

# An Undergraduate Course in Robotics & Machine Intelligence

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## Introduction

- National Science Foundation MRI / RUI grant for 2003–2006
- activities center around intelligent systems
  - curriculum development
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- CSCI 585/682, *Robotics and Machine Intelligence*

## Course Organization

- Course websites:
  - <http://iris.ecst.csuchico.edu/courses/csci585>
  - <http://iris.ecst.csuchico.edu/courses/csci682>

# Scheduling

- twice a week
  - Tuesdays and Thursdays
  - 75-minute class period
- once a week
  - Thursdays
  - 170-minute class period

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  - includes 2–3 graduate students (team leads)
- students participate in
  - curriculum development
  - assisting in instruction
  - research demonstrations
  - setup and testing of exhibitions

## The College

- College of Engineering, Computer Science, and Construction Management
  - Civil Engineering (CIVL)
  - Computer Science (CSCI)
  - Construction Management (CMGT)
  - Electrical and Computer Engineering (EECE)
  - Mechanical Engineering, Mechatronic Engineering, and Manufacturing Technology (MEM)

Five departments with a combined offering of 11 degree programs.

## Prerequisites

- CSCI majors
  - CSCI 220, Assembly Language Programming
  - CSCI 311, Data Structures and Algorithms
- Non-CSCI (Engineering) majors
  - EECE 135, Algorithms and Programming for Engineers
  - EECE 221, Processor Architecture and Assembly Language Programming
- Others
  - Permission of instructor

## LEGO Mindstorms RIS 2.0



# LEGO Mindstorms RIS 2.0

## *Robotics Invention System (RIS) 2.0*



## LEGO Mindstorms RIS 2.0

### *BricxCC: Bricx Command Center for NQC*

The screenshot shows the Bricx Command Center window titled "Bricx Command Center - [test.nqc]". The main editor contains the following NQC code:

```
task main() {  
  OnRev (OUT_A);  
  OnFor (OUT_A+OUT_B, 100);  
}
```

An inset window titled "Code listing of test.nqc" displays the compiled task's execution log:

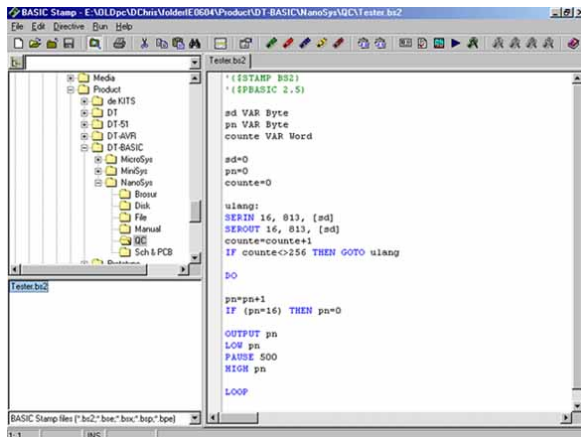
*** Task 0 = main		
000 pwr	ABC, 7	13 07 02 07
004 dir	ABC, Fwd	e1 87
006 dir	A, Rev	e1 01
008 out	A, On	21 81
010 out	AB, On	21 83
012 wait	100	43 02 64 00
016 out	AB, Off	21 43

Below the log, it states "Total size: 18 bytes". The status bar at the bottom shows "4: 1", "COM1", "RCX", and "Insert".





## Basic Stamp Editor



## Course Activities and Exhibitions

- Activities are designed to introduce students to robot platform-specific features

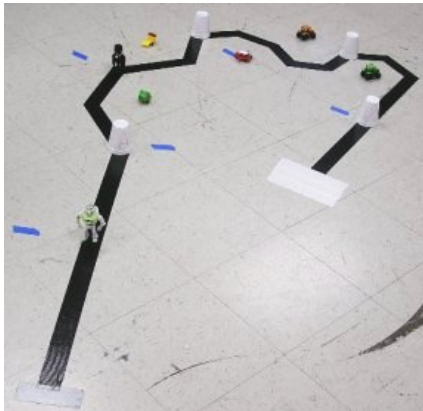
## Course Activities and Exhibitions

- Activities are designed to introduce students to robot platform-specific features
- Exhibitions are described using *AIMA*-style (Russell & Norvig 2003) PEAS:
  - **p**erformance measure
  - **e**nvironment
  - **a**ctuators
  - **s**ensors

## Mindstorms: Mission Mars I



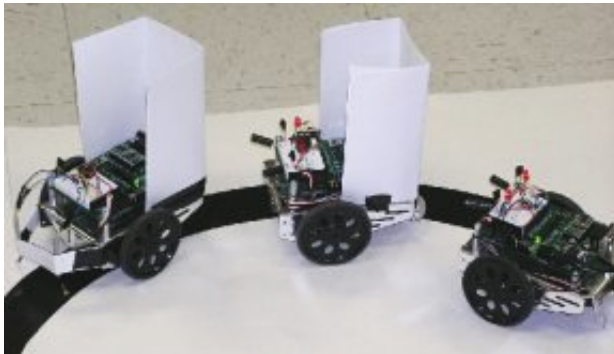
## Mindstorms: Mission Mars II



## 2D-Maze Cave Rescue



## Convoy



## 3D Grid Maze





## Micromouse Challenge



## Team Garbage Collection



## Gender and Classification

Sem/Yr	Gender		Classification				
	F	M	FR	SO	JR	SR	GR
Sp/2004	1	32	0	0	3	20	10
Fa/2004	4	16	0	0	2	10	8
Sp/2005	1	7	1	0	1	5	1
Fa/2005	3	16	0	0	3	12	4
Fa/2006	0	11	1	0	0	10	0

## Major/Degree

Sem/Yr	Major				
	CINS	CSCI	EECE	MECA	Other
Sp/2004	1	22	3	6	1
Fa/2004	5	12	0	2	1
Sp/2005	2	4	0	1	1
Fa/2005	2	14	0	3	0
Fa/2006	0	7	2	1	1

## Lessons Learned

- Workload management
  - team-teaching
  - instructional support

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- Workload management
  - team-teaching
  - instructional support
- Logistics
  - cost to student
  - power source
  - maintenance: robot and exhibition parts
  - team work
  - target two exhibitions per platform
  - number of platforms

Feature	LEGO Mindstorms	Parallax Boe-Bot
processor	Hitachi H8 series 8-bit, 16 MHz 32 KB RAM 16 KB ROM	BASIC Stamp 2 <sup>1</sup> 8-bit, 20 MHz 32 B RAM 2 KB EEPROM
input	four buttons three sensor ports IR interface	16+2 dedicated serial I/O (USB available)
output	built-in LCD screen one internal speaker three actuator ports	breadboard
ISA	57 instructions variable firmware multi-tasking support	33 instructions
coding	RIS 2.0 GUI NQC, Java, Lisp	PBASIC

<sup>1</sup>Microchip PIC16C57c

## LEGO Mindstorms NXT





Introduction  
Course Organization  
Robot Platforms  
Course Activities and Exhibitions  
**Discussion**  
Summary, Conclusions, & Recommendations  
Q & A

Demographics  
Lessons Learned  
Mindstorms vs. Boe-Bots  
**Potential Alternates**

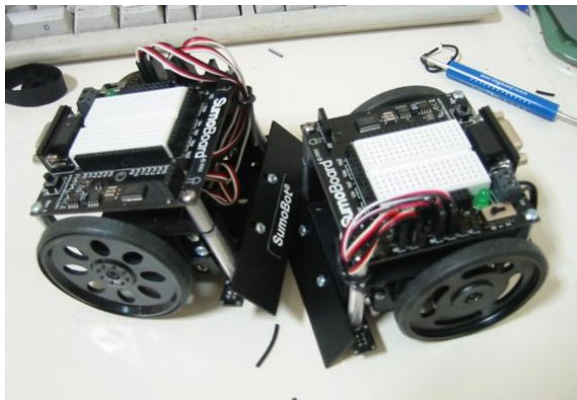
## Vex Robotics Design System



got bots?  
www.gotbots.org



## Parallax SumoBot Robot Kit



## Summary, Conclusions, & Recommendations

- Maintenance: funding and cost
  - grant
  - external funding

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- Team-teaching
  - have trained student assistants for instructional support
- Integrate robotics competitions/exhibitions
- Work with multiple robotics platforms

## Questions?

