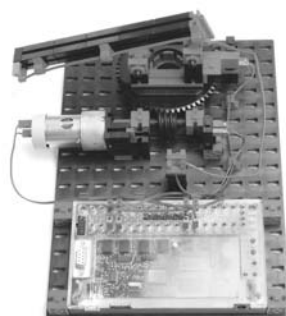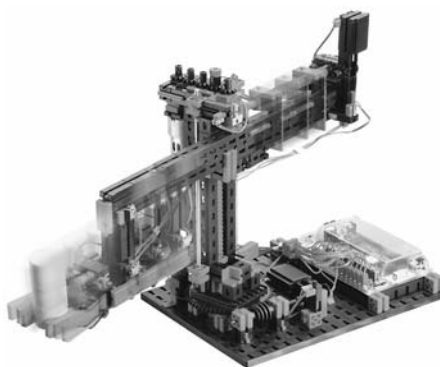## Robots

■ **one-axis**

■ **two-axis**

■ **three-axis**

How to assemble fischertechnik models properly

■ This is the best way to do it:

Read the instructions

Think about it

Assemble

Try it out

Check it over
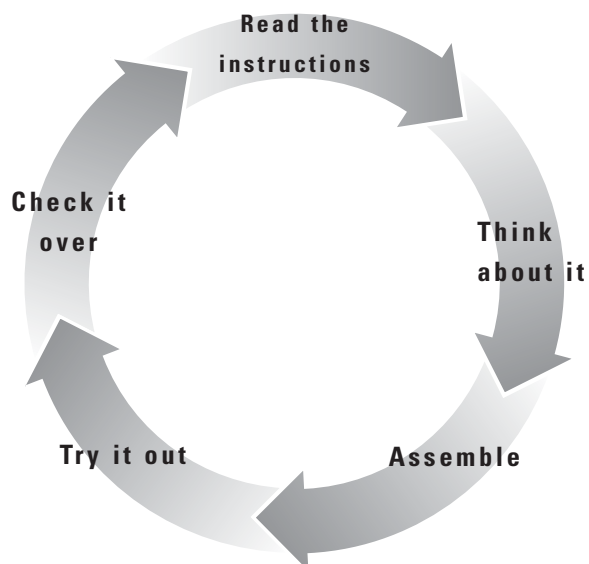
Now this is where the fun starts!

Instructions

■ What do the construction instructions "say?"

■ Are there assembly tips?

■ What is in the operating instructions for the ROBO interface and the ROBO PRO software handbook?

Think about it

■ What steps do I have to take?

■ What do I have to be careful with?

Assemble

■ Don't use force to assemble it!

■ Work quietly.

■ If it doesn't work the first time, then start all over again.

Try it out

■ Well, is everything okay?

■ Move the robot arm carefully.

■ Check the interface with the "interface test" if you have it.

Check it over

■ Is everything like it is supposed to be?

■ Are all parts firmly assembled?

■ Does the robot arm move correctly, not in a jerky manner?

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What is a Robot?

■ Robots are machines, which can make movements that are similar to those people make.

■ Just like us as humans, they have arms and joints, but only one hand.

■ Robots are needed for the manufacturing of lots of parts such as for cars.

■ Robots are used for work that is dangerous for humans and for very repetitive work.

Robot can do the following:

● Weld

● Assemble

● Paint

● Transport

… and lots more.

Where does the name robot come from?

■ The Czech writer, Karel Capek (1890-1938), wrote a play, in which machines similar to people work.
In his novel, R.U.R., which means Rossum's universal robots, he introduced the term "robot" in 1920, which was actually created by his brother, Josef Capek (1887-1945).

There has to be some order in life!

■ The sorting boxes, item No. 94828, along with the sorting plans, which you can cut out of the construction instructions, create more order and making things with your hands is simpler.

Sorting boxes

Einzelteilübersicht
Spare parts list
Liste des pièces détachées

Onderdelenoverzicht
Lista da piezas
Resumo de peça individual

10 497	6x	32 064	28x	35 112	2x	36 334	3x
31 060	24x	32 293	3x	35 113	1x	36 443	1x
31 061	14x	32 850	2x	35 142	1x	36 913	4x
31 078	3x	32 854	4x	35 214	1x	36 914	4x
		32 870	2x	35 409	3x	36 920	2x
31 336	24x	32 879	19x	35 668	1x	36 950	8x
		32 881	24x	35 696	1x	37 157	4x
		32 882	3x	35 697	3x	37 237	4x
		32 985	1x	35 945	6x	37 238	2x
31 597	1x	35 049	10x	35 969	9x	37 468	4x
31 707	6x	35 061	2x	35 973	1x	37 636	2x
31 848	4x	35 063	4x	35 975	2x	37 679	6x
31 915	1x	35 064	1x	35 977	1x	37 783	8x
31 982	21x	35 072	1x	35 981	1x	37 858	2x
31 983	4x	35 090	1x	35 035	1x	37 869	1x

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■ Don't forget that for the perfect robot with all of the extras you still need the ROBO interface, the ROBO Pro software and the power supply unit.

Of course you could place the robot in operation in another way, but you always get the best results with the original fischertechnik accessories.

First, check it over to see if everything is there according to the individual parts list

Important!

For the construction kit, Industry Robots II, you need the ROBO PRO version 1.1.2.40. If you have an older version of the software, you can update this at no cost with the **Help**-menu in ROBO PRO, **download the new version** or at

www.fischertechnik.de/robopro/update.html

To do this your computer must be connected to the Internet.

ROBO Pro Version 1.1.2.40 contains example programs for all models and a teach-in program for the three-axis robot.

ROBO PRO download the new version

■ To check to see if you have connected everything correctly for a model, the "interface test" function in ROBO Pro is an outstanding tool. For example, just connect the motor and test it with the "interface test."
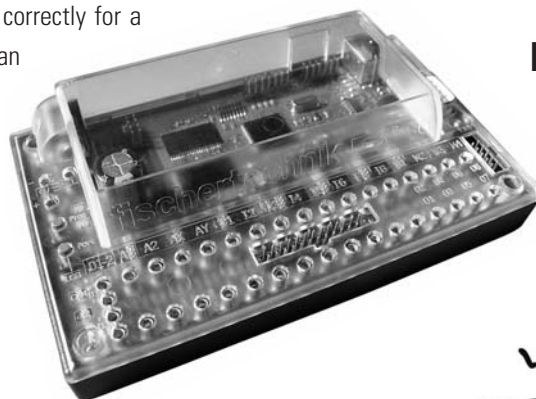
ROBO Interface

A total of three robots

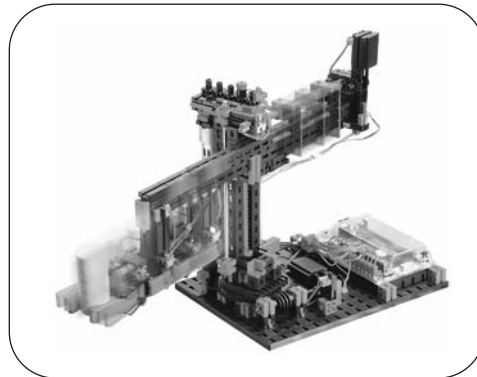■ Now the construction kit is lying in front of you and you can build a total of three robots with this kit.

One-axis welding robot
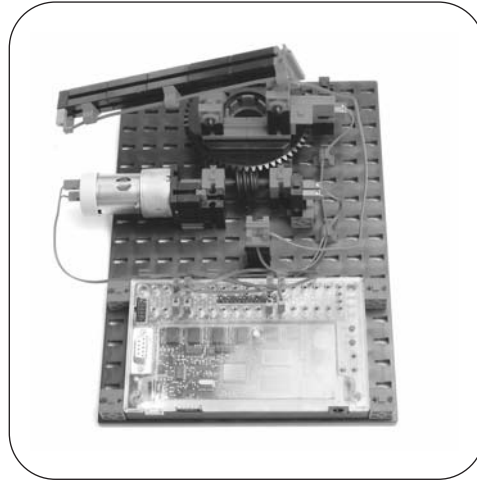
two-axis welding robot
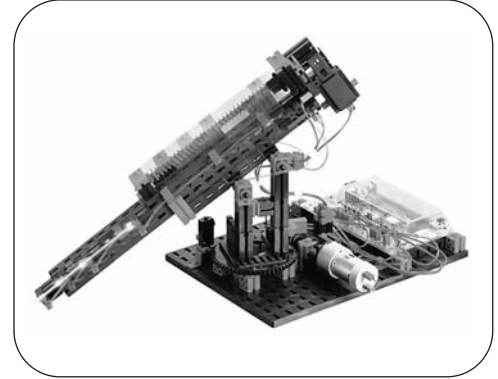
Three-axis robot

■ So that is not too difficult at the beginning, start with the smallest robot, the one-axis welding robot.

You'll see that this is a lot of fun.

■ Work according to the construction instructions that you find in the construction kit. It is important that you always work quietly and carefully and
don't try to use force. Look at everything carefully, read through everything
before you start and you'll see that it almost works by itself.

Okay? So, get started!

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■ Are you finished? Clear, no problem. Did you know that you can also learn some things about fischertechnik models in the Internet?
There is even a forum where you can get information if you have a problem and the address is www.fischertechnik.de.

■ You can find instructions about the ROBO interface and ROBO Pro software in a printed form.

■ Starting with version 1.1.2.40 for ROBO Pro, example programs are supplied for each model in the construction kit. Check out the file C:\Program files\ROBOPro\Sample programs\Industry Robots II.

■ If you are still not so fit at programming, take a good look at these programs and think about how they function and try to write your own programs.

■ If you want to operate the robot with other controls and programs take a look at the corresponding documents.

The one-axis welding robot

Before you turn on the welding robot you must check the following:

❏ Is the power supply okay?

❏ Are the wires connected correctly?

❏ Are all parts firmly assembled?

❏ Is the welding robot standing on a stable surface?

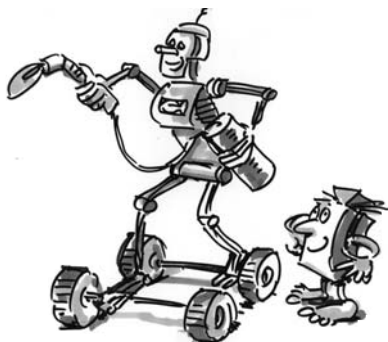❏ Can the welding robot move without bumping into something?
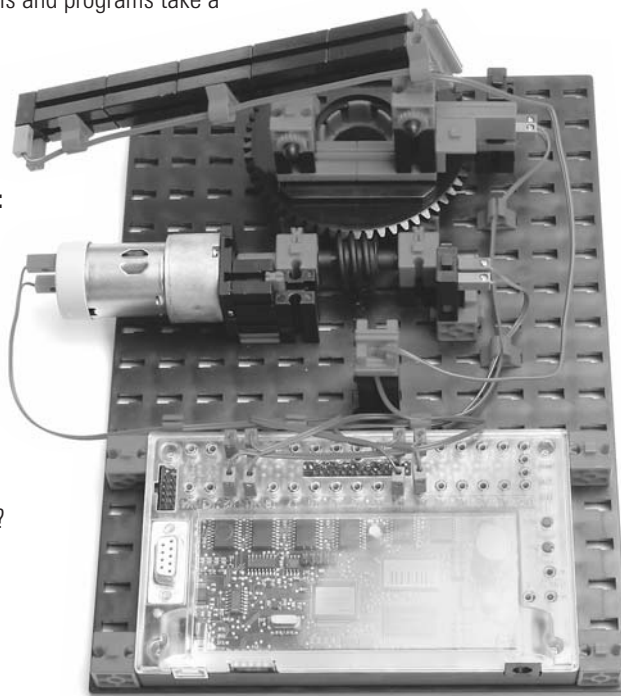
One task for these robots is making spot welds. Your robot can do this too. One professional task for you would be to program the robot now so that it can make spots welds on a yellow drum, which is supplied with the kit. A problem? Of course not!
Invent some of your own tasks and program them.
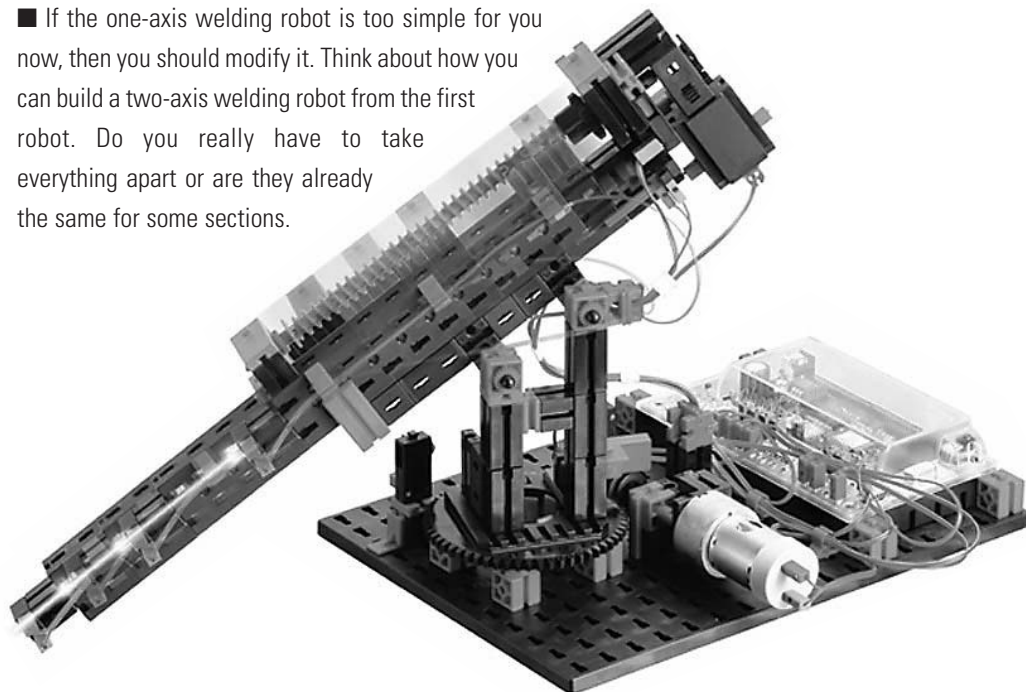Here is an example:
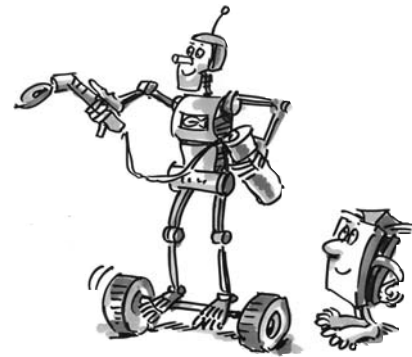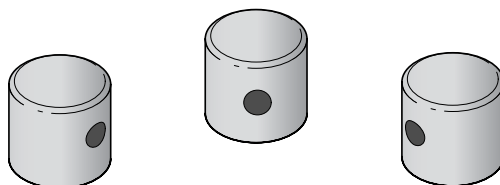
■ If the one-axis welding robot is too simple for you
now, then you should modify it. Think about how you
can build a two-axis welding robot from the first
robot. Do you really have to take
everything apart or are they already
the same for some sections.

The two-axis
welding robot

■ Compare the construction instructions closely
and think about how the modification can be
done the fastest and best. Okay?
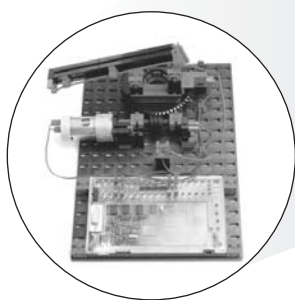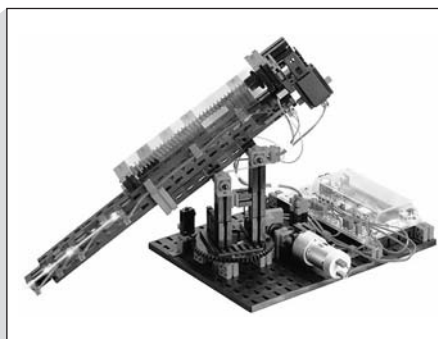
So, get started on the improved welding robot.

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■ Look at the welding robot very closely and quietly ….

Task

What do you think? What task can a welding robot perform? (For suggested solutions see page 32)

_____

_____

_____

_____

_____

_____

_____

_____

■ Important names for parts of a welding robot
(For solutions see page 32)

What are the names

of these parts?
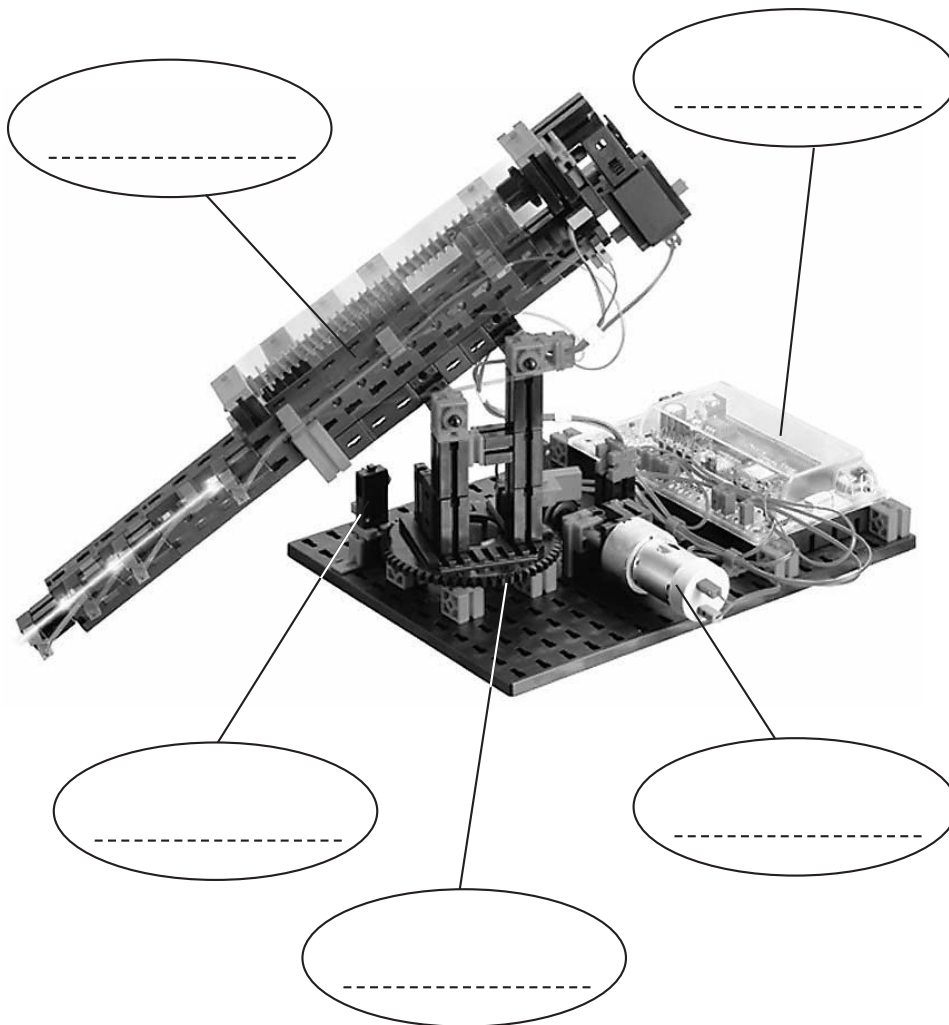
The two-axis welding robot -An exercise-

■ Finished? Then get started with the programming.

■ Before you switch it on, the exact same checks must be made as for the one-axis welding robot..

**Before you turn on the welding robot you must check the following:**

❒ Is the power supply okay?

❒ Are the wires connected correctly?

❒ Are all parts firmly assembled?

❒ Is the welding robot standing on a stable surface?

❒ Can the welding robot move without bumping into something?

■ Here are three other small programming exercises for this robot:

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The three-axis robot
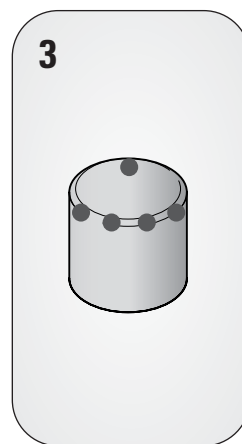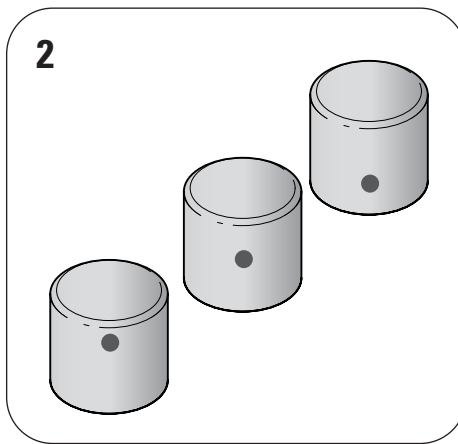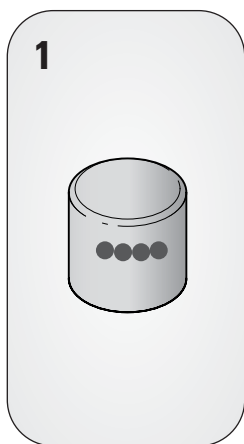
■ So, the first two robots were good for a start. Now, comes the big robot. Just continue to work as carefully as you have been and you will see that the big robot will soon be standing right in front of you.
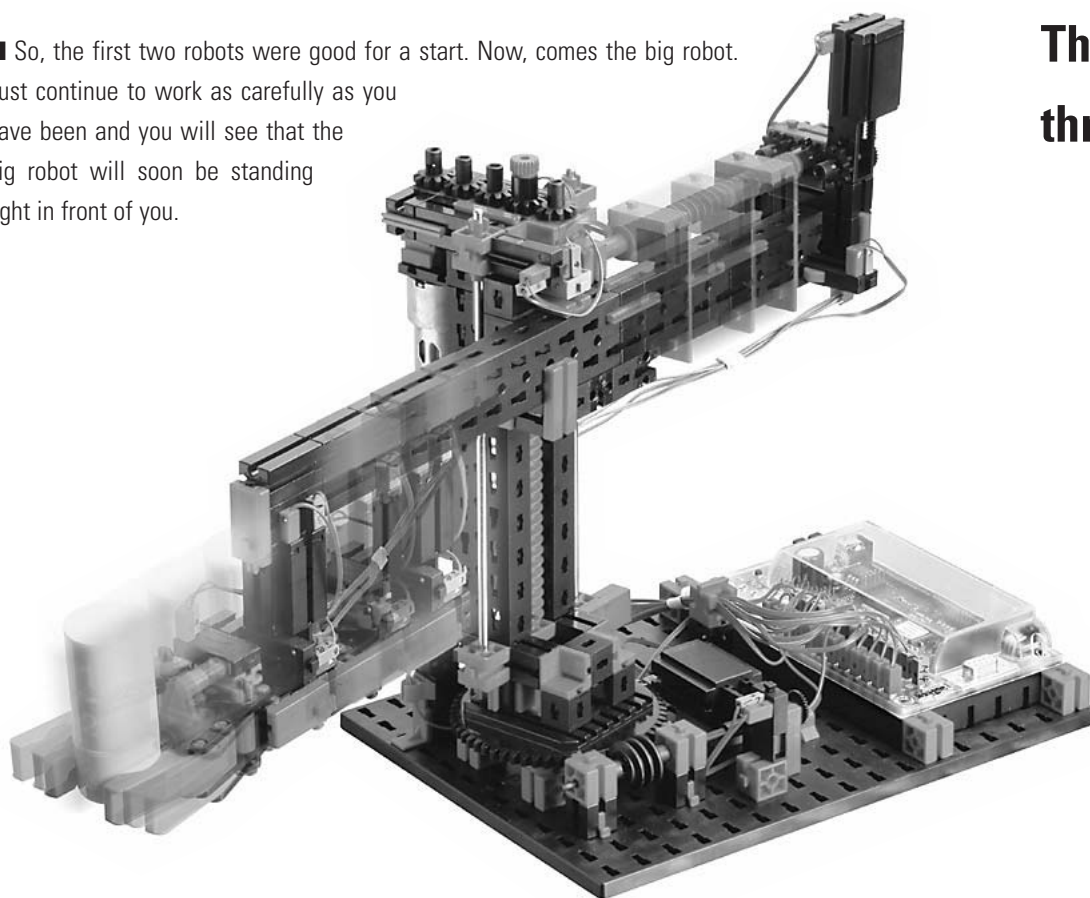
■ What all you can do with this robot is left up to your creativity.
You can have it stir cocoa or use it for useful work, but this is left up to you of course.

■ You can read how to program this robot on the next page. It is important that building the robot was fun.

■ Don't forget that every robot must be serviced. You can find information on this in the construction instructions as well.

■ If the robot stops working then think about what exactly could be the reason for the malfunction and how you can make a useful check to find the problem. Then make a systematic check to find the error. If necessary, write down what error occurred and how you repaired it. In this way, you can make your own servicing catalogue just like professionals and you can have fun with the robot for a long time!
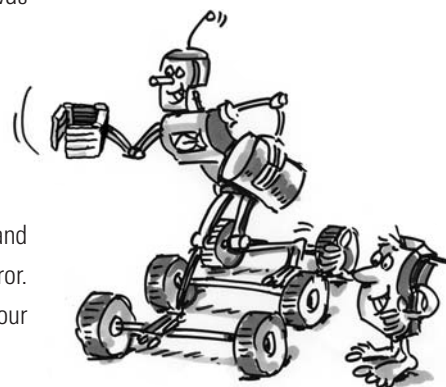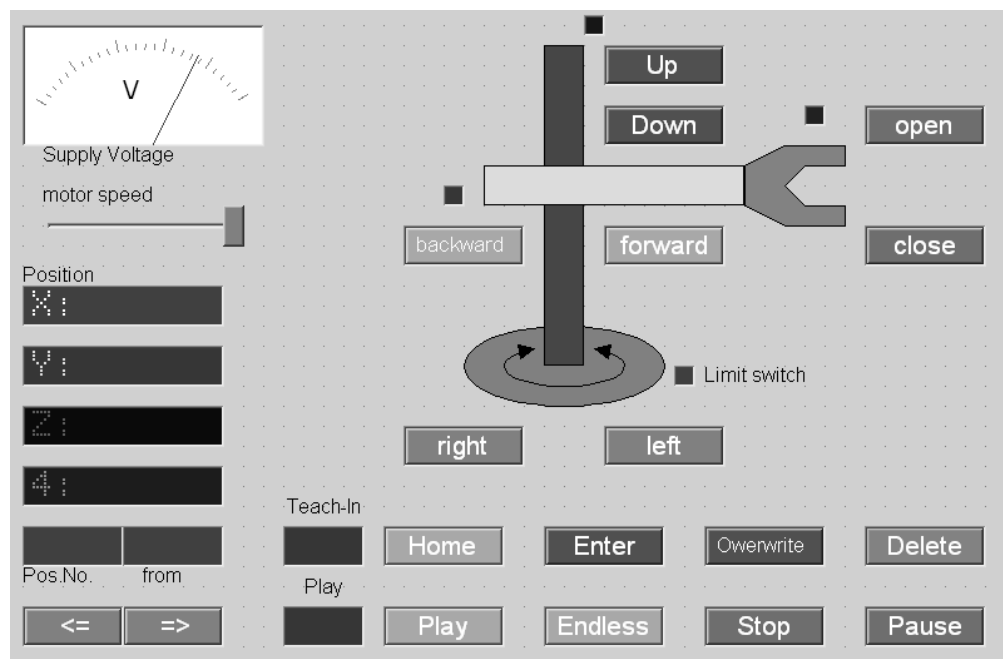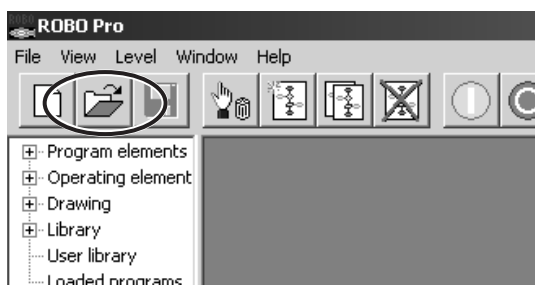
Programming the robot

What is a teach-in?

■ Now teach-in is a type of programming, which is used for industry robots. Teach (enter) means that you can move the robot to wherever you want with the keys on screen.

■ When you have moved the robot into the right position, then you can store this position: teach. When all positions have been entered, then you can let the program run and everything rotates and moves. This teach-in is a good invention, right??

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■ Load the teach-in programm into the computer. The program is located at C:\Program files\ROBOPro\Sample programs\ IndustryRobots II\TeachIn.rpp (starting with ROBO Pro version 1.1.2.40).

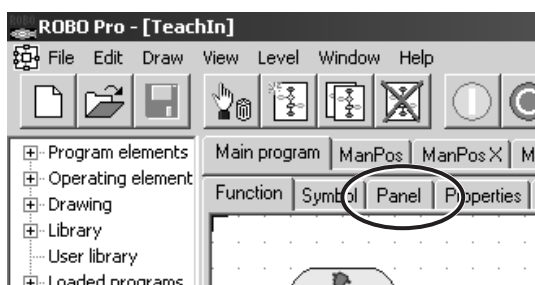## Fast programming of the three-axis robot
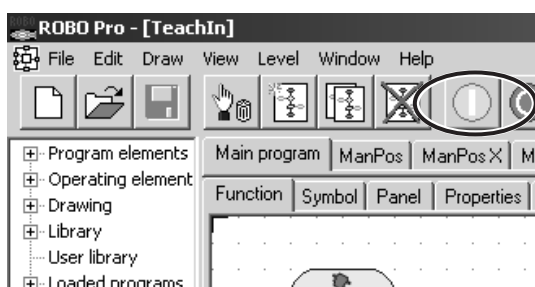
■ Start the teach-In program.
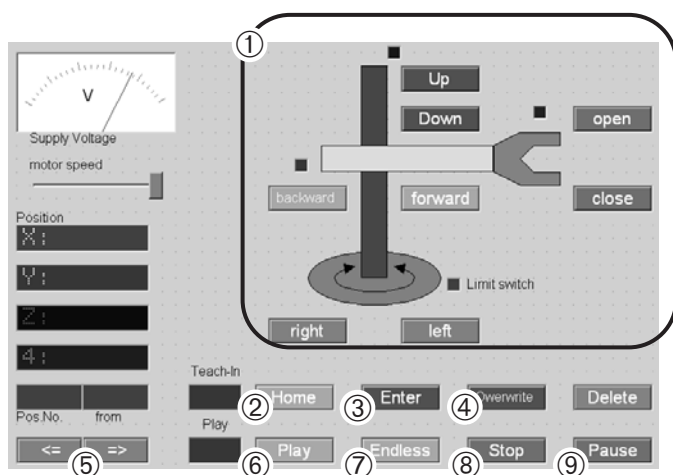
Load

Start

**Select the panel**

■ Select the panel to program the robot.

Buttons on the operator's console:

① Directional buttons for controlling the robot.

② Home = Robot moves to the starting position.

③ Enter = Storing the current position.

④ Overwrite, delete = Changing of existing positions.

⑤ Arrow keys = Jump to the previous or next position.

⑥ Play = Programmed sequence is started, all positions entered are moved to in sequence.

⑦ Endless = Sequence is continuously repeated.

⑧ Stop = Sequence is stopped

⑨ Pause = Sequence is interrupted and continues when the button is pressed again.
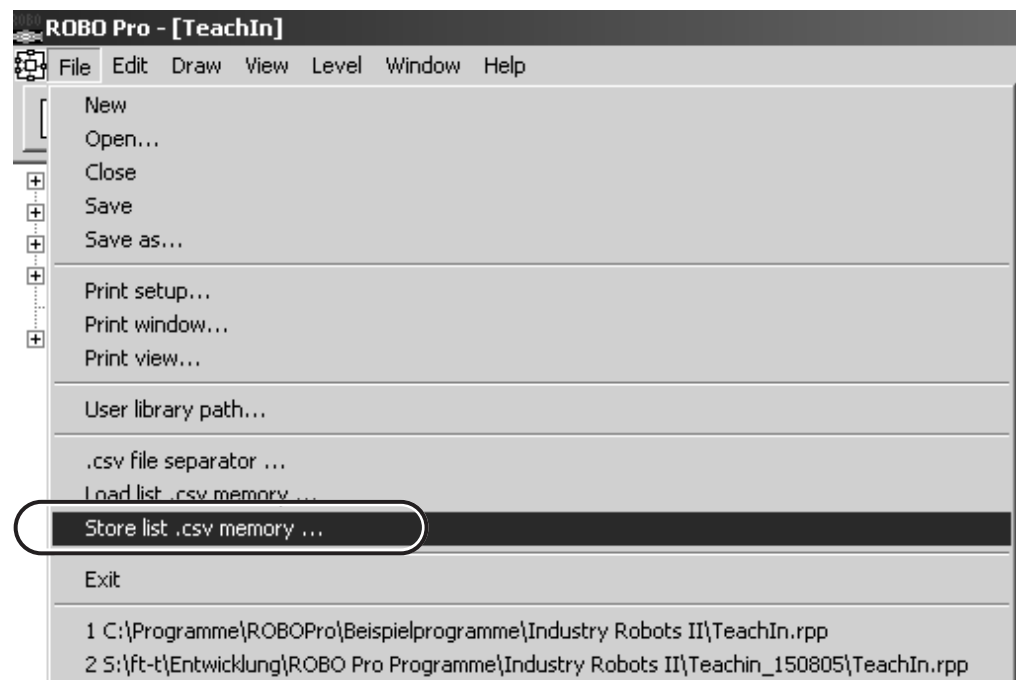
Buttons on the operator's console

Stop
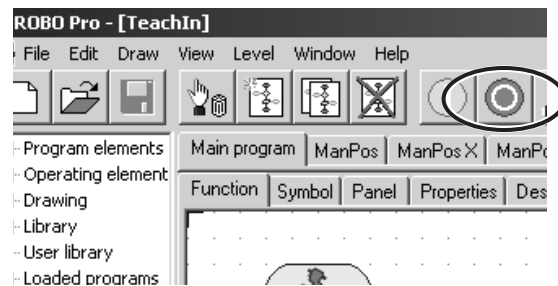
■ Stop the teach-in program.

Store

■ Store the programmed positions as a table in a .csv file before closing the teach-in program. You can reload them every time after opening of the teach-in program.

If you close the program without storing the positions then the positions are deleted.

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Towers of Hanoi

■ For specialists, here is another demanding task for the three-axis robot. This is an ancient mental game,which is called the "towers of Hanoi."

■ History
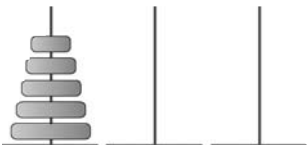
A monk in a monastery in Hanoi was given the task to move 64 disks from the first tower to the third one. There were three towers and 64 disks and they all had a different size and were provided in a certain order. It's a difficult task, but is solvable. But we only want to do this with three drums, which are numbered from one to three.

The rules are as follows

■ There are three "building sites" for drum towers.

■ On site one there is a tower with three drums numbered from one to three.

■ The drums have different "sizes". One is the biggest and three is the smallest and the "size" of the drums decreases in an upwards direction.

● The tower must be moved from site one to site three.
● Only one drum may be moved at a time and this is the highest one.
● You can never put a bigger drum on a smaller drum, for example, one may NOT be placed on two when stacking and number two NOT on three
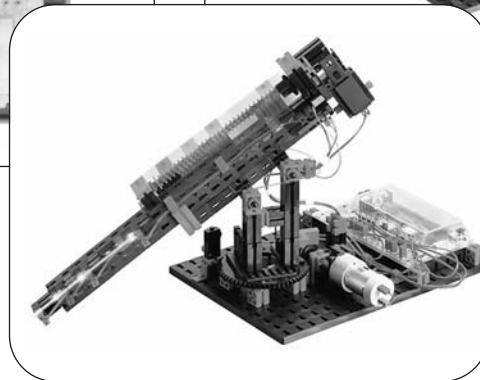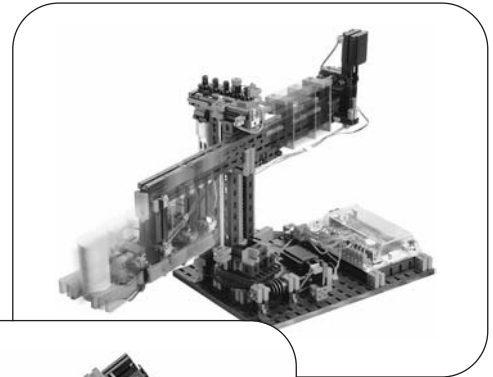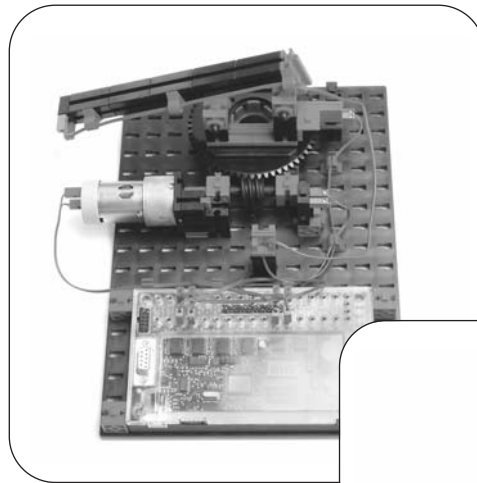
Have fun with the puzzle! If you can surf in the Internet, click your way to the subject of the tower of Hanoi. It's a nice exercise! And when the three-axis robot can do this then the others will be amazed! The solution is also in the example programs.

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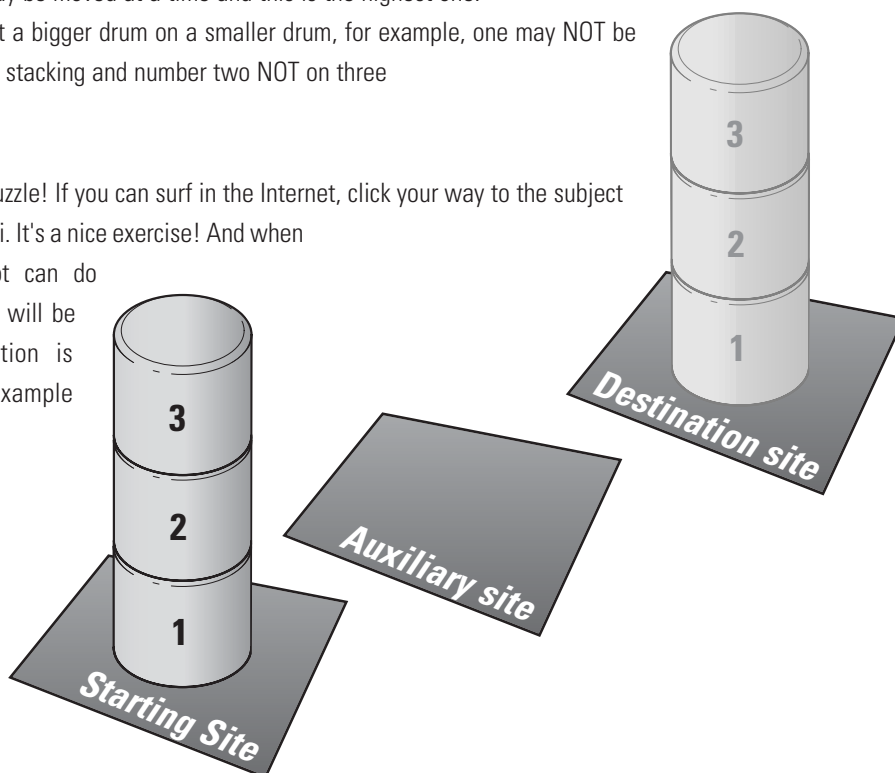
Worked out well though!
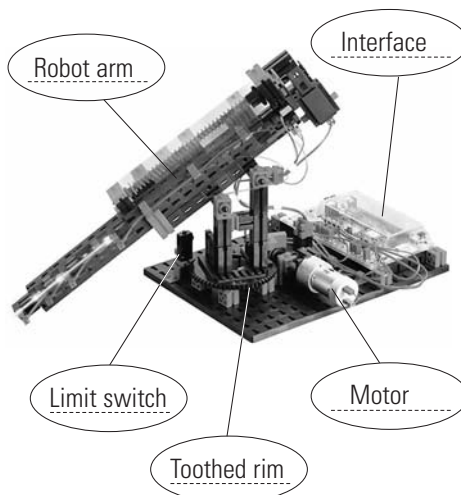# What you did is great!

Can you think of any other tasks for your robots? Have fun with your programming!

Solutions:

Solution:
Important names for parts of a welding robot

Robot arm

Interface

Limit switch

Motor

Toothed rim

Suggested solution:
What do you think? What task can a welding robot perform?

For example, a welding robot can make spot welds.
These spot welds connect metals so that they will not come apart. These spot welds hold better than screws. You can even make entire welding seams with robots. The welded joints can only be separated by destroying part of the metal. If you would put a car together with screws, it would certainly look funny and it certainly would not be stable. Or would you like to drive a car that's "got a loose screw?" Of course not.

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