



ELEC3441 lab4

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5.3 Checkoff 1

(1)

```
add    a1, a0, a0
slli   a2, a1, 8
```

```
sub     a3, a2, a1
slli    a2, a1, 8
```

(2) The subsequent instructions are stalled, and bubbles are pushed into pipeline.

(3) `0x000001e0f`

(4) 2, different with the default processor

6.3 Checkoff 2

- Staled data is used
- `0x00000000f`
- 1.5, which is the same with default
- The 5-stage processor and the 5-stage processor w/o forwarding or hazard detection results in the highest . The 5-stage processor and the 5-stage processor w/o forwarding results in the correct answer.

7.4 Checkoff 3

(1) verify

(2) The default 5-stage processor with forwarding runs at $CPI = 1.65$, the 5-stage processor without forwarding runs at $CPI = 1.85$, so the default 5-stage processor with forwarding has a higher performance.