Assignment 7

Course name: Data Structures
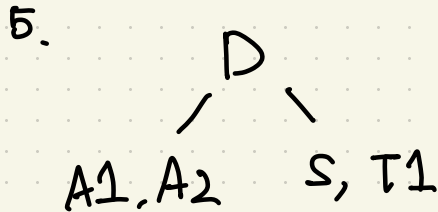Course id: 14461002
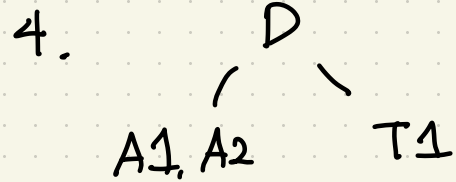
Student id: 2020337762
Student name: 장민호
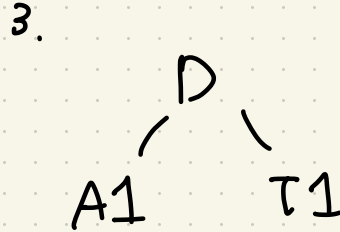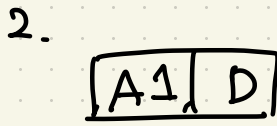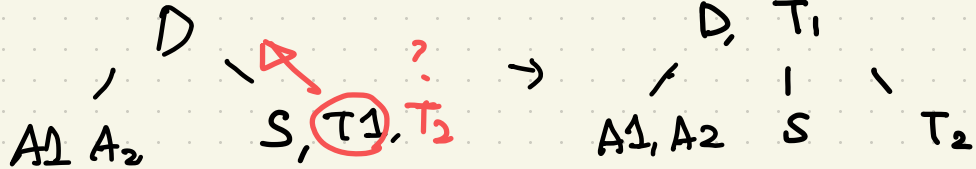Student major: 설비소방공학과
submission date: 2022. 04. 09

HW 7-1

keys : D, A1, T1, A2, S, T2, R1, U1, C, T3, U2, R2, E

1.
| D | |

2.
| A1 | D |

3.

        D
       /   \
     A1   T1

4.
           D
          /   \
      A1, A2   T1

5.
          D
         /   \
     A1, A2   S, T1

6. Insert T_2

          D
         /   \
     A1 A2   S, T1, T2   →
                              D, T1
                             / | \
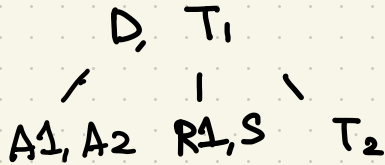   A1, A2 S   T2

keys : D, A1, T1, A2, S, T2, <mark>R1, U1, C,</mark> T3, U2, R2, E
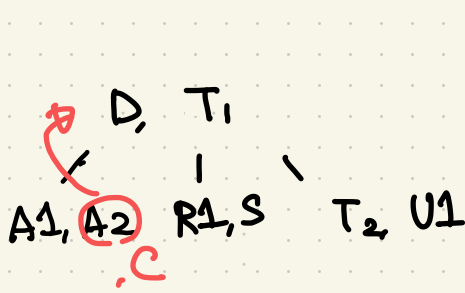
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7. Insert R1

```
        D, T1
      /   |    \
A1, A2  R1,S    T2
```

8. Insert U1

```
        D, T1
      /   |    \
A1, A2  R1,S    T2, U1
```

9. Insert C

```
        D, T1
      /   |    \
A1, A2  R1,S    T2, U1
   C
```

```
     A2  D  T1
     /  \?  |    \
A1, C   R1,S    T2, U1
```

```
         D
       /    \
     A2      T1
    /  \    /   \
  A1    C  R1,S  T2, U1
```
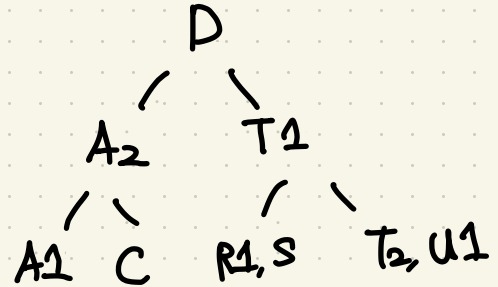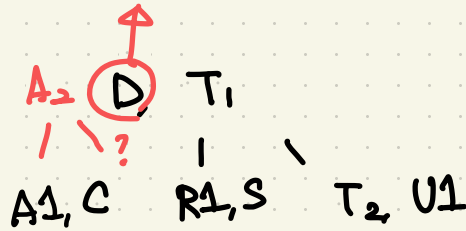
keys : D, A1, T1, A2, S, T2, R1, U1, C, T3, U2, R2, E

10. Insert T3

```
        D
      /   \
    A2     T1
   / \      /
  A1  C  R1,S   T2,U1  (T3)
```
→
```
         D
       /   \
      A2    T1 , T3
     / \    /  |  \
   A1  C  R1,S  T2  U1
```

11. Insert U2

```
         D
       /   \
      A2    T1 , T3
     / \    /  |  \
   A1  C  R1,S  T2  U1,U2
```

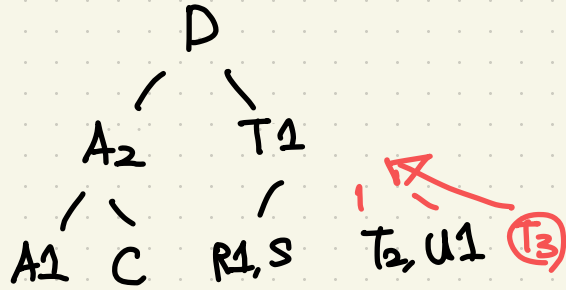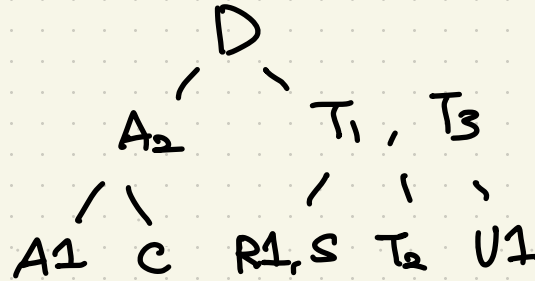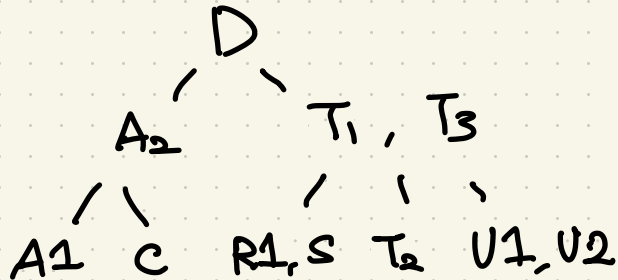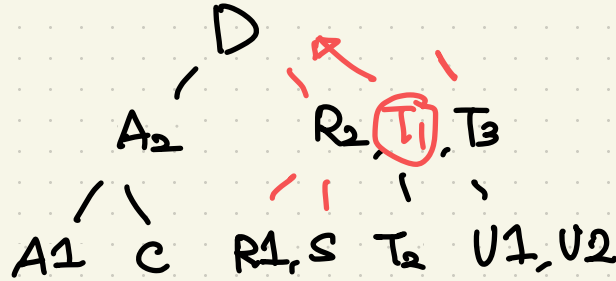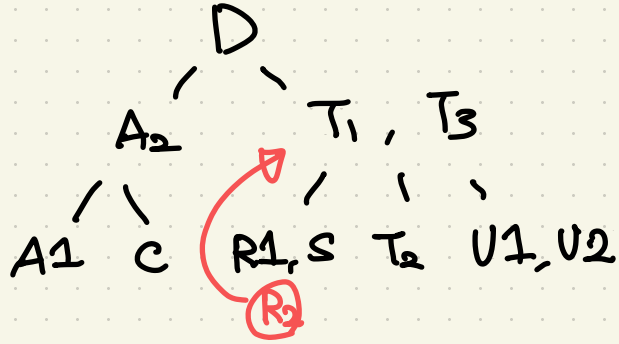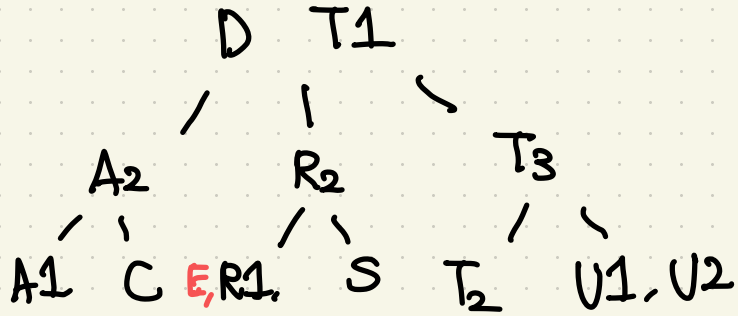keys : D, A1, T1, A2, S, T2, R1, U1, C, T3, U2, R2, E

12. Insert R2

13. Insert E

D T1
  / | \
 A₂ R₂   T₃
/ \ / \ / \
A1 C E,R1. S T₂ U1,U2

→

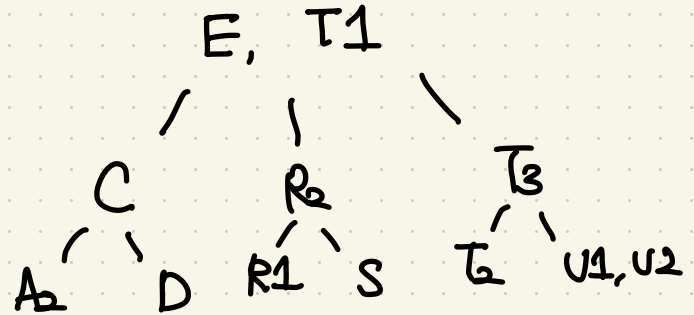D T1
  / | \
 A₂ R₂   T₃
/ \ / \ / \
A1 C E,R1 S T₂ U1,U2
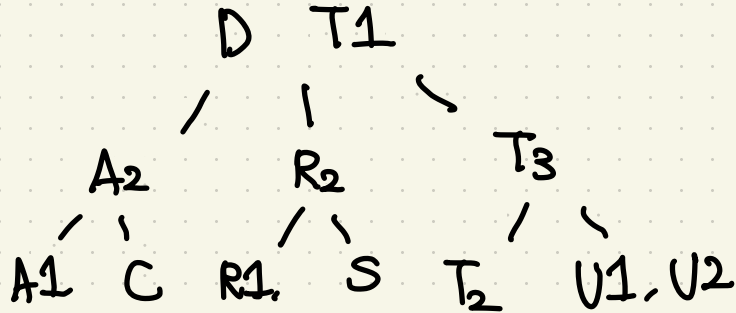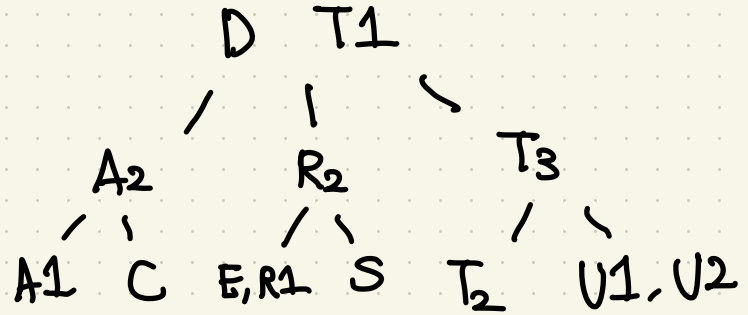
Delete!

keys: A1, T1, T2, T3

---

1. Delete A1.

D   T1

A2

~~A1~~   C   E, R1   S   T3

R2   T3

T2   U1, U2

→

E, T1

C   R2   T3

A2   D   R1   S   T2   U1, U2

2. Delete T1

E, ~~T1~~

C
A₂   D
R₂
R1   S
T₂
T₂   U1 U2

→

E, T₂

C
A₂   D
R₂
R1   S
U1
T₃   U2

3. Delete T₂

E, ~~T₂~~   merge!

C
A₂ D
R₂
R1   S
U1
T₃   U2

→

E

C
A₂   D
R₂, U1
R1 S. T₃   U2

4. Delete T3

Left tree:
```
          E
        /   \
      C       R2, U1
     / \      /  |  \
   A2   D   R1  S.T3  U2
```

Right tree:
```
          E
        /   \
      C       R2, U1
     / \      /  |  \
   A2   D   R1   S   U2
```
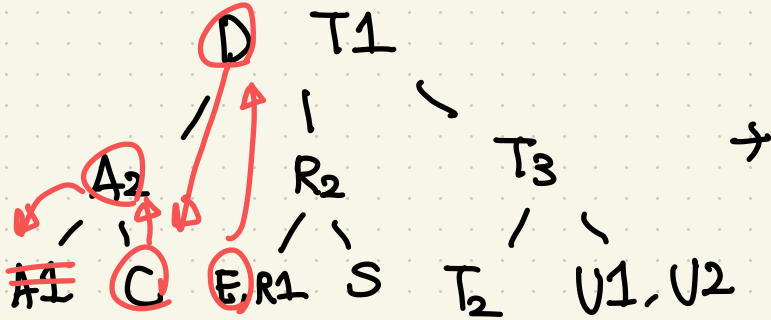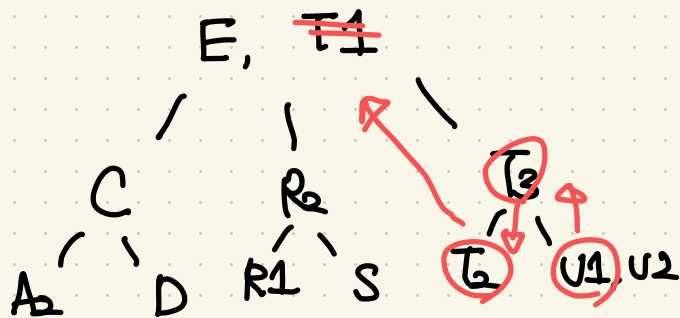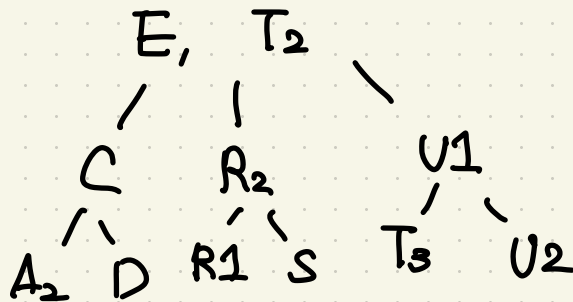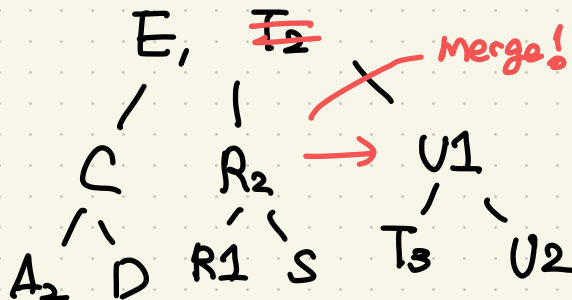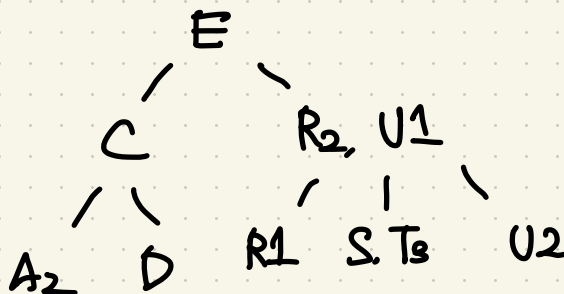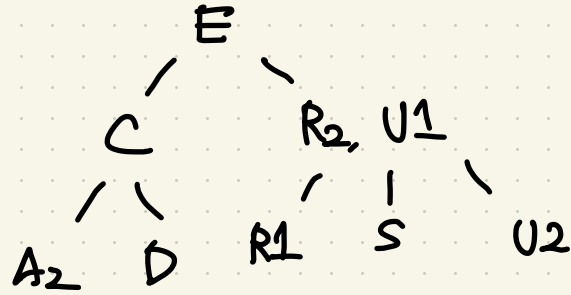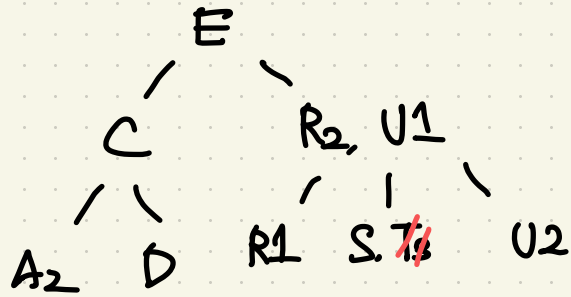
HW 7-2) Insert!

keys: 20, 80, 60. 40, 15, 25, 30, 35 .   N=2

---

1. Insert 20

| 20 | | | |

2. Insert 80

| 20 | 80 | | |

3. Insert 60

| 20 | 60 | 80 | |

4. Insert 40

| 20 | 40 | 60 | 80 |

5. Insert 15

15 | 20 | 40 | 60 | 80 | → | 40 | 60 | 80 | |

| 15 | 20 | | |

6. Insert 25

| 40 | 60 | 80 | |

| 15 | 20 | 25 | |

7. Insert 30

| 40 | 60 | 80 | |

| 15 | 20 | 25 | 30 |

8. Insert 35

| 40 | 60 | 80 | |

| 15 | 20 | 25 | 30 | 35

bf=2

| 40 | 60 | 80 | |

| 15 | 20 | 25 | |

| 20 | 35 | | |

rotate!

| 30 | 35 | | |

| 15 | 20 | 25 | | | 40 | 60 | 80 | |
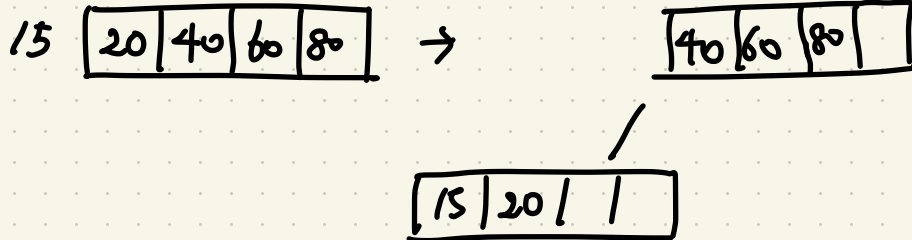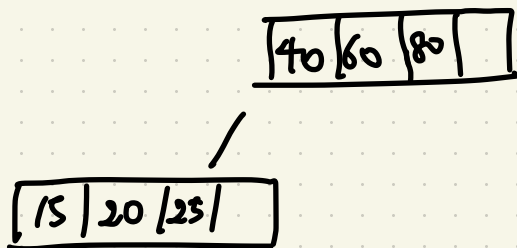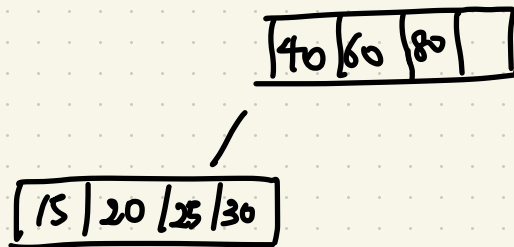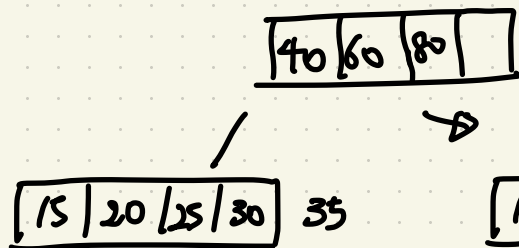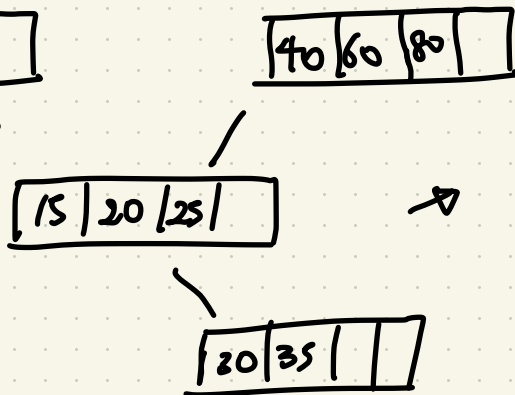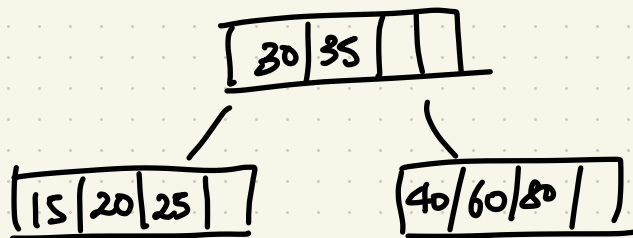
Delete!

keys : 20, 35, 60, 80

---

1. delete 20

```
        | 30 | 35 |  |  |
       /                \
| 15 | 20̶ | 25 |  |      | 40 | 60 | 80 |  |
```

2. delete 35

```
        | 30 | 3̶5̶ |  |  |
       /                \
| 15 | 25 |  |  |      ( 40 | 60 | 80 |  )
                              |
                              ↓
              | 30 | 40 |  |  |
             /                \
     | 15 | 25 |  |  |      | 60 | 80 |  |  |
```

3. delete 60

| 30 | 40 | | |

| 15 | 25 | | |

| ~~60~~ 80 | | |

→

| 30 | 40 | 80 | |

| 15 | 25 | | |

4. delete 80

| 30 | 40 | ~~80~~ | |

| 15 | 25 | | |

→

| 30 | 40 | | |

| 15 | 25 | | |