Graphalyzer

A graph visualization and analysis tool

Team May1618 / Workiva

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Team Members:

- Andrew Bowler - Webmaster
- Alberto Gomez-Estrada - Communications Lead
- Michael Sgroi - Key Concept Holder
- Richard White - Key Concept Holder
- Taylor Welter - Project Lead
- Dr. Simanta Mitra - Advisor
- Ross Hendrickson - Client

Problem - Big Data

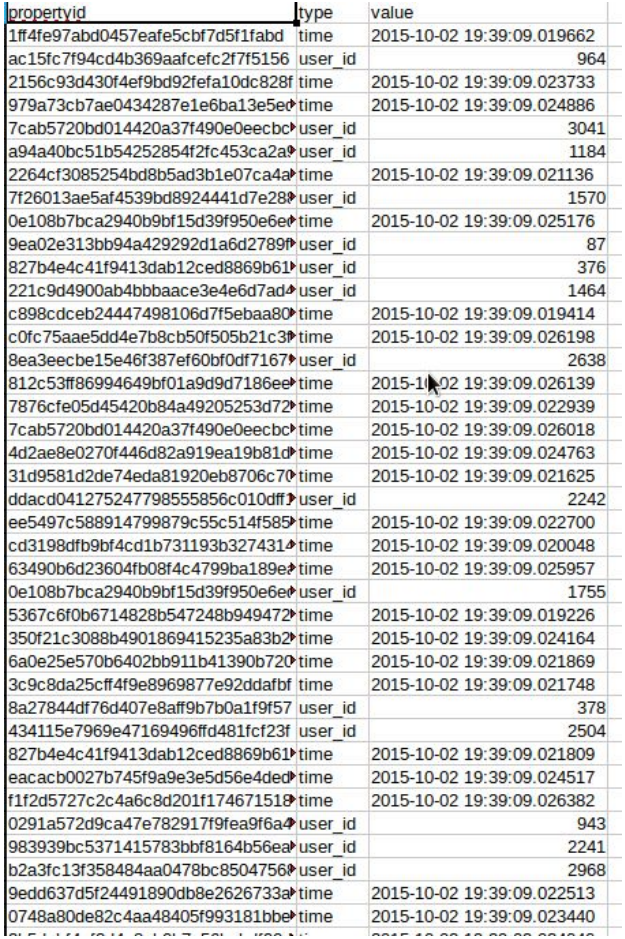
- Companies constantly dealing with Big Data
  - Social media
  - Employee directories
  - Documents on a server
  - Etc...
- How can we understand Big Data? What does it mean?

Solution - Graphs

- Graphs are a helpful way to represent Big Data
  - Structural behavior
  - Relationships
  - Key properties or members of high impact

Looking at data in tables

- Difficult to see or find patterns
- Requires you to join many tables
  - High performance cost
- Example: Sales
  - You have a tables for salesmen, customers, orders, and items
    - Not joined
      - Impossible to see any patterns
    - Joined
      - Hard to see patterns in giant lists
      - High performance cost



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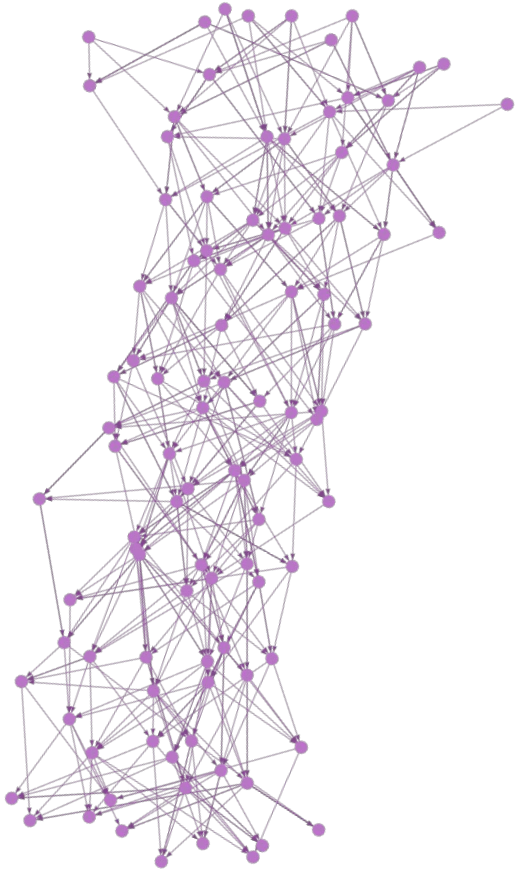
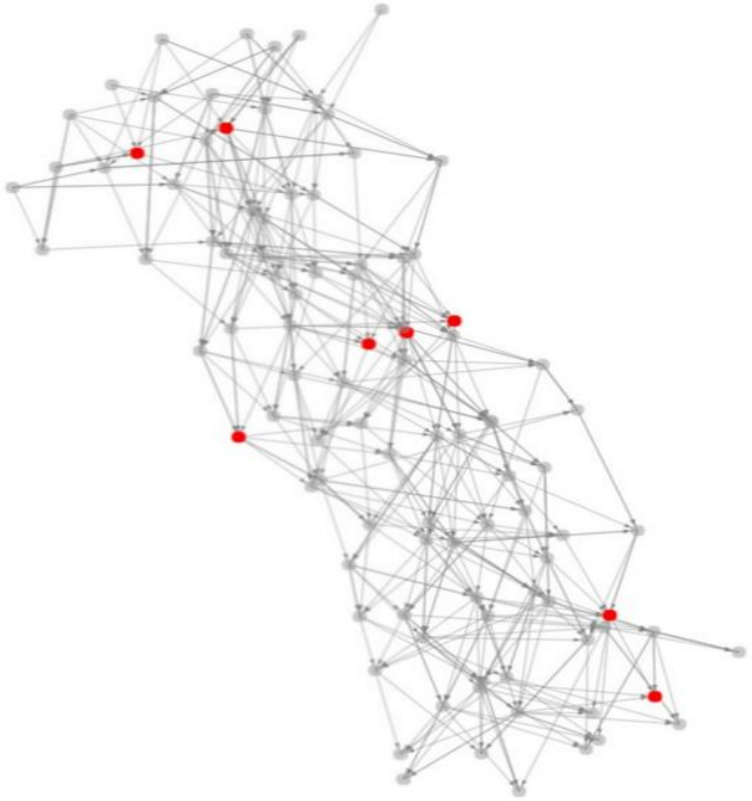
Looking at data in graphs

- Easy to see patterns
- Minimal performance cost
- Example: Sales
    - Each salesmen, customer, order, item is a node
    - Relationships are expressed as edges



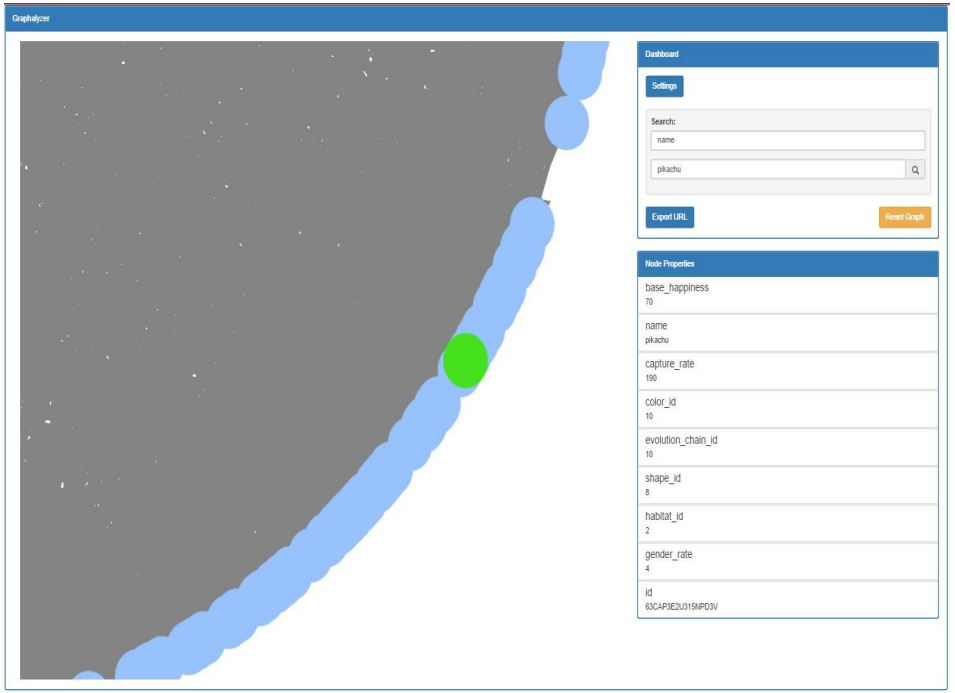
Goals of Graphalyzer - Visualization

- Present a visualization of graphical data to the user through an Internet browser
    - Context of data is arbitrary, serve as a tool for any graph data
    - Display graph through intuitive interface - **use shapes and colors**



Goals of Graphalyzer - Analysis

- Allow user to specify parameters for visualization
  - Filtering and highlighting nodes by properties
  - Search for and focus in on nodes, display their properties



Goals of Graphalyzer - Performance

- Handle large data
  - Size of data can range from very small to many gigabytes
  - Hundreds of nodes or edges to millions of nodes or edges

Technical Challenge #1 - Uncharted Waters

- Working with new technologies
  - Angular and D
  - Server administration
- **Solution:** Don’t reinvent the wheel
  - Use familiar tools to get the job done
  - Follow Workiva’s advice

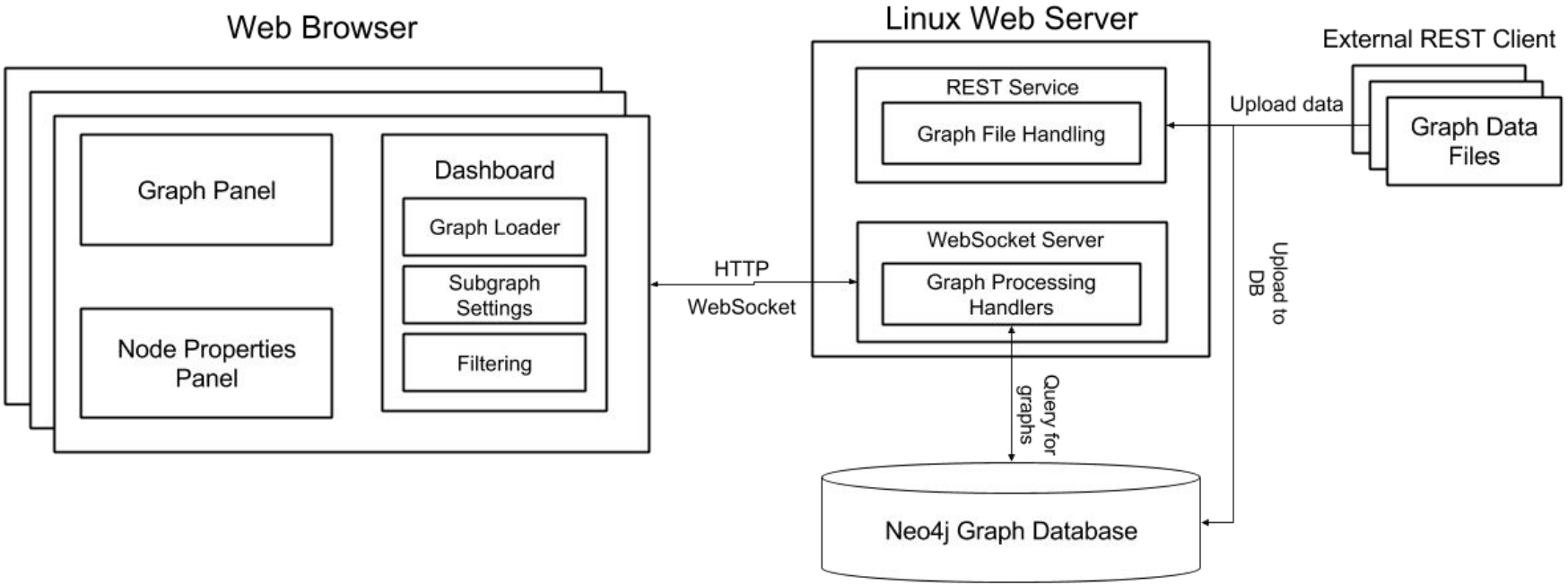
Technology Stack

- Graph Libraries
  - Vis.js
  - neo4j
- Workiva Stack
  - React.js
  - Python
- REST service
- Ubuntu Web Server

- This project is expected to continue under Workiva

- Keep code organized and familiar with style guidelines, so work can continue

Design


Web Browser
Graph Panel
Node Properties Panel
Dashboard
Graph Loader
Subgraph Settings
Filtering
HTTP
WebSocket
Linux Web Server
REST Service
Graph File Handling
WebSocket Server
Graph Processing Handlers
Query for graphs
Upload data
Upload to DB
External REST Client
Graph Data Files
Neo4j Graph Database

Technological Challenge #2 - Implementing a test plan

- We planned on using Jest, the testing framework bundled with React.js and based on JUnit
  - Our implementation encountered issues when running Jest.
- Testing front-end and back-end simultaneously presented issues on TravisCI
  - Our Python server filters all IP Addresses except those within a range determined by Workiva.
- **Solutions:**
  - Using Jest and PyUnit to test both the front and back-ends.
  - For the sake of the project, we only unit tested, since the server is not reachable.

Test Plan

- Using Jest:
  - Validate rendering of Javascript objects
  - Verify that the React components maintain a consistent state and manipulate their data as expected
  - Validate requests and response to Python server
- Goals
  - Ensure maintainability of code, keeping in mind that our software may be used by Workiva in the future

Technological Challenge #3 - Scalability and Performance

- Be able to visualize data that could be gigabytes in size

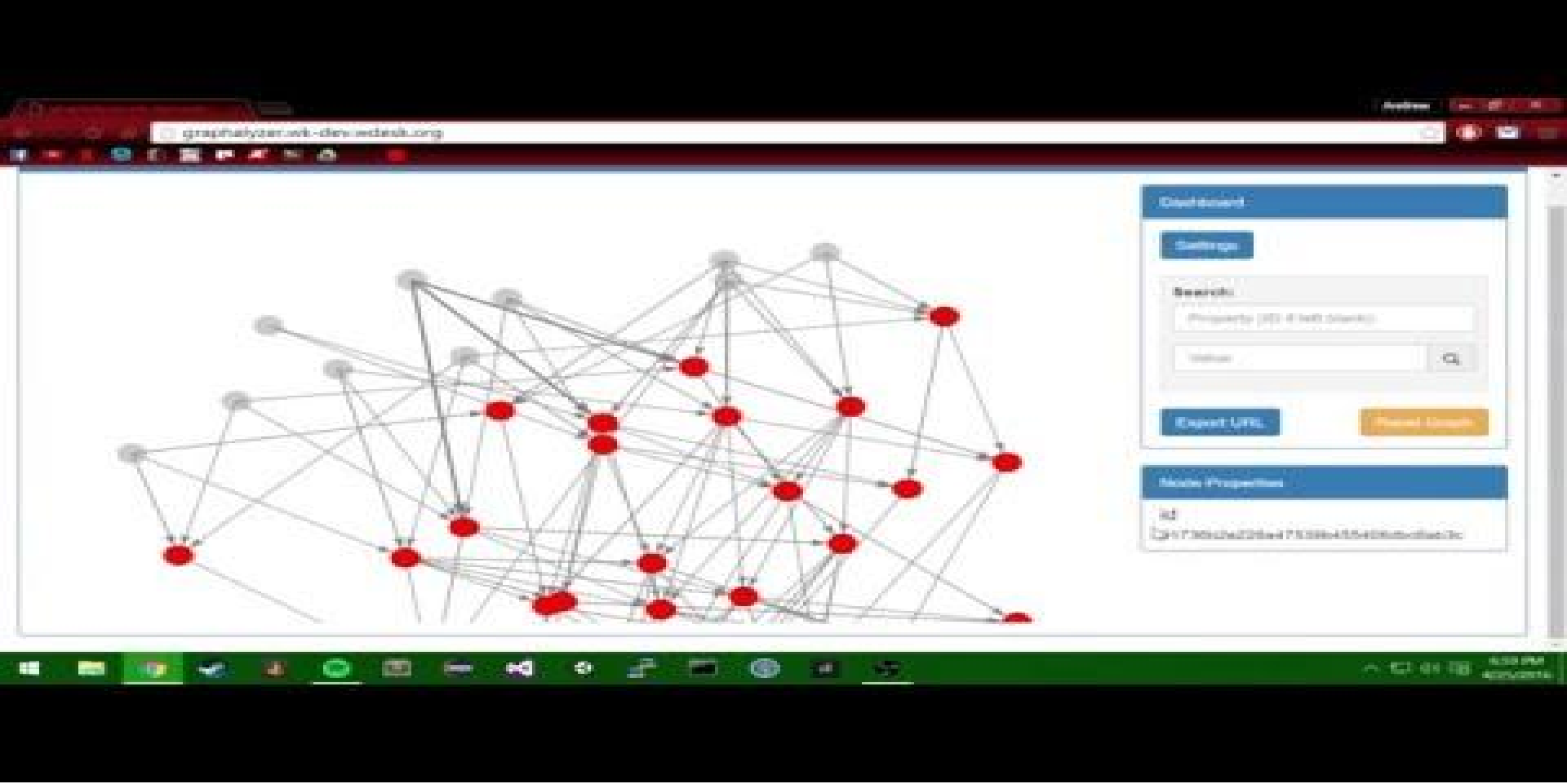
- Maximize scalability and performance, minimize impact to user interactivity

Technological Challenge #3 - Solutions

- **Solutions:**
  - Stream the data - query data from neo4j and send previously received data to the client simultaneously in chunks.
  - Do graph processing server-side as much as possible
    - Reduces loads on browser, CPU, and GPU
  - Visualize only what the user wants
    - Draw subgraphs - up to the user
- The provided server has very limited disk space and RAM, so we can only store a few hundred megabyte sized graphs

Filtering

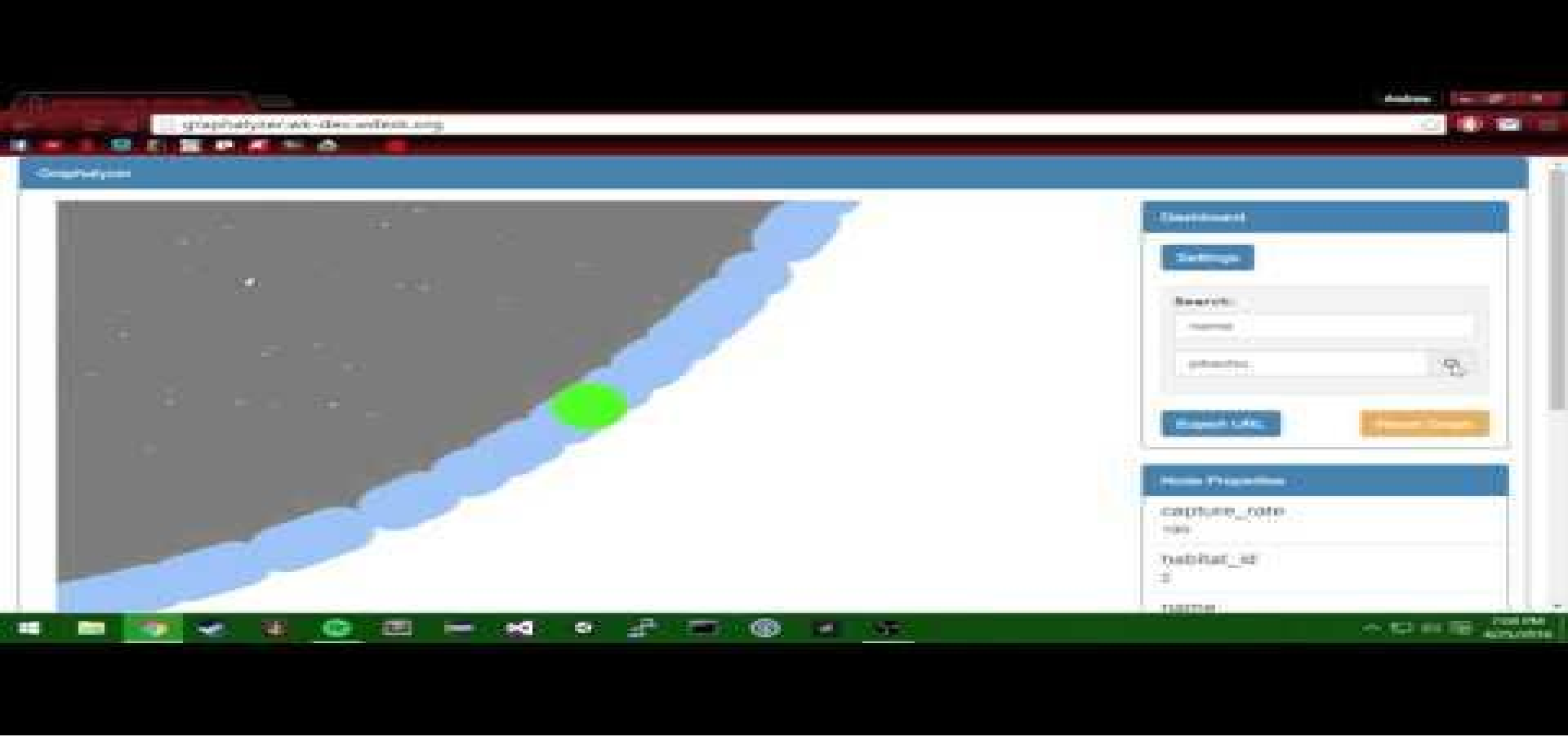
- Lots of data, need to find certain entries
  - May have properties with values
  - **Example:** find all people on payroll with a salary greater than a certain value
- Graphalyzer provides users with customizable options
- Highlight nodes that pass filter test, grey out all others



https://youtu.be/P5A3UxZwodU

Searching

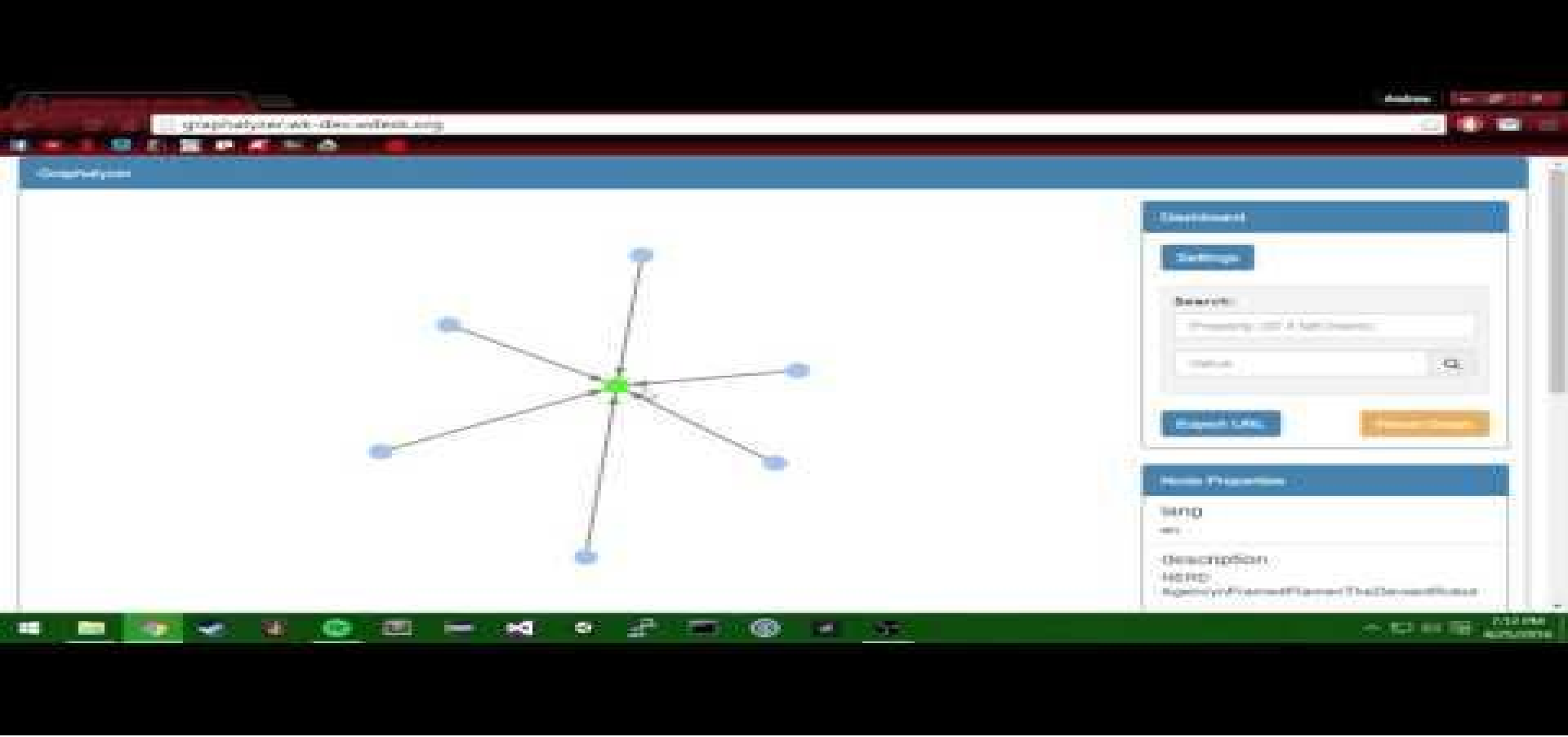
- Important node exists somewhere within giant graph
  - Find it, and display all of its properties to the user
  - **Example:** Find a CEO of a company with more than 10,000 employees and display all of that person's information in the graph's data
- Graphalyzer makes this easy by zooming into the node and listing all of its properties



https://www.youtube.com/watch?v=ArWq8q4BD04&feature=youtu.be

Subgraphs

- Often times the user does not need to see the entire graph, but only a part of it
- The graph could have thousands of nodes and edges the user doesn't care about
    - **Example: Given a name of a person on Twitter, display all of their followers and people they are following**
- Graphalyzer only requires a source node (person in this case), and a depth of connectivity (incoming and outgoing)



https://www.youtube.com/watch?v=hqfuVaon-54&feature=youtu.be

Sharing Your Graph Analysis Results

- Graph analysis can often be done collaboratively
- Graphalyzer allows users to export a custom web URL and share it with others
  - Copied to clipboard, paste it in an email, group chat, etc.
  - Paste the URL in the browser on another computer
  - Watch it go
- In addition, you can save your visualization as a PNG image
  - HTML5 Canvas makes this trivial

Achievements

- **Visualization and Analysis:**
  - Subgraphs
  - Filtering
  - Searching
  - Listing properties
- **File Handling and Performance:**
  - Folder uploads
  - REST service
  - Tested to handle many thousands of nodes and edges
- **Other Achievements:**
  - Dedicated Amazon Web Server with deployed code
  - Unit testing suite with continuous integration
  - URL Exporting for sharing analysis
  - Open source GitHub repository

Questions