

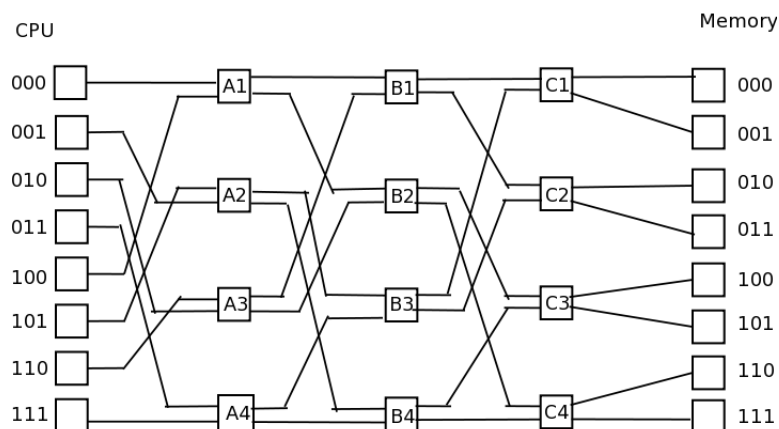


# Assignment 1

Please read the document, **General Requirements for Non-Programming Assignments**, posted on the course website and make sure you follow them when you do this assignment. The first two problems are really just math review exercises related to the topic of the course. If you have trouble with them, then review what you learned in your algebra and discrete structures classes.

## 1 Questions

- (25%) How many different paths are there between the node in the lower left corner and the node in the upper right corner of a square mesh with  $n$  nodes in each row and column? Justify your answer.
- (25%) An omega network, shown below for eight processors<sup>1</sup> (the processors on the left and right are the same), is an indirect topology in which each switch has identical input connections and except for the rightmost column, the same output connections. The rows are numbered 0 through 7 in binary. The output from row  $j$  in any column, including the 0<sup>th</sup> column, is to the row whose binary representation is a left cyclic rotation of the  $j$ . For example, 010 connects to 100 and 100 connects to 001. Row 000 always connects to 000. In the last column, the output of switch  $C_j$  connects the two outputs to processors  $2j - 2$  and  $2j - 1$ .



For an omega network with  $n = 2^k$  processors,

- How many switching elements are in the network?
  - What is its diameter?
  - What is its bisection width?
  - What is the maximum number of edges per switch?
  - Does the network have constant edge length as the number of processors is increased?
- (25%) How many different ways can a  $d$ -dimensional hypercube be labeled?
  - (25%) Why is the number of processors in a centralized multiprocessor limited to a few dozen or so? Explain.

<sup>1</sup>From [https://commons.wikimedia.org/wiki/File:Omega\\_network.png](https://commons.wikimedia.org/wiki/File:Omega_network.png), licensed with CC-BY-SA-3.0.



## 2 Grading Rubric

There are four questions in this assignment, each worth the percentage indicated. Questions are assessed on their completeness and correctness and graded in accordance with the *General Requirements for Non-Programming Assignments* document posted on the course website.

## 3 Submitting the Homework

## 4 Instructions for Submitting the Homework

1. **Due Date:** This assignment is due by the end of the day (i.e. 11:59PM, EST) on September 22.
2. Your homework must comply with the *General Requirements for Non-Programming Assignments* document posted on the course website for full credit.
3. **The assignment must be submitted as a PDF.**
4. **You must put your name, first name followed by last name, in the upper left corner of the first page**, which is nothing but a title page; it should have nothing else on it.
5. **Each question must be written on a separate page, and be no longer than one page in length.** There will be exactly five pages in total.
6. To submit the assignment, you must use the `submithwk_cs49365` program that is located in the directory

```
/data/biocs/b/student.accounts/cs493.65/bin
```

Assuming that your file is named `hwk1.pdf` and is in your current working directory, run the command

```
/data/biocs/b/student.accounts/cs493.65/bin/submithwk_cs49365 -p 1 hwk1.pdf
```

The `-p` is a switch that tells the program it is a PDF file. This program will make a copy of your file and place it in the directory

```
/data/biocs/b/student.accounts/cs493.65/hwks/hwk1/
```

transferring ownership to me and setting permissions so that no one can read or modify it. ***You can only run these commands on a cslab host. You cannot run them on eniac, so remember to ssh into a cslab host before doing this!***