# Semantic Visual Search: Visual Exploration of Spore Creations

CS294 Final Project Presentation
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# Problem Description


Spore database: 140 million+ creations

How do you browse / search this data?

How do creatures relate to each other?

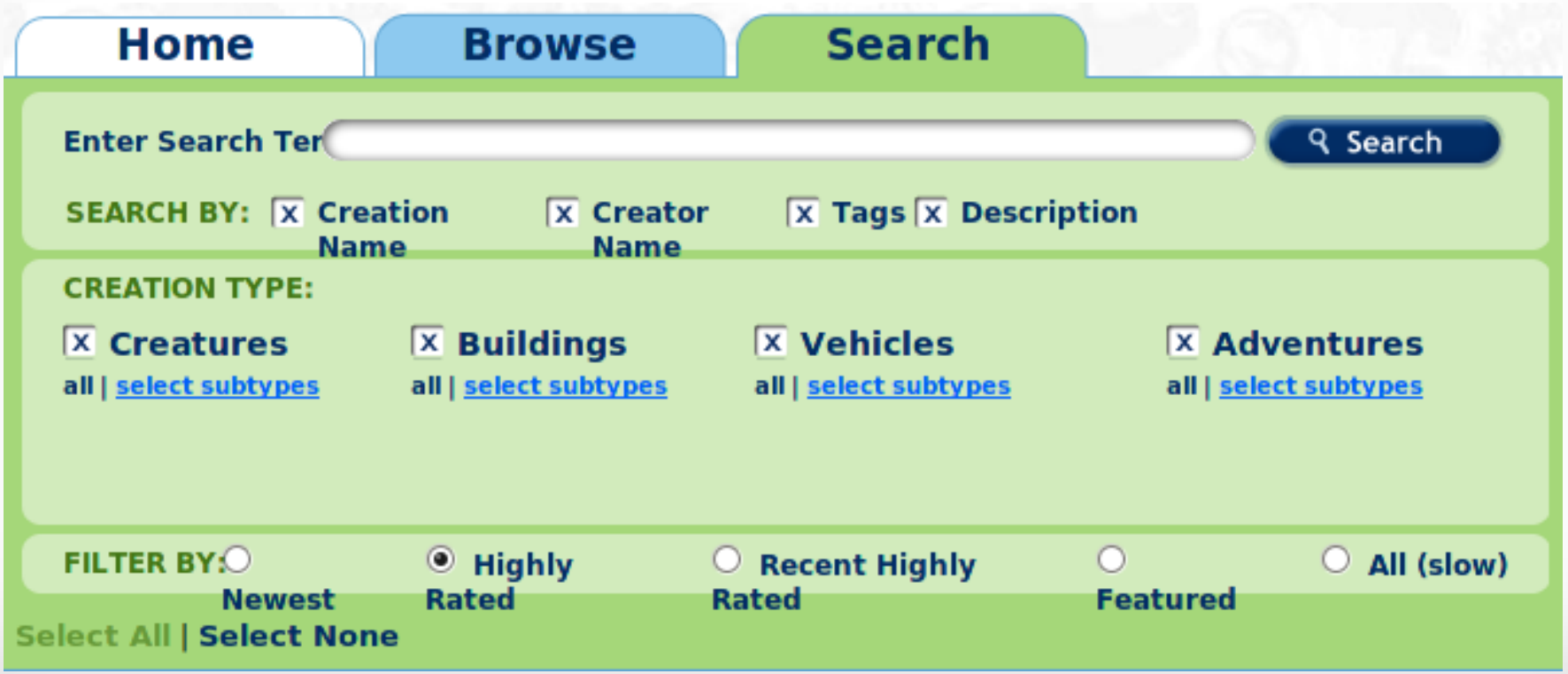
# Existing Keyword-based Search

**Slow, not very interactive**

Type in search terms, select category, pages of results

**Inaccurate, imprecise**

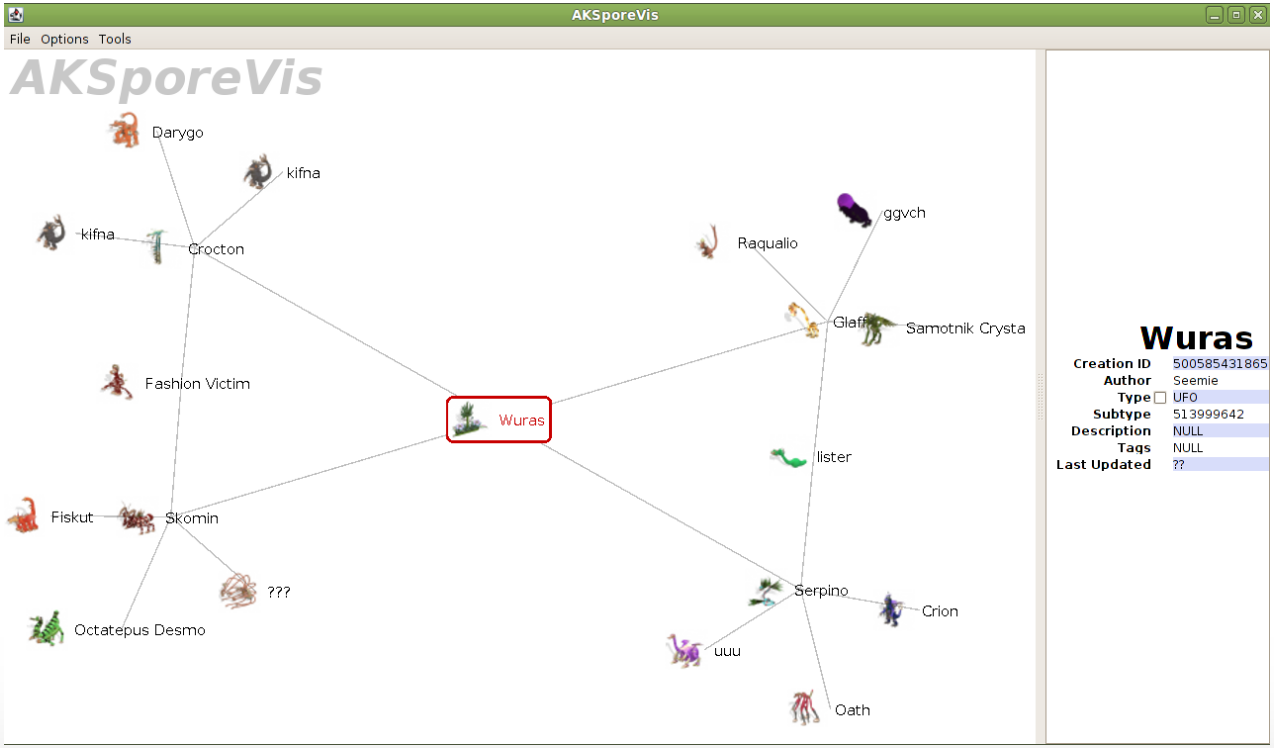
Mislabeled / mistagged creations, ambiguity



# Solution: Morphology Tree

**Find most similar creations, link them together**
semantically-meaningful results linked by morphology

**Dynamic query techniques**
Trees with overview, zoom & filter, details-on-demand



# Step 1: Data Parsing

## 1,000 XML Files

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<?xml version="1.0" encoding="UTF-8"?>
<sporemodel>
  <formatversion>16</formatversion>
  <properties>
    <modeltype>0x9ea3031a</modeltype>
    <skineffect1>0xf9081c4e</skineffect1>
    <skineffect2>0xf726d097</skineffect2>
    <skineffect3>0x91c84cb2</skineffect3>
    <skineffectseed1>1234</skineffectseed1>
    <skineffectseed2>1234</skineffectseed2>
    <skineffectseed3>1234</skineffectseed3>
    <skincolor1>0.961000,0.898000,0.796998</skincolor1>
    <skincolor2>0.576469,0.572548,0.498039</skincolor2>
    <skincolor3>1,0.941176,0.831371</skincolor3>
    <zcorpscore>0</zcorpscore>
  </properties>
  <blocks count="88">
    <blockref>
      <blockid>0x40626000, 0xd05c53a3</blockid>
      <transform>
        <scale>0.280000</scale>
        <position>0,-0.256773,1.672280</position>
        <triangledirection>0,0.994836,-0.101489</triangledirection>
        <trianglepickorigin>0,0,0</trianglepickorigin>
        <orientation>
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          <row1>0,0.994836,-0.101489</row1>
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        </orientation>
      </transform>
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        <childid>58</childid>
        <childid>1</childid>
      </childlist>
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    <blockref>
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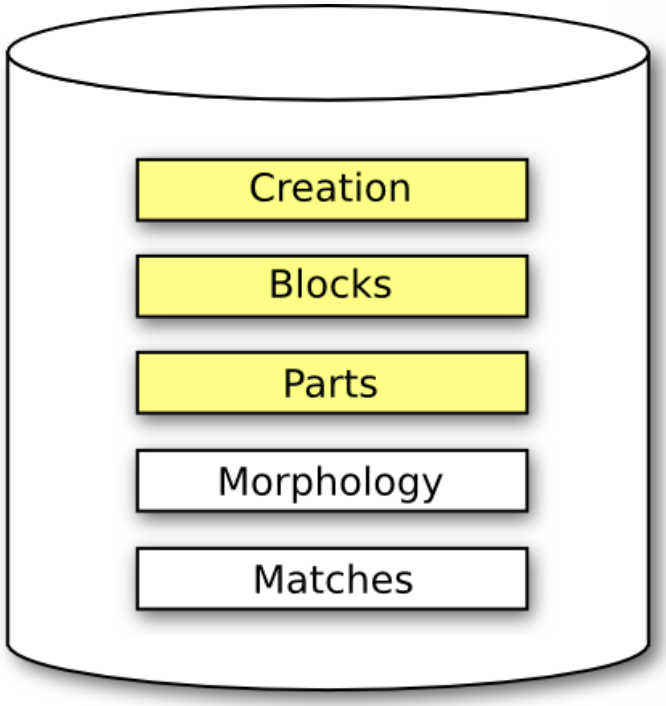
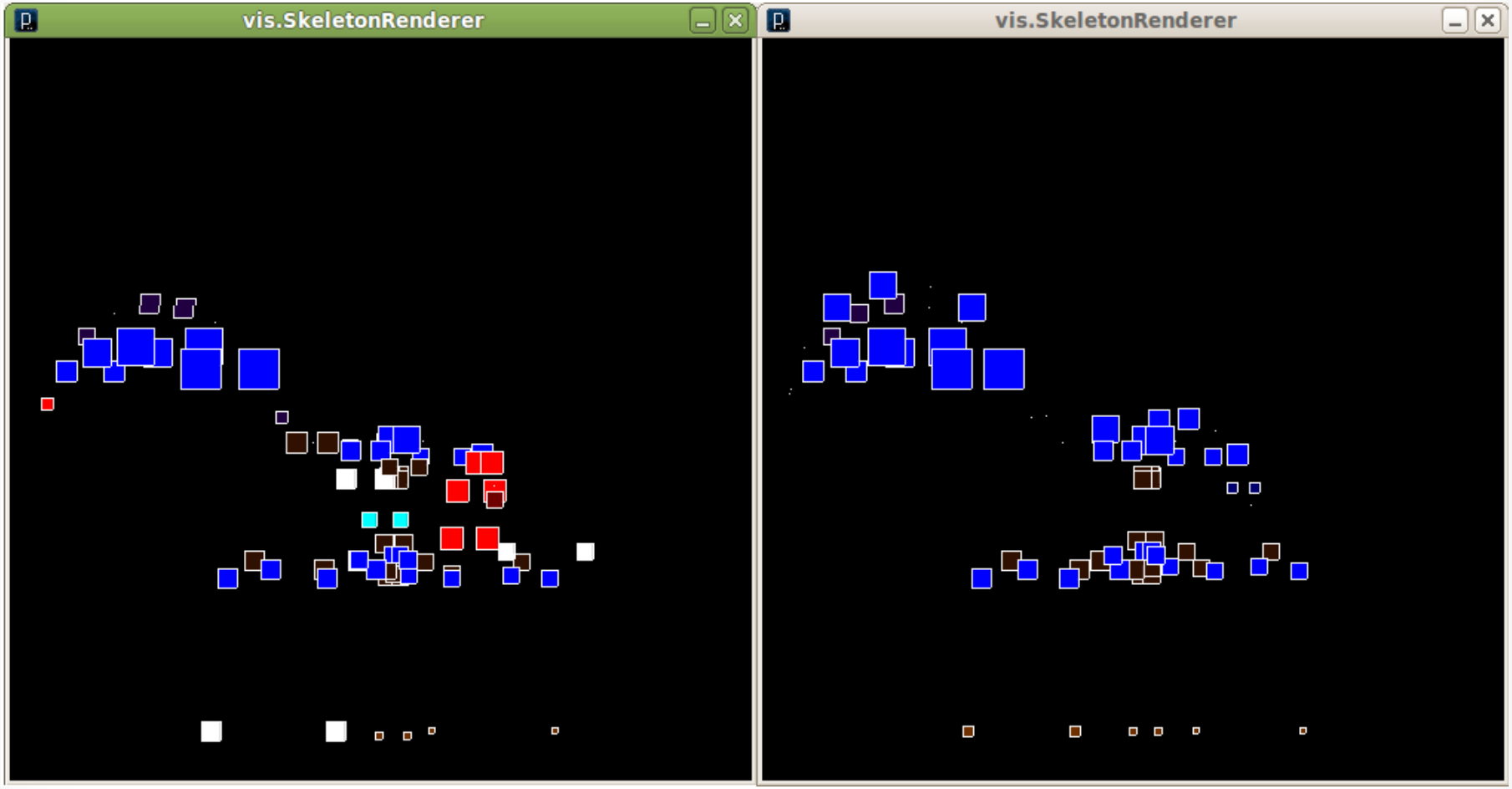
        <trianglepickorigin>0,0,0</trianglepickorigin>
        <orientation>
          <row0>1.000000,0,0</row0>
          <row1>0,0.850822,-0.525452</row1>
          <row2>0,0.525452,0.850822</row2>
```

## PostgreSQL Database

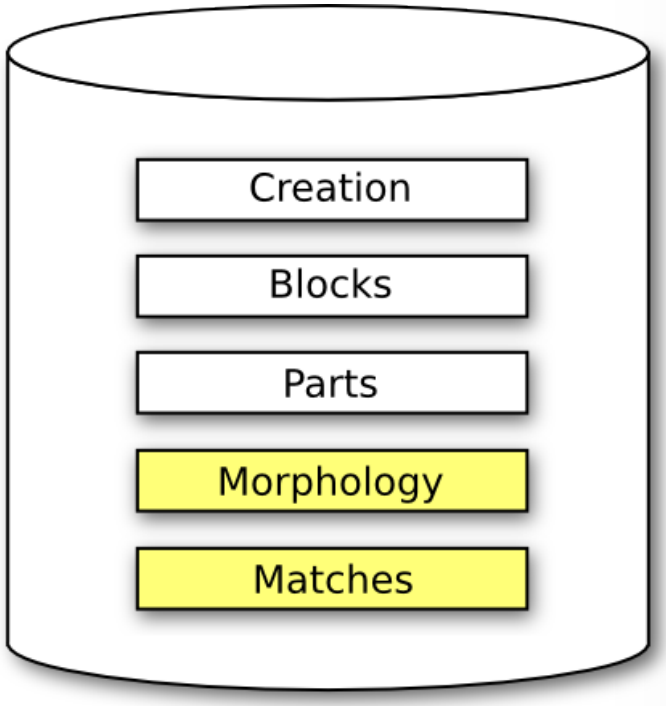


# Step 2: Determine Morphology



# Step 3: Calculate Matches

1. Find starting block of creature description
2. Generate creature topology (how parts are connected)
3. Find all sequences of 3 connected blocks in creation.
4. Generate match index for each creature in database
5. Sort creature pairs by number of matches.



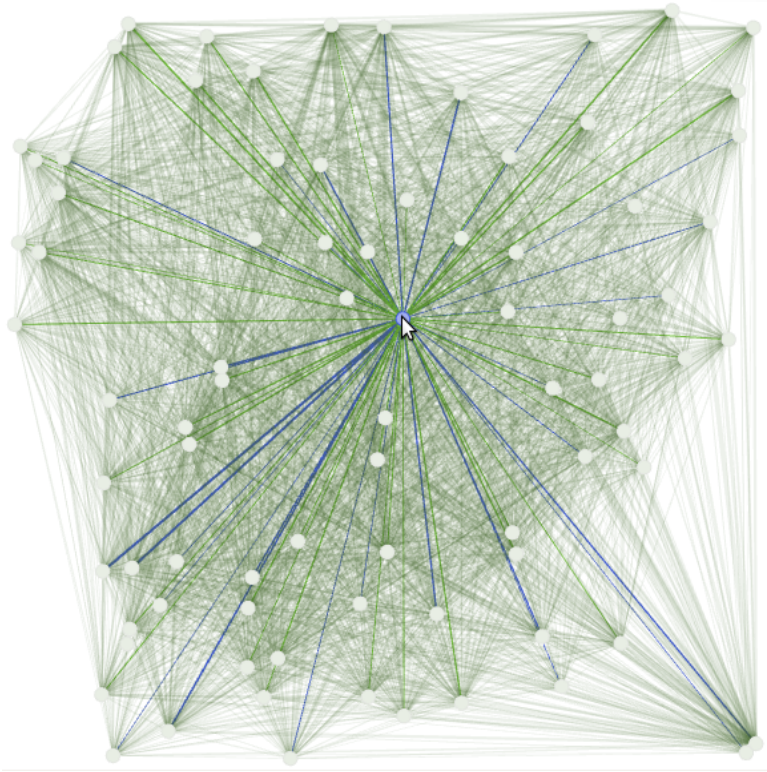
# Step 4: Build Graph

1. Start with 80 creatures, calculate match index between each pair.

2. Initial graph is too dense (3000 edges), does not convey useful information

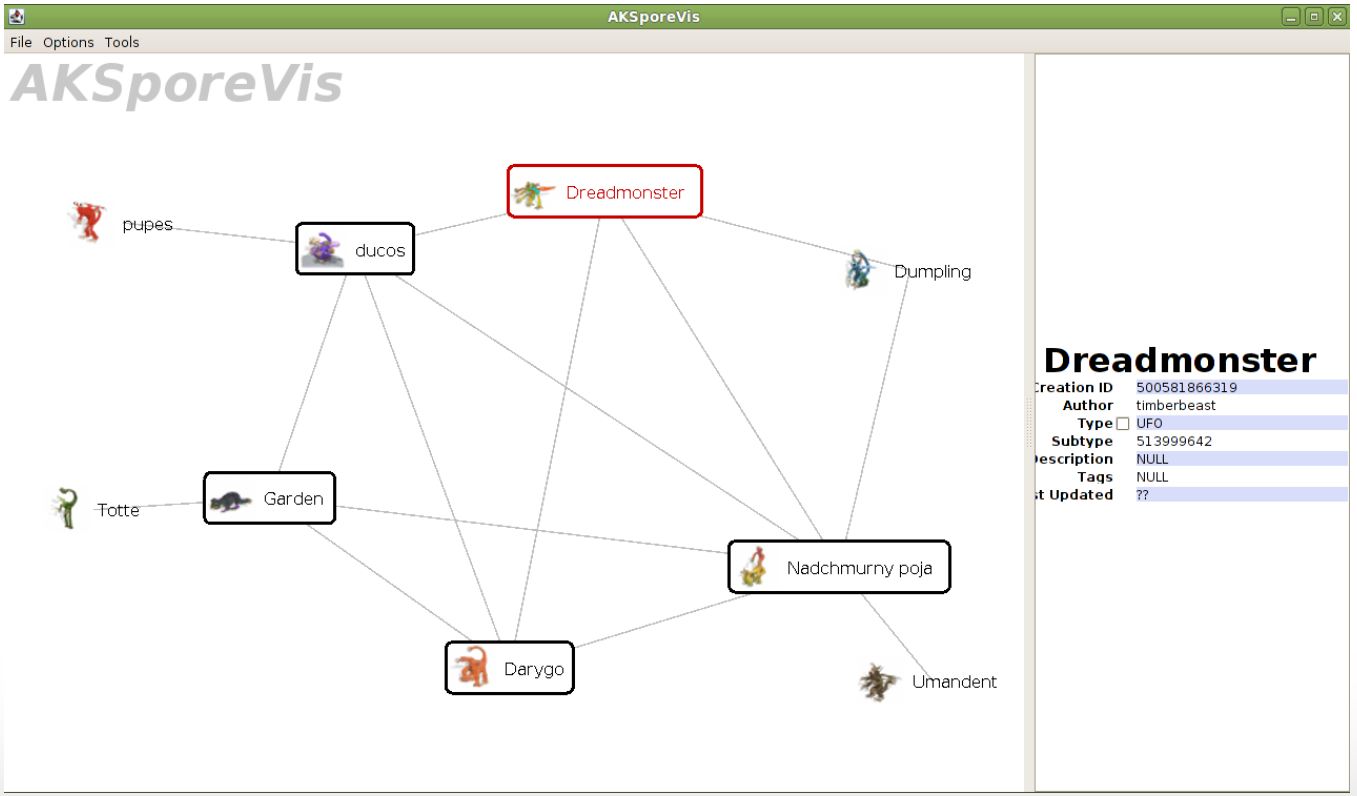
3. Solution: Reduce number of nodes, only connect a creature to its 4 top matches

**Gephi Demo**



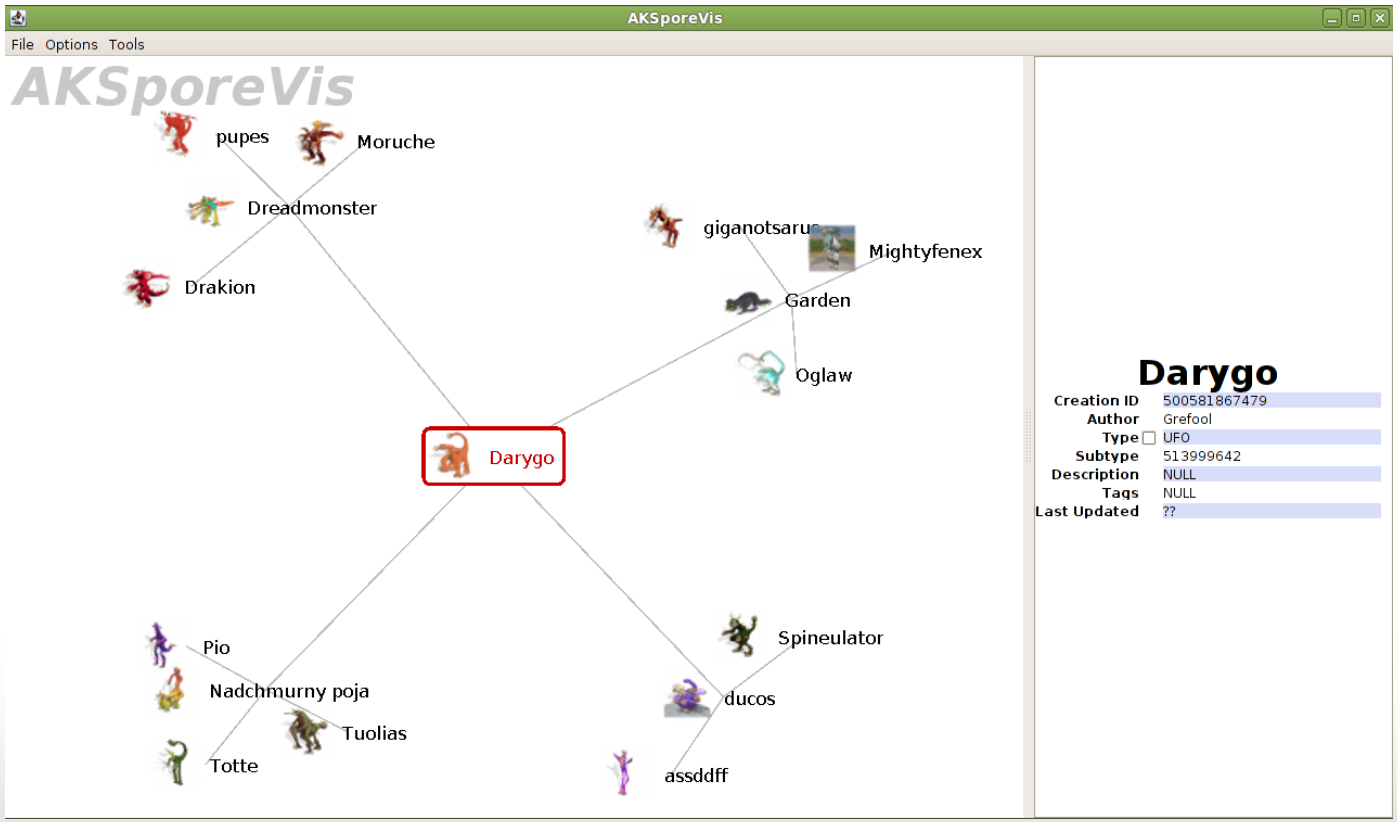
# Step 5: Build Visualization

1. Build visualization based on Prefuse framework; interactive zoom, details on demand, animation
2. Use small graph and display pictures of creatures
3. Edges are still annoying; Solution: turn graph into tree using hierarchical clustering



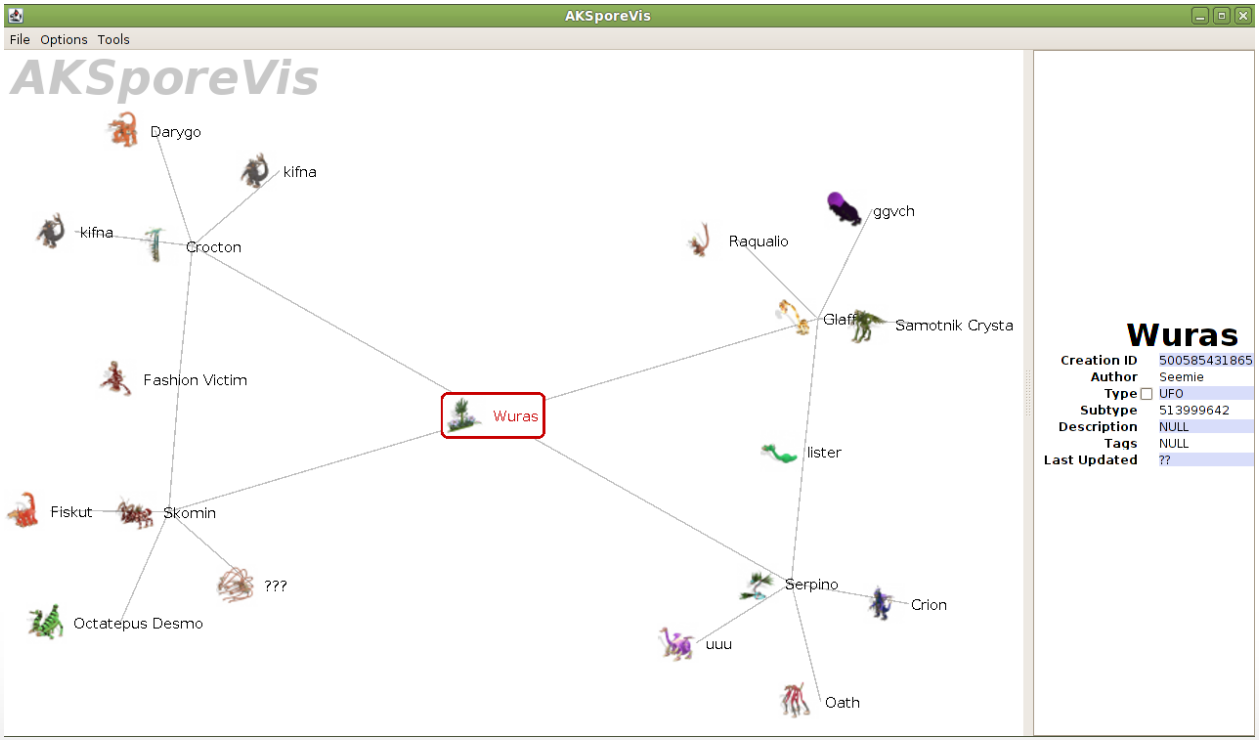
# Step 6: Iterate and Refine

1. Increase size of dataset, add additional metrics for determining matches
2. Improve performance via caching most recently used images and data.
3. Add additional functionality, search criteria.



# Future Work

1. Better visualization of specific matching parts.
2. Find more optimal node layout (currently using Fruchterman-Reingold algorithm)
3. Add additional functionality, search and filtering criteria.



# Questions?

# Image Credits and Attribution

Spore
http://www.spore.com

Prefuse
http://prefuse.org

Vizster
http://hci.stanford.edu/jheer/projects/vizster/

Full list of references at:
http://vis.berkeley.edu/courses/cs294-10-sp10/wiki/index.php/FP-ArpadKovacs