Cool Applications: Graphics

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The Plan

1. Overview of Graphics
   - 2D Graphics: Transformations, Vector Graphics
   - 3D Graphics: Modeling, Animation
   - HCI

2. Emerging Technologies!
   - Procedural Generation
   - Virtual Reality, Augmented Reality
Sketchpad

[Sutherland, 1963]
2D Graphics
2D Graphics
2D Graphics

Cathode Ray Tube Screen (old school)

iPhones

iPad

iPhone 1G

iPhone 3G

iPhone 4G
2D Graphics

Transformations: Scaling, Rotating, Translating
2D Graphics

Transformations: Scaling, Rotating, Translating
2D Graphics

Transformations: Scaling, Rotating, Translating
2D Graphics: Scaling

Transformations: **Scaling**, Rotating, Translating
2D Graphics: Scaling

Transformations: **Scaling**, Rotating, Translating
2D Graphics: Scaling

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2D Graphics: Scaling

Transformations: **Scaling**, Rotating, Translating
2D Graphics: Scaling

Transformations: **Scaling**, Rotating, Translating
2D Graphics: Rotating

Transformations: Scaling, Rotating, Translating
2D Graphics: Rotating

Transformations: Scaling, Rotating, Translating
2D Graphics: Rotating

Transformations: Scaling, Rotating, Translating
Image Blending
Image Blending
Image Blending

Copy and Paste
Image Blending

Copy and Paste

Blending!
Sketch 2 Photo
Vector Graphics
Vector Graphics

Goal: make an image that can be scaled arbitrarily!
Vector Graphics

Goal: make an image that can be scaled arbitrarily!
Vector Graphics

Pixels (bit map = map of bits!)

Pixel 1 = red
Pixel 2 = blue
Pixel 3 = red

Vector (Infinite!)

Draw a circle
Draw a right-pointing triangle
Draw an oval
Vector Graphics

Pixels

Vector (Infinite!)
Vector Graphics

Pixels

Make it smaller!

Vector
(Infinitive!)
Vector Graphics

Pixels

Vector (Infinite!)

Make it smaller!
Vector Graphics

Pixels

Vector (Infinite!)

Make it BIGGER!
Vector Graphics

pixels

Vector (Infinite!)

Make it BIGGER!
Vector Graphics

・ We can do this because a circle is just: \( \langle center, radius \rangle \)
Vector Graphics

- We can do this because a circle is just: \( \langle \text{center}, \text{radius} \rangle \)
- And a triangle is just: \( \langle \text{point}_1, \text{point}_2, \text{point}_3 \rangle \)
We can do this because a circle is just: \( \langle \text{center}, \text{radius} \rangle \)

And a triangle is just: \( \langle \text{point}_1, \text{point}_2, \text{point}_3 \rangle \)

And a square is just: \( \langle \text{point}_1, \text{point}_2, \text{point}_3, \text{point}_4 \rangle \)
Vector Graphics

- We can do this because a circle is just: $\langle \text{center}, \text{radius} \rangle$
- And a triangle is just: $\langle \text{point}_1, \text{point}_2, \text{point}_3 \rangle$
- And a square is just: $\langle \text{point}_1, \text{point}_2, \text{point}_3, \text{point}_4 \rangle$
- So no matter what resolution, we just rescale the points and draw those shapes!
3D Graphics

The Teapot
The Teapot

- The “Hello World” of Graphics
- Like a Vector graphic!

(just 3D)
The Teapot

- The “Hello World” of Graphics
- Like a Vector graphic!

This is the gist! Make a model of a teapot, just like we had a model of a square
Transformations

Rotation 90° around Y

Translate along X

Translate along X

Rotation 90° around Y

http://www.codinglabs.net/public/contents/article_world_view_projection_matrix/images/order_dependency.png
Transformations

- Scaling
- Rotation
- Translation
- Blurring
- Sharpening
- Blending
Transformations

› Scaling
› Rotation
› Translation = some equation that carries out this transformation
› Blurring
› Sharpening
› Blending
Transformations

- Scaling
- Rotation
- Translation
- Blurring
- Sharpening
- Blending

= some equation that carries out this transformation

QUICK BLENDER DEMO
Triangle Primitives!
Transformations

- Scaling
- Rotation
- Translation
- Blurring
- Sharpening
- Blending

= some equation that carries out this transformation

Q: There’s something else we need to do in 3D though... what is it?
Transformations

- Scaling
- Rotation
- Translation
- Blurring
- Sharpening
- Blending

Hint:

= some equation that carries out this transformation

Q: There’s something else we need to do in 3D though… what is it?
Rendering

The Aristotelian Rainbow: From Philosophy to Computer Graphics
Jeppe Revall Frisvad, Niels Jørgen Christensen, and Peter Falster

[Frisvad, Christensen, Falster 2006]
Rendering

- INPUT: 2D or 3D model
- OUTPUT: A scene!
Rendering

- **INPUT:** 2D or 3D model
- **OUTPUT:** A scene!

Lighting, Shading, etc.
Rendering

Goal: Realism

Goal: Aesthetic
3D Eyes
Train

ARRIVAL OF A TRAIN AT LA CIOTAT

Lumière No. 653
The Uncanny Valley

- The uncanny valley
  - Moving: dashed line
  - Still: solid line

- human likeness
  - Industrial robot
  - Stuffed animal
  - Corpse
  - Prosthetic hand
  - Bunraku puppet
  - Healthy person
  - Zombie
Interaction!

‣ Simulate Physics! Such as:

- Light
- Water
- Gravity
- Collisions
- Energy

Artist: Quentin Blake
Animation
Review: Representation
Animation
Animation

Same but 3D movements!
Andy!
Human Computer Interaction
+
User Interfaces
Human Computer Interaction
+
User Interfaces
Human Computer Interaction
+
User Interfaces
How can we best get humans to take advantage of solving problems in SOLVE?
Gestalt Principles of Grouping

Proximity
Gestalt Principles of Grouping

Proximity

Continuation
Gestalt Principles of Grouping

Proximity

Continuation

Similarity
Q: How can we take our knowledge of human psychology to design the objects humans interact with?
Q: How can we take our knowledge of human psychology to design the objects humans interact with?

Q: What if those objects are computers?
Q: How can we take our knowledge of human psychology to design the objects humans interact with?

Q: What if those objects are computers?
HCI, UI, UX

What’s next?
HCI, UI, UX

Virtual Reality

What's next?

Natural Language

Brain Computer Interfaces

Wearables