

EXAMINATION BLUE BOOK

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SUBJECT Algo

INSTRUCTOR Chen

EXAM SEAT NO. _____

SECTION _____

DATE 10/18/17

GRADE 88/100



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On my honor, as a University of Colorado® Boulder student, I have neither given nor received unauthorized assistance on this work.

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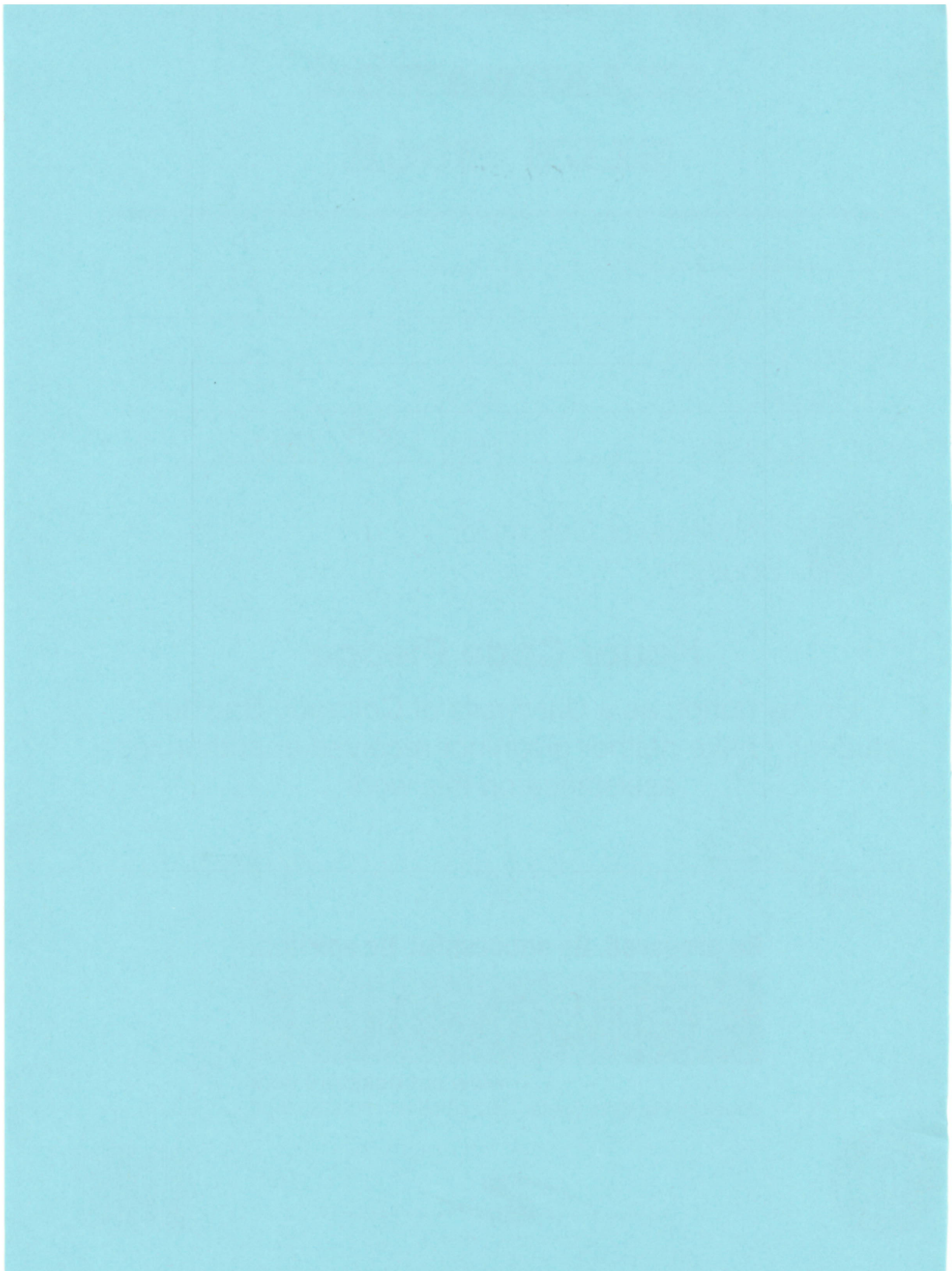
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1a) $f(g(n)) = 10 n^{4/3} \lg n^{4/3}$
 $\Omega(n^{4/3} \lg n^{4/3}) \Theta(n^{4/3} \lg n^{4/3}) O(n^{4/3} \lg n^{4/3})$

1b) $a=3 \quad b=3 \quad f(n) = cn$

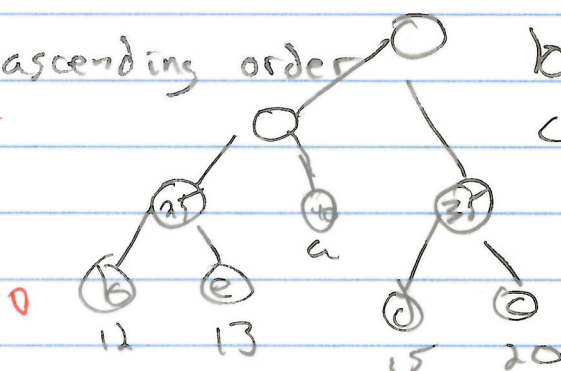
$\log_3 3 = 1 \quad \Theta(n^{\log_3 3}) = \Theta(n^1) = f(n) = cn$
 $\therefore T(n) \Theta(n \lg n)$

1c) Second one 2

1d) False 2

1e) An array in ascending order 2 b: 0 0 0
c: 1 1

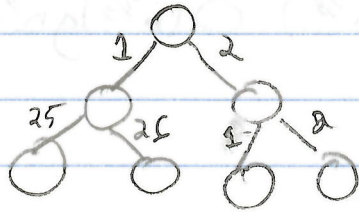
1f) a: 40
~~b: 12~~
~~c: 12~~
~~d: 15~~ be = 25
~~e: 15~~ de = 35



1g) $P(2 \text{ keys same slot}) = 1$ 0

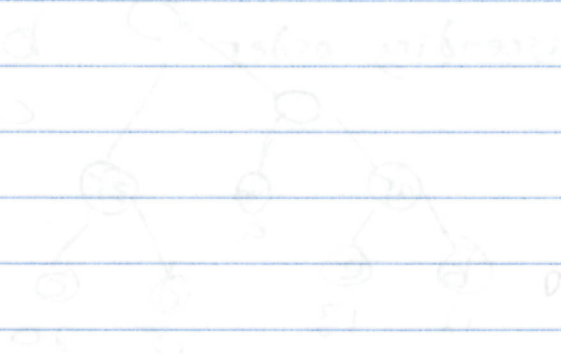
1h) 11, 22, 33, 44, 55, 66, 77, 88 2

41
 1i) when the shortest di. = $(\log n)!$



(j) A-B

2



$$m = 2 \quad n = 4$$

2a) compute Product(m, n) {

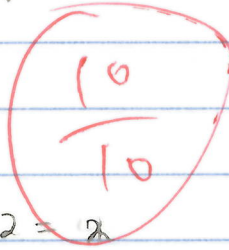
$prod = 0;$

 for ($i = 1; i \leq n; i++$) {

$prod = prod + m$

 }

 return $prod$;


$$\begin{array}{r} 10 \\ + 10 \\ \hline 20 \end{array}$$

$i = 1$ 1st iter: $m = 0 + 2 = 2$

$i = 2$ 2nd iter: $m = 2 + 2 = 4$

$i = 3$ 3rd iter: $m = 4 + 2 = 6$

$i = 4$ 4th iter: $m = 6 + 2 = 8$ ✓

2b) $\Theta(n)$

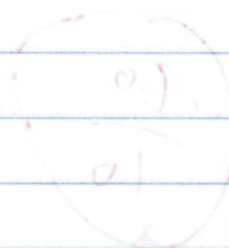
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1. (a) $\log_2 16 = 4$

$$10 = \log_2 1024$$

$$\log_2 1024 = 10$$

$$10 + \log_2 10 = 10.332192809488736$$



$$10.332192809488736$$

$$10.332192809488736$$

$$10.332192809488736$$

(b) $\log_2 1024 = 10$

2

3) $V = [1, 2, 3]$ $W = [1, 2, 3]$

$$v(n) = (v(n-1) + v(n-2)) \cdot n$$

01

$$v(n) = (v(n-1) + v(n-2)) \cdot n$$

$$v(n) = (v(n-1) + v(n-2)) \cdot n$$

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01

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$$v(n) = (v(n-1) + v(n-2)) \cdot n$$

$$v(n) = (v(n-1) + v(n-2)) \cdot n$$

01

4) Let S be a set of n elements. Let A be a subset of S .

Let $f(n)$ be the number of subsets of S that contain A .

$$f(n) = 2^{n-k} \cdot 2^k = 2^n$$

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Let $f(n)$ be the number of subsets of S that contain A .

5b) $A = [2, 6, 4, 1, 5, 3]$, $q_a = 4, q_b = 5$

$$x = A[\text{floor}((5+0)/2)] = A[2] = 4$$

$$i = -1$$

$$j = 0 : i = 0 \quad A = [2, 6, 4, 1, 5, 3]$$

$$j = 1 : x$$

$$j = 2 : i = 1 \quad \text{swap}(A[1], A[2]) \quad A = [2, 4, 6, 1, 5, 3]$$

$$j = 3 : i = 1 \quad \text{swap}(A[1], A[3]) \quad A = [2, 1, 4, 6, 5, 3]$$

$$j = 4 : x$$

$$j = 5 : i = 2 \quad \text{swap}(A[2], A[5]) \quad A = [2, 1, 3, 6, 5, 4]$$

$$\text{swap}(A[i+1], A[\text{floor}((5+0)/2)] A[2])$$

$$A = [2, 1, 6, 3, 5, 4]$$

$$B = [2, 6, 1]$$

$$x = 6$$

$$i = -1$$

$$j = 0 : i = 0$$

$$j = 1 : x$$

$$j = 2 : i = 1 \quad \text{swap}(B[1], B[2]) \quad B = [2, 1, 6]$$

$$\text{swap}(B[2], B[1]) \quad B = [2, 6, 1]$$

$$\text{return } i+1 = 2 \quad \text{null}$$

$$P = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad [E, 2, 1, 5, 2, 6, 7] = A \quad (52)$$

$$P = [E]A = [(5)(0+2) \bmod 27]A = 1$$

$$1 = 1$$

$$[E, 2, 1, 5, 2, 6, 7] = 1 \quad 0 = 1 : 0 = 1$$

$$1 = 1$$

$$[E, 2, 1, 5, 2, 6, 7] = 1 \quad (E, 2, 1, 5, 2, 6, 7) \bmod 27 = 1$$

$$[E, 2, 1, 5, 2, 6, 7] = 1 \quad (E, 2, 1, 5, 2, 6, 7) \bmod 27 = 1$$

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$$[E, 2, 1, 5, 2, 6, 7] = 1$$

$$[E, 2, 1, 5, 2, 6, 7] = 1$$

$$1 = 1$$

$$1 = 1$$

$$0 = 0$$

$$1 = 1$$

$$[E, 2, 1, 5, 2, 6, 7] = 1 \quad (E, 2, 1, 5, 2, 6, 7) \bmod 27 = 1$$

$$[E, 2, 1, 5, 2, 6, 7] = 1 \quad (E, 2, 1, 5, 2, 6, 7) \bmod 27 = 1$$

$$\text{Here } 1 = 1 \text{ and } 0 = 0$$

(a) $\Omega(n^2)$ $\Theta(n^2)$ $O(n^2)$

20
20

(b) @ the start of each iteration of the outside for loop the subarray $A[1 \dots j-1]$ contains elements in ascending sorted order

Initialization:

(c) when $\text{length}(A) = 0$ the first 0 elements of array A are trivially sorted

Maintenance:

When inner loop terminates either:

1) $A[i \dots n] \geq A[\text{imin}]$ in which case $\text{imin} = j$ thus $A[i \dots n] \geq A[j]$ and loop invariant holds

2) or $A[i \dots n] < A[j]$ $\& i \neq j$
 $\text{swap}(A[i], A[j])$ and thus the i th element of A is now greater than the j th element of A thus $A[i]$ must be the i th smallest element of A and our loop invariant holds

Termination: When $j = n-2$ and $i = n-1$ array $A[1 \dots n]$ contains n elements of A in ascending order

5/1/19

(a) (b) (c) (d)

(a) the list of each element of the array is
the array $A[1..n]$ contains elements in
ascending order.

(b) when $length(A) = 0$ the list of elements is
empty.

(c) when $length(A) = 1$ the list of elements is
the array $A[1..1]$ contains elements in
ascending order.

(d) when $length(A) = 2$ the list of elements is
the array $A[1..2]$ contains elements in
ascending order.

(e) when $length(A) = 3$ the list of elements is
the array $A[1..3]$ contains elements in
ascending order.

7) // create binary search tree for two array
// at each node of A search B for
arr b_i = 0

int Zero(A, B) {

createTree(A);

createTree(B);

for i = a₀ to a_n

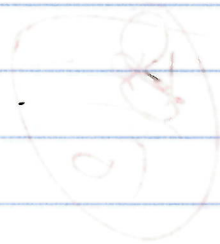
zero = binarySearch(B, -a_i) // search array B
for -a_i

if (zero != null) {
return zero

else return null

algorithm iterates through A n times and on
each iteration does a binary search which takes
lg n time that total time complexity
 $O(n \lg n)$

1) If create binary code then for the binary
If we can write of A which is 101



2) (A, B) = 101

(A) = 101

(B) = 101

3) If we can write of A which is 101
for A

4) (A, B) = 101

(A) = 101

5) (A, B) = 101

6) If we can write of A which is 101
for A
7) (A, B) = 101

$$8a) T(n) = 2T\left(\frac{n}{2}\right) + n$$

$$T(1) = 1$$

n because 2 for loops one running from $\frac{n}{2} \rightarrow 0$
and another running from $\frac{n}{2} + 1 \rightarrow n$

$$\frac{n}{2} + \frac{n}{2} = n$$

$$\frac{15}{15}$$

$$8b) \log_2 2 = 1 \quad \Theta(n^{\log_2 2}) = \Theta(n^1) = f(n) = n$$

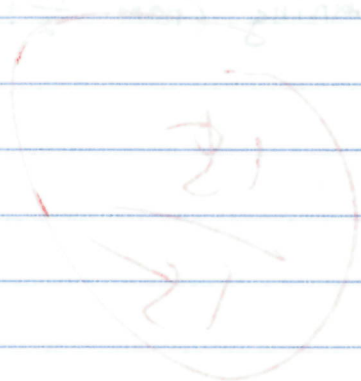
$$\therefore T(n) = \Theta(n \lg n)$$

$$1 + \left(\frac{1}{2}\right)TC - (1)T$$

$$1 - \frac{1}{2}T$$

0.5 more years on April 1st 6 months

(1 + 0.5 more years on April 1st)



$$1 + \left(\frac{1}{2}\right)TC = \left(\frac{1}{2}\right)TC = \left(\frac{1}{2}\right)TC = 1 + \left(\frac{1}{2}\right)TC$$

$$\left(\frac{1}{2}\right)TC = \left(\frac{1}{2}\right)TC$$