Quiz 4

The Art of Computer Programming

20 October 2025

Full name: .....

You have 10 minutes to answer this quiz, directly on this sheet of paper. No electronic devices or material of any kind is allowed. Do not forget to add your name above. Every question amounts to 2 points; the quiz is graded out of 10 points.

Questions

Q1. Circle the correct statement about memory allocation in C/C++:

a. Variables created with `malloc` are stored on the stack.

b. Local variables declared in a function are stored on the heap.

c. Memory allocated with `new` must be released with `delete`.

d. The stack is used for global variables.

Q2. Circle the correct statement about scope and lifetime of variables in C/C++:

a. Global variables exist only during the execution of a single function.

b. A local variable ceases to exist when the function returns.

c. Heap-allocated memory is automatically freed when it goes out of scope.

d. Static variables are reinitialized each time the function is called.

Q3. Circle the correct definition of *amortized complexity*:

a. The worst-case cost of a single operation.

b. The average cost of an operation over a sequence of operations.

c. The total cost of all operations divided by input size.

d. The best-case time complexity of an operation.

Q4. Circle the correct statement about C++ collections:

a. `std::vector` automatically resizes its storage when full.

b. `std::array` is dynamically sized.

c. `std::list` provides random access to elements in $O(1)$ time.

d. `std::set` allows duplicate elements.

Q5. Consider the following code fragment:

```
int* p = new int(5);
int* q = p;
delete p;
*q = 6;
```

What kind of error does this code contain? Circle the only correct answer.

a. Memory leak

b. Dangling pointer (use after free)

c. Stack overflow

d. Dereferencing a null pointer