

COMS30046 Advanced Computer Architecture

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ISA

Instruction	arg 1	arg 2	arg 3	Functionality	cycles	Instruction	arg 1	arg 2	arg 3	Functionality	cycles
add	r_1	o_1	o_2	$r_1 \leftarrow o_1 + o_2$	2	ld	r_1	o_1	–	$r_1 \leftarrow mem[o_1]$	10
sub	r_1	o_1	o_2	$r_1 \leftarrow o_1 - o_2$	3	st	o_1	o_2	–	$mem[o_1] \leftarrow o_2$	10
mul	r_1	o_1	o_2	$r_1 \leftarrow o_1 \times o_2$	10	j	o_1	–	–	$pc \leftarrow pc + o_1$	2
not	r_1	o_1	–	$r_1 \leftarrow \neg o_1$	1	bilz	r_1	l_1	–	$\begin{cases} pc \leftarrow l_1 & \text{if } r_1 < 0 \\ pc \leftarrow pc & \text{otherwise} \end{cases}$	5
and	r_1	o_1	o_2	$r_1 \leftarrow o_1 \wedge o_2$	1	biez	r_1	l_1	–	$\begin{cases} pc \leftarrow l_1 & \text{if } r_1 = 0 \\ pc \leftarrow pc & \text{otherwise} \end{cases}$	5
or	r_1	o_1	o_2	$r_1 \leftarrow o_1 \vee o_2$	1	bigz	r_1	l_1	–	$\begin{cases} pc \leftarrow l_1 & \text{if } r_1 > 0 \\ pc \leftarrow pc & \text{otherwise} \end{cases}$	5
xor	r_1	o_1	o_2	$r_1 \leftarrow o_1 \oplus o_2$	1	halt	–	–	–	Halts program	1
cp	r_1	o_1	–	$r_1 \leftarrow o_1$	5	noop	–	–	–	None	1

Features

- Superscalar pipeline with n^* Execution Units
- Out of Order execution with Tomasulo's Algorithm

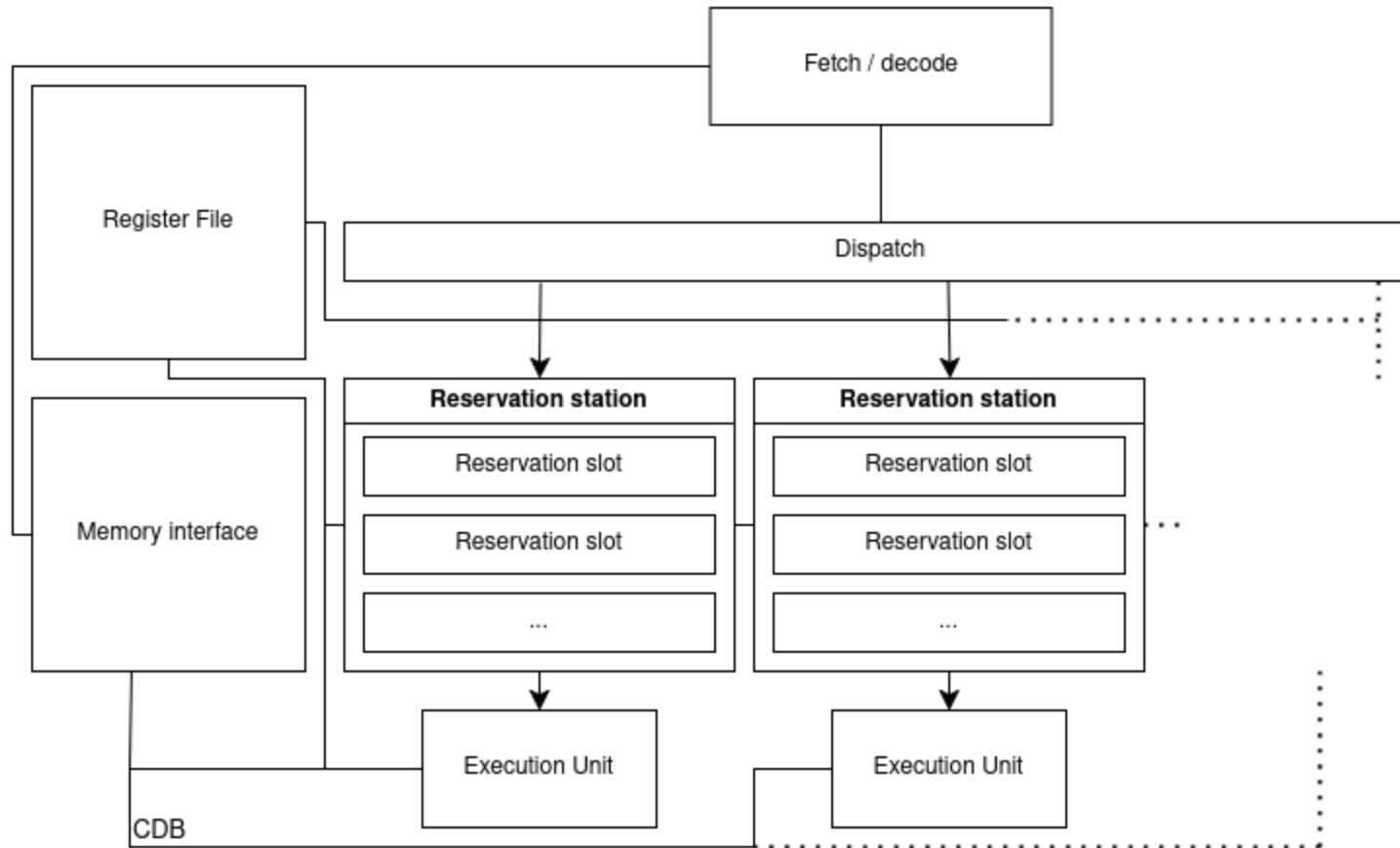
Execution units each have 1 reservation station containing reservation slots.

Each execution can perform all instructions in the ISA

Instructions are issued to the stations with the highest number of free slots, and are fetched from the reservation stations in array order by the execution units (effective random order).

*number of EUs and slots per Reservation Station configurable via constants

Diagram



Experiments

Collatz

Processor calculating the number of collatz iterations for input '27' (111 iterations)

Cycles	1 EU	2 EUs	3 EUs	4 EUs
1 Slot	1181245	1180539	1180456	1180456
2 Slots	1222128	1261871	1180956	1180456
3 Slots	1262821	1262012	1180956	1180456
4 Slots	1303503	1262012	1180956	1180456

The more EUs in the processor, the faster the calculations. The increase in cycles with more reservation slots is a bug that will be found and diagnosed for the viva