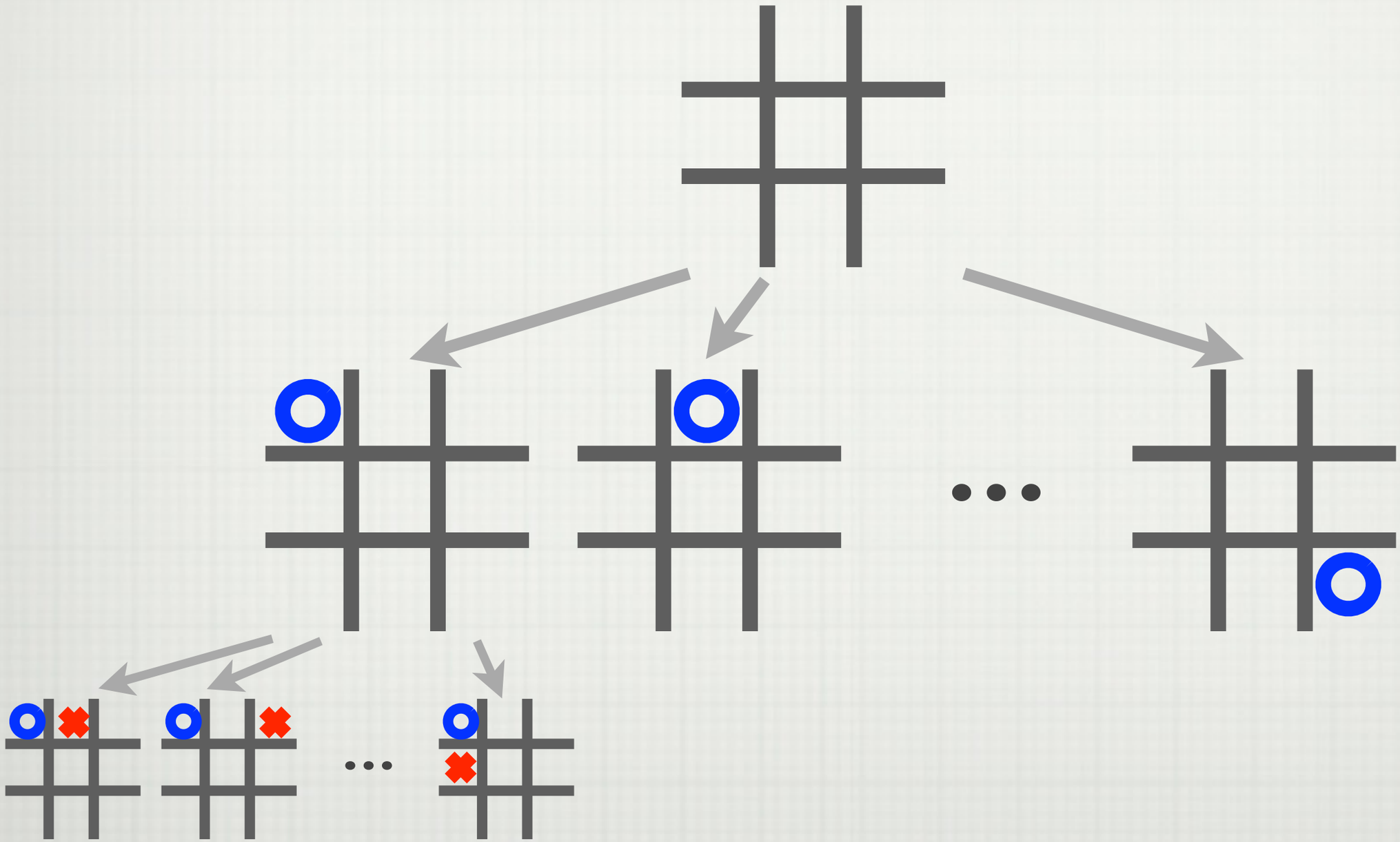
JOHDATUS TEKOÄLYYN

TEEMU ROOS

HELSINGIN YLIOPISTO

PELIPUU



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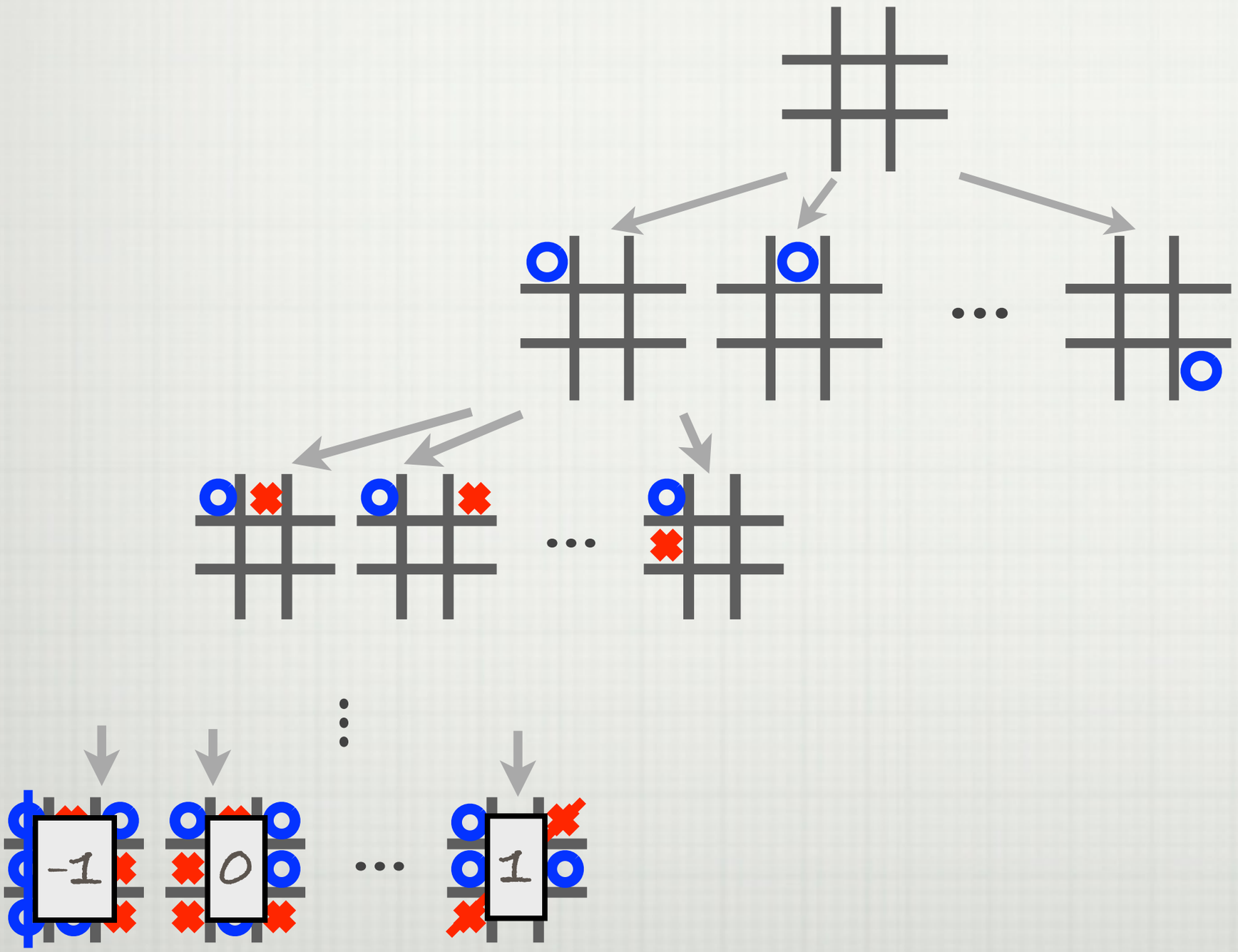

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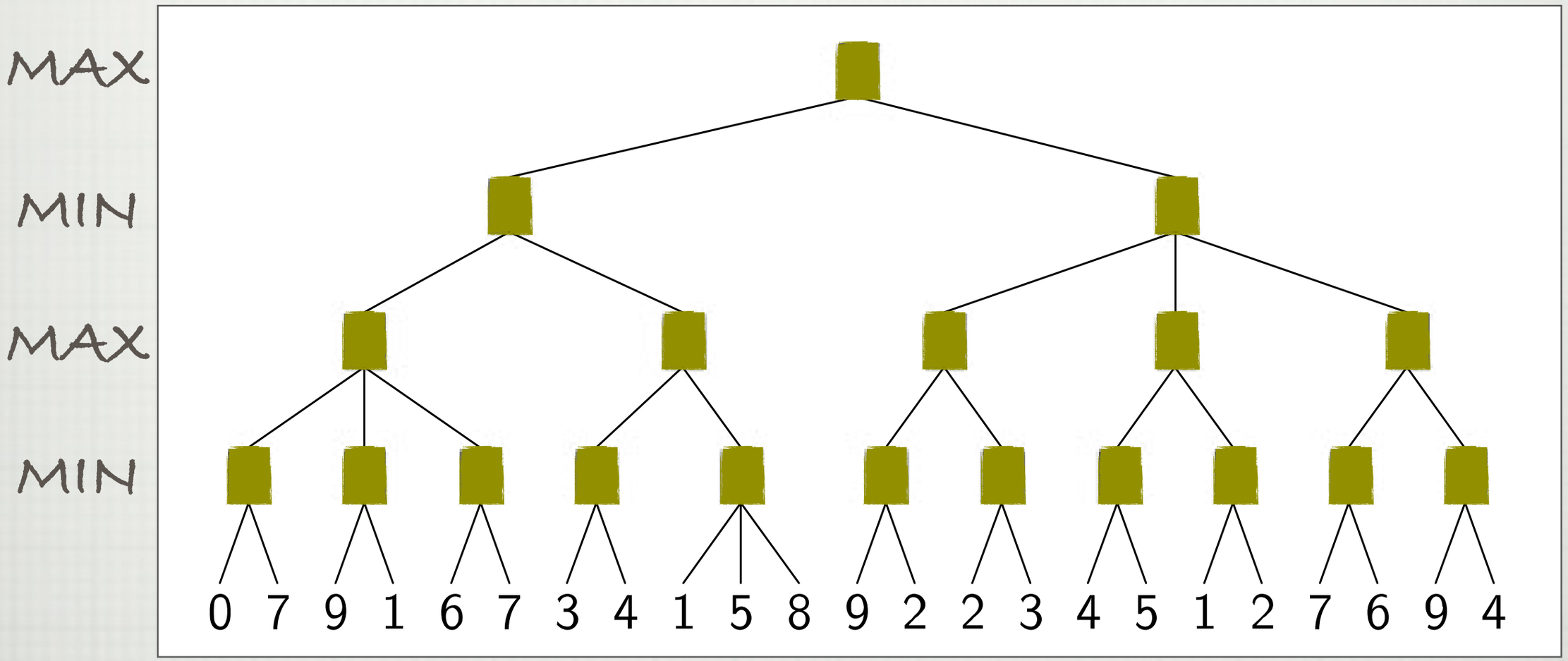

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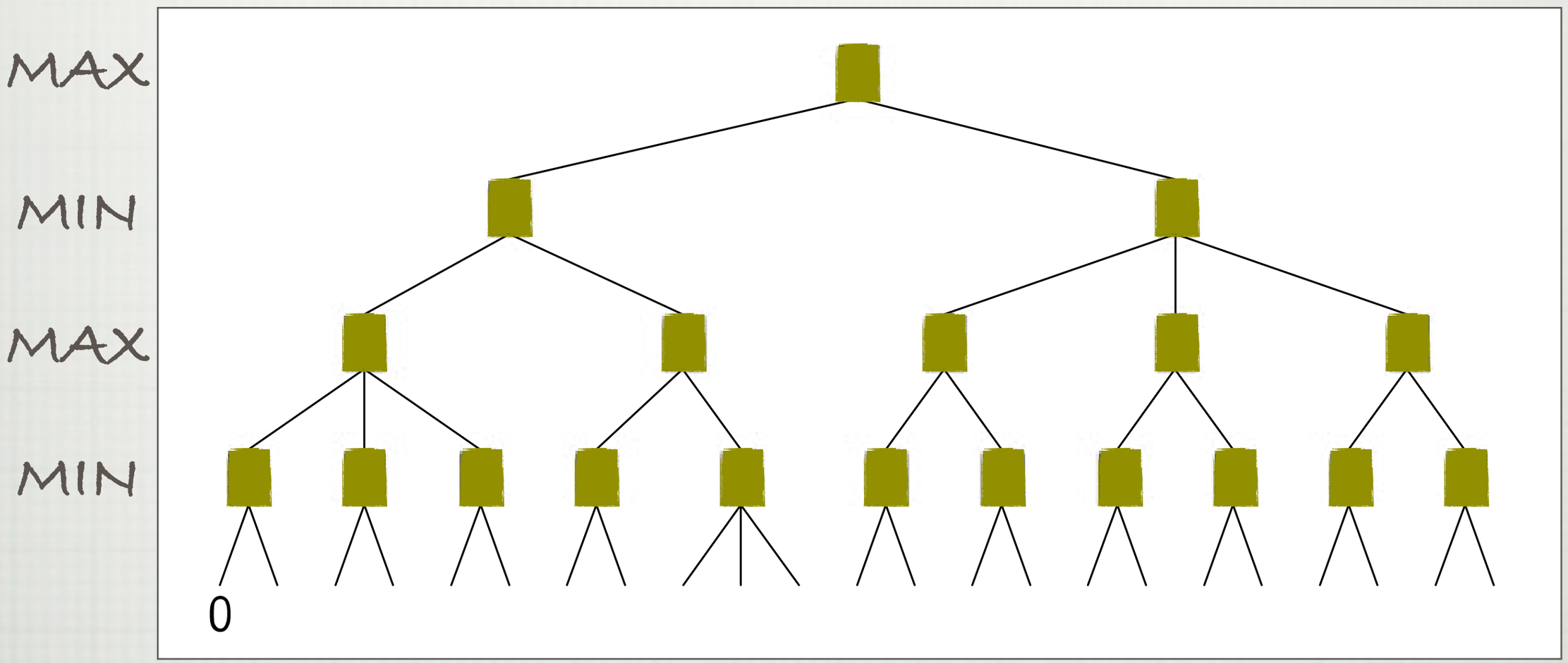

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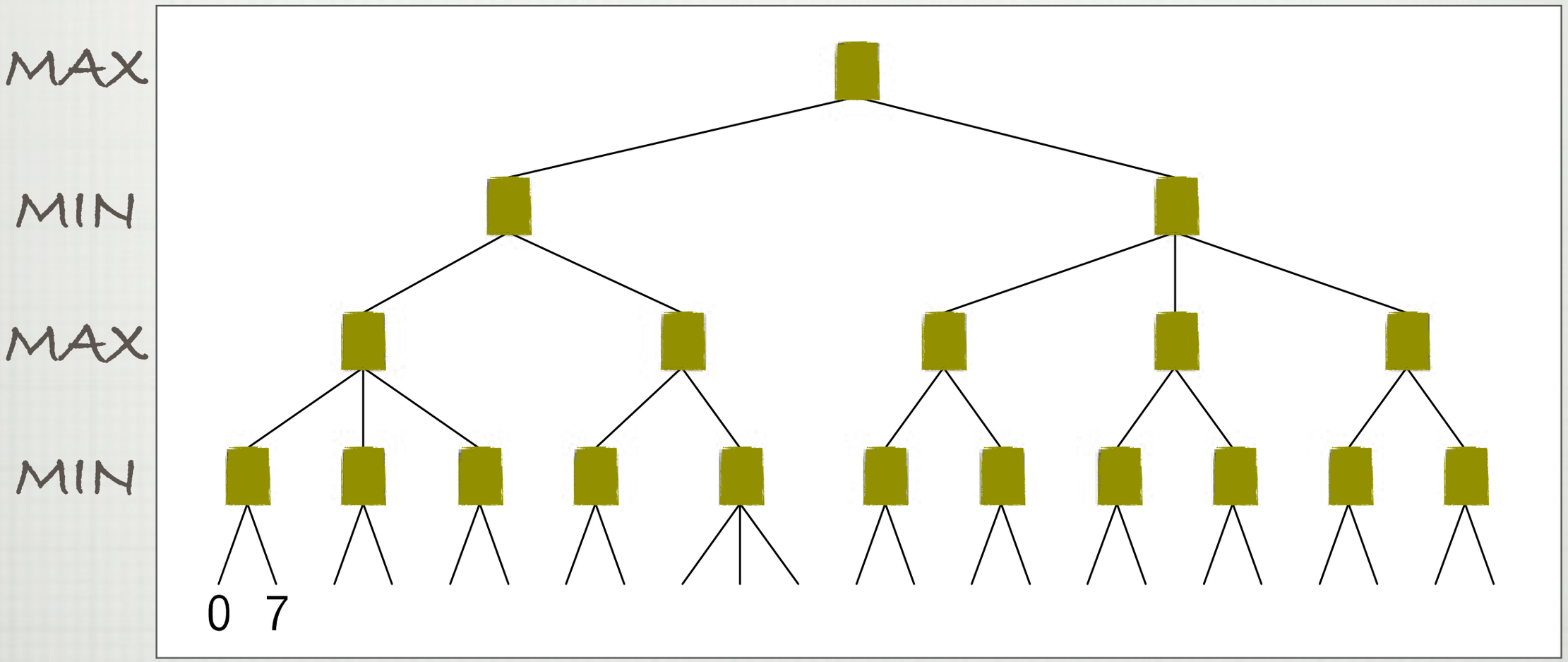

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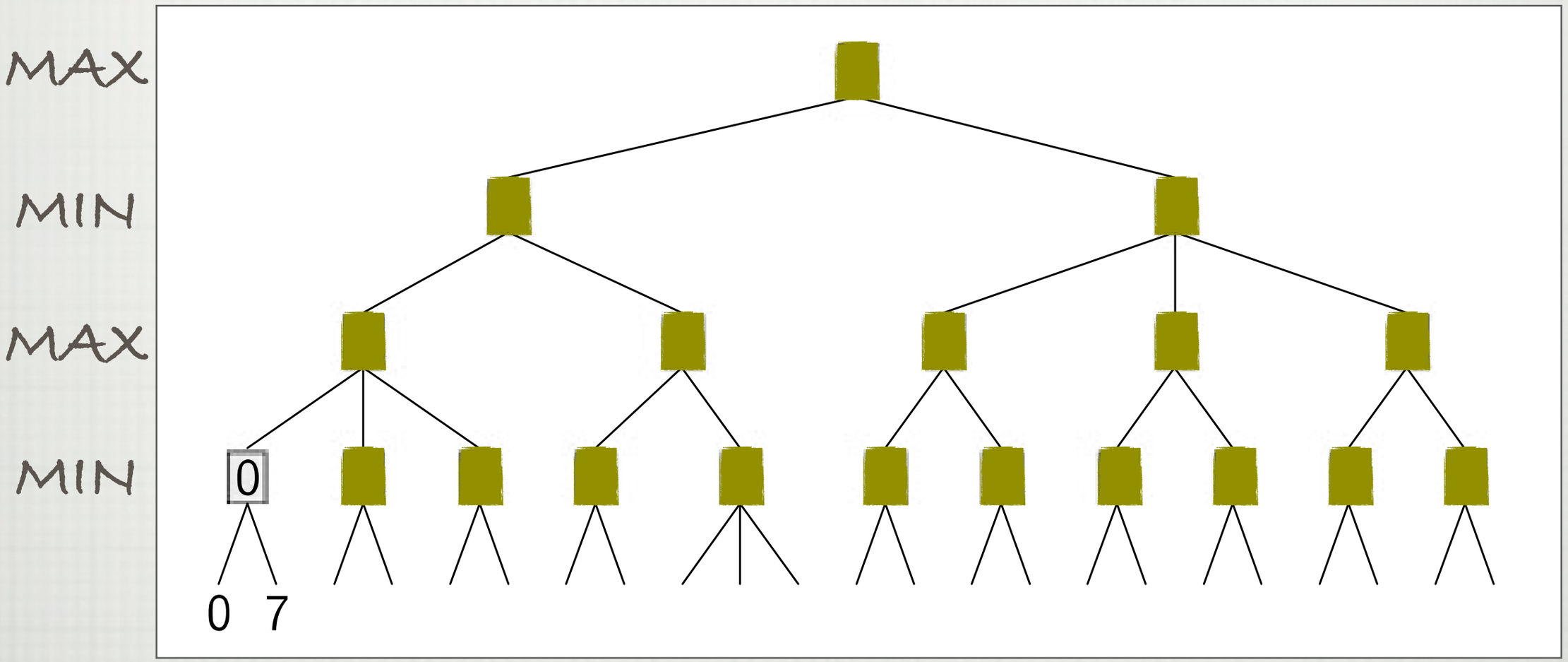

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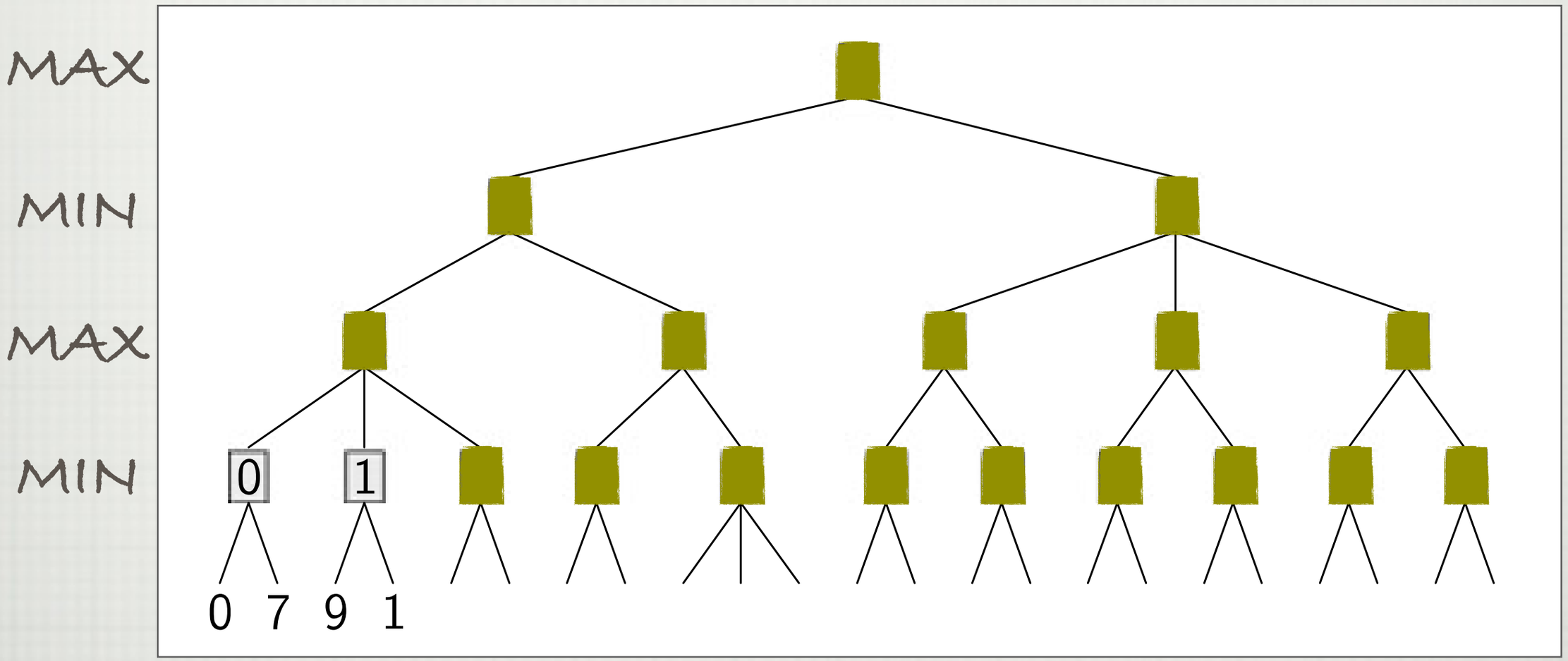

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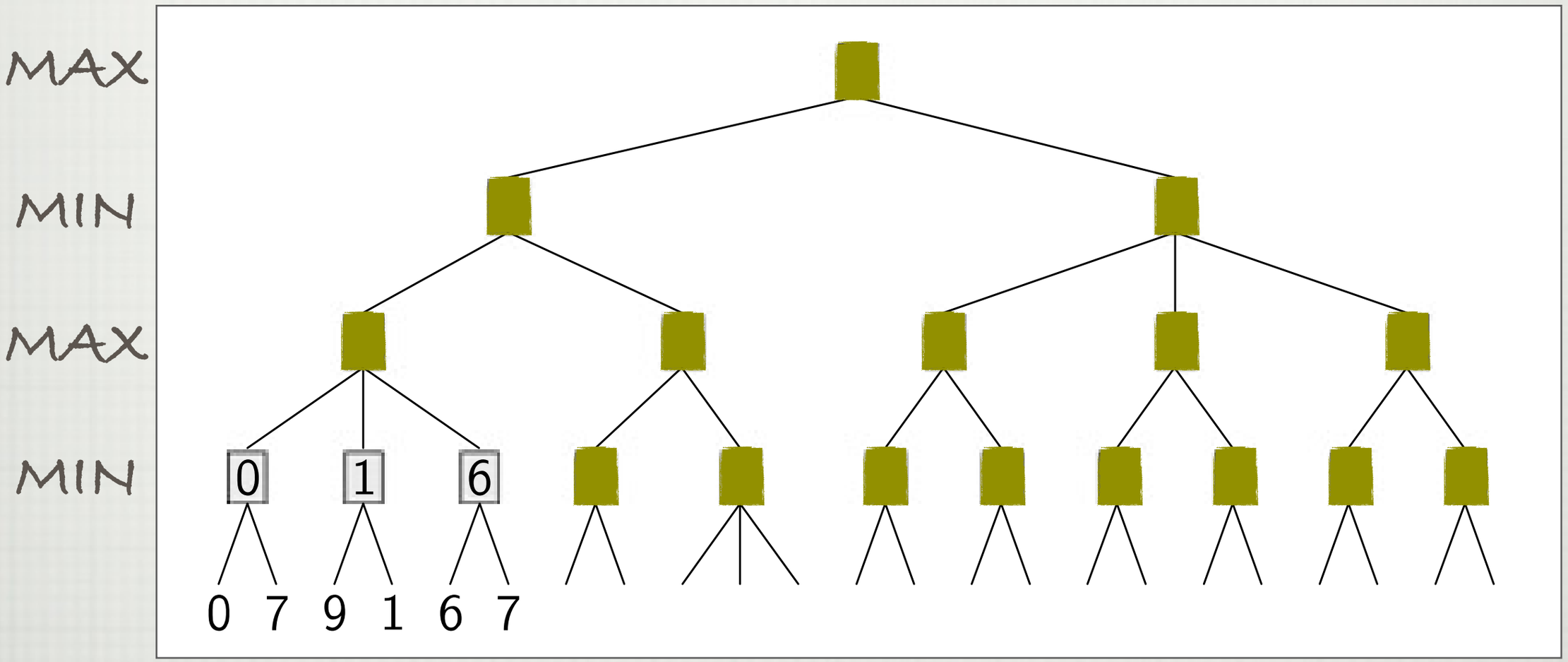

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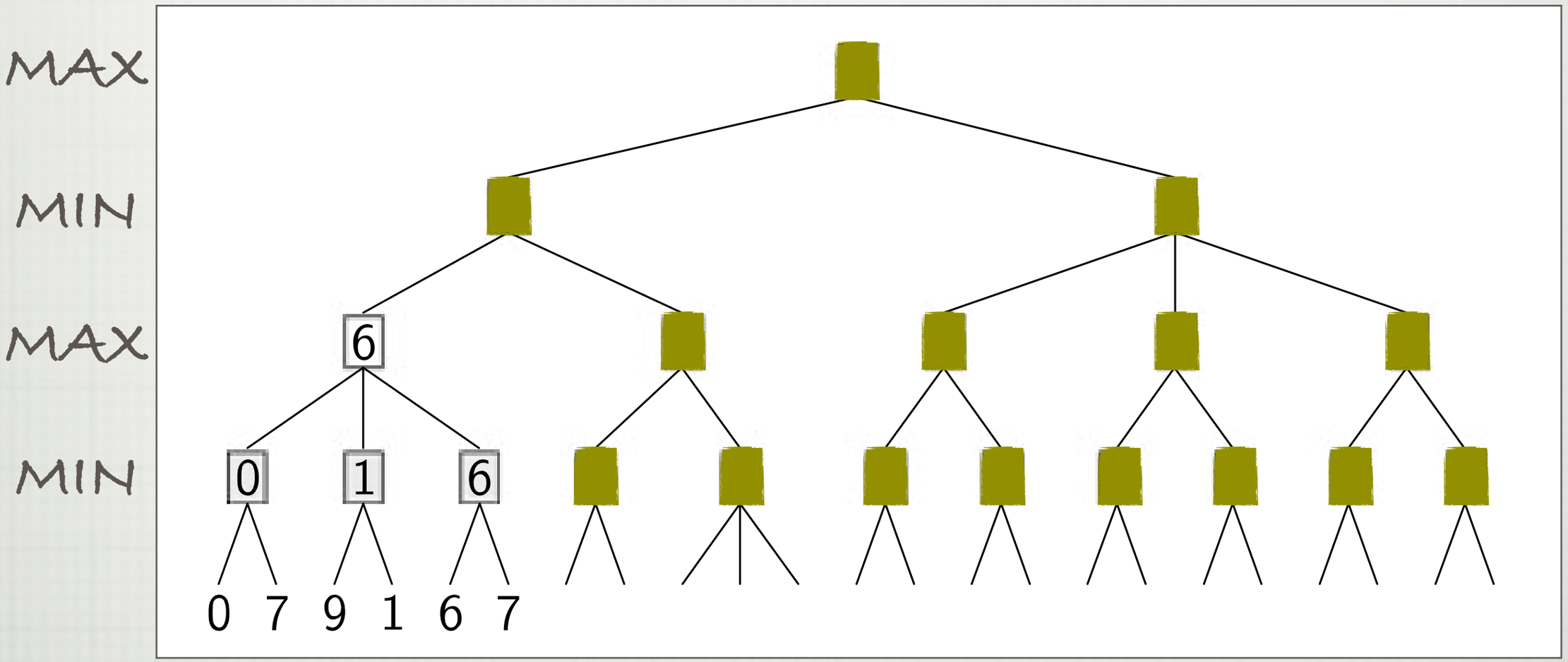

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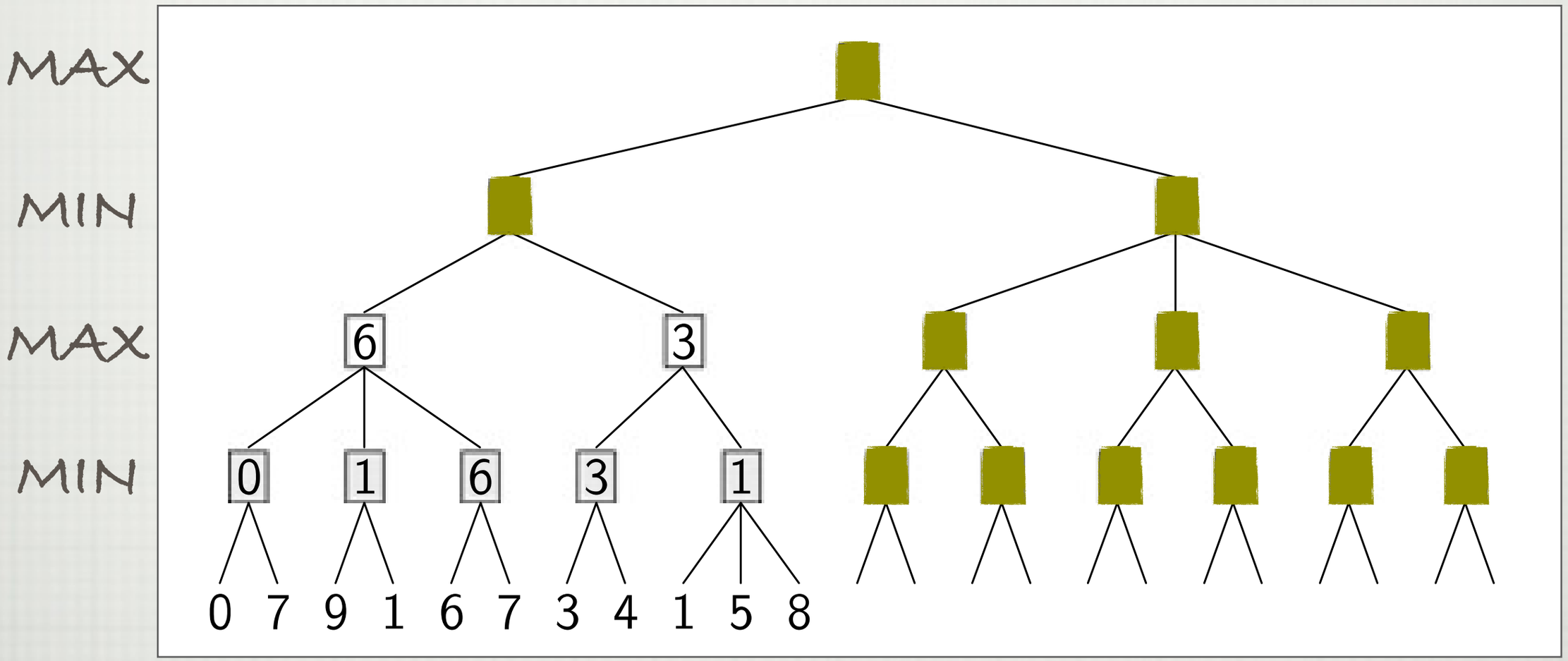

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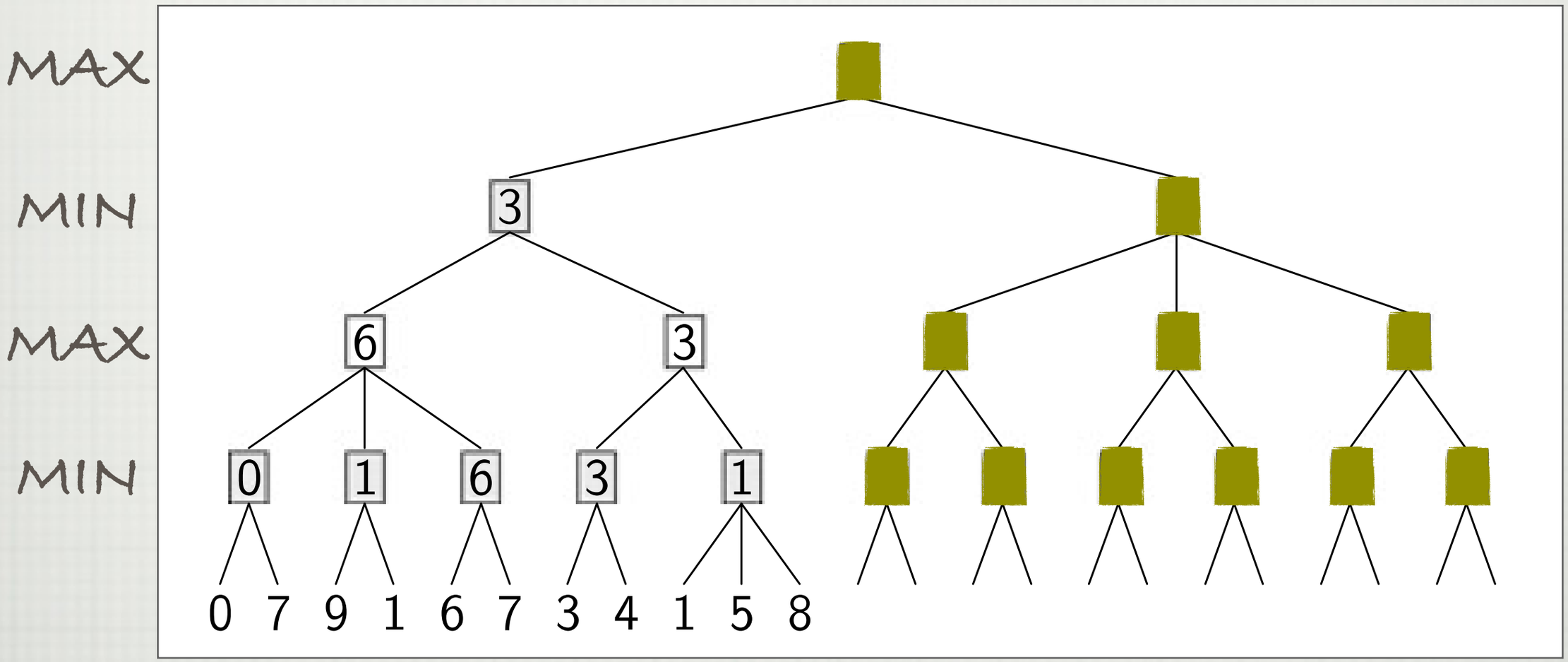

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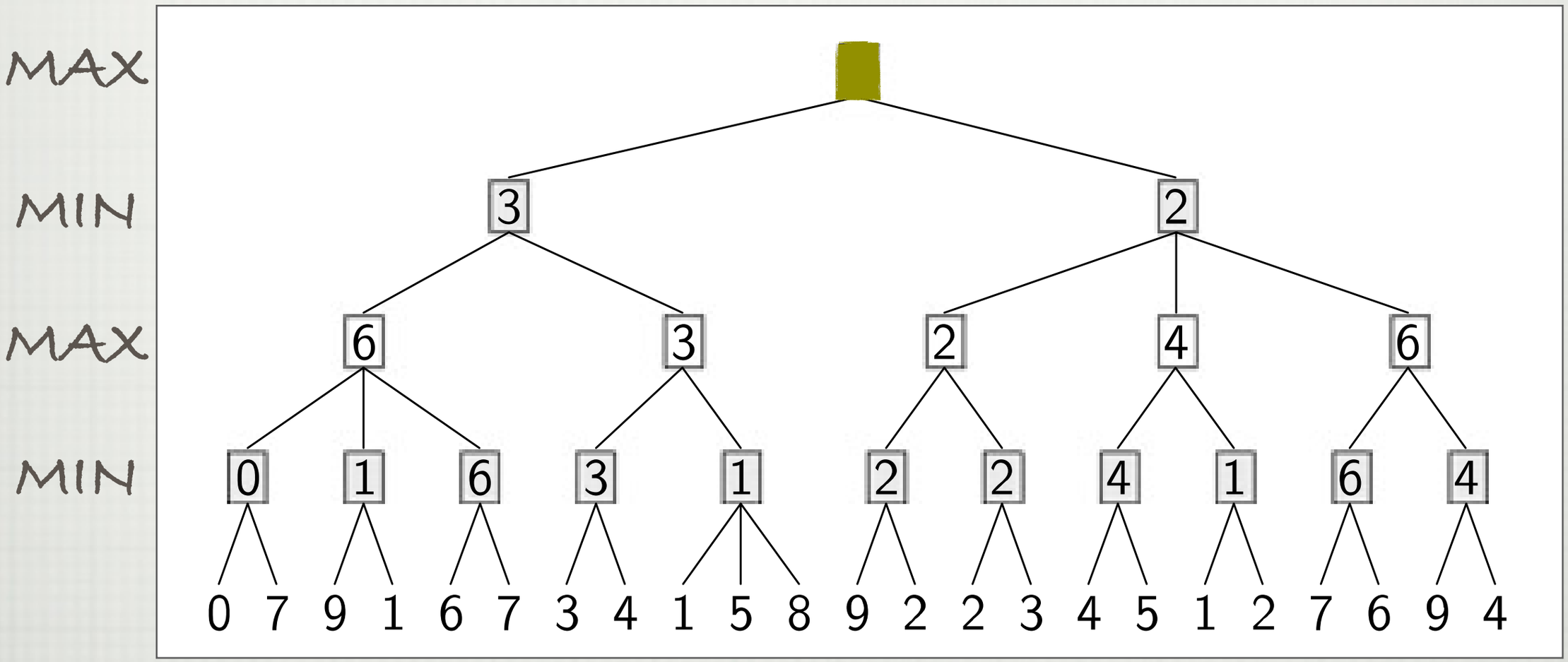
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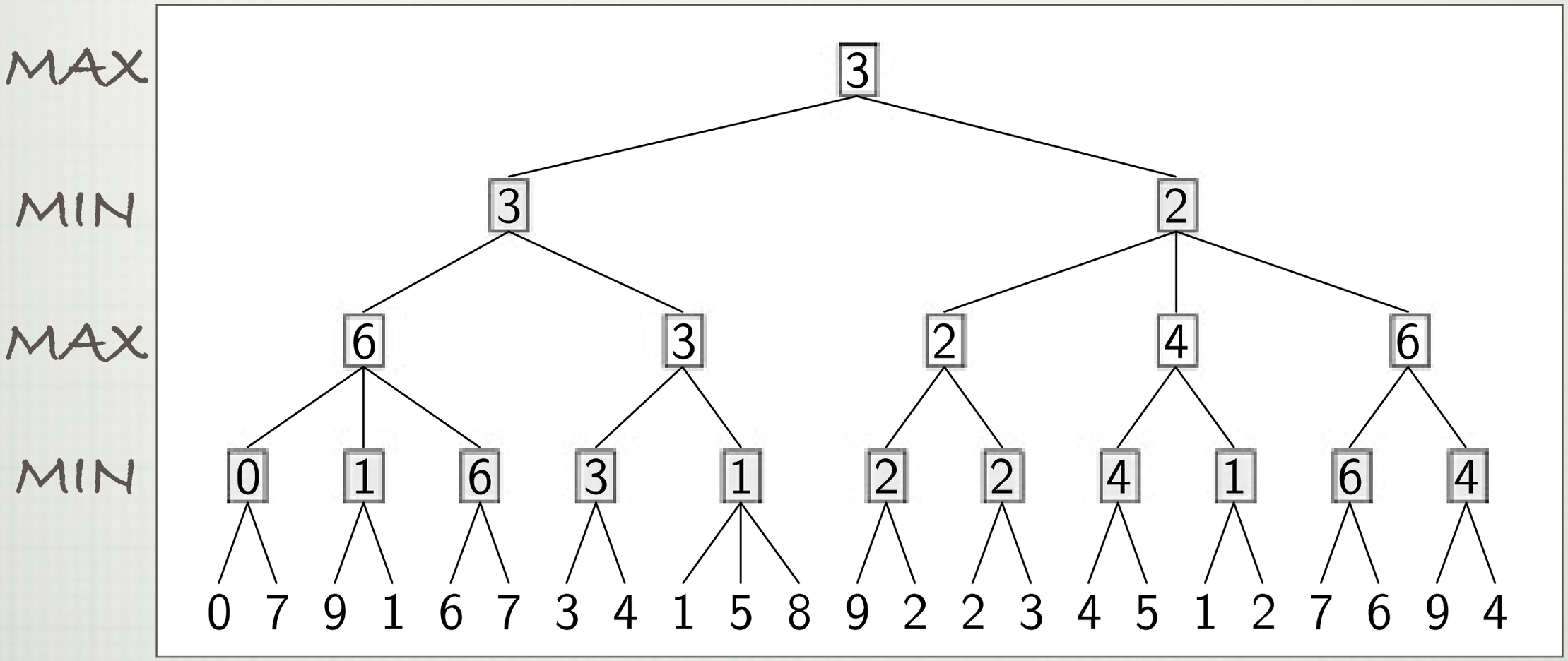
PELIPUU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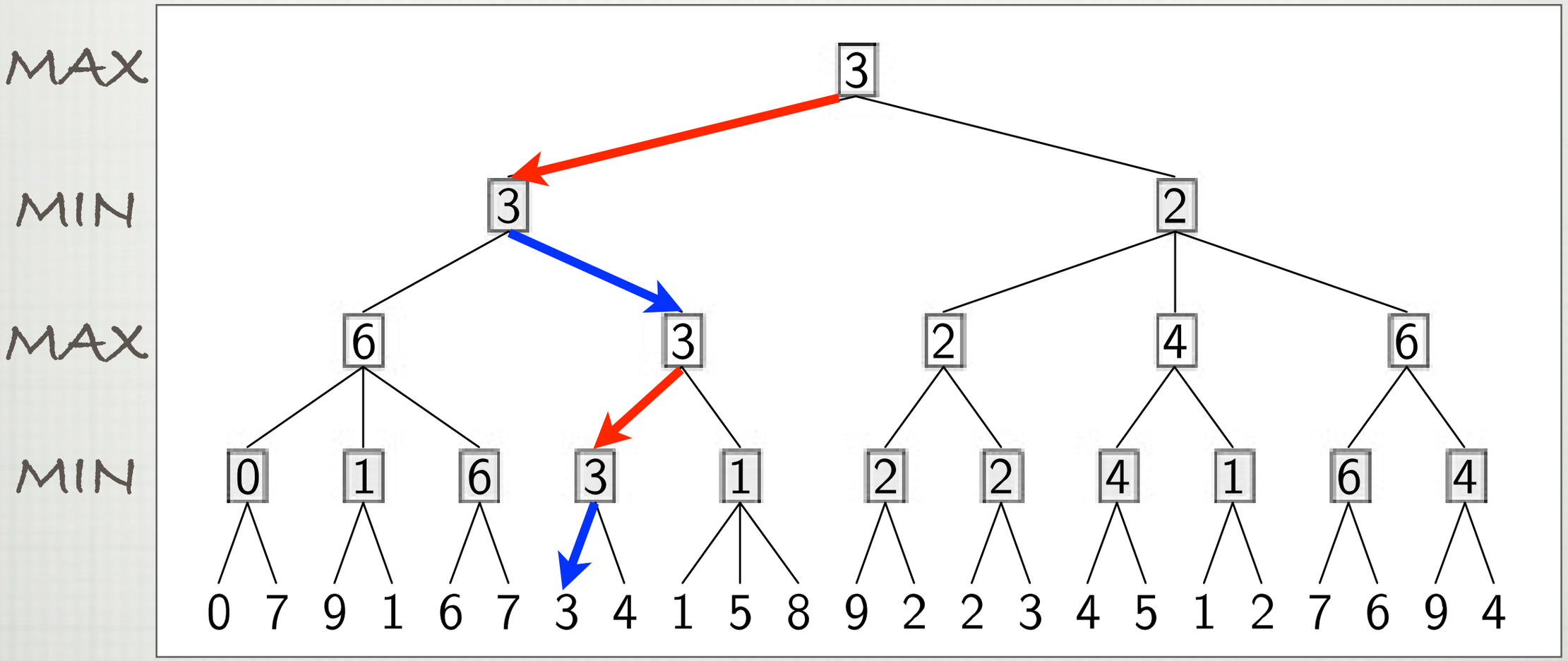
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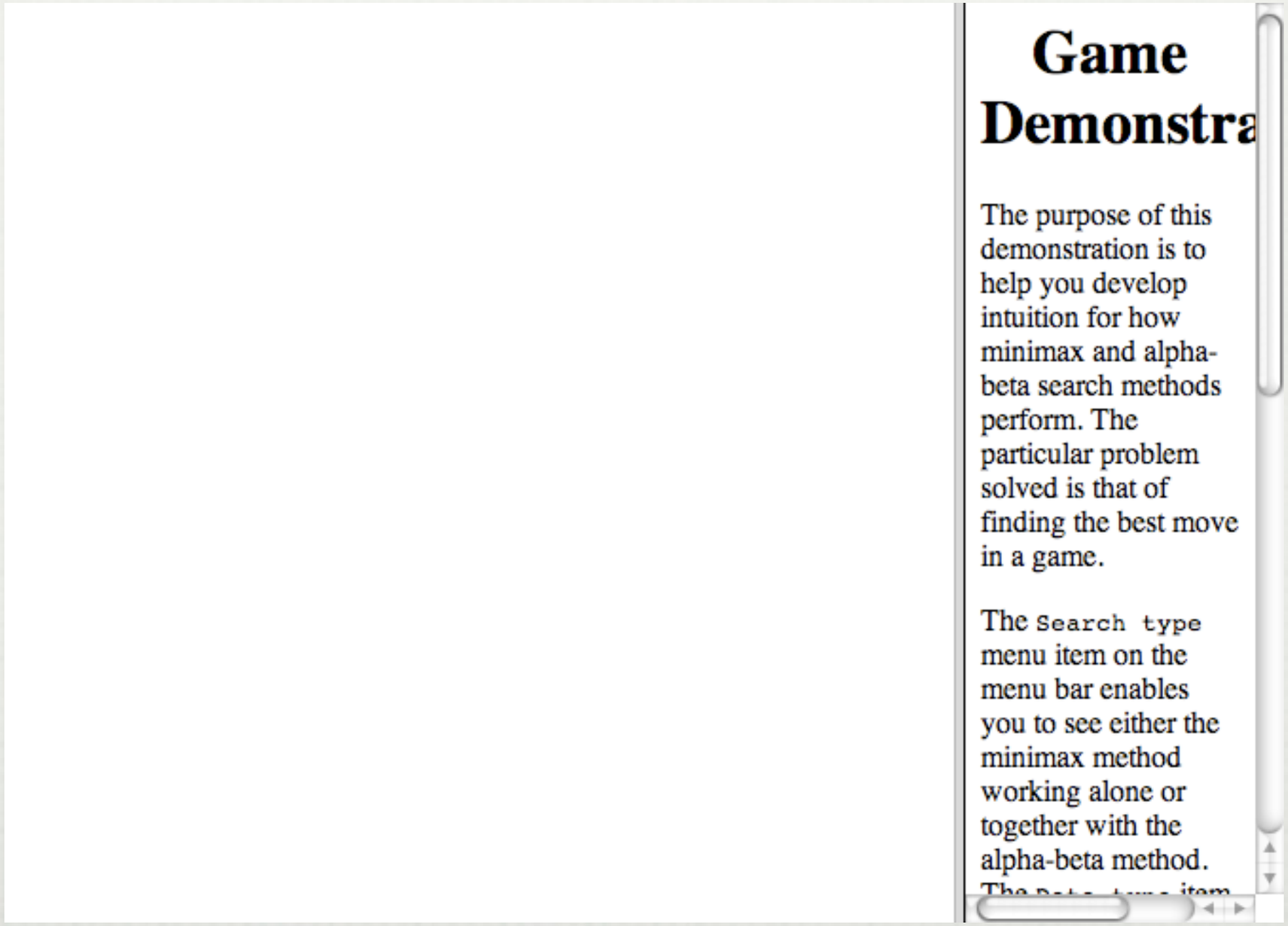
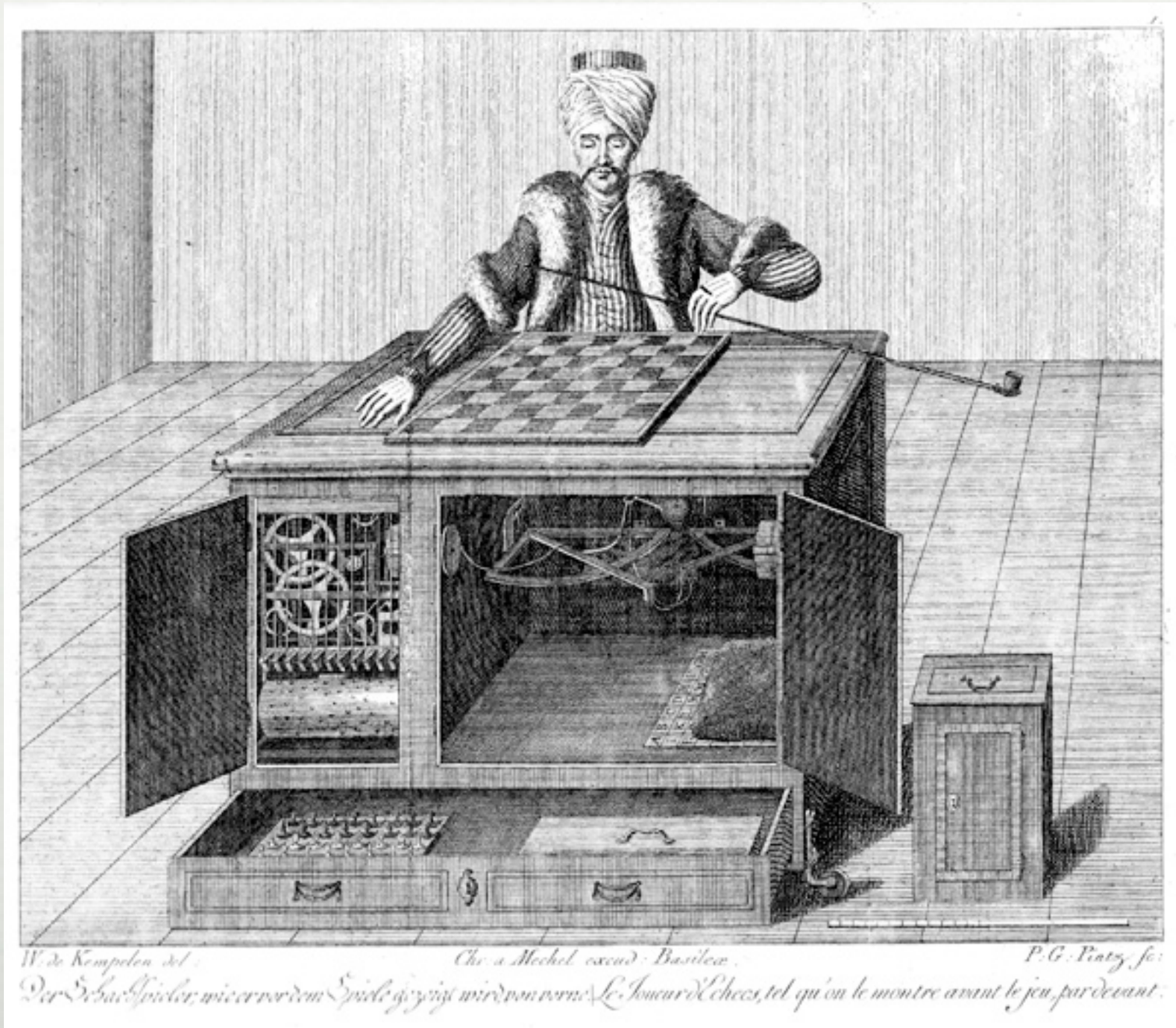
MINIMAX

```
MAX-ARVO(Solmu)

    if LOPPUTILA(Solmu) return(ARVO(Solmu))
    v = −∞
    for each Lapsi in LAPSET(Solmu)
        v = MAX(v, MIN-ARVO(Lapsi))
    return(v)


MIN-ARVO(Solmu)

    if LOPPUTILA(Solmu) return(ARVO(Solmu))
    v = +∞
    for each Lapsi in LAPSET(Solmu)
        v = MIN(v, MAX-ARVO(Lapsi))
    return(v)
```

MINIMAX


Game Demonstra
The purpose of this demonstration is to help you develop intuition for how minimax and alpha-beta search methods perform. The particular problem solved is that of finding the best move in a game.
The Search type menu item on the menu bar enables you to see either the minimax method working alone or together with the alpha-beta method.

SHAKKI



W. de Kempelen del. *Chr. a Mechel excud. Basileæ.* *P. G. Platz fc.*

Der Schachspieler, wie er vor dem Spiele gezeigt wird, von vorne. Le Joueur d'Echecs, tel qu'on le montre avant le jeu, par devant.

SHAKKI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Deep Blue beat G. Kasparov in 1997
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0:00 / 6:06
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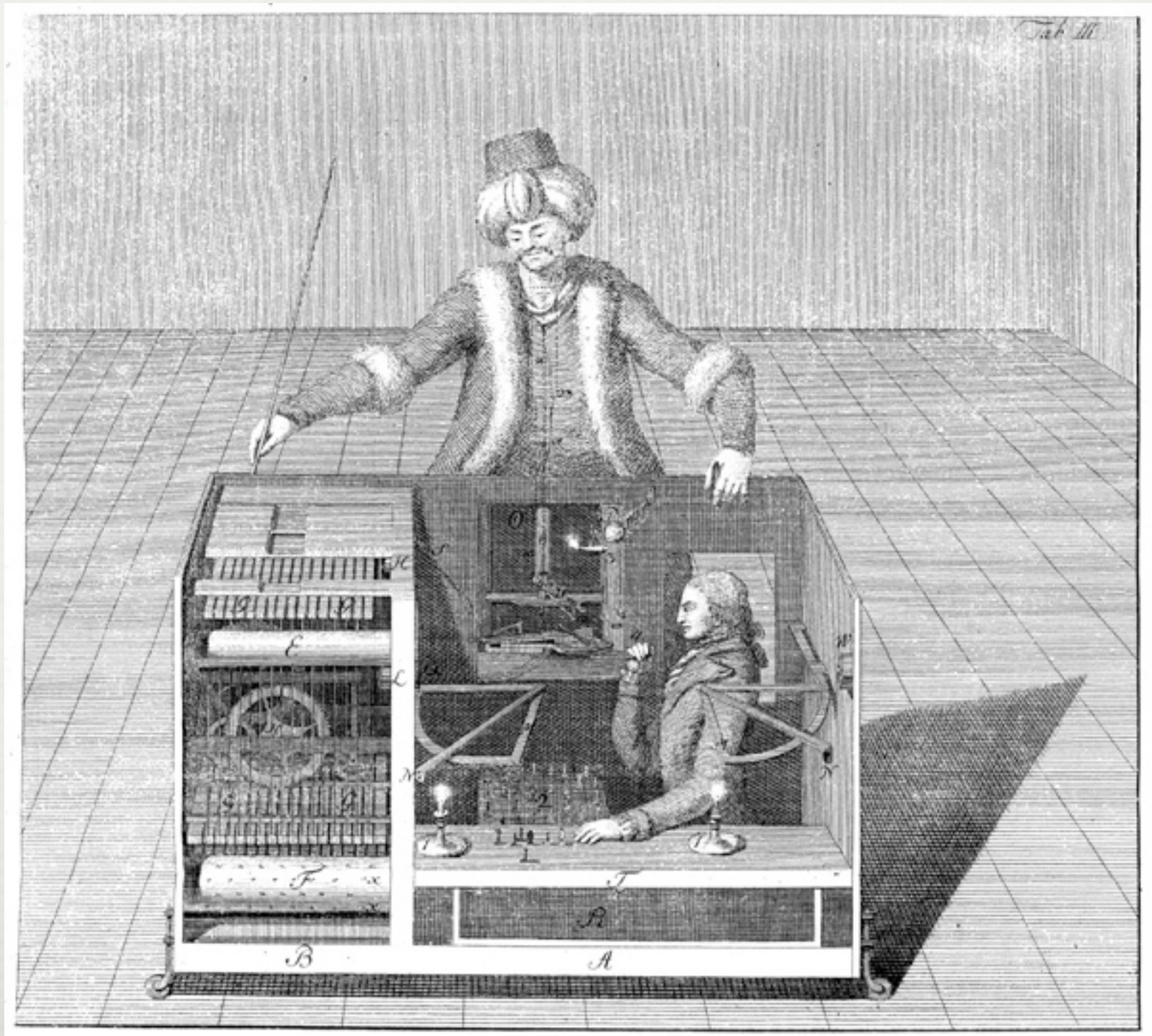
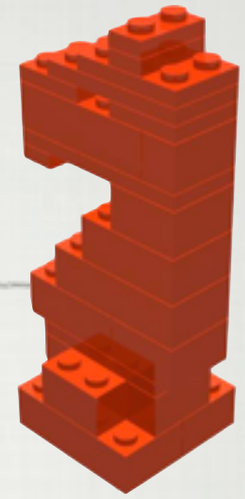
SHAKKI



SHAKKI

(NICE TO KNOW: EI TARVITSE OPETELLA)



1769 **Wolfgang von Kempelen** **rakentaa "Turkin"**

1912 **L. Torres y Quevedo** **rakentaa koneen kuningas&torni vs kuningas -loppupeleihin**

1948 **Norbert Wiener** **esittää syvyysrajoitetun minimax-algoritmin heuristisella arviontifunktiolla**

1950 **Claude Shannon** **julkaisee artikkelin "Programming a Computer for Playing Chess"**

1951 **Alan Turing** **kehittää ensimmäisen algoritmin, joka pystyy pelaamaan kokonaisen shakkiottelun**

1956 **Los Alamos chess: ensimmäinen tietokoneohjelma, joka pelaa (yksinkertaistettua) shakkia**

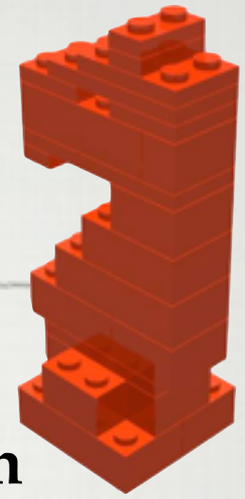
1956 **John McCarthy** **keksii alpha-beta-karsinnan**

1957 **Ensimmäiset oikeaa shakkia pelaavat ohjelmat**

1966-67 **Ensimmäiset tietokoneohjelmien väliset ottelut (Moskova voittaa.)**

SHAKKI

(NICE TO KNOW: EI TARVITSE OPETELLA)



1967 **Ensimmäinen tietokoneohjelman voitto turnauksessa.**

1981 **Cray Blitz voittaa Mississippin osavaltion mestaruuden ja saa ensimmäisenä tietokoneena mestarin statuksen.**

1988 **Deep Thought voittaa ensimmäistä kertaa suurmestarin turnauksessa.**

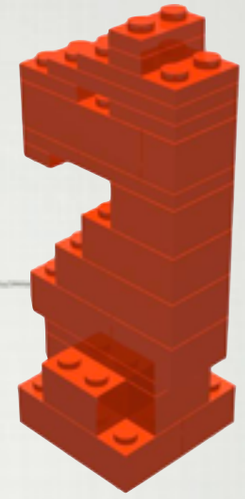
1989 **Garry Kasparov voittaa kaksi näytösottelua Deep Thoughtia vastaan.**

1996 **Garry Kasparov voittaa Deep Bluen kuuden pelin ottelussa.**

1997 **Deep Blue voittaa Garry Kasparovin kuuden pelin ottelussa.**

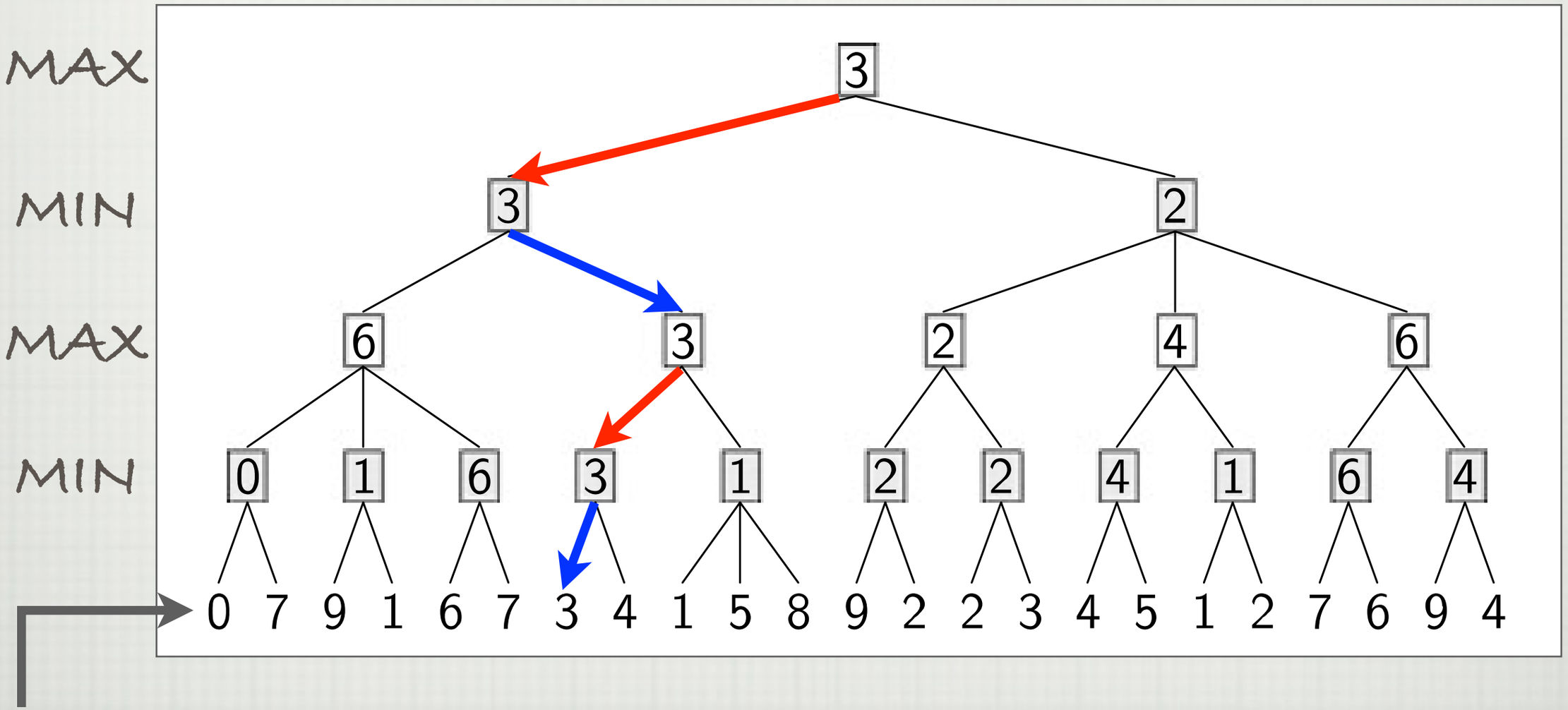
2006 **Deep Fritz voittaa maailmanmestari Vladimir Kramnikin.**

SHAKKI



- TILA: (LAUDAN TILANNE)
- SIIRTYMÄT: (SALLITUT SIIRROT)
- MENETELMÄ: SYVYYSRAJOITETTU ALPHA-BETA-KARSINTA

PELIPUU



ARVIOITA TILANTEEN HYVYYDESTÄ

SHAKKI

- TILA: (LAUDAN TILANNE)
- SIIRTYMÄT: (SALLITUT SIIRROT)
- MENETELMÄ: SYVYYSRAJOITETTU ALPHA-BETA-KARSINTA
- TEHTÄVÄ: SUUNNITTELE HEURISTINEN ARVIOINTIFUNKTIO

HEURISTIIKKOJEN VALINNASTA

(NICE TO KNOW: EI TARVITSE OPETELLA)

- HEURISTIIKAN HYVYYS VAIKUTTAA PELIN TULOKSEEN:
  HYVÄ HEURISTIIKKA -> HYVÄ TULOS

- VASTAAVASTI HEURISTIIKAN HYVYYTTÄ VOI MITATA TARKKAILEMALLA PELIEN TULOKSIA:
  HYVÄ TULOS -> HYVÄ HEURISTIIKKA

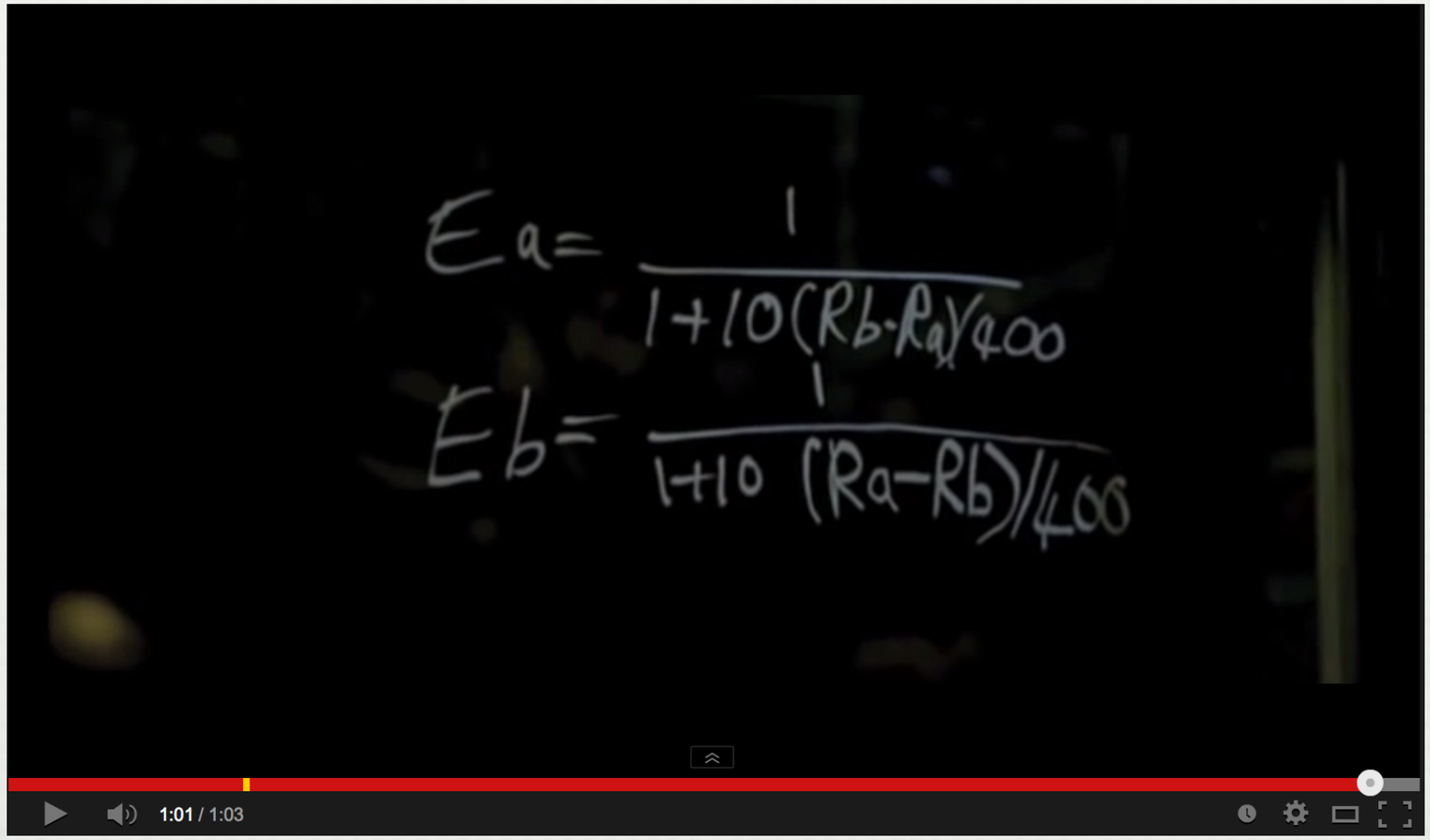
- JOSKUS HYVÄKIN PELAAJA VOI SILTI HÄVITÄ HUONOMMALLEEN JA TOISINPÄIN, JOTEN ARVIOINTI EI OLE HELPPOA

- YLEINEN MENETELMÄ HYVYYDEN ARVIONTIIN:
  ELO-RATING

HEURISTIIKKOJEN VALINNASTA

(NICE TO KNOW: EI TARVITSE OPETELLA)

ELO RATING – "I NEED THE ALGORITHM"



The Social Network

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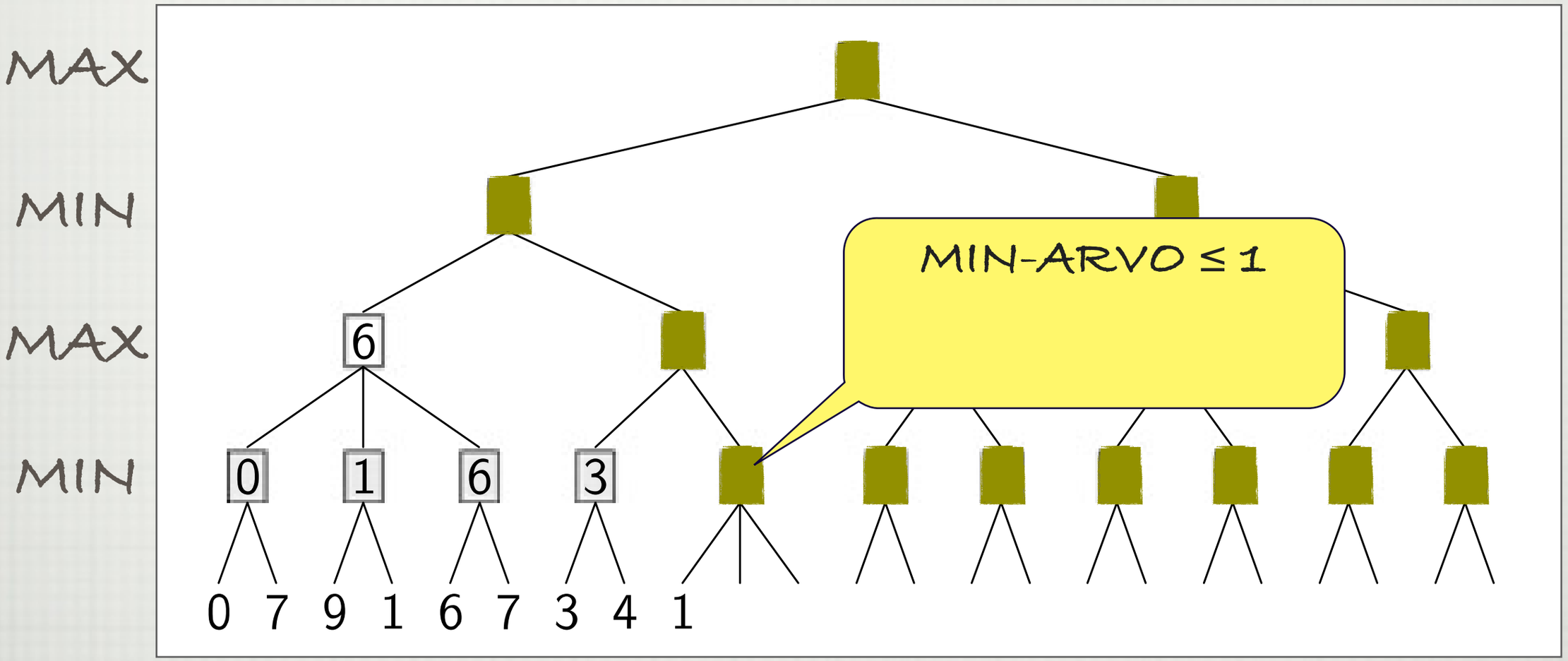
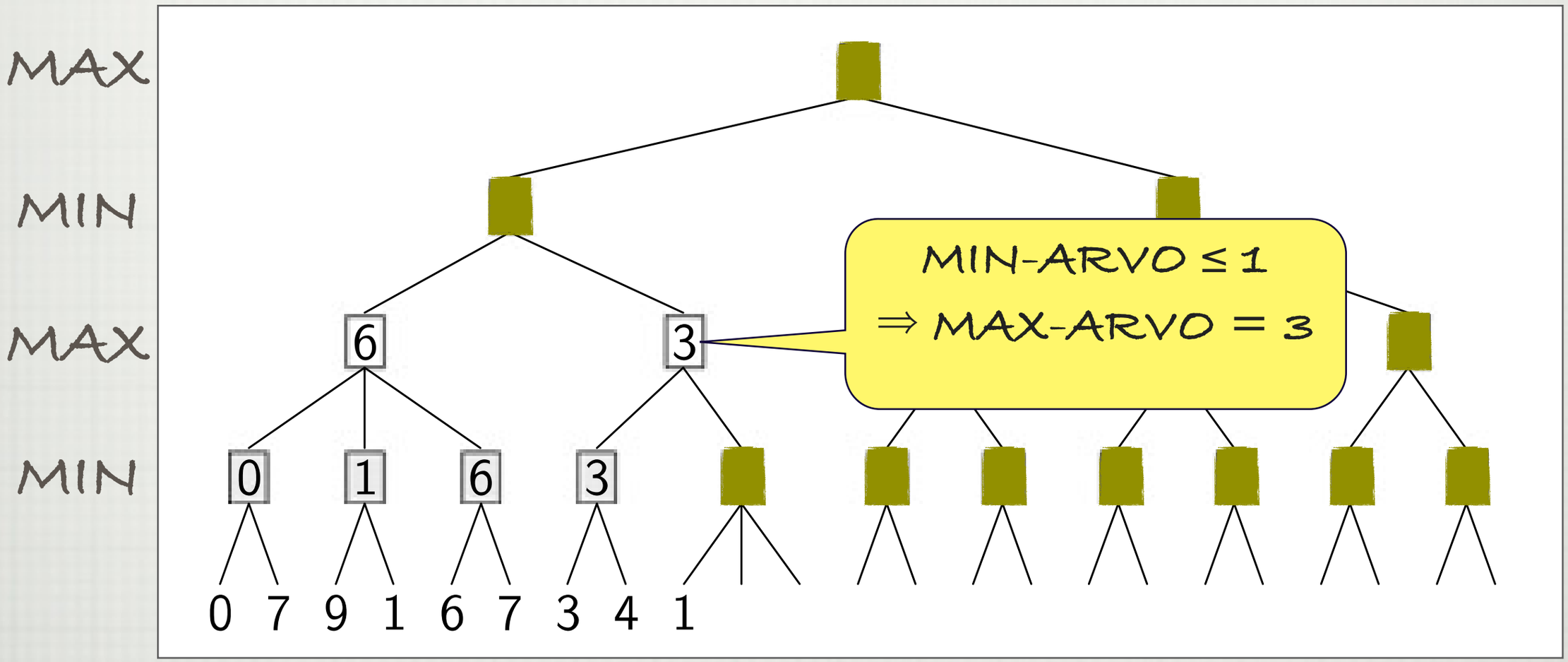
ARPAPELIT

ALPHA-BETA-KARSINTA



ALPHA-BETA-KARSINTA



ALPHA-BETA-KARSINTA

MAX-ARVO(Solmu, α, β)

if LOPPUTILA(Solmu) **return**(ARVO(Solmu))
v = $-\infty$
for each Lapsi in LAPSET(Solmu)
  v = MAX(v, MIN-ARVO(Lapsi, α, β))
  if v $\geq \beta$ **return**(v)
  α = MAX(α, v)
return(v)

MIN-PELAAJAN TOISTAISEKSI PARAS ARVO

MAX-PELAAJAN TOISTAISEKSI PARAS ARVO

ALPHA-BETA-KARSINTA

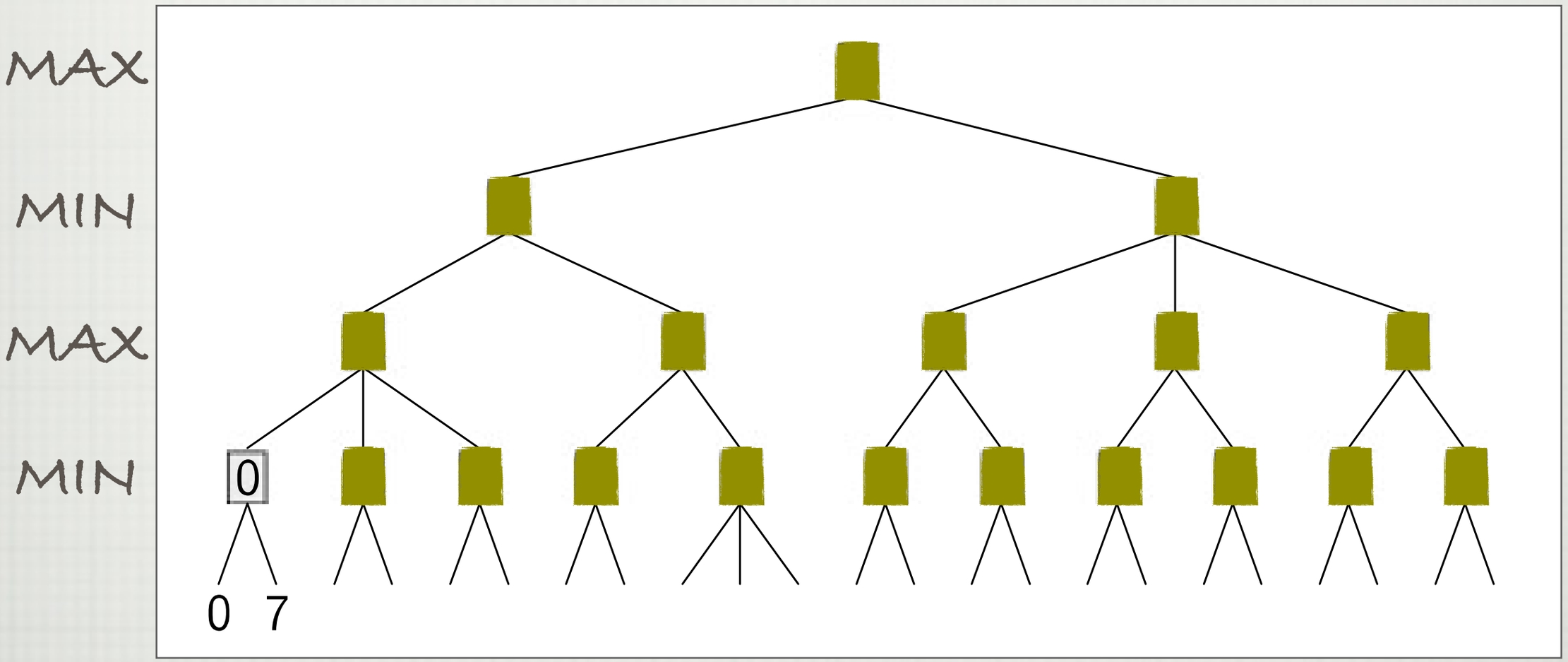
```
MAX-ARVO(Solmu, α, β)

    if LOPPUTILA(Solmu) return(ARVO(Solmu))
    v = −∞
    for each Lapsi in LAPSET(Solmu)
        v = MAX(v, MIN-ARVO(Lapsi, α, β))
        if v ≥ β return(v)
        α = MAX(α, v)
    return(v)
```

```
MIN-ARVO(Solmu, α, β)

    if LOPPUTILA(Solmu) return(ARVO(Solmu))
    v = +∞
    for each Lapsi in LAPSET(Solmu)
        v = MIN(v, MAX-ARVO(Lapsi, α, β))
        if v ≤ α return(v)
        β = MIN(β, v)
    return(v)
```

ALPHA-BETA-KARSINTA



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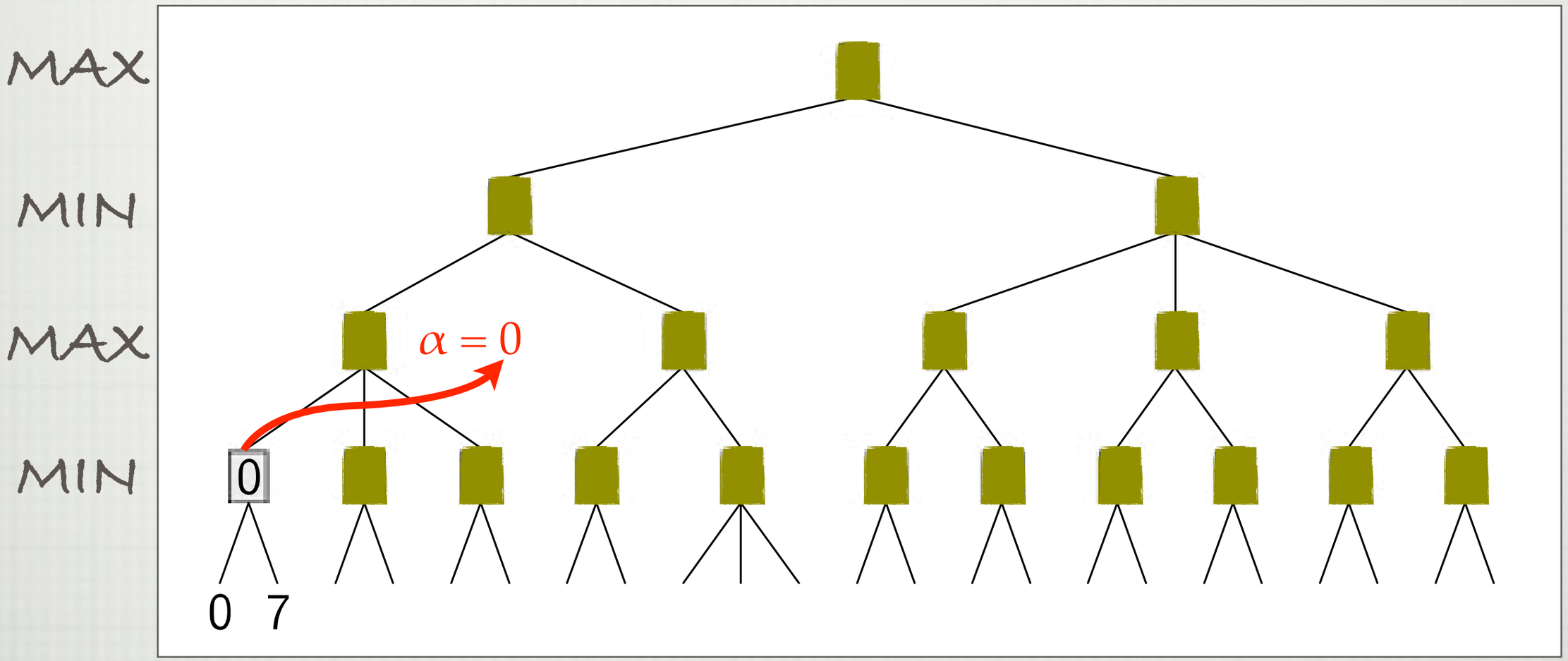

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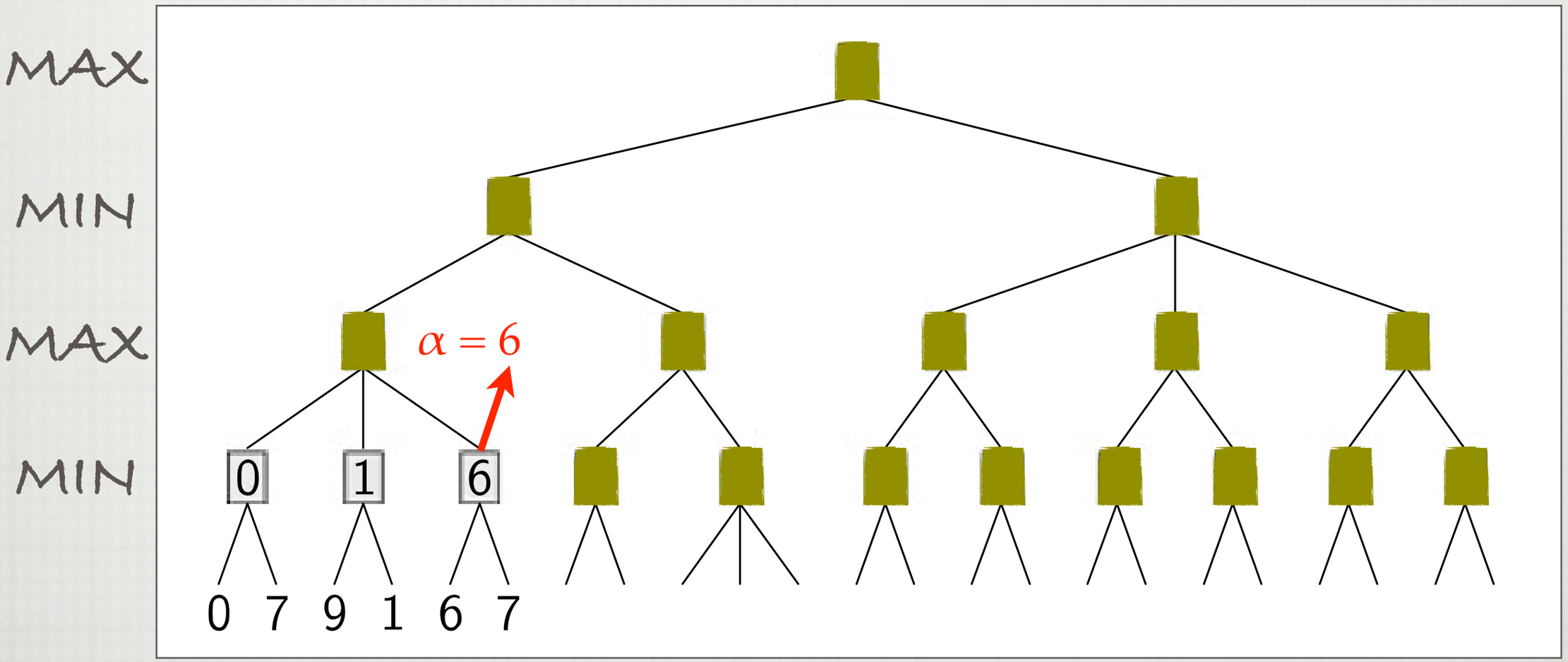

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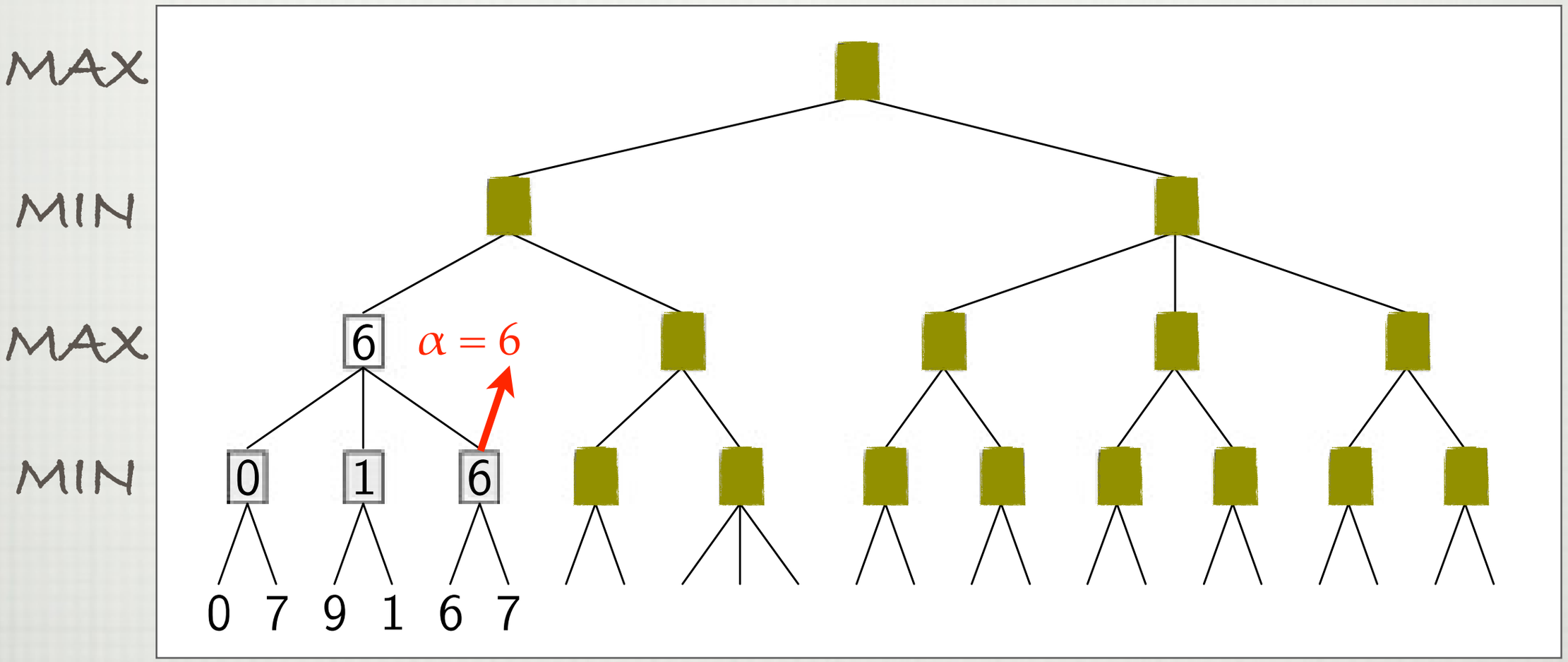

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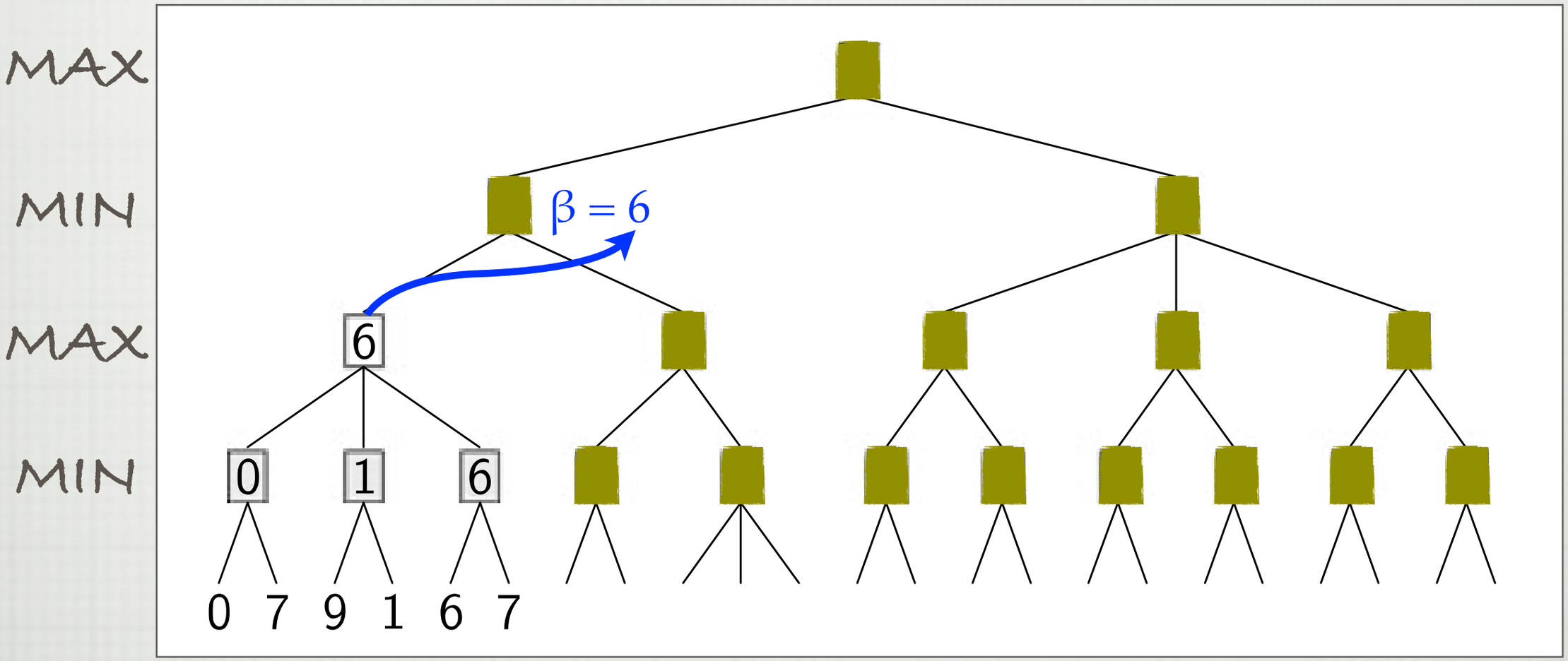

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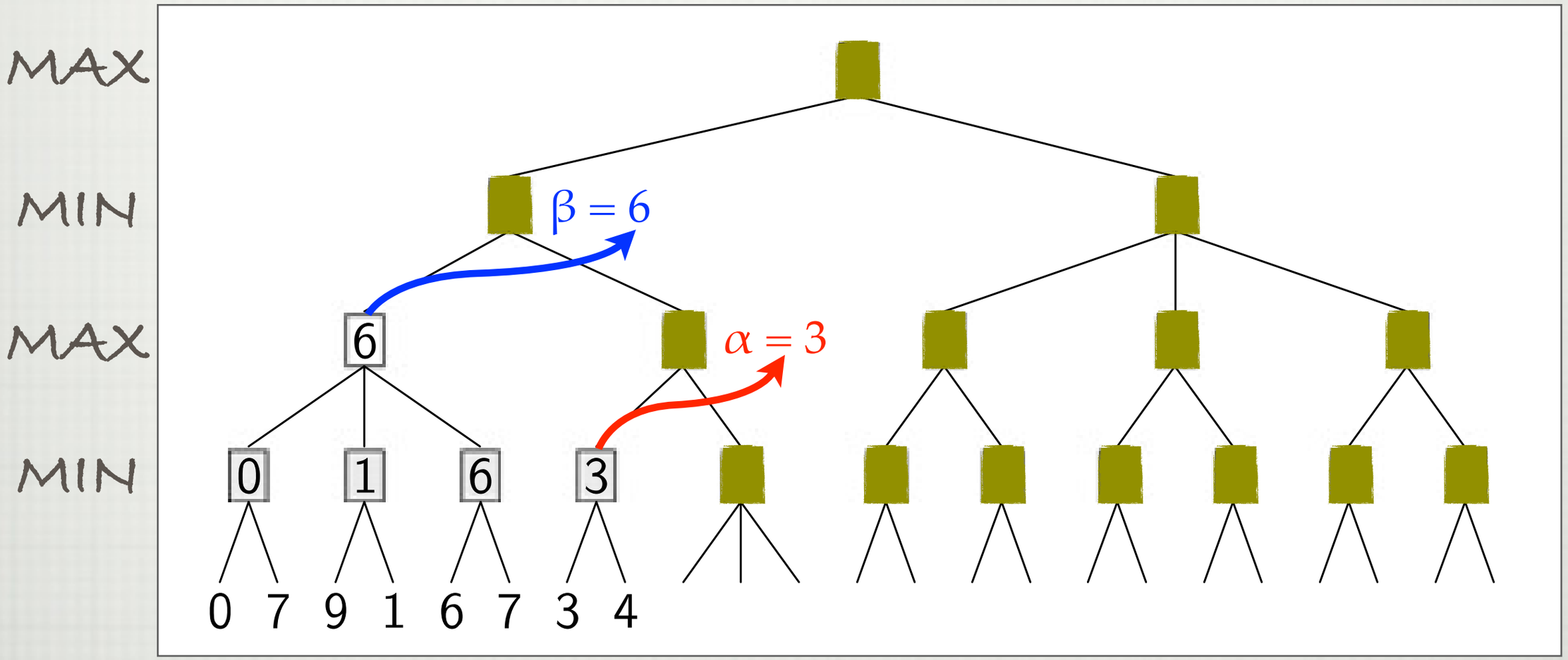

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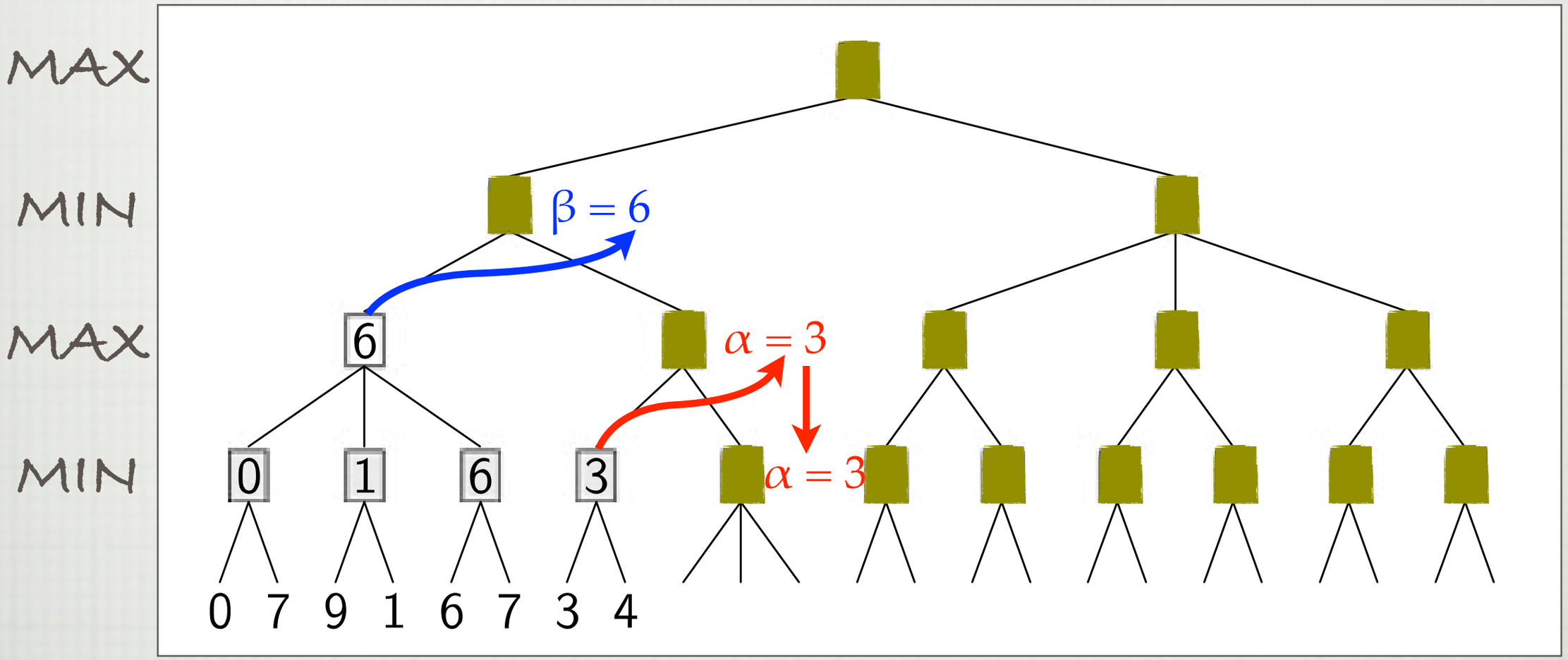
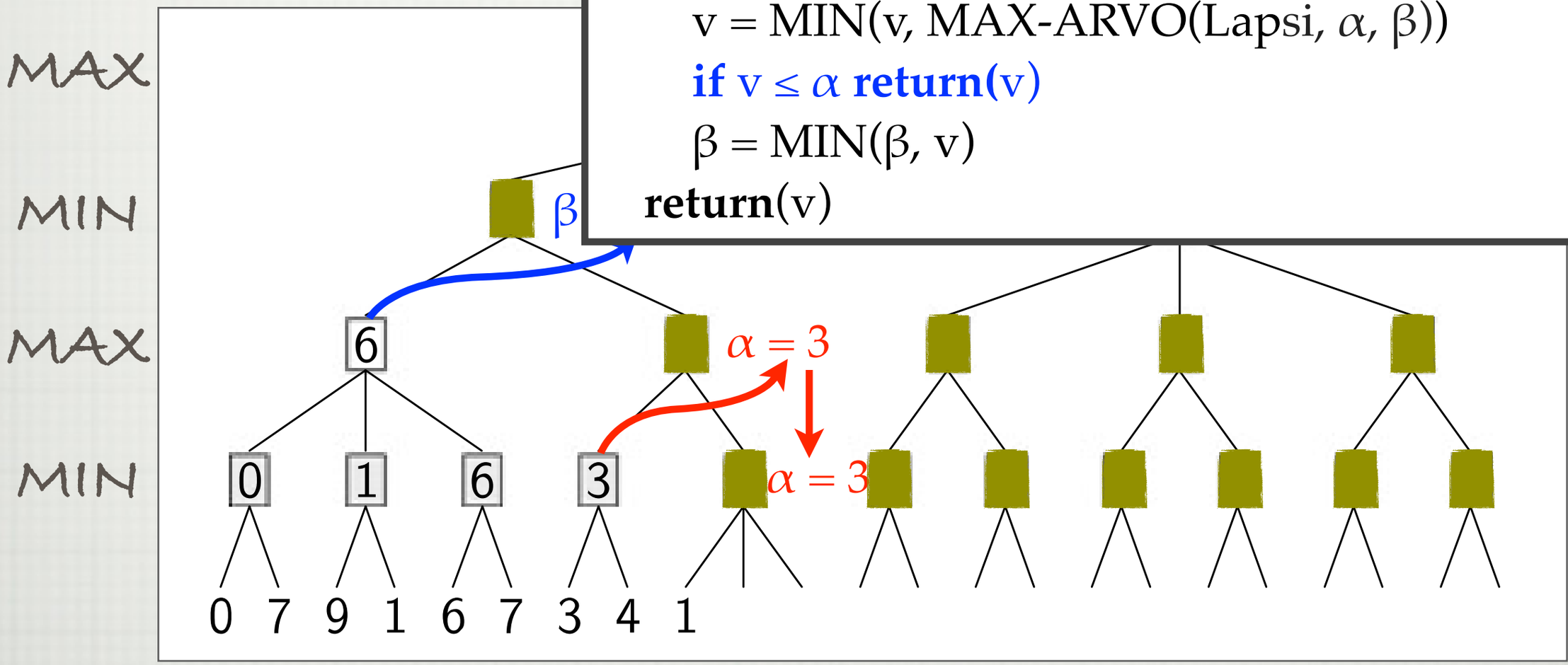


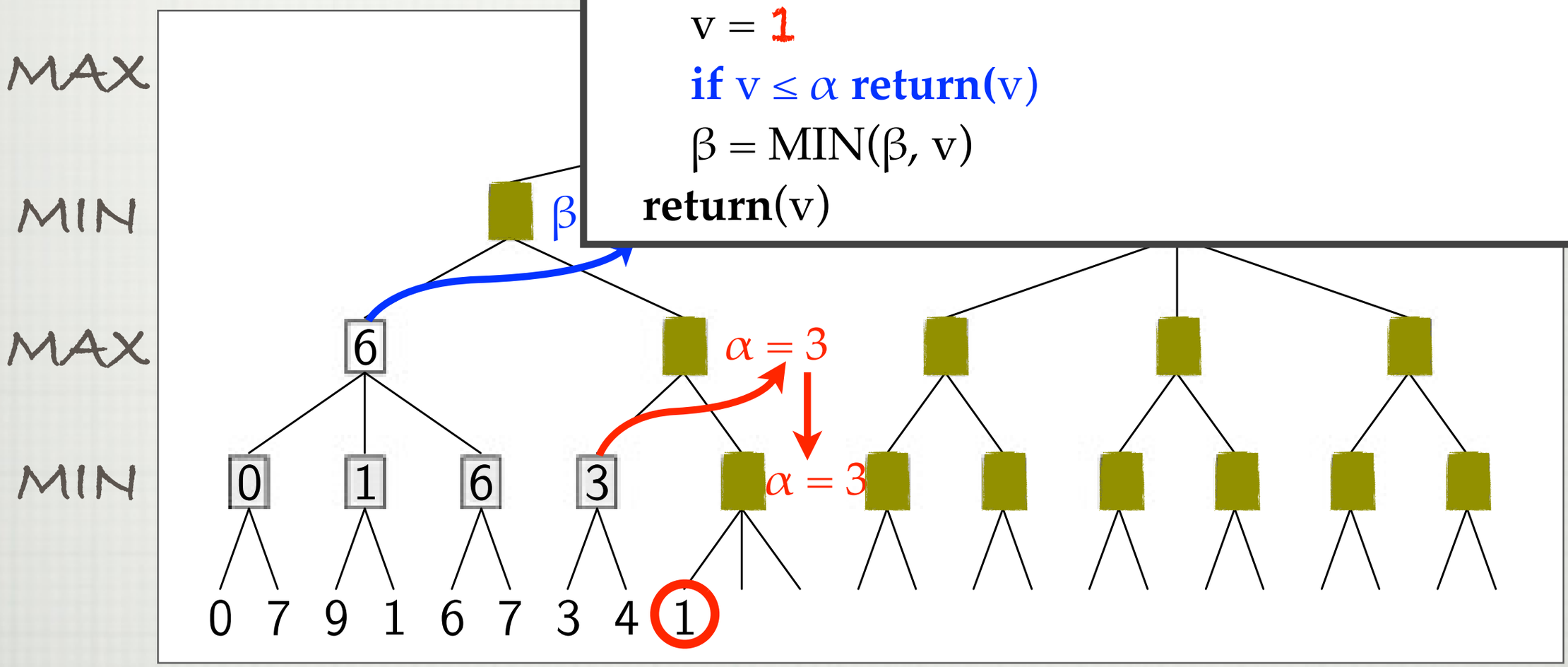
ALPHA

```
MIN-ARVO(Solmu, α, β)

  if LOPPUTILA(Solmu) return(ARVO(Solmu))
  v = +∞
  for each Lapsi in LAPSET(Solmu)
      v = MIN(v, MAX-ARVO(Lapsi, α, β))
      if v ≤ α return(v)
      β = MIN(β, v)
  return(v)
```



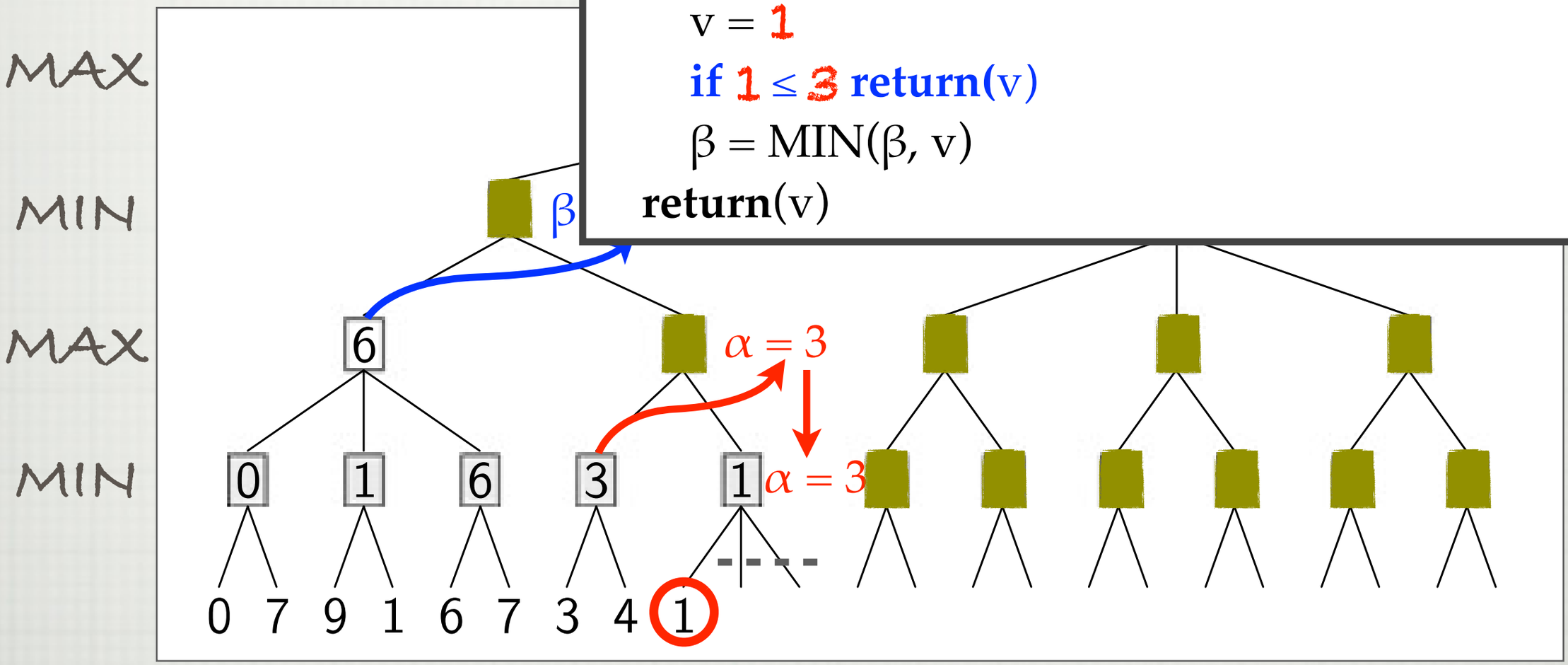
ALPHA

```
MIN-ARVO(Solmu, α, β)

  if LOPPUTILA(Solmu) return(ARVO(Solmu))
  v = +∞
  for each Lapsi in LAPSET(Solmu)
     v = 1
     if v ≤ α return(v)
     β = MIN(β, v)
  return(v)
```



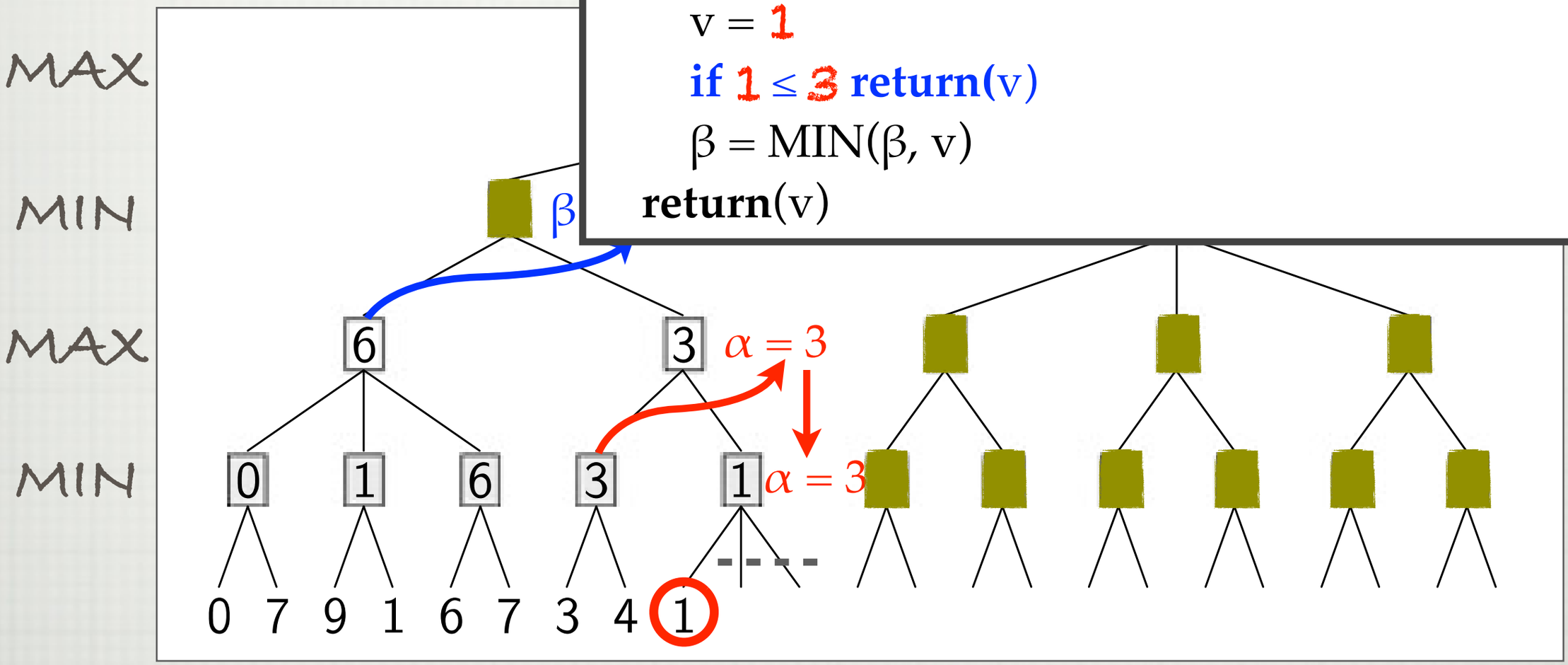
ALPHA

```
MIN-ARVO(Solmu, α, β)

  if LOPPUTILA(Solmu) return(ARVO(Solmu))
  v = +∞
  for each Lapsi in LAPSET(Solmu)
      v = 1
      if 1 ≤ 3 return(v)
      β = MIN(β, v)
  return(v)
```

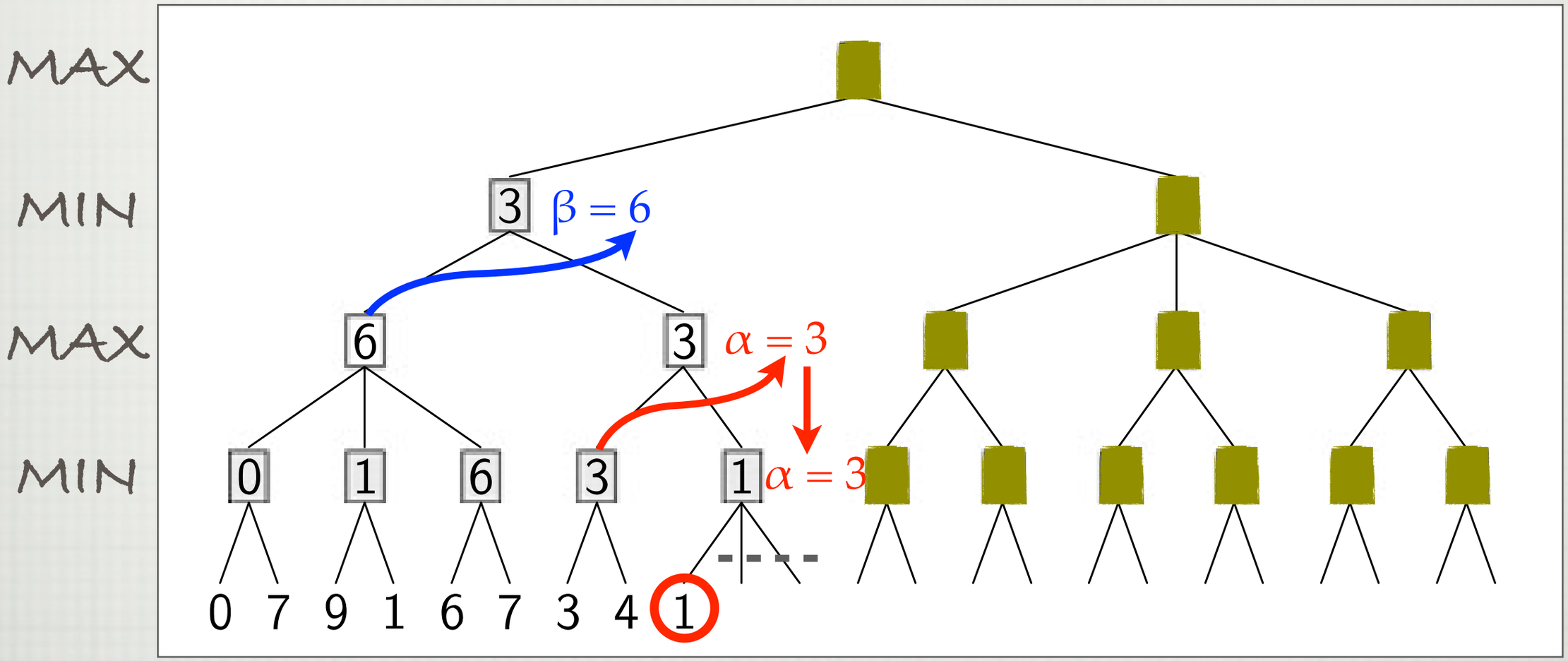


ALPHA

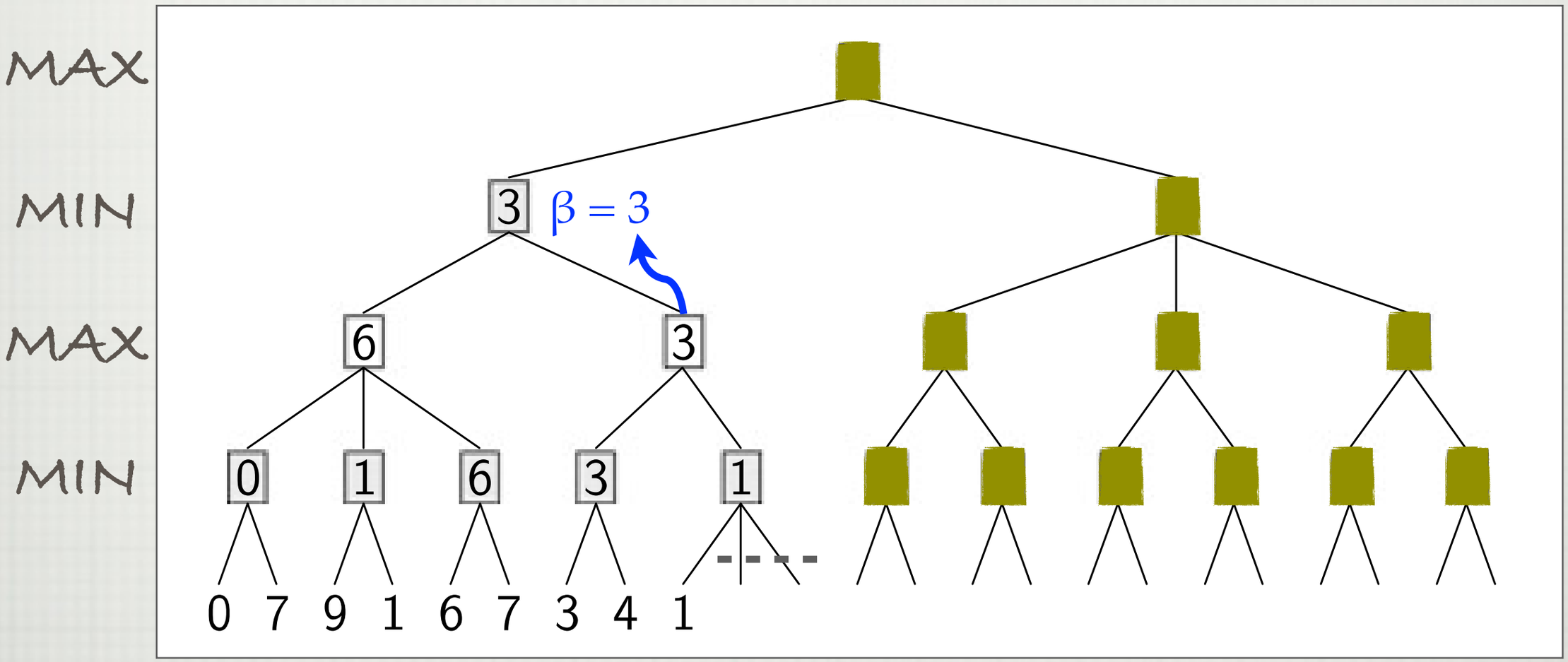
```
MIN-ARVO(Solmu, α, β)

  if LOPPUTILA(Solmu) return(ARVO(Solmu))
  v = +∞
  for each Lapsi in LAPSET(Solmu)
      v = 1
      if 1 ≤ 3 return(v)
      β = MIN(β, v)
  return(v)
```



ALPHA-BETA-KARSINTA



ALPHA-BETA-KARSINTA



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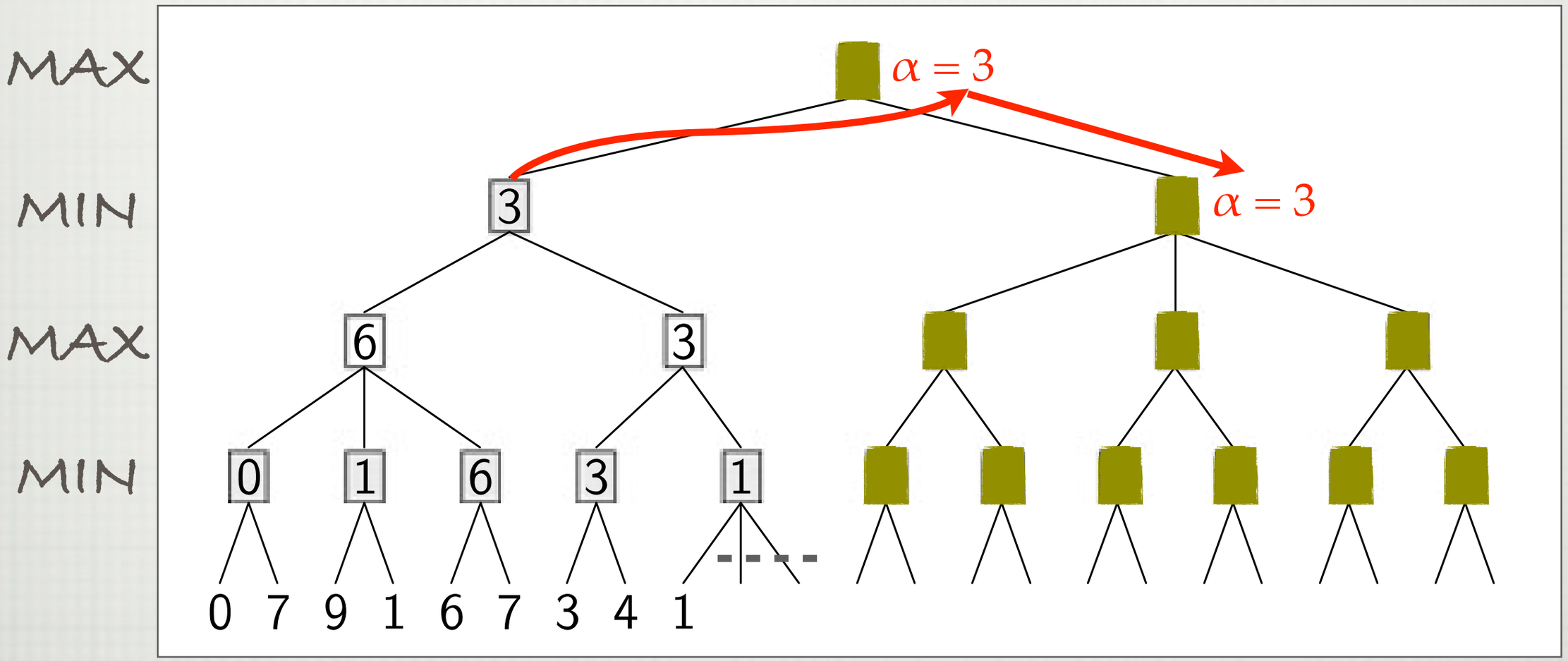
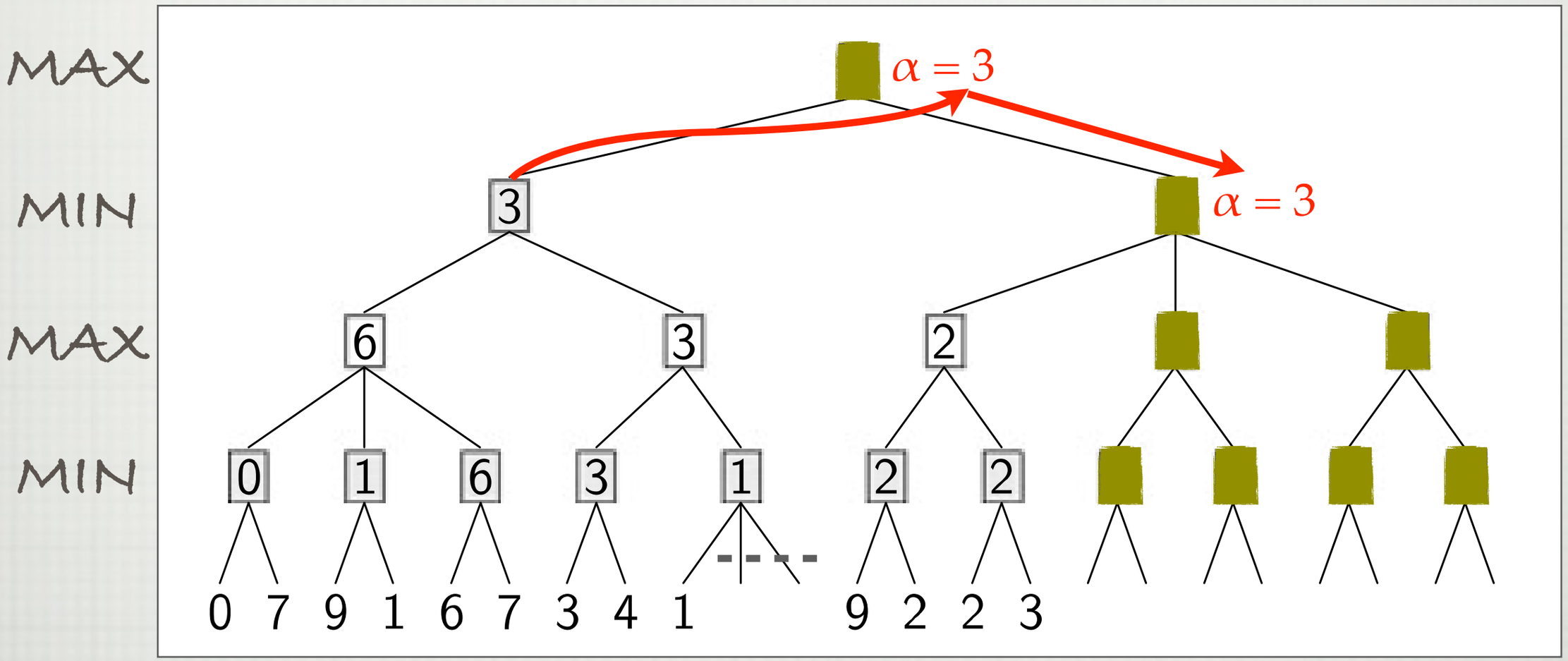


ALPHA-BETA-KARSINTA



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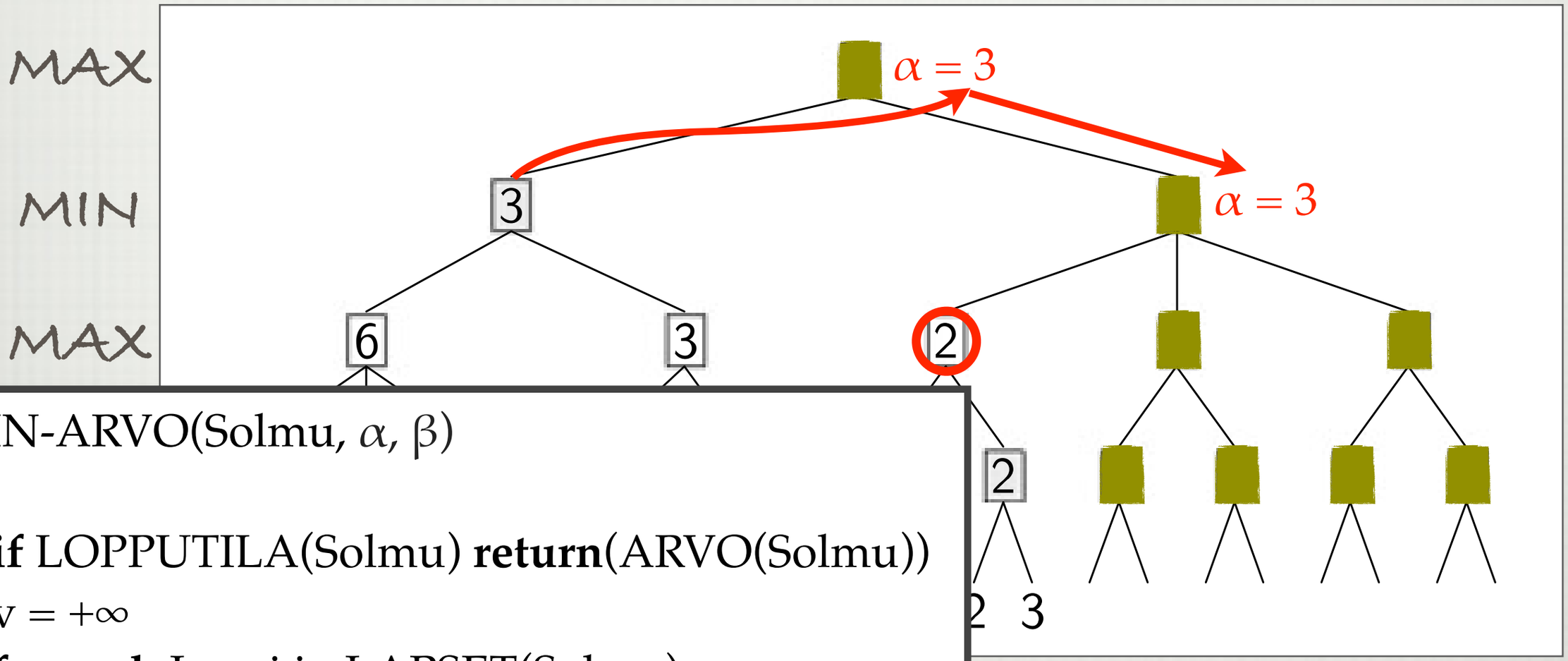
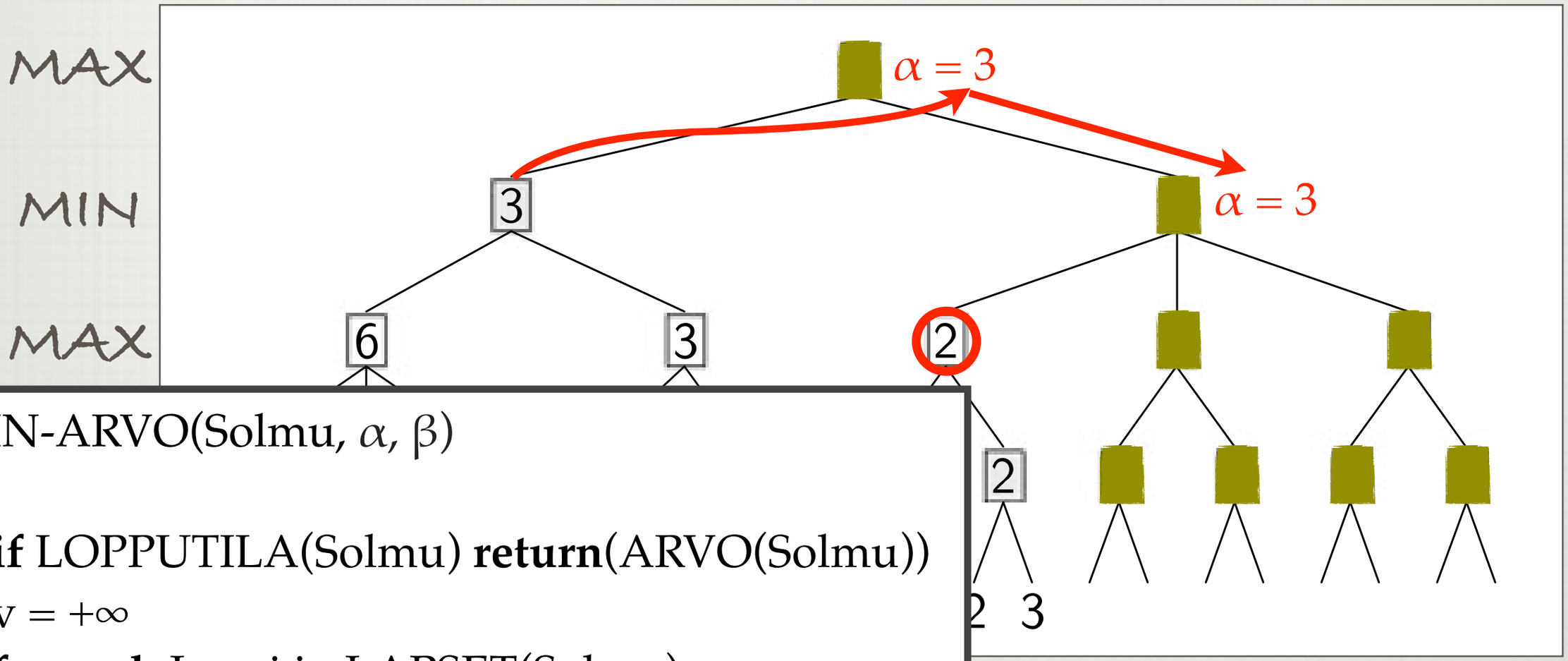


MIN-ARVO(Solmu, α, β)

if LOPPUTILA(Solmu) **return**(ARVO(Solmu))
v = $+\infty$
for each Lapsi in LAPSET(Solmu)
    v = MIN(v, MAX-ARVO(Lapsi, α, β))
    if v $\leq \alpha$ **return**(v)
    β = MIN(β, v)
return(v)

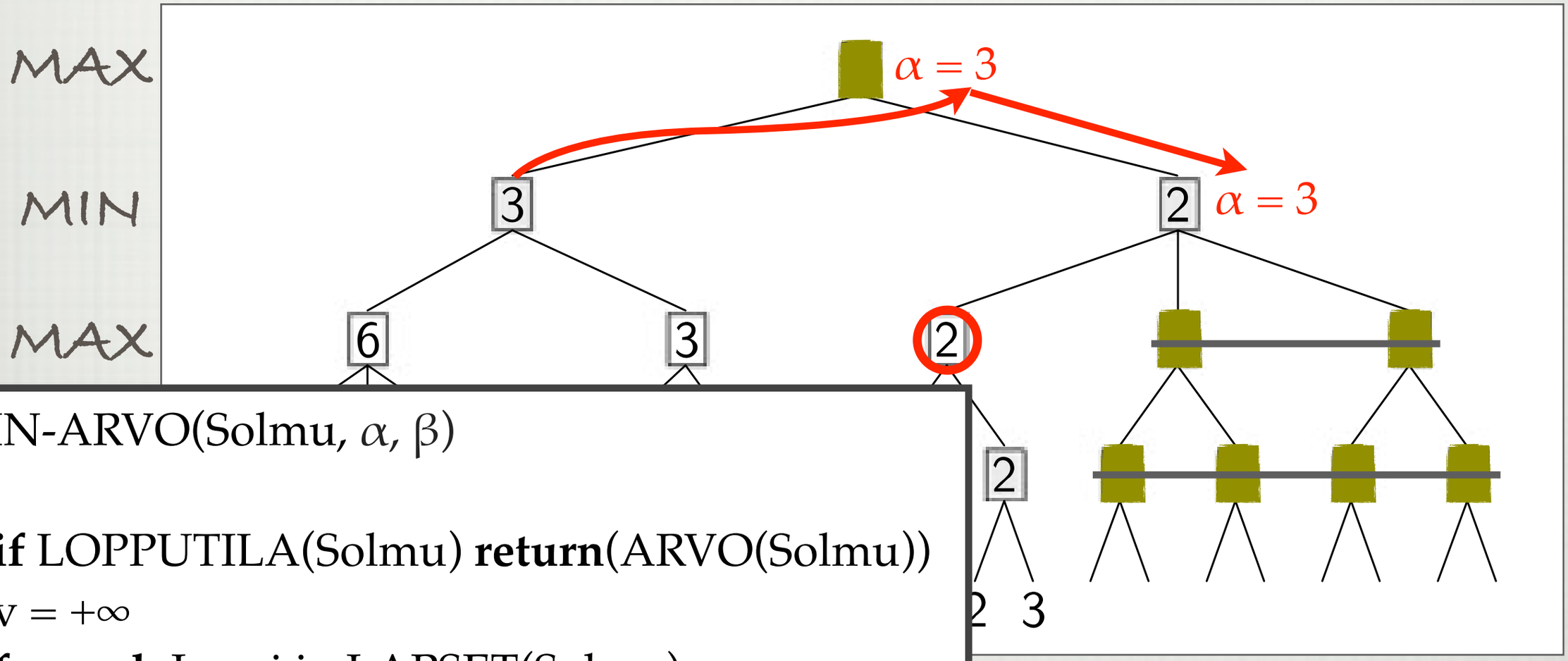
ALPHA-BETA-KARSINTA



MIN-ARVO(Solmu, α, β)

if LOPPUTILA(Solmu) **return**(ARVO(Solmu))
v = $+\infty$
for each Lapsi in LAPSET(Solmu)
    v = 2
    if 2 ≤ 3 **return**(v)
    β = MIN(β, v)
return(v)

ALPHA-BETA-KARSINTA



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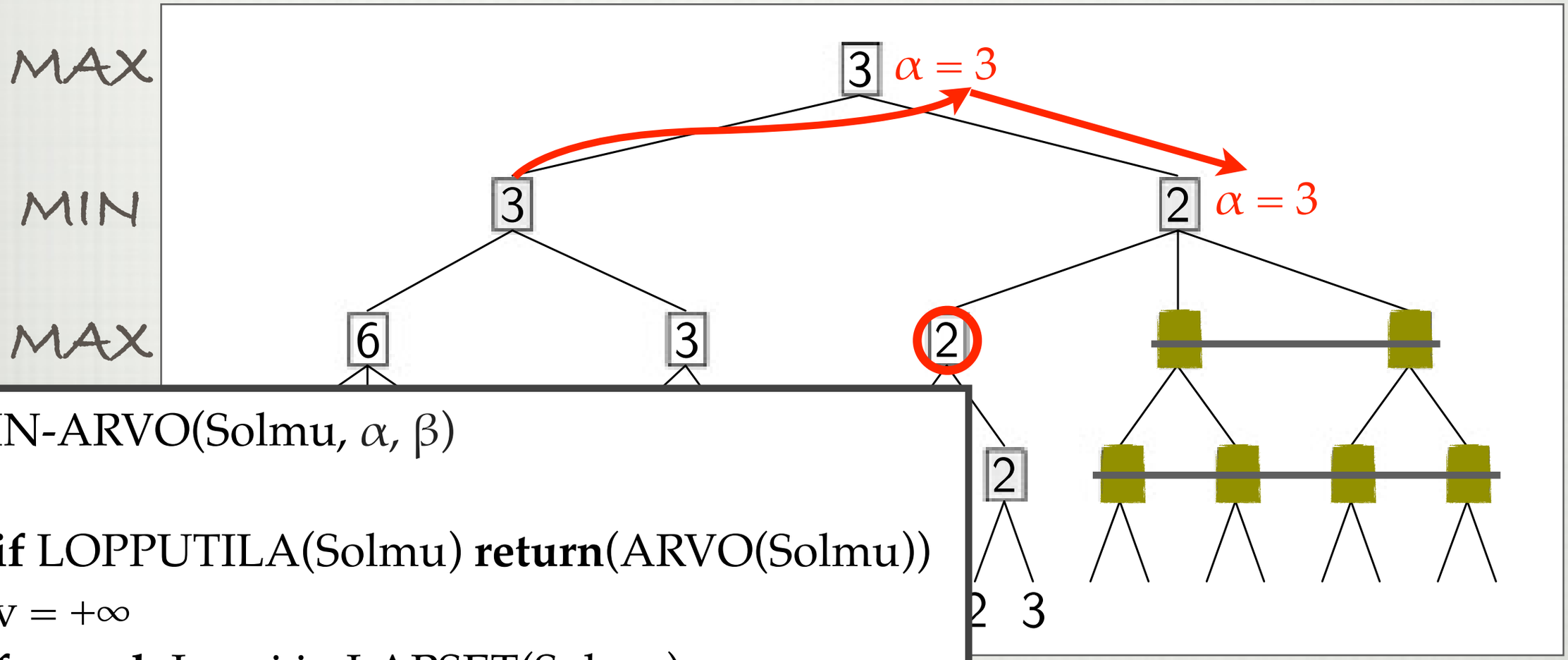

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ALPHA-BETA-KARSINTA