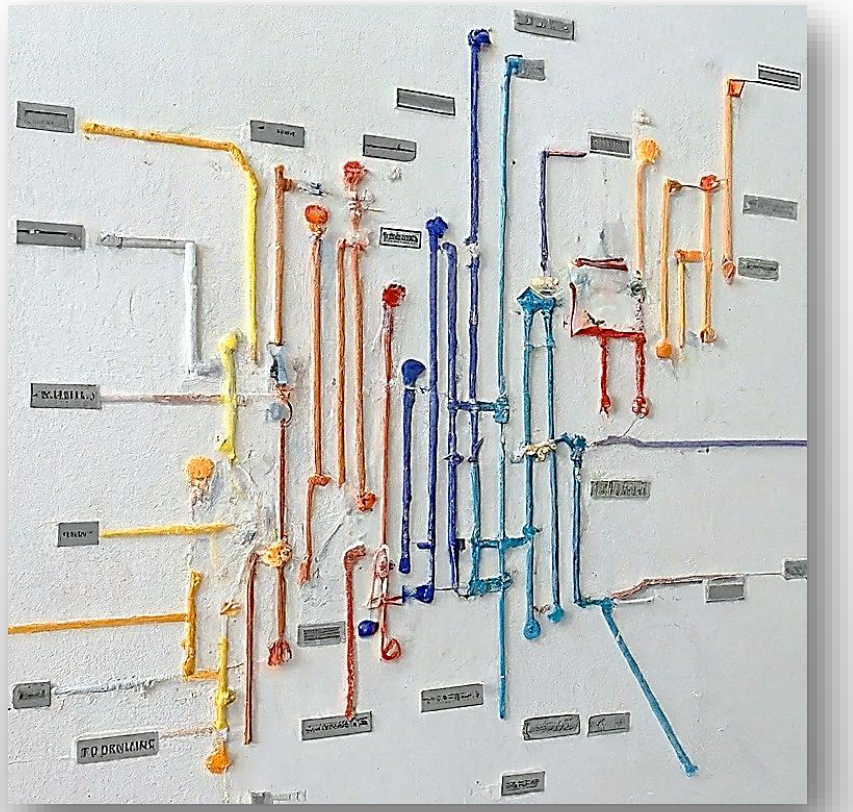
Bölüm 4: Çizge Algoritmaları

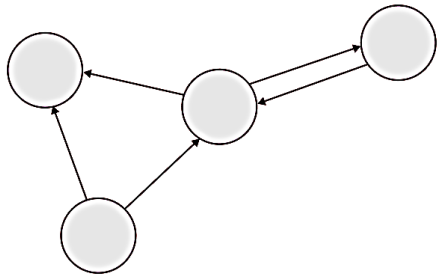
Algoritmalar

Çizge Algoritmaları

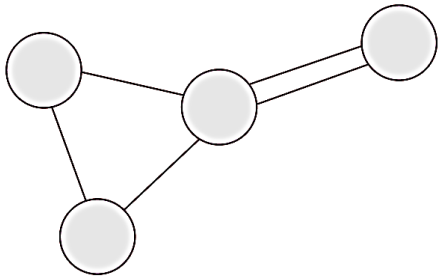
- Dünya aslında bir ağ gibidir.
  - Şehirler yollarla,
  - İnsanlar ilişkilerle,
  - Bilgisayarlar kablolarla birbirine bağlıdır.
- Çizge algoritmaları bu ağları inceler ve anlamlandırır.



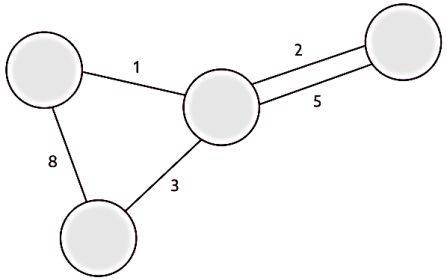
Çizge Türleri



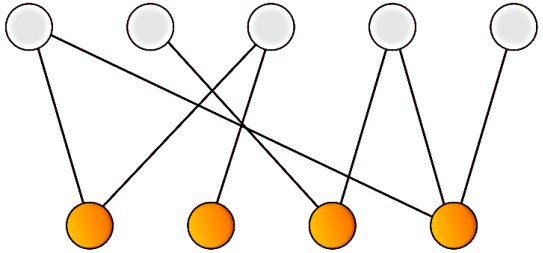
Directed graph



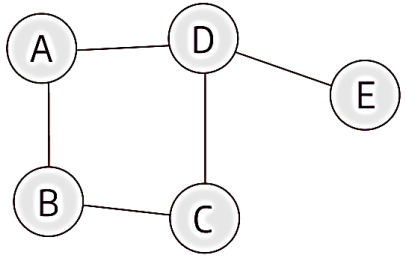
Undirected



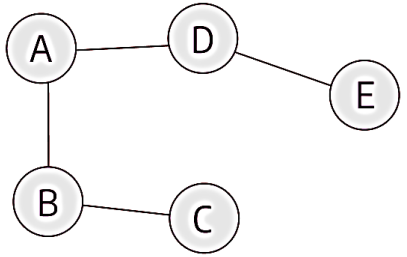
Weighted



Bipartite graph



Cyclic graph



Acyclic graph

Çizge Algoritmaları

- Birbirine bağlı noktalar (düğüm) ve bu noktaları birleştiren çizgiler (kenar) ile temsil edilen ağ yapılarını inceler.
- Ağlarda en kısa yolu hesaplama, gruplama gibi işlemleri gerçekleştirir.
- Sosyal ağlar, harita uygulamaları, navigasyon gibi birçok alanda kullanılır.

Çizge Algoritmalarının Çeşitleri

- Farklı çizge algoritmaları, farklı işlemler için kullanılır.
- Derinlik Öncelikli Arama (DFS):
  - Bir düğümden başlar, dallanarak tüm ağı gezer.
- Genişlik Öncelikli Arama (BFS):
  - Bir düğümden başlar, katman katman tüm ağı gezer.
- Dijkstra Algoritması:
  - Başlangıç düğümünden diğer düğümlere en kısa yolları bulur.
- Kruskal Algoritması:
  - Bir ağı minimum maliyetle birbirine bağlayan kenarları seçer.

Çizge Algoritmaları

- DFS bir labirentten çıkış yolu ararken kullanılabilir.
- BFS bir haberin tüm şehire yayılma sürecini modelleyebilir.
- Dijkstra en kısa sürede teslimat yapmak için kullanılabilir.

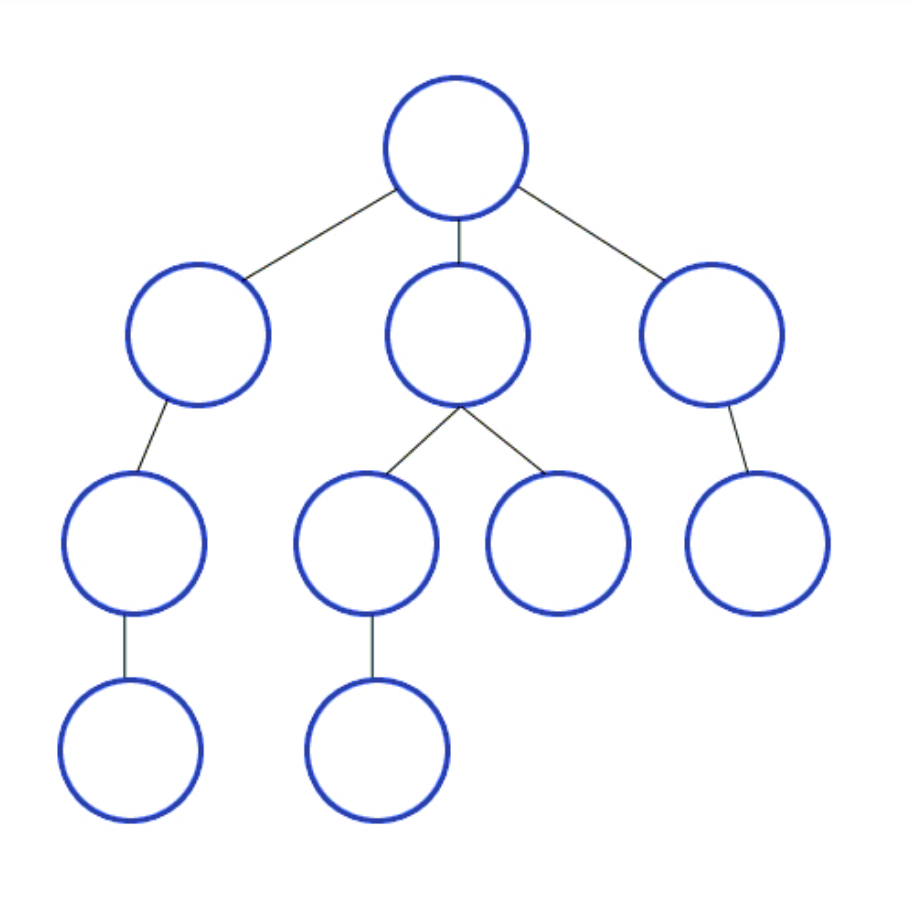
Çizge Algoritmaları

- Çizge gezinme algoritmaları (*Graph traversal*)
- En kısa yol algoritmaları (*Shortest path*)
- Minimum yayılan ağaç algoritmaları (*Minimum spanning tree*)
- Ağ akış algoritmaları (*Network flow*)

Çizge Gezinme Algoritmaları (Graph Traversal)

- Çizgenin yapısını sistematik bir şekilde keşfetmek için kullanılır.
- İki ana kategoriye ayrılır:
  - derinlik öncelikli arama (DFS) ve
  - genişlik öncelikli arama (BFS).
- *DFS*, yığıt veri yapısı kullanarak, bir düğümden başlar ve mümkün olduğunca derinlere iner, tüm komşularını ziyaret ettikten sonra geri döner.
- *BFS*, kuyruk veri yapısı kullanarak, seviye seviye tüm düğümleri ziyaret eder.

Derinlik Öncelikli Arama



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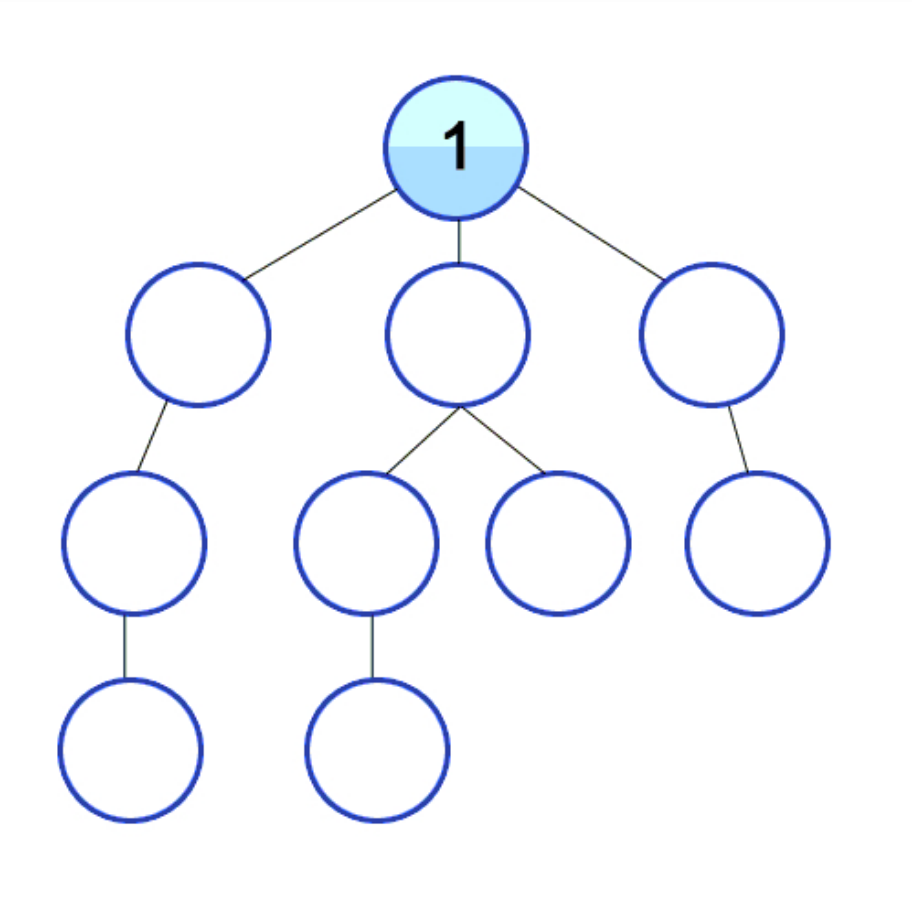

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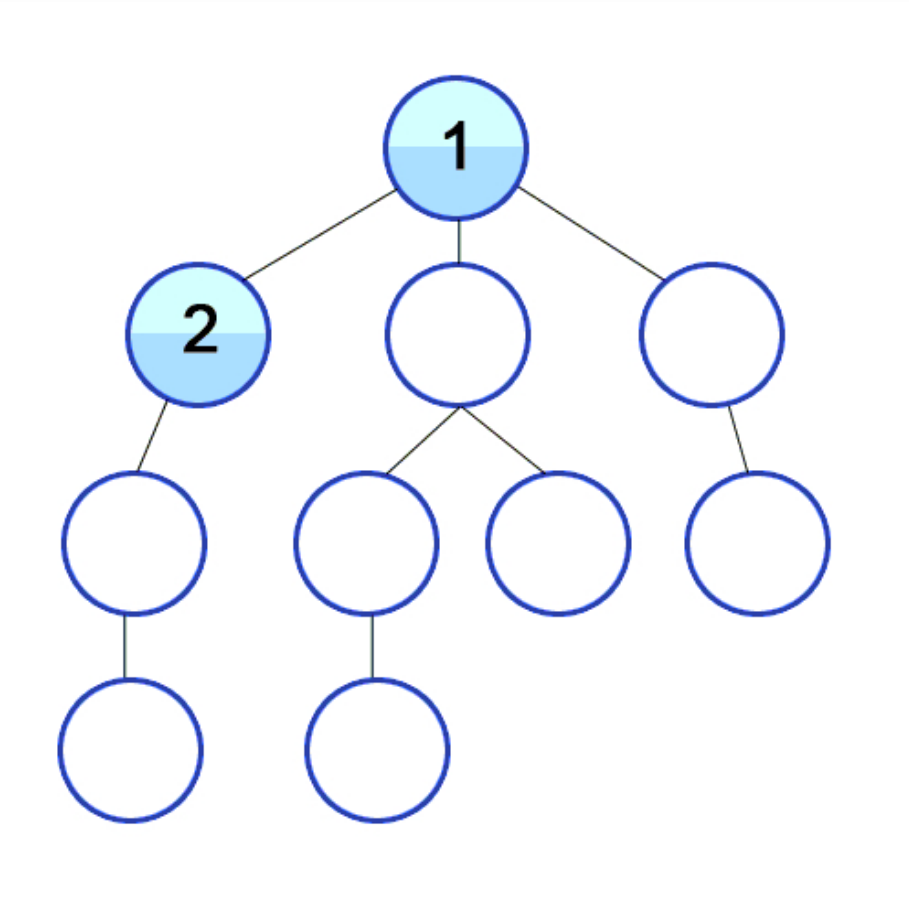

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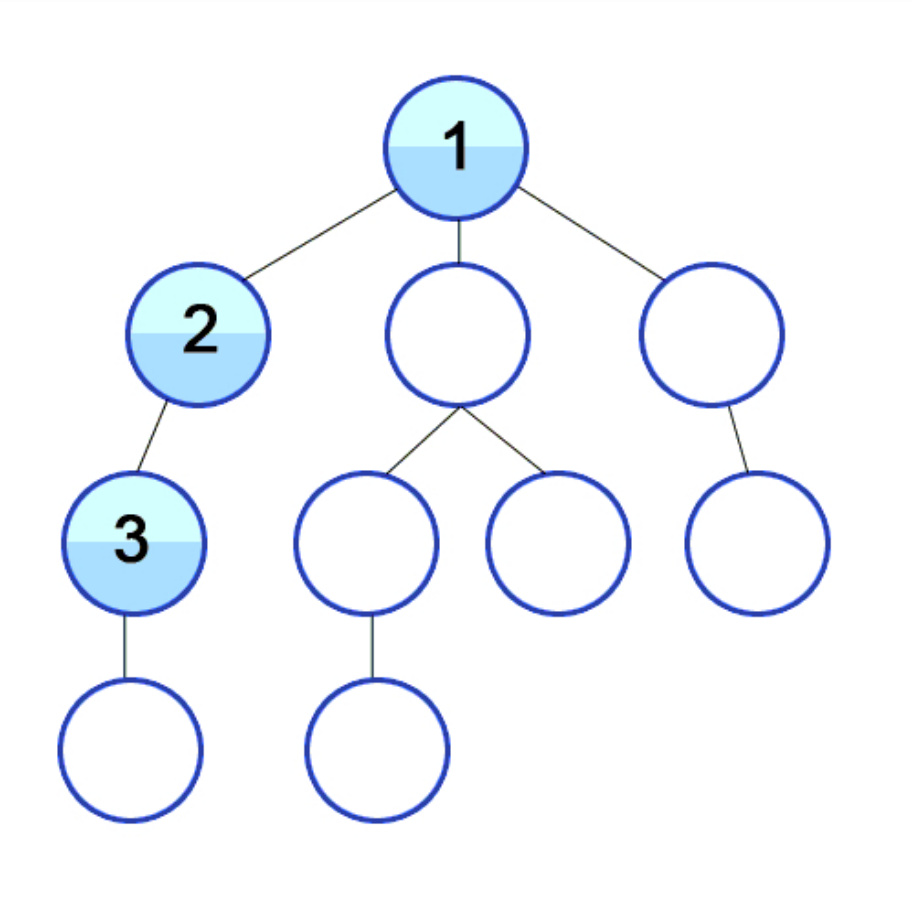

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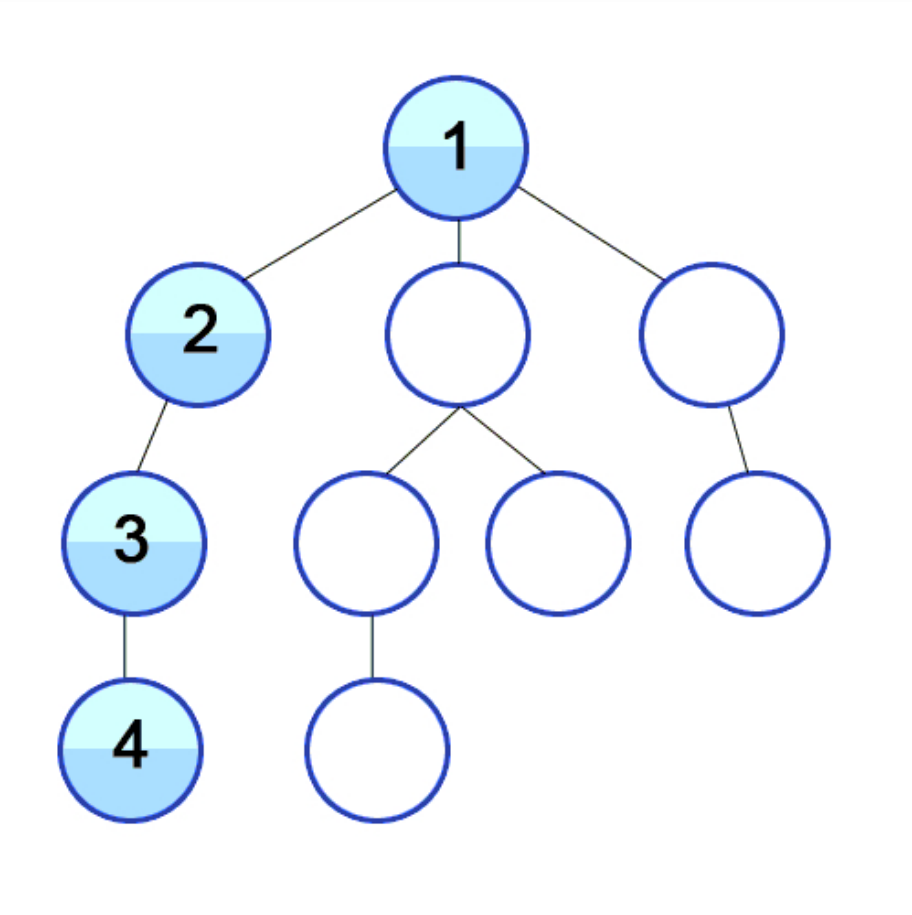

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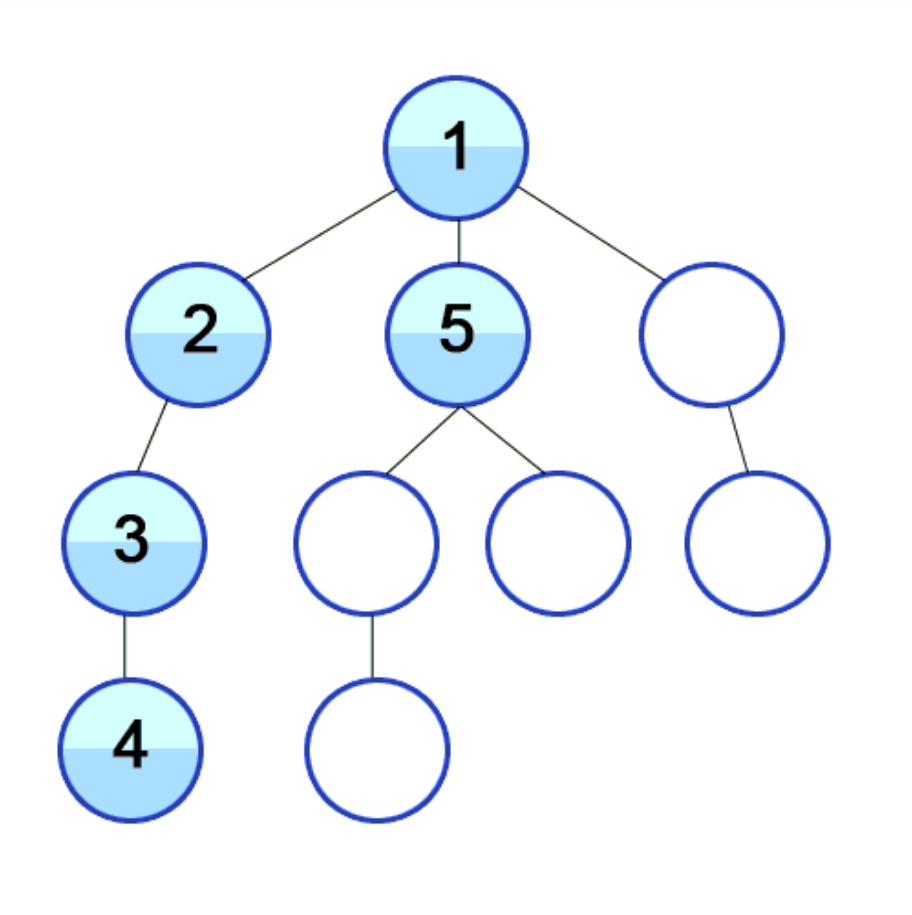

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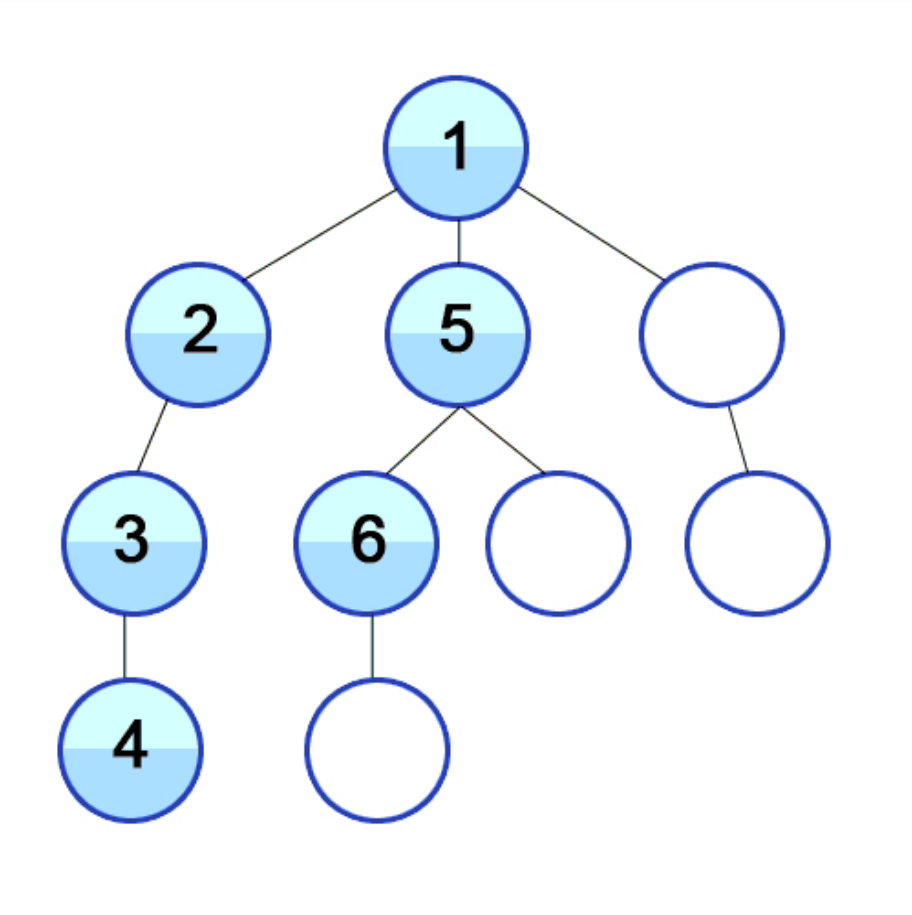

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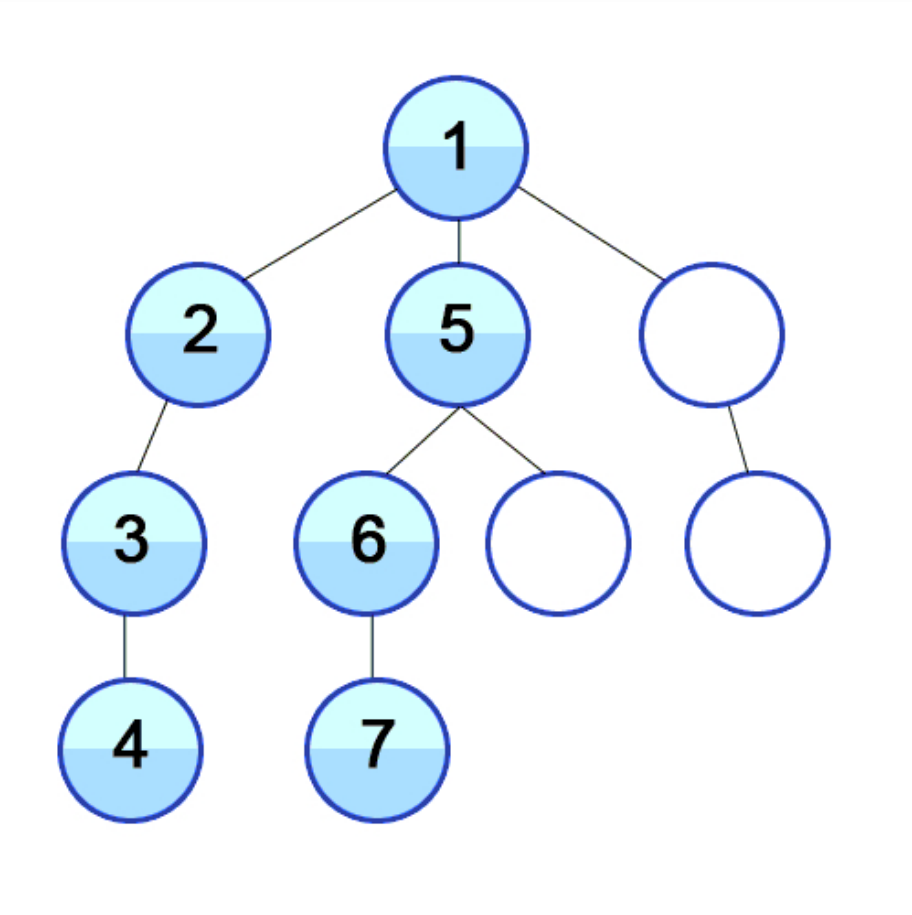

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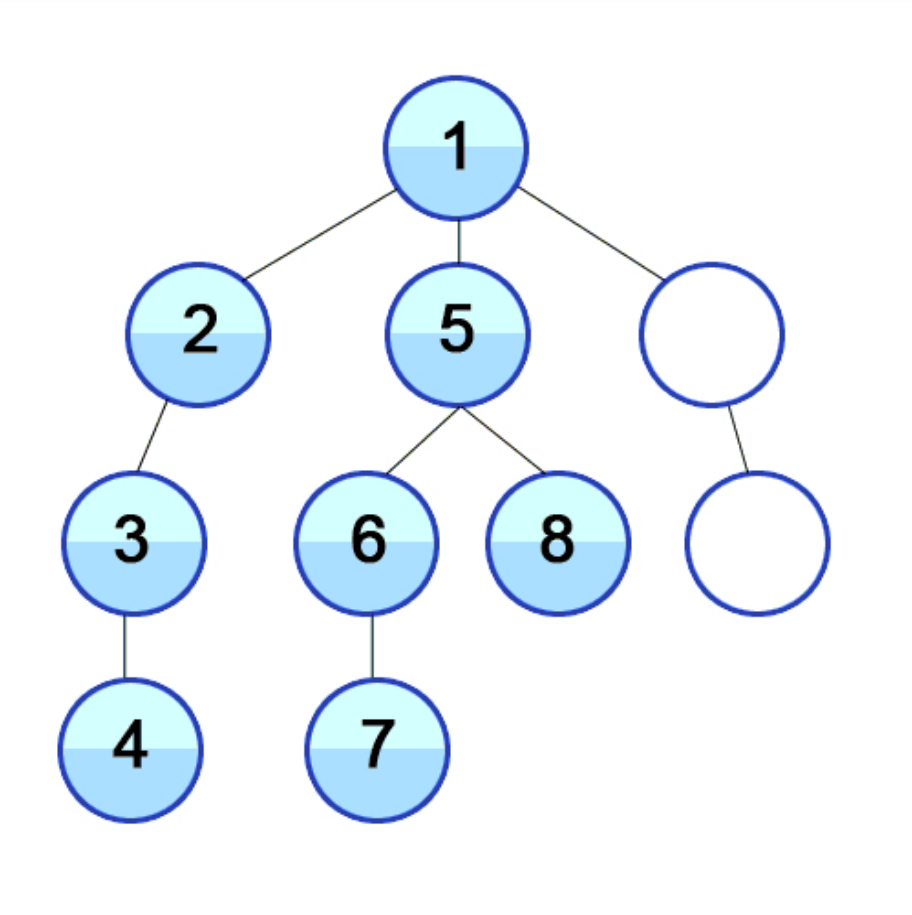

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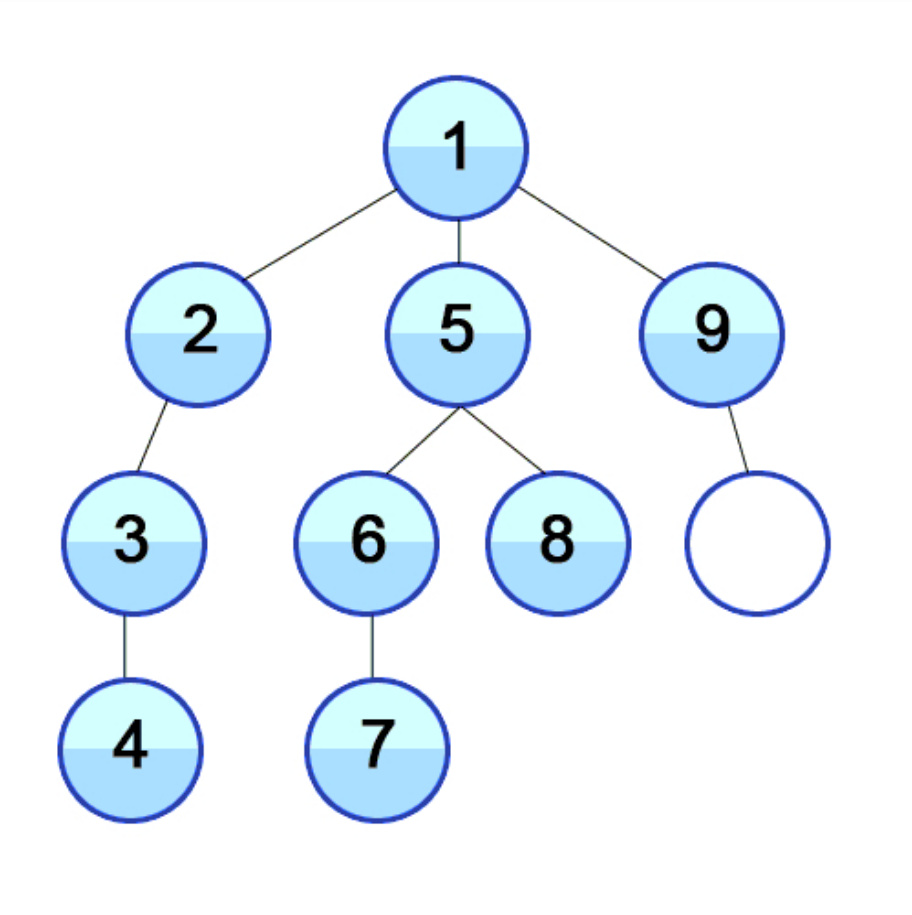

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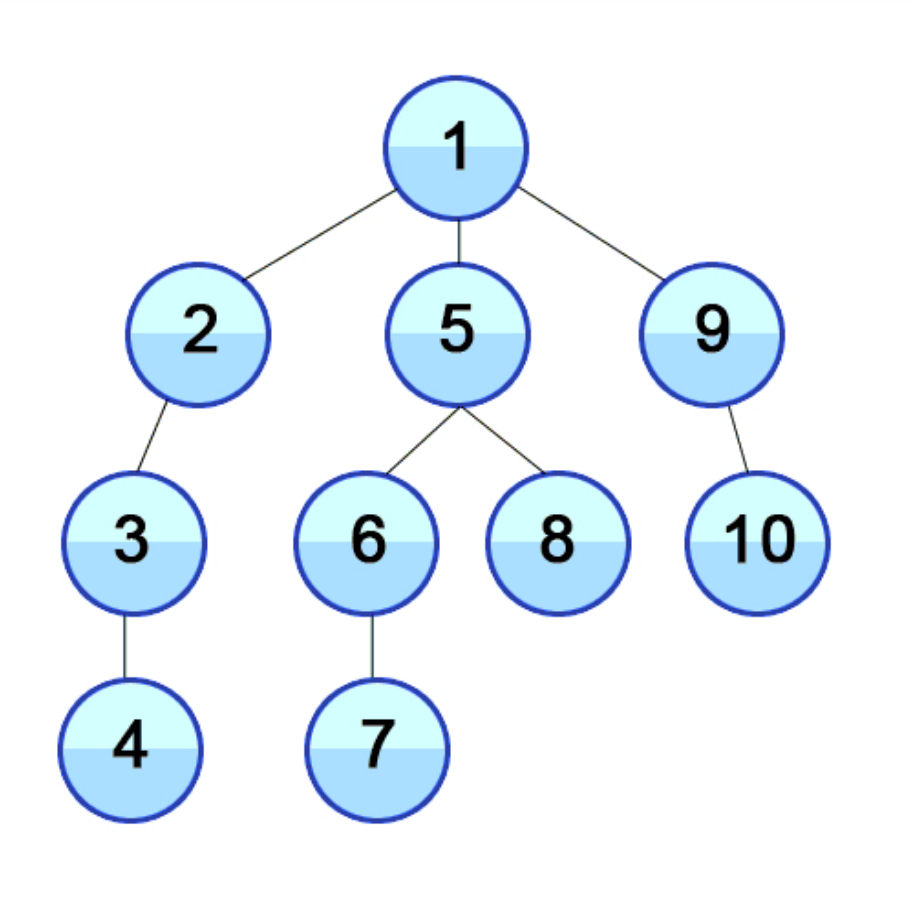


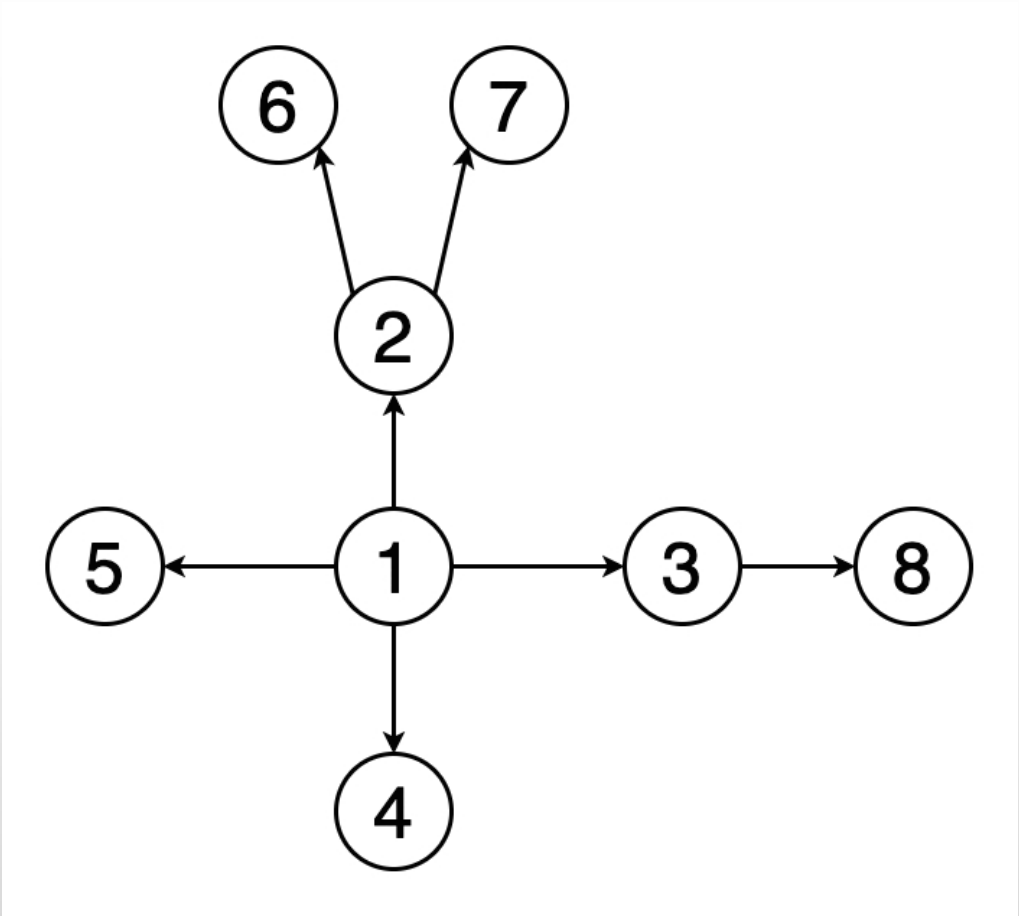
Recursive DFS

```
procedure DFS(G, v) is
    label v as discovered
    for all directed edges from v to w that are in G.adjacentEdges(v) do
        if vertex w is not labeled as discovered then
            recursively call DFS(G, w)
```

Iterative DFS

```
procedure DFS_iterative(G, v) is
    let S be a stack
    S.push(v)
    while S is not empty do
        v = S.pop()
        if v is not labeled as discovered then
            label v as discovered
            for all edges from v to w in G.adjacentEdges(v) do
                S.push(w)
```

Genişlik Öncelikli Arama



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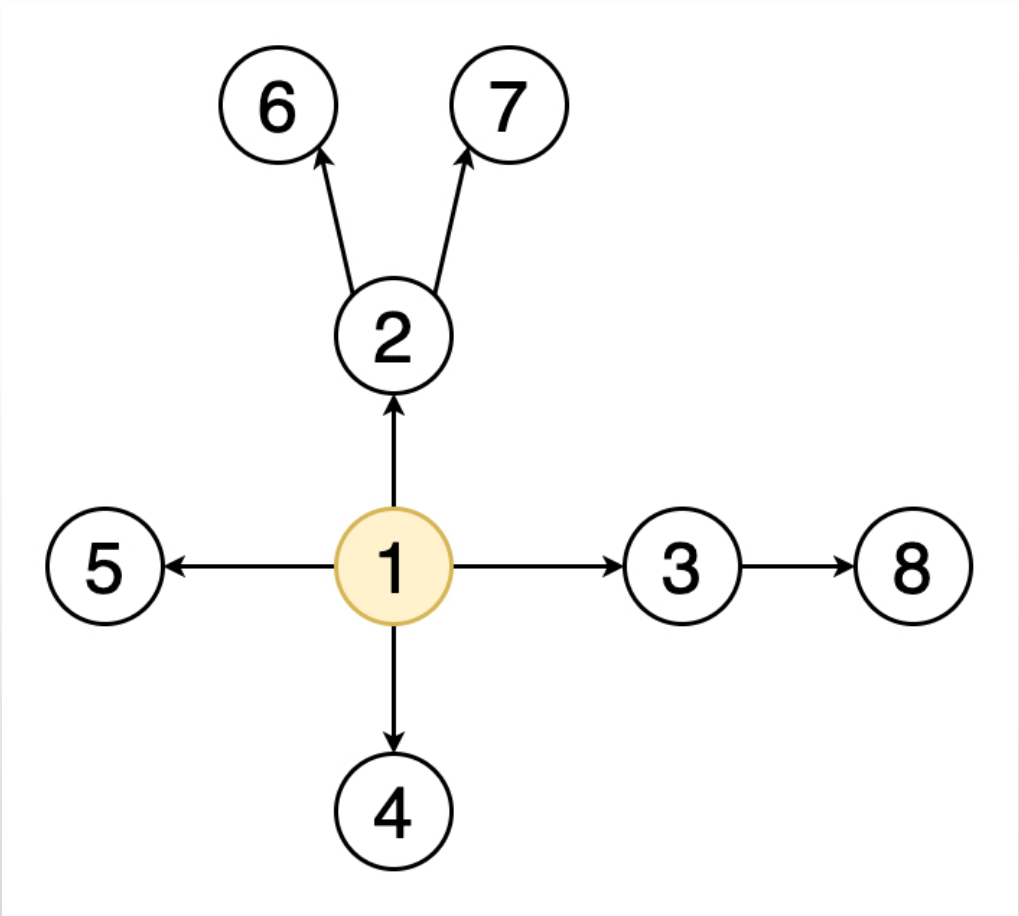

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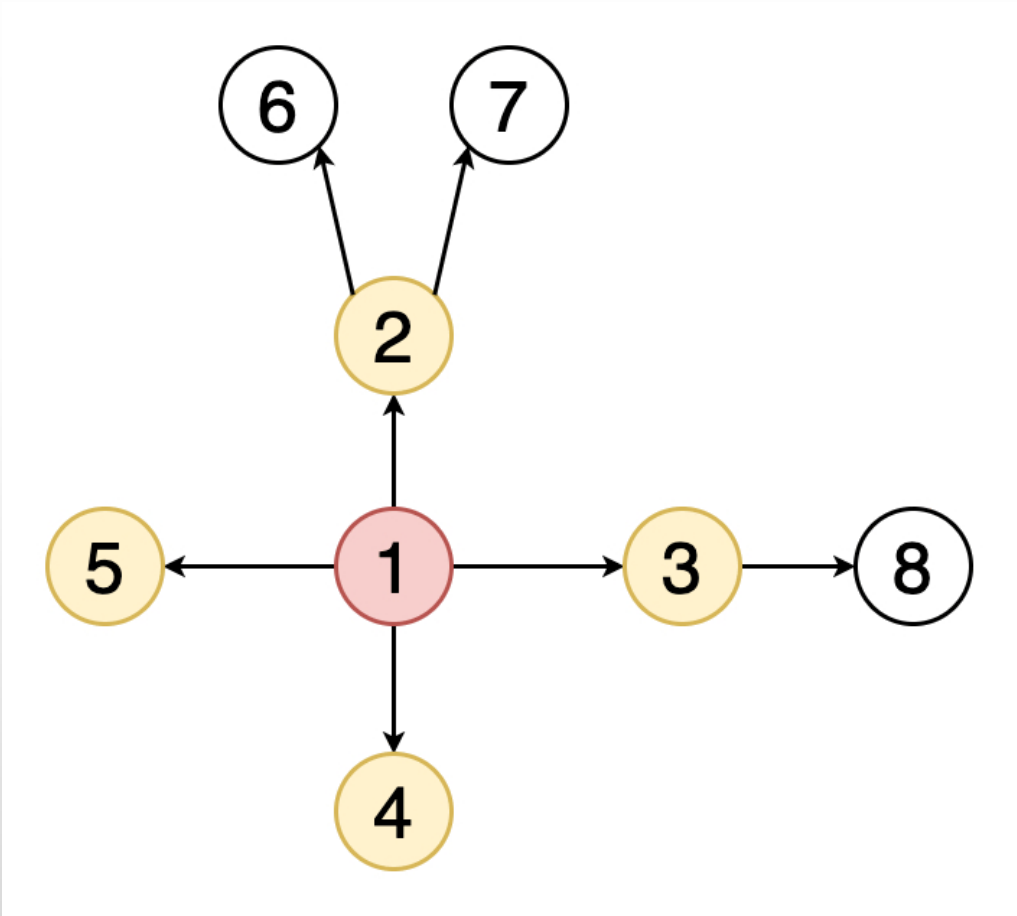

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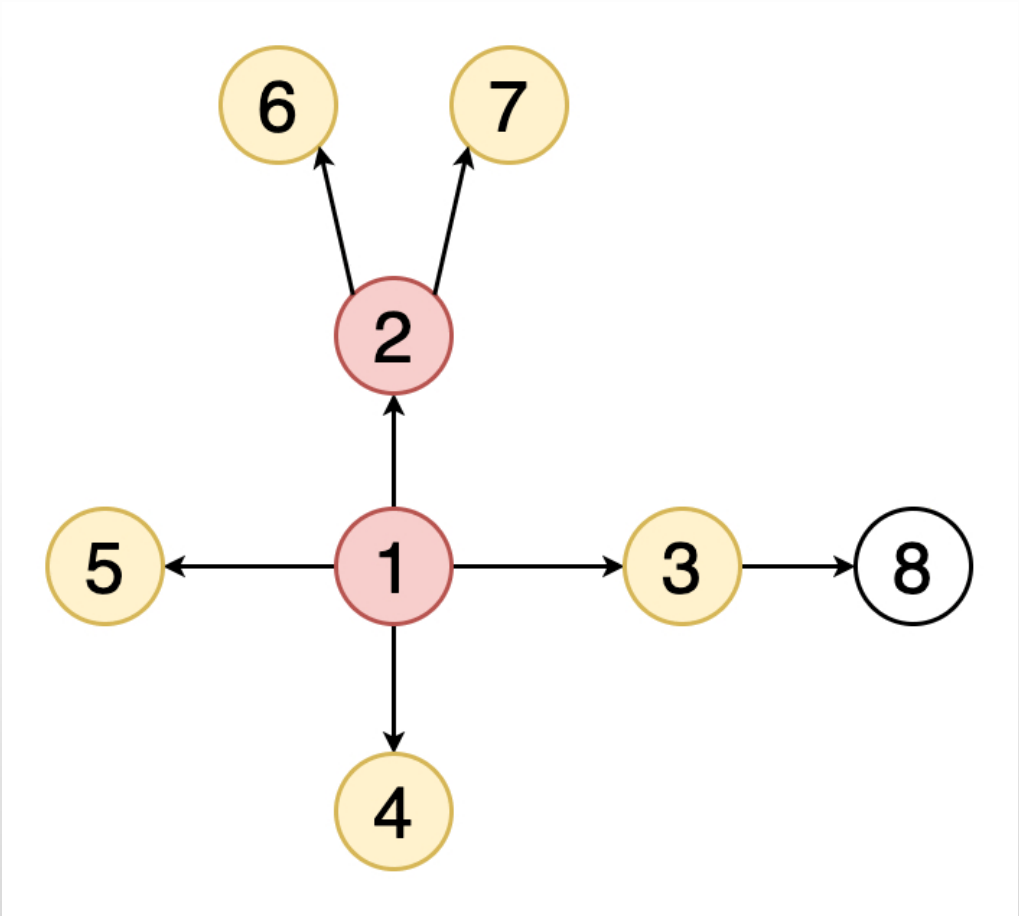

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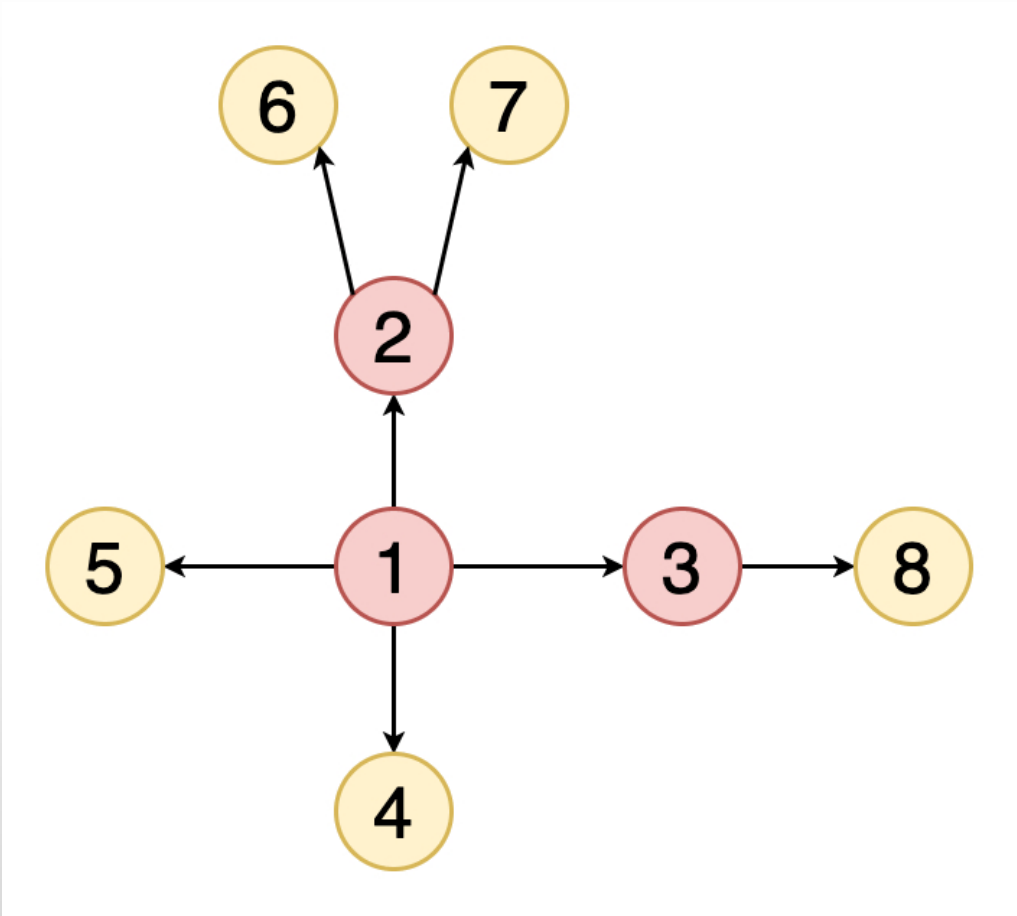

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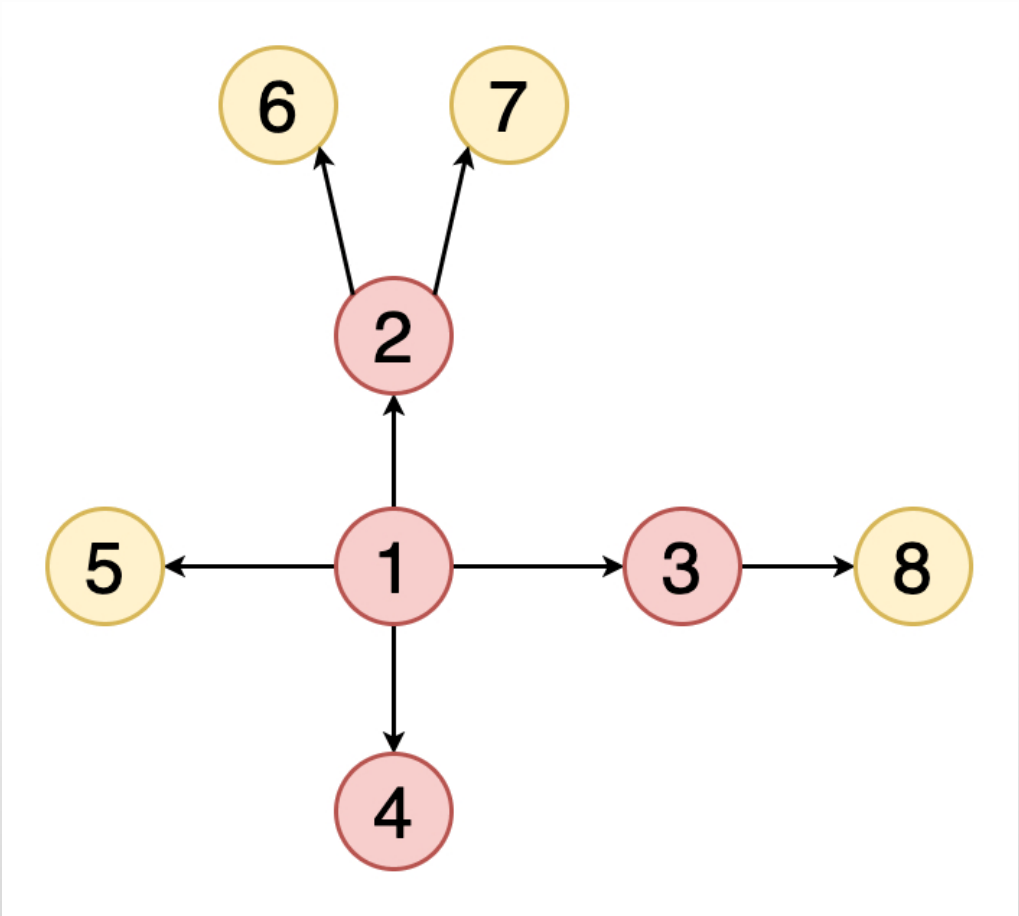

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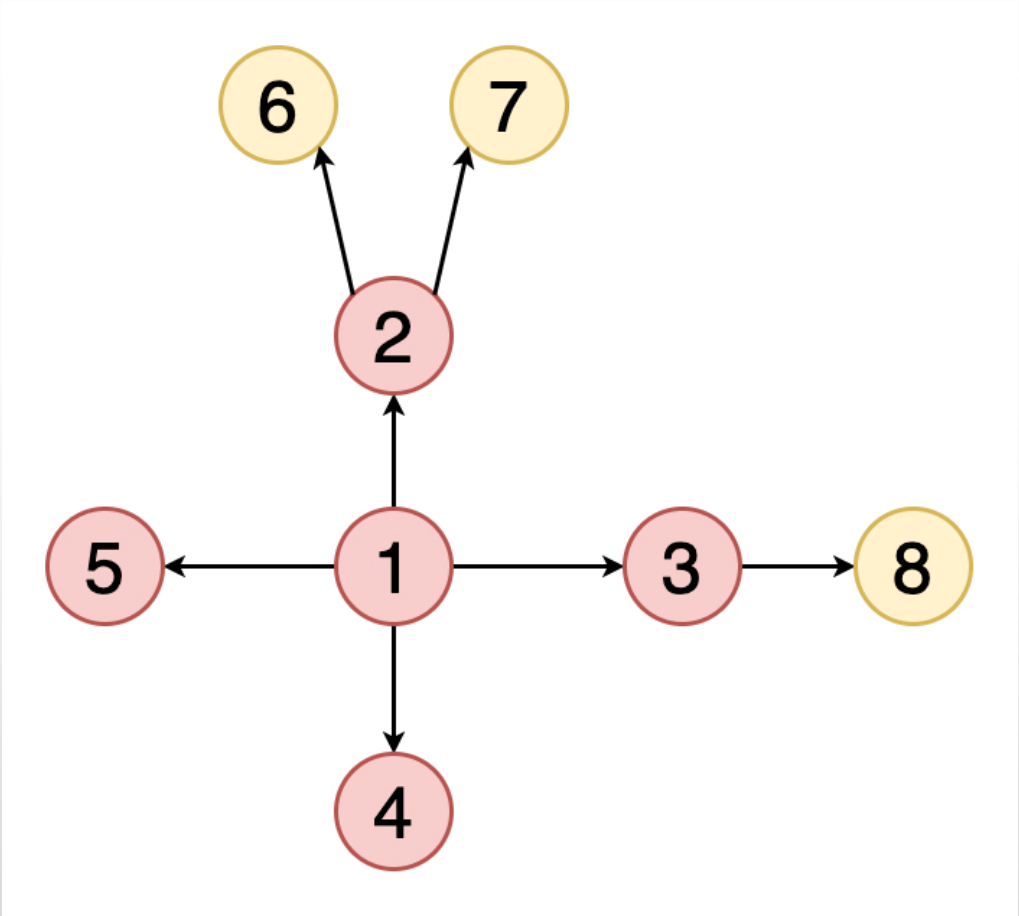

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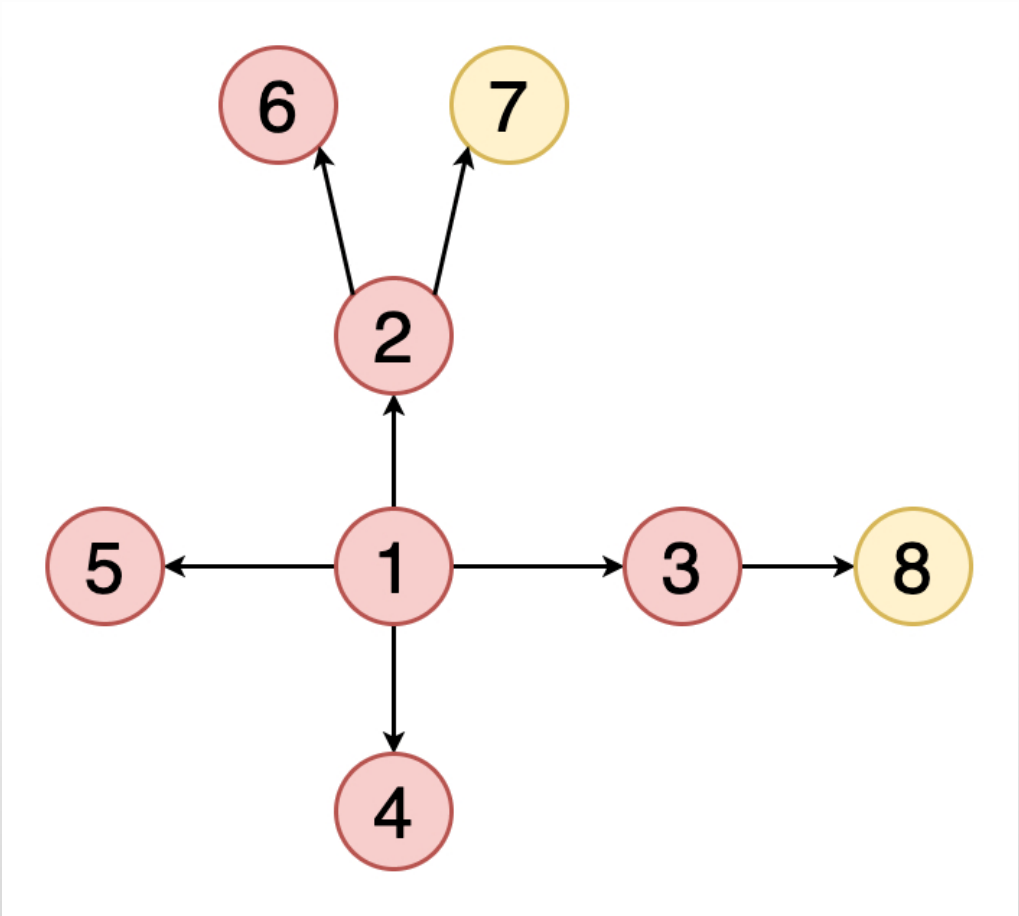

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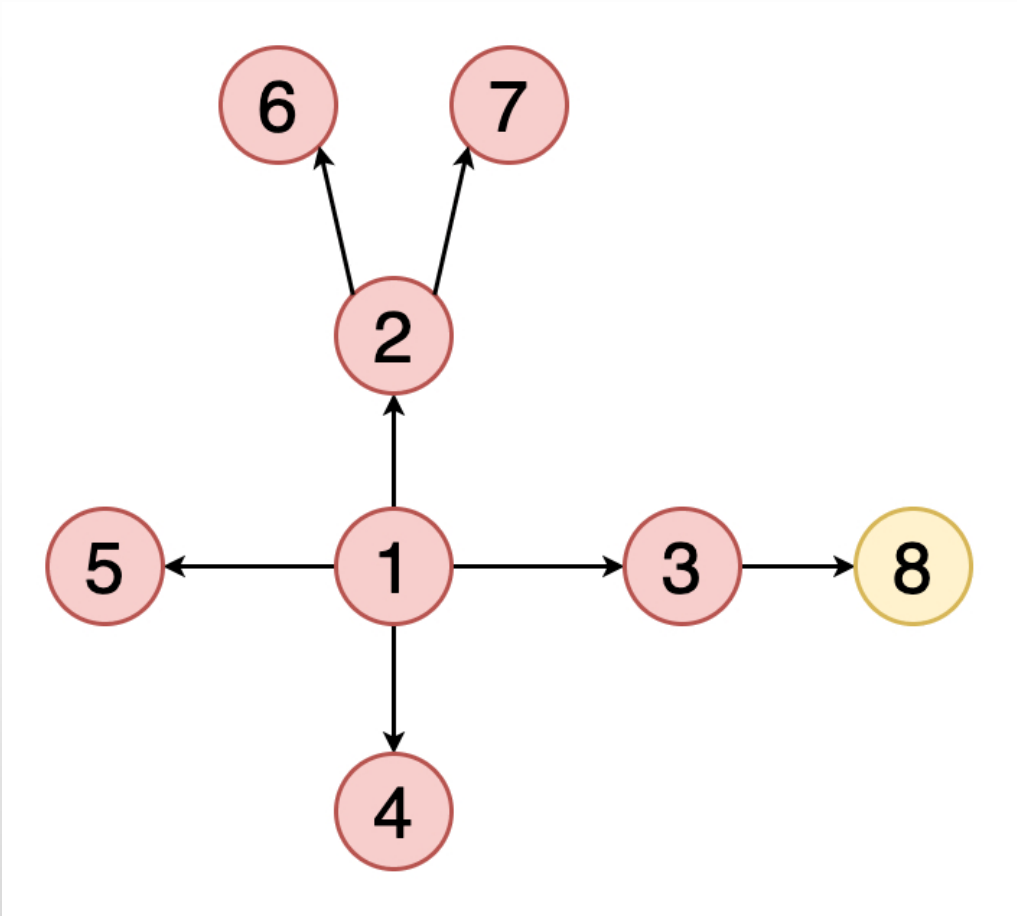

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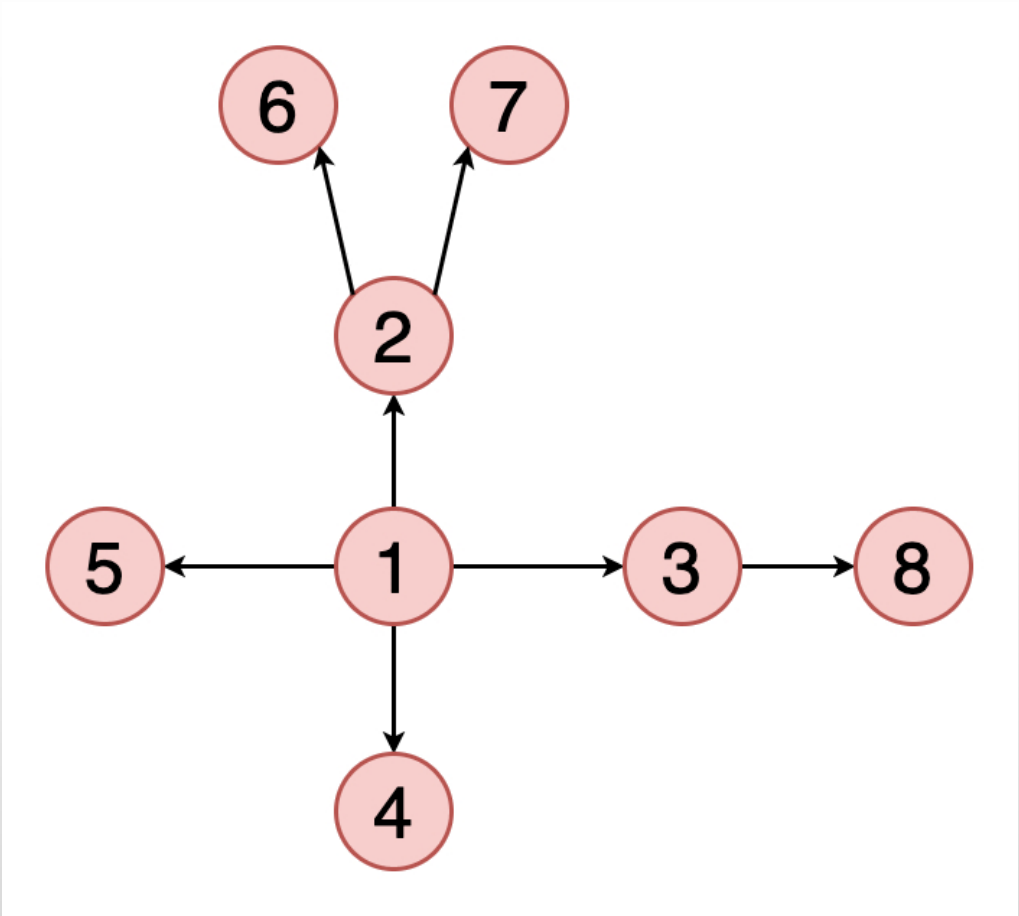
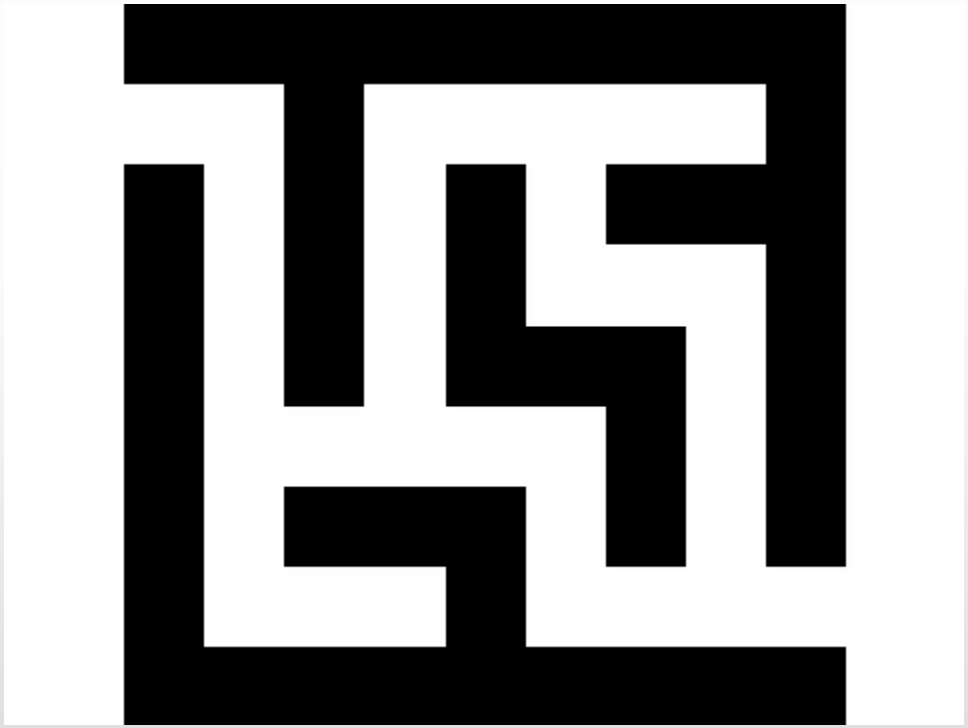


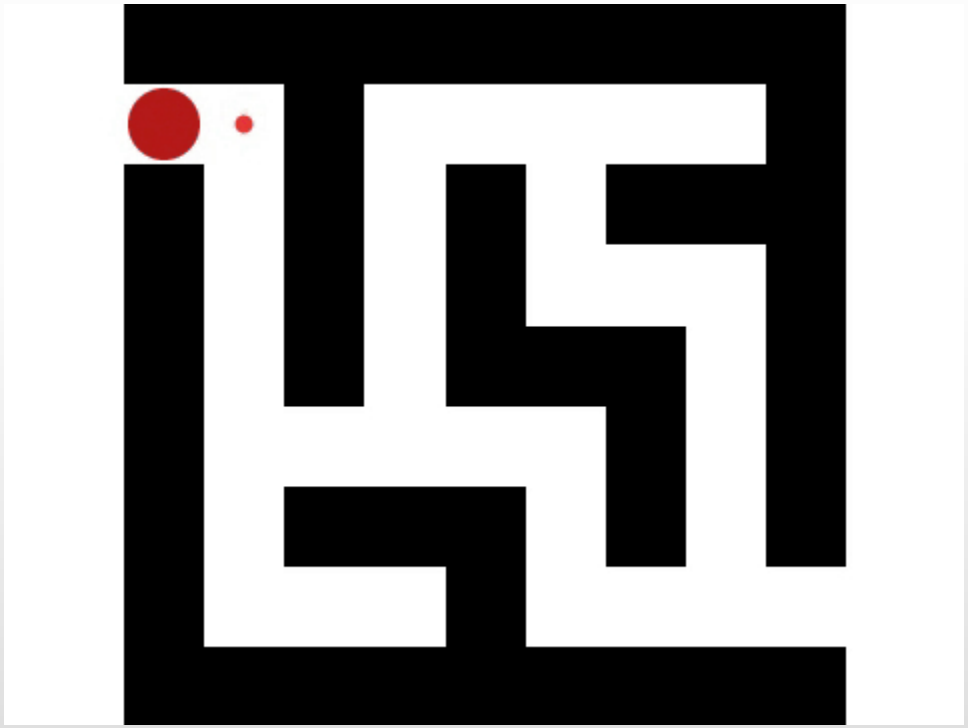
Iterative BFS

```
procedure BFS(G, root) is
    let Q be a queue
    label root as explored
    Q.enqueue(root)
    while Q is not empty do
        v := Q.dequeue()
        if v is the goal then
            return v
        for all edges from v to w in G.adjacentEdges(v) do
            if w is not labeled as explored then
                label w as explored
                w.parent := v
                Q.enqueue(w)
```

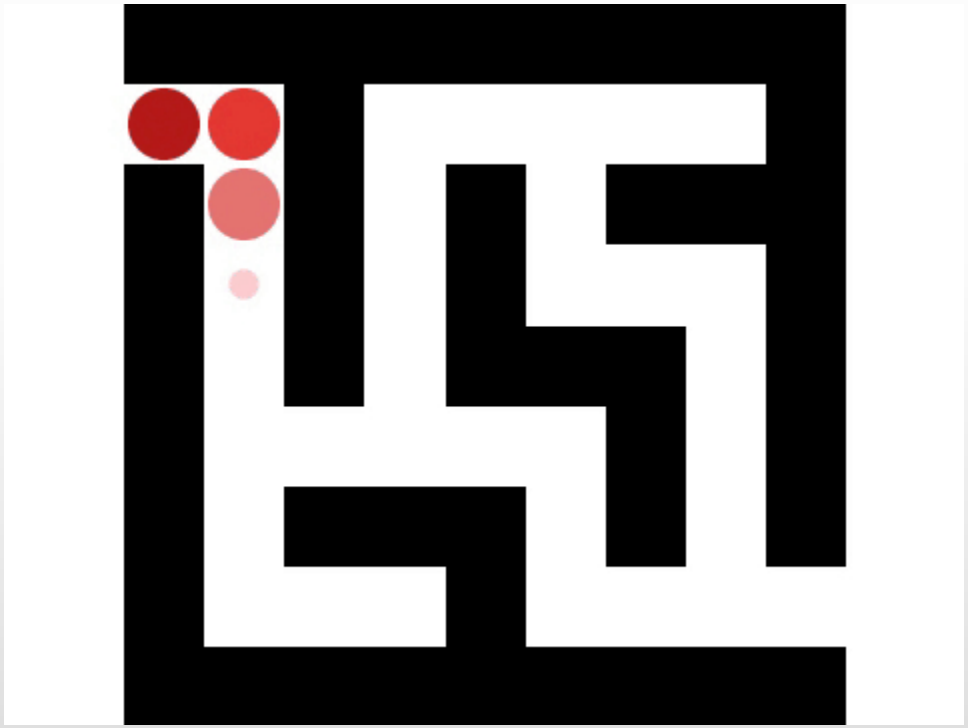
BFS Search Way



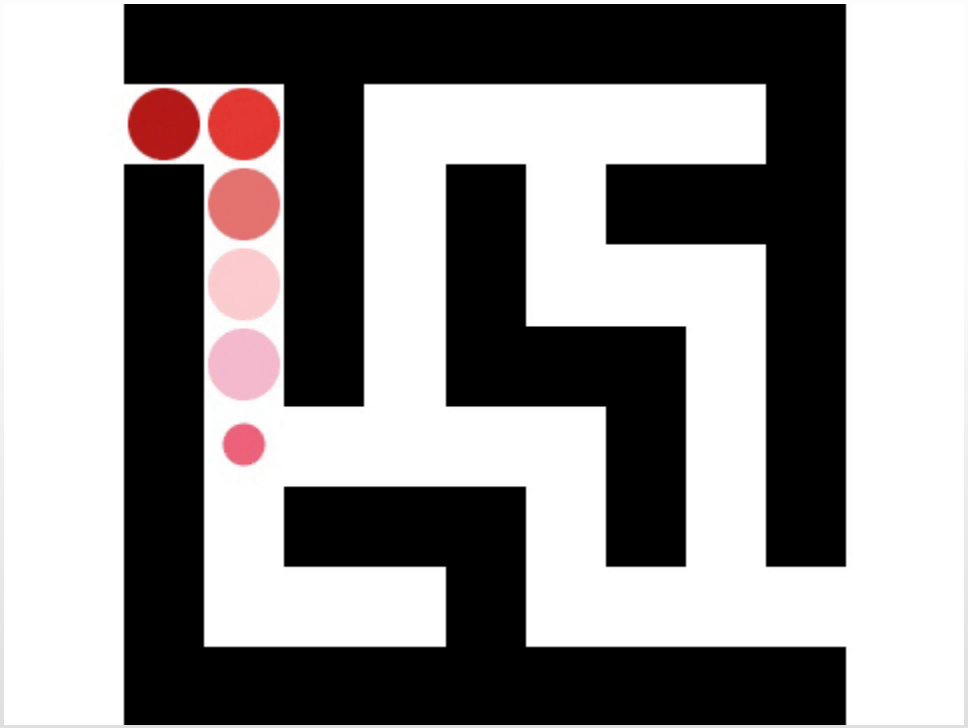
BFS Search Way



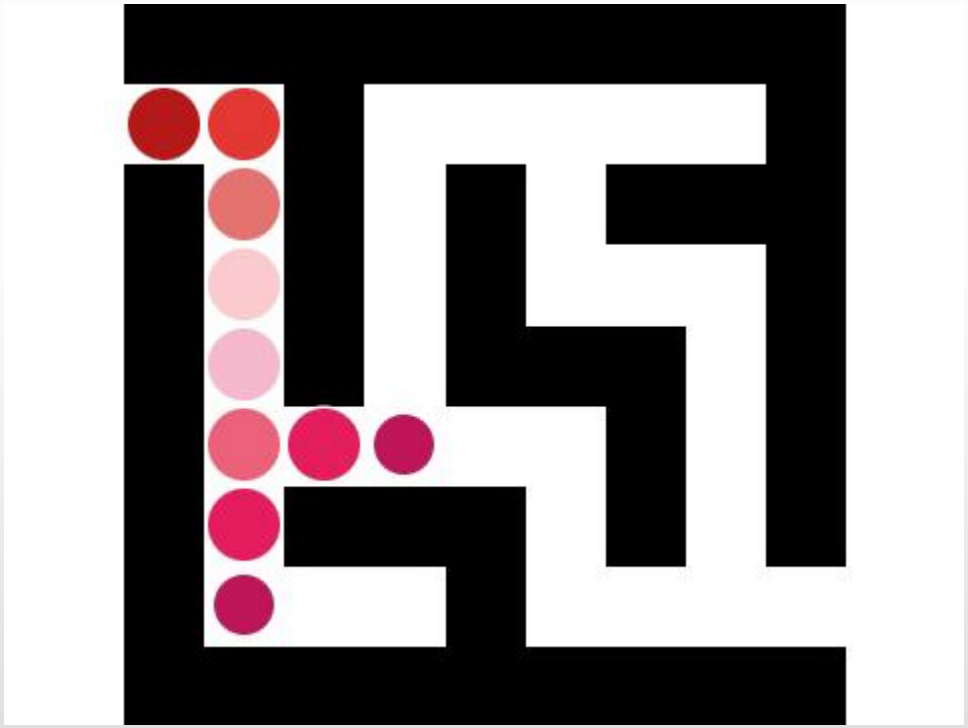
BFS Search Way



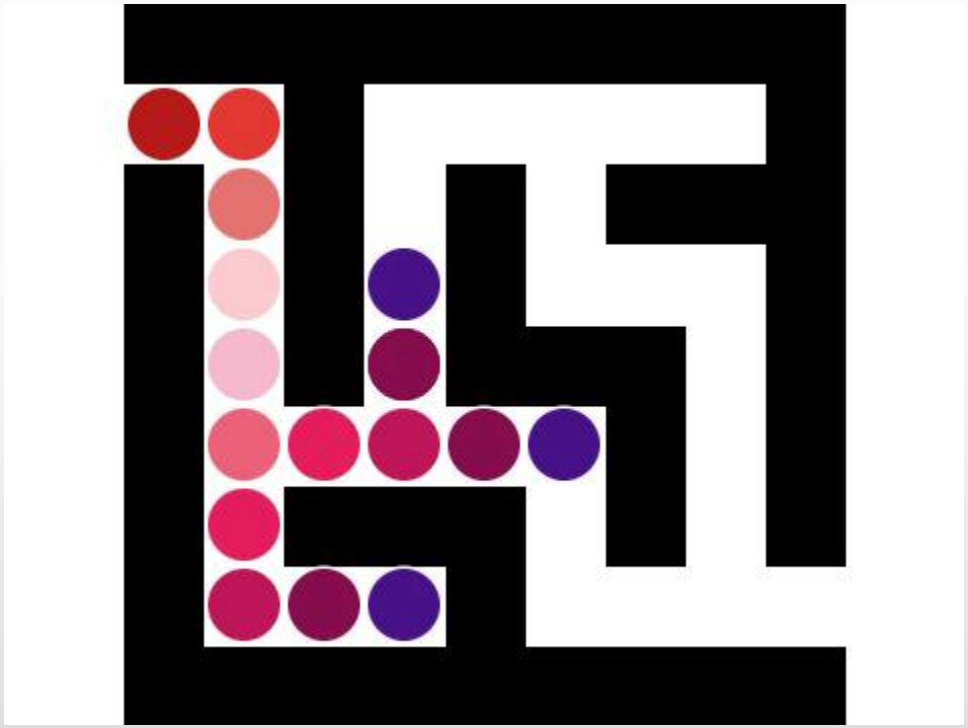
BFS Search Way



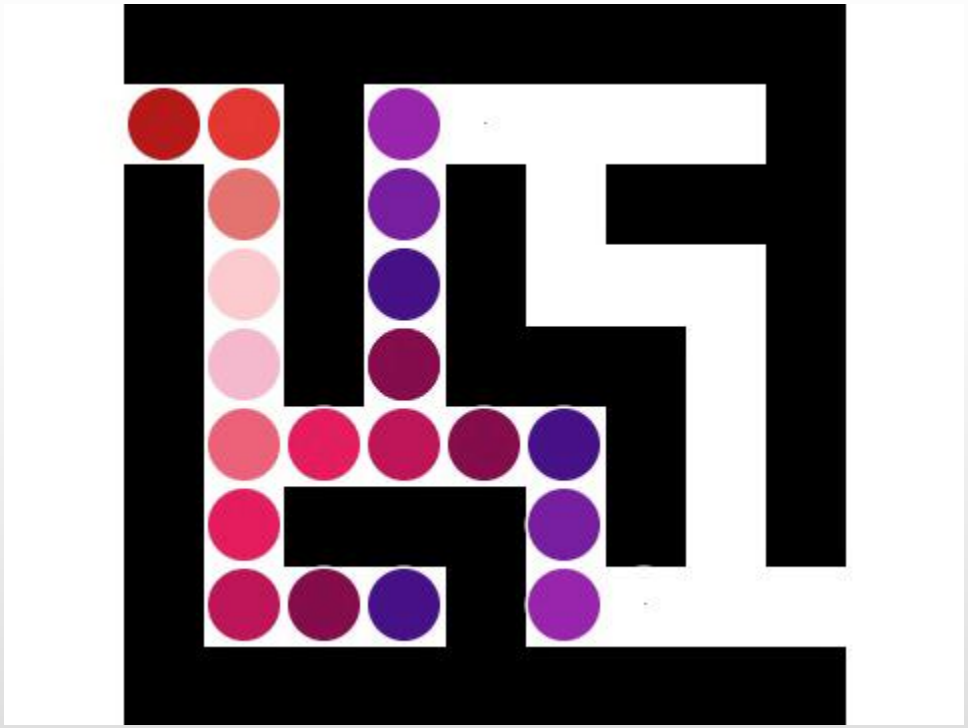
BFS Search Way



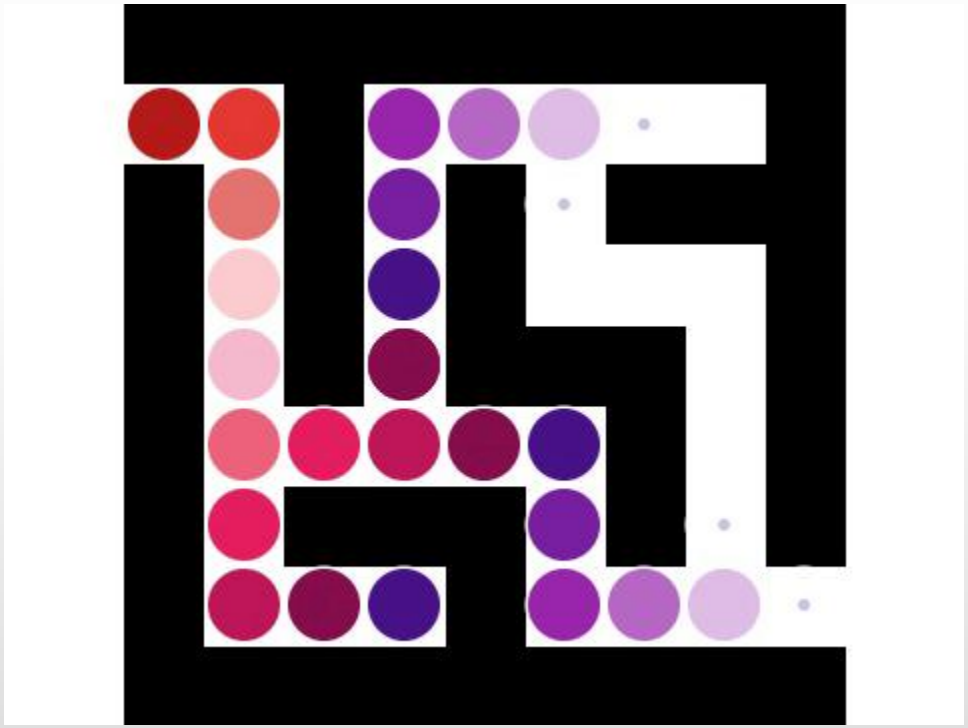
BFS Search Way



BFS Search Way



BFS Search Way



Tarjan'ın Güçlü Bağlantılı Bileşenler Algoritması

- Yönlü çizgede güçlü bağlantılı bileşenleri bulur.
- Güçlü bağlantılı bileşenler, (*strongly connected components*)
  - iki düğüm arasında hem ileri hem de geri yönlü yolların bulunduğu bileşenlerdir.
  - bir düğüm ve ona erişilebilen tüm düğümleri içeren alt çizge.

Algoritma İlkeleri

- DFS (Depth-First Search) tabanlı bir algoritmadır.
- Çizgenin düğümlerini sıra ile ziyaret eder.
- Her ziyaret edilen düğüm için, o düğümden ulaşılabilen en düşük düğüm numarası (index) hesaplanır.

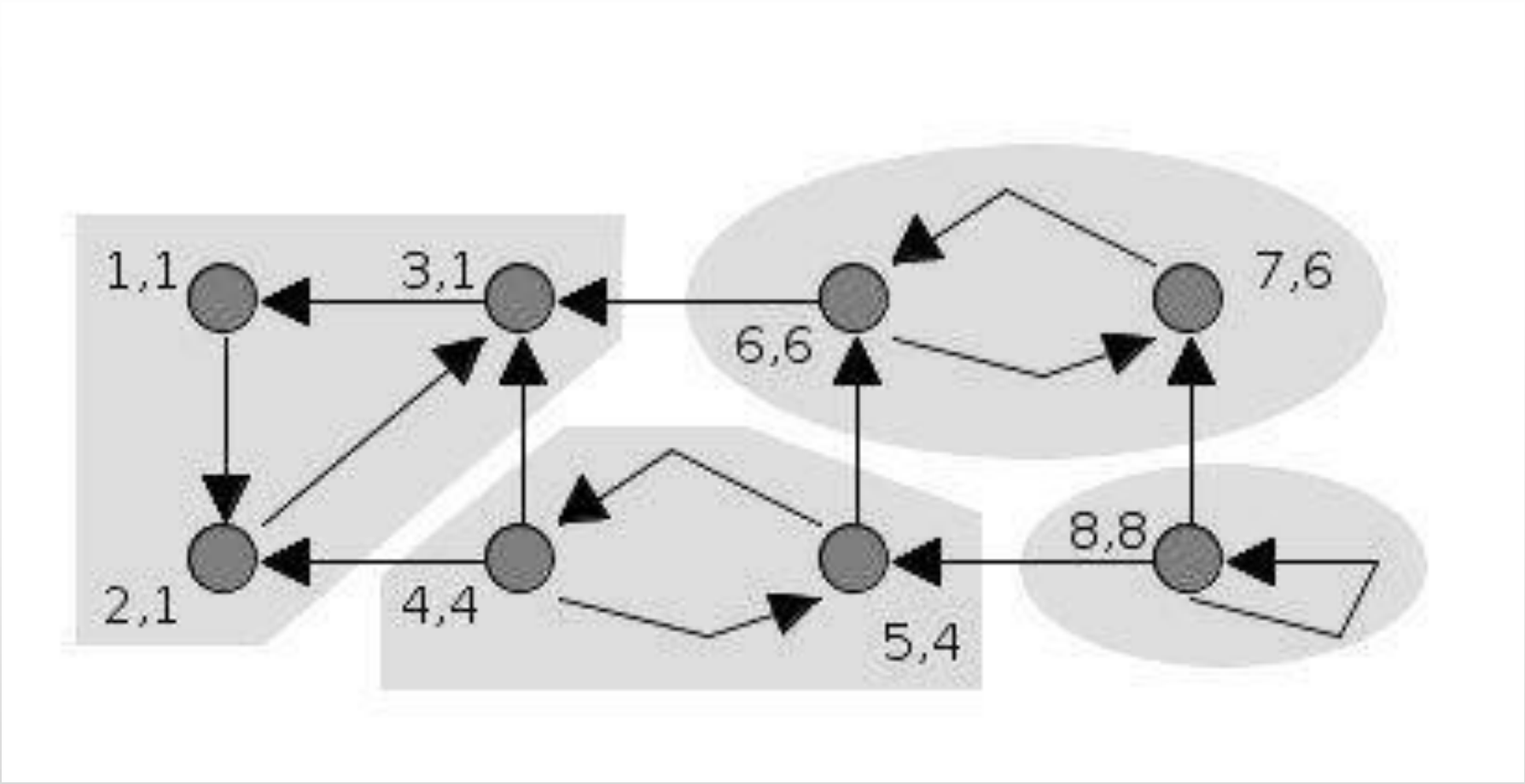
Algoritma Adımları

- Adım 1: Her bir düğüm DFS algoritması ile ziyaret edilir.
- Adım 2: DFS sırasında, ziyaret edilen her düğüm bir numara alır. Bu numara, düğümün çizge içindeki konumunu temsil eder.
- Adım 3: Her düğüm için, düğümden ulaşılabilen en düşük düğüm numarası hesaplanır. Bu, çizgedeki ileri ve geri yönlü yolları kontrol eder.
- Adım 4: Düğüm numaraları ve en düşük düğüm numaraları kullanılarak güçlü bağlantılı bileşenler bulunur.

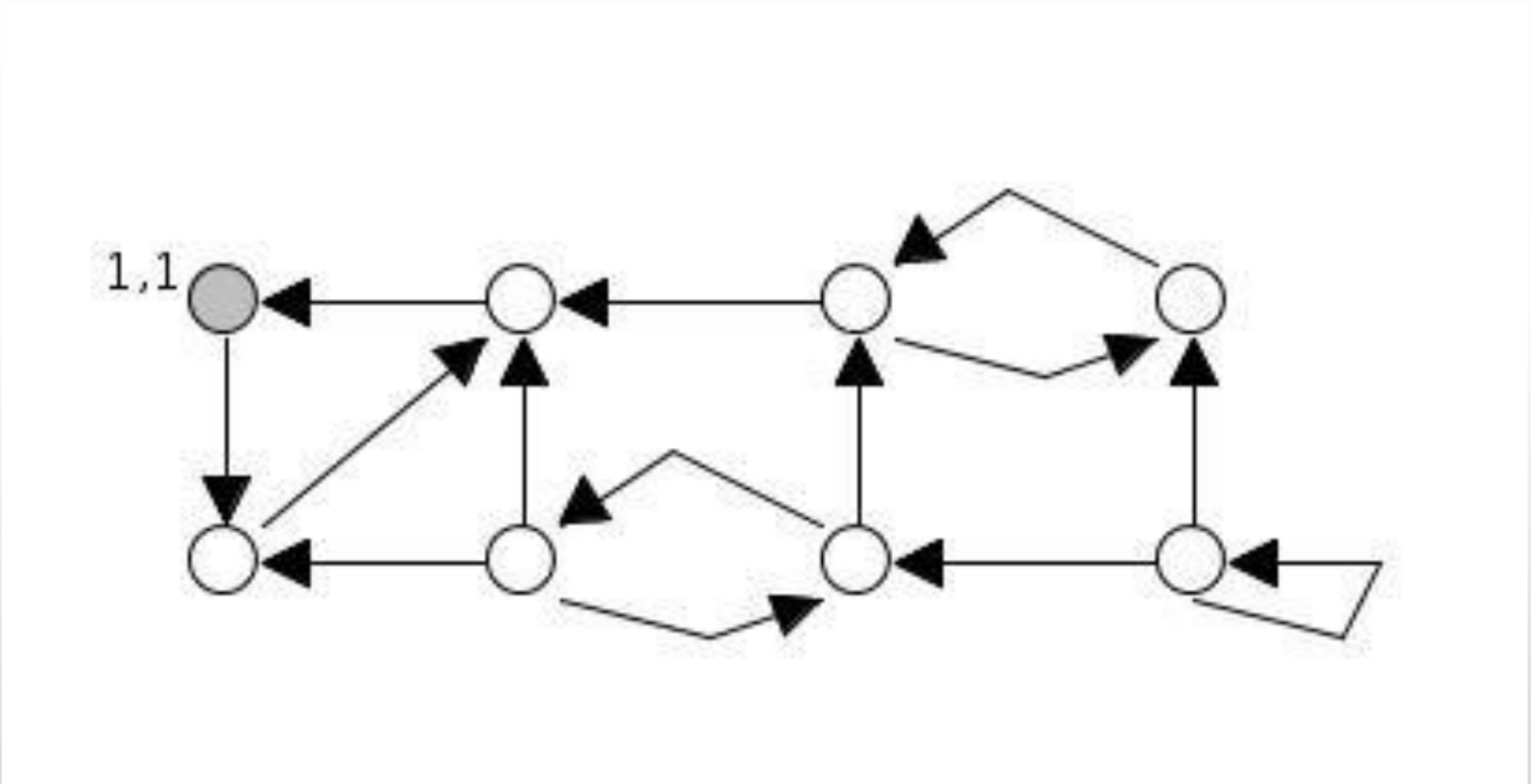
Karmaşıklık Analizi

- Tarjan'ın Algoritması'nın karmaşıklığı,
  - *O(V+E)*
  - V düğüm sayısı
  - E kenar sayısı

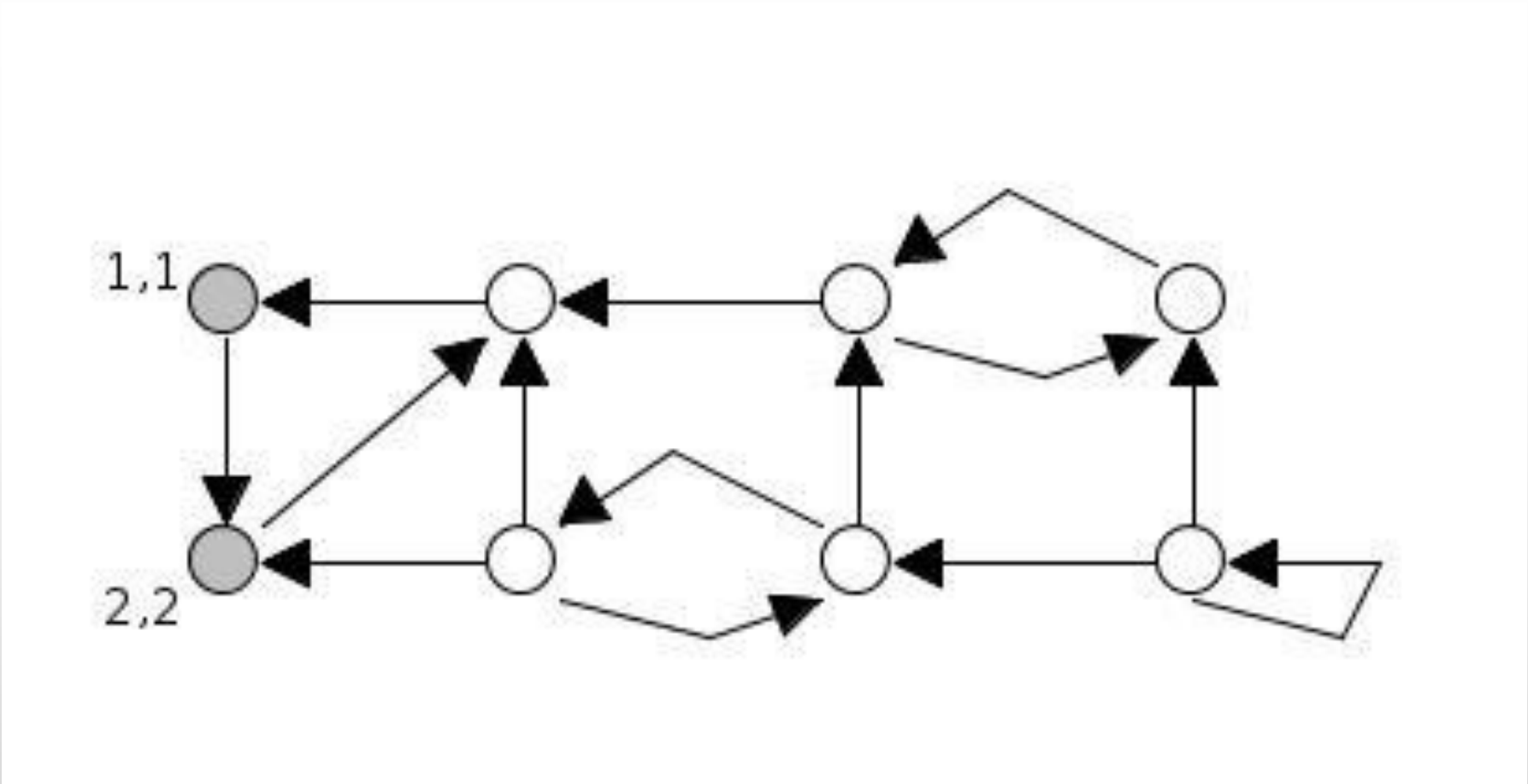
Tarjan's Strongly Connected Components



Tarjan's Strongly Connected Components



Tarjan's Strongly Connected Components



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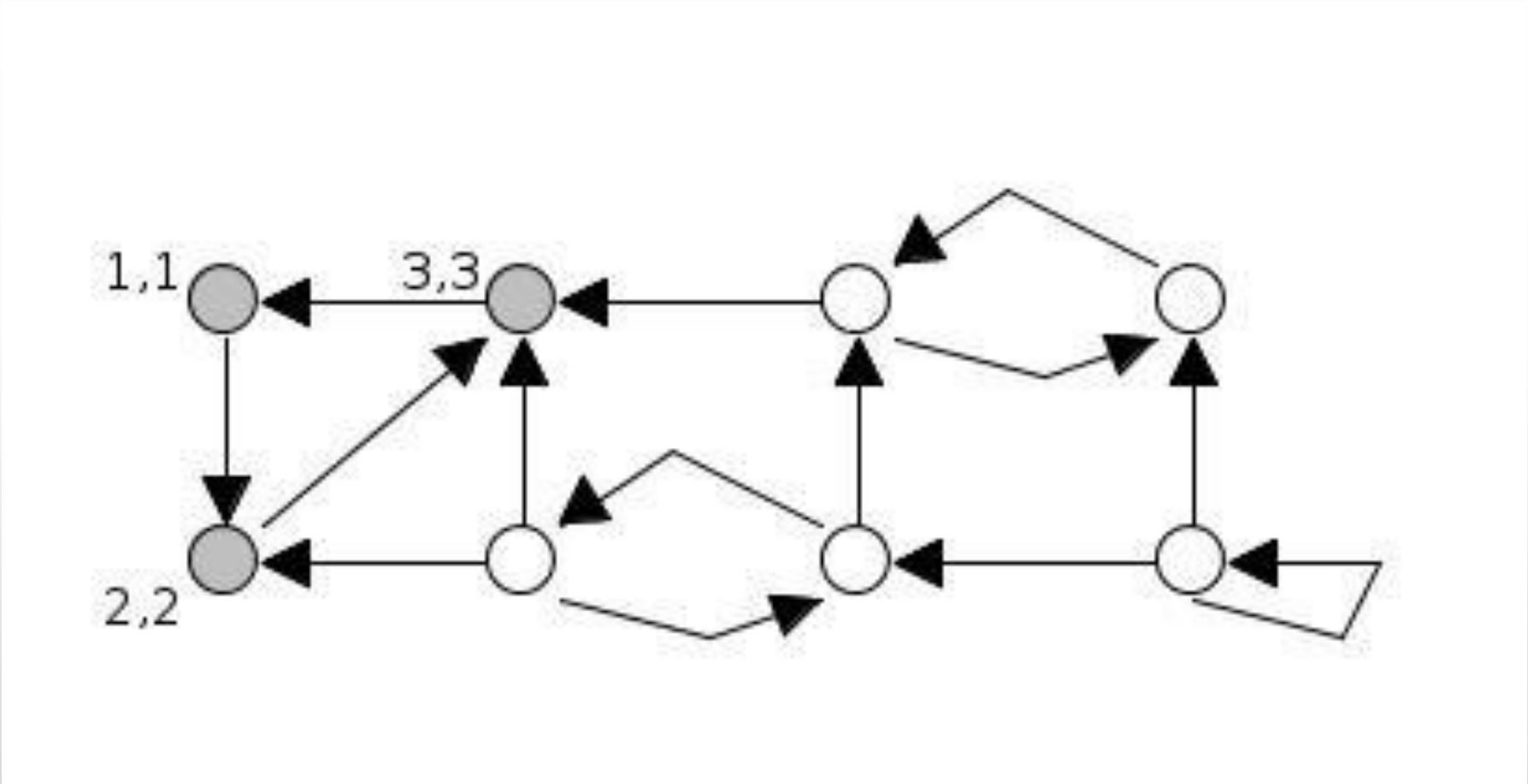

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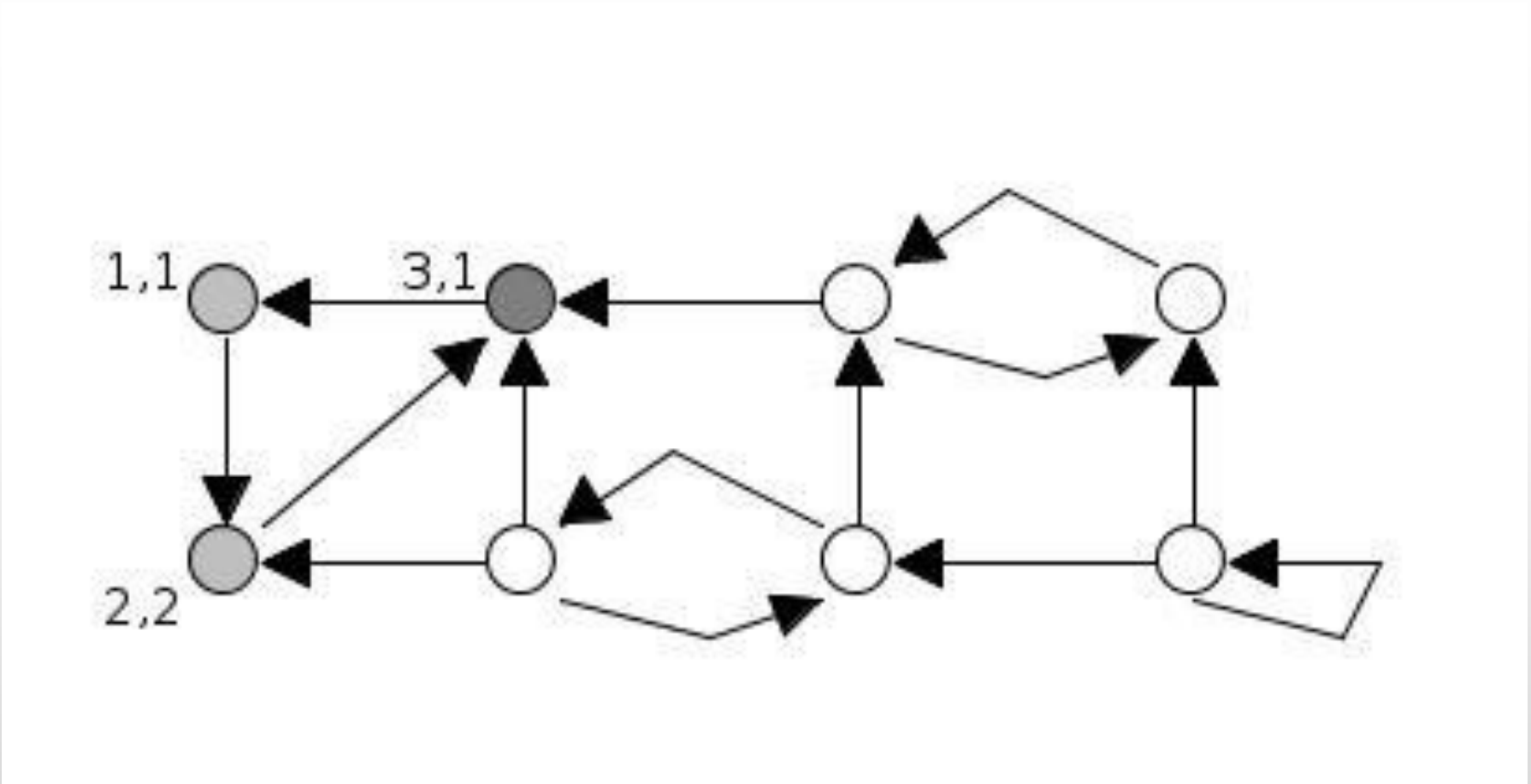
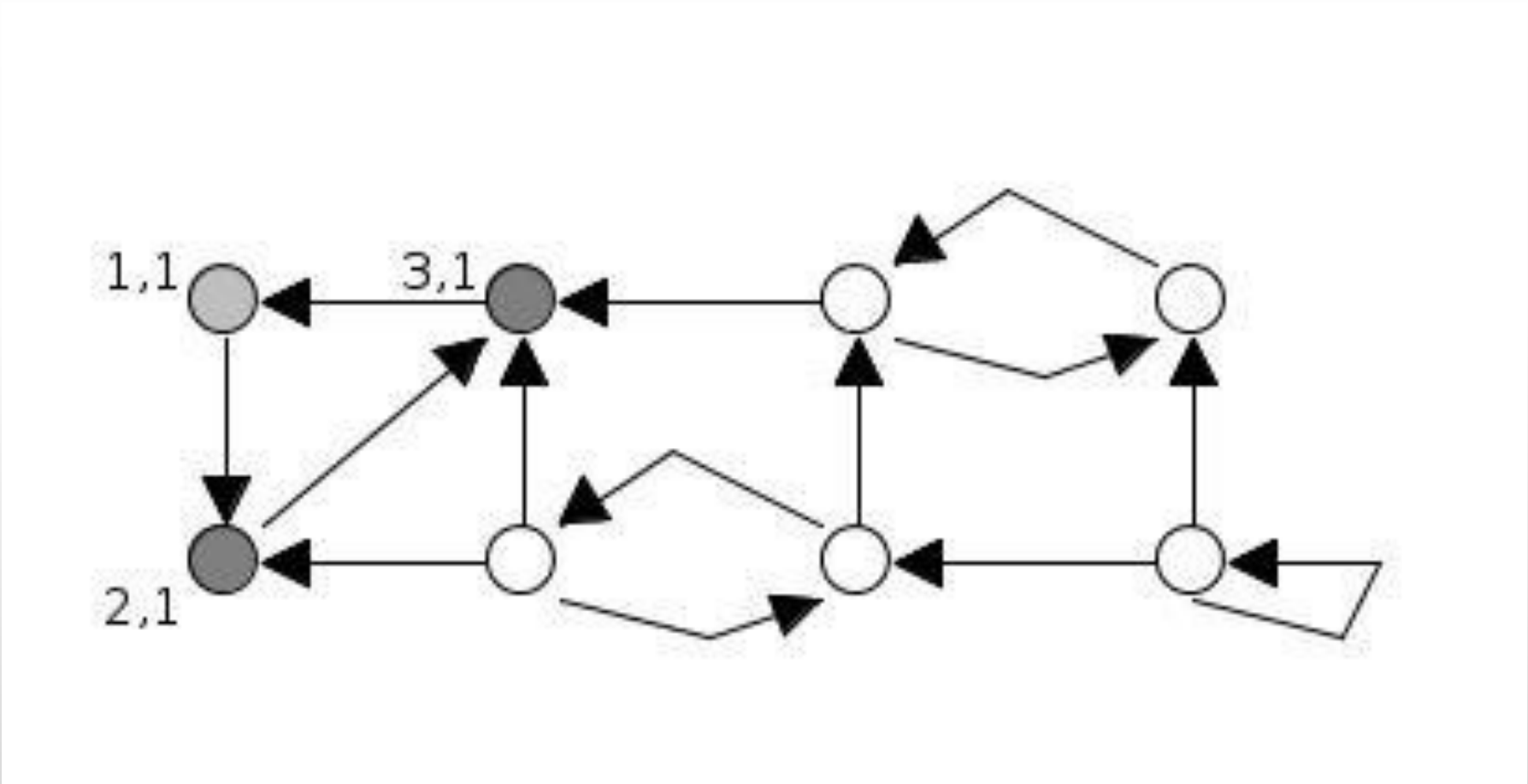
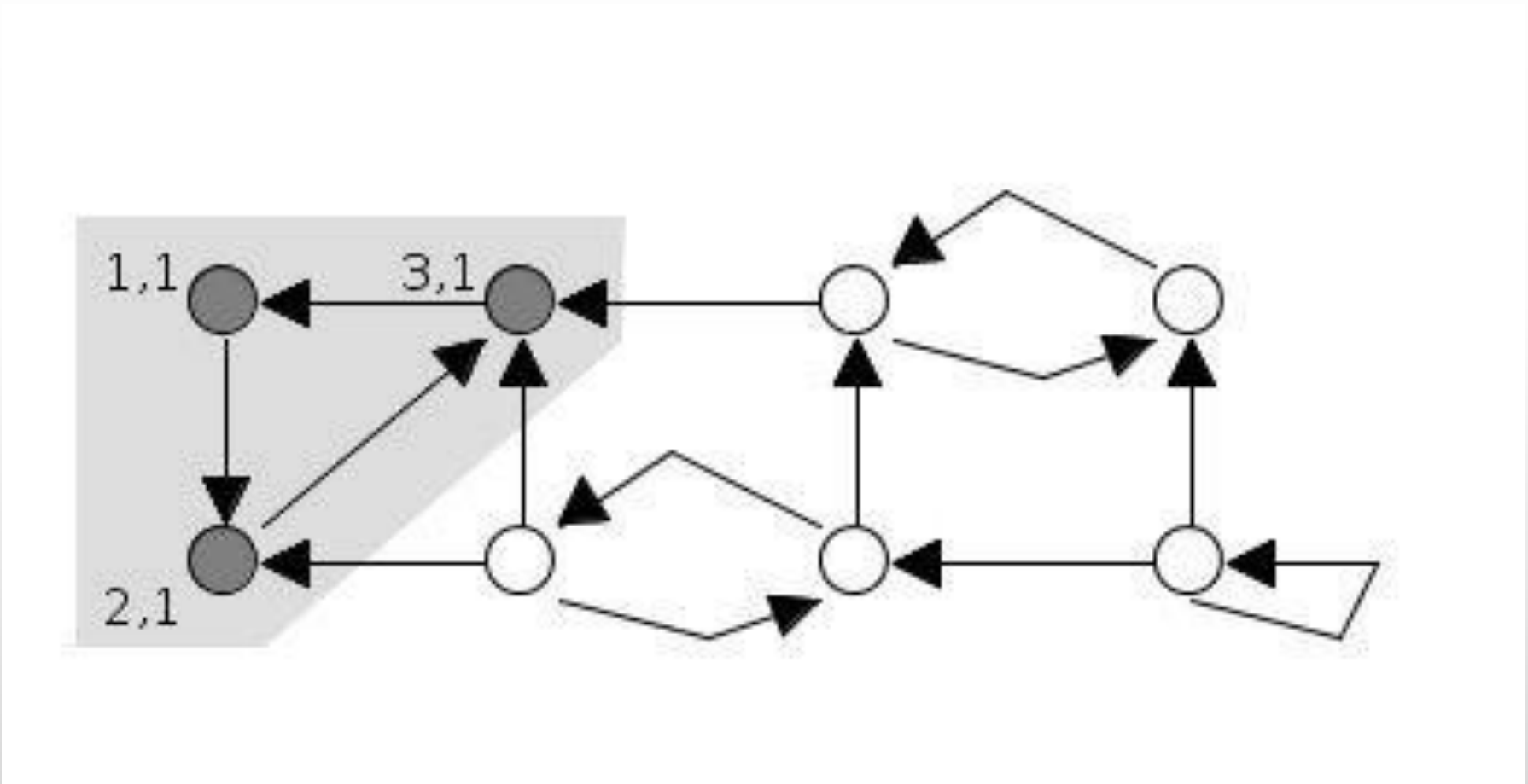


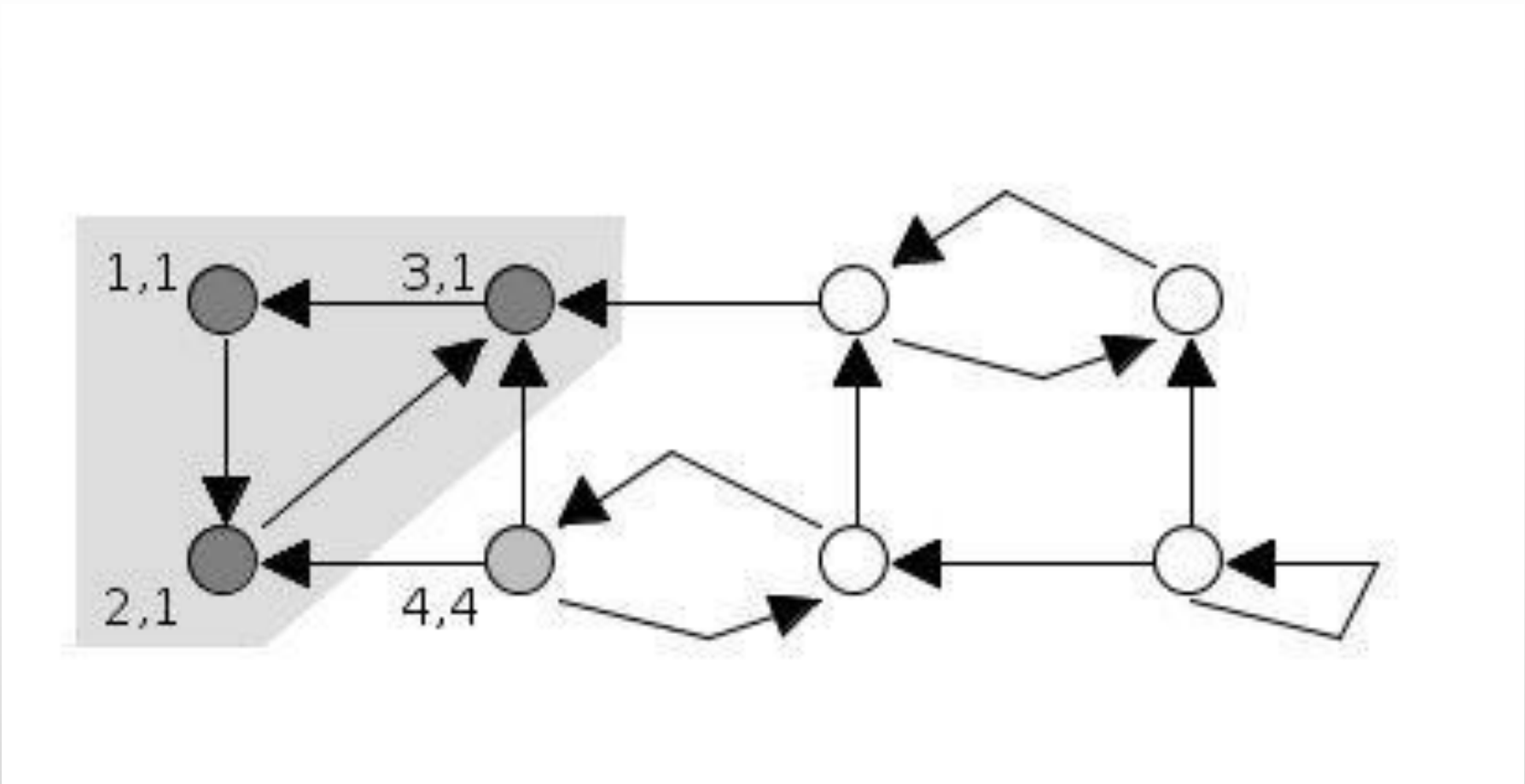
Tarjan's Strongly Connected Components



Tarjan's Strongly Connected Components



Tarjan's Strongly Connected Components



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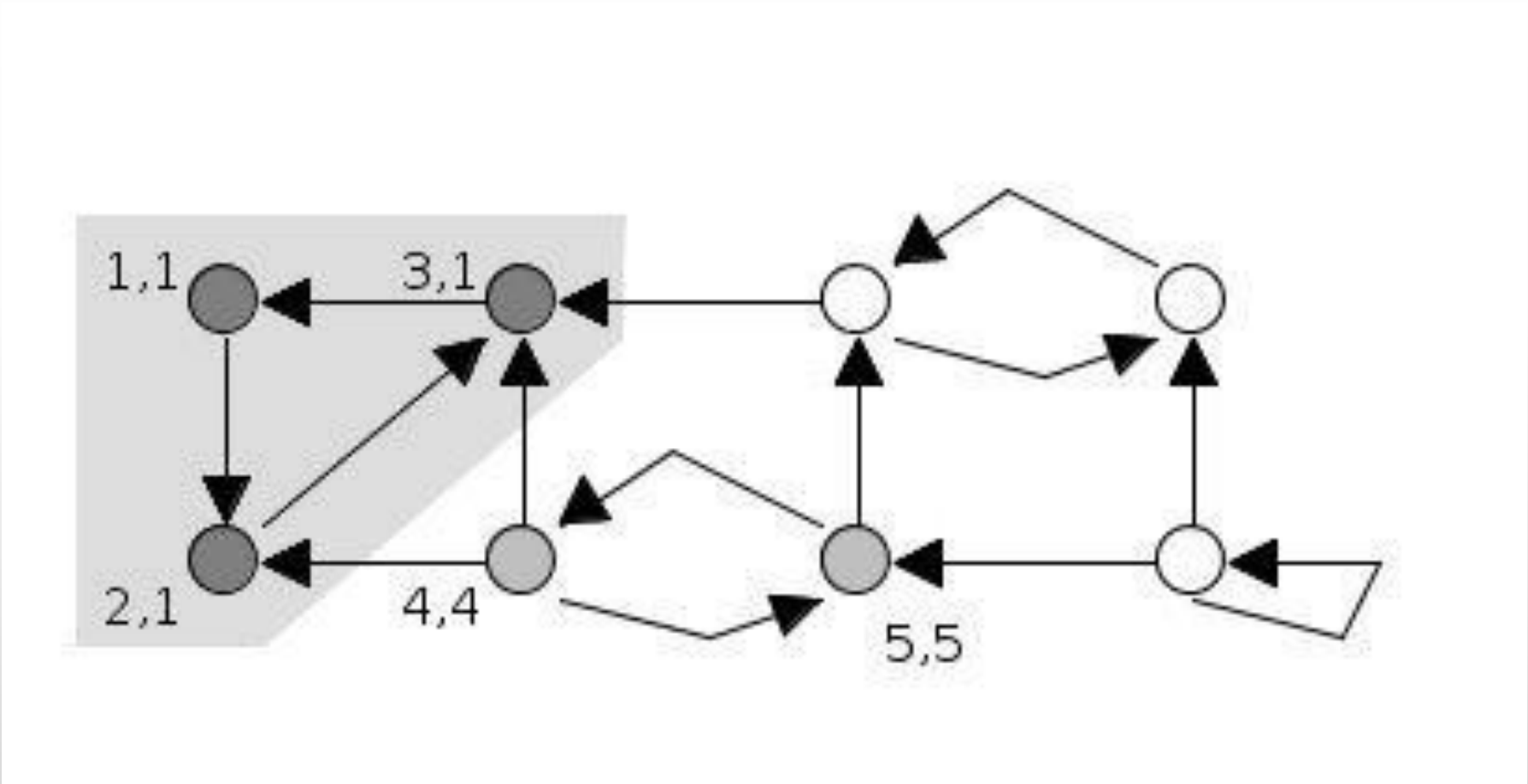

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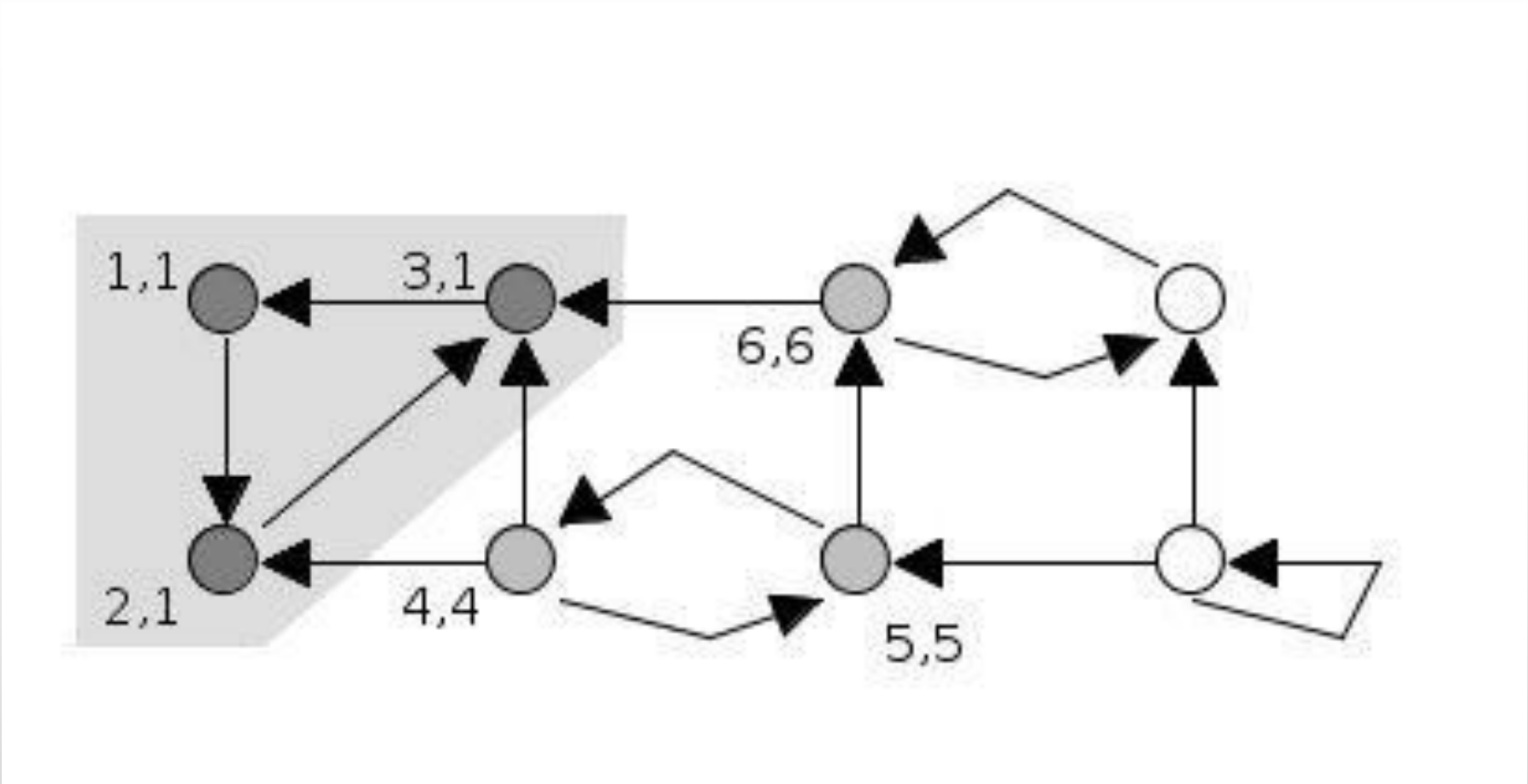

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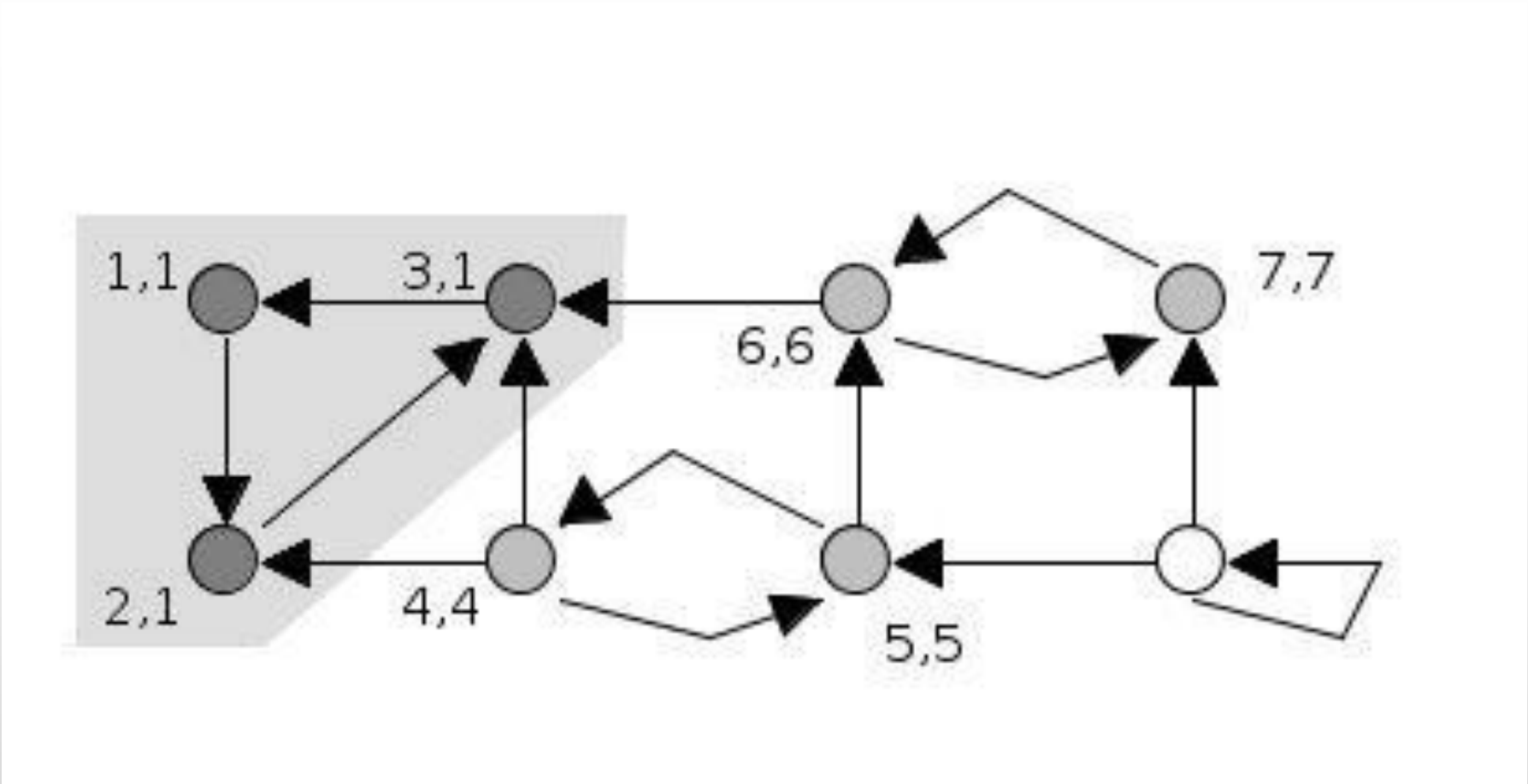

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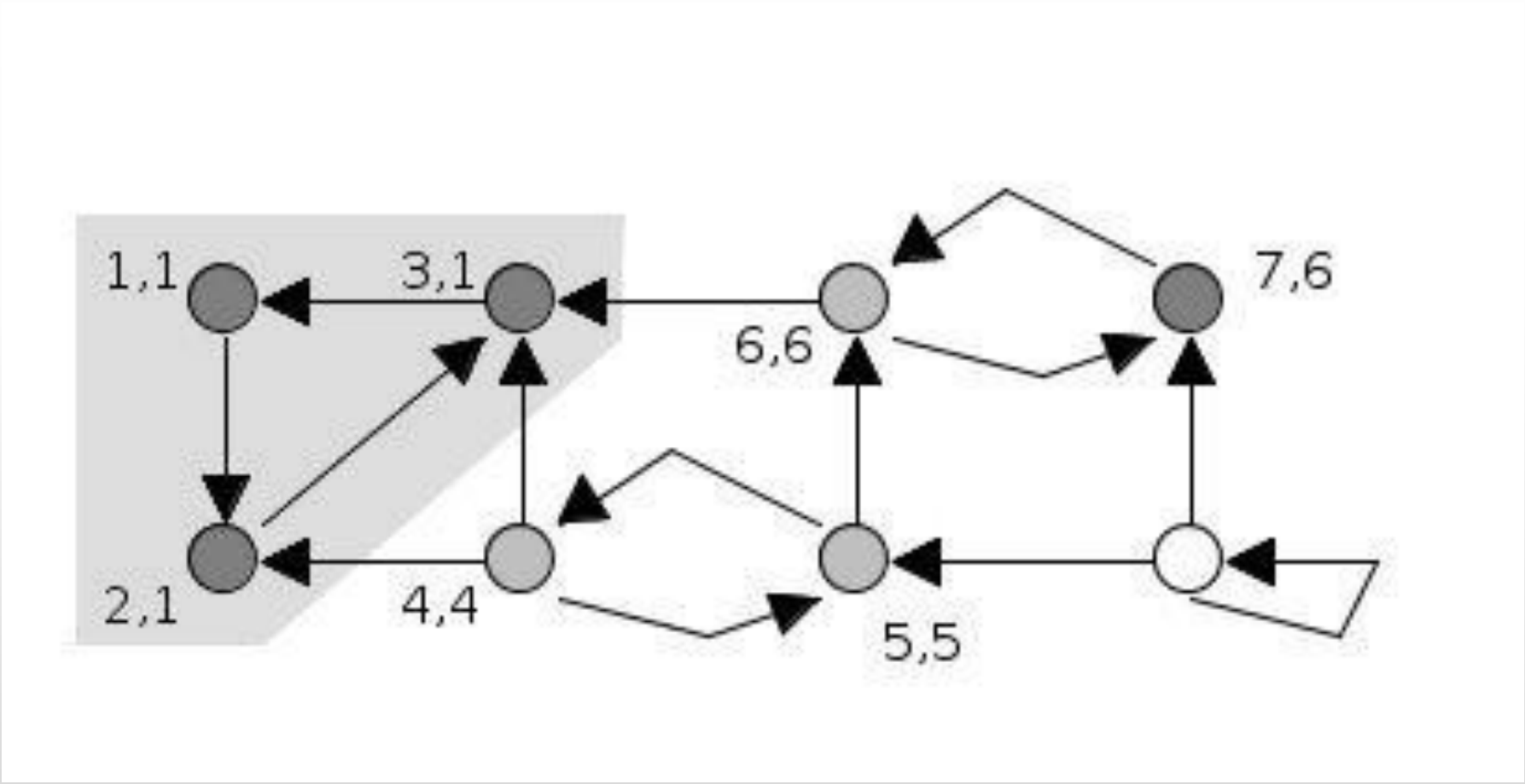

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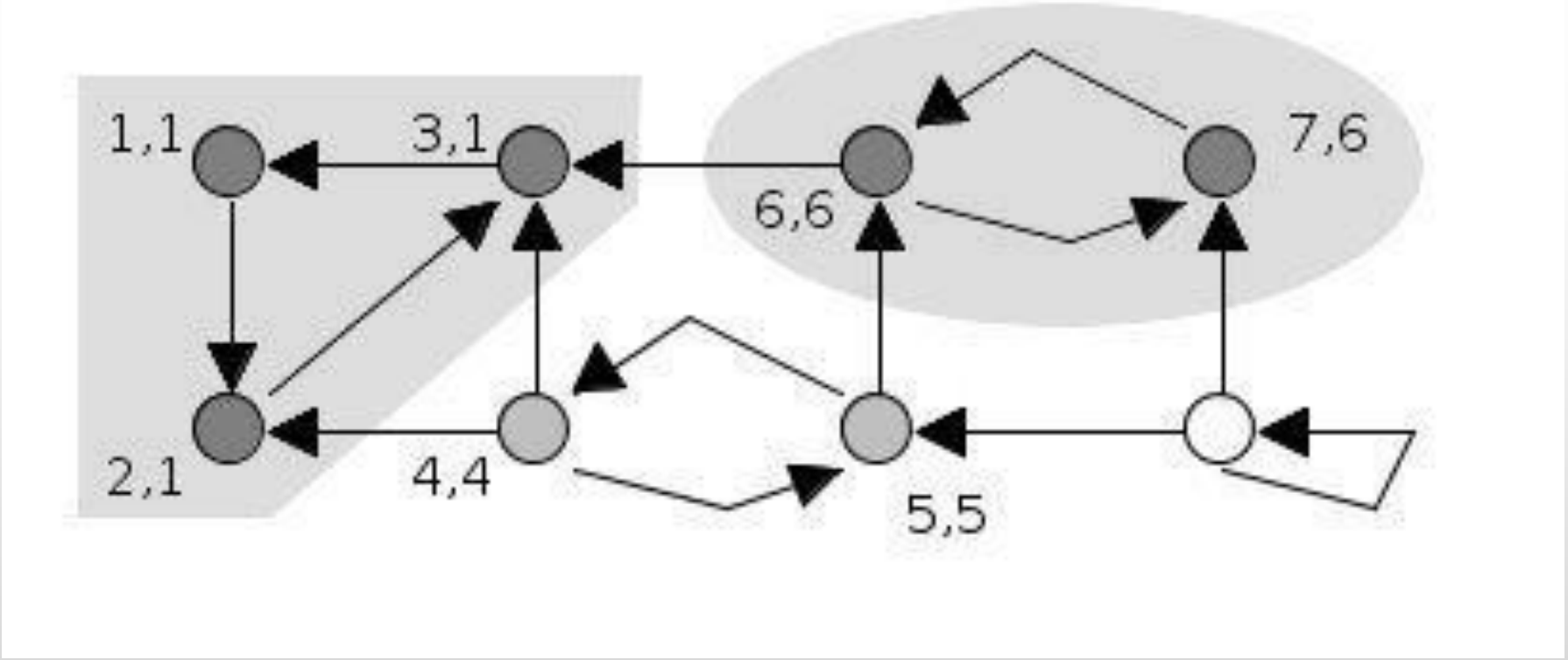

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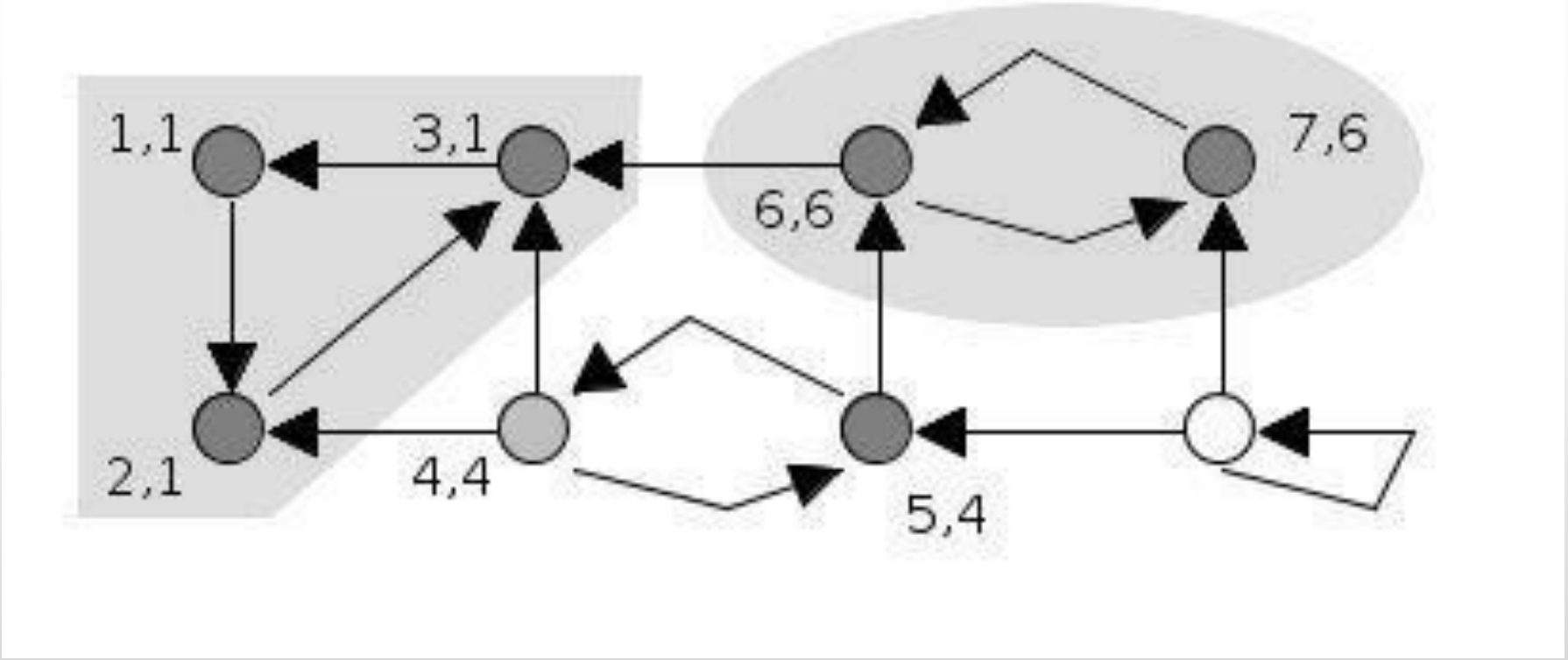

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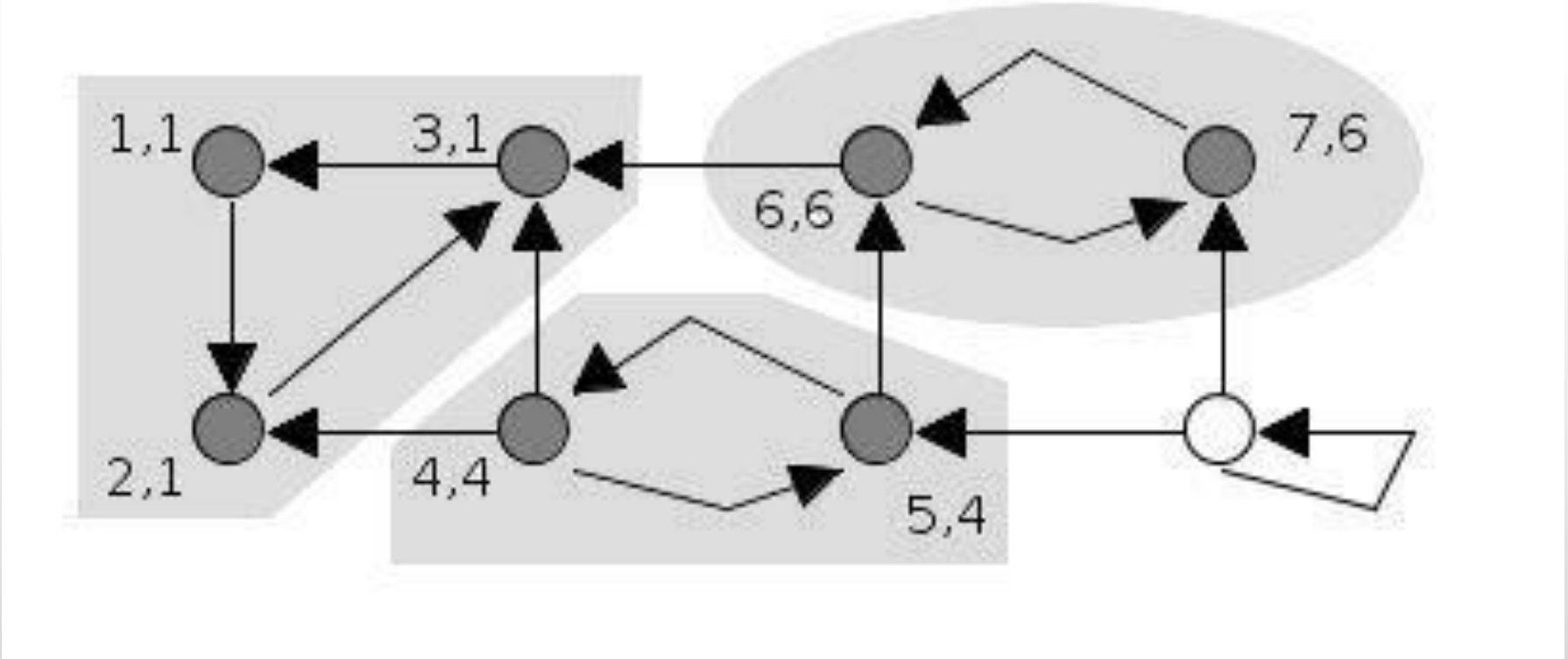

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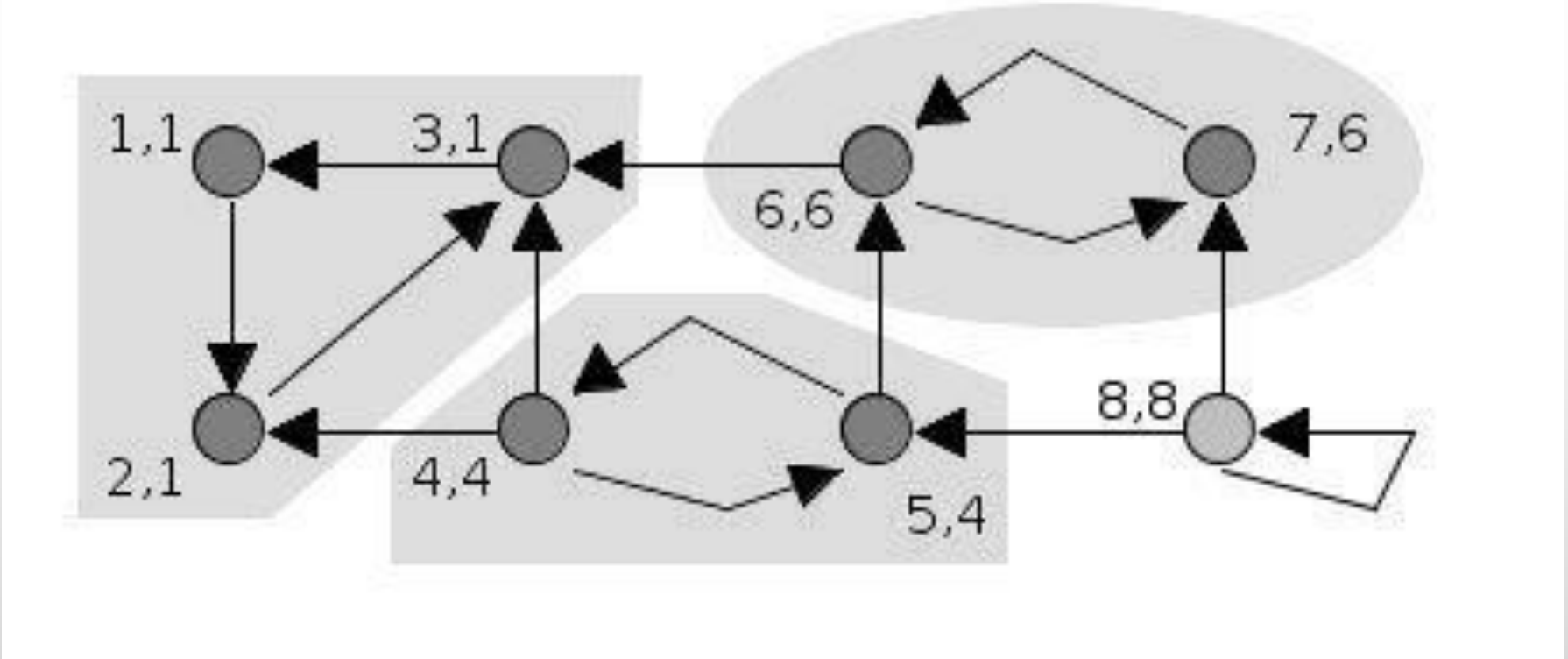

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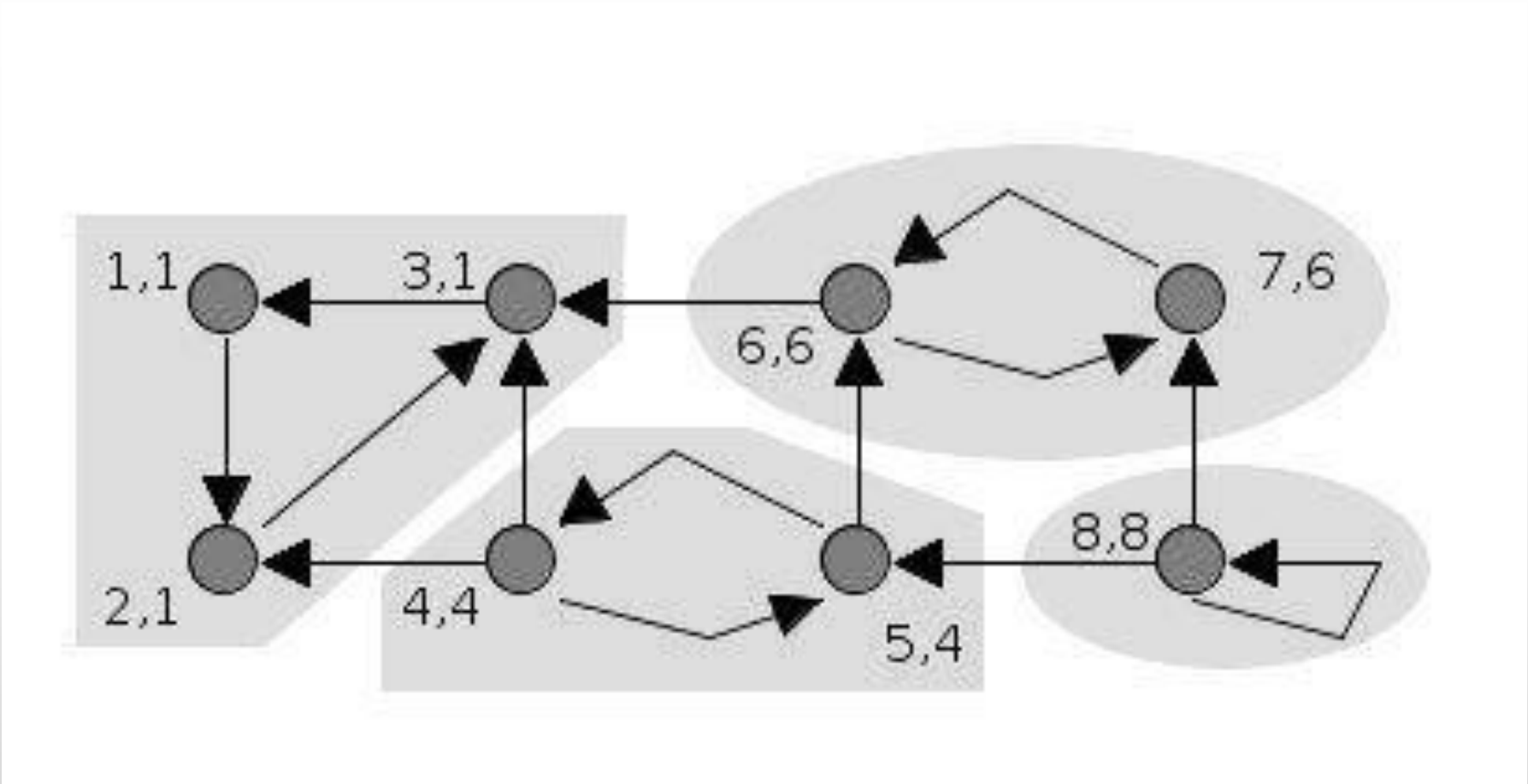

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