Carnegie Mellon University

24-688: Introduction to CAD/CAE Tools

@ HH-B103 (Lecture)
@ BH 140E (Computer Cluster Sessions)

http://www.andrew.cmu.edu/course/24-688/

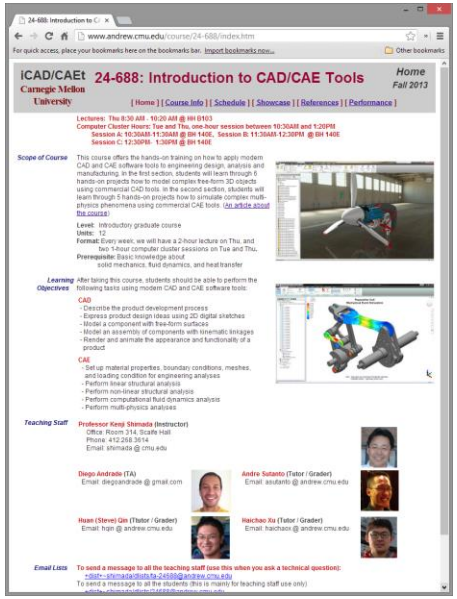
Digital Engineering Courses

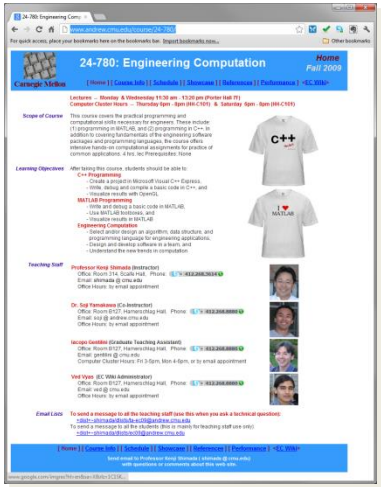
24-688: Introduction to CAD / CAE Tools

24-780: Engineering Computation

24-681: Computer-Aided Design

24-682: Computer-Aided Engineering

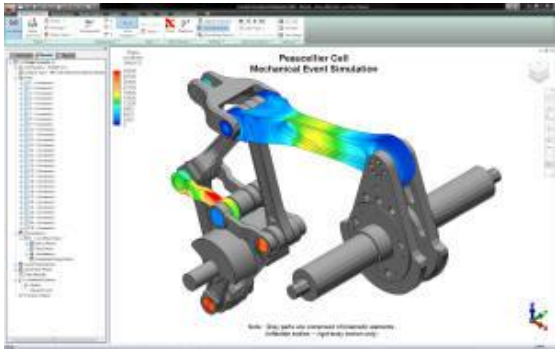




24-688 Introduction to CAD/CAE Tools

This course offers hands-on training on how to apply modern CAD and CAE software tools to engineering design and analysis.

You will learn how to model and simulate complex 3D products using digital engineering tools.



Learning Objectives

CAD

- Describe the product development process
- Express product design ideas using 2D sketches
- Model a component with complex shapes
- Model an assembly of components with kinematic linkages
- Render and animate the appearance and functionality of a product

CAE

- Perform linear structural analysis
- Perform non-linear structural analysis
- Perform kinematic motion study analysis
- Perform Computational Fluid Dynamics analysis
- Design optimization using simulation

Course Schedule at a Glance

Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1 (9/26)		No cluster hours		Lecture 1 (PS1 Out) Cluster Session (CP1)			
2 (9/2)		Cluster Session (CP1)		PS1 Due Lecture 2 (PS2 Out) Cluster Session (CP2)			
3 (9/9)		Cluster Session (CP2)		PS2 Due Lecture 3 (PS3 Out) Cluster Session (CP3)			
4 (9/16)		Quiz 1 (PS1, PS2)		PS3 Due Lecture 4 (PS4 Out) Cluster Session (CP4)	CAD Project Out		
5 (9/23)		Cluster Session (CP4)		PS4 Due Lecture 5 (PS5 Out) Cluster Session (CP5)			
6 (9/30)		Quiz 2 (PS3, PS4)		PS5 Due Lecture 6 (PS6 Out) Cluster Session (CP6)	CAD Project Interim Report Due		
7 (10/7)		Cluster Session (CP6)		PS6 Due Lecture 7 Cluster Session (CP7)			
8 (10/14)		Cluster Session (CP7)		Lecture 8 CAD Project Presentation	Mid-Semester Break	>>>>	>>>>
9 (10/21)		Quiz 3 (PS5, PS6)		Lecture 9 (PS7 Out) Cluster Session (CP9)			
10 (10/28)		Cluster Session (CP9)		PS7 Due Lecture 10 Cluster Session (CP10)	CAE Project Out		
11 (11/4)		Cluster Session (CP10)		PS8 Due Lecture 11 Cluster Session (CP11)			
12 (11/11)		Quiz 4 (PS7, PS8)		PS9 Due Lecture 12 Cluster Session (CP12)			
13 (11/18)		Cluster Session (CP12)		PS10 Due Lecture 13 Cluster Session (CP13)	CAE Project Interim Report Due		
14 (11/25)		Cluster Session (CP13)	>>>>	Thanksgiving Break	>>>>	>>>>	>>>>
15 (12/2)		Quiz 5 (PS9, PS10)		Lecture 14 CAE Project Presentation			

Grading

- 11 Problem Sets – 3% x 11 = 33%
- 5 Quizzes – 8% x 5 = 40%
- CAD Team Project – 8%
- CAE Team Project – 8%
- Class Participation – 11%

Locations

Lectures

- Time: Thursdays 8:30am – 10:20am
- Location: HH B103

Computer Cluster Sessions

- **Session A**
  - Tuesdays & Thursdays 10:30am – 11:20am
  - Location: BH 140E
- **Session B**
  - Tuesdays & Thursdays 11:30am – 12:20pm
  - Location: BH 140E
- **Session C**
  - Tuesdays & Thursdays 12:30pm – 1:20pm
  - Location: BH 140E

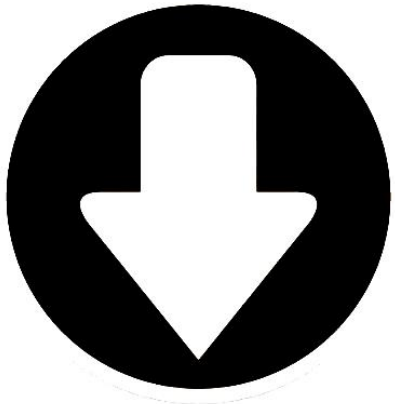
Software Packages

Required Software Packages

- Autodesk SketchBook Designer
- **Autodesk Inventor Professional**
- Autodesk Showcase
- **Autodesk Simulation Multiphysics**
- Autodesk Inventor Publisher

Download the packages from:

- http://students.autodesk.com



The Instructor Team

Professor Kenji Shimada (Instructor)
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Diego Andrade (TA)
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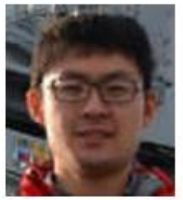

Vijay Raman (Ttutor / Grader)
Email: vijayr @ andrew.cmu.edu

Hakan Kavurt (Tutor / Grader)
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Nan Gao (Ttutor / Grader)
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Songjie Zhong (Tutor / Grader)
Email: songjie @ andrew.cmu.edu

Instructor – Prof. Kenji Shimada

- **28** years of professional experience
  - **14** years at IBM
    (including 4 years of graduate study at MIT,
    Ph.D. in Mechanical Engineering with Business Minor)
  - **16** years at CMU
    (including 9 years of running two technology start-ups)
- Theodore Ahrens Professor in Engineering at Carnegie Mellon University
  - Mechanical Engineering (primary appointment)
  - Robotics Institute
  - Biomedical Engineering
  - Civil and Environmental Engineering
- Director of the Computational Engineering and Robotics Lab.

"Value compass": Needs x Seeds x Experiences = Values

.CERLAB.

Computational Engineering & Robotics Lab.

Kenji Shimada, Ph.D.

Theodore Ahrens Professor in Engineering

Mechanical Engineering

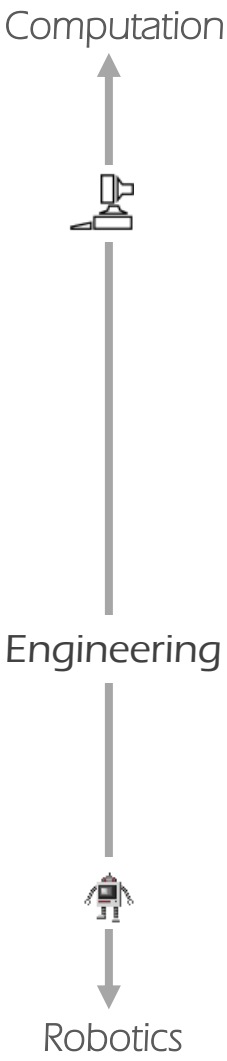
Robotics Institute

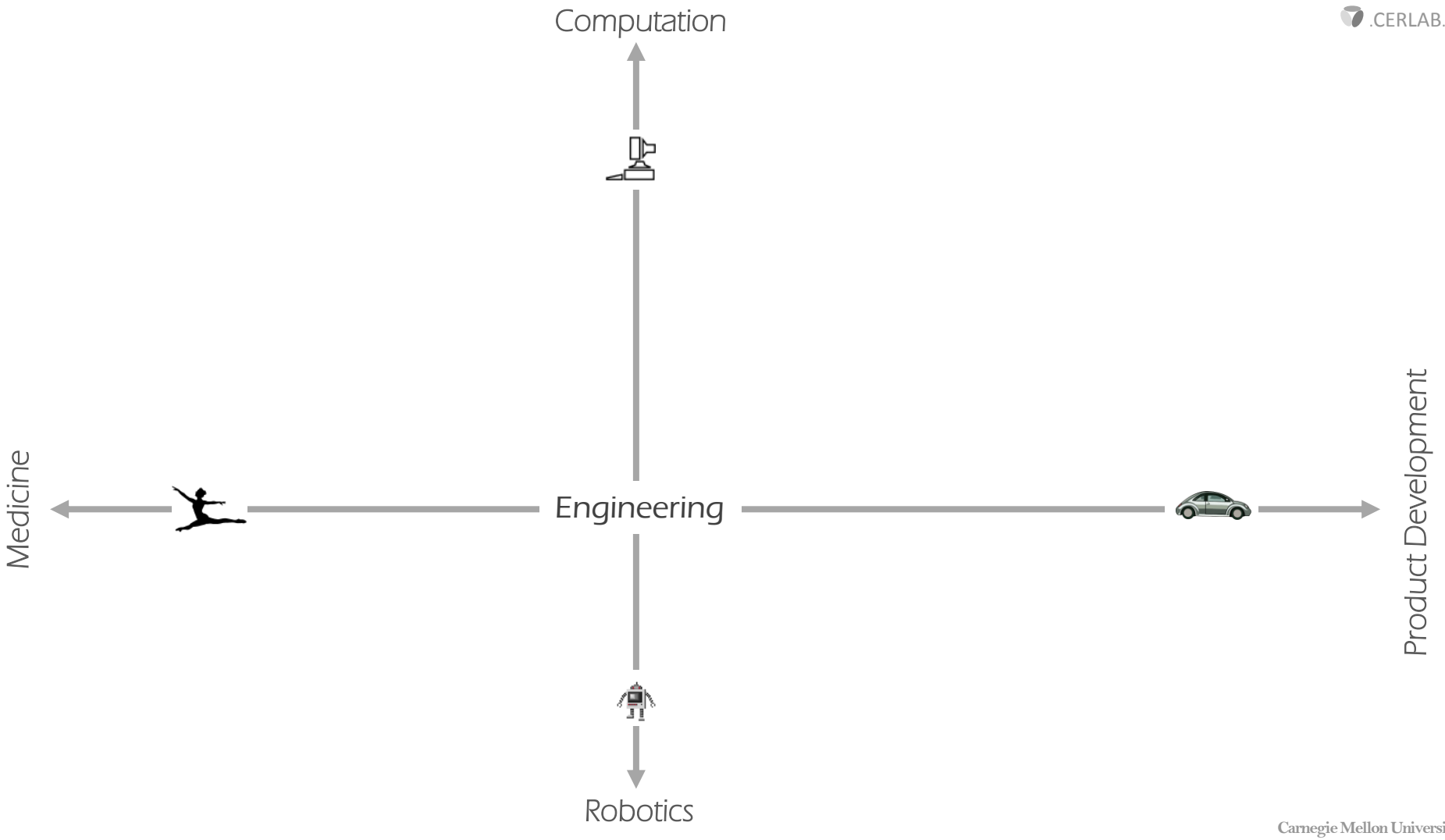
Biomedical Engineering

Civil and Environmental Engineering

Carnegie Mellon University

Engineering


Computation
Engineering
Robotics


Computation
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Medicine
Engineering
Product Development
Robotics
Carnegie Mellon University

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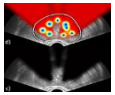
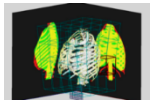
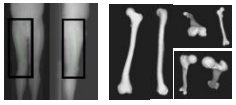
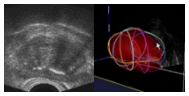
Computation

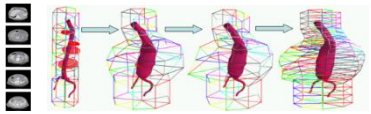

US Image synthesis

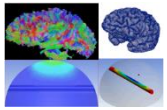

Rib-cage modeling from X-ray

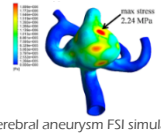

Computer and robot-assisted bone-deformity correction

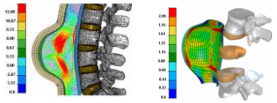

Aneurysm recognition


US-based prostate modeling

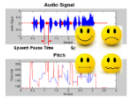

Modeling of abdominal aortic aneurysm from CT

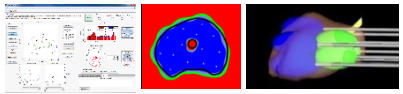

Traumatic brain injury simulation


Cerebral aneurysm FSI simulation


FSI analysis of abdominal aortic aneurysm


Device optimization


Speech emotion recognition


Computer-aide tutor and planner for prostate cryosurgery

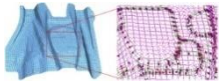

Sketch CAD for automobile styling design

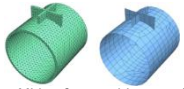
Sketch CAD for automobile seat design

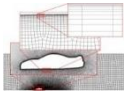

Sketch CAD for industrial design

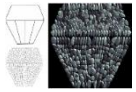

Segmentation and noise removal from a laser-digitized mesh


Volume decomposition


Quad meshing for crash analysis


Mid-surface meshing

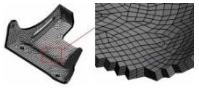

CFD mesh generation

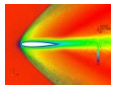

Texture generation

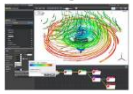

Feature generation

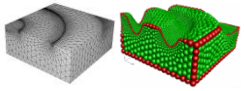

Anisotropic tet meshing

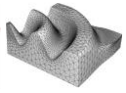

Hex-dominant meshing

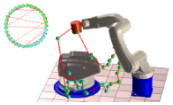

Layered hex meshing

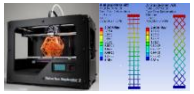

Adaptive CFD meshing


Cloud-based CFD


Mesh adaptation for large-deformation FEM


Nesting for rapid prototyping


TPSN Path Optimization


Optimization of 3D printed part

Medicine

Engineering

Product Development


Clubfoot correction

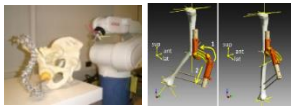

Trachea measurement


Image-guided arthroscopic hip surgery with position-tracking


3D US for RCI


AR-assisted intubation


US-guided biopsy


Robot-assisted bone deformity correction


12 DOF legged robot


7DOF redundant robotic manipulator


UAV flight path optimization

Machine-learned robot controller

Robotic gluing

Motion-teaching 3D pen

Gesture-based motion teaching

Laser digitizing for reverse engineering

Optimal path generation

Robotics

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