

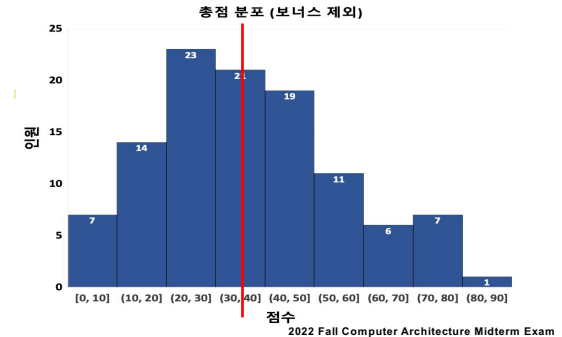
2022 Fall Midterm Exam

- Write in PEN!!!
 - name, student #, and then sign
 - number the sheets handed out
- Answers may be written either in pen or pencil

2022 Fall Computer Architecture Midterm Exam

2022 Fall Midterm Exam

- Average: 36.91 (x: point ranges, y: # of students)



SMD

1. Spell out the Acronyms (10 points, 1 each) 5 minutes

- ABI : Application Binary Interface
- ISA : Instruction Set Architecture
- CPI : Clock cycles Per Instruction
- RISC : Reduced Instruction Set Computer
- MIPS (a performance measure)
- JIT : Just In Time (Compiled) Instructions per Second
- SIMD : Single Instruction stream Multiple data stream
- SSE2
- PC (an important component in the CPU)
- DLL

CISC
: Complex
Instru-
cti-
on
set
Computer

DYNAMIC
Linked
Library

Program Counter

MIPS

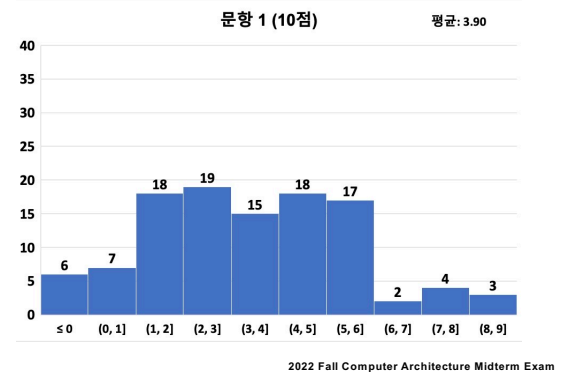
: Millions of Instructions per Second
or
Interlocked Pipeline Stages

2. Give Short Answers to the following questions (10 points, 2 each) 10 minutes

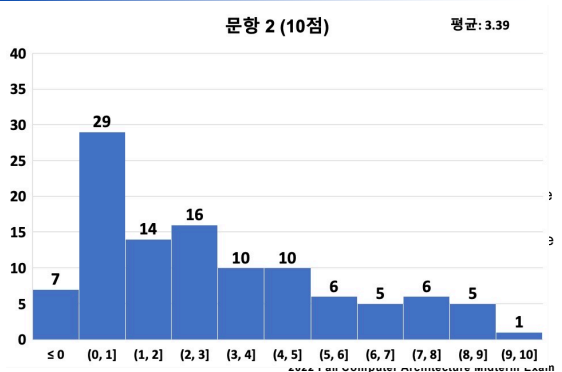
- (2) Give the names (the first and last names) of the authors of the textbook that we are using for this is course. Give the full name of the professor (either in English or Korean) who is teaching this course. *David A. Patterson, John L. Hennessy*
- (2) Explain how the overflow for integer and floating point operations are different.
- (1) Explain what the instruction 'mfhi rd' does.
- (1) lwc1 and swc1 are instructions that, respectively, load and store floating point words. Where does the c1 part of the instruction name come from?
- (4) Consider a program that you have written with an execution time of 10 seconds. With multicores, you have the choice to improve 10% of your code by 5 times or to improve 40% of your code by 2 times. Which would you choose? You need to clearly justify your answer.

2022 Fall Computer Architecture Midterm Exam

1. Spell out the Acronyms (10 points, 1 each) 5 minutes



2. Give Short Answers to the following questions (10 points, 2 each) 10 minutes



AFR: Annual Failure Rate

3. Define the following terms (20 points, 2 each) 15 minutes

- a) Yield (in the context of manufacturing IC chips)
- b) Response time *bandwidth*
- c) Throughput *total amount of work done in given time*
- d) Clock Frequency *Inverse of clock cycle time.*
- e) Amdahl's law
- f) Benchmark
- g) Pseudoinstruction
- h) Activation record *= procedure frame*
- i) Data race *segment of stack address*
- j) Alignment restriction

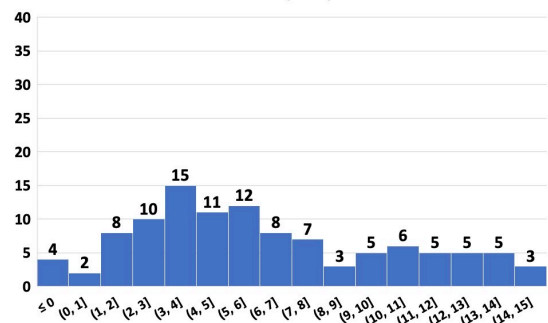
A requirement that data be aligned in memory on natural boundaries

2022 Fall Computer Architecture Midterm Exam

3. Define the following terms (20 points, 2 each) 15 minutes

문항 3 (20점)

평균: 6.70



2022 Fall Computer Architecture Midterm Exam

4. True or False? If you answer false, you MUST explain what is false with the statement. (10 points, 1 each) 15 minutes

- a) There are 32 registers in the MIPS architecture. *T*
- b) Upon MIPS division, the quotient and remainder are placed in the HI and LO registers, respectively. *X*
- c) A benefit of dynamic linking is that it reduces CPU cycles. *X*
- d) While the instruction count of a program is not a good indicator of performance, the CPI is an excellent performance indicator of performance. *X*
- e) Instead of simple instructions, powerful instructions are a good way to improve performance as more things can be done with a single instruction. *X*
- f) The accent for the word 'multiplicand' is in 'mul'. *X*
- g) In floating point representation of numbers, the exponent is the component that determines the precision of the number. *X*
- h) Most computers today use a standard format defined by ACM, which is the most prestigious computer related organization in the world. *True*
- i) To improve precision, the so-called guard, round, and sticky bits are specified as standards. They are implemented in all floating points units as they are part of the standard. *True*
- j) ARM is the most popular instruction set architecture for embedded devices, whose acronym stands for Advanced RISC Machine. *True*

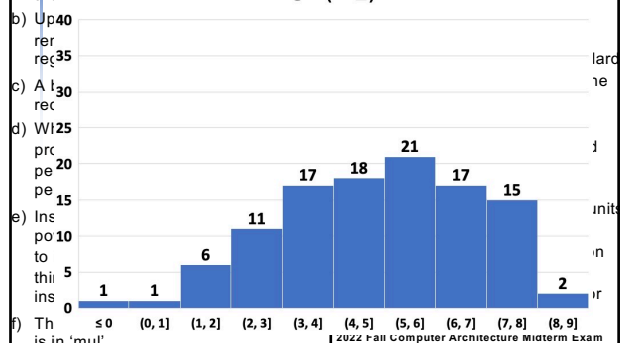
2022 Fall Computer Architecture Midterm Exam

4. True or False? If you answer false, you MUST explain what is false with the statement. (10 points, 1 each) 15 minutes

- a) There are 32 registers in the MIPS architecture. *T*
- b) Upon MIPS division, the quotient and remainder are placed in the HI and LO registers, respectively. *X*
- c) A benefit of dynamic linking is that it reduces CPU cycles. *X*
- d) While the instruction count of a program is not a good indicator of performance, the CPI is an excellent performance indicator of performance. *X*
- e) Instead of simple instructions, powerful instructions are a good way to improve performance as more things can be done with a single instruction. *X*
- f) The accent for the word 'multiplicand' is in 'mul'. *X*
- g) In floating point representation of numbers, the exponent is the component that determines the precision of the number. *X*
- h) Most computers today use a standard format defined by ACM, which is the most prestigious computer related organization in the world. *True*
- i) To improve precision, the so-called guard, round, and sticky bits are specified as standards. They are implemented in all floating points units as they are part of the standard. *True*
- j) ARM is the most popular instruction set architecture for embedded devices, whose acronym stands for Advanced RISC Machine. *True*

문항 4 (10점)

평균: 5.39



2022 Fall Computer Architecture Midterm Exam

5. Answer the following questions (15 points) 15 minutes

- a) (2) What does it mean when we say that, at the assembly language level, that a read or write instruction is atomic?
- b) (2) Two instructions ll and sc are available in MIPS to handle synchronization of memory access. What does ll and sc stand for?
- c) (2) ll and sc need to be used in combination to support synchronization. Does this mean that there can be no instructions between these two instructions being called?
- d) (9) Write the MIPS assembly code to implement the following C code as an atomic "set max" operation using the ll/sc instructions. Here, the argument shvar contains the address of a shared variable, which should be replaced by x if x is greater than the value it points to:

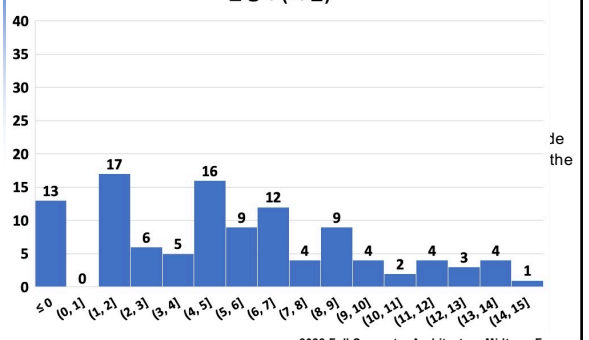
```
void setmax(int* shvar, int x) {
    if (x > *shvar)
        *shvar = x;
}
```

2022 Fall Computer Architecture Midterm Exam

5. Answer the following questions (15 points) 15 minutes

문항 5 (15점)

평균: 5.72



2022 Fall Computer Architecture Midterm Exam

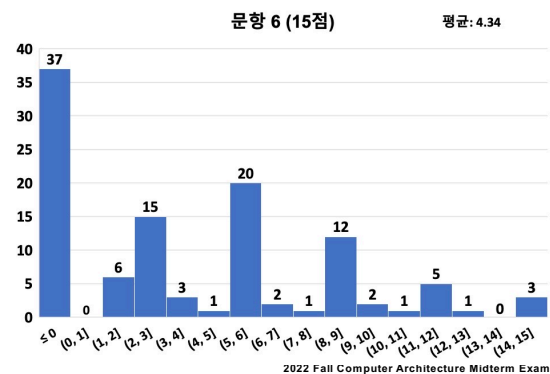
6. Convert the assembly code into hexadecimals and hexadecimals into assembly code (15 points, 3 each) 15 minutes

- a) j 0x2000000
- b) add \$t1, \$s7, \$t1
- c) sw \$t0, 4(\$t8)
- d) 0x15402000
- e) 0x01100080

** Make use of the MIPS reference data sheet
 ** You may choose to just write the final answer, but showing the calculation may help you get partial credit

2022 Fall Computer Architecture Midterm Exam

6. Convert the assembly code into hexadecimals and hexadecimals into assembly code (15 points, 3 each) 15 minutes

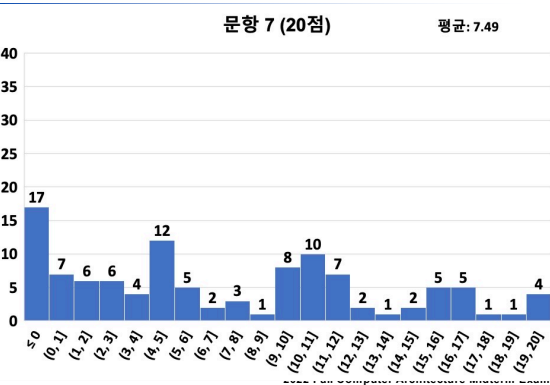


7. Answer the following questions (20 points) 20 minutes
 * Use the diagrams on the back sheet of the MIPS reference data

- a) (3) Fill in (a), (b), and (c) of Figure 1.
- b) (1) Specifically, what operation is performed by the ALU in Figure 1?
- c) (3) Assuming that operations performed with the multiplicand, the multiplier, and the ALU each take 1 cycle, roughly how many cycles does it take to multiply two 32-bit integers? Show your calculations.
- d) (2) Figure 2 shows an optimized version of Figure 1. Fill in (d) and (e) of Figure 2.
- e) (4) In the optimized version, what happened to the multiplier? Explain how the multiplier is involved in this multiplication.
- f) (4) In the same optimized version, we observe that the ALU is now a 32-bit ALU instead of a 64-bit one. Explain how this is possible.
- g) (3) This optimized version also performs better due to parallelism. Explain using specific descriptions what this parallelism is referring to.
- h) (*bonus 3) Calculate the cycles needed to execute a 32-bit multiplication in this optimized version. State your assumption and show your calculations.

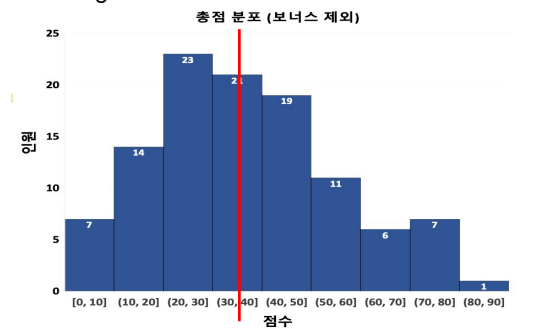
2022 Fall Computer Architecture Midterm Exam

7. Answer the following questions (20 points) 20 minutes
 * Use the diagrams on the back sheet of the MIPS reference data



2022 Fall Midterm Exam

Average: 36.91



2022 Fall Midterm Exam

- Average / Total Score
- The lower the number, the more difficult the question is

