

Question 8: Cache Performance Analysis

For a **32KB 1-way** set associative cache with **64-byte** blocks on a machine with **32-bit** address space, consider the following code snippet. The cache uses a Least Recently Used replacement policy. *Note: The memory is byte addressable as always and data is stored in row-major order. Assume that the cache is initially empty.*

You may also assume that expressions in C code get evaluated in the order from left to right - e.g. `a += b * c` accesses `a` then `b` then `c` then `a`.

`double` and `long long` are 8B; `float` and `int` are 4B; `short` are 2B, and `char` are 1B.

```
#define N 151
struct pokemon {double level; char hp;};
struct pokemon all_pokemon[N];
int hp_needed = get_needed_hp();
for (int i = 0 ; i < N ; i++) {
    if (all_pokemon[i].level < 100) { // IF 1
        if (all_pokemon[i].hp >= hp_needed) { // IF 2
            all_pokemon[i].level ++;
        }
    }
}
```

Only data structures `all_pokemon` is stored in memory, and all other variables are register allocated. `all_pokemon` is stored starting at address `0x0A390848`.

Part(a) Assuming that IF 1 is true for the first 80 times and IF2 is true for the first 17 times, compute the number of accesses and misses for `all_pokemon`.

Number of Accesses		Number of Misses	
all_pokemon:	<input type="text"/>	all_pokemon:	<input type="text"/>

Part(b) How would the number of misses change if:

(i) `level` was of type `short`.

Number of Misses	
all_pokemon:	<input type="text"/>

(ii) `hp` was of type `float`.

Number of Misses	
all_pokemon:	<input type="text"/>

Part(c) For the original code, consider now how the behavior of the code changes if the compiler didn't register allocate `hp_needed`, and instead left it in memory at address `0x3B260848` and it has to be loaded each iteration of the loop. Compute the number of misses, assuming both the IF statements are always true.

Total # of Misses:	<input type="text"/>
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Save & Grade 6 attempts left

Save only

40 points available for this attempt
(following attempts are worth: 36, 32, 25, 15, 5)

Practice Quiz 6

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Question 8

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Total points: — /40

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