

High Performance Computing

5th appello – September 6, 2013

The answers can be written in English or in Italian. Please, present the work in a legible and readable form. All the answers must be properly and clearly explained.

Question 1

In a 3-stage pipeline computation $\Sigma = \{S_0, S_1, S_2\}$ S_0 is the stream generator. The stages have calculation times $T_0 = 20t$, $T_1 = 100t$, $T_2 = 80t$ respectively (t denotes a generic time unit). The communication latency is equal to $40t$ for each channel. Every processing node is associated a communication processor.

- Determine the ideal service time, the effective service time and the relative efficiency of Σ , S_0 , S_1 , S_2 .
- Is $n = 3$ the optimal parallelism degree for this computation ?

Question 2

With reference to a SMP multiprocessor architecture with 64 Processing Elements and binary generalized fat tree wormhole interconnection structure:

- explain the deterministic routing algorithm implemented in a generic switch unit;
- determine the ideal service time of a generic switch unit;
- determine the ideal service time of the Processing Element Interface unit (W);
- explain the hardware-firmware support for indivisible sequences of memory accesses.

Question 3

The following computation transforms an integer array $A[M]$ into an integer array $B[M]$:

```
int A[M], B[M]; float E = ...;
do
    {  $\forall i = 0 .. M - 1: B[i] = A[i];$ 
       $\forall i = 0 .. M - 1: A[i] = F(B[i])$ 
    }
while  $\exists i : \text{abs}(A[i] - B[i]) > E$ 
```

Assuming that the average number s of iterations is known, define and explain a parallel version and find the optimal parallelism degree as a function of s , M , T_F , T_{setup} , T_{trasm} . Array A is initially present in a distinct node, and the final value of array B has to be stored into another distinct node.