

Comparative Architectures Supervision Problem (Set 3)

Wei Song 27/02/2016

The following problems are mostly open-ended. Diagrams or charts are not needed in the answers. Therefore it is highly recommended to type the answers. Please keep your answers organised and tidy. If you feel difficult to answer some questions or would like a discussion during the supervision session, please label it in your answer.

Lecture 9 & 10. Cache

Q1. What does it mean if a cache memory hierarchy adopts a multi-level inclusion policy? What might influence a decision on whether to adopt a multi-level inclusion or exclusion policy? (2008 Paper 7 Q 5)

Q2. A naive programmer writes the following code for performing the matrix multiply-add function $C=AB+C$ on square matrices:

```
for (i=0; i<N; ++i) {
    for (j=0; j<N; ++j) {
        for (k=0; k<N; ++k) {
            C[k][i] = C[k][i] + ( A[k][j] * B[j][i] );
        }
    }
}
```

(Where $X[v][u]$ refers to the element in row v , column u . Arrays are stored in memory row by row, i.e. $X[0][0]$, $X[0][1]$, $X[0][2]$, ... $X[0][N]$, $X[1][0]$, ... etc.)

1. When used to multiply very large matrices, performance of the programmer's algorithm is very poor. Explain what is happening.
2. The algorithm can be improved simply by changing the order of the loops. Demonstrate how and why.
3. Show how further improvement can be obtained through a technique known as cache blocking
4. Could the algorithm be successfully parallelised to run on a microprocessor supporting Simultaneous Multithreading (SMT)? Briefly justify your answer.

(2002 Paper 7 Q 3)

Q3. [Open] Describe at least 3 different ways to improve the performance of a directly mapped cache.

Q4. [Open] Describe the three different reasons of cache misses and the potential software/hardware methods to reduce the cache miss overhead caused by each reason.

Lecture 11. Vector Machine

Q5. [Open] Both VLIW and Vector (SIMD) improve ILP. Describe the pros and cons of VLIW and Vector machines.

Q6. [Open] Why does a vector processor offer a particularly energy efficient solution to execute some type of program?

Q7. [Open] In which situations might a vector processor perform worse than a simple pipelined processor?