FAKULTAS TEKNIK
UNIVERSITAS NEGERI YOGYAKARTA

LAB. SHEET PRAKTIKUM GRAFIKA KOMPUTER 1			
No. : ST/EKA/PTI223/10	Revisi : 00	Senin 010509	Hal. 1 dari 23 hal.
Sem.:Genap	**Studi kasus Program**		4 x 50 menit

Pengantar

Dalam pembuatan sebuah gambar obyek sebenarnya merupakan gabungan dari beberapa obyek sederhana. Misalnya sebuah gambar robot terdiri dari gabungan kubus, tabung, bola, kerucut dan lain sebagainya. Untuk membuat obyek yang komplek dan terdiri dari obyek sederhana tersebut diperlukan sebuah penguasaan terhadap masing-masing obyek yang lebih sederhana atau bahkan harus dimulai dengan titik atau garis. Belum lagi hal-hal lain yang melekat dalam obyek tersebut sehingga seolah-olah obyek tersebut hampir seperti kondisi aslinya. Pencahayaan misalnya, iluminasi, bayangan, pengkabutan dan lain sebagainya yang mempenharuhi sebuah obyek.

Program 1

```
#include <GL/glut.h>
#include <math.h>
#include <stdio.h>
#include <stdlib.h>
#include <time.h>
#define obj 25
typedef struct {float m[4][4];} matrix3D_t;
typedef struct {float v[4];} vector3D_t;
typedef struct {float x; float y; float z;} point3D_t;
typedef struct {float x; float y;} point2D_t;
typedef struct {float r; float g; float b;} color_t;
int static move = 0;
bool stat = false, tempStat = false;

/////////// matrices and vectors 3D ///////////
  matrix3D_t createIdentity(void) {
  matrix3D_t u;
  int i,j;
  for (i=0;i<4;i++) {
    for(j=0;j<4;j++) u.m[i][j]=0.;
    u.m[i][i]=1.;
    }
  return u;
  }

matrix3D_t operator * (matrix3D_t a,matrix3D_t b) {
  matrix3D_t c; //c=a*b
  int i,j,k;
  for (i=0;i<4;i++) for (j=0;j<4;j++) {
    c.m[i][j]=0;
    for (k=0;k<4;k++)
    c.m[i][j]+=a.m[i][k]*b.m[k][j];
  }
```

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```
    return c;
}

vector3D_t operator * (matrix3D_t a, vector3D_t b) {
    vector3D_t c; //c=a*b
    int i,j;
    for (i=0;i<4;i++) {
    c.v[i]=0;
        for (j=0;j<4;j++) c.v[i]+=a.m[i][j]*b.v[j];
    }
    return c;
}
/////////// matrix 3D translation ////////////
matrix3D_t translationMTX(float dx,float dy,float dz) {
    matrix3D_t trans=createIdentity();
    trans.m[0][3]=dx;
    trans.m[1][3]=dy;
    trans.m[2][3]=dz;
    return trans;
}

/////////// matrix 3D rotation X, Y, Z ////////////
matrix3D_t rotationXMTX(float theta) {
    matrix3D_t rotate=createIdentity();
    float cs=cos(theta);
    float sn=sin(theta);
    rotate.m[1][1]=cs; rotate.m[1][2]=-sn;
    rotate.m[2][1]=sn; rotate.m[2][2]=cs;
    return rotate;
}

matrix3D_t rotationYMTX(float theta) {
    matrix3D_t rotate=createIdentity();
    float cs=cos(theta);
    float sn=sin(theta);
    rotate.m[0][0]=cs; rotate.m[0][2]=sn;
    rotate.m[2][0]=-sn; rotate.m[2][2]=cs;
    return rotate;
}

matrix3D_t rotationZMTX(float theta) {
    matrix3D_t rotate=createIdentity();
    float cs=cos(theta);
    float sn=sin(theta);
```

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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```c
    rotate.m[0][0]=cs; rotate.m[0][1]=-sn;
    rotate.m[1][0]=sn; rotate.m[1][1]=cs;
    return rotate;
}

/////////// matrix 3D scaling ///////////
matrix3D_t scalingMTX(float factorx, float factory,float factorz) {
    matrix3D_t scale=createIdentity();
    scale.m[0][0]=factorx;
    scale.m[1][1]=factory;
    scale.m[2][2]=factorz;
    return scale;
    }

matrix3D_t perspectiveMTX(float eyelength) {
    matrix3D_t perspective=createIdentity();
    perspective.m[3][2]=-1./eyelength;
    return perspective;
}

/////////// Vector 2D and Vector 3D ///////////
point2D_t Vector2Point2D(vector3D_t vec) {
    point2D_t pnt;
    pnt.x=vec.v[0];
    pnt.y=vec.v[1];
    return pnt;
}

point3D_t Vector2Point3D(vector3D_t vec) {
    point3D_t pnt;
    pnt.x=vec.v[0];
    pnt.y=vec.v[1];
    pnt.z=vec.v[2];
    return pnt;
}
vector3D_t Point2Vector(point3D_t pnt) {
    vector3D_t vec;
    vec.v[0]=pnt.x;
    vec.v[1]=pnt.y;
    vec.v[2]=pnt.z;
    vec.v[3]=1.;
    return vec;
}
```

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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
vector3D_t homogenizeVector(vector3D_t vec) {
    int i;
    for (i=0;i<3;i++) {
        vec.v[i]/=vec.v[3];
        }
    vec.v[3]=1.;
    return vec;
    }


vector3D_t unitVector(vector3D_t vec) {
int i;
    float vec2=0.;
    float vec1,invvec1;
    for (i=0;i<3;i++) {
        vec2+=vec.v[i]*vec.v[i];
    }
    vec1=sqrt(vec2);
    if (vec1!=0.) {
        invvec1=1./vec1;
        for (i=0;i<3;i++) {
          vec.v[i]*=invvec1;
        }
    }
    vec.v[3]=1.;
    return vec;
    }


float operator * (vector3D_t a, vector3D_t b) {
    float c;//c=a*b
    int i;
    c=0;
    for (i=0;i<3;i++) {
        c+=a.v[i]*b.v[i];
    }
    return c;
}

// i j k
// a0 a1 a2
// b0 b1 b2
vector3D_t operator ^ (vector3D_t a, vector3D_t b) {
    vector3D_t c; //c=a*b
    c.v[0]=a.v[1]*b.v[2]-a.v[2]*b.v[1];
    c.v[1]=a.v[2]*b.v[0]-a.v[0]*b.v[2];
```

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```
        c.v[2]=a.v[0]*b.v[1]-a.v[1]*b.v[0];
        c.v[3]=1.;
        return c;
}

vector3D_t operator - (vector3D_t v1,vector3D_t v0) {
        vector3D_t c; //c=v1-v0
        c.v[0]=v1.v[0]-v0.v[0];
        c.v[1]=v1.v[1]-v0.v[1];
        c.v[2]=v1.v[2]-v0.v[2];
        c.v[3]=1.;
        return c;
}

vector3D_t operator - (vector3D_t v) {
        vector3D_t c; //c=-v
        c.v[0]=-v.v[0];
        c.v[1]=-v.v[1];
        c.v[2]=-v.v[2];
        c.v[3]=1.;
        return c;
}

vector3D_t operator * (float r, vector3D_t b) {
        vector3D_t c; //c=r*b
        int i;
        for (i=0;i<3;i++) {
            c.v[i]=r*b.v[i];
        }
        c.v[3]=1.;
        return c;
}

vector3D_t operator * (vector3D_t b, float r) {
vector3D_t c; //c=r*b
int i;
for (i=0;i<3;i++) {
c.v[i]=r*b.v[i];
        }
            c.v[3]=1.;
            return c;
            }
        float funcPositive(float x) {
            if (0.<x) return x;
```

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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
        else return 0.;
        }


// x to yth power
float power(float x,float y) {
        if (x==0.) return 0;
        return exp(y*log(x));
}
color_t operator + (color_t c1, color_t c2) {
        color_t col;
        col.r=c1.r+c2.r;
        col.g=c1.g+c2.g;
        col.b=c1.b+c2.b;
        return col;
}
color_t operator * (float r, color_t c) {
        color_t col;
        col.r=r*c.r;
        col.g=r*c.g;
        col.b=r*c.b;
        return col;
}
color_t operator * (color_t c, float r) {
        color_t col;
        col.r=r*c.r;
        col.g=r*c.g;
        col.b=r*c.b;
        return col;
}


//PhongModel color calculation
// LightVector, NormalVector, ViewVector, ColorofObject
color_t PhongModel(vector3D_t Light,vector3D_t Normal,vector3D_t View, color_t col)
{
float kspe=0.7; // specular reflection coefficient
float kdif=0.6; // diffuse reflection coefficient
float kamb=0.4; // ambient light coefficient
float tmp,NL,RV;
color_t ColWhite={0.8,0.8,0.8};
vector3D_t ReflectionVector=(2.*(Light*Normal)*
Normal)-Light;
tmp=Normal*Light;
NL=funcPositive(tmp);
tmp=ReflectionVector*View;
```

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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
RV=funcPositive(tmp);
return kdif*NL*col+kspe*power(RV,4)
*ColWhite+kamb*col;
}

////// End of matrices and vectors 3D ver 2 //////
////// OpenGL drawShape Functions ver 1 //////
void setColor(float red,float green,float blue) {
    glColor3f(red, green, blue);
    }

void setColor(color_t col) {
    glColor3f(col.r, col.g, col.b);
}

void drawDot(float x,float y) {
    glBegin(GL_POINTS);
    glVertex2f(x, y);
    glEnd();
}

void drawLine(float x1, float y1, float x2, float y2) {
    glBegin(GL_LINES);
    glVertex2f(x1, y1);
    glVertex2f(x2, y2);
    glEnd();
}

void drawLine(point2D_t p1,point2D_t p2) {
    drawLine(p1.x,p1.y,p2.x,p2.y);
}

//n: number of points
void drawPolyline(point2D_t pnt[],int n) {
    int i;
    glBegin(GL_LINE_STRIP);
    for (i=0;i<n;i++) {
    glVertex2f(pnt[i].x, pnt[i].y);
    }
    glEnd();
}

//n: number of vertices
void drawPolygon(point2D_t pnt[],int n) {
```

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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
  int i;
  glBegin(GL_LINE_LOOP);
  for (i=0;i<n;i++) {
   glVertex2f(pnt[i].x, pnt[i].y);
   }
  glEnd();
}


// The function fillPolygon can fills only convex polygons
//n: number of vertices
void fillPolygon(point2D_t pnt[],int n,color_t color) {
  int i;
  setColor(color);
  glBegin(GL_POLYGON);
  for (i=0;i<n;i++) {
    glVertex2f(pnt[i].x, pnt[i].y);
  }
  glEnd();
  }


// n: number of vertices
void gradatePolygon(point2D_t pnt[],int num,color_t col[]) {
    int i;
    glBegin(GL_POLYGON);
    for (i=0;i<num;i++) {
        setColor(col[i]);
        glVertex2f(pnt[i].x, pnt[i].y);
    }
    glEnd();
}


////// End of OpenGL drawShape Functions ver 1 //////
void userdraw(void);
void display(void) {
    glClear( GL_COLOR_BUFFER_BIT);
    userdraw();
    glutSwapBuffers();
}


//////////////////////////////////////////////////////
void drawcharX(float x,float y) {
    drawLine(x,y,x+10,y+12);drawLine(x,y+12,x+10,y);
}
```

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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
void drawcharY(float x,float y) {
    drawLine(x+5,y,x+5,y+7);drawLine(x,y+12,x+5,y+7);
    drawLine(x+10,y+12,x+5,y+7);
}

void drawcharZ(float x,float y) {
    drawLine(x,y+12,x+10,y+12);
    drawLine(x+10,y+12,x,y);drawLine(x,y,x+10,y);
}

void drawAxes(matrix3D_t view) {
    #define HALFAXIS 220
    #define HALFAXIS1 (HALFAXIS-10)
    point3D_t axes[14]={{-HALFAXIS,0,0},{HALFAXIS,0,0},
    {HALFAXIS1,5,0},{HALFAXIS1,0,0},
    {0,0,0},
    {0,-HALFAXIS,0},{0,HALFAXIS,0},
    {0,HALFAXIS1,5},{0,HALFAXIS1,0},
    {0,0,0},
    {0,0,-HALFAXIS},{0,0,HALFAXIS},
    {5,0,HALFAXIS1},{0,0,HALFAXIS1}};
    vector3D_t vec[14];
    point2D_t buff[14];
    int i;

    for (i=0;i<14;i++) {
        vec[i]=Point2Vector(axes[i]);
        vec[i]=view*vec[i];
        buff[i]=Vector2Point2D(vec[i]);
        }
    drawPolyline(buff,14);
    drawcharX(buff[1].x,buff[1].y);
    drawcharY(buff[6].x,buff[6].y);
    drawcharZ(buff[11].x-14,buff[11].y);
    }
////////////////// buat objek 3D //////////////////
typedef struct {
    int NumberofVertices; //in the face
    short int pnt[50];
    color_t col;
    }
    face_t;
    typedef struct {
        int NumberofVertices; //of the object,jumlah titik
```

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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
    point3D_t pnt[2096];
    color_t col[2096];
    int NumberofFaces; //of the object, jumlah faces
    face_t fc[1024];
    } object3D_t;
float zRata(object3D_t obyek,matrix3D_t mat){
float z=0;
vector3D_t vec;
for(int i=0;i<obyek.NumberofVertices;i++){
vec=Point2Vector(obyek.pnt[i]);
vec=mat*vec;
z=z+vec.v[2];
}
    z=z/obyek.NumberofVertices;
    return z;
    }


void draw3D(object3D_t obyek,matrix3D_t mat){
    vector3D_t vec[2096], vecbuff[180];
    vector3D_t vecNormal;
    point2D_t p[180];
    int i,j;
    for(i=0;i<obyek.NumberofVertices;i++){
    vec[i]=Point2Vector(obyek.pnt[i]);
    vec[i]=mat*vec[i];
    }
    setColor(1,0,0);
    for(i=0;i<obyek.NumberofFaces;i++){
        for(j=0;j<obyek.fc[i].NumberofVertices;j++)

        vecbuff[j]=vec[obyek.fc[i].pnt[j]];
        vecNormal=(vecbuff[1]-vecbuff[0])^
        (vecbuff[2]-vecbuff[0]);
        if(vecNormal.v[2]<0){
        for(j=0;j<obyek.fc[i].NumberofVertices;j++){
            p[j]=Vector2Point2D(vecbuff[j]);
            }
        drawPolygon(p,obyek.fc[i].NumberofVertices);
        }
    }
    setColor(1,1,1);
    for(i=0;i<obyek.NumberofFaces;i++){
        for(j=0;j<obyek.fc[i].NumberofVertices;j++)
        vecbuff[j]=vec[obyek.fc[i].pnt[j]];
```

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```
        vecNormal=(vecbuff[1]-vecbuff[0])^
        (vecbuff[2]-vecbuff[0]);
        if(vecNormal.v[2]>=0){
        for(j=0;j<obyek.fc[i].NumberofVertices;j++){
            p[j]=Vector2Point2D(vecbuff[j]);
            }
        drawPolygon(p,obyek.fc[i].NumberofVertices);
        }
    }
}

void draw3Dw(object3D_t obyek,matrix3D_t mat,color_t col){
    vector3D_t vec[2096], vecbuff[180];
    vector3D_t vecNormal;
    vector3D_t lightVector={0,0,1,1},
    viewVector={0,0,1,1};
    color_t colbuff;
    point2D_t p[180];
    int i,j;
    for(i=0;i<obyek.NumberofVertices;i++){
        vec[i]=Point2Vector(obyek.pnt[i]);
        vec[i]=mat*vec[i];
    }
    for(i=0;i<obyek.NumberofFaces;i++){
        for(j=0;j<obyek.fc[i].NumberofVertices;j++)vecbuff[j]=vec[obyek.fc[i].pnt[j]];
        vecNormal=(vecbuff[1]-vecbuff[0])^(vecbuff[2]-vecbuff[0]);
        if(vecNormal.v[2]<0){
            for(j=0;j<obyek.fc[i].NumberofVertices;j++){
                p[j]=Vector2Point2D(vecbuff[j]);
        }
    vecNormal=unitVector(vecNormal);
    colbuff=PhongModel(lightVector,vecNormal,viewVector,col);
    fillPolygon(p,obyek.fc[i].NumberofVertices,colbuff);
    }
}

for(i=0;i<obyek.NumberofFaces;i++){
    for(j=0;j<obyek.fc[i].NumberofVertices;j++)
    vecbuff[j]=vec[obyek.fc[i].pnt[j]];
    vecNormal=(vecbuff[1]-vecbuff[0])^
    (vecbuff[2]-vecbuff[0]);
    if(vecNormal.v[2]>=0){
    for(j=0;j<obyek.fc[i].NumberofVertices;j++){
        p[j]=Vector2Point2D(vecbuff[j]);
```

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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
        }
    vecNormal=unitVector(vecNormal);
    colbuff=PhongModel(lightVector,vecNormal,
    viewVector,col);
    fillPolygon(p,obyek.fc[i].NumberofVertices,colbuff);
    }
 }
}

void draw3Dc(object3D_t obyek,matrix3D_t mat){
    vector3D_t vec[2096], vecbuff[180];
    vector3D_t vecNormal;
    vector3D_t lightVector={0,0,1,1},
    viewVector={0,0,1,1};
    color_t colbuff;
    point2D_t p[180];
    int i,j;
    for(i=0;i<obyek.NumberofVertices;i++){
    vec[i]=Point2Vector(obyek.pnt[i]);
    vec[i]=mat*vec[i];
    }
    for(i=0;i<obyek.NumberofFaces;i++){
    for(j=0;j<obyek.fc[i].NumberofVertices;j++)
    vecbuff[j]=vec[obyek.fc[i].pnt[j]];
    vecNormal=(vecbuff[1]-vecbuff[0])^
    (vecbuff[2]-vecbuff[0]);
    if(vecNormal.v[2]<0){
    for(j=0;j<obyek.fc[i].NumberofVertices;j++){
    p[j]=Vector2Point2D(vecbuff[j]);
    }

    vecNormal=unitVector(vecNormal);
    colbuff=PhongModel(lightVector,vecNormal,
    viewVector,obyek.fc[i].col);
    fillPolygon(p,obyek.fc[i].NumberofVertices,colbuff);
    }
}

        for(i=0;i<obyek.NumberofFaces;i++){
        for(j=0;j<obyek.fc[i].NumberofVertices;j++)
        vecbuff[j]=vec[obyek.fc[i].pnt[j]];
        vecNormal=(vecbuff[1]-vecbuff[0])^
        (vecbuff[2]-vecbuff[0]);
        if(vecNormal.v[2]>=0){
```

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```
            for(j=0;j<obyek.fc[i].NumberofVertices;j++){
                    p[j]=Vector2Point2D(vecbuff[j]);
                }
            vecNormal=unitVector(vecNormal);
            colbuff=PhongModel(lightVector,vecNormal,
            viewVector,obyek.fc[i].col);
            fillPolygon(p,obyek.fc[i].NumberofVertices,colbuff);
            }
        }
    }


void draw3Dcg(object3D_t obyek,matrix3D_t mat){
    vector3D_t vec[2096], vecbuff[180];
    vector3D_t vecNormal;
    vector3D_t lightVector={0,0,1,1},
    viewVector={0,0,1,1};
    color_t colbuff[180];
    point2D_t p[180];
    int i,j;
    for(i=0;i<obyek.NumberofVertices;i++){
        vec[i]=Point2Vector(obyek.pnt[i]);
        vec[i]=mat*vec[i];
    }
    for(i=0;i<obyek.NumberofFaces;i++){
        for(j=0;j<obyek.fc[i].NumberofVertices;j++)
        vecbuff[j]=vec[obyek.fc[i].pnt[j]];
        vecNormal=(vecbuff[1]-vecbuff[0])^
        (vecbuff[2]-vecbuff[0]);
        if(vecNormal.v[2]<0){

        for(j=0;j<obyek.fc[i].NumberofVertices;j++){
            p[j]=Vector2Point2D(vecbuff[j]);
            vecNormal=unitVector(vecbuff[j]);
            colbuff[j]=PhongModel(lightVector, vecNormal,
            viewVector,
            obyek.col[obyek.fc[i].pnt[j]]);
                }
            gradatePolygon(p,obyek.fc[i].NumberofVertices,
            colbuff);
            }
        }
        for(i=0;i<obyek.NumberofFaces;i++){
        for(j=0;j<obyek.fc[i].NumberofVertices;j++)
        vecbuff[j]=vec[obyek.fc[i].pnt[j]];
```

FAKULTAS TEKNIK
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LAB. SHEET PRAKTIKUM GRAFIKA KOMPUTER 1

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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
                    vecNormal=(vecbuff[1]-vecbuff[0])^
                    (vecbuff[2]-vecbuff[0]);
                    if(vecNormal.v[2]>=0){
                    for(j=0;j<obyek.fc[i].NumberofVertices;j++){
                    p[j]=Vector2Point2D(vecbuff[j]);
                    vecNormal=unitVector(vecbuff[j]);
                    colbuff[j]=PhongModel(lightVector,vecNormal,
                    viewVector,
                    obyek.col[obyek.fc[i].pnt[j]]);
                    }
                gradatePolygon(p,obyek.fc[i].NumberofVertices,
                colbuff);
                }
        }
}


void makeCube(object3D_t &kubus, float x, float y, float z){
        object3D_t obyek={8,{{0,0,0},{x,0,0},{x,0,z},
        {0,0,z},{0,y,0},{x,y,0},{x,y,z},{0,y,z}},
        {{1,1,0},{1,1,0},{1,1,0},{1,1,0},
        {1,1,0},{1,1,0},{1,1,0}},6,
        {{4,{0,1,2,3},{1,1,0}},{4,{4,7,6,5},{1,1,0}},
        {4,{1,5,6,2},{1,1,0}},{4,{0,3,7,4},{1,1,0}},
        {4,{2,6,7,3},{1,1,0}},{4,{0,4,5,1},{1,1,0}}}};
        matrix3D_t mat=translationMTX(-x/2,-y/2,-z/2);
        vector3D_t vec;
        kubus=obyek;

        for(int i=0;i<kubus.NumberofVertices;i++){
            vec=Point2Vector(kubus.pnt[i]);
            vec=mat*vec;
            kubus.pnt[i]=Vector2Point3D(vec);
        }
}

void makeCylinder(object3D_t &silinder, int n,float r, float h){
  float a=6.28/n;
  int i;
  for(i=0;i<n;i++){
        silinder.pnt[i].x=r*cos(i*a);
        silinder.pnt[i].y=0;
        silinder.pnt[i].z=r*sin(i*a);
        silinder.pnt[n+i].x=r*cos(i*a);
        silinder.pnt[n+i].y=h;
```

FAKULTAS TEKNIK

UNIVERSITAS NEGERI YOGYAKARTA

	LAB. SHEET PRAKTIKUM GRAFIKA KOMPUTER 1			
No. : ST/EKA/PTI223/10	Revisi : 00	Senin 010509	Hal. 15 dari 23 hal.	
Sem.:Genap	**Studi kasus Program**		4 x 50 menit	

```
            silinder.pnt[n+i].z=r*sin(i*a);
        }
    silinder.NumberofVertices=2*n;
    for(i=0;i<n;i++){
    silinder.fc[i].NumberofVertices=4;
    silinder.fc[i].pnt[0]=i;
    silinder.fc[i].pnt[1]=n+i;
    silinder.fc[i].pnt[2]=n+i+1;
    silinder.fc[i].pnt[3]=i+1;
    if(i==(n-1)){
    silinder.fc[i].pnt[2]=n;
    silinder.fc[i].pnt[3]=0;
    }
}

silinder.fc[n].NumberofVertices=n;
for(i=0;i<n;i++) silinder.fc[n].pnt[i]=i;
silinder.fc[n+1].NumberofVertices=n;
for(i=0;i<n;i++) silinder.fc[n+1].pnt[i]=2*n-1-i;
silinder.NumberofFaces=n+2;
color_t c={1,1,0};
for(i=0;i<silinder.NumberofFaces;i++)
silinder.fc[i].col=c;
for(i=0;i<silinder.NumberofVertices;i++)
silinder.col[i]=c;
}

void make1per2Cylinder(object3D_t &silinder, int n,float r, float h){
    float a=3.14/n;
    int i;
    for(i=0;i<n;i++){
        silinder.pnt[i].x=r*cos(i*a);
        silinder.pnt[i].y=0;
        silinder.pnt[i].z=r*sin(i*a);
        silinder.pnt[n+i].x=r*cos(i*a);
        silinder.pnt[n+i].y=h;
        silinder.pnt[n+i].z=r*sin(i*a);
        }
    silinder.NumberofVertices=2*n;
    for(i=0;i<n;i++){
    silinder.fc[i].NumberofVertices=4;
    silinder.fc[i].pnt[0]=i;
    silinder.fc[i].pnt[1]=n+i;
    silinder.fc[i].pnt[2]=n+i+1;
```

FAKULTAS TEKNIK
UNIVERSITAS NEGERI YOGYAKARTA

LAB. SHEET PRAKTIKUM GRAFIKA KOMPUTER 1

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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
        silinder.fc[i].pnt[3]=i+1;
        if(i==(n-1)){
        silinder.fc[i].pnt[2]=n;
        silinder.fc[i].pnt[3]=0;
        }
}
silinder.fc[n].NumberofVertices=n;
for(i=0;i<n;i++) silinder.fc[n].pnt[i]=i;
silinder.fc[n+1].NumberofVertices=n;
for(i=0;i<n;i++) silinder.fc[n+1].pnt[i]=2*n-1-i;
silinder.NumberofFaces=n+2;
color_t c={1,1,0};
for(i=0;i<silinder.NumberofFaces;i++)
silinder.fc[i].col=c;
for(i=0;i<silinder.NumberofVertices;i++)
silinder.col[i]=c;
}

void makeCylinderN(object3D_t &silinder,int m,int n,float r[],float h[],int sw){
    float a=6.26/n;
    float b=0;
    int i,j;
    silinder.NumberofVertices=(m+1)*n;
    for(i=0;i<=m;i++){
    if(i>0) b=b+h[i-1];
    for(j=0;j<n;j++){
    silinder.pnt[i*n+j].x=r[i]*cos(j*a);
    silinder.pnt[i*n+j].y=b;
    silinder.pnt[i*n+j].z=r[i]*sin(j*a);
    }
}
    silinder.NumberofFaces=m*n+2;
    for(i=0;i<m;i++){
        for(j=0;j<n;j++){
            silinder.fc[i*n+j].NumberofVertices=4;
            silinder.fc[i*n+j].pnt[0]=i*n+j;
            silinder.fc[i*n+j].pnt[1]=(i+1)*n+j;
            silinder.fc[i*n+j].pnt[2]=(i+1)*n+j+1;
            silinder.fc[i*n+j].pnt[3]=i*n+j+1;
            if(j==(n-1)){
            silinder.fc[i*n+j].pnt[2]=i*n+j+1;
            silinder.fc[i*n+j].pnt[3]=(i-1)*n+j+1;
            }
        }
```

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LAB. SHEET PRAKTIKUM GRAFIKA KOMPUTER 1

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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
        }
if(sw==0 || sw==1){
        silinder.fc[m*n].NumberofVertices=n;
        for(i=0;i<n;i++) silinder.fc[m*n].pnt[i]=i;
        }
if(sw==0 || sw==2){
        silinder.fc[m*n+1].NumberofVertices=n;
        for(i=0;i<n;i++)
        silinder.fc[m*n+1].pnt[i]=(m+1)*n-1-i;
        }
        color_t c={1,1,0};
        for(i=0;i<silinder.NumberofFaces;i++)
        silinder.fc[i].col=c;
        for(i=0;i<silinder.NumberofVertices;i++)
        silinder.col[i]=c;
}

static void makeCylinderN2(object3D_t &silinder,
int m,int n,float r[],float h[],
float sbx[], float sbz[]){
float a=6.28/n;
int i,j;
silinder.NumberofVertices=m*n;
for(i=0;i<m;i++){
        for(j=0;j<n;j++){
                silinder.pnt[i*n+j].x=r[i]*(float)cos(j*a)+sbx[i];
                silinder.pnt[i*n+j].z=r[i]*(float)sin(j*a)+sbz[i];
                silinder.pnt[i*n+j].y=h[i];
                }
        }
silinder.NumberofFaces=(m-1)*n;
for(i=0;i<m-1;i++){
        for(j=0;j<n-1;j++){
                silinder.fc[i*n+j].NumberofVertices=4;
                silinder.fc[i*n+j].pnt[0]=i*n+j;
                silinder.fc[i*n+j].pnt[1]=(i+1)*n+j;
                silinder.fc[i*n+j].pnt[2]=(i+1)*n+j+1;
                silinder.fc[i*n+j].pnt[3]=i*n+j+1;
                }
        silinder.fc[(i+1)*n-1].NumberofVertices=4;
        silinder.fc[(i+1)*n-1].pnt[0]=(i+1)*n-1;
        silinder.fc[(i+1)*n-1].pnt[1]=(i+2)*n-1;
        silinder.fc[(i+1)*n-1].pnt[2]=(i+1)*n;
        silinder.fc[(i+1)*n-1].pnt[3]=i*n;
```

FAKULTAS TEKNIK
UNIVERSITAS NEGERI YOGYAKARTA

LAB. SHEET PRAKTIKUM GRAFIKA KOMPUTER 1			
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Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
        }
}

static void makeBall(object3D_t &sphere,int n,float r){
float a=6.28/n;
float b=6.28/n;
int i,j;
sphere.NumberofVertices=(n+1)*n;
for(i=0;i<=n;i++){
     for(j=0;j<n;j++){
     sphere.pnt[i*n+j].x=r*cos(j*a)*sin(i*b);
     sphere.pnt[i*n+j].y=r*cos(i*b);
     sphere.pnt[i*n+j].z=r*sin(j*a)*sin(i*b);
     }
}

sphere.NumberofFaces=n*n+2;
for(i=0;i<n;i++){
     for(j=0;j<n;j++){
          sphere.fc[i*n+j].NumberofVertices=4;
          sphere.fc[i*n+j].pnt[0]=i*n+j;
          sphere.fc[i*n+j].pnt[1]=(i+1)*n+j;
          sphere.fc[i*n+j].pnt[2]=(i+1)*n+j+1;
          sphere.fc[i*n+j].pnt[3]=i*n+j+1;
          if(j==(n-1)){
          sphere.fc[i*n+j].pnt[2]=i*n+j+1;
          sphere.fc[i*n+j].pnt[3]=(i-1)*n+j+1;
          }
     }
}
sphere.fc[n*n].NumberofVertices=n;
for(i=0;i<n;i++) sphere.fc[n*n].pnt[i]=i;
sphere.fc[n*n+1].NumberofVertices=n;
for(i=0;i<n;i++) sphere.fc[n*n+1].pnt[i]=(n+1)*n-1-i;
color_t c={1,1,0};
for(i=0;i<sphere.NumberofFaces;i++)
sphere.fc[i].col=c;
for(i=0;i<sphere.NumberofVertices;i++)
sphere.col[i]=c;
}
point3D_t interpolate(point3D_t p1,point3D_t p2,float a){
     point3D_t p;
     p.x=(1-a)*p1.x+a*p2.x;
     p.y=(1-a)*p1.y+a*p2.y;
```

	FAKULTAS TEKNIK		
	UNIVERSITAS NEGERI YOGYAKARTA		
	LAB. SHEET PRAKTIKUM GRAFIKA KOMPUTER 1		
No. : ST/EKA/PTI223/10	Revisi : 00	Senin 010509	Hal. 19 dari 23 hal.
Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
        p.z=(1-a)*p1.z+a*p2.z;
        return p;
        }


void userdraw(void) {
static int tick=0;
float theta=tick*3.1419/180;
matrix3D_t tilting=translationMTX(0,50,0)*
rotationXMTX(0.5)*
rotationYMTX(-2.5);
point2D_t p[4]={{-600,-450},{600,-450},
{600,450},{-600,450}};
color_t w[4]={ {(float)110/255,(float)110/255,
(float)110/255},{(float)110/255,
(float)110/255,(float)110/255},
{(float)162/255,(float)163/255,
(float)149/255},{(float)162/255,
(float)163/255,(float)149/255}};
color_t warna = {(float)0/255,(float)100/255,
(float)100/255};
gradatePolygon(p,4,w);
static object3D_t objek[obj];
static matrix3D_t mat[obj];
//kepala
makeBall(objek[16],31,50);
mat[16] = tilting*translationMTX(0,195,0);
//badan
makeCube(objek[15],160,220,70);
mat[15] = tilting*translationMTX(0,45,0);
/////////// tangan ///////////
//tangan kanan
//sendi atas kanan
makeBall(objek[19], 31, 30);
mat[19] = tilting*translationMTX(110,130,0)*
rotationXMTX(0)*rotationXMTX(theta);
//lengan atas kanan
makeCylinder(objek[20], 31, 25, -75);
mat[20] = tilting*translationMTX(110,120,0)*
rotationXMTX(0)*rotationXMTX(theta);
//siku kanan
makeBall(objek[18], 31, 25);
mat[18] = tilting*translationMTX(110,120,0)*
rotationXMTX(0)*rotationXMTX(theta)*
translationMTX(0,-75,0);
```

![logo]	**FAKULTAS TEKNIK**			
	UNIVERSITAS NEGERI YOGYAKARTA			
	LAB. SHEET PRAKTIKUM GRAFIKA KOMPUTER 1			
	No. : ST/EKA/PTI223/10	Revisi : 00	Senin 010509	Hal. 20 dari 23 hal.
	Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
//lengan bawah kanan
makeCylinder(objek[21], 31, 20, -75);
mat[21] = tilting*translationMTX(110,120,0)*
rotationXMTX(0.25)*rotationXMTX(theta)*
translationMTX(0,-75,20);
//telapak tangan kanan
makeBall(objek[17], 31, 20);
mat[17] = tilting*translationMTX(110,120,0)*
rotationXMTX(0)*rotationXMTX(theta)*
translationMTX(0,-150,-20);
//tangan kiri
//sendi atas kiri
makeBall(objek[0], 31, 30);
mat[0] = tilting*translationMTX(-110,130,0)*
rotationXMTX(0)*rotationXMTX(-theta);
//lengan atas kiri
makeCylinder(objek[1], 31, 25, -75);
mat[1] = tilting*translationMTX(-110,120,0)*
rotationXMTX(0)*rotationXMTX(-theta);
//siku kiri
makeBall(objek[2], 31, 25);
mat[2] = tilting*translationMTX(-110,120,0)*
rotationXMTX(0)*rotationXMTX(-theta)*
translationMTX(0,-75,0);
//lengan bawah kiri
makeCylinder(objek[3], 31, 20, -75);
mat[3] = tilting*translationMTX(-110,120,0)*
rotationXMTX(0.25)*rotationXMTX(-theta)*
translationMTX(0,-75,20);
//telapak tangan kiri
makeBall(objek[4], 31, 20);
mat[4] = tilting*translationMTX(-110,120,0)*
rotationXMTX(0)*rotationXMTX(-theta)*
translationMTX(0,-150,-20);


/////////// kaki ///////////
//kaki kanan
//sendi atas kaki kanan
makeBall(objek[10], 31, 35);
mat[10] = tilting*translationMTX(45,-80,0)*
rotationXMTX(-theta/2);
//paha kanan
makeCylinder(objek[11], 31, 30, -100);
```

FAKULTAS TEKNIK
UNIVERSITAS NEGERI YOGYAKARTA

LAB. SHEET PRAKTIKUM GRAFIKA KOMPUTER 1			
No. : ST/EKA/PTI223/10	Revisi : 00	Senin 010509	Hal. 21 dari 23 hal.
Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```
mat[11] = tilting*translationMTX(45,-80,0)*
rotationXMTX(0)*rotationXMTX(-theta/2);
//lutut kanan
makeBall(objek[12], 31, 30);
mat[12] = tilting*translationMTX(45,-80,0)*
rotationXMTX(-theta/2)*
translationMTX(0,-100,0);
//betis kanan
makeCylinder(objek[13], 31, 25, -100);
mat[13] = tilting*translationMTX(45,-80,0)*
rotationXMTX(0)*rotationXMTX(-theta/2)*
translationMTX(0,-100,0);
//alas kaki kanan
makeCube(objek[14],60,20,100);
mat[14] = tilting*translationMTX(45,-80,0)*
rotationXMTX(-theta/2)*
translationMTX(0,-200,-20);
//kaki kiri
//sendi atas kaki kiri
makeBall(objek[5], 31, 35);
mat[5] = tilting*translationMTX(-45,-80,0)*
rotationXMTX(theta/2);
//paha kiri
makeCylinder(objek[6], 31, 30, -100);
mat[6] = tilting*translationMTX(-45,-80,0)*
rotationXMTX(0)*rotationXMTX(theta/2);
//lutut kiri
makeBall(objek[7], 31, 30);
mat[7] = tilting*translationMTX(-45,-80,0)*
rotationXMTX(theta/2)*
translationMTX(0,-100,0);

//betis kiri
makeCylinder(objek[8], 31, 25, -100);
mat[8] = tilting*translationMTX(-45,-80,0)*
rotationXMTX(0)*rotationXMTX(theta/2)*
translationMTX(0,-100,0);
//alas kaki kiri
makeCube(objek[9],60,20,100);
mat[9] = tilting*translationMTX(-45,-80,0)*
rotationXMTX(theta/2)*
translationMTX(0,-200,-20);
//Z Order
int objke = obj;
```

FAKULTAS TEKNIK
UNIVERSITAS NEGERI YOGYAKARTA

LAB. SHEET PRAKTIKUM GRAFIKA KOMPUTER 1			
No. : ST/EKA/PTI223/10	Revisi : 00	Senin 010509	Hal. 22 dari 23 hal.
Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```c
int n = objke-1;
float z[obj];
int i,j;
for(i=0;i<objke;i++)
z[i]=zRata(objek[i],mat[i]);

// sorting by z
//objek 0 - 9
float ztemp;
object3D_t temp;
matrix3D_t matTemp;
color_t colTemp;
for(i=0;i<n;i++) {
    for(j=0;j<n;j++) {
        if(z[j]>z[j+1]) {
            ztemp=z[j];
            z[j]=z[j+1];
            z[j+1]=ztemp;
            temp=objek[j];
            objek[j]=objek[j+1];
            objek[j+1]=temp;
            matTemp=mat[j];
            mat[j]=mat[j+1];
            mat[j+1]=matTemp;
            }
        }
    }
for(i=0;i<objke;i++) {
    draw3Dw(objek[i],mat[i],warna);
    draw3D(objek[i],mat[i]);
    }

if(fabs(tick) >= 60) {
    if(tick >= 60) tick = 60;
    if(tick <= -60) tick = -60;
    tempStat = false;
    stat = false;
    move = -move;
    }
else if(fabs(theta) < 1 && fabs(theta) > 0)
    stat = tempStat;
    tick += move;
    printf(" %d\n",tick);
    printf(" %d\n",theta);
```

FAKULTAS TEKNIK
UNIVERSITAS NEGERI YOGYAKARTA

LAB. SHEET PRAKTIKUM GRAFIKA KOMPUTER 1

No. : ST/EKA/PTI223/10	Revisi : 00	Senin 010509	Hal. 23 dari 23 hal.
Sem.:Genap	**Studi kasus Program**		4 x 50 menit

```c
        if(tick == 0 && stat == false) move = 0;
}

void keyboard (unsigned char key, int x, int y) {
switch (key) {
    case 'm':
        printf("Button M Presed\n");
        move = 5;
        tempStat = true;
        break;
    case 'b':
        printf("Button B Presed\n");
        move = -5;
        tempStat = true;
        break;
    default:
    break;
    }
}

int main(int argc, char **argv) {
    glutInit(&argc,argv);
    glutInitDisplayMode ( GLUT_DOUBLE | GLUT_RGB );
    glutInitWindowPosition(150,20);
    glutInitWindowSize(1000,700);
    glutCreateWindow ("Model Robot 3D dengan menggunakan OpenGL");
    glClearColor(0.0, 0.0, 0.0, 0.0);
    gluOrtho2D(-500., 500., -350.0, 350.0);
    glutIdleFunc(display);                  // idle event call back
    glutKeyboardFunc(keyboard);
    glutDisplayFunc(display);
    glutMainLoop();
    return 0;
}
```

Tugas
1. Cobalah program diatas
2. Lakukan perubahan sintak atau nilai yang ada dalam program diatas
3. Masukan hasil pengamatan dan masukan hasilnya yang disertai gambar hasil compile dalam tabel pengamatan yang disesuaikan dengan pengamatan anda.
4. Berilah bayangan gambar hasil program tersebut diatas

**Minggu depan Ujian Praktikum Semester
dan sekaligus pemberian project akhir**