

## Course overview

Digital Visual Effects

*Yung-Yu Chuang*

DigiVFX

## Logistics

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- Meeting time: 2:20pm-5:20pm, Wednesday
- Classroom: CSIE Room 104
- Instructor: Yung-Yu Chuang ([cyy@csie.ntu.edu.tw](mailto:cyy@csie.ntu.edu.tw))
- Teaching assistants:
- Textbook: Readings from books, journals and proceedings. Richard Szeliski's [Computer Vision: Algorithms and Applications](#). Richard Radke's [Computer Vision for Visual Effects](#).
- Webpage: (user name/password: **\*\*\*/\*\***)  
<http://www.csie.ntu.edu.tw/~cyy/vfx>

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

DigiVFX

## It isn't about photography

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## It isn't about 3D animations

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## It isn't about watching movies

DigiVFX



## It isn't about physical effects

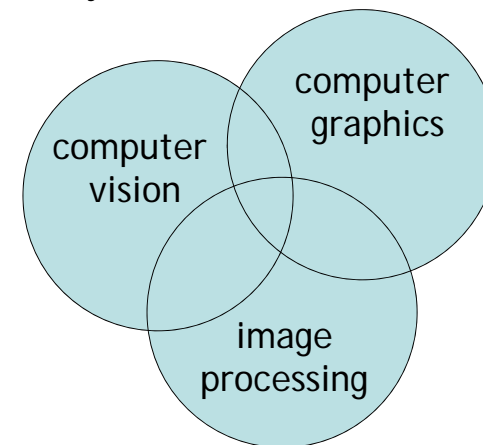
DigiVFX



## 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.



## Prerequisites

DigiVFX

- 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

DigiVFX



what other professors  
think you do

what other students  
think you do

what you thought  
you will do



what you actually do

## Be cautious!

DigiVFX



## Warning from previous students

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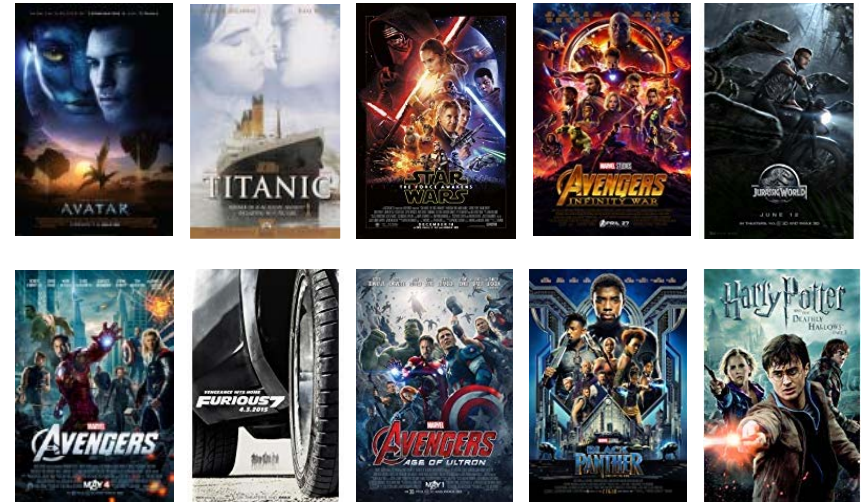
- 請學期初老師要多提醒這門課的困難度請興趣或實力不足同學勿修，否則就會像我一樣停修 XD



This course is about ...

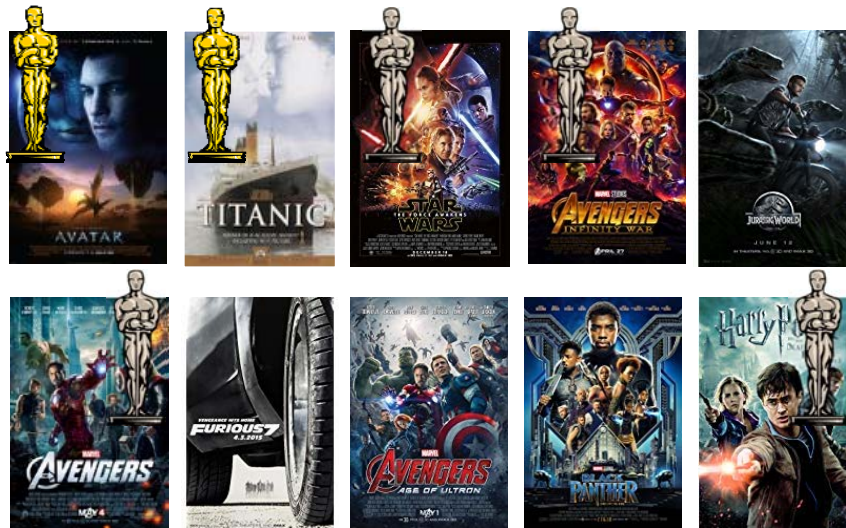
## Digital Visual Effects

DigiVFX



## Digital Visual Effects

DigiVFX



## Deadpool

DigiVFX



## Deadpool

DigiVFX



## Life of Pi

DigiVFX



## Life of Pi

DigiVFX



## 獨自一人拍和十三人的戲

DigiVFX



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

DigiVFX



## Retouching

DigiVFX





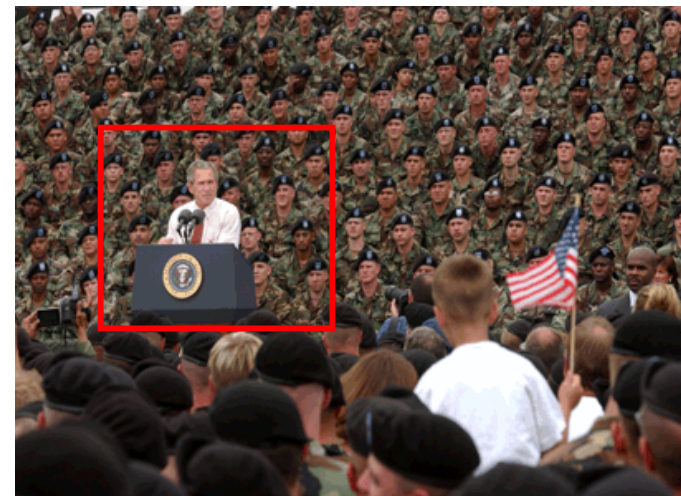
## Retouching

DigiVFX



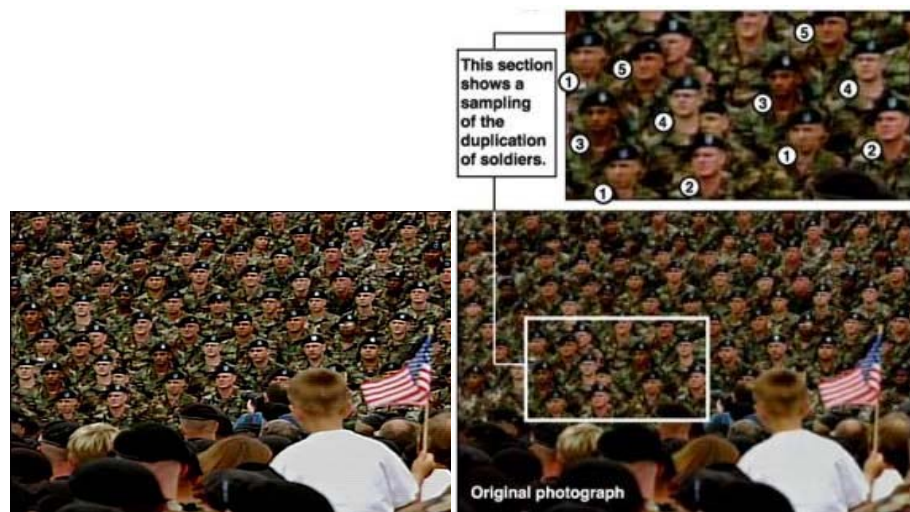
## Bush campaign's TV AD, 2004

DigiVFX



## Texture synthesis and inpainting

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## Iraq War, LA Times, April 2003

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## Domestic example

DigiVFX



The Liberty Times  
2007.12.17



## Special effects

## Stop action

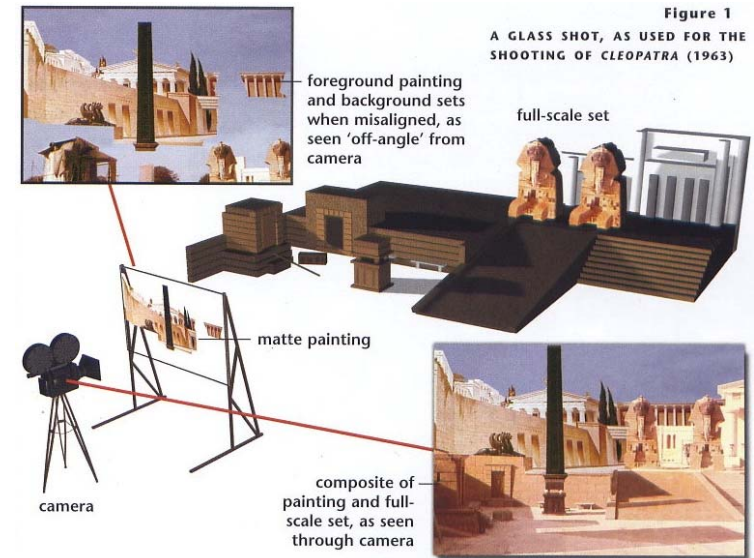
DigiVFX



*The execution of Mary, 1895*

## Glass shot

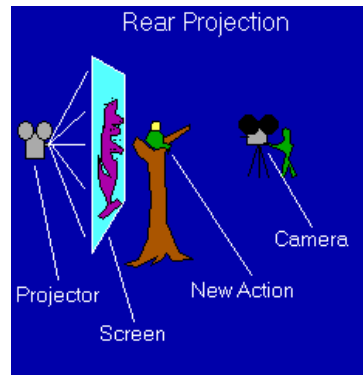
DigiVFX





## Rear projection

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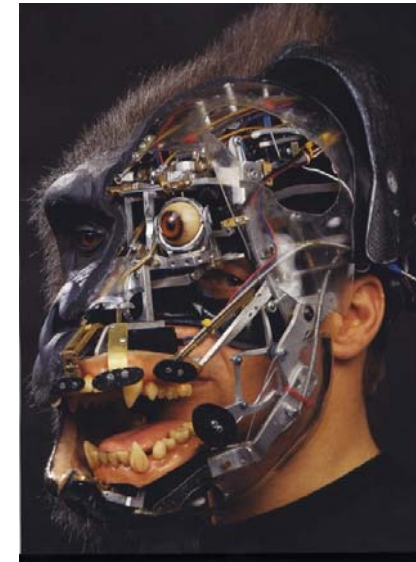
stop motion



*King Kong, 1933*

## Special effects (make-up)

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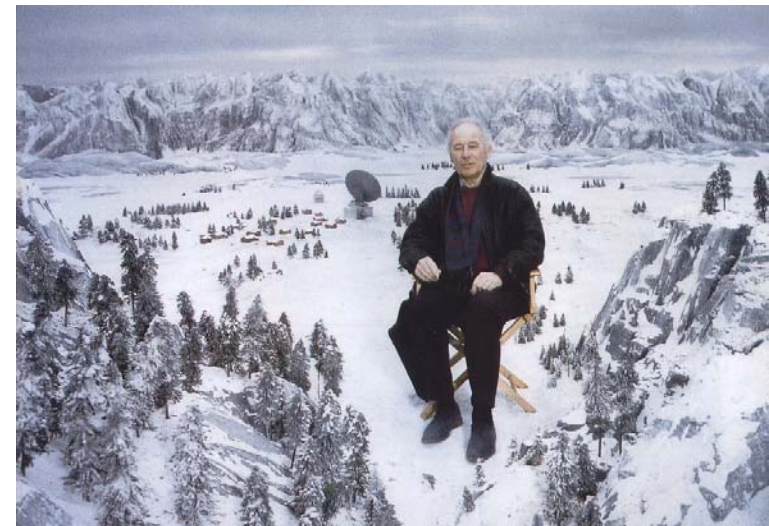
## Special effects (physical effects)

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## Special effects (miniature)

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## Special effects (matte painting)

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## Lord of the Rings

DigiVFX



## Illusion - forced perspective

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## Computer-generated model

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## The Avengers

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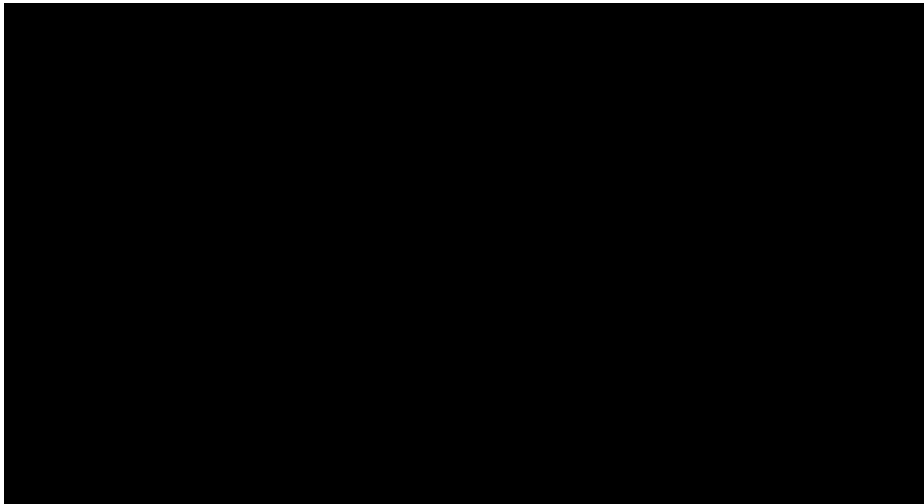
## The Avengers (1978)

DigiVFX



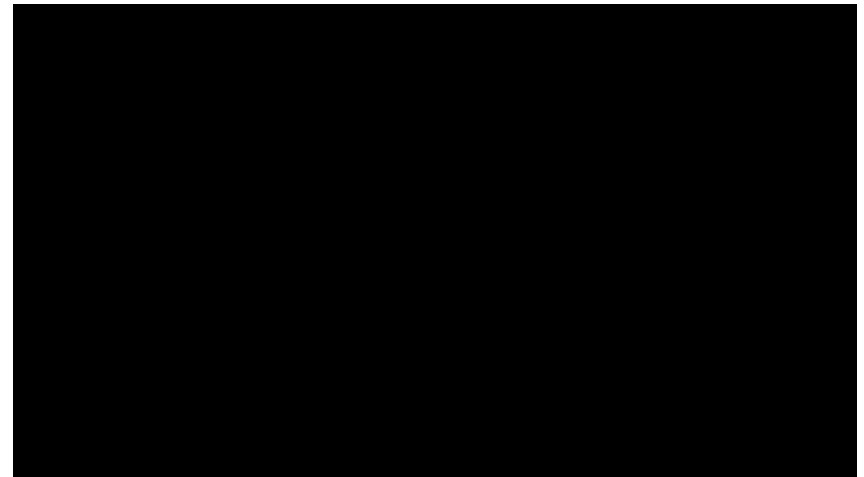
## The Avengers (2012)

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## Visual effects 100 Years

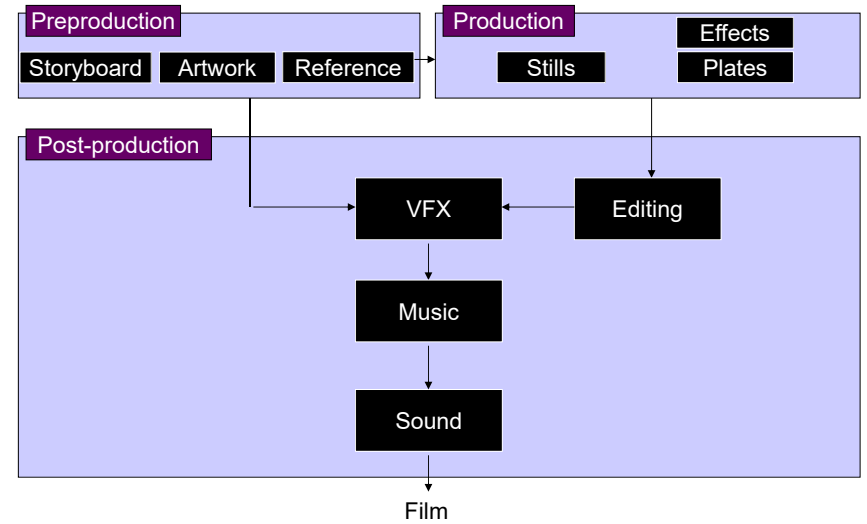
DigiVFX



# Production pipeline

## Production pipeline

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## Preproduction

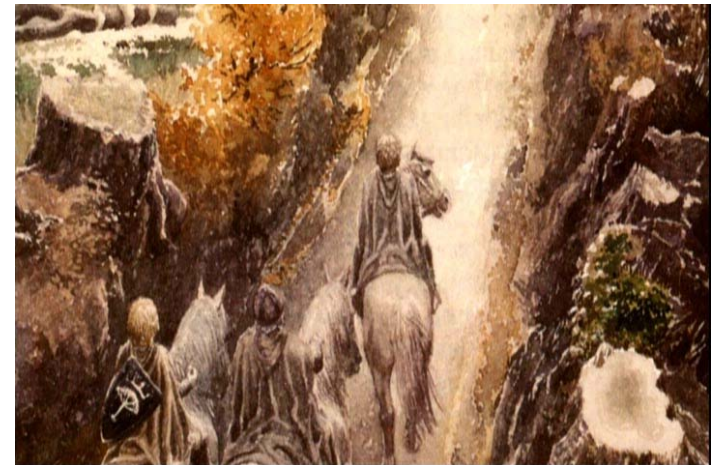
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Storyboard

## Preproduction

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Artwork



## Preproduction

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Reference & Research

## Production

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Shooting

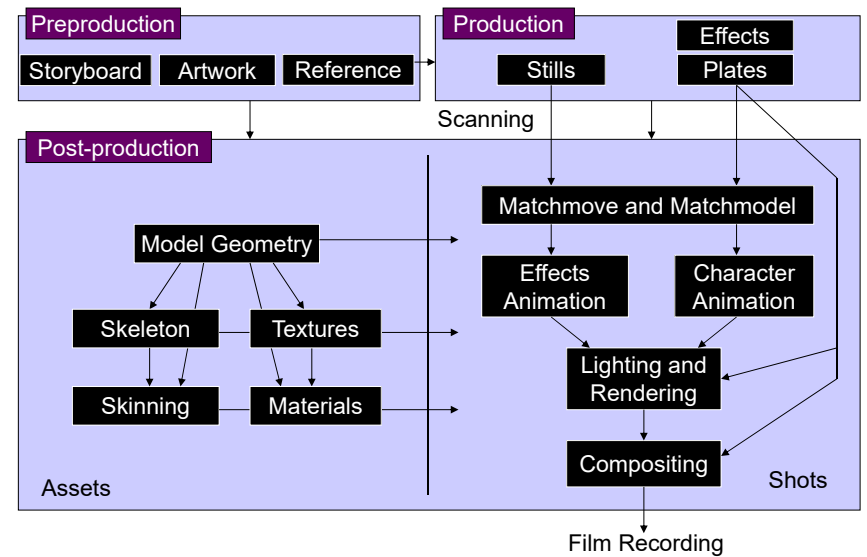
## Post-production

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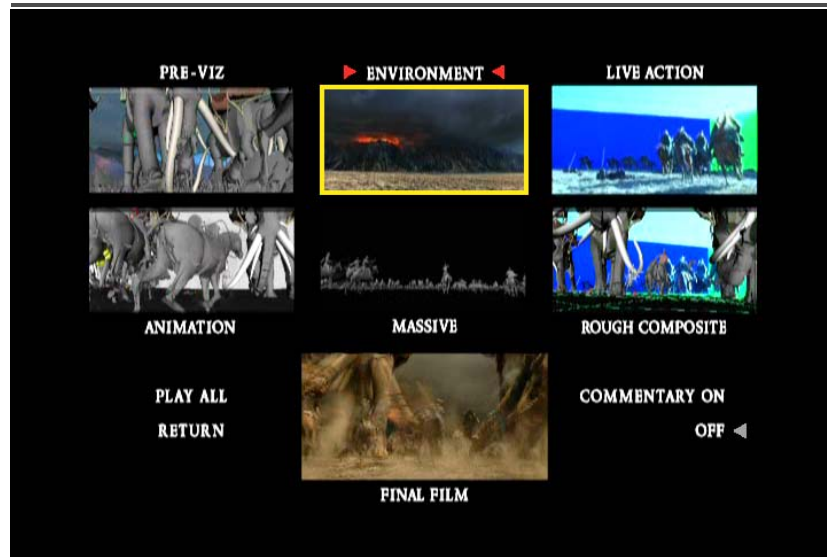
## Visual effects production

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## Visual effects post-production

DigiVFX



## A case study

### 405: The Movie

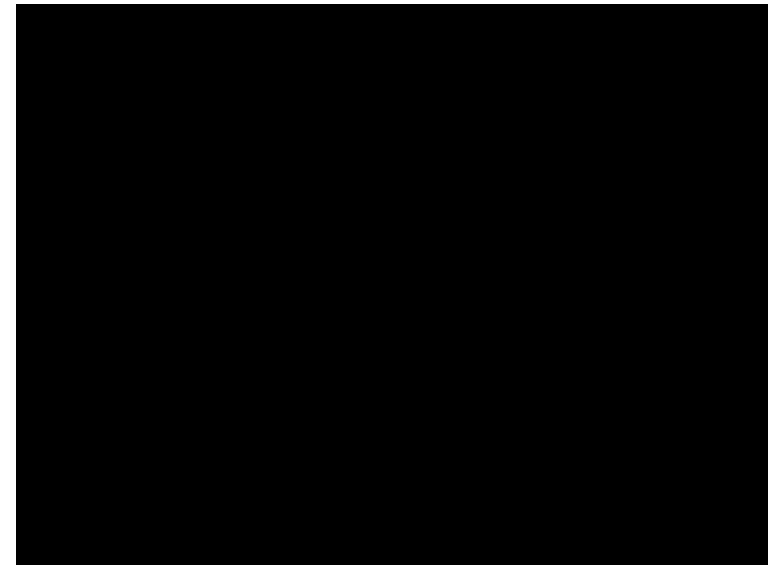
DigiVFX

- 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

DigiVFX





## Making of 405

DigiVFX

### 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

DigiVFX

### Step 1: shooting

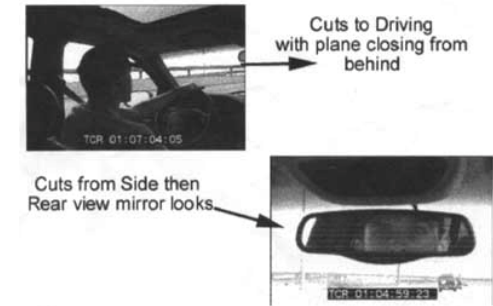
two days with a Canon Optura DV camera with progressive mode.

⇒ a 70-minute raw footage



initial editing

⇒ pickup shots



## Making of 405

DigiVFX

### 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

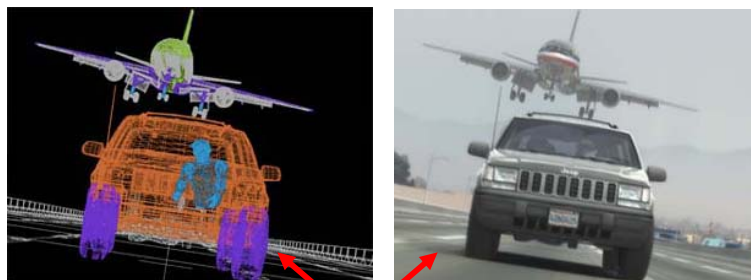


photo-based 3D environment

## Making of 405

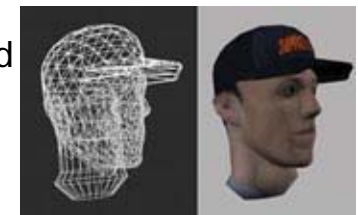
DigiVFX

Real cars were used for close-up and interior shots



A low-resolution mesh scanned by a cyberscanner.

Mapped with photographs.

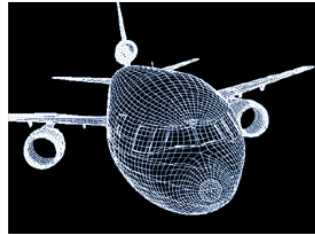


## Making of 405

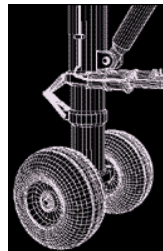
DigiVFX

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

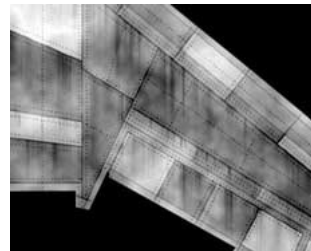
59 objects, 142,439 polygons



reference



modeling



material painting

## Making of 405

DigiVFX

### Step 3: traffic clearing

clean plate



close-up shots



inpainting

## Making of 405

DigiVFX

### Step 4: compositing



shot with the vehicle standing still in a backyard



## Making of 405

DigiVFX





## Making of 405

DigiVFX

### Step 5: fine touchup



3D hat

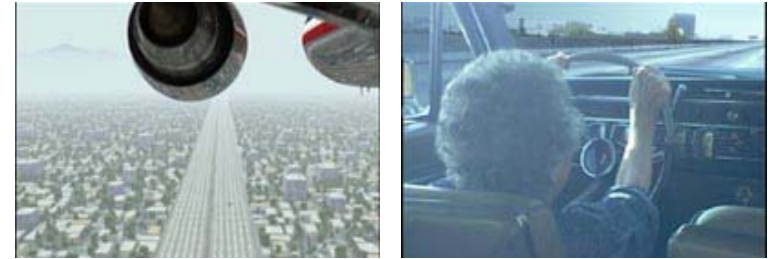


compositing and inpainting

## Making of 405

DigiVFX

### Step 6: music and delivery



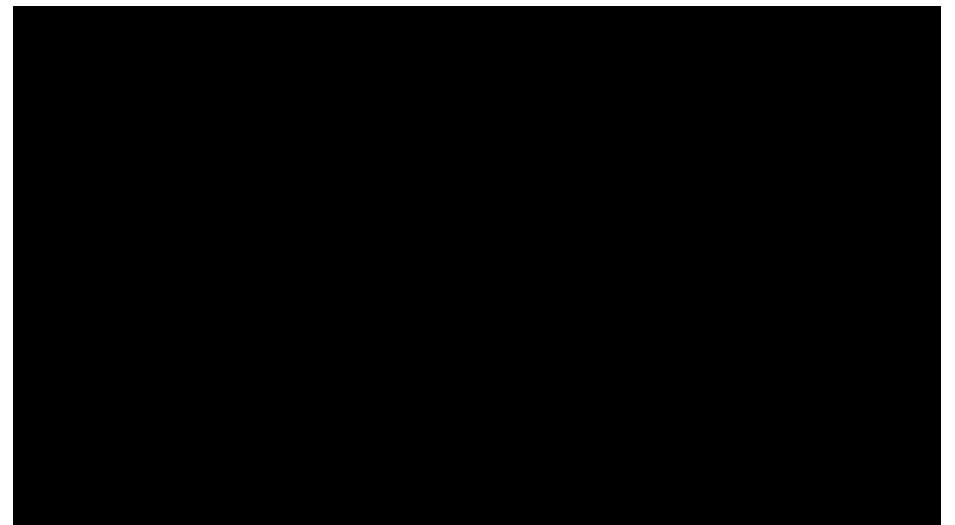
## Bloody Omaha

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## Breakdown (Wolf of Wall Street)

DigiVFX



## Topics we plan to cover

### Camera

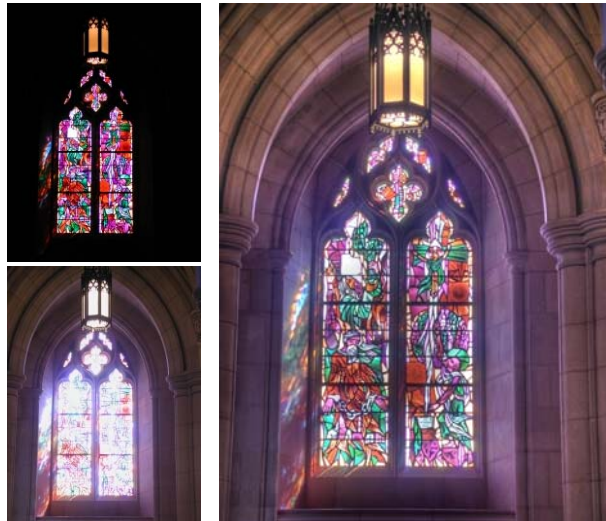
DigiVFX



Canon 10D

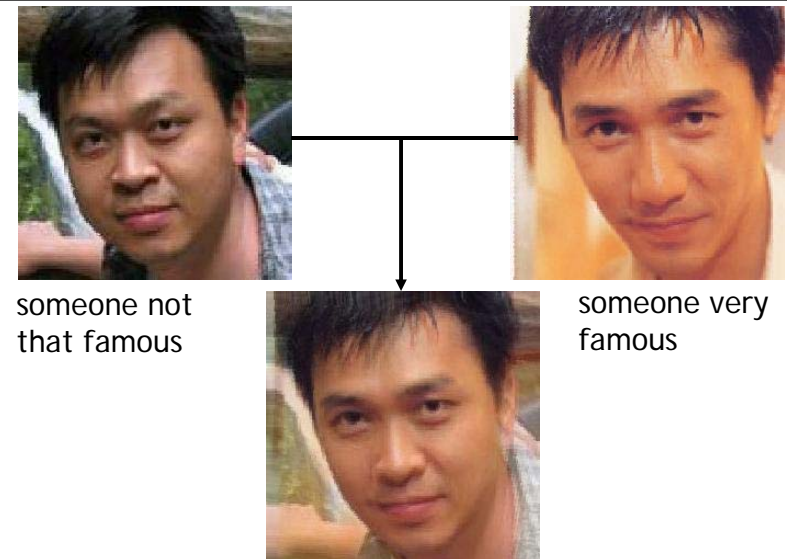
### High dynamic range imaging/display

DigiVFX



### Image warping/morphing

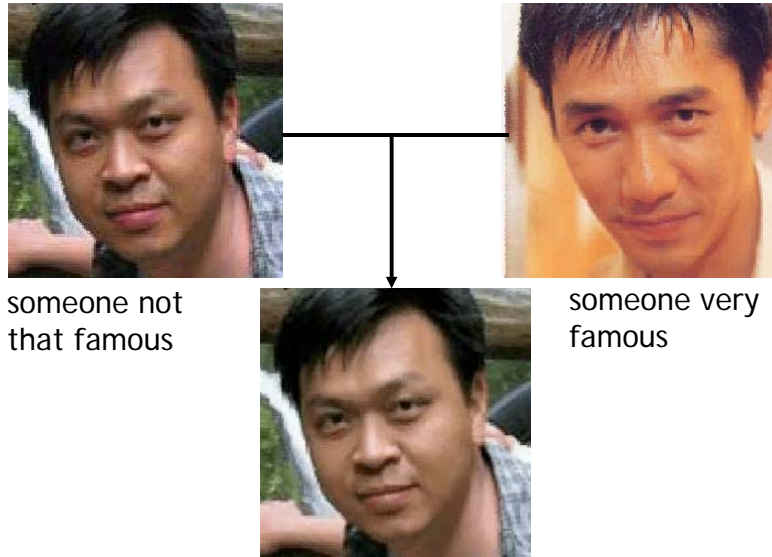
DigiVFX





## Image warping/morphing

DigiVFX



## Image warping/morphing

DigiVFX



## Tracking

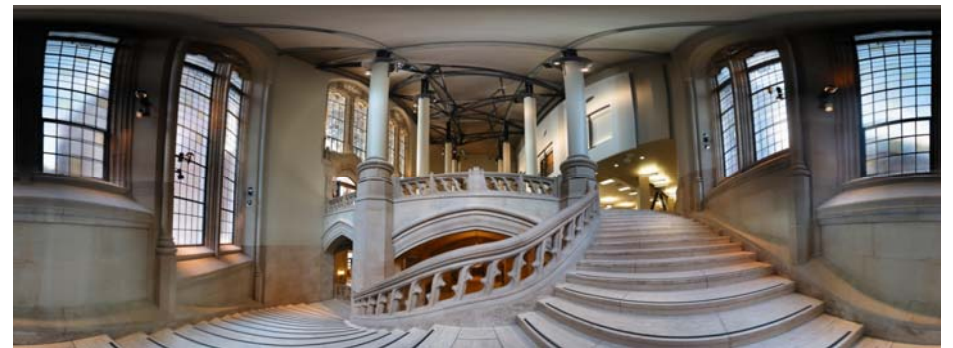
DigiVFX



Feature tracking

## Image stitching

DigiVFX



## MatchMove

DigiVFX



*Move matching using scene planes*

## Matchmove

DigiVFX



*Move matching using scene planes*

## Matchmove

DigiVFX



*Move matching using scene planes*

## Photo tourism

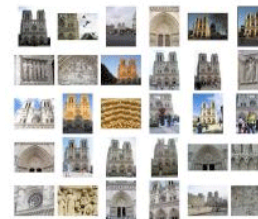
DigiVFX



### Photo Tourism

Exploring photo collections in 3D

Microsoft



(a)



(b)



(c)



## Video matching

DigiVFX



*Matrix*

*MOCO (Motion control camera)*

## Video matching

DigiVFX



*Video matching*

## Matting and compositing

DigiVFX



*Titanic*

## Matting

DigiVFX



## Object selection

DigiVFX



*LazySnapping*

## Image-based modeling

DigiVFX



*photogrammetric modeling and projective texture-mapping*

## Image-based modeling

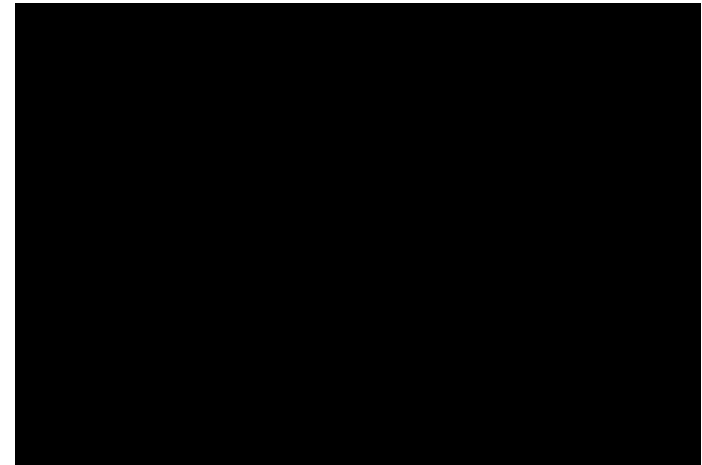
DigiVFX



*photogrammetric modeling and projective texture-mapping*

## Image-based modeling

DigiVFX



*photogrammetric modeling and projective texture-mapping*



## Image-based modeling

DigiVFX



*Tour into a picture*

## Image-based modeling

DigiVFX



*Tour into a picture*

## 3D photography (active)

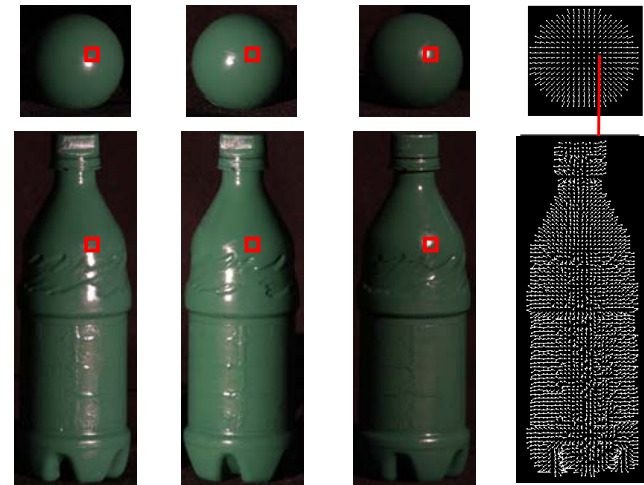
DigiVFX



*Cyberware whole body scanner*

## 3D photography (active)

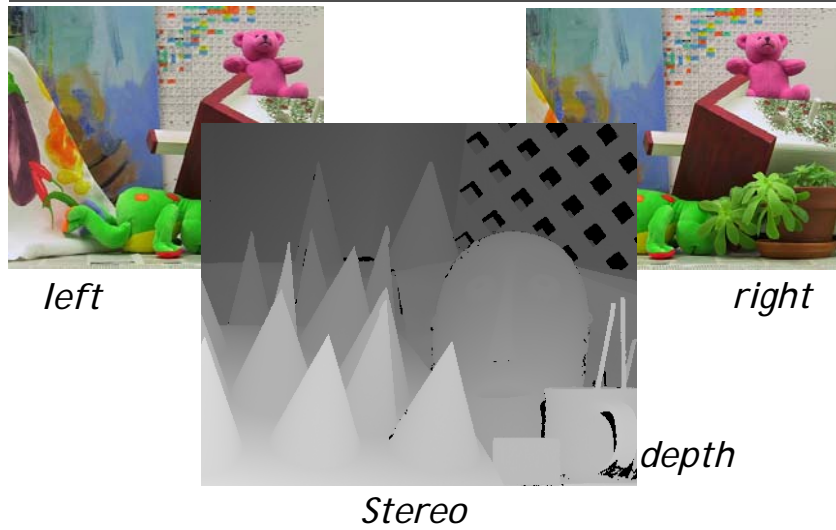
DigiVFX



*Photometric stereo*

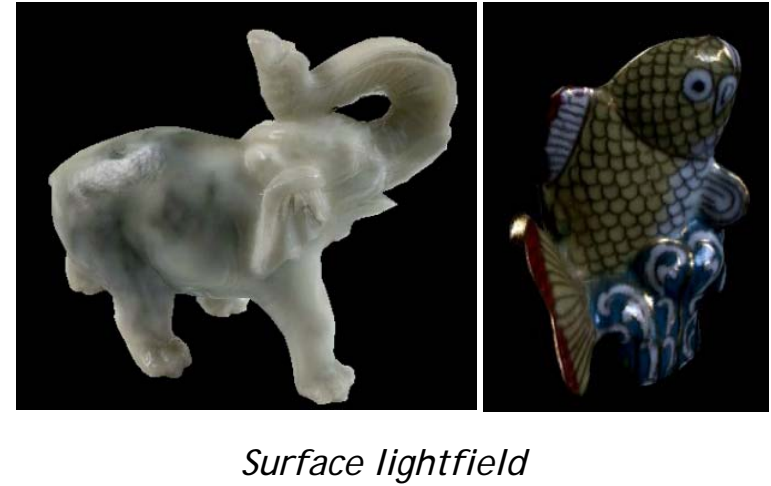
## 3D photography (passive)

DigiVFX



## Image-based rendering

DigiVFX



## View interpolation

DigiVFX



## View interpolation

DigiVFX





## Image manipulation

DigiVFX



*GraphCut Texture*

## Image manipulation

DigiVFX



*Poisson blending*

## Stereoscopic films

DigiVFX



## Making face

DigiVFX



*Gollum*

*Spacetime face*

## Virtual human

DigiVFX



## Video rewrite

DigiVFX



Trainable videorealistic speech animation

## Inpainting (wire removal)

DigiVFX



*Inpainting*

## Texture synthesis/replacement

DigiVFX

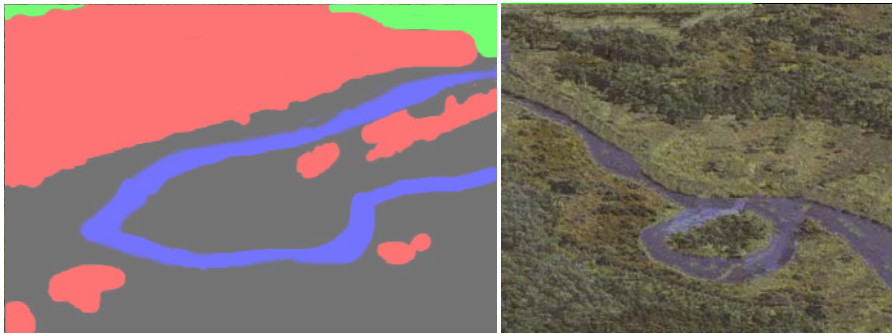


*Texture replacement*



## Semi-automatic matte painting

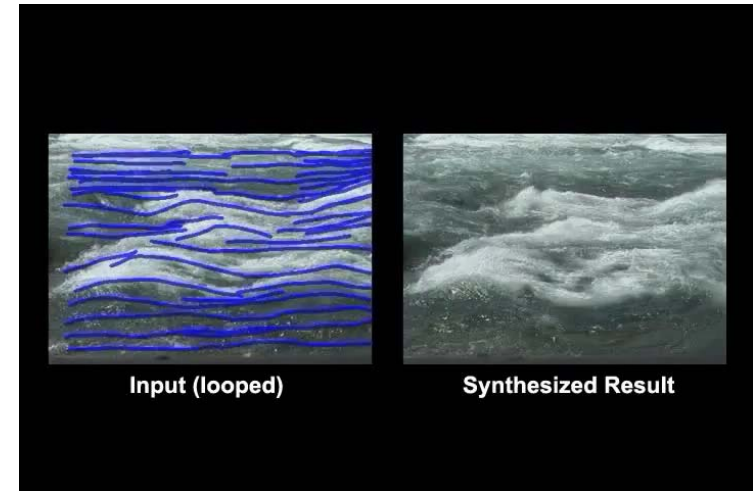
DigiVFX



*Image analogies*

## Video editing

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*Flow-based video editing*

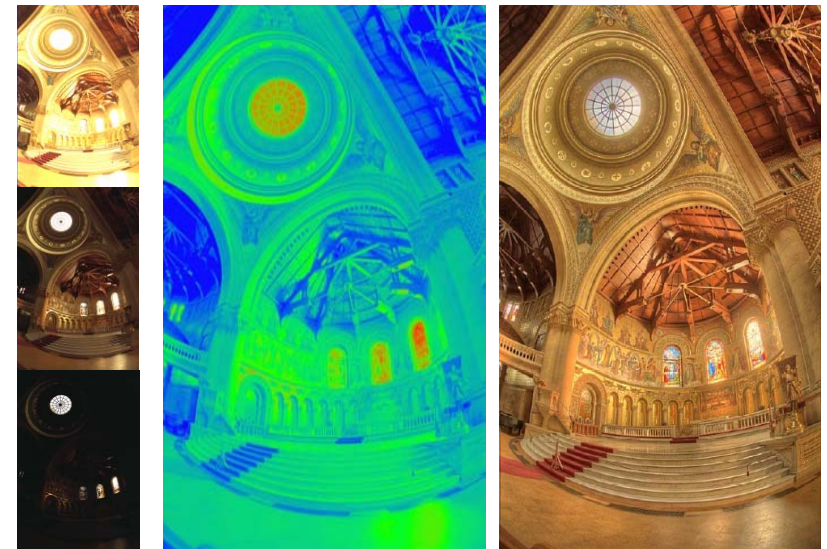
## Grading (subject to change)

DigiVFX

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

## High dynamic range imaging

DigiVFX



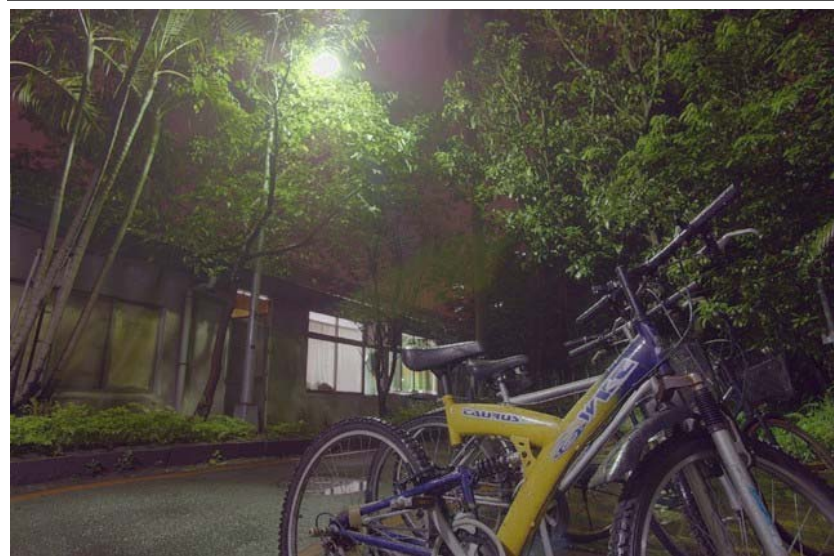
From past semesters (鄭逸廷 陳柏勸) DigiVFX



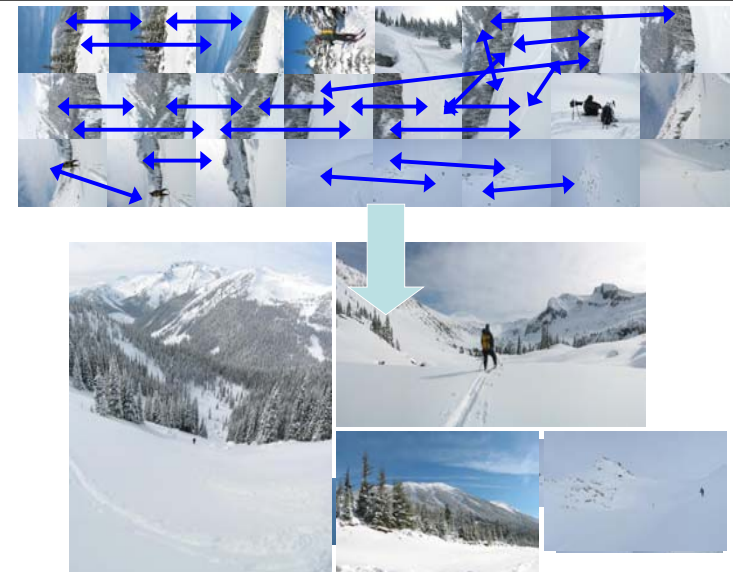
From past semesters (吳侑親, 張書瑋) DigiVFX



From past semesters (王瑋馥, 余雁雲) DigiVFX



AutoStitch DigiVFX





## AutoStitch

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羅聖傑



連奕婷 張宇蓓

Final projects from the past.

## MathMove

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梁家愷 鐘志遠



姜任遠 林立峯



楊宗碩 林柏劭



翁憲政 洪韶憶

## YoYo Flight

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