

3D Models from 2D Images

A Lecture in the Freshman Seminar Series:
Puzzling Problems in Science and Technology



Oct. 2018



3D Models from 2D Images



Slide 1

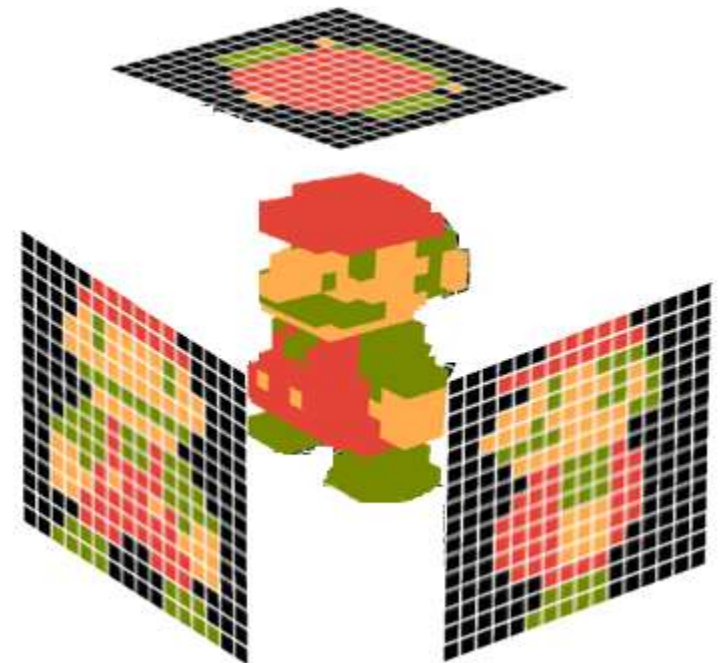
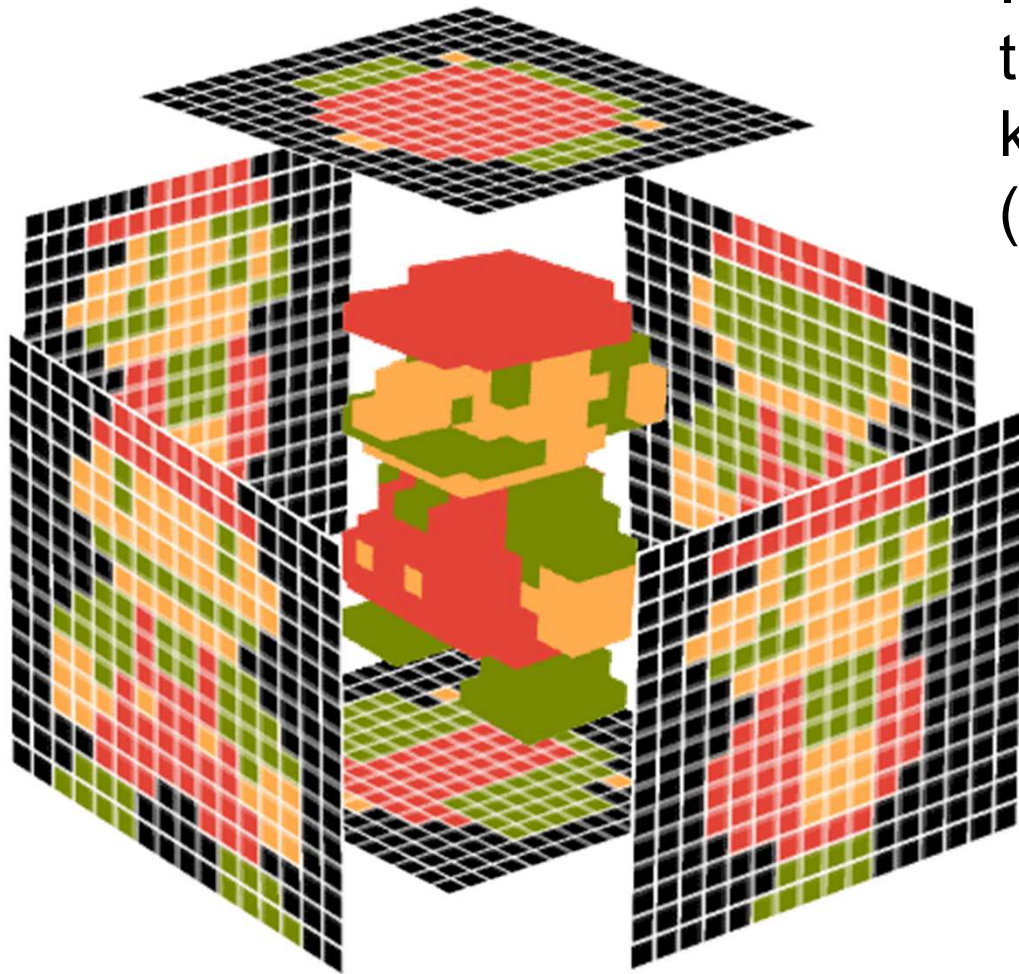
About This Presentation

This presentation belongs to the lecture series entitled “Puzzling Problems in Science and Technology,” devised for a ten-week, one-unit, freshman seminar course by Behrooz Parhami, Professor of Computer Engineering at University of California, Santa Barbara. The material can be used freely in teaching and other educational settings. Unauthorized uses, including any use for financial gain, are prohibited. © Behrooz Parhami

Edition	Released	Revised	Revised	Revised	Revised
First	Oct. 2016	Oct. 2018			

A 3D Object's Six 2D Projections

If we were to manufacture this object, we also need to know about its insides (e.g., is it hollow or solid?)



3D Structures Built of Cubic Blocks

A 3D assembly of blocks can be specified by three views:

Top view (aka base view)

Front view

Right view (aka side view)



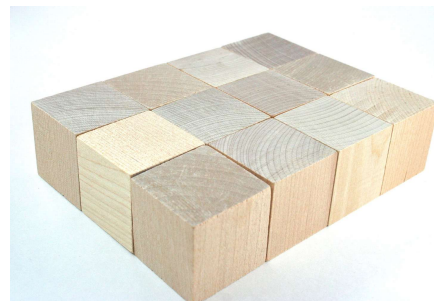
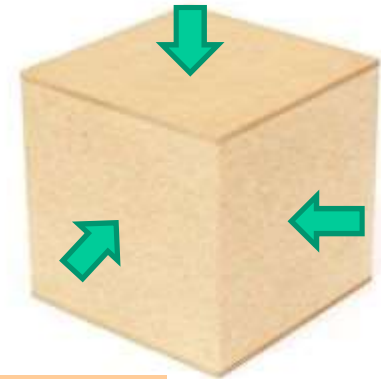
Top (Base)



Front



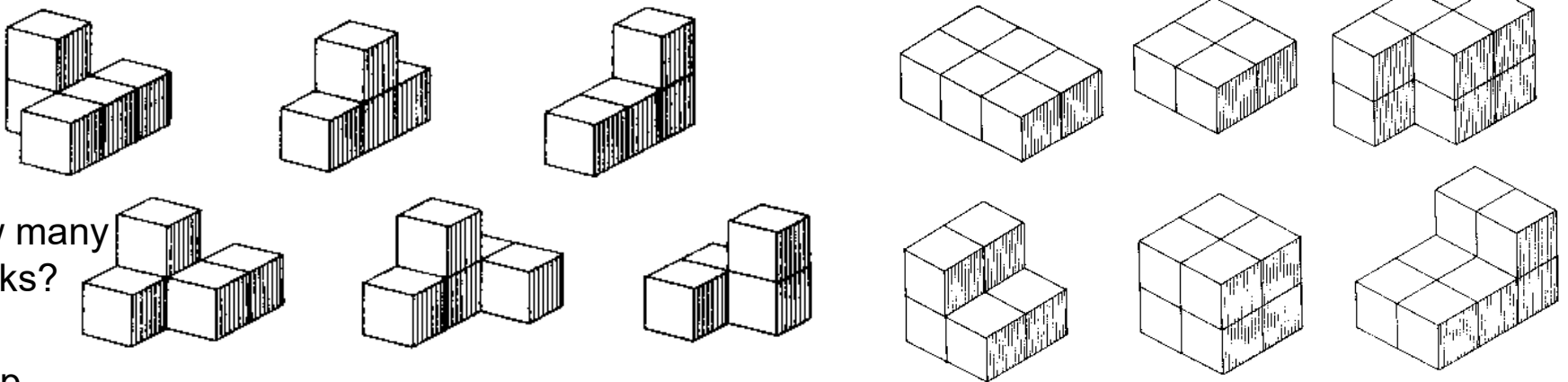
Right (Side)



3D Structures Built of Cubic Blocks

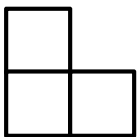
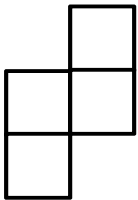
Draw the top, front, and right projections in two cases

1. Shapes formed from blocks; 2. Shapes carved out in one piece

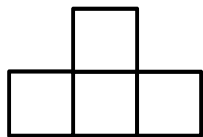


How many blocks?

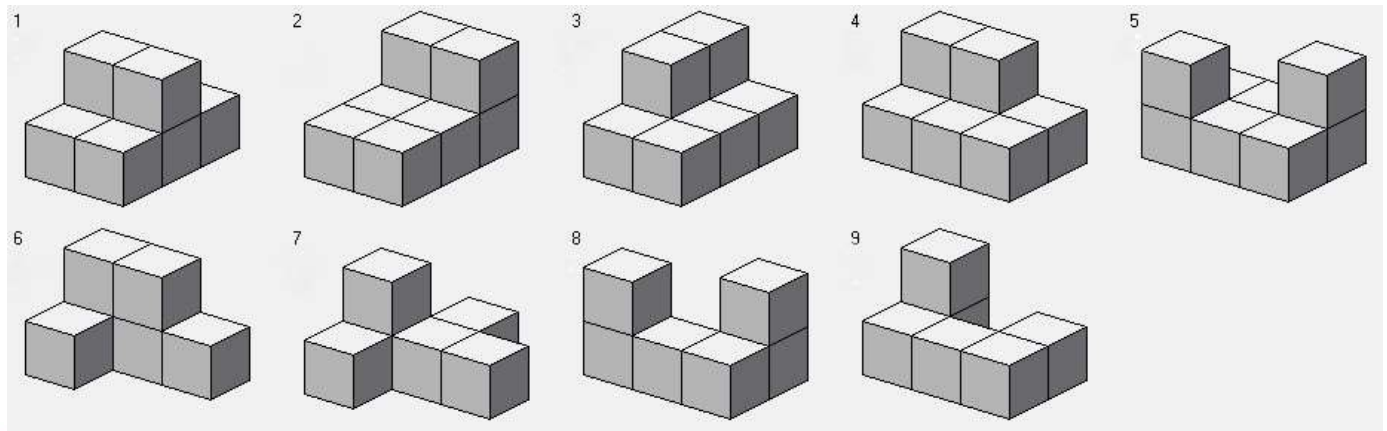
Top



Front

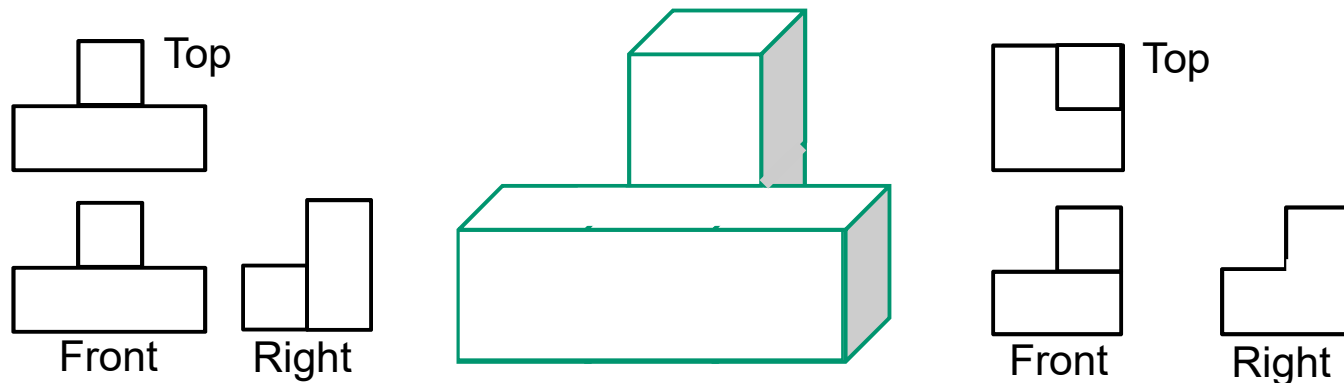
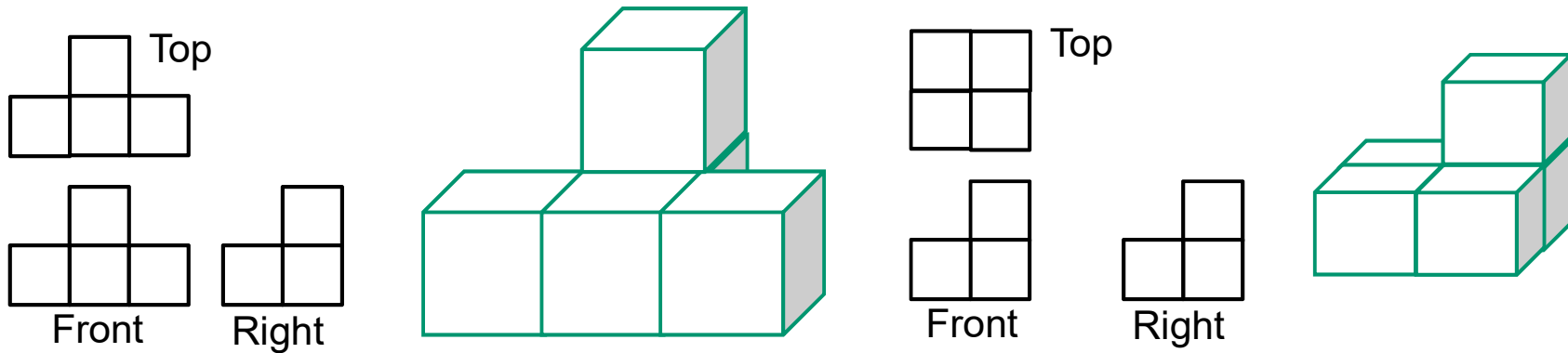


Right



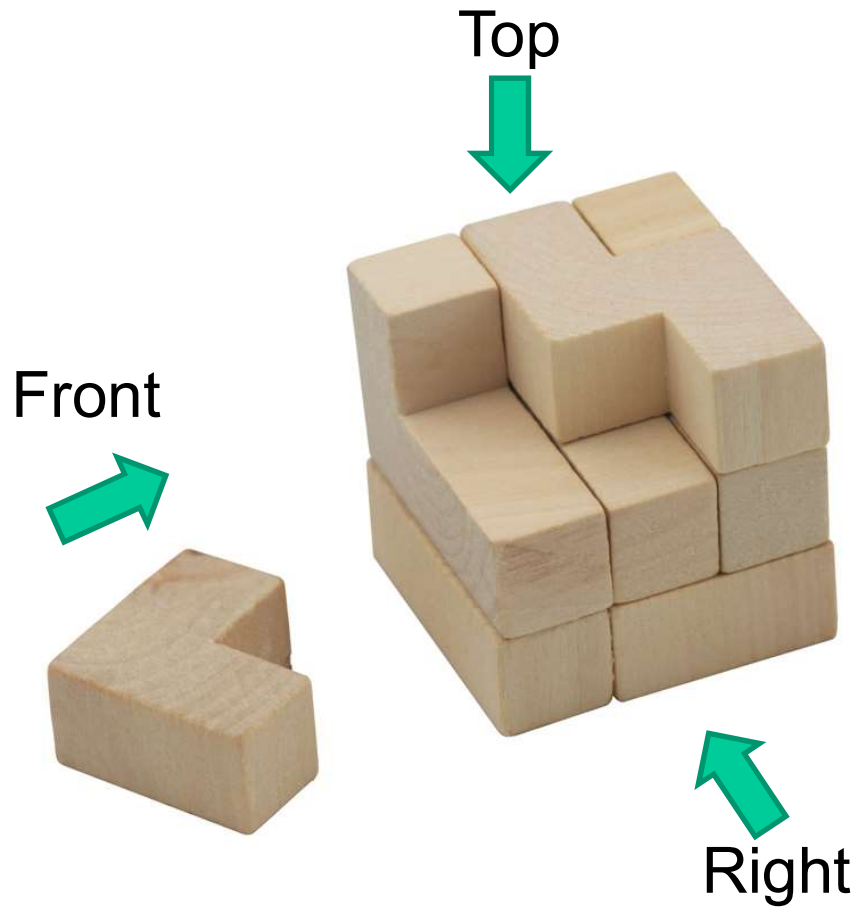
3D Reconstruction from 2D Projections

5-minute video: <https://www.youtube.com/watch?v=PXp3D-R7--E>



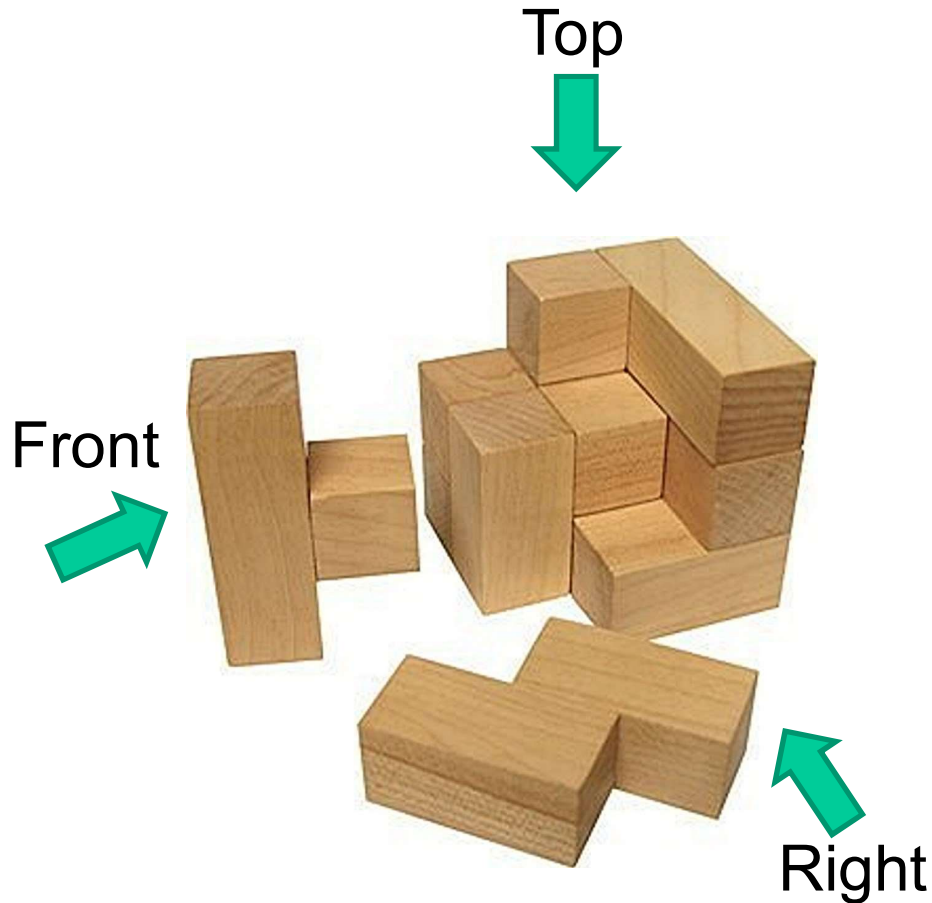
Challenge Puzzle 1: Draw the Three Views

Draw once without and once with the removed piece



Challenge Puzzle 2: Draw the Three Views

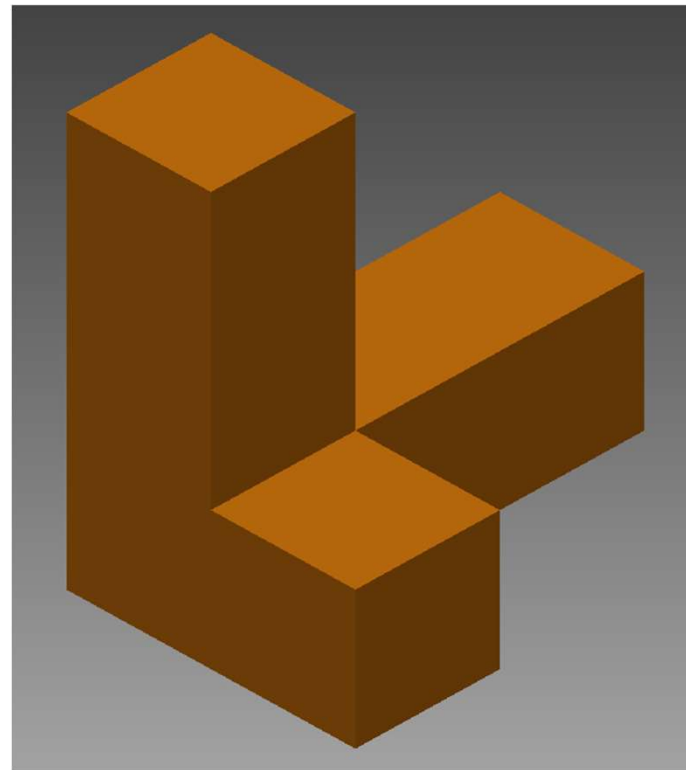
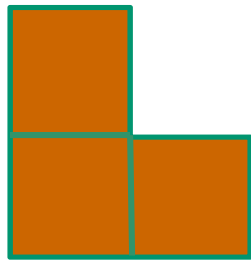
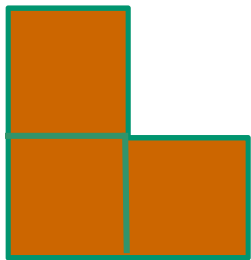
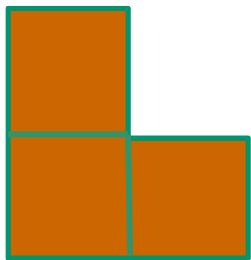
Draw once without and once with the two removed pieces



Comparing 3D Objects with 2D Projections

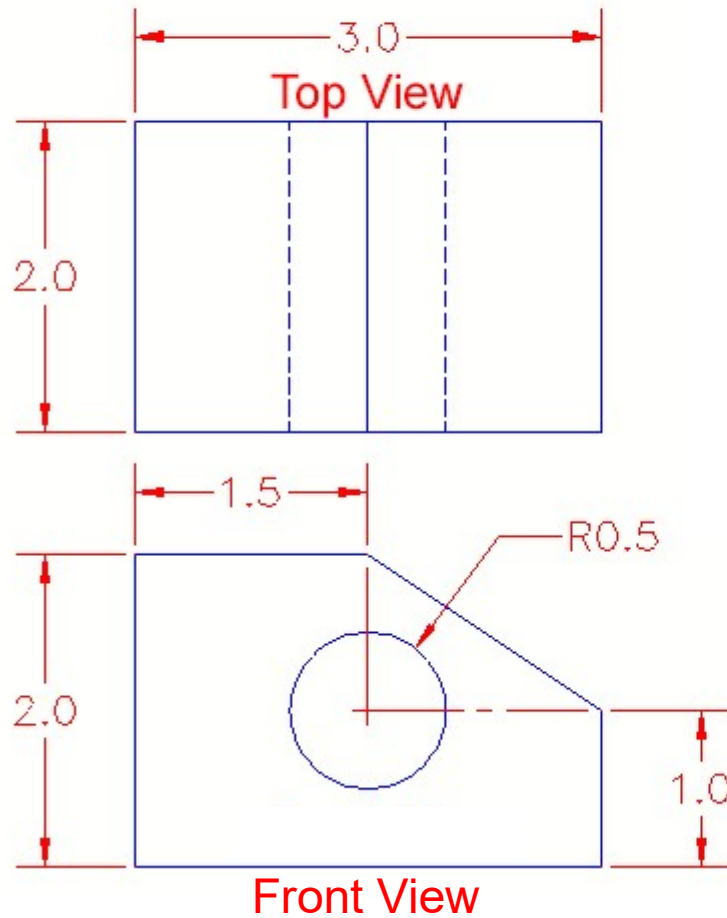
Are these two objects the same? If not, list the differences.

Change the projections so that they correspond to the 3D object



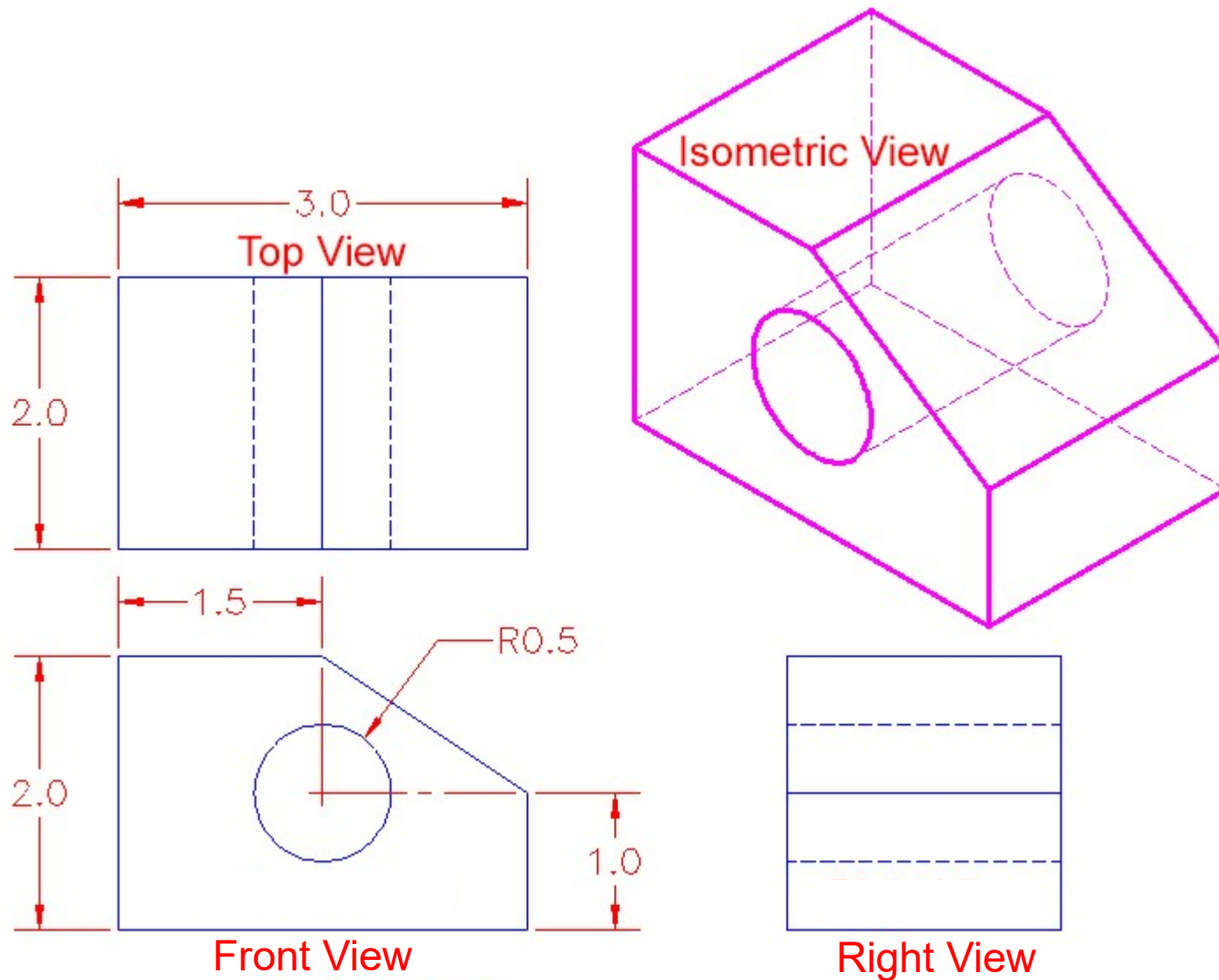
Engineering Drawings of A 3D Object

Draw the 3D object here



Dashed lines represent elements that are invisible in that view (i.e., they are on the back side or inside the object)

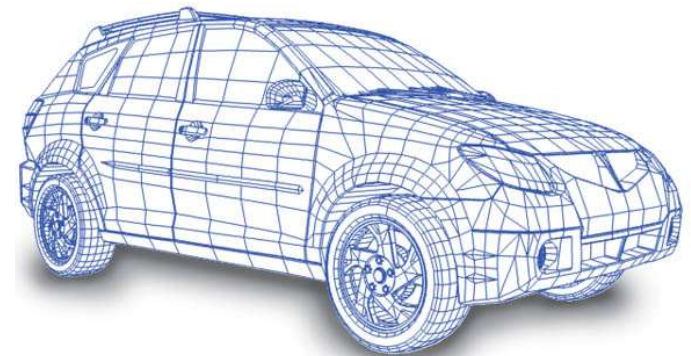
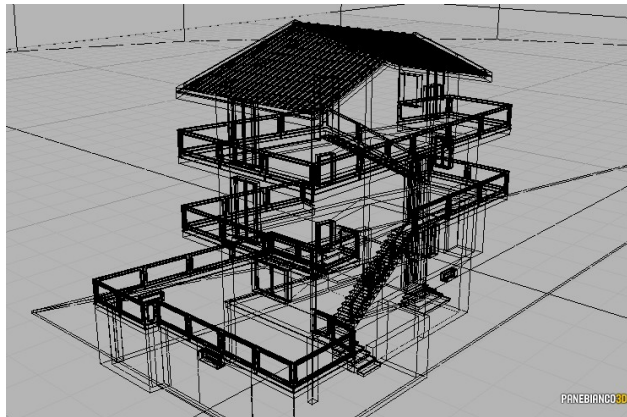
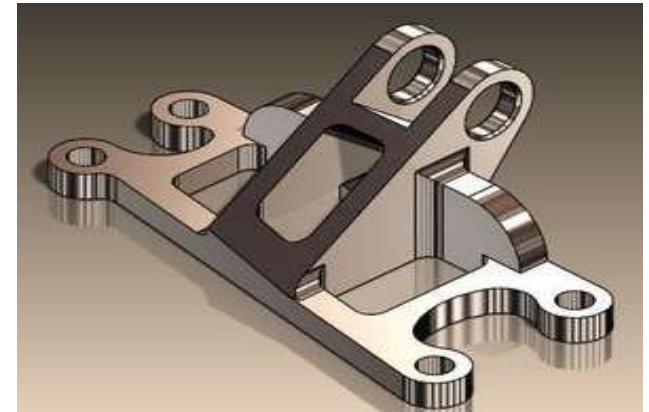
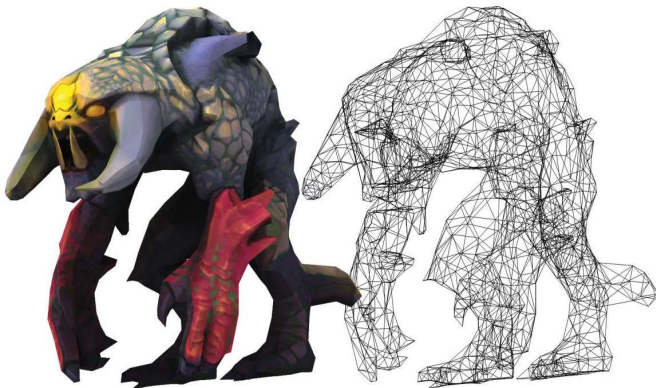
Engineering Drawings of A 3D Object



3D Modeling in Practice

3D models are needed everywhere:

Computer games | Architecture | Medical diagnostics
Industrial manufacturing (mechanical parts, cars, planes, ...)



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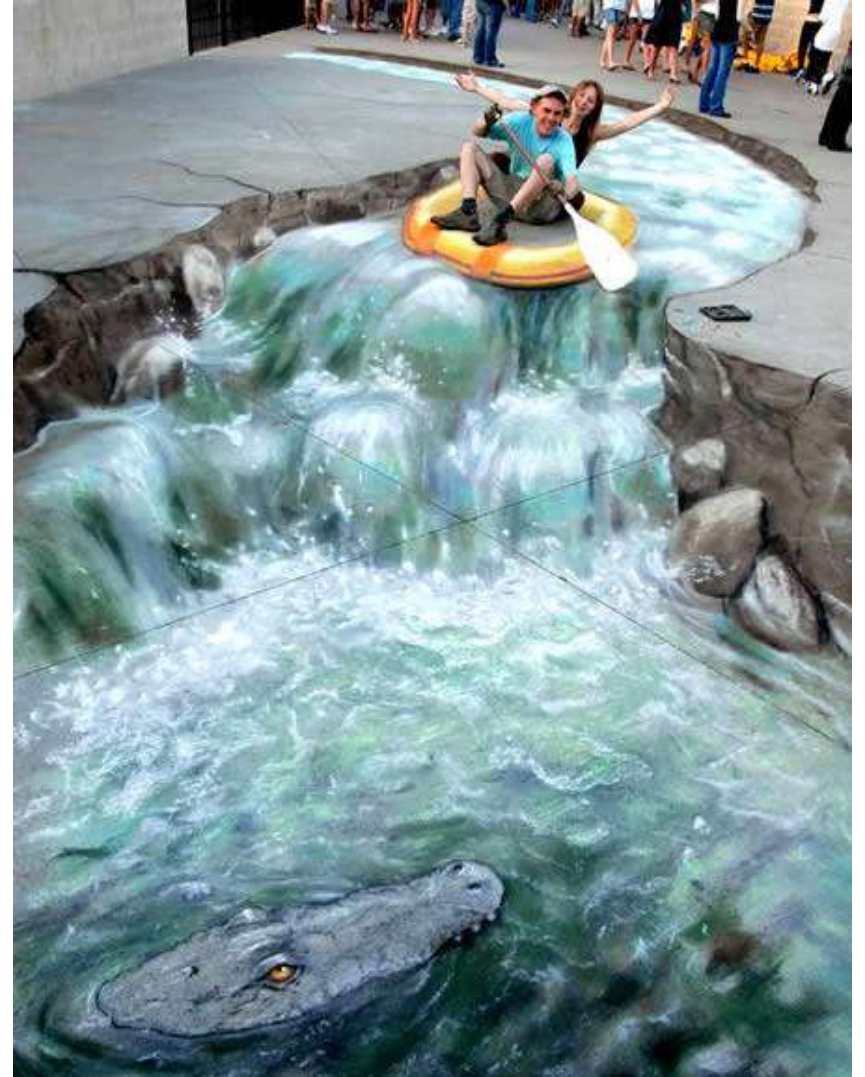


3D Models from 2D Images



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3D Optical Illusions: Sidewalk Art



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3D Models from 2D Images



Slide 13

3D Optical Illusions

How to create a 3D illusion: Hole on palm of hand

2-minute video: <http://www.youtube.com/watch?v=s2LrmAThAhk>



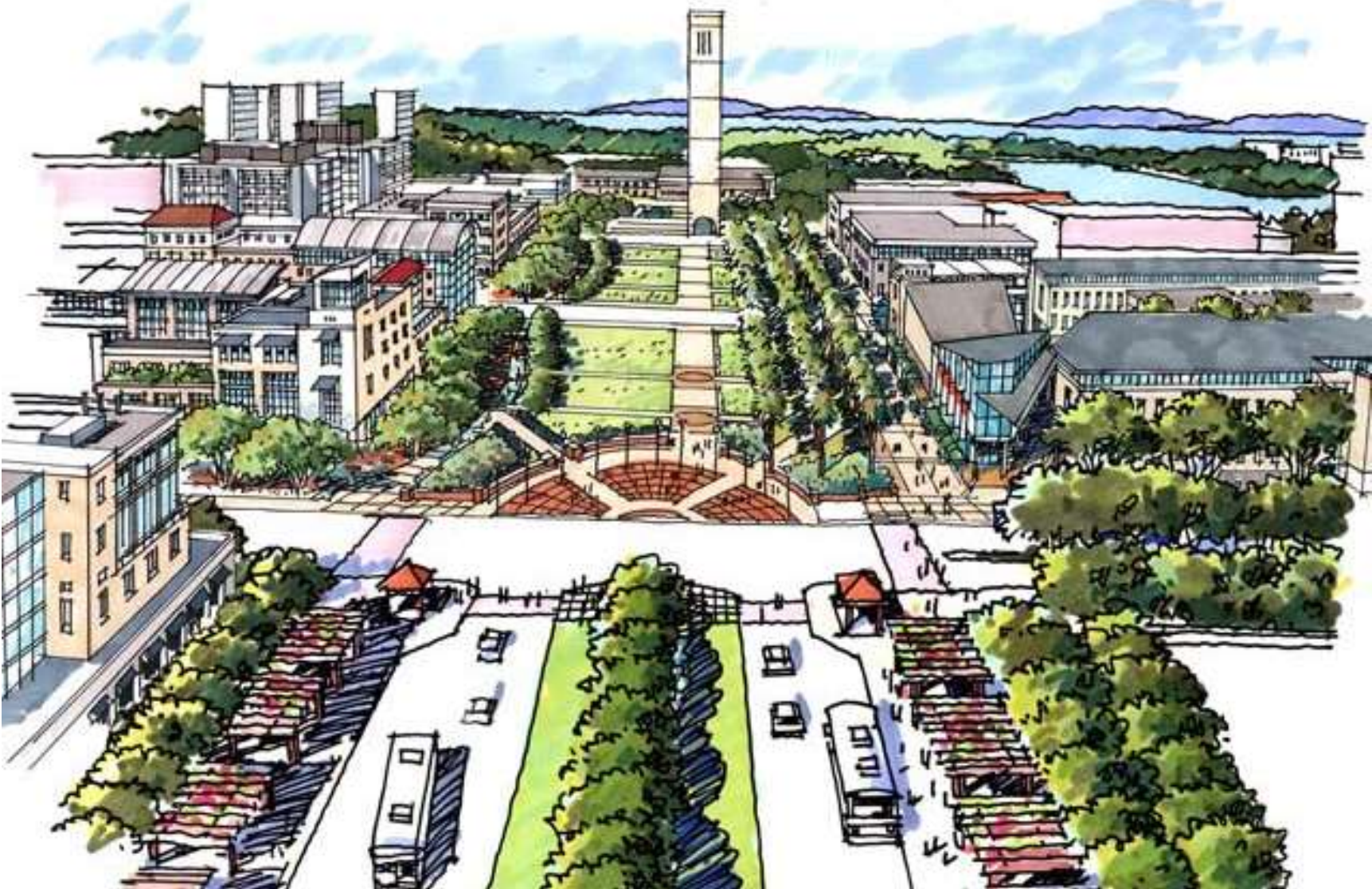
Computer Game Character Animation

Similar to animation for film, but here speed is more important

1-minute video: <http://www.youtube.com/watch?v=yQuStfDbd9s>



UCSB's Long-Term Development Plan



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3D Models from 2D Images



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Virtual Architectural Preview

Residential complex viewed from different angles before it is built:
3-minute video: http://www.youtube.com/watch?v=_zeEiQfgicY



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3D Models from 2D Images



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Virtual Reconstruction of the Temple Mount

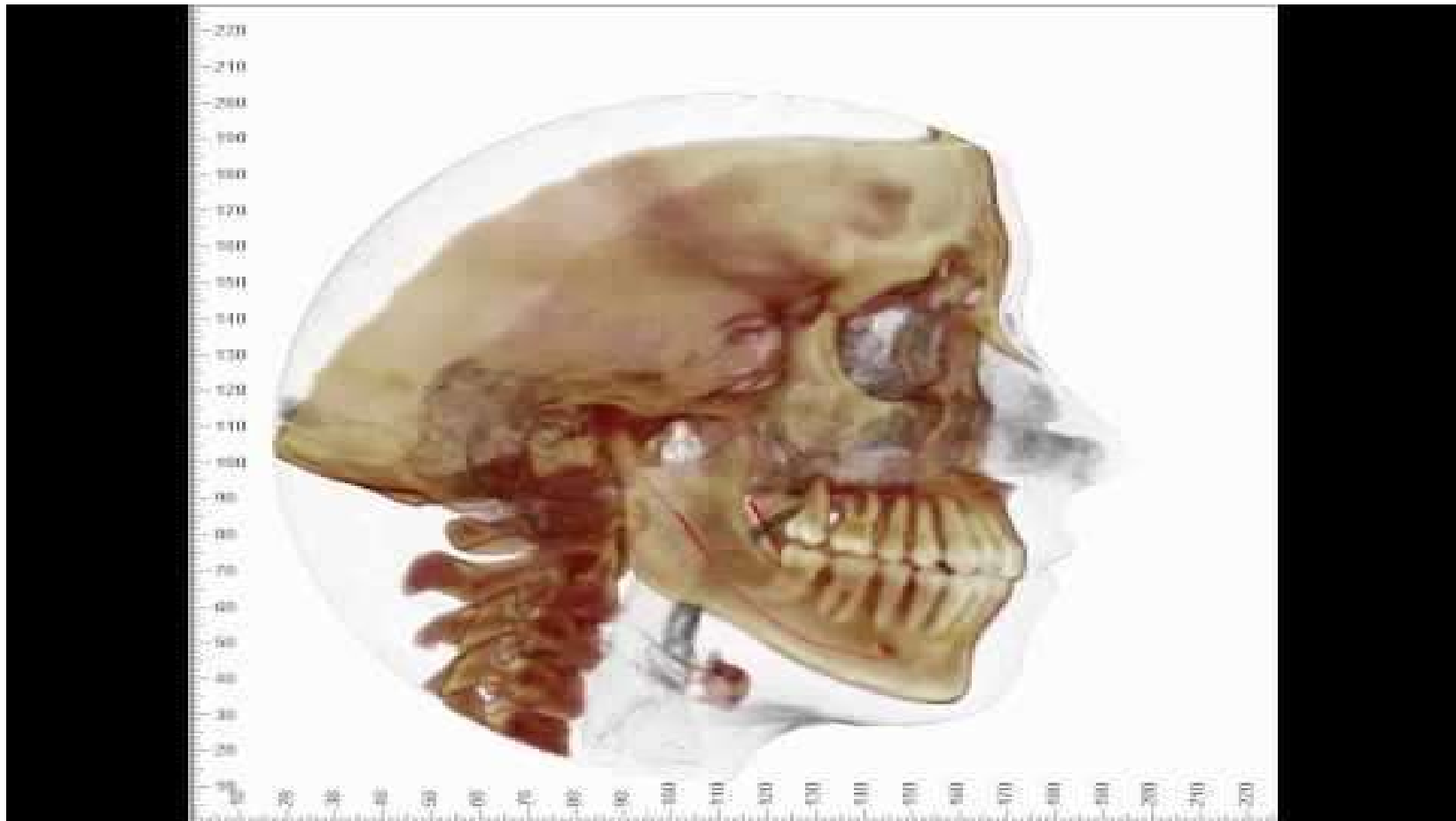
UCLA's Urban Simulation Team built a 3D computer model:
8-minute video: <http://www.youtube.com/watch?v=HHLD6RXVLam>



3D Medical Imaging

Multiple 2D images (views or slices) turned into a 3D model.

1-minute video: <http://www.youtube.com/watch?v=QeqzJbRgQx0>



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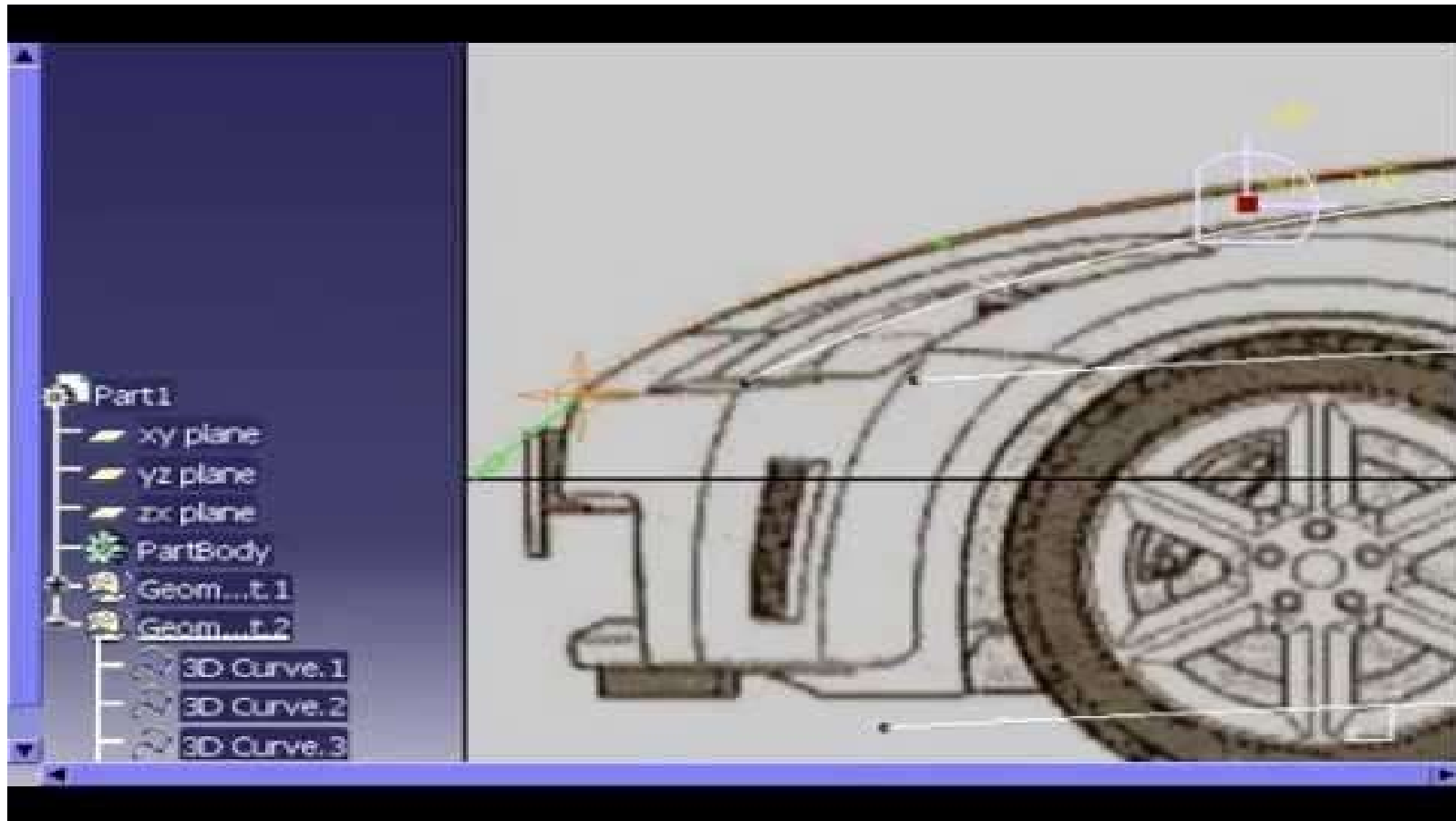
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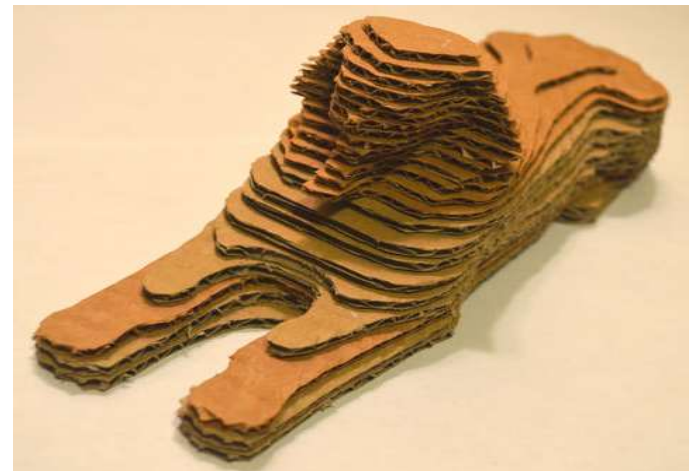
3D Modeling of a Car

Turning 2D views into a 3D model

2-minute video: <http://www.youtube.com/watch?v=uwvthq5ZD0o>



3D Model Built from Slices: Terrains, etc.



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3D Models from 2D Images



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3D Model Built from Slices: Human Body

Darth Vader's head assembled from slices

2-minute video: <http://www.youtube.com/watch?v=S2G2ySEaJso>



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3D Models from 2D Images



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3D Printing: Important Emerging Technology

Printing an actual usable wrench with moving parts

4-minute video: <http://www.youtube.com/watch?v=qx5fDHqHVOE>



Example 3D Printing Application

Airbus's Thor concept aircraft:

Built from sixty 3D-printed structural segments



Nov. 2016



3D Models from 2D Images



Slide 24

3D Pen: For Playful Experimentation

Pen with rapidly cooling molten plastic “ink” for creating wireframes

2-minute video: http://www.youtube.com/watch?v=6r5q9T_7u8A

