

Contraintes_temporelles

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2 Texte d'oral de modélisation - Agrégation Option Informatique

2.1 Préparation à l'agrégation - ENS de Rennes, 2016-17

- *Date* : 7 avril 2017
- *Auteur* : [Lilian Besson](#)
- *Texte*: Annale 2009, "Contraintes temporelles"

2.2 À propos de ce document

- Ceci est une *proposition* de correction, partielle et probablement non-optimale, pour la partie implémentation d'un [texte d'annale de l'agrégation de mathématiques, option informatique](#).

- Ce document est un [notebook Jupyter](#), et est [open-source sous Licence MIT sur GitHub](#), comme les autres solutions de textes de modélisation que j'ai écrites cette année.
- L'implémentation sera faite en OCaml, version 4+ :

```
In [2]: Sys.command "ocaml -version";;
```

The OCaml toplevel, version 4.04.2

```
Out [2]: - : int = 0
```

Notez que certaines fonctions des modules usuels `List` et `Array` ne sont pas disponibles en OCaml 3.12. J'essaie autant que possible de ne pas les utiliser, ou alors de les redéfinir si je m'en sers.

2.3 Question de programmation

La question de programmation pour ce texte était donnée en question 1 en page 9 :

“Programmer l'algorithme PC. Faites le tourner sur l'exemple de réseau non distributif.”

La consigne était très courte, mais avec aucune indication. Notez qu'il est rare que le texte exige un exemple particulier.

2.4 Réponse à l'exercice requis

Ça va être assez long, en fait...

1. D'abord, il faut définir les types de données avec lesquels on va travailler,
2. Ensuite, implémenter les deux opérations \oplus et \otimes sur les ensembles d'intervalles,
3. Puis implémenter l'algorithme PC (similaire à Floyd-Warshall),
4. Et enfin, l'exécuter sur l'exemple de réseau non distributif donné en page 8.

Si possible, on va essayer de faire des *tests* pour chaque fonction intermédiaire, et un exemple de plus à la fin.

Un des problèmes que l'on va rencontrer est le fait que l'on doit manipuler $-\infty$ et $+\infty$, pour pouvoir gérer une contrainte qui n'est pas une contrainte, à savoir l'intervalle $(-\infty, +\infty)$.

2.4.1 Structures de données

On va travailler avec des valeurs entières ou $\pm\infty$. En écrivant nous même les opérations arithmétiques (+, *max*) sur les entiers “étendus” on obtiendra ce qu’on veut.

```
In [75]: type entier_etendu = MInf | PInf | E of int;;
```

```
Out[75]: type entier_etendu = MInf | PInf | E of int
```

On se restreint aux intervalles à coordonnées *entières*, et on considère des listes d’intervalles. Tous les intervalles sont fermés à gauche et à droite.

```
In [76]: type intervalle = (entier_etendu * entier_etendu);; (* (a, b) représente l'interval
```

```
Out[76]: type intervalle = entier_etendu * entier_etendu
```

```
In [77]: type intervalles = intervalle list;;
```

```
Out[77]: type intervalles = intervalle list
```

On définit tout de suite deux exemples, T_a et S_a tirés de la Figure 2.a) et T_b, S_b de la Figure 2.b). Cela permettra de vérifier les opérations \oplus et \otimes .

- $T_a = \{[1,4], [6,8]\}$ et $S_a = \{[0,1], [3,5], [6,7]\}$.

```
In [78]: let t_a : intervalles = [  
          (E(1), E(4));  
          (E(6), E(8))  
        ];;
```

```
        let s_a : intervalles = [  
          (E(0), E(1));  
          (E(3), E(5));  
          (E(6), E(7))  
        ];;
```

```
Out[78]: val t_a : intervalles = [(E 1, E 4); (E 6, E 8)]
```

```
Out[78]: val s_a : intervalles = [(E 0, E 1); (E 3, E 5); (E 6, E 7)]
```

- $T_b = \{[-1,0], [2,4]\}$ et $S_b = \{[0,1], [4,4]\}$.

```
In [80]: let t_b : intervalles = [  
          (E(-1), E(0));  
          (E(2), E(4))  
        ];;
```

```

let s_b : intervalles = [
  (E(0), E(1));
  (E(4), E(4)) (* Intervalle de longueur nulle *)
];;

```

```
Out[80]: val t_b : intervalles = [(E (-1), E 0); (E 2, E 4)]
```

```
Out[80]: val s_b : intervalles = [(E 0, E 1); (E 4, E 4)]
```

- Et la contrainte vide, $T = \{[-\infty, +\infty]\}$:

```

In [79]: let t_vide : intervalles = [
  (MInf, PInf)
];;

```

```
Out[79]: val t_vide : intervalles = [(MInf, PInf)]
```

2.4.2 Arithmétiques sur nos entiers étendus

Max/min

```

In [81]: let max_ee x y =
  match x, y with
  | MInf, _ -> y
  | PInf, _ -> PInf
  | _, MInf -> x
  | _, PInf -> PInf
  | E(vx), E(vy) -> E(max vx vy)
;;

```

```
Out[81]: val max_ee : entier_etendu -> entier_etendu -> entier_etendu = <fun>
```

```

In [86]: max_ee MInf (E(10));;
max_ee PInf (E(10));;
max_ee (E(10)) MInf;;
max_ee (E(10)) PInf;;
max_ee (E(-10)) (E(10));;
max_ee (E(10)) (E(-10));;

```

```
Out[86]: - : entier_etendu = E 10
```

```
Out[86]: - : entier_etendu = PInf
```

```
Out [86]: - : entier_etendu = E 10
```

```
Out [86]: - : entier_etendu = PInf
```

```
Out [86]: - : entier_etendu = E 10
```

```
Out [86]: - : entier_etendu = E 10
```

```
In [87]: let min_ee x y =  
        match x, y with  
        | PInf, _ -> y  
        | MInf, _ -> MInf  
        | _, PInf -> x  
        | _, MInf -> MInf  
        | E(vx), E(vy) -> E(min vx vy)  
        ;;
```

```
Out [87]: val min_ee : entier_etendu -> entier_etendu -> entier_etendu = <fun>
```

```
In [90]: min_ee MInf (E(10));;  
min_ee PInf (E(10));;  
min_ee (E(10)) MInf;;  
min_ee (E(10)) PInf;;  
min_ee (E(-10)) (E(10));;  
min_ee (E(10)) (E(-10));;
```

```
Out [90]: - : entier_etendu = MInf
```

```
Out [90]: - : entier_etendu = E 10
```

```
Out [90]: - : entier_etendu = MInf
```

```
Out [90]: - : entier_etendu = E 10
```

```
Out [90]: - : entier_etendu = E (-10)
```

```
Out [90]: - : entier_etendu = E (-10)
```

On peut utiliser la fonction minimum pour trier deux entiers étendus :

```
In [115]: let pluspetiteq_ee x y =
          let m = min_ee x y in
          m = x || x = y
          ;;
```

```
Out[115]: val pluspetiteq_ee : entier_etendu -> entier_etendu -> bool = <fun>
```

```
In [116]: let pluspetit_ee x y =
          let m = min_ee x y in
          m = x && x != y
          ;;
```

```
Out[116]: val pluspetit_ee : entier_etendu -> entier_etendu -> bool = <fun>
```

Somme/produit

```
In [88]: let plus_ee x y =
          match x, y with
          | MInf, PInf -> failwith "-inf + +inf = ?"
          | PInf, MInf -> failwith "-inf + +inf = ?"
          | PInf, _ -> PInf
          | MInf, _ -> MInf
          | _, MInf -> MInf
          | _, PInf -> PInf
          | E(vx), E(vy) -> E(vx + vy)
          ;;
```

```
Out[88]: val plus_ee : entier_etendu -> entier_etendu -> entier_etendu = <fun>
```

```
In [92]: plus_ee MInf (E(10));;
plus_ee PInf (E(10));;
plus_ee (E(10)) MInf;;
plus_ee (E(10)) PInf;;
plus_ee (E(-10)) (E(10));;
plus_ee (E(10)) (E(-10));;
plus_ee (E(10)) (E(10));;
plus_ee (E(-10)) (E(-10));;
```

```
Out[92]: - : entier_etendu = MInf
```

```
Out[92]: - : entier_etendu = PInf
```

```
Out[92]: - : entier_etendu = MInf
```

Out [92]: - : entier_etendu = PInf

Out [92]: - : entier_etendu = E 0

Out [92]: - : entier_etendu = E 0

Out [92]: - : entier_etendu = E 20

Out [92]: - : entier_etendu = E (-20)

```
In [93]: let produit_ee x y =  
        match x, y with  
        | MInf, PInf -> MInf  
        | PInf, MInf -> PInf  
        | PInf, E(vy) when vy < 0 -> MInf  
        | PInf, _ -> PInf  
        | MInf, E(vy) when vy < 0 -> PInf  
        | MInf, _ -> MInf  
        | E(vx), PInf when vx < 0 -> MInf  
        | _, PInf -> PInf  
        | E(vx), MInf when vx < 0 -> PInf  
        | _, MInf -> MInf  
        | E(vx), E(vy) -> E(vx * vy)  
        ;;
```

Out [93]: val produit_ee : entier_etendu -> entier_etendu -> entier_etendu = <fun>

```
In [94]: produit_ee MInf (E(10));;  
        produit_ee PInf (E(10));;  
        produit_ee (E(10)) MInf;;  
        produit_ee (E(10)) PInf;;  
        produit_ee (E(-10)) (E(10));;  
        produit_ee (E(10)) (E(-10));;  
        produit_ee (E(10)) (E(10));;  
        produit_ee (E(-10)) (E(-10));;
```

Out [94]: - : entier_etendu = MInf

Out [94]: - : entier_etendu = PInf

Out [94]: - : entier_etendu = MInf

```
Out [94]: - : entier_etendu = PInf
```

```
Out [94]: - : entier_etendu = E (-100)
```

```
Out [94]: - : entier_etendu = E (-100)
```

```
Out [94]: - : entier_etendu = E 100
```

```
Out [94]: - : entier_etendu = E 100
```

2.4.3 Opérations de base, \oplus et \otimes

On peut écrire des opérations d'intersection et de composition sur deux intervalles, ensuite il suffira de les généraliser à un ensemble d'intervalles.

On suit les définitions de l'énoncé.

Intersection

$$\forall T = (I_1, \dots, I_l), \forall S = (J_1, \dots, J_m), T \oplus S := \{K_1, \dots, K_n\} \text{ Où } K_k = I_i \cap J_j.$$

Notez que $n \leq l + m$ ici.

Pour l'intersection de deux intervalles, l'intervalle vide \emptyset peut être obtenu, donc la fonction suivante renvoie un type intervalle option : soit None si $I \cap J = \emptyset$, soit Some (x, y) si $I \cap J = [x, y]$.

```
In [96]: let intersection (i : intervalle) (j : intervalle) : intervalle option =
         let a = fst i and b = snd i in
         let c = fst j and d = snd j in
         if pluspetit_ee b c || pluspetit_ee d a then
           None
         else
           Some (max_ee a c, min_ee b d)
         ;;
```

```
Out [96]: val intersection : intervalle -> intervalle -> intervalle option = <fun>
```

Ensuite, il suffit d'explorer tous les couples (I, J) possible, et de ne garder que ceux qui donnent un intervalle. On supprimera les doublons en vérifiant au fur et à mesure (ça a la même complexité que si on le fait à la fin).

En manipulant une liste d'intervalle option, on doit ruser un peu pour n'ajouter que ceux qui ne sont pas dans acc et qui sont des vrais intervalles.


```
In [98]: let ajoute_nouveaux_option (acc : intervalles) (liste_option : intervalle option list)
List.map
(fun i -> match i with Some i2 -> i2 | None -> (MInf, PInf))
(List.filter (fun i ->
  match i with
  | None -> false
  | Some i2 -> not (List.mem i2 acc)
) liste_option)
;;
```

```
Out[98]: val ajoute_nouveaux_option :
intervalles -> intervalle option list -> intervalle list = <fun>
```

Avec tout ça, on a une belle fonction récursive, avec un accumulateur acc qui contient la liste des intervalles dans $T \oplus S$, construite en considérant les intervalles de S les un après les autres. On s'assure de n'avoir ni intervalles vide, ni doublon, grâce à `ajoute_nouveaux_option`.

```
In [101]: let intersections (t : intervalles) (s : intervalles) : intervalles =
let rec inter_aux acc tx sx =
  match sx with
  | [] -> acc      (* Plus rien à ajouter *)
  | j :: s2 ->     (* On traite j, puis récursivement la suite de s *)
    let t_inter_j = List.map (intersection j) tx in
    inter_aux ((ajoute_nouveaux_option acc t_inter_j) @ acc) tx s2
in
List.sort compare (inter_aux [] t s)
(* On trie pour les avoir en ordre croissant, c'est tout *)
;;
```

```
Out[101]: val intersections : intervalles -> intervalles -> intervalles = <fun>
```

Pour frimer un peu et simplifier l'écriture de l'algorithme PC, on peut définir une opération infix en raccourci :

$$T \oplus S = t ++ s.$$

```
In [102]: let ( ++ ) = intersections;;
```

```
Out[102]: val ( ++ ) : intervalles -> intervalles -> intervalles = <fun>
```

Composition Ce sera plus facile.

$\forall T = (I_1, \dots, I_l), \forall S = (J_1, \dots, J_m), T \otimes S := \{K_1, \dots, K_n\}$ Où $K_k = [a+c, b+d]$, si $I_i = [a, b], J_j = [c, d]$.

Notez que $n \leq l \times m$ ici.

Pour la composition de deux intervalles, il n'y pas de difficulté particulière :

```
In [103]: let composition (i : intervalle) (j : intervalle) : intervalle =
          let a = fst i and b = snd i in
          let c = fst j and d = snd j in
          (* (a + c, b + d) *)
          ((plus_ee a c), (plus_ee d b))
          ;;
```

```
Out[103]: val composition : intervalle -> intervalle -> intervalle = <fun>
```

Et on les combine facilement, en gardant la même architecture que pour intersections.

```
In [104]: let ajoute_nouveaux (acc : intervalles) (liste : intervalles) : intervalles =
          List.filter (fun i -> not (List.mem i acc)) liste
          ;;
```

```
Out[104]: val ajoute_nouveaux : intervalles -> intervalles -> intervalles = <fun>
```

```
In [105]: let compositions (t : intervalles) (s : intervalles) : intervalles =
          let rec compo_aux acc tx sx =
              match sx with
              | [] -> acc      (* Plus rien à ajouter *)
              | j :: s2 ->    (* On traite j, puis récursivement la suite de s *)
                  let t_compo_j = List.map (composition j) tx in
                  compo_aux ((ajoute_nouveaux acc t_compo_j) @ acc) tx s2
          in
          List.sort compare (compo_aux [] t s)
          (* On trie pour les avoir en ordre croissant, c'est tout *)
          ;;
```

```
Out[105]: val compositions : intervalles -> intervalles -> intervalles = <fun>
```

Pour frimer un peu et simplifier l'écriture de l'algorithme PC, on peut définir une opération infix en raccourci :

$$T \otimes S = t ** s.$$

```
In [106]: let ( ** ) = compositions;;
```

```
Out[106]: val ( ** ) : intervalles -> intervalles -> intervalles = <fun>
```

Union On peut aussi rapidement définir $T \cup S$, pour l'union. C'est très facile.

```
In [107]: let union (t : intervalles) (s : intervalles) : intervalles =
          List.append t s
          ;;
```

```
Out[107]: val union : intervalles -> intervalles -> intervalles = <fun>
```

Exemples On aimerait reproduire les exemples de la Figure 2 du texte.

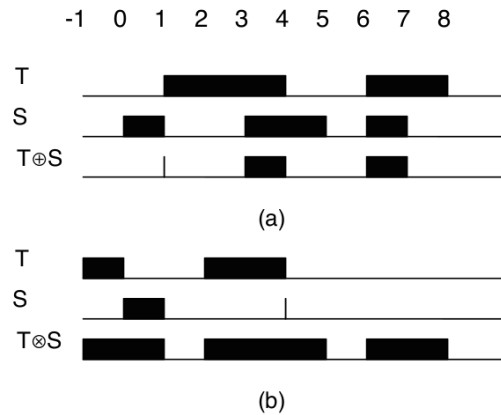


FIG. 2 – Opérations sur les contraintes : (a) intersection, (b) composition.

- Pour les deux intervalles de la Figure 2.a) : $T_a = \{[1,4], [6,8]\}$ et $S_a = \{[0,1], [3,5], [6,7]\}$.

```
In [108]: t_a ++ s_a;;
```

```
Out[108]: - : intervalles = [(E 3, E 4); (E 6, E 7)]
```

On retrouve bien le résultat de la Figure 2.a).

```
In [109]: t_a ** s_a;;
union t_a s_a;;
```

```
Out[109]: - : intervalles =
[(E 1, E 5); (E 4, E 9); (E 6, E 9); (E 7, E 11); (E 9, E 13); (E 12, E 15)]
```

```
Out[109]: - : intervalles =
[(E 1, E 4); (E 6, E 8); (E 0, E 1); (E 3, E 5); (E 6, E 7)]
```

- Pour les deux intervalles de la Figure 2.b) : $T_b = \{[-1,0], [2,4]\}$ et $S_b = \{[0,1], [4,4]\}$.

```
In [110]: t_b ** s_b;;
```

```
Out[110]: - : intervalles = [(E (-1), E 1); (E 2, E 5); (E 3, E 4); (E 6, E 8)]
```

On retrouve bien le résultat de la Figure 2.b).

L'intervalle $[3,4]$ est inclus dans $[2,5]$, donc on devrait ajouter une étape de nettoyage pour donner une forme canonique aux intervalles produit par composition. On le fait plus bas.

```
In [113]: t_b;;
          s_b;;
```

```
Out[113]: - : intervalles = [(E (-1), E 0); (E 2, E 4)]
```

```
Out[113]: - : intervalles = [(E 0, E 1); (E 4, E 4)]
```

```
In [114]: t_b ++ s_b;;
          union t_b s_b;;
```

```
Out[114]: - : intervalles = []
```

```
Out[114]: - : intervalles = [(E (-1), E 0); (E 2, E 4); (E 0, E 1); (E 4, E 4)]
```

On remarque que les intervalles sont bien donnés dans l'ordre croissant, puisqu'on a pensé à trier la sortie des deux fonctions, mais ça ne change rien.

Une étape de plus : ne pas inclure des intervalles inclus dans ceux déjà présents On va raffiner les fonctions définis ci-dessus en ajoutant un test, sur leur résultat final.

- `est_inclus i j` teste si $I \subseteq J$.

```
In [119]: let est_inclus (i : intervalle) (j : intervalle) : bool =
          let a = fst i and b = snd i in
          let c = fst j and d = snd j in
          (* on peut aussi écrire directement
           let a, b = i and c, d = j in
           pour extraire les valeurs d'un coupe i=(a,b) et j=(c,d)
           *)
          (* c <= a && b <= d *)
          (pluspetiteq_ee c a) && (pluspetiteq_ee b d)
          ;;
```

```
Out[119]: val est_inclus : intervalle -> intervalle -> bool = <fun>
```

```
In [121]: est_inclus (E(3), E(4)) (E(2), E(5));; (* true *)
          est_inclus (E(2), E(5)) (E(3), E(4));; (* false *)
          est_inclus (E(1), E(1)) (E(1), E(1));; (* true *)
```

```
Out[121]: - : bool = true
```

```
Out[121]: - : bool = false
```

```
Out[121]: - : bool = true
```

- `est_inclus_dans_un i acc` teste si $I \subseteq J$ pour **un** $J \neq I \in \text{Acc}$.

```
In [122]: let est_inclus_dans_un (i : intervalle) (acc : intervalles) : bool =
          List.exists (fun j -> (i != j) && (est_inclus i j)) acc
          ;;
```

```
Out[122]: val est_inclus_dans_un : intervalle -> intervalles -> bool = <fun>
```

- On peut écrire une fonction filtre qui retire les intervalles inclus dans d'autres, puis retire les doublons.

```
In [123]: let retire_les_inclus (liste : intervalles) : intervalles =
          List.filter (fun i -> not (est_inclus_dans_un i liste)) liste
          ;;
```

```
let retire_les_doublons (liste : intervalles) : intervalles =
  let reponse = ref [] in
  List.iter (fun i ->
    if not (List.mem i !reponse) then
      reponse := i :: !reponse
  ) liste;
  !reponse
;;
```

```
let filtre liste =
  retire_les_doublons (retire_les_inclus liste)
;;
```

```
Out[123]: val retire_les_inclus : intervalles -> intervalles = <fun>
```

```
Out[123]: val retire_les_doublons : intervalles -> intervalles = <fun>
```

```
Out[123]: val filtre : intervalles -> intervalles = <fun>
```

- L'intersection ne devrait pas être impactée.

```
In [124]: let intersections2 (t : intervalles) (s : intervalles) : intervalles =
          List.sort compare (filtre (intersections t s))
          (* On trie pour les avoir en ordre croissant, c'est tout *)
          ;;
```

```
Out[124]: val intersections2 : intervalles -> intervalles -> intervalles = <fun>
```

```
In [125]: let ( ++ ) = intersections2;;
          t_a ++ s_a;;
```

```
Out[125]: val ( ++ ) : intervalles -> intervalles -> intervalles = <fun>
```

```
Out[125]: - : intervalles = [(E 3, E 4); (E 6, E 7)]
```

- Mais la composition va donner la bonne réponse désormais pour l'exemple de la figure 2.b).

```
In [126]: let compositions2 (t : intervalles) (s : intervalles) : intervalles =
          List.sort compare (filtre (compositions t s))
          (* On trie pour les avoir en ordre croissant, c'est tout *)
          ;;
```

```
Out[126]: val compositions2 : intervalles -> intervalles -> intervalles = <fun>
```

```
In [127]: let ( ** ) = compositions2;;
          t_b ** s_b;;
```

```
Out[127]: val ( ** ) : intervalles -> intervalles -> intervalles = <fun>
```

```
Out[127]: - : intervalles = [(E (-1), E 1); (E 2, E 5); (E 6, E 8)]
```

C'était un peu long, mais c'est propre au moins.

Notez que pour obtenir une vraie forme canonique, il faudrait aussi rassembler les intervalles consécutifs ($\{[0, 1], [1, 2]\} \rightarrow \{[0, 1]\}$) et se recoupant ($\{[0, 3], [2, 4]\} \rightarrow \{[0, 4]\}$).

Ça prendrait trop de temps. Et ce n'était pas exigé.

2.4.4 L'algorithme PC

Structure de données pour les réseaux STP On a besoin désormais de considérer des réseaux STP, qui sont des graphes dont les sommets sont des entiers, et dont les arêtes sont étiquetées par des *listes* (non vides) d'intervalles.

L'algorithme PC demande de pouvoir accéder rapidement et facilement à l'arête entre deux sommets x, y , $T_{x,y}$. Ainsi, la structure de matrice d'adjacence semble appropriée. Les arêtes inexistantes dans le réseau auront simplement $T_{x,y} = \emptyset$, c'est-à-dire [] (liste vide).

On supposera que toutes les matrices données aux différentes fonctions définies plus bas sont carrées, on ne le vérifie pas (mais ce serait facile).

```
In [128]: type sommet = int;;
         type arete = intervalles;; (* c'est l'idée *)

         type reseauSTP = intervalles array array;
```

```
Out[128]: type sommet = int
```

```
Out[128]: type arete = intervalles
```

```
Out[128]: type reseauSTP = intervalles array array
```

On essaie tout de suite notre structure de données avec l'exemple du réseau STP de la figure 4 :

```
In [235]: let t_01 : intervalles = [(E(0), E(1)); (E(10), E(20))];;
         let t_12 : intervalles = [(E(0), E(10))];;
         let t_13 : intervalles = [(E(25), E(50))];;
         let t_23 : intervalles = [(E(0), E(20)); (E(40), E(40))];;

         let t_vide = [(MInf, PInf)];;

         let stp_4 : reseauSTP = [|
           [| t_vide; t_01; t_vide; t_vide |];
           [| t_vide; t_vide; t_12; t_13 |];
           [| t_vide; t_vide; t_vide; t_23 |];
           [| t_vide; t_vide; t_vide; t_vide |];
         |];;
```

```
Out[235]: val t_01 : intervalles = [(E 0, E 1); (E 10, E 20)]
```

```
Out[235]: val t_12 : intervalles = [(E 0, E 10)]
```

```
Out[235]: val t_13 : intervalles = [(E 25, E 50)]
```

```
Out[235]: val t_23 : intervalles = [(E 0, E 20); (E 40, E 40)]
```

```
Out[235]: val t_vide : (entier_etendu * entier_etendu) list = [(MInf, PInf)]
```

```
Out[235]: val stp_4 : reseauSTP =
  [| [| [(MInf, PInf)]; [(E 0, E 1); (E 10, E 20)]; [(MInf, PInf)];
      [(MInf, PInf)] |];
    [| [(MInf, PInf)]; [(MInf, PInf)]; [(E 0, E 10)]; [(E 25, E 50)] |];
  |];;
```

```

[[[(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)];
  [(E 0, E 20); (E 40, E 40)]];
[[[(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]]]]

```

On peut vérifier qu'il n'est pas distributif, en prenant l'exemple du texte (fin page 8) :

```
In [236]: let s_13 = t_12 ** t_23;;
```

```

t_13 ++ s_13;;
t_01 ** (t_13 ++ s_13);; (* 1er cas *)

```

```

t_01 ** t_13;;
t_01 ** s_13;;
(t_01 ** t_13) ++ (t_01 ** s_13);; (* 2nd cas *)

```

```
Out [236]: val s_13 : intervalles = [(E 0, E 30); (E 40, E 50)]
```

```
Out [236]: - : intervalles = [(E 25, E 30); (E 40, E 50)]
```

```
Out [236]: - : intervalles = [(E 25, E 31); (E 35, E 50); (E 40, E 51); (E 50, E 70)]
```

```
Out [236]: - : intervalles = [(E 25, E 51); (E 35, E 70)]
```

```
Out [236]: - : intervalles = [(E 0, E 31); (E 10, E 50); (E 40, E 51); (E 50, E 70)]
```

```
Out [236]: - : intervalles = [(E 25, E 50); (E 50, E 70)]
```

En simplifiant, on obtient :

- $T_{01} \otimes (T_{13} \oplus S_{13}) = \{[25, 31], [35, 70]\}$,
- $(T_{01} \otimes T_{13}) \oplus (T_{01} \otimes S_{13}) = \{[25, 70]\}$,

qui sont bien différents.

Enfin, on peut rapidement vérifier si la matrice d'un graphe est bien carrée :

```
In [237]: let est_carree matrice =
          let n = Array.length matrice in
          Array.fold_left (fun b x -> b && (n = (Array.length x))) true matrice
          ;;
```

```
Out [237]: val est_carree : 'a array array -> bool = <fun>
```

```
In [238]: est_carree stp_4;;
```

```
Out [238]: - : bool = true
```


L'algorithmme PC Ça semble être un bon choix. Maintenant, passons à l'algorithmme PC.

```
PC =  
repeat  
  S := T;  
  for k := 1 to n do  
    for i, j := 1 to n do  
      Tij := Tij ⊕ Tik ⊗ Tkj;  
      if Tij = ∅ then exit  
until S=T
```

Il n'y a pas de boucle until en Caml, mais avec une boucle while on arrivera presque à la même chose.

```
In [239]: exception Fini;; (* Pour faire le [exit]. *)
```

```
Out[239]: exception Fini
```

On peut l'écrire avant pour la rendre plus claire, mais l'étape clé de l'algorithmme PC (et Floyd-Warshall) est une opération dite de *relaxation* :

$$T_{ij} \oplus (T_{ik} \otimes T_{kj}).$$

```
In [240]: let relaxe (reseau : reseauSTP) i j k =  
  let t_ij = reseau.(i).(j)  
  and t_ik = reseau.(i).(k)  
  and t_kj = reseau.(k).(j)  
  in t_ij ++ (t_ik ** t_kj)  
;;
```

```
Out[240]: val relaxe : reseauSTP -> int -> int -> int -> intervalles = <fun>
```

On a tout ce qu'il faut pour écrire l'algorithmme. Mais comme il ne marche pas encore, on va le déboguer.

```
In [241]: let string_of_entieretendu = function  
  | MInf -> "-oo"
```

```

    | PInf -> "+oo"
    | E(x) -> string_of_int x
;;

```

Out[241]: val string_of_entieretendu : entier_etendu -> string = <fun>

```

In [242]: let print_intervalle (une_contrainte : intervalle) =
    let a, b = une_contrainte in
    Printf.printf "(%s, %s) " (string_of_entieretendu a) (string_of_entieretendu b)
;;

```

Out[242]: val print_intervalle : intervalle -> unit = <fun>

```

In [243]: let print_intervalles (contraintes : intervalles) =
    List.iter print_intervalle contraintes
;;

```

Out[243]: val print_intervalles : intervalles -> unit = <fun>

```

In [244]: let flush_force () =
    Printf.printf "\n";
    flush_all();
    Printf.printf "\n";
    flush_all();
    Printf.printf "\n";
    flush_all();
;;

```

Out[244]: val flush_force : unit -> unit = <fun>

```

In [245]: let print_reseau (reseau : reseauSTP) : unit =
    flush_force ();
    Printf.printf "\nReseau =\n";
    Array.iteri (fun i ligne ->
        Array.iteri (fun j case ->
            if case != [(MInf, PInf)] then begin
                Printf.printf "\n    T[i=%i, j=%i] = [" i j;
                print_intervalles case;
                Printf.printf " ]";
            end) ligne
        ) reseau;
    flush_all ();
;;

```

Out[245]: val print_reseau : reseauSTP -> unit = <fun>

```
In [246]: stp_4;;
```

```
Out[246]: - : reseauSTP =  
  [[|[(MInf, PInf)]; [(E 0, E 1); (E 10, E 20)]; [(MInf, PInf)];  
    [(MInf, PInf)]|];  
  [|[(MInf, PInf)]; [(MInf, PInf)]; [(E 0, E 10)]; [(E 25, E 50)]|];  
  [|[(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)];  
    [(E 0, E 20); (E 40, E 40)]|];  
  [|[(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]|]]
```

```
In [247]: flush_force();;
```

```
T[i=3, j=3] = [(-oo, +oo) ]
```

```
Out[247]: - : unit = ()
```

```
In [248]: print_reseau stp_4;;
```

```
Reseau =
```

```
T[i=0, j=0] = [(-oo, +oo) ]  
T[i=0, j=1] = [(0, 1) (10, 20) ]  
T[i=0, j=2] = [(-oo, +oo) ]  
T[i=0, j=3] = [(-oo, +oo) ]  
T[i=1, j=0] = [(-oo, +oo) ]  
T[i=1, j=1] = [(-oo, +oo) ]  
T[i=1, j=2] = [(0, 10) ]  
T[i=1, j=3] = [(25, 50) ]  
T[i=2, j=0] = [(-oo, +oo) ]  
T[i=2, j=1] = [(-oo, +oo) ]  
T[i=2, j=2] = [(-oo, +oo) ]  
T[i=2, j=3] = [(0, 20) (40, 40) ]  
T[i=3, j=0] = [(-oo, +oo) ]  
T[i=3, j=1] = [(-oo, +oo) ]  
T[i=3, j=2] = [(-oo, +oo) ]
```

```
Out[248]: - : unit = ()
```

On est prêt à écrire l'algorithme :

```

In [249]: let algorithmePC ?(max_etape=10) (reseau : reseauSTP) : (reseauSTP * intervalles list)
  let resT = Array.map Array.copy reseau in (* on ne modifie pas l'entrée *)
  let resS = ref [||] in
  let n = Array.length resT in
  let allseen = ref [] in (* Pour déboguer, je veux la liste des Tij vus *)
  let etape = ref 0 in
  begin
    try begin
      while !etape < max_etape && !resS != resT do
        incr etape;
        resS := Array.map Array.copy resT; (* S := T *)
        for k = 0 to n - 1 do
          for i = 0 to n - 1 do
            for j = 0 to n - 1 do
              Printf.printf "\n\nEtape %i, k = %i, i = %i, j = %i.\n" !etape k i j;
              print_string "Contraintes :";
              print_reseau resT;
              resT.(i).(j) <- relaxe resT i j k;
              allseen := (resT.(i).(j)) :: !allseen; (* on l'ajoute *)
              if resT.(i).(j) = [] then
                raise Fini
            done
          done
        done
      done;
    end
    with Fini -> () (* On ignore l'exception, on a juste terminé. *)
  end;
  resT, !allseen
;;

```

```

Out[249]: val algorithmePC :
  ?max_etape:int -> reseauSTP -> reseauSTP * intervalles list = <fun>

```

2.4.5 Exemple de réseau non distributif

On va traiter l'exemple de la Figure 4 du texte, comme défini plus haut :

```

In [250]: stp_4;;

```

```

Out[250]: - : reseauSTP =
  [| [| [(MInf, PInf)]; [(E 0, E 1); (E 10, E 20)]; [(MInf, PInf)];
    [(MInf, PInf)] |];
  [| [(MInf, PInf)]; [(MInf, PInf)]; [(E 0, E 10)]; [(E 25, E 50)] |];
  [| [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)];
    [(E 0, E 20); (E 40, E 40)] |];

```

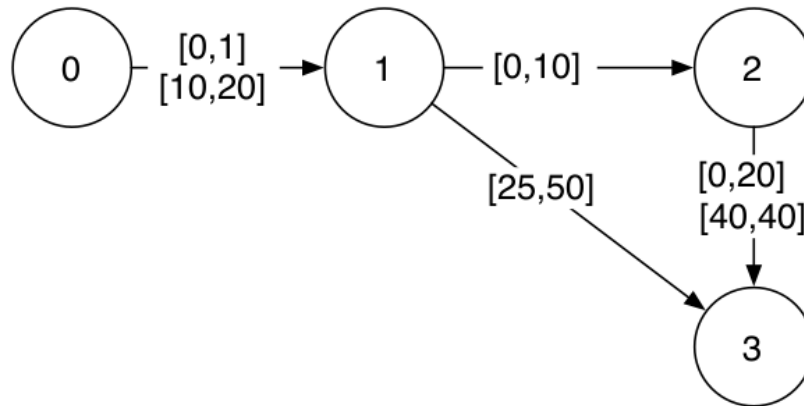


FIG. 4 – Un réseau non distributif.

images/reseau_distributif.png

```
[[[(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]]]]
```

```
In [251]: relaxe stp_4 1 2 3;;
```

```
Out[251]: - : intervalles = [(E 0, E 10)]
```

```
In [252]: stp_4.(1).(3)
```

```
Out[252]: - : intervalles = [(E 25, E 50)]
```

```
In [ ]:
```

```
In [253]: algorithmePC stp_4;;
```

```
T[i=3, j=3] = [(-oo, +oo) ]
```

Etape 1, k = 0, i = 0, j = 0.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
```

```
T[i=0, j=1] = [(0, 1) (10, 20) ]
```

$T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 0$, $j = 1$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 0$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$

$T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 0$, $j = 3$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 1$, $j = 0$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$

$T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 1$, $j = 1$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 1$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$

$T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
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 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 1$, $j = 3$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 2$, $j = 0$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$

$T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
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 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 2$, $j = 1$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 2$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$

$T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 2$, $j = 3$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 3$, $j = 0$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$

$T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 3$, $j = 1$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 3$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$

$T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 3$, $j = 3$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(0, 10)]$
 $T[i=1, j=3] = [(25, 50)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(0, 20) (40, 40)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(-\infty, +\infty)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 0$, $j = 0$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(0, 1) (10, 20)]$

```

T[i=0, j=2] = [(-oo, +oo) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(0, 10) ]
T[i=1, j=3] = [(25, 50) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(0, 20) (40, 40) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(-oo, +oo) ]

```

```

Out [253]: - : reseauSTP * intervalles list =
  (|[|[]; [(E 0, E 1); (E 10, E 20)]; [(MInf, PInf)]; [(MInf, PInf)]|];
    |[[(MInf, PInf)]; [(MInf, PInf)]; [(E 0, E 10)]; [(E 25, E 50)]|];
    |[[(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)];
      [(E 0, E 20); (E 40, E 40)]|];
    |[[(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]|],
  [|[]; [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)];
    [(E 0, E 20); (E 40, E 40)]; [(MInf, PInf)]; [(MInf, PInf)];
    [(MInf, PInf)]; [(E 25, E 50)]; [(E 0, E 10)]; [(MInf, PInf)];
    [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]; [(E 0, E 1); (E 10, E 20)];
    [(MInf, PInf)]]

```

Je ne suis pas sûr de comment interpréter ce résultat..

- soit j'ai fait une erreur dans l'implémentation,
- soit l'algorithme PC devait ne rien modifier à T sur cet exemple...

2.4.6 D'autres exemples

On peut étudier le STP de la Figure 1., en enlevant la contrainte $[60, \infty)$, qui ne rentre pas dans notre implémentation.

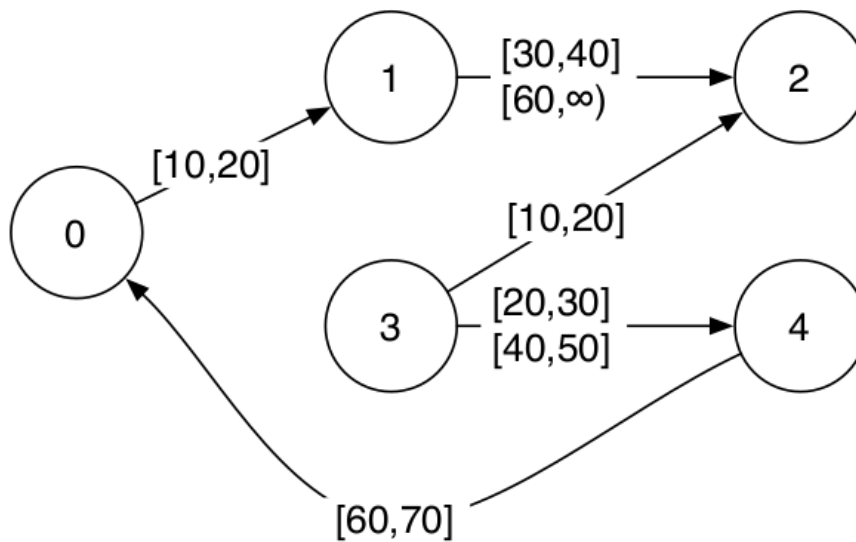


FIG. 1 – Un graphe de contraintes

```

In [254]: let t_01 : intervalles = [(E(10), E(20))];;
let t_12 : intervalles = [(E(30), E(40))];;
let t_32 : intervalles = [(E(10), E(20))];;
let t_34 : intervalles = [(E(20), E(30)); (E(40), E(50))];;
let t_40 : intervalles = [(E(60), E(70))];;

```

```

let stp_1 : reseauSTP = [
  [| t_vide; t_01; t_vide; t_vide; t_vide |];
  [| t_vide; t_vide; t_12; t_vide; t_vide |];
  [| t_vide; t_vide; t_vide; t_vide; t_vide |];
  [| t_vide; t_vide; t_32; t_vide; t_34 |];
  [| t_40; t_vide; t_vide; t_vide; t_vide |];
];;

```

```

Out[254]: val t_01 : intervalles = [(E 10, E 20)]

```

```

Out[254]: val t_12 : intervalles = [(E 30, E 40)]

```

```

Out[254]: val t_32 : intervalles = [(E 10, E 20)]

```

```

Out[254]: val t_34 : intervalles = [(E 20, E 30); (E 40, E 50)]

```

```
Out[254]: val t_40 : intervalles = [(E 60, E 70)]
```

```
Out[254]: val stp_1 : reseauSTP =  
  [| [| [(MInf, PInf)]; [(E 10, E 20)]; [(MInf, PInf)]; [(MInf, PInf)];  
        [(MInf, PInf)] |];  
    [| [(MInf, PInf)]; [(MInf, PInf)]; [(E 30, E 40)]; [(MInf, PInf)];  
        [(MInf, PInf)] |];  
    [| [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)];  
        [(MInf, PInf)] |];  
    [| [(MInf, PInf)]; [(MInf, PInf)]; [(E 10, E 20)]; [(MInf, PInf)];  
        [(E 20, E 30); (E 40, E 50)] |];  
    [| [(E 60, E 70)]; [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)];  
        [(MInf, PInf)] |] |]
```

```
In [255]: print_reseau stp_1;;
```

```
Out[255]: - : unit = ()
```

```
T[i=3, j=3] = [(-oo, +oo) ]
```

```
Reseau =
```

```
T[i=0, j=0] = [(-oo, +oo) ]  
T[i=0, j=1] = [(10, 20) ]  
T[i=0, j=2] = [(-oo, +oo) ]  
T[i=0, j=3] = [(-oo, +oo) ]  
T[i=0, j=4] = [(-oo, +oo) ]  
T[i=1, j=0] = [(-oo, +oo) ]  
T[i=1, j=1] = [(-oo, +oo) ]  
T[i=1, j=2] = [(30, 40) ]  
T[i=1, j=3] = [(-oo, +oo) ]  
T[i=1, j=4] = [(-oo, +oo) ]  
T[i=2, j=0] = [(-oo, +oo) ]  
T[i=2, j=1] = [(-oo, +oo) ]  
T[i=2, j=2] = [(-oo, +oo) ]  
T[i=2, j=3] = [(-oo, +oo) ]  
T[i=2, j=4] = [(-oo, +oo) ]  
T[i=3, j=0] = [(-oo, +oo) ]  
T[i=3, j=1] = [(-oo, +oo) ]  
T[i=3, j=2] = [(10, 20) ]  
T[i=3, j=3] = [(-oo, +oo) ]  
T[i=3, j=4] = [(20, 30) (40, 50) ]  
T[i=4, j=0] = [(60, 70) ]  
T[i=4, j=1] = [(-oo, +oo) ]
```


T[i=4, j=2] = [(-oo, +oo)]
T[i=4, j=3] = [(-oo, +oo)]

In [256]: `algorithmePC stp_1;`

T[i=4, j=4] = [(-oo, +oo)]

Etape 1, k = 0, i = 0, j = 0.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(-oo, +oo)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]
T[i=1, j=4] = [(-oo, +oo)]
T[i=2, j=0] = [(-oo, +oo)]
T[i=2, j=1] = [(-oo, +oo)]
T[i=2, j=2] = [(-oo, +oo)]
T[i=2, j=3] = [(-oo, +oo)]
T[i=2, j=4] = [(-oo, +oo)]
T[i=3, j=0] = [(-oo, +oo)]
T[i=3, j=1] = [(-oo, +oo)]
T[i=3, j=2] = [(10, 20)]
T[i=3, j=3] = [(-oo, +oo)]
T[i=3, j=4] = [(20, 30) (40, 50)]
T[i=4, j=0] = [(60, 70)]
T[i=4, j=1] = [(-oo, +oo)]
T[i=4, j=2] = [(-oo, +oo)]
T[i=4, j=3] = [(-oo, +oo)]
T[i=4, j=4] = [(-oo, +oo)]

Etape 1, k = 0, i = 0, j = 1.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(-oo, +oo) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(-oo, +oo) ]
T[i=4, j=2] = [(-oo, +oo) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]

```

Etape 1, k = 0, i = 0, j = 2.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(-oo, +oo) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]

```

$T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 0$, $j = 3$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 0$, $j = 4$.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(-oo, +oo) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(-oo, +oo) ]
T[i=4, j=2] = [(-oo, +oo) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]
```

Etape 1, k = 0, i = 1, j = 0.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(-oo, +oo) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
```

$T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 1$, $j = 1$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 1$, $j = 2$.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(-oo, +oo)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]
T[i=1, j=4] = [(-oo, +oo)]
T[i=2, j=0] = [(-oo, +oo)]
T[i=2, j=1] = [(-oo, +oo)]
T[i=2, j=2] = [(-oo, +oo)]
T[i=2, j=3] = [(-oo, +oo)]
T[i=2, j=4] = [(-oo, +oo)]
T[i=3, j=0] = [(-oo, +oo)]
T[i=3, j=1] = [(-oo, +oo)]
T[i=3, j=2] = [(10, 20)]
T[i=3, j=3] = [(-oo, +oo)]
T[i=3, j=4] = [(20, 30) (40, 50)]
T[i=4, j=0] = [(60, 70)]
T[i=4, j=1] = [(-oo, +oo)]
T[i=4, j=2] = [(-oo, +oo)]
T[i=4, j=3] = [(-oo, +oo)]
T[i=4, j=4] = [(-oo, +oo)]

Etape 1, k = 0, i = 1, j = 3.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(-oo, +oo)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]

$T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 1$, $j = 4$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$

$$T[i=4, j=4] = [(-\infty, +\infty)]$$

Etape 1, k = 0, i = 2, j = 0.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(-\infty, +\infty)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \\ T[i=1, j=1] &= [(-\infty, +\infty)] \\ T[i=1, j=2] &= [(30, 40)] \\ T[i=1, j=3] &= [(-\infty, +\infty)] \\ T[i=1, j=4] &= [(-\infty, +\infty)] \\ T[i=2, j=0] &= [(-\infty, +\infty)] \\ T[i=2, j=1] &= [(-\infty, +\infty)] \\ T[i=2, j=2] &= [(-\infty, +\infty)] \\ T[i=2, j=3] &= [(-\infty, +\infty)] \\ T[i=2, j=4] &= [(-\infty, +\infty)] \\ T[i=3, j=0] &= [(-\infty, +\infty)] \\ T[i=3, j=1] &= [(-\infty, +\infty)] \\ T[i=3, j=2] &= [(10, 20)] \\ T[i=3, j=3] &= [(-\infty, +\infty)] \\ T[i=3, j=4] &= [(20, 30) (40, 50)] \\ T[i=4, j=0] &= [(60, 70)] \\ T[i=4, j=1] &= [(-\infty, +\infty)] \\ T[i=4, j=2] &= [(-\infty, +\infty)] \\ T[i=4, j=3] &= [(-\infty, +\infty)] \\ T[i=4, j=4] &= [(-\infty, +\infty)] \end{aligned}$$

Etape 1, k = 0, i = 2, j = 1.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(-\infty, +\infty)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \end{aligned}$$

$T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 2$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$

$T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 2$, $j = 3$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 2$, $j = 4$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$

$T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 3$, $j = 0$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$

$T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 3$, $j = 1$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 3$, $j = 2$.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(-oo, +oo) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(-oo, +oo) ]
T[i=4, j=2] = [(-oo, +oo) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]

```

Etape 1, k = 0, i = 3, j = 3.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(-oo, +oo) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]

```

$T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 3$, $j = 4$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 4$, $j = 0$.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(-oo, +oo)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]
T[i=1, j=4] = [(-oo, +oo)]
T[i=2, j=0] = [(-oo, +oo)]
T[i=2, j=1] = [(-oo, +oo)]
T[i=2, j=2] = [(-oo, +oo)]
T[i=2, j=3] = [(-oo, +oo)]
T[i=2, j=4] = [(-oo, +oo)]
T[i=3, j=0] = [(-oo, +oo)]
T[i=3, j=1] = [(-oo, +oo)]
T[i=3, j=2] = [(10, 20)]
T[i=3, j=3] = [(-oo, +oo)]
T[i=3, j=4] = [(20, 30) (40, 50)]
T[i=4, j=0] = [(60, 70)]
T[i=4, j=1] = [(-oo, +oo)]
T[i=4, j=2] = [(-oo, +oo)]
T[i=4, j=3] = [(-oo, +oo)]
T[i=4, j=4] = [(-oo, +oo)]

Etape 1, k = 0, i = 4, j = 1.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(-oo, +oo)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]
T[i=1, j=4] = [(-oo, +oo)]
T[i=2, j=0] = [(-oo, +oo)]
T[i=2, j=1] = [(-oo, +oo)]

$T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(-\infty, +\infty)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 4$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 0$, $i = 4$, $j = 3$.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(-oo, +oo)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]
T[i=1, j=4] = [(-oo, +oo)]
T[i=2, j=0] = [(-oo, +oo)]
T[i=2, j=1] = [(-oo, +oo)]
T[i=2, j=2] = [(-oo, +oo)]
T[i=2, j=3] = [(-oo, +oo)]
T[i=2, j=4] = [(-oo, +oo)]
T[i=3, j=0] = [(-oo, +oo)]
T[i=3, j=1] = [(-oo, +oo)]
T[i=3, j=2] = [(10, 20)]
T[i=3, j=3] = [(-oo, +oo)]
T[i=3, j=4] = [(20, 30) (40, 50)]
T[i=4, j=0] = [(60, 70)]
T[i=4, j=1] = [(70, 90)]
T[i=4, j=2] = [(-oo, +oo)]
T[i=4, j=3] = [(-oo, +oo)]
T[i=4, j=4] = [(-oo, +oo)]

Etape 1, k = 0, i = 4, j = 4.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(-oo, +oo)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]

$T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 0$, $j = 0$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(-\infty, +\infty)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$

$$T[i=4, j=4] = [(-\infty, +\infty)]$$

Etape 1, k = 1, i = 0, j = 1.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(-\infty, +\infty)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \\ T[i=1, j=1] &= [(-\infty, +\infty)] \\ T[i=1, j=2] &= [(30, 40)] \\ T[i=1, j=3] &= [(-\infty, +\infty)] \\ T[i=1, j=4] &= [(-\infty, +\infty)] \\ T[i=2, j=0] &= [(-\infty, +\infty)] \\ T[i=2, j=1] &= [(-\infty, +\infty)] \\ T[i=2, j=2] &= [(-\infty, +\infty)] \\ T[i=2, j=3] &= [(-\infty, +\infty)] \\ T[i=2, j=4] &= [(-\infty, +\infty)] \\ T[i=3, j=0] &= [(-\infty, +\infty)] \\ T[i=3, j=1] &= [(-\infty, +\infty)] \\ T[i=3, j=2] &= [(10, 20)] \\ T[i=3, j=3] &= [(-\infty, +\infty)] \\ T[i=3, j=4] &= [(20, 30) (40, 50)] \\ T[i=4, j=0] &= [(60, 70)] \\ T[i=4, j=1] &= [(70, 90)] \\ T[i=4, j=2] &= [(-\infty, +\infty)] \\ T[i=4, j=3] &= [(-\infty, +\infty)] \\ T[i=4, j=4] &= [(-\infty, +\infty)] \end{aligned}$$

Etape 1, k = 1, i = 0, j = 2.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(-\infty, +\infty)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \end{aligned}$$

$T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 0$, $j = 3$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$

$T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 0$, $j = 4$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 1$, $j = 0$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$

$T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 1$, $j = 1$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$

$T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 1$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 1$, $j = 3$.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(-oo, +oo) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]

```

Etape 1, k = 1, i = 1, j = 4.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]

```


$T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 2$, $j = 0$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 2$, $j = 1$.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(-oo, +oo) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]
```

Etape 1, k = 1, i = 2, j = 2.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
```

$T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 2$, $j = 3$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 2$, $j = 4$.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(40, 60)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]
T[i=1, j=4] = [(-oo, +oo)]
T[i=2, j=0] = [(-oo, +oo)]
T[i=2, j=1] = [(-oo, +oo)]
T[i=2, j=2] = [(-oo, +oo)]
T[i=2, j=3] = [(-oo, +oo)]
T[i=2, j=4] = [(-oo, +oo)]
T[i=3, j=0] = [(-oo, +oo)]
T[i=3, j=1] = [(-oo, +oo)]
T[i=3, j=2] = [(10, 20)]
T[i=3, j=3] = [(-oo, +oo)]
T[i=3, j=4] = [(20, 30) (40, 50)]
T[i=4, j=0] = [(60, 70)]
T[i=4, j=1] = [(70, 90)]
T[i=4, j=2] = [(-oo, +oo)]
T[i=4, j=3] = [(-oo, +oo)]
T[i=4, j=4] = [(-oo, +oo)]

Etape 1, k = 1, i = 3, j = 0.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(40, 60)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]

$T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 3$, $j = 1$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$

$$T[i=4, j=4] = [(-\infty, +\infty)]$$

Etape 1, k = 1, i = 3, j = 2.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(40, 60)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \\ T[i=1, j=1] &= [(-\infty, +\infty)] \\ T[i=1, j=2] &= [(30, 40)] \\ T[i=1, j=3] &= [(-\infty, +\infty)] \\ T[i=1, j=4] &= [(-\infty, +\infty)] \\ T[i=2, j=0] &= [(-\infty, +\infty)] \\ T[i=2, j=1] &= [(-\infty, +\infty)] \\ T[i=2, j=2] &= [(-\infty, +\infty)] \\ T[i=2, j=3] &= [(-\infty, +\infty)] \\ T[i=2, j=4] &= [(-\infty, +\infty)] \\ T[i=3, j=0] &= [(-\infty, +\infty)] \\ T[i=3, j=1] &= [(-\infty, +\infty)] \\ T[i=3, j=2] &= [(10, 20)] \\ T[i=3, j=3] &= [(-\infty, +\infty)] \\ T[i=3, j=4] &= [(20, 30) (40, 50)] \\ T[i=4, j=0] &= [(60, 70)] \\ T[i=4, j=1] &= [(70, 90)] \\ T[i=4, j=2] &= [(-\infty, +\infty)] \\ T[i=4, j=3] &= [(-\infty, +\infty)] \\ T[i=4, j=4] &= [(-\infty, +\infty)] \end{aligned}$$

Etape 1, k = 1, i = 3, j = 3.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(40, 60)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \end{aligned}$$

$T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 3$, $j = 4$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$

$T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 4$, $j = 0$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 4$, $j = 1$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$

$T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 4$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$

$T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(-\infty, +\infty)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 4$, $j = 3$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 1$, $i = 4$, $j = 4$.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(100, 130) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]

```

Etape 1, k = 2, i = 0, j = 0.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]

```

$T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 0$, $j = 1$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 0$, $j = 2$.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(100, 130) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]
```

Etape 1, k = 2, i = 0, j = 3.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
```

$T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 0$, $j = 4$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 1$, $j = 0$.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(40, 60)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]
T[i=1, j=4] = [(-oo, +oo)]
T[i=2, j=0] = [(-oo, +oo)]
T[i=2, j=1] = [(-oo, +oo)]
T[i=2, j=2] = [(-oo, +oo)]
T[i=2, j=3] = [(-oo, +oo)]
T[i=2, j=4] = [(-oo, +oo)]
T[i=3, j=0] = [(-oo, +oo)]
T[i=3, j=1] = [(-oo, +oo)]
T[i=3, j=2] = [(10, 20)]
T[i=3, j=3] = [(-oo, +oo)]
T[i=3, j=4] = [(20, 30) (40, 50)]
T[i=4, j=0] = [(60, 70)]
T[i=4, j=1] = [(70, 90)]
T[i=4, j=2] = [(100, 130)]
T[i=4, j=3] = [(-oo, +oo)]
T[i=4, j=4] = [(-oo, +oo)]

Etape 1, k = 2, i = 1, j = 1.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(40, 60)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]

$T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 1$, $j = 2$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$

$$T[i=4, j=4] = [(-\infty, +\infty)]$$

Etape 1, k = 2, i = 1, j = 3.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(40, 60)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \\ T[i=1, j=1] &= [(-\infty, +\infty)] \\ T[i=1, j=2] &= [(30, 40)] \\ T[i=1, j=3] &= [(-\infty, +\infty)] \\ T[i=1, j=4] &= [(-\infty, +\infty)] \\ T[i=2, j=0] &= [(-\infty, +\infty)] \\ T[i=2, j=1] &= [(-\infty, +\infty)] \\ T[i=2, j=2] &= [(-\infty, +\infty)] \\ T[i=2, j=3] &= [(-\infty, +\infty)] \\ T[i=2, j=4] &= [(-\infty, +\infty)] \\ T[i=3, j=0] &= [(-\infty, +\infty)] \\ T[i=3, j=1] &= [(-\infty, +\infty)] \\ T[i=3, j=2] &= [(10, 20)] \\ T[i=3, j=3] &= [(-\infty, +\infty)] \\ T[i=3, j=4] &= [(20, 30) (40, 50)] \\ T[i=4, j=0] &= [(60, 70)] \\ T[i=4, j=1] &= [(70, 90)] \\ T[i=4, j=2] &= [(100, 130)] \\ T[i=4, j=3] &= [(-\infty, +\infty)] \\ T[i=4, j=4] &= [(-\infty, +\infty)] \end{aligned}$$

Etape 1, k = 2, i = 1, j = 4.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(40, 60)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \end{aligned}$$

$T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 2$, $j = 0$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$

$T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 2$, $j = 1$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 2$, $j = 2$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$

$T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 2$, $j = 3$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$

$T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 2$, $j = 4$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 3$, $j = 0$.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(100, 130) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]

```

Etape 1, k = 2, i = 3, j = 1.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]

```

$T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 3$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 3$, $j = 3$.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(100, 130) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]
```

Etape 1, k = 2, i = 3, j = 4.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
```


$T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 4$, $j = 0$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 4$, $j = 1$.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(40, 60)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]
T[i=1, j=4] = [(-oo, +oo)]
T[i=2, j=0] = [(-oo, +oo)]
T[i=2, j=1] = [(-oo, +oo)]
T[i=2, j=2] = [(-oo, +oo)]
T[i=2, j=3] = [(-oo, +oo)]
T[i=2, j=4] = [(-oo, +oo)]
T[i=3, j=0] = [(-oo, +oo)]
T[i=3, j=1] = [(-oo, +oo)]
T[i=3, j=2] = [(10, 20)]
T[i=3, j=3] = [(-oo, +oo)]
T[i=3, j=4] = [(20, 30) (40, 50)]
T[i=4, j=0] = [(60, 70)]
T[i=4, j=1] = [(70, 90)]
T[i=4, j=2] = [(100, 130)]
T[i=4, j=3] = [(-oo, +oo)]
T[i=4, j=4] = [(-oo, +oo)]

Etape 1, k = 2, i = 4, j = 2.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(40, 60)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]

$T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 2$, $i = 4$, $j = 3$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$

$$T[i=4, j=4] = [(-\infty, +\infty)]$$

Etape 1, k = 2, i = 4, j = 4.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(40, 60)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \\ T[i=1, j=1] &= [(-\infty, +\infty)] \\ T[i=1, j=2] &= [(30, 40)] \\ T[i=1, j=3] &= [(-\infty, +\infty)] \\ T[i=1, j=4] &= [(-\infty, +\infty)] \\ T[i=2, j=0] &= [(-\infty, +\infty)] \\ T[i=2, j=1] &= [(-\infty, +\infty)] \\ T[i=2, j=2] &= [(-\infty, +\infty)] \\ T[i=2, j=3] &= [(-\infty, +\infty)] \\ T[i=2, j=4] &= [(-\infty, +\infty)] \\ T[i=3, j=0] &= [(-\infty, +\infty)] \\ T[i=3, j=1] &= [(-\infty, +\infty)] \\ T[i=3, j=2] &= [(10, 20)] \\ T[i=3, j=3] &= [(-\infty, +\infty)] \\ T[i=3, j=4] &= [(20, 30) (40, 50)] \\ T[i=4, j=0] &= [(60, 70)] \\ T[i=4, j=1] &= [(70, 90)] \\ T[i=4, j=2] &= [(100, 130)] \\ T[i=4, j=3] &= [(-\infty, +\infty)] \\ T[i=4, j=4] &= [(-\infty, +\infty)] \end{aligned}$$

Etape 1, k = 3, i = 0, j = 0.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(40, 60)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \end{aligned}$$

$T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 0$, $j = 1$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$

$T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 0$, $j = 2$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 0$, $j = 3$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$

$T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 0$, $j = 4$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$

$T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 1$, $j = 0$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 1$, $j = 1$.

Contraintes :

Reseau =


```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(100, 130) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]

```

Etape 1, k = 3, i = 1, j = 2.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]

```

$T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 1$, $j = 3$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 1$, $j = 4$.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(100, 130) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]
```

Etape 1, k = 3, i = 2, j = 0.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
```

$T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 2$, $j = 1$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 2$, $j = 2$.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(40, 60)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]
T[i=1, j=4] = [(-oo, +oo)]
T[i=2, j=0] = [(-oo, +oo)]
T[i=2, j=1] = [(-oo, +oo)]
T[i=2, j=2] = [(-oo, +oo)]
T[i=2, j=3] = [(-oo, +oo)]
T[i=2, j=4] = [(-oo, +oo)]
T[i=3, j=0] = [(-oo, +oo)]
T[i=3, j=1] = [(-oo, +oo)]
T[i=3, j=2] = [(10, 20)]
T[i=3, j=3] = [(-oo, +oo)]
T[i=3, j=4] = [(20, 30) (40, 50)]
T[i=4, j=0] = [(60, 70)]
T[i=4, j=1] = [(70, 90)]
T[i=4, j=2] = [(100, 130)]
T[i=4, j=3] = [(-oo, +oo)]
T[i=4, j=4] = [(-oo, +oo)]

Etape 1, k = 3, i = 2, j = 3.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(40, 60)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]

$T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 2$, $j = 4$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$

$$T[i=4, j=4] = [(-\infty, +\infty)]$$

Etape 1, k = 3, i = 3, j = 0.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(40, 60)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \\ T[i=1, j=1] &= [(-\infty, +\infty)] \\ T[i=1, j=2] &= [(30, 40)] \\ T[i=1, j=3] &= [(-\infty, +\infty)] \\ T[i=1, j=4] &= [(-\infty, +\infty)] \\ T[i=2, j=0] &= [(-\infty, +\infty)] \\ T[i=2, j=1] &= [(-\infty, +\infty)] \\ T[i=2, j=2] &= [(-\infty, +\infty)] \\ T[i=2, j=3] &= [(-\infty, +\infty)] \\ T[i=2, j=4] &= [(-\infty, +\infty)] \\ T[i=3, j=0] &= [(-\infty, +\infty)] \\ T[i=3, j=1] &= [(-\infty, +\infty)] \\ T[i=3, j=2] &= [(10, 20)] \\ T[i=3, j=3] &= [(-\infty, +\infty)] \\ T[i=3, j=4] &= [(20, 30) (40, 50)] \\ T[i=4, j=0] &= [(60, 70)] \\ T[i=4, j=1] &= [(70, 90)] \\ T[i=4, j=2] &= [(100, 130)] \\ T[i=4, j=3] &= [(-\infty, +\infty)] \\ T[i=4, j=4] &= [(-\infty, +\infty)] \end{aligned}$$

Etape 1, k = 3, i = 3, j = 1.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(40, 60)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \end{aligned}$$

$T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 3$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$

$T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 3$, $j = 3$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 3$, $j = 4$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$

$T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 4$, $j = 0$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$

$T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 4$, $j = 1$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 4$, $j = 2$.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(100, 130) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]

```

Etape 1, k = 3, i = 4, j = 3.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]

```

$T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 3$, $i = 4$, $j = 4$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 0$, $j = 0$.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(100, 130) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]
```

Etape 1, k = 4, i = 0, j = 1.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
```

$T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 0$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 0$, $j = 3$.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(40, 60)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]
T[i=1, j=4] = [(-oo, +oo)]
T[i=2, j=0] = [(-oo, +oo)]
T[i=2, j=1] = [(-oo, +oo)]
T[i=2, j=2] = [(-oo, +oo)]
T[i=2, j=3] = [(-oo, +oo)]
T[i=2, j=4] = [(-oo, +oo)]
T[i=3, j=0] = [(-oo, +oo)]
T[i=3, j=1] = [(-oo, +oo)]
T[i=3, j=2] = [(10, 20)]
T[i=3, j=3] = [(-oo, +oo)]
T[i=3, j=4] = [(20, 30) (40, 50)]
T[i=4, j=0] = [(60, 70)]
T[i=4, j=1] = [(70, 90)]
T[i=4, j=2] = [(100, 130)]
T[i=4, j=3] = [(-oo, +oo)]
T[i=4, j=4] = [(-oo, +oo)]

Etape 1, k = 4, i = 0, j = 4.

Contraintes :

Reseau =

T[i=0, j=0] = [(-oo, +oo)]
T[i=0, j=1] = [(10, 20)]
T[i=0, j=2] = [(40, 60)]
T[i=0, j=3] = [(-oo, +oo)]
T[i=0, j=4] = [(-oo, +oo)]
T[i=1, j=0] = [(-oo, +oo)]
T[i=1, j=1] = [(-oo, +oo)]
T[i=1, j=2] = [(30, 40)]
T[i=1, j=3] = [(-oo, +oo)]

$T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 1$, $j = 0$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$

$$T[i=4, j=4] = [(-\infty, +\infty)]$$

Etape 1, k = 4, i = 1, j = 1.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(40, 60)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \\ T[i=1, j=1] &= [(-\infty, +\infty)] \\ T[i=1, j=2] &= [(30, 40)] \\ T[i=1, j=3] &= [(-\infty, +\infty)] \\ T[i=1, j=4] &= [(-\infty, +\infty)] \\ T[i=2, j=0] &= [(-\infty, +\infty)] \\ T[i=2, j=1] &= [(-\infty, +\infty)] \\ T[i=2, j=2] &= [(-\infty, +\infty)] \\ T[i=2, j=3] &= [(-\infty, +\infty)] \\ T[i=2, j=4] &= [(-\infty, +\infty)] \\ T[i=3, j=0] &= [(-\infty, +\infty)] \\ T[i=3, j=1] &= [(-\infty, +\infty)] \\ T[i=3, j=2] &= [(10, 20)] \\ T[i=3, j=3] &= [(-\infty, +\infty)] \\ T[i=3, j=4] &= [(20, 30) (40, 50)] \\ T[i=4, j=0] &= [(60, 70)] \\ T[i=4, j=1] &= [(70, 90)] \\ T[i=4, j=2] &= [(100, 130)] \\ T[i=4, j=3] &= [(-\infty, +\infty)] \\ T[i=4, j=4] &= [(-\infty, +\infty)] \end{aligned}$$

Etape 1, k = 4, i = 1, j = 2.

Contraintes :

Reseau =

$$\begin{aligned} T[i=0, j=0] &= [(-\infty, +\infty)] \\ T[i=0, j=1] &= [(10, 20)] \\ T[i=0, j=2] &= [(40, 60)] \\ T[i=0, j=3] &= [(-\infty, +\infty)] \\ T[i=0, j=4] &= [(-\infty, +\infty)] \\ T[i=1, j=0] &= [(-\infty, +\infty)] \end{aligned}$$

$T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 1$, $j = 3$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$

$T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 1$, $j = 4$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 2$, $j = 0$.
 Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$

$T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 2$, $j = 1$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$

$T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 2$, $j = 2$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 2$, $j = 3$.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(-oo, +oo) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(100, 130) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]

```

Etape 1, k = 4, i = 2, j = 4.

Contraintes :

Reseau =

```

T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]

```

$T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 3$, $j = 0$.

Contraintes :

Reseau =

$T[i=0, j=0] = [(-\infty, +\infty)]$
 $T[i=0, j=1] = [(10, 20)]$
 $T[i=0, j=2] = [(40, 60)]$
 $T[i=0, j=3] = [(-\infty, +\infty)]$
 $T[i=0, j=4] = [(-\infty, +\infty)]$
 $T[i=1, j=0] = [(-\infty, +\infty)]$
 $T[i=1, j=1] = [(-\infty, +\infty)]$
 $T[i=1, j=2] = [(30, 40)]$
 $T[i=1, j=3] = [(-\infty, +\infty)]$
 $T[i=1, j=4] = [(-\infty, +\infty)]$
 $T[i=2, j=0] = [(-\infty, +\infty)]$
 $T[i=2, j=1] = [(-\infty, +\infty)]$
 $T[i=2, j=2] = [(-\infty, +\infty)]$
 $T[i=2, j=3] = [(-\infty, +\infty)]$
 $T[i=2, j=4] = [(-\infty, +\infty)]$
 $T[i=3, j=0] = [(-\infty, +\infty)]$
 $T[i=3, j=1] = [(-\infty, +\infty)]$
 $T[i=3, j=2] = [(10, 20)]$
 $T[i=3, j=3] = [(-\infty, +\infty)]$
 $T[i=3, j=4] = [(20, 30) (40, 50)]$
 $T[i=4, j=0] = [(60, 70)]$
 $T[i=4, j=1] = [(70, 90)]$
 $T[i=4, j=2] = [(100, 130)]$
 $T[i=4, j=3] = [(-\infty, +\infty)]$
 $T[i=4, j=4] = [(-\infty, +\infty)]$

Etape 1, $k = 4$, $i = 3$, $j = 1$.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(80, 100) (100, 120) ]
T[i=3, j=1] = [(-oo, +oo) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(100, 130) ]
T[i=4, j=3] = [(-oo, +oo) ]
T[i=4, j=4] = [(-oo, +oo) ]
```

Etape 1, k = 4, i = 3, j = 2.

Contraintes :

Reseau =

```
T[i=0, j=0] = [(-oo, +oo) ]
T[i=0, j=1] = [(10, 20) ]
T[i=0, j=2] = [(40, 60) ]
T[i=0, j=3] = [(-oo, +oo) ]
T[i=0, j=4] = [(-oo, +oo) ]
T[i=1, j=0] = [(-oo, +oo) ]
T[i=1, j=1] = [(-oo, +oo) ]
T[i=1, j=2] = [(30, 40) ]
T[i=1, j=3] = [(-oo, +oo) ]
T[i=1, j=4] = [(-oo, +oo) ]
T[i=2, j=0] = [(-oo, +oo) ]
T[i=2, j=1] = [(-oo, +oo) ]
```

```

T[i=2, j=2] = [(-oo, +oo) ]
T[i=2, j=3] = [(-oo, +oo) ]
T[i=2, j=4] = [(-oo, +oo) ]
T[i=3, j=0] = [(80, 100) (100, 120) ]
T[i=3, j=1] = [(90, 120) (110, 140) ]
T[i=3, j=2] = [(10, 20) ]
T[i=3, j=3] = [(-oo, +oo) ]
T[i=3, j=4] = [(20, 30) (40, 50) ]
T[i=4, j=0] = [(60, 70) ]
T[i=4, j=1] = [(70, 90) ]
T[i=4, j=2] = [(100, 130) ]
T[i=4, j=3] = [(-oo, +oo) ]

```

```

Out [256]: - : reseauSTP * intervalles list =
  ([|[|[ (MInf, PInf)]; [(E 10, E 20)]; [(E 40, E 60)]; [(MInf, PInf)];
    [(MInf, PInf)]|]);
  |[|[ (MInf, PInf)]; [(MInf, PInf)]; [(E 30, E 40)]; [(MInf, PInf)];
    [(MInf, PInf)]|]);
  |[|[ (MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)];
    [(MInf, PInf)]|]);
  |[|[ (E 80, E 100); (E 100, E 120)]; [(E 90, E 120); (E 110, E 140)];
    []; [(MInf, PInf)]; [(E 20, E 30); (E 40, E 50)]|]);
  |[|[ (E 60, E 70)]; [(E 70, E 90)]; [(E 100, E 130)]; [(MInf, PInf)];
    [(MInf, PInf)]|]|],
  [|[|[ (E 90, E 120); (E 110, E 140)]; [(E 80, E 100); (E 100, E 120)];
    [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)];
    [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]; [(E 30, E 40)];
    [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)]; [(MInf, PInf)];
    [(E ...); ...]; ...])

```

Je ne suis pas sûr de comment interpréter ce résultat...

- soit j'ai fait une erreur dans l'implémentation,
- soit l'algorithme PC devait ne rien modifier à T sur cet exemple...

2.5 Conclusion

Voilà pour la question obligatoire de programmation :

- on a décomposé le problème en sous-fonctions,
- on a essayé d'être fainéant, en réutilisant les sous-fonctions,
- on a fait des exemples et *on les garde* dans ce qu'on présente au jury,
- on a testé la fonction exigée sur de petits exemples et sur un exemple de taille réelle (venant du texte)

Et on a essayé de faire *un peu plus*, en implémentant la vérification d'une contrainte de plus.

Bien-sûr, ce petit notebook ne se prétend pas être une solution optimale, ni exhaustive.