CS 225

Data Structures

October 13 – AVL Applications

G Carl Evans

Why Balanced BST?

Summary of Balanced BST

Pros:

- Running Time:

  - Improvement Over:

- Great for specific applications:

Every Data Structure So Far

	Unsorted Array	Sorted Array	Unsorted List	Sorted List	Binary Tree	BST	AVL
Find							
Insert							
Remove							
Traverse							

Summary of Balanced BST

Cons:

- Running Time:

- In-memory Requirement:

Iterators

Why do we care?

```
DFS dfs(...);
for ( ImageTraversal::Iterator it = dfs.begin(); it != dfs.end(); ++it ) {
  std::cout << (*it) << std::endl;
}
```

Iterators

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```
DFS dfs(...);
for ( const Point & p : dfs ) {
  std::cout << p << std::endl;
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```

Iterators

Why do we care?

```
DFS dfs(...);
for ( ImageTraversal::Iterator it = dfs.begin(); it != dfs.end(); ++it ) {
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```

```
DFS dfs(...);
for ( const Point & p : dfs ) {
  std::cout << p << std::endl;
}
```

```
ImageTraversal & traversal = /* ... */;
for ( const Point & p : traversal ) {
  std::cout << p << std::endl;
}
```

CS 225 Office Hours

Office Hours

- Must have online contact info

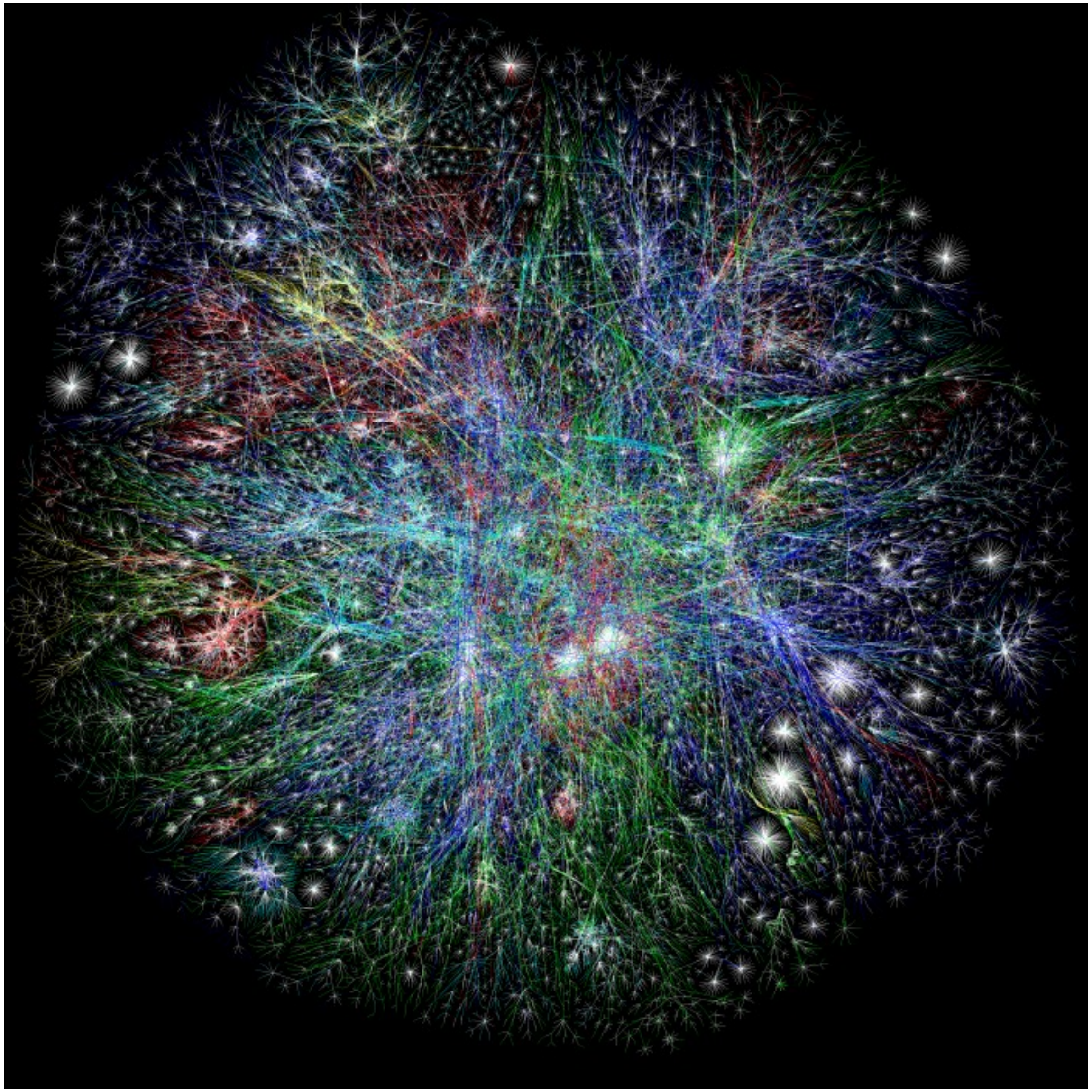
- Must have a specific question

- We will remove students that don’t do the above

- Purpose to get you unstuck not to fix your code

CS 225 Final Project

Working with data and using graphs

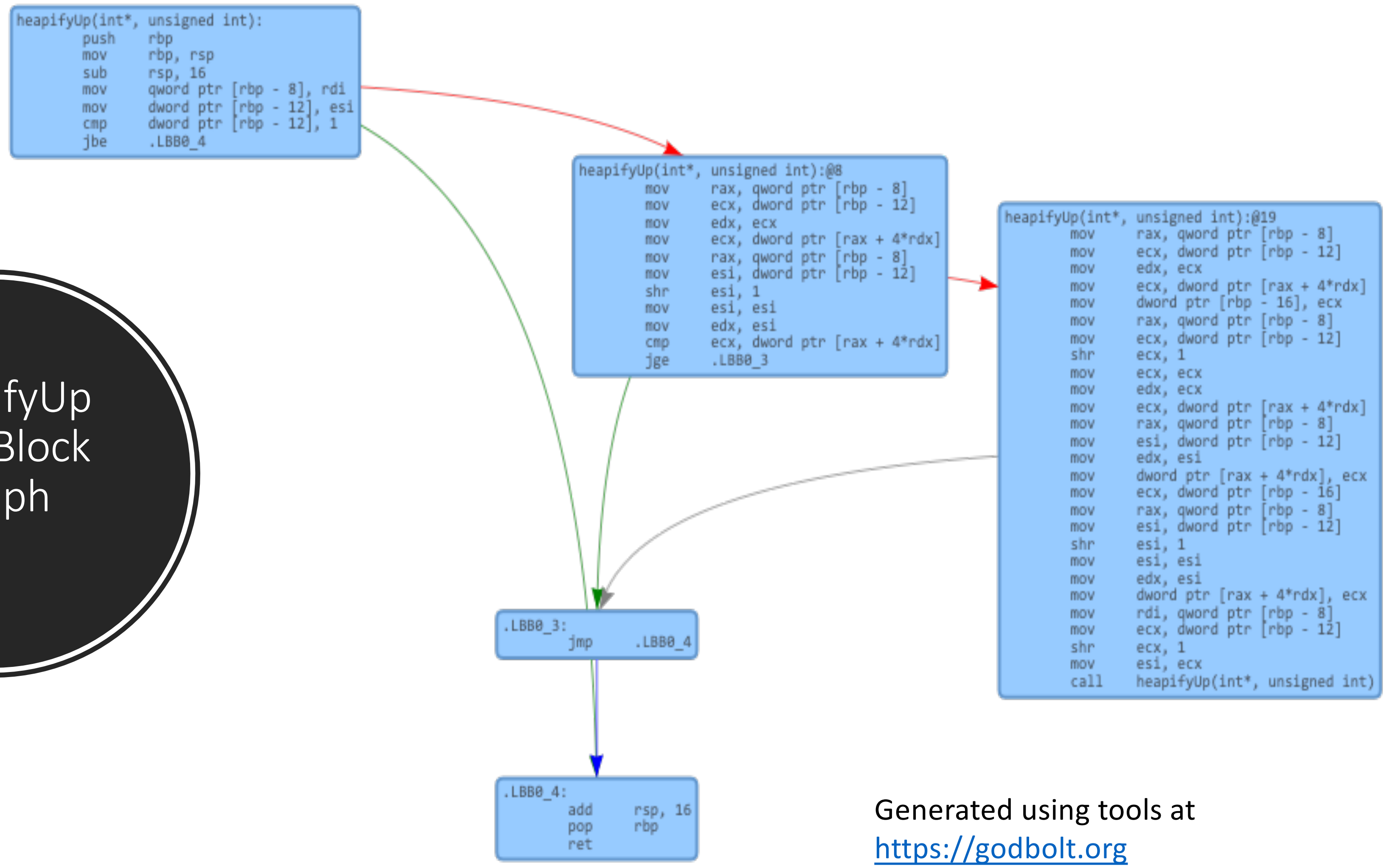


The Internet 2003

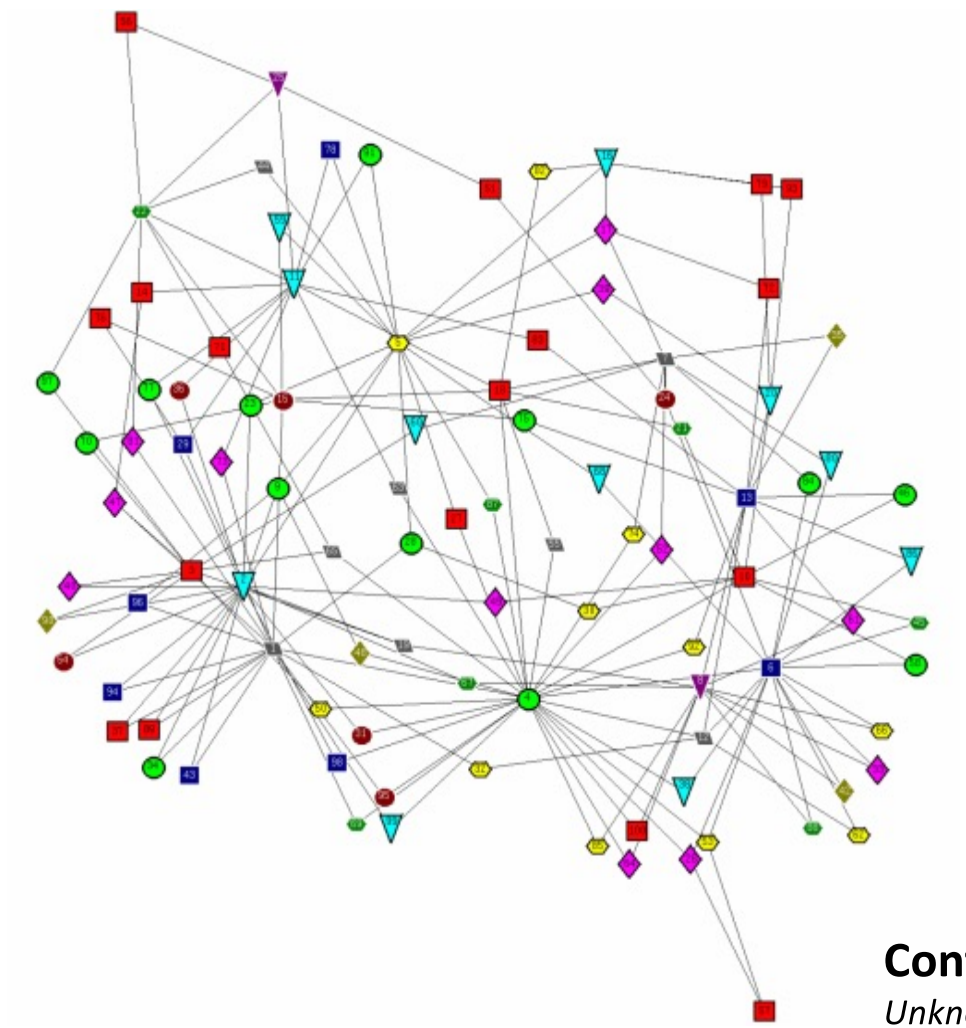
The OPTE Project (2003)

Map of the entire internet; nodes are routers; edges are connections.

HeapifyUp BasicBlock Graph



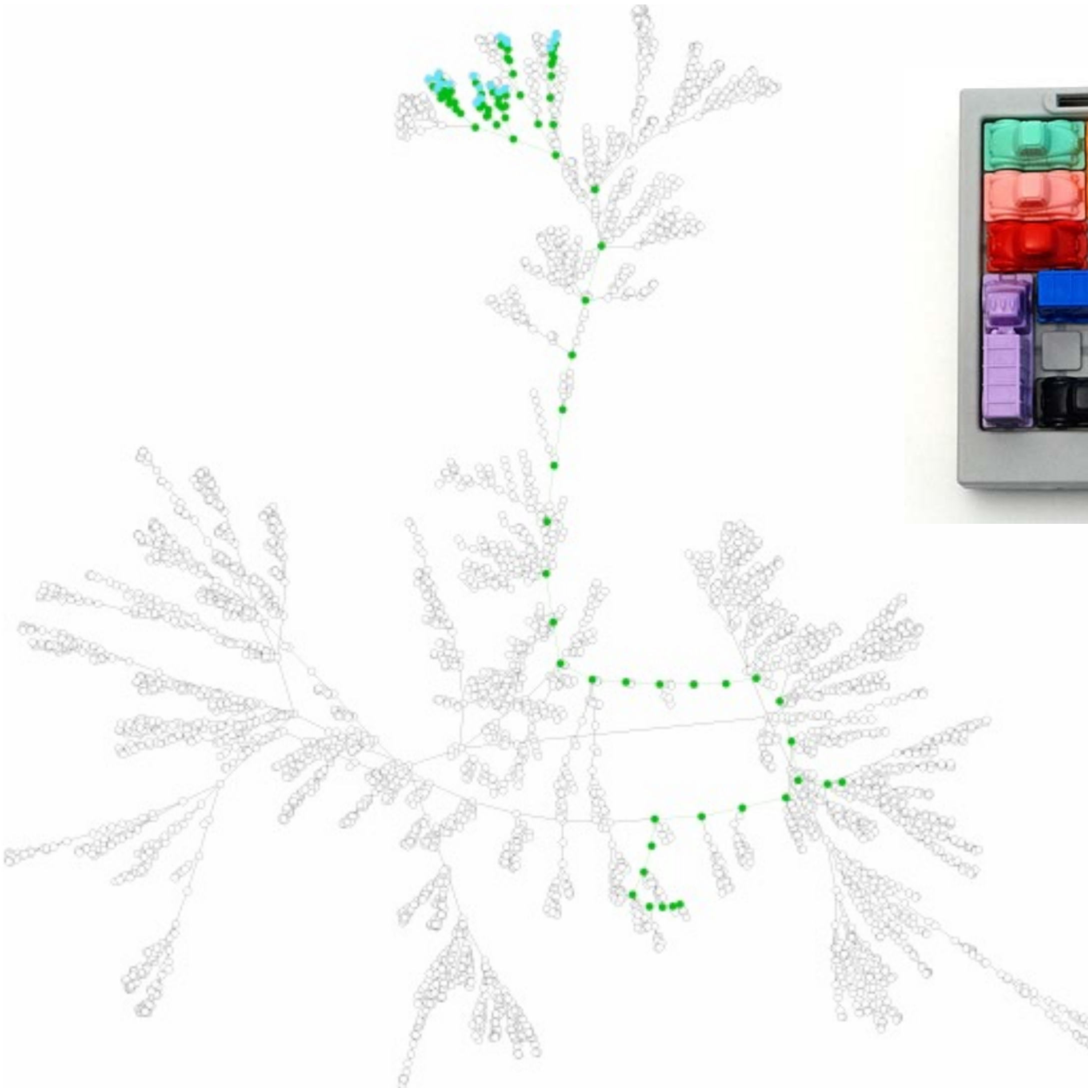
Generated using tools at https://godbolt.org



Conflict-Free Final Exam Scheduling Graph

Unknown Source

Presented by Cinda Heeren, 2016



“Rush Hour” Solution

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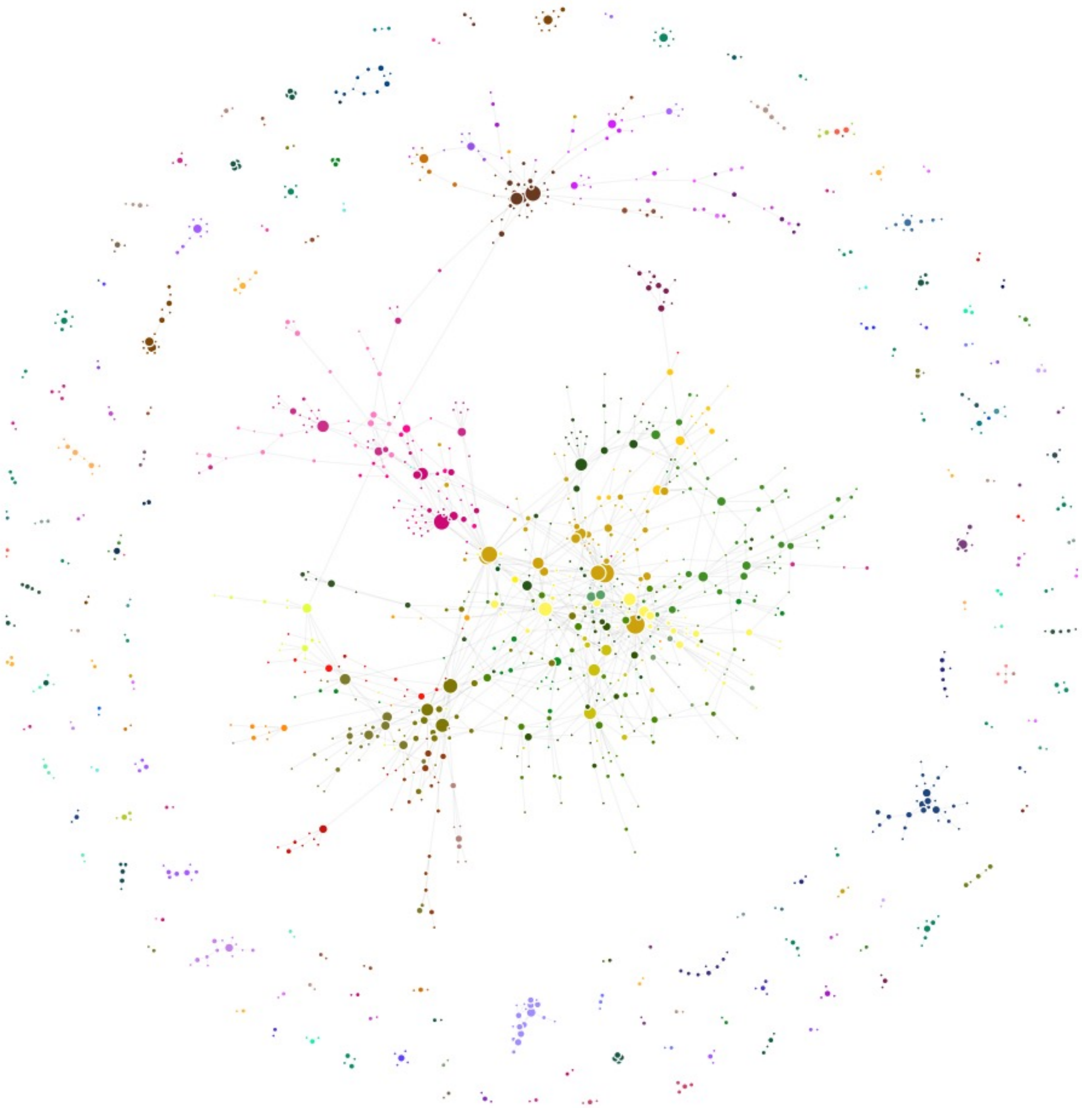
Presented by Cinda Heeren, 2016

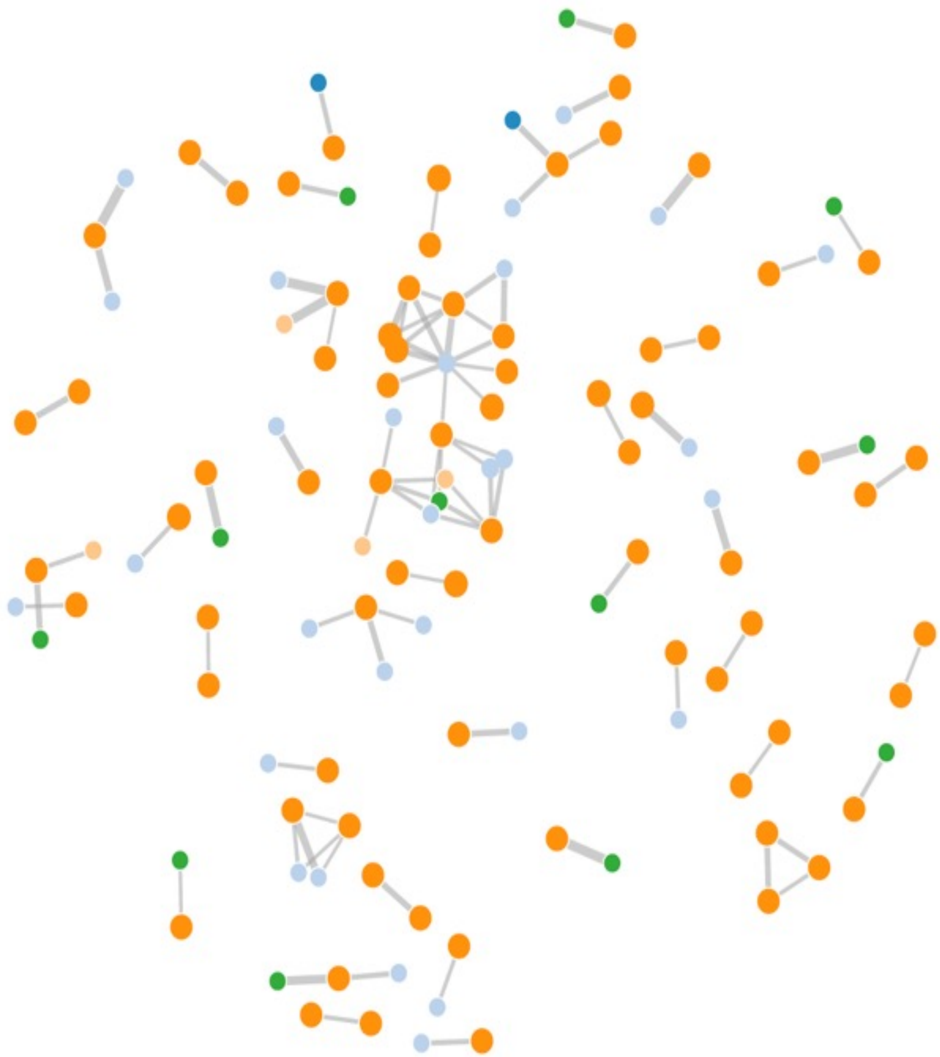


Class Hierarchy At University of Illinois Urbana-Champaign

A. Mori, W. Fagen-Ulmschneider, C. Heeren

Graph of every course at UIUC; nodes are courses, edges are prerequisites

http://waf.cs.illinois.edu/discovery/class_hierarchy_at_illinois/



MP Collaborations in CS 225

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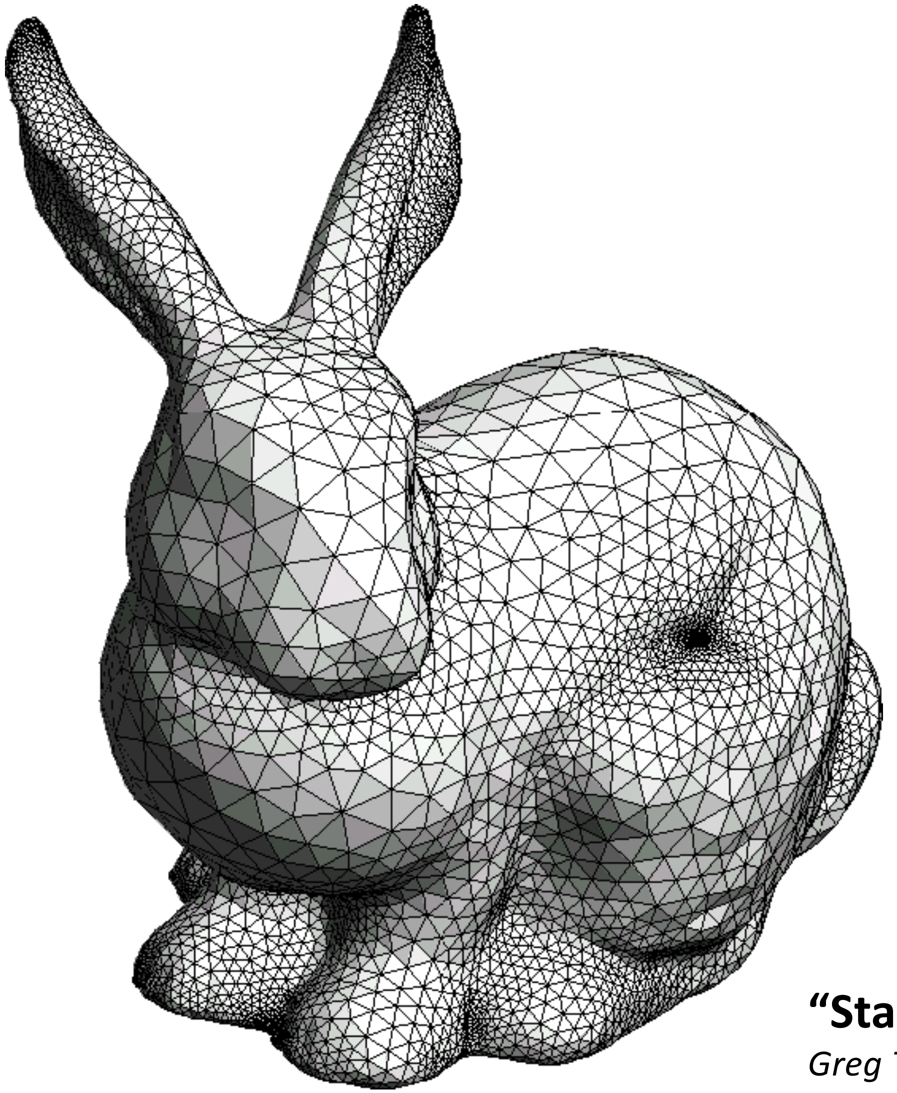
Presented by Cinda Heeren, 2016



“Stanford Bunny”
Greg Turk and Mark Levoy (1994)

Final Project - Form a Team

- Team formation will be happening next week.
- If you don’t find a team we will match you up.
- You must fill out the form next week

Range-based Searches

Q: Consider points in 1D: $\mathbf{p = \{p_1, p_2, \ldots, p_n\}}$.

…what points fall in [11, 42]?

Tree construction:

Range-based Searches

Balanced BSTs are useful structures for range-based and nearest-neighbor searches.

Q: Consider points in 1D: $\mathbf{p = \{p_1, p_2, \ldots, p_n\}}$.

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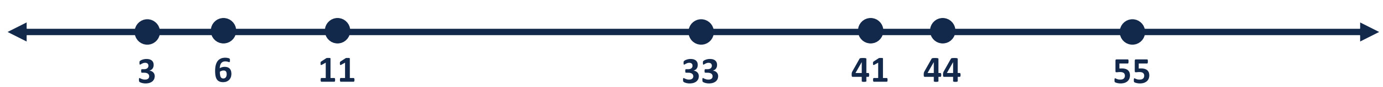
Ex:



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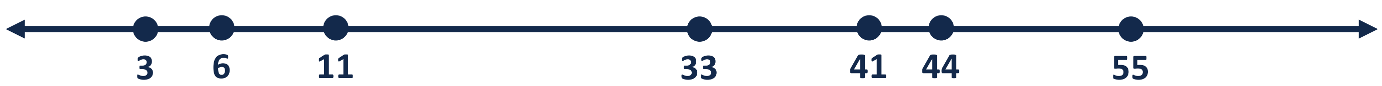

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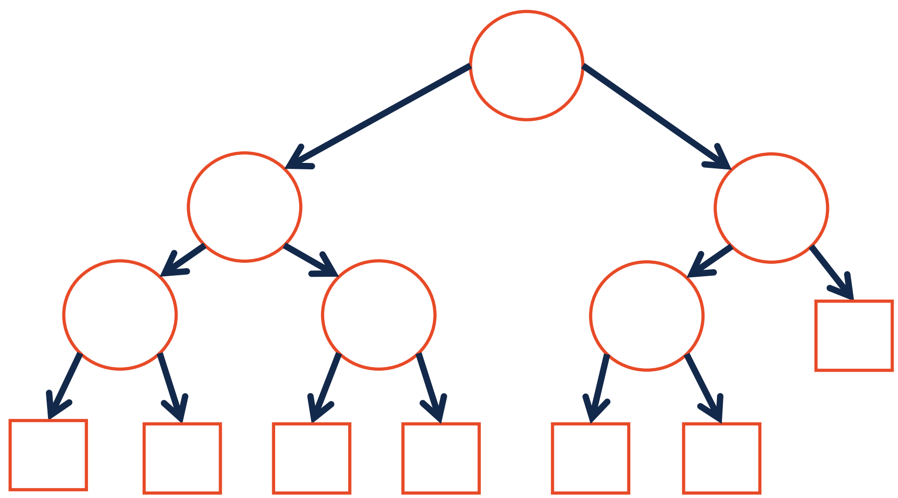
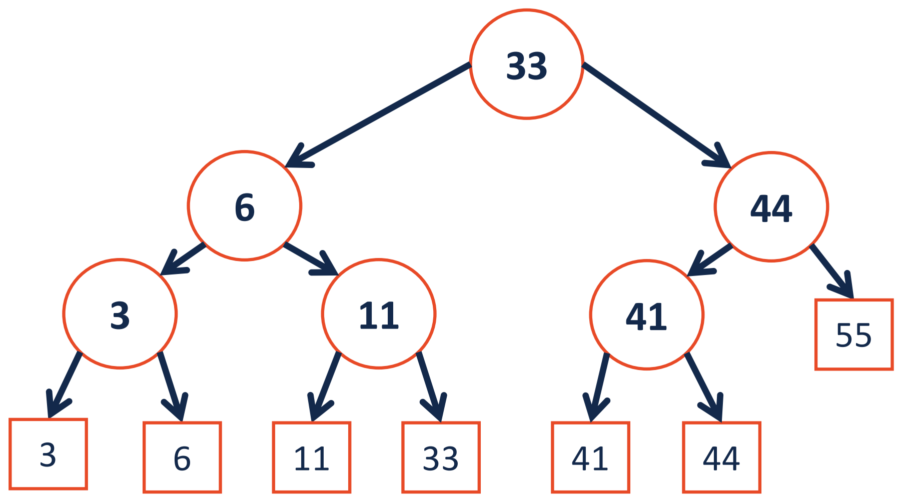


Range-based Searches



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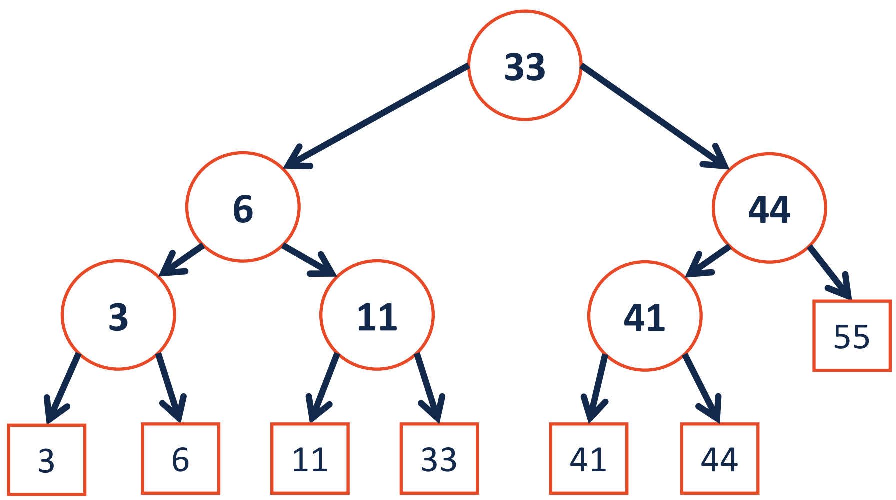
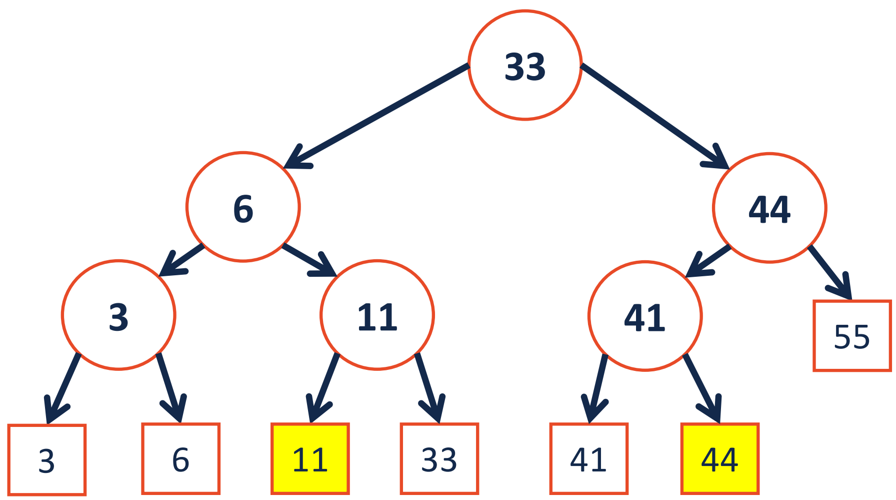
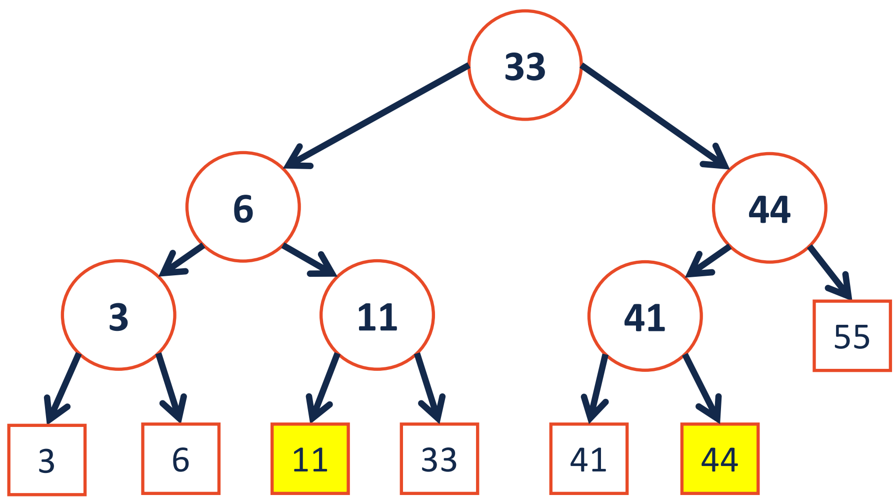


Range-based Searches



Running Time



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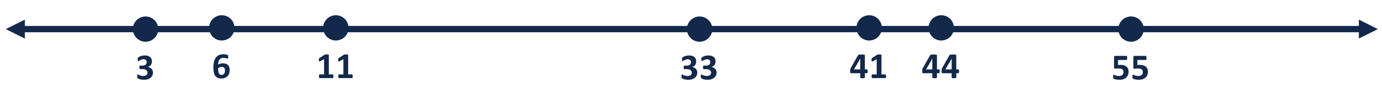
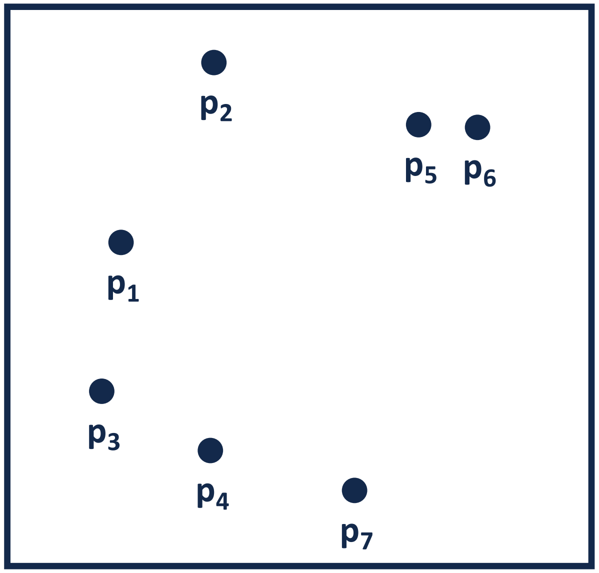


Range-based Searches

Consider points in 2D: $\mathbf{p = \{p_1, p_2, \ldots, p_n\}}$.

Q: What points are in the rectangle:
[(x_1, y_1), (x_2, y_2)]?

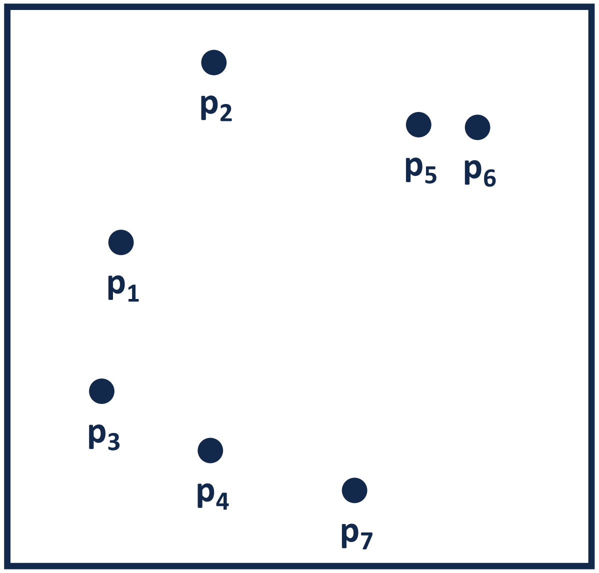


Q: What is the nearest point to $\mathbf{(x_1, y_1)}$?

Range-based Searches

Consider points in 2D: $\mathbf{p} = \{\mathbf{p_1}, \mathbf{p_2}, \ldots, \mathbf{p_n}\}$.

Tree construction:



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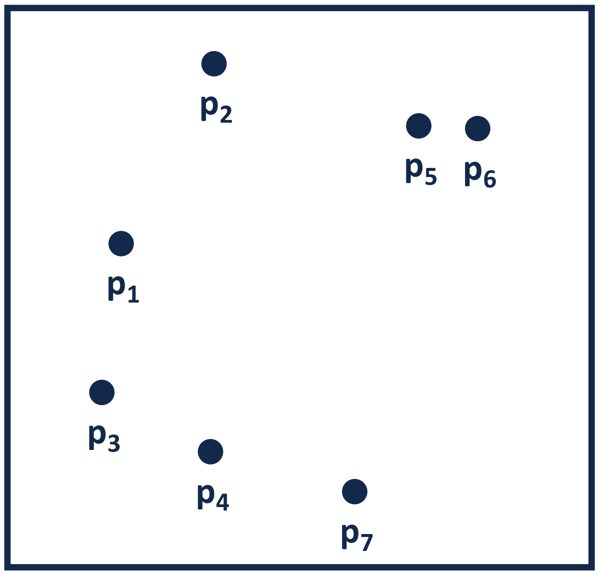
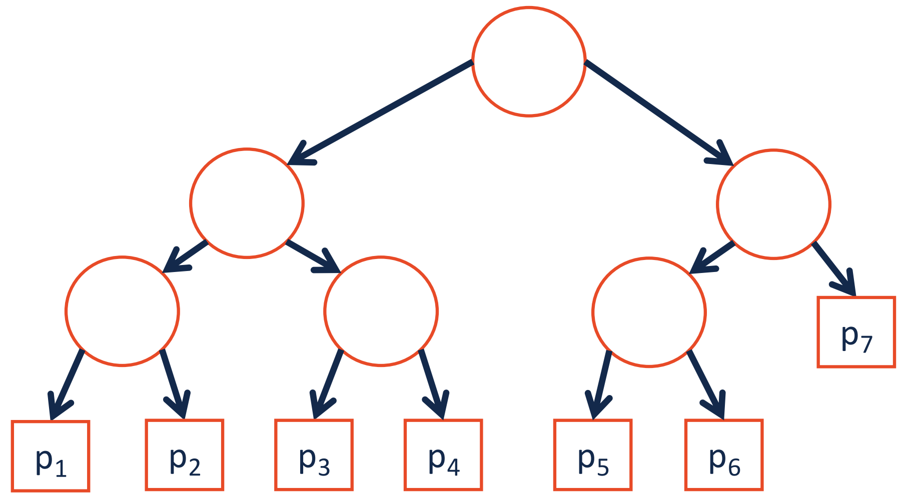
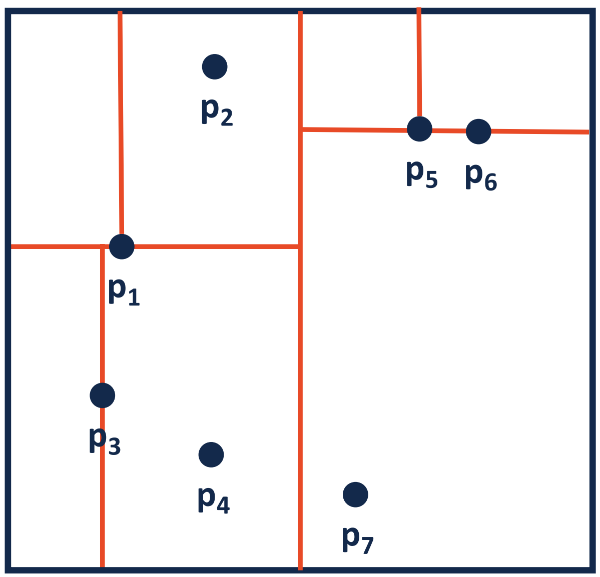
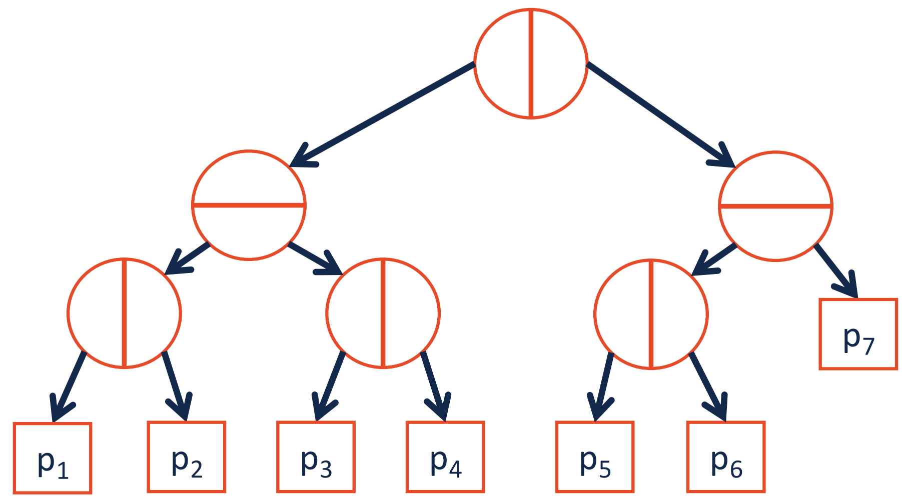




kD-Trees





kD-Trees