偏微分方程

公式

$$\begin{cases} \frac{\partial^2 y}{\partial t^2}=\frac{\partial^2 y}{\partial x^2} \quad 0<x<1 \quad 0<t \\ y(x,0)=\sin 2\pi x \quad \frac{\partial y(x,0)}{\partial t}=0.0 \quad 0\le x\le 1 \\ y(0,t)=y(1,5)=0 \quad 0<t \end{cases}$$

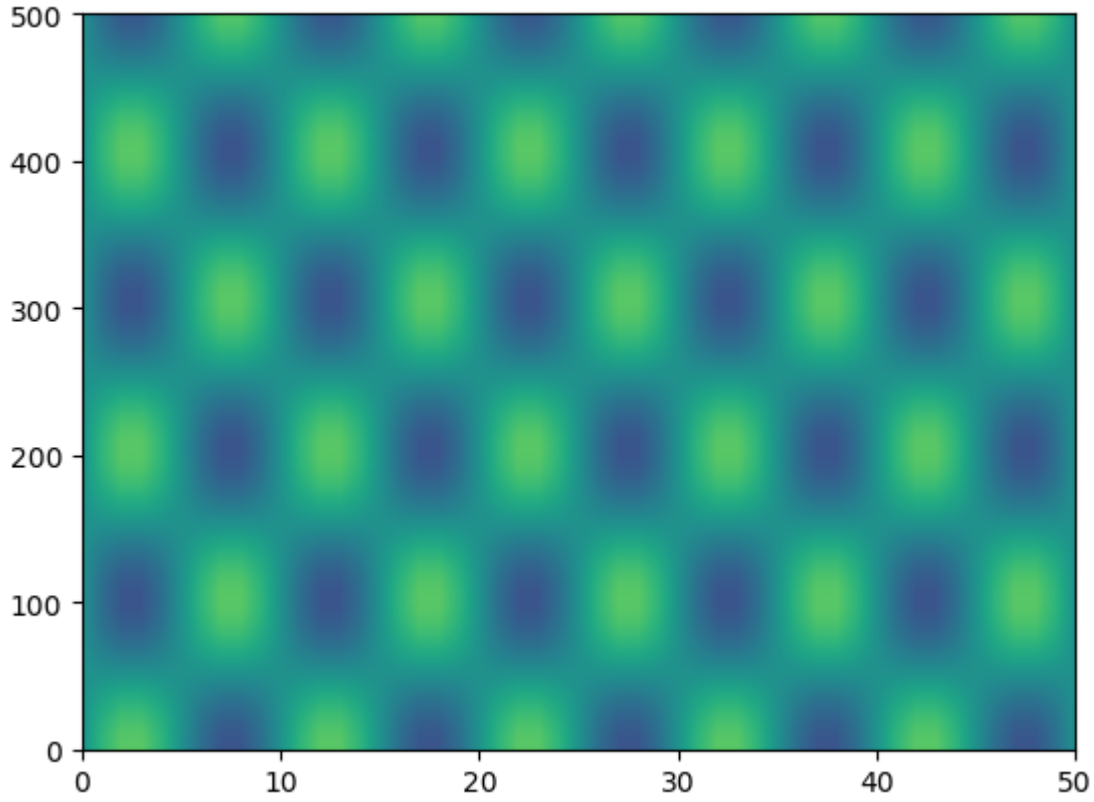
$$y_{i,k+1}=2(1-(\frac{\tau\nu}{h})^2)y_{i,k}+(\frac{\tau\nu}{h})^2(y_{i+1,k}+y_{i-1,k})-y_{i,k-1}$$

$$y_{i,0}=\sin(2\pi ih),y_{i,1}=\sin(2\pi ih),y_{0,k}=y_{N,k}=0$$

代码实现

```
import numpy as np
import matplotlib.pyplot as plt
f=lambda x:np.sin(2*np.pi*x)                                    #定义函数
tao=0.005                                                       #选定参数
h=0.1
N=500
M=50
U=np.zeros([N+1,M+1])                                           #构建解空间
for i in range(M+1):                                          #在解空间写入初始条件
    U[0][i]=f(i*h)
    U[1][i]=f(i*h)
for k in range(1,N):                                            #计算
    for i in range(1,M):
        U[k+1][i]=2*(1-(tao/h)**2)*U[k][i]+(tao/h)**2*(U[k][i+1]+U[k][i-1])-U[k-1][i]
fig=plt.figure()                                                #绘图
ax1=fig.add_subplot(1,1,1)
levels=np.arange(-2.0,2.0,0.01)
ax1.contourf(U,levels,camp=plt.cm.hot)
plt.show()
```

绘图



纵轴时间，横轴长度