

7 Introduction to Computer Architecture (swm11)

- (a) The following code is written in C, where elements within the same row are stored contiguously. Assume each element of the two dimensional arrays A and B is a 64-bit integer. Assume that each cache line is 16-bytes.

```
for(i=0; i<1024; i++)
  for(j=0; j<1024; j++)
    A[i][j] = B[i][0] + A[j][i];
```

- (i) Which variable references exhibit temporal locality? Explain your answer including a definition of temporal locality. [4 marks]
- (ii) Which variable references exhibit spatial locality? Explain your answer including a definition of spatial locality. [4 marks]
- (b) Imagine we have a tiny 256-byte direct-mapped data cache with 16-byte cache lines. The cache is initially empty. Below is a sequence of 32-bit memory load accesses. For each load identify the tag, index, offset and hit/miss status.  
0x003, 0x0b4, 0x001, 0x102, 0x001, 0x2c2, 0x004, 0x2c0 [4 marks]
- (c) Data hazards can impact the performance of a pipelined processor. What is a data hazard and how can load and arithmetic instructions be reordered to minimise data hazards arising? [4 marks]
- (d) For a write-back L1 cache that is full of dirty cache lines, how is a write-miss handled? [4 marks]