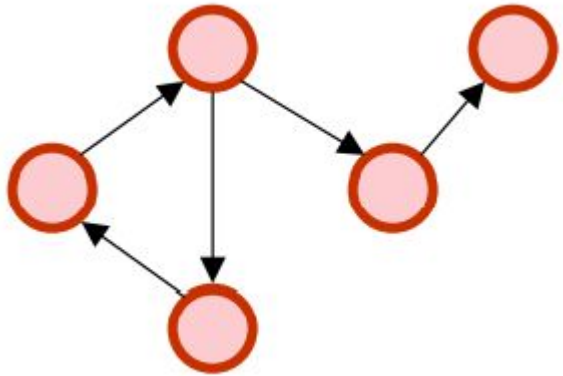
Topological Sort

Topological Sort

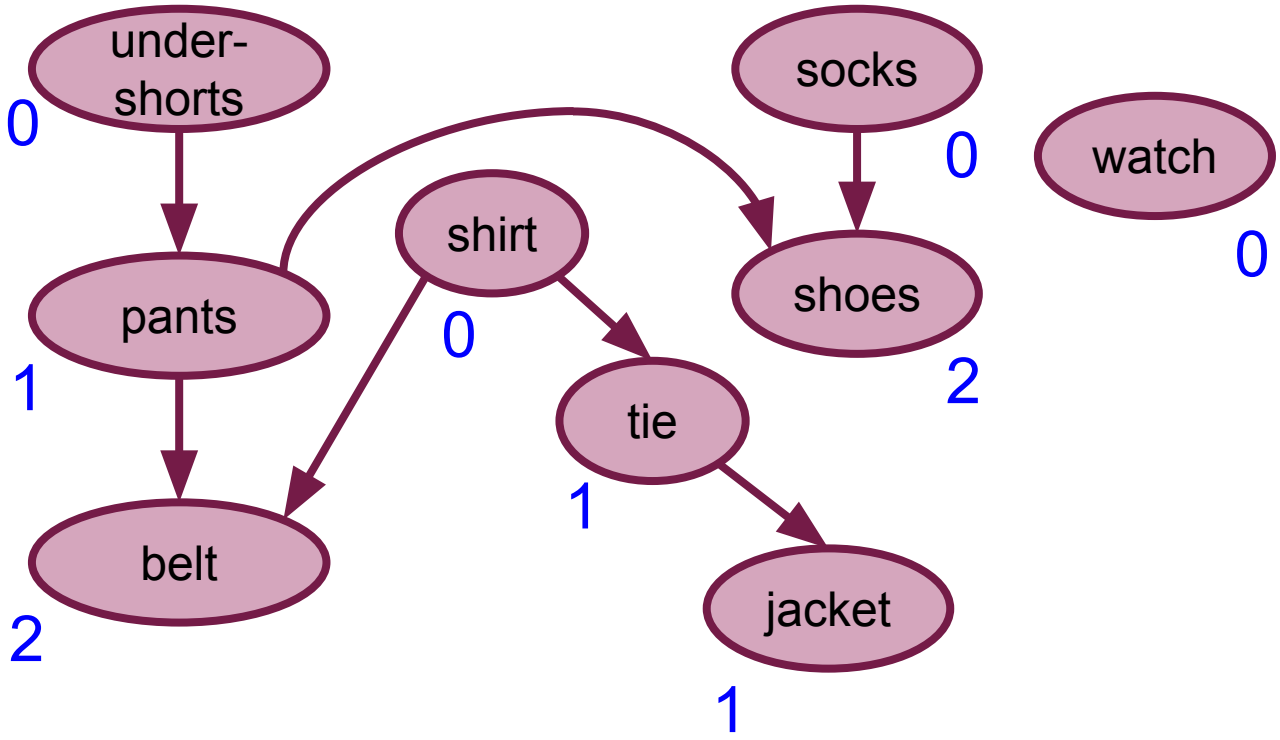
- Given a directed graph G
- Try to find an order of all vertices in G, such that for any edge (u, v), u appears before v in the ordering.

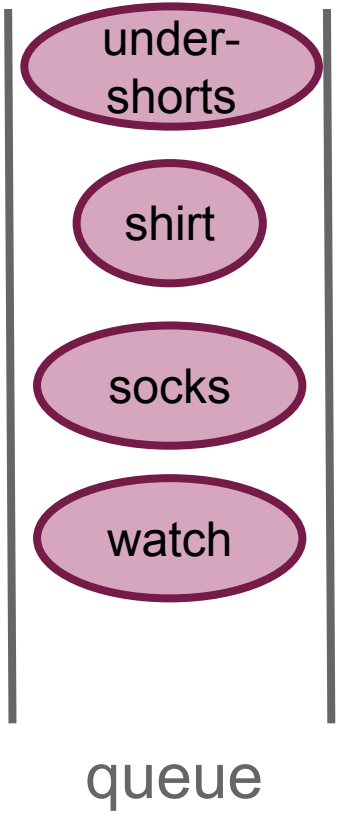
Topological Sort

- We can find a topological order if G is acyclic (contains no cycle)
- If G contains a cycle, then it is impossible to find such an ordering. (Proof by contradiction)



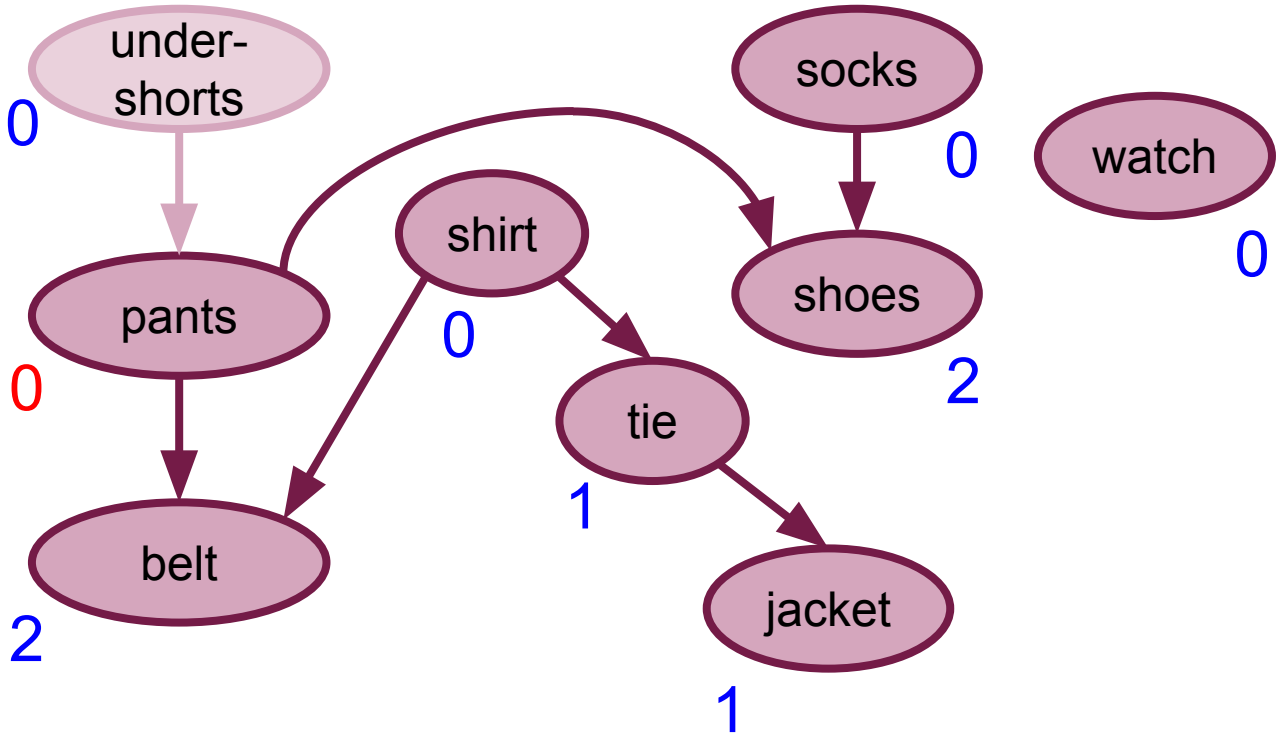
Topological Sort - Example

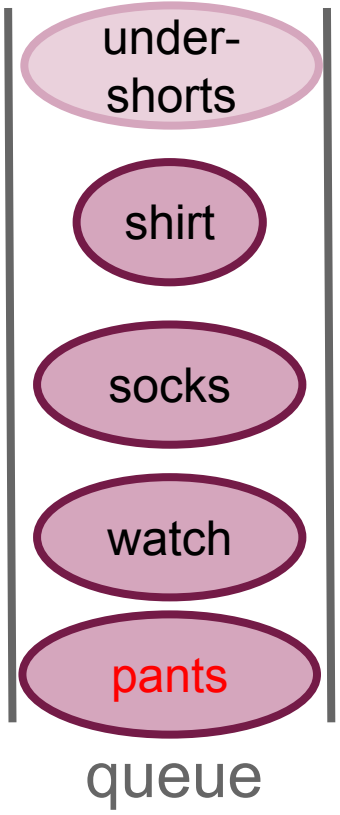




Topological order: (empty)

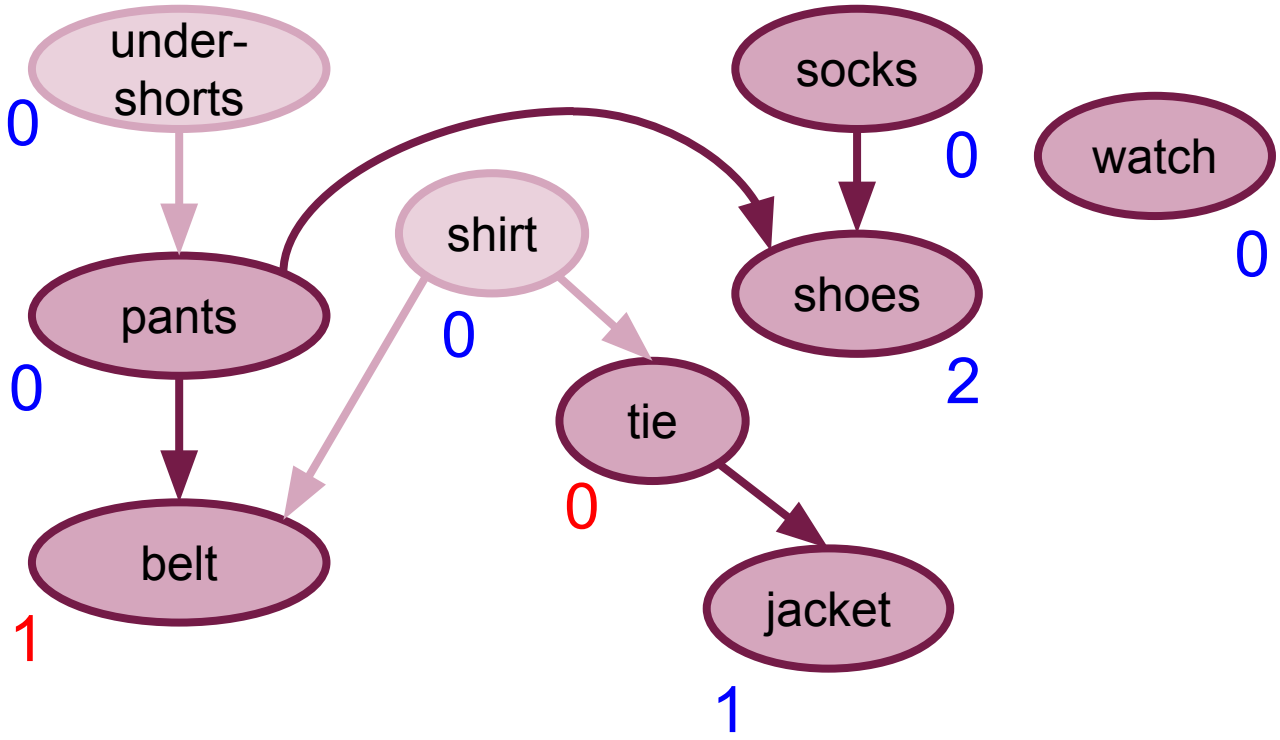
Topological Sort - Example

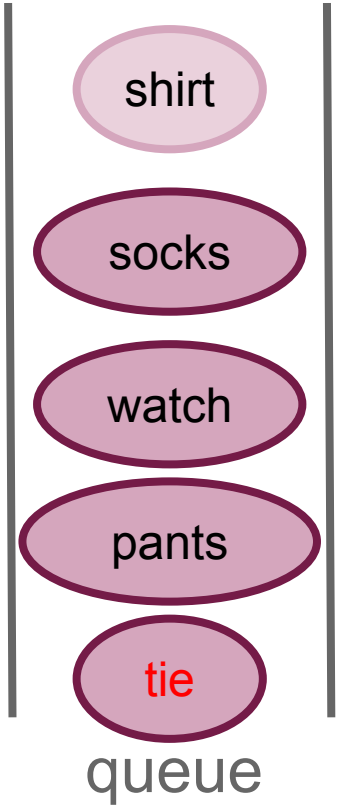




Topological order: under-shorts

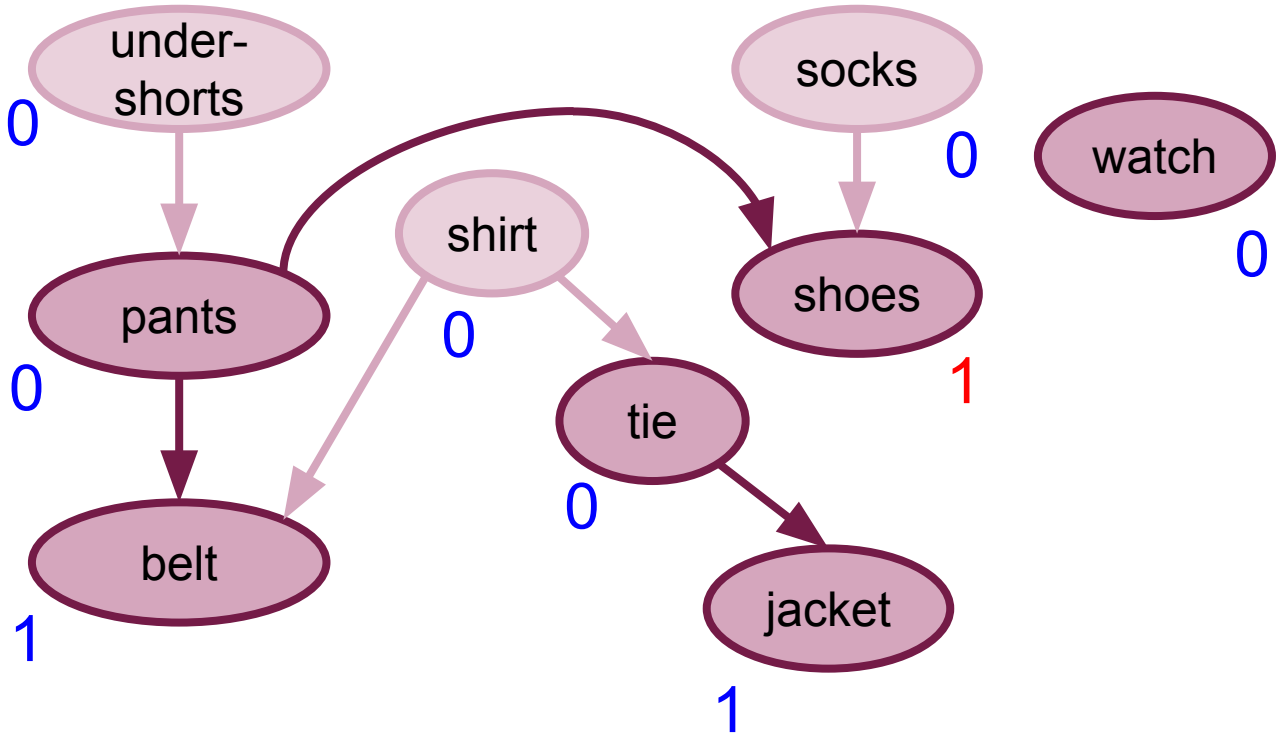
Topological Sort - Example

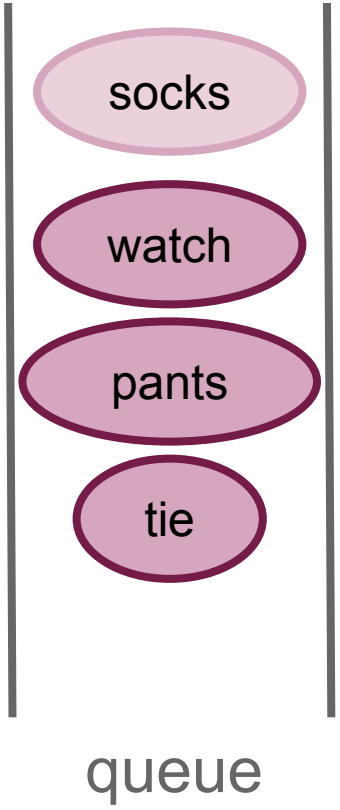




Topological order: under-shorts, shirt

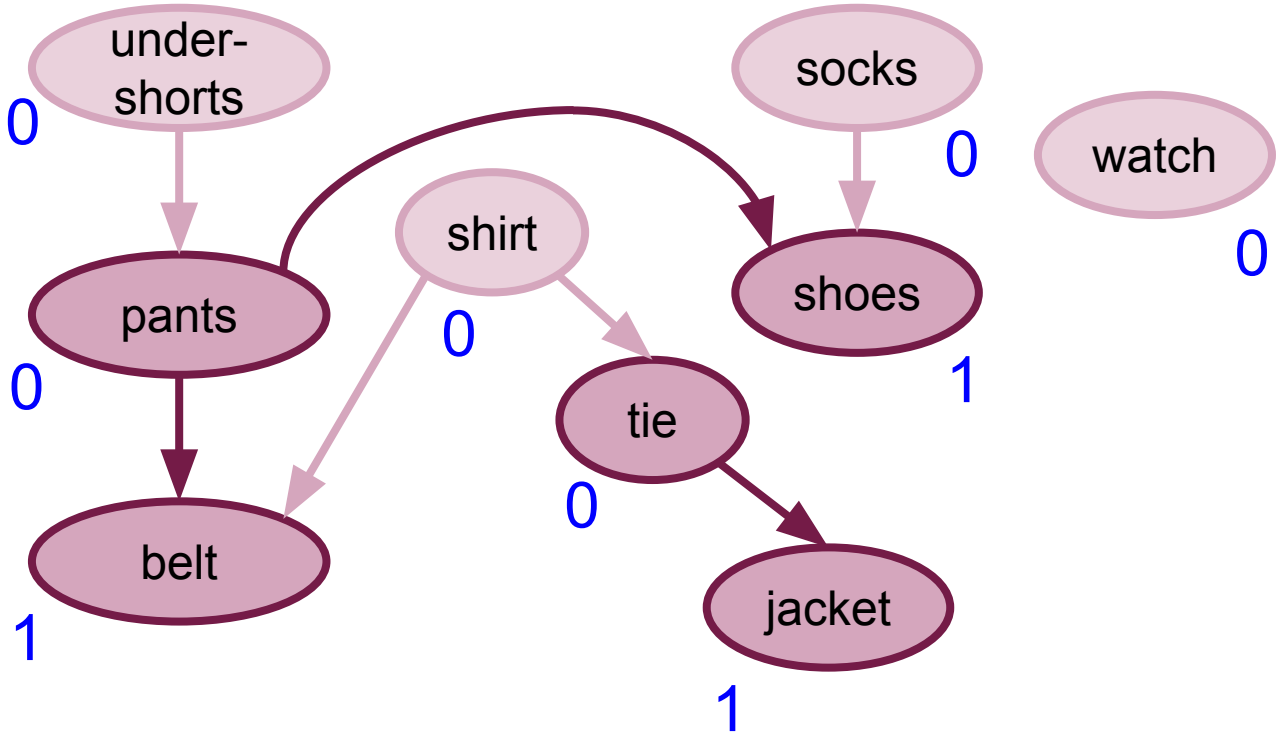
Topological Sort - Example

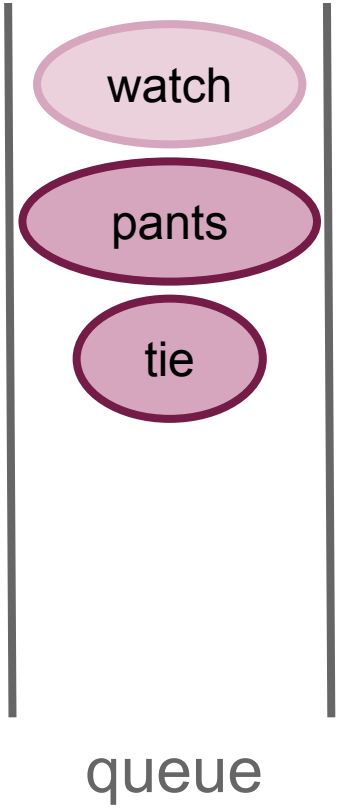




Topological order: under-shorts, shirt, socks

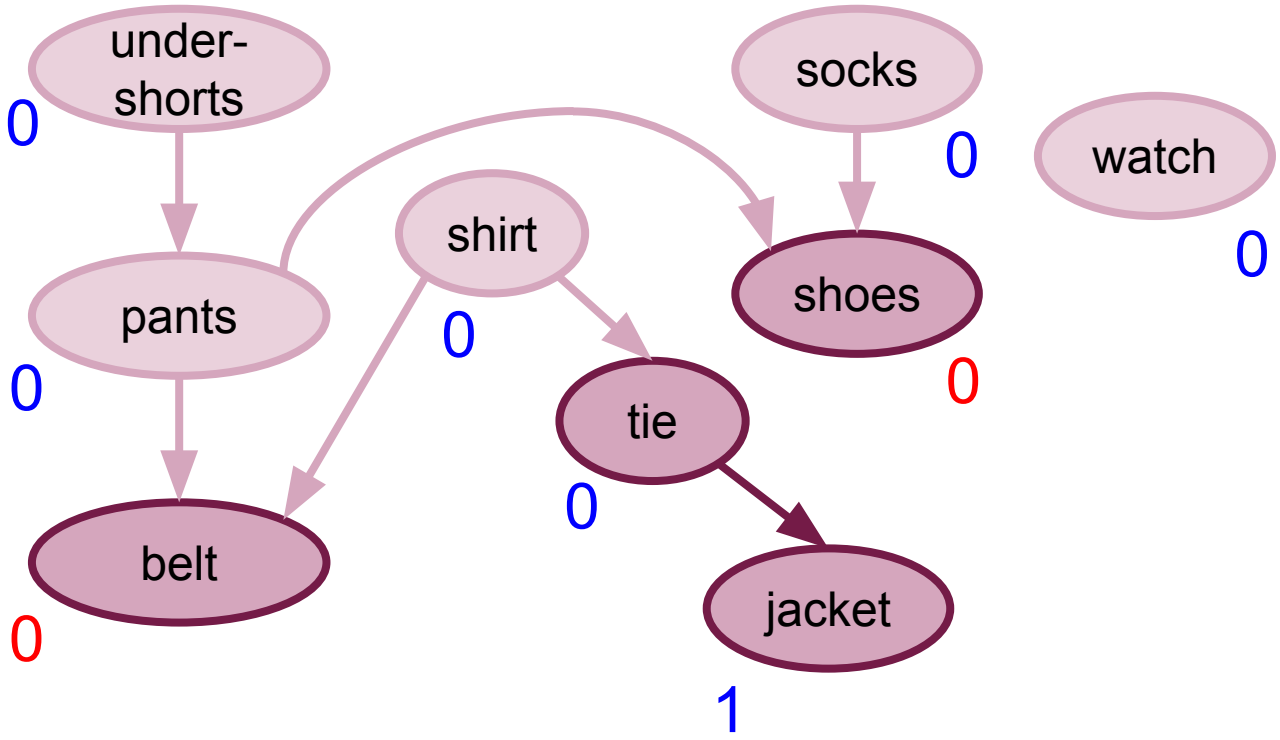
Topological Sort - Example

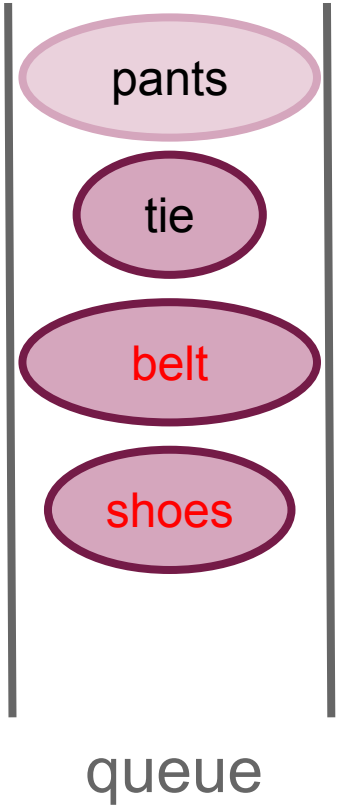




Topological order: under-shorts, shirt, socks, watch

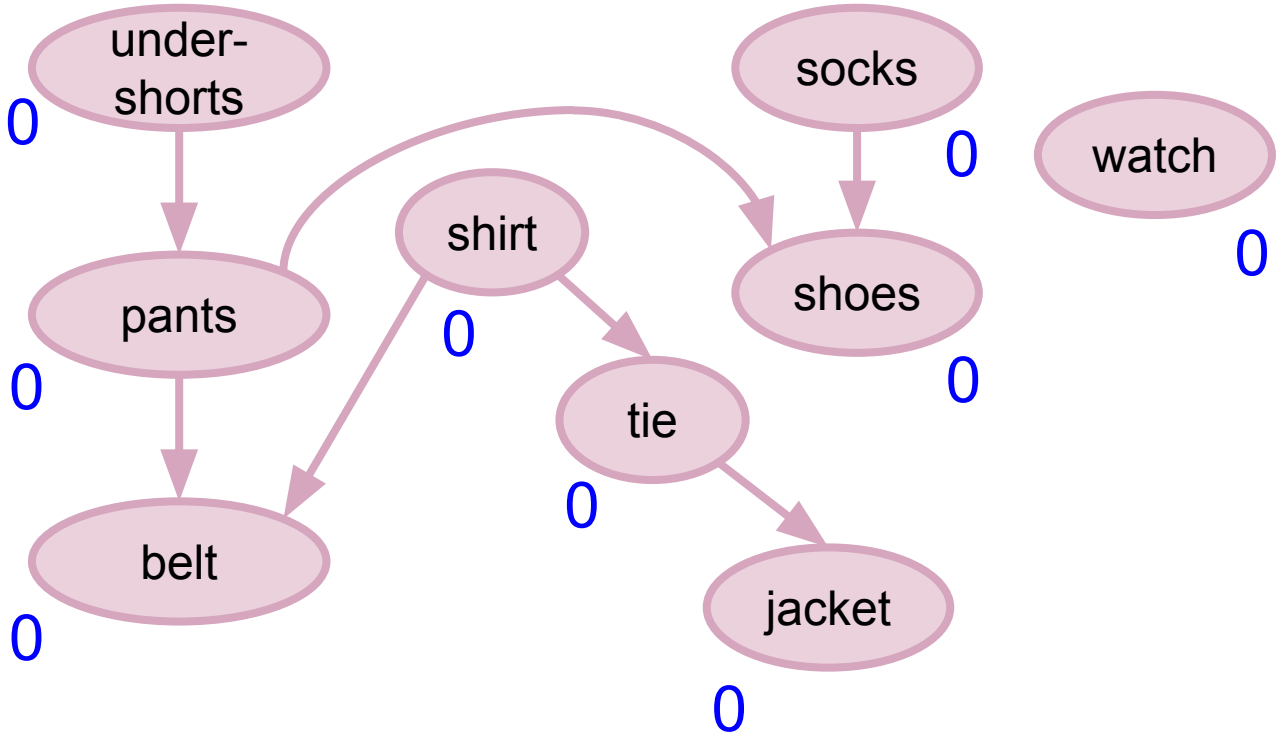
Topological Sort - Example

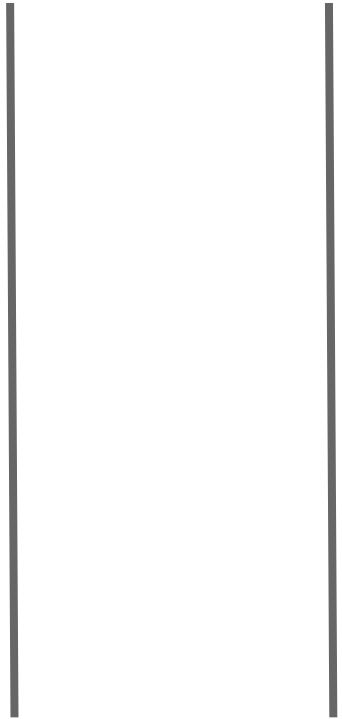




Topological order: under-shorts, shirt, socks, watch, pants

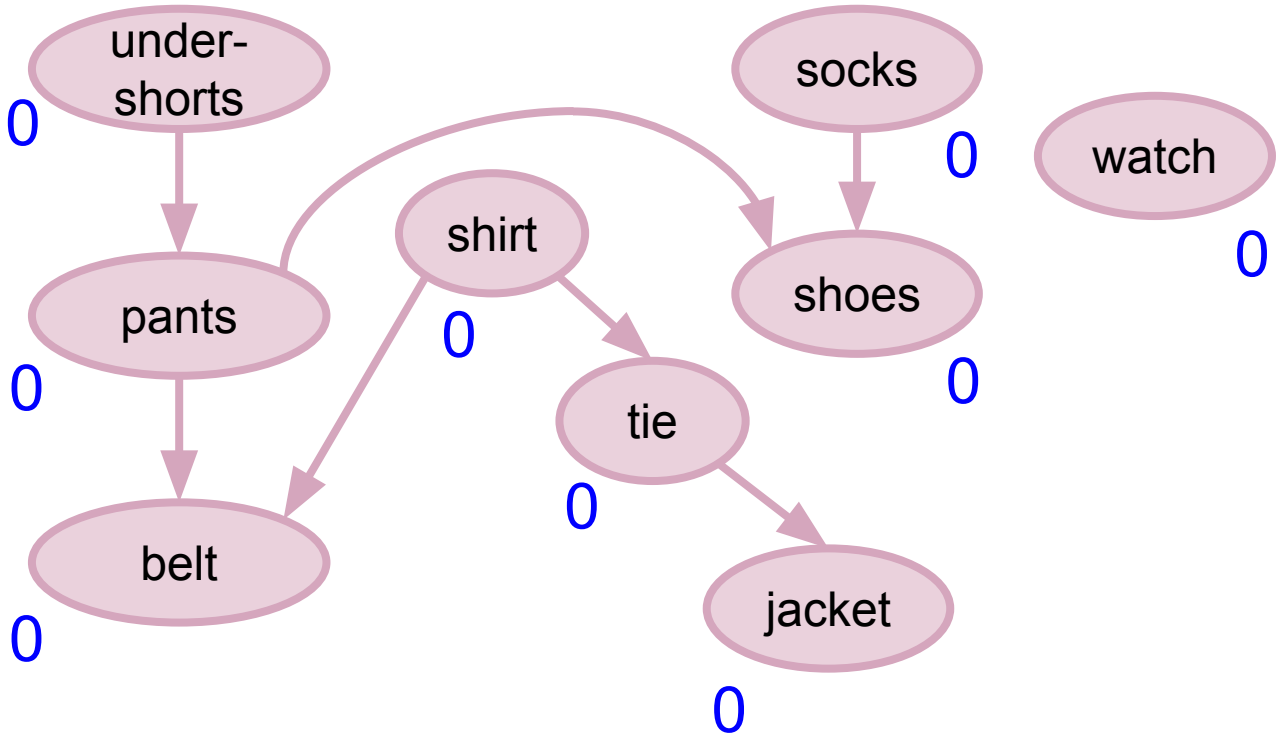
Topological Sort - Example (result)





Topological order: under-shorts, shirt, socks, watch, pants, tie, belt, shoes, jacket

Topological Sort - Example (result)

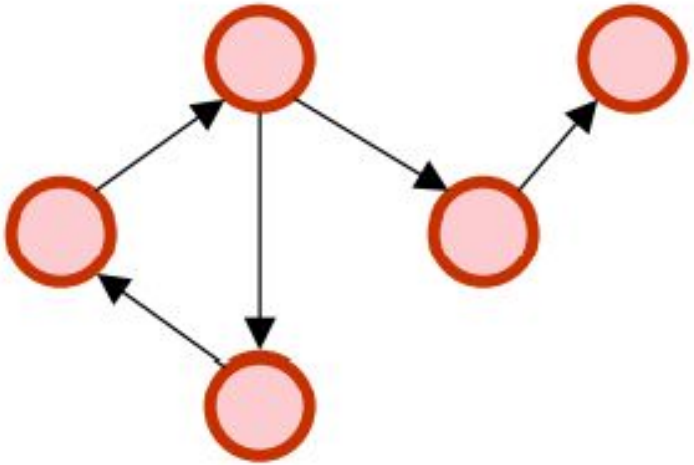


queue

[shirt, tie, jacket, watch, socks, under-shorts, pants, belt, shoes] can also be a Topological order.

How to check it’s DAG or not?

```
topological_sort(G, indegree);
if(ans.size() == n) cout<<"Yes\n";
else cout<<"No\n";
```



Topological Sort - Alternative Implementation

- Using out-degree instead of in-degree
- Call DFS
  - For every vertex, save the timestamp of finish time
  - Output vertices in decreasing order of their timestamp

in class sample codes

In-degree:
https://ide.usaco.guide/O4F1WE2aSueZryJYWYQ

dfs:

https://ide.usaco.guide/O4F1_8WCsrRDQho7zHn

Lab18 Is Dag

題意:

給你一張無向圖, 請回答該圖是否是一張 DAG。

Lab18 Is Dag (cont.)

- 直接用跑拓樸排序檢查是否為 DAG 即可
- https://gist.github.com/rurutoria7/53fc6da52d0c7db91b7db7732bf4b776

Lab18 Spreadsheet

題意：

給你一張試算表，每一格的公式為某些其他格的值的和。請求出每一格的值是多少，或回答無法求出。

Lab18 Spreadsheet (cont.)

- 令第 u 格加上的值為 $a[u]$, 若 u 參考到 v 則建邊 (u,v)
  - 令 $f(u)$ 為第 u 格的值
  - 若 $f(u)$ 已經被計算完, 直接 return
  - 若 $f(u)$ 尚未計算, 則 $f(u)$ 為 $a[u]$ 加上所有參考點的值 $f(v)$
  - 若 $f(u)$ 仍在等待答案, 則詢問非法

- https://gist.github.com/rurutoria7/4156b6a9d22a3d3de257295b3035ab05