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Intro to Robotics

ME 2984

“We’ll do it live!”

Instructors

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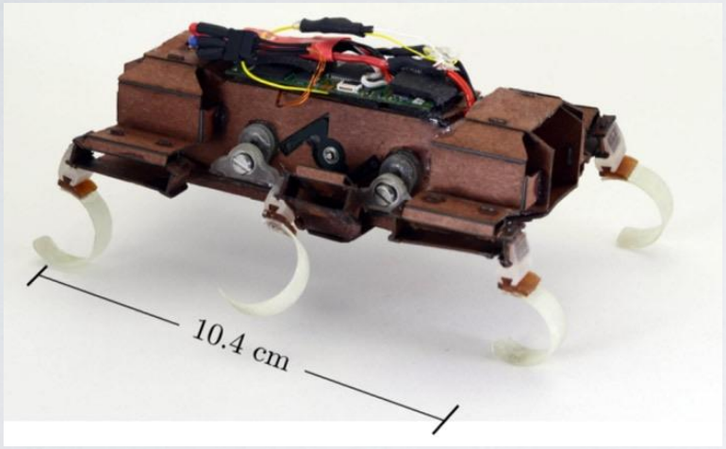
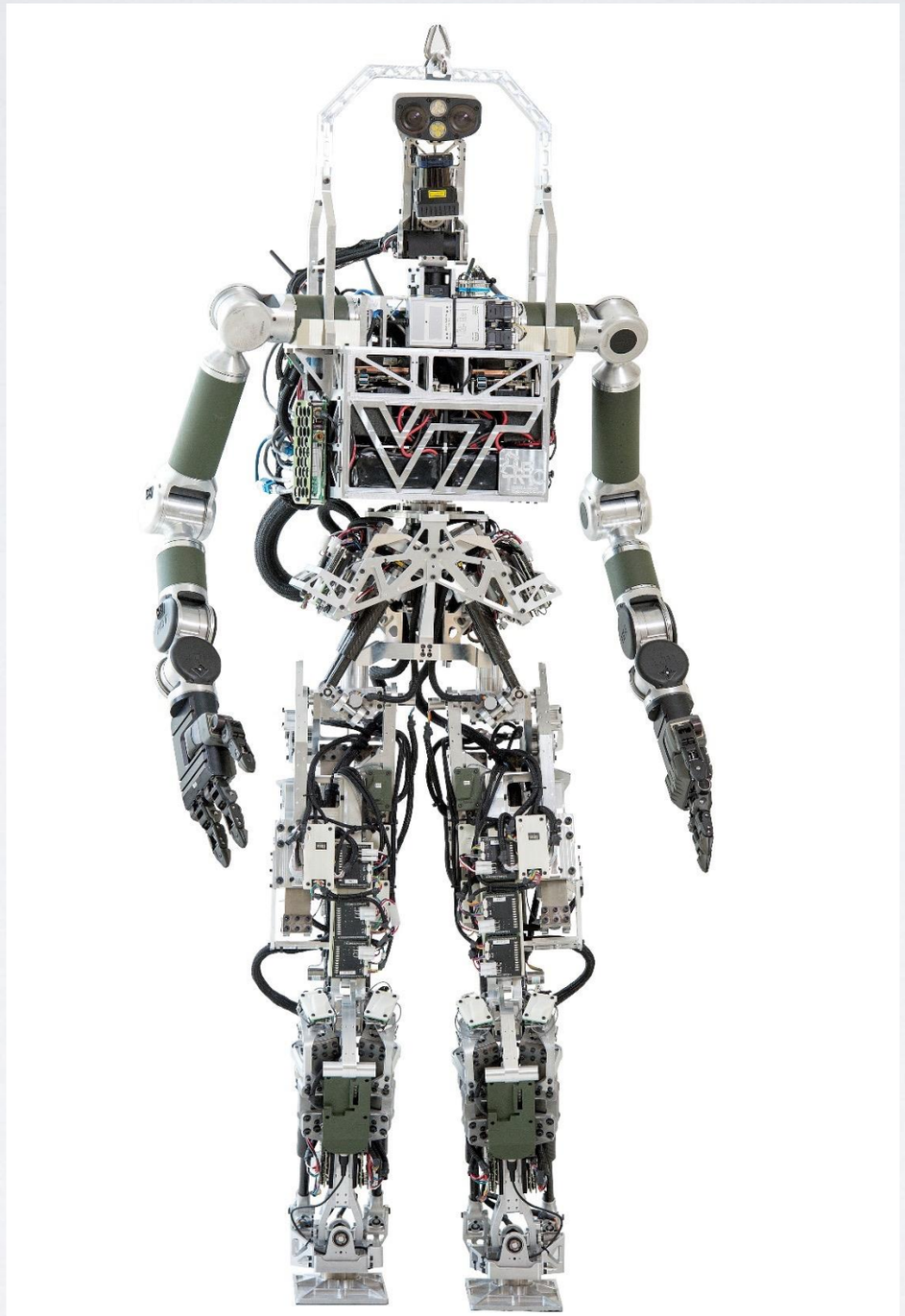
What's A Robot?



Credit: Biomimetic MilliSystems Lab



Credit: Logan Wallace

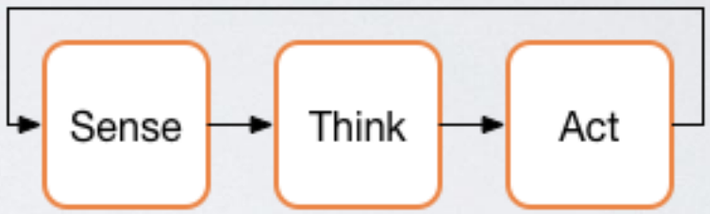
Credit: Google

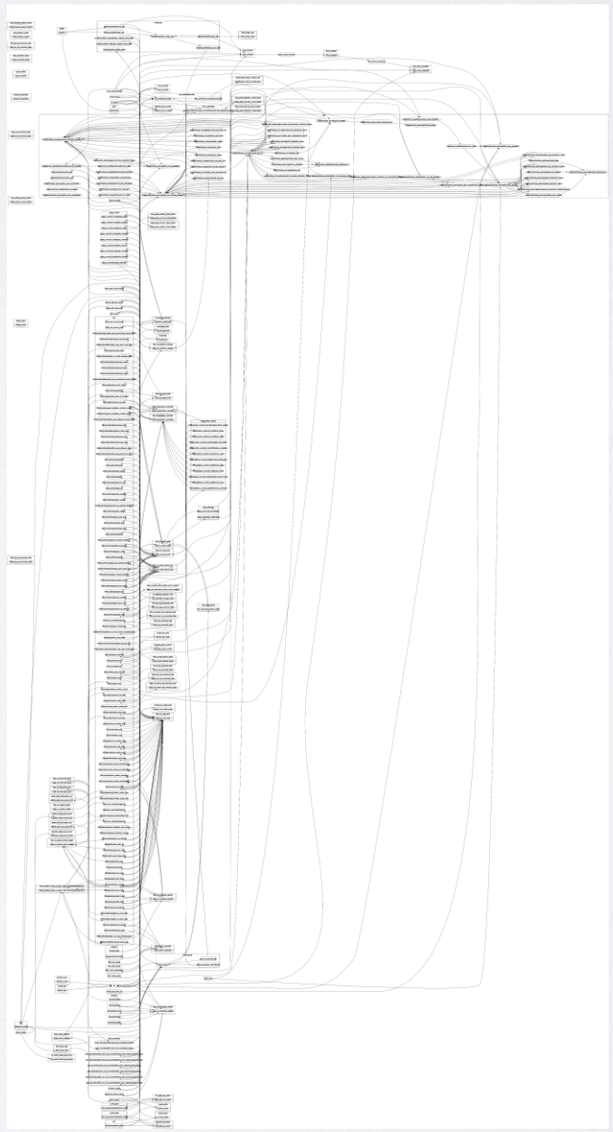
Credit: US Air Force

Credit: Nest

General Definition

- "Sense, Think, Act"
  - Too broad
  - Treat it like art
- "Robots are Hard" - TREC Unofficial Motto





… WHAT ABOUT ROBOTICS?

- Which field of study is “home” to robotics?
- Where does the academic community place it?
  - CMU - Computer Science
  - MIT - EECS
  - Johns Hopkins - ME
  - Georgia Tech - ECE, ME, Aerospace, Biomedical, Interactive Computing
  - VT - ME, ECE, CS, AOE

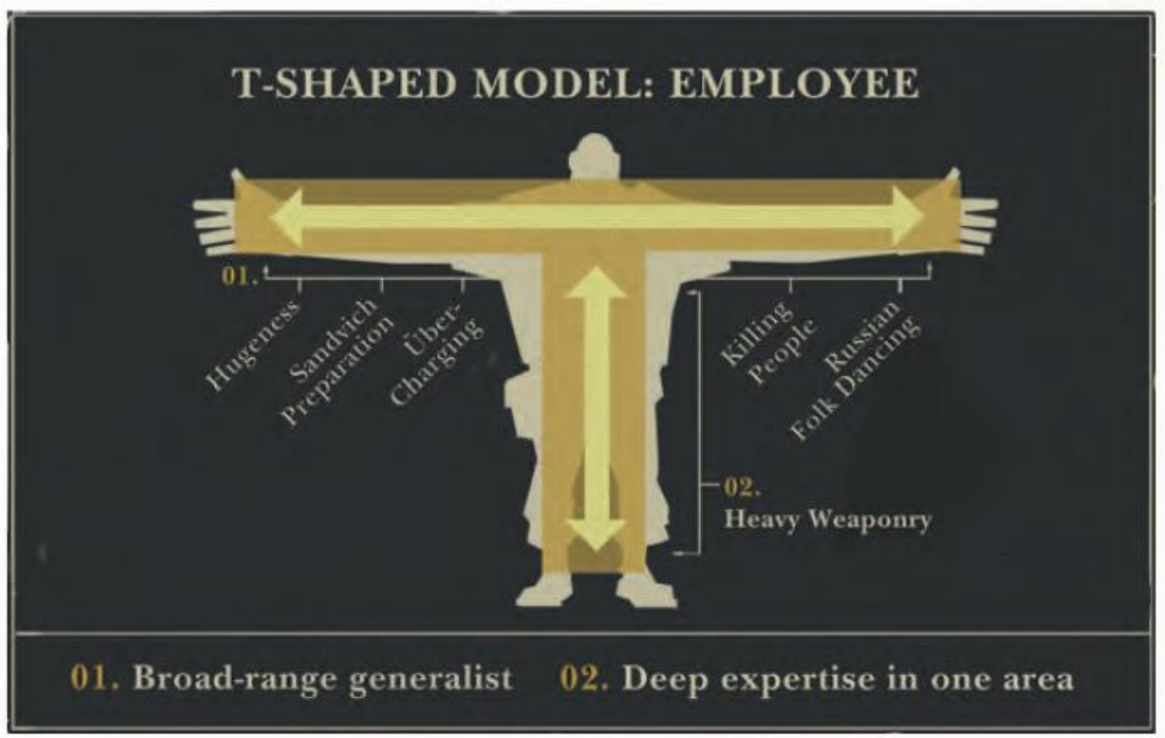


Image Credit: Valve

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SO WHAT?

- Building robots requires expertise in many areas
- Be cognizant of interactions between areas
- Take advantage of thinking outside the box and at the edges

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SO WHAT?

Advanced Robotic Laser Coating Removal System

CTC
Concurrent Technologies Corporation

OGDEN ALC

NATIONAL ROBOTICS
NREC
ENGINEERING CENTER

DISTRIBUTION STATEMENT A.
Approved for public release;
distribution is unlimited.
Cleared December 4, 2012.
Case Number: 88ABW-2012-6375

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AFRL
THE AIR FORCE RESEARCH LABORATORY
LEAD | DISCOVER | DEVELOP | DELIVER

SO HOT RIGHT NOW

- Impact daily life
- Accessible from hobbyists to professionals
- Research, Jobs, Excitement

Credit: Mugatu

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SO HOT RIGHT NOW

Towards a Swarm of Nano Quadrotors

Alex Kushleyev, Daniel Mellinger, and Vijay Kumar
GRASP Lab, University of Pennsylvania

COURSE GOALS

- Survey relevant topics
- To build your own robot
- Using real world tools
- Get excited and make things!

Quote Credit: Wil Wheaton

Syllabus

- (08/24 - 08/28) – Introduction
- (08/31 - 09/04) – Mechatronics and System Design
- (09/07 - 09/11) – Programming
- (09/14 - 09/18) – Kinematics ** Initial Project Proposals Due **
- (09/21 - 09/25) – Review, Workshop & Project Ideas
- (09/28 - 10/2) – Sensing
- (10/5 - 10/9) – Perception
- (10/12 - 10/16) – Planning and Review
- (10/19 - 10/23) – Tools & Teams ** Final Project Proposal Due **
- (10/26 - 10/30) – Project Q&A
- (11/2 - 11/6) – Survey & Case Studies
- (11/9 - 11/13) – Special Topics
- (11/16 - 11/20) – Project Work
- (11/23 - 11/27) – Thanksgiving Break
- (11/30 - 12/4) – Project Work

GRADING

- 35% Homework
- 30% Project
  - 5% Initial Project Proposal
  - 15% Final Project Proposal
- 35% Final Paper & Discussion
- Up to 10% Extra Credit Available for contributions useful to the class for final projects
  - Will be available after relevant assignments are completed

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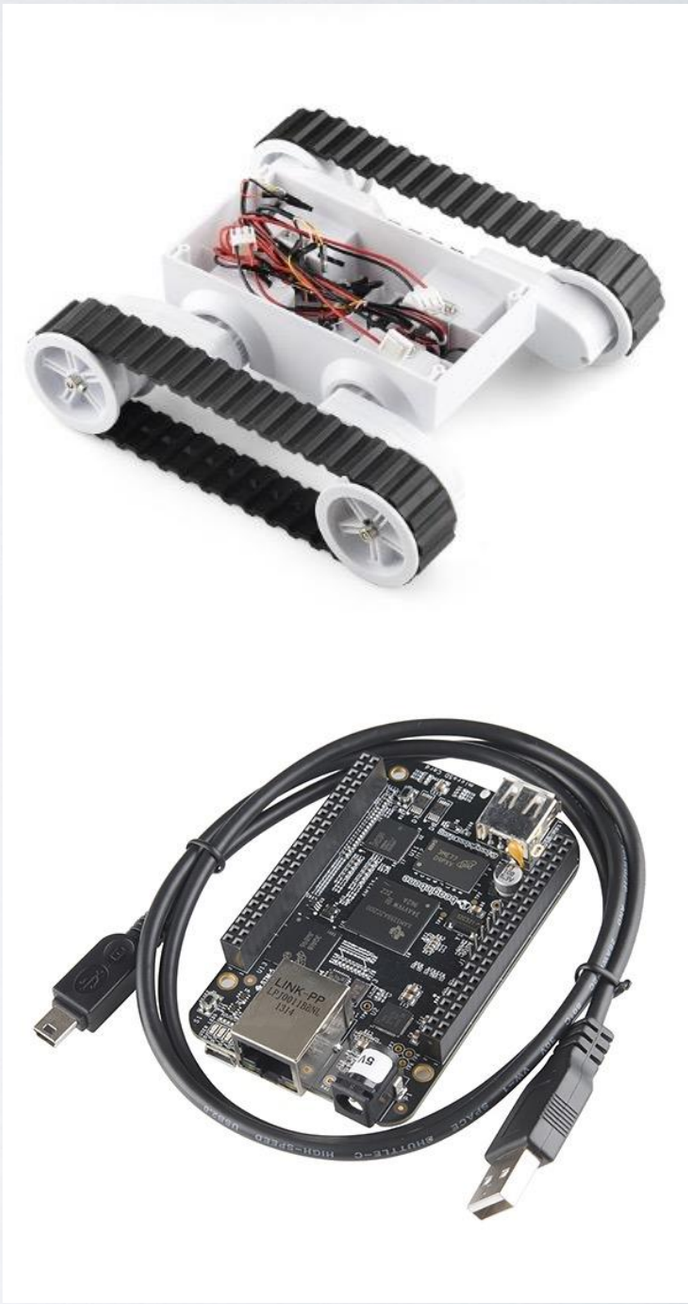
CLASS ASSIGNMENTS

- Construct a complete robot from kit
- Implement key components to enable mobility, kinematic dead reckoning, and obstacle detection
- Document progress & lessons learned, demonstrate capability
- Submissions will be video of robot performing an assigned task, along with a git repository of relevant code

K.H.A.N.

- Mobile Base
  - 4 Motors with Quadrature Encoders
  - Adjustable Wheelbase
  - Built-in Power
- Computing - Beagle Bone Rev-C
  - AM3358 1GHz ARM® Cortex-A8 Processor
  - 4GB 8-bit eMMC Onboard Flash
  - 2x PRU 32-bit Microcontroller
- ~$150 (with educational discount)



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CLASS PROJECT

- Group project (2 - 4 people)
- Take K.H.A.N. and do something interesting
  - Follow a laser pointer
  - Fetch a ball
  - Solve a maze
  - Be creative!
- Two Phases for Project Proposal

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Some Tools Of The Trade

- Ubuntu 14.04
- Robot Operating System (ROS)
- Gazebo
- Python
- Git
- Unigraphics NX

MANAGING SCOPE

- Class covers a huge span of topics
  - Focus is hands-on
- Intentional, but shouldn't be scary
  - Meant to be easy
- Robotics is a group effort, we're all in this together
  - Yes, even us
- Failure is fine, if it starts from trying and ends in learning

FIRST ASSIGNMENT

- Place an order for K.H.A.N. with the instructors
  - You can order it yourself, but we can get ~20% discount
- Install Ubuntu 14.04 on your laptop
- Install ROS
- Setup Gazebo
- Run K.H.A.N. in Gazebo
- Due Next Tuesday (09/01)

OFFICE HOURS

- Scheduled Office Hours are ~30 minutes after class each week
  - Curtailed this Thursday
    - Happens starting in the class room, ending in TREC (Goodwin 232)
- Additional time can be scheduled with instructors
- No official TA’s, but we have a volunteer

FINAL THOUGHTS

- Share Our Passion
- Find Your Niche
- Balance the Theoretical with the Application
- Have Fun

FINAL THOUGHTS

Credit: DARPA TV

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QUESTIONS?