PRACTICE FOR TEST 1

Advanced Algorithms I (7081) Fall 2015

The questions on Test 1 on Wednesday, Oct 21 will be similar to a (small) subset of questions from this Practice Test.

Multiple Choice: For each of the following questions **circle** the **best** answer.

e) n^2

1. Quicksort has best, average and worst case complexities, respectively: a) $\Theta(n)$, $\Theta(n \log n)$, $\Theta(n \log n)$ b) $\Theta(n \log n)$, $\Theta(n \log n)$, $\Theta(n \log n)$ c) $\Theta(n \log n)$, $\Theta(n \log n)$, $\Theta(n^2)$ d) $\Theta(n \log n)$, $\Theta(n^2)$, $\Theta(n^2)$ e) $\Theta(n^2)$, $\Theta(n^2)$, $\Theta(n^2)$ 2. Mergesort has best, average and worst case complexities, respectively: a) $\Theta(n)$, $\Theta(n \log n)$, $\Theta(n \log n)$ b) $\Theta(n \log n)$, $\Theta(n \log n)$, $\Theta(n \log n)$ c) $\Theta(n \log n)$, $\Theta(n \log n)$, $\Theta(n^2)$ d) $\Theta(n \log n)$, $\Theta(n^2)$, $\Theta(n^2)$ e) $\Theta(n^2)$, $\Theta(n^2)$, $\Theta(n^2)$ 3. *Heapsort* has worst case complexity: a) $\Theta(\log n)$ b) $\Theta(n)$ c) $\Theta(n \log n)$ d) $\Theta(n^2)$ e) None of the above 4. An sorting algorithm that is **not** comparison-based: a) Mergesort b) Quicksort c) Insertion Sort d) Treesort e) Radix Sort 5. An algorithm with worst-case complexity W(n) is said to be polynomial-time if a) W(n) is a polynomial b) $W(n) \in O(n^k)$ for some constant k c) $W(n) \in \Omega(n^k)$ for some constant k d) $W(n) \in \Theta(n^k)$ for some constant k e) W(n) has sub-exponential order 6. The smallest worst-case complexity of a comparison-based sorting algorithm is: a) $\Theta(\log n)$ b) $\Theta(n)$ c) $\Theta(n \log n)$ d) $\Theta(n^2)$ e) $\Theta(n^2)$ 7. The smallest worst case complexity for computing the maximum and minimum elements in an list of even size n: i a) n-1b) 3n/2-2c) 2n-2d) 5n/2 - 1

a) $\Theta(\log n)$, $\Theta(1)$ b) $\Theta(\log n)$, $\Theta(\log n)$ c) $\Theta(\log n)$, $\Theta(n)$ d) $\Theta(n)$, $\Theta(\log n)$ e) $\Theta(\log n)$, $\Theta(n)$ d) $\Theta(n)$, $\Theta(\log n)$ e) $\Theta(n)$, $\Theta(n)$ e) $\Theta(n)$, $\Theta(n)$ g) Binary Search assumes as a precondition that: a) The search element is on the list b) The list consists of integers or floating point numbers c) The list satisfies a uniform distribution d) The list is sorted once the search element is added e) The list is sorted once the search element is added e) The list is sorted once the search element is added e) The list is sorted once the search element is added e) The list is sorted once the search element is added e) The list is sorted once the search element is added e) The list is sorted once the search element is added e) The list is sorted once the search element is added e) The list is sorted once the search element is added e) The list is and -n/2 d) The list is already sorted d) Different by one c) Consecutive Fibonacci numbers e) Consecutive Fibonacci numbers e) Consecutive Fibonacci numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution e) The largest element occurs in the first position e) The largest element occurs in the first position e) The list is already sorted b) The largest element occurs in the first position e) The list is already sorted b) The largest element occurs in the first position e) The list is already sorted b) The largest element occurs in the first position e) The list is already sorted b) The largest element occurs in the first position e) The list is already sorted b) The largest element occurs in the first position e) The list is already sorted b) The list is already sorted b) The list is already sorted b) The list	8.	Linear Search and Interpolation Search have worst-case complexities, respectively:	
b) $\Theta(\log n)$, $\Theta(\log n)$ c) $\Theta(\log n)$, $\Theta(n)$ d) $\Theta(n)$, $\Theta(\log n)$ e) $\Theta(n)$, $\Theta(\log n)$ file list consists of integers or floating point numbers c) The list satisfies a uniform distribution d) The list is sorted once the search element is added e) The list is sorted 10. $1 + 2 + 3 + + 999$ a) 9990 b) 99900 c) 999000 d) 500000 e) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) $-n/2$ and $-n/4$ b) $-n(\log n)$ and $-\log n/2$ c) $-4n$ and $-2n$ d) $-n/2$ and $-n/4$ e) $-4n^2/2$ and $-2n^2$ 12. The worst-case complexity of Euclid's algorithm for computing the $\gcd(a,b)$ occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution d) The input list satisfy an inform distribution e) The input list satisfy an inform distribution e) The input list satisfy an inform distribution d) The input list satisfy an inform distribution e) The input list has large size e) Nome of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort c) Merge Sort d) Quicksort e) The enumber of binary digits of an integer n is approximately equal to: a) 2^n b) $n \log_{2n}$ c) \log_{2n} e) Nome of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Homer's rule b) Powers and FFT c) Randomized Quicksort			
c) $\Theta(\log n), \Theta(n)$ d) $\Theta(n), \Theta(\log n)$ c) $\Theta(n), \Theta(\log n)$ e) $\Theta(n), \Theta(n)$ e) In list assumes as a precondition that: a) The search element is on the list b) The list stasfies a uniform distribution d) The list is sorted once the search element is added e) The list is sorted 10. $1+2+3++999$ a) 9990 b) 99900 c) 999000 d) 500000 e) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) $-n/2$ and $-n/4$ b) $-n\log_2 n$ and $-\log_2 n/2$ c) $-4n$ and $-2n$ d) $-n^2/2$ and $-n/4$ e) $-4n^2/2$ and $-n/4$ f) $-n^2/2$ and $-n/4$ e) $-4n^2/2$ and $-n/4$ e) $-4n^2/2$ and $-2n^2$ 12. The worst-case complexity of Euclid's algorithm for computing the ged(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive Exponential numbers e) Consecutive Exponential numbers e) Consecutive Exponential numbers e) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort c) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2^n b) $n \log_2 n$ c) $\log_2 n$ d) n^2 e) None of the above		,	
d) O(n), O(log n) c) O(n), O(n) 9. Binary Search assumes as a precondition that: a) The search element is on the list b) The list consists of integers or floating point numbers c) The list satisfies a uniform distribution d) The list is sorted once the search element is added e) The list is sorted 10. 1 + 2 + 3 + + 999 a) 9990 b) 99900 c) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) -n/2 and -n/4 b) -nlog:n and -log:n/2 c) -4n and -2n d) -n²/2 and -n²/4 e) -4n²/2 and -n²/4 f) -n²/6 bit is already sorted b) Different by one c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Exponential numbers e) Consecutive Exponential numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list statisfy a uniform distribution d) The none of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort c) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log:n c) log:n d) n² e) None of the above			
9. Binary Search assumes as a precondition that: a) The search element is on the list b) The list consists of integers or floating point numbers c) The list satisfies a uniform distribution d) The list is sorted once the search element is added e) The list is sorted 10. 1 + 2 + 3 + + 999 a) 9990 b) 99900 c) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) -n/2 and -n/4 b) -n/log_n and -log_n/2 c) -4n and -2n d) -n²/2 and -2n² d) -n²/2 and -2n² e) -4n²/2 and -2n² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive Exponential numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and Horner's rule b) Powers and Horner's rule			
a) The list consists of integers or floating point numbers c) The list satisfies a uniform distribution d) The list is sorted once the search element is added c) The list is sorted 10. 1+2+3++999 a) 9990 b) 99900 c) 999000 c) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) -n/2 and -n/4 b) -nlogn and -logn/2 c) -4n and -2n d) -n/2 and -n/4 e) -n/2 and -n/2 e) -dn/2 and -n/2 e) -dn/2 and -n/2 e) -dn/2 and -n/2 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive Exponential numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and Horner's rule			
b) The list consists of integers or floating point numbers c) The list sis sorted a uniform distribution d) The list is sorted 10. 1+2+3++999 a) 9990 b) 99900 c) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) -n/2 and -n/4 b) -nlogn and -logn/2 c) -4n and -2n d) -n²/2 and -n²/4 e) -4n²/2 and -2n² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive Exponential numbers d) Consecutive Fibonacci numbers d) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2° b) n logn c) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort	9.	Binary Sea	rch assumes as a precondition that:
c) The list is sorted once the search element is added e) The list is sorted 10. 1+2+3++999 a) 9990 b) 99900 c) 999000 c) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) -n/2 and -n/4 b) -nlogn and -logn/2 c) -4n and -2n d) -n²/2 and -n²/4 e) -4n²/2 and -n²/4 e) -6nsecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Exponential numbers d) Consecutive Exponential numbers e) Consecutive Exponential numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution f) The following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2" b) n logn c) logn c) logn e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort		a)	The search element is on the list
d) The list is sorted once the search element is added e) The list is sorted 10. 1+2+3++999 a) 9990 b) 99900 c) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) -n/2 and -n/4 b) -nlogan and -logan/2 c) -4n and -2n d) -n ² /2 and -n ² /4 e) -4n ² /2 and -2n ² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive Fibonacci numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2" b) n logsn c) logsn d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort		b)	The list consists of integers or floating point numbers
e) The list is sorted 10. 1+2+3+ + 999 a) 9990 b) 99900 c) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) ~n/2 and ~n/4 b) ~nlog_n and ~log_n/2 c) ~4n and ~2n d) ~n²/2 and ~n²/4 e) ~4n²/2 and ~2n² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log_n c) log_n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and Horner's rule b) Powers and Horner's rule c) Randomized Quicksort		c)	The list satisfies a uniform distribution
10. 1+2+3++999 a) 99900 b) 99900 c) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) ~n/2 and ~n/4 b) ~n/0sgn and ~log_n/2 c) ~4n and ~2n d) ~n²/2 and ~n²/4 e) ~4n²/2 and ~n²/4 e) ~4n²/2 and ~2n² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive Exponential numbers d) Consecutive Exponential numbers e) Consecutive Exponential numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log_n c) log_n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and Horner's rule c) Randomized Quicksort		,	
a) 9990 b) 99900 c) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) ~n/2 and ~n/4 b) ~nlog_n and ~log_n/2 c) ~4n and ~2n d) ~n²/2 and ~²²/4 e) ~4n²/2 and ~²²/4 e) ~4n²/2 and ~2n² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive Exponential numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log_n c) log_n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and Horner's rule c) Randomized Quicksort		,	
b) 99900 c) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) ~n/2 and ~n/4 b) ~nlog_n and ~log_n/2 c) ~4n and ~2n d) ~n²/2 and ~2n² e) ~4n²/2 and ~2n² e) ~4n²/2 and ~2n² e) An²/2 and ~2n² e) Different by one c) Consecutive prime numbers d) Consecutive Ephonacci numbers e) Consecutive Ephonacci numbers f) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above e) More Sort d) Quicksort c) Merge Sort d) Quicksort e) They are all in-place e) They are all in-place e) They are all in-place e) None of the above e) None of the above e) None of the above e) They are all in-place e) None of the above e) Randomized Quicksort e) Powers and HFIT c) Randomized Quicksort	10.		
c) 999000 d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) ~n/2 and ~n/4 b) ~nlog₂n and ~log₂n/2 c) ~4n and ~2n d) ~n²/2 and ~n²/4 e) ~4n²/2 and ~2n² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive Exponential numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log₂n c) log₂n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort			
d) 500000 e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) ~n/2 and ~n/4 b) ~nlog_n and -log_n/2 c) ~4n and ~2n d) ~n²/2 and ~n²/4 e) ~4n²/2 and ~2n² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log_n c) log_n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort			
e) 499500 11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) ~n/2 and ~n/4 b) ~nlog₂n and ~log₂n/2 c) ~4n and ~2n d) ~n²/2 and ~n²/4 e) ~4n²/2 and ~2n²/4 e) ~4n²/2 and ~2n²/2 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive Exponential numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log₂n c) log₂n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort		,	
11. Assuming a uniform distribution the worst case and average complexities of Insertion sort are: a) -n/2 and -n/4 b) -nlog2n and -log2n/2 c) -4n and -2n d) -n²/2 and -2n² d) -n²/2 and -2n² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2" b) n log2n c) log2n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and Horner's rule c) Randomized Quicksort c) Randomized Quicksort		,	
a) -n/2 and -n/4 b) -nlog ₂ n and -log ₂ n/2 c) -4n and -2n d) -n ² /2 and -n ² /4 e) -4n ² /2 and -2n ² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort		,	
b) ~nlog ₂ n and ~log ₂ n/2 c) ~4n and ~2n d) ~n²/2 and ~n²/4 e) ~4n²/2 and ~2n²/4 e) ~4n²/2 and ~2n²/2 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive Exponential numbers d) Consecutive Fibonacci numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort	11.		
c) ~4n and ~2n d) ~n²/2 and ~n²/4 e) ~4n²/2 and ~2n² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and FFT c) Randomized Quicksort		,	
d) ~n²/2 and ~n²/4 e) ~4n²/2 and ~2n² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive Exponential numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort			
e) ~4n²/2 and ~2n² 12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort			
12. The worst-case complexity of Euclid's algorithm for computing the gcd(a,b) occurs when a and b are: a) Relatively prime b) Different by one c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort		,	
a) Relatively prime b) Different by one c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort	12	,	
b) Different by one c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort	12.		
c) Consecutive prime numbers d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort			
d) Consecutive Exponential numbers e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort			
e) Consecutive Fibonacci numbers 13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort			
13. The worst-case complexity of Quicksort occurs when: a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort			
a) The list is already sorted b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort	13.	,	
b) The largest element occurs in the first position c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort			
c) The input list satisfy a uniform distribution d) The input list has large size e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort		b)	
e) None of the above 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2 ⁿ b) n log ₂ n c) log ₂ n d) n ² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort		c)	
 14. Which of the following sorting algorithms is not in-place a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2ⁿ b) n log₂n c) log₂n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort 		d)	The input list has large size
 a) Bubble sort b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2ⁿ b) n log₂n c) log₂n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort 		e)	None of the above
b) Insertion Sort c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2^n b) $n \log_2 n$ c) $\log_2 n$ d) n^2 e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort	14.	4. Which of the following sorting algorithms is not in-place	
c) Merge Sort d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2^n b) $n \log_2 n$ c) $\log_2 n$ d) n^2 e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort		a)	Bubble sort
d) Quicksort e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2^n b) $n \log_2 n$ c) $\log_2 n$ d) n^2 e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort		b)	
 e) They are all in-place 15. The number of binary digits of an integer n is approximately equal to: a) 2ⁿ b) n log₂n c) log₂n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort 		c)	
 15. The number of binary digits of an integer n is approximately equal to: a) 2ⁿ b) n log₂n c) log₂n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort 		/	
 a) 2ⁿ b) n log₂n c) log₂n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort 			
b) $n \log_2 n$ c) $\log_2 n$ d) n^2 e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort	15.		
 c) log₂n d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort 		,	
 d) n² e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort 			<u> </u>
e) None of the above 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort		,	
 16. The encryption algorithm RSA employs the following algorithms: a) Powers and Horner's rule b) Powers and FFT c) Randomized Quicksort 			
a) Powers and Horner's ruleb) Powers and FFTc) Randomized Quicksort	16	,	
b) Powers and FFTc) Randomized Quicksort	10.		
c) Randomized Quicksort			
		(
		d)	

e) Powers and Extended Euclid GCD

17. For which number of nodes does there exists a full binary tree:a) 16				
b) 25				
c) 63 d) 100				
e) None of the above				
18. The number of nodes of a 2-tree having 100 leaf nodes is: a) 99				
b) 100				
c) 101 d) 199				
e) 200				
Simple Answers				
For each of the following give the best answer using simplest formula.				
a) $1^{11} + 2^{11} + + n^{11} \sim$				
b) $n + 2n^2 + + 10n^{10} \sim$				
c) 1/2+ 1/3 + 1/(2n) ~				
$\mathrm{d)}\log n! \in \Theta\left(\right. $				
e) Worst-case complexity of <i>BinarySearch</i> is $W(n) \sim$				
f) lower bound for worst-case complexity of any comparison-based sor	ting algorithm is			
$W(n) \in \Omega($				
g) Average complexity of <i>MergeSort</i> is $A(n) \in \Theta$ ()			
h) Worst-case complexity of <i>QuickSort</i> is $W(n) \in \Theta$ ()			
i) Worst-case complexity of <i>Interpolation search</i> is $W(n) \in \Theta$ ()			
j) Average complexity of Quicksort with uniform distribution is				
$A(n) \sim$				
14(11)				

- k) The number of decimal digits of a positive integer $n \sim$
- 1) The minimum depth of a binary tree is approximately _____

More detailed Answers. Show Steps.

- 1. Show the action of the left-to-right binary method in computing x^{103} .
- 2. a) Give the recurrence relation for gcd(a,b) on which Euclid's algorithm is based.
 - b) Show the action of Euclid's algorithm for a = 108 and b = 132.
- 3. Prove (using limits) that $O(n^k) \subset O(e^n)$, for any positive constant k.
- 4. Prove the average complexity $2n \ln n$ of *Quicksort* is of smaller order than the average complexity $n^2/4 n/4$ of *Insertionsort*, i.e., show

$$O(2n \ln n) \subset O(n^2/4 - n/4).$$

- 5. Give pseudocode for the algorithm for evaluating a polynomial of degree n using *Horner's rule*, involving only n multiplications and n additions.
- 6. a) Define what is meant by the best-case complexity B(n) of an algorithm.
 - b) Define what is meant by the worst-case complexity W(n) of an algorithm. . .
 - c) Define what is meant by the average complexity A(n) of an algorithm.
- 7. Prove that the relation $f \Theta g$ whenever $f(n) \in g(n)$ is an equivalence relation.
- 8. Let P(n) be a polynomial of degree k whose degree k term as coefficient a_k . Prove that $P(n) \sim a_k n^k$
- 9. a) Derive a recurrence relation for the worst-case complexity W(n) of Mergesort.
 - b) Solve the recurrence relation you have given in part b. SHOW STEPS.
- 10. Prove (using limits) that $O(\ln n) \subset O(n)$, for any positive constant k.
- 11. Prove that $H(n) \sim \ln n$, where $H(n) = 1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n}$
- 12. Give a formula for the average complexity A(n) involving the probabilities p_i , i = 1, 2, ..., where p_i is the probability that the algorithm performs i basic operations for an input of size n.

- 13. a) Give pseudocode for *Quicksort* (Do NOT include pseudocode for *Partition*).
 - b) Analyze the worst-case behavior W(n) of *Quicksort*.
- 14. For *k* a constant, prove that $\log n! = \log 1 + \log 2 + ... + \log n = \Theta(n \log n)$.
- 15. Define what is meant by exponential order.
- 16. Show that the number of decimal digits of n is approximately $\log_{10}n$.
- 17. Explain how both the maximum and minimum element in a list of size n (assume even) can be found in time 3n/2-2
- 18. a) Consider a list L[0: n-1] of distinct elements. Compute A(n) for Linearsearch assuming the search element X is in the list L[0: n-1] and equally likely to occur in any position.
 - b) Repeat part a) assuming that *X* occurs on the list with probability .6 and is equally likely to occur in any position given that *X* is on the list.
- 19. Compute A(n) for *Insertionsort* assuming a uniform distribution. You may assume that the average number of comparisons to insert the j^{th} element is 1/j.
- 20. a) Obtain a recurrence relation for A(n) for *Quicksort* assuming a uniform distribution.
 - b) Solve the recurrence relation you have given in part a.
- 21. Prove that a binary tree having n nodes has depth $\Omega(\log n)$.
- 22. Discuss three ADTs for implementing a priority queue and compare them, i.e., discuss advantages and disadvantage.