Semantic Visual Search: Visual Exploration of Spore Creations

CS294 Initial Problem Presentation

Arpad Kovacs

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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?

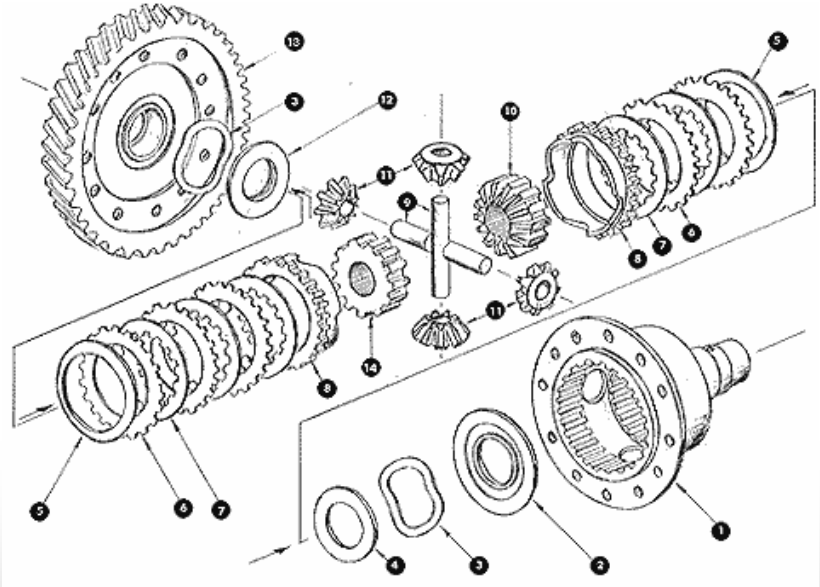
Motivation: Not Just For Games

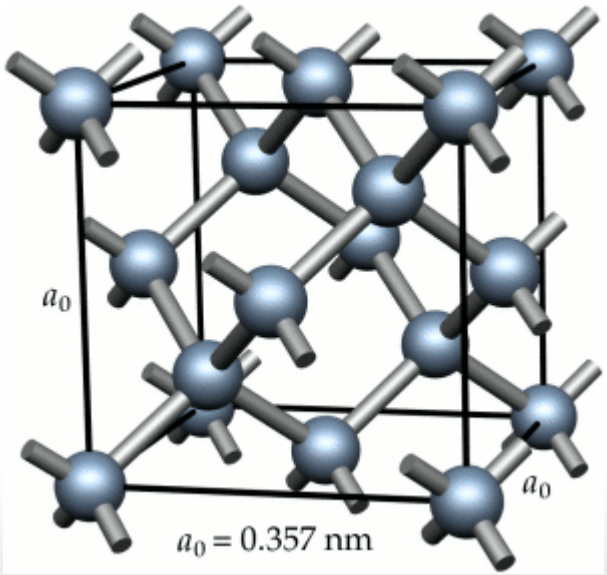
Biology (taxonomy, eg: Encyclopedia of Life)

Mechanical Engineering (automobile parts commonality)

Chemistry (crystal structures / formations)

Anything that can be broken down into building blocks





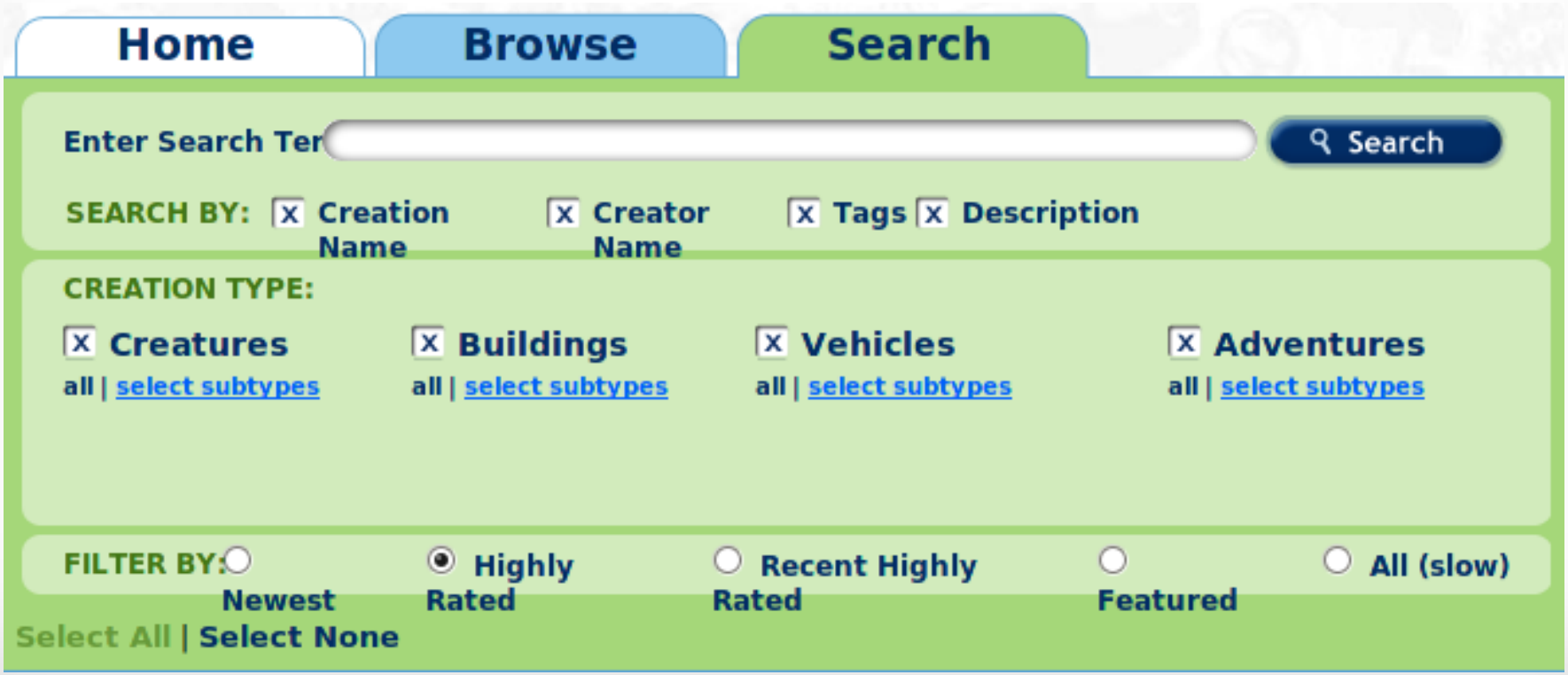
Existing Keyword-based Search

Slow, not very interactive

Type in search terms, select category, pages of results

Inaccurate, imprecise

Mislabeled / mistagged creations, ambiguity



Example: Search for 'Insect'

Ordering is not meaningful
Filter by 'Highest Rating', 'Newest', or 'Featured'

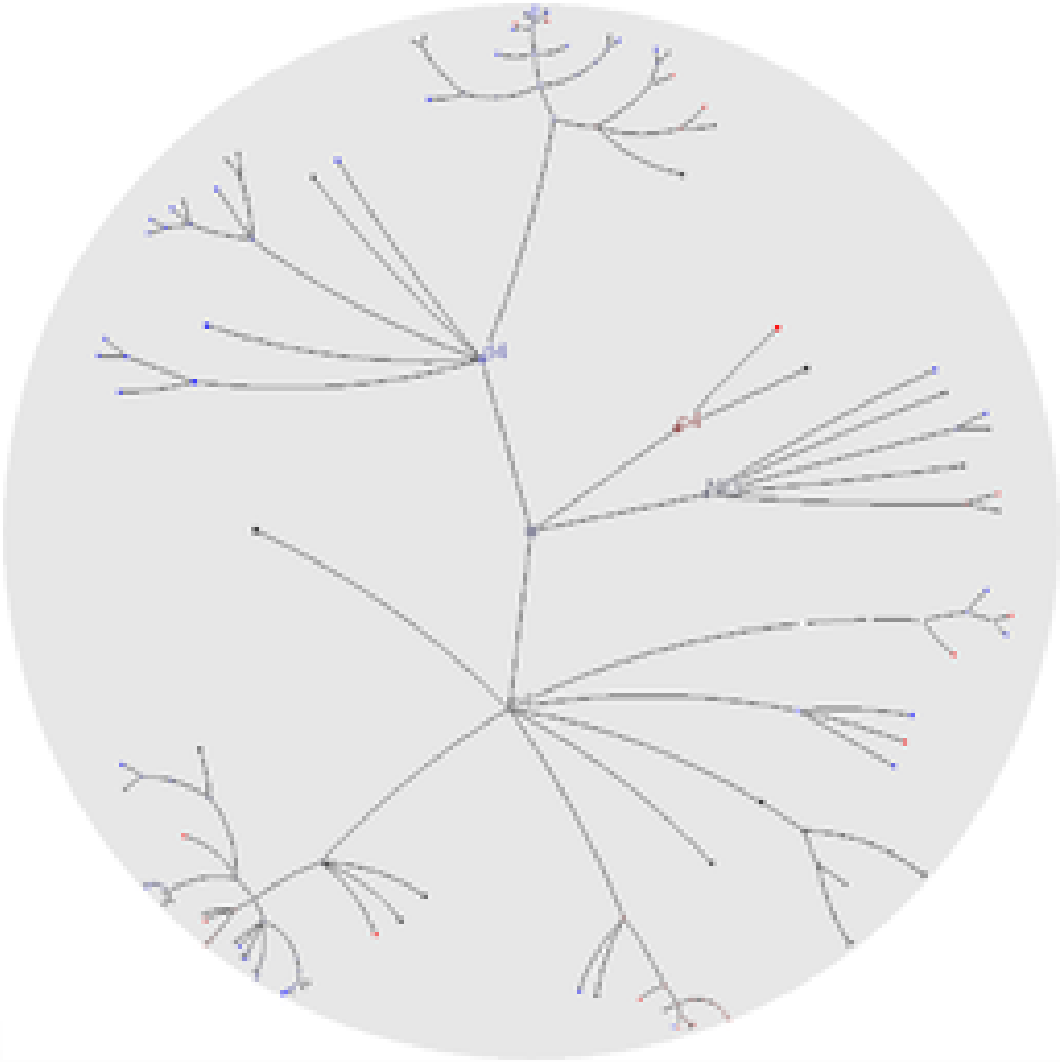
How do you refine your query?
Hard to find similar results

Solution

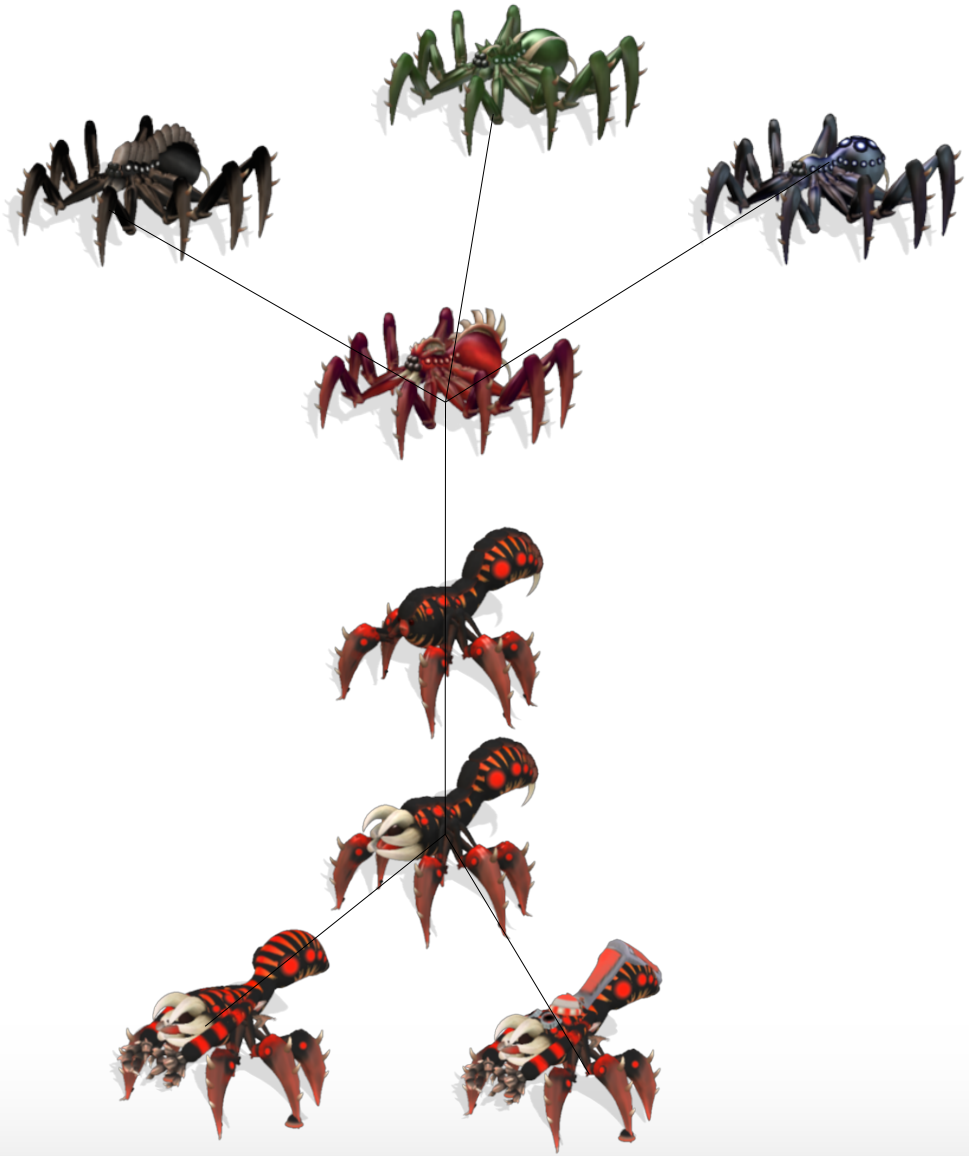
Dynamic query techniques
Trees with overview, zoom & filter, details-on-demand

Auto-generate semantically-meaningful results
linked by lineage, morphology, creator, etc.

Storyboard: Overview



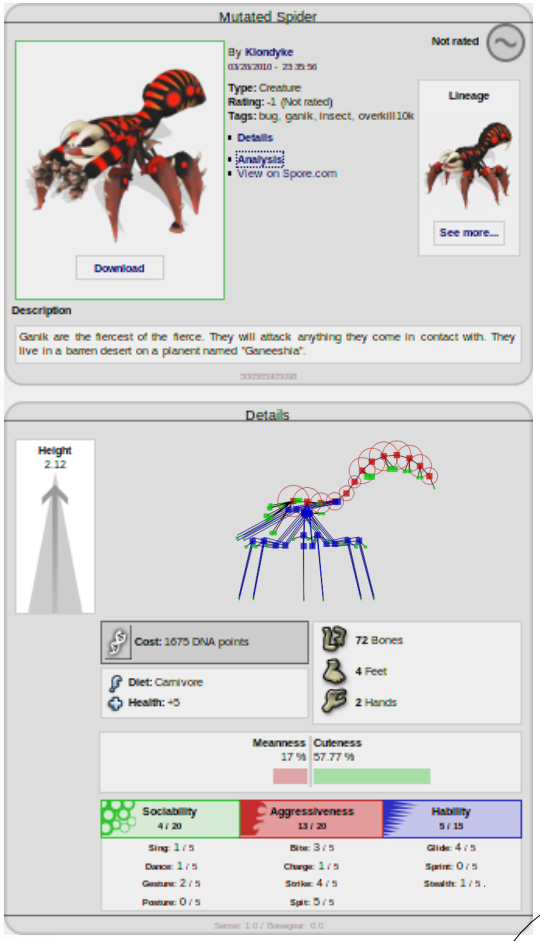
Storyboard: Zoom

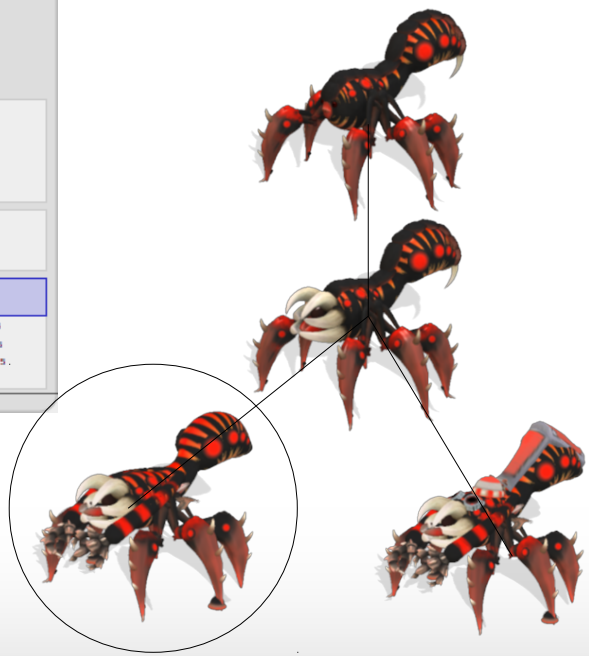


Storyboard: Filter

Example: 6 legs

Storyboard: Details-On-Demand

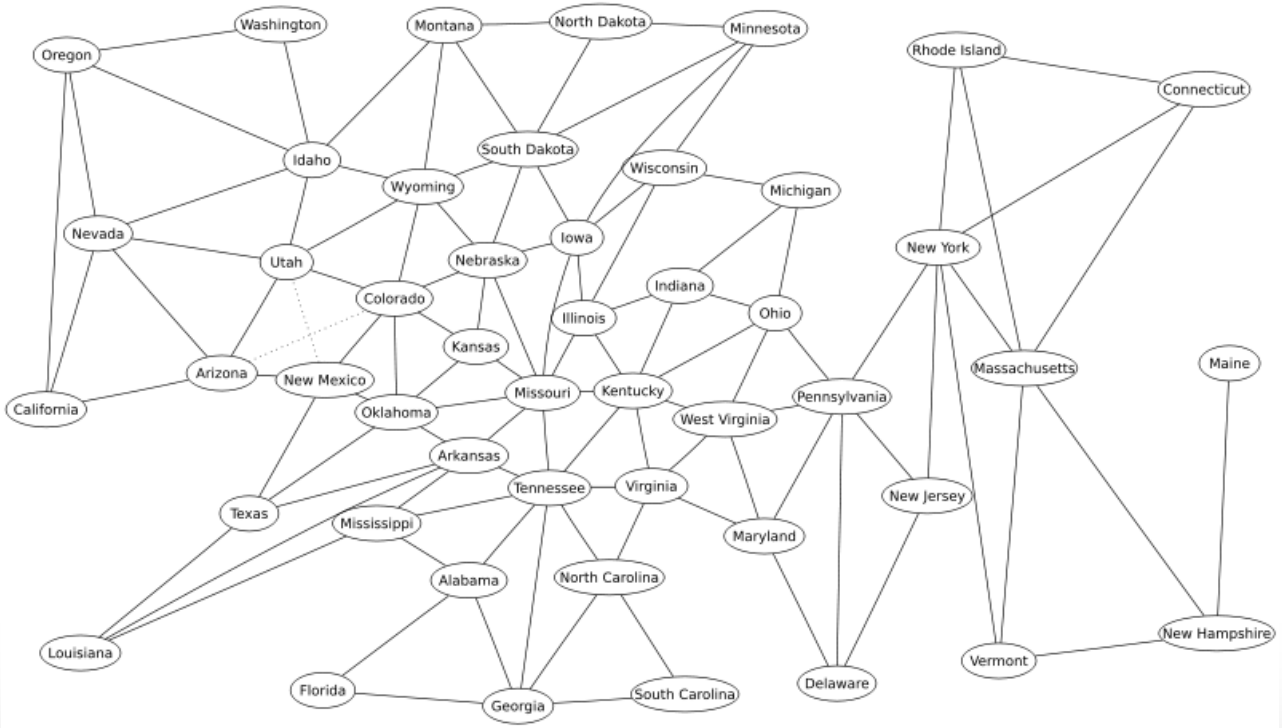




Related Works: GraphViz

Emden et al: An open graph visualization system and its applications to software engineering <http://www.graphviz.org/Documentation/GN99.pdf>

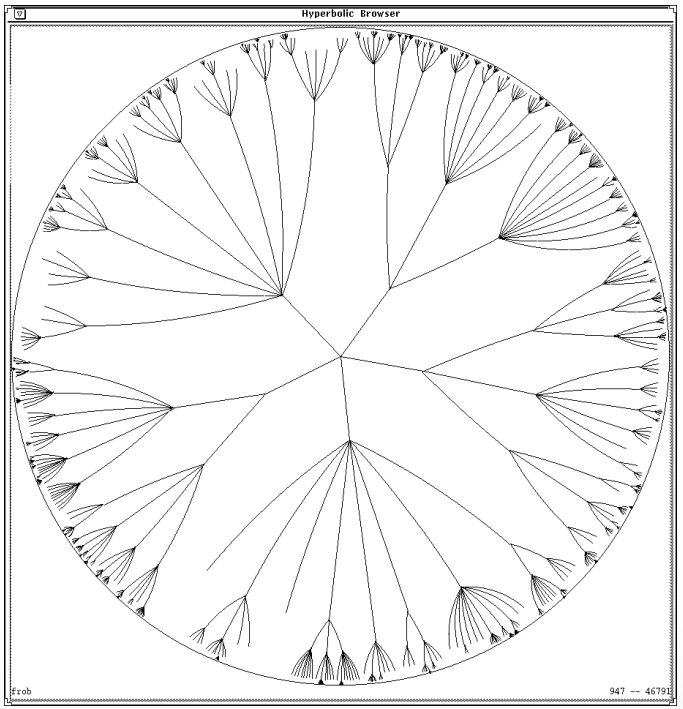
Automatically convert text description into graph



Related Works: Hyperbolic Trees

Lamping et al: A Focus & Context Technique Based on Hyperbolic Geometry for Visualizing Large Hierarchies <http://portal.acm.org/citation.cfm?id=223956>

Fish-eye lens view of entire tree reduces visual clutter

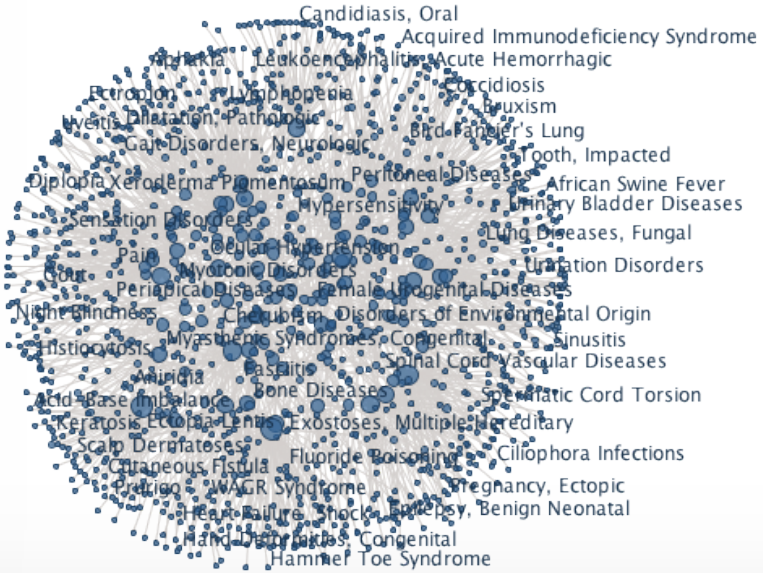


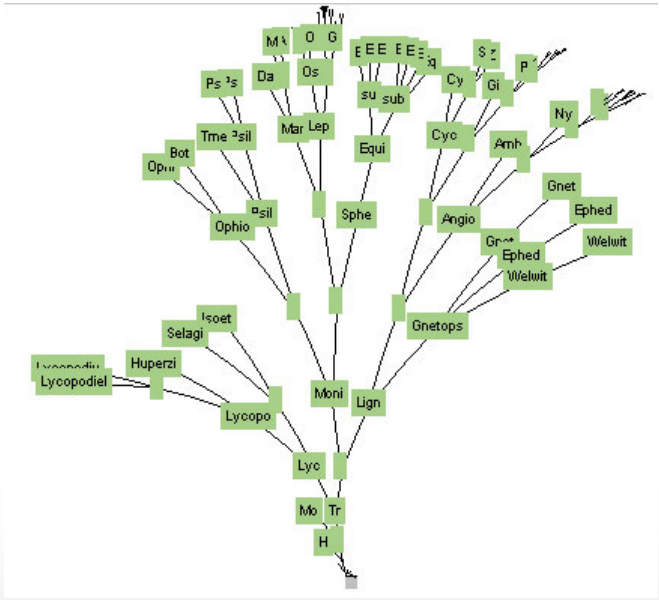
Related Works: Hyperbolic Trees

NSF Tree of Life
<http://ucjeps.berkeley.edu/TreeofLife/hyperbolic.php>

Disease taxonomy (ManyEyes)

Hyperbolic tree applets with overview, zoom, but no filtering or details-on-demand.



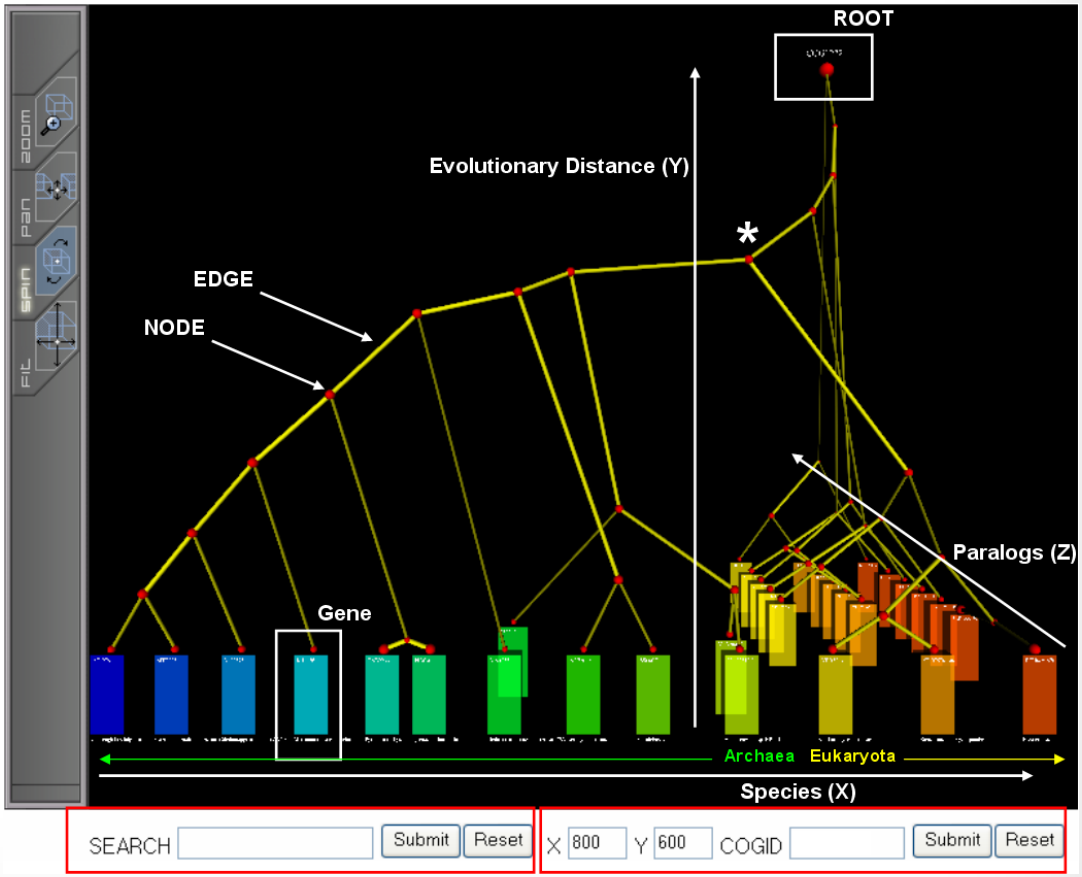


Related Works: Phylogeny

3DPE: 3D Phylogeny Explorer:
http://bioinfo.mbi.ucla.edu/3DPE/

Phylogeny shows hierarchy (but different users' spore creations don't share common ancestor)

Manually specified relationships; my system is automatic



Roadmap & Milestones

Phase 1: ~2010.04.19 (2 weeks)
Datasource parsing, initial hyperbolic graph implementation

Phase 2: ~2010.05.03 (2 weeks)
Dynamic queries: filtering, details-on-demand

Phase 3: remaining time (1 week)
Performance optimization, visual polishing, etc.

Technical Challenges

Performance
If web-based API is too slow for interactive dynamic queries, then cache results to SQLLite database. Restrict domain to just animals; no buildings/vehicles.

Occlusion
Already solved problem, bootstrap off of Graphviz or some other library; focus on dynamic queries.

Morphologies
Cannot query API for all creatures using a particular part; instead need to query creations for common parts. May need to do joins in database to build tree structure.

Questions?

Image Credits, Related Work Sources

Sporepedia (http://www.spore.com/sporepedia)

Sporistics (http://sporistics.atomicday.net)

Wikipedia (http://en.wikipedia.org)

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