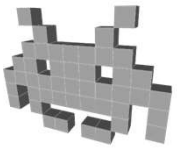
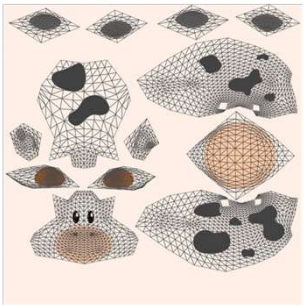
3D VideoGames
Textures



Marco Tarini



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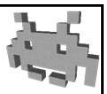
Course Plan



lec. 1: **Introduction**
lec. 2: **Mathematics** for 3D Games
lec. 3: **Scene Graph**
lec. 4: Game **3D Physics** +
lec. 5: Game **Particle Systems**
lec. 6: Game **3D Models**
lec. 7: Game **Textures**
lec. 8: Game **3D Animations**
lec. 9: Game **3D Audio**
lec. 10: **Networking** for 3D Games
lec. 11: **Artificial Intelligence** for 3D Games
lec. 12: Game **3D Rendering Techniques**

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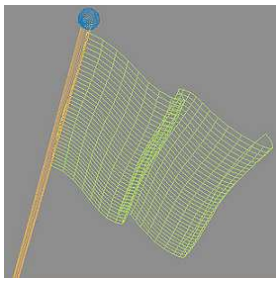
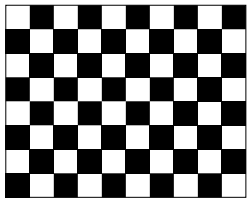
Texture mapping


3D geometry
(set of quadrilaterals)

RGB texture 2D

(here: a color-map)

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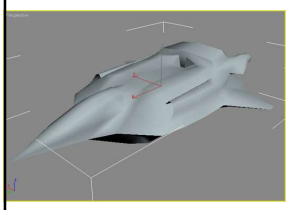
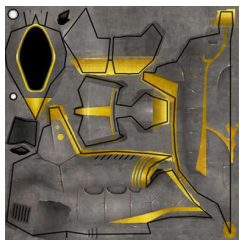
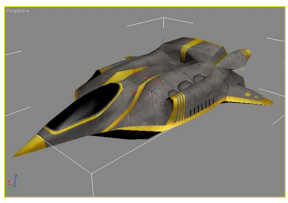
Example (color-map)

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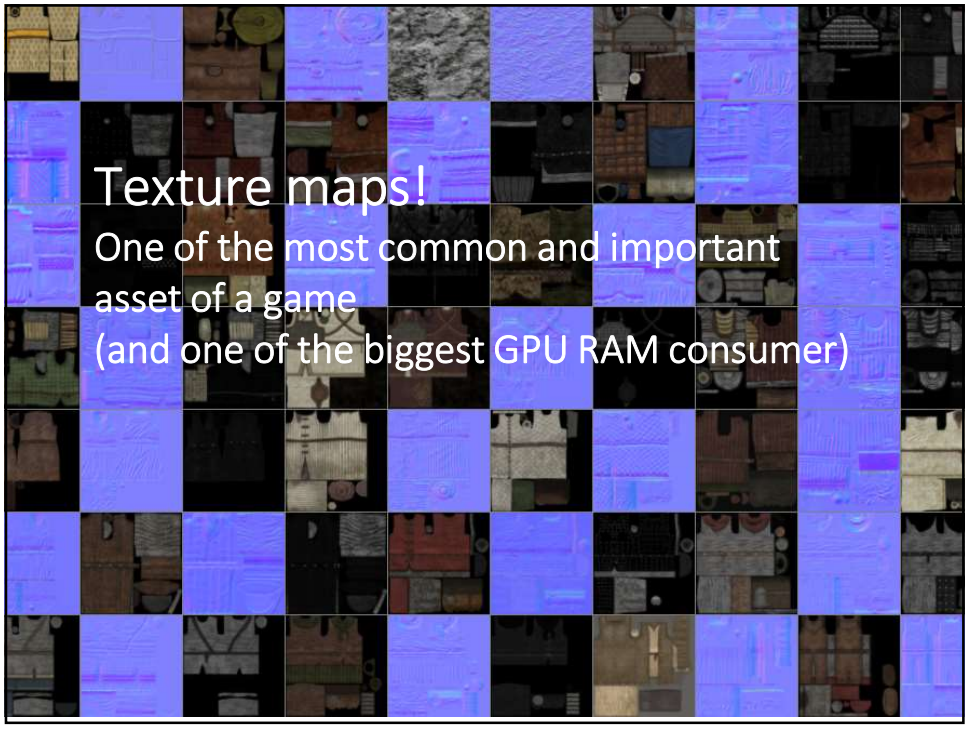

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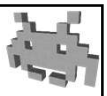
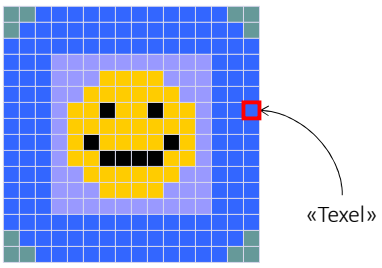
Texture maps: data structures



- In practice, a **rasterized image**



Texture sheet

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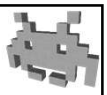
Texutres (in games)



- Texture sheet =
  def. of a singale onto the surface (the mesh)
  - Similar purpose to the per-vertex attributes!
  - but…
    - # texels >> # vertices
    - More complex signals!

Texture: regular sampling, and dense (easy to get detail!)
Attributes: irregular samplling (adaptive), and sparse

- A texel = a sample of that signal
  - Between samples: (bilinear) interpolation
- Signal sampling:
  - On a regular 2D grid (raster image)
  - At a given resolution (NOT adaptive!)

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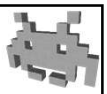
Signals stored in textures (in games)



- Each texel is a base-color (components: *r,g,b*)
  - The texture is called a "diffuse-map" / "color-map" / "RGB-map"
- Each texel is a transparency factor (components: α)
  - The texture is called a "alpha-map" or "cutout-texture" (exp. if 1bit)
- Each texel is a normal (versor, with components: *x,y,z*)
  - The texture is called a "normal-map" or "bump-map"
- Each texel is a specular coefficient value
  - The texture is called a "specular-map"
- Each texel contains a glossiness value
  - The texture is called a "glossiness-map"
- Each texel is a *baked* lighting value…
  - The texture is called a (baked) "light-map"
- Each texel stores a distance from a surface value
  - The texture is called a "displacement map" or "height texture"

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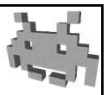
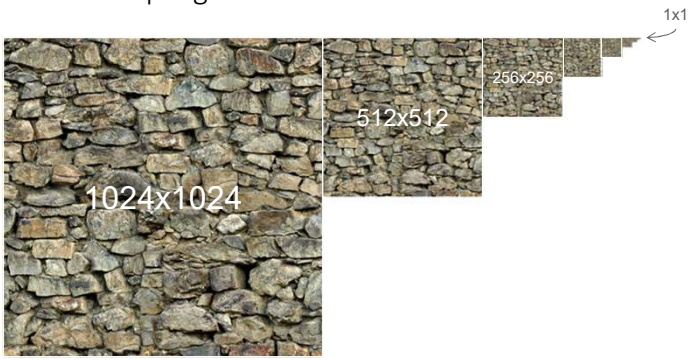
MIP map levels



- Pre-filtering of textures
- LOD pyramid, for images
- Hardware picks the right level (for each screen pixel)
- Avoids subsampling artifacts



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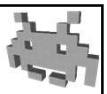
Texture maps as assets: characteristics



- Size:
  - resolution
  - channels (1,2,3,4)
- MIP-map levels
  - are they present?
  - how many
- Compression?
  - e.g. color quantization (“color-map” or “palette”)
  - compression schemas designed specifically for textures such as: DXT1-5 (DirectX Texture – Microsoft)

HW imposed constraints:
- Power of 2 for side (U and V)
  - e.g.: 256x256 or 1024x512
  - not a strict requirement today today
- Hardwired upper buond
  - ever growing limit
  - today: 8K, 4K, 2K

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Most of the visual richness perceived in the typical videogame is due to textures!

Texture resolution has a bigger impact impact on quality than Meshes resolution!

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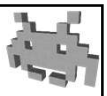
GPU rendering of a Mesh in a nutshell (reminder)



- Load…
  - store all data on GPU RAM
    - Geometry + Attributes
    - Connectivity
    - Textures
    - Shaders
    - Parameters / Settings

THE MESH

THE "MATERIAL"

- …and Fire!
  - send the command: "*do it*" !

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