Exam 26 October 2012, 8:00-13:00, Sparta:A-B

EDAN55 Advanced Algorithms

preliminary alpha draft

The exam consists of 4 large questions; each consisting of a number of smaller subquestions.

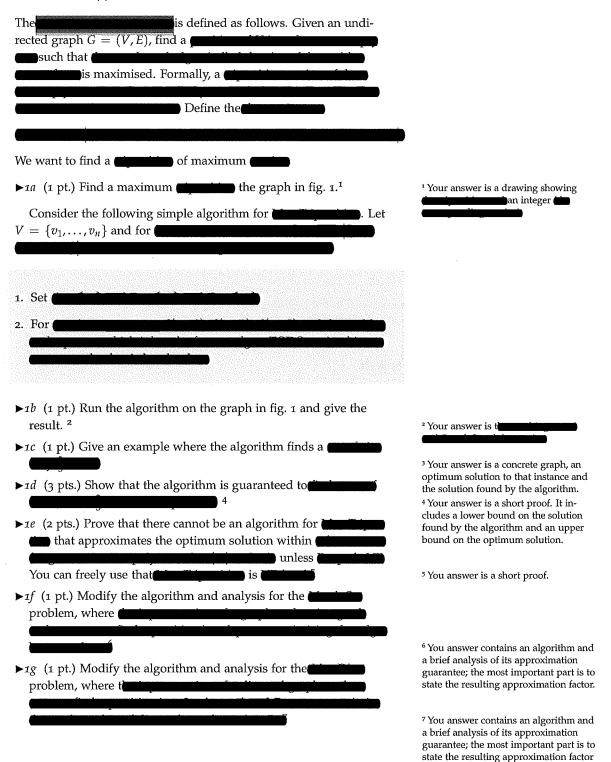
- The exam is "open book," so you can bring whatever material you want, including textbooks, a dictionary, and your own course notes.
- 2. You can bring an electronic calculator, even though I don't see how that is useful.
- 3. We try to minimise the dependencies among subquestions. In particular, you can solve them in any order and are free to *use* the result of subquestion *x* to answer subquestion *y*, even if you didn't answer *x*.
- 4. Scoring: Answering "I don't know" (and nothing else) scores $\frac{1}{4}$ of a subquestion's points. An empty or wrong answer scores o points.
- 5. You can answer in Swedish or English.

Some tips:

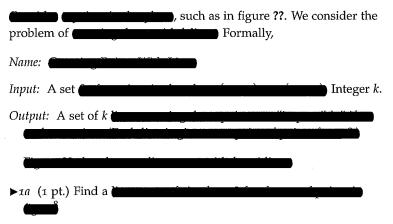
- 1. Shorter is better.
- 2. An example is better than a failed attempt at explaining something in general.
- 3. Drawings, pseudocode, and formulas are good. "Wall of text" is bad.
- 4. Admit ignorance.
- 5. Be tidy.

Good luck!

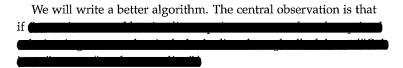
Question 1, Approximation



Question 2, Parameterized Analysis



▶1*a* (2 pts.) Write a simple exhaustive search (or "brute force") algorithm and give its running time in terms of n and k.



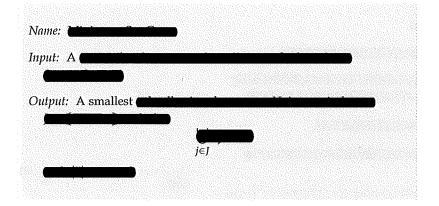
- ▶1a (1 pt.) Why is this true?
- ▶1a (1 pt.) Give a counterexample that shows that this is not true for
- ▶1a (4 pts.) Write an algorithm based on the above observation, briefly argue for its correctness, and state its running time. (The running time must have the form $f(\bullet)n^{O(1)}$ for some function f.)

⁸ Your answer is a drawing showing

9 Your answer is some lines of pseudocode and a running time estimate using asymptotic notation.

Question 3, Exponential Time Algorithms

We	consider	ė.	-	-	



For instance, the graph in fig. ?? contains a

- ►4a (1 pt.) Find a **manifestation** for the instance in fig. ??.
- ▶ 4*a* (2 pt.) Explain very briefly how can be solved using exhaustive search ("brute force") and state the resulting running time.
- ►4a (1 pt.) Explain very briefly why
- ▶ 4*a* (4 pts.) Construct a branching ("decrease-and-conquer") algorithm for You running time must be better than 2". Be precise about which rules you use; for example by writing the algorithm in some form of pseudocode. Briefly argue why each rule is valid. Give a recurrence relation for the running time of the resulting algorithm; read the solution to your recurrence off Table 1. *Hint:* ■

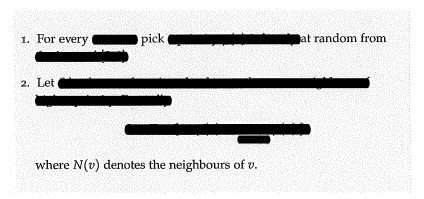
	1	2	3	4	5
1	2	1.62	1.47	1.39	1.33
2		1.42	1.33	1.28	1.24
3			1.26	1.23	1.20
4				1.19	1.17
5					1.15

Table 1: Running times for decrease-and-conquer recurrences of the form $f(N) \leq f(N-a) + f(N-b)$. For example, the Fibonacci reccurence F(N) = F(N-1) + F(N-2) satisfies $F(N) = O(1.62^N)$.

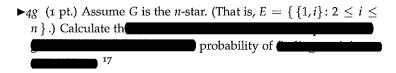
Question 4	R_{ℓ}	andomized	d Al	gorithms

We consider the	
Name:	
Input: A simple, undirected a edges.	graph $G = (V, E)$ with n vertices and m
Output: A	
	(or both).

Consider the following randomized algorithm for this problem:



- 10 Your answer is a drawing s
- $^{\mbox{\tiny 11}}$ Your answer is an expression and an argument for it.
- ¹² Your answer is the word "yes" or the word "no", followed by an argument.
 ¹³ This is not meant to be a trick question. But if you think your answer is weird, it's probably correct.
- $^{\mbox{\tiny 14}}$ Your answer is an expression and an argument for it.
- ¹⁵ Your answer is an expression and an argument for it.
- $^{\mbox{\tiny 16}}$ Your answer is an expression and an argument for it.



 $^{\mbox{\tiny 17}}$ Your answer is an expression and an argument for it.