Learning by Building Robots:
(Directed Constructionism)

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Motivation

- Inspire
- Endow rigor
- Design
- Work in teams

Robotics Minor @ CMU

- Required Courses:
  - Introduction to Robotics (16-311)
  - Controls
  - Manipulation / Kinematics
- 2 Electives
  - Mobile Robot Programming
  - Mechatronics
  - Vision
  - Independent Study

H. Choset,
http://generalrobotics.org

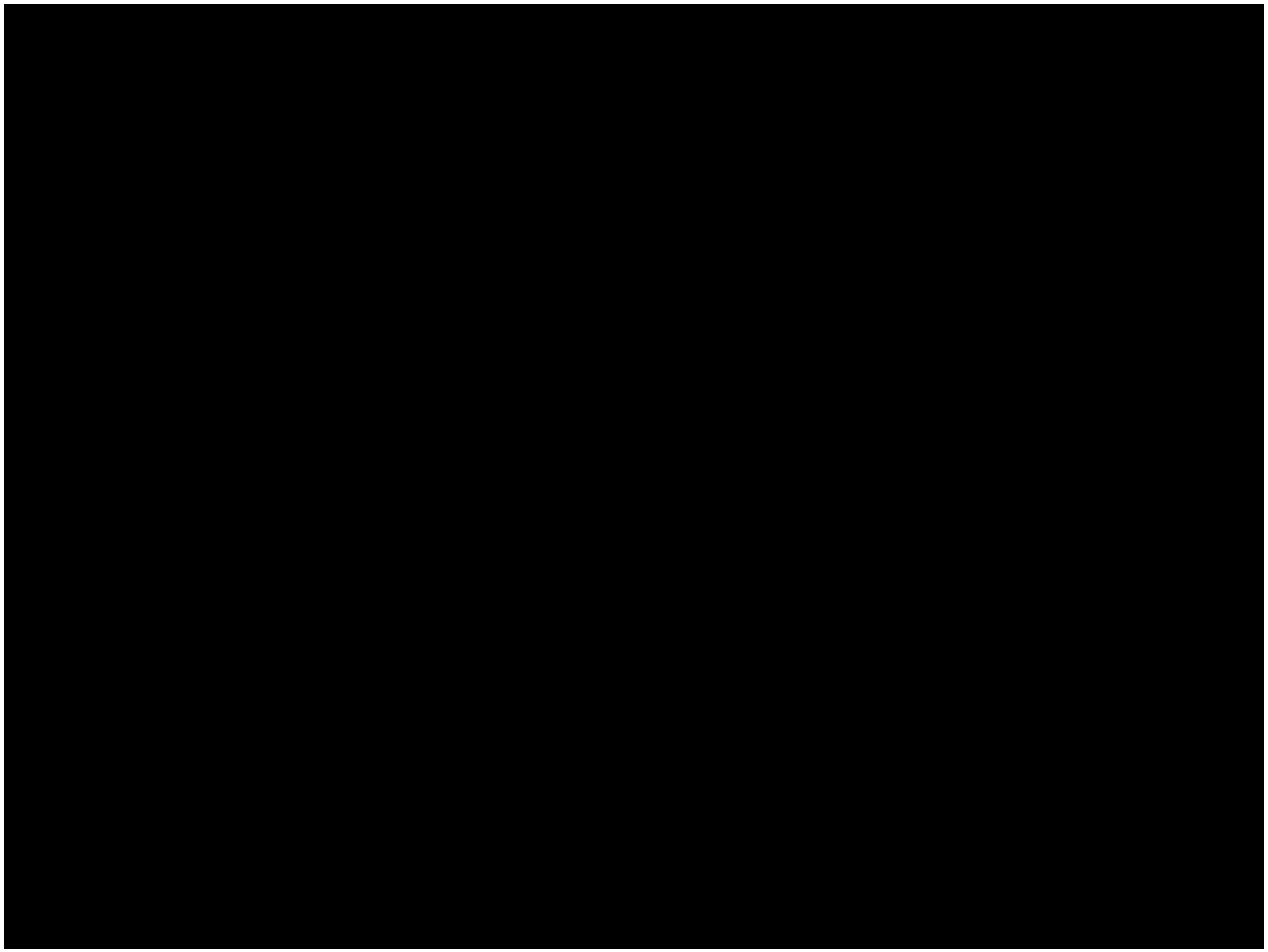
Introduction to Robotics (16-311)

- Rube Goldberg Machines
- Braitenberg Vehicles
- Control
- Motion Planning
- Design
  - Mars Rover
  - Urban Search and Rescue
- Forward Kinematics
- Inverse Kinematics
- Non-holonomic constraints

Path planning and friction error

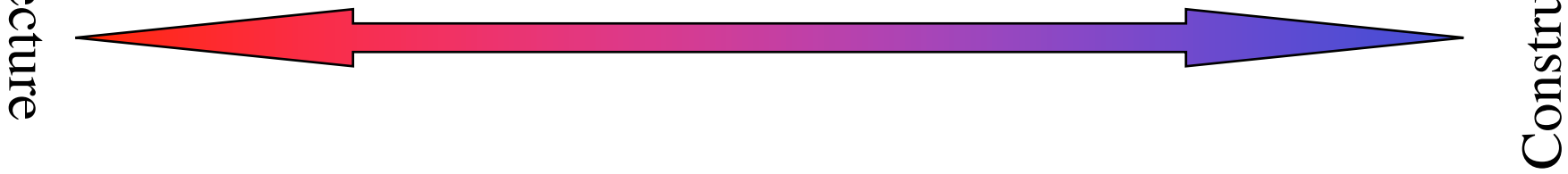
Gateway robotics course for undergraduates

Creative Expression: USAR Lab



Instructional Model	Constructionism
• Lecture based. • Flow of knowledge is unidirectional. • Caters well to curricular structure. • Works well with large class size. • Leaves us wondering if students really connect with the knowledge.	• Students develop knowledge by engaging in the construction of physical artifacts. • Individual, self-paced. • When building things, a lot can go wrong - a strength. • Experience is enhanced when projects are personally meaningful. • Instructor becomes a mentor.

Directed Constructionism



- Artifact construction component that parallels curriculum.
- Design/construction tasks are open ended, allowing opportunity for creativity.
- Assignments attempt to be personally meaningful in that they validate theory on a real artifact.

Lab format and presentation

- Introduction
- Reading
- Pedagogical focus
- Challenge statement
- Evaluation criteria
- Construction tips
- Things to think about

Lab Culture

- Many late nights in the lab.
- Students teaching other students.

Example Lab Format

go to http://generalrobotics.org

Future Investigations

- Upgrading the NXT Systems
- What new tools and methods are required to allow robot building to enhance other subjects?
  - Math, physics, biological sciences.
- Other levels of education
  - Secondary, elementary

Conclusion

- Inspire
  - Robots are cool
  - Not teach CS for CS sake
- Endow rigor
  - Learn something real
  - Teach the realities and depth of science
- Design
  - Use tinkering to explore
  - Connect high and low level issues
- Work in teams