Problem M7.1: Networks-on-Chip

Problem M7.1.A

Consider a flow control method similar to circuit switching but where the request message 'reserves' each channel for a fixed period of time in the future (for example, for 10 cycles since a reservation is made). At each router along the path, a reservation is made if a request from a neighbor can be accommodated. If the request cannot be accommodated a NACK is sent that cancels all previous recommendations for the connection, and the request is retired. If a request reaches the destination, an acknowledgement is sent back to the source, confirming all reservations.

Draw a time-space diagram of a situation that demonstrates the advantage of reservation circuit switching over conventional circuit switching.

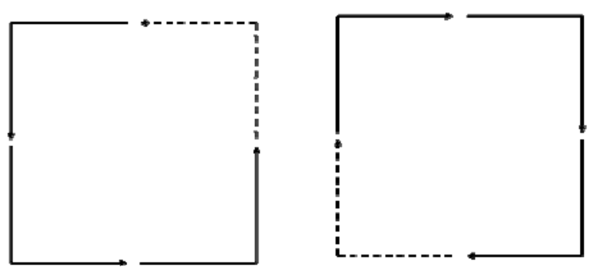
Problem M7.1.B

Determine whether the following oblivious routing algorithms are deadlock-free for the 2-D mesh. There is only one virtual channel per link and no 180-degree turns are allowed for (c).

(a) Randomized dimension-order: All packets are routed minimally. Half of the packets are routed completely in the X dimension before the Y dimension and the other packets are routed Y before X.

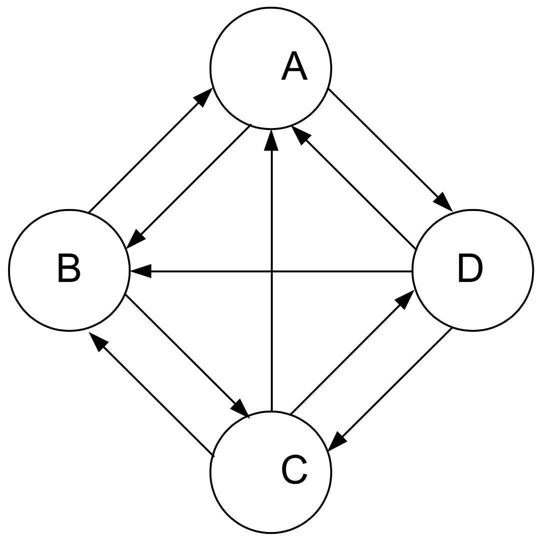
(b) Less randomized dimension-order: All packets are routed minimally. Packets whose minimal direction is increasing in both X and Y, always route X before Y. Packets whose minimal direction is decreasing in both X and Y, always route Y before X. All other packets randomly choose between X before Y and vice versa.

(c) All packets are prohibited to take the two turns in dash:



Problem M7.2: Non-mesh Networks

We have the following network topology with 4 network nodes and 10 links.



Note that each link is unidirectional, and only one link exists between A and C (only a link from C to A (not from A to C), and only from D to B between B and D. Each link can transfer 1 flit per cycle and there is only one virtual channel per link. For all parts, 180-degree turns are not allowed.

Problem M7.2.A

Fill in the following table of the properties of this network.

Diameter	
Average Distance	
Bisection Bandwidth	

Problem M7.2.B

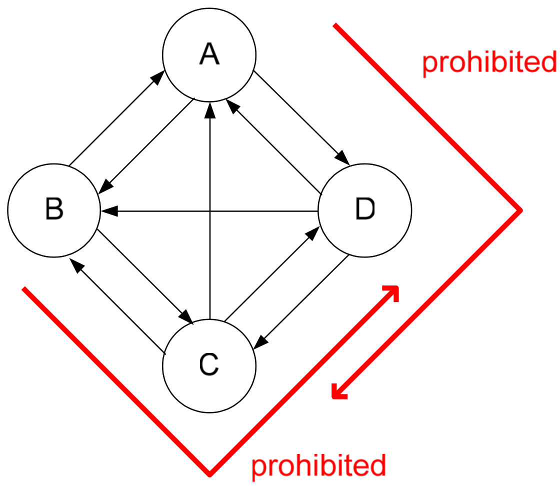
Draw the channel dependency graph of this network.

Problem M7.2.C

Is a **minimal** routing on this network deadlock-free? Show your reasoning and give a deadlock scenario if it is not deadlock -free.

Problem M7.2.D

Now, we use a possibly **non-minimal** routing on this network. Plus, we prohibited the following two movements on the non-minimal routing: 1) A to D then D to C and 2) B to C then C to D.



Is this routing deadlock-free? Show your reasoning and give a deadlock scenario if it is not deadlock -free.

Problem M7.2.E

<u>Still having the two movements in M7.2.D prohibited</u>, we added another restriction in routing: the link from C to A can be used only by packets generated at C, before the packets are transferred to any other nodes (it should be the first link those packets ever take). Also, the link from D to B can be used only by packets generated at D with the same condition (however, routes may be non-minimal).

Is this routing deadlock-free? Show your reasoning and give a deadlock scenario if it is not deadlock -free.