Spider-bot is designed based on insect locomotion. Insects having 6 legs move on alternating sets of tripods. Three legs are always in direct contact with ground according to the illustration (Fig 1) the three black legs are those in direct contact with ground; while three legs are not in contact with ground. According to the illustration below (Fig 1) the yellow legs are being lifted and moved forward.

Three legs are always in direct contact with ground according to the illustration. To be more descriptive, rotate motor gear until the left side middle leg is at the lowest point and two other legs on same side are at their highest point. Now do the opposite for the right side rotate motor until the middle leg is lifted and two other are lowered. This is a statically stable walking gate as the robot will not tip over while standing. With other leg and walking gate configurations robots might also need to be dynamically stable.

This document will tell you some more about the SpiderBot and its design.

**About the design**

SpiderBot is a six legged robot whose goal is to move walk as fast as possible. The goal of this project is to build a fast walking robot (not necessary identical to the robot shown here) having any number of legs (6-legs, 2-legs, etc).

As it walks the robot must be able to detect a black line on the surface of a white background. The robot is required to follow such black line as fast as possible (e.g., faster that a LEGO robot with wheels) while following the desired path (Black line) as close as possible. For this the robot might have to be able to walk in different directions (e.g., turn, go back, etc). The robot should also detect objects actively (i.e., walls) and turn and walk away to avoid colliding with the walls. At the same time the robot should try to follow a line on the ground to help him decide in which direction to turn after it encounters an obstacle.

If you look at the picture on the top of this page, you'll see that the robot does not have sensors to perceive the terrains (Black line) not has ways to jump, etc. One of your tasks is to add sensors to the robot to enable it to perceive the terrains and move its legs according to the direction that the robot must travel (i.e., black line). At the same time you want to move the leg system such that is moves as fast as possible to avoid potential predators or the ability to capture its food. You can search on the Internet for videos of a number of walking robots that might achieve this and to figure out what is the best way to build your robot. The assembly instructions provided to build the SpiderBot robot are just a starting point as you might have to decide how many legs are needed to traverse as...
intended and maneuver to follow the desired path.

**Building instructions**

If you select to work on this project you will be given a step-by-step instructions on how to build a robot that might accomplish the desired goals. However please keep in mind that such building instructions might need to be changed to accommodate the needed requirements with just the pieces in the NXT 2.0 kit.

**Loading the program**

The final task if for you to program the robot to behave as expected (i.e., walk/run around happily following the black path). For this you will use the LEGO Minstromes software but you can also use Matlab.

When you have completed your program (or want to test parts of it) all you need to do is transfer your program to your NXT brick by following these steps.

- Launch the NXT programming software, and open your program.
- Connect your robot to the computer with a USB cable.
- Open the NXT window.
- In the window that pops up, select your NXT from the list, and then click the 'Memory' tab.
- Click 'Download'. Select the program you previously saved and click 'OK'.
- Using the same method, you can also download the following sounds to your robot: "Object Detected.rso", "Hello.rso", "OK.rso", "03.rso", "02.rso", "01.rso", and "Start.rso". You will find these files in the following folder:
  Program Files or Program Files (x86)\LEGO Software\LEGO MINDSTORMS NXT\engine\Sounds
- You can now close the NXT Window by clicking 'close'.

**Fig. 3:** An illustrative example of how your program might look like.
Comments:

- You will have to consider the reflectivity of the black area on the floor close to obstacles when programming your robot. This might be important as this will determine how good the robot detected the black vs white/concrete areas on the ground. The changes in the light might be responsible for the robot behaving in different ways.
- You might want to change the leg and number of legs design to enable it to walk faster and move effectively (statically and dynamically).
- You can include in your program a selection option where you select the speed at which your robot should move around. When testing your program you might want to test different walking gait patterns to see which one works best for your robot. If the walking aspect works then you can move and start considering 'slow' or 'fast robot motions in your program, and then proceed with wall detection (obstacle avoidance).
- You will need to calibrate your light sensor. For this, try running the robot under different light conditions.

Show your SpiderBot to the instructor to receive marks for your project.

You are required to show a working SpiderBot to the course instructor to receive credit for your work. When you are finish please disassemble your robot, pack away all the components that you were given and return the items to the course instructor who will check that everything is returned before you are given credit for your work.

Attention!
Students will be charged for the entire NXT kit and devices given if parts are missing!