Homework Assignment #2 (Due: Wed, Sept 13, 2000)

CSE 5347: Telecommunication Networks Design

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http://www-cse.uta.edu/~das/5347.html

1. In a $d$-dimensional hypercube, let $H(X,Y)$ be the Hamming distance between a pair of nodes $X$ and $Y$. Show that
   (i) there are exactly $d$ distinct (i.e., no overlapping of nodes or links) paths between $X$ and $Y$.
   (ii) $H(X,Y)$ paths have lengths exactly $H(X,Y)$ and the remaining $d-H(X,Y)$ paths have lengths exactly $H(X,Y)+2$.

2. What is the average distance between any two nodes in a $d$-dimensional hypercube? Derive your result.

3. The perfect shuffle-exchange interconnection, $PS(n)$, on $n = 2^k$ nodes is defined as follows.
   There is a directed link from node $i$ to node $j$ if $j = 2i$ for $0 \leq i < \frac{n}{2} - 1$, and $j = 2i \mod (n-1)$ for $\frac{n}{2} \leq i \leq n-1$.
   Additionally, there exist bidirectional links between every even-numbered node and its successor.
   (i) Draw shuffle-exchange networks of 8, 16, 32 and 64 nodes and identify some patterns (e.g., directed cycles) that you observe.
   (ii) What is the node-degree and diameter of $PS(n)$?

4. A star, $S_m$, is an interconnection network of $n = m!$ nodes such that for a given integer $m$, each node corresponds to a distinct permutation of $m$ symbols, say $\{1, 2, \ldots, m\}$. There is a bidirectional link between two nodes $u$ and $v$ if and only if the label of $u$ can be obtained from that of $v$ by exchanging the first symbol with the $i$th symbol, where $2 \leq i \leq m$.
   (i) Draw $S_3$ and $S_4$ and identify some topological structures in general.
   (ii) What is the degree and diameter of $S_m$. 