

## What makes achieving *always-green master* difficult at scale?

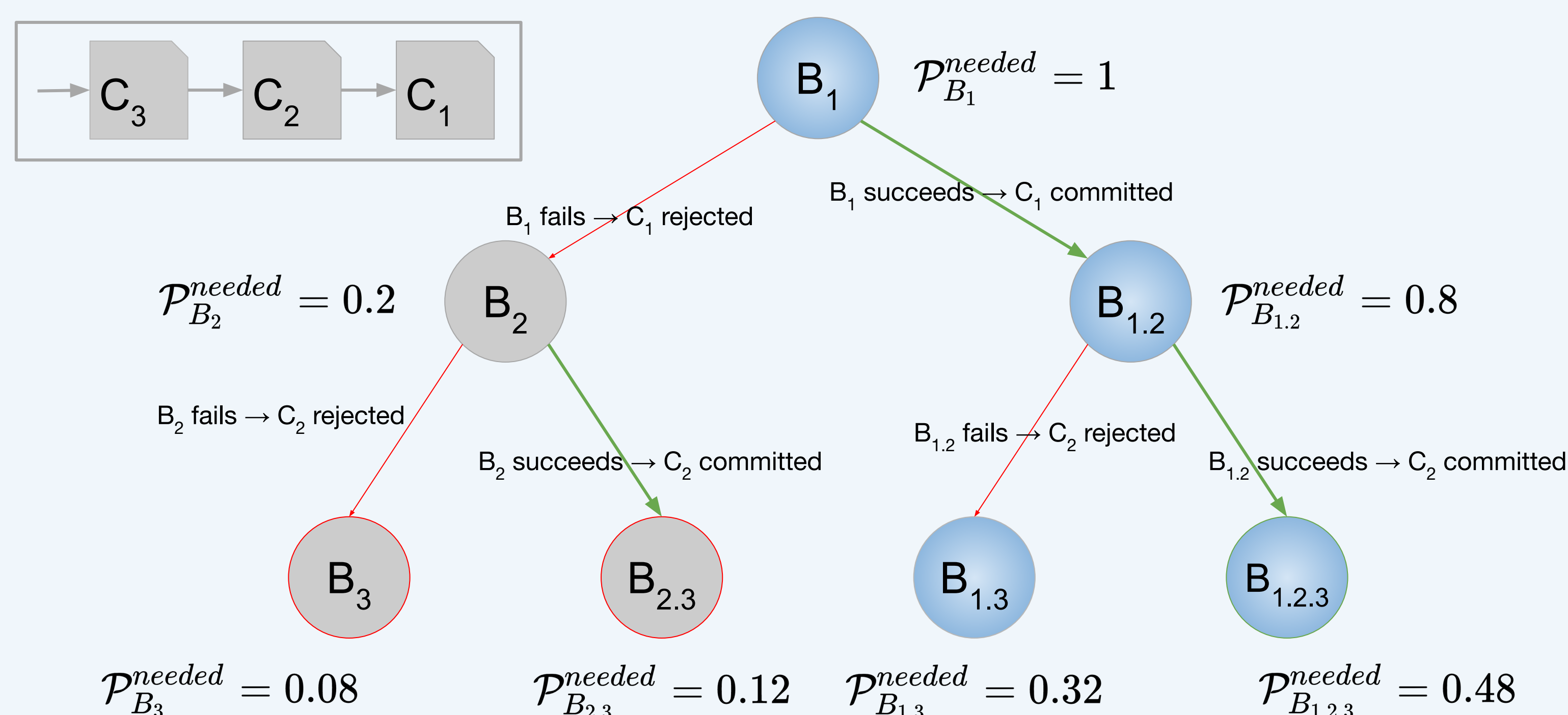
- Commits of 1000s of changes daily lead to frequent breakages
- Affects developer's productivity and delays rollouts (\$\$\$)
- Selection of healthy changes for commit at scale is challenging

1000+ Avg. Commits/day      52% Master success rate before SQ      > 5% Prob. of a breakage 4 concurrent changes      > 40% Prob. of a breakage 15 concurrent changes

### Issues with common approaches

- Test & commit changes sequentially ✗ Takes 100s of hours to process
- Build all combinations ✗  $2^n$  hardware needed
- Batch processing ✗ Batch rejection ✗ Hard to scale manual resolution

$$\mathcal{P}_{C_3}^{succ} = 0.8 \quad \mathcal{P}_{C_2}^{succ} = 0.6 \quad \mathcal{P}_{C_1}^{succ} = 0.8$$



## Probabilistic Speculation

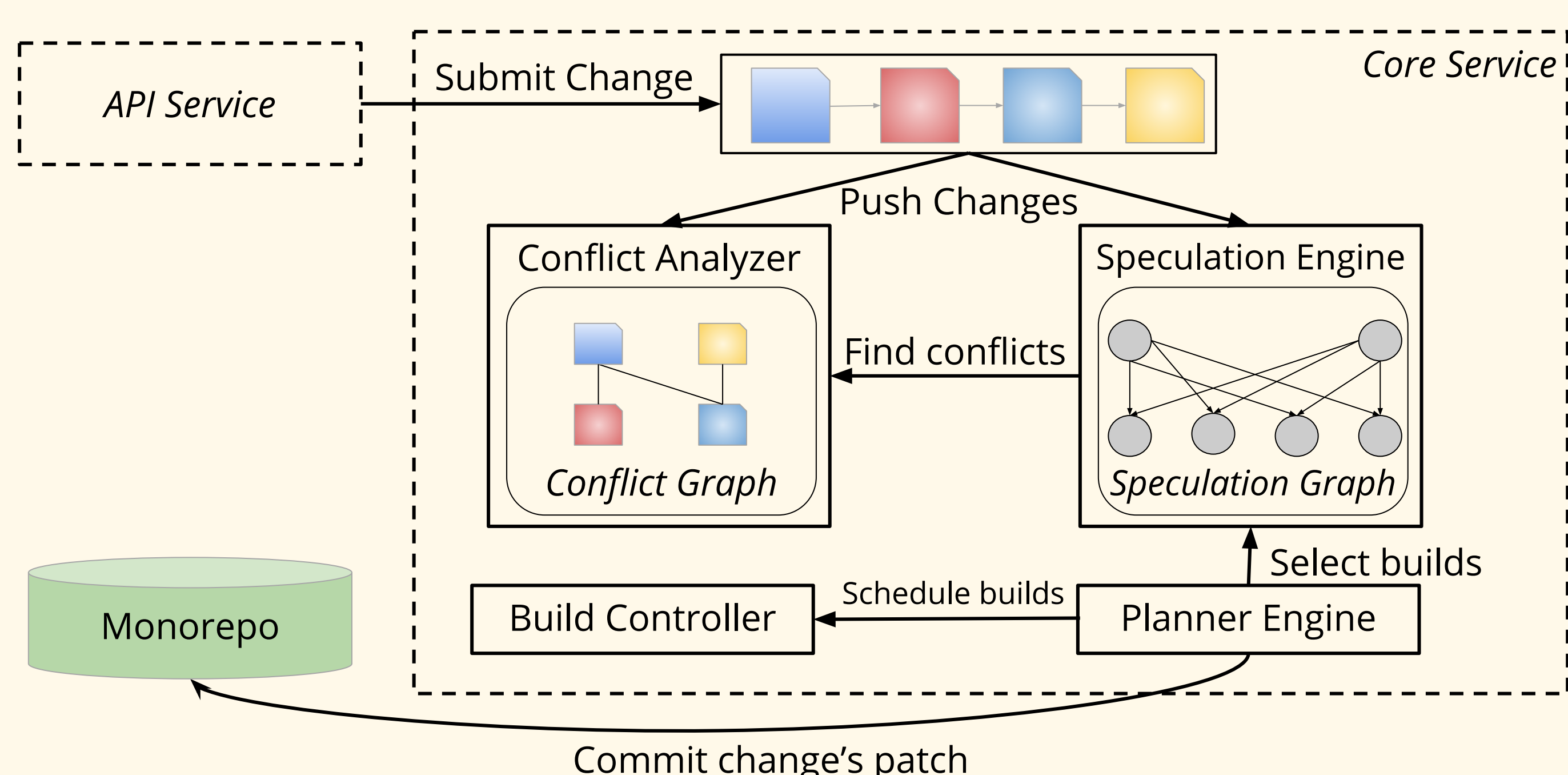
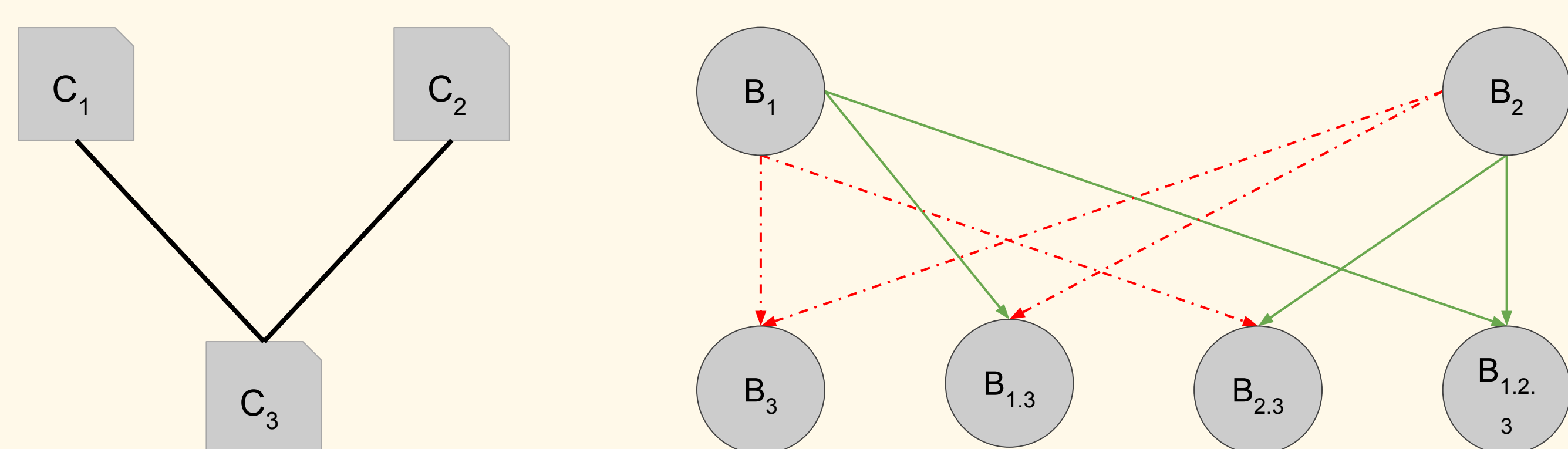
- Prioritize builds most likely to succeed
- ML model computes
  - probability of success of a change
  - probability of conflict among changes

100+ Features

97% Prediction Accuracy

## Conflict Analyzer

- Determining non-conflicting changes allows
  - Commit such changes in parallel
  - Trim speculation space
- Build tool finds build targets affected by a change
- Disjoint set of affected targets means no conflict



## Results and Analysis

### Latency compared to oracle (p95)

Strategy	Low Contention	High Contention
Submit Queue	1.2x	4x
Optimistic	10x	18x
Build all	11x	24x

SUBMITQUEUE

#Changes / Hour	100	200	300	400	500
500	2.56	1.77	1.49	1.38	1.26
400	2.57	1.87	1.59	1.47	1.42
300	2.52	1.87	1.44	1.31	1.28
200	2.98	2.04	1.92	1.72	1.54
100	1.83	1.00	1.02	1.00	1.00

OPTIMISTIC STRATEGY

#Changes / Hour	100	200	300	400	500
500	8.54	8.72	8.62	8.57	8.77
400	8.75	8.70	8.67	8.74	8.69
300	7.33	7.63	7.64	7.56	7.65
200	9.60	9.62	9.62	9.64	9.64
100	7.46	7.46	7.44	7.44	7.44

P50 Turnaround-time normalized against Oracle

### Conflict Analyzer

- Oracle & SQ's latencies improve by up to **60%** & **50%** respectively.