

## โครงการปลายภาค

รายวิชา : CPSC 231 (โครงสร้างข้อมูล)



เสนอ

พศ.บุรินทร์ รุจจนพันธุ์

จัดทำโดย

นายจักรพัฒน์ ไชยแก้ว

รหัสนักศึกษา 61087111001

คณะบริหารธุรกิจและรังสิตศาสตร์

ประจำปีการศึกษา 2562

มหาวิทยาลัยเนชั่น ลำปาง

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## คำนำ

โครงการปลายภาคนี้ ข้าพเจ้าจัดทำขึ้นเพื่อศึกษาหาความรู้ในรายวิชา CPSC 231 (โครงสร้างข้อมูล) โดยโครงการปลายภาคนี้ประกอบไปด้วยหัวข้อต่างๆ ที่ได้เรียนมาในภาคเรียนที่ 2 ของรายวิชา CPSC 231 (โครงสร้างข้อมูล) ตั้งแต่บทที่ 6 ถึงบทที่ 10

ข้าพเจ้าหวังว่า โครงการปลายภาคเล่มนี้จะทำให้ทุกท่านที่อ่านได้รับความรู้ในรายวิชา CPSC 231 (โครงสร้างข้อมูล) ของข้าพเจ้าที่ได้เรียนในภาคเรียนที่ 2

ท้ายสุดนี้ ข้าพเจ้าขอขอบคุณ ผศ.บุรินทร์ รุจันพันธุ์ และเพื่อนๆ ที่มีส่วนร่วมในการให้ความช่วยเหลือ ให้คำแนะนำ การเขียนข้อมูลของหัวข้อต่างๆ และข้อมูลที่เป็นประโยชน์อย่างยิ่งเพื่อจัดทำโครงการปลายภาคในครั้งนี้

.....  
(นายจักรพัฒน์ ไชยแก้ว)

ผู้จัดทำ

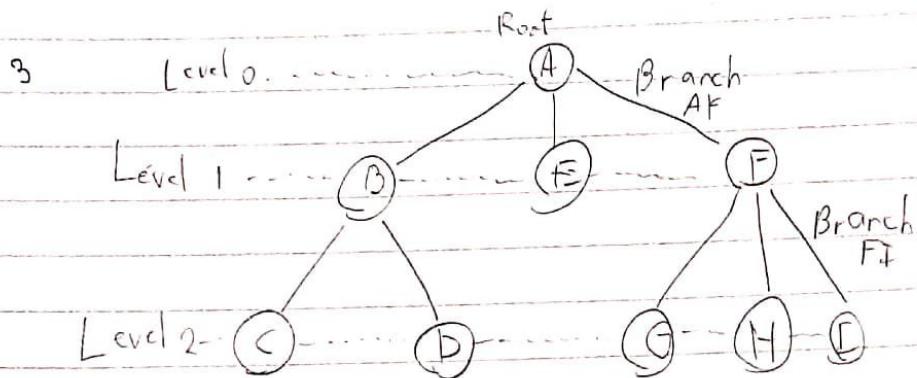
## สารบัญ

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บทที่ ๗	๘
บทที่ ๘	๑๕
บทที่ ๙	๒๒
บทที่ ๑๐	๓๒

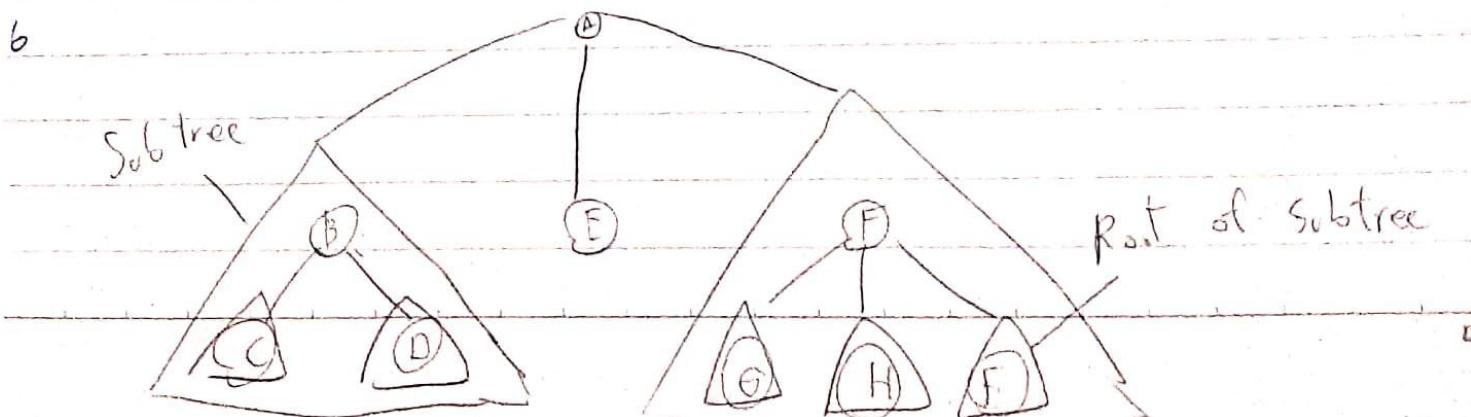
## ឧបករណ៍ និង

- 1 ធម្មតាគម្រូវការក្នុងការសំគាល់
- 2 ក្រុងការសំគាល់
- 3 និង ទីតាំងនៃការសំគាល់នៅក្នុងការសំគាល់
- 4 ផ្តល់ព័ត៌មាន និង ការសំគាល់
- 5 Subtree នេះ
- 6 ឈាមទូរតាម និង ការសំគាល់
- 7 ការសំគាល់ និង ការសំគាល់
- 8 លើកការសំគាល់
- 9 ឯកចារក្នុងការសំគាល់
- 10 លើកក្នុងការសំគាល់
- 11 ការសំគាល់ និង ការសំគាល់
- 12 ការសំគាល់ និង ការសំគាល់
- 13 ការសំគាល់ និង ការសំគាល់
- 14 ការសំគាល់ និង ការសំគាល់
- 15 ការសំគាល់ និង ការសំគាល់
- 16 ការសំគាល់ និង ការសំគាល់
- 17 ការសំគាល់ និង ការសំគាល់
- 18 ការសំគាល់ និង ការសំគាល់
- 19 ការសំគាល់ និង ការសំគាល់
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- 29 ការសំគាល់ និង ការសំគាល់
- 30 ការសំគាល់ និង ការសំគាល់

- ២ នីរក្រោចសម្រាប់បណ្តុះបណ្តាល និងប្រព័ន្ធដឹប សាខានៅក្នុងបណ្តុះបណ្តាល និងប្រព័ន្ធ និង  
សាខាដែលមានឈ្មោះថា សាខា (Branch) ដែលមានប្រាការខ្ពស់ជាបន្ទាន់ជាសាខា និង  
តម្លៃការ សំគាល់ (Degree) និងតម្លៃការ សំគាល់ទីបី (Third degree) ដែលមាន  
ចំណេះដឹង (Indegree)





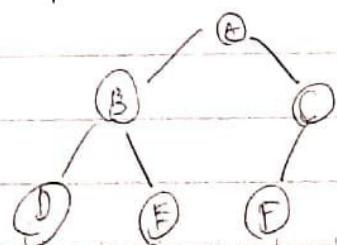
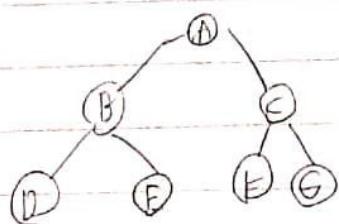
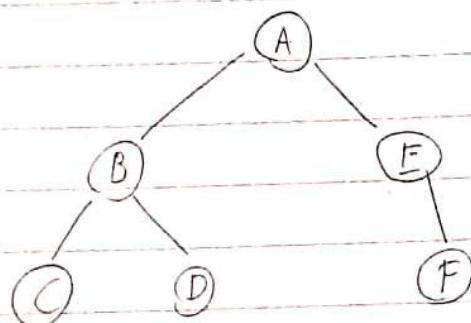



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8 ໄປບាយកំ ចិត្តរៀបការ ពន្លានជំនួយ ការអេតុសមាគ នូវរុណីដំណឹង តួល ពីរាជរាជការ  
ទុកជំនួយ តែបច្ចុប្បន្ន និង តួល ពីរាជរាជការ ទុកជំនួយ តួល ពីរាជរាជការ  
ខ្លួន តាមដៃកាត់កំឡើង ឬ ឱ្យ ការ ចាប់ផ្តើម នូវការ និង ការ ចាប់ផ្តើម

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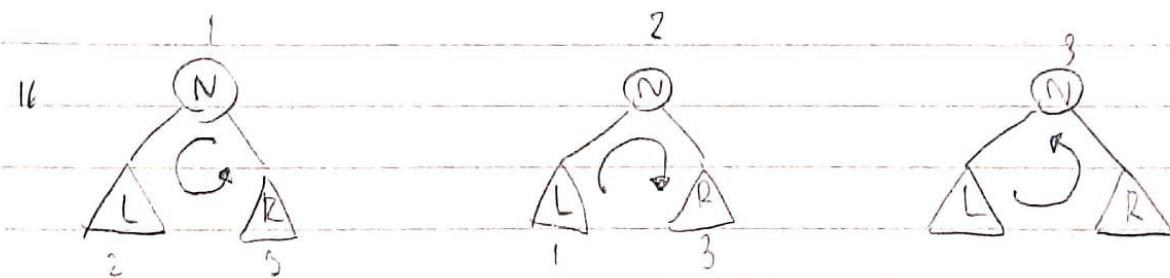


15 Depth-First Traversals ໂມວສ່ອງທີ່ໄປໃນກົດຈຳນວຍເລືດກາງພົນຈາກຮູບແບບ  
ຂອງໄປ້ປັບປຸງໂນຍາດ ແລະ ສັບສົນຕົວຕໍ່ກົດຈຳນວຍໃຫຍ່

N 11045091040

## L ក្រុងខែវេចបាន

R លេខិរុងតឹន



## Preorder traversal

## Inorder traversal

## Postorder traversal

- 17 Preorder Traversal : NLR នៅលើកដែលបានរាយជាប្រព័ន្ធដែលមានការបញ្ជូនទិន្នន័យដោយត្រូវបានបង្ហាញដោយលេខ និងការបង្ហាញនៃការបញ្ជូនទិន្នន័យ។

6

6

ՏՐԱՎՈՒՄ 6

និងសារពិន័យ សារបច្ចុប្បន្ន សារពិន័យ និងសារពិន័យ

ស្ថាបនបានទិន្នន័យនៃការតាមតម្លៃ ក្នុងការរំលែក

កំពង់សារិយាយ និងកំពង់សារិយាយ និងកំពង់សារិយាយ (Root)

ໃຫຍ່ກໍ່ສັນເກດໂຄນອງ ພ້ມ ໄປ ໂພນວະພົມ ເຊັ່ນ ສະບາຍີກຳ ປະ ອຸນຕິພູມ (Siblings)

ປະເທດ តີ່ ດັກຕາມຄວາມສັງລົງ ໄດ້ປະເທດໃຫຍ້ ບົນກອບຊາດພົມພັນ ແລ້ວ  
ຄົນຮັງ ທີ່ ສະໜັກຕົກລົງ ໂດຍ ຖ້ານີ້ສັງລົງໄດ້ ສິ້ນ

ອານຸມັດຕະກຳທີ່ມີຄວາມ  
ສົງລົງສົງລົງ  $H_{max} = N$

ឧមិន្តរោងតាមក្រុងពីរក្រុងខ្លួន ដូច  $H_{min} = \lceil \log_2 N \rceil + 1$

ចំណាំនិងដំឡើង នឹងរាយក្រឹង សង្គម ពីរាយក្រឹង  $N_{\min} = H$

Balance Factor

លើកនេះ គឺជាអនុវត្តន៍យោង ដែល  $B = H_L - H_{\text{ext}}$

ໄປເກົ່າກົມພະນຸມໃນ ລະຫວ່າງທີ່ມີການສົດຍຸດຕະຫຼາດການອຸປະກອດ ສູ່ລັບປະຕົວລູກ  $N_{max}$

ទូរសព្ទអាមេរិកចាប់ពី ១៩៧៨ និងមានការបង្កើតនៅលើសាខាអាមេរិក

ទីផ្សារអនុការណ៍លើកទី 2 និង សំណង់តាម នឹងការងារ។ Depth-First

॥២០៣៩៖ វិភាគការប្រើប្រាស់ (Breadth - First) រាយការណ៍ការប្រើប្រាស់ នូវការ

ମେଳାନ ପ୍ରେଡ଼ର ରୀତ ୩ କୋଷିକା ପ୍ରେଡ଼ର (IU Preyder, Inorder & Postorder

ເມືອງນະຄອນຫຼວງ ດ້ວຍຕະຫຼາກທີ່ພະຈຸບັນ ເປັນພິບຕະຫຼາກ ຂຶ້ງກຽມມະໂຫຼດ ໂພນ

ՀՀ մինչև 1970 թվականը աշխատությունը չէ 350 շետք

for Infix, Post-fix etc. Prefix

ପାଇଁ କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା

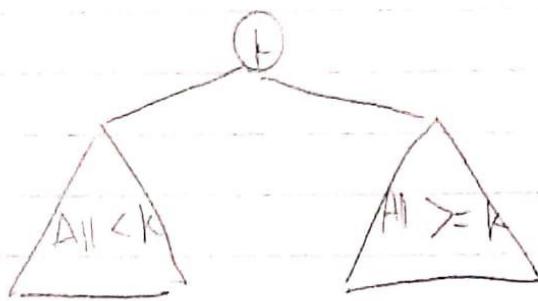
မြန်မာနိုင်ငြပ်မှု (အစိမ်းအသေချွဲ) မြန်မာနိုင်ငြပ်မှု

ମୁଖ୍ୟ ପରିକାଳିକା ଏବଂ ପରିକାଳିକା ପରିକାଳିକା ଏବଂ ପରିକାଳିକା

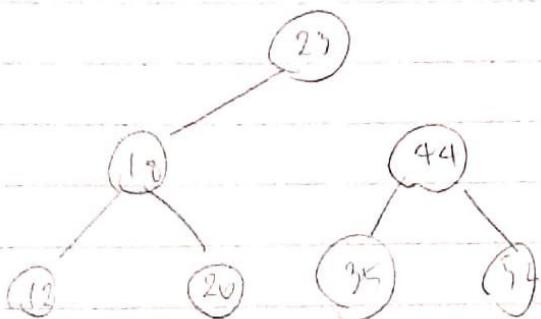
၆၇၈

- 1 ပုဂ္ဂန်အိမ်
- 2 ရုံးပုဂ္ဂန်အိမ်
- 3 ချမှတ်ချွေပုဂ္ဂန်အိမ်
- 4 မြတ်ပုဂ္ဂန်အိမ်
- 5 ချမှတ်ချွေပုဂ္ဂန်အိမ်
- 6 ပုဂ္ဂန်အိမ်
- 7 ဝါယာပုဂ္ဂန်အိမ်
- 8 ဝါယာပုဂ္ဂန်အိမ်
- 9 ပုဂ္ဂန်အိမ်
- 10 Left of Left
- 11 Right of Right
- 12 Right of Left
- 13 Left of Right
- 14 ဘုရား
- 15 ဒုဂ္ဂန်အိမ်
- 16 ဝါယာပုဂ္ဂန်အိမ်
- 17 Reheap Up
- 18 Reheap Down
- 19 မြတ်ပုဂ္ဂန်အိမ်
- 20 ချမှတ်ချွေပုဂ္ဂန်အိမ်
- 21 မြတ်ပုဂ္ဂန်အိမ်
- 22 ဒုဂ္ဂန်အိမ်
- 23 ဒုဂ္ဂန်အိမ်
- 24 ဝါယာပုဂ္ဂန်အိမ်
- 25 မြတ်ပုဂ္ဂန်အိမ်
- 26 မြတ်ပုဂ္ဂန်အိမ်
- 27 မြတ်ပုဂ္ဂန်အိမ်
- 28 မြတ်ပုဂ္ဂန်အိမ်
- 29 AVL tree
- 30 မြတ်ပုဂ္ဂန်အိမ်

2



三







- ៦ ក្រសួងពីរាជក្រឹតា និងក្រសួងពីរាជក្រឹតា និងក្រសួងពីរាជក្រឹតា និងក្រសួងពីរាជក្រឹតា

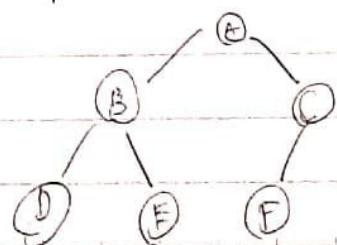
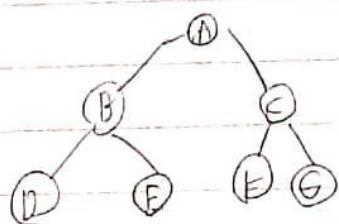
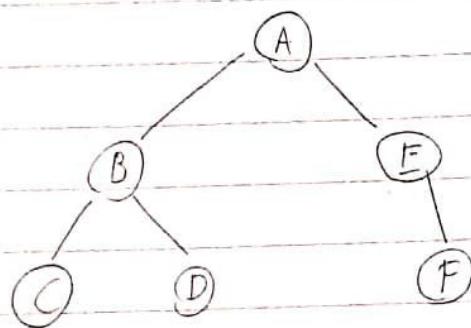
✓97

3. ອົດຖະກອນ ປະຊາທິປະໄຕ ພັນຍາ ທີ່ມີຄວາມ ດັບຕຸລາ ແລ້ວ ດັບຕຸລາ ສຳເນົາ

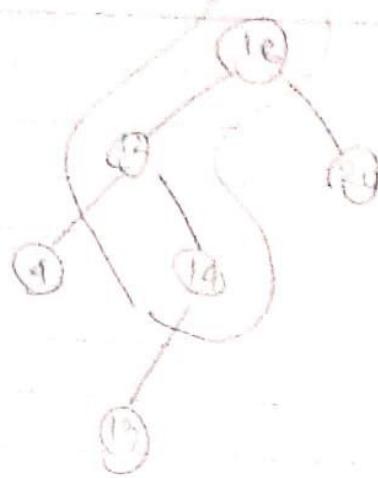
1



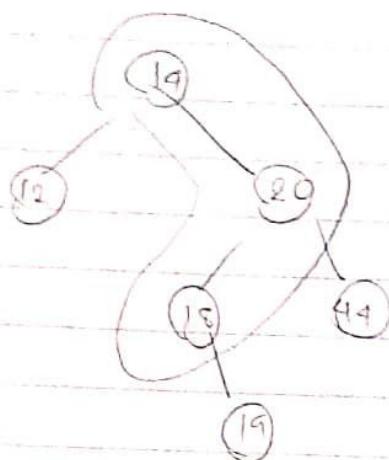
9



12

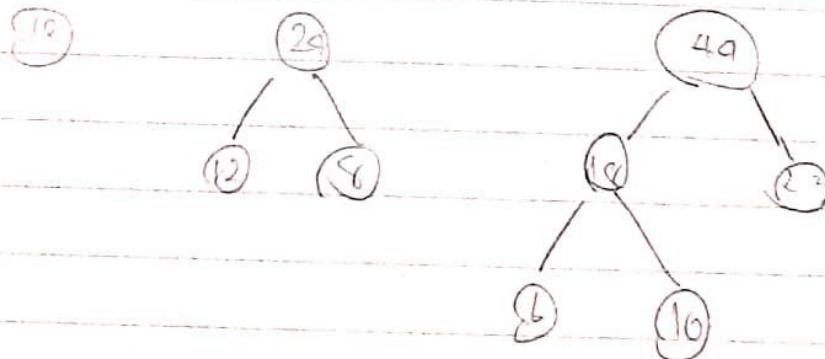


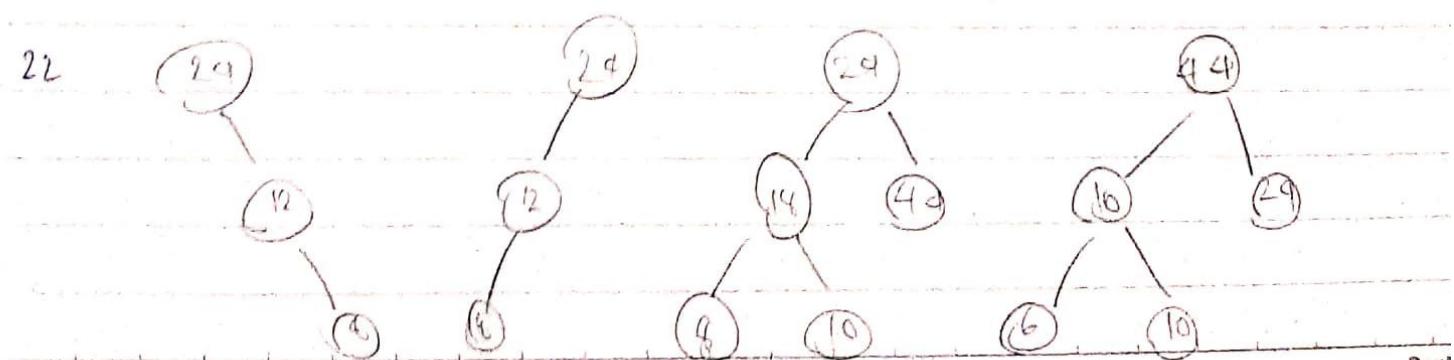
13



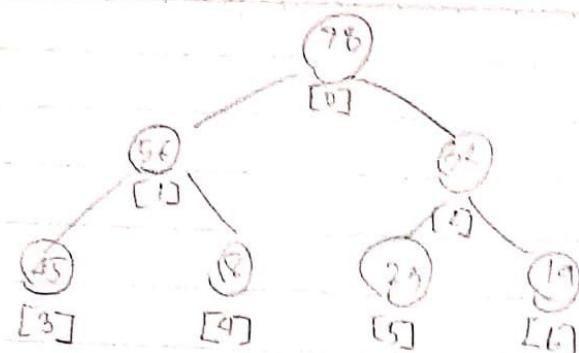
14 សម្រាប់ សំណងកំពុងទីនៅលើបានកត់លើក និងការបញ្ចូនការ  
ដែលអាមេរិកចុះទូទឹងទិន្នន័យថា ការបញ្ចូនការ និងការបញ្ចូនការ  
គឺជាការបញ្ចូនការ ដែលបានកត់លើក និងការបញ្ចូនការ និងការបញ្ចូនការ

15



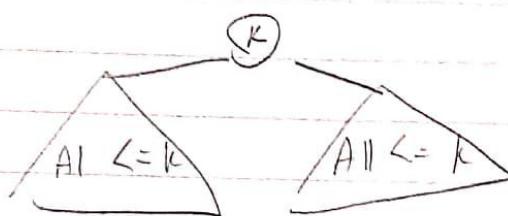


23

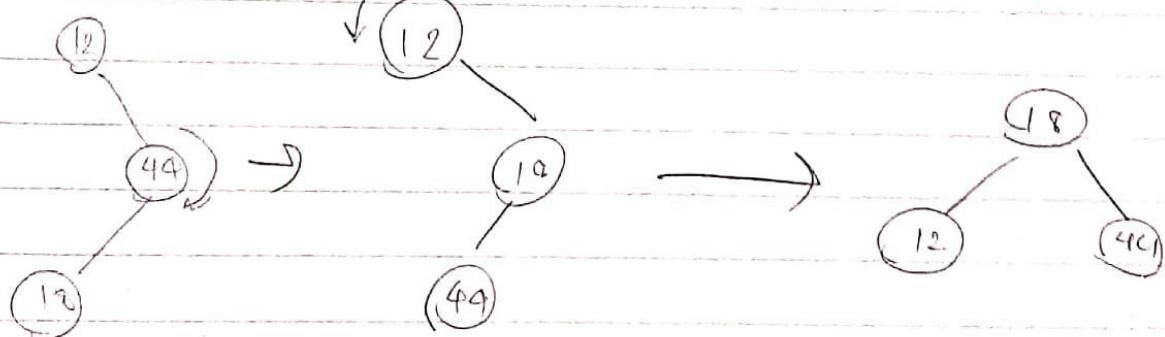


78	86	32	45	8	23	19
(6)	[1]	[2]	[3]	(4)	[5]	[6]

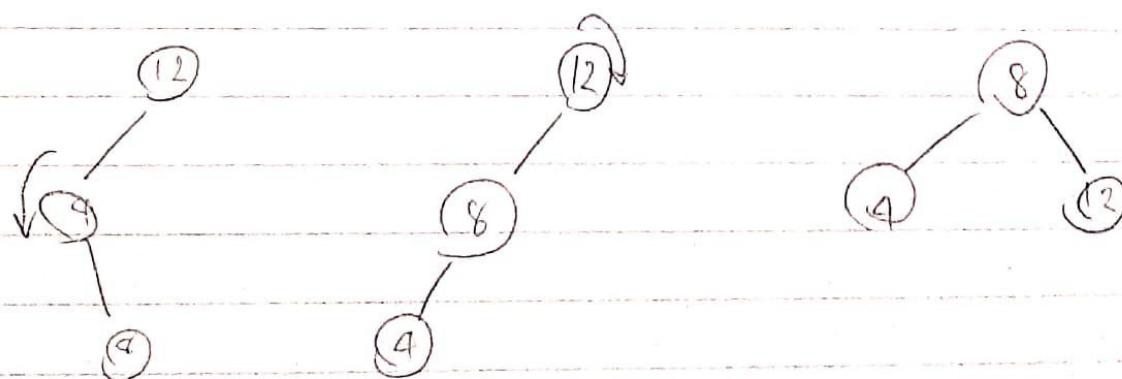
24



25



26



600 H.C.Y.

10

13

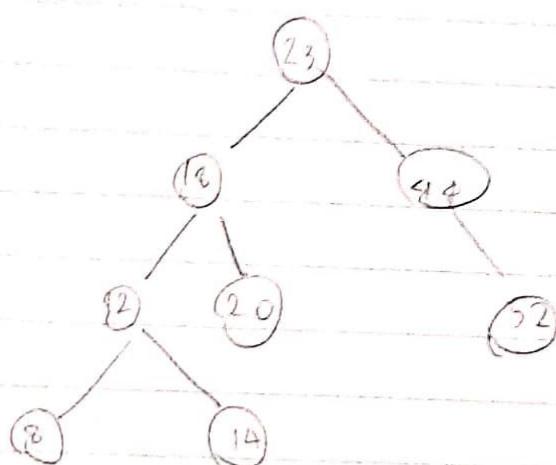
17



128



29



៣០ នរោត្តមន្ត្រីសាធារណក្រសួង BST និងក្រសួងរៀបចំអភិវឌ្ឍន៍  
ក្រសួងសំគាល់លេខាភិបាល, នាយកដ្ឋាន និងជាជាស្តី  
អាជីវកីឡា និងក្រសួង

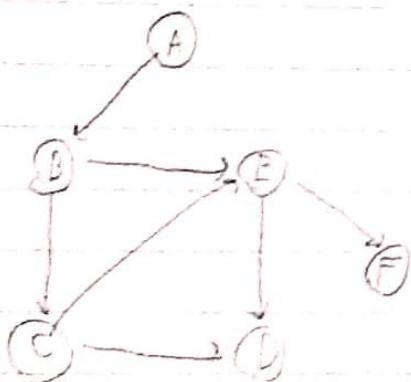
## บทที่ 8 กราฟ

- 1 แนวคิดของกราฟ
- 2 กรณีพิเศษของกราฟ
- 3 กราฟที่ไม่มีจุดสอง
- 4 จุดต่อไปของกราฟที่มีจุดสอง
- 5 ลักษณะของ ~~ที่~~ กราฟที่มีจุดสอง
- 6 จัลก์ดับ
- 7 โครงสร้างปีรีเดต
- 8 จุดต่อไปของจุดสอง
- 9 ตัวอย่างเช่น จุดต่อไปของจุดสอง
- 10 กรณีพิเศษของกราฟ
- 11 ความต่อเนื่องของเส้น
- 12 ความต่อเนื่องแบบสี่เหลี่ยม
- 13 กรณีพิเศษเช่นของกราฟ
- 14 ดีลัก ดู
- 15 กรณีพิเศษของจุดสอง
- 16 รูปโครงสร้างของกราฟ เช่น โครงสร้างของกราฟ
- 17 รูปกราฟ จุดต่อไปของจุดสอง
- 18 กรณีพิเศษของกราฟ
- 19 รูปกราฟของกราฟ
- 20 กรณีพิเศษของกราฟ
- 21 กรณีพิเศษของกราฟ
- 22 กรณีพิเศษของกราฟที่มีจุดสอง
- 23 ตัวอย่างกรณีพิเศษของกราฟที่มีจุดสอง Preorder
- 24 กรณีพิเศษของกราฟที่มีจุดสอง
- 25 กรณีพิเศษของกราฟที่มีจุดสอง
- 26 ตัวอย่างกรณีพิเศษของกราฟ
- 27 แนวคิดของกราฟ
- 28 แนวคิดของกราฟ
- 29 Minimum Spanning Tree
- 30 รูปกราฟเดียว

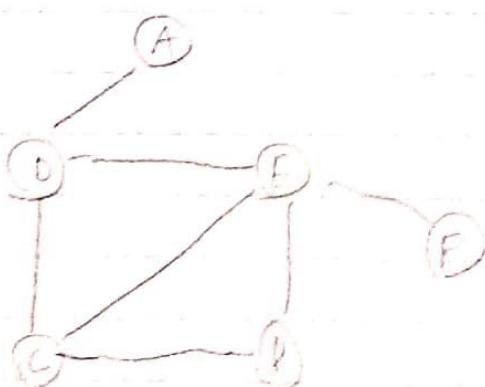
8



9



5

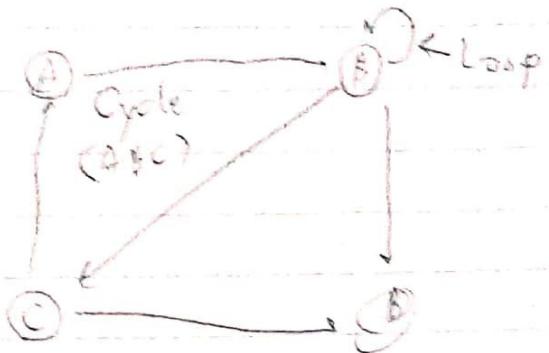


- b. Paths (Path) ရွှေအားပေါ်လိမ့်နည်တွင် လျှောက်စွဲတော်သိမ်ခွဲတွင် အောက်ပါတော်များ၏ အဆင့်မြင့်ဆုံး လျှောက်စွဲတော်များ ဖြစ်ပါသည်။

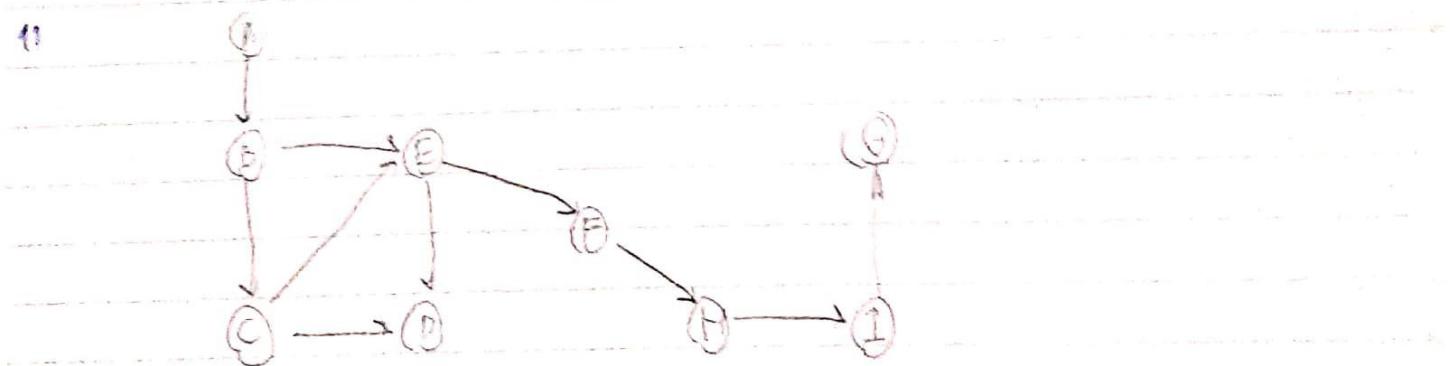
10

9 adjacent vertex) ដែលមានទីតាំងនៅក្នុងក្រឡាយ  
នៃប្រព័ន្ធនេះនិងមិនមែនជាផ្លូវការណាមួយទេ នៅពីរនេះ នឹងធ្វើ  
សំណងជាតិ និងជាប្រព័ន្ធឌីជីថល។

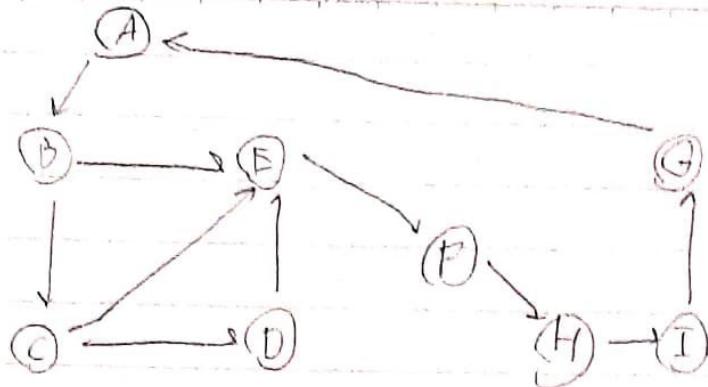
5. Երես հաշվառմանը հայտն է ուղիղ թագավորական պատճեններուն օրուն մասին Բ, Ը, Ծ, Ը, Ը և Երես կառավարության մասին Բ, Ը, Ծ, Ը, Ը լուսուն օբյեկտներուն:



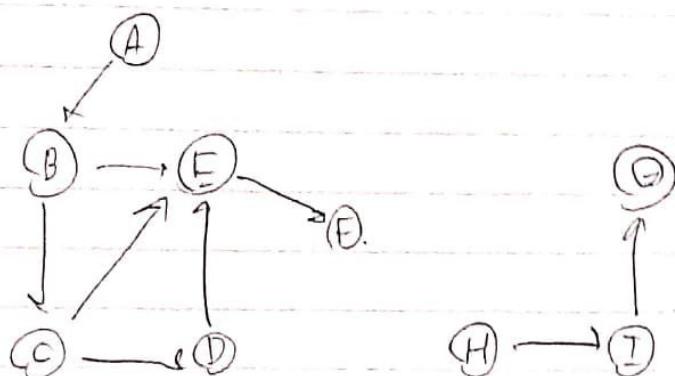
၁၀ ဝက်မိန္ဒရာ ဝက်မိန္ဒရာတော်မြောင်း ရရှိခဲ့သူများ၏ အပိုင်းဆုံး  
လုပ်ငန်းများ၏ အပိုင်းဆုံး အမြတ်ဆုံး အမြတ်ဆုံး အမြတ်ဆုံး  
လုပ်ငန်းများ၏ အပိုင်းဆုံး အမြတ်ဆုံး အမြတ်ဆုံး အမြတ်ဆုံး



12



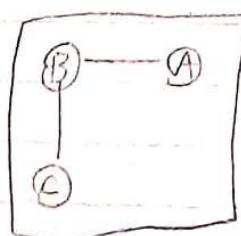
13



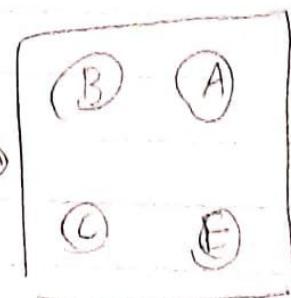
14 តីវិធានរបស់ខ្លួន ចាប់ពីថ្ងៃទី ១០៨៩ ឆ្នាំ ២០១៣ (១០៨៩/២០១៣) ហើយដែលបានការពារ  
ជាមុននឹងការចូលរួមរបស់ខ្លួន និងការចូលរួមរបស់ខ្លួន និងការចូលរួមរបស់ខ្លួន និងការចូលរួមរបស់ខ្លួន

15 ក្រឡការណ៍នេះ គឺជាកំណត់បច្ចុប្បន្នរបស់ខ្លួន ដែល  
ទាក់ទង និងអ្នកទៅក្នុងក្រុងការរួម គឺជាកំណត់បច្ចុប្បន្នរបស់ខ្លួន ដែល  
ពីរឯកជាមួយ និងការរួម គឺជាកំណត់បច្ចុប្បន្នរបស់ខ្លួន ដែល

1



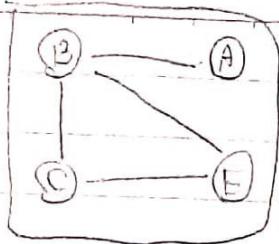
→ Insert Vertex



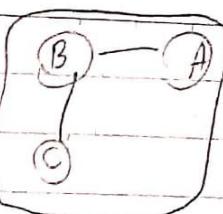
1

6

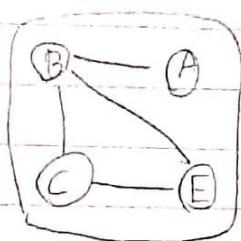
- 17



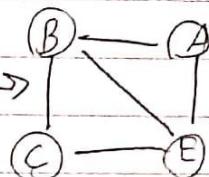
## DeleteVertex



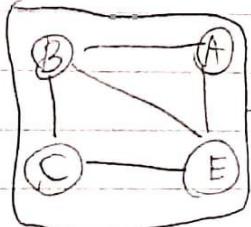
- 18



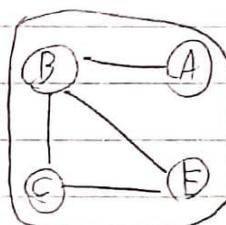
Add Edge



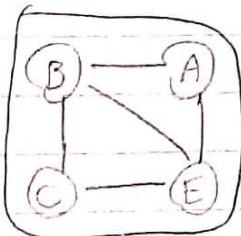
- 19



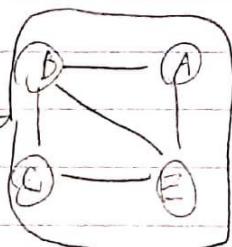
## Delete Edge



- 20



## Find Vertex



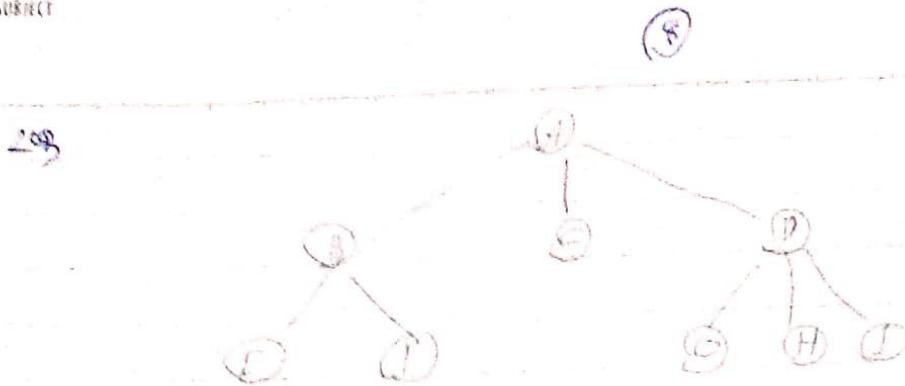


- ២៣ ព្រៃនគេង នៅក្នុងប្រាក់ប្រាកដ ត្រូវបានបញ្ជាក់ ថា ពីរប៉ុណ្ណោះ មិនមែន  
គិតជាបាន ទេ ហើយ តើ តុលាត្រូវបានបញ្ជាក់ ពីរប៉ុណ្ណោះ ពីរប៉ុណ្ណោះ មិនមែន  
គិតជាបាន ទេ ហើយ តើ តុលាត្រូវបានបញ្ជាក់ ពីរប៉ុណ្ណោះ ពីរប៉ុណ្ណោះ មិនមែន  
គិតជាបាន ទេ ហើយ តើ តុលាត្រូវបានបញ្ជាក់ ពីរប៉ុណ្ណោះ ពីរប៉ុណ្ណោះ មិនមែន

SUBJECT

100

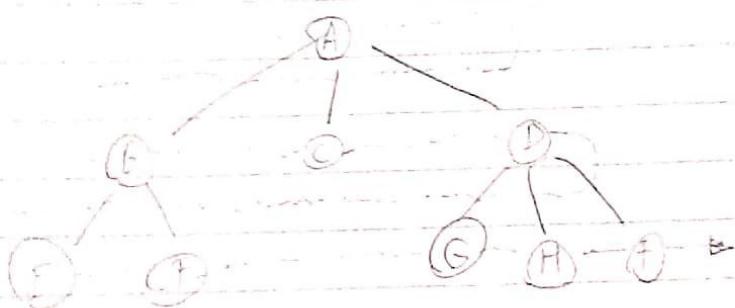
621



Depth-first traversal AB E F C D G H

- ၃၅ သိမ်းချေမှုပါန်ကျော် ပေါ်လဲ  
ရွှေမြစ် အန္တ မြော် စံပြောပါ  
ရွှေမြစ်မှာ များ သော်လည်း  
ကျော်လဲ မြတ်စွာ ပေါ်လဲ

25



Breadth-first traversal ABCDEF GHI

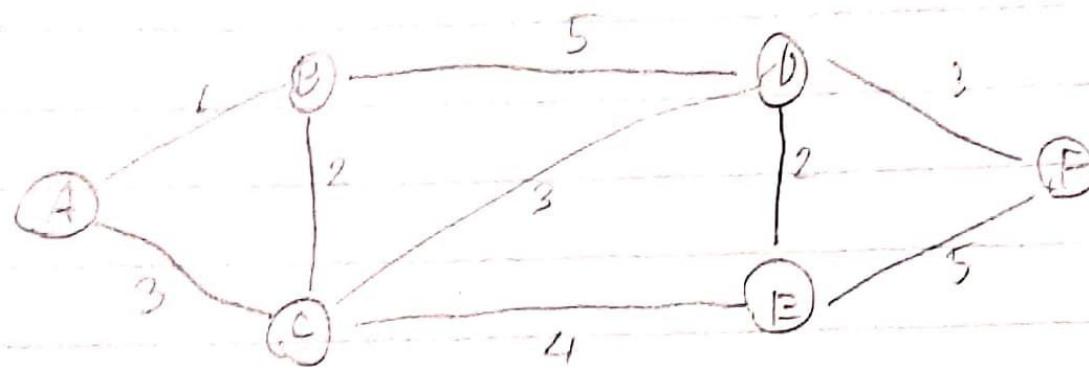
**SUBJECT**

66



- ၇၉ ក្នុងការបង្កើតរឹងចំណេះដីជាប្រព័ន្ធទិន្នន័យ ក្នុងការបង្កើតរឹងចំណេះដីជាប្រព័ន្ធទិន្នន័យ  
ក្នុងការបង្កើតរឹងចំណេះដីជាប្រព័ន្ធទិន្នន័យ 9 គីឡូ-ម៉ែត្រ 1000  
ដែលបានបង្កើតឡើង និងបានបង្កើតឡើង

30



## Unit 4 Gardening

- 1 Insertion Sort
  - 2 Quick Selection Sort
  - 3 Quick Median
  - 4 Selection Sort
  - 5 Merge Sort
  - 6 Quick Median
  - 7 Insertion Sort
  - 8 Selection Sort
  - 9 Heap Sort
  - 10 Insertion Sort
  - 11 Bubble Sort
  - 12 Quick Sort
  - 13 Merge Sort
  - 14 Quick Selection Sort
  - 15 Quick Selection Sort
  - 16 Quick Selection Sort
  - 17 Quick Selection Sort
  - 18 Quick Selection Sort
  - 19 Quick Selection Sort
  - 20 Quick Selection Sort (Bubble Sort)
  - 21 Quick Selection Sort (Merge Sort Phase)
  - 22 Quick Selection Sort (Sort Phase)
  - 23 Quick Selection Sort (Merge)
  - 24 Quick Selection Sort (Merge Sort Phase)
  - 25 Quick Selection Sort
  - 26 Parity Heap Sort
  - 27 Decrease Insertion Sort
  - 28 Decrease Bubble Sort
  - 29 Decrease Median List
  - 30 Decrease Merge File

1

- 1 Internal Sorting မြန်မာစာတမ်းမှာ ပေါ်လေသူများအတွက် အမြန်ဆုံး ဖြစ်သော ပိုမိုမှတ်ချင်ရန် အသိချင်မှုများ အပေါ် အမြန်ဆုံး ဖြစ်သော ပိုမိုမှတ်ချင်ရန် အသိချင်မှုများ

2 Internal Sorting မြန်မာစာတမ်းမှာ ပေါ်လေသူများအတွက် အမြန်ဆုံး ဖြစ်သော ပိုမိုမှတ်ချင်ရန် အသိချင်မှုများ အပေါ် အမြန်ဆုံး ဖြစ်သော ပိုမိုမှတ်ချင်ရန် အသိချင်မှုများ

3 External Sorting မြန်မာစာတမ်းမှာ ပေါ်လေသူများအတွက် အမြန်ဆုံး ဖြစ်သော ပိုမိုမှတ်ချင်ရန် အသိချင်မှုများ အပေါ် အမြန်ဆုံး ဖြစ်သော ပိုမိုမှတ်ချင်ရန် အသိချင်မှုများ

4 Selection Sort, Shell Sort, Insertion Sort

5 External Sorting မြန်မာစာတမ်းမှာ ပေါ်လေသူများအတွက် အမြန်ဆုံး ဖြစ်သော ပိုမိုမှတ်ချင်ရန် အသိချင်မှုများ အပေါ် အမြန်ဆုံး ဖြစ်သော ပိုမိုမှတ်ချင်ရန် အသိချင်မှုများ

6 Selection Sort, Shell Sort, Insertion Sort

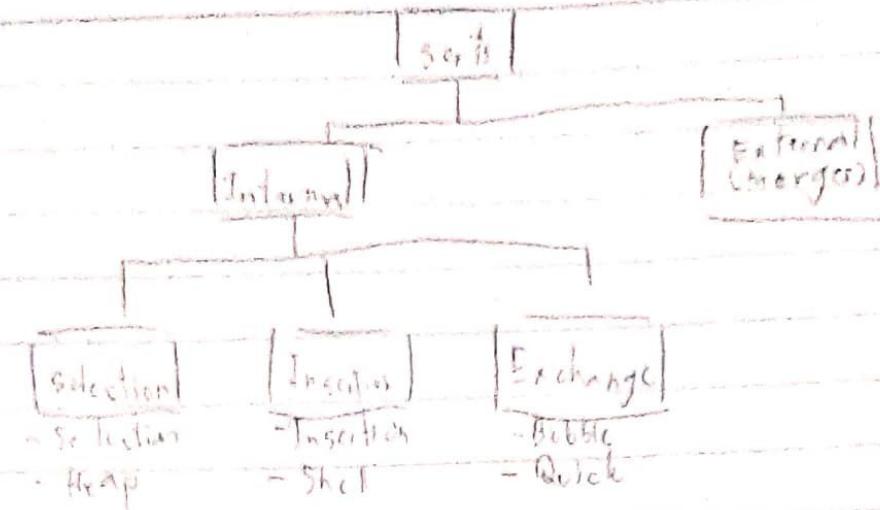
7 Selection Sort, Shell Sort, Insertion Sort, Bubble Sort, Quick Sort, Merge Sort

9

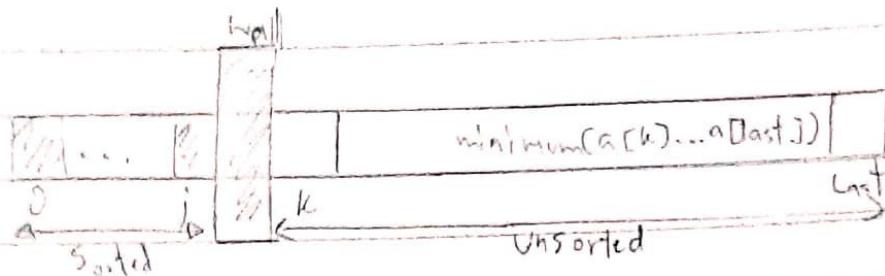
QUESTION

14

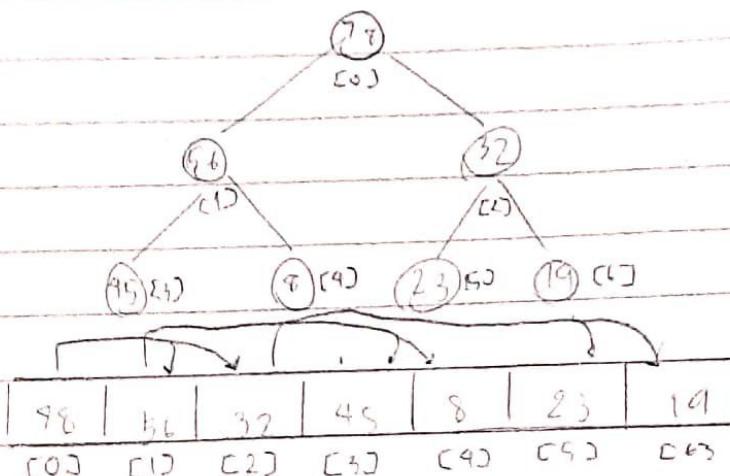
Q



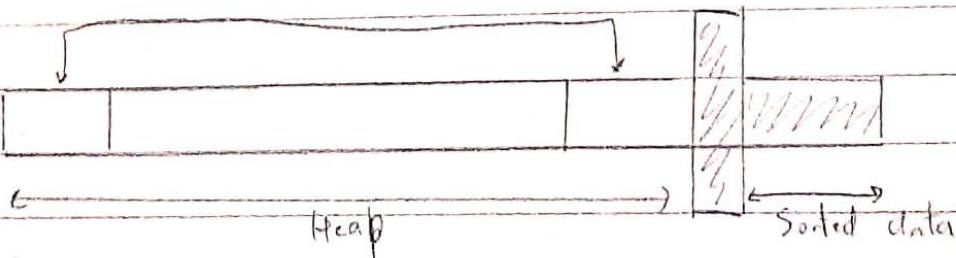
15



16

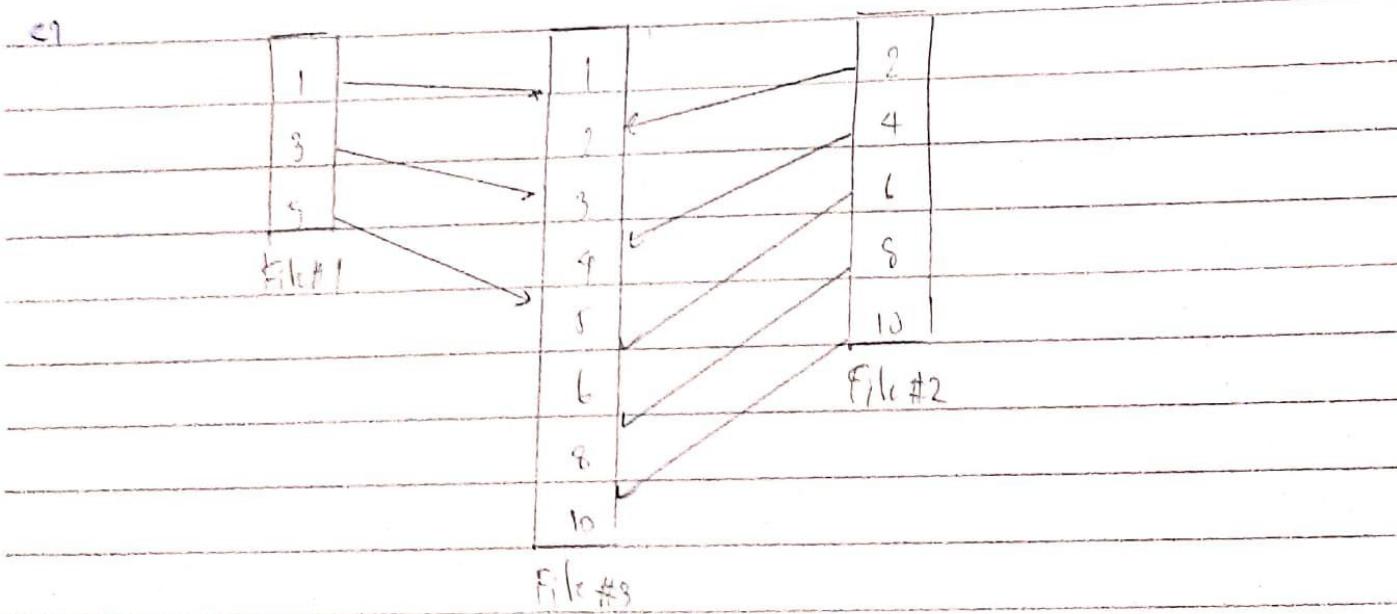
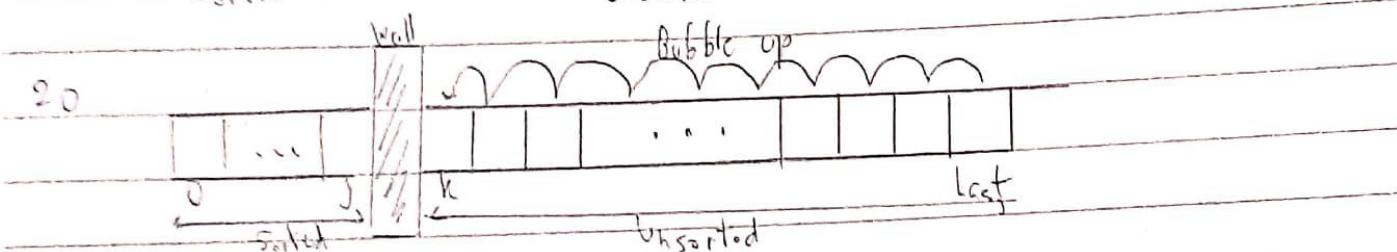
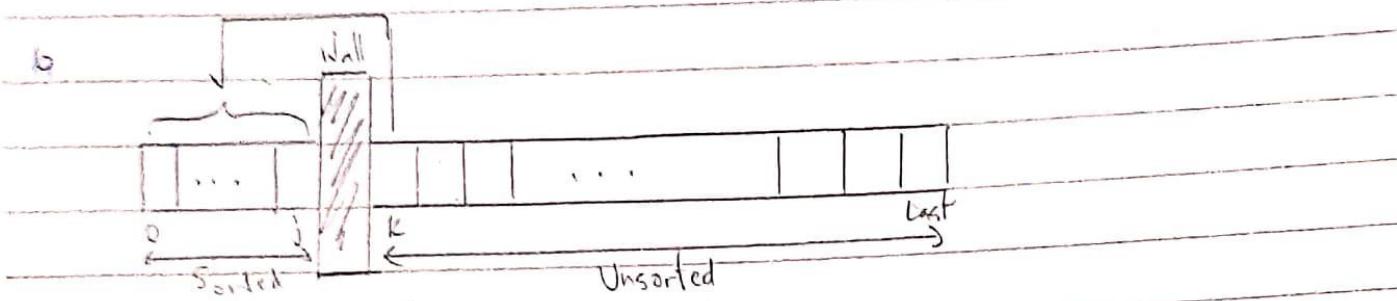


17



(7)

n	Number of loops	
	Selection Sort	Heap Sort
25	625	114
100	10,000	664
500	250,000	4,482
1000	1,000,000	9,965
7000	4,000,000	10,965



⑨

22 Input File

2300 records

Sort

Records 1 - 500 | 1001 - 1500 | 2001 - 2300

Merge 1

501 - 1000 | 1501 - 2000

Merge 2

2;

1 | 5 | 9 | 14 | 17 | 6 | 7 | 13

1 | 5 | 3 | 14

17 | 6 | 9 | 13

1 | 5 | 3 | 14

17 | 6 | 9 | 13

1 | 5 | 3 | 14

17 | 6 | 9 | 13

1 | 5 | 9 | 14

6 | 17 | 9 | 13

1 | 5 | 9 | 14

6 | 7 | 13 | 19 |

1 | 3 | 5 | 14

6 | 7 | 13 | 19 | 17

↓

✓

1 | 3 | 5 | 6 | 7 | 13 | 14 | 17

(q)

Algorithm	Time complexity (Best-case)	Time complexity (Average case)	Time complexity (Worst-case)
Selection Sort	$O(n^2)$	$O(n^2)$	$O(n^2)$
Insertion Sort	$O(n)$	$O(n^2)$	$O(n^2)$
Bubble Sort	$O(n)$	$O(n^2)$	$O(n^2)$
Quick Sort	$O(n \log n)$	$O(n \log n)$	$O(n^2)$
Merge Sort	$O(n \log n)$	$O(n \log n)$	$O(n \log n)$

Q) Algorithm selectionSort (list, last)

- 1 set current to 0
- 2 loop (until last element sorted)
  - 1 set smallest to current
  - 2 set walker to current + 1
  - 3 loop (walker <= last)
    - 1 if (walker key < smallest key)
      - 1 set smallest to walker
      - 2 increment to walker
  - 4 end loop
  - 5 exchange (current, smallest)
  - 6 increment current
- 3 end loop
- end selectionSort

### a) Algorithm HeapSort (char, list)

1 set walker to 1

2 loop (loop if walker)

  1 reheapify (heap, walker)

  2 increment walker

3 end loop

4 set sorted to last

5 loop until all data sorted

  1 exchange char o, sorted

  2 decrement sorted

  3 reheapify (heap, o, sorted)

  4 end loop

end heap sort

### b) Algorithm insertionSort (list, last)

1 set current to 1

2 loop (until last element sorted)

  1 move current element to hold

  2 set walker to current - 1

  3 loop (walker >= 0 AND hold key < walker key)

    1 move walker element right one element

    2 decrement walker

  4 end loop

  5 move hold to walker + 1 element

  6 increment current

  7 end loop

end insertionSort

28 Algorithm bubbleSort (list, last)

- 1 set current to 0
- 2 set sorted to false
- 3 loop current < last AND sorted false:
  - 1 set walker to last
  - 2 set sorted to true
  - 3 loop (walker > current)
    - 1 if (walker data < walker - 1 data)
    - 1 set sorted to false
    - 2 exchange (list, walker, walker - 1)
  - 2 end if
  - 3 decrement walker
- 4 end loop
- 5 increment current
- 6 end loop

end bubbleSort

29 Algorithm medianLeft (sortData, left, right)

- 1 set mid to ( $left + right$ ) / 2
- 2 if (left key > mid key)
  - 1 exchange (sortData, left, mid)
- 3 end if
- 4 if (left key > right key)
  - 1 exchange (sortData, left, right)
- 5 end if
- 6 if (mid key > right key)
  - 1 exchange (sortData, mid, right)
- 7 end if
- 8 exchange (sortData, left, mid)

end medianLeft.

(9)

## 3.0 Algorithm mergeFiles

1 open files

2 read (file1 into record1)

3 read (file2 into record2)

4 loop (not end file1 OR not end file2)

1 if (record1 key &lt;= record2 key)

1 write (record to file3)

2 read (file1 into record1)

3 if (end of file1)

1 set record1 key to infinity

4 end if

9 else

1 write (record2 to file3)

2 read (file2 into record2)

3 if (end of file2)

1 set record2 key to infinity

4 end if

3 end if

5 end loop

6 close files

end mergeFiles

## ຈິງໆ ໂດຍ ມີຄວາມ

- 1 ມາກເມືອນຕັ້ງໃຈ
- 2 ຜົນທະນາ ດີນດີ
- 3 ວິຊາຂະໜາດ ມາກເມືອນຫຼຸດ
- 4 ສຳຄັນຮູ່ ມາກເມືອນ
- 5 ພົບປົງແລະ ອານຸພາບ ດັ່ງນີ້
- 6 ດົກເລີກ ມາກເມືອນ
- 7 ດົກເລີກ ມາກເມືອນ
- 8 ມາກເມືອນໄລ່ສອບຖັນ
- 9 ດົກເລີກ ມາກເມືອນ
- 10 ມາກເມືອນໄລ່ອະນຸຍານ ມາກເມືອນ
- 11 ມາກເມືອນ
- 12 ມາກເມືອນ
- 13 ພົບປົງແລະ ມາກເມືອນ
- 14 ດົກເລີກ ມາກເມືອນ
- 15 ມາກເມືອນ
- 16 ດົກເລີກ ມາກເມືອນ
- 17 ມາກເມືອນ
- 18 ດົກເລີກ ມາກເມືອນ
- 19 ສົມຜົກ ທາງຕົກ ມາກເມືອນ
- 20 (Linear probe)
- 21 ມາກເມືອນ
- 22 ຢົມໂລກ ມາກເມືອນ
- 23 ຕັ້ງກິນ ຖະນຸຍາດ ມາກເມືອນ
- 24 ພົບປົງ Linear Probe
- 25 ມາກເມືອນ
- 26 ຕັ້ງກິນ ນີ້ ມາກເມືອນ
- 27 ມາກເມືອນ
- 28 ຢົມໂລກ ມາກເມືອນ
- 29 ມາກເມືອນ
- 30 ມາກເມືອນ

(10)

1. ព្រមាយនិងលេខរូបនៃសម្រាប់ការសំណងជាមុន ត្រូវបានដាក់ឡើង ដើម្បីស្វែងរកចំណាំ និងស្វែងរកចំណាំ នៅក្នុងសម្រាប់ការសំណងជាមុន។ ការសំណងជាមុន គឺជាការស្វែងរកចំណាំ និងស្វែងរកចំណាំ នៅក្នុងសម្រាប់ការសំណងជាមុន។
  2. ព្រមាយនិងលេខរូបនៃសម្រាប់ការសំណងជាមុន ត្រូវបានដាក់ឡើង ដើម្បីស្វែងរកចំណាំ និងស្វែងរកចំណាំ នៅក្នុងសម្រាប់ការសំណងជាមុន។ ការសំណងជាមុន គឺជាការស្វែងរកចំណាំ និងស្វែងរកចំណាំ នៅក្នុងសម្រាប់ការសំណងជាមុន។
  3. ឥឡូវនេះ ការបង្ហាញទីផ្សារ និងការបង្ហាញទីផ្សារ ត្រូវបានដាក់ឡើង ដើម្បីស្វែងរកចំណាំ និងស្វែងរកចំណាំ នៅក្នុងសម្រាប់ការសំណងជាមុន។ ការសំណងជាមុន គឺជាការស្វែងរកចំណាំ និងស្វែងរកចំណាំ នៅក្នុងសម្រាប់ការសំណងជាមុន។
4. Algorithm seqSearch (list, last, target, loc n)
- 1 set looker to 0
  - 2 loop (looker < last AND target not equal list[looker])
    - 1 increment looker
  - 3 end loop
  - 4 set locn to looker
  - 5 if (target equal list[looker])
    - 1 set found to true
  - 6 else
    - 1 set found to false
  - 7 end if
  - 8 return found
- end seqSearch

៥ សម្រាប់បញ្ជីលក្ខណៈ តុលាង និង តុលាងអាជីវិជ្ជកម្ម របស់ខ្លួន  
ទូទាត់បាននូវលក្ខណៈលើក និង តុលាងអាជីវិជ្ជកម្ម នៅក្នុង  
និង នៅក្នុងរបាយការ និង គំនិតុលាង នៃការបង្កើតរបាយការណ៍

៦ ឥឡូវនាសាស្ត្រពីវិធីសម្រាប់បញ្ជីលក្ខណៈលើក 2 ដែល ស្ថាន់  
ដោយ សារសារណ៍ និង ការសម្រាប់បញ្ជីលក្ខណៈ ដោយ Donald E. Knuth  
ពីចំណាំ "សម្រាប់បញ្ជីលក្ខណៈលើក 2 និង តុលាងអាជីវិជ្ជកម្ម នៃការបង្កើតរបាយការណ៍"

៧ Algorithm sentinelSearch (list, last, target, locn)

1 set (list [last + 1]) to target

2 set looker to 0

3 loop (target not equal list (looker))

    1 increment looker

4 end loop

5 if (looker <= last)

        1 set found to true

        2 set locn to looker

    6 else

        1 set found to false

        2 set locn to last

7 end if

8 return found

end SentinelSearch

៨ សម្រាប់បញ្ជីលក្ខណៈលើក និង តុលាងអាជីវិជ្ជកម្ម នៃការបង្កើតរបាយការណ៍ Probability Search និង  
សម្រាប់បញ្ជីលក្ខណៈលើក និង តុលាងអាជីវិជ្ជកម្ម នៃការបង្កើតរបាយការណ៍ នៅក្នុង  
និង នៅក្នុងរបាយការ និង គំនិតុលាង នៃការបង្កើតរបាយការណ៍

9 Algorithm ProbabilisticSearch (list, last, target, locn)

- ```
4. if target in list
   1 find target in list
   2 if (target in list)
      1 set found to true
   3 set locn to index of element containing target
   4 if (target after first element)
      1 move element containing target up one location
   5 end if
3 else
   1 set found to false
4 end if
5 return found
end ProbabilitySearch
```

12. မရအောင်လောက်မြတ်စွာ ပုဂ္ဂန်ခံစွာ မသိမှတ်ဆောင်ရွက်ခဲ့ဘဲ မရအောင်လောက်မြတ်စွာ ပုဂ္ဂန်ခံစွာ မသိမှတ်ဆောင်ရွက်ခဲ့ဘဲ

$$\text{mid} = \lceil (\text{begin} + \text{end}) / 2 \rceil$$

15 algorithm OrderedListSearch (list, last, target, locn)

    ; if (target less than last element in list)  
    | find first element less than or equal to target  
    | set locn to index of element

2 else

    | set locn to last

3 end if

4 if (target in list)

    | set found to true

5 else

    | set found to false

6 end if

7 return found

end OrderedListSearch

16 មនុស្ស (Hashed Search) ដែលបានរាយការណ៍នាំឡើង  
ជាពេលវេលាដែលត្រូវបានបង្ហាញ នៅពេលដែលបានបង្ហាញ  
នៅក្នុងបញ្ជីទូទាត់ និងខ្លួនបានបង្ហាញ នៅពេលដែលបាន  
បង្ហាញ  $O(1)$

16 1. ឯក (key) ដែលបានបង្ហាញ នៅពេលដែលបានបង្ហាញ

2. អង្គត (Hash Function) ដែលបានបង្ហាញ នៅពេលដែលបានបង្ហាញ  
ឲ្យបានបង្ហាញ នៅពេលដែលបានបង្ហាញ នៅពេលដែលបានបង្ហាញ

3. មិនលើ (Hash Table) ដែលបានបង្ហាញ នៅពេលដែលបានបង្ហាញ

17 នៅពេលដែលបានបង្ហាញ នៅពេលដែលបានបង្ហាញ នៅពេលដែលបានបង្ហាញ  
នៅពេលដែលបានបង្ហាញ នៅពេលដែលបានបង្ហាញ នៅពេលដែលបានបង្ហាញ

Address = key MODULO listSize

18 Algorithm binarySearch (list, target, found)

1 set begin to 0

2 set end to last

3 loop (begin <= end)

4 set mid to (begin + end) / 2

5 if (target > list [mid])

6 set begin to [mid + 1]

7 else if (target < list [mid])

8 set end to [mid - 1]

9 else

10 set begin to (end + 1)

11 end if

12 end loop

13 set loc to mid

14 if (target equal list [mid])

15 set found to true

16 else

17 set found to false

18 end if

19 return found

end binarySearch

19 ຜົນປະຕິເມນີນກ່ຽວຂ້ອງດັບ ຂອງມູນຄຸນໄລ້ແລ້ວມີການຮູ້ຮັບຮູ້ ອີເມນີນ  
ຕົ້ນຕົ້ນ ອີເມນີນໃຫຍ່ກ່ຽວຂ້ອງດັບ ຂອງມູນຄຸນໄລ້ແລ້ວມີການຮູ້ຮັບຮູ້  
ກົດຕົກຕະຫຼາດຕົວຕະຫຼາດໄດ້ສຳເນົາ ແລ້ວສຳເນົາໄດ້

20 Linear Probe ປົນປະຕິເມນີນທີ່ມີການຮູ້ຮັບຮູ້ ແລ້ວມີການຮູ້ຮັບຮູ້  
ຮູ້ຮັບຮູ້ມີກຳນົດກຳນົດ ໃຊ້ການຮູ້ຮັບຮູ້ ມີການຮູ້ຮັບຮູ້  
ມີກຳນົດກຳນົດ ເພື່ອກຳນົດກຳນົດ ເພື່ອກຳນົດກຳນົດ

| Address | content | first digit | first digit |
|---------|---------|-------------|-------------|
| 1       | 4       | 1           | 1           |
| 2       | 6       | 5           | 5           |
| 3       | 6       | 7           | 7           |
| 4       | 13      | 1           | 1           |
| 5       | 14      | 1           | 1           |
| 6       | 17      | 1           | 1           |
| 7       | 20      | 1           | 1           |



Hash table

|       |     |                |
|-------|-----|----------------|
| [000] | 000 |                |
| [001] | 001 | Somesh         |
| [002] | 002 | Hanchal        |
| [003] |     |                |
| [004] |     |                |
| [005] | 005 | Panida         |
| [006] |     |                |
| [007] | 007 | Ananya         |
| [008] |     |                |
| [009] |     |                |
| [099] |     |                |
| [100] | 100 | Kavya (Kavita) |

Address      ↓

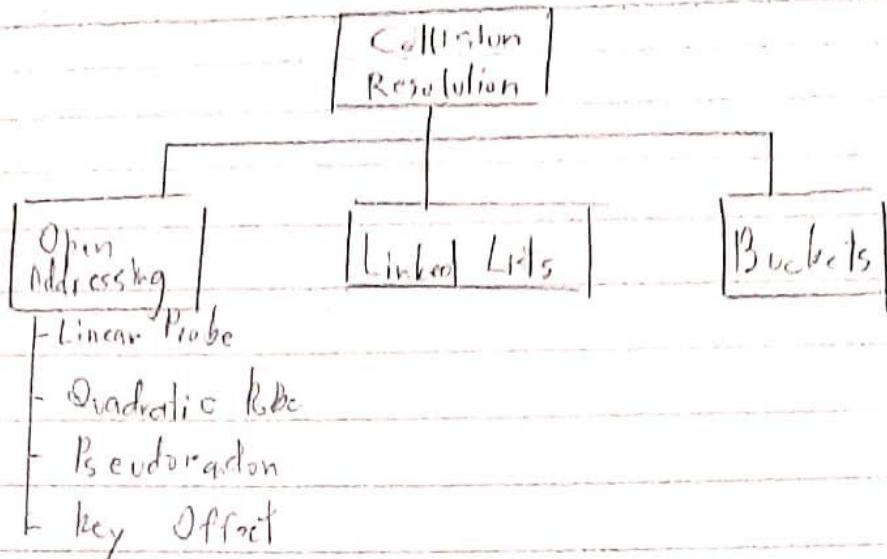
102002 → Hash → 5 → [005] 005 Panida

109096 → Function → 100 → [009]      ↓

111060 →                  ↓      2 → [002] 002 Hanchal

key

23



24 ໃນເກີດໄຫວ້ານັກປະໂຫຍດໄຫວ້າສິນດີວິທີມີຄວາມກຳຈຳຕະຫຼາດໃຫຍ່ພົບພະນັກງານ  
ແລ້ວເພີ້ມຕາມຕາມກົມພາບພື້ນຖານດູດ ໄດ້ເພີ້ມຕົວອະນຸມັດນີ້ດີ່ຈະ  
ມີຄວາມເປັນດີຂອງກາແນ່ງທ່ານດີ່ຈະໄດ້ຮັບຮັບຈິງ

25 ຕ້ອງກົດໃນເປົ້າການໃຫ້ໄລ້ "IP address" ຂັ້ນເວັບໄຊເວັບໄຊ ດ້ວຍ  
ມີກົດຕົວຢ່າງເຊີ້ນຢ່າງເຊີ້ນ ທີ່ມີກົດຕົວຢ່າງເຊີ້ນຢ່າງເຊີ້ນ  
ໃນຈຸດປະເທດໄປສັ່ນໄປສັ່ນ

26 ອະນຸມັດໄຫວ້ານັກປະໂຫຍດໄຫວ້າໄດ້ມີຄວາມກຳຈຳຕະຫຼາດໃຫຍ່ພົບພະນັກງານ  
ທີ່ມີກົດຕົວຢ່າງເຊີ້ນຢ່າງເຊີ້ນ ປຶ້ມັນ (Prime & odd) ຖໍ່ມີກົດຕົວຢ່າງເຊີ້ນ  
ທີ່ມີກົດຕົວຢ່າງເຊີ້ນ ສີ ດັວວິໂລ ໄຫວ້າ Address Tiling ປຶ້ມັນ (over flow)

27 ເສັ້ນໄຫວ້າມີຫຼັບ Bucket ກັບມີກົດຕົວຢ່າງເຊີ້ນຢ່າງເຊີ້ນ ທີ່ມີກົດຕົວຢ່າງເຊີ້ນ  
ທີ່ມີກົດຕົວຢ່າງເຊີ້ນຢ່າງເຊີ້ນ ທີ່ມີກົດຕົວຢ່າງເຊີ້ນຢ່າງເຊີ້ນ ທີ່ມີກົດຕົວຢ່າງເຊີ້ນຢ່າງເຊີ້ນ  
ທີ່ມີກົດຕົວຢ່າງເຊີ້ນຢ່າງເຊີ້ນ ທີ່ມີກົດຕົວຢ່າງເຊີ້ນຢ່າງເຊີ້ນ ທີ່ມີກົດຕົວຢ່າງເຊີ້ນຢ່າງເຊີ້ນ

28 ພົບພະນັກງານມີຄວາມກຳຈຳຕະຫຼາດໃຫຍ່ພົບພະນັກງານ ສົມ ອ(ນ)  
ພົບພະນັກງານມີຄວາມກຳຈຳຕະຫຼາດໃຫຍ່ພົບພະນັກງານ ສົມ ອ(log n)  
ພົບພະນັກງານມີຄວາມກຳຈຳຕະຫຼາດໃຫຍ່ພົບພະນັກງານ ສົມ ອ(1)

29 இலுச் begin இரண்டாவதுபிரிவைக்க

இலுச் mid இரண்டாவதுபிரிவைக்க

இலுச் end இரண்டாவதுபிரிவைக்க

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$$121267 \div 107 = 2$$

$$\therefore \text{Hash}(121267) = 2$$