

# Visualisation d'Arbres et de Graphes

G.-P. Bonneau

# Applications

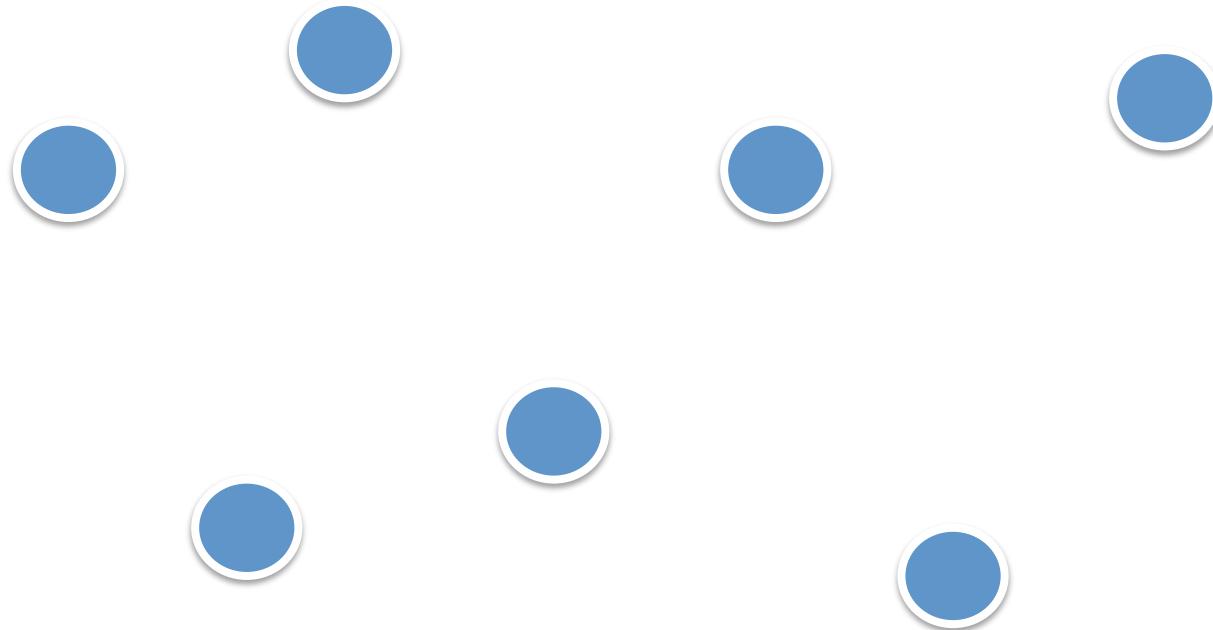
Réseaux sociaux

Segmentation de marchés

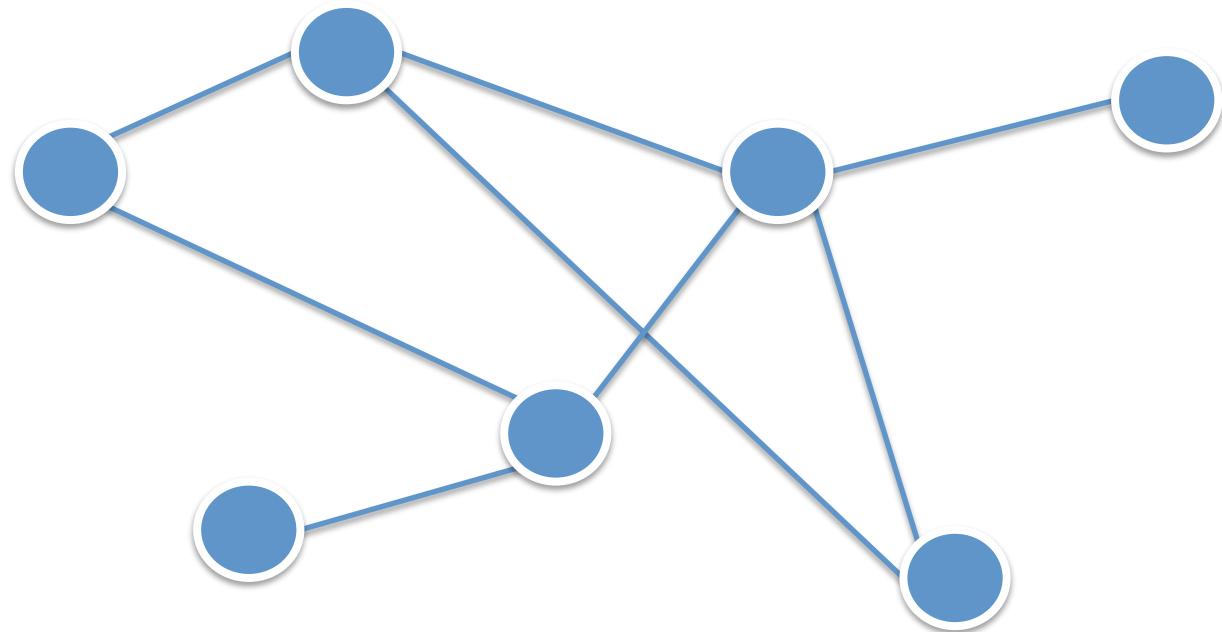
Logistique

Arborescence de fichiers

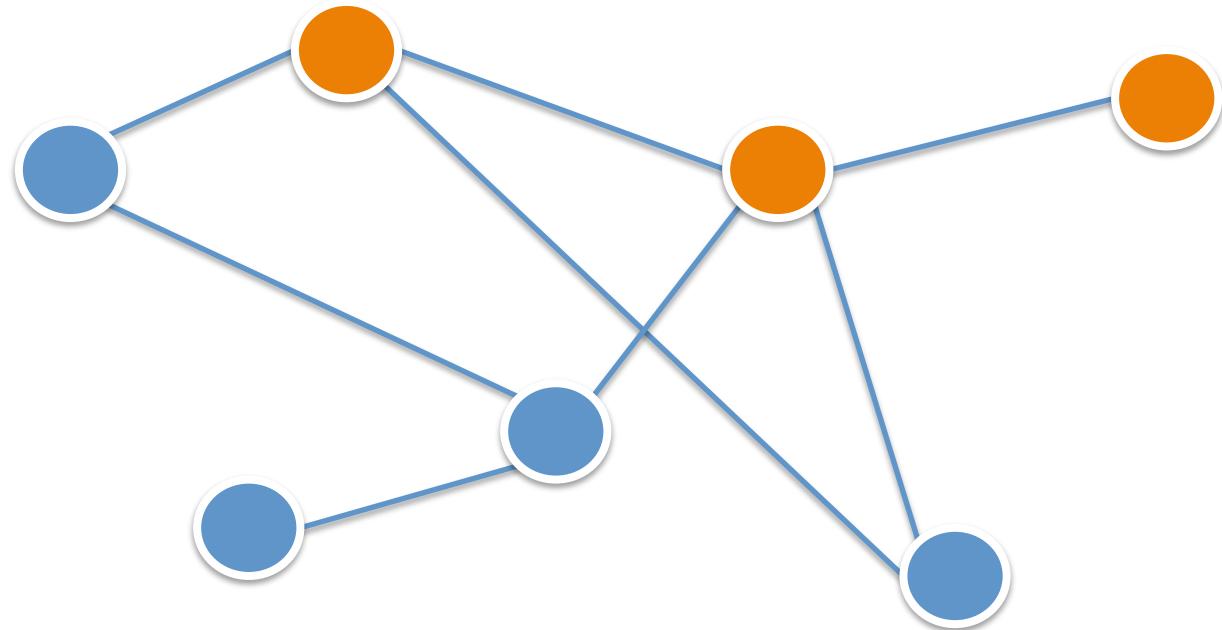
# des Informations Diverses



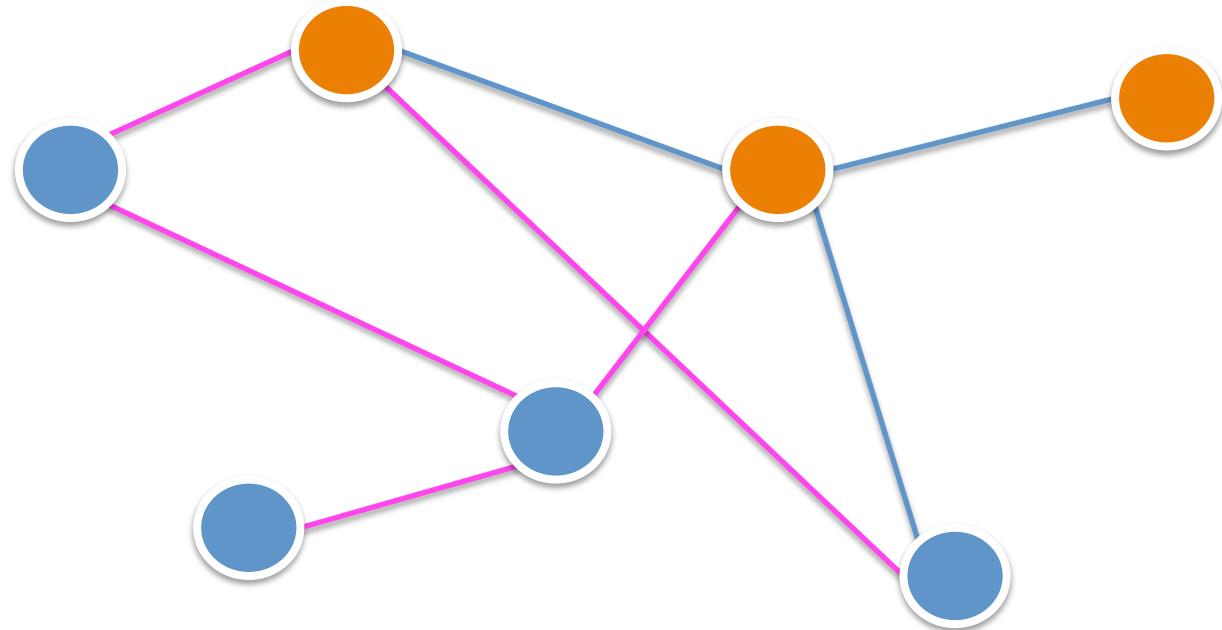
# des Informations Diverses



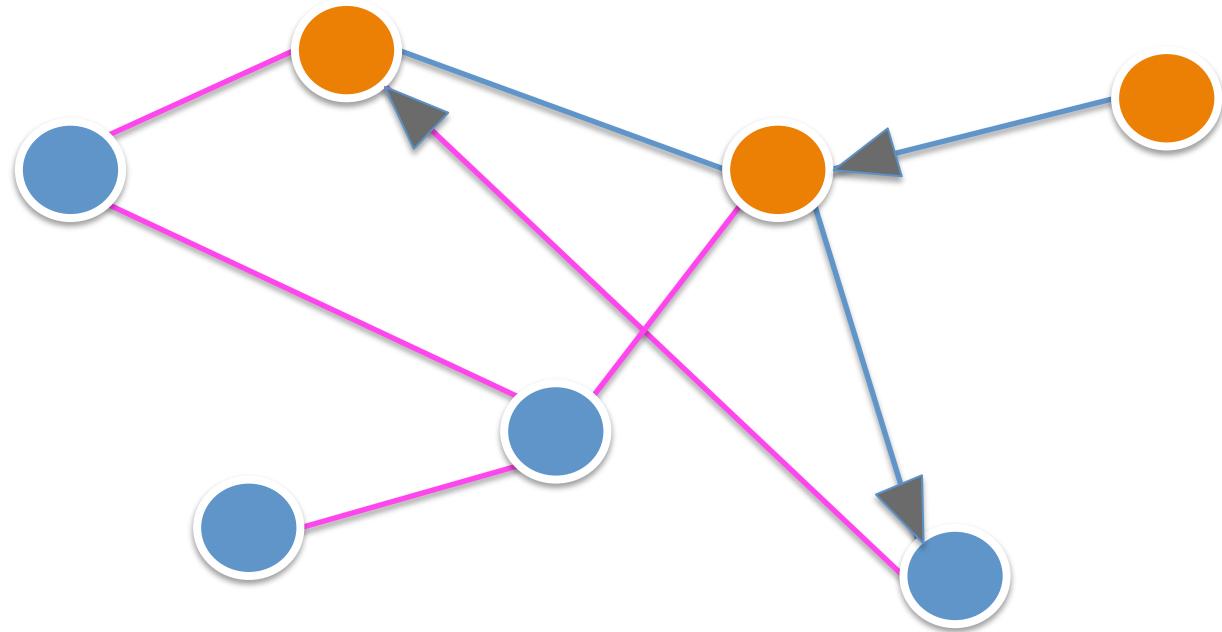
# des Informations Diverses



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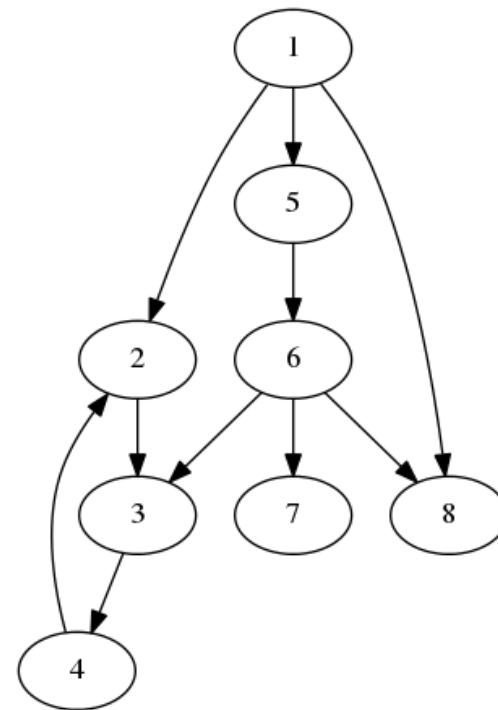
# Problème

Passer des informations de [connectivité]  
... à une représentation [Géométrique]

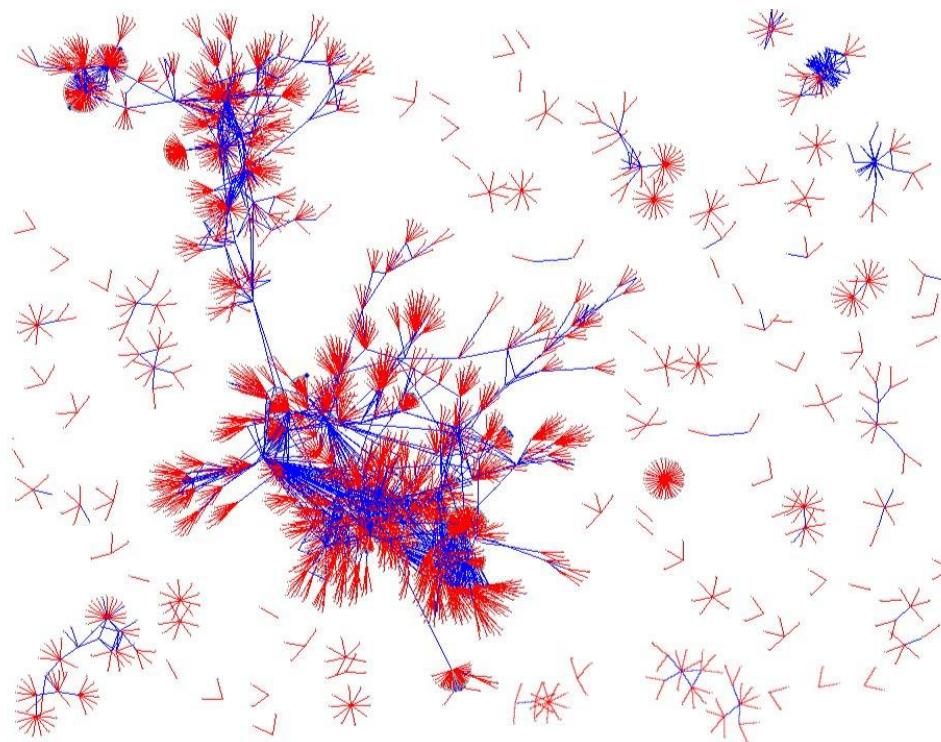
Avec parmi les objectifs possibles:

- visualiser les [Chemins]
- les [Distances]
- les [Clusters]
- la [Hiérarchie]

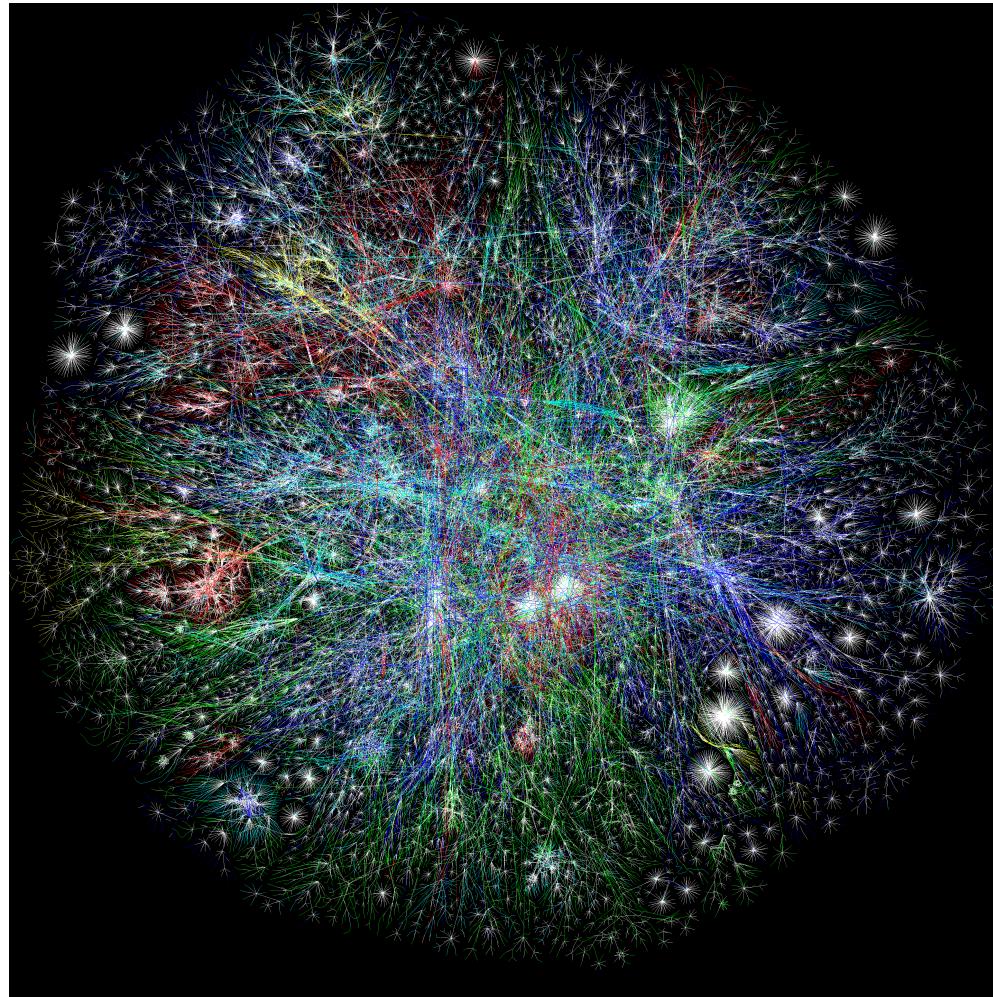
# Passage à l'Échelle



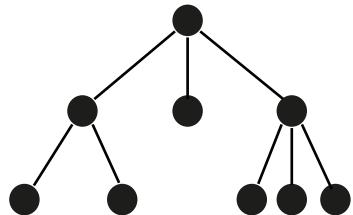
# Passage à l'Échelle



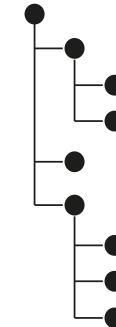
# Passage à l'Échelle



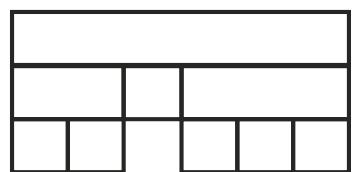
# Visualisation d'Arbres



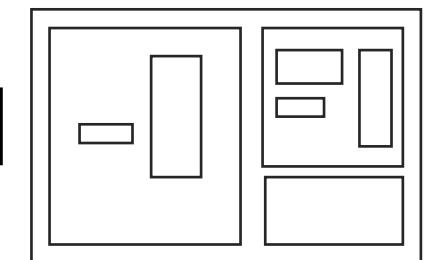
[Diagramme Nœuds/Arêtes]



[Indentation]



[Stratification]



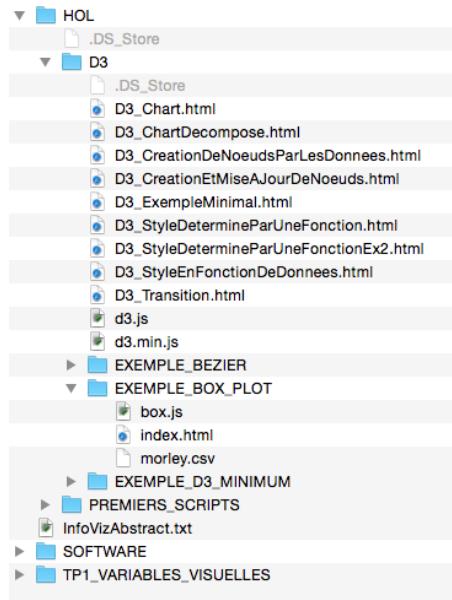
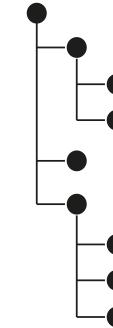
[Carte d'Arbre]

Implémentation  $O(N)$  ou  $O(N \ln(N))$

# [Indentation]

un nœud par ligne

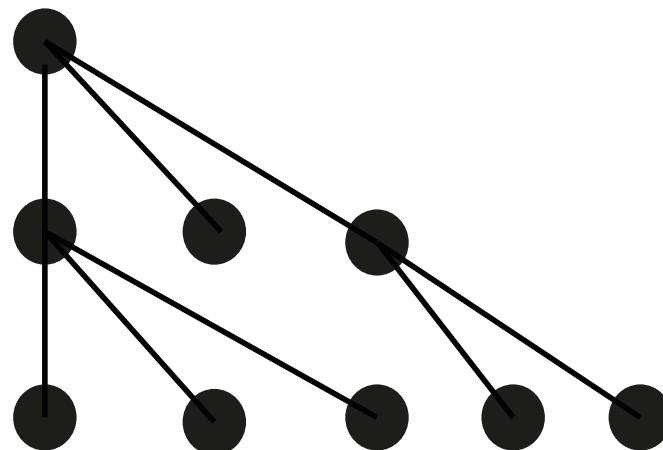
Indentation= profondeur



# Noeuds/Arêtes: Algorithme Naïf

Noeuds du même niveau sur la même ligne

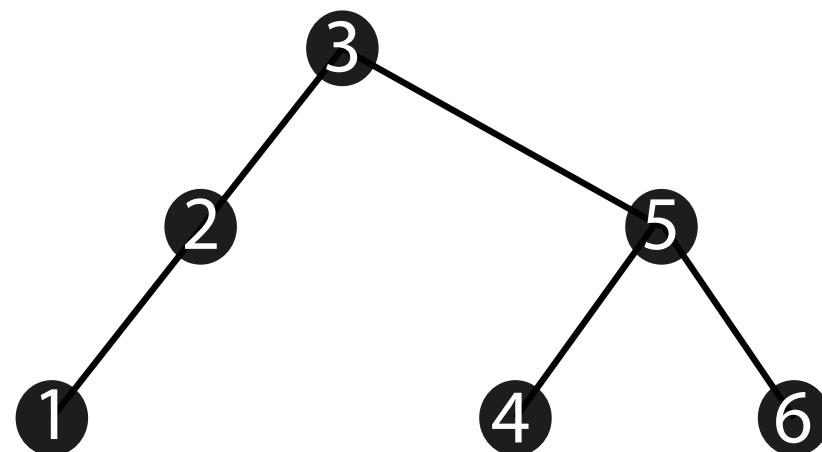
Noeuds placés le plus à gauche possible



# Algorithme de Knuth

Arbres Binaires

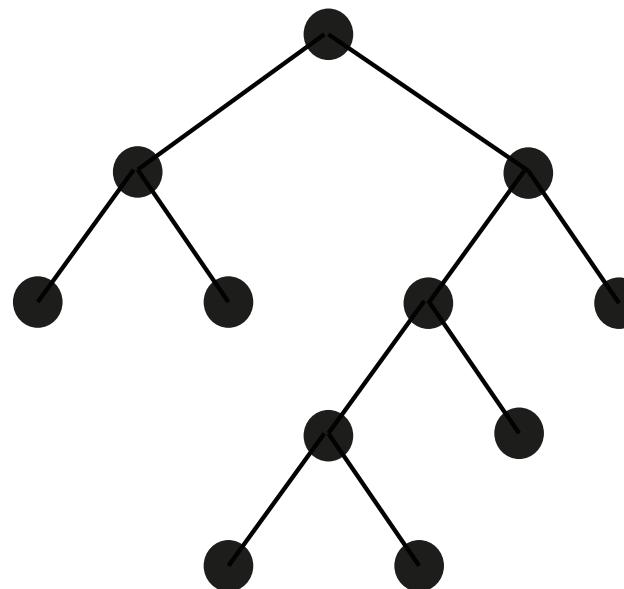
Nœud parent entre ses deux enfants



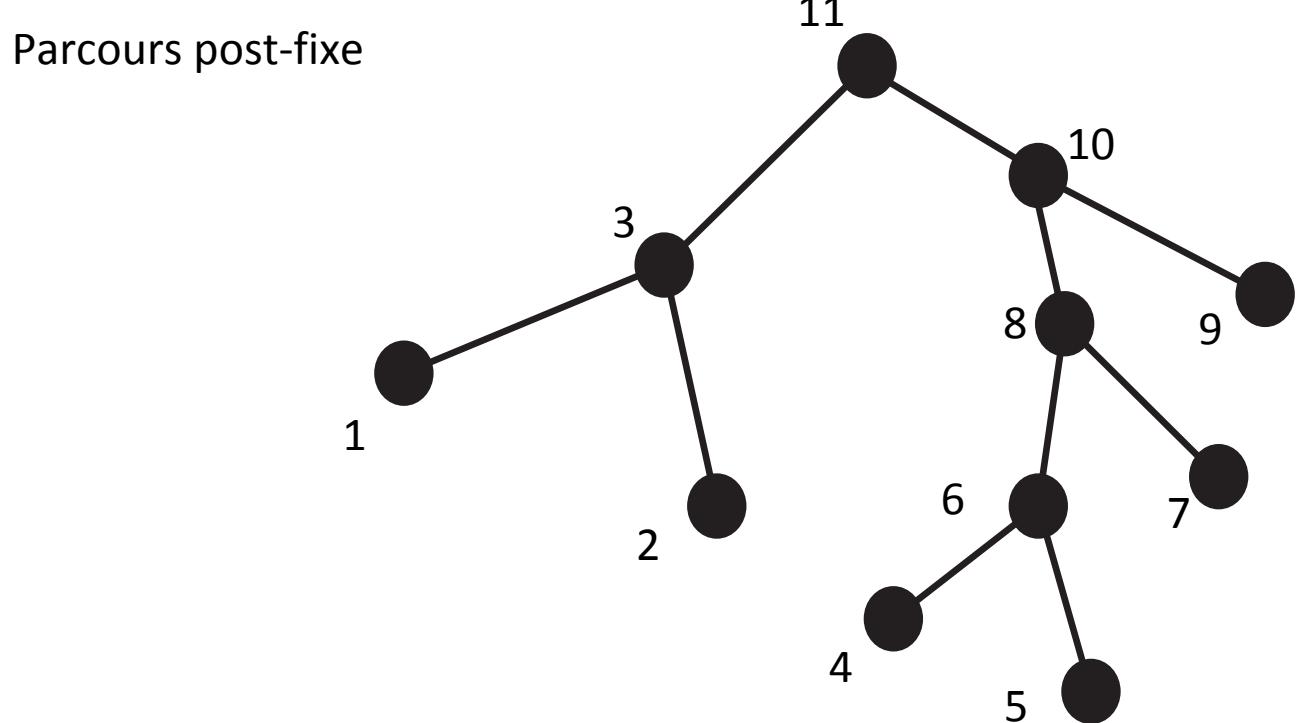
# Algorithme de Wetherell et Shannon

Arbres Binaires

Nœud parent centré entre ses deux enfants



# Wetherell Shannon



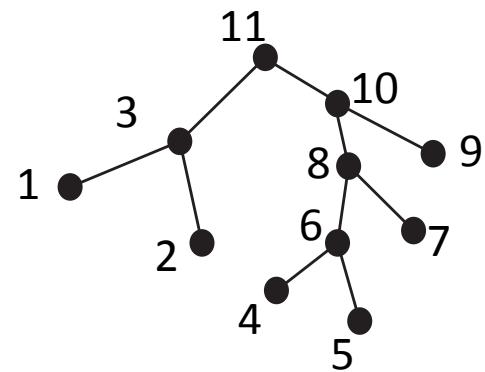
Règle 1: noeud feuille placé 2 unités à droite du noeud le plus à droite du même niveau

Règle 2: noeud avec deux enfants placé au centre de ses enfants

Règle 3: noeud avec un enfant placé une unité du bon côté de cet enfant

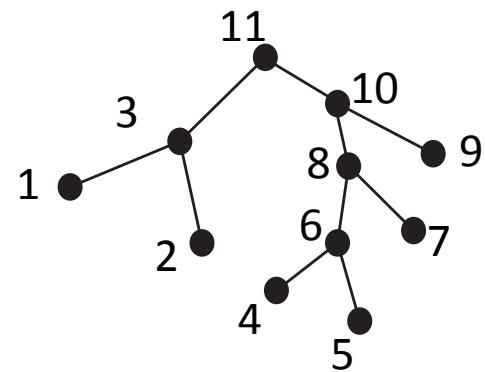
Règle 4: si un décalage est nécessaire, noter ce décalage dans le noeud

# Wetherell Shannon

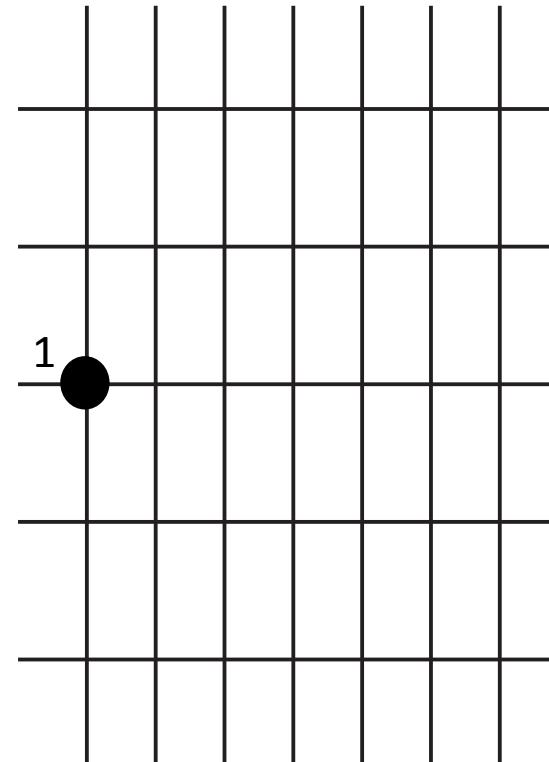


Calcul d'une place provisoire

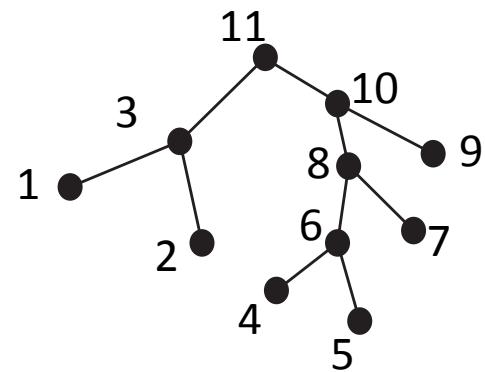

# Wetherell Shannon



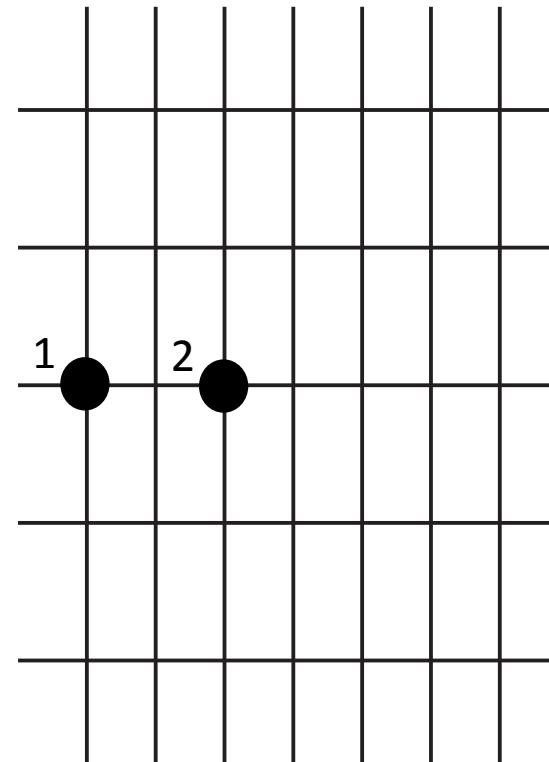
Calcul d'une place provisoire



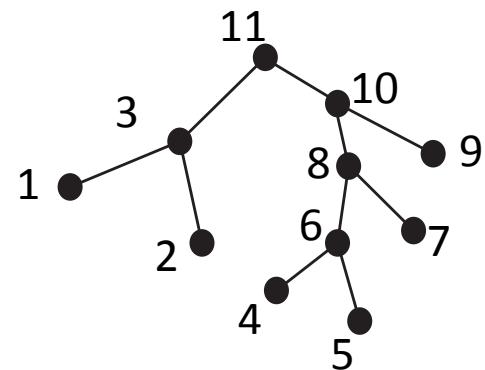
# Wetherell Shannon



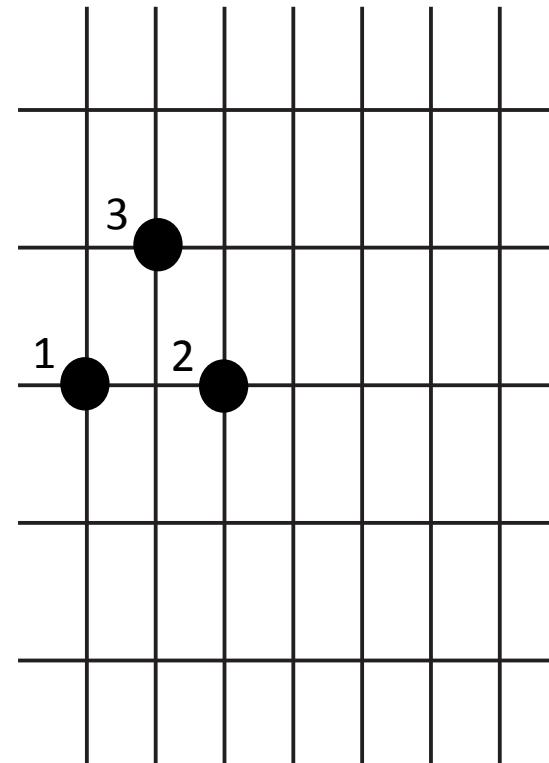
Calcul d'une place provisoire



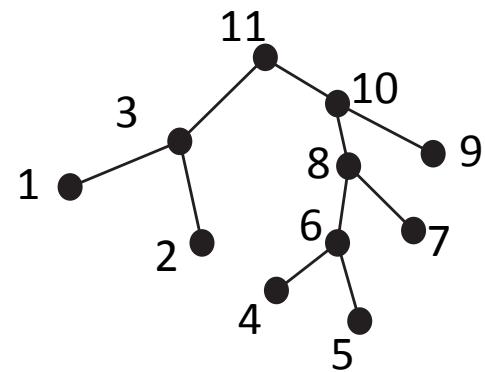
# Wetherell Shannon



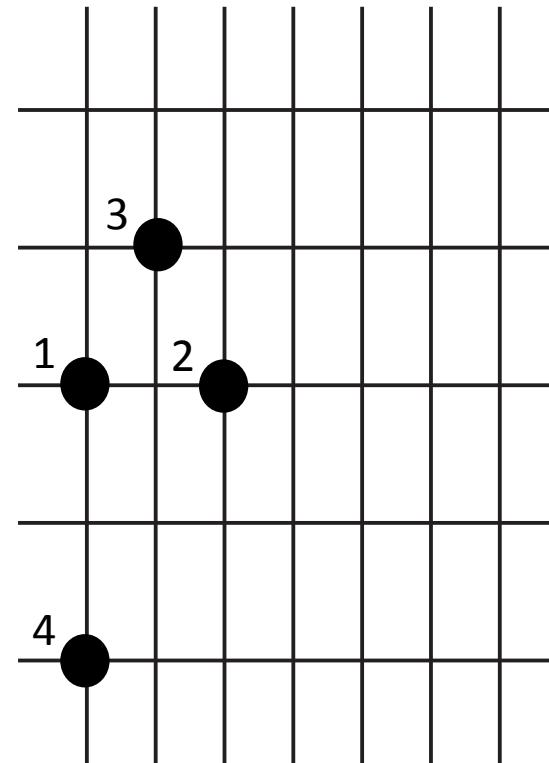
Calcul d'une place provisoire



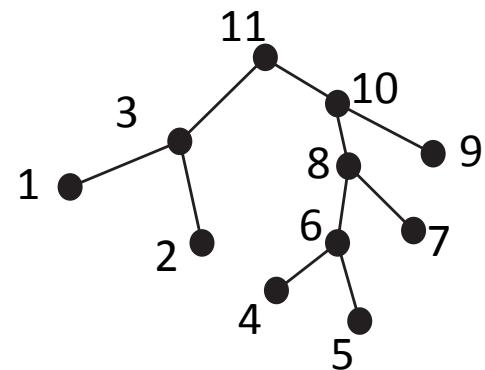
# Wetherell Shannon



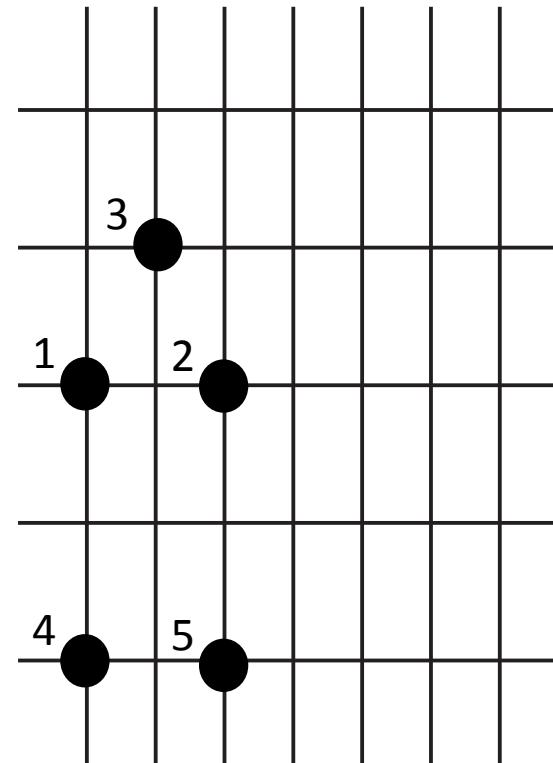
Calcul d'une place provisoire



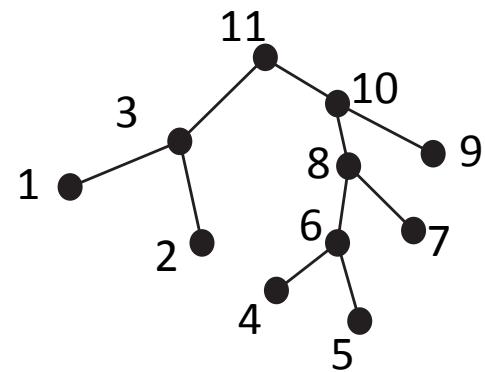
# Wetherell Shannon



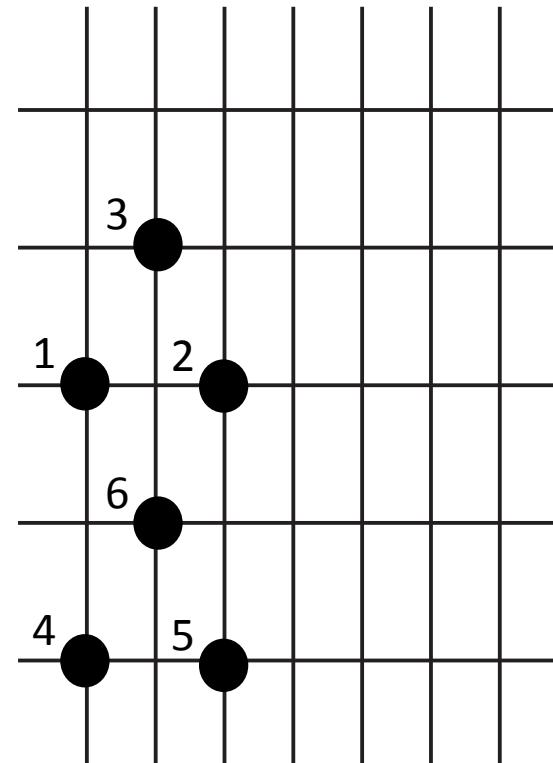
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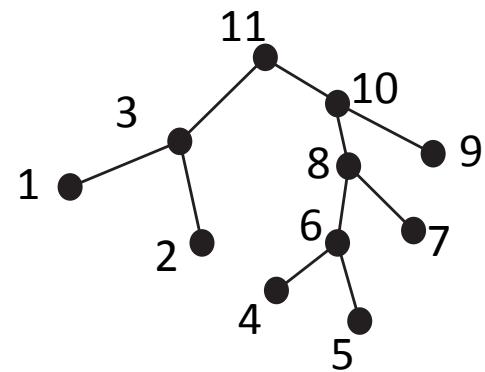
# Wetherell Shannon



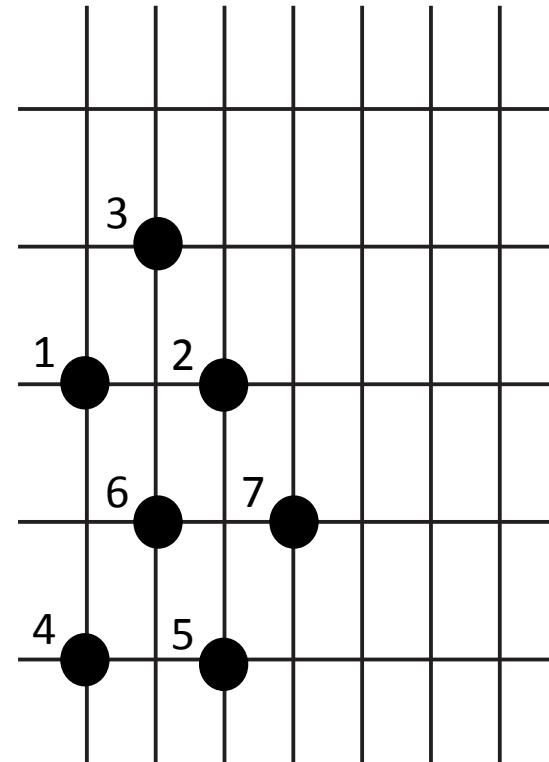
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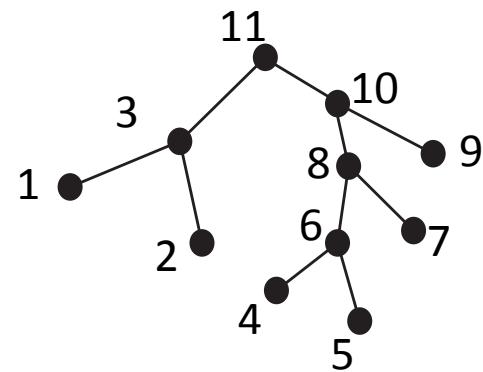
# Wetherell Shannon



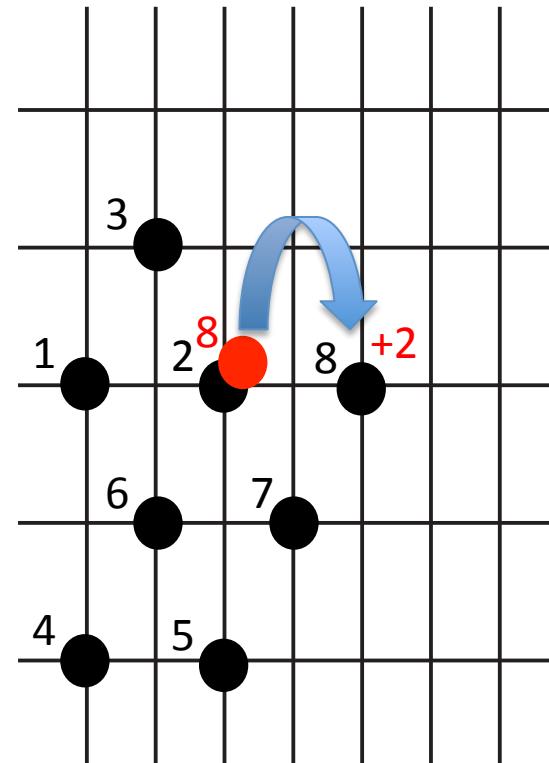
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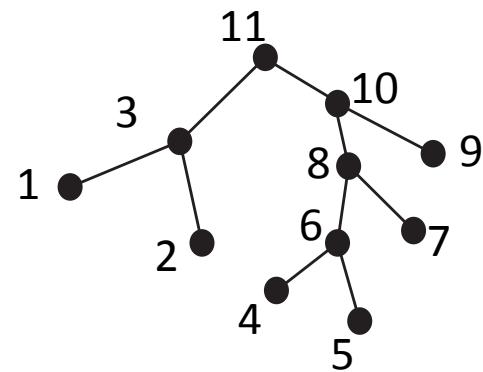
# Wetherell Shannon



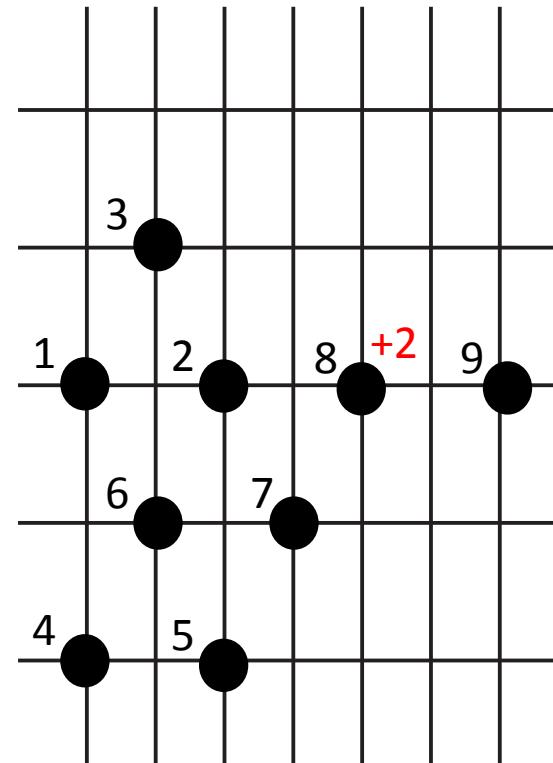
Calcul d'une place provisoire



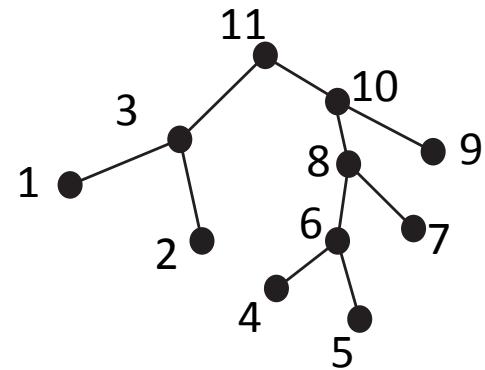
# Wetherell Shannon



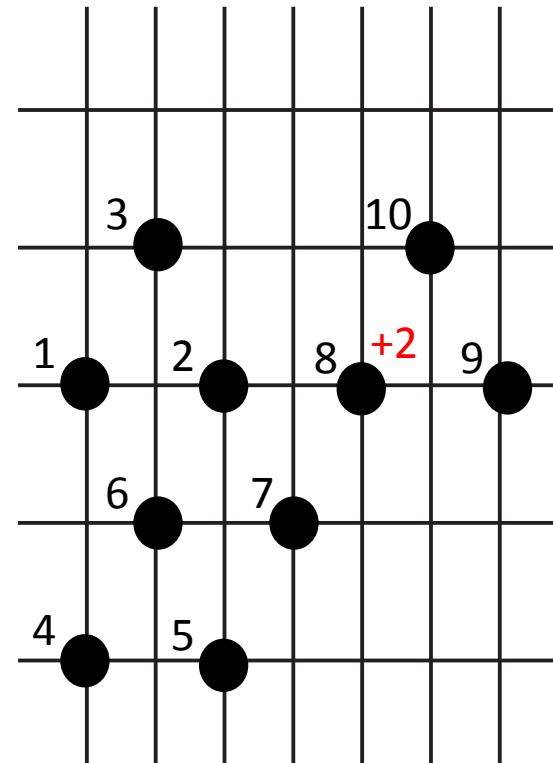
Calcul d'une place provisoire



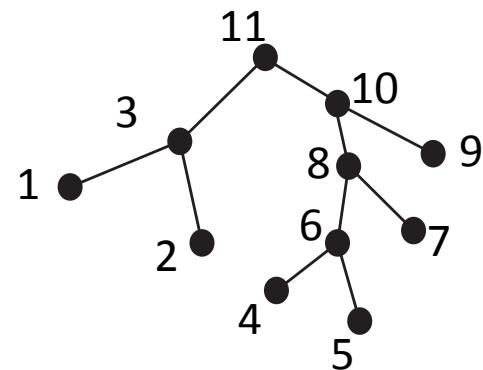
# Wetherell Shannon



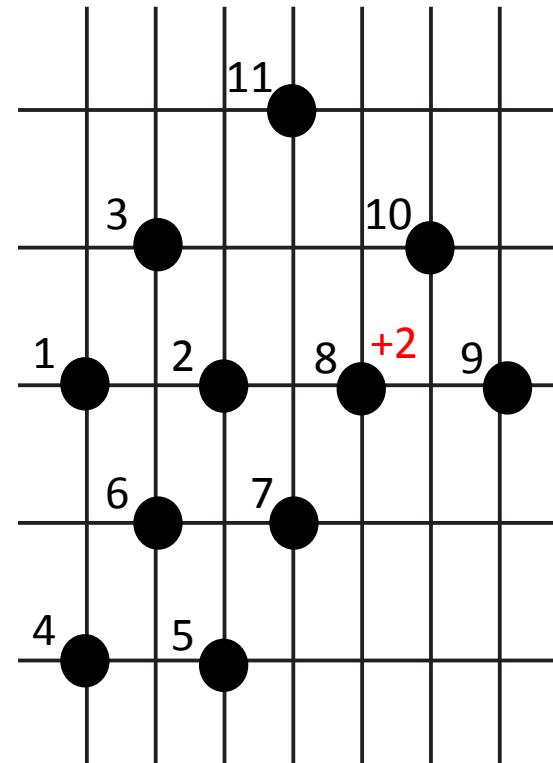
Calcul d'une place provisoire



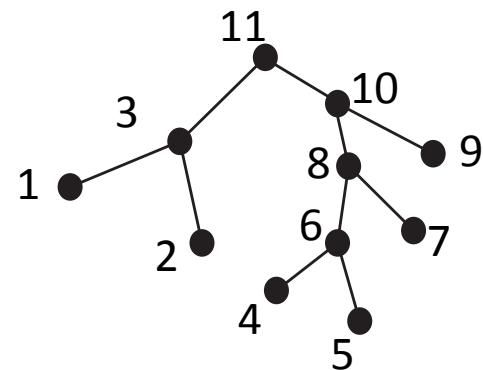
# Wetherell Shannon



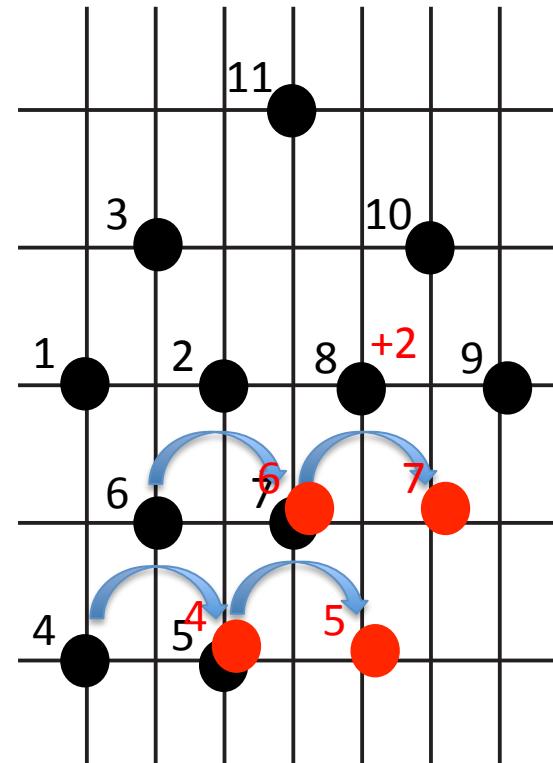
Calcul d'une place provisoire



# Wetherell Shannon

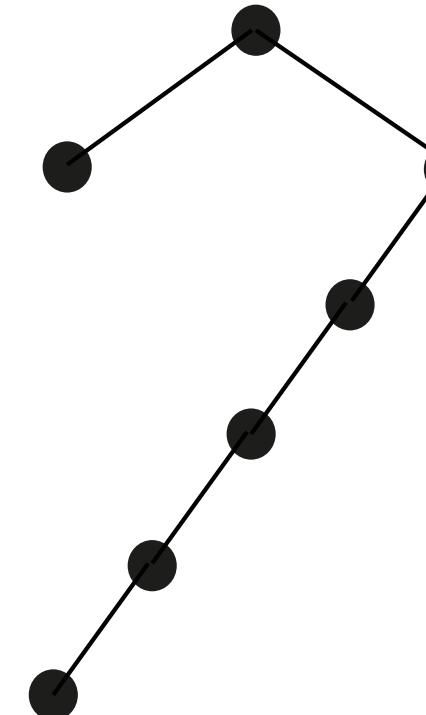
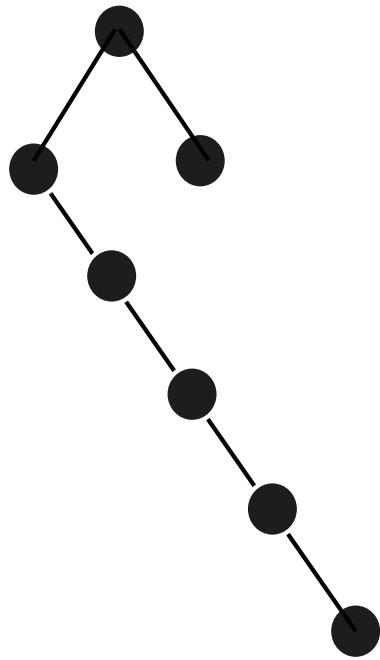


Calcul de la place définitive: parcours préfixe



# Algorithme de Wetherell et Shannon

Arbres symétriques représentés non symétriques



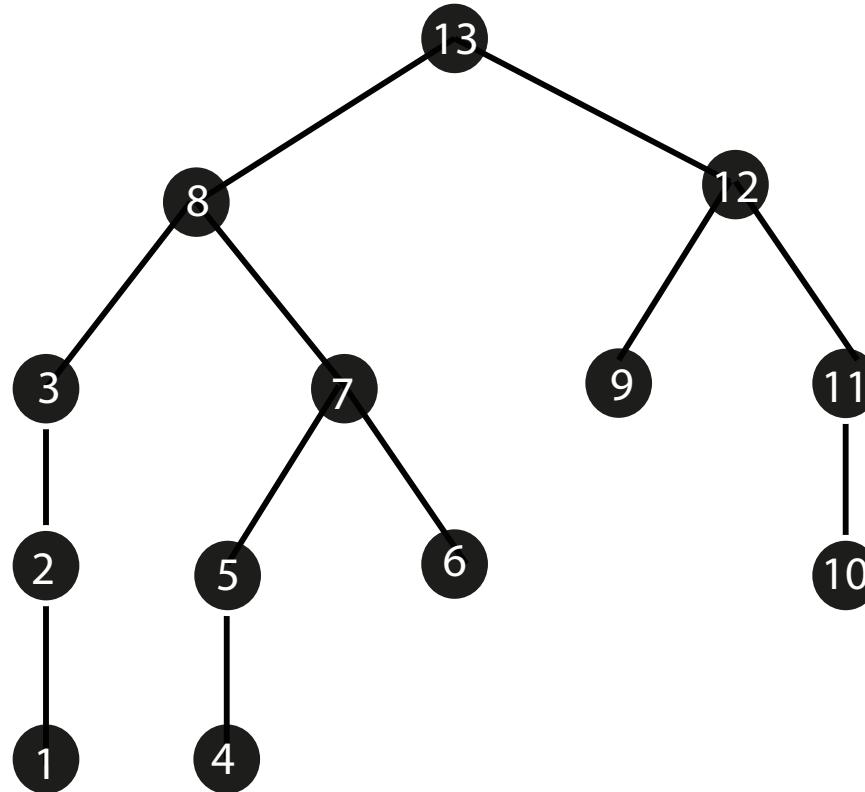
# Algorithme de Reingold et Tilford

Utiliser les silhouettes des sous-arbres pour  
[compacter] la représentation

La relation parent->enfant unique est  
représentée verticalement

Prend en compte les arbres n-aires

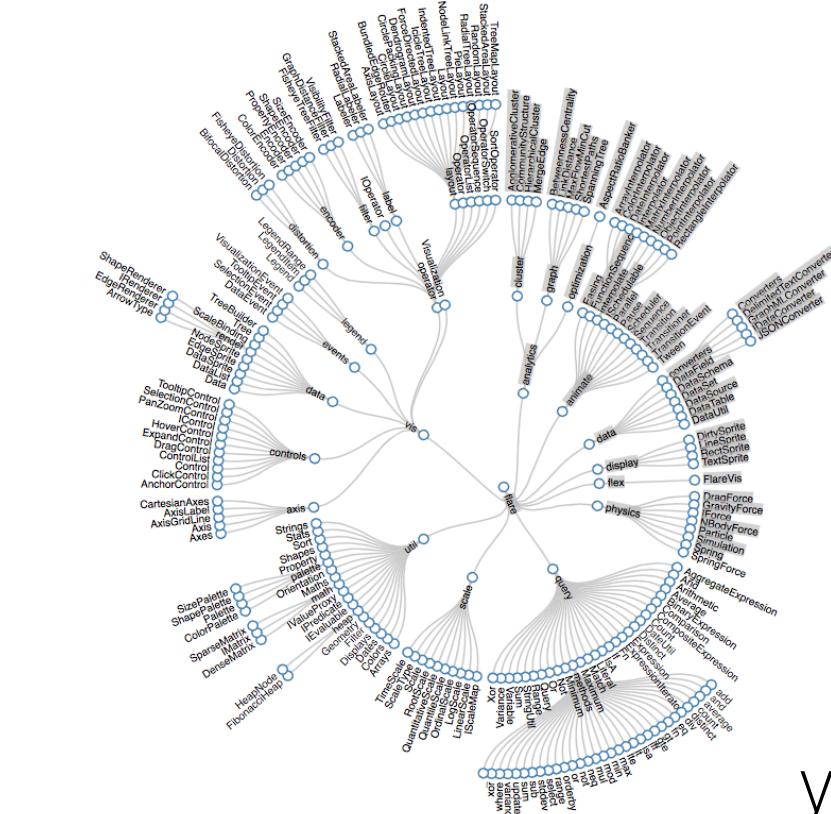
# Algorithme de Reingold et Tilford



# Disposition Radiale

## Coordonnées polaires

# [d3.js]



x devient l'angle  
y devient le rayon

# passage à l'Échelle

Problème:

la largeur augmente [exponentiellement]

Solutions:

Scroll/Pan

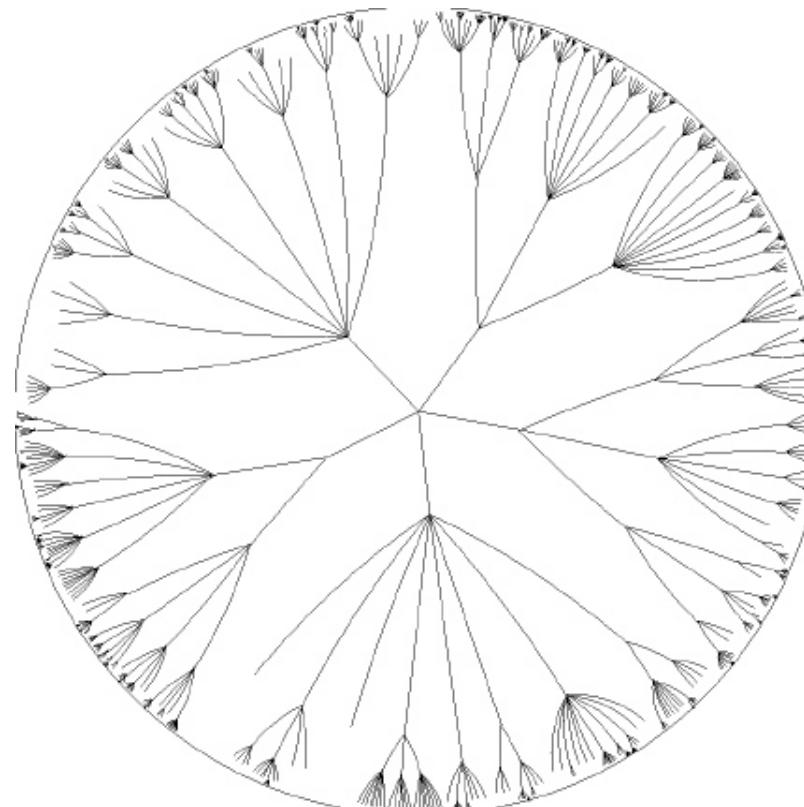
Simplifier (interactivement)

Zoomer

Focus+Context

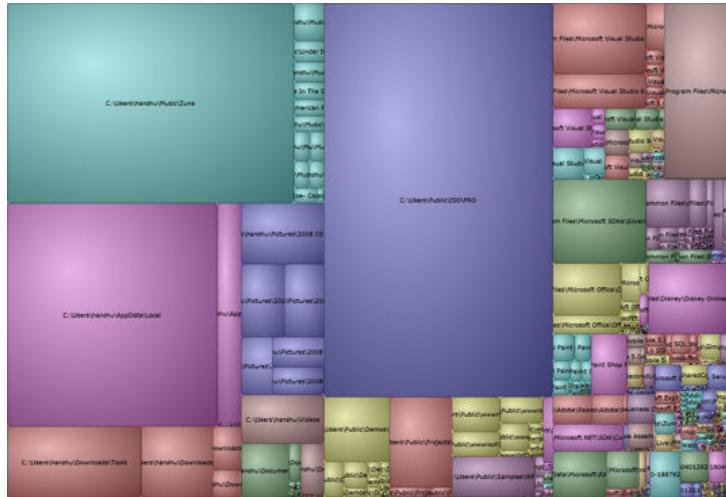
# passage à l'Échelle

Projection hyperbolique

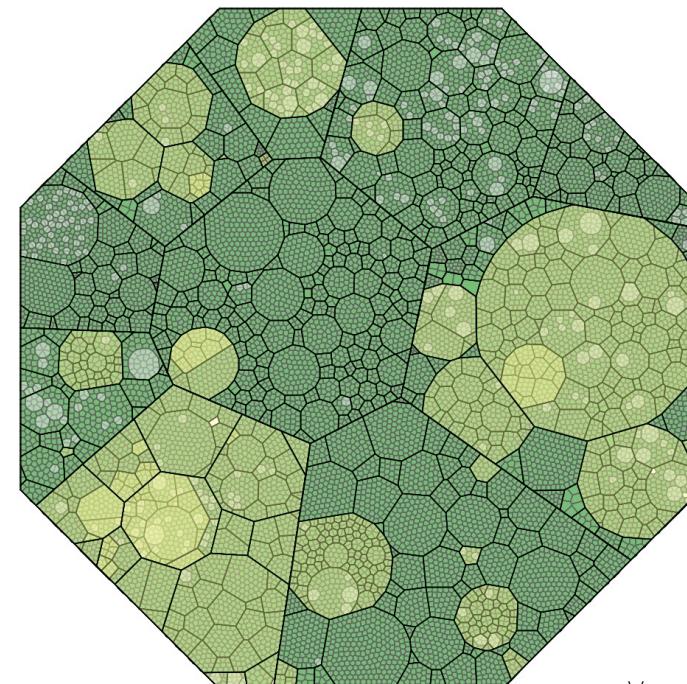


[Lamping, Xerox]

# Carte d'arbre/Tree map



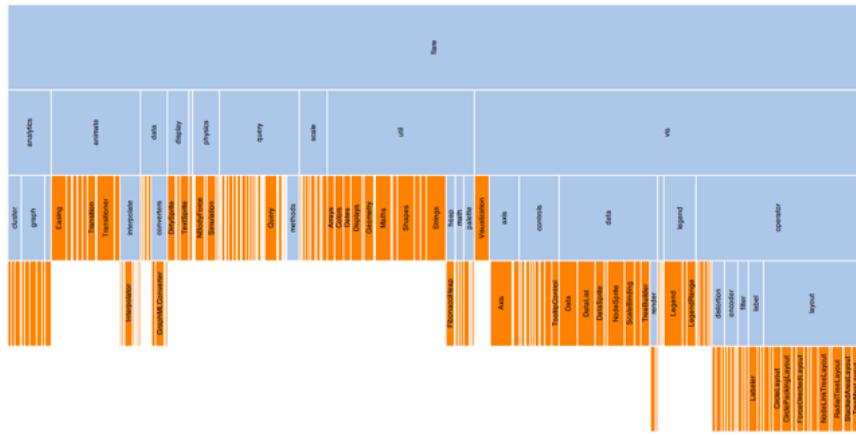
Rectangles [visitmix.com]



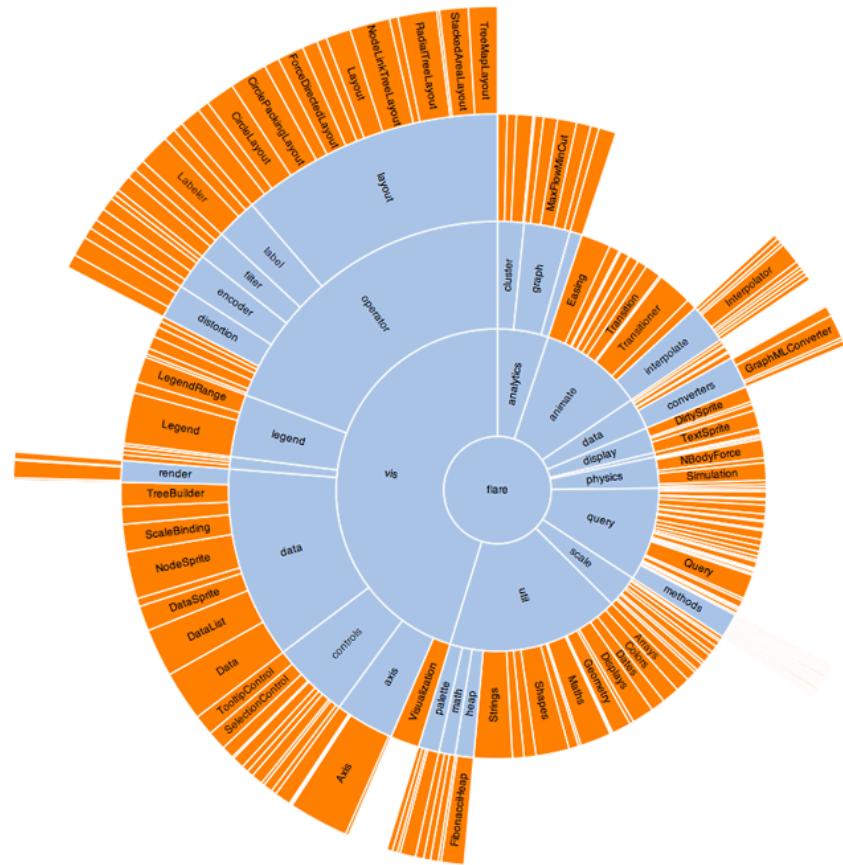
Voronoi [Brandes]

Problème: lecture de la profondeur

# Stratification



Icicle, Sunburst [J. Heer]

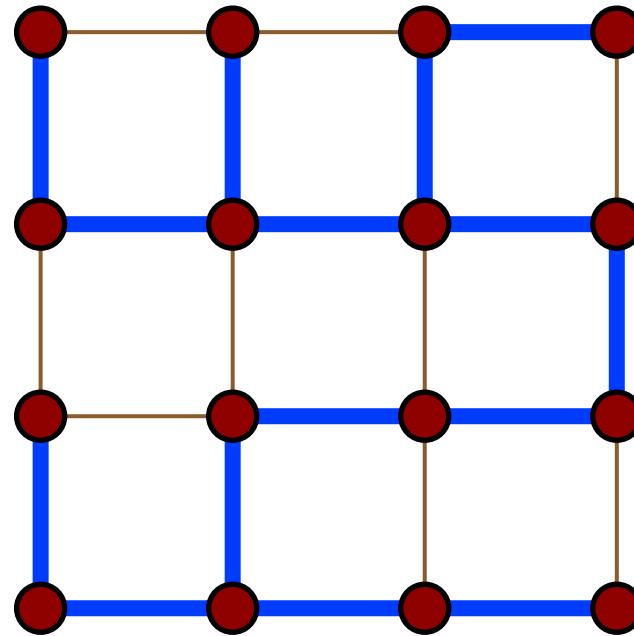


# Graphes

- Positionnement explicite
  - Arbre couvrant
  - Arrangement par niveaux
  - Matrice de connexion
- Optimisation
  - Minimisation d'une énergie
  - Interactivité

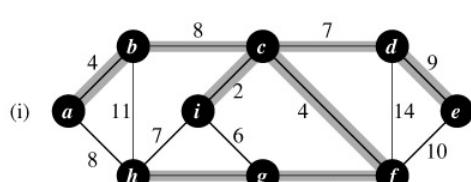
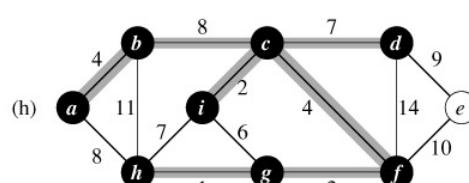
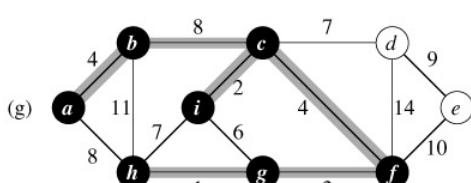
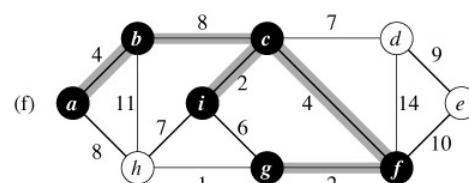
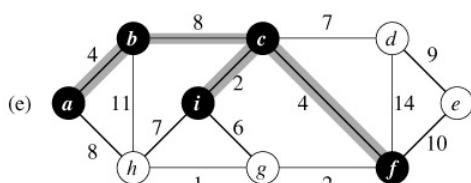
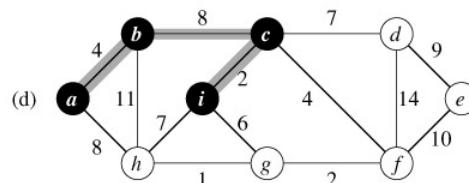
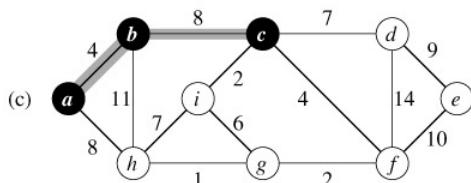
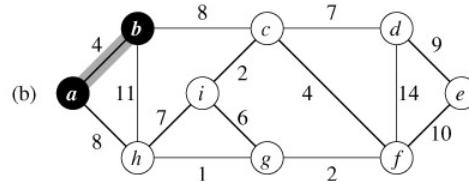
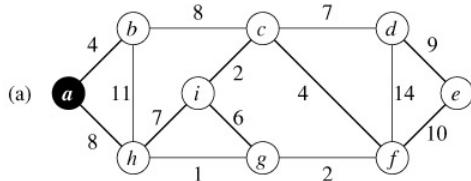
# Arbre couvrant

- Sous-ensemble d'arêtes
  - Ne formant pas de cycle
  - Contenant tous les sommets



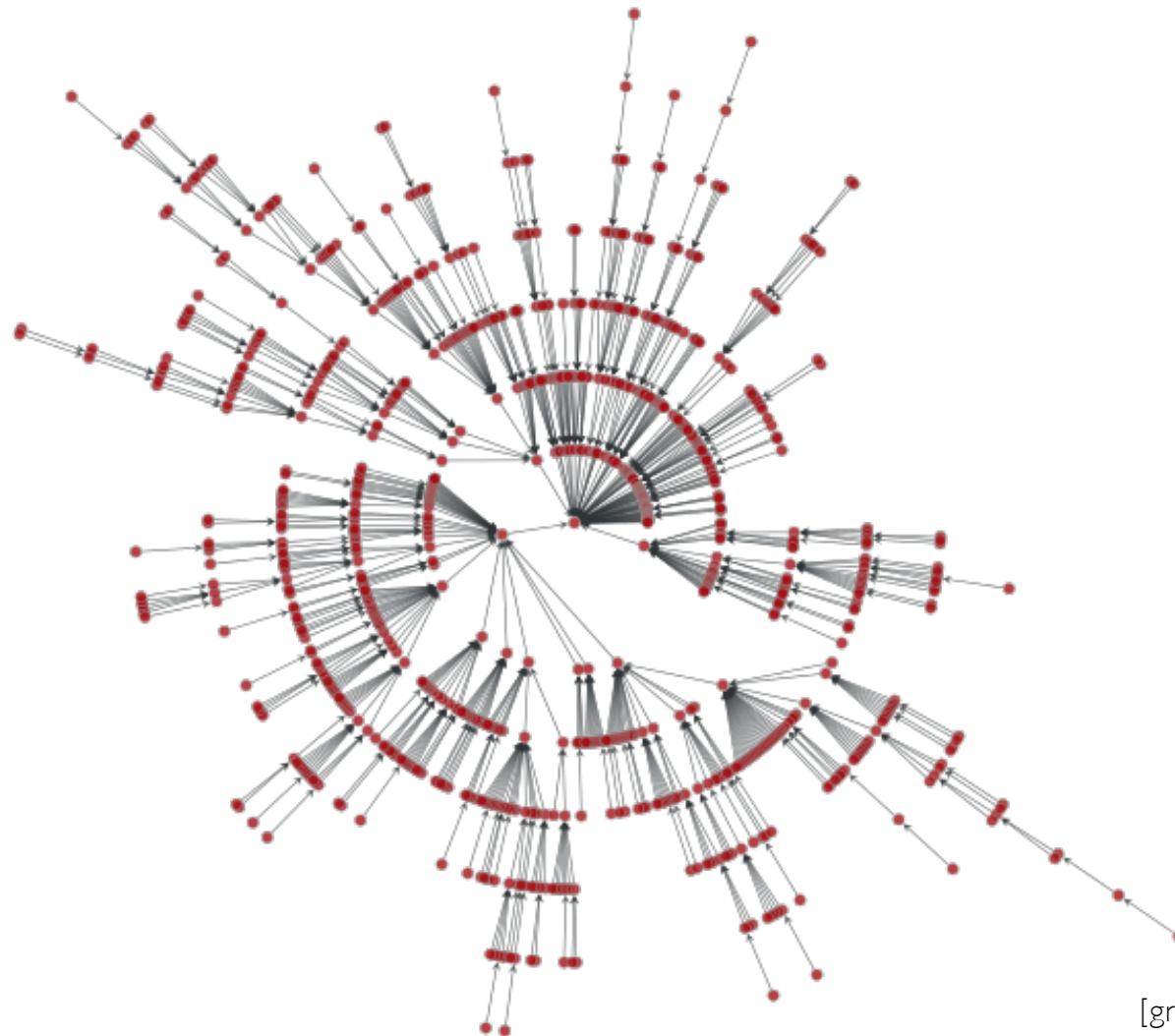
[wikimedia]

# Arbre couvrant



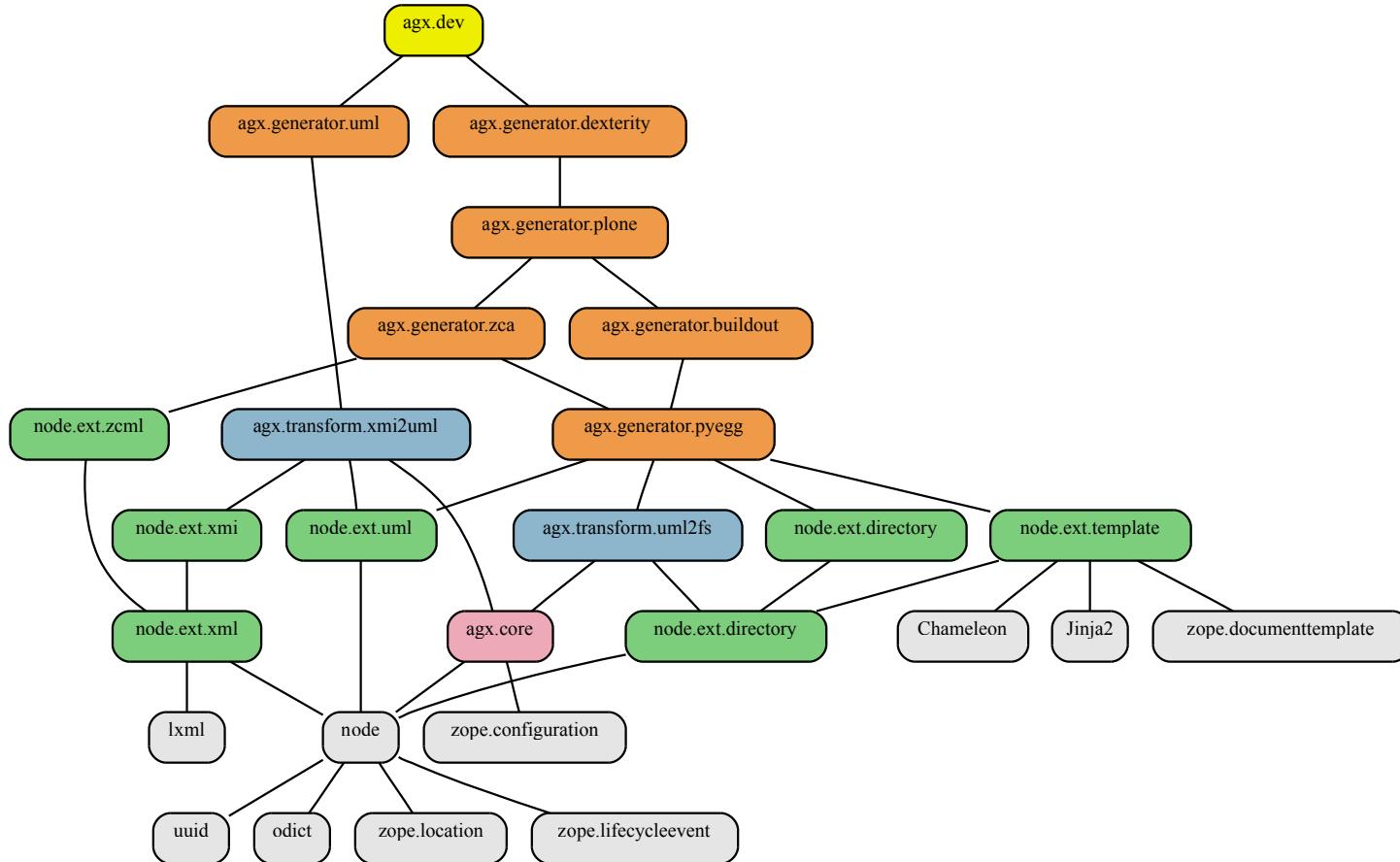
[Introduction to Algorithms]

# Arbre couvrant



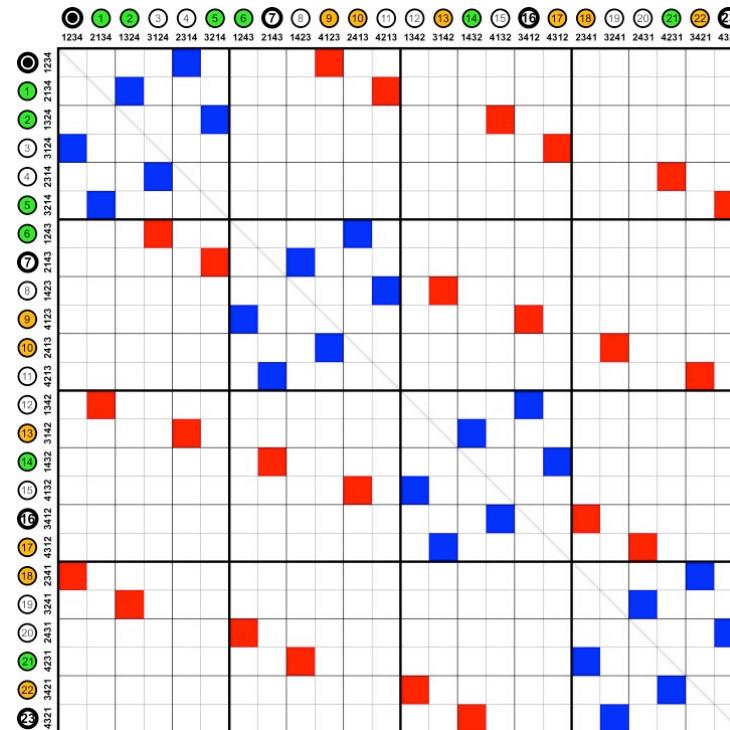
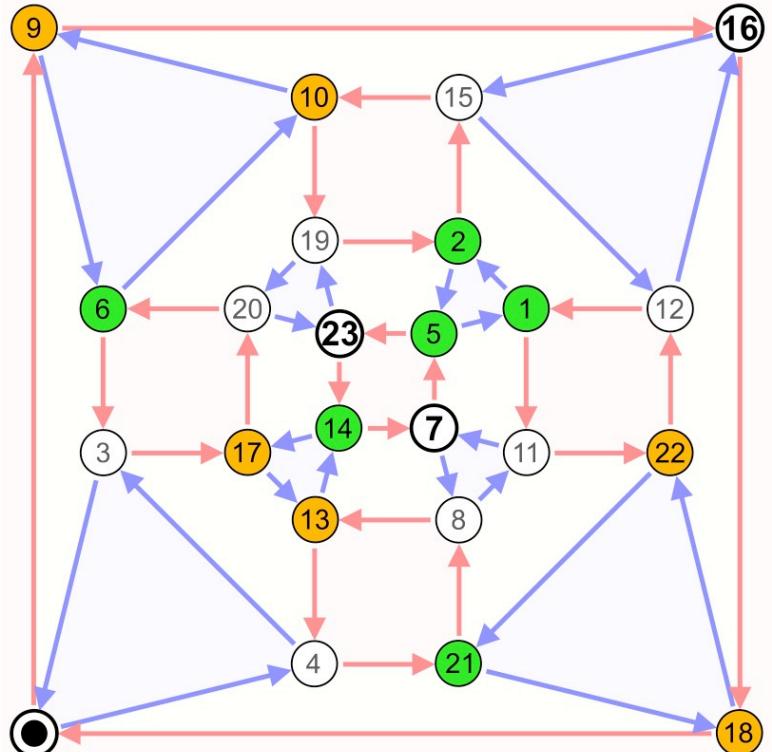
[graph-tool]

# Arrangement par niveaux



[Graphviz]

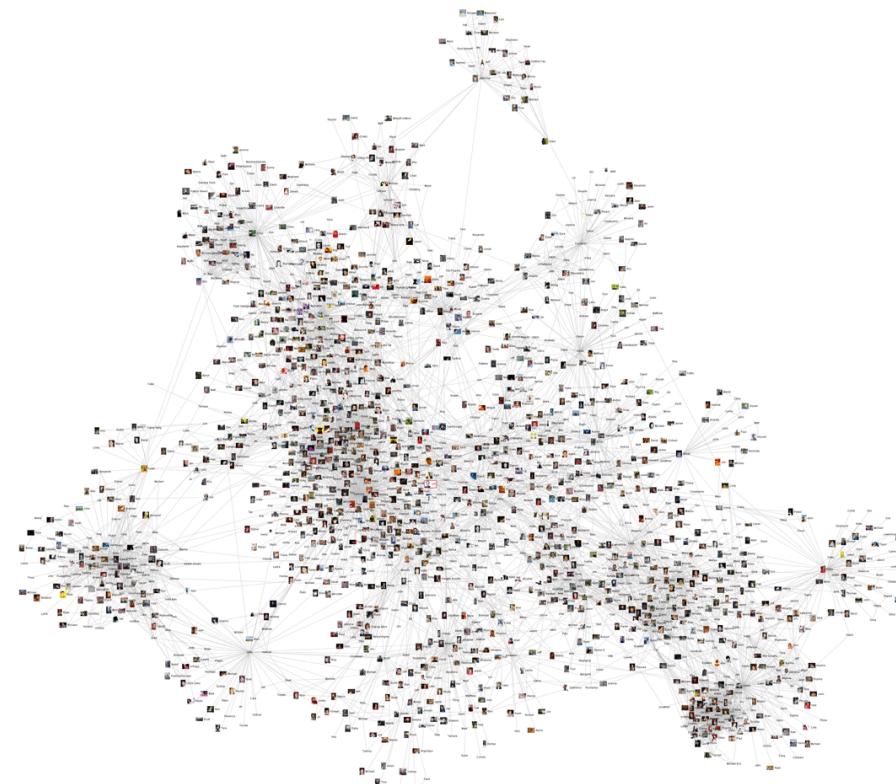
# Matrice de connections



# Placement par simulation

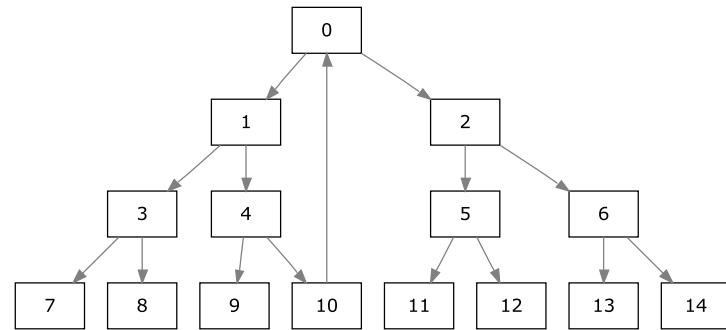
- Objectif: éloigner les nœuds entre eux
- Simulation de particules chargées
  - Forces de répulsion
  - Complexité  $N^2$
  - Accélération avec hiérarchies spatiales
    - Quadtree, k-d tree

# VizTer



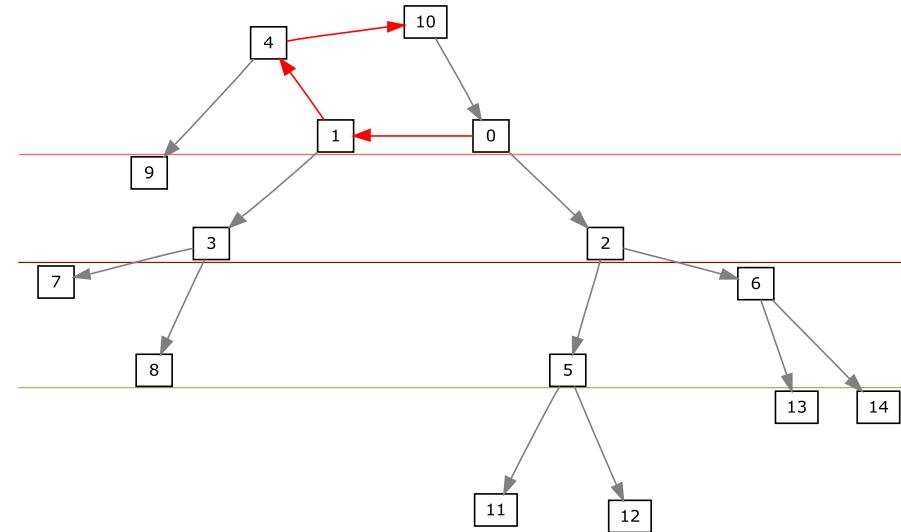
[Heer'05]

# Optimisation avec Contraintes



[Sugiyama style, GraphViz]

[DiGCoLa, Dwyer 05]



pour finir: passage à l'échelle

- Pan/Zoom
- Focus-Context
- Groupement par Attribut
- Groupement d'arêtes: Edge Bundling

