智慧型演化計算

(20240530)

HW3(團體作業) – Auto pilot
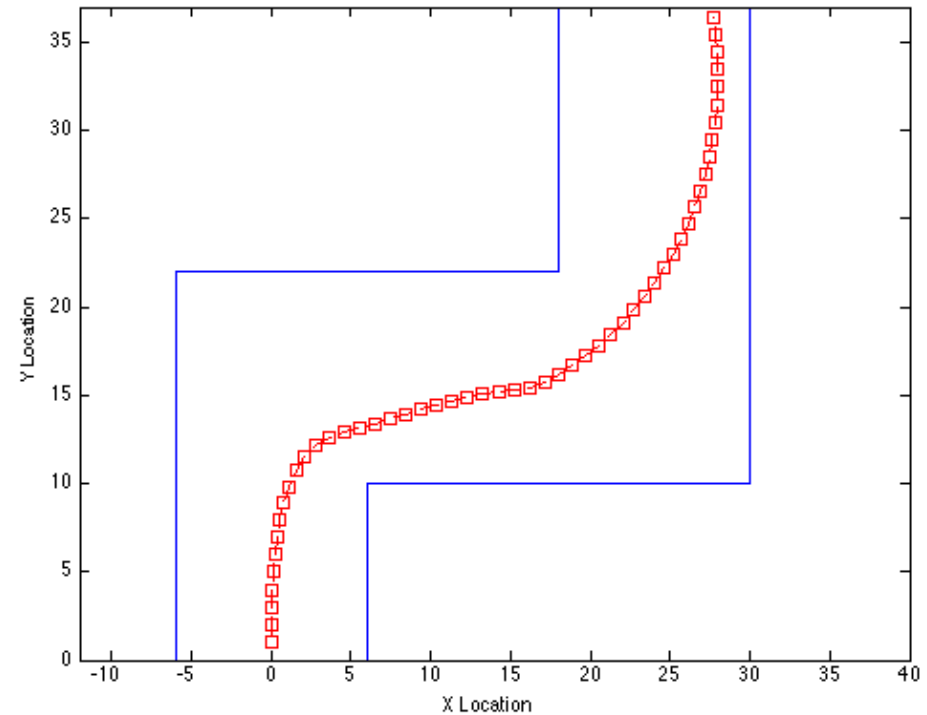
Map & Car movement method
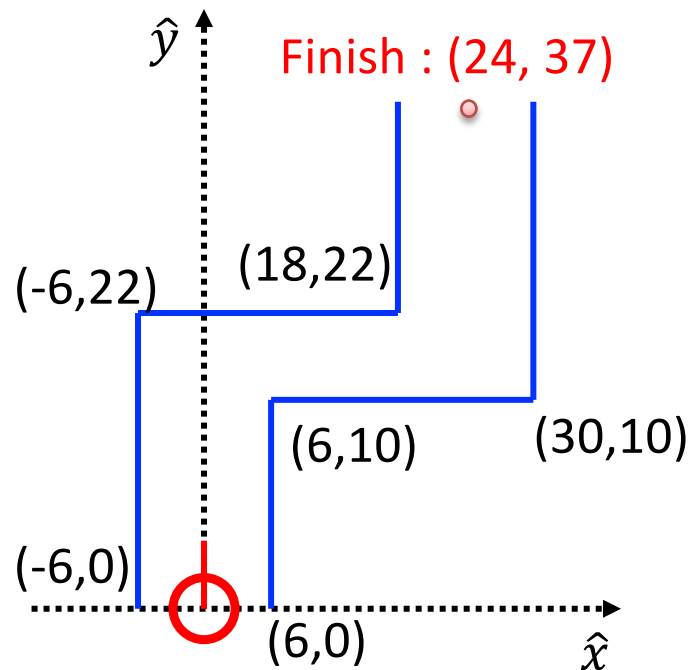
Map

Example

Finish : (24, 37)

(18,22)

(-6,22)

(6,10)   (30,10)

(-6,0)

(6,0)

Initial central position (0,0)
Car radius is 3

Map & Car movement method

Map

Finish : (24, 37)

(-6,22) (18,22)

(6,10) (30,10)

(-6,0) (6,0)

$\hat{y}$ $\hat{x}$
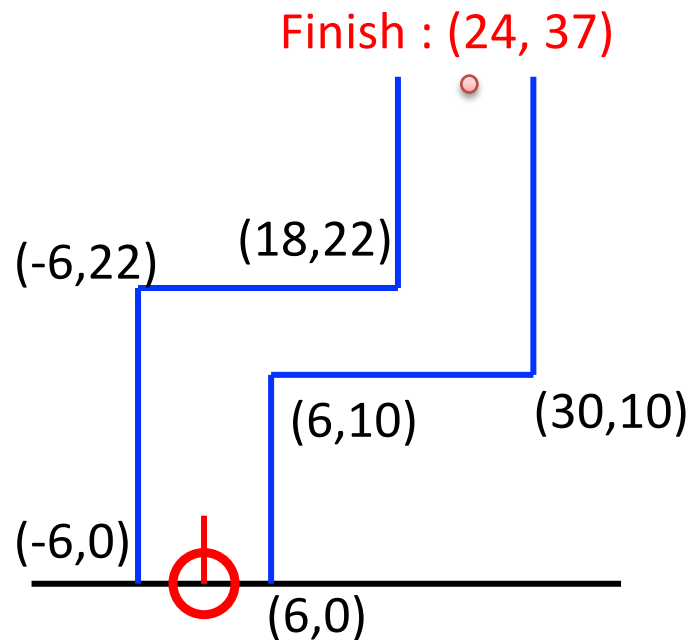
Initial central position (0,0)
Car radius is 3

Car movement method

Position

$$x(t + 1) = x(t) + cos[\phi(t) + \theta(t)] + sin[\theta(t)]sin[\phi(t)]$$
$$y(t + 1) = y(t) + sin[\phi(t) + \theta(t)] - sin[\theta(t)]cos[\phi(t)]$$

Orientation

$$\phi(t + 1) = \phi(t) - sin^{-1}\left[\frac{2sin[\theta(t)]}{b}\right]$$

Where

ϕ: Car orientation angle from x-axis. [-90°, 270°]

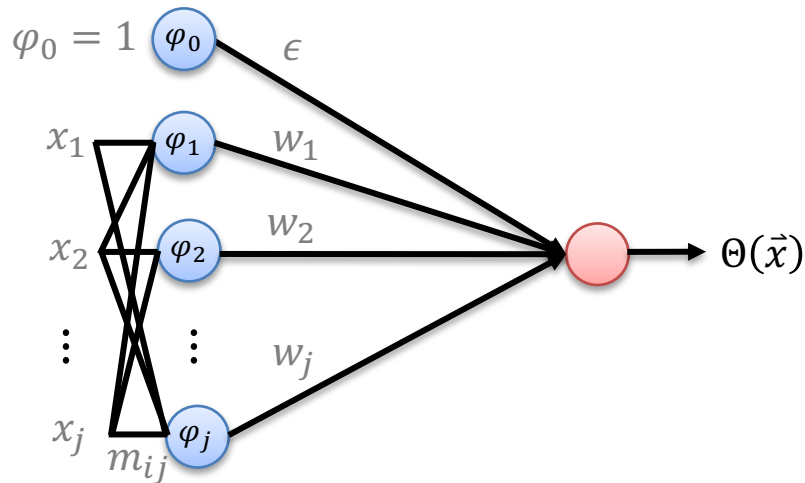θ: Steering wheel angle. [-40°, 40°]

b: Car length

t: Time

x, y: Car center position

Radial basis function network (RBF network)

RBF network

$$\Theta(\vec{x}) = \sum_{i=1}^{M} w_i \varphi_i(\vec{x}) + \epsilon$$

Where

$\vec{x}$: Distance vector $[dF, dL, dR]$ from forward, left and right.

Gaussian basis function (for j-th node)

$$\varphi_i(\vec{x}) = exp\left\{-\frac{\left\|\vec{x} - \vec{m}_j\right\|^2}{2\sigma_j^2}\right\}$$

Scaling:

- w_j: scale to [0, 1]
- ϵ: the random value between [0,1]
- m_{ij}: Link between x_i and φ_j node [0,30]
- σ_j: The j-th node's standard deviation [0, 10]
- θ: Scaling from [-40, 40] to [0, 1]

Training data

	dF	dL	dR	θ
1	22.0000000	8.4852814	8.4852814	2.3702363
2	21.0028513	8.3706824	8.6047198	2.1288341
3	20.0084911	8.2526888	8.7363457	1.8747606
4	19.0155847	8.1329543	8.8768701	1.6106366
5	18.0230339	8.0130431	9.0227666	1.3341385
6	17.0299607	30.0000000	9.1700619	23.2459765
7	16.3702803	7.0563417	10.9448554	−0.9584433
8	15.3545357	30.0000000	11.1818338	22.0627009
9	14.8851383	30.0000000	14.1486565	16.6515600
10	14.4286024	30.0000000	14.3205841	16.7650993
11	14.1130414	30.0000000	12.9284232	23.2852648
12	14.3476980	28.7184580	11.7324302	23.1171819
13	14.9876891	27.8393525	10.8515381	22.6437081
14	16.1776137	17.4010980	10.2365225	22.2447015
15	30.0000000	10.4788788	9.8605062	11.2549845
16	29.0453977	9.9912241	9.4959250	9.2696972
17	27.3173676	9.8592988	9.1748493	8.3640717
18	25.7770864	9.7874518	8.8987403	7.7689582
19	24.3638680	9.7202796	8.6664663	7.2662744
20	23.0468106	9.6474416	8.4758040	6.7946293

Note:
Discard the [dF, dL, dR] = [30, 30, 30]

Objective function

- ## Definition of objective function:

$$fit(N) = \frac{1}{N} \sum_{k=1}^{N} [\theta_k - \Theta(\vec{x}_k)]$$ (Minimum problem)

Where
N: Number of training sample
k: The k-th training data

Chromosome for GA

Example:

- The input dimension is 3
- The number of node is 7
- The number of gene is (7+3*7+7+1 = 36)

| w_1 | w_2 | ... | w_7 | m_{11} | m_{12} | m_{13} | ... ... | m_{71} | m_{72} | m_{73} | σ_1 | .... | σ_7 | ϵ |

團體作業內容

- 發表內容：
  - 程式：
    - 計算部分：含training、testing過程
    - 顯示部分：含操作過程、畫面的顯示
  - 說明文件：
    - 程式碼說明：說明程式如何設計與實作方式
    - 執行結果：成果截圖
    - 成果說明：訓練成果、車行徑圖
    - 心得
  - 展示：
    - 動態展示training與testing過程
  - 加分部分：
    - 可以改變道路型態
    - 一種以上的演算法選擇
- 報告時間:
  - 預計6/13和6/20兩週 (線上)，**會點名**
  - 需每位同學都有發表機會，並接收老師與同學提問，**提問同學有加分**