Learning Relational Algebra by Snapping Blocks

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What is an algebra?

Mathematical system consisting of:

- Operands: variables or values from which new values can be constructed
- Operators: symbols denoting procedures that construct the new values

These building blocks form expressions

What are some examples from arithmetic?

- $[(x + 7)/(y - 3)] + x$

What are some examples from set theory?

- $R - (S \cup T)$

Overview of relational algebra

Formal notation for specifying queries

- DBMS translates SQL into relational algebra

Operands:

- Relations
- Constants (finite relations)

Operators:

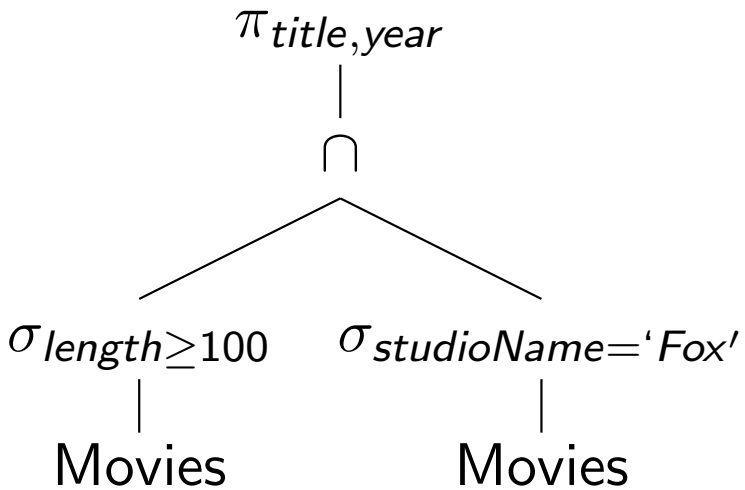
- Set operations (union, intersection, difference)
- Selection and projection (remove tuples/attributes)
- Cartesian product and join (combine tuples)
- Renaming (change schema / copy relation)

Combining operations to form queries

Linear notation:

$$\pi_{title,year}\left(\sigma_{length \geq 100}(Movies) \cap \sigma_{studioName = \text{`}Fox\text{'}}(Movies)\right)$$

Expression tree:



PROBLEM

How do we make theory more hands-on?

Tools of the trade

Block based environments

Advantages [Maloney et al. 2010]

- Simplify the programming environment
- Encourage self-directed learning
- Making program execution visual
- Eliminating syntax error messages
- Making variables/data more concrete

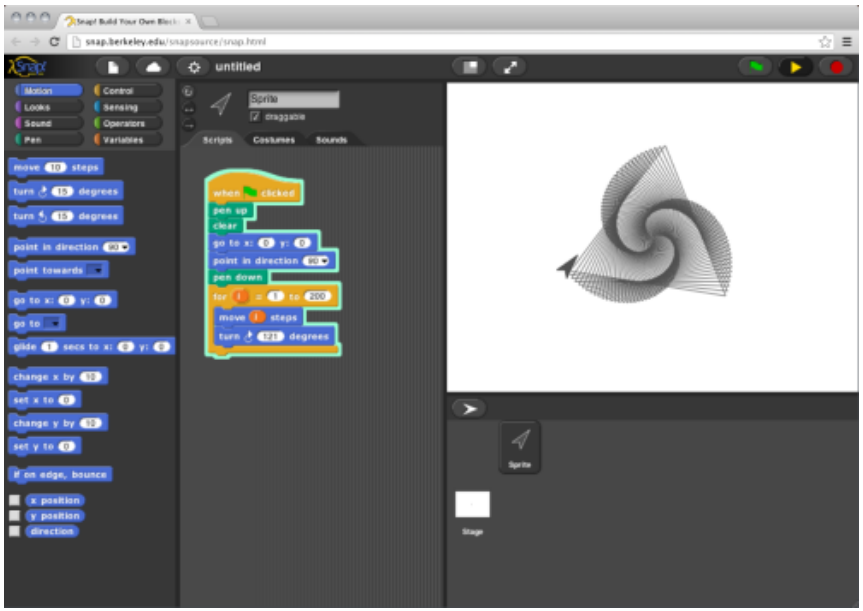
Programming focus

- Object-oriented design
- Interactive media
- Simulation and games
- Mobile development

MAIN IDEA

Block environment for manipulating data!

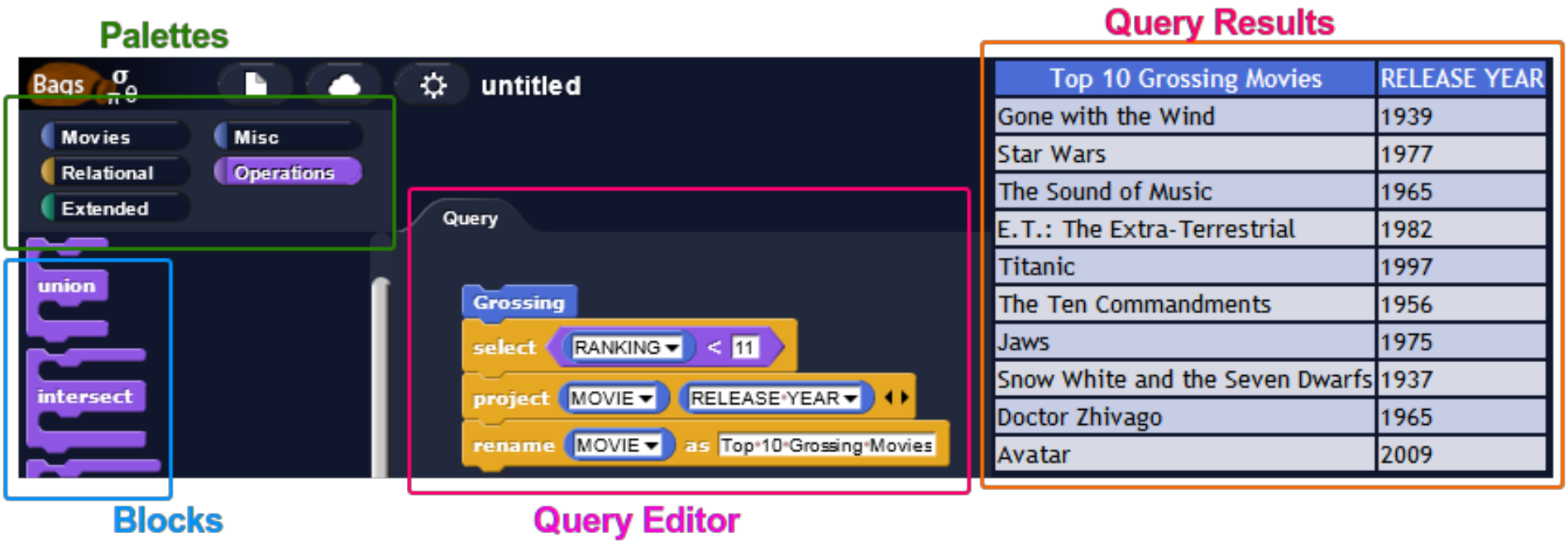
Standing on the shoulders of . . .



Features

- Free and open source (AGPL 3.0)
- Works in the browser (JavaScript)

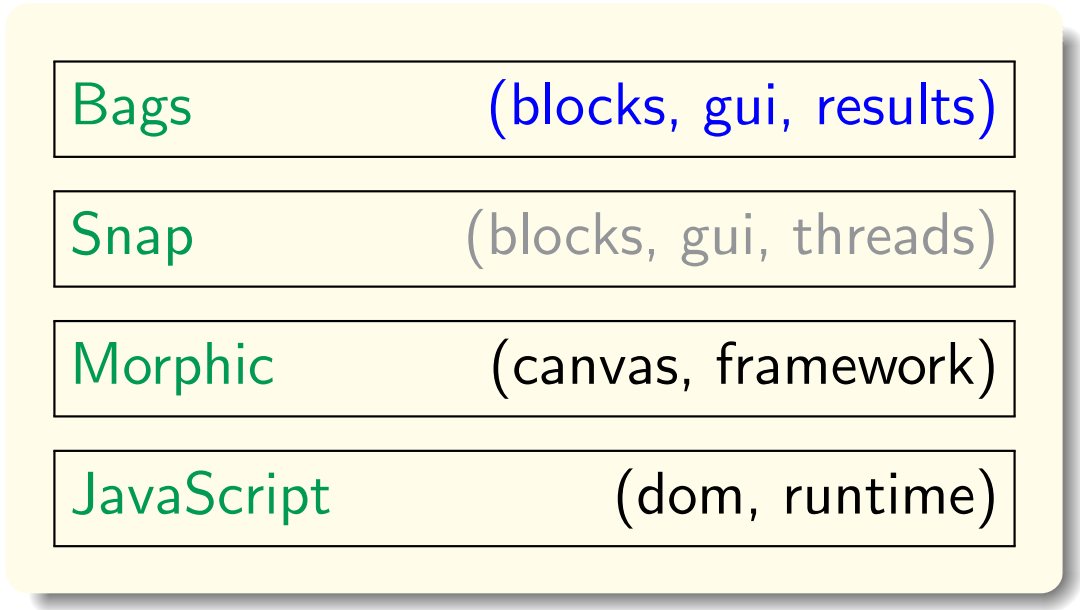
A quick tour of Bags



Top 10 Grossing Movies	RELEASE YEAR
Gone with the Wind	1939
Star Wars	1977
The Sound of Music	1965
E.T.: The Extra-Terrestrial	1982
Titanic	1997
The Ten Commandments	1956
Jaws	1975
Snow White and the Seven Dwarfs	1937
Doctor Zhivago	1965
Avatar	2009

http://bags.cs.jmu.edu/

Bags architecture



Implemented via change sets

- See the paper for details
- Special thanks to Snap!

Moving forward

Additional features

- Bring your own data
- Load/save projects
- From blocks to Greek

Teaching materials

- Exercises and activities
- Scavenger hunt projects

Educational research

- Bags in DB courses
- Bags in CS0 / K-12

Summary

Bags allows you to

- manipulate data sets interactively
- experiment with relational operators
- practice computational thinking
- visualize mathematical concepts

Invitation: Build your own Bags!