CS124 Problem Set 1 Rubric Spring 2024

1 Euclid's Algorithm 20 pts

1.1 Sum decrease 5 pts

0	Correct
-5	Blank

(4 pts)	**Analysis of $A' + B'$**
-0	Correct
-3	Just restates proof from class
-2	Arrives at a correct intermediate bound and then skips directly to $3/2(A'+B')$ without justification
-3.5	Writes out an expression for A', B' in terms of quotients/remainders and hand-waves the claimed bound

(1 pts)	**Conclusion on number steps**
-0	Correct given the analysis of $A' + B'$
-1	Incorrect or missing

1.2 Expression for L, L' 3 pts

-0	Correct
-1	Expression for L' incorrect or missing
-1	Expression for L incorrect or missing
-1	No justification provided
-3	Blank

1.3 Define ratio β 5 pts

-0	Correct
-1	L, L' correct in previous part. Derives correct equation for β but then solves it incorrectly

-2	L, L' correct in previous part. An equation for β is provided but the equation is incorrect
-3	Correctly solves for β based on incorrect values of L, L'
-5	Blank or incorrect

1.4 Improved upper bound — 5 pts

-0	Correct
-1	Correct analysis of a suboptimal bound (possibly due to errors in previous parts) but better than the bound from Part (a)
-3	Fails to properly use the analysis of $g(A, B)$ and thus (implicitly) gets a bound based on $A + B$
-5	Correct bound that does not improve on Part (a)
-5	Gives a bound that uses $O(\cdot)$ notation
-5	Blank

1.5 Tightness of bound — 2 pts

-0	Correct
-1	Gives right sequence of numbers but no justification
-1.5	Gives wrong sequence of inputs but provides reasonable intuition
-2	Blank

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2 Fibonacci Programming — 34 pts

2.1 Estimate running time — 15 pts

-0	Correct
-3	Does not have a reasonably useful way of describing how fast each algorithm is.

-4	Incorrect times: some method(s) should be significantly slower than the other(s) . This might be due to coding errors or an inadequate approach to thinking about how to compare or measure the runtimes of the algorithms .
-4	Incorrect qualitative comparison of runtimes for the methods not covered above.
-4	No precise timings provided (e.g. merely says, "matrix is slower than recursive").

2.2 First overflow — 4 pts

-0	Correct
-1	Index off by 1
-2	Index off by 2
-4	Incorrect (e.g. claims to have calculated the desired Fibonacci number, but value is incorrect)

2.3 Modular Fibonacci — 15 pts

-0	Correct
-3	Incorrect recursive value: should be approx y. We'll accept between x and z—reasonable answers, depending on your system and implementation.
-4	Incorrect iterative value: should be approx y; we'll accept between x and z.
-3	Incorrect matrix value: should be approx y; we'll accept x to z
-15	Blank

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3 Big-Oh Notation — 15 pts

3.1 Compare the given functions — 10 pts

0	All of the statements are given.
-1	Missing statements when $i = j$.

-3	Missing some true statements of the requested type that don't affect the overall ordering of the functions.
-1	Statements that are made are inconsistent with each other. (Further rubric items assume the most similar consistent ordering.)
-2	Statements that are made correspond to one transposition from the correct asymptotic order of the functions
-5	Statements that are made correspond to two transpositions from the correct asymptotic order of the functions
-8	Statements that are made correspond to more than two transposition from the correct asymptotic order of the functions
-1	Small mistake (described in a comment)
-10	Blank or no correct statement.

3.2 Counterexample 5 pts

-0	Function satisfies the conditions given in the problem.
-1	Function is asymptotically incomparable with some reasonable function, but not the given ones.
-2	Function is outside a certain common set of functions in which it'd be harder to find a correct one, but still incorrect.
-5	incorrect/missing
-1	Function takes values outside $\mathbb{R}^+$.

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4 Recurrences 20 pts

4.1 Part a.i. 5 pts

-0	Correct
-4	Gives asymptotic solution using master theorem
-2	Approach correct modulo simple algebraic error
-1	Forgets to verify that proposed solution is consistent with base case
-5	blank/no proof

4.2 Part a.ii. 5 pts

-0	Correct
-4	Gives asymptotic solution using master theorem
-2	Approach correct modulo simple algebraic error
-1	Forgets to verify that proposed solution is consistent with base case
-5	blank/no proof

4.3 Part b.i. 3 pts

-0	Correct
-3	Uses master theorem but arrives at wrong conclusion
-4	Tries to unroll recurrence "by hand" and handwaves the asymptotic behavior
-5	blank/no proof

4.4 Part b.ii. 7 pts

-0	Correct
-3	Applies the correct change of variable but final answer is an expression in terms of the new variable
-5	Applies the correct change of variable but incorrectly applies master theorem
-2	Doesn't address the floor function by arguing that T is increasing and thus suffices to consider tower exponentials
-7	blank/no proof

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5 TwistedBubbleSort 25 pts

5.1 Different from bubble sort 2 pts

-0	Correctly mentions one difference.
-2	Blank or no correct difference.

5.2 i-th iteration 5 pts

-0	Completely correct
-2	Neglects base case
-2	Makes correct partial observations but does not give full proof
-5	blank/no proof

5.3 Correctness 10 pts

-0	Completely correct
-1	Neglects base case
-4	Makes correct partial observations but does not give full proof
-4	Makes erroneous claims about intermediate state of array
-10	blank/no useable observations in proof

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6 InsertionSort 0 pts

-0	Correct
-0	Incorrect