

UNLV ME 425/625 – Robotics

Introduction and Course Philosophy

Paul Oh: Background



- 5+ years industry before Drexel
- ME Professor since 2000
- Advisor: ASME 10-years
- Advisor: 8+ SD teams
- 3 SD awards (COE, ASME, Baiada)
- \$10M+ in research/design funds
- 90+ Journals, Books, Proceedings

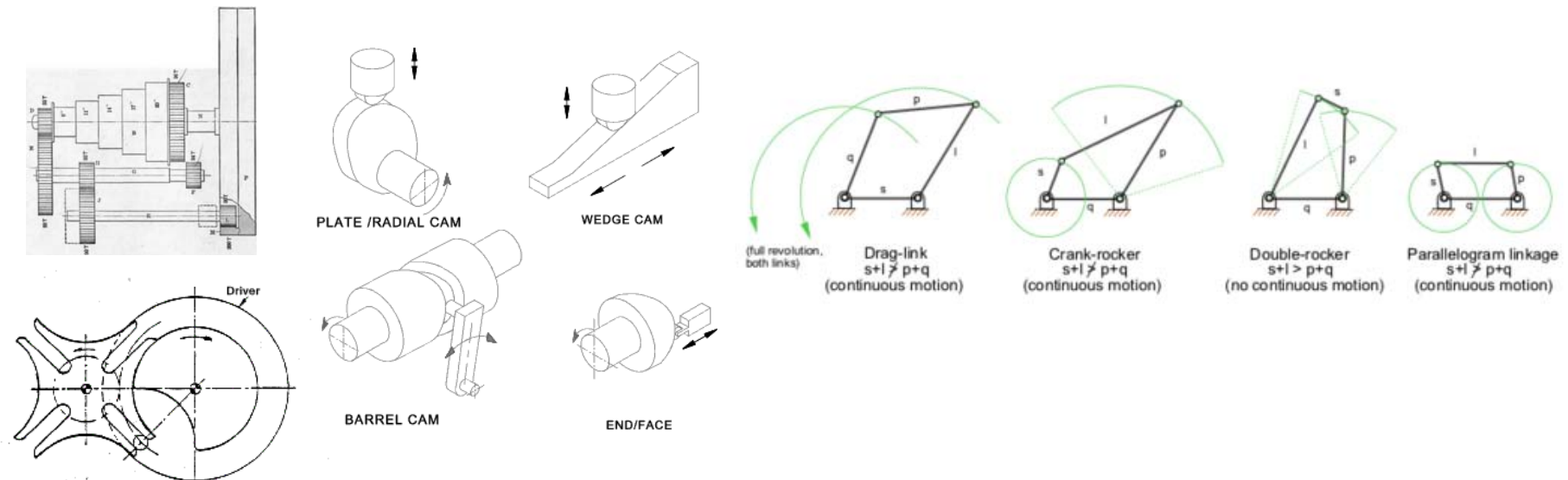
- Drexel Autonomous Systems Lab
- NASA, ONR, Boeing Fellow
- NSF Robotics Program Director (2008-2010)

Enjoy creating courses where labs
reinforce theory

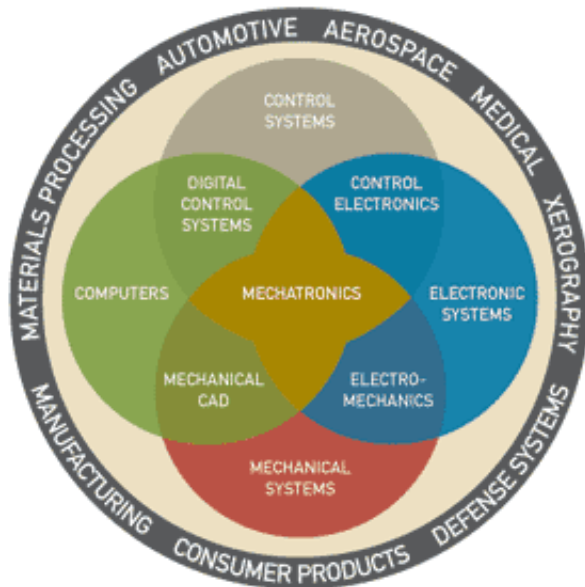
Motivation for UNLV Robotics Course Sequence

More Background:

- **Need 1:** Mechanism design is fundamental but poorly addressed at UNLV
Evidence: Senior Design projects, lack of courses, competitions
- **Need 2:** Lack of Masters- and senior-level courses at UNLV
Evidence: few course options
- **Gap 1:** Mechatronics – taught from point-of-view rather than holistic approach
EE: limited coverage of mechanical aspects (e.g. force, torque, gears)
ME: heavy focus on electronics and embedded micros
- **Resources:** Mathematical theory versus Experiential discovery
Robotics is essentially a collection of “best practices” that should be experienced



My “Issues” with Robotics Courses



Issue 1: Frankenstein Approach

- Ad-hoc: Pieces are slapped together
- One-offs: Hard to reproduce and rarely robust

Issue 2: Lack of Constraints

- If exists, typically only on footprint (SWAP)
- Economics of design are rarely addressed

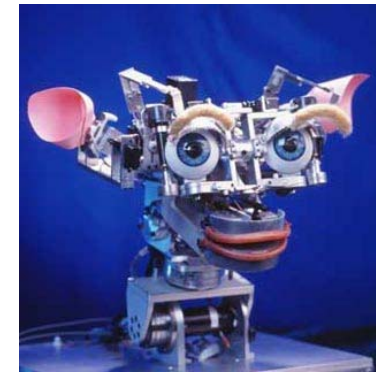
Issue 3: Software tools rarely used in such courses

- CAD rarely ever discussed or used for prototyping
- Simulation rarely used for testing and evaluation

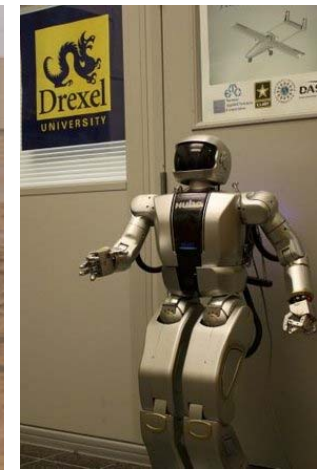
Issue 4: Books lack

- All very similar: focus on basic circuits or force/torque
- Projects difficult to reproduce

Differences: Western Versus Eastern Approach

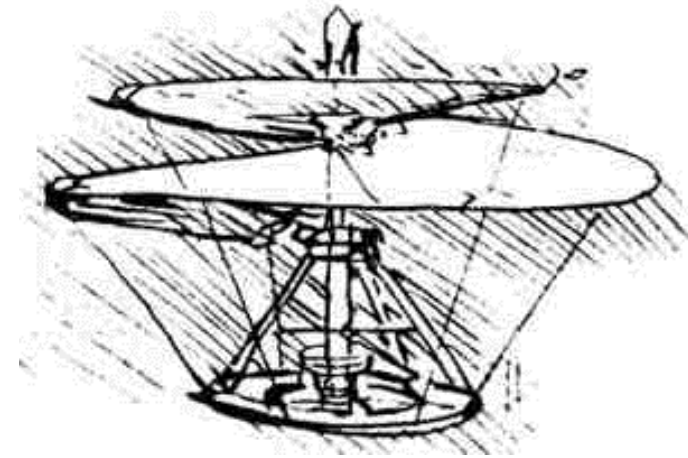
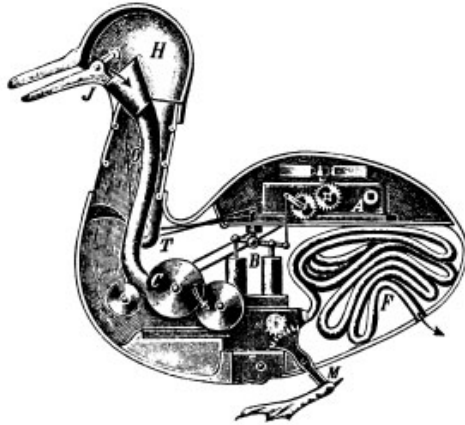


Western Philosophy: The “individual” is sacred – perhaps leads to segmentation



Eastern Philosophy: The “group” is sacred – perhaps leads to harmonic integration

Automatons: Form Follows Function



Japanese Arrow Shooting Automaton

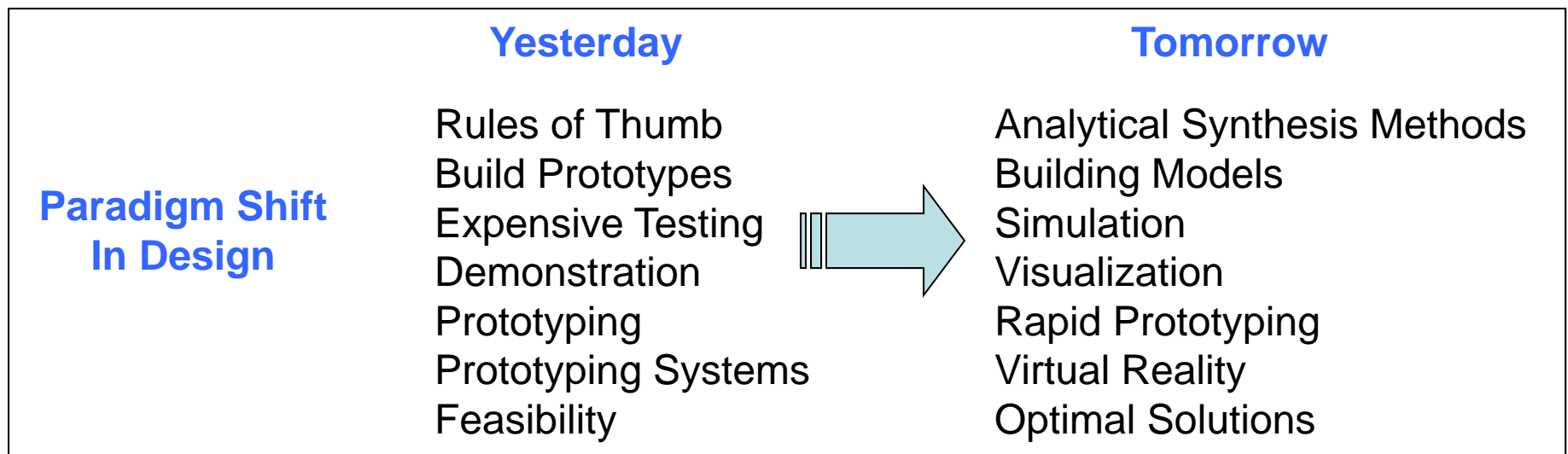
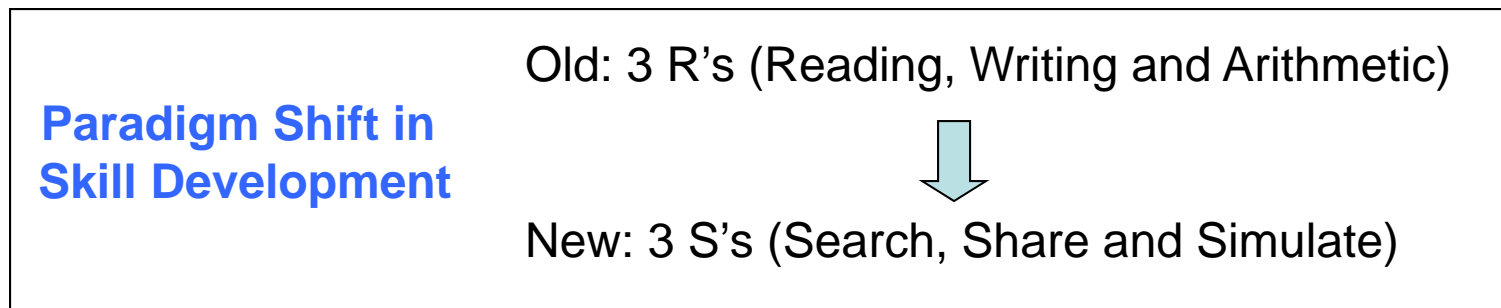
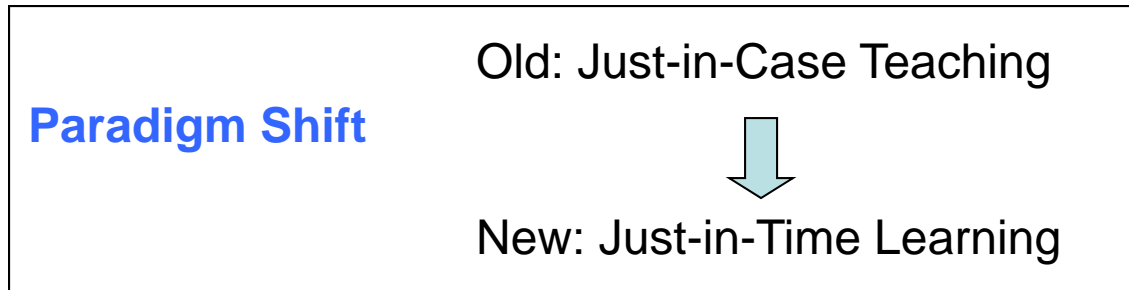
<http://www.youtube.com/watch?v=7PiG-FA11UM>

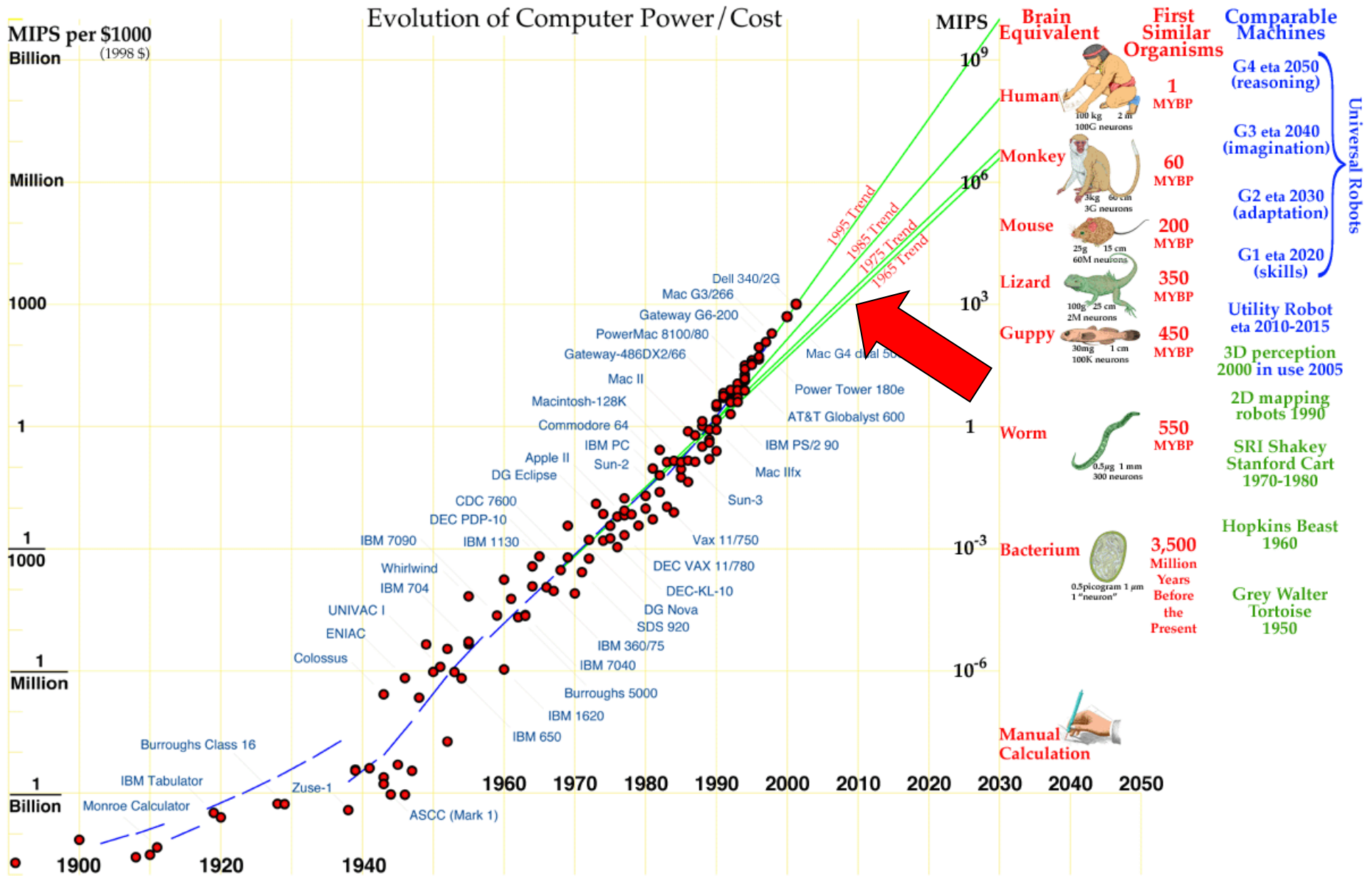


Japanese Tea Serving Automaton

<http://www.youtube.com/watch?v=MSvb8p7DQkE>

Paradigm Shifts in Teaching, Learning and Design

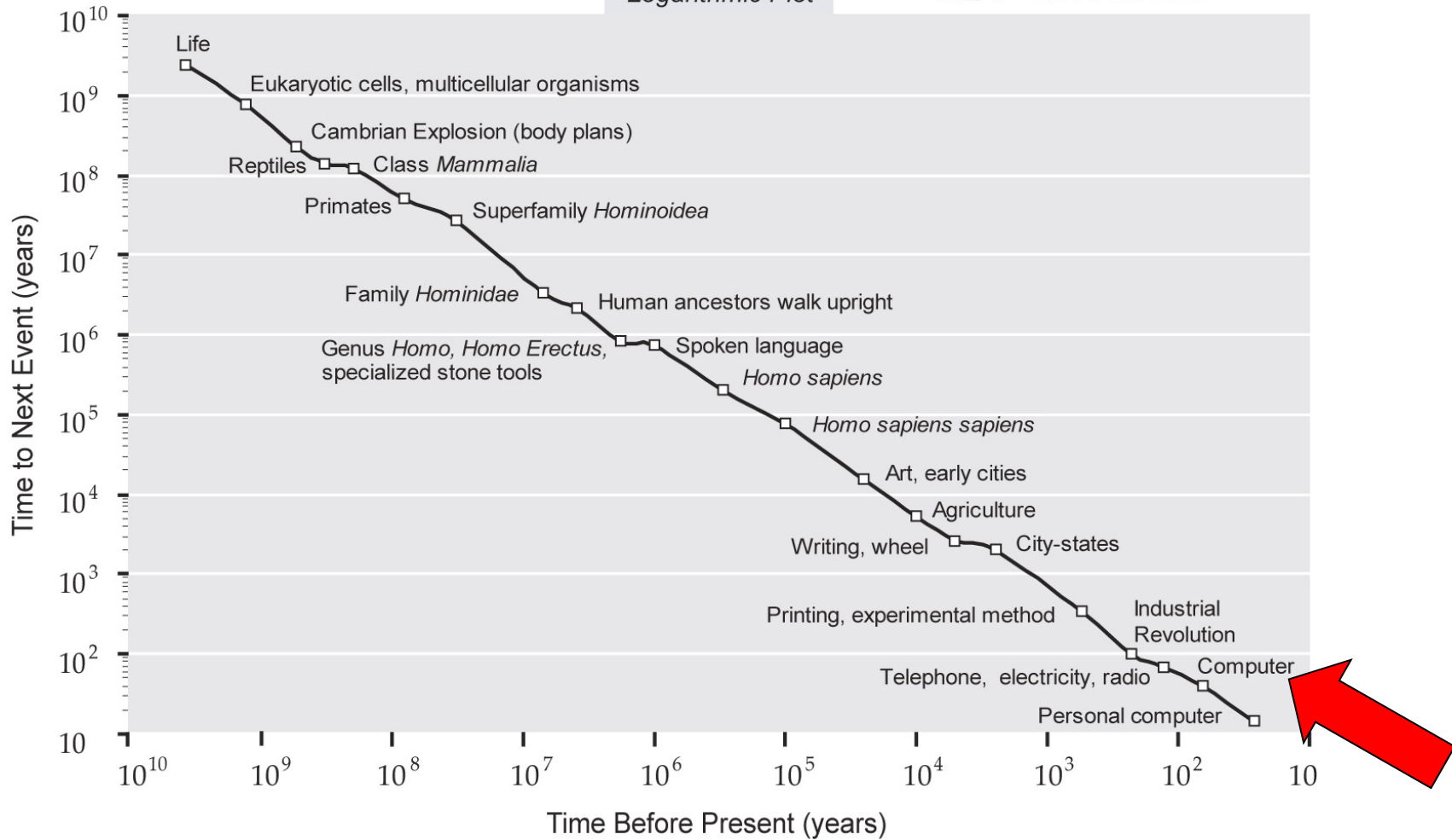
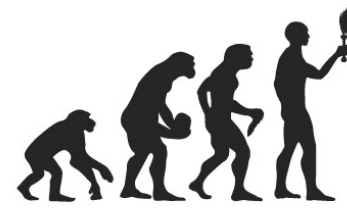




Source: Hans Moravec "When Will Computer Hardware Match the Human Brain", 1997

Countdown to Singularity

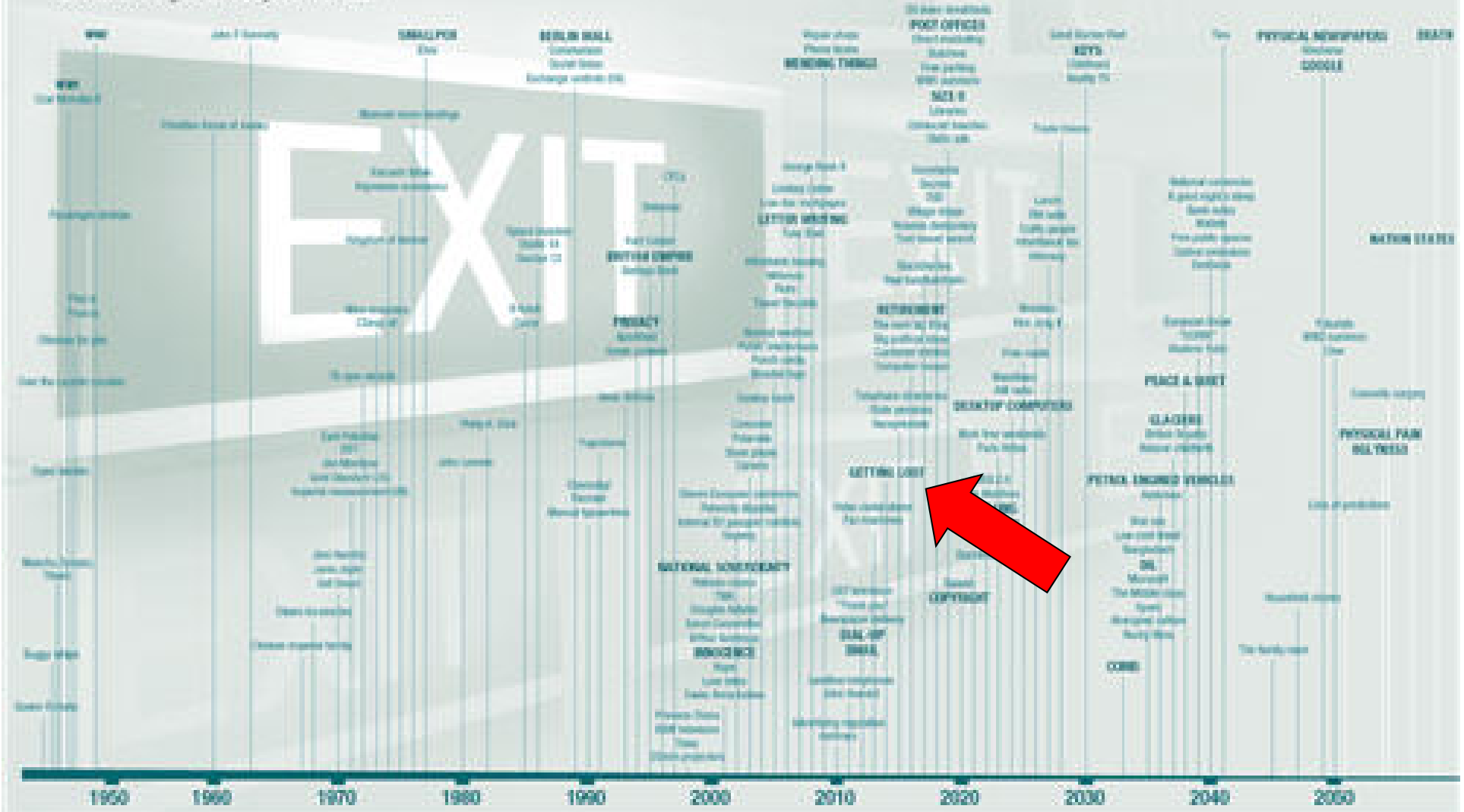
Logarithmic Plot



Biological evolution and human technology both show continual acceleration. The time between events continues to decrease; 2B years from the origin of life to cells and 14 years between the PC and World Wide Web.

Extinction timeline* 1950-2050

* Existence insignificant beyond this date



- 2014: Getting Lost
- 2019: Libraries
- 2020: Copyright

- 2030: Keys
- 2033: Coins
- 2036: IC cars

- 2050+: Ugliness, Nation States, Death

Source: "What's Next" and the "Future Exploration Network"

Erosion of Boundaries in the Information Age

- Between products and services: think cell phones
- Between producers and users: think social media
- Between IT, comm, media, consumer electronics: think Amazon
- Between IT and non-IT industries: think Walmart
- Between academia, industry, disciplines, theory, applied research

1895: “Heavier than air flying machines are impossible”, Lord Kelvin

48 years

1943: “I think there’s a world market for maybe 5 computers”, Thomas Watson

34 years

1977: “There is no reason why anyone should have a PC in their home”, Ken Olsen

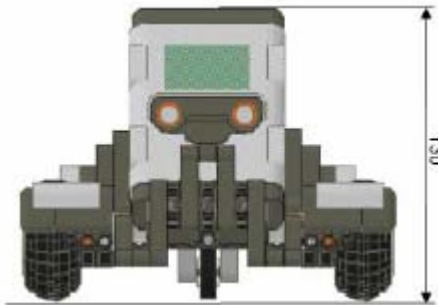
4 years

1981: “640K ought to be enough for anyone”, Bill Gates

What can we expect in the next $111 \frac{1}{2}$ years? i.e. 7 years (decimal)

My “ideal” Robotics Courses

“Be the change you want to see in the world” – M. Gandhi

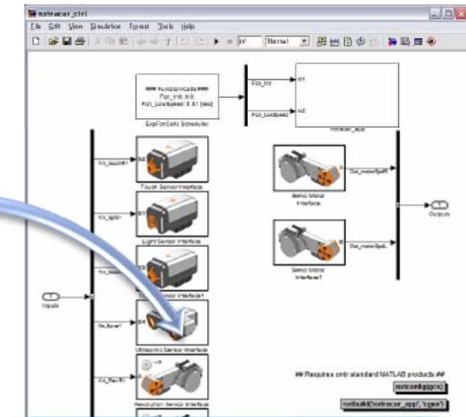


- Hardware design (MLCAD)
- Software tutorial
- Sensor integration
- Virtual Reality model

Design

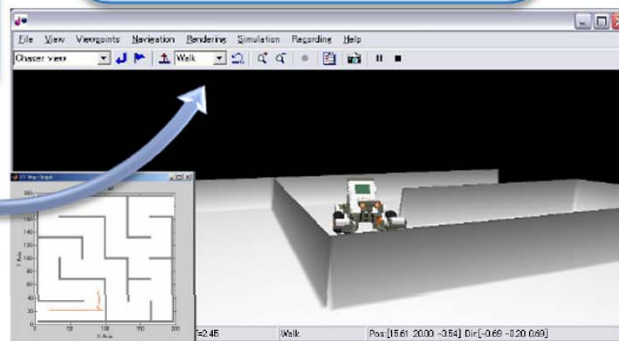
Simulation

- Dynamic model
- Control theory
- MATLAB
- Simulink



- Construction
- Programming
- LEGO MINDSTORMS NXT

Experimentation



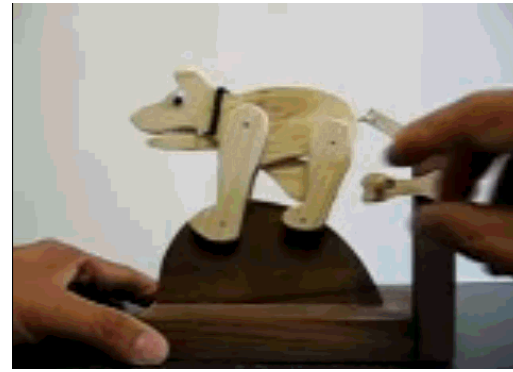
A Single-Term Plan

- Project-Based Course: Automaton (open-loop) and Ball-and-Beam (closed-loop)
- Mechanisms: Cookbook approach – learn fundamental “simple machines” as recipes
- Algorithms: apply fundamental control techniques using sensors and actuators



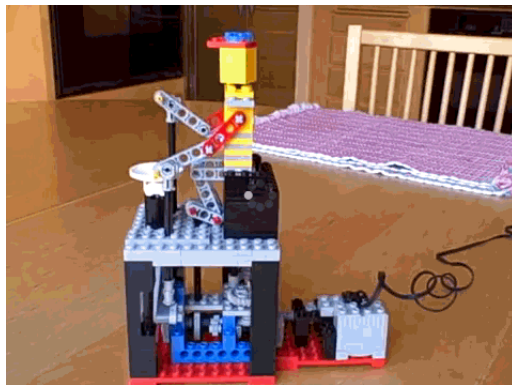
Anibus Press-ups

<http://www.youtube.com/watch?v=YFqkKn9PgNg>



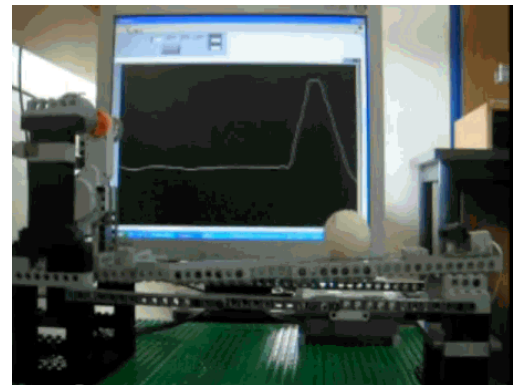
Barking Dog

<http://www.youtube.com/watch?v=3-Zuj5gO60g>



Lego-based Drummer

<http://www.youtube.com/watch?v=TFQRzyZFmek>



Lego-based Ball-and-Beam

<http://www.youtube.com/watch?v=bV9g3AyQ7Vc>

Next Steps

- Pick up NXT Kit (\$50 post-dated check; check cancelled when all parts returned)
- Propose: Lecture/Lab: Every Monday **18:00-21:00** (1325 E. Flamingo Rd)
- Bring NXT Kit to every class

