Dynamic Maximal Independent Sets

Presentation 2

Thilo L. Fischer

June 23, 2020

Outline

Implementation

Testing

Evaluation

Implementation

- Python 3.8.2
- ca. 1000 Lines (algorithms + test + benchmarks)

- 5 Algorithms   update complexity
  - Trivial $\mathcal{O}(m)$
  - Simple $\mathcal{O}(\Delta)$
  - Improved Incremental $\mathcal{O}(min(\Delta, \sqrt{m}))$
  - Dynamic $\mathcal{O}(min(\Delta, m^{2/3}))$
  - Implicit $\mathcal{O}(min(\Delta, \sqrt{m}))$

- Strategy Design Pattern

Algorithm
_graph : nx.Graph
+ _ _init_ _ (graph)
+ is_valid_mis () : Bool
+ is_in_mis (v) : Bool
+ get_mis () : set
+ insert_edge (u, v)
+ remove_edge (u, v)
+ insert_node (v, [edges])
+ remove_node (v)

Testing

Testing

- Remove/insert all nodes/edges
- Verify correctness after each update
- $G(n = 20, p = 0.3)$ graph

Listing 1: Testing Snippet (Modified)

```
1  algo = cls(g)
2
3  for e in insert_order:
4      algo.insert_edge(*e)
5      valid = algo.is_valid_mis()
6      test.assertTrue(valid)
7
8  test.assertTrue(is_isomorphic(g, g_original))
```

Evaluation

- Hardware: Intel Core i7-1065G7
- Average time over 5 runs
- Time includes initilization and updates

Data	Trivial	Simple	Improved Inc	Dynamic	Implicit
Wildbirds	1.281	0.013	0.012	0.064	0.020
Topology	DNF	0.430	0.504	3.205	0.696
Facebook	DNF	2.582	2.228	DNF	4.042
Youtube	DNF	67.058	60.695	DNF	95.488

- Average time in seconds
- DNF: did not finish after 2 minutes

- Brightkite Friendship Dataset
  - 58,228 Nodes
  - 214,078 Edges
- Repeatable: same order of edge deletions
- Varying number of edge deletions

Removals	Trivial	Simple	Dynamic	Implicit
1000	77.246	0.136	0.158	0.100
10,000	DNF	0.157	0.266	0.166
100,000	DNF	0.361	1.252	0.793

- Average time in seconds
- DNF: did not finish after 2 minutes

- In-lining code can save a lot of time
- Caching values is important
  - edge count
  - set of heavy nodes
- Connect to AC power while benchmarking
  - Powersaving on battery mode makes comparisons difficult!

- Questions?
- Code and slides at:
  github.com/thilofischer/dynamic_mis