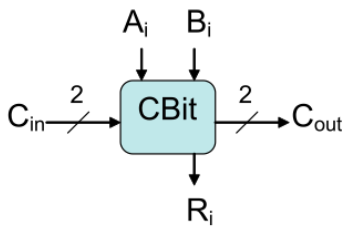
WE7.1

Bookmark this page

Video explanation of solution is provided below the problem.

Pipelining

12/12 points (ungraded)

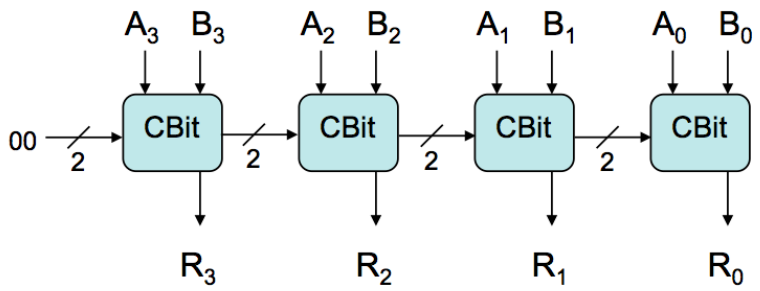


MaxOut is a Cambridge startup whose products are binary comparators which determine the largest of several unsigned binary integers. A building block common to all MaxOut products is the combinational CBit module depicted to the left.

Each CBit module takes corresponding bits of two unsigned binary numbers, A and B, along with two C_{in} bits from higher-order CBit modules. Its output bit, R, is the appropriate bit of the larger among A and B, as determined from these inputs; it passes two C_{out} bits to lower-order CBit modules.

The propagation delay of each CBit module is 4 ns. The two C_{out} bits indicate, respectively, if A>B or B>A in the bits considered thus far.

The first MaxOut product is MAXC, a combinational device which determines the maximum of its two 4-bit unsigned binary inputs. It is constructed using 4 CBit modules:



In the above diagram, unused inputs are tied to 0. The output $R_{3:0}$ is the larger of $A_{3:0}$ or $B_{3:0}$.

(A) What propagation delay specification is appropriate for the combinational MAXC module? What is its throughput?

MAXC propagation delay spec (ns): 16 ✔

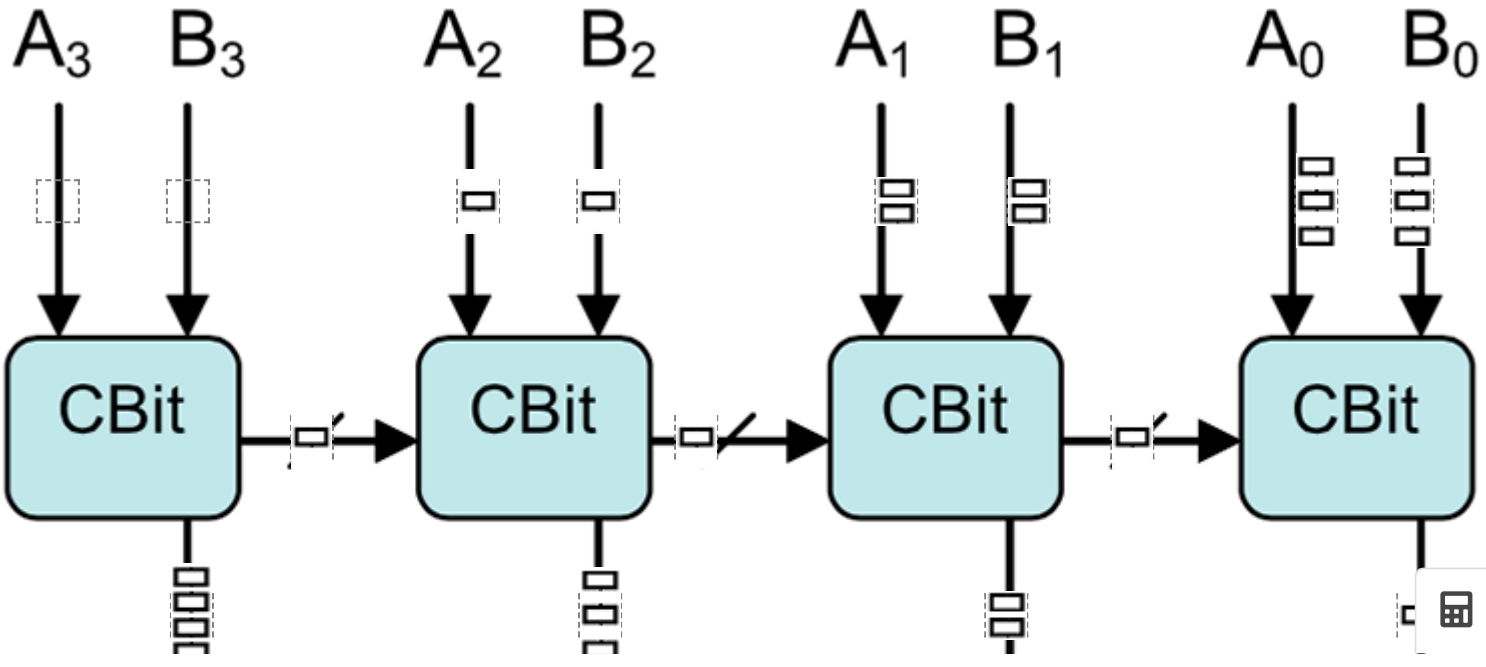
MAXC throughput (provide your answer in the form 1/X) (1/ns): 1/16 ✔

(B) If $A_{3:0}$ and $B_{3:0}$ are identical numbers, what two bits would you expect to see coming out of the (unused) C_{out} outputs from the low-order CBit module?

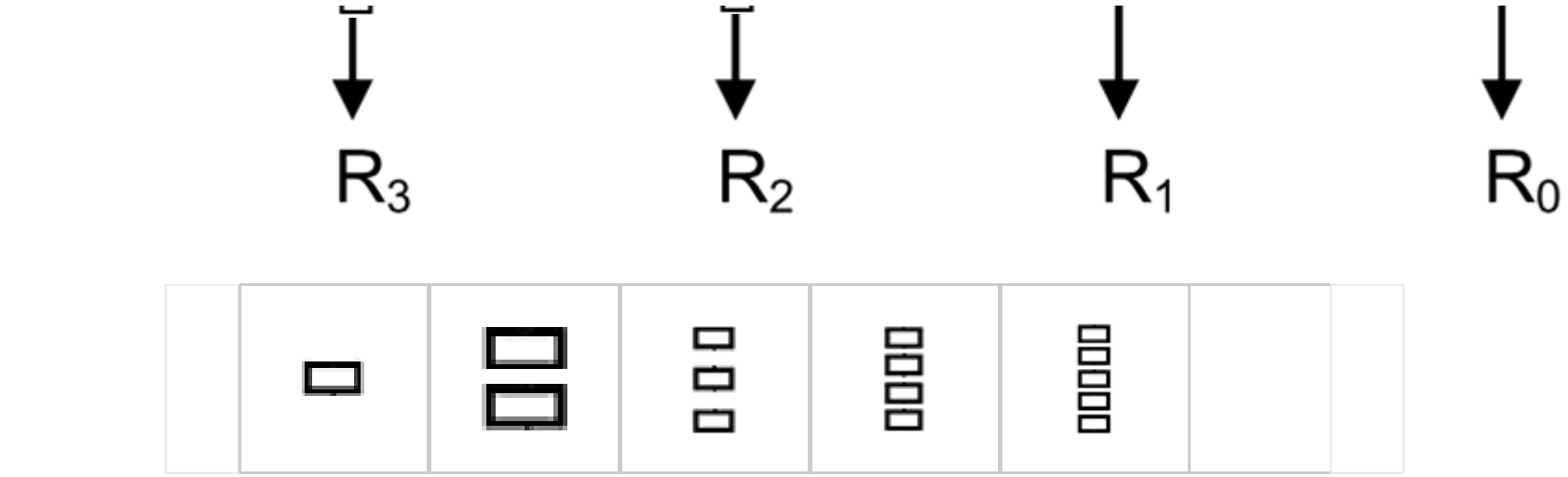
Low-order Cout bits for A=B: 0 ✔ and 0 ✔

MaxOut's second product, MAXP, is identical to MAXC except that it includes the minimum number of registers necessary inserted to pipeline the circuit for maximum throughput.

(C) On the diagram below pipeline the MAXC for maximum throughput. Drag the correct number of ideal (zero delay, zero setup/hold time) registers onto each of the dashed square boxes so that you produce a valid pipeline with maximum throughput. Be sure to include at least one register on each output.



Calculator

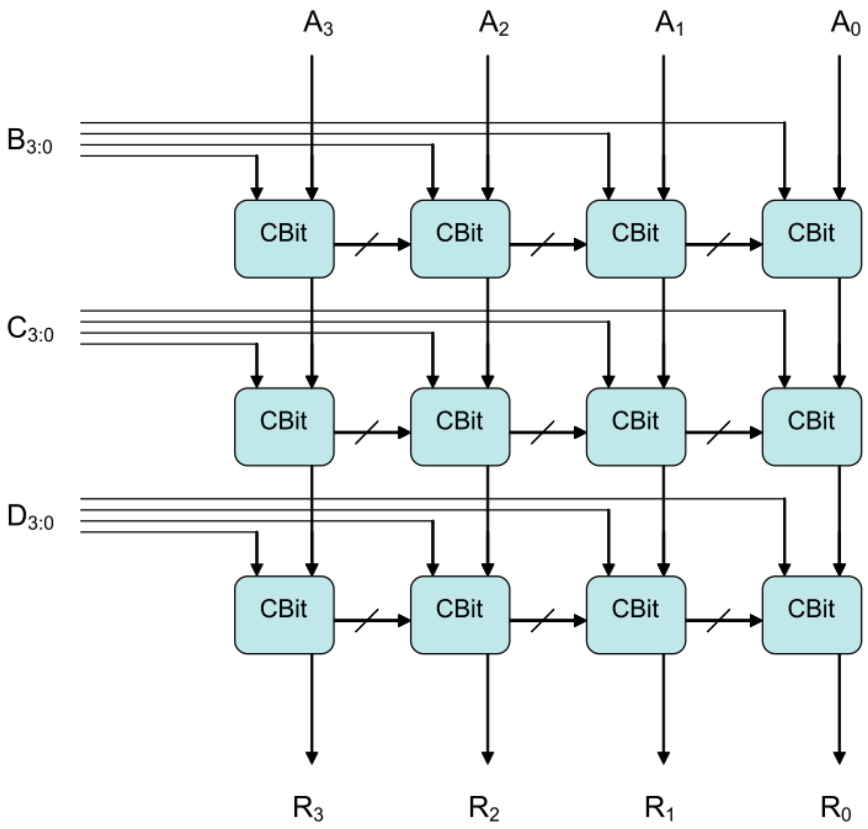


(D) What are the latency and throughput of your pipelined MAXC?

Pipelined MAXC latency (ns): 16

Pipelined MAXC throughput (provide your answer in the form 1/X) (1/ns): 1/4

Expanding their product line, MaxOut's next product – the MAX4X4 -- is a combinational circuit capable of determining the maximum of four 4-bit binary inputs.

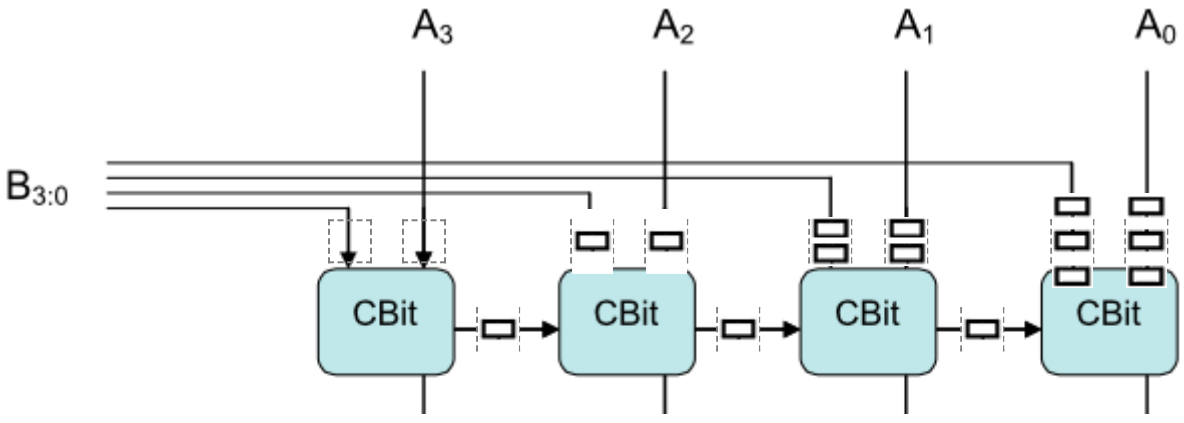


(E) What are the best latency and throughput that can be achieved using the combinational MAX4X4?

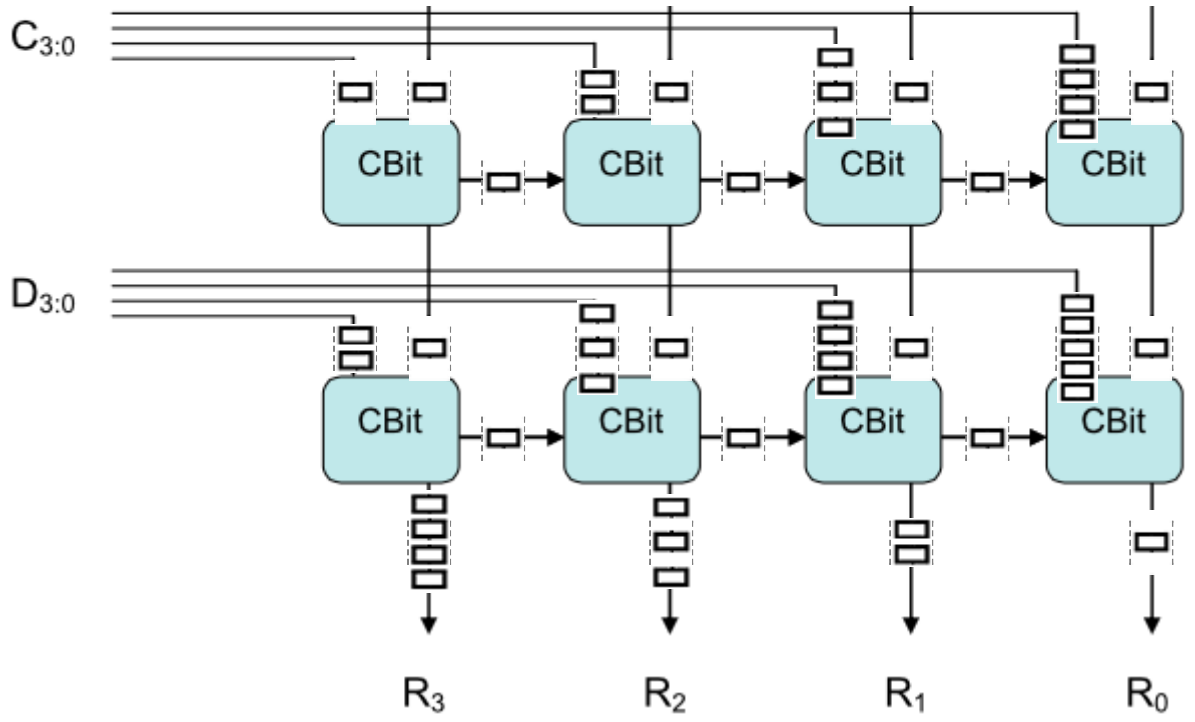
Latency (ns): 24

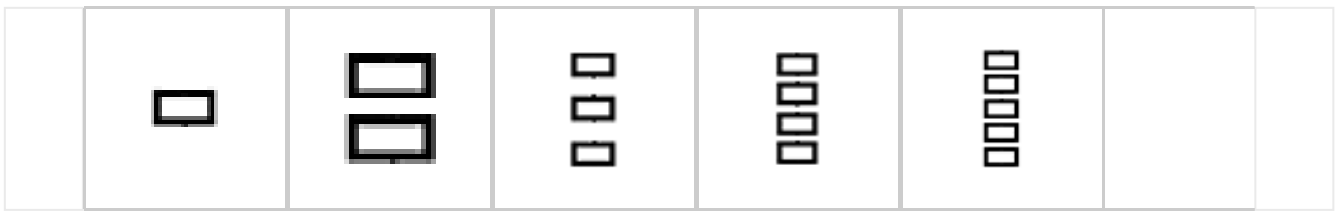
Throughput (provide your answer in the form 1/X) (1/ns): 1/24

(F) On the diagram below, pipeline the MAX4X4 for maximum throughput. Do this by dragging the correct number of ideal registers onto each of the dashed square boxes so that you produce a valid pipeline with maximum throughput. Then give the best latency and throughput that can be achieved by pipelining the MAX4X4.



Calculator





✔

Latency (ns): 24 ✔

Throughput (1/ns): 1/4 ✔

Submit

Pipelining

▶ 0:00 / 0:00 1.0x

Video
Download video file

Transcripts
Download SubRip (.srt) file
Download Text (.txt) file

Discussion

Hide Discus

Calculator

Topic: 7. Performance Measures / WE7.1

Add a Post

Show all posts by recent activity

There are no posts in this topic yet.

‹ Previous Next ›

Calculator