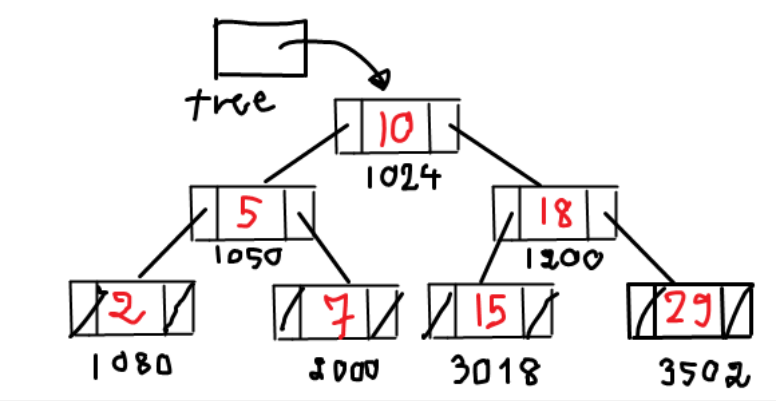
ทบทวน

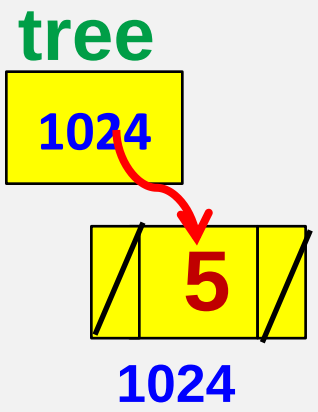
1. นิยามโครงสร้างต้นไม้
2. วิธีการ insert ของ Binary Search Tree :
   - BigO
3. การ print
   - Preorder
   - Inorder
   - Postorder



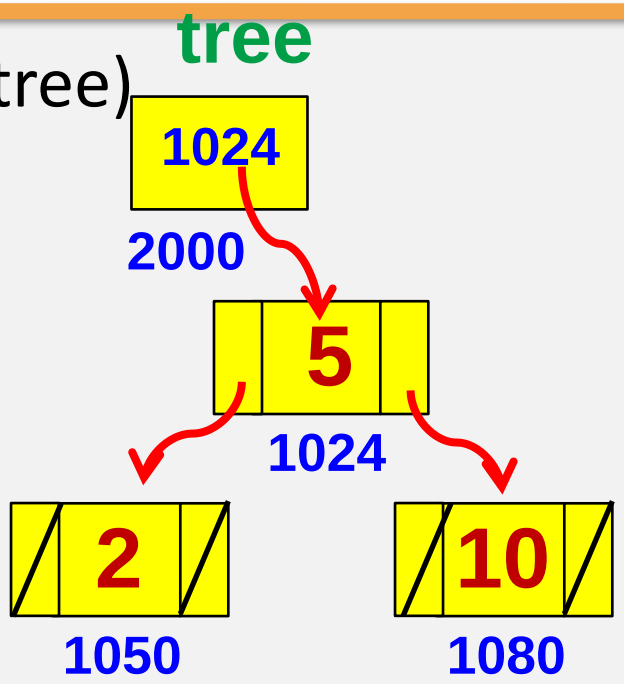
เนื้อหา

1. การ findmin
2. Delete Tree :
   - ไม่มีลูก
   - ลูก 1 ด้าน
   - ลูก 2 ด้าน
3. Expression Trees

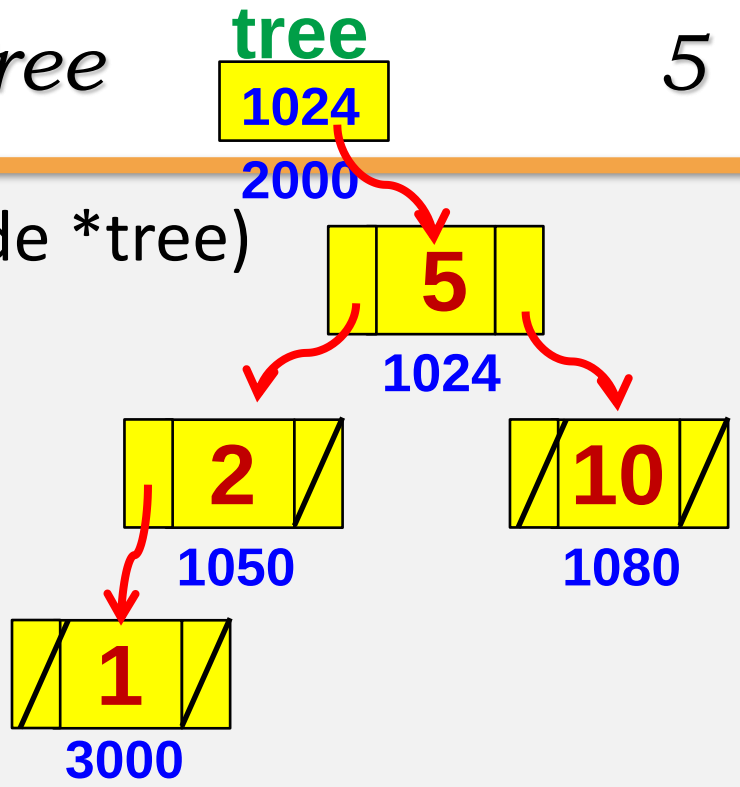
```
   struct node *find_min(struct node *tree)
1  {     if(tree==NULL)
2              return NULL;
3        else
4              if( tree->left == NULL )
5                    return tree;
6              else
7                    return (find_min(tree->left));
   }
```



```
   struct node *find_min(struct node *tree)
1  {     if(tree==NULL)
2              return NULL;
3        else
4              if( tree->left == NULL )
5                    return tree;
6              else
7                    return (find_min(tree->left));
   }
```



```
   struct node *find_min(struct node *tree)
1  {     if(tree==NULL)
2              return NULL;
3        else
4              if( tree->left == NULL )
5                    return tree;
6              else
7                    return (find_min(tree->left));
   }
```



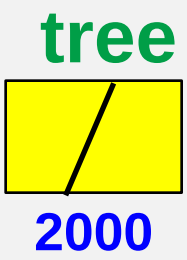
Big O ของการ find min

Delete

1. No Child :
2. One Child :
   - นำลูกที่เหลือมาแทนโหนดที่ถูกลบ
3. Two Childs :
   - นำลูกด้านขวาที่มีค่าน้อยที่สุดมาแทนโหนดที่ถูกลบ

Delete

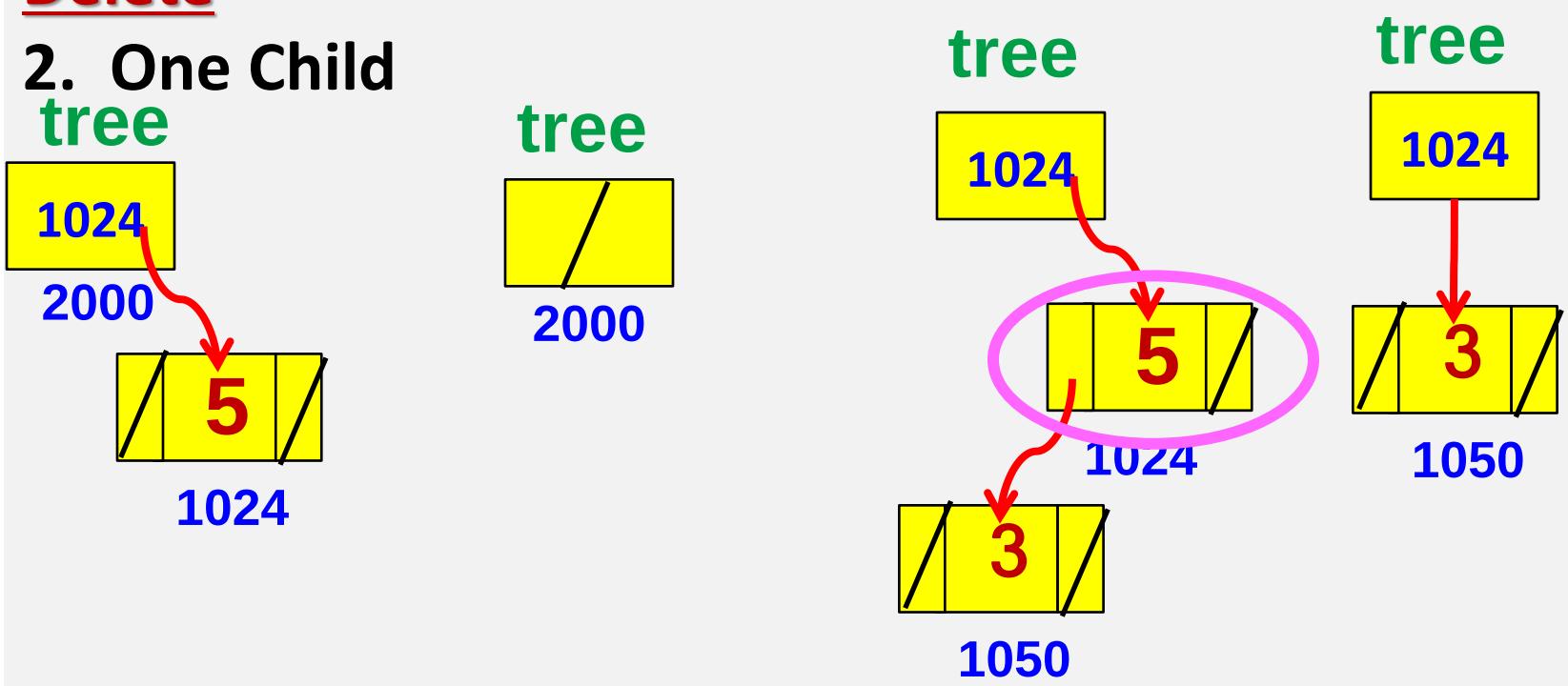
1. No Child

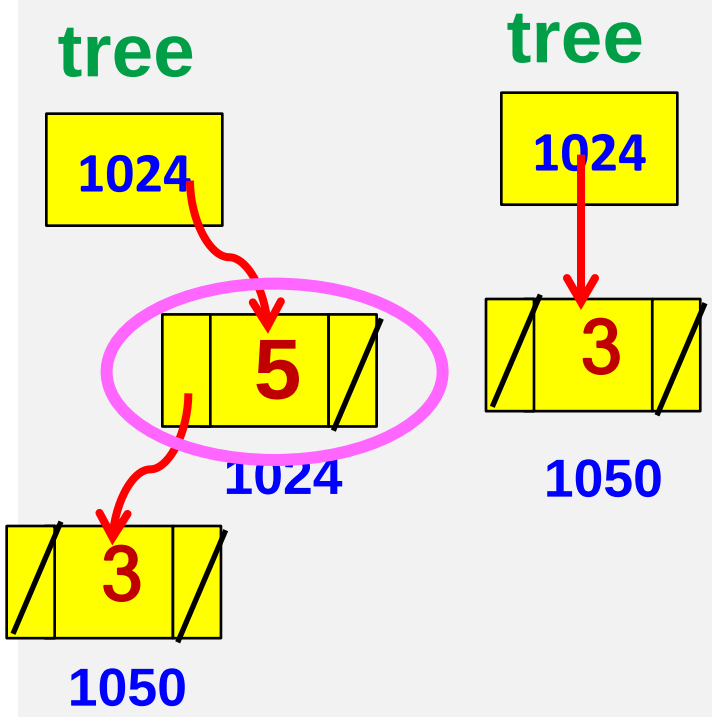



```
if (tree==NULL)
    cout << “No node”;
return tree;
```

Delete

2. One Child



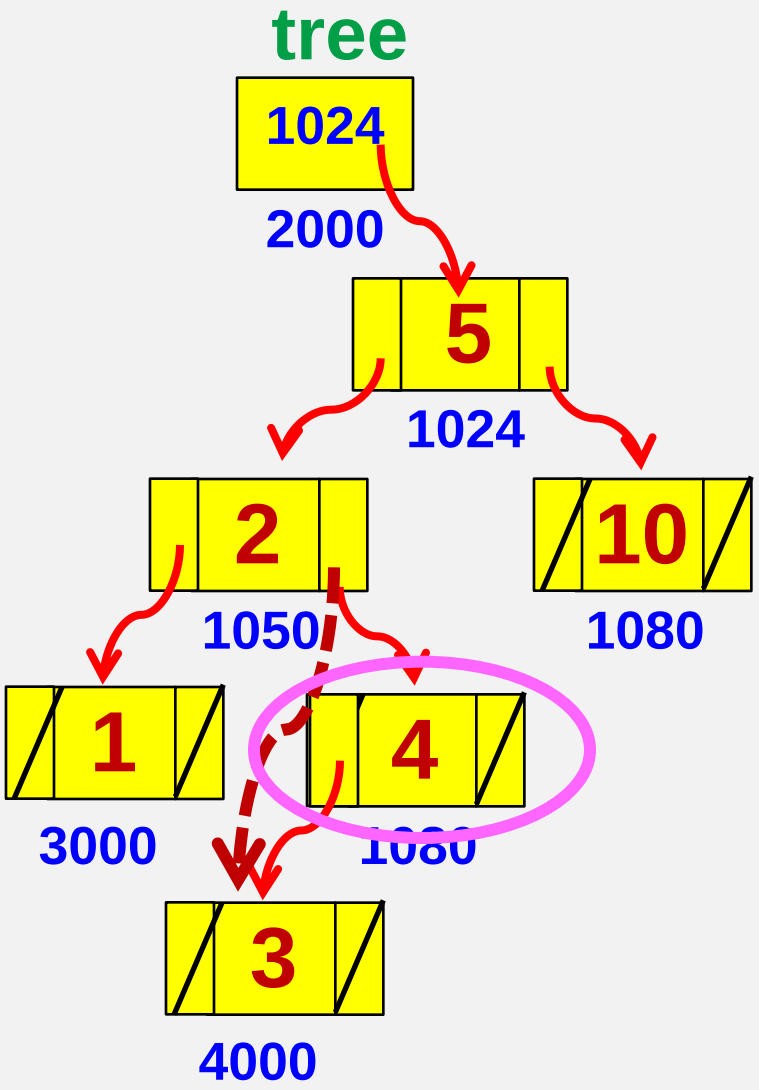



```
tmpcell=tree;
if( tree->left == NULL )
        child = tree->right;
if(tree->right ==NULL)
         child = tree->left;
delete(tmpcell);

return child;
```

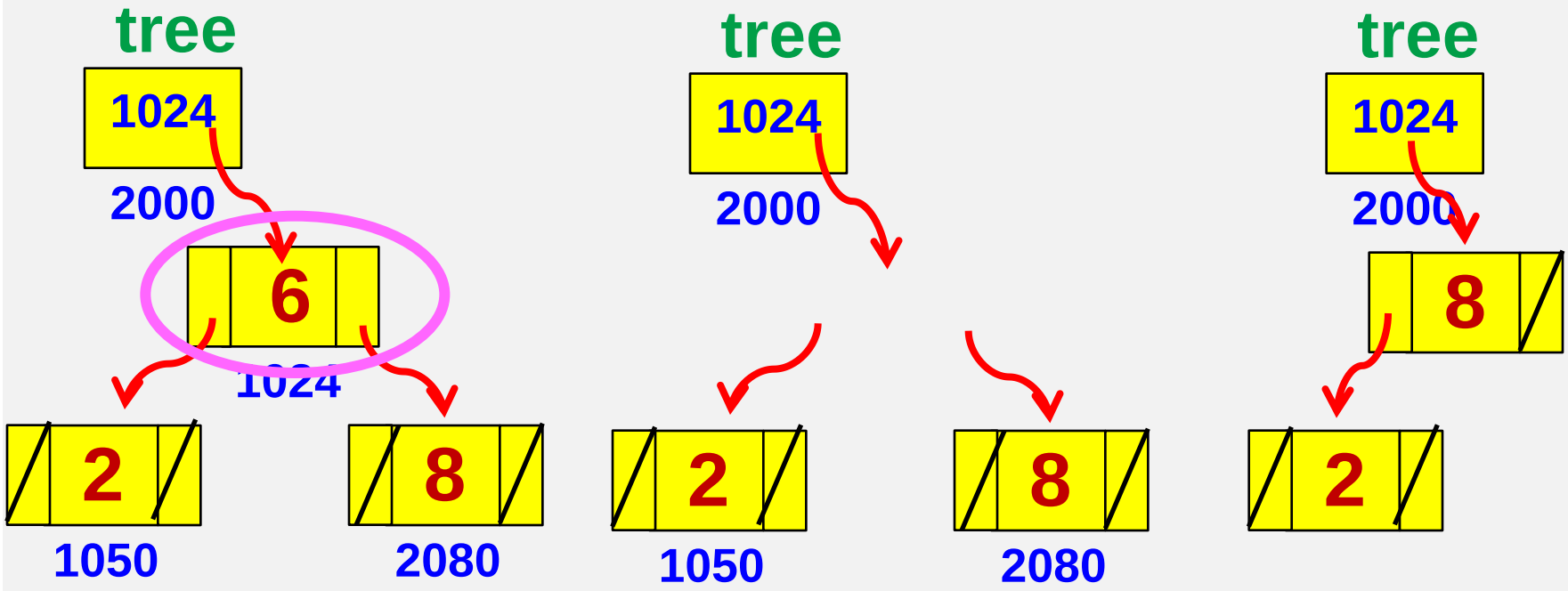
Delete

2. One Child



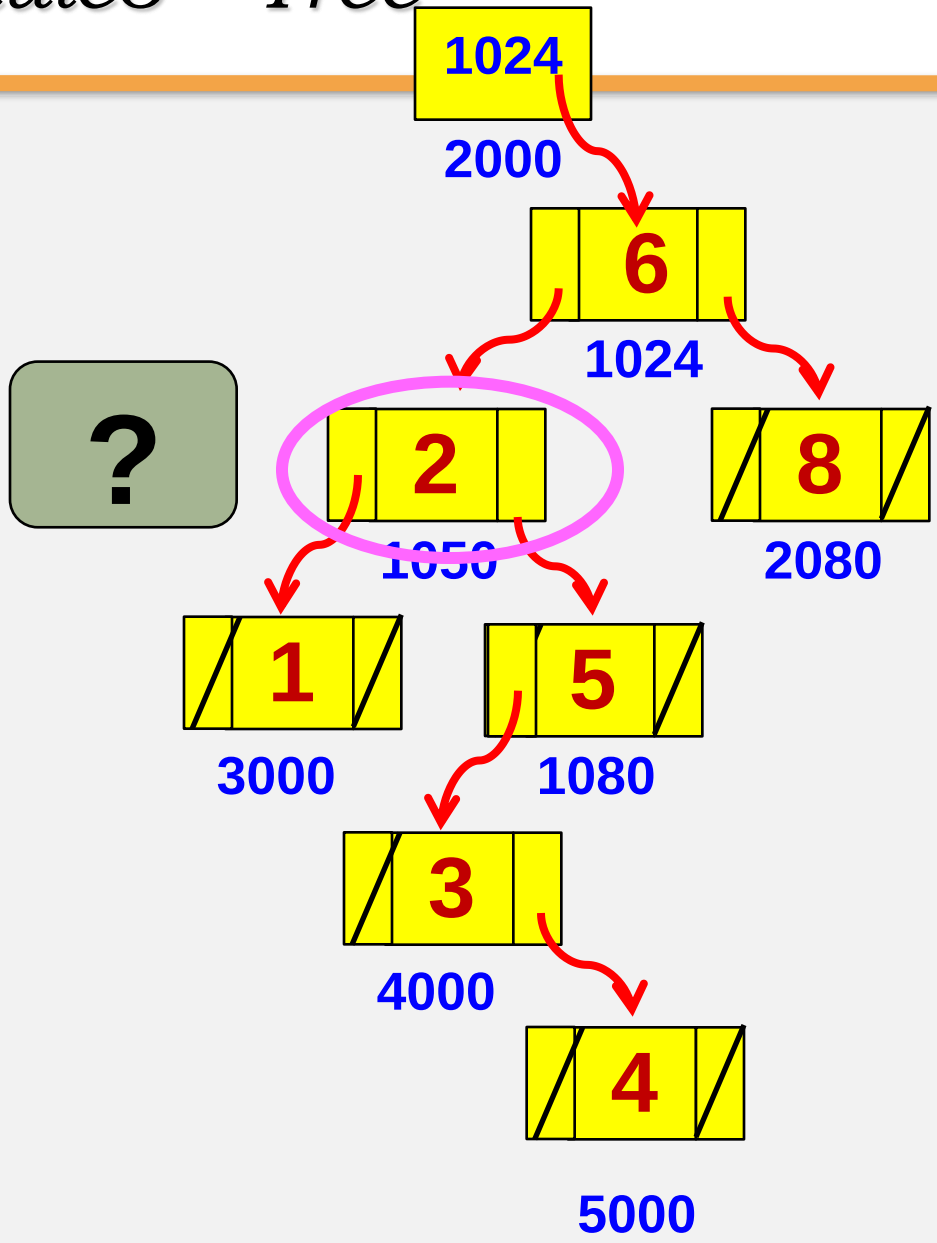
Delete

3. 2 Childs



Delete

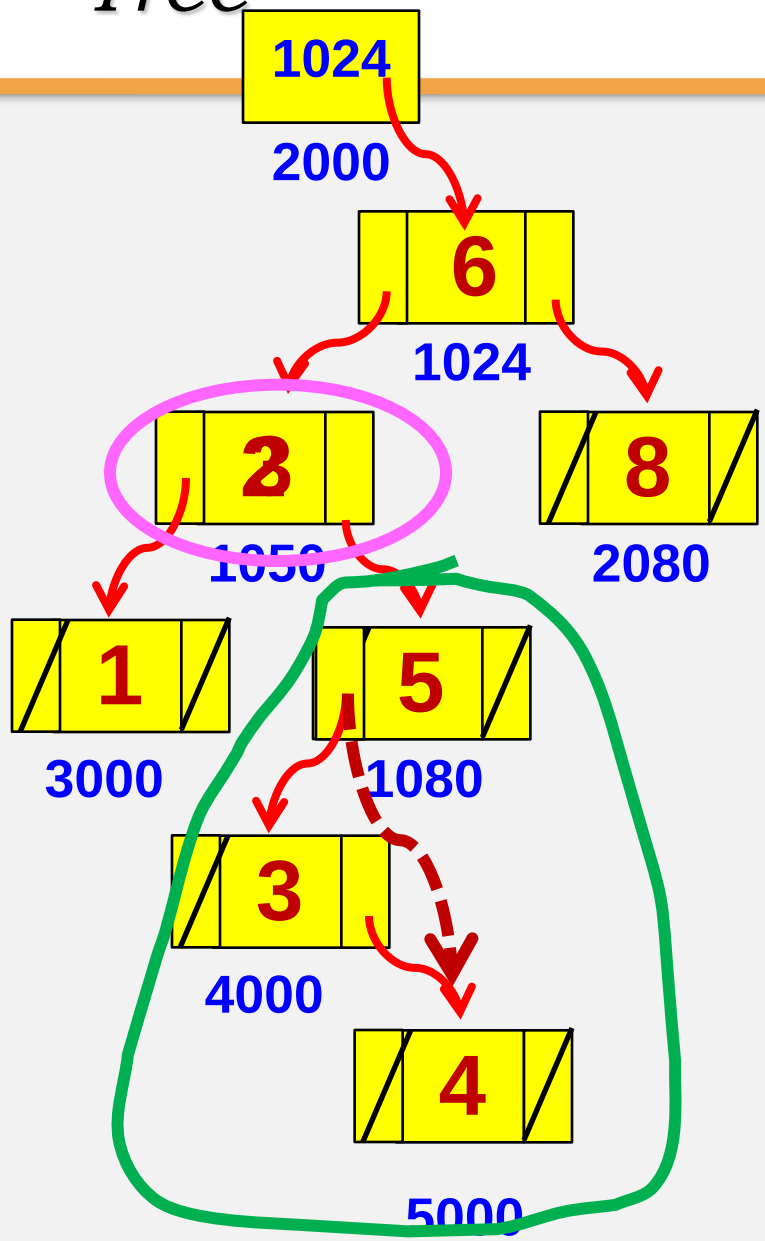
3. 2 Childs



Delete

3. 2 Childs

- นำลูกทีเป็น Min right subtree มาแทนที่
- recursive delete

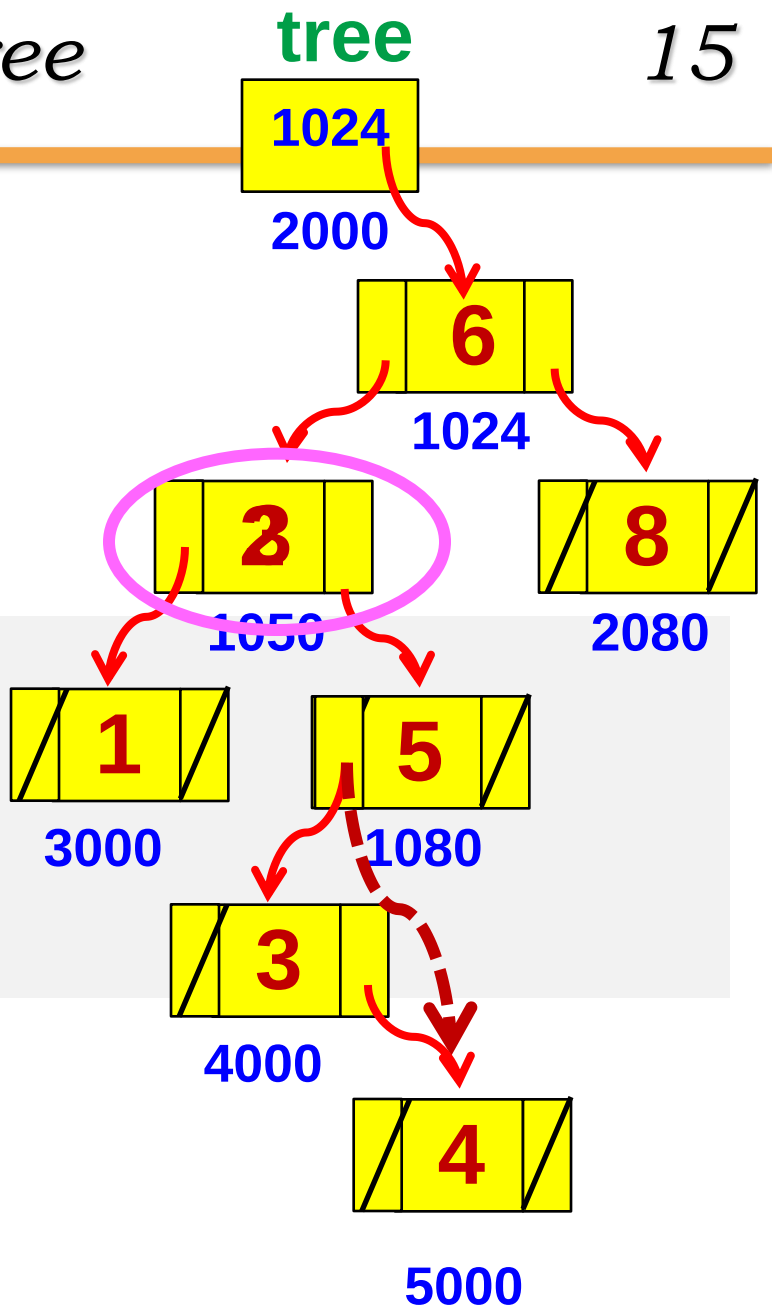


Delete

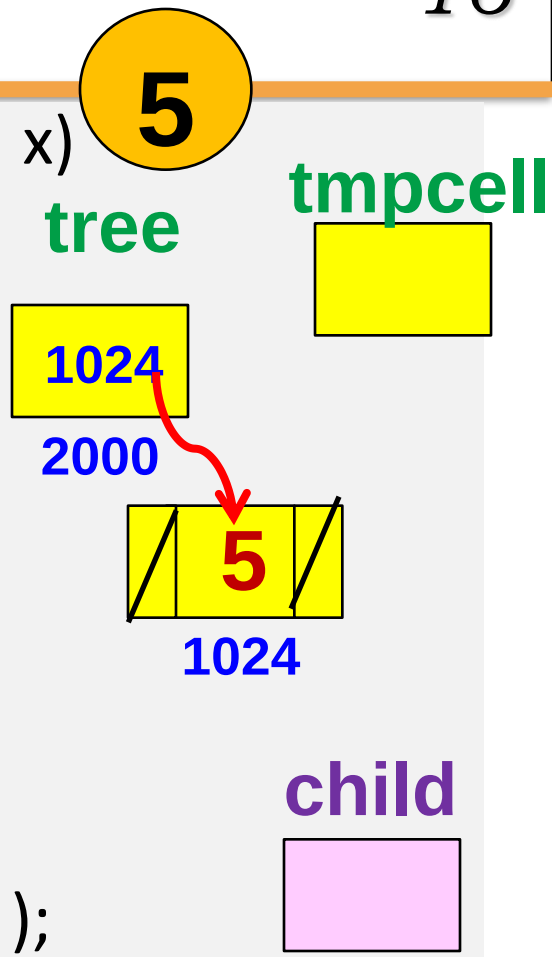
3. 2 Childs

- นำลูกทีเป็น Min right subtree มาแทนที่

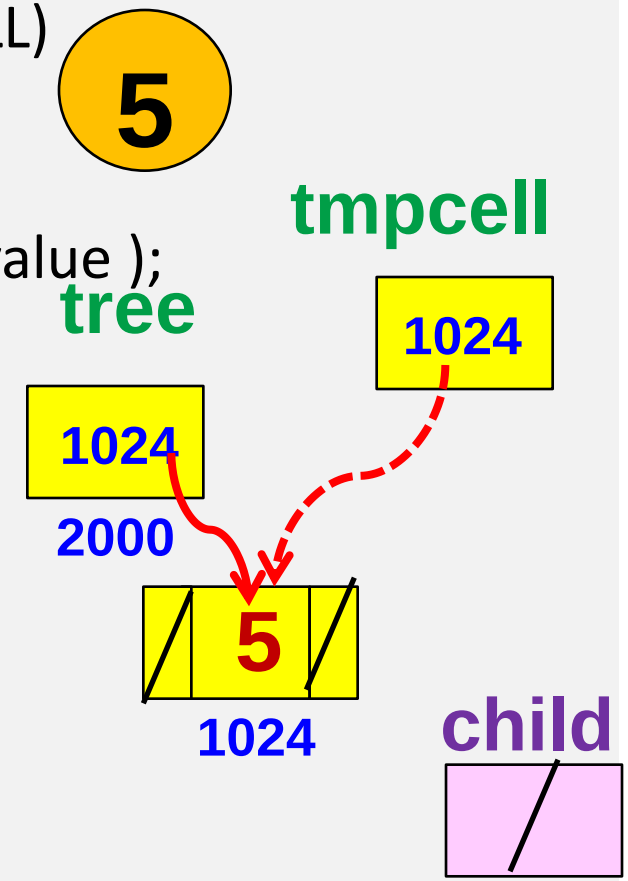
```
tmpcell=find_min(tree->right);
tree->value = tmpcell->value;
tree->right =
    dTree(tree->right,tree->value );
```



```
1   struct node *dTree(struct node *tree,int  x)
2   {   struct node *tmpcell, *child;
3      if ( tree==NULL)
4            printf("No Node\n");
5      else
6      {   if( x < tree->value)
7            tree->left = dTree(tree->left, x);
8        else
9            if( x > tree->value)
10               tree->right=dTree(tree->right,x );
11           else
12               if( tree->left !=NULL&& tree->right!=NULL)
```



```
12  if( tree->left !=NULL&& tree->right!=NULL)
13  {   tmpcell=find_min(tree->right);
14      tree->value = tmpcell->value;
15      tree->right = dTree(tree->right,tree->value );
     }
    else
18   {    tmpcell=tree;
19        if( tree->left == NULL )
20              child = tree->right;
21        if(tree->right ==NULL)
22              child = tree->left;
23        delete(tmpcell);
24        return child;
      }
    } /* end else tree is not NULL */
27   return tree;
    } /* end function */
```



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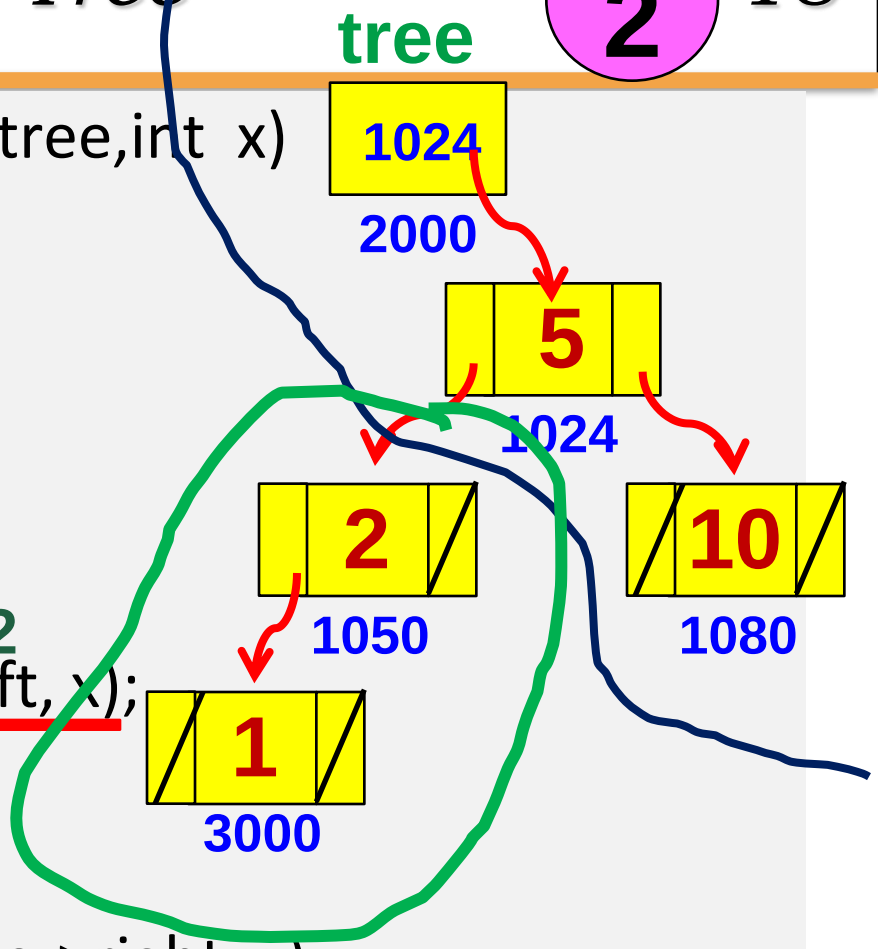
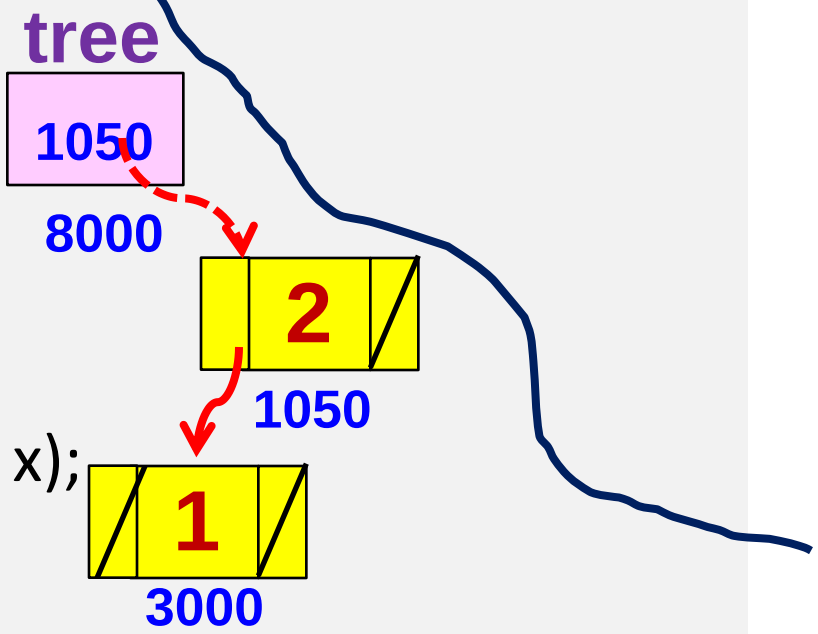
2  {   struct node *tmpcell, *child;
3       if ( tree==NULL)
4            printf("No Node\n");
5       else
6      {   if( x < tree->value)
7              tree->left = dTree(tree->left, x);
8            else
9                if( x > tree->value)
10                    tree->right=dTree(tree->right,x );
11               else
12                    if( tree->left!=NULL && tree->right !=NULL )
```



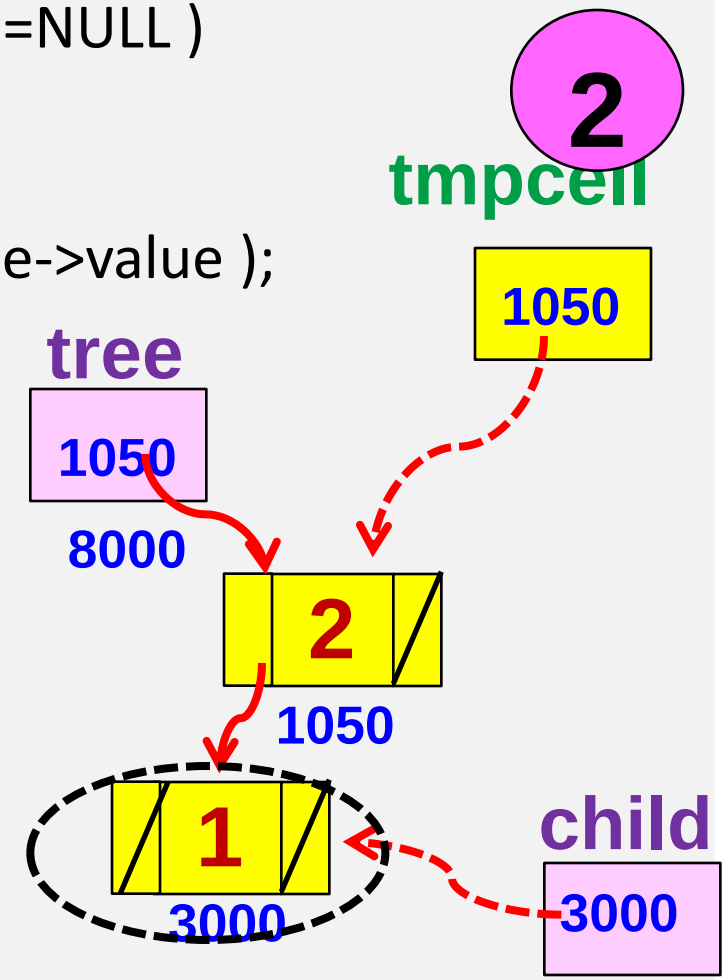
Recursiveครั้งที่1 1050 2

2

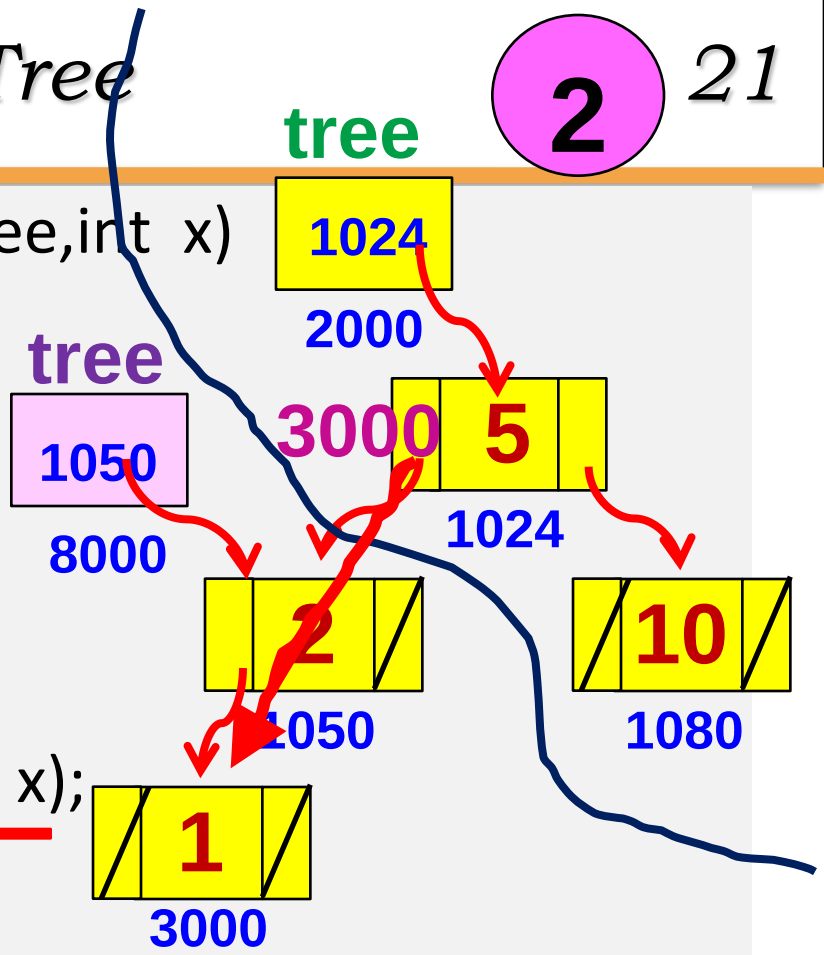
```
1  struct node *dTree(struct node *tree,int  x)
2  {   struct node *tmpcell, *child;
3       if ( tree==NULL)
4            printf("No Node\n");
5       else
6      {   if( x < tree->value)
7             tree->left = dTree(tree->left, x);
8            else
9               if( x > tree->value)
10                   tree->right=dTree(tree->right,x );
11              else
12                   if( tree->left !=NULL && tree->right !=NULL)
```

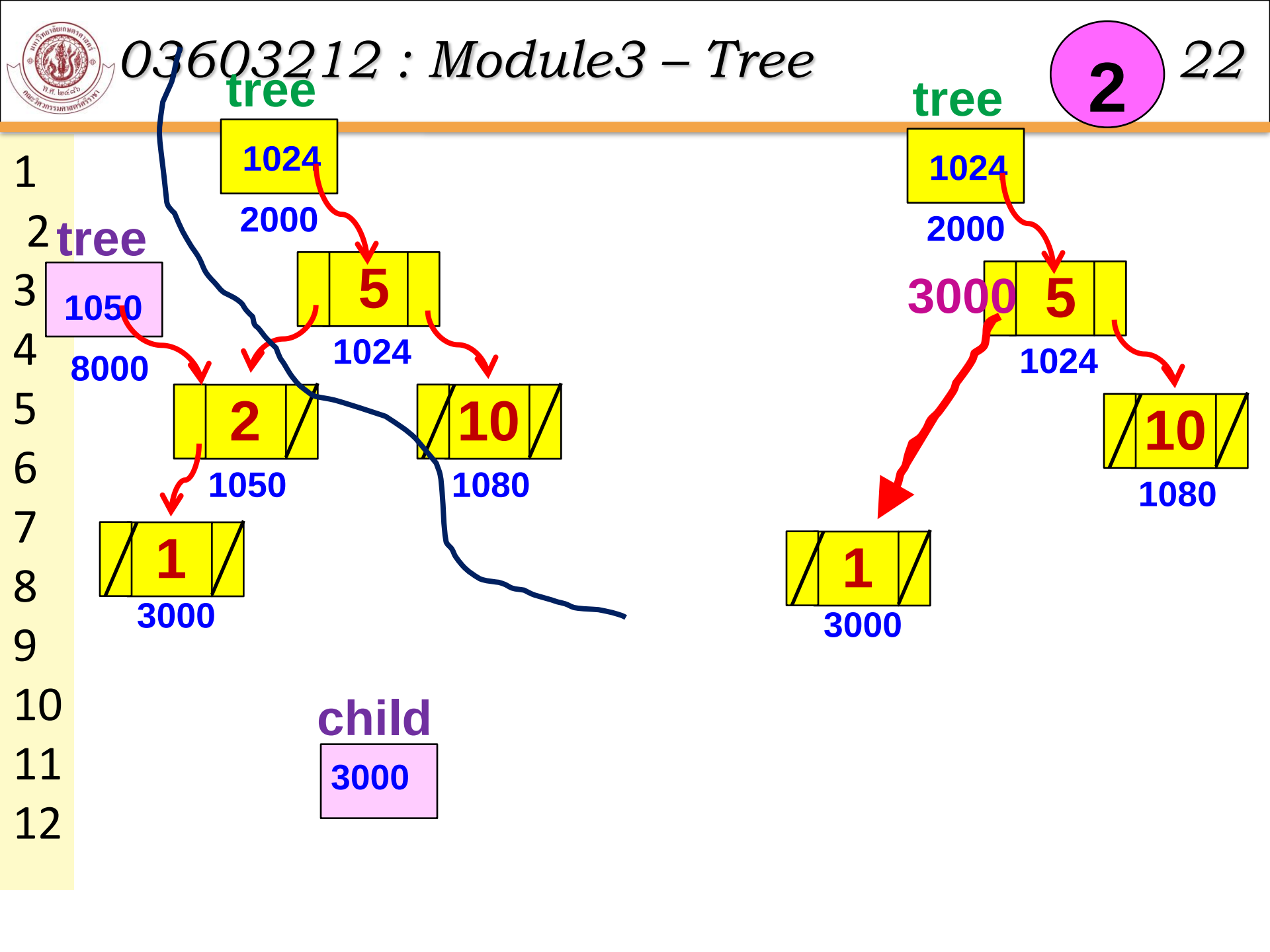


```
12  if( tree->left !=NULL && tree->right !=NULL )
13  {   tmpcell=find_min(tree->right);
14      tree->value = tmpcell->value;
15      tree->right = dTree(tree->right,tree->value );
    }
    else
18  {    tmpcell=tree;
19       if( tree->left == NULL )
20             child = tree->right;
21       if(tree->right ==NULL)
22             child = tree->left;
23       delete(tmpcell);
24       return child;
     }
    } /* end else tree is not NULL */
27  return tree;
    } /* end function */
```



```
1  struct node *dTree(struct node *tree,int  x)
2  {   struct node *tmpcell, *child;
3       if ( tree==NULL)
4            printf("No Node\n");
5       else
6      {   if( x < tree->value)
7              tree->left = dTree(tree->left, x);
8            else
9                if( x > tree->value)
10                    tree->right=dTree(tree->right,x );
11               else
12                    if( tree->left !=NULL && tree->right !=NULL )
```




tree
1024
2000
tree
1050
8000
5
1024
2
1050
10
1080
1
3000
child
3000
tree
1024
2000
3000
5
1024
10
1080
1
3000

```
1  struct node *dTree(struct node *tree,int  x)
2  {   struct node *tmpcell, *child;
3       if ( tree==NULL)
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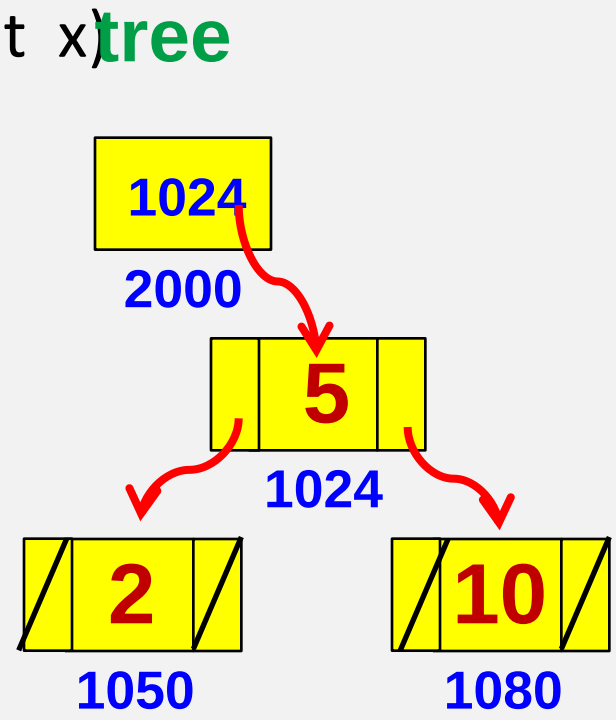
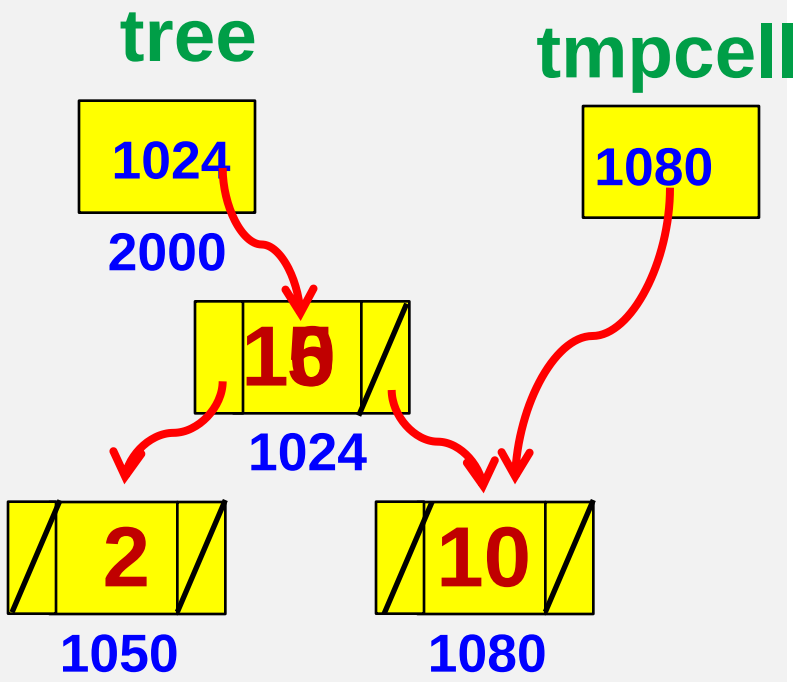
5       else
6      {   if( x < tree->value)
7             tree->left = dTree(tree->left, x);
8            else
9               if( x > tree->value)
10                   tree->right=dTree(tree->right,x );
11              else
12                   if( tree->left !=NULL && tree->right !=NULL )
```



```
12  if( tree->left && tree->right)
13  {   tmpcell=find_min(tree->right);
14      tree->value = tmpcell->value;
15      tree->right = dTree(tree->right,tree->value );
     }
    else
18   {    tmpcell=tree;
19        if( tree->left == NULL )
20              child = tree->right;
21        if(tree->right ==NULL)
22              child = tree->left;
23        delete(tmpcell);
24        return child;
     }
    } /* end else tree is not NULL */
27   return tree;
    } /* end function */
```

5

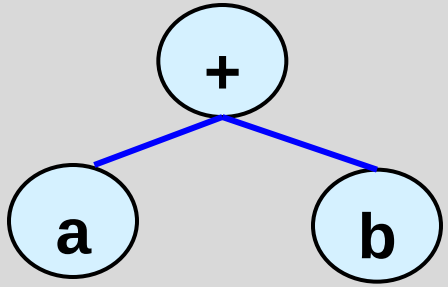


Application

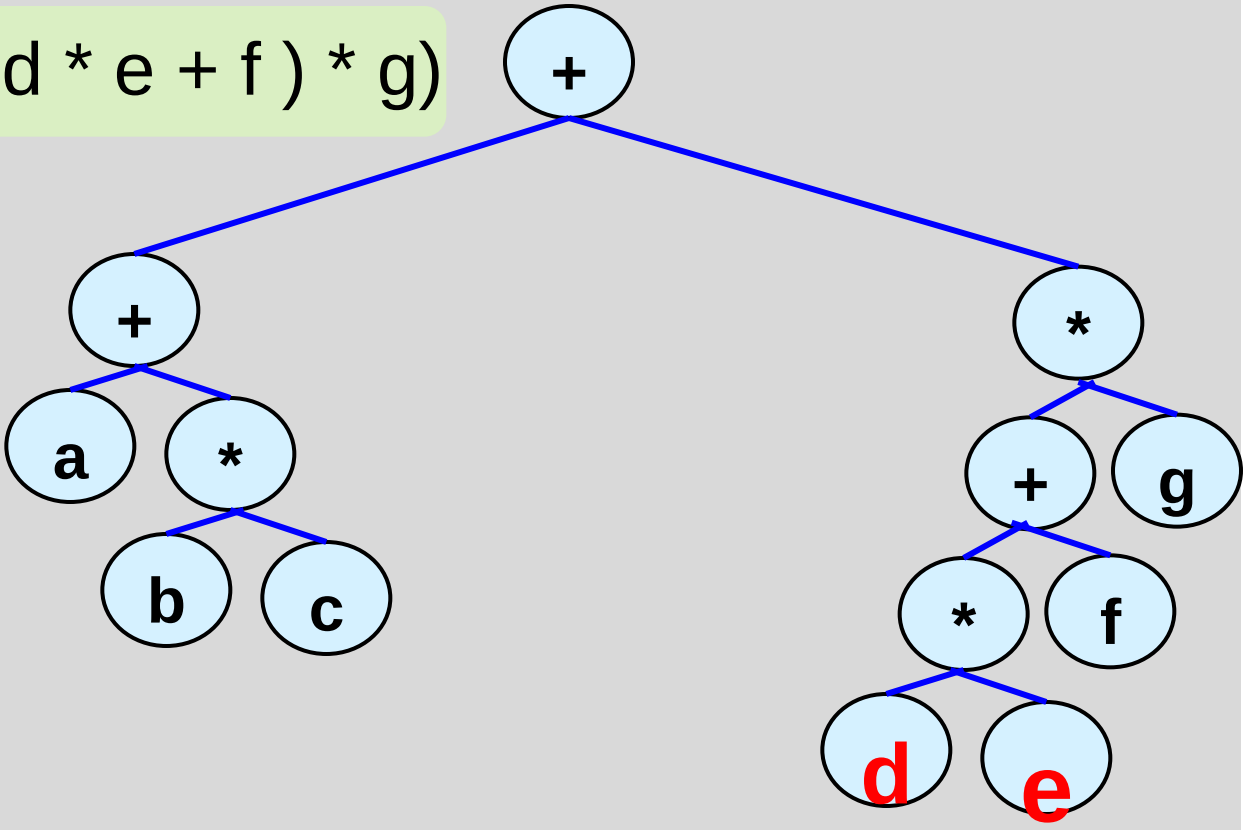
Expression Tree

- Leaves are operand
- Nonleaves are operator

a + b

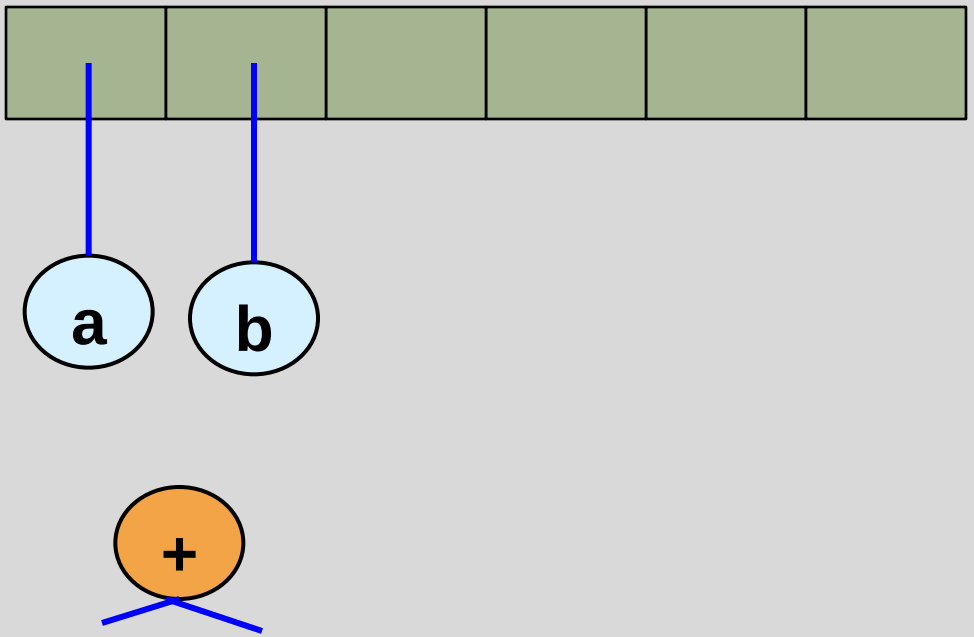


(a + b * c) + ((d * e + f) * g)

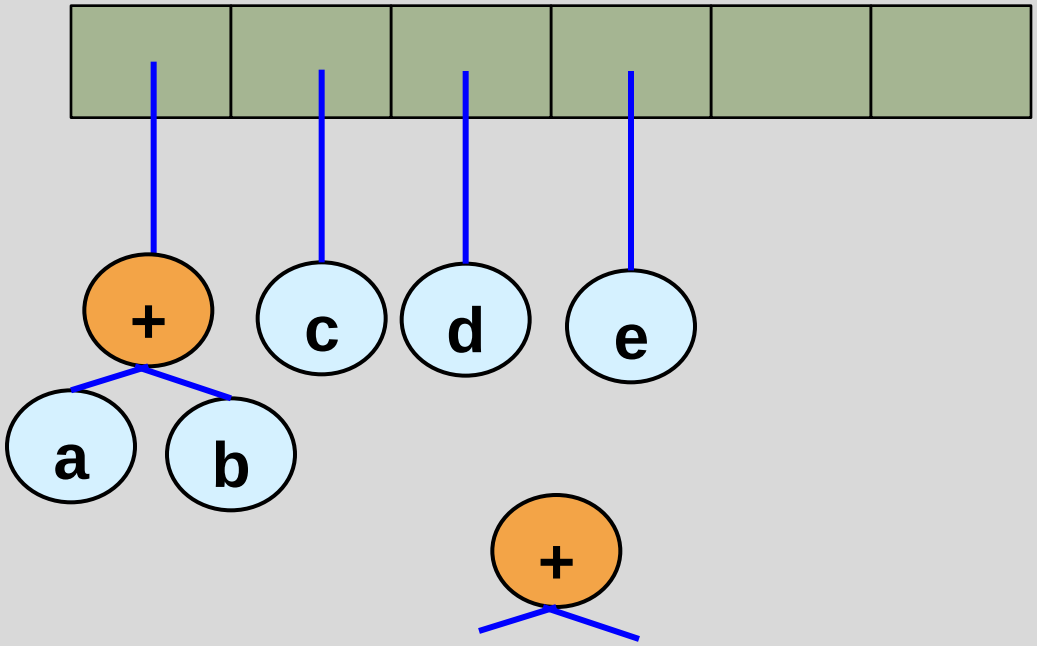


a+b + c*(d+e)

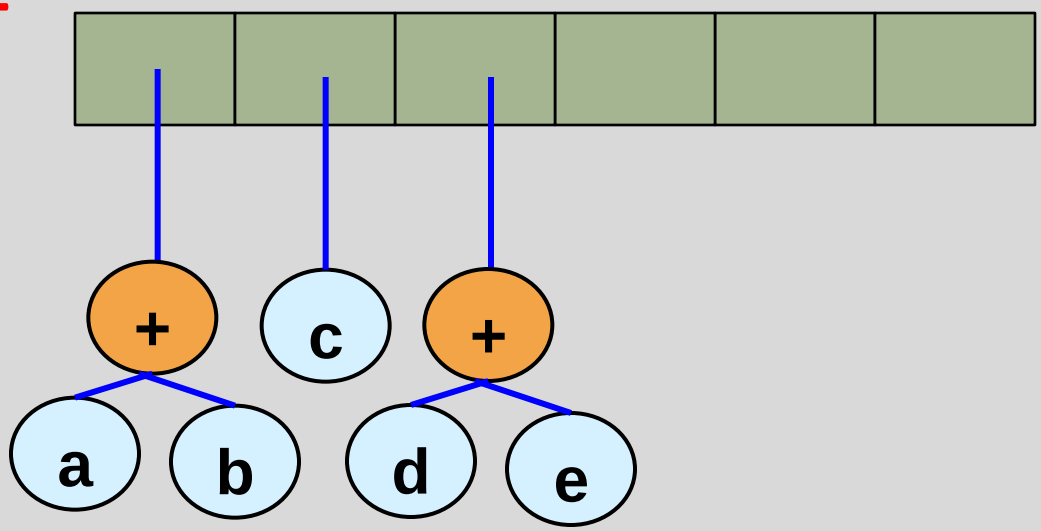
a b + c d e + *+



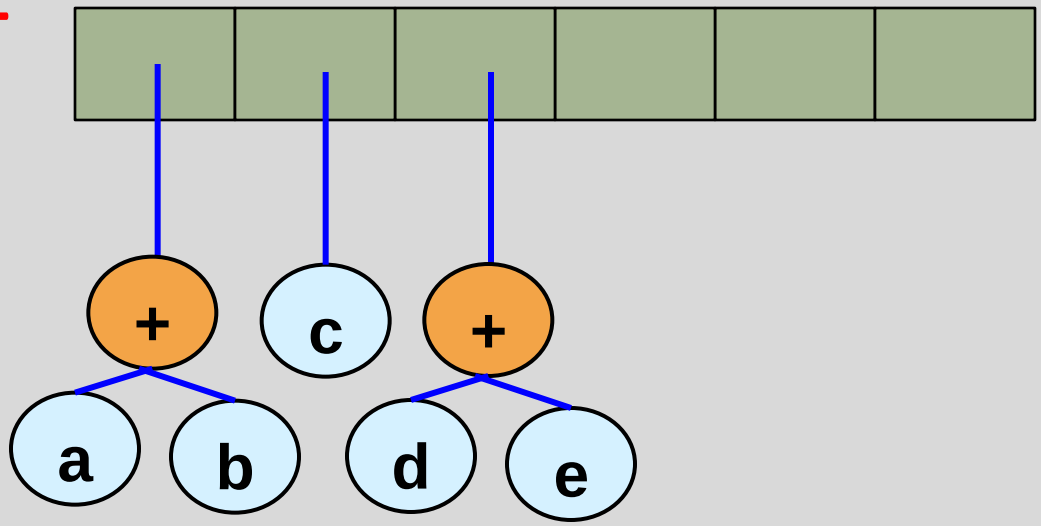
a b + c d e + *+



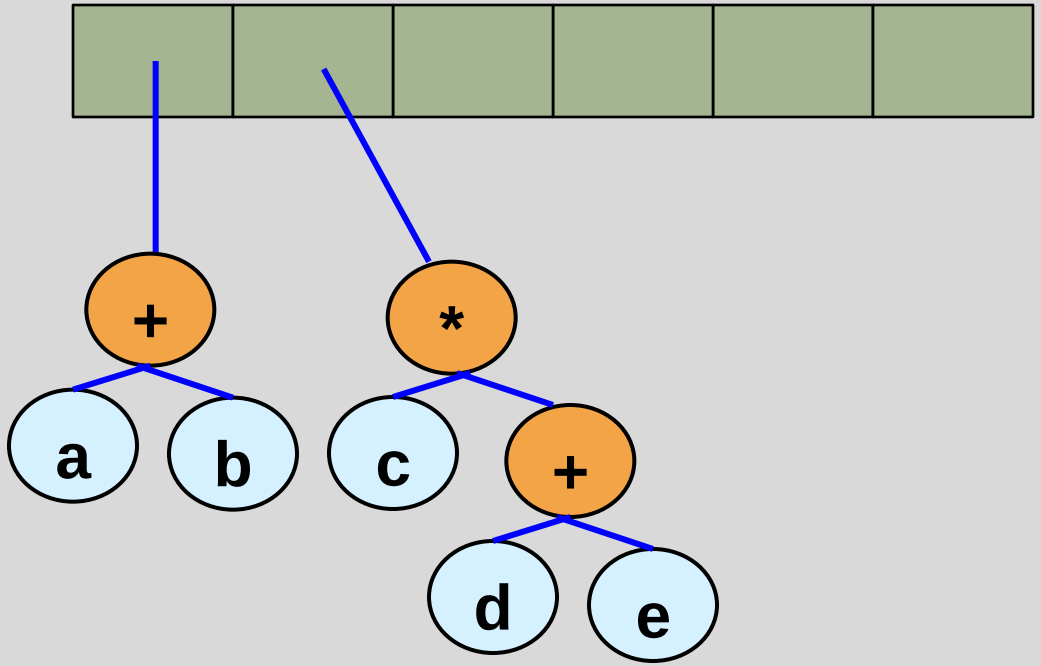
a b + c d e + *+



a b + c d e + *+



a b + c d e + *+



a b + c d e + *+