SC2001

$\sum$ Sum of all even num $= n(n+1)$

$\sum$ Sum of all odd num $= n^2$

$\sum$ $1+2+ \ldots + (n-1) = \dfrac{n(n-1)}{2}$ Check

$\sum$ $1+2+\ldots+n = \dfrac{n(n+1)}{2}$

$$\sum_{i=0}^{k-1} a^i = a^0 + a^1 + \ldots + a^{k-1} = \frac{a^k - 1}{a-1}$$

$$a^{\log_b n} = n^{\log_b a}$$

DI Theorem

$w[p] = d[y] + w(y,z)$

$w[p'] = d[z_{k-1}] + w(z_{k-1}, z_k) +$ distnce from z_k to z

$d[z_{k-1}] + w(z_{k-1}, z_k) \geq d[y] + w(y,z)$

Limit L'Hopital's rule $\lim_{n\to\infty} \dfrac{f(n)}{g(n)} = \lim_{n\to\infty} \dfrac{f'(n)}{g'(n)}$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

master

- $f(n) < O(n^{\log_b a - \epsilon})$ $\epsilon > 0$
  $w(n) = \Theta(n^{\log_b a})$
- $f(n) = \Theta(n^{\log_b a} \log^k n)$ $w(n) = \Theta(n^{\log_b a} \log^{k+1} n)$
- $f(n) = \Omega(n^{\log_b a + \epsilon})$ $\epsilon > 0$
  $af(n/b) \leq c f(n)$ $c < 1$
  $w(n) = \Theta(f(n))$

best = decending order

get max() put at end list

fix heap log n

deleteMax log n

heapifying n

Construct heap n

max heap n log n

h1 O(hea

	initialization	union	Find	connected
Quickfind	O(N)	O(N)	O(1)	O(1)
QuickUnion	O(N)	O(N)	O(N)	O(N)
weighted QuickUnion	O(N)	O(log N)	O(log N)	O(log N)

Dynamic programing (top down) O(n)

(bottom up) O(n)

longest common Subsequence O(nm) O(n+m)

| longest, — not yet, \ equal

matrix Optimal order $O(n^3)$

	Size	Complexity	
Mergesort	$1+m$	$O(n \lg n)$	
Dijkstra	$1+n+n^2$	$O(n^2)$	
Knapsack	$2+2n$	$O(nc)$	
DP for chain matrix	.	$O(n^3)$	
DP for Fibonacci		$O(n)$	
boyer-Moore			
Simple Scan		worst $O(mn)$	m = pattern n = text
Rabin-Karp		hash = $\theta(m)$ worst = $\theta((n-m+1)m)$	convert to number hash new = $(\text{old} - \text{MSB} * d^{m-1}) * d + \text{LSB}$ $(x+y) \bmod q = [(x \bmod q) + (y \bmod q)] \bmod q$ $(x \bmod q) \bmod q = x \bmod q$ $xy \bmod q = [(x \bmod q)(y \bmod q)] \bmod q$
boyer-moore		$O(\lvert\Sigma\rvert + m)$	
mergesort		$O(n \log n)$	worst $n-1$ best $n/2$
insertion sort		best $O(n)$ ($n-1$)	worst, avg $O(n^2)$
quick sort		$\theta(n \log n)$	
Heap		$O(n \log n)$	
Dijkstra		worst $O(\lvert V\rvert^2)$	
Kruskal		$O(\lvert E\rvert \log \lvert E\rvert)$	

Polynomial time	Exponential Time
n - Linear Search	2^n - 0/1 knapsack
logn - Binary Search	2^n - Travelling SP
n*n - Insertion Sort	2^n - Sum of Subsets
n*logn - Merge Sort	2^n - Graph Coloring
n*n*n - Matrix Multiplication	2^n - Hamilton Cycle
n^2 - Dijkstra	

7 5 6 | 10 9 1

1 9

7 56 10 ~~9 1~~

3 1 2 5 2 6

~~8~~ 6 7 ~~1~~ 9 10

7 8 9 10

1 5 6 7 9 10

77 15 96 89 42 80 35 04 93 06

42 15 96 89 77 80 35 04 93 06

1 2 3 4 5 6 7 8 9

42 15 35 04 06 80 96 89 93 77

06 15 35 04 42 80 96 89 93 77

15 06 35 04 42 89 96 80 93 77

10 11 12 14 15 16 17

06 04 15 35 42 89 80 77 93 96

13

04 06 15 35 42 77 80 89 93 96

18 19

04 06 15 35 42 77 80 89 93 96

TUT 3

1) worst case (n^2)

$n, n-1, n-2, \ldots 3, 2, 1$

$1, n, n-2, n-3, \ldots, 2$

2) divide and conquer $n = 2^k$

$w(0) = 0 \quad w(1) = 0 \quad w(2) = 1$

$w(n/2) = 2w(n/4) + 2$

$w(n/4) = 2w(n/8) + 2$

$w(n) = 2w(n/2) + 2$

$w(n) = 2(2w(n/4) + 2) + 2$

$\underline{w(n) = 2^2 w(n/4) + 2^2 + 2}$

$w(n) = 2^2(2w(n/8) + 2) + 2^2 + 2$

$w(n) = 2^3 w(n/2^3) + 2^3 + 2^2 + 2$

$2^{k-1} \underline{w(n/2^{k-1})} + 2^{k-1} + 2^{k-2} + \ldots + 2$

$2^{k-1} + 2^{k-1} + 2^{k-2} + \ldots + 2$

$2^{k-1} + 2(2^{k-2} + 2^{k-3} + \ldots + 1)$

$2^{k-1} + 2\left(\frac{2^{k-1} - 1}{\cancel{2-1}}\right)$

$n/2 + 2(n/2 - 1) = n/2 + n - 2 = 3n/2 - 2$

$= 1.5n - 2$

$n = 2^k$

$\ln n = \ln_2 k$

$k = \ln_2 n$

$n = 2^{k-1} \cdot 2^1$

$2 = \frac{n}{2^{k-1}}$

3) a) 14 40 31 28 | 3 15 17 51

14 40 ① 31 28 ② 3 15 ③ 17 51 ④

~~14~~ 40 ~~28~~ ~~31~~ ⑤ ⑥ ⑦ ~~3~~ ~~15~~ 17 51 ⑧ ⑨

~~14~~ 28 ~~31~~ ~~40~~ ~~3~~ 15 ~~17~~ 51 ⑩ ⑪ ⑫ ⑬ ⑭ ⑮ ⑯

3 14 15 17 28 31 40 51

16//

b) 23 23 23 23 | 23 23 23 23

~~23~~ ~~23~~ ~~23~~ ~~23~~ ~~23~~ ~~23~~ ~~23~~ ~~23~~ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧

~~23~~ 23 ~~23~~ ~~23~~ ~~23~~ 23 ~~23~~ ~~23~~ ⑨ ⑩ ⑪ ⑫

23 23 23 23 23 23 23 23

12//

A A B A A C A A B A B A

m	0	1	2	3	4	5	6
slide	1	12-8	12	2			
MJ	1	5	14 " 13	5	" 15	16	17

A S T R A C A S T R A

0	1	2	3	4	5	6
1	4	10			6	6
1	5	12	13	14	11	12

week 4

4) Quick Sort best ^{Avg} $n \log n$
worse n^2

$E[\text{first}] =$
$E[(\text{first} + \text{last})/2] =$
$E[\text{last}] =$

worst case
$E[F] = 100$
$E[L] = 98$
$E[F+L/2] = 99$
other elements > 100

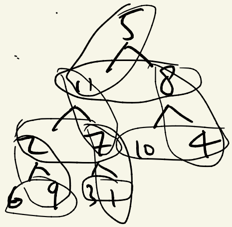
5)

6)

week 5

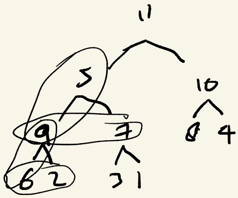
7) 1 Jul, 30 Jan, 22 Mar, 22 Dec, 30 May, 21 Feb, 3 Nov, 7 Jun, 22 Feb, 21 Nov, 30 Dec

5 11 8 2 7 10 4 6 9 3 1



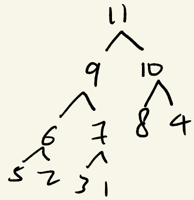
$5 \cdot 2 = 10$

swap = 1 + 1 + 1 = 3



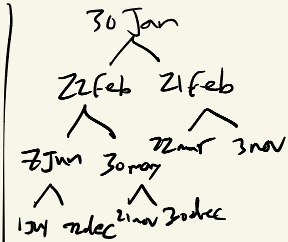
4

1 + 1

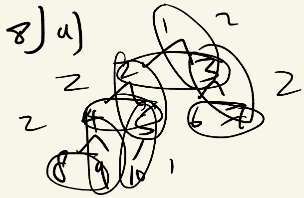


14

5 Swap



8) a)



$4 \cdot 2 + 1 = 9$

b) $n-1$

c) best

9) size = K $O(n \log_2 K)$

$K \geq 2$ max-heap = $O(K)$

$\Sigma = n$ fix heap = $O(\log_2 K)$

Week 6

Q1)

		1	2	3	4	5
i=0	d	0	∞	∞	∞	∞
	pi	-	-	-	-	-
	s	0	0	0	0	0
i=1	d	0	4	2	6	8
	pi	-	1	1	1	1
	s	1	0	0	0	0
i=2	d	0	4	2	3	8
	pi	-	1	1	3	1
	s	1	0	1	0	0
i=3	d	0	4	2	3	6
	pi	-	1	1	3	4
	s	1	0	1	1	0
i=4	d	0	4	2	3	6
	pi	-	1	1	3	4
	s	1	1	1	1	0
i=5	d	0	4	2	3	6
	pi	-	1	1	3	4
	s	1	1	1	1	1

2) add array Count variable at end of loop
initiate Count = 0 at source = 1

```
Count[V] = Count[u]
else if (d[V] == d[u] + w[u,V]){
    Count[V] += Count[u]
}
```

3) assume of non-negative weights used in proof 01

$w[P] = d[Y] + w(Y, Z)$

$w[P'] = d[Z_{k-1}] + w(Z_{k-1}, Z_k)$ + distance from Z_k to Z

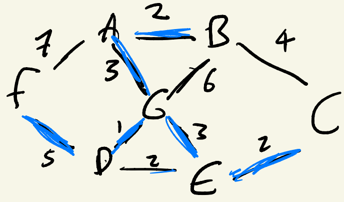
$d[Z_{k-1}] + w(Z_{k-1}, Z_k) \geq d[Y] + w(Y, Z)$

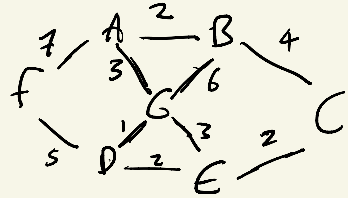
week 7

- = null

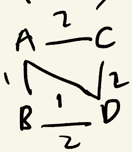
4)

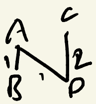
i		A	B	C	D	E	F	G
0	s	0	0	0	0	0	0	1
	d	∞	∞	∞	∞	∞	∞	0
	Pi	-	-	-	-	-	-	-
1	s	0	0	0	0	0	0	1
	d	3	6	∞	1	3	∞	∞
	Pi	G	G	-	G	G	-	-
2	s	0	0	0	1	0	0	1
	d	3	6	∞	1	2	5	∞
	Pi	G	G	-	G	G	D	-
3	s	1	0	0	1	0	0	1
	d	3	2	∞	1	2	5	∞
	Pi	G	A	-	G	G	D	-
4	s	1	0	0	1	1	0	1
	d	3	2	2	1	2	5	∞
	Pi	G	A	E	G	G	D	-
5	s	1	1	0	1	1	0	1
	d	3	2	2	1	2	5	∞
	Pi	G	A	E	G	G	D	-
6	s	1	1	1	1	1	0	1
	d	3	2	2	1	2	5	∞
	Pi	G	A	E	G	G	D	-
7	s	1	1	1	1	1	1	?
	d	3	2	2	1	2	5	∞
	Pi	G	A	E	G	G	D	-





5) False, given graph

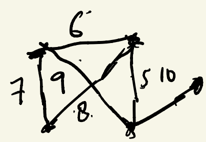


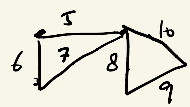


is minimum spanning tree
but A to C = 3
while A to C can be 2

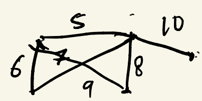
6) 5 6 7 8 9 10

$$28 = 5+6+7+10^{8,9}$$
$$= 5+6+8+9^{7,10}$$





$$29 = 8+10+6+5^{7,9}$$
$$= 8+9+7+5^{6,10}$$

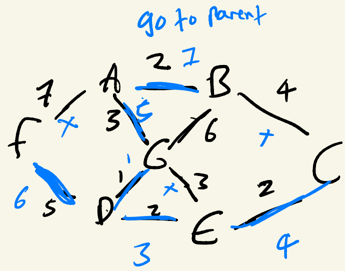


week 8

kruskal

7) i

		A	B	C	D	E	F	G
0	id	A	B	C	D	E	F	G
	sz	1	1	1	1	1	1	1
1	id	A	B	C	D	E	F	D
	sz	1	1	1	2	1	1	1
2	id	A	B	C	D	D	F	D
	sz	1	1	1	3	1	1	1
3	id	A	A	C	D	D	F	D
	sz	2	1	1	3	1	1	1
4	id	A	A	D	D	D	F	D
	sz	2	1	1	4	1	1	1
5	id	D	A	D	D	D	F	D
	sz	2	1	1	6	1	1	1
6	id	D	A	D	D	D	D	D
	sz	2	1	1	7	1	1	1



8) !!

9) !!

week 9

1) ① $T(1) = 1 \quad n \geq 2 \qquad T(2) = 3T(1) + 2 = 5$

k=1 $\quad T(n) = 3T(n-1) + 2 \qquad T(n-1) = 3T(n-2) + 2$

$T(n) = 3(3T(n-2) + 2) + 2 \quad T(n-2) = 3T(n-3) + 2$

k=2 $\quad = 3^2 T(n-2) + 2.3 + 2$

$= 3^2(3T(n-3) + 2) + 2.3 + 2 \qquad n-k = 1$

$k = n-1$

k=3 $\quad = 3^3 T(n-3) + 2 \cdot 3^2 + 2.3 + 2$

$= 3^k T(n-k) + 2(3^{k-1} + 3^{k-2} + \dots + 1)$

$= 3^{n-1} T(1) + 2(3^{n-2} + 3^{n-3} + \dots + 1)$

$= 3^{n-1} + \cancel{2}\left(\frac{3^{n-1} - 1}{\cancel{3-1}}\right) \qquad O(3^n)$

$= 2 . 3^{n-1} - 1 \leq 3^n$

② $T(1) = 1 \quad n \geq 2$

$T(n) = 2T(n/2) + 6n \qquad T(n/2) = 2T(n/4) + 6n/2$

$= 2\left(2T(n/4) + \frac{6n}{2}\right) + 6n \quad T(n/4) = 2T(n/2^3) + 6\frac{n}{2^2}$

$= 2^2 T\left(\frac{n}{2^2}\right) + 6n + 6n$

$= 2^2\left(2T\left(\frac{n}{2^3}\right) + 6\frac{n}{2^2}\right) + 2.6n \qquad \frac{n}{2^k} = 1$

$= 2^3 T\left(\frac{n}{2^3}\right) + 3.6n \qquad n = 2^k$

$= 2^k T\left(\frac{n}{2^k}\right) + k.6n \qquad \ln_n = \ln_2 k$

$\qquad k = \frac{\ln_n}{\ln_2}$

$= 2^{\log_n} \cancel{T(1)} + \log_n 6n \qquad k = \log_n$

$= n + 6n \log_n \leq O(n \log_n)$

2) ① $T(1) = 1 \quad n \geq 2$

$T(n) = 3T(n-1) + 2$ $\qquad$ inductive

guess $= T(n) \leq O(3^n) \quad T(n) \leq C.3^n \rightarrow T(n+1) \leq C3^{n+1}$

base case

$T(1) = 1 \leq 3^1$ true

$T(n+1) = 3T(n\cancel{+1}\cancel{-1}) + 2$

$= 3T(n) + 2$

$\leq 3 . 3^n + 2$

$\leq 3^{n+1} + 2 \leq O(3^{n+1})$

② $T(1) = 1 \quad$ guess : $O(8n\log_n) \qquad n = 2^k$

base case = $T(n) \leq O(8n \log_n) \qquad T(2^k) \leq 8.2^k k$

$T(2) = 14 < 16$

Inductive step $\quad T(2^{k+1}) \leq 8 . 2^{k+1}(k+1)$

$T(2^{k+1}) = 2T(2^{k+1}/2) + 6 \cdot 2^{k+1} \qquad 2^{k+1}(8k + 6)$

$= 2T(2^k) + 2^k 6.2 \qquad 8 \cdot 2^{k+1}(k + \frac{1}{4}) \leq 8.2^{k+1}(k+1)$ ✓

$= \cancel{2}(8 \cdot 2^k k) + 2^k 6.\cancel{2}$

3) a) $W(n) = W(n/3) + 5$ $\quad f(n) = 5$

$a = 1 \quad b = 3 \qquad n^{\log_3 1} = 1 \le 5$

$W(n) = \theta(n^{\log_3 1} \log_n) \qquad f(n) = \theta(n)$ $\quad$ 2nd

$= \theta(\log_n)$

b) $T(n) = 2T(n/2) + n/4$ $\quad$ 2nd

$n^{\log_b a} = n^{\log_2 2} = n \le n/4$

$T(n) = \theta(\log_n)$

c) $W(n) = 2W(n/4) + n^{\frac{3}{2}}$

$f(n) = n^{3/2} \qquad n^2 \ge n^{3/2}$ $\quad$ 3rd

$n^{\log_4 2} = n^2$

$2\left(\left(\frac{n}{4}\right)^{3/2}\right) \le c\, n^{3/2} \qquad c < 1$

$0.25 \quad \frac{2}{8}\sqrt{n^3} \le c\sqrt{n^3}$

$T(n) = \theta(n^{3/2})$

4) a) $x^3 - 4x - 5 = 0$ $\quad$ 3

b) x

3) $x^4 - x^3 - 1 = 0$ $\quad$ 4

4) x

5) x

5) a) $a_n = 7a_{n-1} - 10a_{n-2} \quad n \ge 2 \quad a_0 = 1 \quad a_1 = 0$

$x^2 - 7x + 10 = 0$

$(x-5)(x-2) = 0$

$x = 5$

$x = 2$

$-\frac{2}{3}5^n + \frac{5}{3}2^n$

$a_n = 5^n C + 2^n D$

$a_0 = C + D = 1 \qquad C = 1 - D$

$a_1 = 5C + 2D = 0 \qquad D = \frac{5}{3} \quad C = -\frac{2}{3}$

$5 - 5D + 2D = 0$

b) $a_n = 4a_{n-2} \quad a_0 = 6 \quad a_1 = 8$

$x^2 - 4 = 0$

$(x-2)(x+2) = 0 \qquad a_n = 2^n 5 + (-2)^n$

$x = 2$

$x = -2$

$a_n = 2^n C + (-2)^n D \qquad C = 6 - D$

$a_0 = 6 = C + D \qquad -4 = -4D$

$a_1 = 8 = 2C - 2D \qquad D = 1$

$8 = 2(6 - D) - 2D \qquad C = 5$

$8 = 12 - 4D$

c) $a_n = 2a_{n-1} - a_{n-2} \quad a_0 = 1 \quad a_1 = 3$

$x^2 - 2x + 1 = 0$

$(x-1)(x-1)$

$a_n = c(1^n) + dn(1^n)$

$a_0 = 1 = c$

$a_1 = 3 = c + d \qquad d = 2$

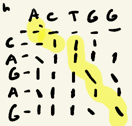
$a_n = (1^n) + 2n(1^n)$

$a_n = 1 + 2n$

week 10/11

1)

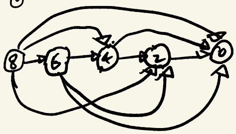
	Y	A	C	T	G	G
x	0	0	0	0	0	0
C	0	0	1	1	1	1
A	0	1	1	1	1	1
G	0	1	1	1	2	2
A	0	1	1	1	2	2
G	0	1	1	1	2	3

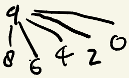


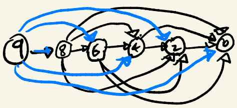
CGG

2) a)

b)







3) a)

b) C(5,3)

	0	1	2	3
0	0,0	0,1	0,2	0,3
1	1,0	1,1	1,2	1,3
2	2,0	2,1	2,2	2,3
3		3,1	3,2	3,3
4			4,2	4,3
5				5,3

4)

A	B	C
100 × 1	1 × 100	100 × 1

A(BC) = 1 × 100 × 1 + 100 × 1 × 1
= 100 + 100 = 200

(AB)C = 100 × 1 × 100 + 100 × 100 × 1
= 10000 + 10000 = 20000

5)

	0	1	2	3	4
d	20	2	15	40	4

cost

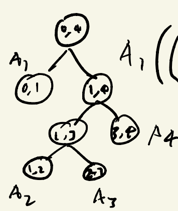
	0	1	2	3	4
0		0	600	2800	1680
1			0	1200	1520
2				0	2400
3					0
4					

last

	0	1	2	3	4
0			1	1	1
1				2	3
2					3
3					
4					

1 2 2 4 = 0 + 2400 + 120
1 3 3 4 = 1200 + 0 + 320

0 1 1 4 = 0 + 1520 + 160 ✓
0 2 2 4 = 600 + 2400 + 1200
0 3 3 4 = 2800 + 0 + 3200



$A_1((A_2 \cdot A_3)A_4)$

6)

=10 =4

P	10	40	30	50
S	5	4	6	3
	1	2	3	4

(10,0) ← (10,1) ← (10,2) ← (10,3) ← (10,4)

	0	1	2	3	4
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	50
4	0	0	40	40	50
5	0	10	40	40	50
6	0	10	40	40	50
7	0	10	40	40	90
8	0	10	40	40	90
9	0	10	50	50	90
10	0	10	50	70	90

Check

→ max can handle

0	1	2	3	4
20	2	15	40	4

	0	1	2	3	4
0		0	600	2800	1680
1			0	1200	1520
2				0	2400
3					0
4					

0 1 1 1
0 2 3
0 3
0

01 12 = 600
12 23 = 1200
23 34 = 2400

0 1 1 3 = 1600 + 0 + 1200
0 2 2 3 = 9600 ×

1 2 2 4 = 120 + 0 + 2400
1 3 3 4 = 3200 + 1200 + 0
0 1 1 4 = 0 + 1520 + 160
0 2 2 4 = 600 + 2400 +
0 3 3 4 = 2800 + 0 +

7)

B A

A = B |
A > B —

		A	C	T	G	G
	0	0	0	0	0	0
C	0	0	1	1	1	1
A	0	1	1	1	1	1
G	0	1	1	1	2	2
A	0	1	1	1	2	2
G	0	1	1	1	2	3

week12

1)

2)

3) $P = AAA \ldots AB$ $\quad m-1$

$m=0$ $\quad m=1$ $\quad m = m-2$

slide $=1$ $\quad$ Slide $= m$ $\quad$ Slide $= m+m-2$ $= 2m-2$

1 $\quad m+1$ $\quad m+2$ $\ldots\ldots$ $2m-2$ $\quad 2m-1$

$2m-1$	$2m-2$	$\ldots\ldots$	$m+2$	$m+1$	1

$m-1$

2) $T =$ "AAA...A" $\quad n$ $\quad n$

$\sim B$ $\quad 1 = 1$ $\quad A=1$

$\sim A \sim A$ $\quad B = 0$

$X = n$

1

$n-(m-1)$

$n-m+1$

4) i) BANANA

$M=0$ $\quad m=1$ $\quad m=2$ $\quad m=3$ $\quad m=4$

$S=1$ $\quad S=6-2=4$ $\quad S=6$ $\quad S=6-4=2$ $\quad S=6$

$mJ=1$ $\quad mJ=5$ $\quad mJ=8$ $\quad mJ=5$ $\quad mJ=10$

11	10	5	8	5	1

2) POTATO

1 $\quad m=1$ $\quad m=2$ $\quad m=3$ $\quad m=4$ $\quad m=5$

$S=6-2=4$ $\quad S=6$ $\quad S=6$ $\quad S=6$ $\quad S=6$

$mJ=5$ $\quad mJ=8$ $\quad mJ=9$ $\quad mJ=10$ $\quad mJ=11$

11	10	9	8	5	1

week13

1) P

R A T S C A T S

m = 10
slide = 1
mJ = 1

m = 1
slide = 8
mJ = 9

m = 2
slide = 8
mJ = 10

m = 3
slide = 8-4 = 4
mJ = 7

m = 4
slide = 8
mJ = 12

m = 5
slide = 8
mJ 13

m = 6
slide = 8
14

m = 7
slide = 8
15

2020-2021 S2

1) a) $w(1) = 0$

$w(n) = 2w(n-1) + 2$

$w(n) = 2(2w(n-2) + 2) + 2$

$= 2^2 w(n-2) + 2^2 + 2$

$= 2^2(2w(n-3) + 2) + 2^2 + 2$

$= 2^3 w(n-3) + 2^3 + 2^2 + 2$

$= 2^k w(n-k) + 2^k + 2^{k-1} + 2$

$n-k=1$

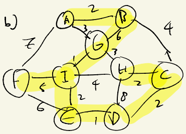
$k=n-1$

$= 2^{n-1} \cancel{w(1)} + 2^{n-1} + 2^{n-2} + \dots + 2$

$= 2(2^{n-2} + 2^{n-3} + \dots + 1)$

$= \frac{2^{n-1}-1}{\cancel{1}} = 2^n - 2 \le 2^n \quad O(2^n)$

b)



i-

i		A	B	C	D	E	F	G	H	I
0	S	1	0	0	0	0	0	0	0	0
	d	0	∞	∞	∞	∞	∞	∞	∞	∞
	p	-	-	-	-	-	-	-	-	-
1	S	1	0	0	0	0	0		0	0
	d	0	2	∞	∞	∞	∞7	3	∞	
	p	-	A	-	-	-	A	A	-	

2 S 1 1 0 0 0 0 0 0

d 2 4 7 3

p A B A A

3 S 1 1 0 0 0 0 1 0 0

d 2 4 7 3 3 1

p A B A A G G

4 S 1 1 0 0 0 0 1 0 1

d 2 4 2 5 3 3 1

p A B I I A G G

5 S 1 1 0 0 1 0 1 0 1

d 2 4 1 ~~2~~ ~~5~~ 3 3 1

p A B E I I A G G

6 S 1 1 0 1 1 0 1 0 1

d 2 ~~2~~ 1 ~~2~~ ~~5~~ 3 3 1

p A ~~B~~ E I I A G G

7. S 1 1 1 1 1 0 1 0 1

d 2 ~~2~~ 1 ~~2~~ ~~5~~ 3 2 1

p A ~~B~~ E I I A C G

8. S 1 1 1 1 1 0 1 1 1

d 2 ~~2~~ 1 ~~2~~ ~~5~~ 3 2 1

p A ~~B~~ E I I A C G

4. (a) The Travelling Salesman Problem for the cities is given in Figure Q4.

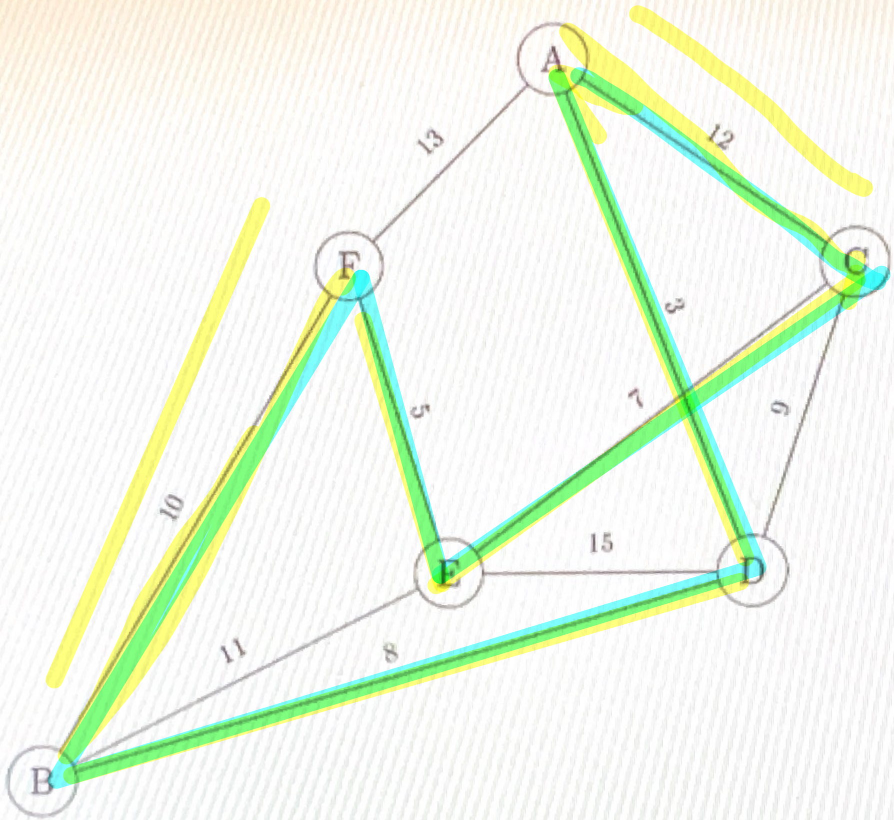


Figure Q4

(i) Show the total distance and the sequences of the edges of the graph chosen by using the Shortest-link algorithm.

(5 marks)

(ii) Show the total distance and the sequences of the edges of the graph chosen by using the Nearest Neighbour algorithm, starting from node A.

(5 marks)

19/20 S1

1) a) i) $\log N \cdot \log^3 N = O(\log N^2)$

ii) $T(n) = 2T(n-1) + N$

$O(2^N)$

b)

5 7 9

5 5 5 13

5 7 9 13

2) a) 7 5 13 9 5 2 10

1 2 3 5

4

~~10~~ 5

~~4~~ 8

9

10

2 7 9 13

2 5

10 5 7 9 X