# FlowGPT: How Long Can LLMs Trace Back and Predict the Trends of Graph Dynamics?


Mississippi State University — James Worth Bagley College of Engineering

author

*Zijian Zhang*
*Zonghan Zhang*
*Zhiqian Chen*


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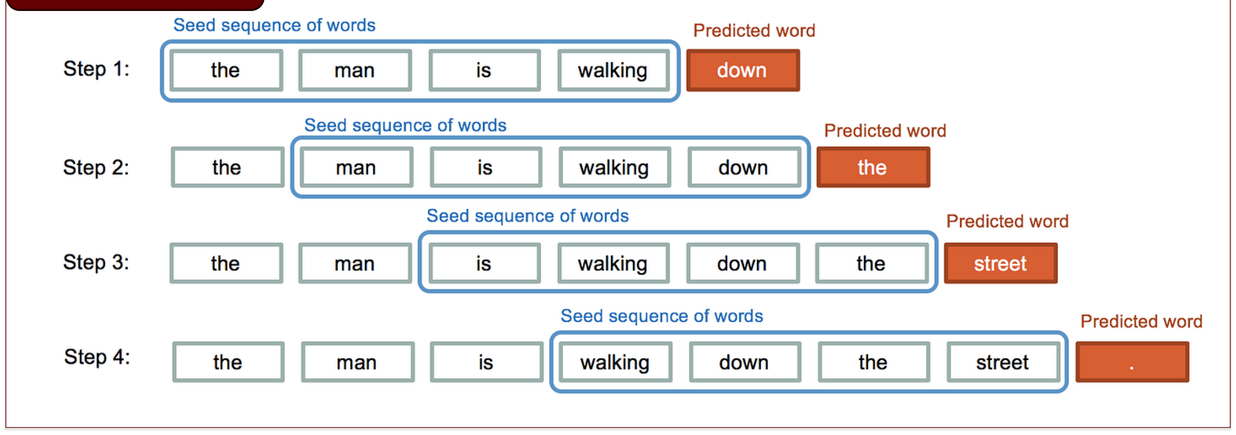
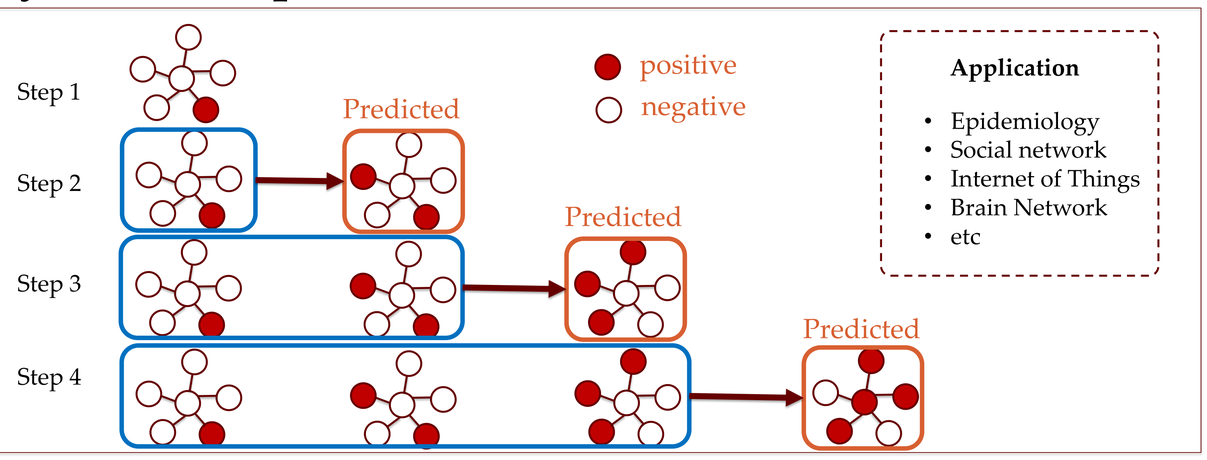
## Motivation




## LLM Dynamic Graph




## Question

**Optimal option for graph-text interaction?**

**Natural Input Formats**

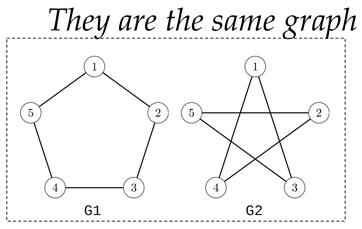
Visual? *E.g., take each snapshot of dynamic graph as an image*

Textual? *E.g., "I have a Renyi graph with size of 30 nodes, the first node is activated…."*

**Unnatural Input** (Professional setting) Adjacency Matrix/List? Graph Markup Language? → Code LLM

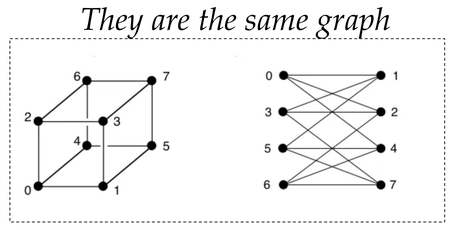
Graph is quite different Images: **no style**, only **structure** with **attributes**

*They are the same graph*

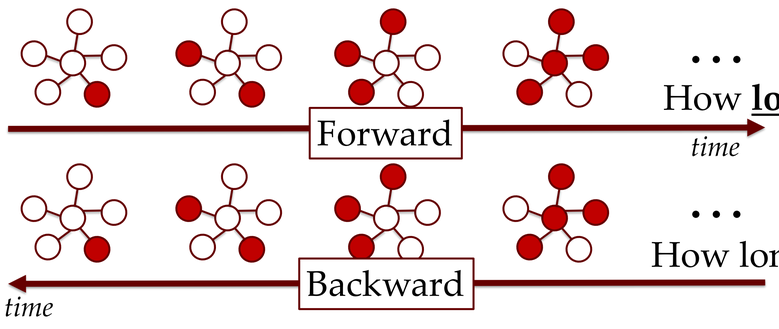



*"Graph Isomorphisms"*

*They are the same graph*



## Task: Dynamic Graph




… How **long** can LLM predict?

… How long under the **reverse** task?

| Flow Tasks | Shared Input | Variable Input | Output |
|---|---|---|---|
| Forward | graph $G$, diffusion model $D$, observation intervals $I$ | source nodes $\Omega$ | target nodes $\omega$ |
| Backward | graph $G$, diffusion model $D$, observation intervals $I$ | target nodes $\omega$ | source nodes $\Omega$ |

## Direction and step size combination

**FW1**: Step differences is 1 and forward prediction. including step 1→2, 2→ 3 ...

**BW2**: Step differences is 2 and backward prediction. including step 3→ 1, 5→ 3 ...

**FW1_2**: mixed with **FW1 and FW2**

## Data and Metrics

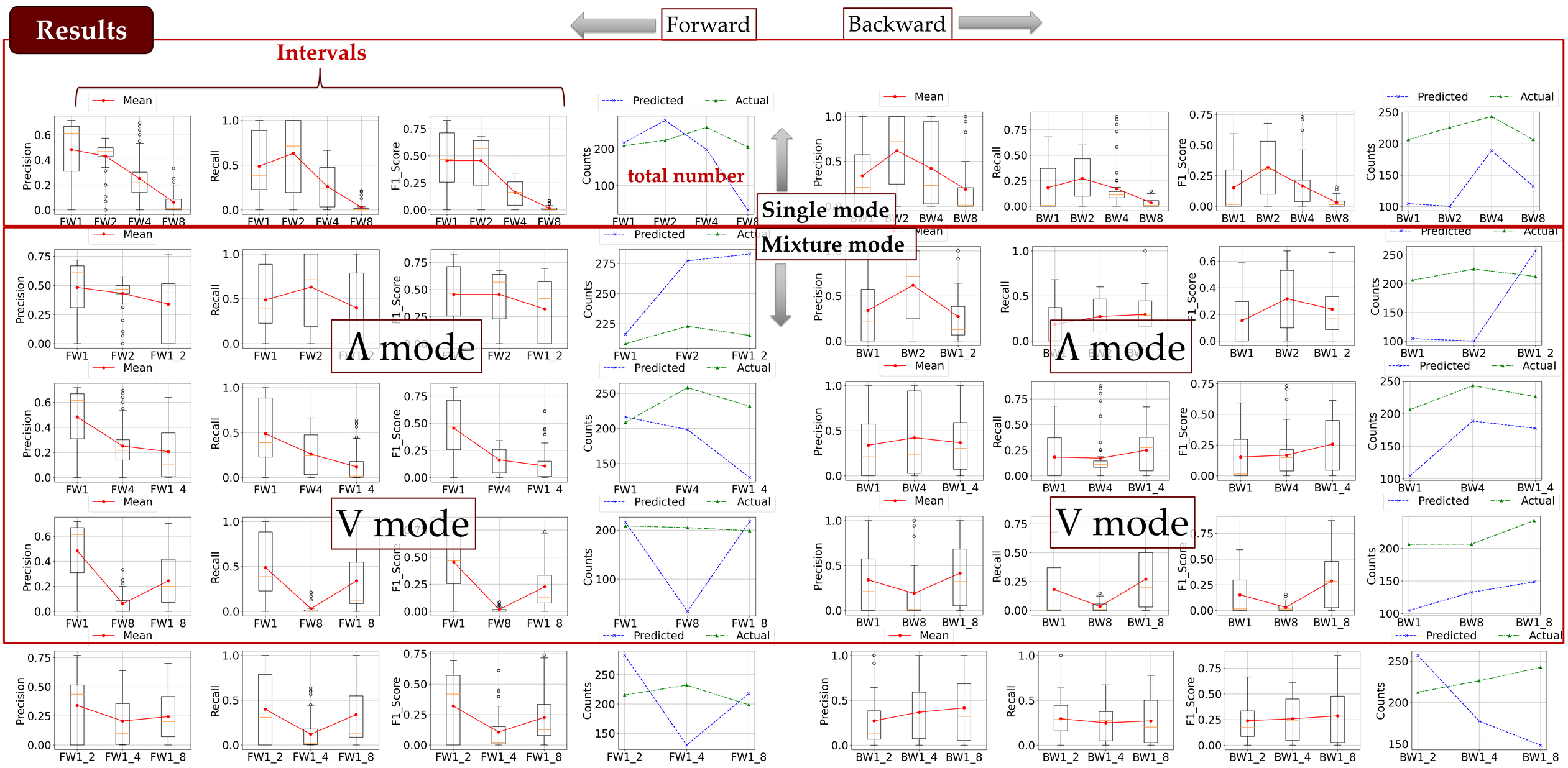
**Graph:** Watts-Strogatz small-world graphs **Diffusion:** SIR

**Implementation:** https://github.com/XGraph-Team/XFlow

**LLM:** ChatGPT-4, GUI version, 10 results for each test

**Metrics:** count the distance to real results; count the total number

## Results




- Long dependency is still limited with text input, even with short intervals.
- Single-mode performance drops down significantly as the interval increases.
- Mixture-model: from mixing interval 1 with 2/4/8: from V to flat and then to Λ

## Future Plan

- Text mode: GPT API; Other LLMs;
- Professional mode: graph format & Customized Transformer