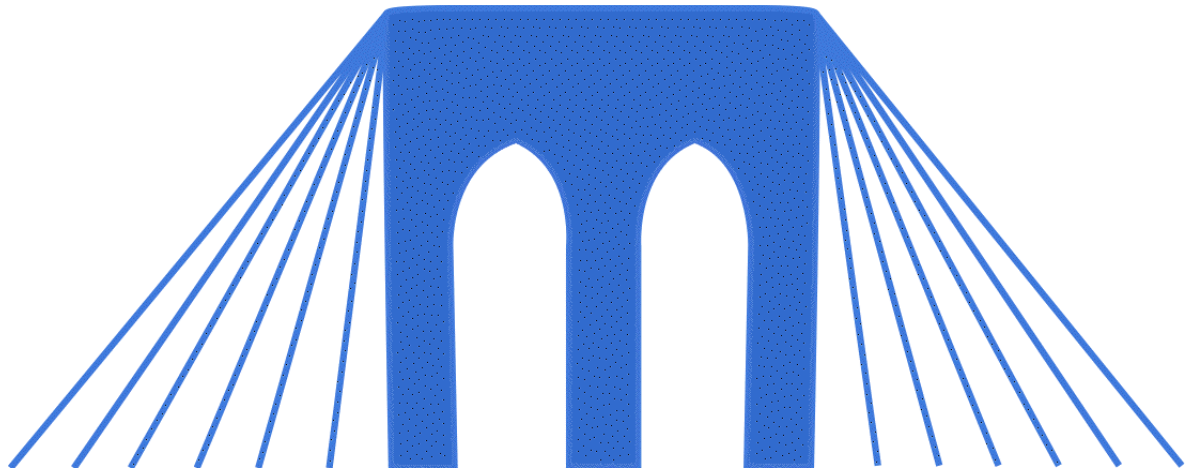
Bridges To Computing



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Introduction to Robotics
Lecture 2

Bridges to Computing
2011
M. Meyer

Topics:

- What is a robot?
- Robot Components
- Introduction to the course robots (RCX)
- Programming in Robolab

Robot Definition

- A robot is an autonomous system which exists in the physical world that can sense its environment and act on its environment to achieve some goals.

- Robotics: The study of robots: their design, construction, capabilities and purpose.

(3) Robot Components

- A robot is an autonomous system (agent) which exists in the physical world (is embodied), that can sense its environment (including its own internal state) and act on its environment to achieve some goals.

- So our robot must have:
  1. A body
  2. Sensors
  3. Effectors
  4. A controller

(3) Embodiment

- In a software environment (ex: a game world) we get to make the rules, and we can let an agent do anything we want.
- In the real world:
  - The laws of physics apply (gravity, friction, entropy).
  - Objects can't overlap (collision avoidance).
  - Physical bodies have range, strength, distance and shape limitations.
  - Physical bodies have time limitations.

(3) Sensing

- A robot gathers information about its state and the environment via sensors.
- Sensors can be classified as active and passive.
- Typically a robot has a suite of sensors capable of monitoring numerous features, such as battery level, odometry, and distance to nearby objects.
- With this information, the robot can determine its current state.
- The robot can then use this state information to decide what actions are appropriate.
- In the end, all sensors, are converting a physical property, into an electronic signal.

(3) Types of Sensors

Property being sensed	Type of sensor
contact	bump, switch
distance	ultrasound, radar, infra-red, laser
light level	photo cell, camera
sound level	microphone
smell	chemical
temperature	thermal
inclination	gyroscope
rotation	encoder
pressure	pressure gage
altitude	altimeter

(3) Action

- Effectors enable a robot to take action, to change the state of the world (including its own position).
- Actuators are the underlying mechanisms (muscles, motors, solenoids) which do the actual work.
- Main action activities are:
  - Locomotion (moving around)
  - Manipulation (handling objects)
- Degrees of freedom: Refers to the range of motion, the dimensions in which a manipulator can move

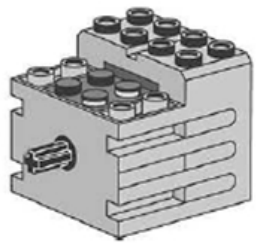
(3) Controllers

- Robots utilize small, highly specialized computers to allow them to reason about their world.
- The kind of reasoning employed varies (reflexive reasoning versus "intelligence").
- We can talk about two kinds of intelligence in our controllers.
  - Reasoning (if/then)
  - Learning (this is what the past was like...so...)

(3) State

- May be hidden, partially observable, observable (don't have perfect knowledge in the real world).
- May be discrete (0/1) or continuous (3.33 m/sec).
- State space refers to all of the possible values (may be infinite) that a systems state could be in.
- We can conceptualize both an internal and external state space.
- Robots may carry around a representation (model) of the external world, as part of their internal state.

Robotics Command Explorer (RCX)



- The RCX is the controller (the brain) of the MINDSTORM.
- It has:
  - An IR transceiver
  - 3 input ports (1-3)
    - light sensors
    - bumpers
  - 3 output ports (A-C)
    - motors
    - lights

(3) For the Hardware Junkies

hardware	*spec*
Processor	8-bit Hitachi H8/3292, 16 MHz
ROM (Read Only Memory)	16 KB
SRAM , on chip	512 bytes
SRAM (Random Access Memory), external	16 KB
Outputs	3 motor ports, 9V 500 mA
Inputs	3 sensor ports
Display	1 LCD
Sound	1 sound unit
Timers	4 System timers (8-bit)
Batteries	6x 1.5V
Power adapter (only in RIS 1.0)	9-12V, DC/AC
Communications	IR port (transmitter and receiver)

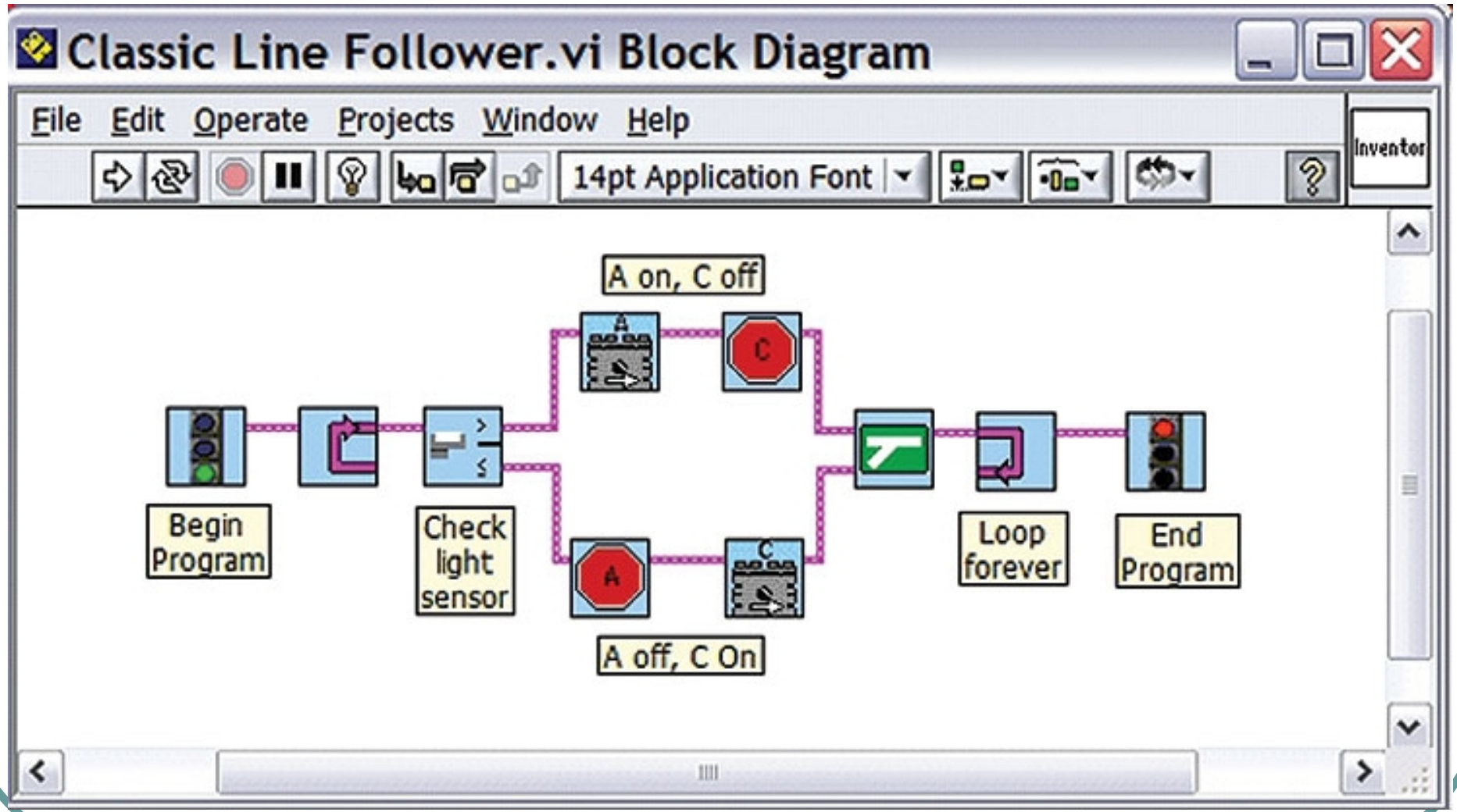
(3) Programming

- You will write your programs on a computer and download them to the RCX using an IR transmitter ("communications tower").
- We will use Robolab a VPL (Visual Programming Language) IDE (integrated development environment) to write our programs.
- There are other program interfaces to the RCX.

Imperative Programming in Robolab

- There is an example program on the next slide.
- Discuss the program and see if you can identify the following Imperative paradigm components:
  - Sequence (what is the order of commands?)
  - Selection (where is a choice made?)
  - Repetition (what section of code loops?)

Line following with Robolab



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