Mestrado em Computação (IC/UFF) – Arquiteturas Paralelas II
Bacharel em Ciência da Computação (DCC/UFF) – Tópicos em Arq. de Computadores II
Lista de Exercícios – Prof. Vinod Rebello

1. **Architectural Models**
   (a) Describe the architectural and operational characteristics of SIMD and MIMD computers.
   (b) Distinguish between *multiprocessors* and *multicomputers*.
   (c) Explain the differences among UMA, NUMA, COMA, CC-NUMA and NORMA computers.

2. **SIMD and Scalability**
   (a) *In SIMD machines, intructions are broadcast from a central control unit to the individual processing elements (PEs). Given n PEs in k dimensions, how does the system performance scale with n and k?

3. **Networks**
   (a) Interconnection networks may be characterised by a number of "active" and passive design features, describe them.
   (b) Which static and dynamic networks could be employed to connect processors for the *parallel prefix sum* problem (na pagina 16 do tópico 2)? Which is best and why? If the sequence of numbers is large, is the answer still the same?

4. **Permutations**
   (a) The routing function $R_i(x)$ is defined as follows:
   $$R_i(x) = \lfloor \frac{x}{2^i} \rfloor \times 2^i + (((x \bmod 2^i) + 2^{i-1}) \bmod 2^i) \text{ where } 1 \leq i \leq log_2 x$$
   What permutation does this represent and what is the binary representation of $R_i(a_{n-1}...a_0)$, if $a_{n-1}...a_0$ is the binary representation of the parameter x.

5. **Static Networks** – For a k-Cube Connected Cycles (k node CCC):
   (a) How many rings of k nodes are there and how many nodes exist in total?
   (b) What is the *network bandwidth*, *node degree* and *network diameter* of such a network?
   (c) Which is better a 64 node CCC or a 64 node Hypercube?

6. **Dynamic Networks** – Omega Networks
   (a) How many legitimate states are there in a 4×4 switch?
   (b) Construct a 64 input Omega network using 4×4 switches.
   (c) How many permutations can be implemented directly in a single pass through the network without blocking?
   (d) What is the percentage of one-pass permutations compared with the total number of permutations achievable in one or more passes of the network?

7. **Performance**
   (a) *Suppose a multiprocessor is built out of individual processors capable of sustaining 250 MFLOPS. What is the *largest fraction* of a *program's execution time* that could be devoted to sequential operations if the parallel computer is to exceed the performance of a supercomputer capable of sustaining 1 TFLOP?