You are asked to implement a program that controls a simulated Turtlebot to find and identify a Cluedo character in an environment. In the environment, there will be two rooms. Your robot needs to enter the “green room”, which has a green circle near its entrance, and identify the character in the room. The second room will be a “red room”, with a red circle near its entrance. Your robot should **not** go into this room.

You will work on this project as a group.

您需要执行一个程序来控制模拟的Turtlebot，以在环境中查找和识别Cluedo角色。 在环境中，将有两个房间。 您的机器人需要进入“绿色房间”，该房间的入口附近有一个绿色圆圈，并标识房间中的角色。 第二个房间将是“红色房间”，其入口附近有一个红色圆圈。 您的机器人不应进入这个房间。

您将作为一个小组来从事此项目。

During week 11, your program will be tested in a demo using the Turtlebot Gazebo simulation. At the beginning of your demo, you will be given a map of the environment (You will learn about what a map is, how to build it and how to use it, in Lab Session 4). Your robot will be placed at a start point, which will be the same for all groups. You will be given (x,y) coordinates of the entrance points of the two rooms in the map. One room will have a red circle on the wall near its entrance, and the other a green circle. The green/red circles on the walls will be visible from these entrance points, but not necessarily from a direct angle. (You might or might not need to move your robot around the entrance points to have a better view of the circles. You are recommended to experiment with different positions of the circles and robot, build a robust program, and report your findings in your report.) Your robot will need to enter the room with the green circle on the door.

在第11周内，您的程序将使用Turtlebot Gazebo仿真在演示中进行测试。 在演示的开始，您将获得一张环境地图（在实验课程4中，您将了解什么是地图，如何构建以及如何使用它）。 您的机器人将放置在起点上，所有组都将相同。 您将在地图中获得两个房间的入口点的（x，y）坐标。 一个房间在其入口附近的墙壁上将有一个红色圆圈，另一个房间将有一个绿色圆圈。 从这些入口点可以看到墙壁上的绿色/红色圆圈，但不一定是直接角度。 （您可能需要，也可能不需要在入口点附近移动机器人，以更好地了解圆圈。建议您尝试使用圆圈和机器人的不同位置，构建健壮的程序，并在报告中报告您的发现 。）您的机器人需要进入房间，门上有绿色圆圈。

You will be given the (x,y) coordinates of the centre points of both rooms. There will be a Cluedo character in the green room. Your robot will have to find this Cluedo character and report the identity of the character. In your group’s gitlab repo, we will provide you with a set of images of different Cluedo characters and their names. Your robot will need to identify which one is in the green room. We will also provide you with an example Gazebo environment, an associated map, and an example input file. This will be just an example; the actual shape of the environment, shape of the rooms, exact position of the green/red circles, and the position of the Cluedo character may change. Your program should be robust to such changes.

In addition to the test in simulation, we encourage you to test your program on a real Turtlebot. You will get marks for testing your program on a real robot and describing it in your report.

This project has three components:

您将获得两个房间的中心点的（x，y）坐标。 绿色房间中将有一个Cluedo角色。 您的机器人将必须找到此Cluedo角色并报告该角色的身份。 在您小组的gitlab存储库中，我们将为您提供一组不同的Cluedo字符及其名称的图像。 您的机器人将需要识别绿色房间中的哪一个。 我们还将为您提供示例凉亭环境，关联的地图和示例输入文件。 这仅仅是一个例子。 环境的实际形状，房间的形状，绿色/红色圆圈的确切位置以及Cluedo角色的位置可能会发生变化。 您的程序应该对此类更改具有鲁棒性。

除了模拟测试外，我们建议您在真正的Turtlebot上测试程序。 您将获得在真实的机器人上测试程序并在报告中进行描述的标记。

该项目包含三个组成部分：

 The Simulation Demo - to be implemented as a group

 The Written Group Report – to be written and submitted as a group

 The Written Individual Report – to be written and submitted individually

Simulation Demo

**Deadline:** Monday, 9 December, 10:00 am. (Your group’s actual demo time during week 11 will be announced later, but your code should be ready by the deadline above. You will need to push your code to your group’s gitlab repo by that time, and we will use your code from gitlab during your demo.)

模拟演示

截止日期：12月9日，星期一，上午10:00。 （您的小组在第11周的实际演示时间将在稍后宣布，但您的代码应在上述截止日期之前准备好。您需要在该时间之前将代码推送到小组的gitlab存储库中，在此期间，我们将使用gitlab的代码您的演示。）

提交：您将编写一个Python程序来执行任务，并应在上述截止日期之前将其推送到您组的gitlab存储库中。

**Submission:** You will write a Python program to perform the task, which should be pushed to the gitlab repo of your group by the above deadline.

You can collect 10 points, according to the following rules.

**Detecting the green room (3 points):** We would like your robot to find the green circle and save a snapshot of the camera image of the green circle (3 points). The green circle must be completely contained within the saved image. The image file name must be “green\_circle.png”. If an image with this name is saved and it does not show the green circle, you will get an -2 penalty point.

**Going into the green room (3 points):** Accessing the centre point of the green room will earn you 3 points. Going into the red room will cost you -2 penalty points.

**Character identification (4 points):** When your robot thinks it saw the image of the Cluedo character, it should save a snapshot of the camera image with the filename “cluedo\_character.png” (2 points). The character must be completely contained within the saved image. If an image with this name is saved and it does not show the character, you will get -1 penalty point. Your program must then identify the character, by printing out the character name into a text file with the filename “cluedo\_character.txt” (2 points). If a file with this name is created, but includes a wrong character name, you will get -1 penalty points.

The minimum you can get from the demo is 0 (zero) points; in other words you cannot go negative due to penalties.

Your program will have at most 5 minutes to complete the tasks. If, after 5 minutes of running, your program has not stopped by itself, it will be stopped and the points you have collected up to that point will be your mark

您可以按照以下规则收集10分。

检测绿色空间（3分）：我们希望您的机器人找到绿色圆圈并保存绿色圆圈的摄像机图像快照（3分）。绿色圆圈必须完全包含在保存的图像中。图像文件名必须为“ green\_circle.png”。如果保存了具有该名称的图像，但没有显示绿色圆圈，则您将获得-2罚分。

进入绿色房间（3分）：进入绿色房间的中心点将获得3分。进入红色房间将花费您-2分。

角色识别（4分）：当您的机器人认为自己看到了Cluedo角色的图像时，应使用文件名“ cluedo\_character.png”（2分）保存摄像机图像的快照。字符必须完全包含在保存的图像中。如果保存了具有该名称的图像并且不显示该字符，则您将获得-1罚分。然后，您的程序必须通过将字符名称打印到带有文件名“ cluedo\_character.txt”（2分）的文本文件中来识别字符。如果创建了具有该名称的文件，但包含错误的字符名称，则您将获得-1分的罚款。

您可以从演示中获得的最低分数是0（零）分。换句话说，您不会因为处罚而变得消极。

您的程序最多有5分钟的时间来完成任务。如果在运行5分钟之后，您的程序尚未自行停止，则它将停止，并且您在该点之前收集的点将成为您的标记

Written Group Report

**Deadline:** Monday, 9 December, 10:00am

**Submission:** The report is to be submitted electronically in the VLE as a PDF file. Only one member of a group should submit this group report. (Please see below for the additional individual report, which should be submitted by *every* member of the group separately.) All code should be submitted into the group gitlab repo.

**Content:** Write up your solution as a group, as if it was a report to a client. This should be **no more than 10 sides**. In particular;

 Include details of the design options you considered and justification of why you chose the particular options you did.

 Describe how you have tested your solution. Give examples of different environments/maps you have created to test your program.

 Include in your report **images**, **a link to a video** and **data** to demonstrate that your solution works. Outline and discuss the limitations of your proposed approach. Suggest scenarios where it might not work.

 State any OpenCV/ROS codes you have used that are not part of the standard distribution.

 If you have tested your program on a real Turtlebot, report about any specific issues you had with your real robot implementation, and provide **a link to a video** showing your robot attempting the task. Feel free to use your smartphone to record this video and upload to youtube.

书面小组报告

截止日期：12月9日，星期一，上午10:00

提交：该报告将以电子形式在VLE中以PDF文件形式提交。小组中只有一名成员应提交此小组报告。 （请参阅下面的其他个人报告，该报告应由该组的每个成员分别提交。）所有代码都应提交到gitlab库中。

内容：将您的解决方案作为一个小组编写，就像向客户报告一样。这不应超过10个面。特别是;

•包括您考虑的设计选项的详细信息以及选择原因的理由。

•描述如何测试解决方案。举例说明您创建的用于测试程序的不同环境/地图。D

•在报告图像中包括指向视频和数据的链接，以证明您的解决方案有效。概述并讨论您建议的方法的局限性。建议可能不起作用的方案。

•说明您使用的所有OpenCV / ROS代码，它们都不属于标准发行版。

•如果您已经在真正的Turtlebot上测试了程序，请报告有关实际机器人实施过程中遇到的任何特定问题，并提供指向视频的链接，该视频显示了机器人尝试执行此任务的过程。随时使用智能手机录制该视频并上传到youtube。

**Markscheme:**

*Design (14 points):* Marks will be awarded for:

 Well designed solutions

 Justification of decisions and general knowledge of possible methods

 Novelty

 Likelihood of working in a wide range of environments and images (other than those provided)

*Implementation and Results (5 points)*: Marks will be awarded for:

 Efficiency/accuracy of reaching to the rooms, use of planning and search methods.

 Accuracy of identification of the room colors and cluedo character.

[so test results, numbers, figures and diagrams should be presented!]

*Real robot test (3 points): Marks will be awarded if you test your program on a real Turtlebot:*

 *Describing what needed to be done to make the program work on the real robot*

 *Describing how the robot performed in the real world*

 *A link to a video showing real robot attempt*

*Writeup (3 points):* Marks will be awarded for:

 Clarity of presentation of solution and results [N.B. Large chunks of code with no explanation are unlikely to gain high marks!]

 Discussion of the strengths and weaknesses of the system presented

 Presentation

 Use references to credit the resources you used, if any.

Markscheme：

设计（14分）：得分将授予：

•精心设计的解决方案

•决策依据常识和可能的方法

•新颖性

•可以在各种环境和图像中工作（除非提供）

实施和结果（5分）：得分将授予：

•使用计划和搜索方法，提高到达房间的效率/准确性。

•准确识别房间的颜色和线索字符。

[因此，应提供测试结果，数字，图形和图表！ ]

真实的机器人测试（3分）：如果您在真实的Turtlebot上测试程序，您将获得积分：

•描述使程序在真正的机器人上运行需要做什么

•描述机器人在现实世界中的表现

•链接到显示真实机器人尝试的视频

写作（3分）：满分：

•清楚说明解决方案和结果[注：没有解释的大代码块不太可能获得高分！ ]

•讨论引入系统的优缺点

• 介绍

•使用引用记入您使用的资源（如果有）。