

Ph.D. Qualification Examination

Computer Organization (October 2012)

1. (20%) Please use simplified datapaths to show the pipelined dependences in the following MIPS code. Please indicate all the pipelined hazards in the sequence. For each hazard, please explain the possibility and how to fix it using **forwarding**. If forwarding cannot fix the problem, please explain how to fix it using **stalling**. All your explanation should be done graphically using simplified datapaths.

```
sub $2, $1, $3
and $12, $2, $5
lw $2, 20($1)
or $4, $5, $2
```

2. (15%) Please explain the differences between **temporal locality** and **spatial locality** in memory access. How to take advantage of each kind of locality?
3. (15%) Please explain the differences between **write-through** and **write-back** in memory hierarchy. Please also compare the advantages and disadvantages between these two schemes.
4. (18%) Structure hazard, control hazard, and data hazard may appear to degrade the performance in the pipelining system. Please explain these three hazards and give proper solutions to remove them.
5. (10%) The representation of a MIPS floating-point number is shown as (*s*, *exponent*, *significand*), where *s* is the sign of the floating-point number (1 means negative), *exponent* is the value of the 8-bit exponent field (including the sign of the exponent), and *significand* is the 23-bit number in the fraction. What decimal number is represented by this word?

1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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6. (22%) A program runs in 10 seconds on computer A, which has a 400-MHz clock. We are trying to help a computer designer build a machine, B, that will run this program in 6 seconds. The designer has determined that a substantial increase in the clock rate is possible, but this increase will affect the rest of the CPU design, causing machine B to require 1.2 times as many clock cycles as machine A for this program. What clock rate should we tell the designer to target?