Introduction to TigerGraph
Today's Presenters

Steven Fuller
Sales Engineering
100% Annual Growth in Graph through 2022

Graph ranked No. 5 on Gartner’s Top 10 Data and Analytics Technology Trends for 2019

What is graph analytics?
A set of analytic techniques that allows for the exploration of relationships between entities of interest such as organizations, people and transactions.

What’s unique about graph?
Graph data stores can efficiently model, explore and query data with complex interrelationships across data silos.

Why is graph one of the top 10 trends for data and analytics?
Graph analytics is growing due to the need to ask complex questions across complex data, which is not always practical or even possible at scale using SQL queries.
“Graph analysis is possibly the single most effective competitive differentiator for organizations pursuing data-driven operations and decisions after the design of data capture.”
Who is TigerGraph?

We provide **advanced analytics in graph**:

- Foundational for ML, AI features and applications
- Built on the only scalable graph database
  - Designed for OLAP and OLTP workloads in same database
- SQL-like querying for fast user adoption

Our **customers** include:

- Largest banks, healthcare, telecoms and utilities
- Innovative startups in cybersecurity, ecommerce and finserv

Founded in 2012, **HQ** in Redwood City, California
What is Graph ~ How Graph Works

Graph is a natural model for connected data - data exploration the way people think

- A **Graph** is a collection of **Vertices** and Vertex-to-Vertex Connections, called **Edges**
- Each Vertex (sometimes referred to as a node) and each Edge has a type and characteristic **properties**.
- **Natural storage model** for modeling data and its interconnections or relationships
- **Natural model** for representing **transactions**
- **Natural model** for **knowledge/analysis/ learning** – through following and studying connections

Relationships between logical concepts and entities such as organizations, people and transactions

- Accelerates data preparation and data science
- Use the power of relationships and deep analysis to provide insights
- Analyze data at scale - not practical, often not possible with RDBMS
The Evolution of Databases

**Relational Database**
- Complex, slow, table joins required

**Key-Value Database**
- Multiple scans of massive table required

**Graph Database**
- Pre-connected business entities - no joins needed

- **Product**: xxxxxxx
- **Customer**: xxxxxxx
- **Supplier**: xxxxxxx
- **Location**: xxxxxxx
- **Order**: xxxxxxx

- **Rigid schema**
- **High performance for transactions**
- **Poor performance for deep analytics**

- **Highly fluid schema/no schema**
- **High performance for simple transactions**
- **Poor performance for deep analytics**

- **Flexible schema**
- **High performance for complex transactions**
- **High performance for deep analytics**

© 2020 TigerGraph. All Rights Reserved
TigerGraph = OLTP + OLAP

OLTP - Transactional
- Real-time read and write
- ACID properties
  (guarantee that transaction is correct)
- Concurrency
  (many transactions at the same time)

OLAP - Analytical
- Multi-dimensional Analysis
- Compute-intensive
- Data-intensive
- Aggregation

TigerGraph
- Real-time read & write
- Real-time, compute-intensive,
  multi-dimensional analysis
- Real-time aggregation

OLTP and OLAP Together in Graph

Some Graph Databases
- ACID
- Concurrency

All Graph Databases
- Multi-dimensional data
- Real-time read
Move Faster with TigerGraph Cloud

Built for agile teams who would rather develop innovative applications than procure hardware or configure and manage databases

**Start in Minutes**
1. Start free at tigergraph.com/cloud
2. Select a Starter Kit
3. Explore & design with GraphStudio

**Build in Hours**
Build your proof of concept in hours leveraging 20+ Starter Kits (pre-built schema, queries & dataset)

**Deploy in Days**
- Scale up to terabytes, with security and privacy
- Support 100,000+ deep link analytics queries per second

Thousands of users are building new applications easier and faster

www.tigergraph.com/strarterkits
### Starter Kits Available with TigerGraph Cloud

<table>
<thead>
<tr>
<th>Starter Kit</th>
<th>Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer 360 - Engagement and Attribution</td>
<td>Create 360 view of customer journey for attribution and engagement insights</td>
</tr>
<tr>
<td>Entity Resolution (MDM)</td>
<td>Identify, link and merge entities such as customers with analysis of attributes and relationships</td>
</tr>
<tr>
<td>Enterprise Knowledge (Corporate Data, Crunchbase Data)</td>
<td>Analyze corporate and Crunchbase data including founders and investments</td>
</tr>
<tr>
<td>Fraud and Money Laundering (Financial Services)</td>
<td>Detect different types of fraud and money laundering patterns</td>
</tr>
<tr>
<td>Healthcare (Referral Networks, Hub &amp; community detection)</td>
<td>Analyze member claims to establish referral networks, identify hubs or influential prescribers and detect community of connected prescribers</td>
</tr>
<tr>
<td>Healthcare (Drug Interaction/FAERS)</td>
<td>Connect &amp; analyze public data (FAERS) and private data on pharmaceutical drugs</td>
</tr>
<tr>
<td>Machine Learning for Fraud Detection</td>
<td>Accelerate fraud detection with graph-based features for machine learning</td>
</tr>
<tr>
<td>Network and IT Resource Optimization</td>
<td>Model the impact of hardware outages on network and IT resources</td>
</tr>
<tr>
<td>Recommendation Engine</td>
<td>Build a recommendation engine based on user ratings (movie dataset)</td>
</tr>
<tr>
<td>Social Network Analysis</td>
<td>Understand and analyze social network relationships</td>
</tr>
<tr>
<td>Supply Chain Analysis</td>
<td>Improve supply chains with better inventory planning and impact analysis</td>
</tr>
</tbody>
</table>

See overview videos & other info at [tigergraph.com/starterkits](http://tigergraph.com/starterkits)
Demonstration 1: Entity Resolution MDM
TigerGraph Deployment Options

- **Bare Metal Servers**
  - Runs on Linux

- **Ready-to-go Virtual Machine Images**
  - E.g. Amazon AWS AMI
  - Azure and Google Cloud as well

- **TigerGraph Cloud**
  - Fully managed
  - 20+ Starter Kits available

- **Clustering,** for HA and for distributed database
TigerGraph: 3rd Generation Graph Database

Real-time Performance
Sub-second response for queries touching tens of millions of entities/relationships

Transactional (Mutable) Graph
Hundreds of thousands of updates per second, Billions of transactions per day

Scalability for Massive Datasets
100 B+ entities, 1 Trillion+ relationships

Deep Link Multi-Hop Analytics
Queries traverse 10+ hops deep into the graph performing complex calculations

Ease of Development & Deployment
- GraphStudio - visual SDK
- GSQL - Intuitive, Turing complete graph query language for developing complex analytics in days
- User extensible graph algorithms library

Enterprise Grade Security
- Encryption Support
- Control access to sensitive data based on user role, dept or organization with MultiGraph
Seamless integration enables businesses to **accomplish more with existing investments**

### Business Outcomes, Solutions & Use Cases

<table>
<thead>
<tr>
<th>Increase revenue</th>
<th>Reduce Costs &amp; Manage Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product &amp; Service Marketing</td>
<td>Anti-Money Laundering</td>
</tr>
<tr>
<td>Real-time Customer 360/MDM</td>
<td>Cyber Security</td>
</tr>
<tr>
<td>Recommendation Engine</td>
<td>Fraud Detection</td>
</tr>
<tr>
<td><strong>Foundational</strong></td>
<td><strong>Improve Operational Efficiency</strong></td>
</tr>
<tr>
<td>AI &amp; Machine Learning</td>
<td>Energy Management System</td>
</tr>
<tr>
<td>Geospatial Analysis</td>
<td>Enterprise Knowledge Graph</td>
</tr>
<tr>
<td>Time Series Analysis</td>
<td>Network, IT &amp; Cloud Resource Optimization</td>
</tr>
<tr>
<td><strong>Operational Data</strong></td>
<td></td>
</tr>
<tr>
<td>IoT Signals</td>
<td></td>
</tr>
<tr>
<td>Orders</td>
<td></td>
</tr>
<tr>
<td>Payments</td>
<td></td>
</tr>
<tr>
<td>Shipments</td>
<td></td>
</tr>
<tr>
<td>Invoices</td>
<td></td>
</tr>
<tr>
<td>Visits</td>
<td></td>
</tr>
<tr>
<td>Downloads</td>
<td></td>
</tr>
</tbody>
</table>

**Operational Data**

- IoT Signals
- Orders
- Payments
- Shipments
- Invoices
- Visits
- Downloads

**Master Data**

- Customers
- Supplier
- Employee
- Device

Queries / Lookups, Comprehensive Graph Patterns and Algorithms

Batch and Streaming

Graph Computed Features

**Historical Data**
Graph Use Cases

- Entity Resolution
- Customer 360
- Supply Chain Management
- Cybersecurity
- Machine Learning
- Recommendation Systems
- Data Lineage
- Fraud Prevention
- Investment Opportunity Analysis
- Law Enforcement
- Network & IT Resource Utilization
- Influencer & Community Identification
- Knowledge Graphs
- Social Network Analysis
- Drug Reaction Analysis
- Explainable AI
Example: Driving Business Value in 3 Steps

**Step 1: Entity Resolution**
Link IDs to create a unified identity

**Step 2: Relationship Analysis**
Connect & analyze the internal and external datasets for user behavior
- Marketing Campaigns
- Viewership History
- Promotional Responses
- Engagement Activity
- Purchase History
- And More

**Step 3: Insights and Actions**
- Find similar users/customers
- Uncover hidden connections
- Recommended next best action
- Find most influential users/customers
- Detect connected users (communities)
Entity Resolution

- Problem exists across multiple industries and verticals:
  - e-commerce websites, airline bookings, digital advertising, IoT, etc.
- A Natural Graph Problem
- TigerGraph is a perfect fit for this type of problems
  - especially if you have a lot of data to resolve

**Step 1: Entity Resolution**
- Link IDs to create a unified entry

**Step 2: Relationship Analysis**
- Connect & analyze the internal and external datasets for user behavior
  - Marketing Campaigns
  - Viewership History
  - Promotional Responses
  - Engagement Activity
  - Purchase History
  - And More

**Step 3: Insights and Actions**
- Find similar users/customers
- Uncover hidden connections
- Recommended next best action
- Find most influential users/customers
- Detect connected users (communities)

Problem exists across multiple industries and verticals:
- e-commerce websites, airline bookings, digital advertising, IoT, etc.

A Natural Graph Problem

TigerGraph is a perfect fit for this type of problems
- especially if you have a lot of data to resolve
Graph Based Entity Resolution for MDM with TigerGraph

Visit the solution page - https://www.tigergraph.com/solutions/real-time-customer-360mdm/
Demonstration 2: Entity Resolution
Machine Learning
Building A Real-time Customer 360 Data Hub

Business Challenge
Combine all available data for the customer with transactions (orders, payments, calls, rides..) in real-time to improve business outcomes

Solution
• Build on top of current investments in master data management, data warehouse/Hadoop data lake and NoSQL repositories
• Find new relationships among data to drive better fraud and money laundering detection, credit risk scoring and monitoring, product & service marketing, cross-sell and up-sell recommendation for higher revenue & profits
• Analyze temporal (Time Series) and spatial data to find new patterns and insights
• Expand schema (attributes/fields, relationships) to accommodate new data sources & use cases

Business Benefits
Improve customer experience, increase revenue and lower costs
# 7 Key Data Science Capabilities Powered By a Native Parallel Graph

1. **Deep Link Analysis**
   - For a set of entities (e.g. customers, accounts, citizens, doctors), show all links or connections.

2. **Multi-dimensional Entity & Pattern Matching**
   - Given a pattern (e.g. connections indicating fraud), find similar patterns in the graph.

3. **Relational Commonality Discovery & Computation**
   - Given 2 entities (e.g. customers, merchants, doctors), follow their relationship to find commonality.

4. **Hub & Community Detection**
   - Find most influential members of a group (customers, doctors, citizens) & detect community around them.

5. **Geospatial Graph Analysis**
   - Analyze changes in entities & relationships with location data.

6. **Temporal (Time-Series) Graph Analysis**
   - Analyze changes in entities & relationships over time.

7. **Machine Learning Feature Generation & Explainable AI**
   - Extract graph-based features to feed as training data for machine learning; Power Explainable AI.

© 2018 TigerGraph. All Rights Reserved
## The TigerGraph Difference

<table>
<thead>
<tr>
<th>Feature</th>
<th>Design Difference</th>
<th>Benefit</th>
</tr>
</thead>
</table>
| **Real-Time Deep-Link Query** | • Native Graph, for speed and efficiency  
• C++ engine, for high performance  
• Architected and designed for interoperability | • Uncovers hard-to-find patterns  
• Operational, real-time  
• HTAP: Transactions+Analytics |
| **Handling Massive Scale**   | • World’s first Native parallel and distributed Graph  
• Distributed DB architecture  
• Massively parallel processing  
• Compressed storage reduces footprint and messaging | • Integrates all your data  
• Automatic partitioning  
• Complete data → Better detection  
• Scale to meet business requirements |
| **GSQL**                    | • Simple Graph Traversal  
• GSQL: High-level yet Turing-complete language  
• ACID (OLTP) and Accumulators (OLAP) | • Quick retrieval of data based on complex logic  
• Develop custom logic and analytics  
• Real-time data ingestion and analytics in a single platform |
| **In-Database Analytics**   | • User-extensible graph algorithm library, runs in-DB  
• Machine learning feature generation  
• Explainable AI | • Avoids transferring data  
• Richer graph context  
• Option for in-DB machine learning |
Q&A

Please submit your questions via the Q&A tab in Zoom
Get Started with TigerGraph

- Download TigerGraph’s Developer or Enterprise Free Trial - tigergraph.com/download
- Advance your graph knowledge with the eBook - “Native Parallel Graphs” - tigergraph.com/ebook
- Get Certified - tigergraph.com/certification

@TigerGraphDB /tigergraph /TigerGraphDB /company/TigerGraph

Continue your journey to graph at TigerGraph.com/Cloud