Constraint based scheduling of Weakly Consistent C programs for Reconfigurable Hardware

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Problem

- Scheduling concurrent C programs for HLS.
- When using atomics, scheduling can be incorrect.
- Existing solution assumes no constraints on resources.

Current Approach

- Introduce memory dependency edges to influence scheduling.
- Map each thread to an independent H/W Accelerator.
- No constraints on resources.

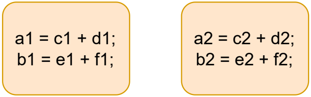
Proposed Solution: Sequentialize

- Merge two or more concurrent threads to meet resource constraints.
- Give the merged program to be synthesized by the same HLS tool.
- Merging would also expose other thread-local optimizations in synthesis which may reduce clock cycles(why?).

Current Progress

- Added shared memory accesses to coursework code base.
- Added new dependency order to respect memory consistency rules.
- Modified scheduling algorithm of coursework to handle shared memory programs.
- Identified a good benchmark to showcase advantage of merging.

Benchmark Programs



```
a1 = c1 + d1;
b1 = e1 + f1;
```

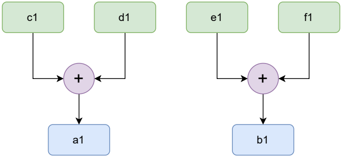
```
a2 = c2 + d2;
b2 = e2 + f2;
```

- Change any access above to shared one – eg: c1–¿cs.
- Do this for all memory accesses – total 4096 possibilitie – giving us 4096 programs.

Test Example 0: No shared memory

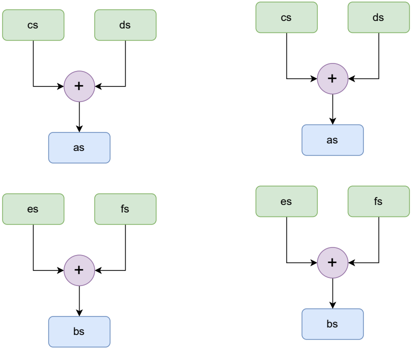
```
a1 = c1 + d1;
b1 = e1 + f1;
```

```
a2 = c2 + d2;
b2 = e2 + f2;
```



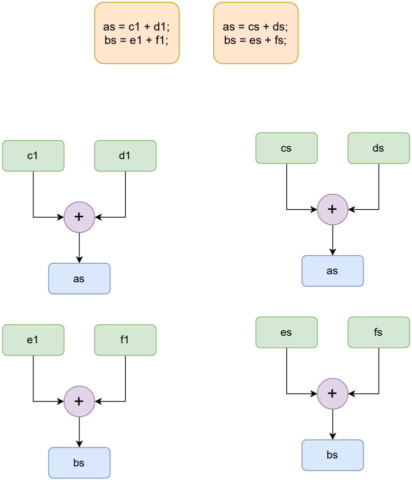
Test Example 1: All Shared memory

T1;T2



Test Example 2: Save Clock Cycles

T2;T1



```
as = c1 + d1;
bs = e1 + f1;
```

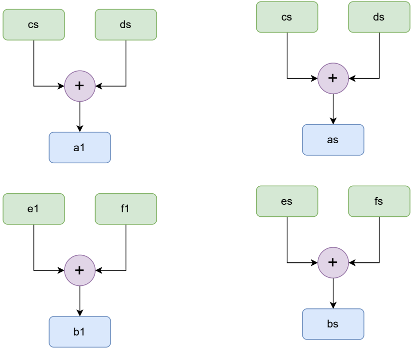
```
as = cs + ds;
bs = es + fs;
```

Test Example 3: Save Both Clock Cycles and Resources

T1;T2

```
a1 = cs + ds;
b1 = e1 + f1;
```

```
as = cs + ds;
bs = es + fs;
```

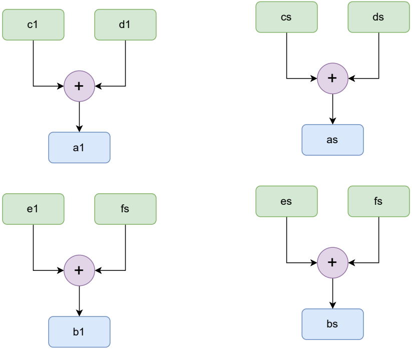


Can do even better

T2-T1-T1-T2

```
a1 = c1 + d1;
b1 = e1 + fs;
```

```
as = cs + ds;
bs = es + fs;
```



Pending

- Global Analysis to identify best merging combination.
- Implement Redundant R/W elimination to improve scheduling (identified how to implement this)
- Graphs of relevance summarizing all 4096 examples and the effect of merging different ways.