Data-Driven Behavioral Analytics:
Observations, Representations and Models

Meng Jiang (UIUC)
Peng Cui (Tsinghua)
Jiawei Han (UIUC)

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What is Behavior?

- *Definition*. **Interactions** made by **individuals** in conjunction with **themselves** or their **environment**. (*Wikipedia*)

Behavioral Analysis

- *Significance*. What can we discover from behavioral data?
  - *Ex*. Given every phone call/message between military leaders, scientists, businesspersons, find…

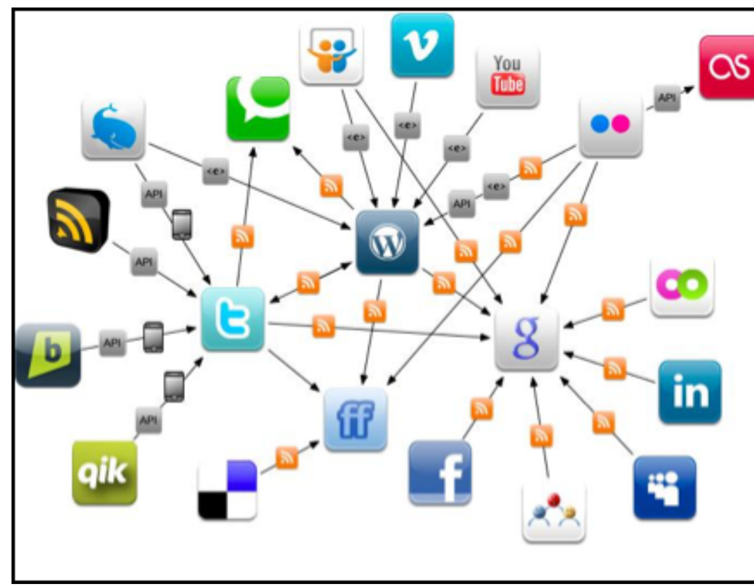
Observations	Who, what, where, when, why, how… (scientific view)
Representations	Graph, network, matrix, tensor… (mathematical view)
Models	Prediction, recommendation, anomaly detection… (application view)

Why Behavioral Analysis Today?

- *Today*. The human behaviors are broadly recorded in an unprecedented level. Insights of sciences and society?

Physical World

Online Applications



Basic Research Areas

- Six Disruptive Basic Research Areas
  - Engineered Materials (metamaterials and plasmonics)
  - Quantum Information and Control
  - Cognitive Neuroscience
  - Nanoscience and Nanoengineering
  - Synthetic Biology
  - Computational Modeling of Human and Social Behavior

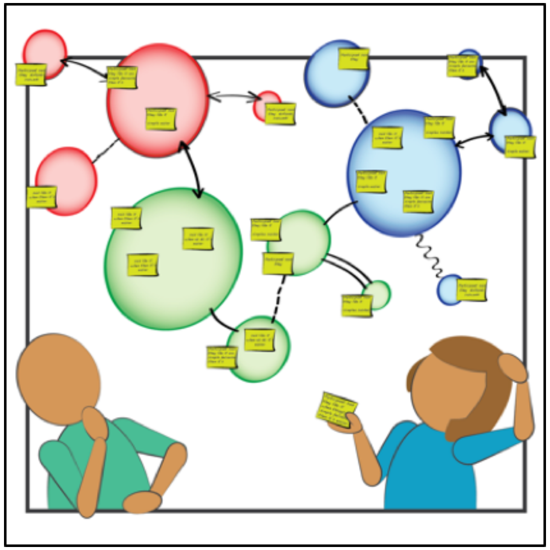
VI. Computational Models of Human Behavior

A fundamental understanding and predictive capability of human behavior dynamics from individuals to societies.

- ***Enabled capabilities***
  - *Predictive models supporting strategic, operational, and tactical decision making and planning*
  - *Real time cultural situational awareness*
  - *Immersive training and mission rehearsal*
  - *Cross cultural coalition building*
- ***Key research challenges:***
  - *Conflicting theories*
  - *Data management and fusion*
  - *Mathematical complexity*
  - *Validation of models*

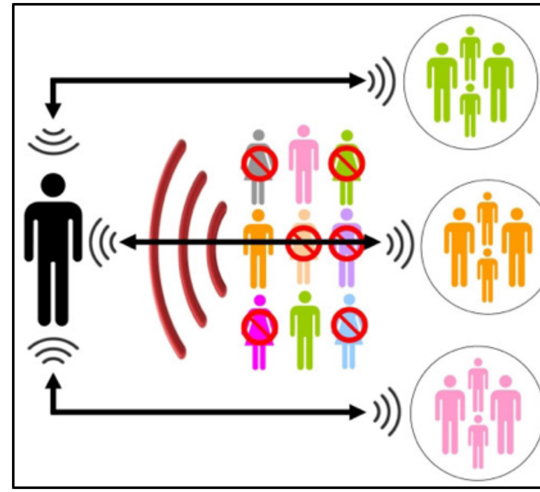
- ***Measures of success***
  - *Early success of simple models*
  - *Success of social network analysis*
  - *Prediction of crowd tipping points*

Challenges in Behavioral Analysis



Content
(preference)

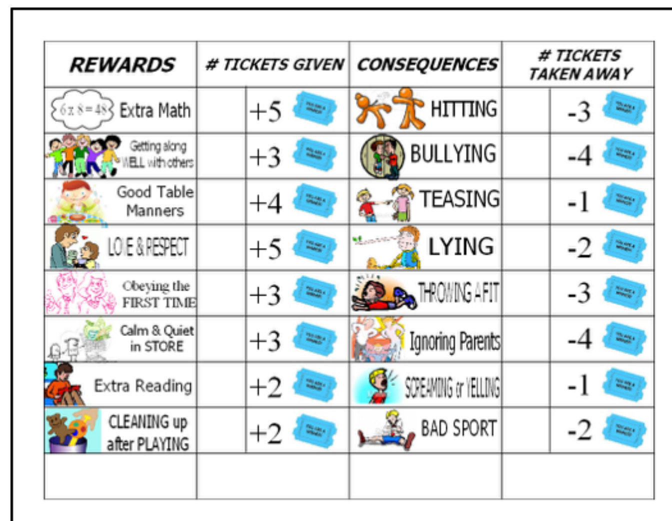
Social context
(influence)



Behavioral Analysis

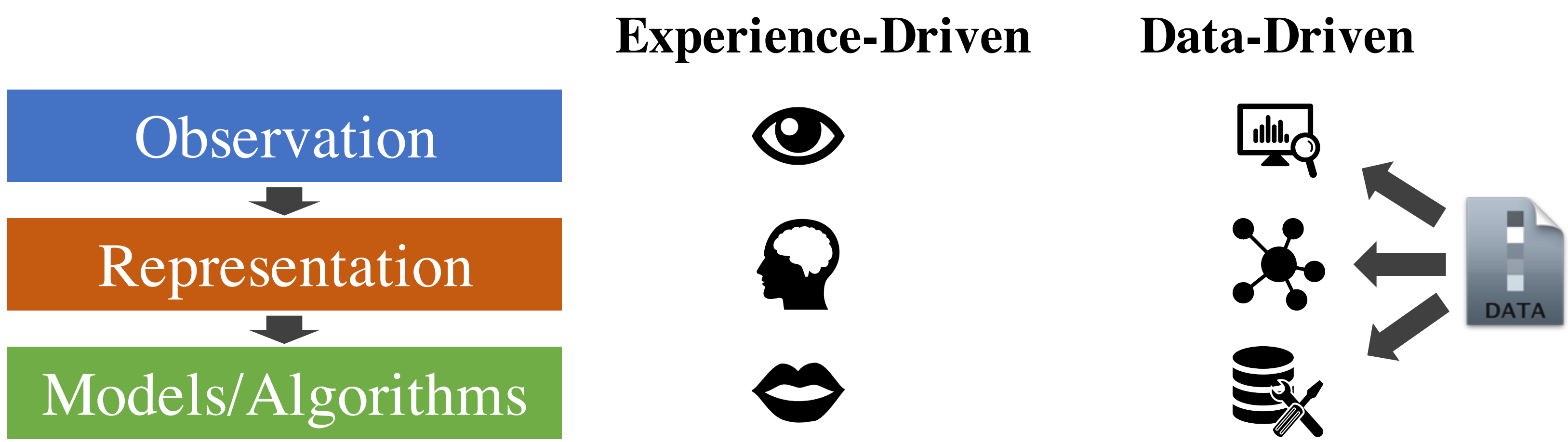
Spatiotemporal context

Intention
(suspiciousness)



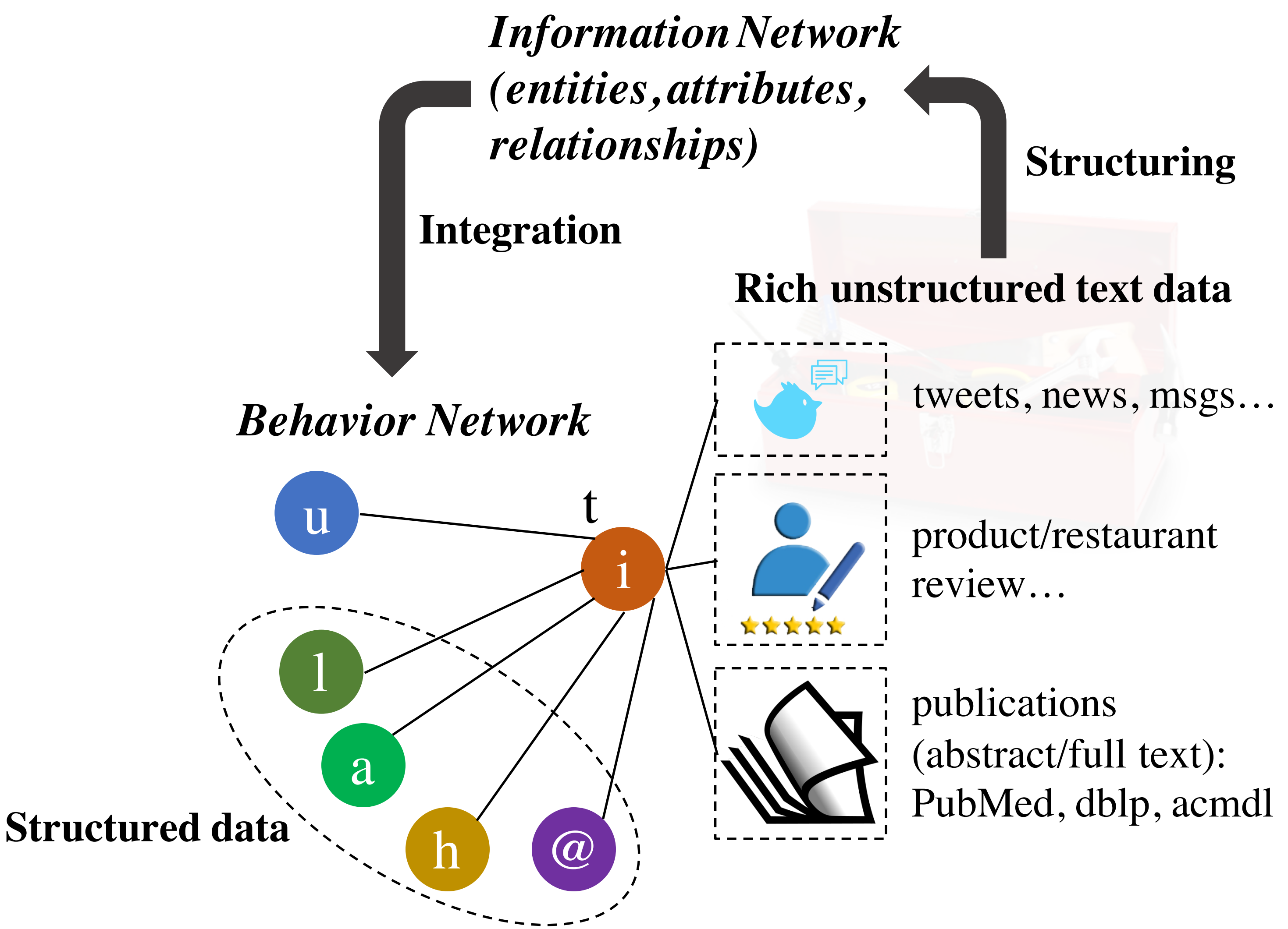
REWARDS	# TICKETS GIVEN	CONSEQUENCES	# TICKETS TAKEN AWAY
Extra Math	+5	HITTING	-3
Getting along WELL with others	+3	BULLYING	-4
Good Table Manners	+4	TEASING	-1
LOVE & RESPECT	+5	LYING	-2
Obeying the FIRST TIME	+3	THROWING A FIT	-3
Calm & Quiet in STORE	+3	Ignoring Parents	-4
Extra Reading	+2	SCREAMING or YELLING	-1
CLEANING up after PLAYING	+2	BAD SPORT	-2

Methodology: Why Data-Driven?



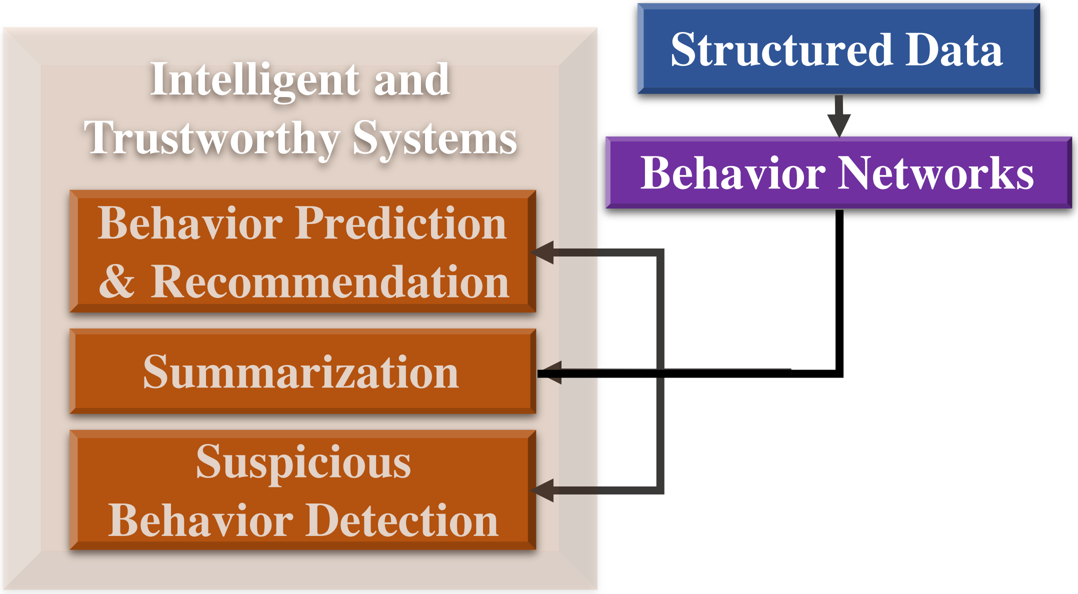
- ❑ *Applications*. Recommender systems, fraud/spam detection.
- ❑ *Representation*. **B**ehavior **N**etwork for interaction.
  - ❑ **Nodes:** users/authors, items (*e.g.*, products, tweets, papers), *etc*.
  - ❑ **Links:** (interaction) following, purchasing, tweeting, publishing, *etc*.
  - ❑ **Node attributes:** user profiles, item properties/features, *etc*.
  - ❑ **Link attributes:** similarity, distance, weight, *etc*.

Data to Network to Knowledge



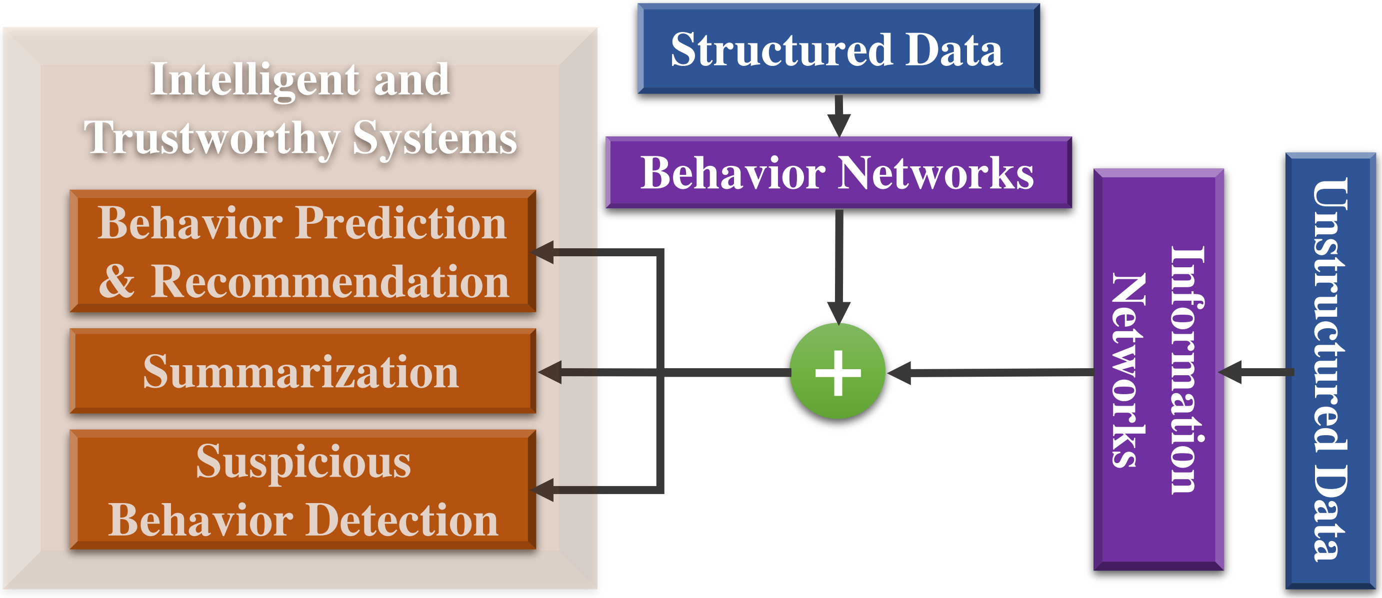
Outline: Data-Driven Behavioral Analytics

- Mining **behavior networks** with **social and spatiotemporal contexts** to support intelligent and trustworthy systems
  - Mining for **behavior prediction and recommendation**
  - Mining for **suspicious behavior detection**



Outline: Data-Driven Behavioral Analytics

- Mining **behavior networks** with **social and spatiotemporal contexts** to support intelligent and trustworthy systems
  - Mining for **behavior prediction and recommendation**
  - Mining for **suspicious behavior detection**
- Structuring behavioral content and integrating behavioral analysis with **information networks**



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Thank you!

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