

From LEGO to youBot: a new education path in service robotics



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EUROSURGE Workshop



Presentation Outline

Challenges in Robotics Education

Solutions adopted in the past

Device driven curricula

Robots are Coming



Scientific American, December 16, 2006

A Robot in Every Home, By Bill Gates

The leader of the PC revolution predicts that the next hot field will be robotics

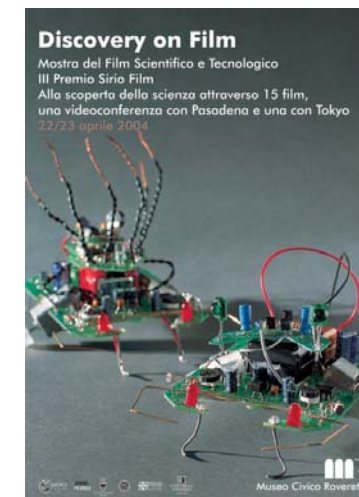
This statement was a bit premature, but it motivates the need for addressing robotic education in a different way than current academic programs

Past Approaches

- Programs have included:
 - Scientific Festivals
 - Student seminars and lectures
 - Teacher seminars and courses
 - Organization of broader activities
- However, the results have been very limited and with little impact, thus the need to develop a new strategy.
- No quantitative measurement has been put in place.

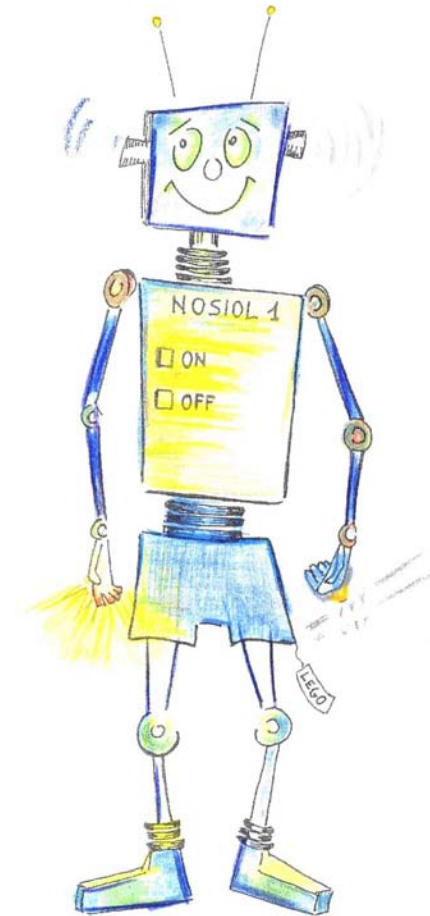
Scientific Festivals for Youngsters

- Discovery on Film, in cooperation with the Natural Sciences Museum of Rovereto
- Typical program includes (since 2001):
 - Scientific films in the morning with discussion and Q&A
 - Lectures in the afternoon for teachers and students
 - Lectures in evening for the general public
 - Exhibits of science projects (high and middle schools) and research projects



High School Courses

- High Schools:
 - Review of state of the art in robotics
 - Review of basic technologies
 - Description of robotic projects
 - Formal courses on Robotics and Automation in HS (with HS teachers)
 - Joint HS-University courses (Tandem)
- Middle Schools:
 - Focus on LEGO as a learning tool
 - Focus on general scientific subjects





Education Workshop



College Courses

The RoboticsCourseWare initiative:

Started in 2007 with a grant from IEEE R&A Society

Aims at collecting lecture material from known researchers and put it on the web, in a copyright free form.

It included 4 courses:

[Introduction to Autonomous Mobile Robots \(EPFL\), October 2003 - February 2004](#)

[Introduction to Robotics \(Harvard University, ES 159/259\), Spring 2007](#)

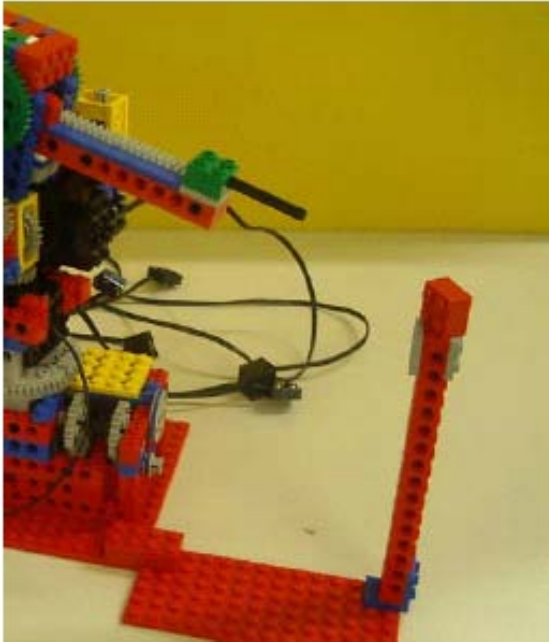
[Motion Planning and Applications \(NU Singapore, CS5247\), Semester 1, 2006-2007](#)

[Robotics: Science and Systems \(MIT, CSAIL 6.141\), Spring 2007](#)

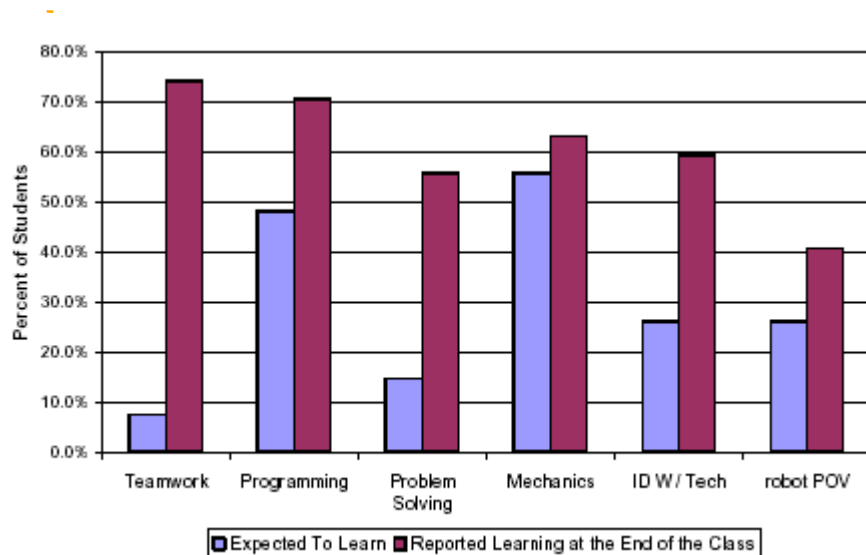
New courses to come before the end of the year



The CMU-RI experience (2004)



CMU Results



No significant differences from what boys and girls state to have learnt

Girls have started with less confidence, but show the largest increase in confidence at the end of the course.

Some comments:

It does not matter how difficult the problem is, we are able to solve it.

I learnt to be more confident in my own capabilities

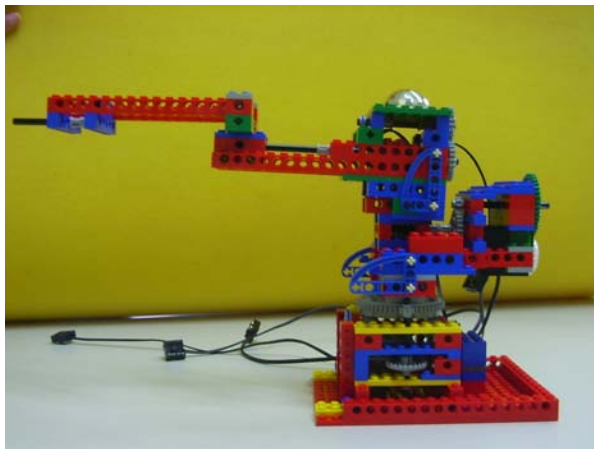
Team work requires lots of communication

I learnt that it is better to do something slowly than doing it twice.

TANDEM @ UNIVR



Andrea
Castellani e
Stefano Galvan
Università di
Verona --
2002-2008





KinePlay

Robotics Teaching Using LEGO®



Active learning
Laboratory activities involving students in doing things and thinking about what they are doing are necessary for teaching complex concepts such as kinematics.

Curriculum

- framework: Tandem High School/Univ cooperation
- 10 hours of mathematics at school
- 10 hours of robotics basic concepts at University
- 12 hours of laboratory in 3 days:
 - design, build and control a 3 dof robotic arm
 - reference frame definition and assignments
 - define Denavit-Hartenberg parameters
 - forward and inverse kinematics computation
 - sensors and actuators use



Lego® Mindstorm™

- low cost
- highly reusable
- robust
- tune the complexity
- famous
- enjoyable

An innovative way of "play" with robotic arms



BrickOS

- C and C++ via cross-compiling
- no limitation of variables number (RAM size)
- threads and objects utilization
- floating point numbers
- mathematical and trigonometric functions
- communication with USB tower via Inphost
- available for different platforms

Free download at <http://brickos.sourceforge.net>
<http://lnphost.sourceforge.net>

Soon available

- detailed handbook for teachers
- complete software solutions
- new curricula for University courses

<http://metropolis.sci.univr.it>

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IEEE International Conference on
Robotics and Automation
Rome, April 2007



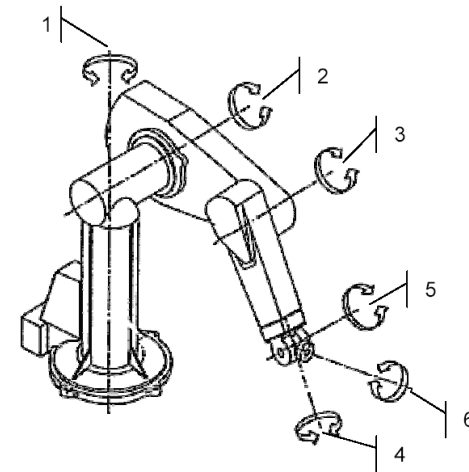
Kineplay Structure

Mathematical background (20 h)
(matrices, transformations..)

Robot Kinematics (10 h)

Laboratory experiments (12 h)

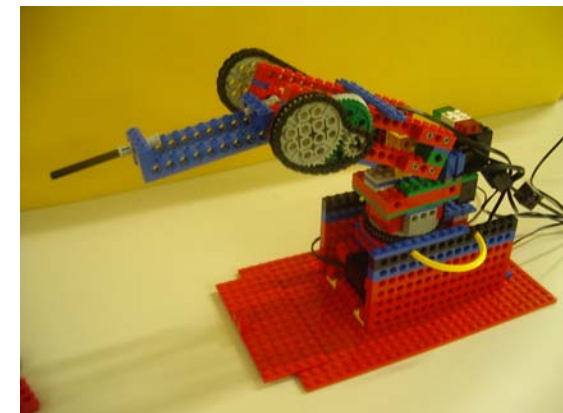
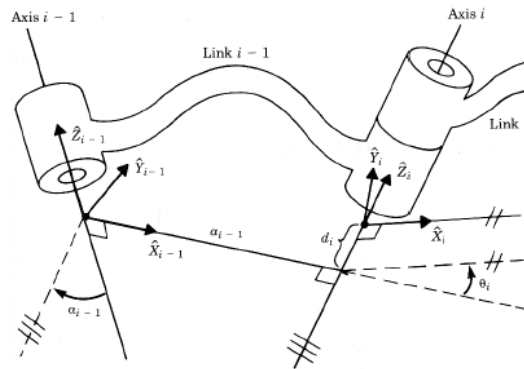
Self booting memory pen



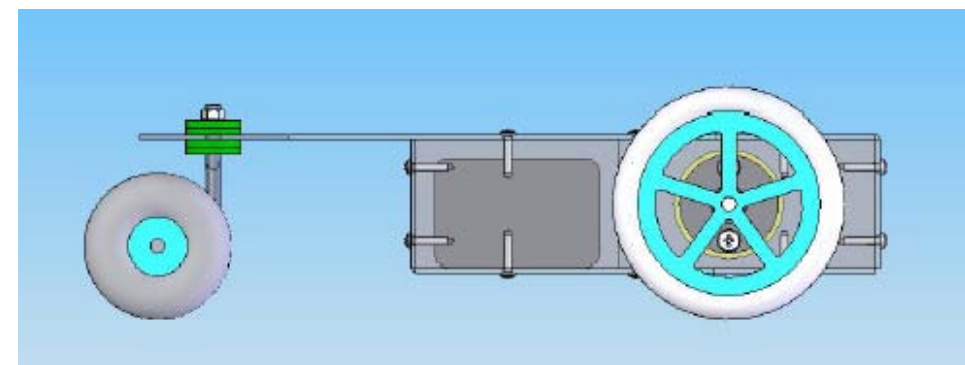
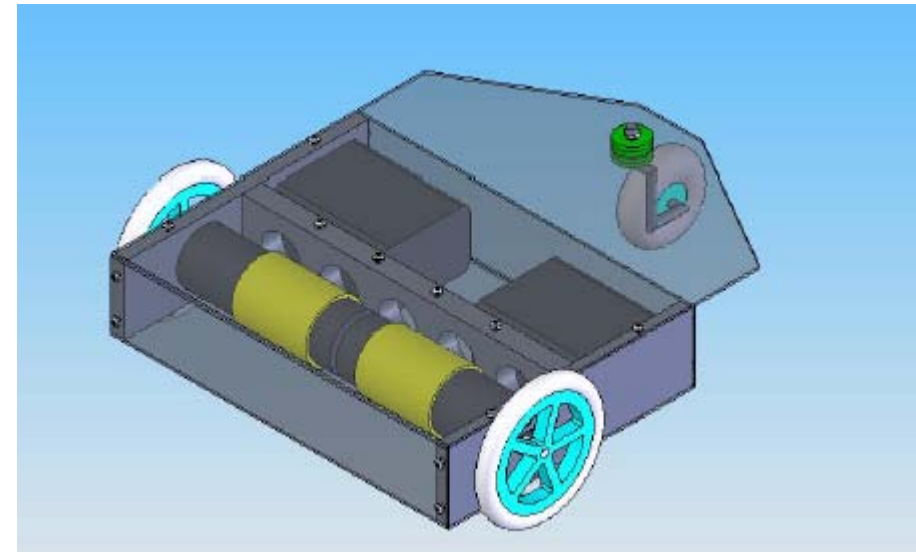
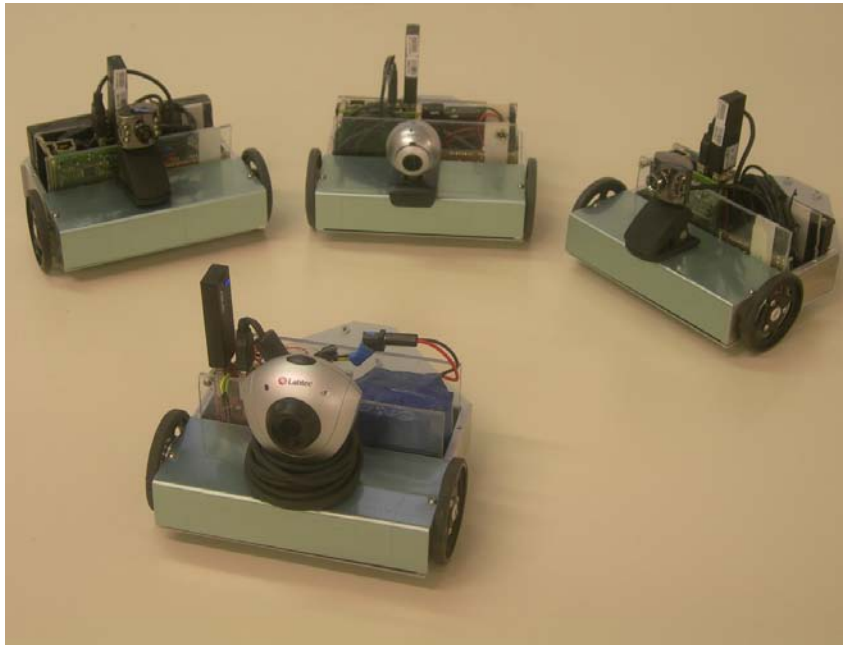
PUMA 200



PUMA 500



Eddy Educational Robot



Open Hardware and Software System

Welcome on Eddy Web Site

Eddy (Educational Device, Do it Yourself) is a Linux mobile platform for education, entertainment and research. It is based on an Embedded Linux System and custom electronic boards. It can be equipped with a webcam, bumpers, and infrared sensors.



EDDY: Educational Device: Do it Yourself!

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[HARDWARE](#)

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[BUILD or BUY?](#)

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Other Educational OpenSource Robots

TeRK

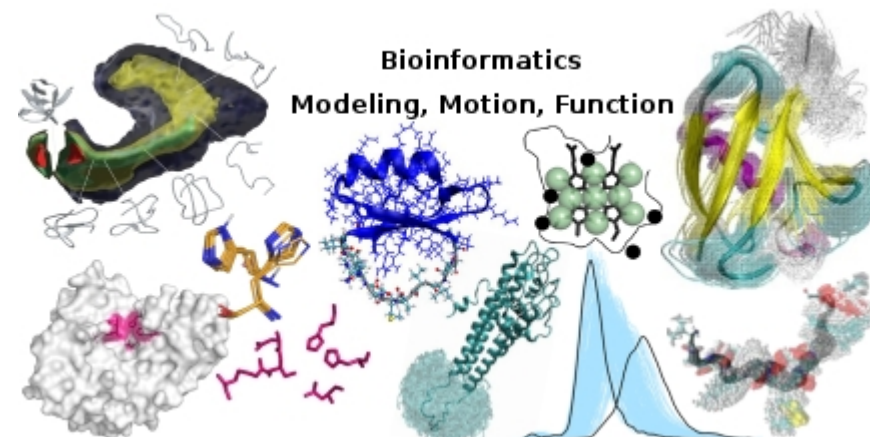
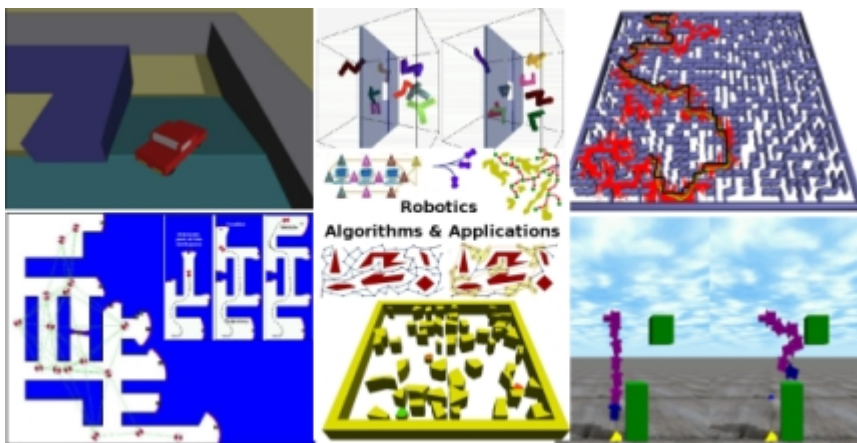
e-puck

Open Robotino

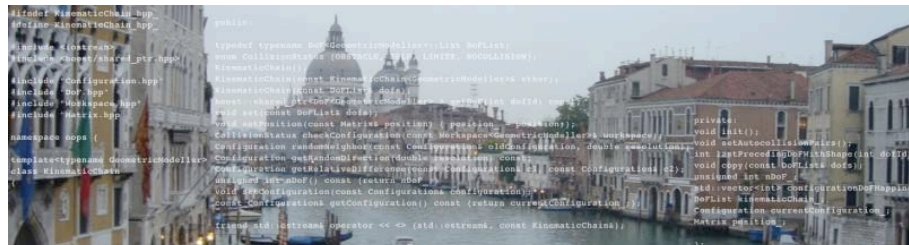
Planning and Execution Software



Kavvaki Lab



Doctoral Courses



International Conference on SIMULATION, MODELING and PROGRAMMING for AUTONOMOUS ROBOTS (SIMPAR 2008) **Venice(Italy) November, 3-7 2008**

IEEE Robotics and Automation Society (RAS) and International Foundation of Robotics Research (IFRR)
School of Robotics Science on Learning
Lazise, Italy, September 24-28, 2007

Background
The development of robust and intelligent service robots requires very advanced capabilities, especially from a cognitive point of view. Even in simple applications, a service robot needs to understand complex and dynamic situations, for which no pre-programmed function can be fully satisfactory. Thus the robot must continuously adapt to its changing world and develop ways to address, and possibly carry out, instances of problems for which it has not been instructed in advance. For these reasons, learning new skills, new settings and new ways to carry out a given task is one of the prerequisite of future service robots.

Goals
The 4th IEEE-RAS/IFRR Summer School aims at exploring various learning paradigms that have been proposed for robotics systems and, in particular, will pursue the ambitious objective of comparing their performance in a given situation.

Lectures
Lectures will address learning methods, among which the most prominent are:

- learning classification and regression trees
- reinforcement learning
- rule learning
- autonomous discovery
- neural networks
- skill learning

The laboratory part of the school, will be organized so that students will be able to use the learning tools available on laboratory robots and data sets for machine learning.

Public Colloquium
A workshop will be held on the first day to summarize the state of the art in robotic learning and its main applications.

Application
PhD students and postdocs are encouraged to apply. Attendance is limited to 40 students only. Details regarding cost of tuition and participation in the school will follow. It should be noted that students may only participate if they attend the entire week.

In order to be considered for participation, students are required to submit an application (in pdf) containing the following information:
Name and contact details, curriculum vitae, one page description of relevant current research project(s), motivation for participation, a letter/email of recommendation from their supervisor.
Applications for participation must be sent to both the organizers by electronic mail paolo.fiorini@univr.it and erwin.prassler@fh-brs.de no later than July 1, 2007.

Organization and coordination:
Paolo Fiorini, University of Verona
Erwin Prassler, University of Applied Science Bonn-Rhein-Sieg

Scientific Advisors:
Ivan Bratko, University of Ljubljana
Rüdiger Dillman, Universität Karlsruhe

For all the latest information (including registration, accommodation, academic and social programme,

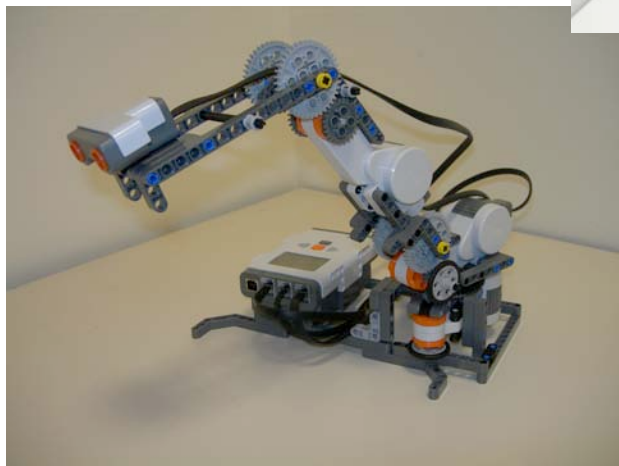
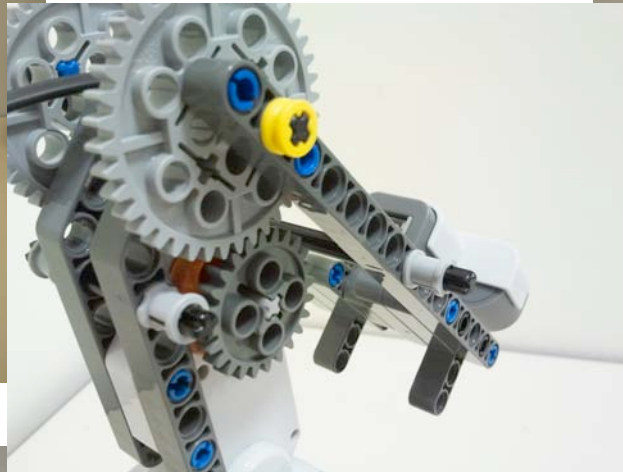
Limitations of the “Standard” approach

- It takes long time
- Does not address the needs of new jobs
- Does not match the complexity of real tasks
- Research oriented not “use” oriented
- There is no equivalent of “integrators” in Service robotics

- Thus the need of a new approach: the EDUFILL project.

- Develop professional competences without the need of a doctoral degree

Using Commercial Hardware: a LEGO NXT arm



Do not invest in
hardware
development but in
curricula





Develop a Curriculum for youBot





EUROSURGE Workshop



Thank You for Your attention!

