

# Course overview

Digital Visual Effects

*Yung-Yu Chuang*

# Logistics

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- **Instructor:** Yung-Yu Chuang ([cy@csie.ntu.edu.tw](mailto:cy@csie.ntu.edu.tw))
- **Textbook:** Readings from books, journals and proceedings. Richard Szeliski's [Computer Vision: Algorithms and Applications](#). Richard Radke's [Computer Vision for Visual Effects](#).
- **Webpage:** <http://www.csie.ntu.edu.tw/~cy/vfx>

This course is **NOT** about ...

# It isn't about photography

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# It isn't about 3D animations



# It isn't about watching movies



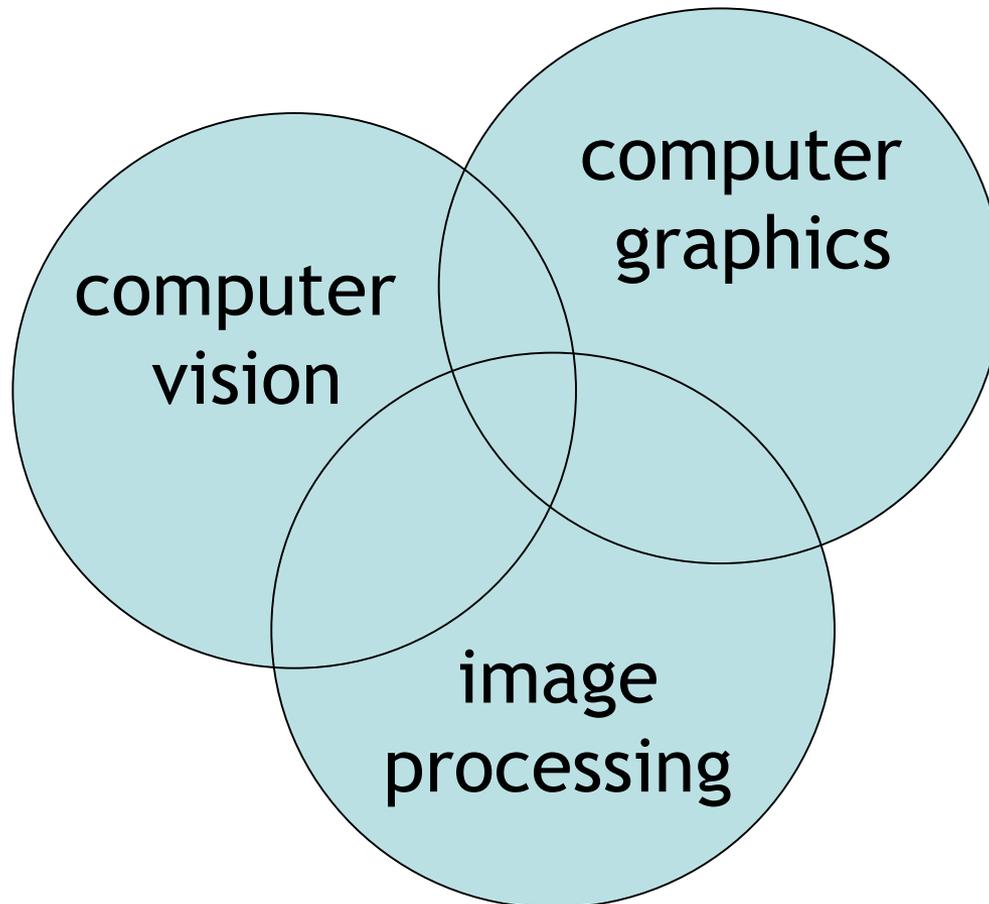
# It isn't about physical effects



# It's not about industrial tricks

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You will learn more about Taylor and Poisson than Lucas and Spielberg in this course. If you hear Lucas in the class, it is more likely to refer to Bruce Lucas, not George Lucas.



# It's not about deep learning

- Although some of the discussed problems have better deep learning solutions, we mostly cover the classical approaches.

Why

**Traditional Computer Vision**

Thrives Alongside

**Deep Learning?**



# Prerequisites

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- It is a *must* that you have programming experiences.
- It is a *must* that you have basic knowledge on linear algebra and probability.
- It is a *plus* if you have background knowledge on computer vision, image processing and computer graphics.
- It is a *plus* if you have access to digital cameras and camcorders.

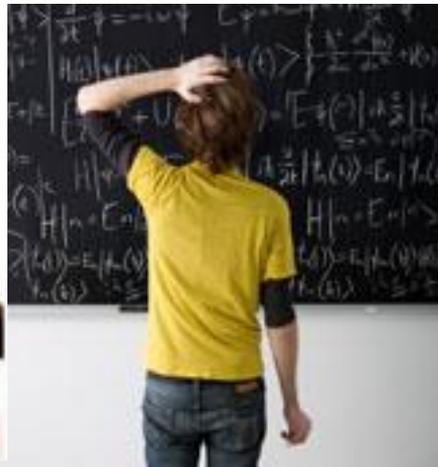
# The vfx course



what other professors  
think you do

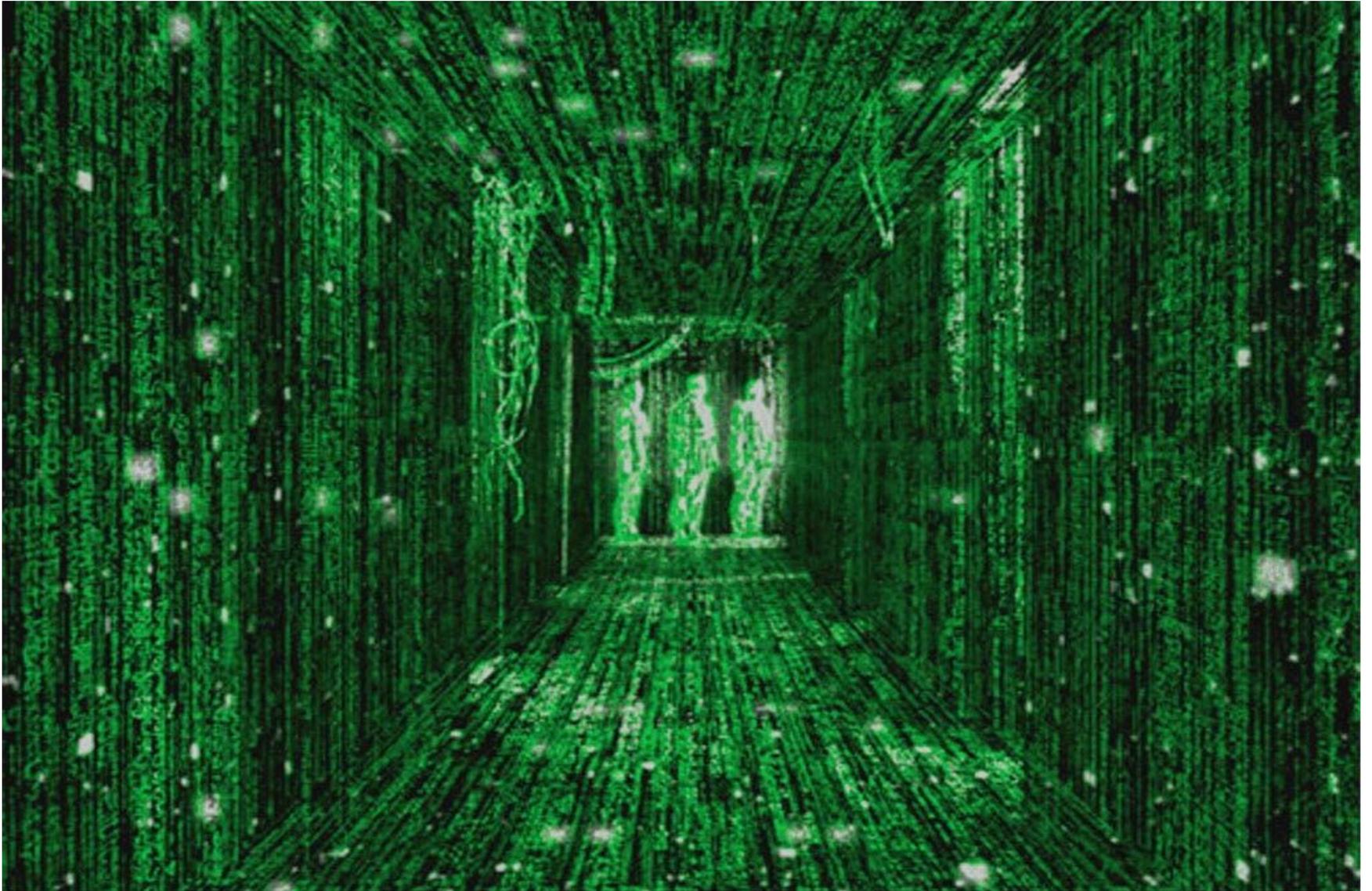
what other students  
think you do

what you thought  
you will do



what you actually do

# Be cautious!



**This course is about ...**

# Digital Visual Effects



# Digital Visual Effects



# Deadpool

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# Deadpool



# Life of Pi

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# Life of Pi

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# 獨自一人拍和十三人的戲



要把身材高大的甘道夫和小矮人們拍攝在一起，我們是沒法在同一個片場的。和我一起拍攝的只有柱子上貼著的**13**張他們的照片，後面還有一個小燈，哪個角色說話了燈就亮起來。想像一下你在拍一場和**13**個人一起演的戲，但你卻只有獨自一人。這真的會把你的演技推到極限。我哭了，真的，我當時真的哭了。然後我還說出了聲：我認真演了一輩子不是為了跟這些照片對戲啊！

# VFX of the Hobbit

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# Reality?

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# Retouching

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# Retouching



# Retouching



# Bush campaign's TV AD, 2004



# Texture synthesis and inpainting

This section shows a sampling of the duplication of soldiers.



# Iraq War, LA Times, April 2003



Digital photomontage

# Domestic example



The Liberty Times  
2007.12.17



# Special effects

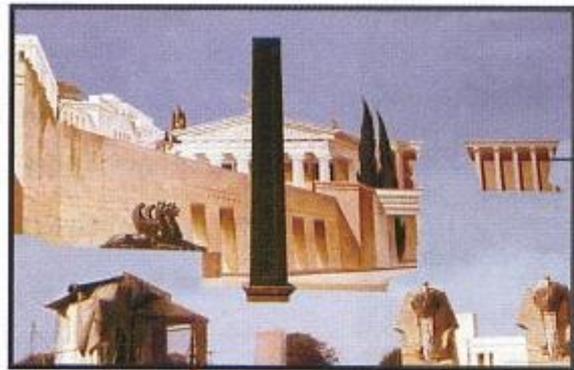
# Stop action

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*The execution of Mary, 1895*

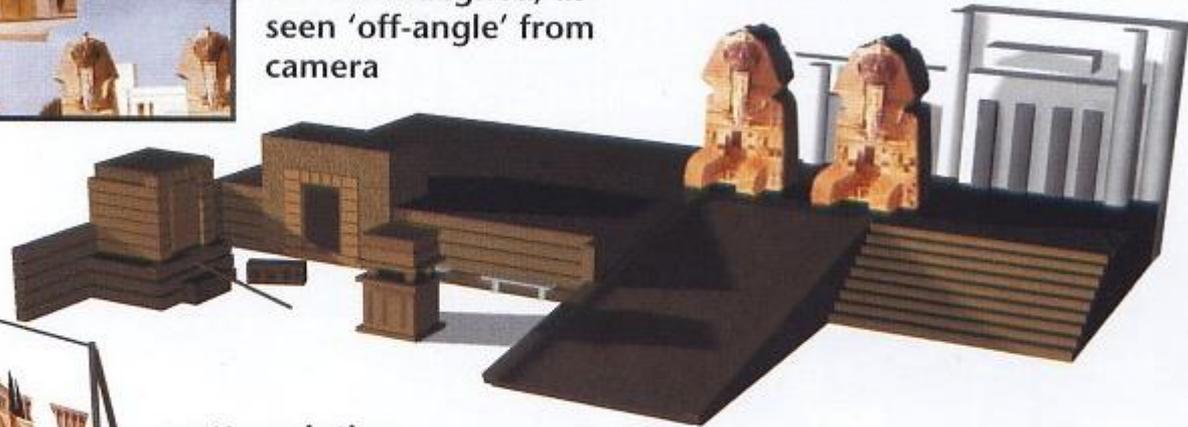
# Glass shot



foreground painting and background sets when misaligned, as seen 'off-angle' from camera

**Figure 1**  
A GLASS SHOT, AS USED FOR THE SHOOTING OF CLEOPATRA (1963)

full-scale set



matte painting



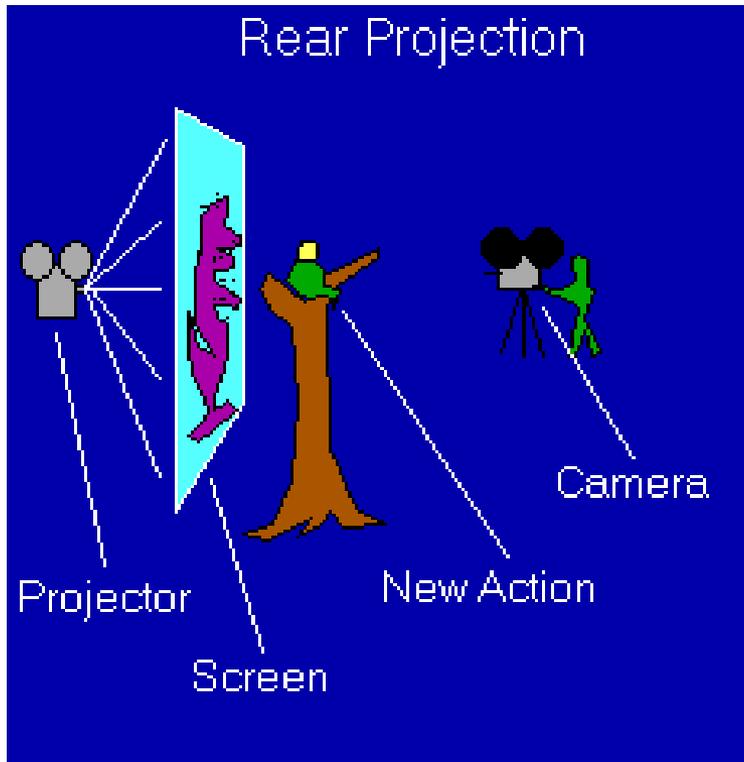
camera

composite of painting and full-scale set, as seen through camera



# Rear projection

stop motion



*King Kong, 1933*

# Special effects (make-up)

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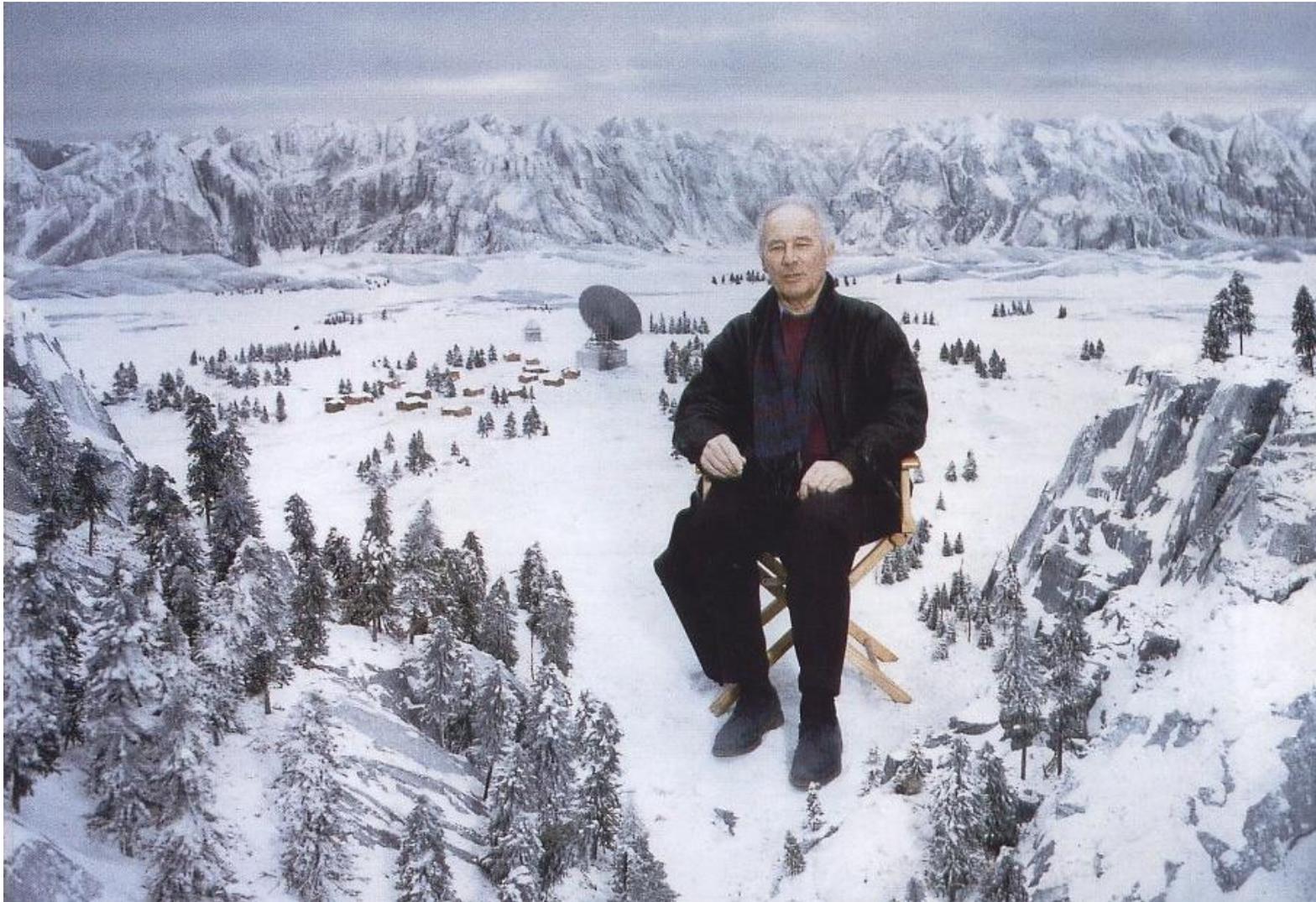


# Special effects (physical effects)

Figure 7 CANNON CAR



# Special effects (miniature)



# Special effects (matte painting)



# Lord of the Rings

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# Illusion - forced perspective

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# Computer-generated model



# The Avengers

*AVENGERS 1979*



# The Avengers (1978)

DigiVFX

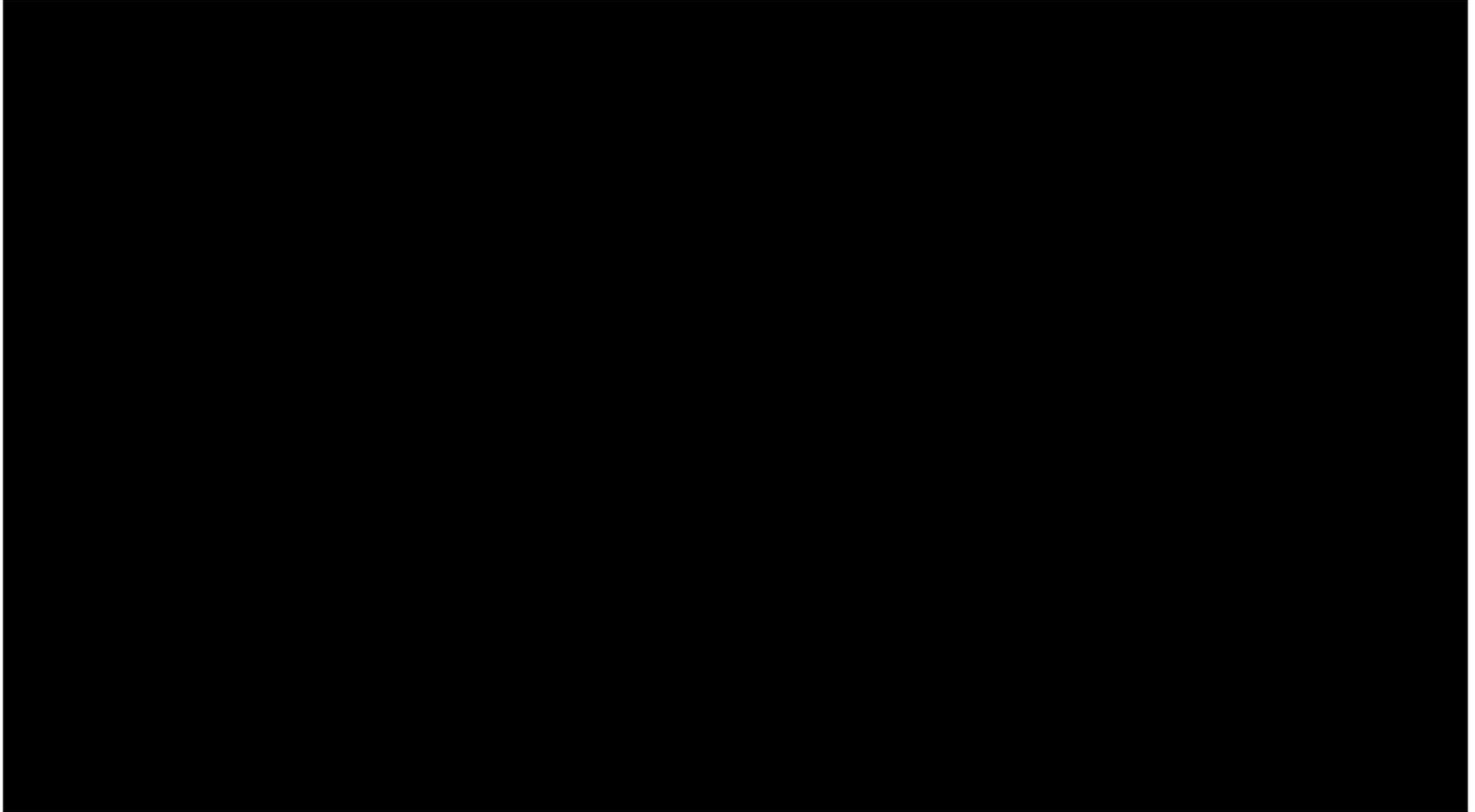


# The Avengers (2012)

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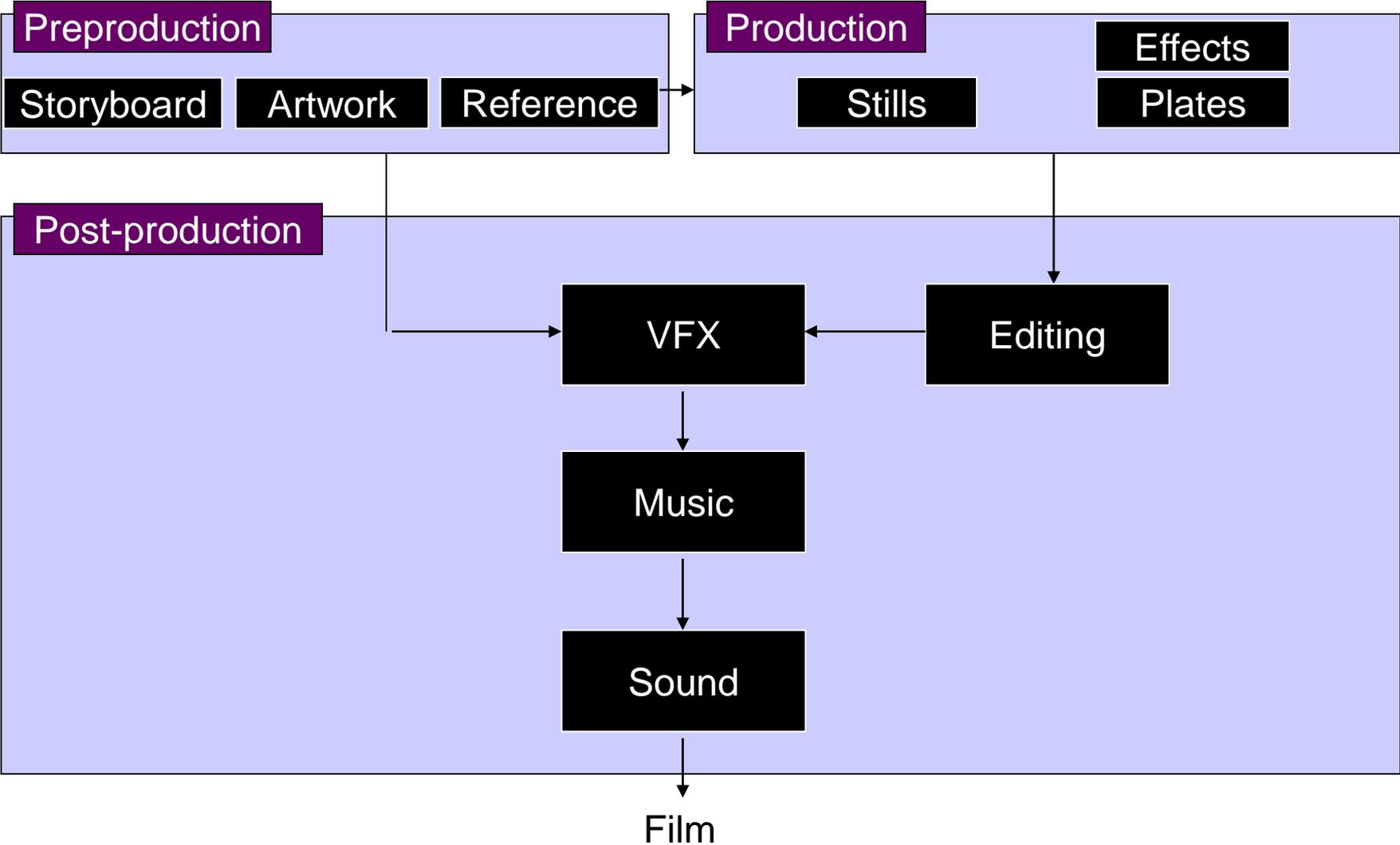
# Visual effects 100 Years

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# Production pipeline

# Production pipeline



# Preproduction



Storyboard

# Preproduction

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Artwork

# Preproduction



Reference & Research

# Production



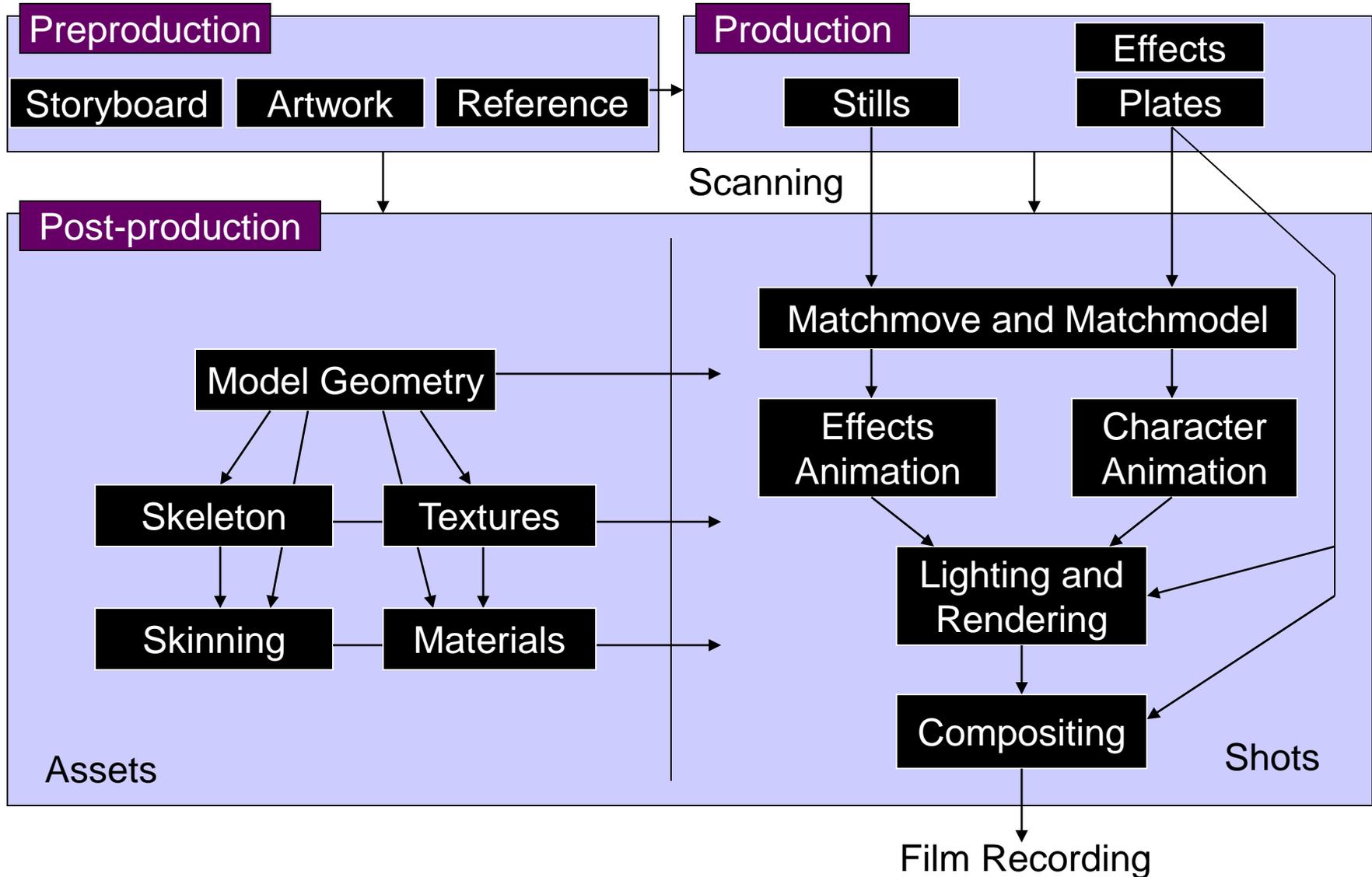
Shooting

# Post-production

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# Visual effects production



# Visual effects post-production

**PRE-VIZ**



**▶ ENVIRONMENT ◀**



**LIVE ACTION**



**ANIMATION**



**MASSIVE**



**ROUGH COMPOSITE**



**PLAY ALL**

**RETURN**

**COMMENTARY ON**

**OFF ◀**

**FINAL FILM**



# **A case study**

# 405: The Movie

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- This movie were created solely by two visual effects artists in the year of 2000. It was a process that took over three months of nights, weekends and any spare moments that they could find.
- [https://en.wikipedia.org/wiki/405\\_\(film\)](https://en.wikipedia.org/wiki/405_(film))
- An early example of digital filmmaking and the use of Internet as media
- Budget: \$300 (\$140 for tickets. The officer is acknowledged)



# 405: The Movie

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# Making of 405

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## Step 0: script and shooting plan

Shot#	Description	Full CG	CG	Length Frames
01	Title Animation	X	X	401
02	Freeway speeds beneath car			123
03	Speed Limit 65			120
04	LA Freeway from Overpass			238
05	Empty Freeway--Car enters frame	X	X	150
06	Pan From Freeway J looks at lack of traffic			237
07	Plane swings into landing position toward freeway	X	X	139
08	Hand on Gear shift			36
09	Plane lowers into view through rear window		X	84
10	Plane nears Car	X	X	65
11	J looks to side mirror--plane visible behind		X	84
12	Plane in sideview mirror		X	65
13	J looks from side view to rear view mirror -- plane behind		X	27
14	J eyes react in rear view mirror--remove traffic		X	33
15	Plane chases Car toward camera	X	X	77

# Making of 405

**Step 1: shooting**  
two days with a Canon Optura DV camera with progressive mode.  
⇒ a 70-minute raw footage



initial editing  
⇒ pickup shots



Cuts to Driving  
with plane closing from  
behind

Cuts from Side then  
Rear view mirror looks



# Making of 405

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## Step 2: building CG world

total 62 shots, 42 enhanced with digital VFX.

19 shots are entirely digital creations.

plane, two cars, freeway background are digital

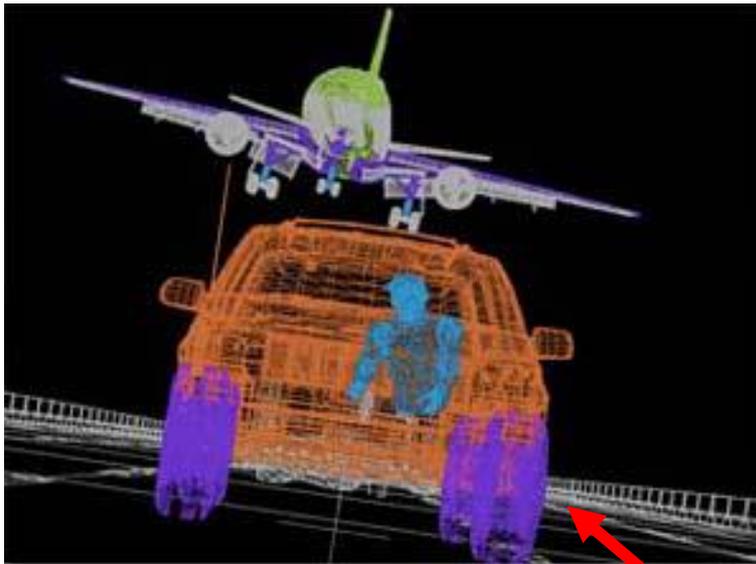


photo-based 3D environment

# Making of 405

Real cars were used for close-up and interior shots



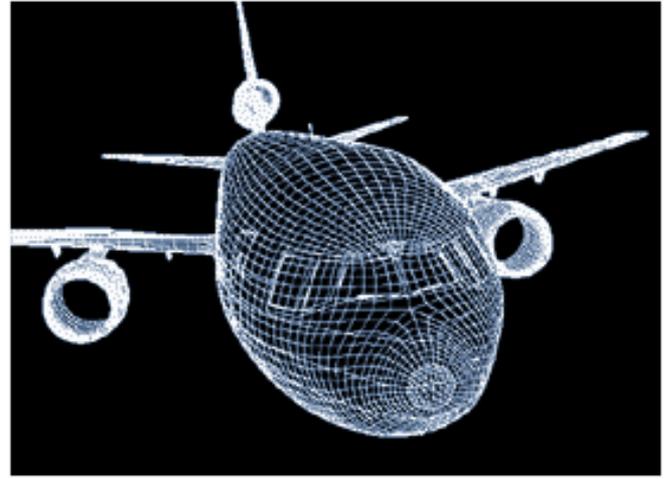
A low-resolution mesh scanned by a cyberscanner.  
Mapped with photographs.



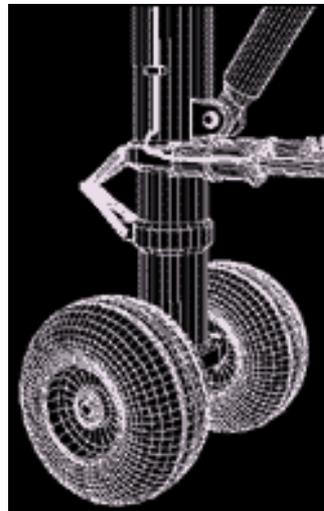
# Making of 405

DC-10 plane took a month to model in details for the needs of close-up shots.

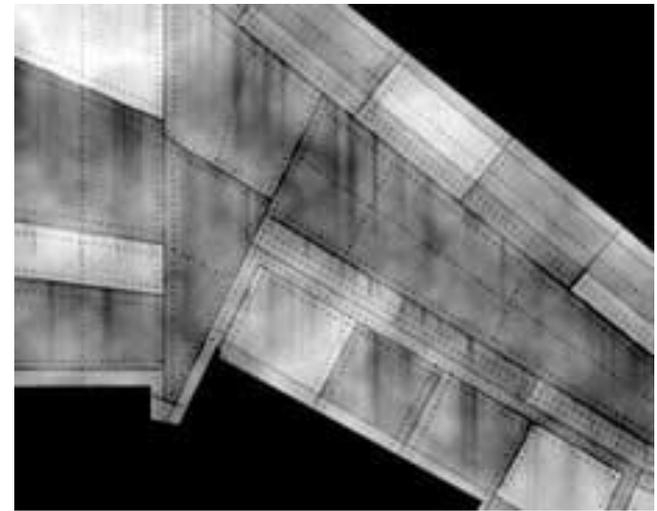
59 objects, 142,439 polygons



reference



modeling



material painting

# Making of 405

## Step 3: traffic clearing

clean plate



close-up shots



inpainting

# Making of 405

## Step 4: compositing



shot with the vehicle standing still in a backyard



# Making of 405



# Making of 405

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## Step 5: fine touchup



3D hat



compositing and inpainting

# Making of 405

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## Step 6: music and delivery



# Bloody Omaha

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**Topics we plan to cover**

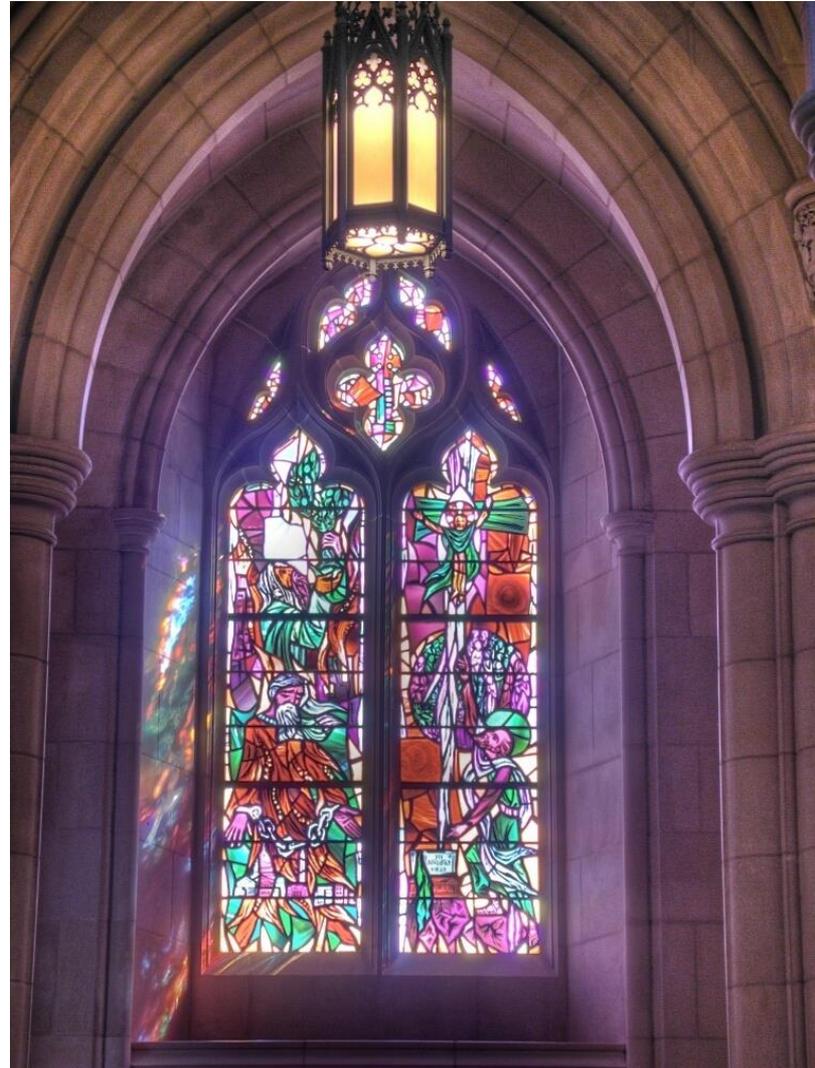
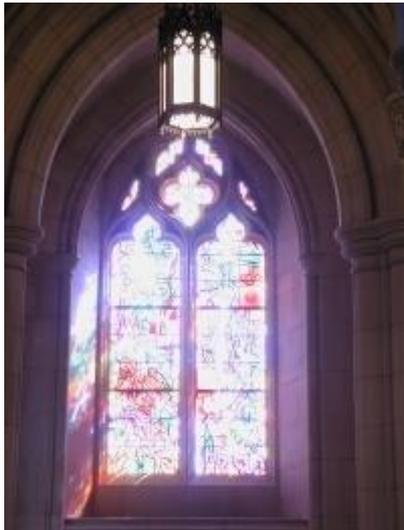
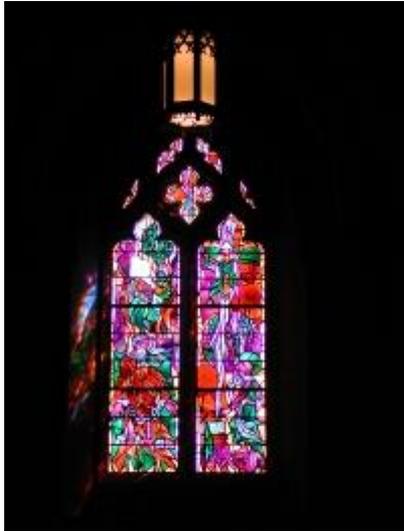
# Camera

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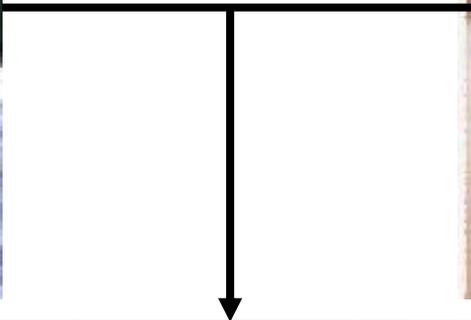
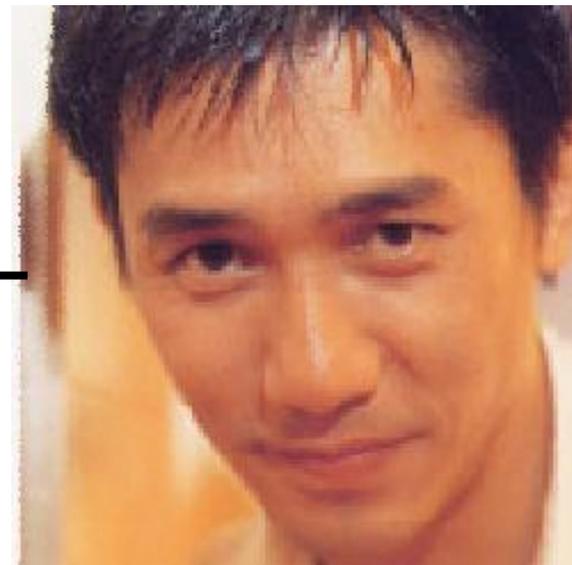


Canon 10D

# High dynamic range imaging/display

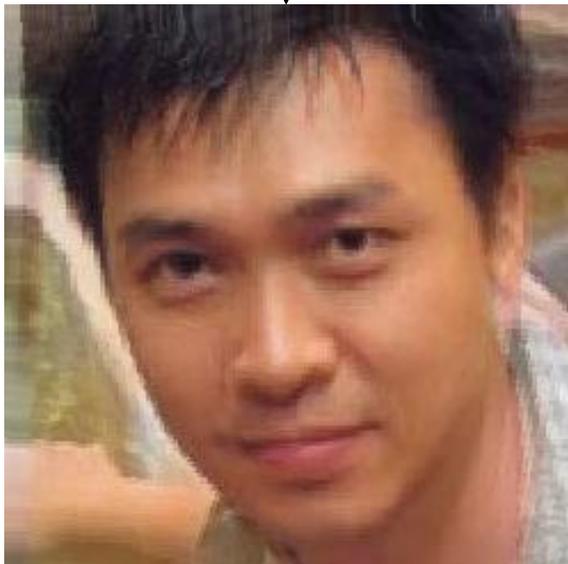


# Image warping/morphing

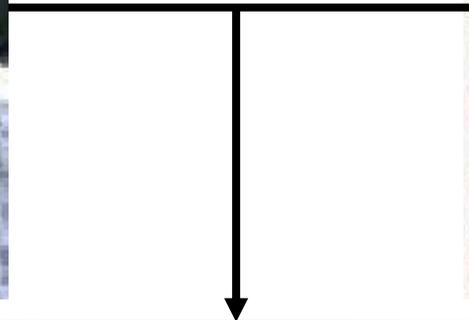
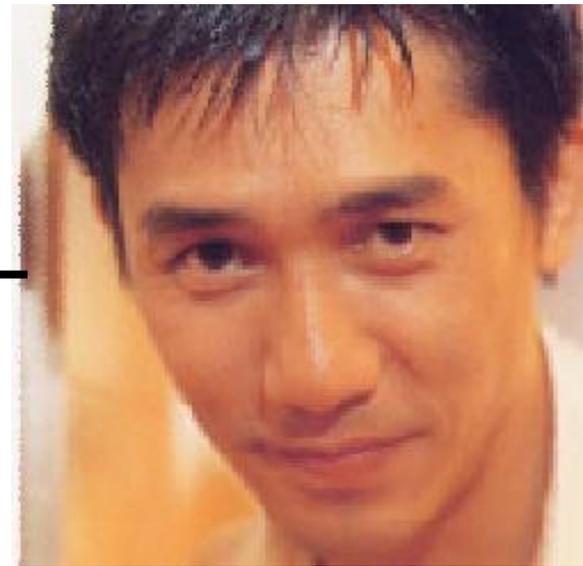


someone not  
that famous

someone very  
famous



# Image warping/morphing

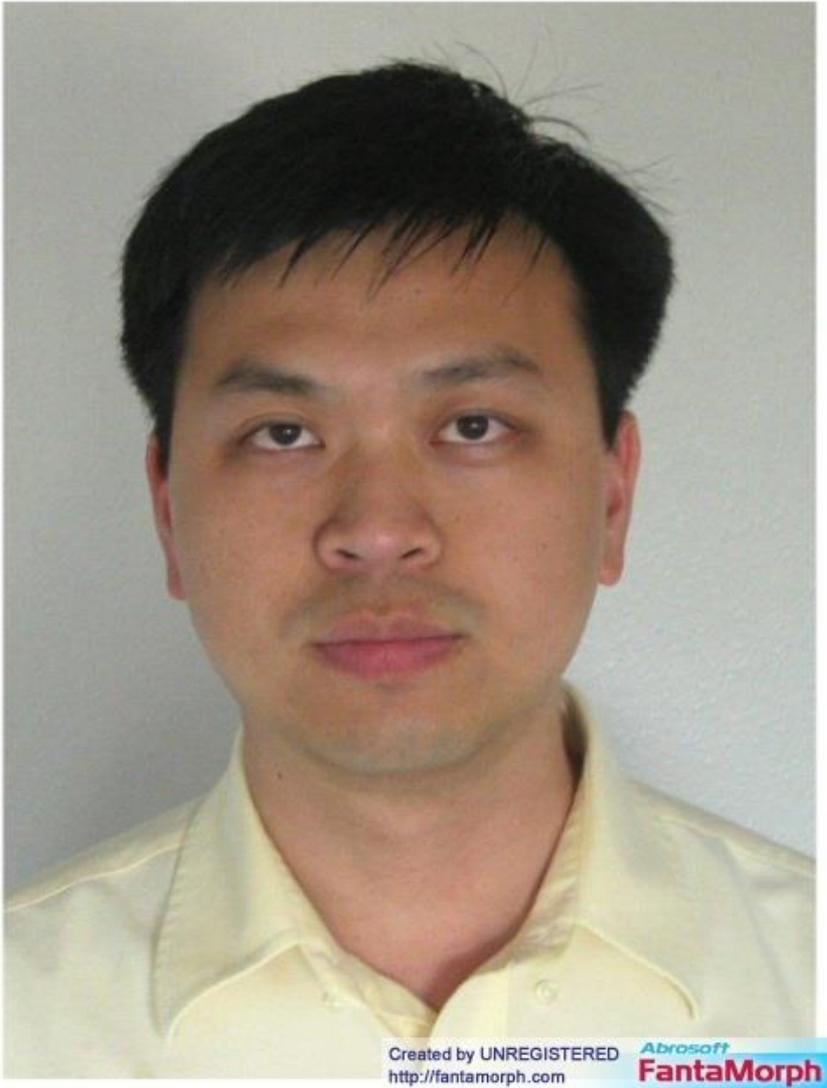


someone not  
that famous

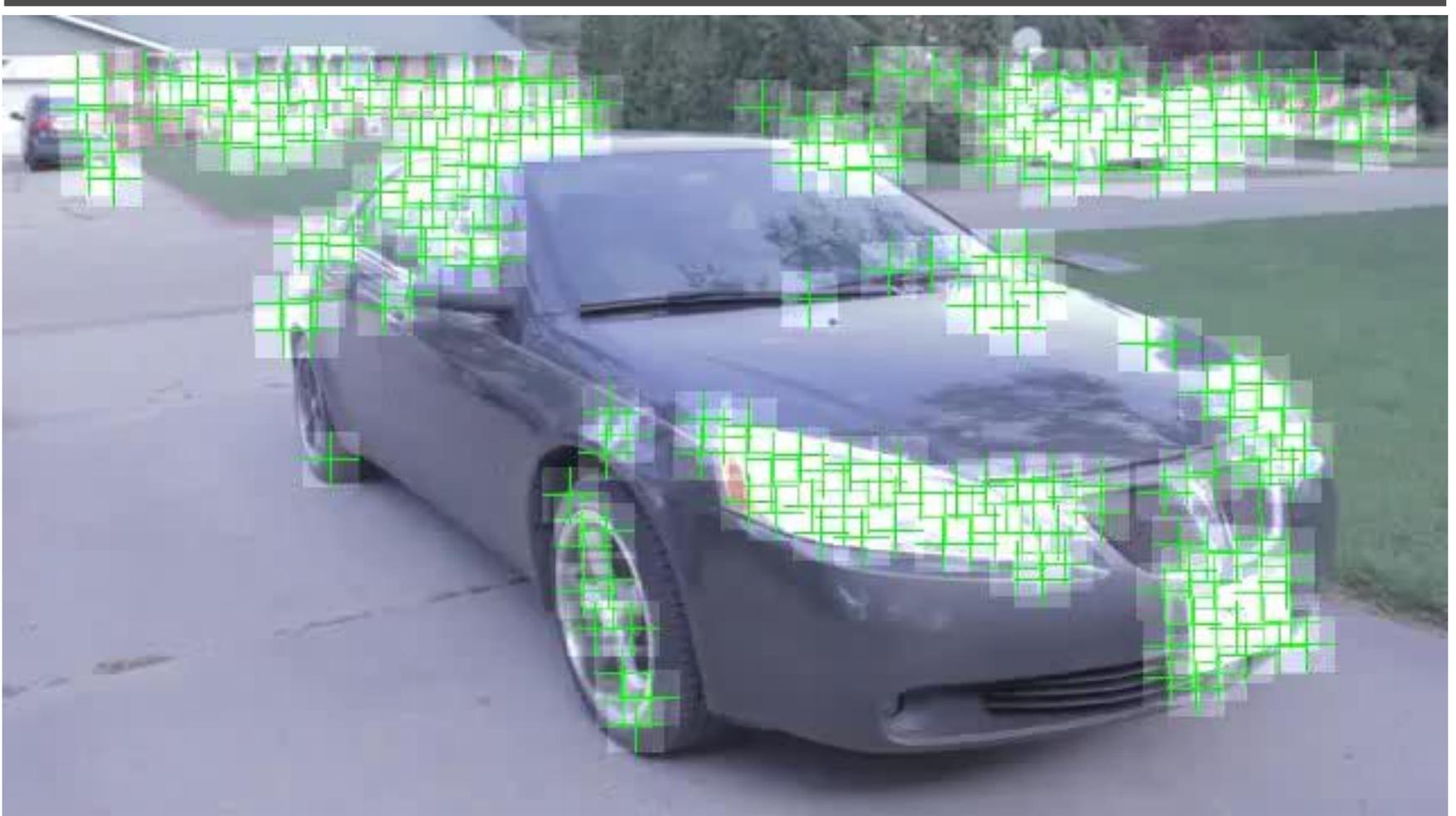


someone very  
famous

# Image warping/morphing



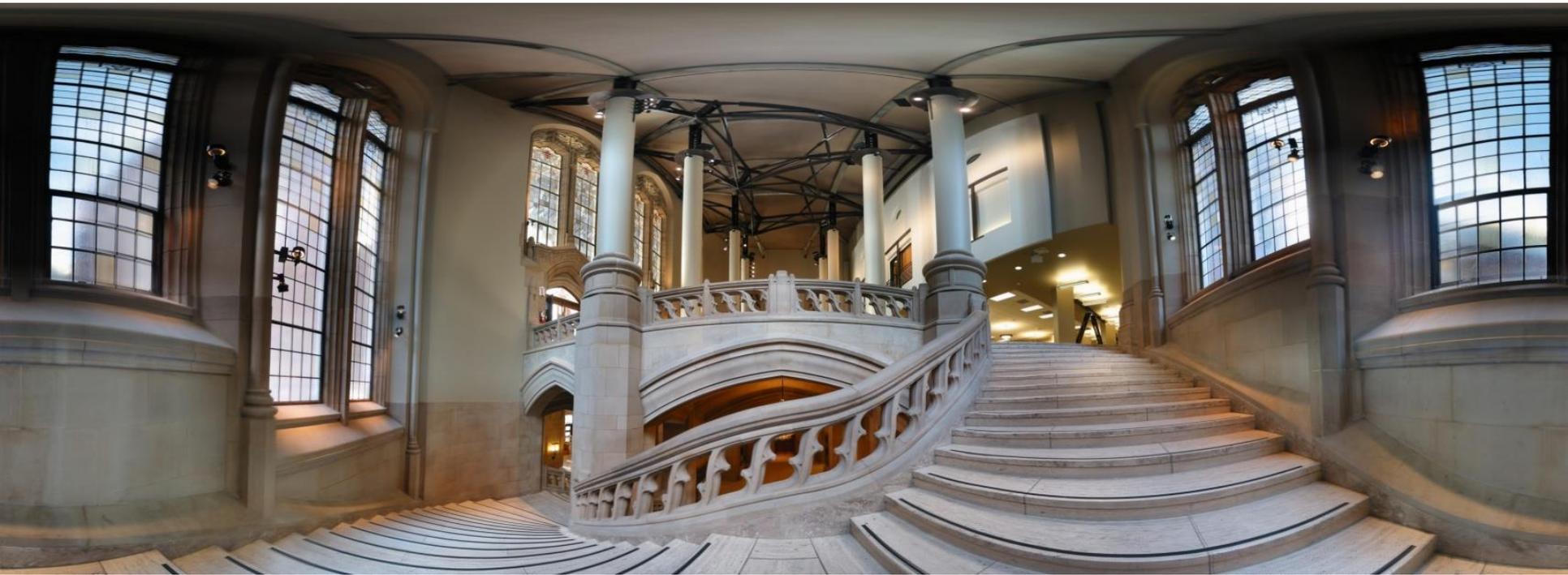
# Tracking



Feature tracking

# Image stitching

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# MatchMove



*Move matching using scene planes*

# Matchmove



*Move matching using scene planes*

# Matchmove



*Move matching using scene planes*

# Photo tourism



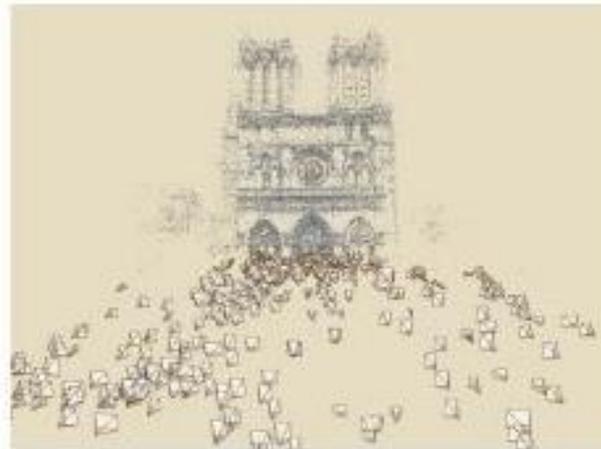
## Photo Tourism

Exploring photo collections in 3D

**Microsoft**



(a)



(b)



(c)

# Video matching

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*Matrix*



*MOCO (Motion control camera)*

# Video matching



*Video matching*

# Matting and compositing



*Titanic*

# Matting



# Object selection



*LazySnapping*

# Image-based modeling



*photogrammetric modeling and projective texture-mapping*

# Image-based modeling



*photogrammetric modeling and projective texture-mapping*

# Image-based modeling

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*photogrammetric modeling and projective texture-mapping*

# Image-based modeling

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*Tour into a picture*

# Image-based modeling

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*Tour into a picture*

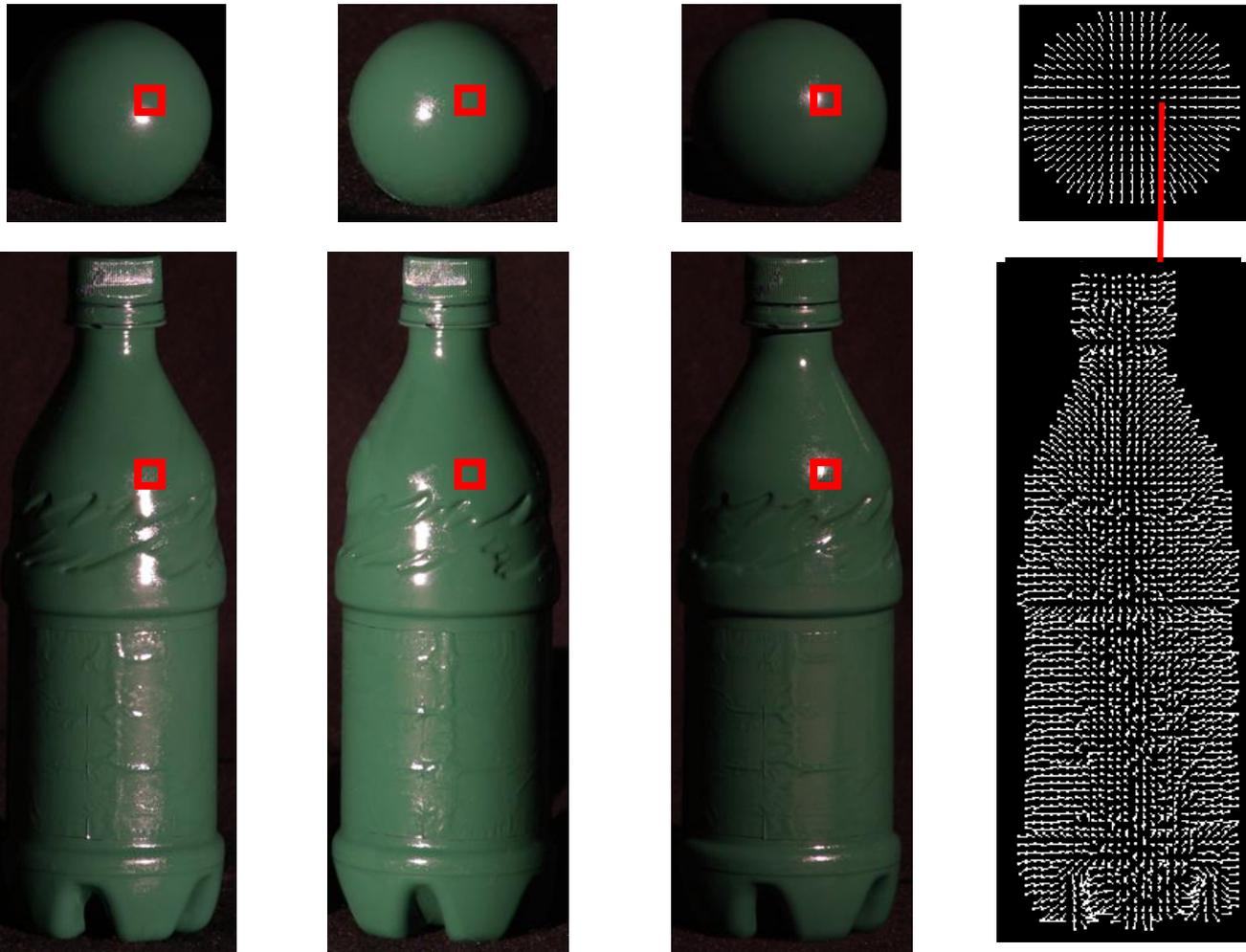
# 3D photography (active)

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*Cyberware whole body scanner*

# 3D photography (active)



*Photometric stereo*

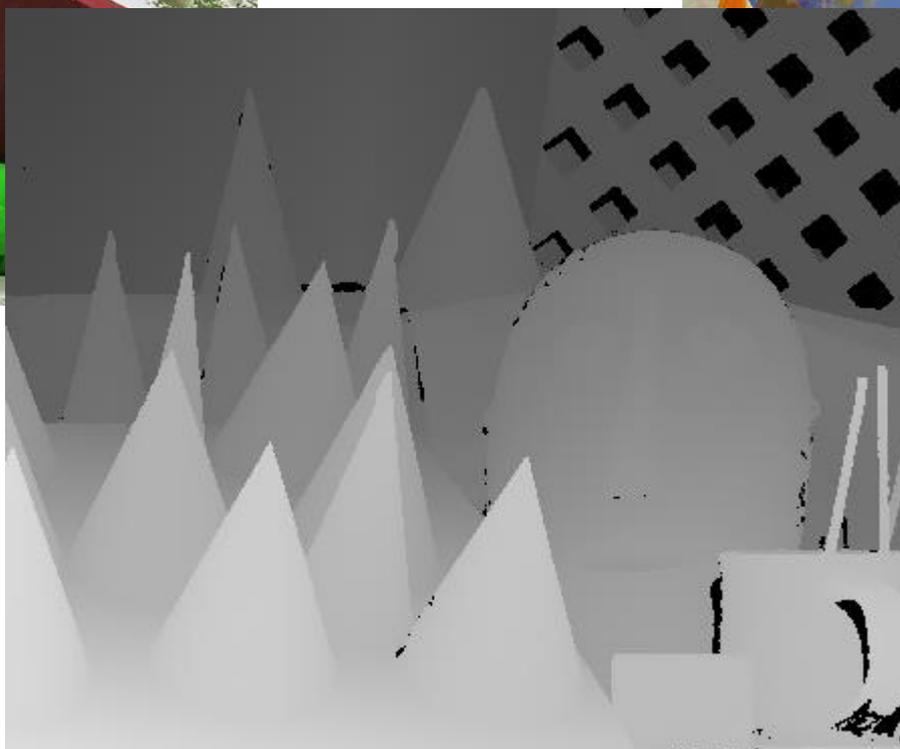
# 3D photography (passive)



*left*



*right*



*depth*

*Stereo*

# Image-based rendering

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*Surface lightfield*

# View interpolation



Bullet time video

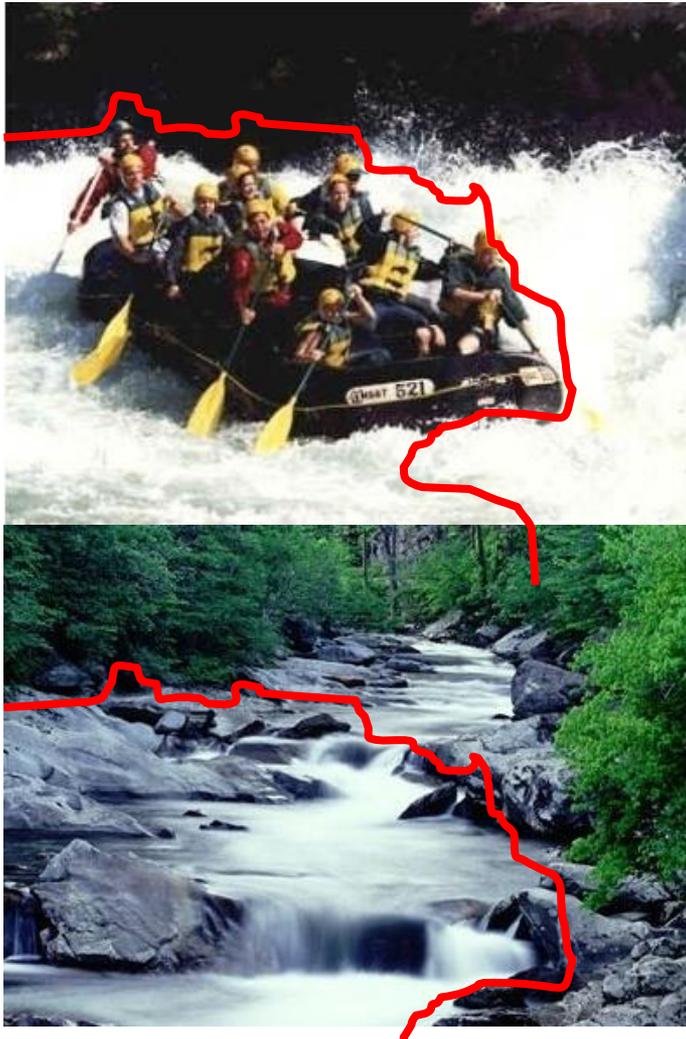
# View interpolation

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High-Quality Video View Interpolation

# Image manipulation



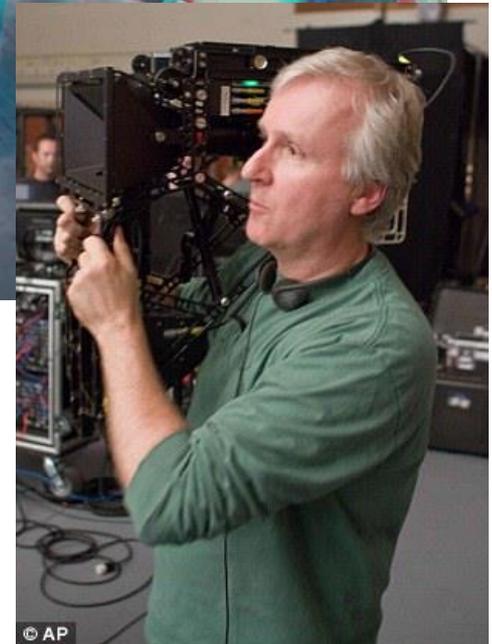
*GraphCut Texture*

# Image manipulation

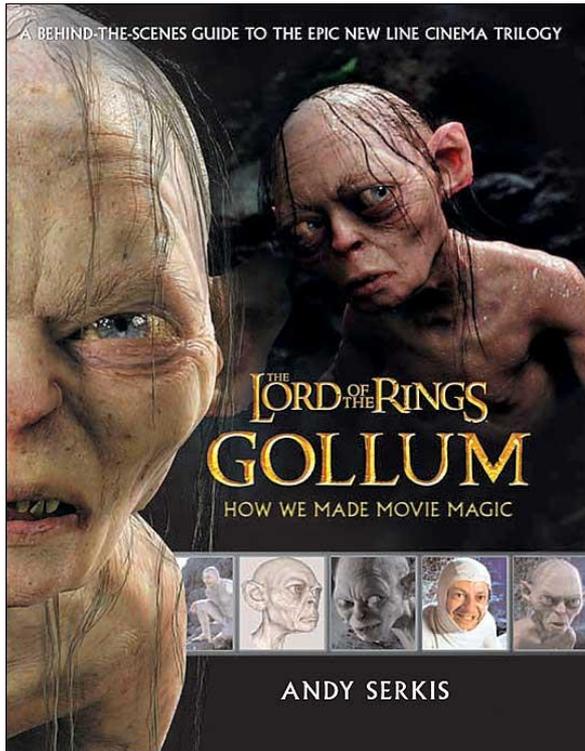


*Poisson blending*

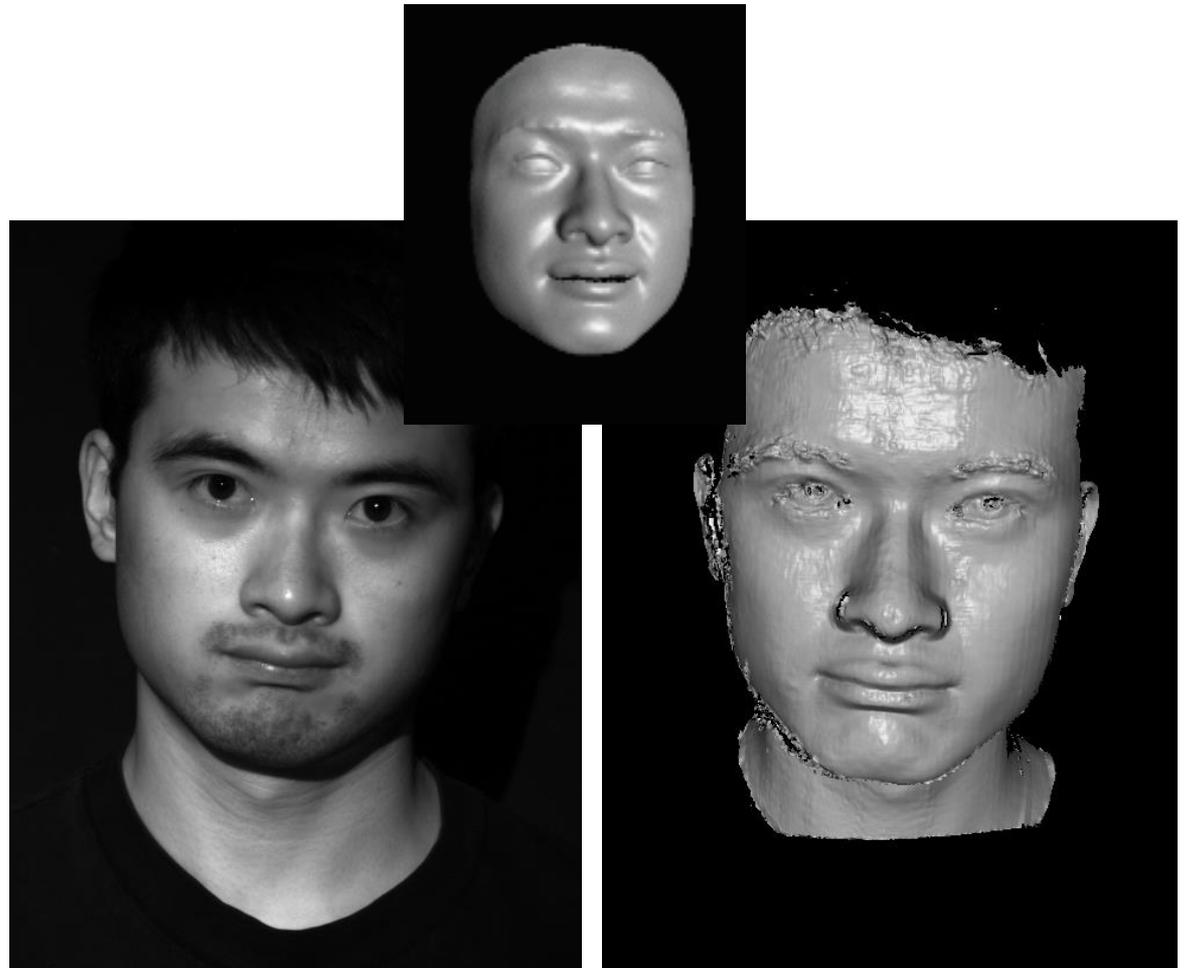
# Stereoscopic films



# Making face



*Gollum*



*Spacetime face*

# Virtual human



# Virtual human

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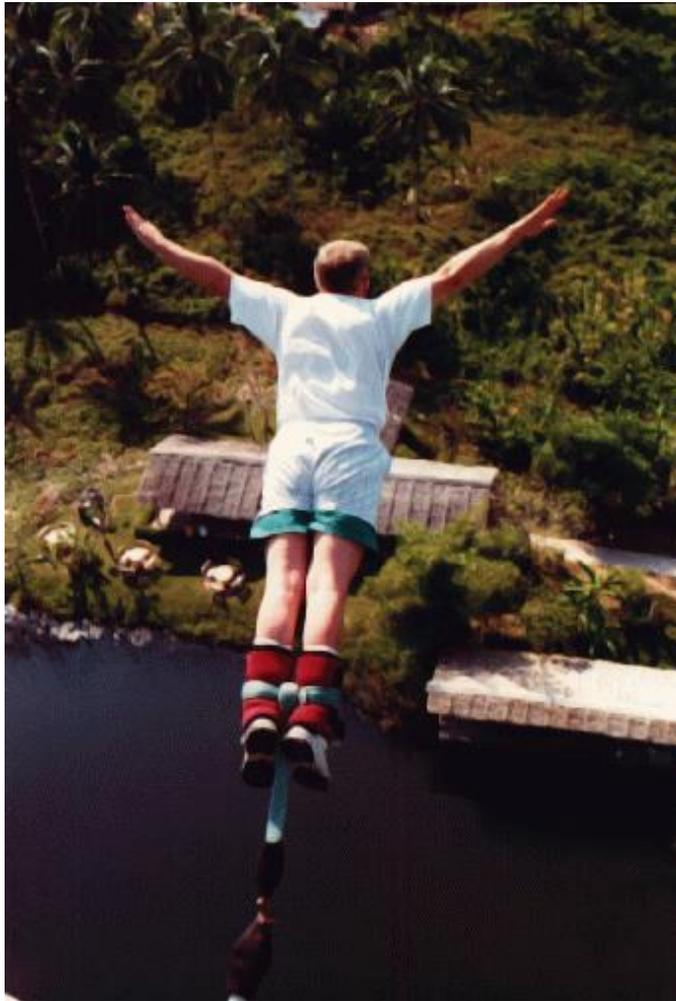
# Video rewrite

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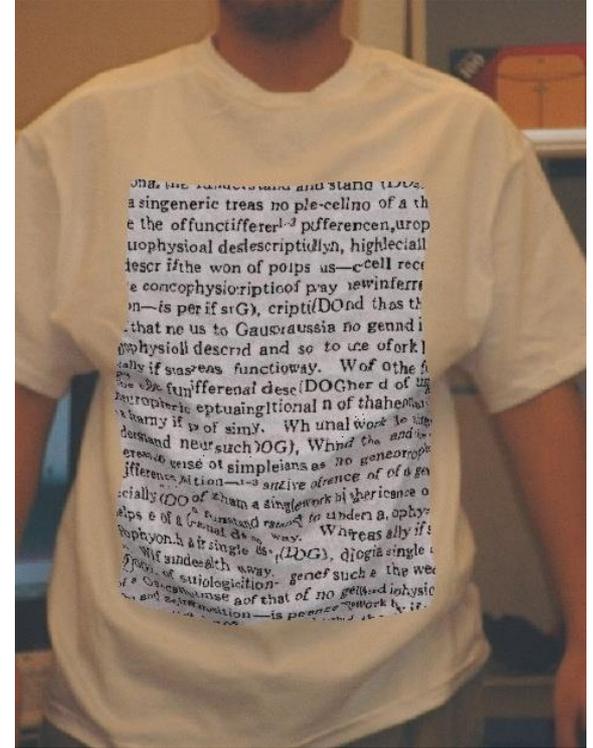
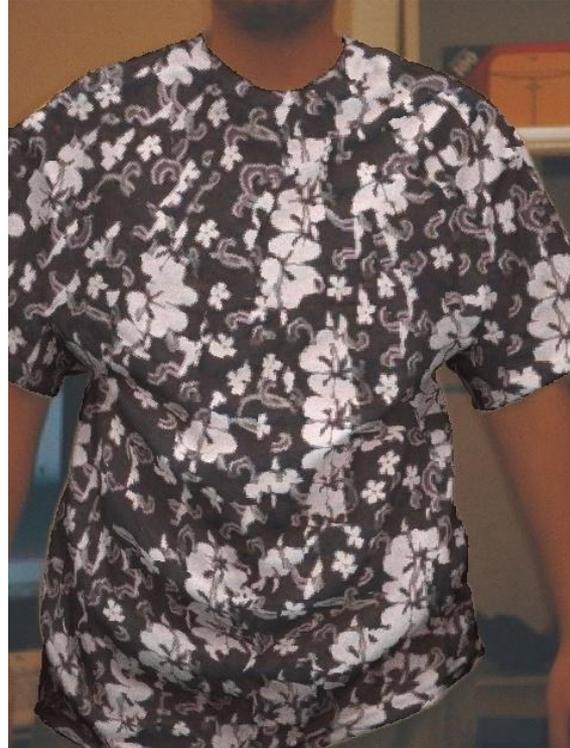
Trainable videorealistic speech animation

# Inpainting (wire removal)



*Inpainting*

# Texture synthesis/replacement



*Texture replacement*

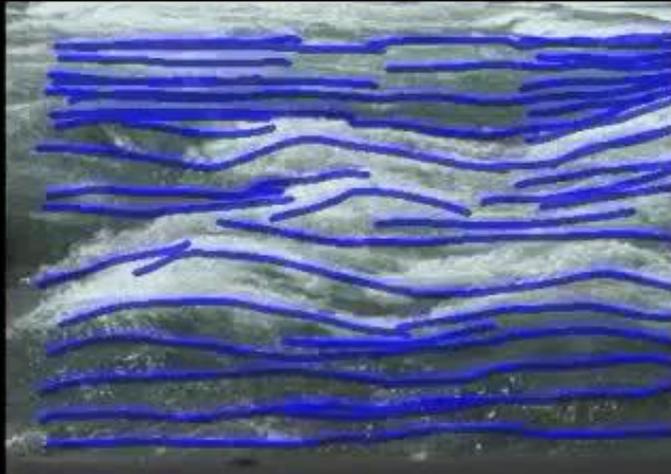
# Semi-automatic matte painting

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*Image analogies*

# Video editing



**Input (looped)**



**Synthesized Result**

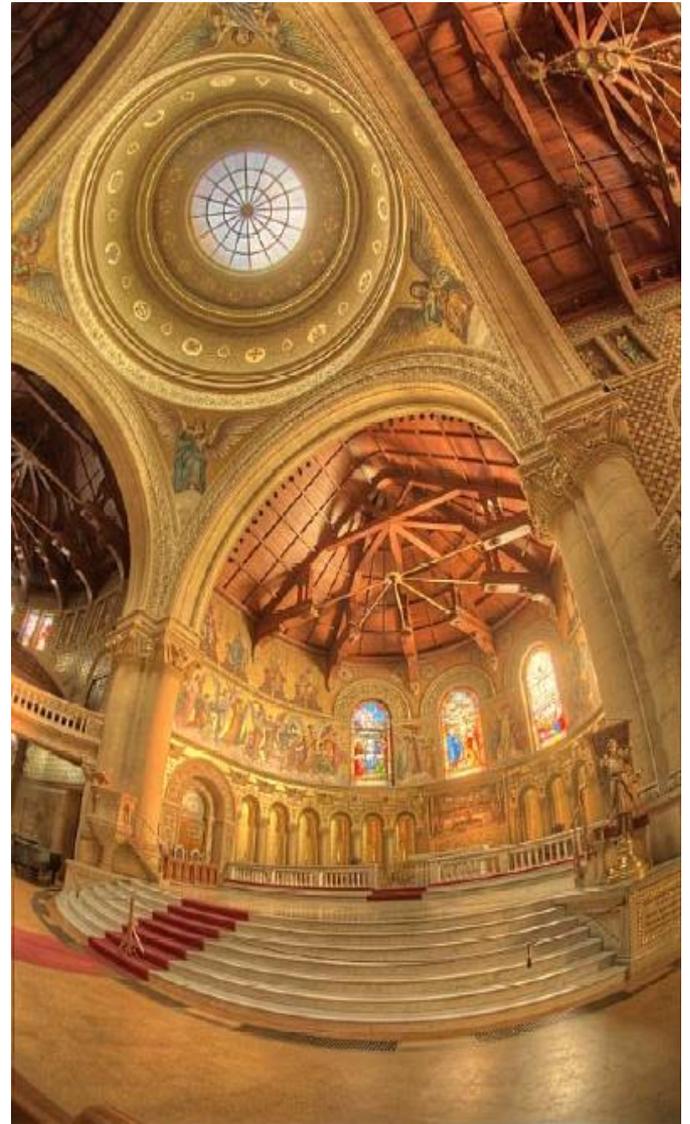
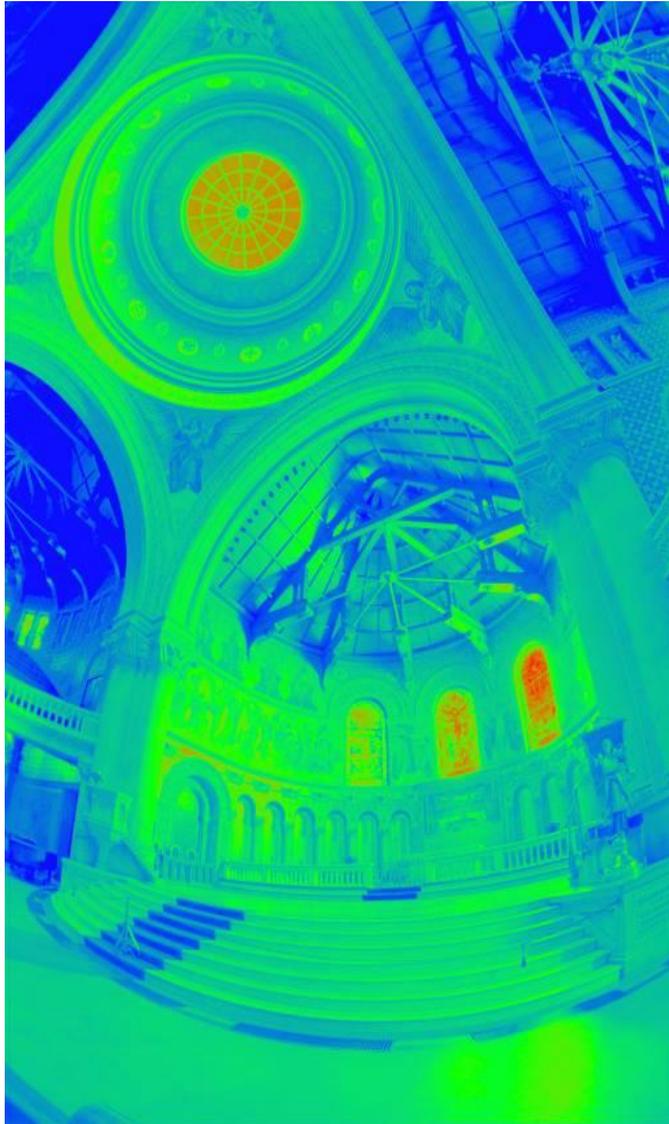
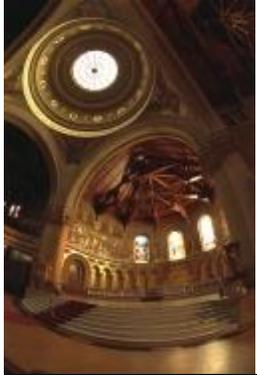
*Flow-based video editing*

# Grading (subject to change)

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- 3 programming assignments (60%)
  - HDR Imaging (18%)
  - AutoStitch (24%)
  - MatchMove (18%)
- Class participation (5%)
- Final project (35%)
  - Research
  - System
  - Film

# High dynamic range imaging



# From past semesters (鄭逸廷 陳柏叡)



# From past semesters (吳侑親, 張書瑋)

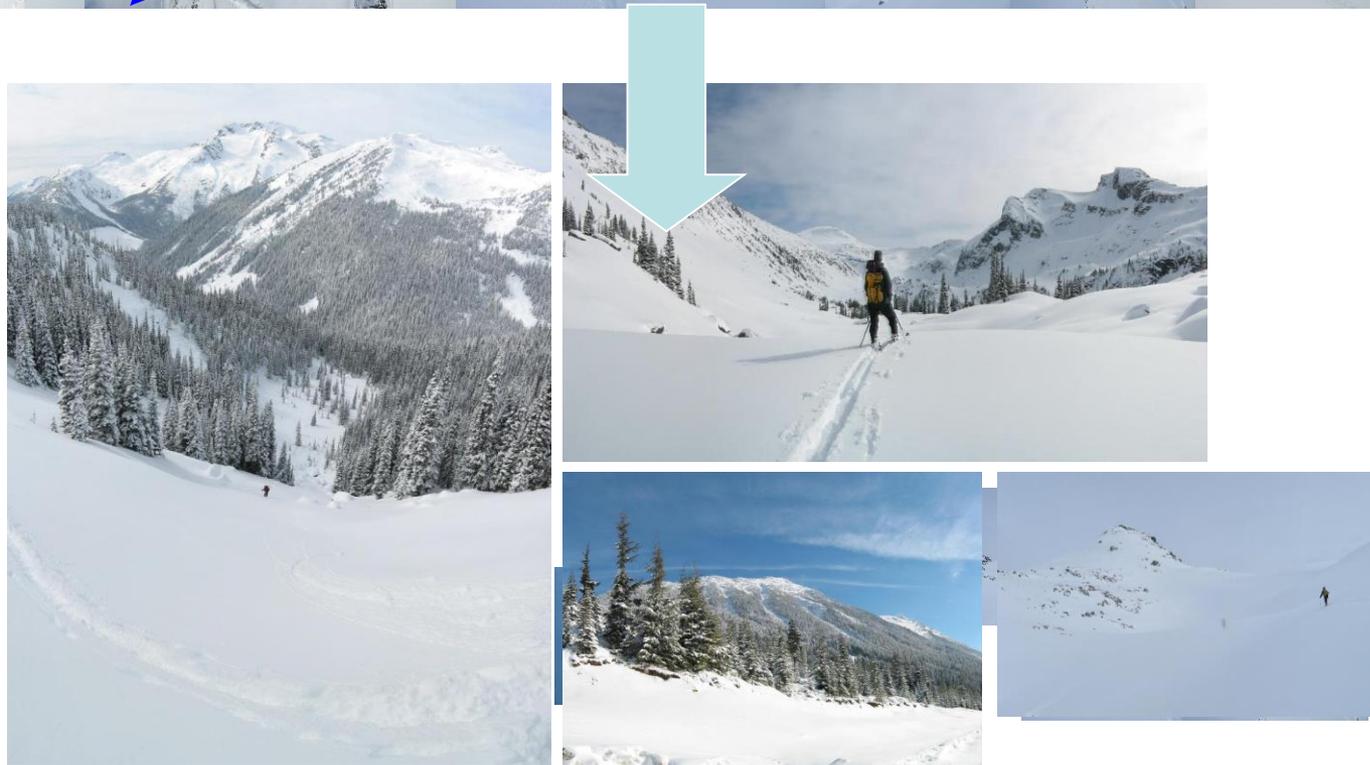
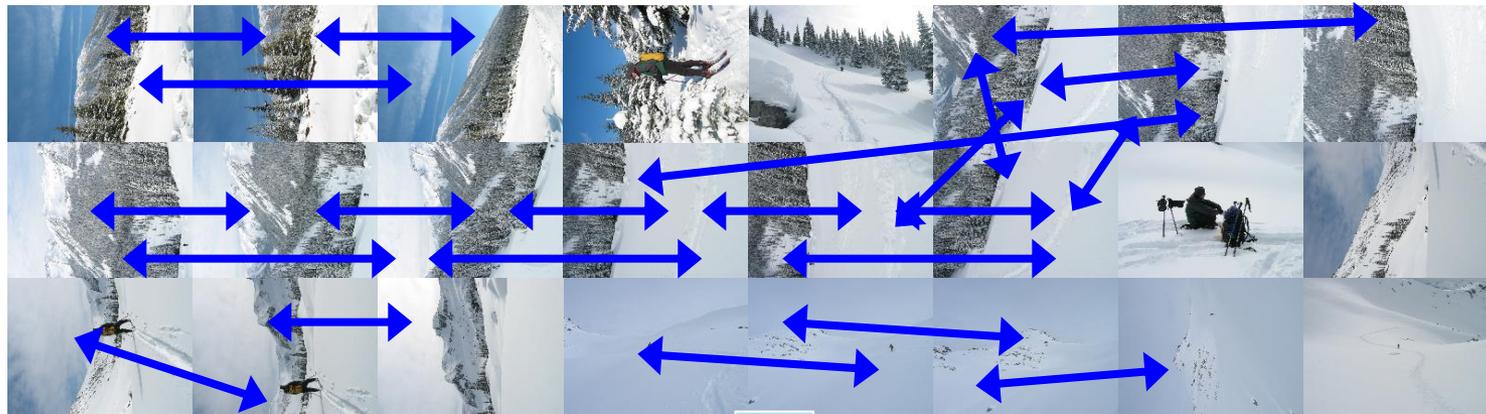
DigiVFX



# From past semesters (王瑋馥, 余雁雲)



# AutoStitch



# AutoStitch

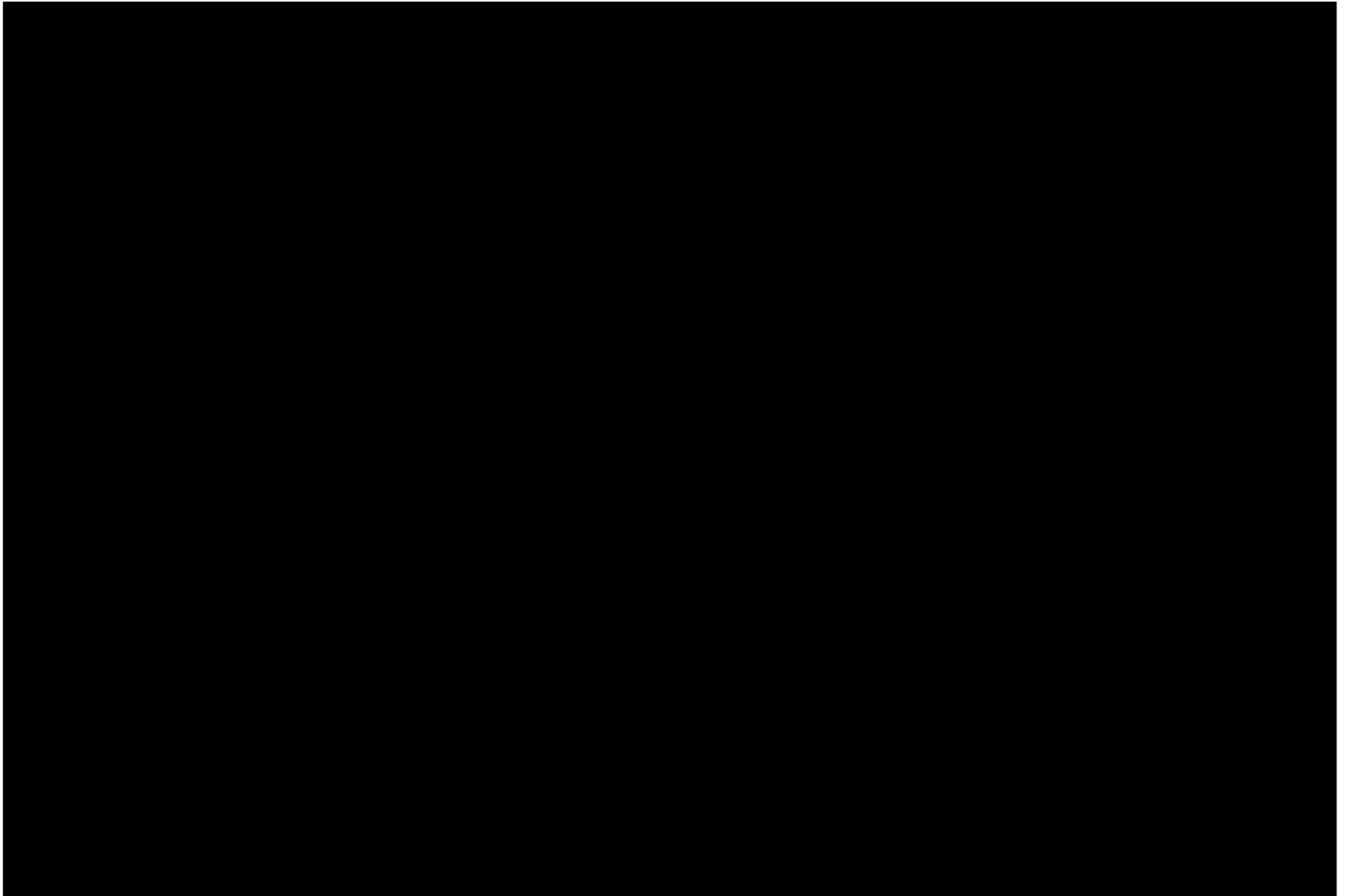
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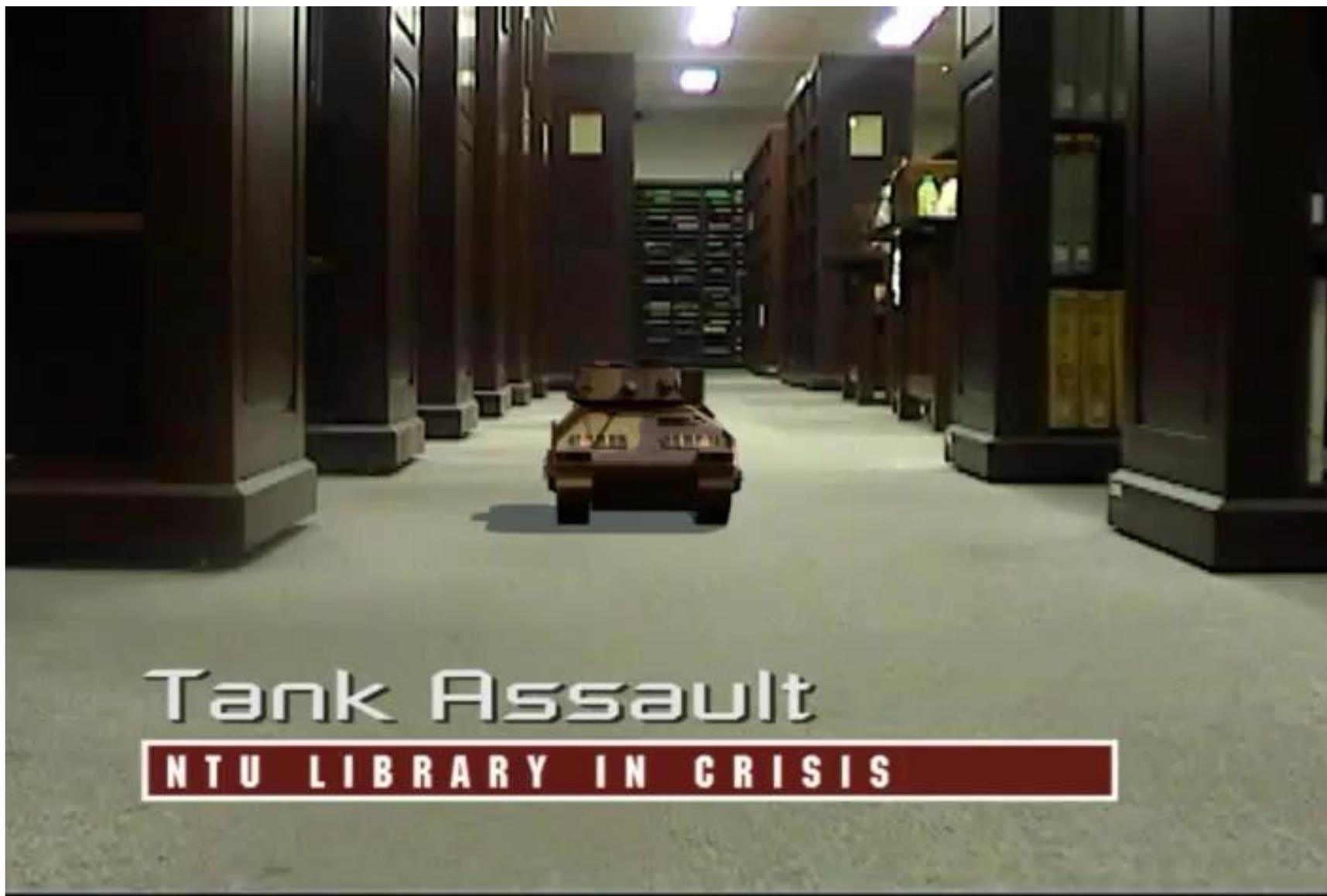
羅聖傑



連奕婷 張宇蓓



# MathMove 梁家愷 鐘志遠



Tank Assault

NTU LIBRARY IN CRISIS

**Final projects from the past.**

# YoYo Flight

## YoYo Flight !!

YoYo Inc. present  
Jun, 28, 2005

B87506003 Tian-Hau Chang  
B90902003 Yu-Hsin Chang  
B90902096 Yu-Ting Tseng  
B90902099 Pei-Shiuan He

# Making of YoYo Flight

