

Practical-7

1. Find dual of a given Boolean polynomial/expression.
2. Whether or not two Boolean polynomials are equivalent.
3. Disjunctive normal form (Conjunctive normal form) from a given Boolean expression.
4. Disjunctive normal form (Conjunctive normal form) when the given Boolean polynomial function is expressed by a table of values.

In[1]:= **Dual**

Out[1]= Dual

In[2]:= **dual**[expr_] := expr /. {And → Or, Or → And, 0 → 1, 1 → 0}

In[3]:= **dual**[x ∧ y]

Out[3]= x | | y

In[4]:= **dual**[x ']

Out[4]= x

In[5]:= **dual**[Or[x, y]]

Out[5]= x && y

In[6]:= **dual**[x ∨ y]

Out[6]= x && y

In[7]:= **dual**[(x ∧ y) ∨ (x ∧ y ') ∨ (x ' ∧ y)]

Out[7]= (x | | y) && (x | | y) && (x | | y)

Equivalent Function

Distributive laws:

In[8]:= **distributiveL** = x ∧ (y ∨ z);
distributiveR = (x ∧ y) ∨ (x ∧ z);

In[10]:= **TautologyQ**[Equivalent[distributiveL, distributiveR], {x, y, z}]

Out[10]= True

In[11]:= **TautologyQ**[Equivalent[x ∨ (x ∧ y), y], {x, y}]

Out[11]= False

Disjunctive normal form

```
In[12]:= p = x ∨ (x ∧ y);  
In[13]:= BooleanConvert[p, "DNF"]  
Out[13]= x  
  
In[14]:= q = (x ∧ (y ∨ z)') ∨ (((x ∧ y) ∨ z') ∧ x);  
In[15]:= BooleanConvert[q, "DNF"]  
Out[15]= (x && y) || (x && z') || (x && (y || z)')
```

Conjunctive Normal form

```
In[16]:= BooleanConvert[p, "CNF"]  
Out[16]= x  
  
In[17]:= BooleanConvert[q, "CNF"]  
Out[17]= x && (y || z' || (y || z)')  
  
In[18]:= r = x ∧ y';  
In[19]:= BooleanConvert[r, "CNF"]  
Out[19]= x && y'  
  
In[24]:= t = (x ∨ y) ∧ z';  
Out[24]= (x || y) && z'  
  
In[25]:= BooleanConvert[t, "DNF"]  
Out[25]= (x && z') || (y && z')  
  
In[26]:= BooleanConvert[t, "CNF"]  
Out[26]= (x || y) && z'
```

DN and CN form when table is given

Given

$$\begin{array}{lllll} f(1,1,1)=0, & f(1,1,0)=1, & f(1,0,1)=0, & f(1,0,0)=1 & f(0,1,1)=0 \\ f(0,1,0)=1 & f(0,0,1)=1 & f(0,0,0)=0 & & \end{array}$$

```
In[27]:= BooleanFunction[{{1, 1, 1} → 0, {1, 1, 0} → 1, {1, 0, 1} → 0, {1, 0, 0} → 1, {0, 1, 1} → 0, {0, 1, 0} → 1, {0, 0, 1} → 1, {0, 0, 0} → 0}, {x, y, z}, "DNF"]  
Out[27]= (x && ! z) || (! x && ! y && z) || (y && ! z)  
  
In[28]:= BooleanFunction[{{1, 1, 1} → 0, {1, 1, 0} → 1, {1, 0, 1} → 0, {1, 0, 0} → 1, {0, 1, 1} → 0, {0, 1, 0} → 1, {0, 0, 1} → 1, {0, 0, 0} → 0}, {x, y, z}, "CNF"]  
Out[28]= (! x || ! z) && (x || y || z) && (! y || ! z)
```