Solution of 1-D Heat equation with python by Saif Abbas

In [17]:
```
import numpy as np
import matplotlib.pyplot as plt
```

In [18]:
```
h = 0.25
k = 0.25
x = np.arange(0,1+h,h)
t= np.arange(0,1+k,k)
t
```

Out[18]:
```
array([0.  , 0.25, 0.5 , 0.75, 1.  ])
```

In [19]:
```
n = len(x)
m = len(t)
T = np.zeros((n,m))
T
```

Out[19]:
```
array([[0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0.],
       [0., 0., 0., 0., 0.]])
```

In [20]:
```
#boundary Condition
boundaryConditions = [0 ,0]
initialConditions = np.sin(np.pi*x)
T[0,:] = boundaryConditions[0]
T[-1, :] = boundaryConditions[1]
T[:,0] = initialConditions
T
```

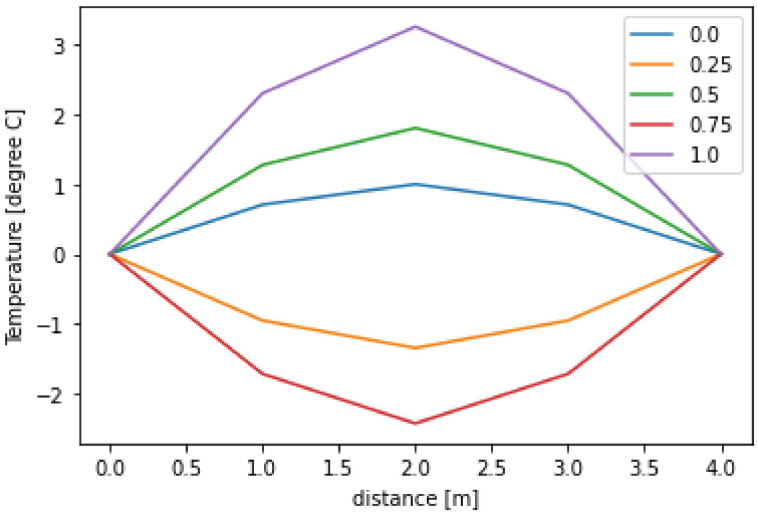
Out[20]:
```
array([[0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
        0.00000000e+00],
       [7.07106781e-01, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
        0.00000000e+00],
       [1.00000000e+00, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
        0.00000000e+00],
       [7.07106781e-01, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
        0.00000000e+00],
       [1.22464680e-16, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
        0.00000000e+00]])
```

In [21]:
```
factor = k/h**2
for j in range(1,m):
    for i in range(1,n-1):
        T[i,j] = factor*T[i-1 , j-1] +(1-2*factor)*T[i ,j-1]+ factor*T[i+1 , j-1]
T = T.round(3)
T
```

Out[21]:
```
array([[ 0.   ,  0.   ,  0.   ,  0.   ,  0.   ],
       [ 0.707, -0.95 ,  1.276, -1.713,  2.301],
       [ 1.   , -1.343,  1.804, -2.423,  3.255],
       [ 0.707, -0.95 ,  1.276, -1.713,  2.301],
       [ 0.   ,  0.   ,  0.   ,  0.   ,  0.   ]])
```

In [22]:
```
plt.plot(T)
plt.legend(t)
plt.xlabel('distance [m]')
plt.ylabel('Temperature [degree C]')
```

Out[22]:
```
Text(0, 0.5, 'Temperature [degree C]')
```



Solution of 2-D Heat Equation with python

In [26]:
```
maxIter = 500
lenX = 10
lenY = 10
delta = 1
Ttop = 500
Tbottom =30
Tleft = 30
Tright = 30
Tintial = 30
colorinterpolation = 50
colourMap = plt.cm.jet
X,Y = np.meshgrid (np.arange(0,lenX),np.arange(0,lenY))
T= np.empty((lenX ,lenY))
T.fill(Tintial)
T[(lenY-1):,:] = Ttop
T[:1 ,:] = Tbottom
T[:,(lenX-1):] = Tright
T[:,:1] = Tleft
print(T[(lenY-1):,:],T[:1,:],T[:,(lenX-1):],T[:,:1])
```

```
[[ 30. 500. 500. 500. 500. 500. 500. 500. 500.  30.]] [[30. 30. 30. 30. 30. 30. 30. 3
0. 30. 30.]] [[30.]
 [30.]
 [30.]
 [30.]
 [30.]
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 [30.]] [[30.]
 [30.]
 [30.]
 [30.]
 [30.]
 [30.]
 [30.]
 [30.]
 [30.]
 [30.]]
```
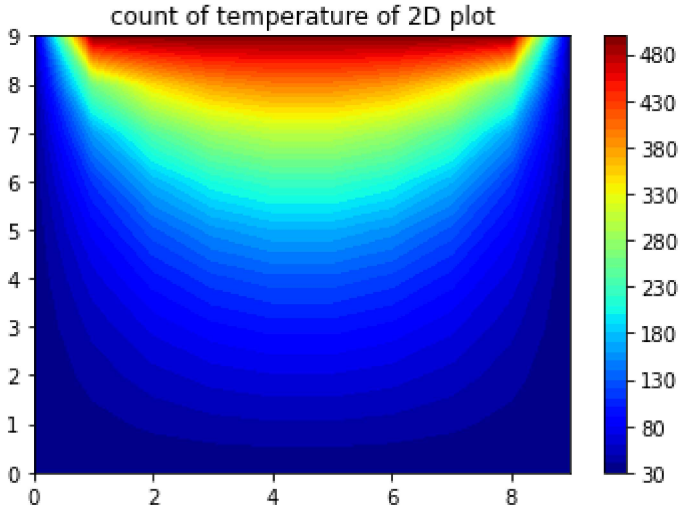

In [29]:

```
for iteration in range(0,maxIter):
    for i in range(1,lenX-1 ,delta):
        for j in range(1,lenX-1 ,delta):
            T[i,j] = 0.25*(T[i+1][j]+T[i-1][j]+T[i][j+1]+ T[i][j-1])
print("Iteration is finished")
plt.title("count of temperature of 2D plot")
plt.contourf(X,Y,T,colorinterpolation,cmap = colourMap)
plt.colorbar()
plt.show()
```

```
Iteration is finished
```



In [ ]: