6.270: Autonomous Robot Design Competition

- Welcome
- Lab and class orientation
- Overview of course and schedule
- The Contest
- What's in your kit
- Assignment 1 handed out
- Kit distribution

Lecture 1: Getting Started

Who We Are

- 7 Organizers prepare contest all year

- 7 TAs help during IAP

- We are students who have taken 6.270

- Each team assigned to one Organizer and TA

- Introductions will be made at the end, with kit distribution

Communication

- Mail
- Web
- Best way: talk to staff in lab

Lab

- Lab Hours:
  - Weekdays: 9 am – 11:45 pm
  - Weekends: noon – 10 pm
  - Extended lab hours in last week, of course

- Cleanliness, etc… or else!
  - We will take away LEGO
  - And during the last week, please remember to take showers

Getting Credit

- 6 units general elective credit P/F, 6 EDP's
- Decide if you want credit by the time you get assignment 1 checked off
  - Tell us your student ID number at assignment 1 checkoff
- Criteria for receiving credit:
  - Qualifying robot
  - Timely completion of all assignments
  - Robot web page, due at end of course – *NO EXTENSIONS!*

Overview of Course

- First week
  - Soldering
  - Basic LEGO structure and bracing
  - Programming the HandyBoard
  - Making motion—actuators and gearboxes
  - Using the RF data
  - Digital sensors (mechanical)
  - Build your first complete robot

Overview of Course

- Second week
  - Coding paradigms
  - Using unique LEGO pieces
  - Robot behavior
  - Analog sensors (color-sensing)
  - Shaft encoders
  - Servos
  - Begin building competition robot

Overview of Course

- Last two weeks
  - Build competition robot
  - Debug
  - Live in lab (willingly?)

Schedule – Lectures

- Lecture 1, January 3, Monday, 10 am
  - Welcome
  - Contest Description
  - Kit Distribution
- Optional Evening Lecture, January 4, Tuesday, 7 pm
  - Basic C syntax
  - Coding Paradigms
- Lecture 2, January 5, Wednesday, 10 am
  - Electronics
  - HandyBoard / Interactive IC
- Lecture 3, January 7, Friday, 10 am
  - Servos, Sensors, Shaft Encoders
  - Robot Behavior
  - Threads

Schedule – Workshops

- Seven workshops this year
- Can help you finish this week's assignments
- Meet in various places
  - Third floor rooms
  - Sixth floor, 6.111 Lab

Schedule – Workshops

- Start at 1, 2, 7, 8 pm

- Workshop discussion and activity take one hour

- Limited space available, signups available in 6th floor lab by 6.270 office

Schedule – Workshops

- Signup TODAY!
- Monday, January 3, and Tuesday, January 4
- Workshop 1 – Basic Techniques of LEGO Assembly
  - Basic LEGO infrastructure
  - Review of basic LEGO pieces
- Workshop 2 – Motor Mounting and LEGO Gearboxes
  - Building a gearbox
  - Mounting motors onto your robot
  - Make a gearbox (Assignment 2)

Schedule – Workshops

- Signup after Wednesday's lecture
- Wednesday, January 5, and Thursday, January 6
- Workshop 3 – Electronics Assembly
  - How to solder
  - Soldering RF receiver (Assignment 2)
- Workshop 4 – Code & Sensors I: Basic Control and Robot Skills
  - Programming the HB (Assignment 2)

Schedule – Workshops
(Next Week)

- Signup after Friday's lecture
- Monday, January 10, and Tuesday, January 11
- Workshop 5 – Servos, Sensors, and Shaft Encoders
    - Using analog sensors
    - Servo – the other motor
    - Shaft encoding with breakbeam sensor
    - Accelerometers to detect tilt
- Workshop 6 – Advanced LEGO
    - Using the unique pieces
    - Interesting gadgets
- Workshop 7 – Code & Sensors II: Advanced Techniques
    - Open vs. closed loop control
    - Line following

Schedule – Deliverables

- **Seven Assignments**
  - Due Tuesday (1/4), Thursday (1/6), Friday (1/7), Tuesday (1/11), Friday (1/14), Tuesday (1/18), Friday (1/21)
  - Available online
- **Web Page – Saturday, January 29, 11:59 pm**
- **A Qualifying Robot**
- **Tuesday, January 25 – Impounding, 5 pm**
  - Assuming robot qualified
  - Opportunity for staff to make sure robots have no rules violations
  - No further work on robot may be completed at this point
  - ***NO EXTENSIONS!***

Schedule – Contest Week

- **Mock Contest (for the early birds)**
  - Friday, January 21, 7 pm
- **Contest, Qualifying and Seeding Rounds**
  - Sunday, January 23, 10 am
  - You can lose *and* qualify!
- **Contest, First and Second Rounds**
  - Wednesday, January 26, 10 am
- **Contest, Final Rounds**
  - Wednesday, January 26, 6 pm
- **Lab Cleanup**
  - Thursday, January 27, 2 pm
  - One person-hour per team, like Parts Sorting – **MANDATORY**

The Contest…

A short time from now, in a galaxy very close by, the masses are in unrest.

The non-trademark-infringing Gedi Knights Council, droid masters, guardians of the free world, and practitioners of the ancient interlocking plastic brick arts, have suffered a huge loss. Their former leader, Chin-wala-kane-ra, better known as "Chuck", has transcended to a higher plane of existence, and no longer will be around to keep the masses in check. An election will be held to determine "Chuck's" replacement, for without a leader, the Gedi Knights will be powerless to stop the ever-growing threats of all-nighters in lab, freshman showering, and Red Sox fans.
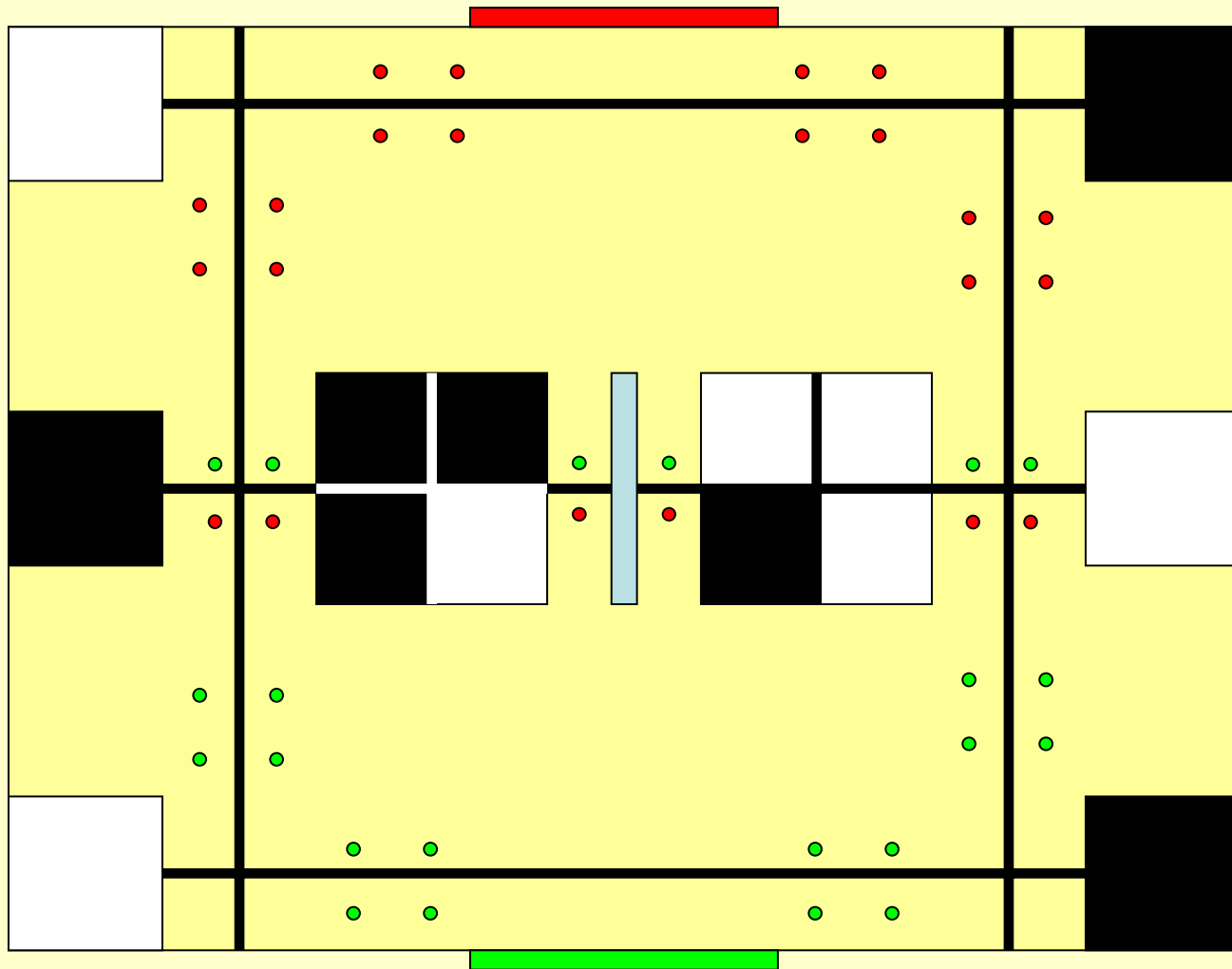
2005: Attack of the Drones

May the torque be with you!

A Second Contest!

- We need a t-shirt design!
  - Family friendly (please)
  - Non-trademark infringing
- Submit entries by Monday, January 10, 5 pm
  - 4 color designs (no grayscale)
  - Winner gets fabulous prizes (LEGOs, shirts, etc.)

Contest Rules: The Fine Print

- **Competition rounds**
  - Qualifying rounds do not count for losses, but count for seeding
  - First and second rounds can lead to elimination before final rounds
  - Seeding based on past performance
- **Electronics modifications are permitted**
  - New driver circuitry, bigger battery packs, etc.
  - Must provide full schematics (and more) to 6.270 staff BEFORE modification, and they will be made public
- **No more beacon**
  - Information transmitted wirelessly to your robot during the competition

Contest Rules: The Fine Print

- Assignment extension policy
  - Assignments are due at the time given; if you need an extension, **talk to us!**
  - The first extension is free
  - Each extension after that counts as a loss
  - An extension is good until the next assignment's due date (except the last assignment)

Contest Rules: The Fine Print

- ## At next lecture
  - Sensor points
  - $30 electronics rule
- ## Rules questions?
  - Any decisions on rules questions will be posted on the server

- ## For more information, see Course Notes, Chapter 2

Your Kit

- Valued at $1500
- Big thanks to our generous sponsors:

Your Kit

Your Kit

The Brain: Handy Board

- For Assignment 1, run through test suite to ensure original Handy Board is in working order

- Manual is not included, can get it from "Handouts" site or http://handyboard.com
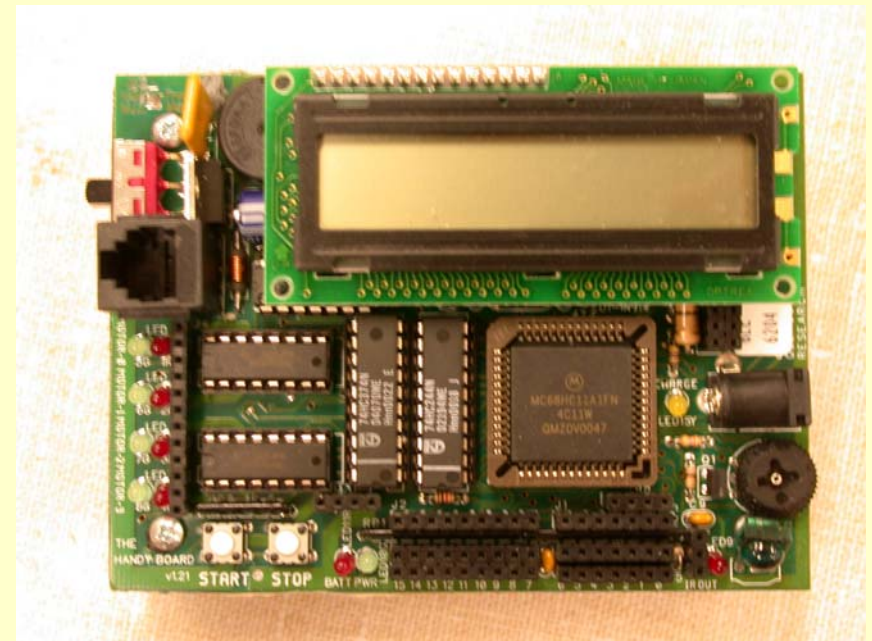
Your Kit

Damaged Handy Board Policy

- After Assignment 1, we assume your Handy Board was good when you got it, and any malfunctions that happen thereafter we will assume were your fault

- If anything breaks, it's your problem—we can help debug, but we won't guarantee anything

- Most common reasons a Handy Board breaks down:
  - Doubling up motor ports
  - Plugging things in backwards
  - Shorting things

Your Kit

Expansion Board for the HB
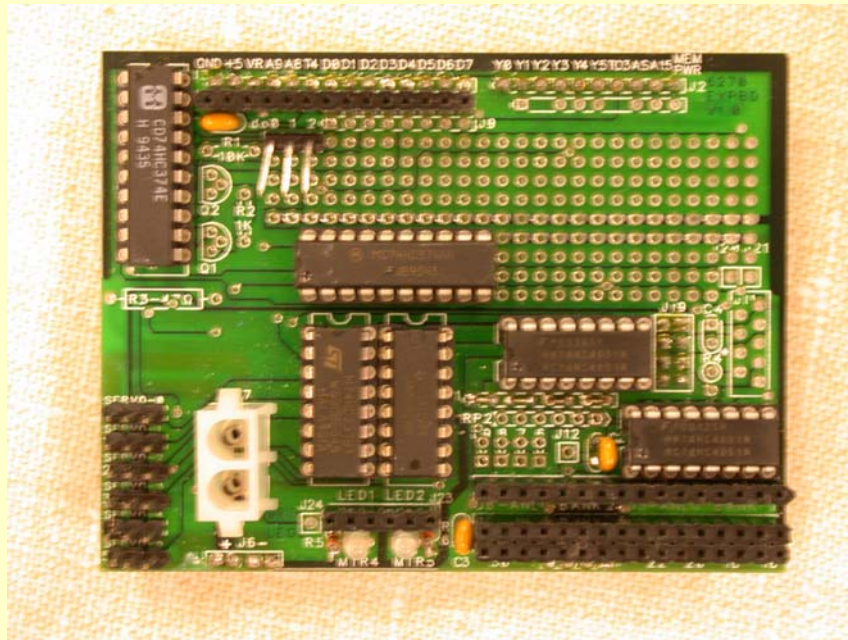
- Must be soldered for Assignment 2
- Don't put on Handy Board yet
  - A hack needs to be made
  - We will tell you how to alter the Handy Board for the expansion board upon completion of Assignment 2
- Will be handed out Tuesday

Your Kit

The Juice: Hawker Batteries

- Three batteries soldered in series (6V)
- Be careful when soldering—they come charged
  - Pro (not really) demo in Lecture 2
- Build them for assignment 4
- Will be handed out at the end of this week
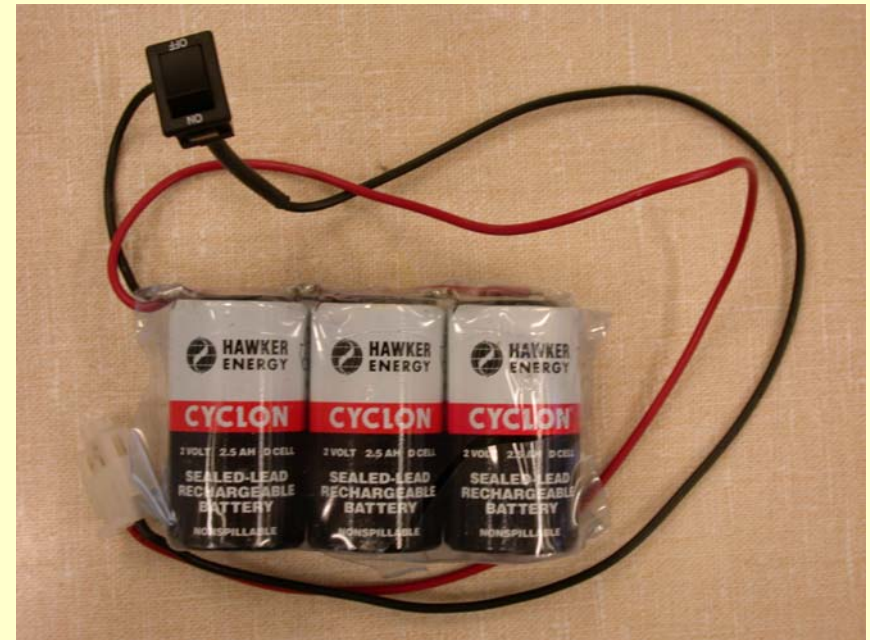
Your Kit

Battery Recharger

- Must be soldered for Assignment 4
- Four ports for the two battery packs
- Two speeds of recharge: fast and slow
  - Recharging on slow is not dangerous
  - Monitor charger if on fast charge (4 hours max)
- Will be handed out at the end of this week

Your Kit

The Muscles: Motors

- Two kinds of actuators allowed in 6.270: DC motors and servos
- Need to "LEGOize" these devices – go to workshop 3
- Can use glue or tape to mount them
- Allowed to alter LEGO for mounting

Your Kit

The Sensors
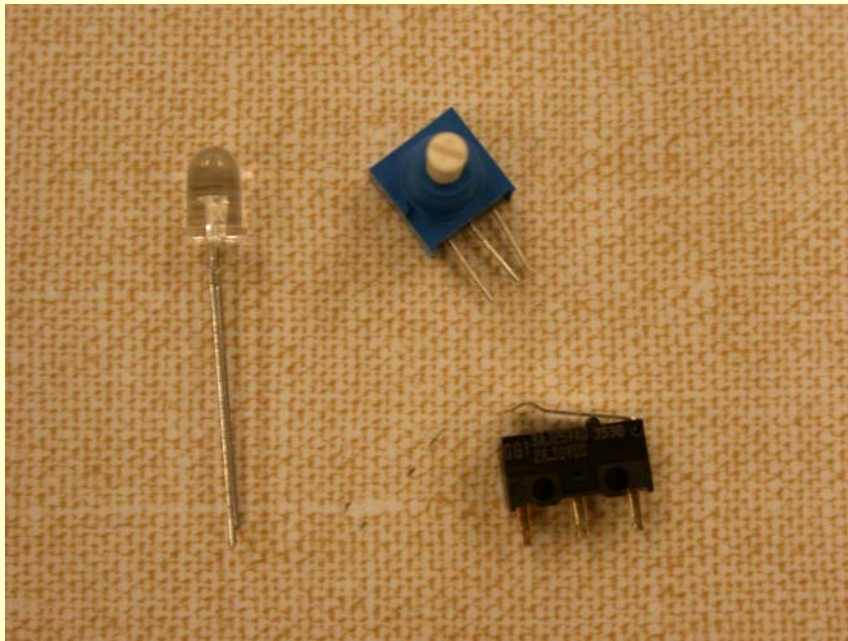
- **Digital**
  - Switches
  - Shaft encoders
- **Analog**
  - Phototransistors
  - Potentiometers
  - Gyroscope
- **More to come in Lecture 2**

Your Kit

The RF Receiver

- Assemble for assignment 2
- Lets us give you information during the competition round
  - Voting
  - Position
  - Start/end of match

Your Kit

The Infrastructure: LEGO

- Plates: structural reinforcement and spacing

- Flat Plates, smooth surfaces for sliding mechanisms or for sensor and motor mounting

Your Kit

LEGO Dimensions and Bracing

- Bracing makes structures stronger
- 3 plates = 1 beam

- 2 beams + 2 plates = 3 holes

- Pythagoras works, too
- Count number of nubs between holes

- Any other combination could add unnecessary shear forces
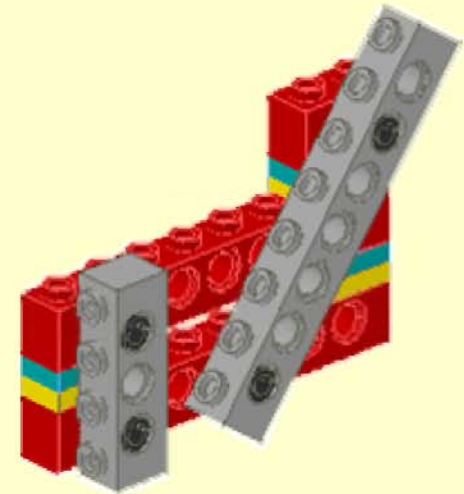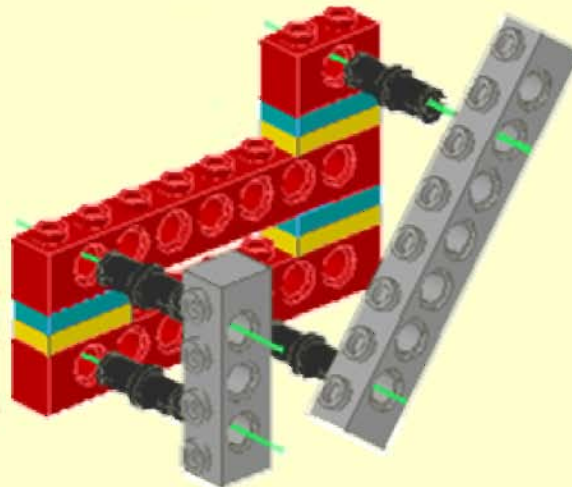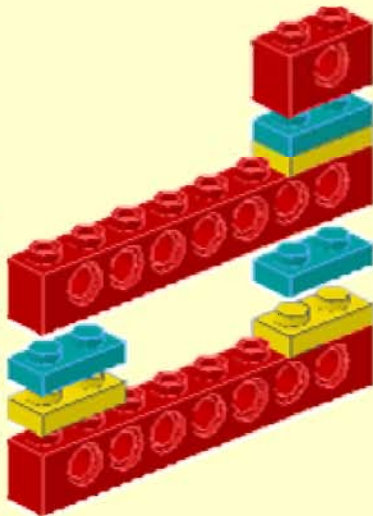
Your Kit

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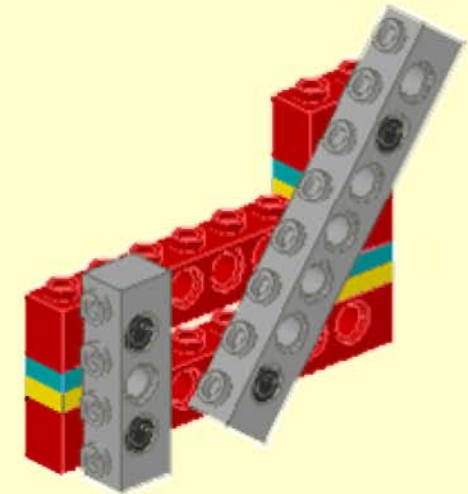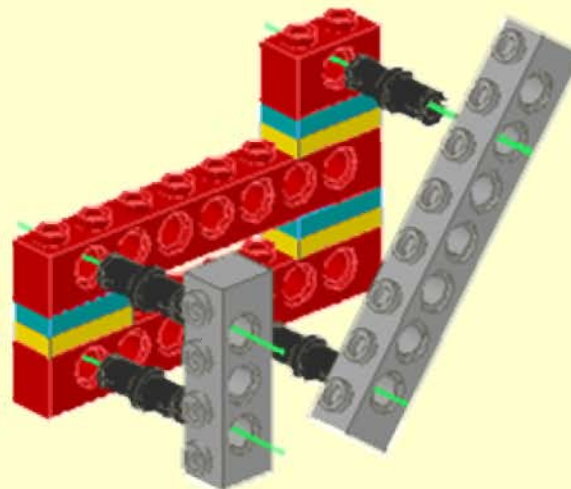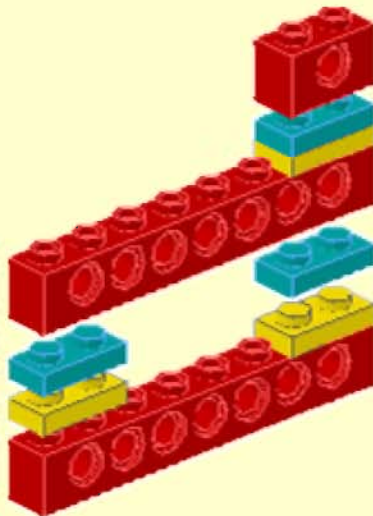
Your Kit

Connectors

Friction peg – creates structural support between beams; stiff

Frictionless peg – allow angular movement

¾ pin – joint two 1-FLU liftarms; create flat surfaces for shafts

½ pin (with stud) – join two 1-FLU liftarms

Axle with stud – can create lateral movement with a stop instead of a ½ bush

Long friction peg – join three beams together conveniently

Long frictionless peg – rotate arm that is structurally stronger

Long friction peg with bush – connect beams from the outside

Technic axle pin – extending axles out of beams, combining various connectors

Pin with towball – attach rubber bands, ball and socket

Axle with towball – attach rubber bands, ball and socket (no friction)

Your Kit

Treads

- Chains are same thickness as gears

- Treads are wider; use for tank models

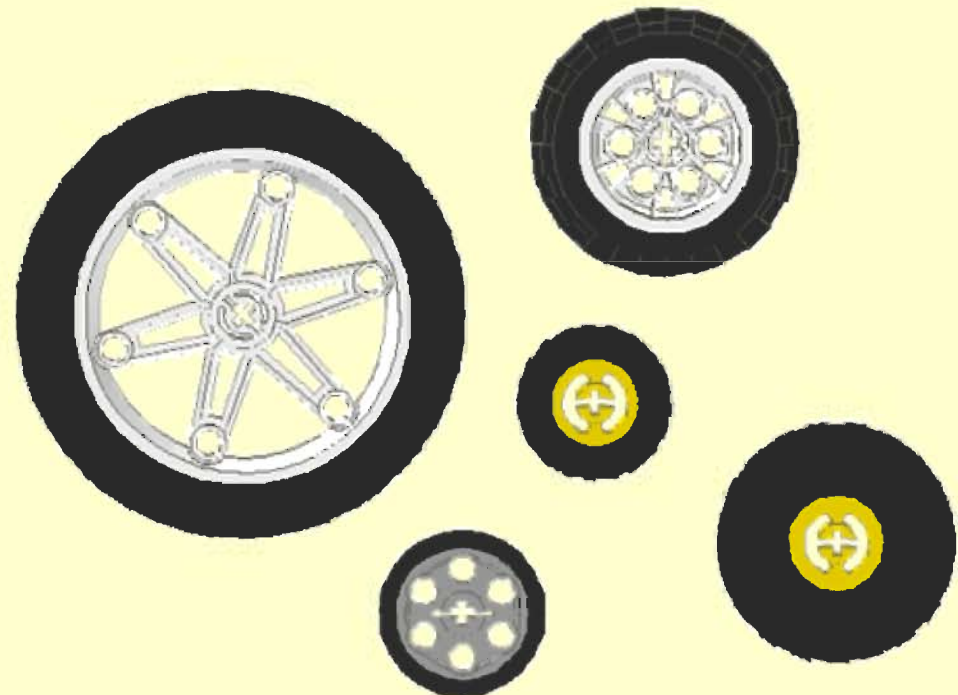- Some have tried to make conveyor belts—clever, but impractical
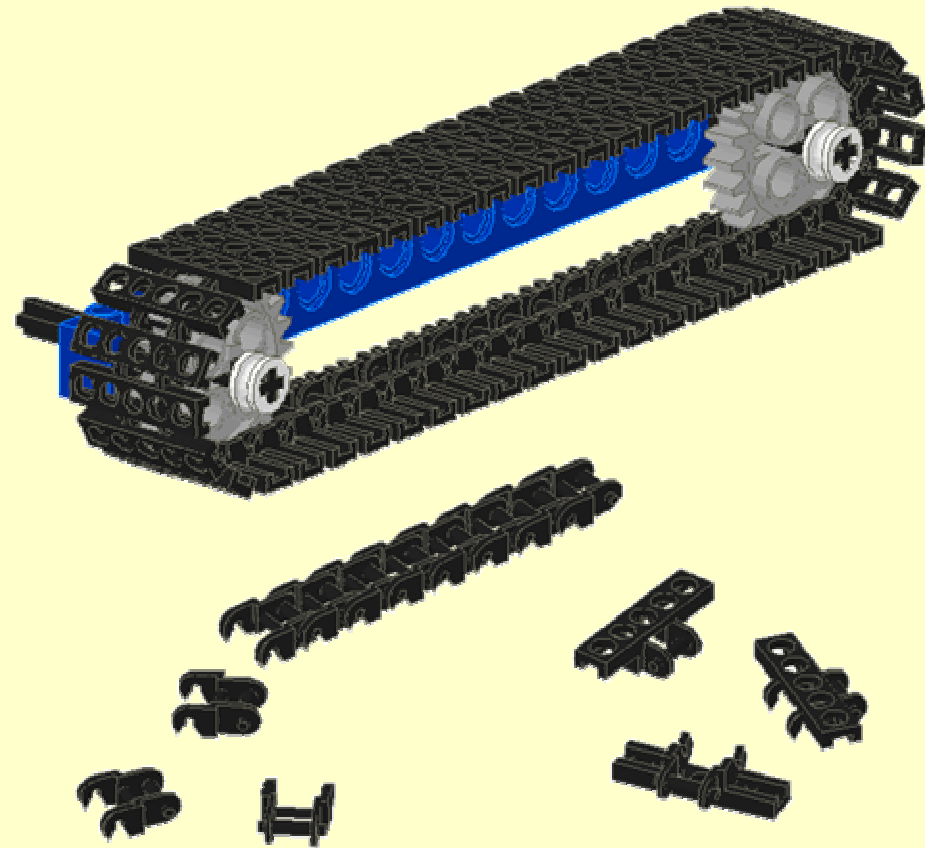
Your Kit

Tires

- The wheel is the final gear in your gearbox
- You can use tape or rubber bands on tires to alter coefficient of friction
- Tires are not always for locomotion—use to draw in or throw out objects
- Your robot will be heavy! Test your robots and wheels with full weight (batteries, HB, game objects)

Your Kit

What's *Not* in Your Kit

- Heat Shrink
- Ribbon Cable
- Tools (tool store)
- Extra sensors, servos, motors
- Some stuff that we'll be giving you soon
  - Expansion board kit
  - Batteries and charger kit
  - RF receiver kit

Your Kit

At this point, don't touch:

- The distance sensor (we will talk about it Lecture 3)

Assignment 1

- Due Tuesday night (TOMORROW!) at 11:30 pm
- Five tasks to complete:
  1. Read directions carefully!
  2. Know your Organizer and TA
  3. Test the Handy Board
  4. Make the front-end loader
  5. Discuss rules and strategy

What's Next

- **Distribution**
  - Kits
  - Handy Board
  - Pick up Assignment 1
- Go to the sixth floor lab and sign up for workshops beginning today
- Open up your kit and make sure you have everything (go to server to kit contents)

What's Next

- Get to work on Assignment 1 (due tomorrow)
- Workshops available:
    - Workshop 1 – Basic Techniques of LEGO Assembly
        - Basic LEGO infrastructure
        - Review of basic LEGO pieces
    - Workshop 2 – Motor Mounting and LEGO Gearboxes
        - Building a gearbox
        - Mounting motors onto your robot
        - Make a gearbox (Assignment 2)
- Don't forget to sign up in the 6th floor lab

Come Pick Up Your Kits!

- Teams 1-8
- Organizer: Ross Glashan
- TA: Mike Lin

Come Pick Up Your Kits!

- Teams 9-16
- Organizer: Michael Thilmont
- TA: Cliff Frey

Come Pick Up Your Kits!

- Teams 17-24
- Organizer: Dave Wang
- TA: Roberto Ramirez

Come Pick Up Your Kits!

- Teams 25-32
- Organizer: Vimal Bhalodia
- TA: Shuang You

Come Pick Up Your Kits!

- Teams 33-40
- Organizer: Zane Tian
- TA: Mike Matczynski

Come Pick Up Your Kits!

- Teams 41-48
- Organizer: Brett
- TA: Jim Roewe

Come Pick Up Your Kits!

- Teams 49-56
- Organizer: David Ziegler
- TA: Jonathan Wang

Why are you still here?
GO TO LAB!!