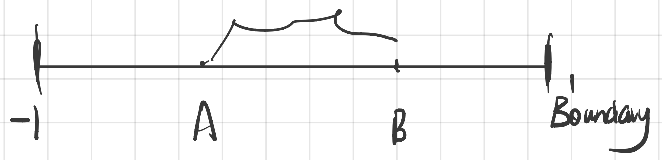
$T_A = T_a = T_B$



$T(A, t_0) = T_a$ $\quad T(B, t_0) = T_a$

$T(x, t) = ? \longrightarrow \frac{\partial T}{\partial t} = -k(T(x,t) - T_a) + u(B, t)$

1D Heat Equation

$x \in (0, L)$

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2} + u(x,t), \quad \left.\begin{array}{l} T(0,t) = T_L(t) \\ T(L,t) = \cancel{T_a}\, T_R(t) \end{array}\right\} \text{Boundary condition}$$

T_a

$$, T(x,0) = T_0(x) \} \text{ initial condition}$$

$\theta(x,t) = T(x,t) - T_a$

$\theta(0,t) = \theta(L,t) = 0$

$\underline{\theta_t = \alpha\theta_{xx} + u(x,t)}$

令 $\theta(x,t) = X(x)G(t)$

代入 $\theta_t = \alpha\theta_{xx}$，则

$XG' = \alpha X'' G \Rightarrow \frac{G'}{\alpha G} = \frac{X''}{X} = -\lambda$

- 时间部分 $G' = -\alpha\lambda G \Rightarrow G(t) = e^{-\alpha\lambda t}$
- 空间部分 $X'' + \lambda X = 0$，配 Dirichlet: $X(0) = X(L) = 0$

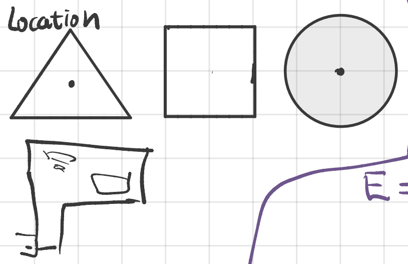
$\lambda_n = \left(\frac{n\pi}{L}\right)^2$, $X_n(x) = \sin\left(\frac{n\pi x}{L}\right)$, $n = 1, 2, \cdots$

$$\underline{\theta(x,t) = \sum_{n=1}^{\infty} b_n e^{-\alpha(n\pi/L)^2 t} \sin\left(\frac{n\pi x}{L}\right)}$$

Biological Aspect

Target: keep the room $T(t)$ at a comfort temperature T_{se}

Location



→ Criteria
↓
Online Search

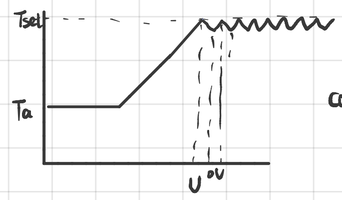
$E = \int_0^T$

Function: Effective + Energy cost

2. How to make it effective

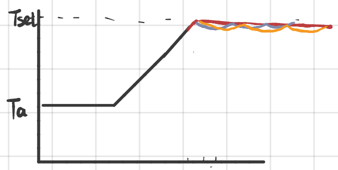
2

3. Control Theory

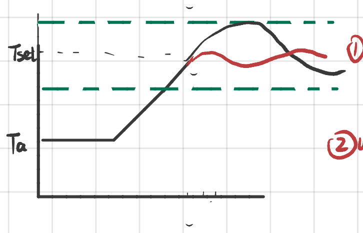


Bad

cost function



$u(x,t) \neq U_{max}$
$= U_{comfort}$



① $U = U_{max}$
U_{season}

② without switch

1 Mini-task 1. 1D $\frac{dT}{dt} = -k(T(t) - T_a) + u(t)$

2. 2D heat

Variable: $u_t = \begin{cases} U_{max} & T(t-\tau) < T_{test} \\ 0 & \text{otherwise.} \end{cases}$

Final: Multiple Heat sources formulation