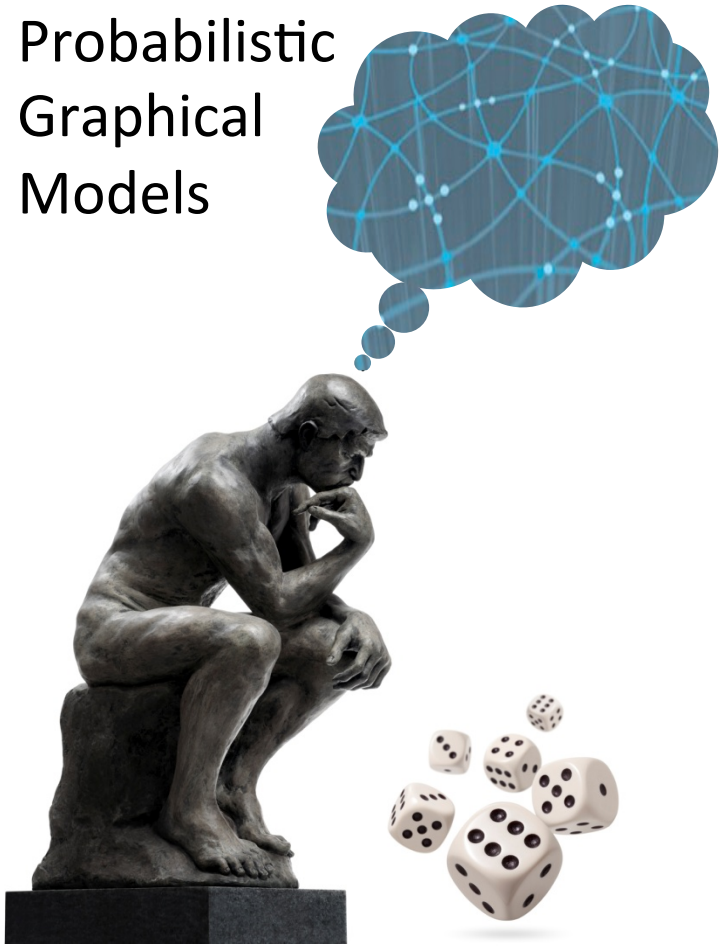
Probabilistic Graphical Models



Representation

Bayesian Networks

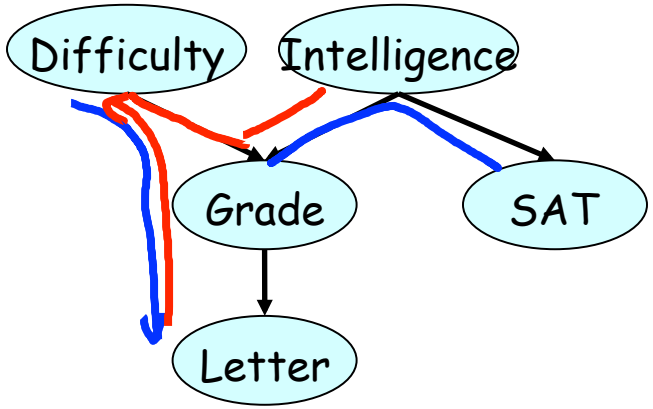
Flow of Probabilistic Influence

When can X influence Y?

condition on W changes beliefs about Y

- X → Y ✓
- X ← Y ✓
- X → W → Y ✓
- X ← W ← Y ✓
- X ← W → Y ✓
- X → W ← Y ✗

v-structure



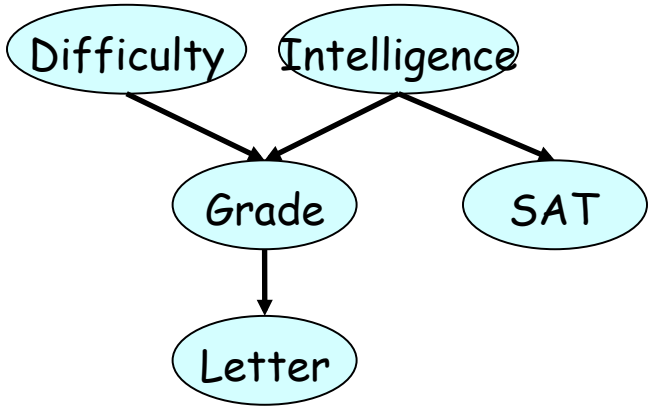
Active Trails

- A trail $X_1 - \ldots - X_n$ is active if:
  it has no v-structures $X_{i-1} \rightarrow X_i \leftarrow X_{i+1}$

When can X influence Y Given evidence about Z

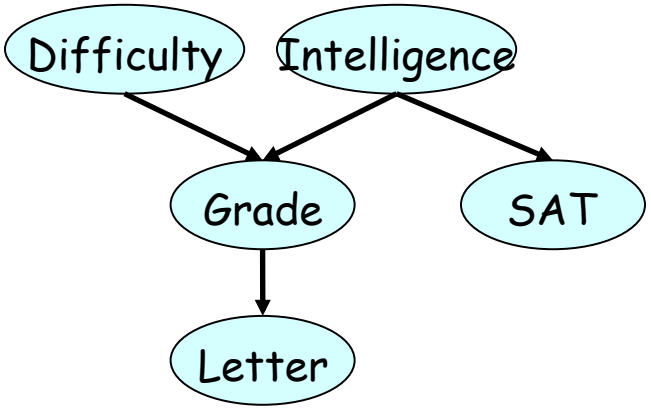
- $X \rightarrow Y$
- $X \leftarrow Y$
- $X \rightarrow W \rightarrow Y$
- $X \leftarrow W \leftarrow Y$
- $X \leftarrow W \rightarrow Y$
- $X \rightarrow W \leftarrow Y$

$W \notin Z$	$W \in Z$
✓	✗
✓	✗
✓	✗
✗	✓



When can X influence Y given evidence about **Z**

- S — I — G — D allows influence to flow when:



I is observed ✗

I not observed, nothing else ✗

I not observed G is observed

Active Trails

- A trail $X_1 - \ldots - X_n$ is active given $\mathbf{Z}$ if:
  - for any v-structure $X_{i-1} \rightarrow X_i \leftarrow X_{i+1}$ we have that X_i or one of its descendants $\in Z$
  - no other X_i is in Z

activate v-structures

not in v-structures