

# 4-8 샘플링 기법 6: RRT-Connect



# 강의 요약

01

## RRT\*

- Tree
- Single-query
- Rewire
- Probabilistic Completeness
- Narrow Passage

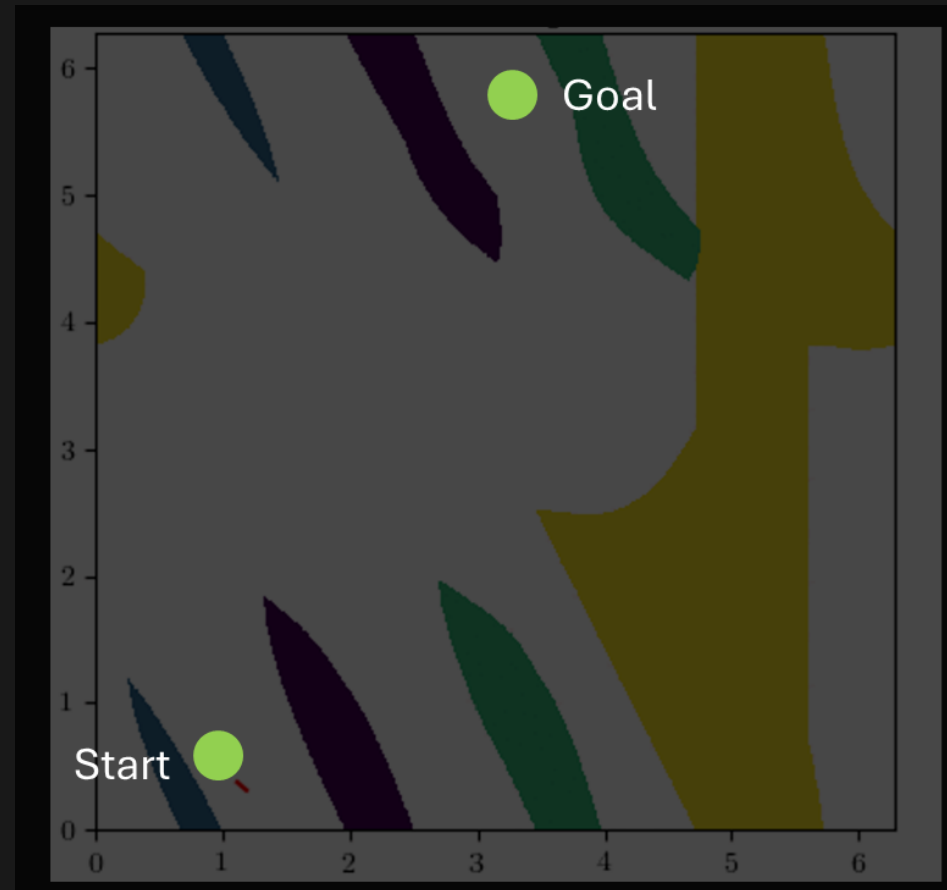
02

## 알고리즘

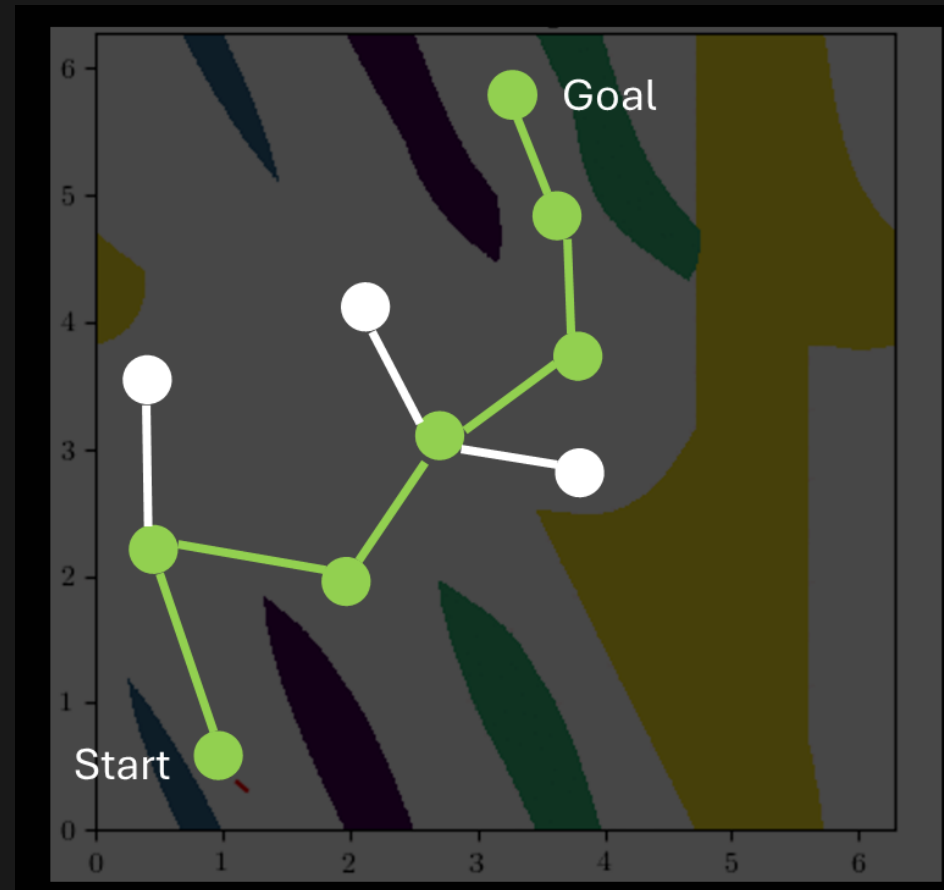
03

## 코드 분석

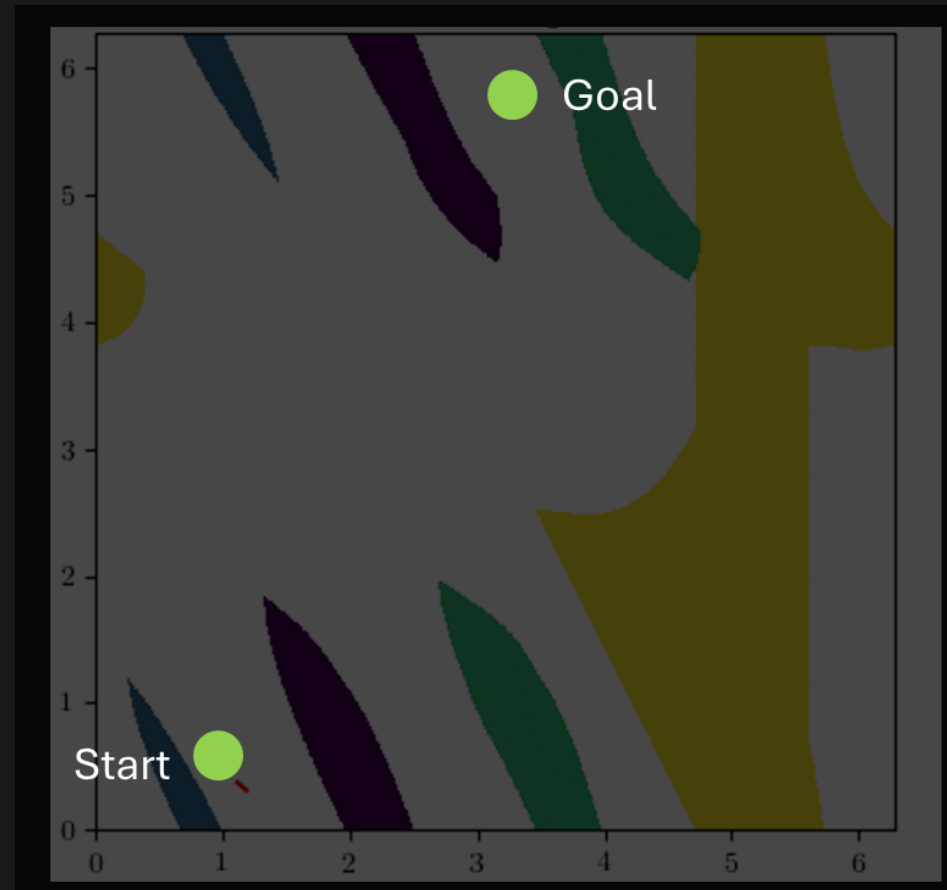
# Rapidly exploring Random Tree (RRT)



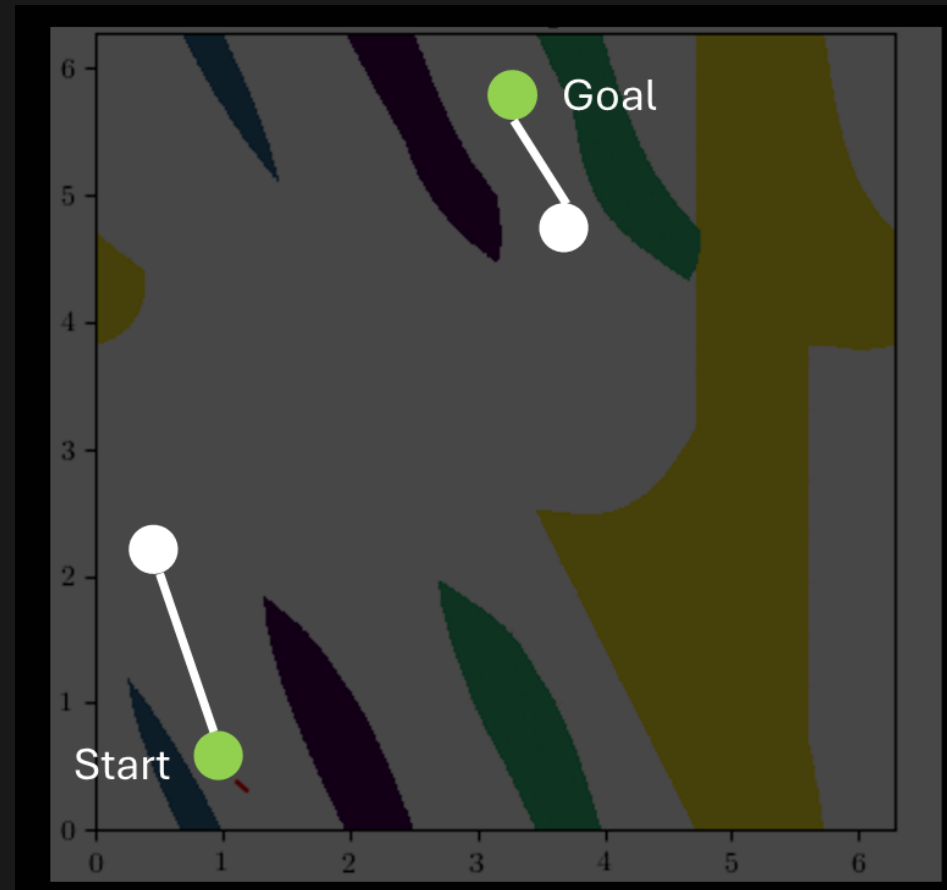
# Rapidly exploring Random Tree (RRT)



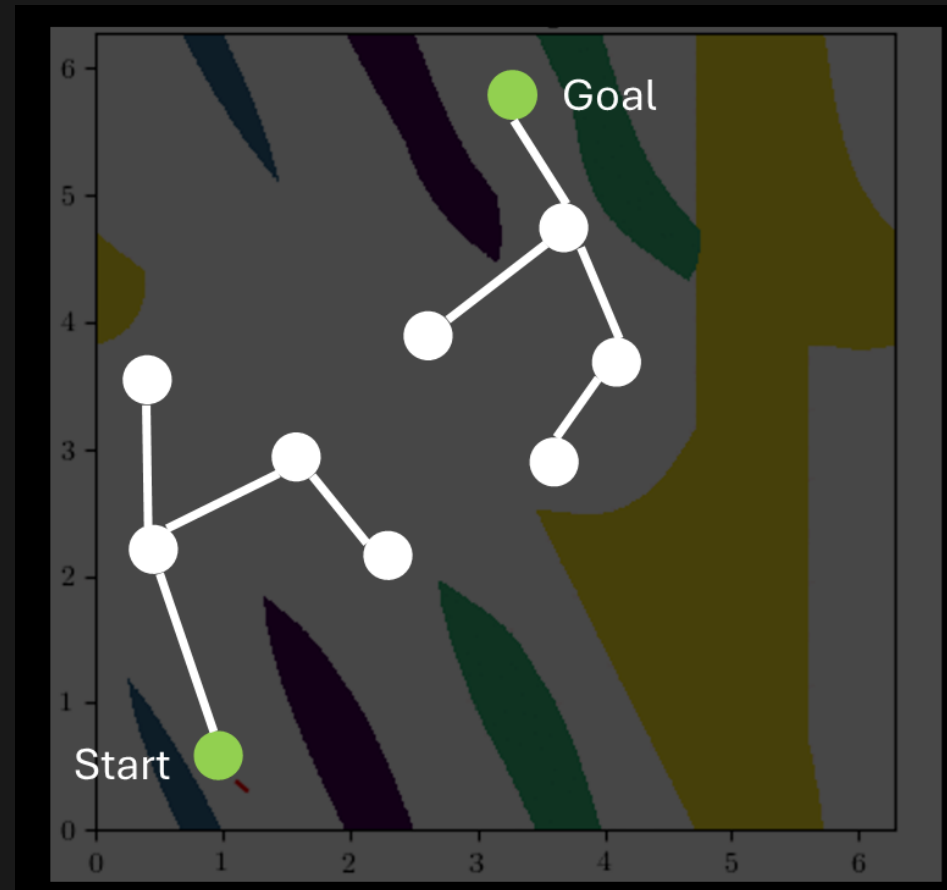
# RRT-Connect



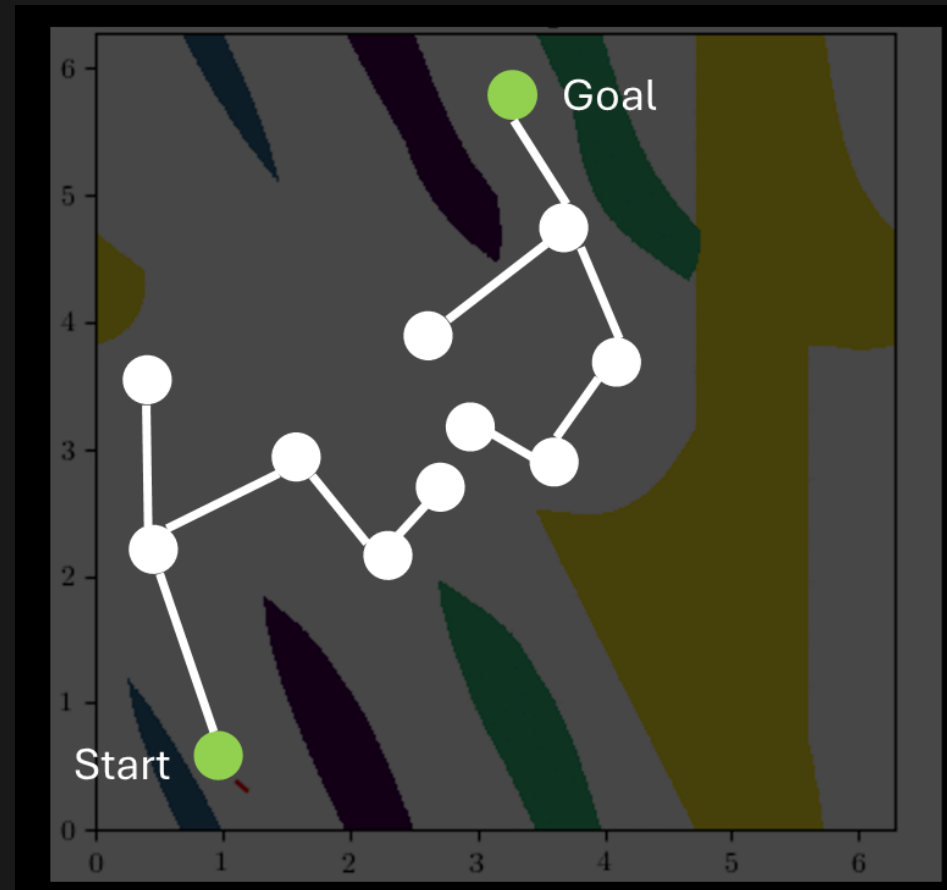
# RRT-Connect



# RRT-Connect

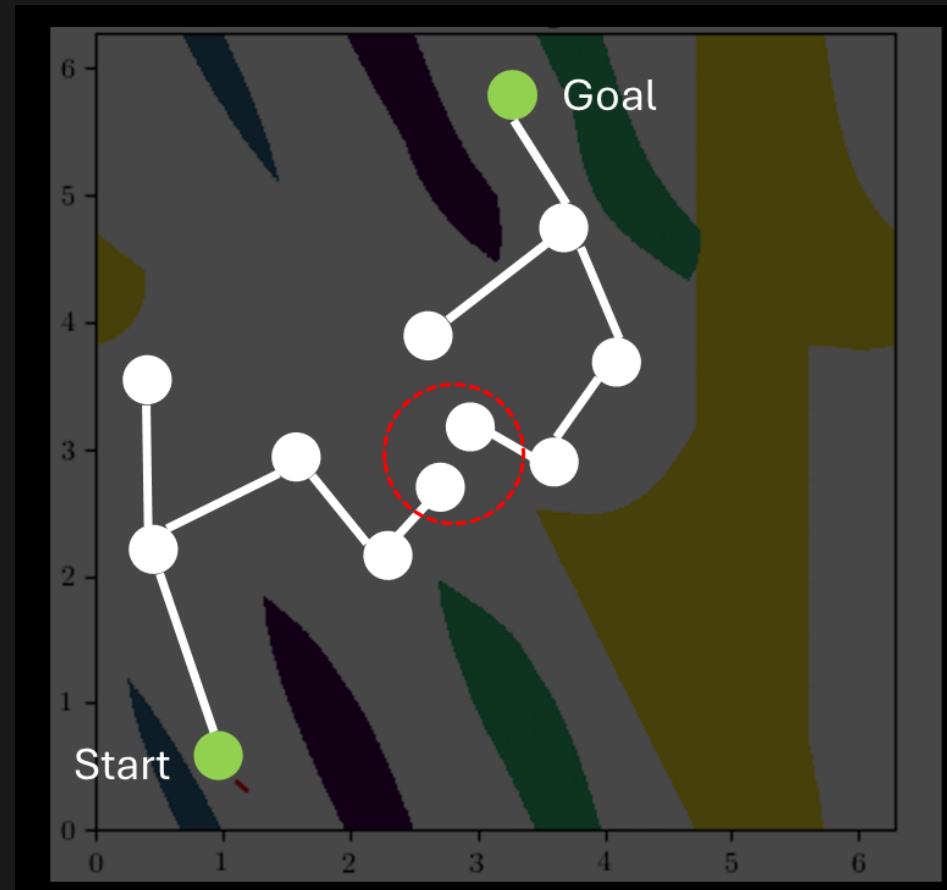


# RRT-Connect



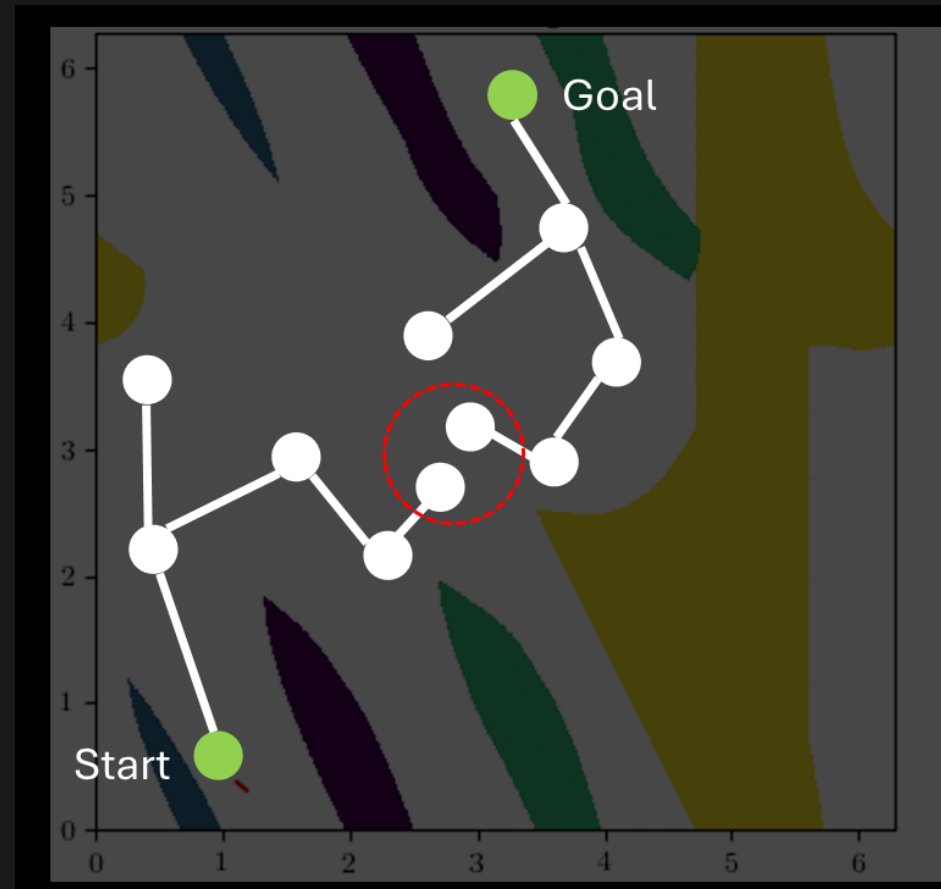


# RRT-Connect



# RRT-Connect

- 주요 특징
  - Single-query
  - Narrow Passage
  - 샘플링 방법에 따라 성능이 결정 됨
  - 최적의 경로 보장 X
  - Probabilistically Complete



# RRT-Connect

## Algorithm 4 Rapidly-exploring Random Tree (RRT)

**Require:** Maximum iterations  $N$ , step size  $\delta$ , start  $q_{\text{start}}$ , goal  $q_{\text{goal}}$

**Ensure:** A path from  $q_{\text{start}}$  to  $q_{\text{goal}}$ , if one exists

```

1: Initialize tree  $T \leftarrow \{q_{\text{start}}\}$ 
2: for  $i = 1$  to  $N$  do
3:   Sample random configuration  $q_{\text{rand}}$ 
4:    $q_{\text{near}} \leftarrow \text{Nearest}(T, q_{\text{rand}})$ 
5:    $q_{\text{new}} \leftarrow \text{Steer}(q_{\text{near}}, q_{\text{rand}}, \delta)$ 
6:   if collision-free( $q_{\text{near}}, q_{\text{new}}$ ) then
7:     Add  $q_{\text{new}}$  to  $T$  with edge from  $q_{\text{near}}$ 
8:     if  $q_{\text{new}} \approx q_{\text{goal}}$  then
9:       return Extract path from  $q_{\text{start}}$  to  $q_{\text{goal}}$ 
10:    end if
11:  end if
12: end for
13: return Failure (no path found)

```

## Algorithm 6 RRT-Connect

**Require:** Maximum iterations  $N$ , step size  $\delta$ , start  $q_{\text{start}}$ , goal  $q_{\text{goal}}$

**Ensure:** A path from  $q_{\text{start}}$  to  $q_{\text{goal}}$ , if one exists

```

1: Initialize two trees:  $T_{\text{start}} \leftarrow \{q_{\text{start}}\}, T_{\text{goal}} \leftarrow \{q_{\text{goal}}\}$ 
2: for  $i = 1$  to  $N$  do
3:   Sample random configuration  $q_{\text{rand}}$ 
4:    $q_{\text{near}} \leftarrow \text{Nearest}(T_{\text{start}}, q_{\text{rand}})$ 
5:    $q_{\text{new}} \leftarrow \text{Steer}(q_{\text{near}}, q_{\text{rand}}, \delta)$ 
6:   if collision-free( $q_{\text{near}}, q_{\text{new}}$ ) then
7:     Add  $q_{\text{new}}$  to  $T_{\text{start}}$ 
8:      $q_{\text{connect}} \leftarrow \text{Connect}(T_{\text{goal}}, q_{\text{new}}, \delta)$ 
9:     if  $q_{\text{connect}} = q_{\text{new}}$  then
10:      return Extract path from both trees
11:    end if
12:  end if
13:  Swap  $T_{\text{start}} \leftrightarrow T_{\text{goal}}$ 
14: end for
15: return Failure (no connection found)

```

# RRT vs. RRT-Connect

## RRT

- Tree
- Single-query
- Probabilistic Completeness
- Narrow Passage Problem
- 샘플링 기법에 따라 성능이 달라짐

최단 경로  
알고리즘

## RRT-Connect

- Bidirectional Tree
- Single-query
- Probabilistic Completeness
- Narrow Passage Problem
- 샘플링 기법에 따라 성능이 달라짐

# 강의 요약

01

## RRT-Connect

- Bidirectional Tree
- Single-query
- Probabilistic
- Completeness
- Narrow Passage

02

## 알고리즘

03

## 코드 분석