网格点和初始化

选五个点，根据初值条件：

- $j=1$ 到 $j=5$，初始条件 $u^0=[1,1,0.5,0,0]$

数值格式和计算步骤

1. **左偏心格式（迎风）**
    - 更新方程：$u_j^{k+1}=u_j^k-\frac{1}{2}(u_j^k-u_{j-1}^k)$
2. **右偏心格式（背风）**
    - 更新方程：$u_j^{k+1}=u_j^k-\frac{1}{2}(u_{j+1}^k-u_j^k)$
3. **Lax-Wendroff格式**
    - 更新方程：$u_j^{k+1}=u_j^k-\frac{1}{2}(u_{j+1}^k-u_{j-1}^k)+\frac{1}{8}(u_{j+1}^k-2u_j^k+u_{j-1}^k)$

就你书上132页公式

$k=0$

左偏心格式

- $u_1^1=1$
- $u_2^1=1-0.5\times(1-1)=1$
- $u_3^1=0.5-0.5\times(0.5-1)=0.75$
- $u_4^1=0-0.5\times(0-0.5)=0.25$
- $u_5^1=0$

右偏心格式

- $u_1^1=1-0.5\times(1-1)=1$
- $u_2^1=1-0.5\times(0.5-1)=1.25$
- $u_3^1=0.5-0.5\times(0-0.5)=0.75$
- $u_4^1=0-0.5\times(0-0)=0$
- $u_5^1=0$

LW格式

- $u_1^1=1)$
- $u_2^1=1-0.5\times(0.5-1)+0.125\times(0.5-2\times1+1)=1-0.25+0.0625=0.8125$
- $u_3^1=0.5-0.5\times(0-0.5)+0.125\times(0-2\times0.5+1)=0.75-0.125=0.625$
- $u_4^1=0-0.5\times(0-0)+0.125\times(0-2\times0+0.5)=0.0625$
- $u_5^1=0$

$k=1$

- 左偏心：
$$u^1=[1,1,0.75,0.25,0]$$
- 右偏心：
$$u^1=[1,1.25,0.75,0,0]$$

左偏心格式

- $u_1^2=1$
- $u_2^2=1-0.5\times(1-1)=1$
- $u_3^2=0.75-0.5\times(0.75-1)=0.875$
- $u_4^2=0.25-0.5\times(0.25-0.75)=-0.125$
- $u_5^2=0$

右偏心格式

利用方程:

$$u_j^{k+1} = u_j^k - \frac{1}{2}(u_{j+1}^k - u_j^k)$$

- $u_1^2 = 1$
- $u_2^2 = 1 - 0.5 \times (1.25 - 1) = 0.875$
- $u_3^2 = 1.25 - 0.5 \times (0.75 - 1.25) = 1.5$
- $u_4^2 = 0.75 - 0.5 \times (0 - 0.75) = 1.125$
- $u_5^2 = 0$

LW

懒得算了，这是python

```
u_previous = [1, 1, 0.75, 0.25, 0]


u_lw = u_previous.copy()
for j in range(1, len(u_previous)-1):
    u_lw[j] = (u_previous[j] - 0.5 * (u_previous[j+1] - u_previous[j-1]) +
               0.125 * (u_previous[j+1] - 2*u_previous[j] + u_previous[j-1]))


u_lw
```

$$u^2 = [1, 1.09375, 1.09375, 0.65625, 0]$$