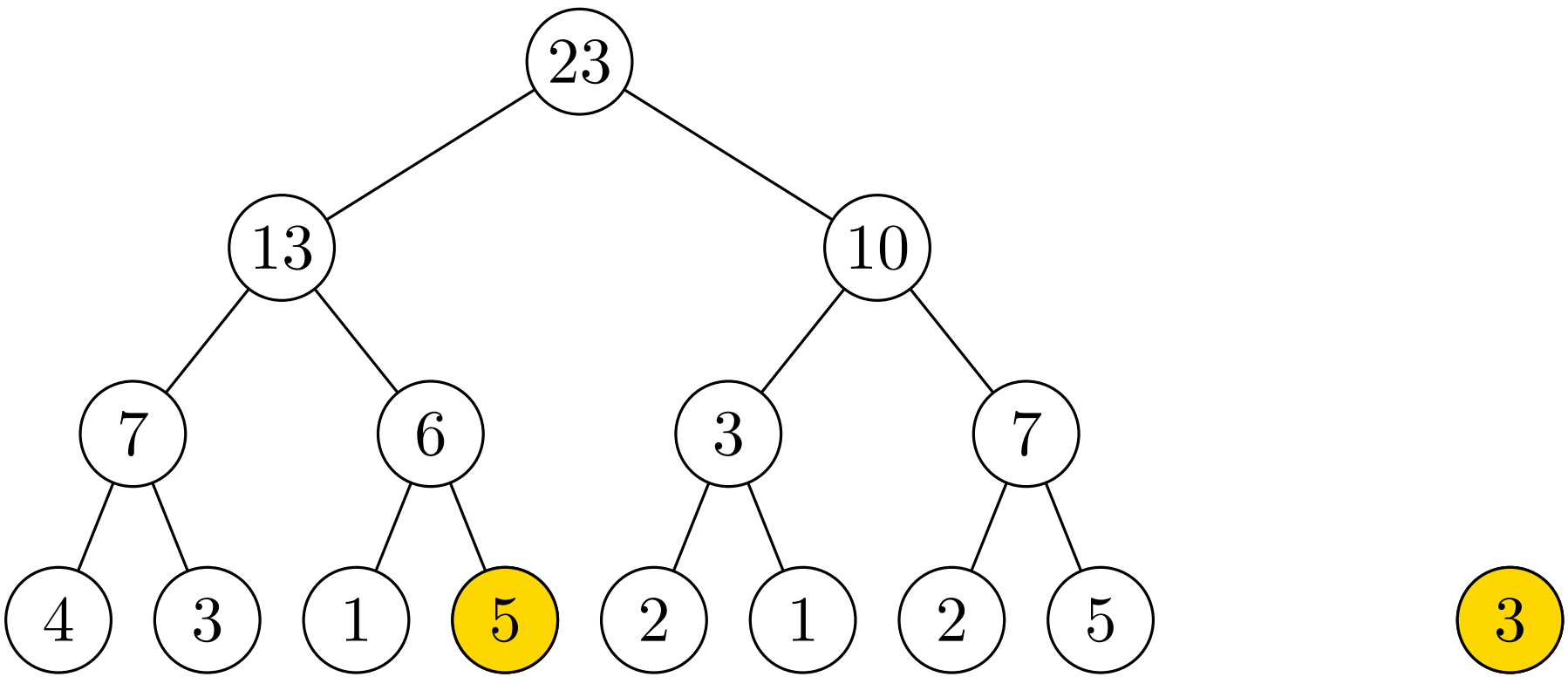
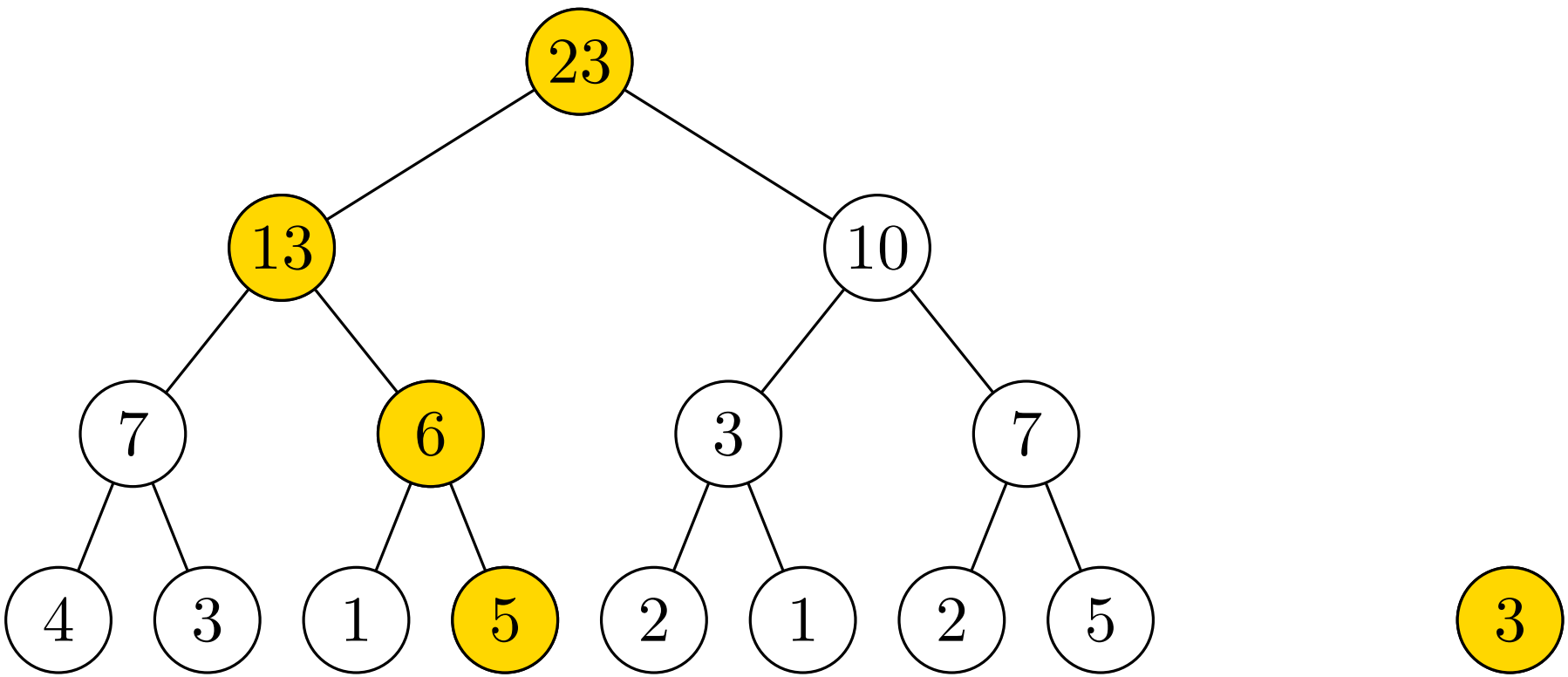


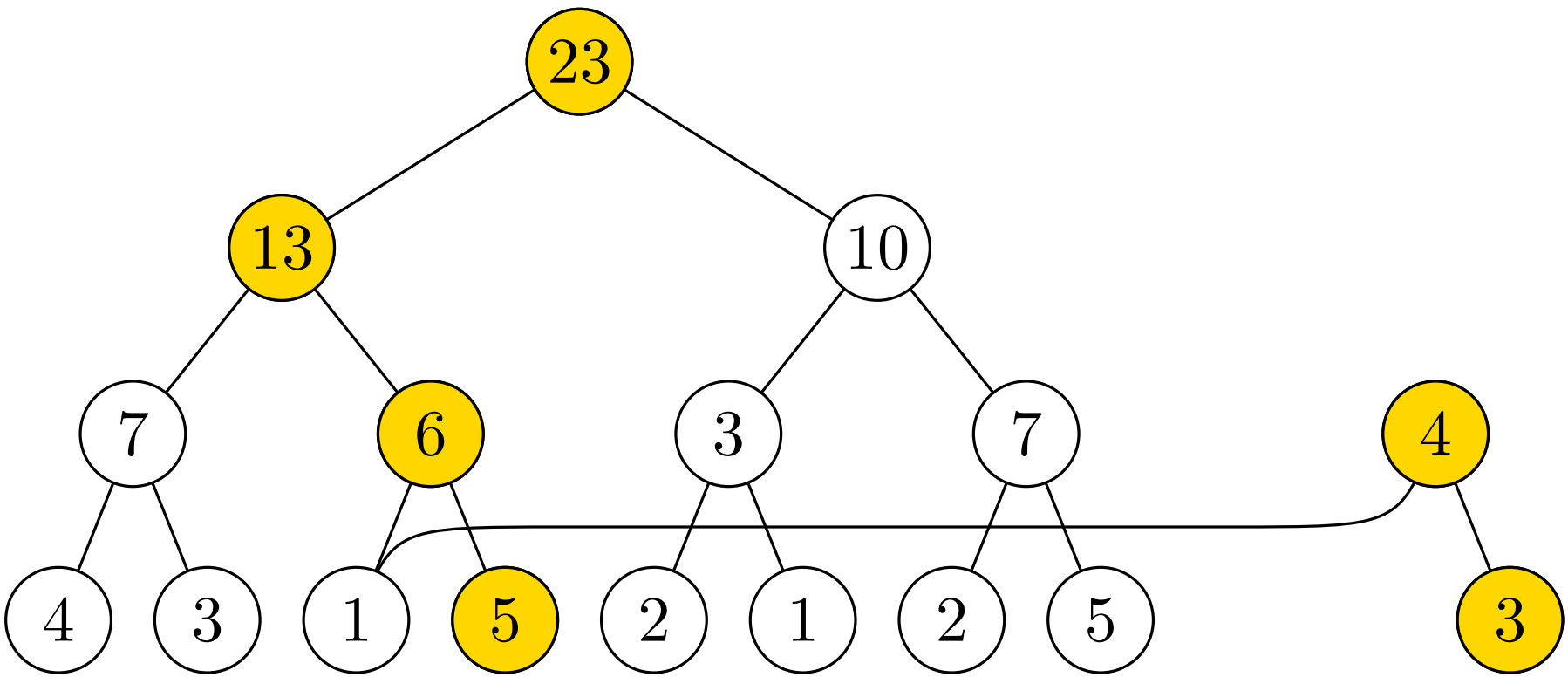
Persistentit segmenttipuut



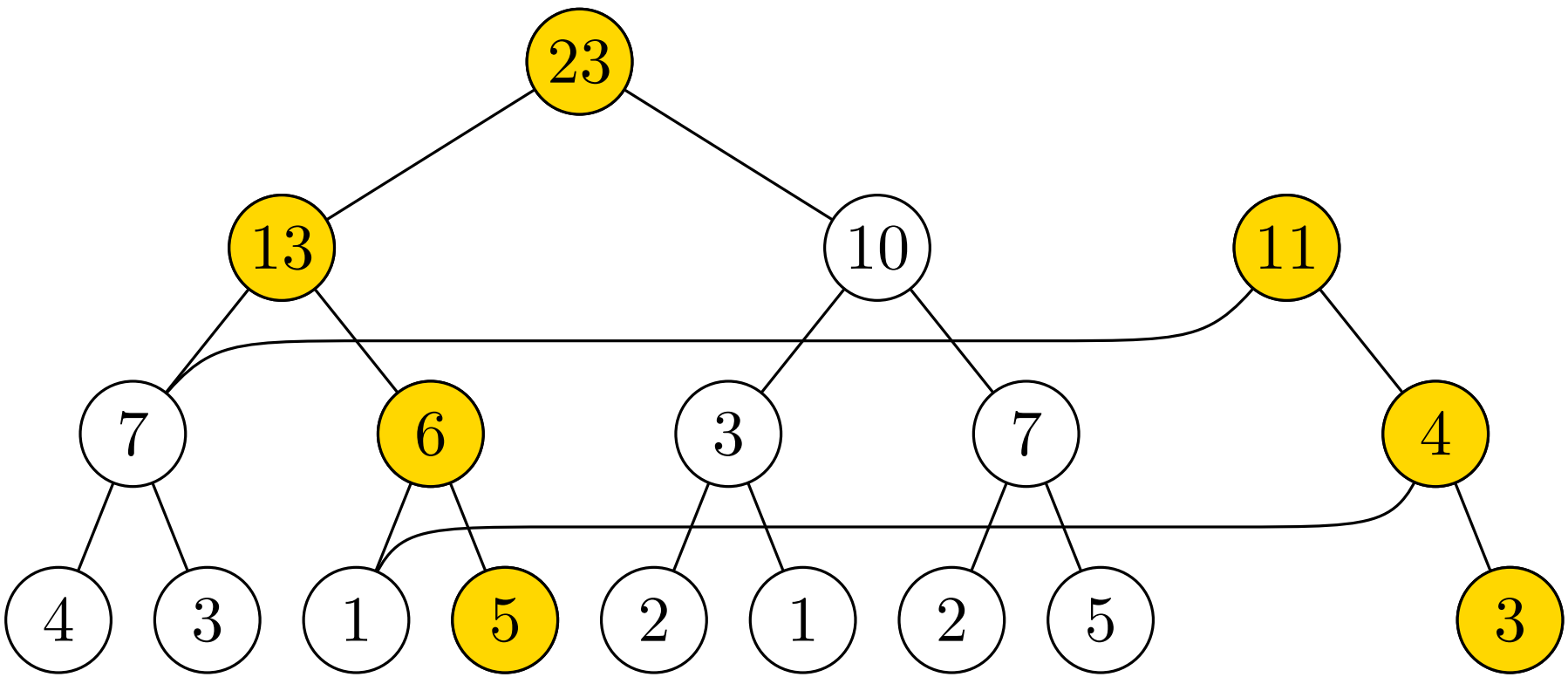
Persistentit segmenttipuut



Persistentit segmenttipuut



Persistentit segmenttipuut



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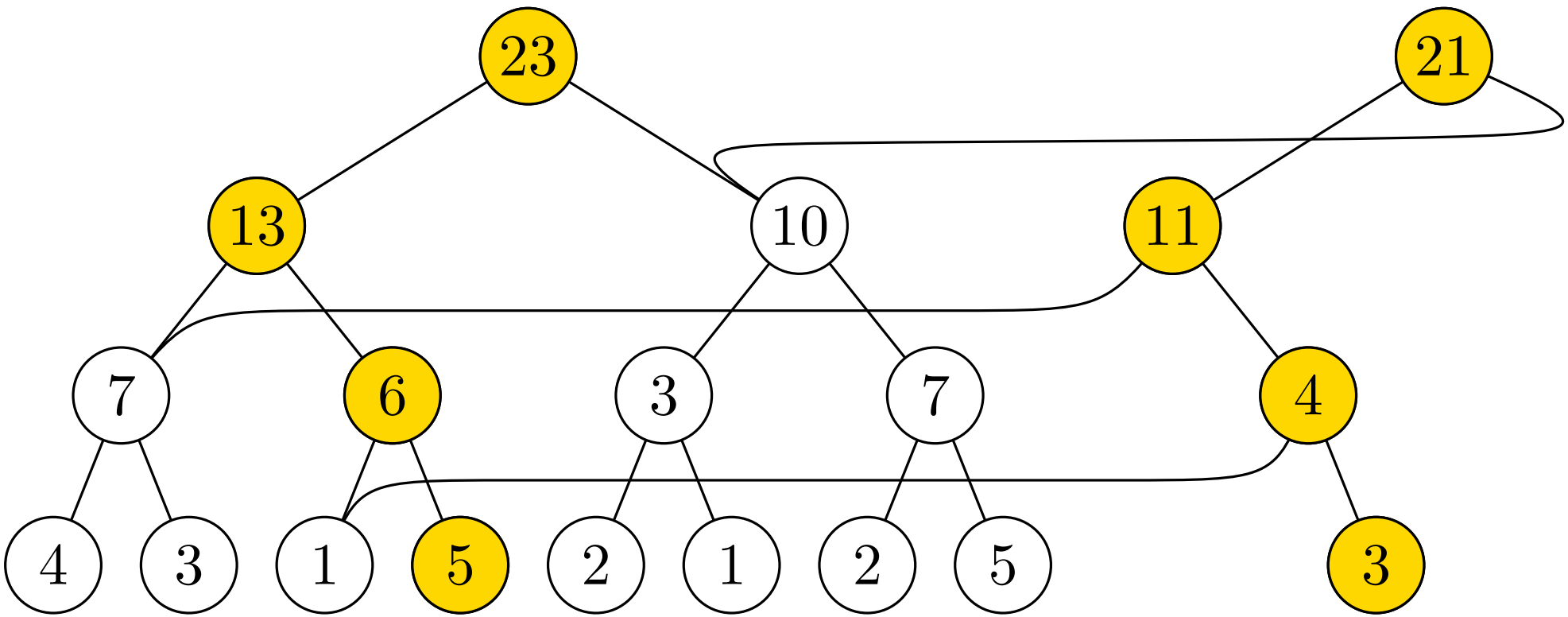

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