Synthétisation d'une image numérique

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  - Objet numérique
  - Lancer de rayons
  - Rastérisation
- II / Eclairage
  - Modèle de Phong

III/ Champ de hauteur

- Complexité spatiale
- Complexité temporelle

TIPE 2017/2018

« Optimalité : Choix, contraintes, hasards. »

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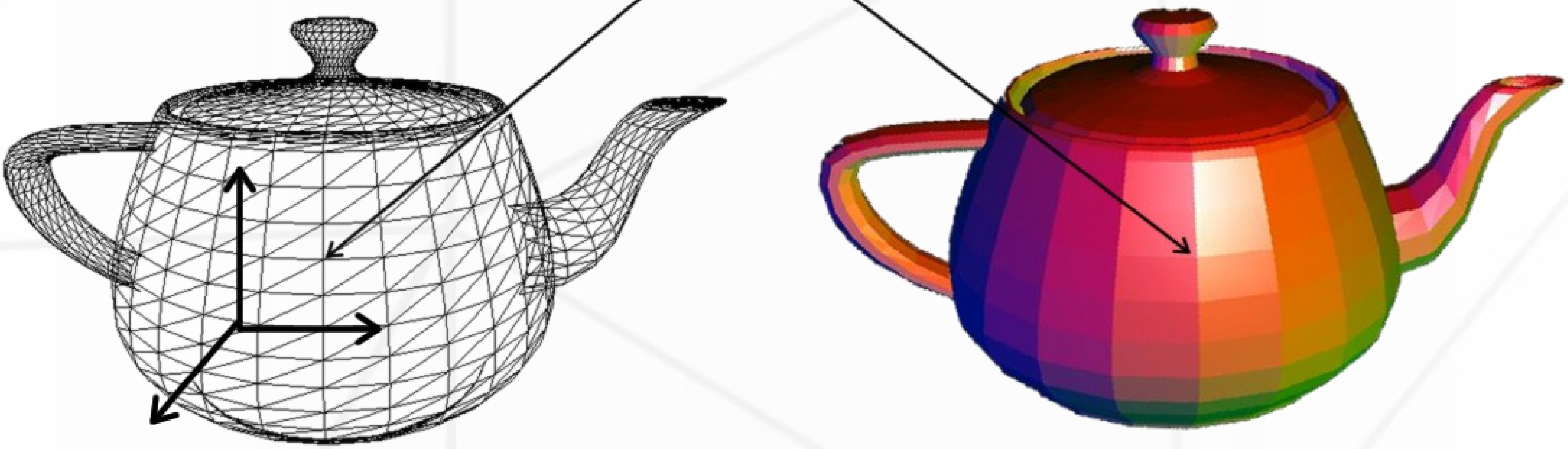
Rendu graphique

- Objet numérique

$$L=((V_{1,}V_{2,}V_3),(V_{1,}V_{2,}V_4),\ldots,(V_i,V_j,V_k))$$

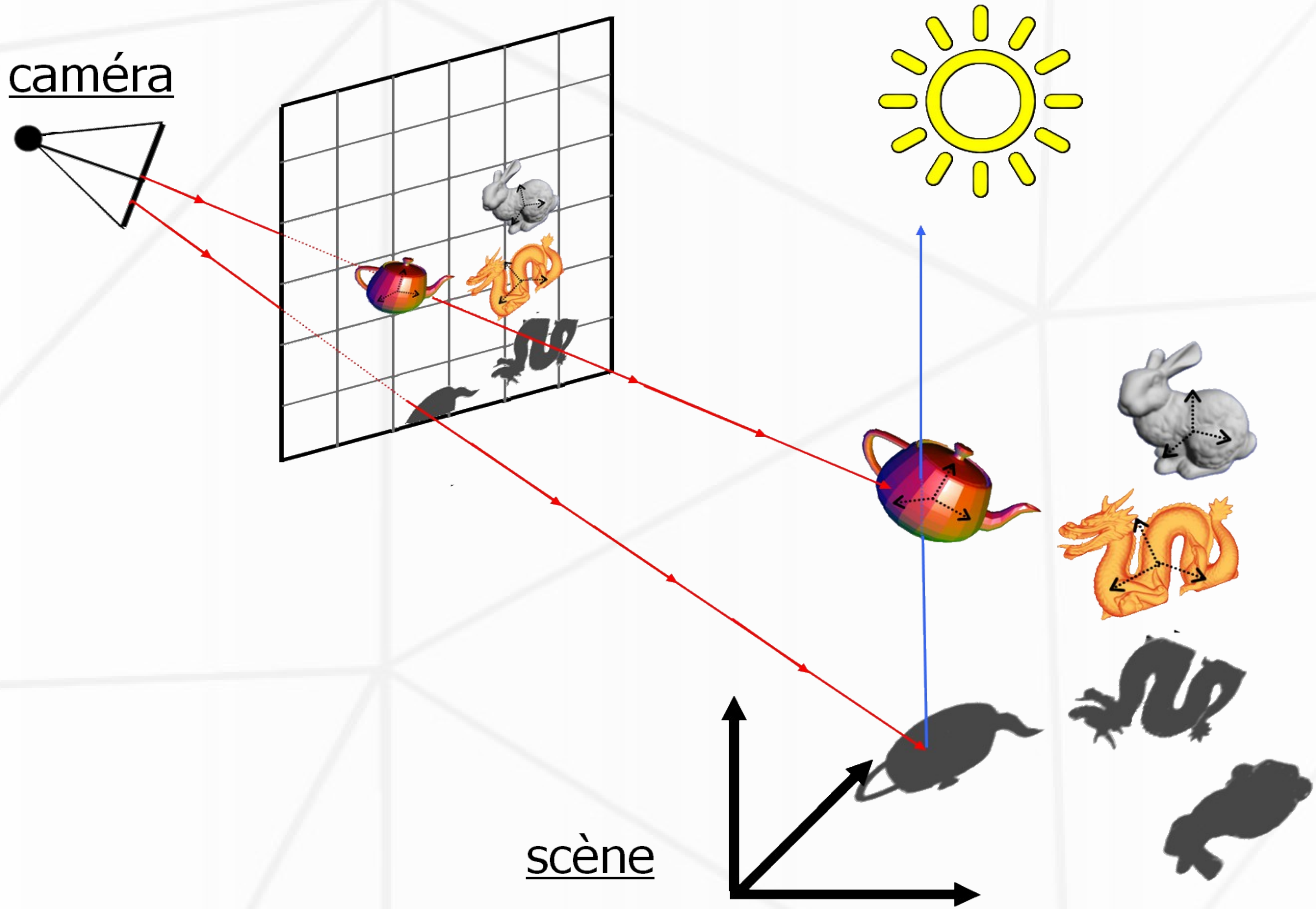
$$V_i=((x_i,y_i,z_i),(r_i,g_i,b_i),\ldots)$$

$$V_i=((1.4,2.8,1.1),(255,80,100),\ldots)$$



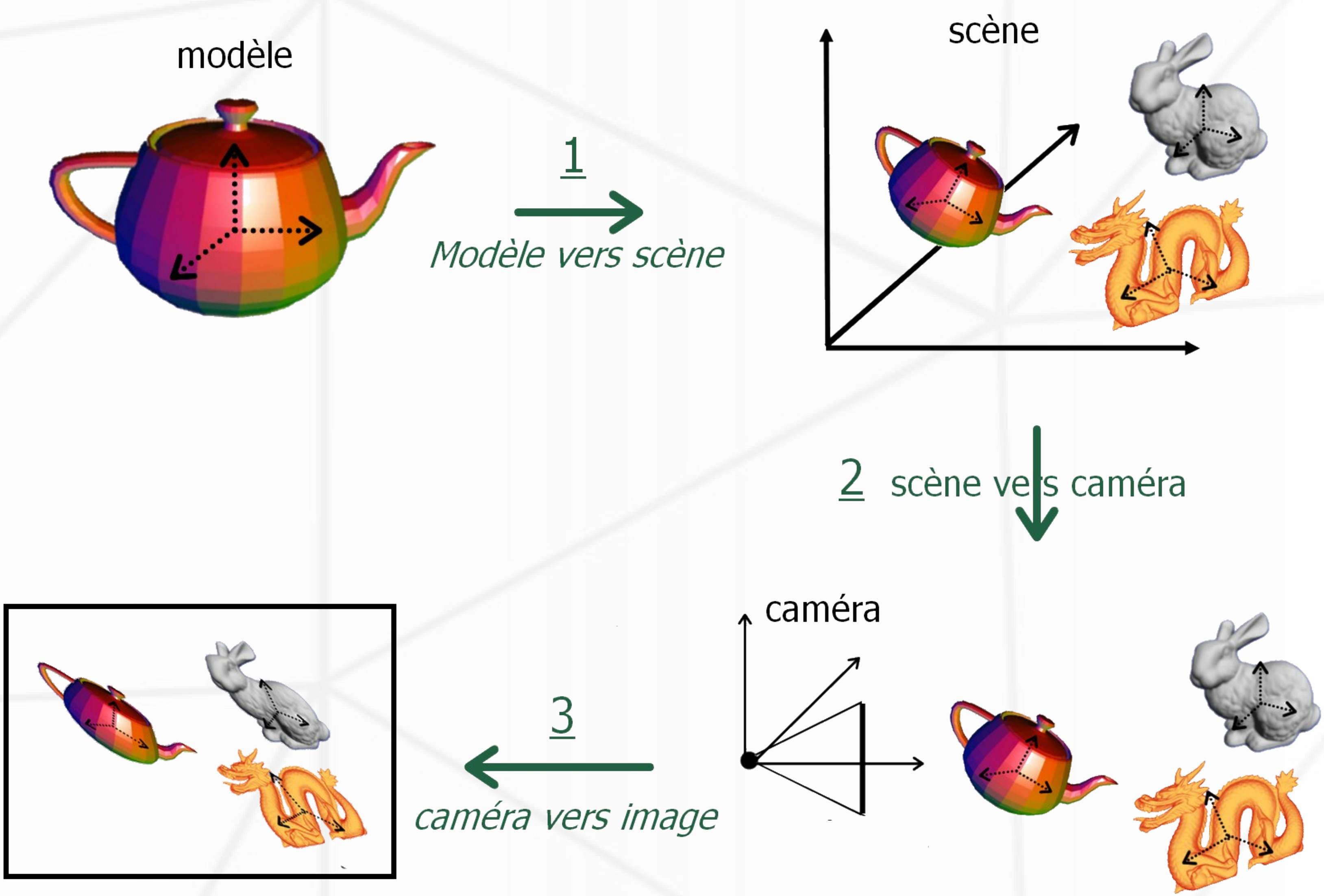
Rendu graphique

- Lancer de rayons



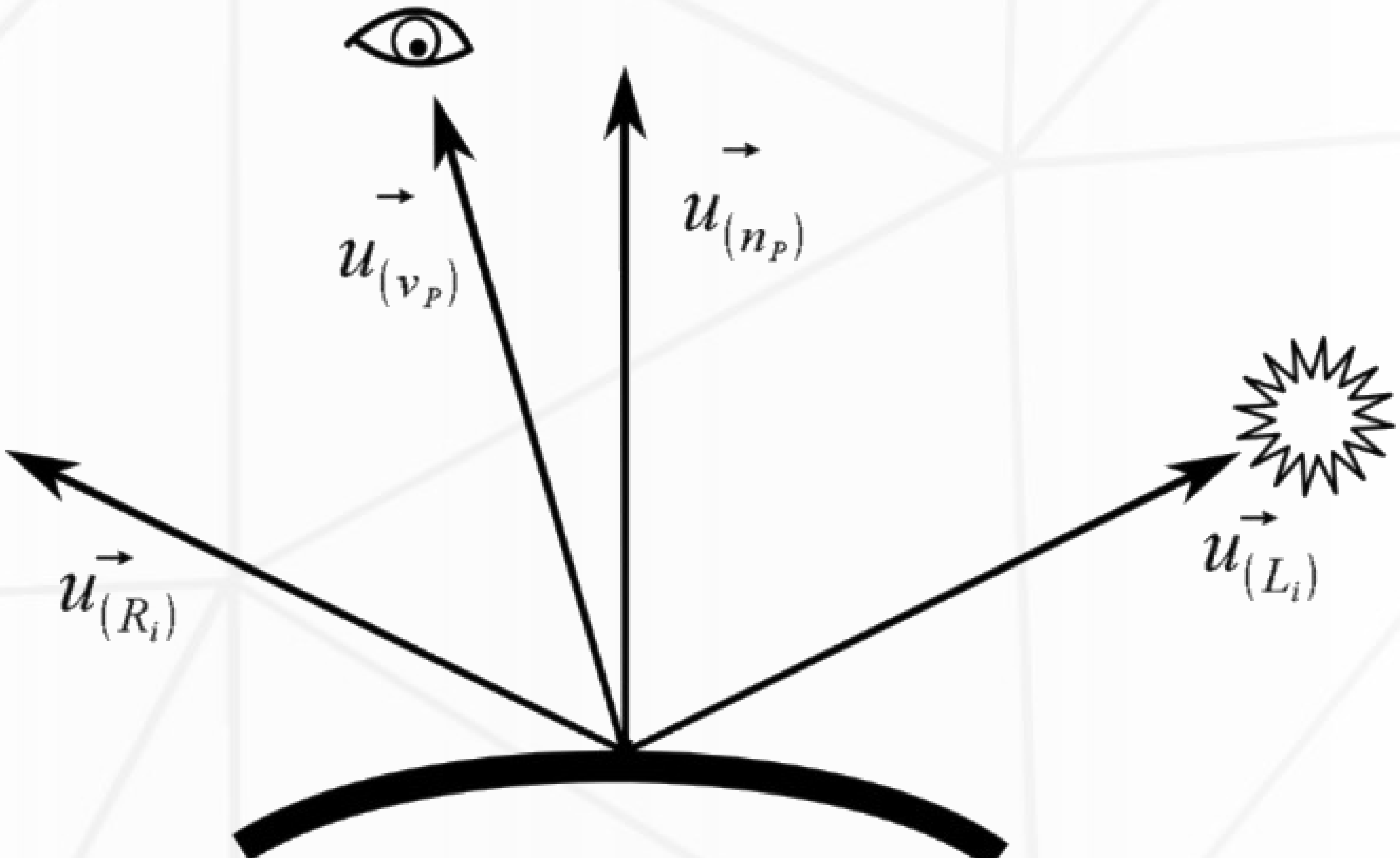
Rendu graphique

- Rastérisation



Eclairage : ombrage de Phong

$$I(P) = I_A(P) + \sum_{i=1}^{n} \vec{u_{(L_i)}} \bullet \vec{u_{(n_P)}} * I_i + (\vec{u_{(R_i)}} \bullet (\vec{u_{(v_P)}}))^{\alpha} * I_i$$

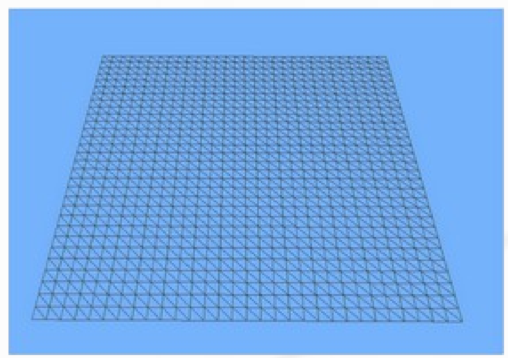


Champ de hauteur

- Définition

$$H(x, z) = y$$
$$F(x, y, z) = H(x, z) - y$$

+



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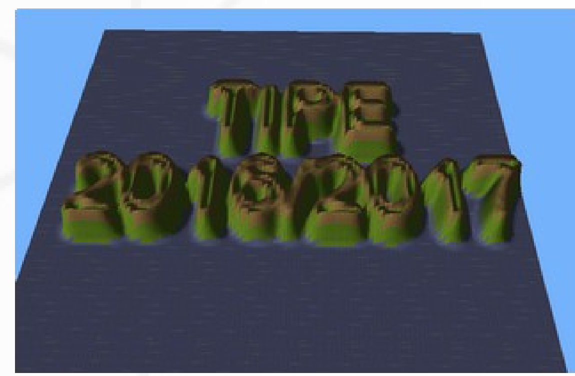
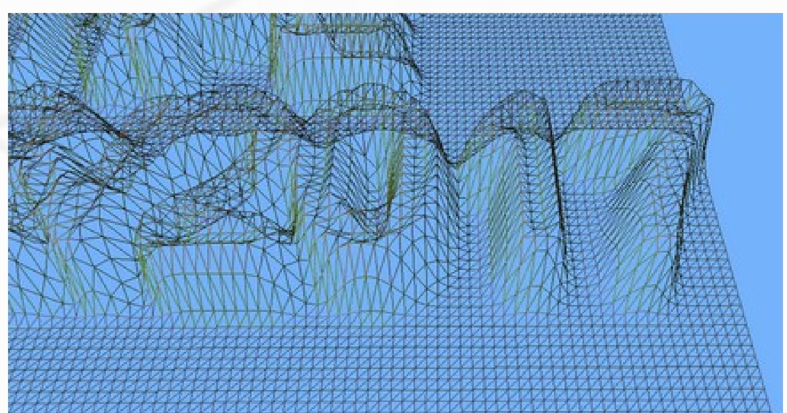
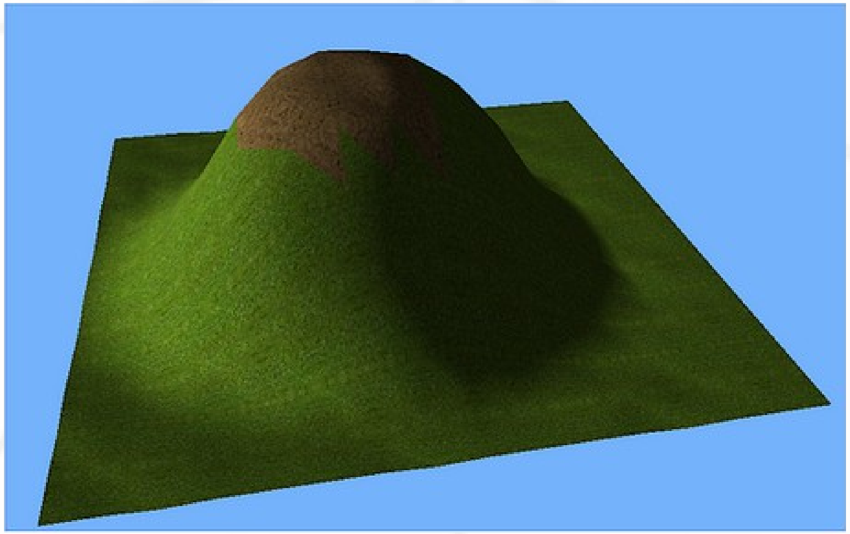
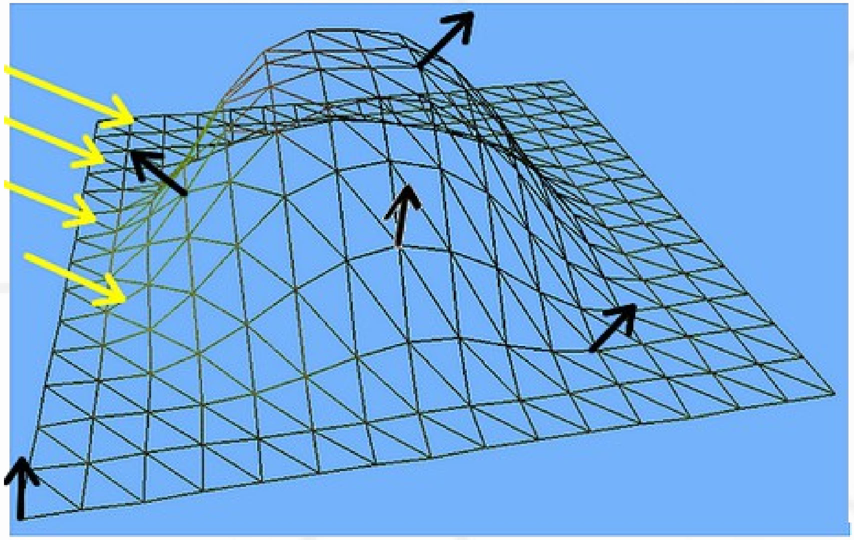




Champ de hauteur

- Calcul des normales





$$F(x,y,z) = H(x,z) - y$$

$$\vec{N}(x_0,y_0,z_0) = \begin{vmatrix} \dfrac{\partial F(x_0,y_0,z_0)}{\partial x} \\ \dfrac{\partial F(x_0,y_0,z_0)}{\partial y} \\ \dfrac{\partial F(x_0,y_0,z_0)}{\partial z} \end{vmatrix}$$

$$\boxed{= \begin{vmatrix} \dfrac{H(x_0+dx, z_0) - H(x_0,z_0)}{dx} \\ -1 \\ \dfrac{H(x_0,z_0+dz) - H(x_0,z_0)}{dz} \end{vmatrix}}$$

Champ de hauteur

- Complexité spatiale

$$n = \text{'nombre de points sur un coté du terrain'}$$
$$M(n) = \text{'mémoire total utilisé'}$$
$$N(n) = \text{'nombre de vecteurs distincts'}$$
$$T(n) = \text{'nombre de triangles'}$$
$$I(n) = \text{'nombre d'indices du maillage'}$$

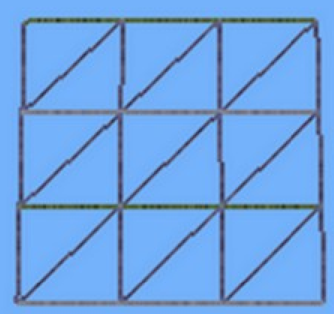


Figure X: Mesh pour n = 4

$$S = (3+3+1) * 4 = 28\, octets$$
$$V = ((x, y, z), (n_x, n_y, n_z), c)$$

$$\boxed{\begin{aligned} N(n) &= n^2 \\ T(n) &= 2(n-1)^2 \\ I(n) &= 3T(n) \end{aligned}}$$

Champ de hauteur

- Complexité spatiale
  - Formats de stockage

$$L_1(n)=((V_{1,}V_{2,}V_3)_{1,}(V_{1,}V_{2,}V_4)_{2,}\dots,(V_a,V_b,V_c)_{(T(n))})$$

$$M_1(n)=I(n)*S$$

$$\boxed{=168n^2+o(n^2)}$$

$$L_2=(V_1,V_{2,}\dots,V_n)$$

$$I_2=((1,2,3)_{1,}(1,2,4)_{2,}\dots,(a,b,c)_{(T(n))})$$

$$M_2(n)=N(n)*S+2*I(n)$$

$$\boxed{=40n^2+o(n^2)}$$

Champ de hauteur

- Complexité spatiale

$$M_2(n) - M_1(n)$$

$$n_0 = \frac{\sqrt{(6 * S * (S-2))} + 6 * (S-2)}{5 * S - 12}$$

n	0	n_0	$+\infty$
$M_2(n) - M_1(n)$	+		-

$$S = 28\,octets \Rightarrow n_0 = 2$$

$$n = 1024 \Rightarrow M_1(n) = \boxed{168\text{Mo}}$$

$$M_2(n) = \boxed{40\text{Mo}}$$

$$M_2(n) - \underline{M_1(n) = -128\text{Mo}}$$

$$T(n) = \underline{2\ 000\ 000\ triangles}$$

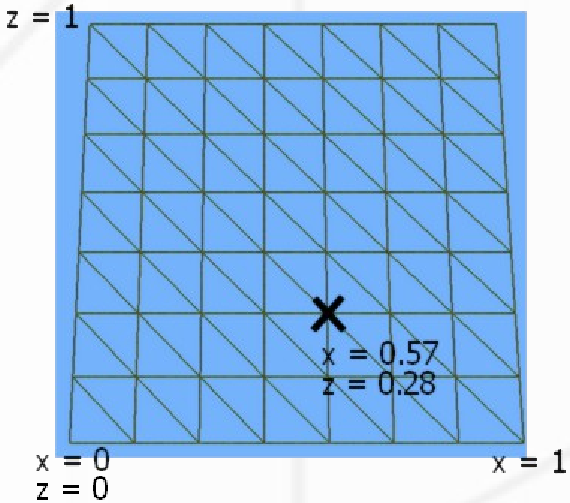
→ 2ème méthode optimal

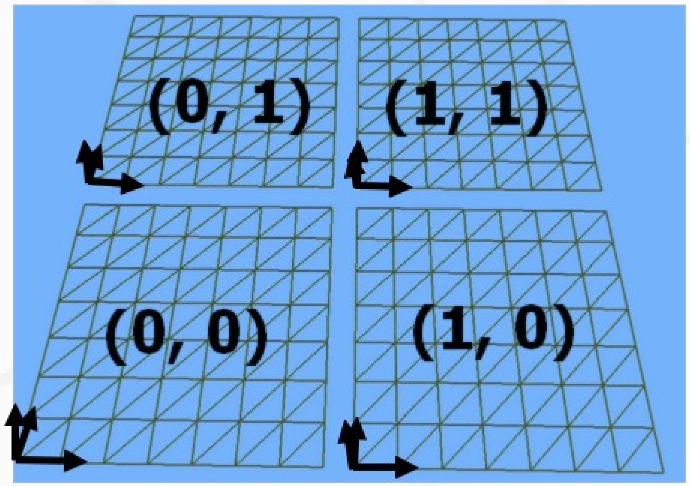
Champ de hauteur

- Complexité spatiale

$$((\cancel{x}, y, \cancel{z}), (n_x, \cancel{n_y}, n_z), c)$$

$$7 * 4 = 28\, octets \rightarrow 4 * 4 = 16\, octets$$



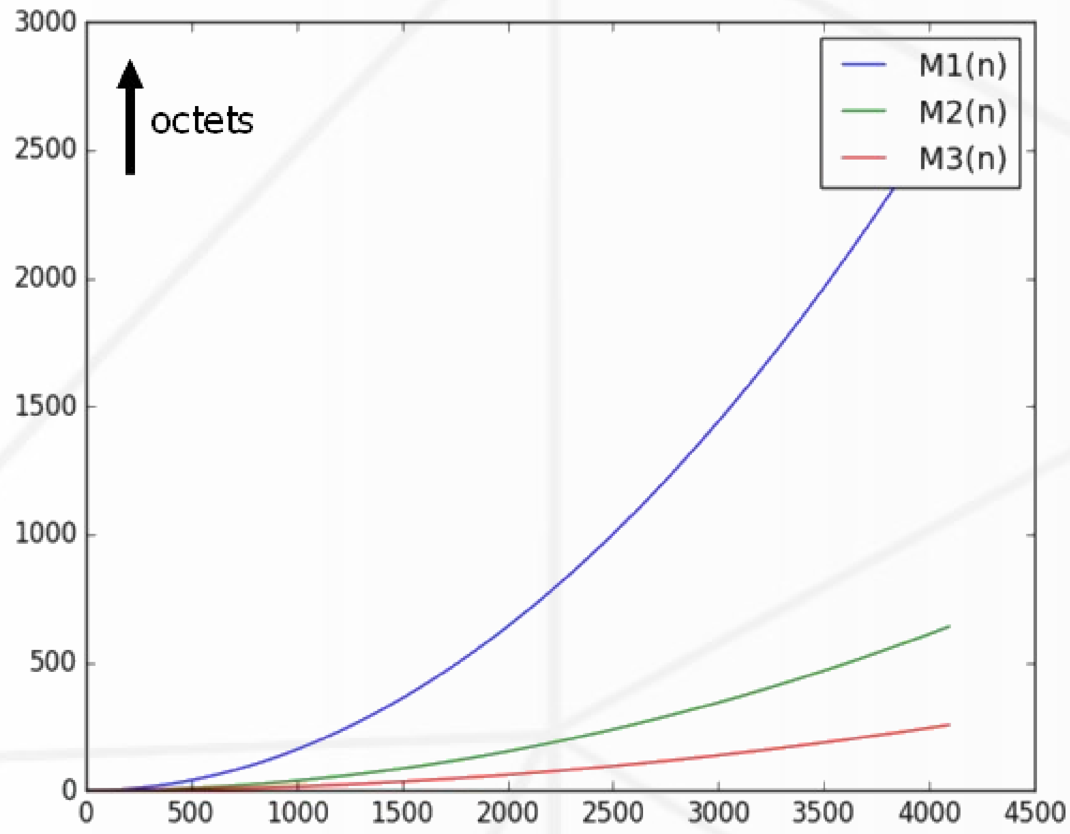


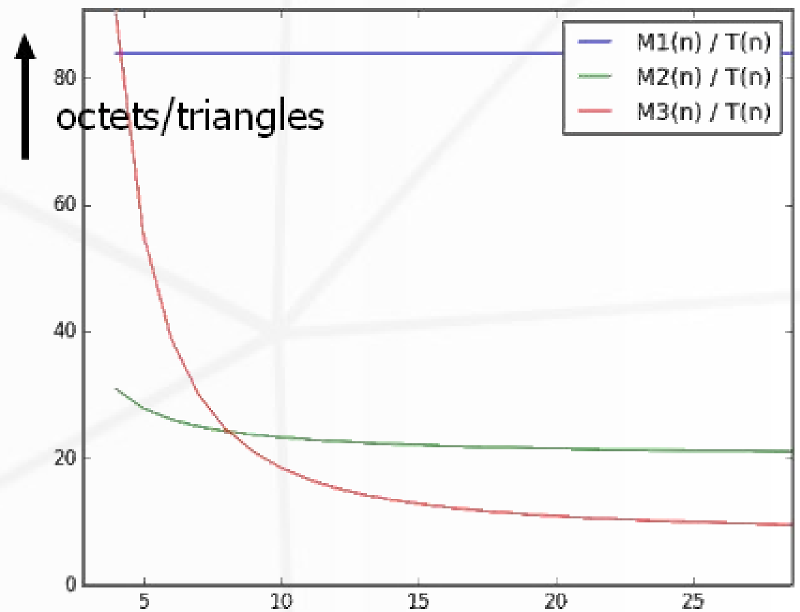
$$M_3 = N(n) * S + \frac{n}{n_u} * (16 * 4 + 2 * 4) + I(16) * 2$$

$$\boxed{= 16 n^2 + o(n^2)}$$

Champ de hauteur

- Complexité spatiale : conclusion





format	M_1	M_2	M_3
octet/vecteur	$S=28$	$S=28$	$S=16$
octets/triangles	84	20	$\boxed{8}$