”Учиться, учиться и учиться!”
Влади́мир Ильи́ч Улья́нов (Ленин)

Számítógépes grafika

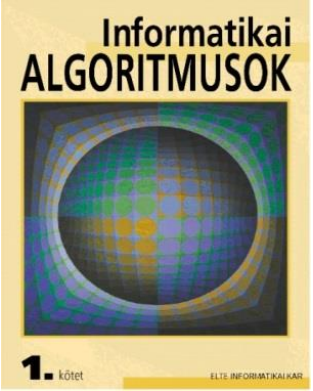
Bevezetés

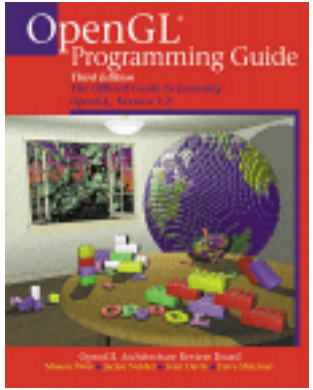
Szirmay-Kalos László

email: szirmay@iit.bme.hu
http://cg.iit.bme.hu/

Moodle

- Powerpoint
- Mintaprogramok
- Ellenőrző kérdések
- Kvíz
- Könyvek
- Videók: kiegészítés!
- Kommunikáció





Tárgykövetelmények: TAD

3 előadás/hét
félévközi jegy: házi + ZH
3 kredit

kisházik:

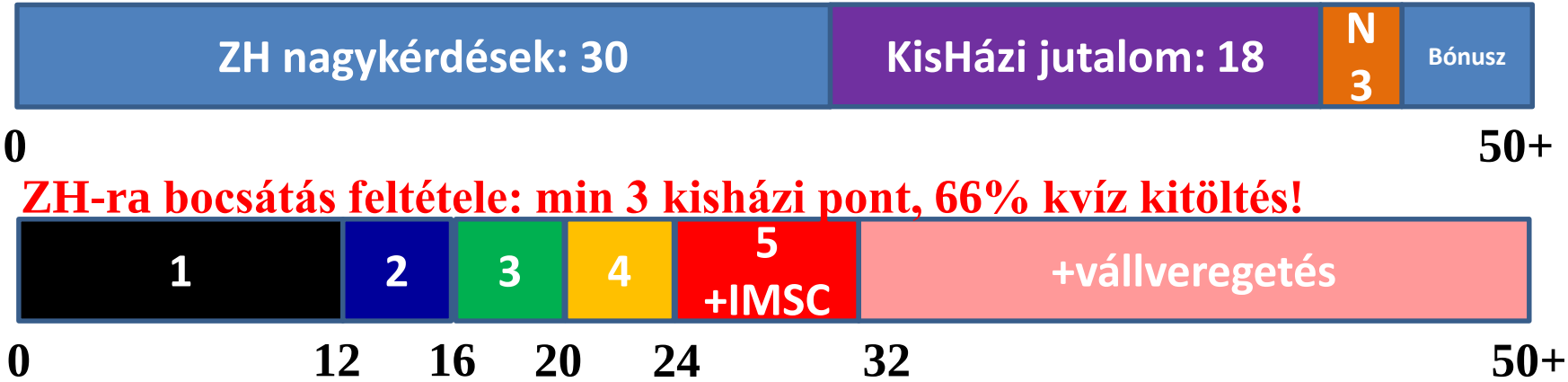
I 2 | II 3 | III 4

2 | 2 | 2

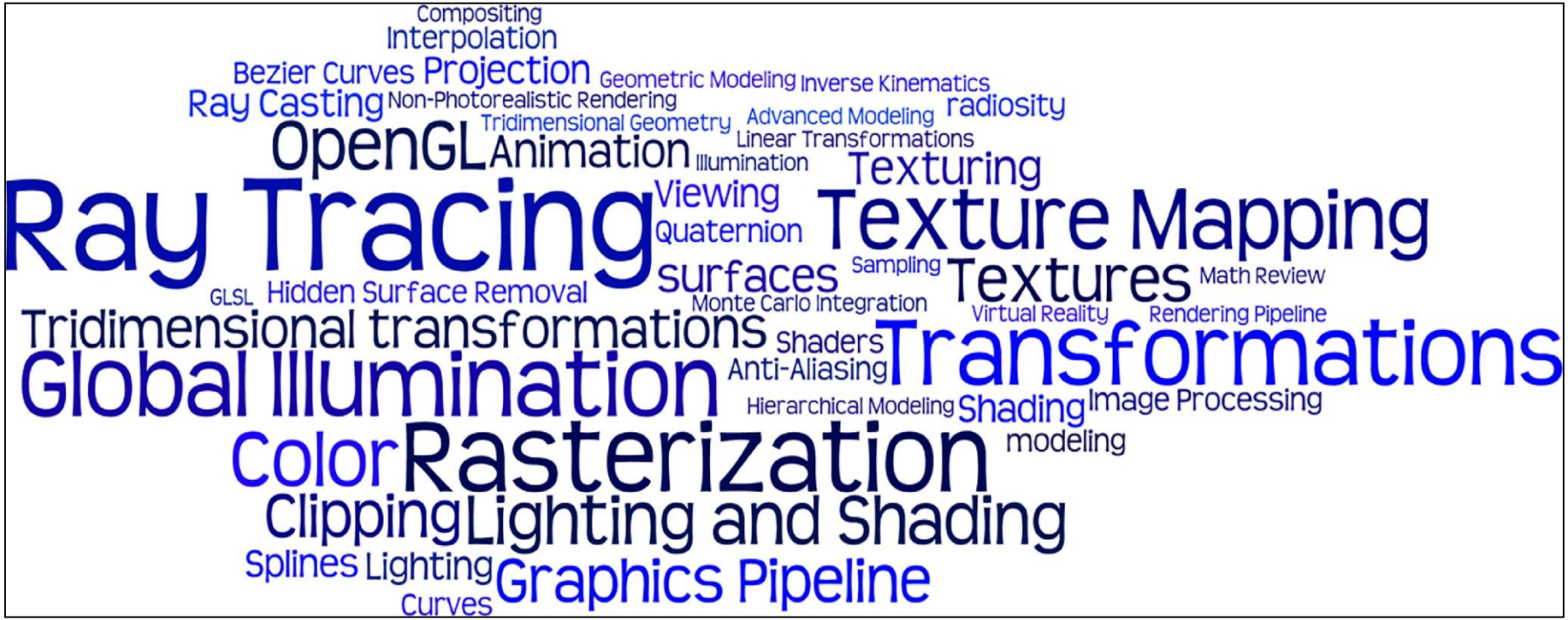
Nagyházi:

N 3

Kisházi bónusz kérdés:



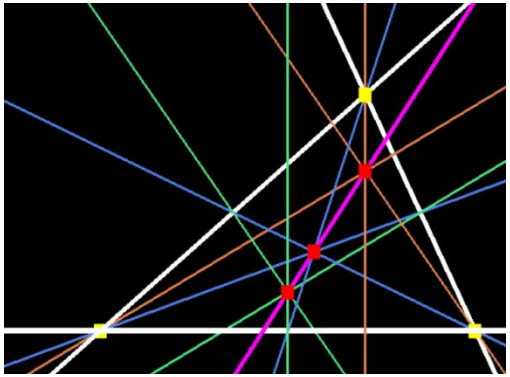
Számítógépes grafika mint tárgy

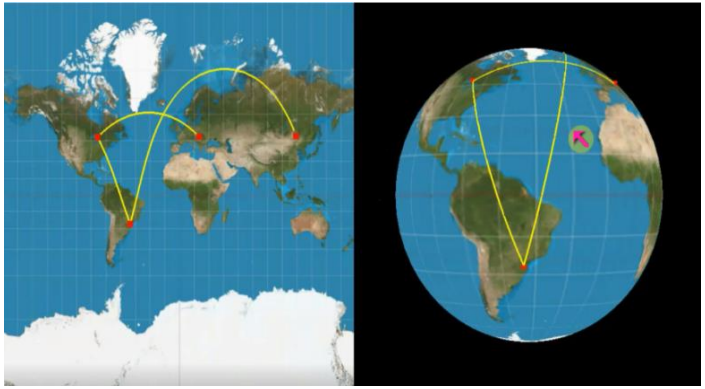


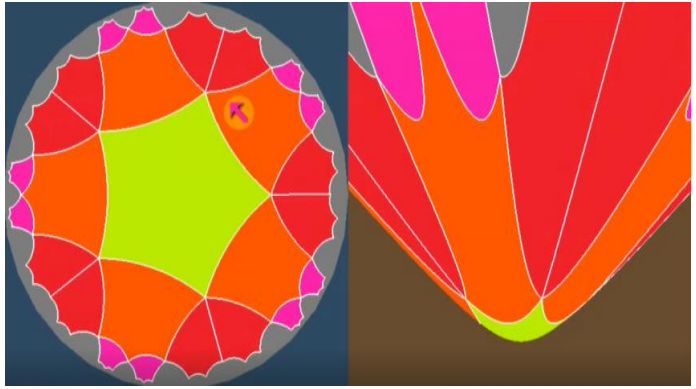
Dennis G.Balreira, Marcelo Walter, Dieter W. Fellner: **A survey of the contents in introductory Computer Graphics courses**, Computers & Graphics, Vol. 77, December 2018, Pages 88-96

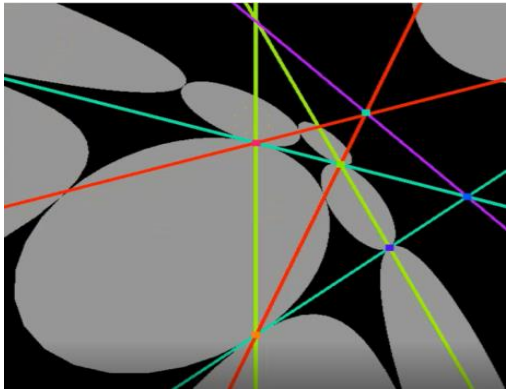
Geometriák és algebrák

- Euklideszi és nem-euklideszi geometriák
- Analitikus geometria **külső nézőpont**ból
- Pont, vektor, sík, kvaternió = **vec4**



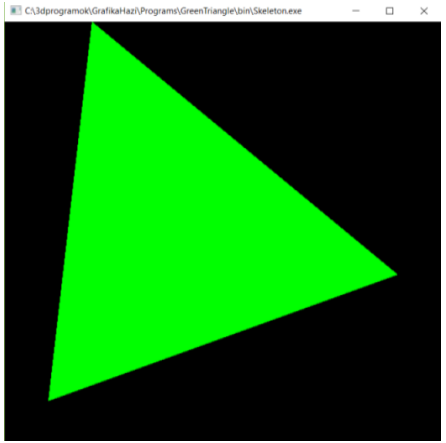


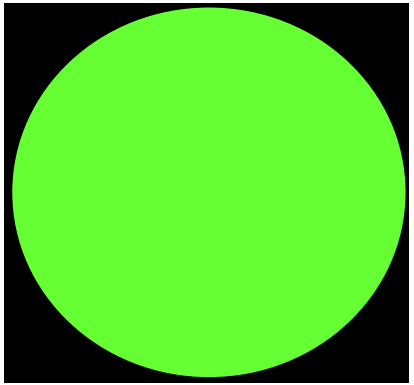


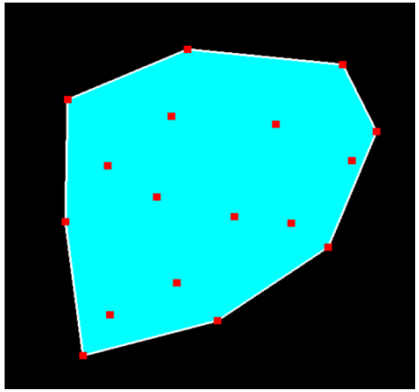


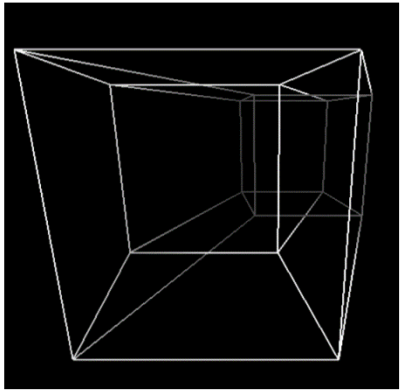
Grafikus hw/sw

- Interaktív grafikus alkalmazások
- OpenGL 3+, GLUT, Glew,
- GPU, GLSL

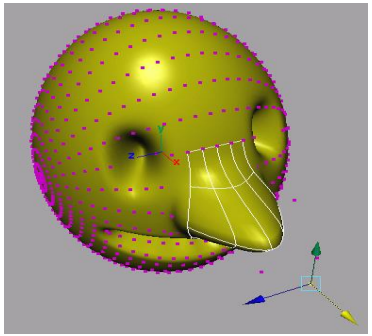




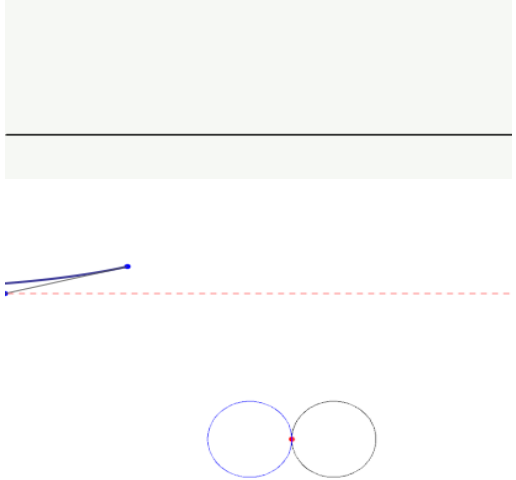


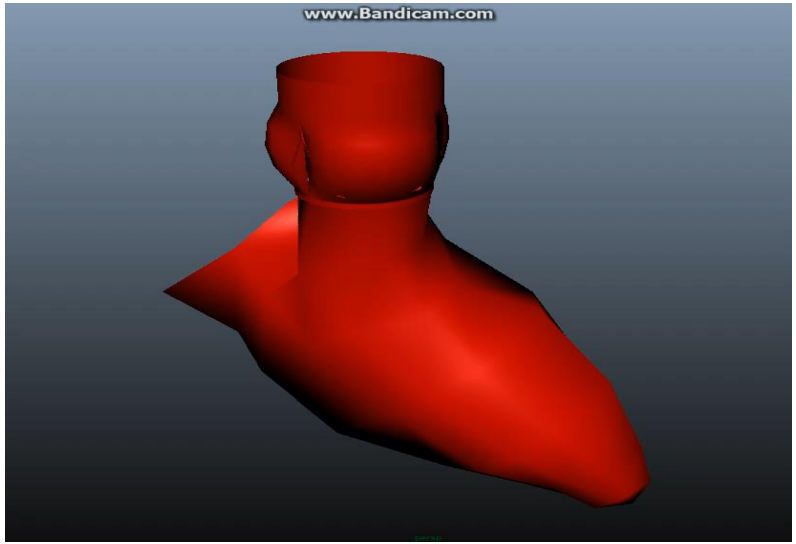


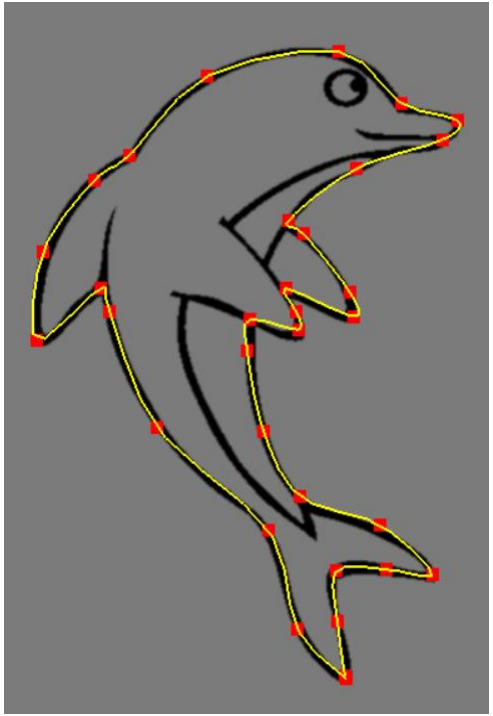
Modellezés



- Descartes és baricentrikus koordinátarendszer
- Implicit és parametrikus görbék/felületek
- Szabadformájú görbék/felületek

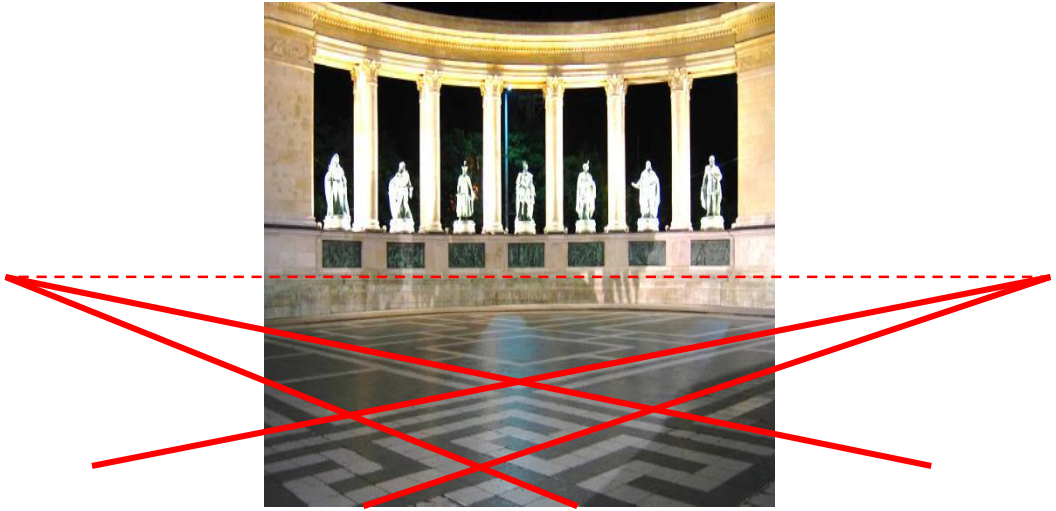






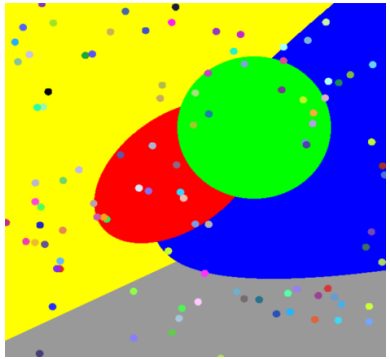
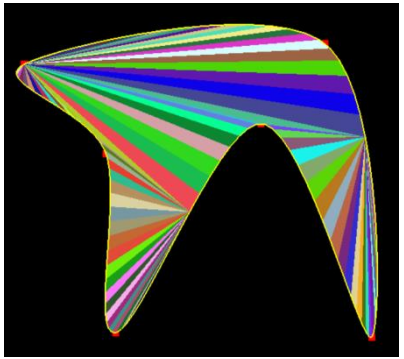
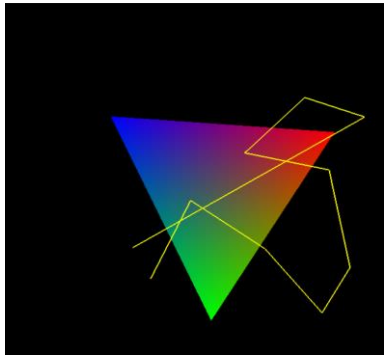
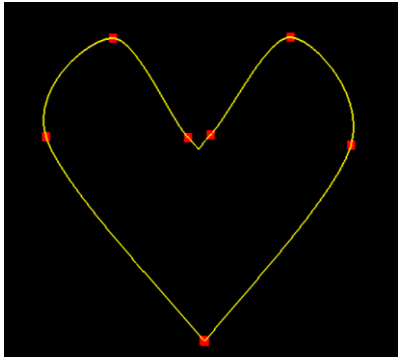
Homogén lineáris transzformációk

- Affin transzformációk (elfolás, forgatás, stb.)
- Egyenestartó transzformációk: **mat4**
- Perspektíva



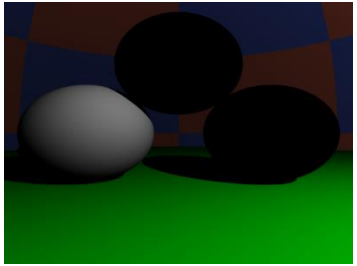
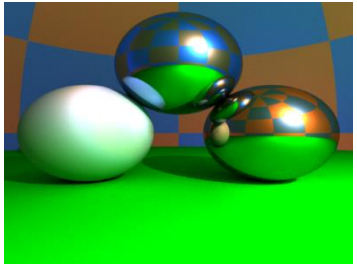
2D képszintézis

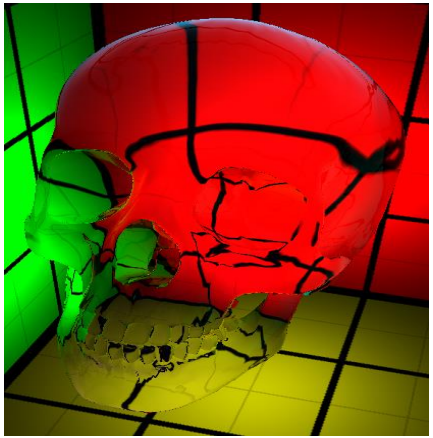
- Pixel vezérelt képszintézis
- Objektum vezérelt képszintézis
  - Vektorizáció és háromszögesítés
  - Vágás
  - Raszterizáció

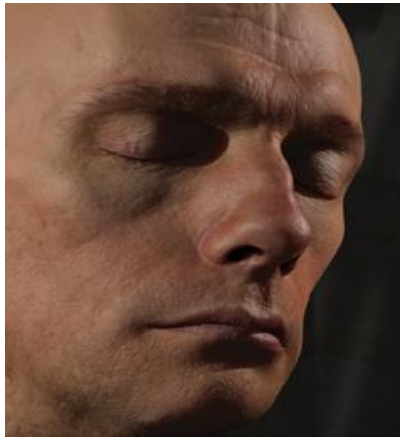





3D grafika fizikai alapjai

- Színek
- Sugársűrűség és számítása
- Optikailag sima anyagok
- Optikailag rücskös anyagok

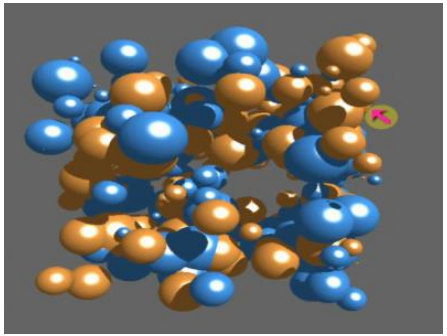


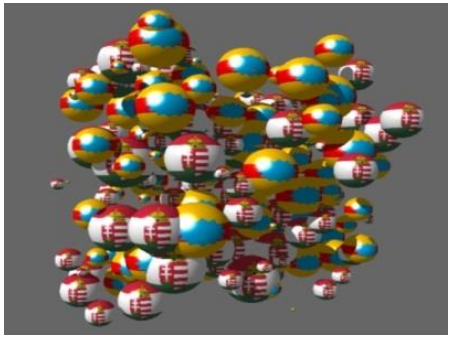


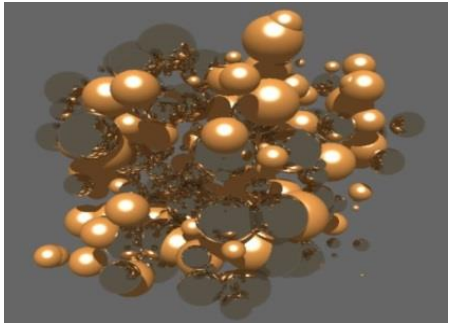
Sugárkövetés

- Láthatóság, árnyékszámítás
- Tükröződés és törés

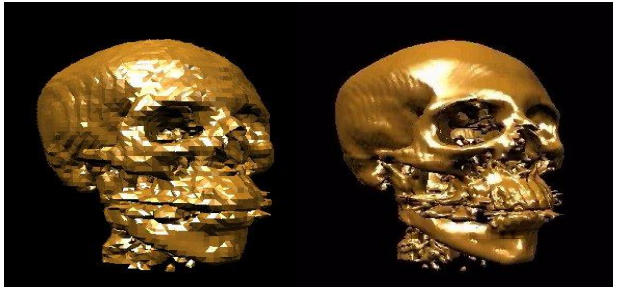
```
typedef struct{double x,y,z}vec;vec U,black,amb={.02,.02,.02}; struct sphere{ vec cen,color;double rad,kd,ks,kt,kl,ir}*s,
*best,sph[]={0.,6.,.5,1.,1.,1.,.9, .05,.2,.85,0.,1.7,-1.,8.,-.5,1.,.5,.2,1.,.7,.3,0.,.05,1.2,1.,8.,-.5,.1,.8,.8, 1.,.3,.7,0.,0.,1.2,3.,-6.,15.,1.,
.8,1.,7.,0.,0.,0.,.6,1.5,-3.,-3.,12.,.8,1., 1.,5.,0.,0.,0.,.5,1.5,};yx; double u,b,tmin,sqrt(),tan();double vdot(A,B)vec A ,B;
{return A.x*B.x+A.y*B.y+A.z*B.z;}vec vcomb(a,A,B)double a;vec A,B; {B.x+=a* A.x;B.y+=a*A.y;B.z+=a*A.z;return B;}
vec vunit(A)vec A;{return vcomb(1./sqrt( vdot(A,A)),A,black);}struct sphere *intersect(P,D)vec P,D;{best=0;tmin=1e30;
s= sph+5;while(s-->sph)b=vdot(D,U=vcomb(-1.,P,s->cen)),u=b*b-vdot(U,U)+s->rad*s ->rad,u=u>0?sqrt(u):1e31,u=b-u>
1e-7?b-u:b+u,tmin=u>=1e-7&&u<tmin?best=s,u: tmin;return best;}vec trace(level,P,D)vec P,D;{double d,eta,e;vec N,color;
struct sphere*s,*l;if(!level--)return black;if(s=intersect(P,D));else return amb;color=amb;eta=s->ir;d= -vdot(D,N=vunit(vcomb
(-1.,P=vcomb(tmin,D,P),s->cen )));if(d<0)N=vcomb(-1.,N,black),eta=1/eta,d= -d;l=sph+5;while(l-->sph)if((e=l ->kl*vdot(N,
U=vunit(vcomb(-1.,P,l->cen))))>0&&intersect(P,U)==l)color=vcomb(e ,l->color,color);U=s->color;color.x*=U.x;color.y*=
U.y;color.z*=U.z;e=1-eta* eta*(1-d*d);return vcomb(s->kt,e>0?trace(level,P,vcomb(eta,D,vcomb(eta*d-sqrt (e),N,black))):
black,vcomb(s->ks,trace(level,P,vcomb(2*d,N,D)),vcomb(s->kd, color,vcomb(s->kl,U,black))));}

main(){printf("%d %d\n",32,32);while(yx<32*32) U.x=yx%32-32/2,U.z=32/2-yx++/32,U.y=32/2/tan(25/114.5915590261),
U=vcomb(255., trace(3,black,vunit(U)),black),printf("%.0f %.0f %.0f\n",U);}/*minray!*/
```



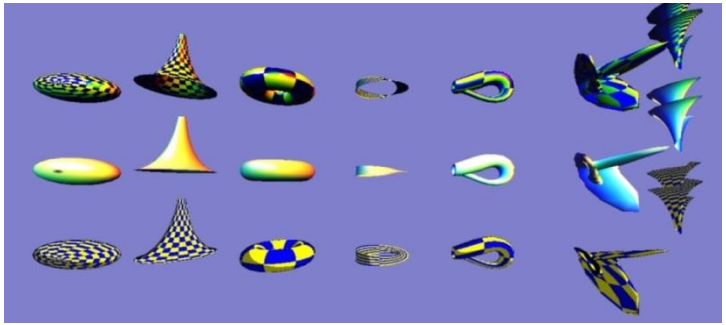


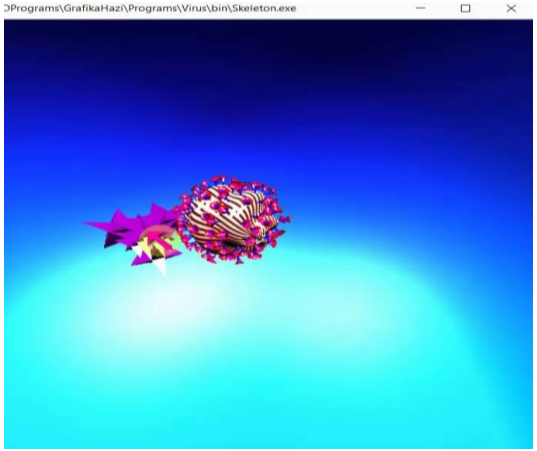


Inkrementális képszintézis



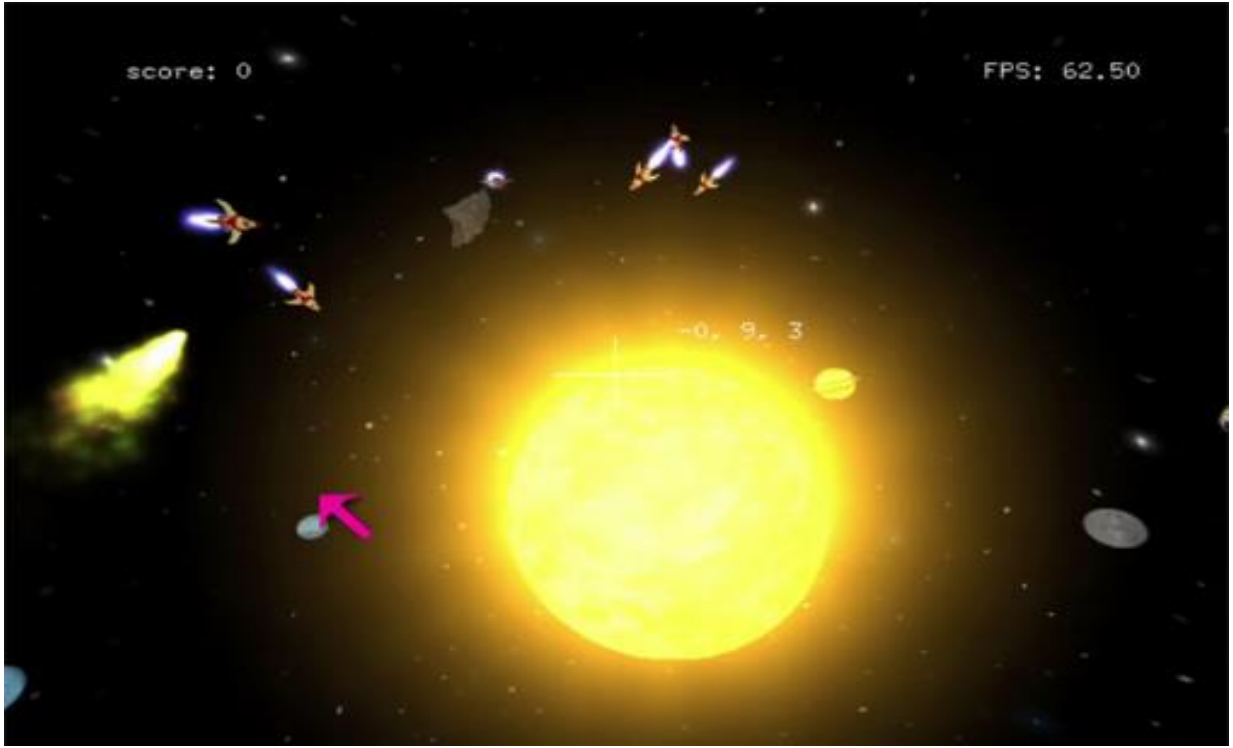
- GPU csővezeték
  - Tesszelláció
  - Transzformációk és vágás
  - Láthatóság és árnyalás

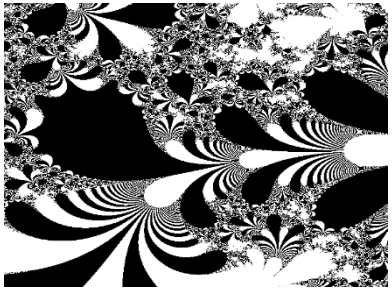
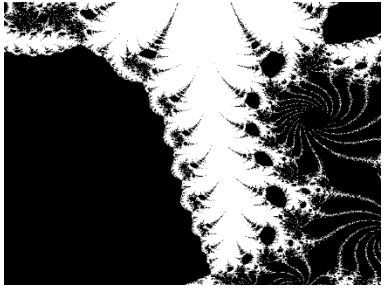




Játékfejlesztés

- Játékmotor, avatár, plakátok, részecske rendszerek



Fraktálok és káosz

- Hausdorff dimenzió
- Lindenmayer rendszerek
- Perlin zaj
- Iterált függvények