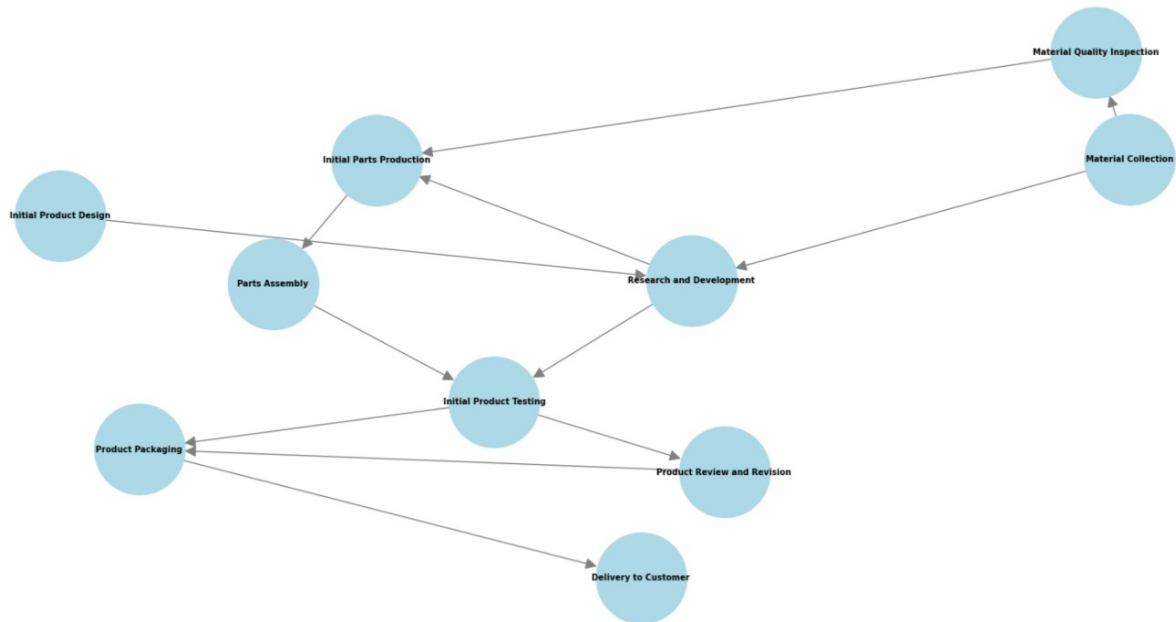




😊 ساخت محصول

در هر پروژه **تولید محصول**، وظایف مختلفی باید به ترتیب خاصی انجام شوند تا پروژه به درستی پیش رود. برخی از وظایف به طور مستقل قابل انجام هستند، در حالی که برخی دیگر نیاز به انجام وظایف قبلی دارند تا بتوانند به مرحله بعدی منتقل شوند.

این گراف که در ادامه آورده شده، روابط وابستگی میان 10 وظیفه مختلف در فرآیند توسعه یک محصول را نشان می‌دهد.



هدف شما این است که ترتیب انجام این وظایف را به گونه‌ای پیدا کنید که هیچ وظیفه‌ای پیش از وظایف وابسته به آن انجام نشود. به عبارت دیگر، باید یک **ترتیب توپولوژیک** از گراف پیدا کنید. ترتیب توپولوژیک به معنای یافتن ترتیبی از گره‌ها است که در آن برای هر یال (u,v) در گراف، گره u قبل از گره v قرار داشته باشد.

گره ریشه **Material Collection** در نظر بگیرید.

برای اینکه نمره y کامل را بگیرید روند بدست آوردن نتیجه خود را بصورت مرحله به مرحله نشان دهید.

```
In-degree = { Material_Quality_Inspection = 1, Material_Collection = 0,
               Research_and_Development = 2, Initial_Parts_Production = 2,
               Initial_Product_Design = 0, Parts_Assembly = 1,
               Initial_Product_Testing = 2, Product_Packaging = 2,
               Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }
```

```
Ready_queue = {}
```

```
Answer = {}
```

```
In-degree = { Material_Quality_Inspection = 1,  
              Research_and_Development = 2, Initial_Parts_Production = 2,  
              Parts_Assembly = 1,  
              Initial_Product_Testing = 2, Product_Packaging = 2,  
              Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }
```

```
Ready_queue = {Material_Collection, Initial_Product_Design}  
Answer = {}
```

```
In-degree = { Material_Quality_Inspection = 0,  
              Research_and_Development = 1, Initial_Parts_Production = 2,  
              Parts_Assembly = 1,  
              Initial_Product_Testing = 2, Product_Packaging = 2,  
              Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }
```

```
Ready_queue = {Initial_Product_Design}  
Answer = {Material_Collection}
```

```
In-degree = {  
              Research_and_Development = 1, Initial_Parts_Production = 2,  
              Parts_Assembly = 1,  
              Initial_Product_Testing = 2, Product_Packaging = 2,  
              Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }
```

```
Ready_queue = {Initial_Product_Design, Material_Quality_Inspection}  
Answer = {Material_Collection}
```

|

```
In-degree = {  
              Research_and_Development = 0, Initial_Parts_Production = 2,  
              Parts_Assembly = 1,  
              Initial_Product_Testing = 2, Product_Packaging = 2,  
              Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }
```

```
Ready_queue = {Material_Quality_Inspection}  
Answer = {Material_Collection, Initial_Product_Design}
```

```
In-degree = {  
              Initial_Parts_Production = 2,  
              Parts_Assembly = 1,  
              Initial_Product_Testing = 2, Product_Packaging = 2,  
              Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }
```

```
Ready_queue = {Material_Quality_Inspection, Research_and_Development}  
Answer = {Material_Collection, Initial_Product_Design}
```

```
In-degree = {  
    Initial_Parts_Production = 1,  
    Parts_Assembly = 1,  
    Initial_Product_Testing = 2, Product_Packaging = 2,  
    Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }
```

```
Ready_queue = {Research_and_Development}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection }
```

```
In-degree = {  
    Initial_Parts_Production = 1,  
    Parts_Assembly = 1,  
    Initial_Product_Testing = 2, Product_Packaging = 2,  
    Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }
```

```
Ready_queue = {Research_and_Development}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection }
```

```
In-degree = {  
    Initial_Parts_Production = 0,  
    Parts_Assembly = 1,  
    Initial_Product_Testing = 1, Product_Packaging = 2,  
    Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }
```

```
|  
Ready_queue = {}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development }
```

```
In-degree = {  
    Parts_Assembly = 1,  
    Initial_Product_Testing = 1, Product_Packaging = 2,  
    Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }
```

```
Ready_queue = {Initial_Parts_Production}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development }
```

```
In-degree = {  
    Parts_Assembly = 0,  
    Initial_Product_Testing = 1, Product_Packaging = 2,  
    Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }
```

```
Ready_queue = {}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development,  
    Initial_Parts_Production }
```

```
In-degree = {  
    Initial_Product_Testing = 1, Product_Packaging = 2,  
    Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }  
|
```

```
Ready_queue = {Parts_Assembly}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development,  
    Initial_Parts_Production }
```

```
In-degree = {  
    Initial_Product_Testing = 0, Product_Packaging = 2,  
    Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }  
|
```

```
Ready_queue = {}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development,  
    Initial_Parts_Production, Parts_Assembly }
```

```
In-degree = {  
    Product_Packaging = 2,  
    Product_Review_and_Revision = 1, Delivery_to_Customer = 1 }  
|
```

```
Ready_queue = {Initial_Product_Testing}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development,  
    Initial_Parts_Production, Parts_Assembly }
```

```
In-degree = {  
    Product_Packaging = 1,  
    Product_Review_and_Revision = 0, Delivery_to_Customer = 1 }  
|
```

```
Ready_queue = {}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development,  
    Initial_Parts_Production, Parts_Assembly, Initial_Product_Testing }
```

```
In-degree = {  
    Product_Packaging = 1,  
    Delivery_to_Customer = 1 }  
|
```

```
Ready_queue = {Product_Review_and_Revision}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development,  
    Initial_Parts_Production, Parts_Assembly, Initial_Product_Testing }
```

```
In-degree = {  
    Product_Packaging = 0,  
    Delivery_to_Customer = 1 }
```

```
Ready_queue = {}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development,  
    Initial_Parts_Production, Parts_Assembly, Initial_Product_Testing  
    Product_Review_and_Revision }
```

```
In-degree = {  
    Delivery_to_Customer = 1 }
```

```
Ready_queue = {Product_Packaging}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development,  
    Initial_Parts_Production, Parts_Assembly, Initial_Product_Testing  
    Product_Review_and_Revision }
```

```
In-degree = {  
    Delivery_to_Customer = 0 }
```

```
Ready_queue = {}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development,  
    Initial_Parts_Production, Parts_Assembly, Initial_Product_Testing  
    Product_Review_and_Revision, Product_Packaging }
```

```
In-degree = {}
```

```
Ready_queue = {Delivery_to_Customer}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development,  
    Initial_Parts_Production, Parts_Assembly, Initial_Product_Testing  
    Product_Review_and_Revision, Product_Packaging }
```

```
In-degree = {}
```

```
Ready_queue = {}  
Answer = {Material_Collection, Initial_Product_Design,  
    Material_Quality_Inspection, Research_and_Development,  
    Initial_Parts_Production, Parts_Assembly, Initial_Product_Testing  
    Product_Review_and_Revision, Product_Packaging, Delivery_to_Customer}
```