Árboles de juego

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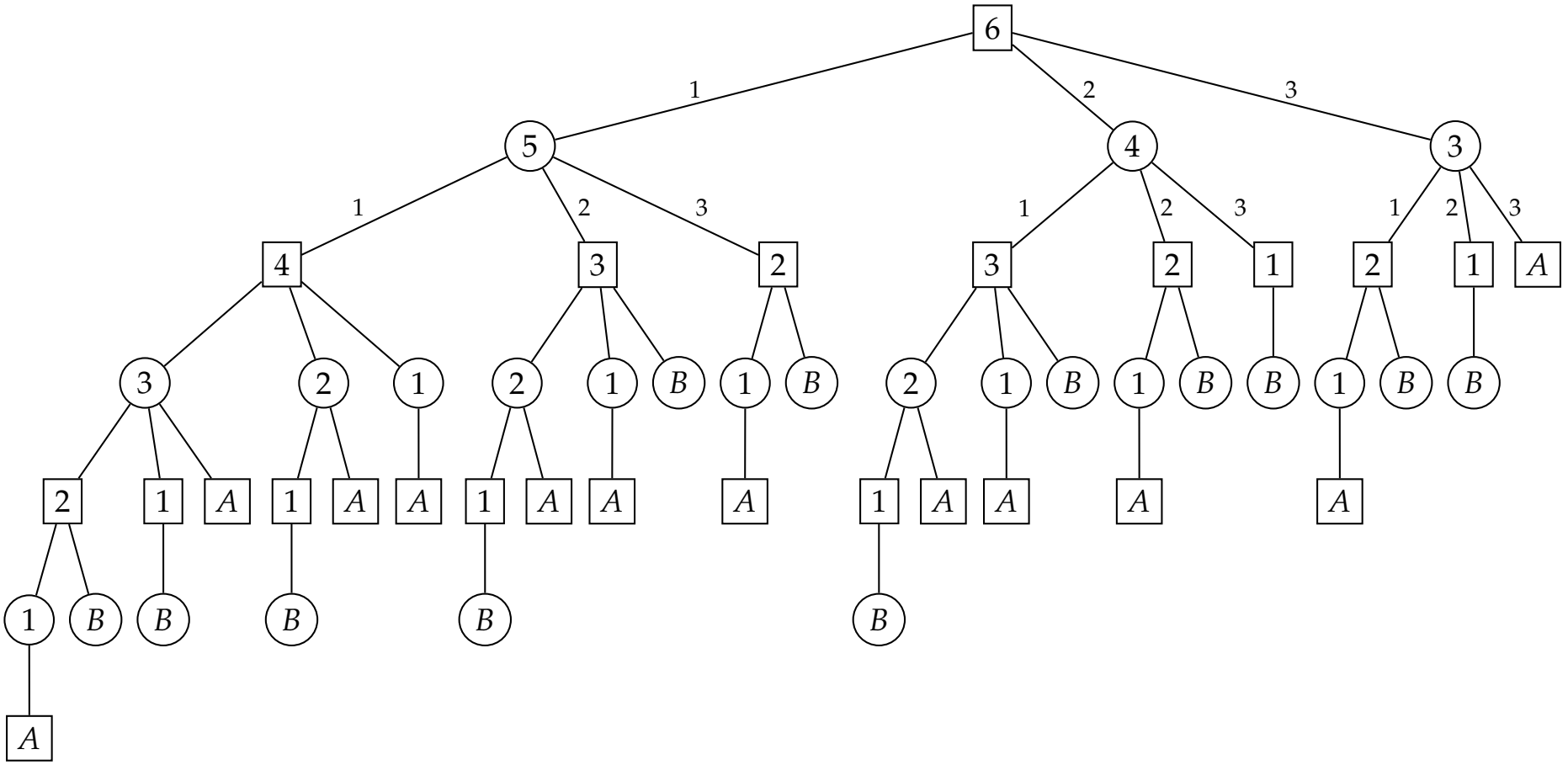
Motivación

- Queremos un programa que sepa jugar, lo haga de forma óptima y en un tiempo razonable.
- Tipos de juegos:

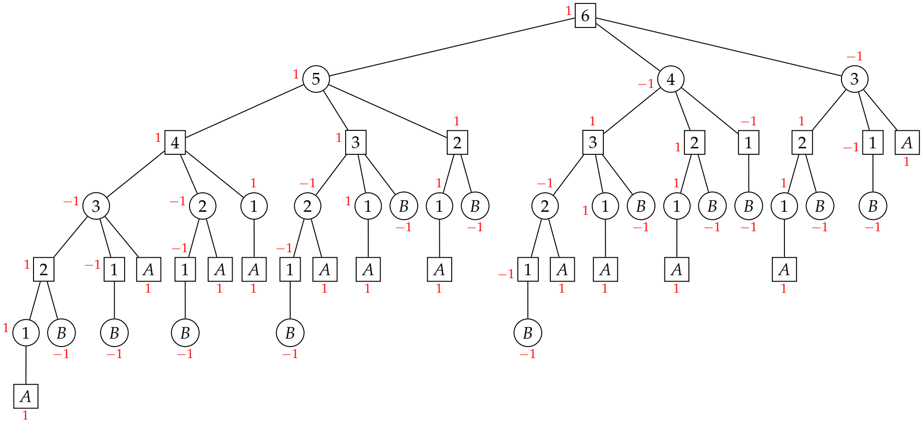
	Determinista	No determinista (aleatoriedad)
Totalmente observable	Ajedrez Damas Go Othello	Backgammon Monopoly
Parcialmente observable	Hundir la flota	Juegos de cartas

Juego de NIM con 6 palillos

Dos jugadores A y B y un tablero que inicialmente contiene n $(= 6)$ palillos. Los jugadores se alternan comenzando A. Un *movimiento legal* consiste en eliminar 1, 2 o 3 palillos (pero no más de los que haya). Pierde el jugador que elimina el último palillo y el otro gana.



Juego de NIM con 6 palillos, nodos valorados

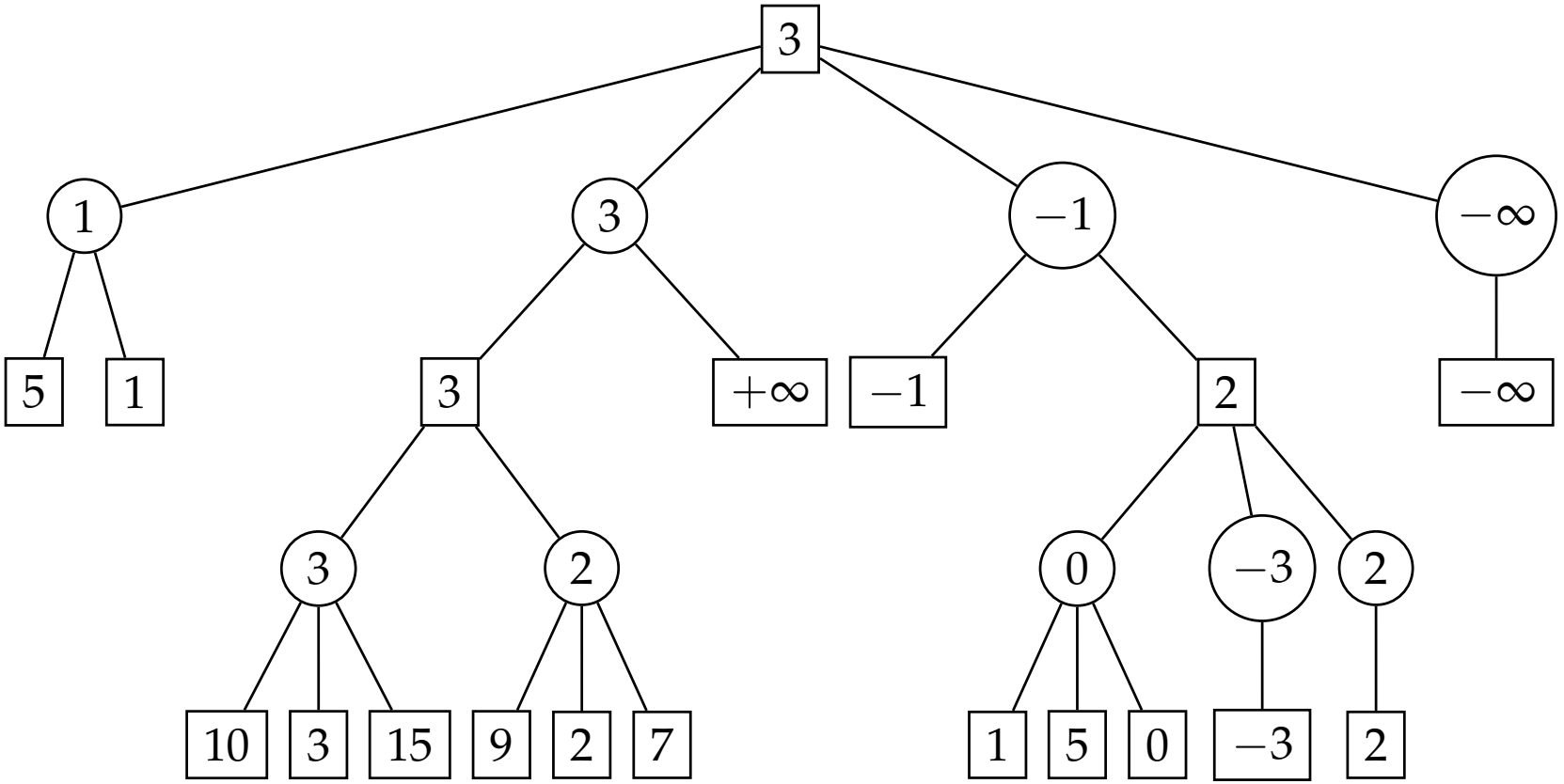


Algoritmo de minimax

```
jugada Jugador::juega(Juego EJ) {
   jugada mejorC;
   float mejorV = −∞;
   for (jugada c : jugadasDesde(EJ)) {
      float v = valoraMin(EJ.aplica(c), nivel-1);
      if (v > mejorV){ mejorV = v; mejorC = c; }
   }
   return mejorC;
}

float Jugador::valoraMin(Juego EJ, int n) {
  if (terminal(EJ) || n==0) return Heuristica(EJ)
  else { float mejorV = +∞;
         for (jugada c : jugadasDesde(EJ))
            mejorV = min(valoraMax(EJ.aplica(c), n-1), mejorV);
         return mejorV; }
}

float Jugador::valoraMax(Juego EJ, int n) {
  // igual que valoraMin pero haciendo un máximo
}
```

Podas α y β

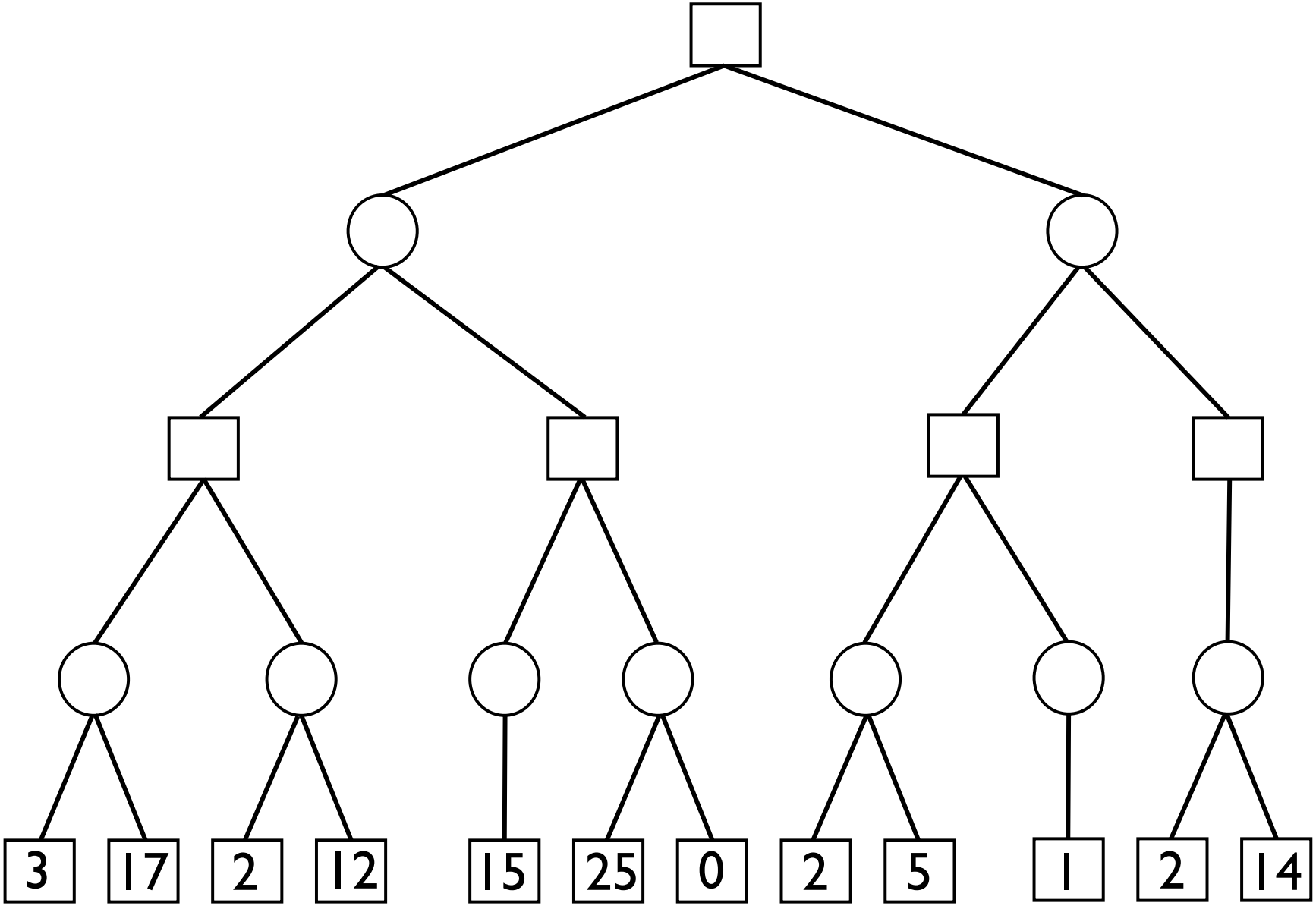
Evitan el procesamiento de subárboles que no afectan a la decisión sobre cuál es la mejor jugada.



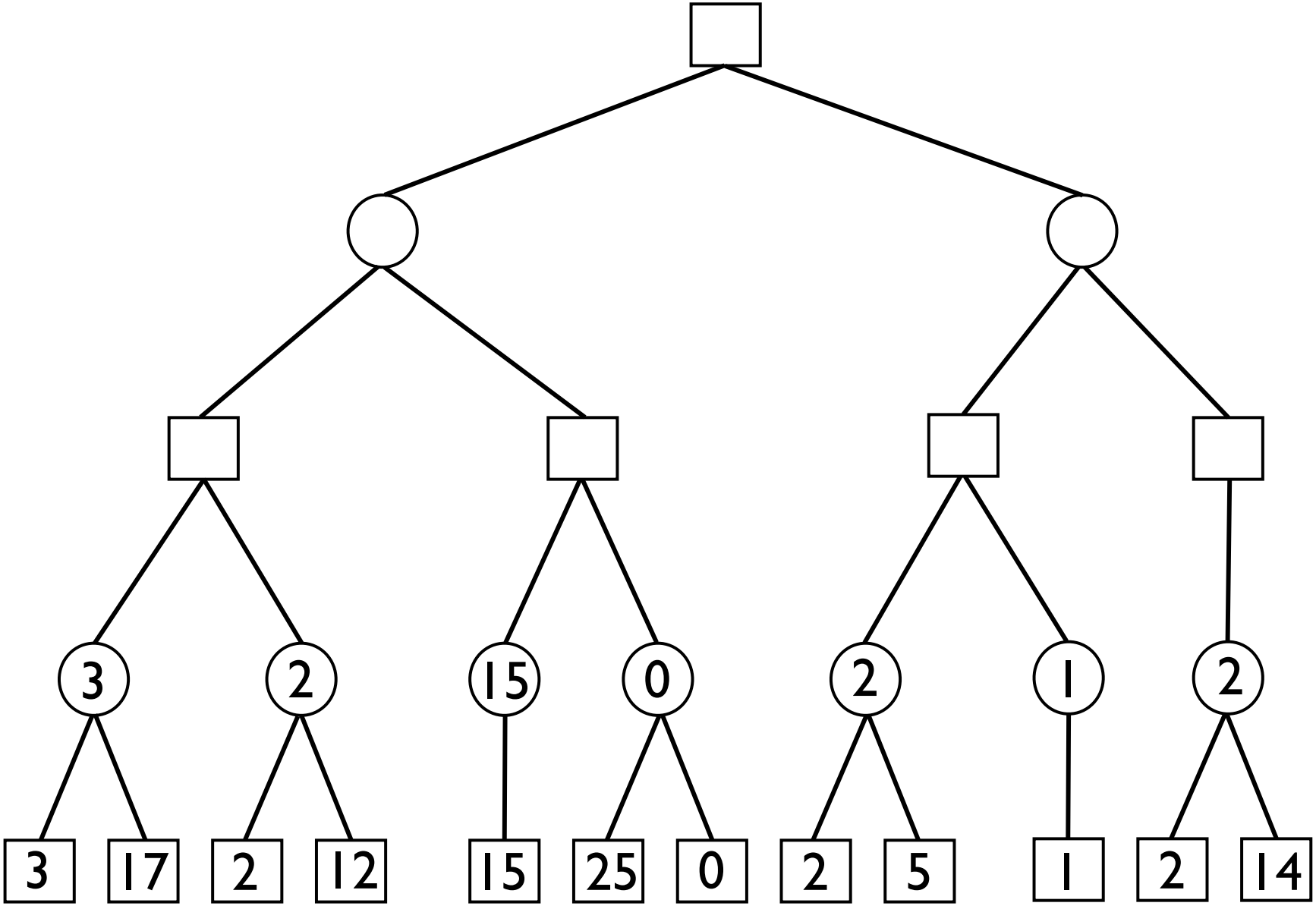
Algoritmo de poda alfa-beta

```
jugada Jugador::juega(Juego EJ) {
   jugada mejorC;
   float mejorV = −∞;
   for (jugada c : jugadasDesde(EJ)) {
      float v = valoraMin(EJ.aplica(c), nivel-1, mejorV, +∞);
      if (v > mejorV){ mejorV = v; mejorC = c; }
   }
   return mejorC;
}

float Jugador::valoraMin(Juego EJ, int n, float α, float β) {
  if (terminal(EJ) || n==0) return Heuristica(EJ)
  else { for (jugada c : jugadasDesde(EJ)) {
            β = min(valoraMax(EJ.aplica(c), n-1, α, β), β);
            if (α >= β) return β;
         }
         return β; }
}

float Jugador::valoraMax(Juego EJ, int n, float α, float β) {
  // similar a valoraMin pero haciendo un máximo e intercambiando
  // los papeles de α y β
}
```

Algoritmo minimax



Algoritmo minimax



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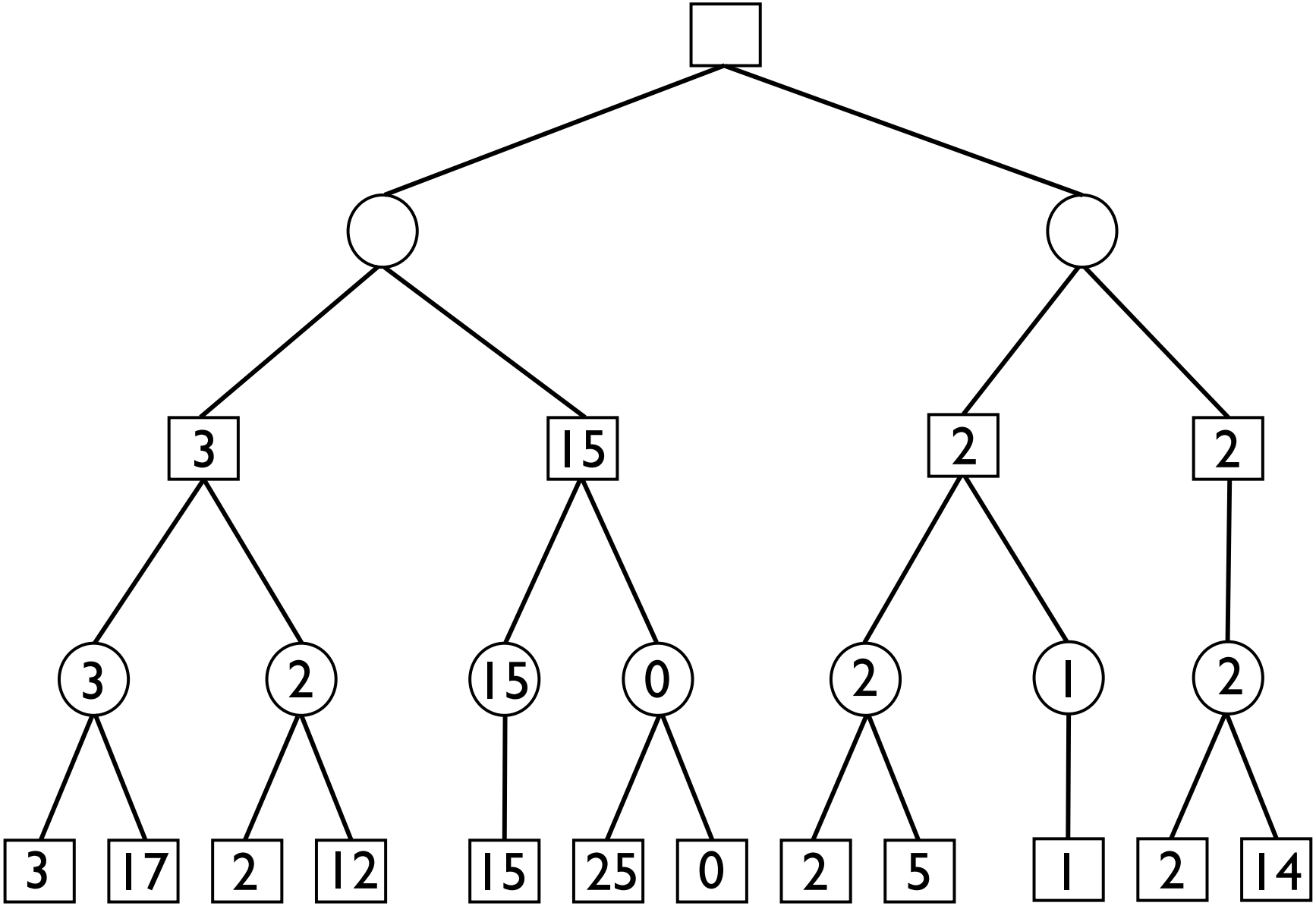

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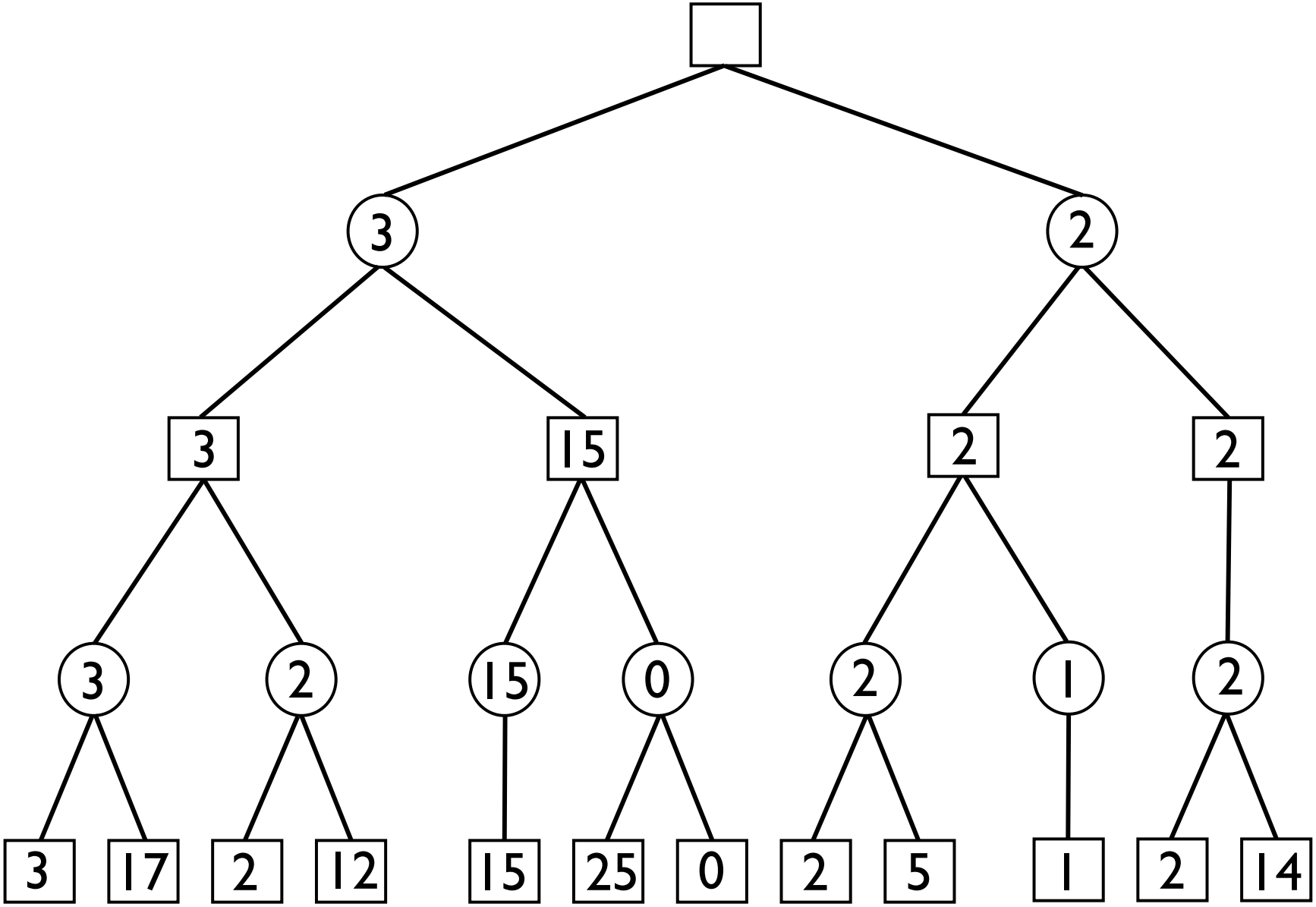
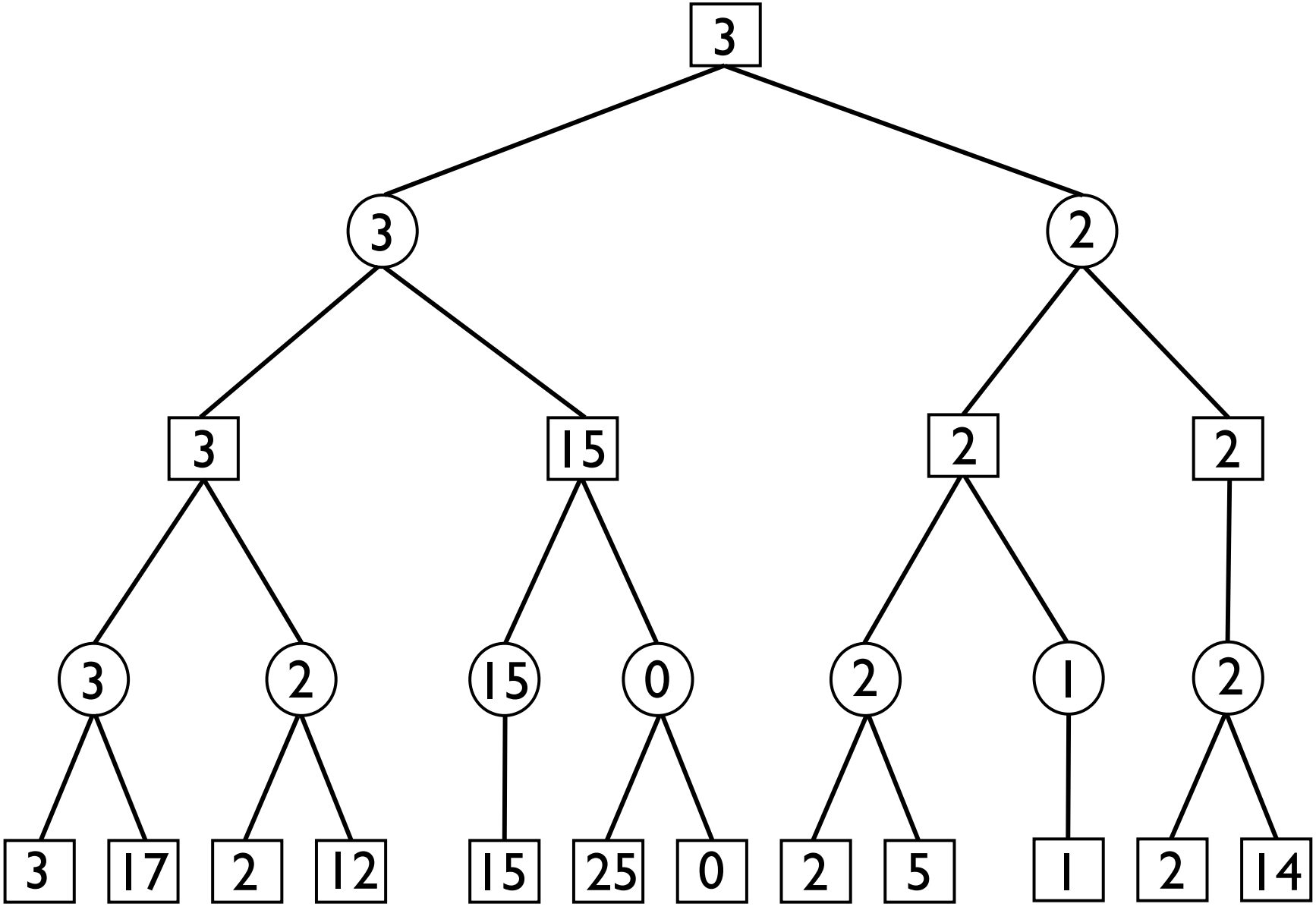
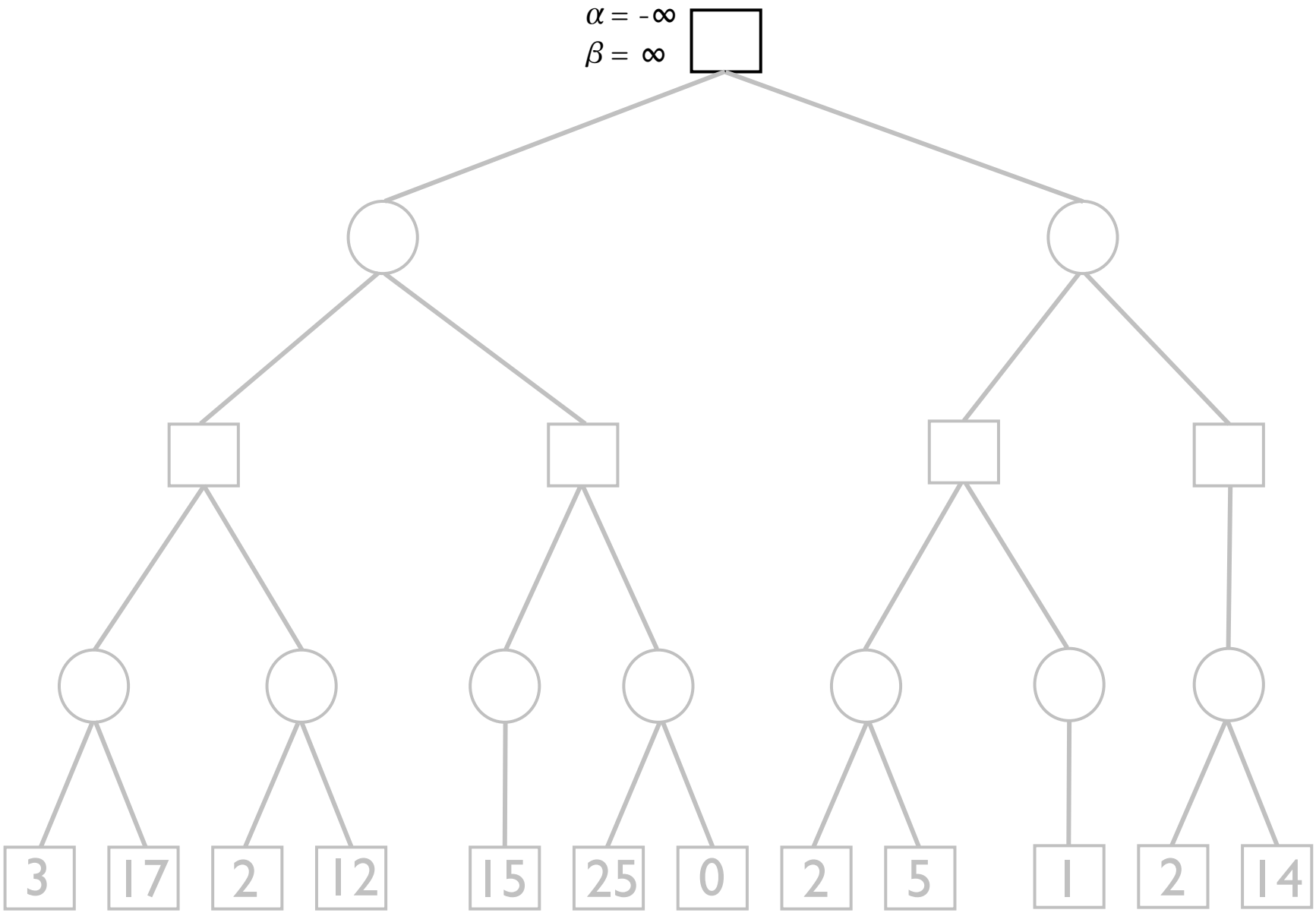


Algoritmo minimax



Poda alfa-beta



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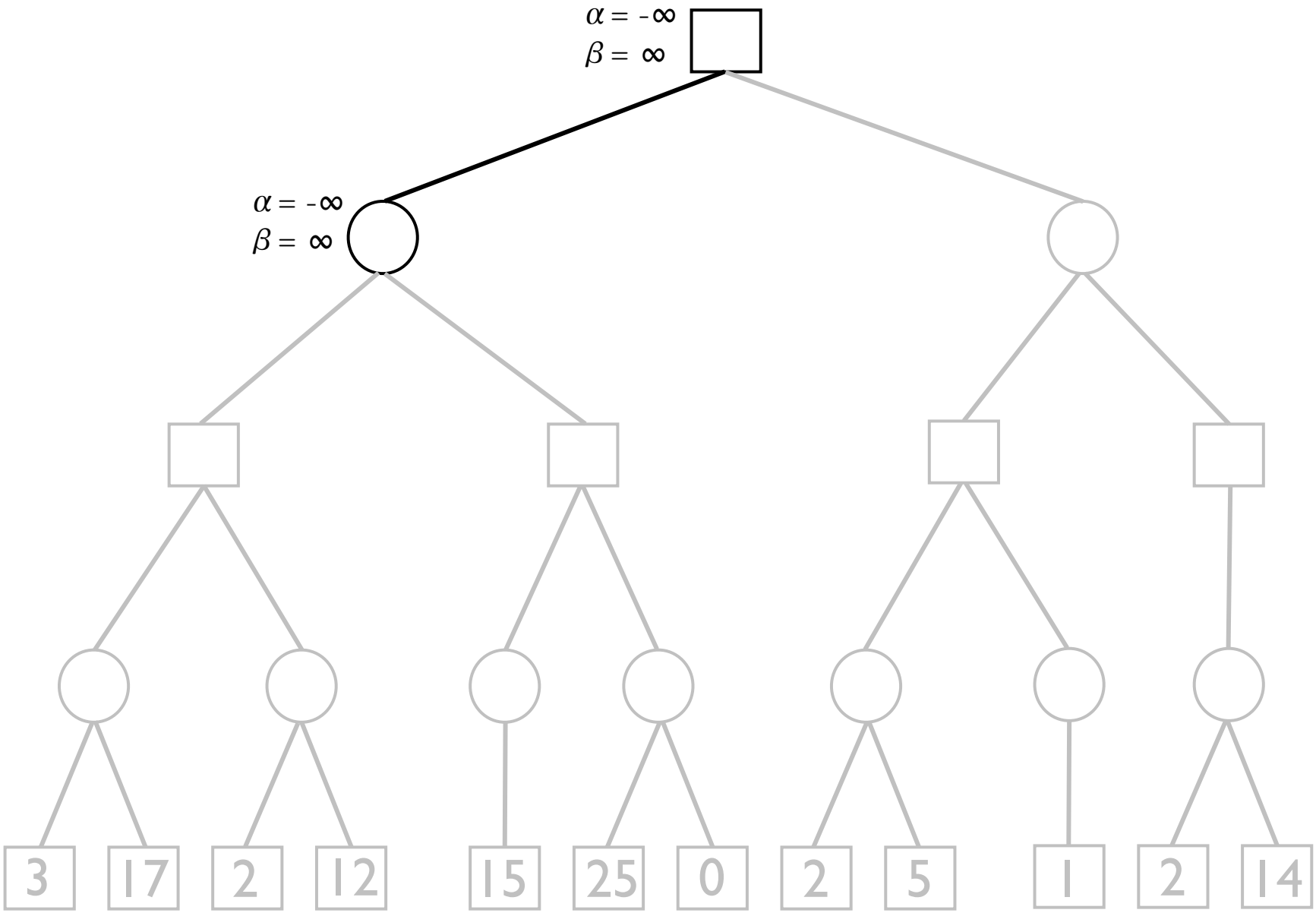

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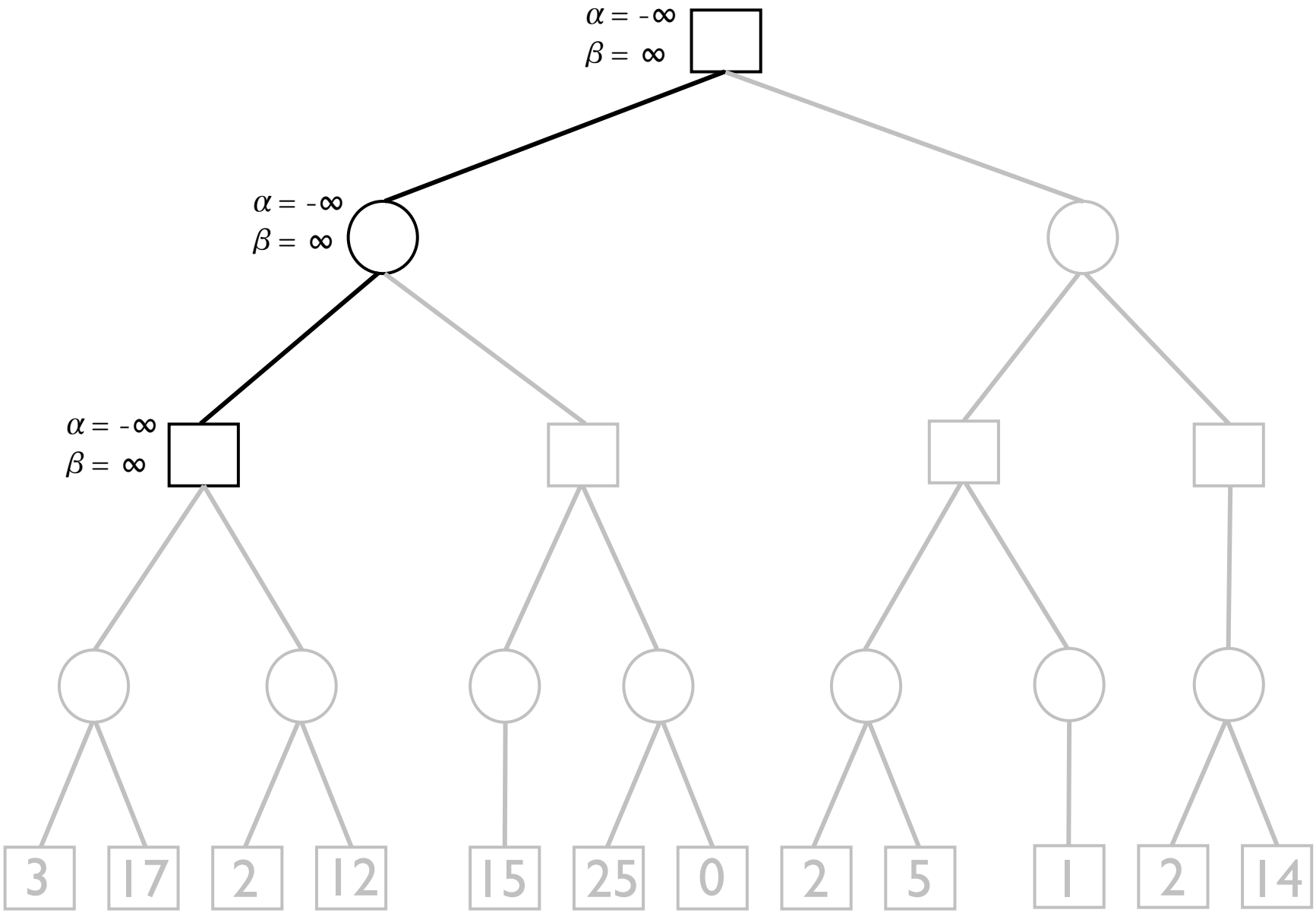

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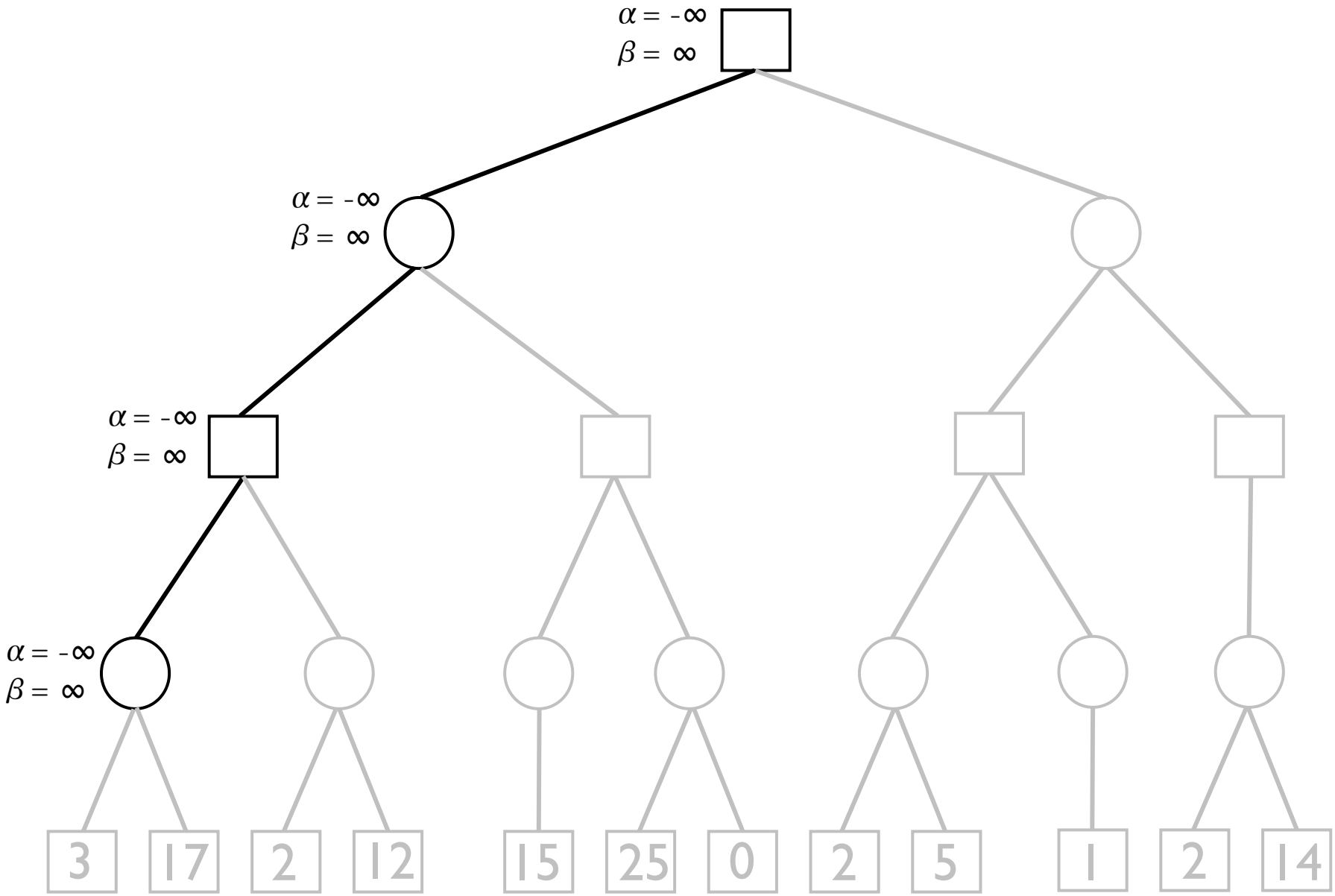

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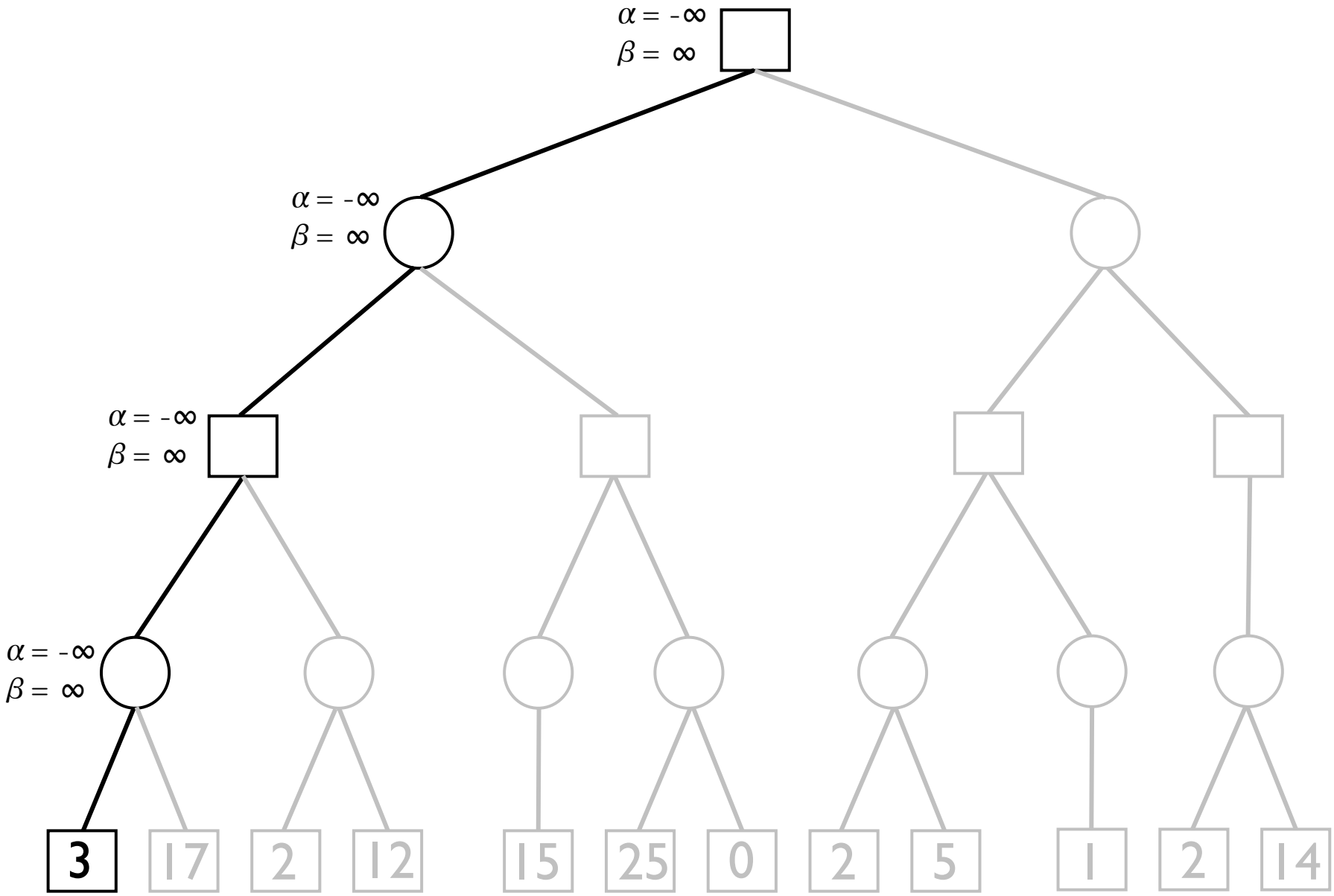

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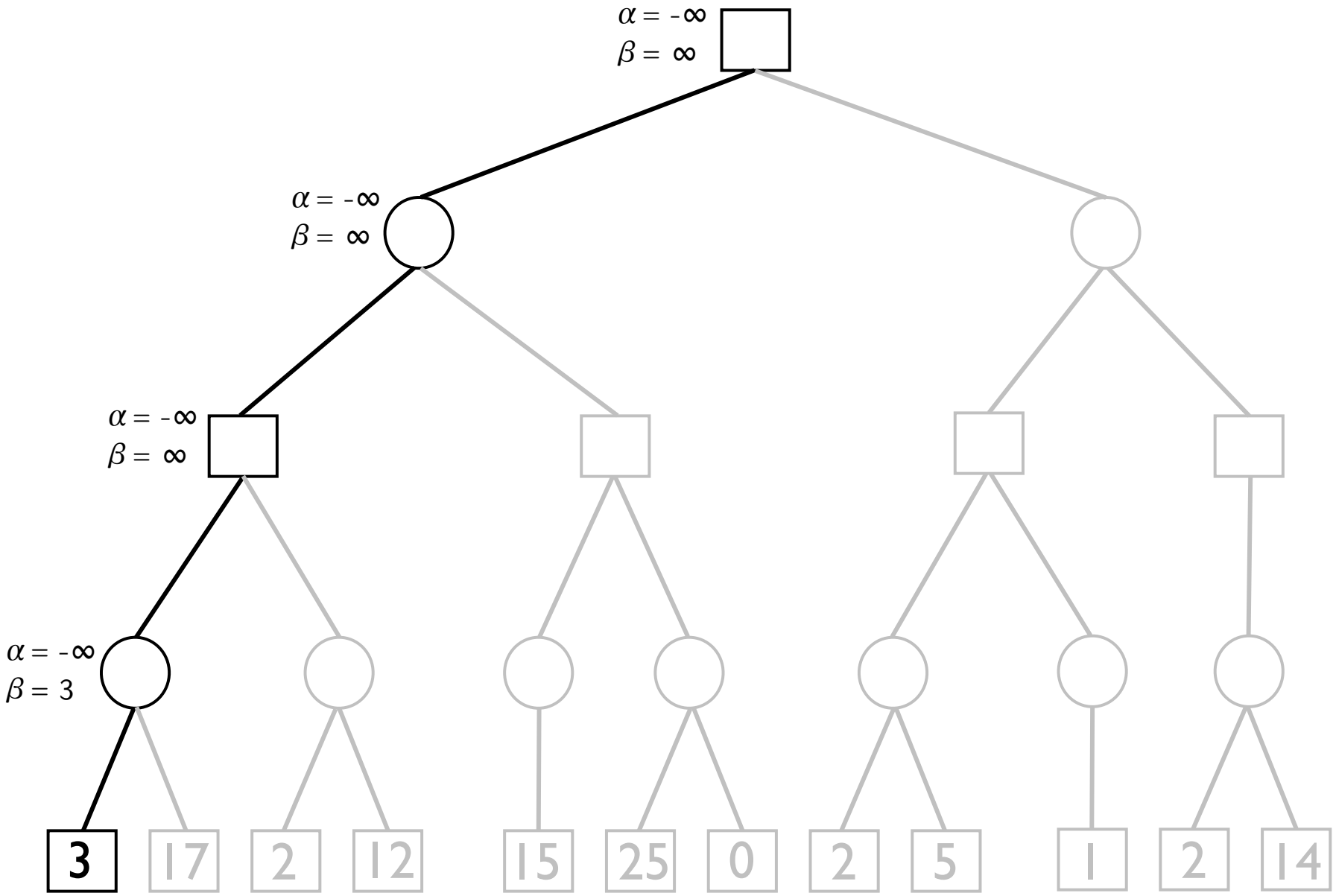

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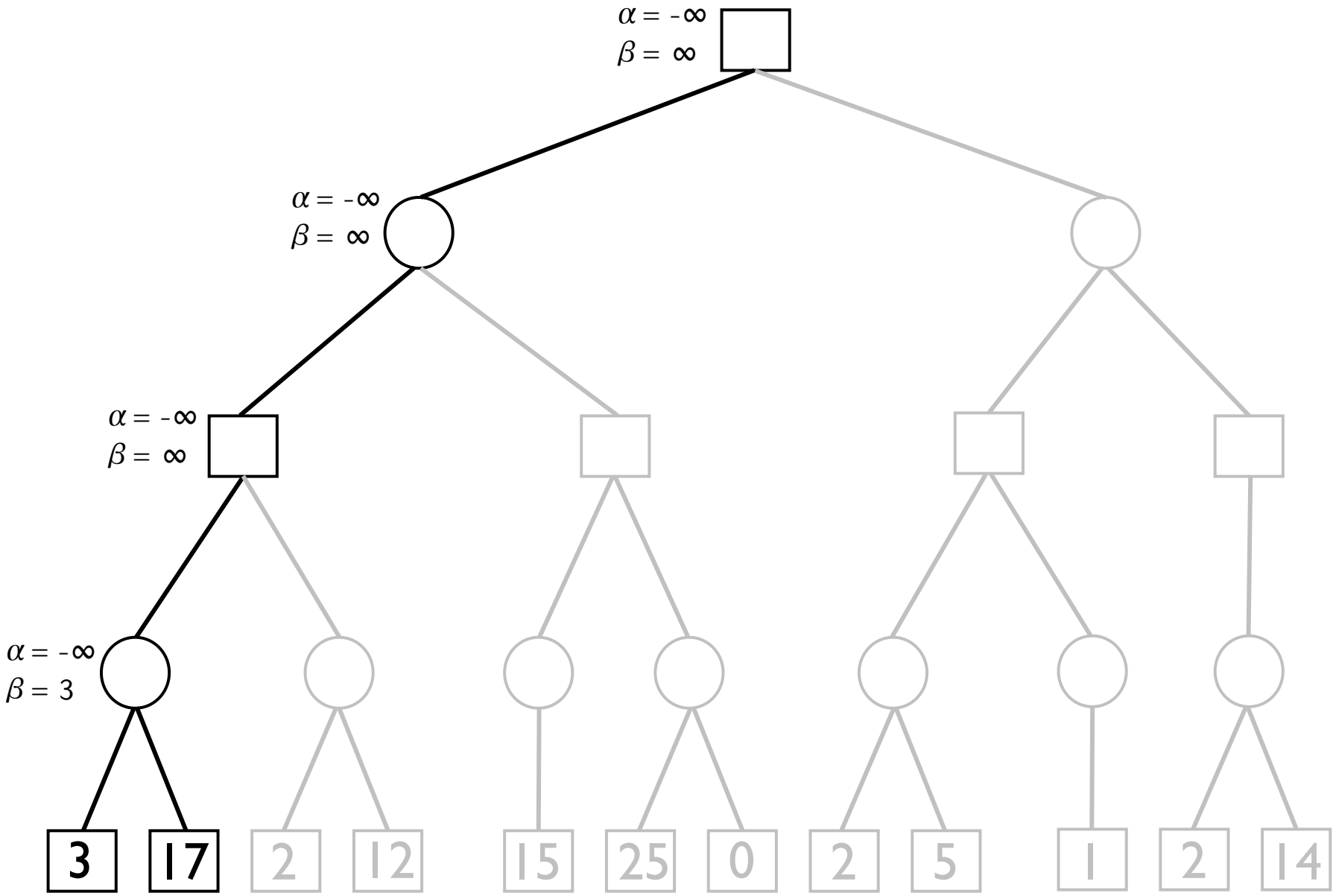

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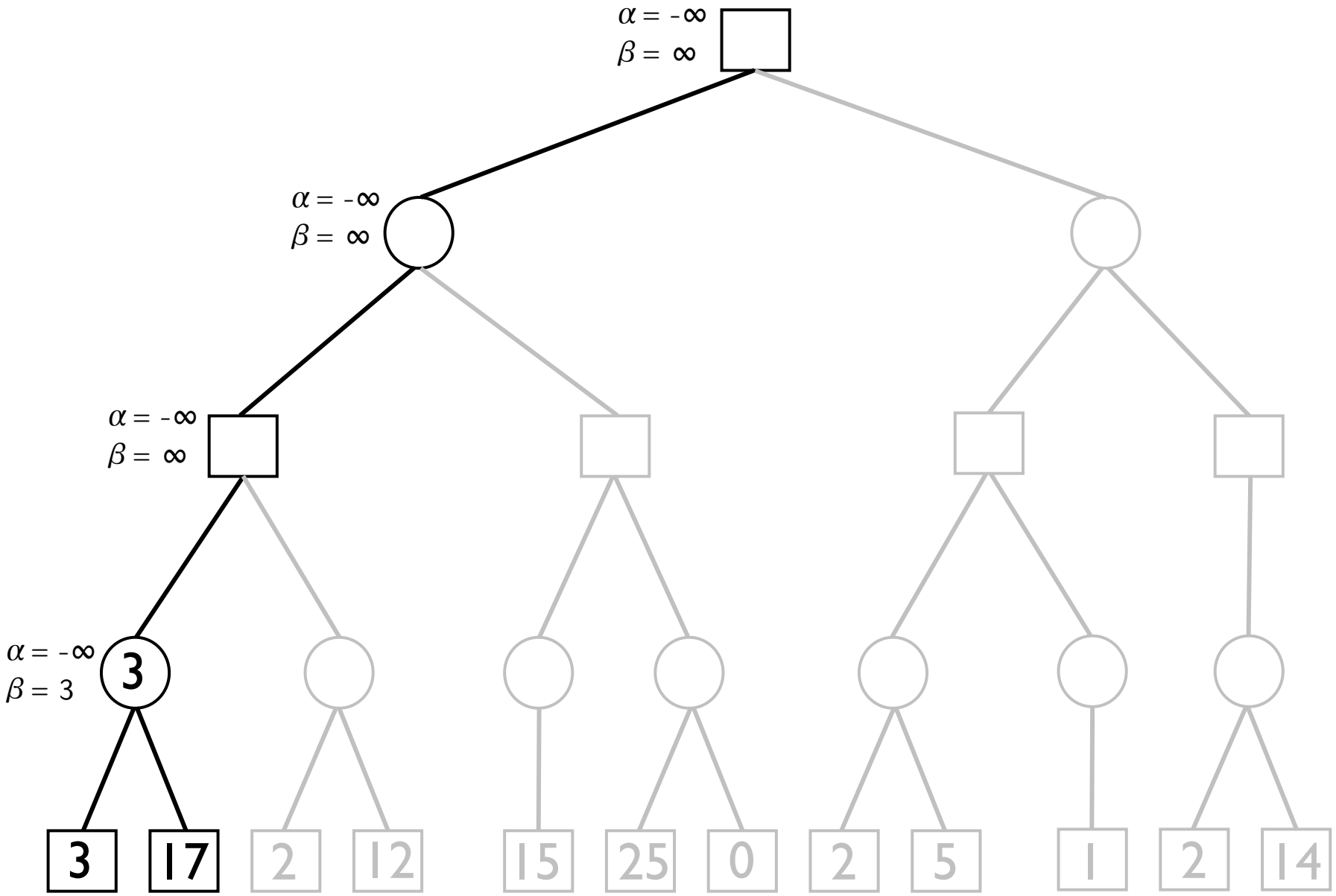

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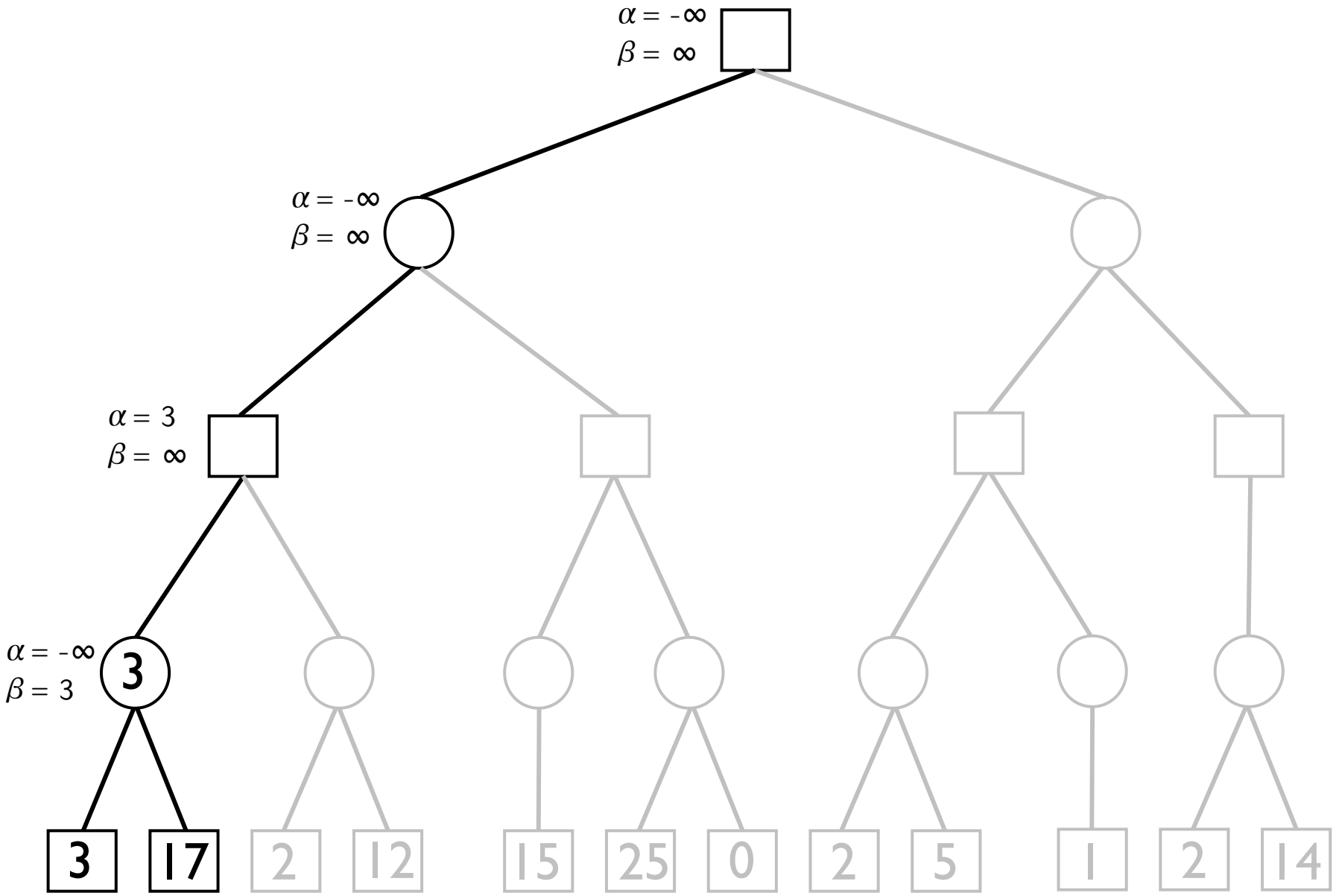

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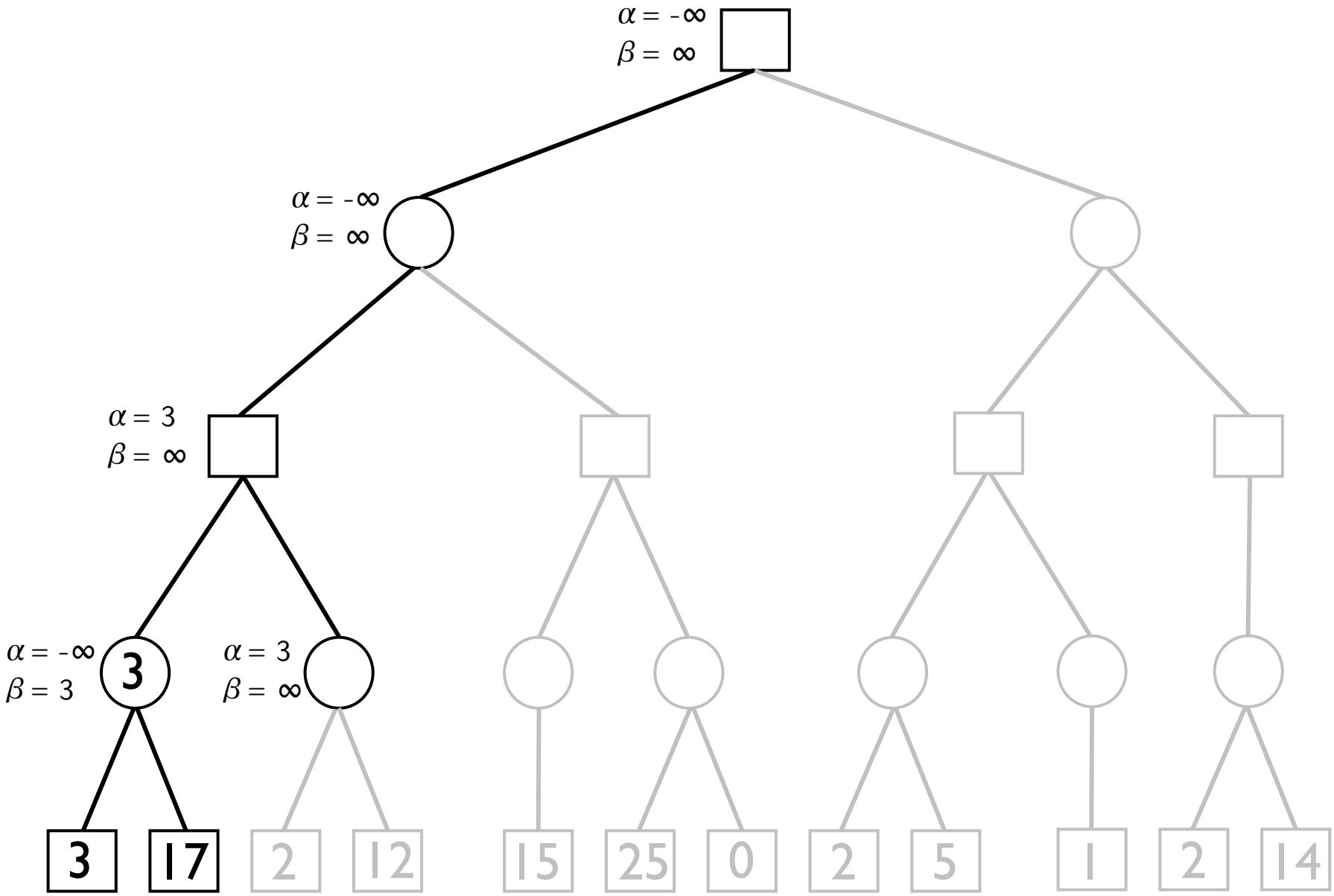

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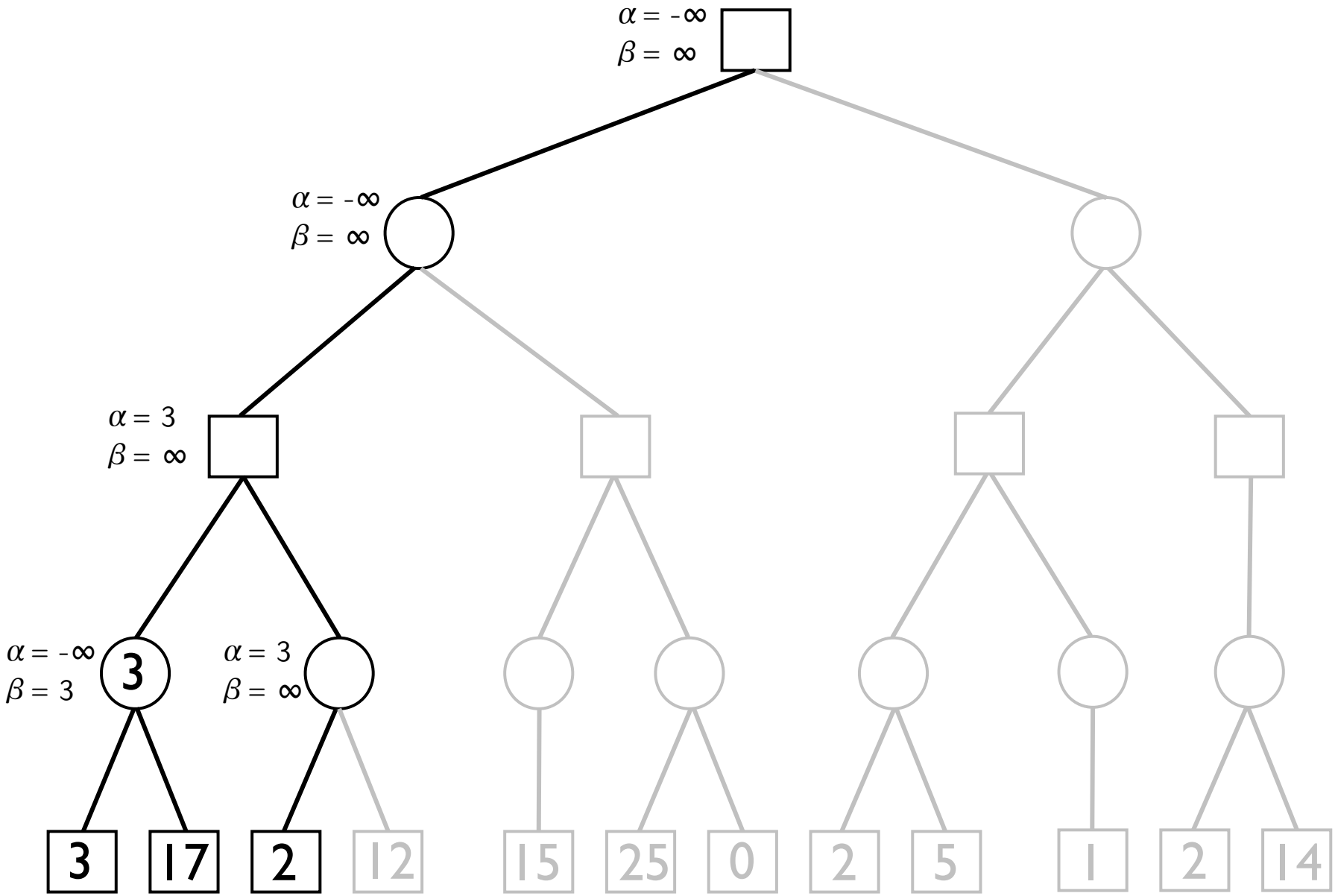

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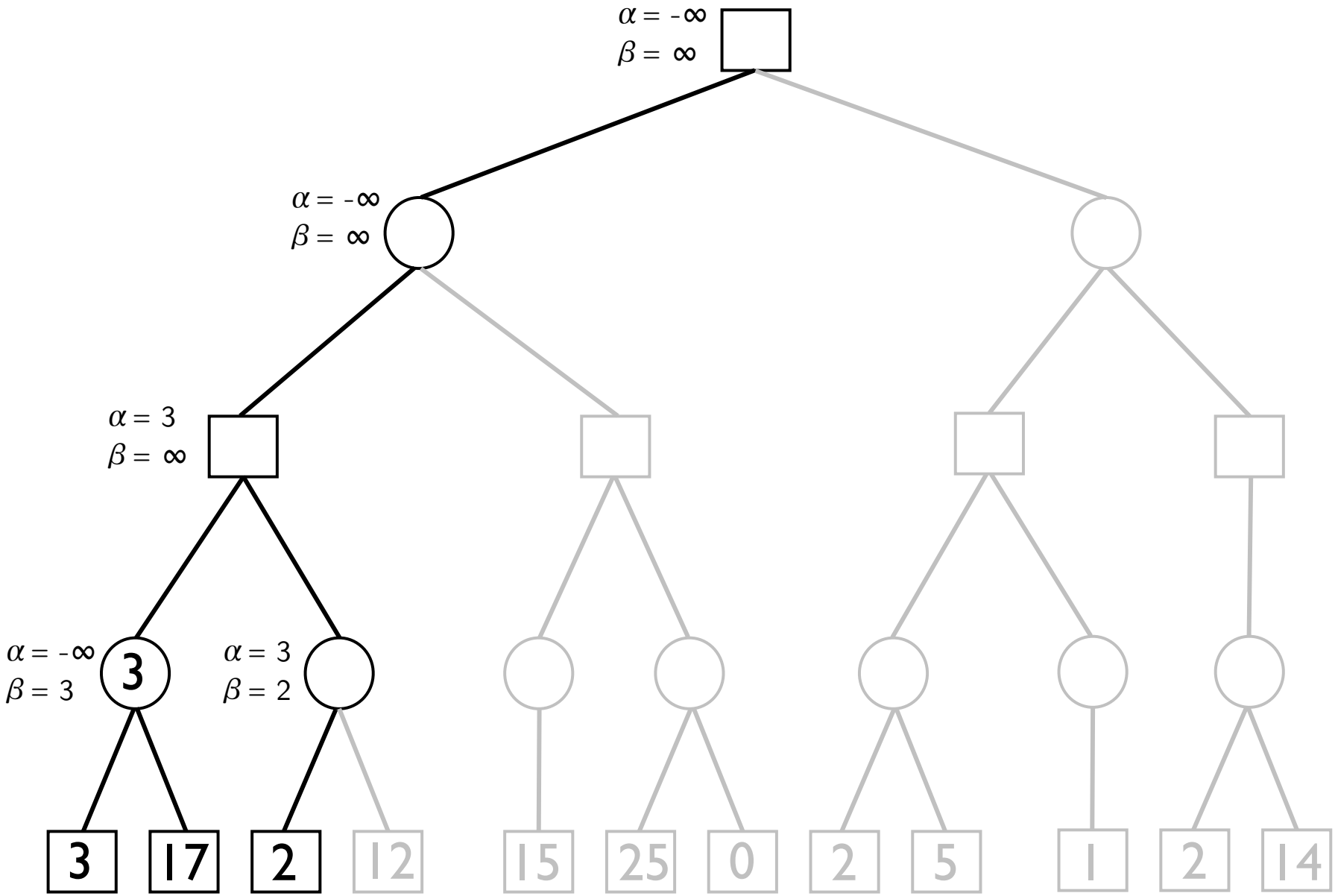

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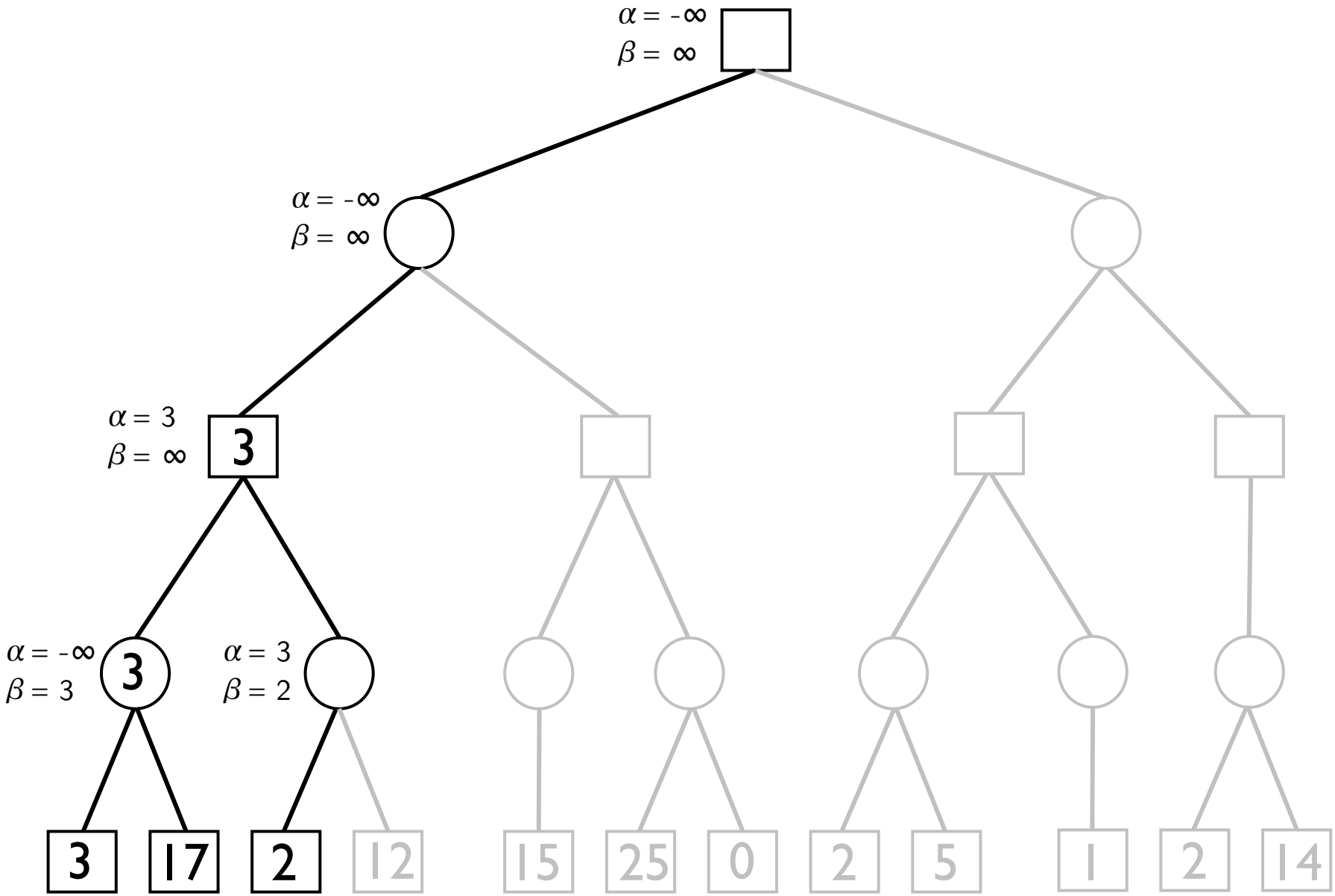

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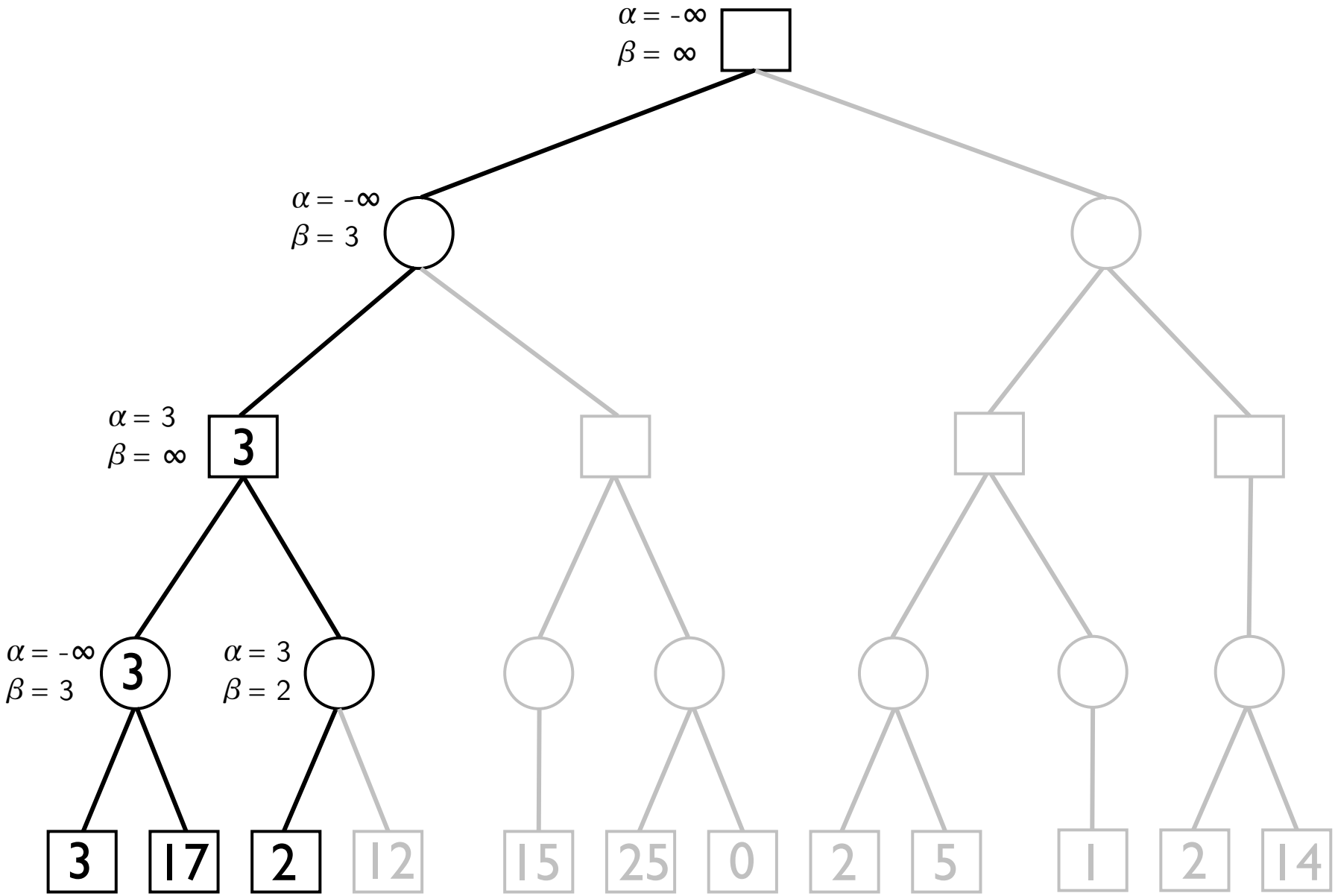

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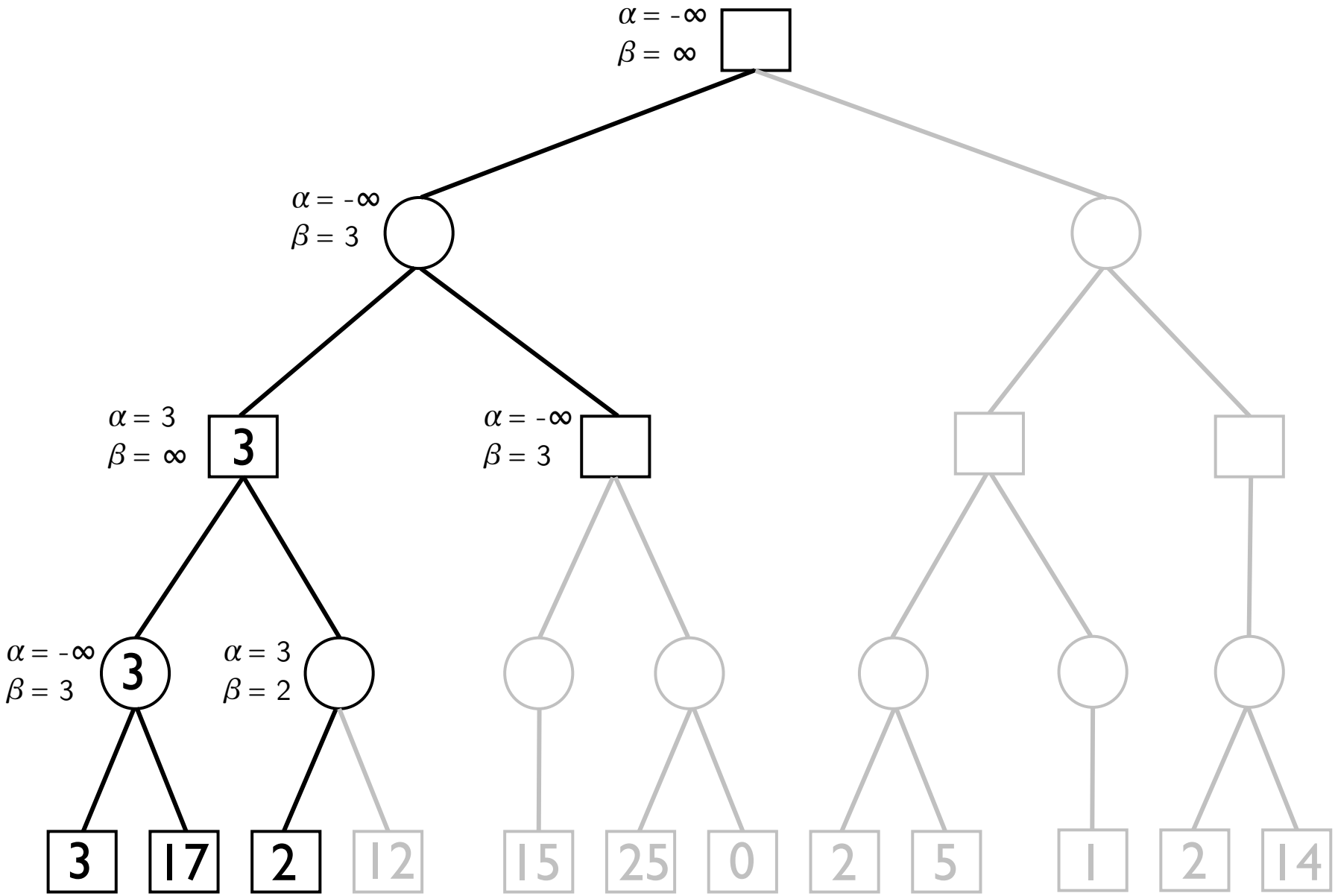

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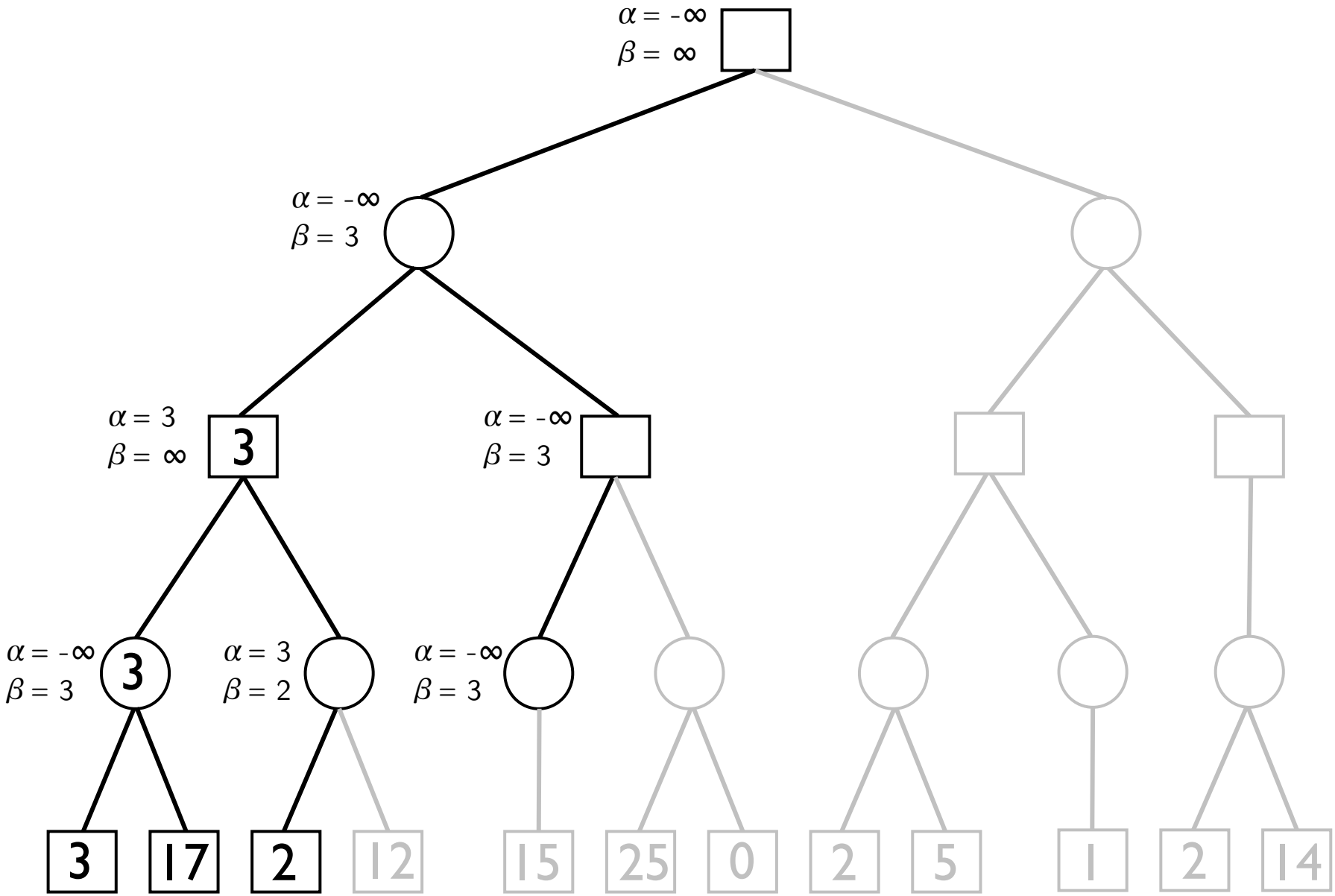

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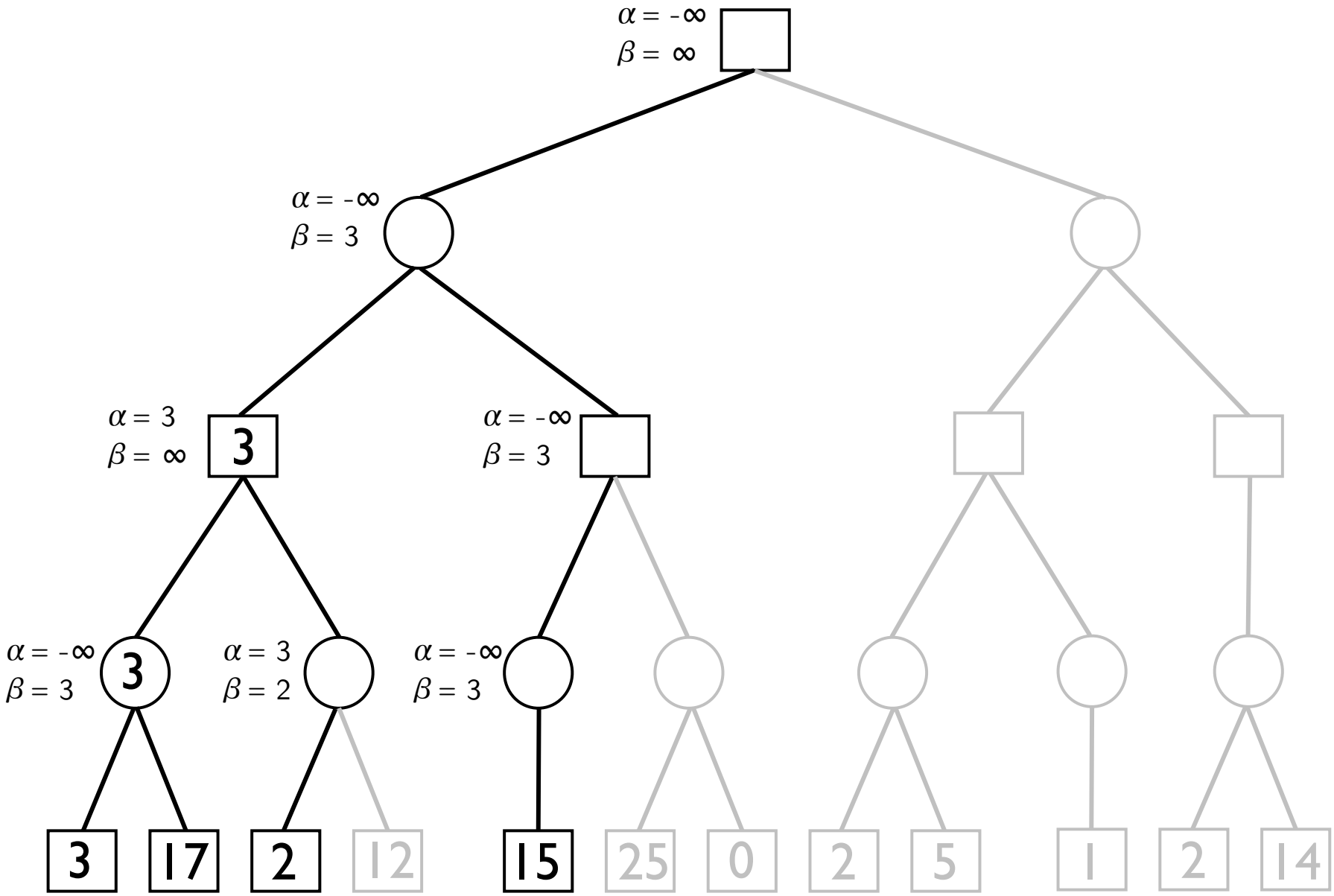

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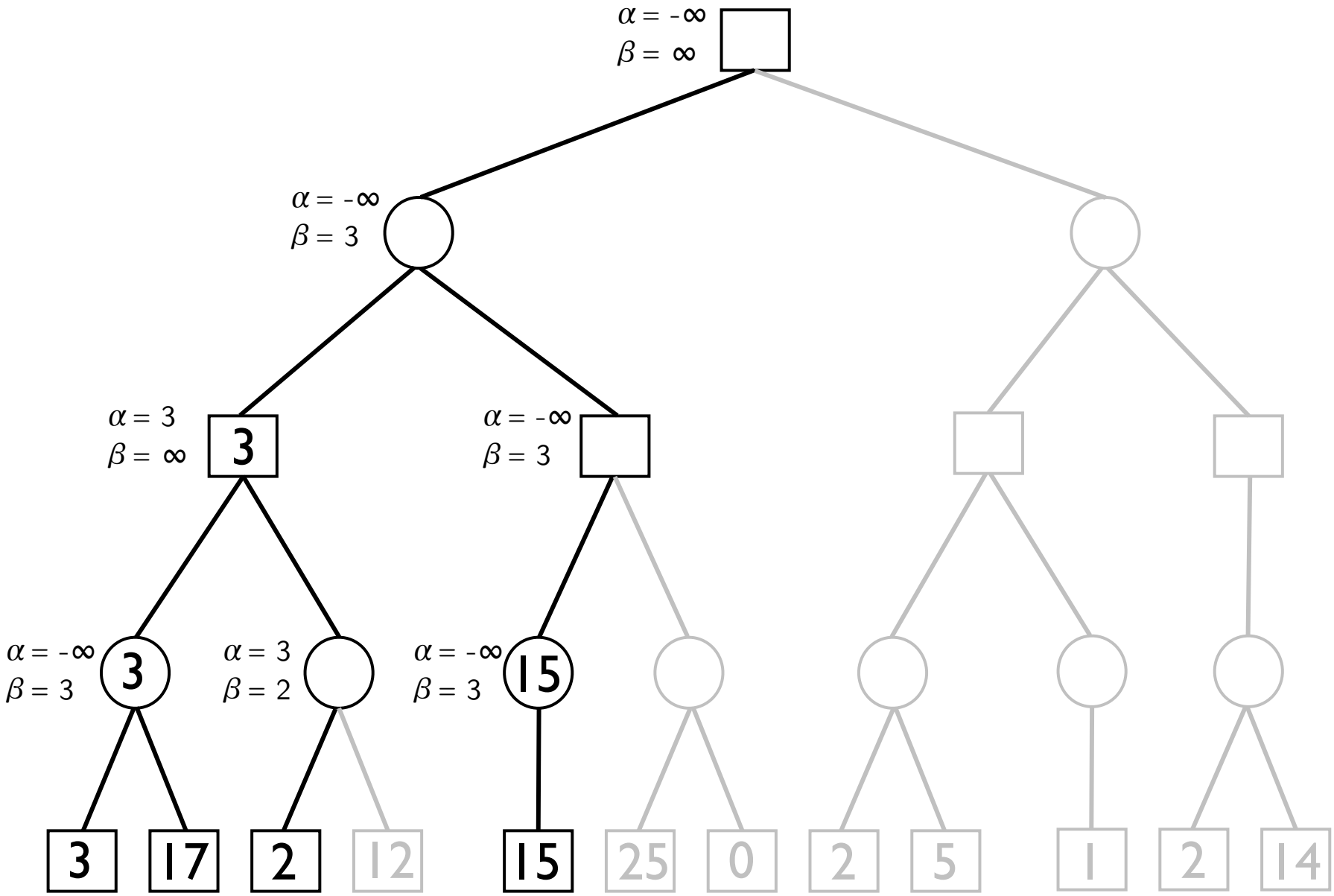

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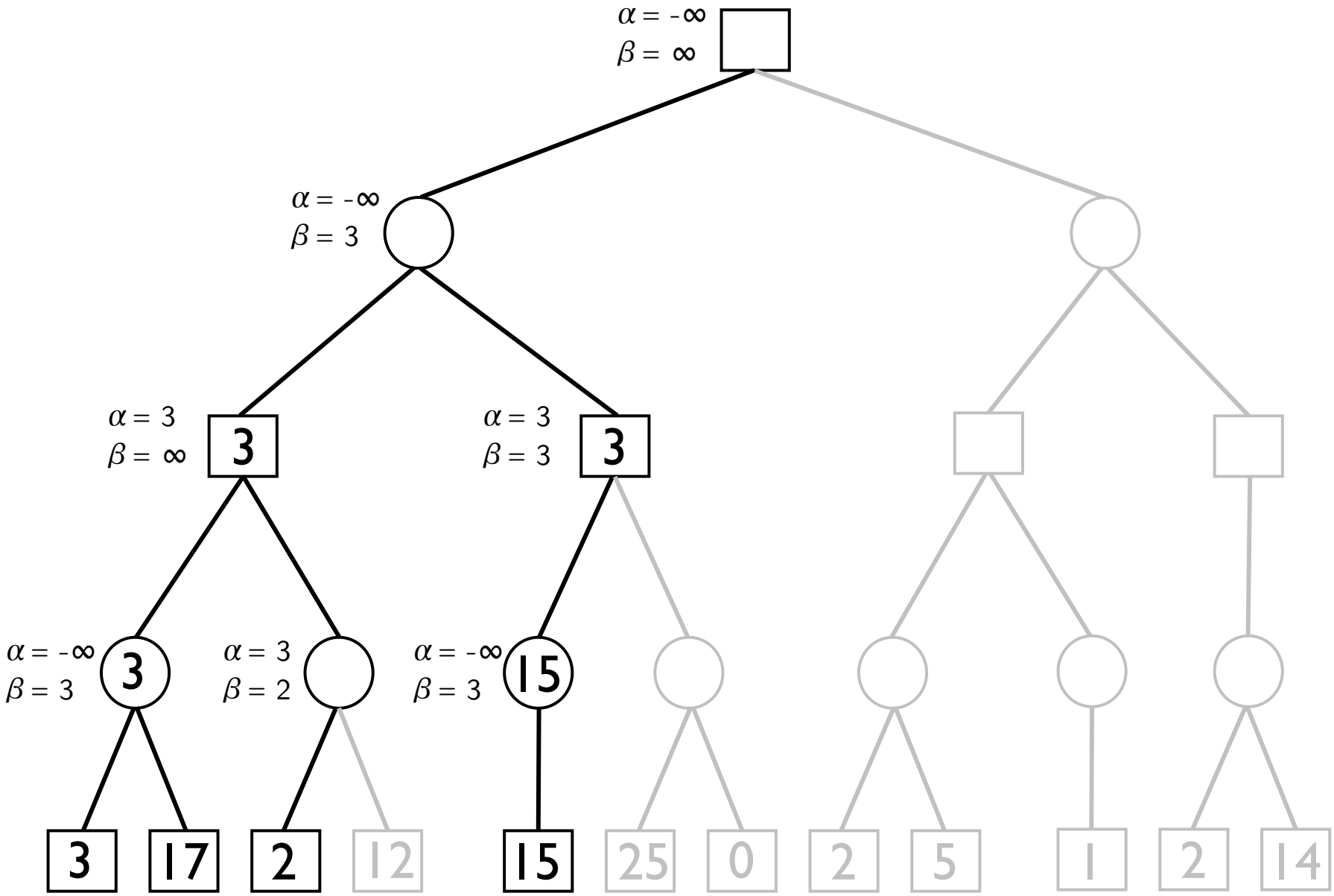

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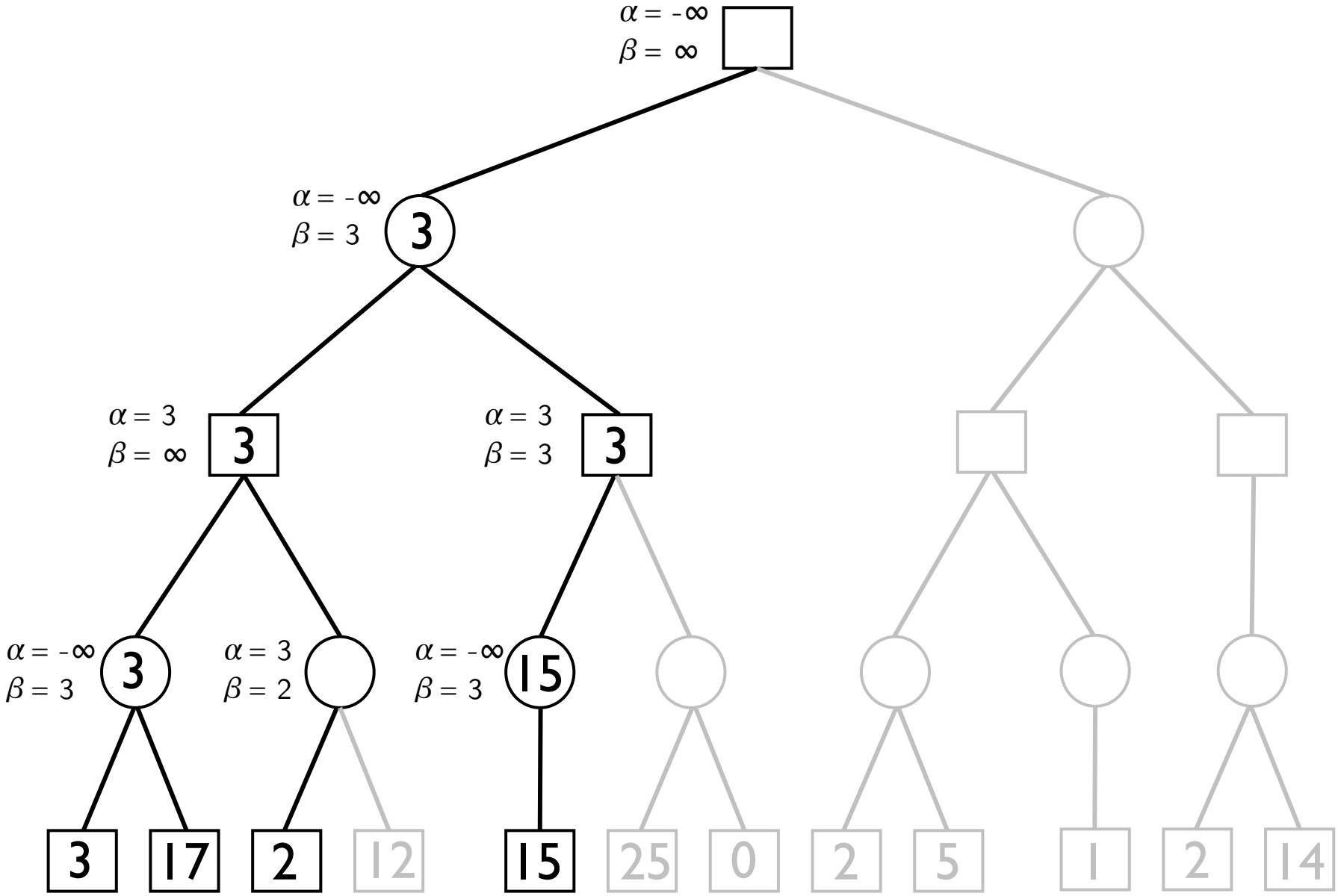

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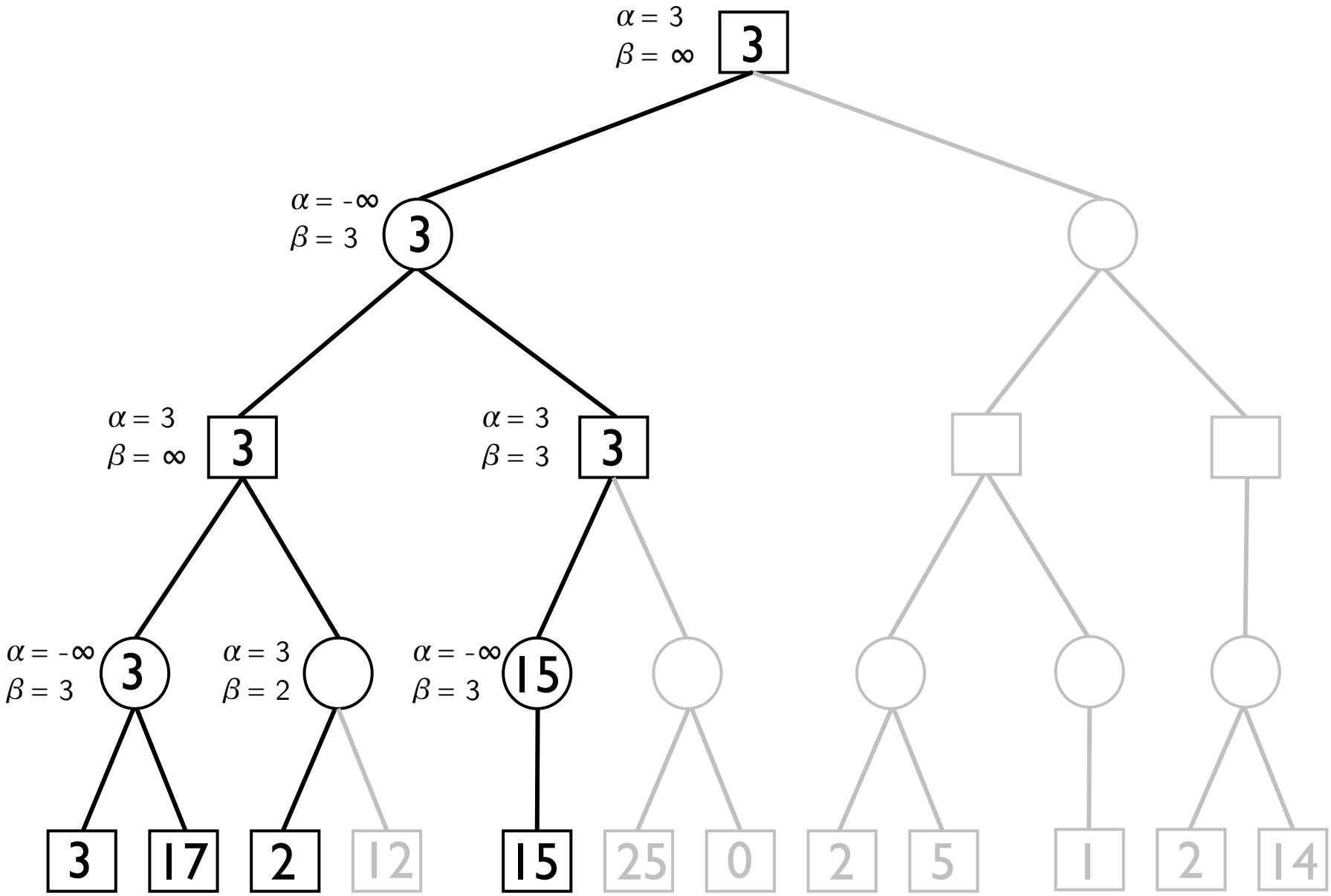

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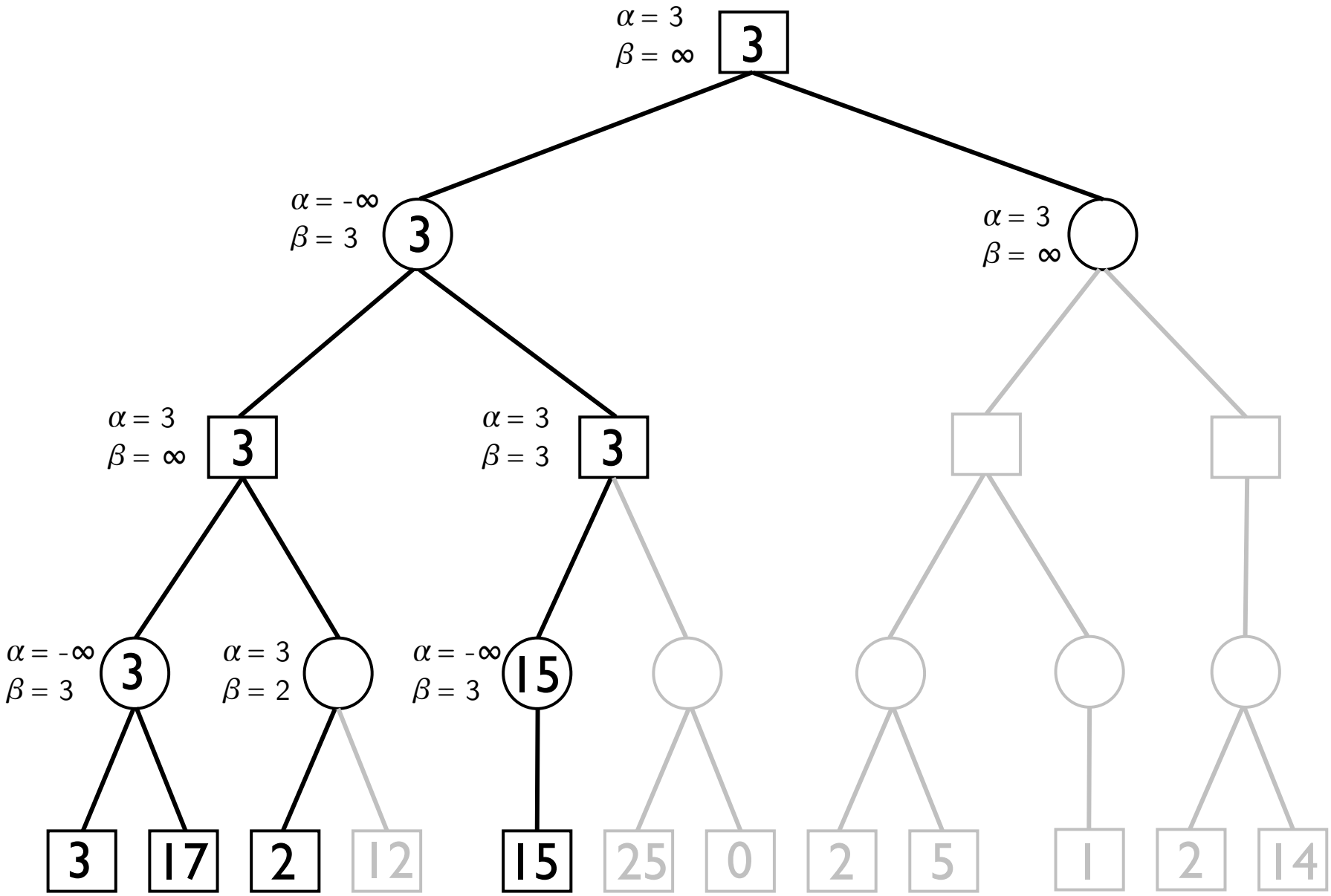

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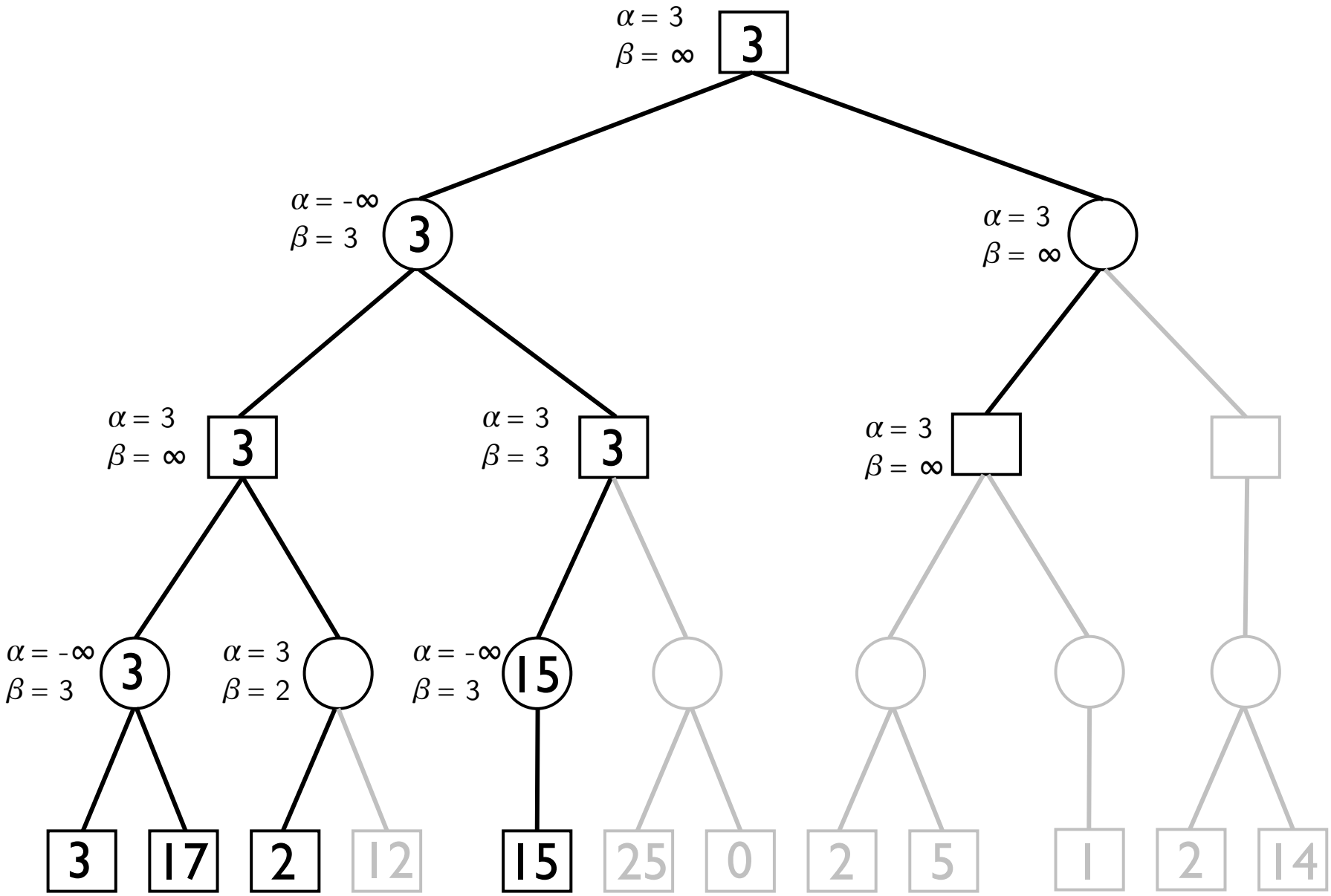

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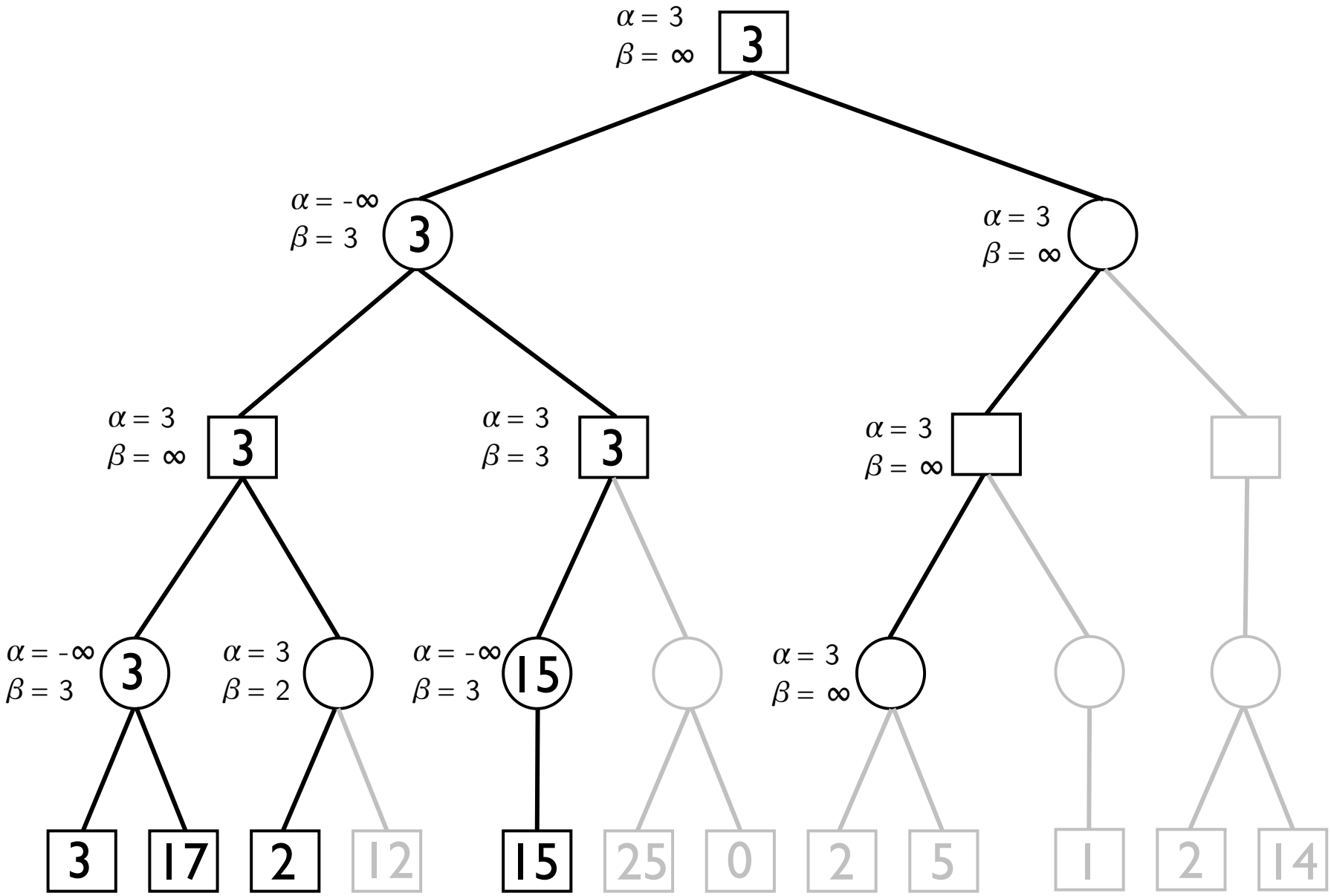

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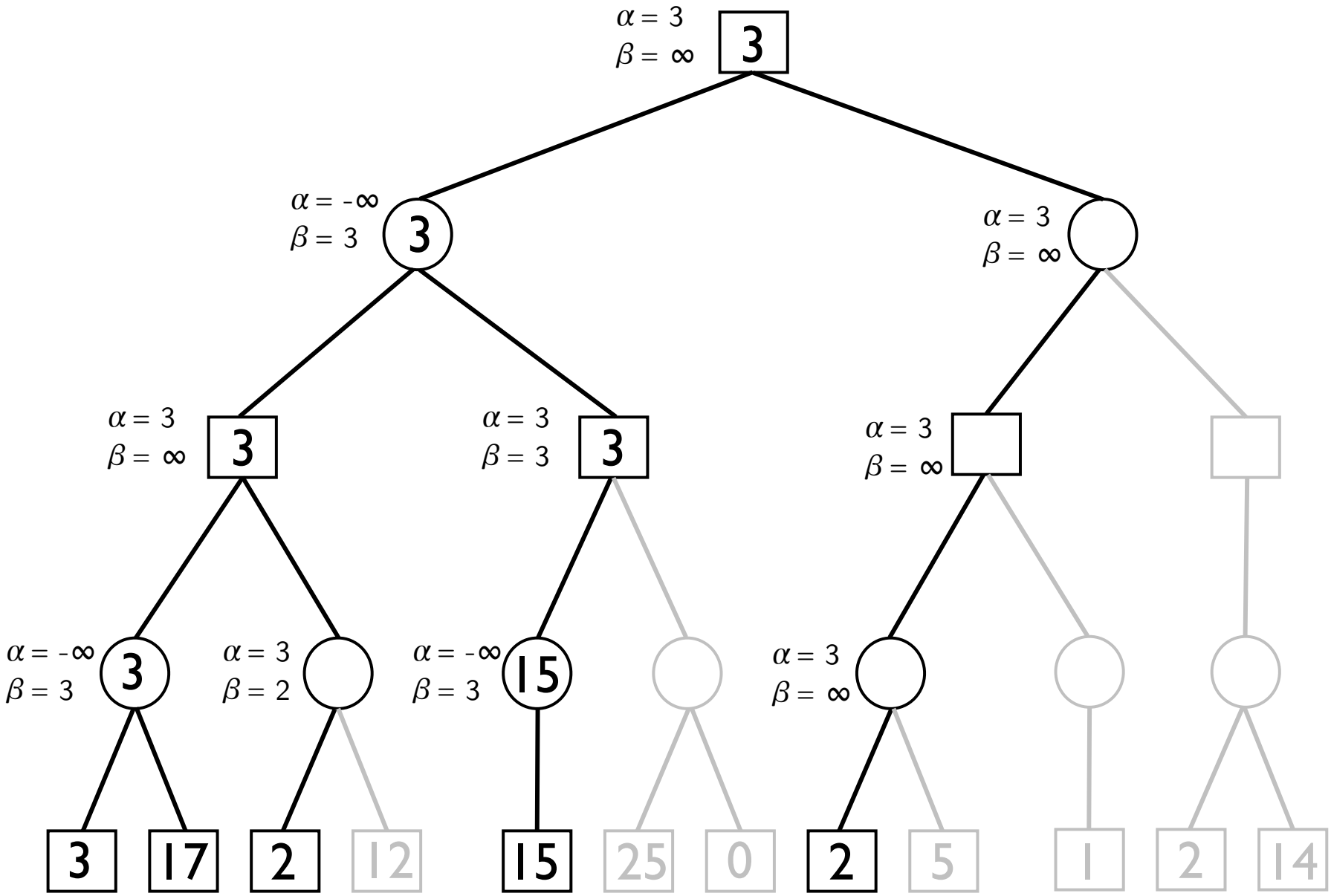

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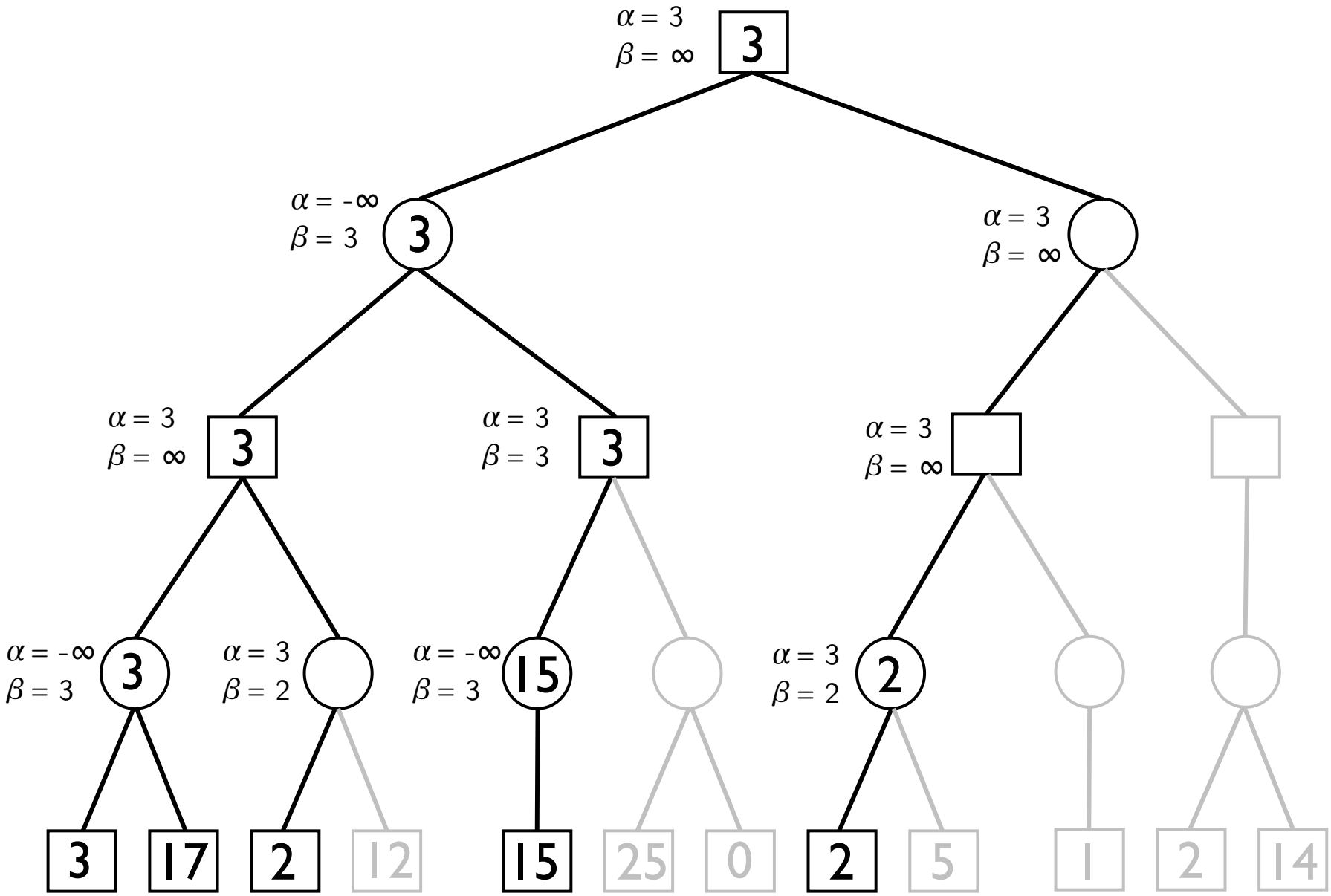

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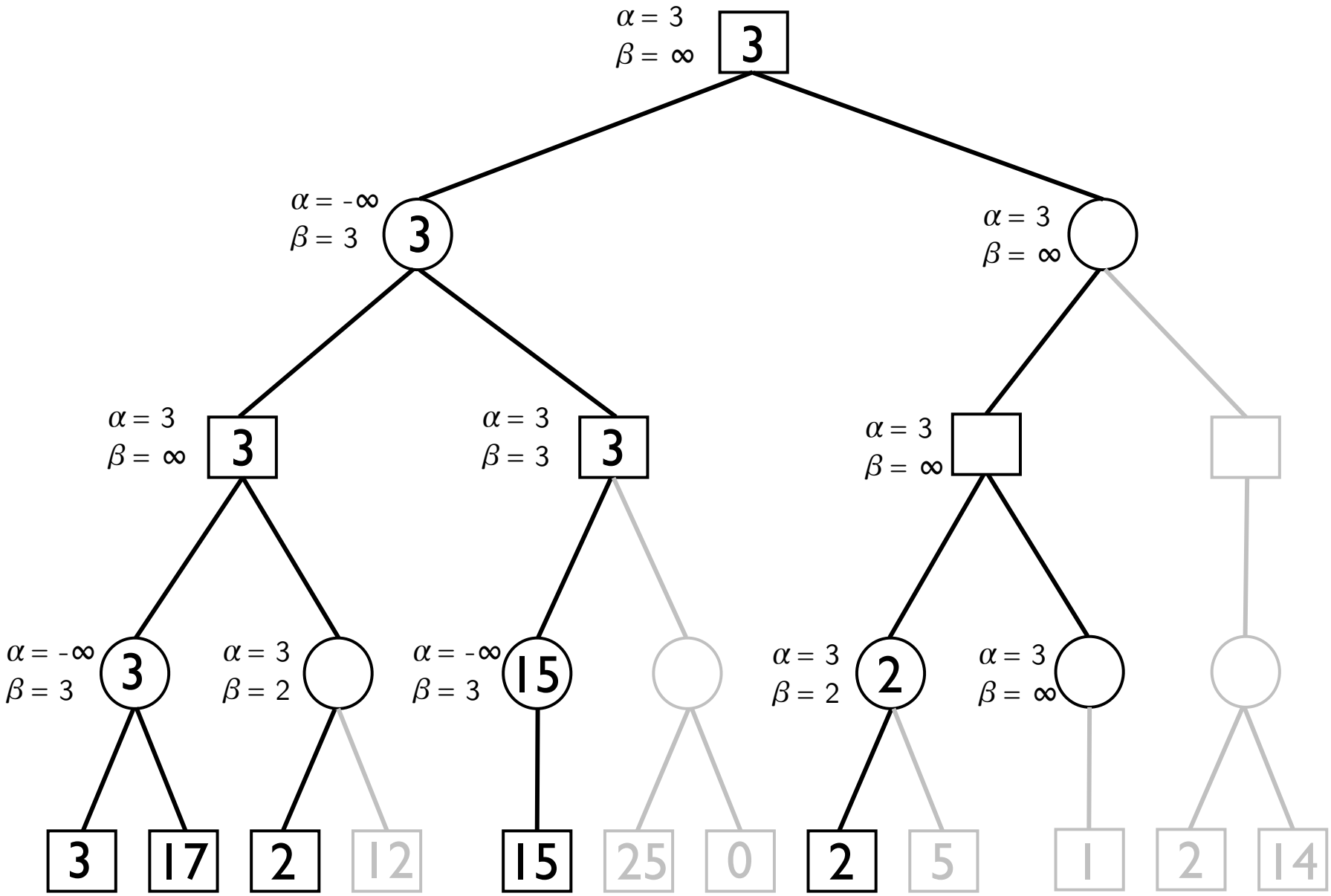

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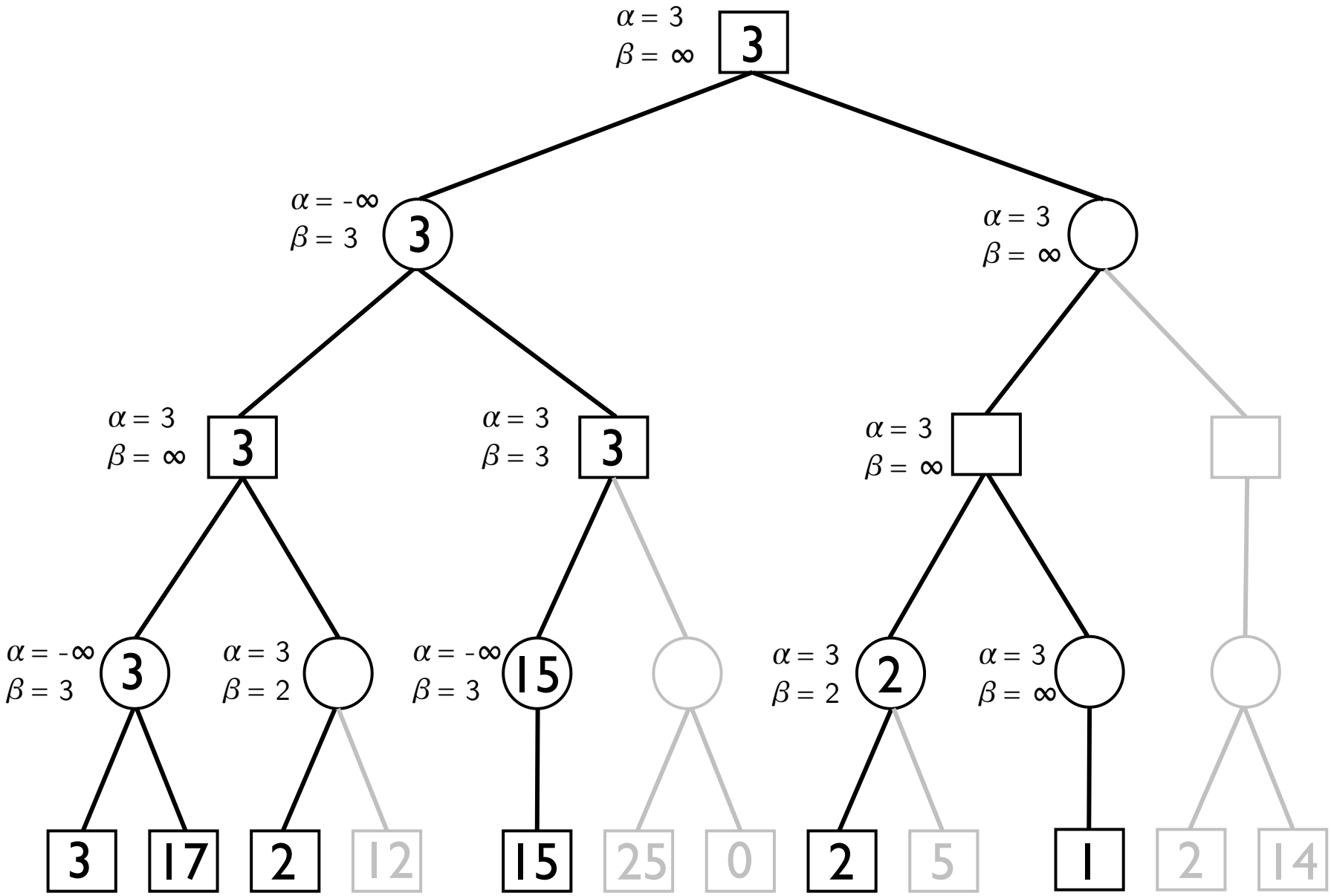

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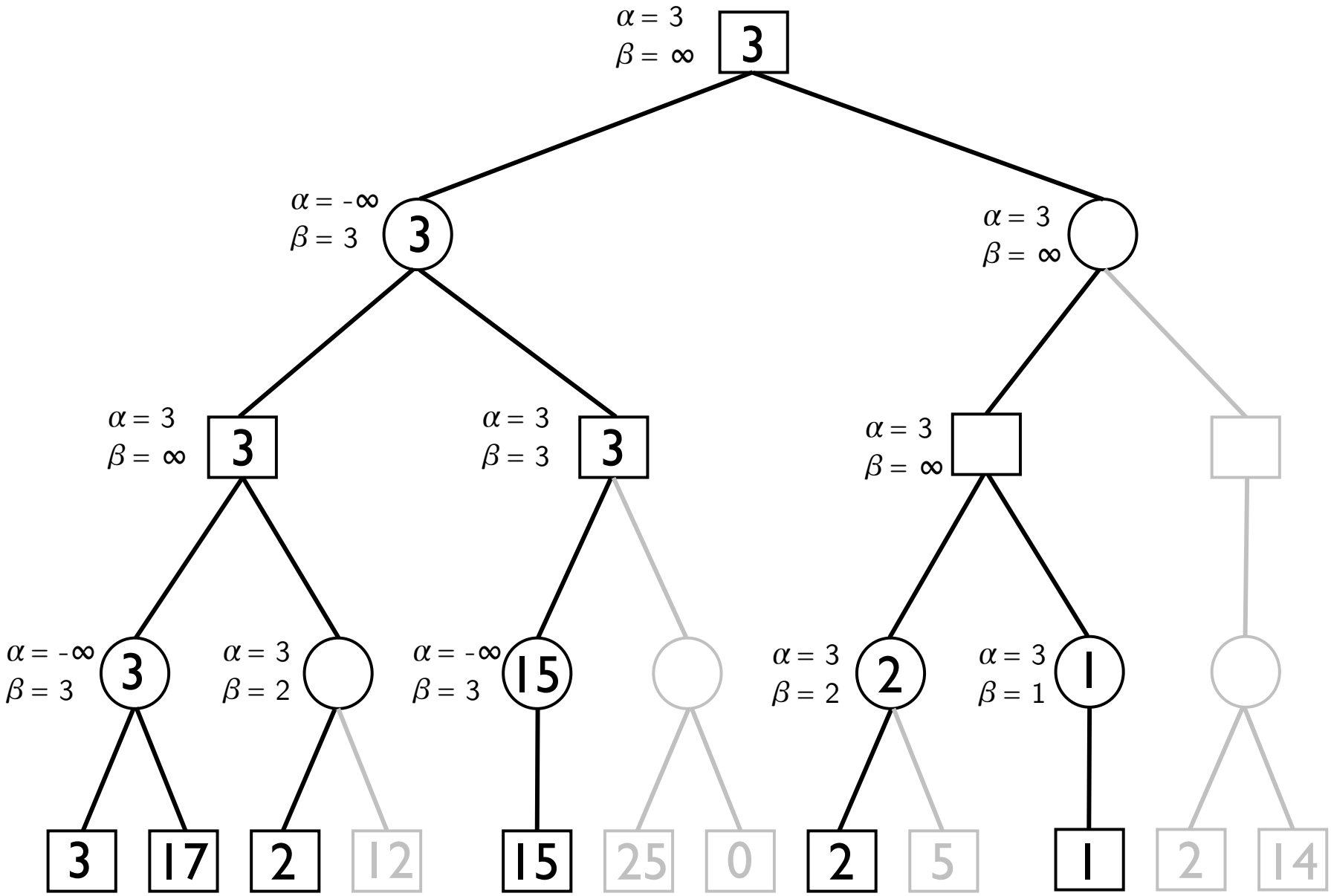

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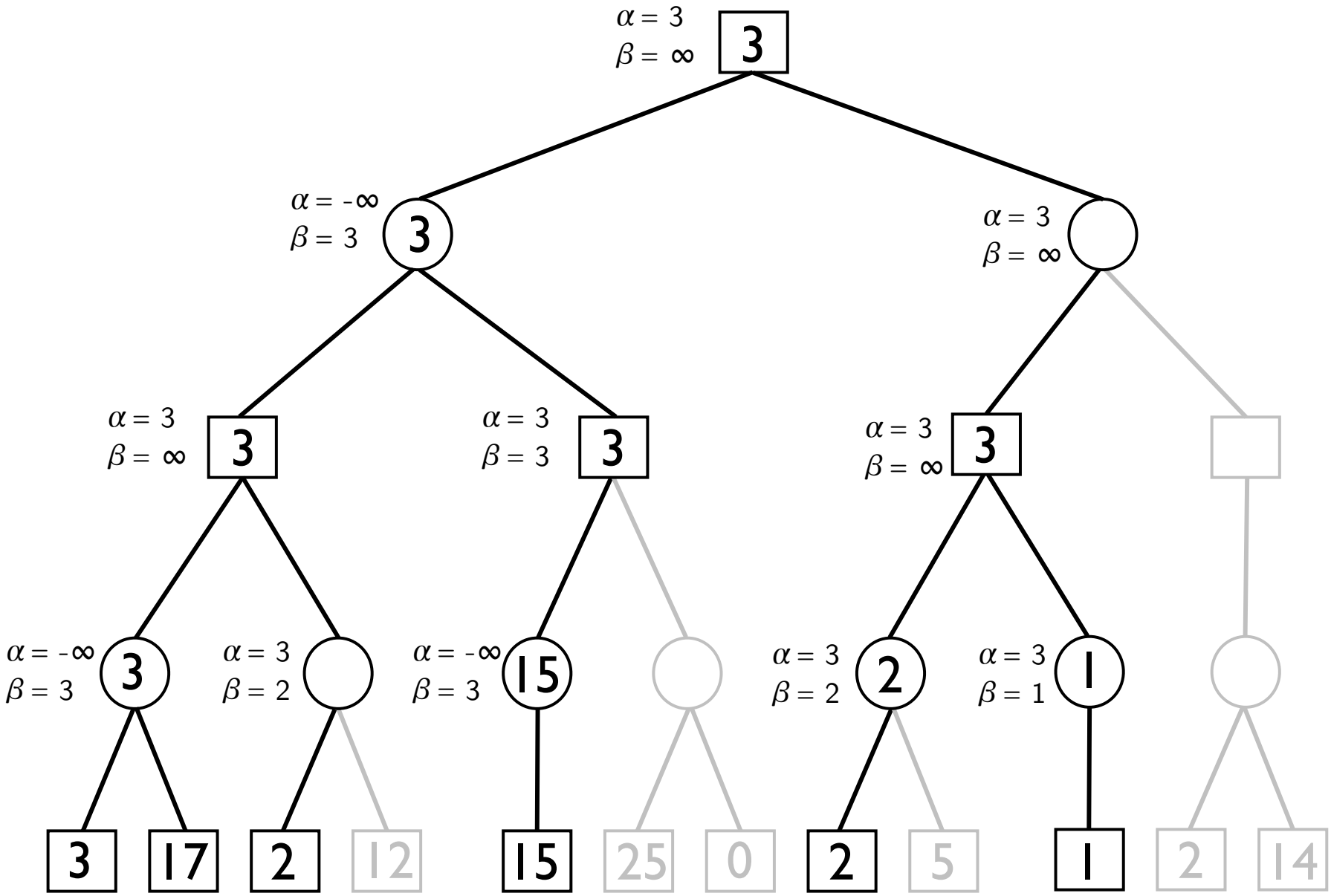

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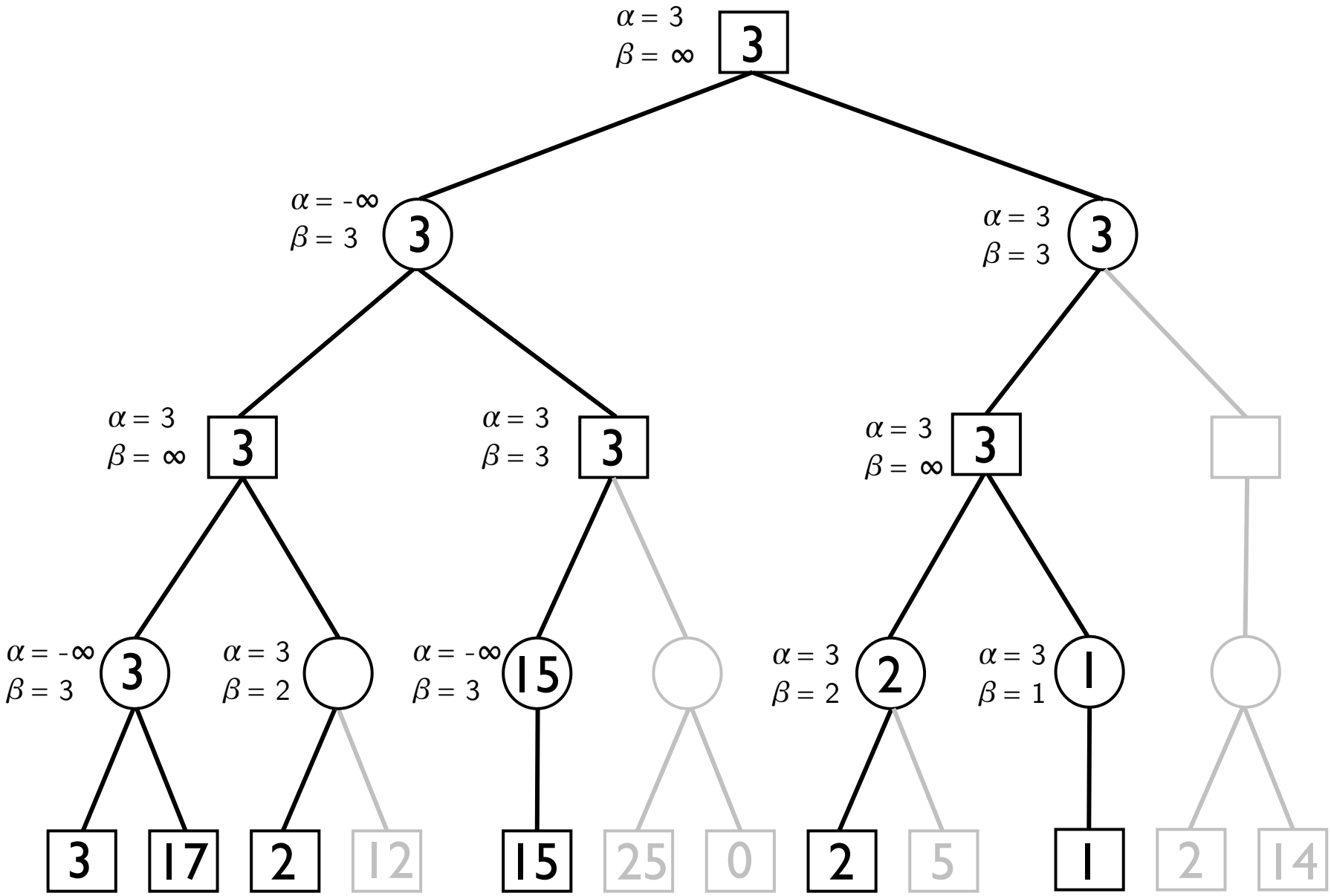

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