

**Work:** Trying to mine patterns from gem5 still

**Progress:** only got it to work with some files, ran into issues

**Challenge:** working with odd indices, slow performance, low acceptance ratios

### **Message file groups:**

('cpu0', 'dcache0', (10, 19, 20, 23, 26, 28, 37, 38, 39, 40, 42, 58, 64))  
('cpu0', 'icache0', (0, 9))  
('cpu1', 'dcache1', (49, 52, 53, 57, 61, 69, 70, 71, 72, 77, 83))  
('cpu1', 'icache1', (44, 48))  
('cpu2', 'dcache2', (90, 93, 94, 97, 98, 101, 102, 103, 104, 107, 111))  
('cpu2', 'icache2', (86, 89))  
('dcache0', 'l2bus', (12, 18, 21, 22, 27, 30, 41, 43, 55, 59, 60, 65, 67, 74, 76))  
('dcache1', 'l2bus', (50, 51, 54, 56, 66, 68, 73, 78, 79, 80, 84, 85))  
('dcache2', 'l2bus', (91, 92, 95, 96, 99, 100, 105, 108, 109, 110, 112, 113))  
('dram', 'membus', (3, 5, 13, 15, 34))  
('icache0', 'l2bus', (2, 8, 25, 36, 45))  
('icache1', 'l2bus', (46, 47, 81, 82))  
('icache2', 'l2bus', (87, 88, 106, 114))  
('l2bus', 'l2cache', (1, 7, 11, 17, 24, 29, 31, 33, 63, 75))  
('l2cache', 'membus', (4, 6, 14, 16, 32, 35, 62))

### **New algorithm**

Tree/node structure.

Read in first value of trace. See if its in of the possible pairs generated from the indices. If it is, remove the pair from the trace, generate child node.

If the first value of the trace isn't part of any pairs and hasn't been used before, then proceed to the next.

If nothing in the trace can be part of any pair, then it's a leaf node. Calculate acceptance ratio by looking at the number of orphaned nodes compared to the original trace.

Problem, no repeated nodes

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File: unsliced-cpu0-dcache0.txt, Group: cpu0-dcache0, Indices: [64, 58, 37, 38, 39, 40, 10, 42, 19, 20, 23, 26, 28]
BinaryPatterns: ((10, 19), (20, 23), (26, 39), (28, 37)), Acceptance Ratio: 0.9862867167276383
BinaryPatterns: ((10, 26), (19, 37), (20, 23), (28, 39)), Acceptance Ratio: 0.6824123398155874
BinaryPatterns: ((10, 28), (19, 37), (20, 23), (26, 39)), Acceptance Ratio: 0.6737265472905034
BinaryPatterns: ((10, 42), (19, 37), (20, 23), (26, 39)), Acceptance Ratio: 0.6670517510643306
BinaryPatterns: ((10, 40), (19, 37), (20, 23), (26, 39)), Acceptance Ratio: 0.6667094538219627
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Checking:

10 19 correct

10:cpu0:dcache0:WriteReq

19:dcache0:cpu0:WriteResp

20 23 correct

20:cpu0:dcache0:ReadReq

23:dcache0:cpu0:ReadResp

26 39

26:dcache0:cpu0:CleanEvict

39:cpu0:dcache0:LockedRMWWriteReq no, 39 is an initial node

28 37

28:dcache0:cpu0:WritebackDirty

37:cpu0:dcache0:LockedRMWReadReq no, 37 is an initial node

**Bug**, doesn't work for cpu0 icach0, but that just is one pair (0,9) anyways, will see why. Gets stuck

**fail:**

-bad acceptance ratios for cpu1-dcache1. Because this doesn't allow for repeated nodes. I can try and change that so it allowed nodes to be repeated

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acceptance 0.006194614127161713
[[ (49, 72), (52, 61), (53, 69), (57, 70) ], 0.006194614127161713)
acceptance 0.006194614127161713
[[ (49, 71), (52, 61), (53, 72), (57, 70) ], 0.006194614127161713)
acceptance 0.12217155639679944
[[ (49, 77), (52, 61), (53, 72), (57, 70) ], 0.12217155639679944)
acceptance 0.0055063236685881645
[[ (49, 83), (52, 61), (53, 72), (57, 70) ], 0.0055063236685881645)
acceptance 0.37976426051793855
[[ (49, 52), (53, 72), (57, 61), (69, 70) ], 0.37976426051793855)
acceptance 0.37976426051793855
[[ (49, 57), (52, 61), (53, 72), (69, 70) ], 0.37976426051793855)
acceptance 0.006194614127161713
[[ (49, 69), (52, 61), (53, 72), (57, 70) ], 0.006194614127161713)

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I think the highest acceptance ratios are probably. Maybe I could rerun it on the orphaned nodes, allowing nodes to be used again

## Results:

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File: unsliced-cpu0-dcache0.txt, Group: cpu0-dcache0, Indices: [64, 58, 37, 38, 39, 40, 10, 42, 19, 20, 23, 26, 28]

BinaryPatterns: ((10, 19), (20, 23), (26, 39), (28, 37)), Acceptance Ratio: 0.9862867167276383

BinaryPatterns: ((10, 26), (19, 37), (20, 23), (28, 39)), Acceptance Ratio: 0.6824123398155874

BinaryPatterns: ((10, 28), (19, 37), (20, 23), (26, 39)), Acceptance Ratio: 0.6737265472905034

BinaryPatterns: ((10, 42), (19, 37), (20, 23), (26, 39)), Acceptance Ratio: 0.6670517510643306

BinaryPatterns: ((10, 40), (19, 37), (20, 23), (26, 39)), Acceptance Ratio: 0.6667094538219627

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('cpu0', 'icache0', (0, 9)) **fail**

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File: unsliced-cpu1-dcache1.txt, Group: cpu1-dcache1, Indices: [69, 70, 71, 72, 77, 49, 83, 52, 53, 57, 61]

BinaryPatterns: ((49, 57), (52, 61), (53, 72), (69, 70)), Acceptance Ratio: 0.37976426051793855

BinaryPatterns: ((49, 52), (53, 72), (57, 61), (69, 70)), Acceptance Ratio: 0.37976426051793855

BinaryPatterns: ((49, 77), (52, 61), (53, 72), (57, 70)), Acceptance Ratio: 0.12217155639679944

BinaryPatterns: ((49, 71), (52, 61), (53, 72), (57, 70)), Acceptance Ratio: 0.006194614127161713

BinaryPatterns: ((49, 72), (52, 61), (53, 69), (57, 70)), Acceptance Ratio: 0.006194614127161713

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File: unsliced-cpu1-icache1.txt, Group: cpu1-icache1, Indices: [48, 44]

BinaryPatterns: ((44, 48),), Acceptance Ratio: 1.0

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File: unsliced-cpu2-dcache2.txt, Group: cpu2-dcache2, Indices: [97, 98, 101, 102, 103, 104, 107, 111, 90, 93, 94]

BinaryPatterns: ((90, 107), (93, 102), (94, 97), (98, 101)), Acceptance Ratio: 0.7014195395443159

BinaryPatterns: ((90, 93), (94, 107), (97, 102), (98, 101)), Acceptance Ratio: 0.26255517117976857

BinaryPatterns: ((90, 97), (93, 102), (94, 107), (98, 101)), Acceptance Ratio: 0.26255517117976857

BinaryPatterns: ((90, 104), (93, 102), (94, 107), (97, 98)), Acceptance Ratio: 0.01980198019801982

BinaryPatterns: ((90, 103), (93, 102), (94, 107), (97, 98)), Acceptance Ratio:  
0.0035786711201241106

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File: unsliced-cpu2-icache2.txt, Group: cpu2-icache2, Indices: [89, 86]

BinaryPatterns: ((86, 89),), Acceptance Ratio: 1.0

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File: unsliced-dcache0-l2bus.txt, Group: dcache0-l2bus, Indices: [65, 67, 41, 59, 43, 12, 74, 76, 18, 21, 22, 55, 27, 60, 30]

BinaryPatterns: ((12, 18), (21, 41), (22, 74), (27, 59), (30, 43), (55, 65), (60, 76)), Acceptance Ratio:  
0.2820069204152249

BinaryPatterns: ((12, 22), (18, 74), (21, 41), (27, 59), (30, 43), (55, 65), (60, 76)), Acceptance Ratio:  
0.272318339100346

BinaryPatterns: ((12, 43), (18, 74), (21, 41), (22, 67), (27, 59), (30, 65), (55, 76)), Acceptance Ratio:  
0.05432525951557099

BinaryPatterns: ((12, 65), (18, 74), (21, 41), (22, 67), (27, 59), (30, 43), (55, 76)), Acceptance Ratio:  
0.05432525951557099

BinaryPatterns: ((12, 76), (18, 74), (21, 41), (22, 67), (27, 59), (30, 43), (55, 65)), Acceptance Ratio:  
0.05432525951557099

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File: unsliced-dcache1-l2bus.txt, Group: dcache1-l2bus, Indices: [66, 68, 73, 78, 79, 80, 50, 51, 84, 85, 54, 56]

BinaryPatterns: ((50, 56), (51, 80), (54, 73), (66, 78), (68, 79), (84, 85)), Acceptance Ratio:  
0.9667975722956087

BinaryPatterns: ((50, 51), (54, 73), (56, 80), (66, 78), (68, 79), (84, 85)), Acceptance Ratio:  
0.9667975722956087

BinaryPatterns: ((50, 73), (51, 80), (54, 68), (56, 79), (66, 78), (84, 85)), Acceptance Ratio:  
0.5312388432702606

BinaryPatterns: ((50, 68), (51, 80), (54, 73), (56, 79), (66, 78), (84, 85)), Acceptance Ratio:  
0.5219564441270974

BinaryPatterns: ((50, 84), (51, 80), (54, 73), (56, 79), (66, 78), (68, 85)), Acceptance Ratio:  
0.5105319528739736

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File: unsliced-dcache2-l2bus.txt, Group: dcache2-l2bus, Indices: [96, 99, 100, 105, 108, 109, 110, 112, 113, 91, 92, 95]

BinaryPatterns: ((91, 92), (95, 96), (99, 100), (105, 113), (108, 109), (110, 112)), Acceptance Ratio:  
0.6918357715903728

BinaryPatterns: ((91, 105), (92, 109), (95, 96), (99, 100), (108, 112), (110, 113)), Acceptance Ratio:  
0.6908919301557339

BinaryPatterns: ((91, 108), (92, 109), (95, 96), (99, 100), (105, 113), (110, 112)), Acceptance Ratio:  
0.680509674374705

BinaryPatterns: ((91, 100), (92, 109), (95, 96), (99, 105), (108, 112), (110, 113)), Acceptance Ratio:  
0.679565832940066

BinaryPatterns: ((91, 110), (92, 109), (95, 96), (99, 100), (105, 113), (108, 112)), Acceptance Ratio:  
0.6748466257668712

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File: unsliced-dram-membus.txt, Group: dram-membus, Indices: [34, 3, 5, 13, 15]

BinaryPatterns: ((3, 5), (13, 15)), Acceptance Ratio: 0.9983530468633028

BinaryPatterns: ((3, 15), (5, 34)), Acceptance Ratio: 0.20032939062733945

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File: unsliced-icache0-l2bus.txt, Group: icache0-l2bus, Indices: [2, 36, 8, 45, 25]

BinaryPatterns: ((2, 8), (25, 45)), Acceptance Ratio: 0.738404452690167

BinaryPatterns: ((2, 45), (8, 25)), Acceptance Ratio: 0.6328592042877756

BinaryPatterns: ((2, 36), (8, 25)), Acceptance Ratio: 0.5792620078334364

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File: unsliced-icache1-l2bus.txt, Group: icache1-l2bus, Indices: [81, 82, 46, 47]

BinaryPatterns: ((46, 81), (47, 82)), Acceptance Ratio: 0.6736842105263158

BinaryPatterns: ((46, 47), (81, 82)), Acceptance Ratio: 0.668421052631579

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File: unsliced-icache2-l2bus.txt, Group: icache2-l2bus, Indices: [88, 106, 114, 87]

BinaryPatterns: ((87, 88), (106, 114)), Acceptance Ratio: 0.9958847736625515

BinaryPatterns: ((87, 114), (88, 106)), Acceptance Ratio: 0.10699588477366251

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File: unsliced-l2bus-l2cache.txt, Group: l2bus-l2cache, Indices: [1, 33, 7, 11, 75, 17, 63, 24, 29, 31]

BinaryPatterns: ((1, 7), (11, 75), (17, 24), (29, 31), (33, 63)), Acceptance Ratio: 0.8016380016380016

BinaryPatterns: ((1, 31), (7, 29), (11, 75), (17, 24), (33, 63)), Acceptance Ratio: 0.3045045045045045

BinaryPatterns: ((1, 75), (7, 29), (11, 17), (24, 33), (31, 63)), Acceptance Ratio:  
0.30106470106470107

BinaryPatterns: ((1, 33), (7, 29), (11, 75), (17, 24), (31, 63)), Acceptance Ratio:  
0.30106470106470107

BinaryPatterns: ((1, 17), (7, 29), (11, 75), (24, 33), (31, 63)), Acceptance Ratio:  
0.30090090090090094

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File: unsliced-l2cache-membus.txt, Group: l2cache-membus, Indices: [32, 35, 4, 6, 14, 16, 62]

BinaryPatterns: ((4, 6), (14, 16)), Acceptance Ratio: 0.9797237731413458

BinaryPatterns: ((4, 16), (6, 14)), Acceptance Ratio: 0.3878930355568616

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### Failed Attempt/Another method:

-before generating routes it checks the trace for what indices are used, usually the traces end up using every single one

-Tried making it so it would generate all the pairings, and then there are unused indices, and for each unused index you get all the causal pairs and add that to each route (fail)

Ex: ('dram', 'membus', (3, 5, 13, 15, 34)), get an even amount of pairs, for the unused index try all combinations with that

Problem: doesn't work for ('cpu0', 'dcache0', (10, 19, 20, 23, 26, 28, 37, 38, 39, 40, 42, 58, 64))

Tried just generating routes that didn't use all the indices but could see atleast some patterns, then maybe from the remaining ones more could be mined but

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Trying route 155/51679: [(42, 39), (38, 20), (37, 23), (10, 19)]
Trying pair: (42, 39)
Trying pair: (38, 20)
Trying pair: (37, 23)
Trying pair: (10, 19)
Acceptance ratio: 0.3243266371435295
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In cases like

('cpu0', 'dcache0', (10, 19, 20, 23, 26, 28, 37, 38, 39, 40, 42, 58, 64))

There were too many routes to try, it took too long.

But it works for:

('dram', 'membus', (3, 5, 13, 15, 34)) for example. So we could look at the remaining numbers and make guesses.

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File: unsliced-dram-membus.txt,

Group: dram-membus Indices: (3, 5, 13, 15, 34)

BinaryPatterns: ((13, 15), (3, 5)), Acceptance Ratio: 0.9983530468633028

BinaryPatterns: ((15, 13), (3, 5)), Acceptance Ratio: 0.9980536008384489

BinaryPatterns: ((34, 15), (3, 5)), Acceptance Ratio: 0.8025153466087738

BinaryPatterns: ((15, 34), (3, 5)), Acceptance Ratio: 0.8025153466087738

BinaryPatterns: ((3, 5),), Acceptance Ratio: 0.8007186704596496

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**Worked for other files, failed for some**

File: unsliced-cpu1-icache1.txt,

Group: cpu1-icache1 Indices: (44, 48)

BinaryPatterns: ((44, 48),), Acceptance Ratio: 1.0

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File: unsliced-cpu2-icache2.txt,

Group: cpu2-icache2 Indices: (86, 89)

BinaryPatterns: ((86, 89),), Acceptance Ratio: 1.0

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File: unsliced-dram-membus.txt,

Group: dram-membus Indices: (3, 5, 13, 15, 34)

BinaryPatterns: ((13, 15), (3, 5)), Acceptance Ratio: 0.9983530468633028

BinaryPatterns: ((15, 13), (3, 5)), Acceptance Ratio: 0.9980536008384489

BinaryPatterns: ((34, 15), (3, 5)), Acceptance Ratio: 0.8025153466087738

BinaryPatterns: ((15, 34), (3, 5)), Acceptance Ratio: 0.8025153466087738

BinaryPatterns: ((3, 5),), Acceptance Ratio: 0.8007186704596496

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File: unsliced-icache2-l2bus.txt,

Group: icache2-l2bus Indices: (87, 88, 106, 114)

BinaryPatterns: ((106, 114), (87, 88)), Acceptance Ratio: 0.9958847736625515

BinaryPatterns: ((114, 106), (87, 88)), Acceptance Ratio: 0.9465020576131687

BinaryPatterns: ((87, 88),), Acceptance Ratio: 0.9465020576131687

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File: unsliced-l2cache-membus.txt,

Group: l2cache-membus Indices: (4, 6, 14, 16, 32, 35, 62)

BinaryPatterns: ((4, 6), (14, 16)), Acceptance Ratio: 0.9797237731413458

BinaryPatterns: ((4, 6), (16, 14)), Acceptance Ratio: 0.9794299147810756

BinaryPatterns: ((16, 32), (4, 6)), Acceptance Ratio: 0.8172200999118425



BinaryPatterns: ((4, 6), (32, 16)), Acceptance Ratio: 0.8101674992653541

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**Issues:**

Issue: For some reason is taking too long on 0,9 (cpu0-icache0)

These are failing too because they have low acceptance ratios, will examine why

Group: icache0-l2bus Indices: (2, 8, 25, 36, 45)

Group: icache1-l2bus Indices: (46, 47, 81, 82)