# Practical 6

Finding the following for a given Boolean polynomial function:

i. Representation of Boolean polynomial function and finding its value when the Boolean variables in it take particular values over the Boolean algebra {0,1}.

ii. Display in table form of all possible values of Boolean polynomial function over theBoolean algebra {0,1}.

## 1 or + ∨

```
(%i1) kill(all);
(%o0) done
```

```
(%i1) (true or true);
(%o1) true
```

```
(%i2) (true ∨ true);
(%o2) true
```

```
(%i3) (true or false);
(%o3) true
```

```
(%i4) (false or false);
(%o4) false
```

```
(%i5) (false or true);
(%o5) true
```

## 2 and . ∧

```
(%i6) kill(all);
(%o0) done
```

```
(%i1) (true and true);
(%o1) true
```

```
(%i2) (true and false);
(%o2) false
```

(%i3) (false and false);
(%o3) **false**

(%i4) (false and true);
(%o4) **false**

### 3 not ¬

(%i5) kill(all);
(%o0) *done*

(%i1) not(true);
(%o1) **false**

(%i2) not(false);
(%o2) **true**

(%i3) ¬(true);
(%o3) **false**

### 4

(%i4) kill(all);
(%o0) *done*

(%i1) not(true and true);
(%o1) **false**

(%i2) not(true and false);
(%o2) **true**

(%i3) not(false and false);
(%o3) **true**

(%i4) not(false and true);
(%o4) **true**

### 5 . and
### + or
### ¬ not

Rosen
EXAMPLE 1
Find the value of 1 · 0 + ¬(0 + 1).

```
(%i5) kill(all);
(%o0) done
```

```
(%i1) r:(true ⋀ false )⋁ ¬ (false ⋁ true);
(%o1) false
```

EXAMPLE 3
Translate the logical equivalence
(T ∧ T) ∨ ¬F ≡ T into an identity in Boolean algebra.

```
(%i2) r:(1 and 1) or not(0);
(%o2) 1 ⋀ 1 ⋁ ¬0
```

```
(%i3) x:(true and true) or not(false);
(%o3) true
```

## 6

```
(%i4) kill(all);
(%o0) done
```

EXAMPLE 4
The function F(x, y) = xy from the set of ordered pairs
of Boolean variables to the set {0, 1} is
a Boolean function of degree 2 with
F(1, 1) = 0, F(1, 0) = 1, F(0, 1) = 0, and F(0, 0) = 0.

```
(%i1) F(x,  y):=x and not(y);
(%o1) F(x,y):=x ⋀ ¬y
```

```
(%i2) print("x              y              F(x,   y)");
      x              y              F(x,   y)
(%o2) x              y              F(x,   y)
```

```
(%i3) print("x              y              F(x,   y)")$
      x              y              F(x,   y)
```

```
(%i5) print("x              y           F(x,   y)")$
      for i in [true,  false] do(
         for j in [true,   false] do(
            print(i,  "     ",    j,   "      ",    F(i,   j))
         )
      );
```

| x | y | F(x, y) |
|---|---|---|
| true | true | false |
| true | false | true |
| false | true | false |
| false | false | false |

(%o5) done

```
(%i6) printTable(f):=block(
         print("x              y           f(x,   y)"),
         for i in [true,  false] do(
            for j in [true,   false] do(
               print(i,  "     ",    j,   "      ",    f(i,   j))
            )
         )
      );
```

(%o6)
```
printTable(f):=block(
print(x              y           f(x,   y)),for i in [true,false] do
for j in [true,false] do print(i,     ,j,      ,f(i,j)))
```

```
(%i7) printTable(F);
```

| x | y | f(x, y) |
|---|---|---|
| true | true | false |
| true | false | true |
| false | true | false |
| false | false | false |

(%o7) done

```
(%i8) g(x,  y):=x and y;
```

(%o8) $g(x,y):=x \wedge y$

```
(%i9) printTable(g);
```

| x | y | f(x, y) |
|---|---|---|
| true | true | true |
| true | false | false |
| false | true | false |
| false | false | false |

(%o9) done

```
(%i10) printTable(x or y);
```

| x | y | f(x, y) |
|---|---|---|
| true | true | (x ⋁ y)(true,true) |
| true | false | (x ⋁ y)(true,false) |
| false | true | (x ⋁ y)(false,true) |
| false | false | (x ⋁ y)(false,false) |

```
(%o10) done
```

## 7

```
(%i11) kill(all);
(%o0) done
```

EXAMPLE 5 -- Rosen
Find the values of the Boolean function represented by
F(x, y, z) = xy + z.

```
(%i1) f(x, y, z):=(x and y) or not(z);
(%o1) f(x,y,z):=x ⋀ y ⋁ ¬z

(%i2) printTable(f):=block(
    print("x          y          z          f(x, y, z)"),
    for i in [true, false] do(
        for j in [true, false] do(
            for k in [true, false] do(
                print(i, "          ", j,
                    "          ", k, "          ", f(i, j, k))
            )
        )
    )
);
(%o2) printTable(f):=block(
print(x y z f(x, y, z)),for i in [true,
false] do for j in [true,false] do for k in [true,false] do
print(i, ,j, ,k, ,f(i,j,k)))
```

(%i3)
```
printTable(f);
```

| *x* | *y* | *z* | *f(x, y, z)* |
|---|---|---|---|
| ***true*** | ***true*** | ***true*** | ***true*** |
| ***true*** | ***true*** | ***false*** | ***true*** |
| ***true*** | ***false*** | ***true*** | ***false*** |
| ***true*** | ***false*** | ***false*** | ***true*** |
| ***false*** | ***true*** | ***true*** | ***false*** |
| ***false*** | ***true*** | ***false*** | ***true*** |
| ***false*** | ***false*** | ***true*** | ***false*** |
| ***false*** | ***false*** | ***false*** | ***true*** |

(%o3) *done*