Features

Other than the required features such as reflection and shadow, I designed 4 other features shown below:

1. Handling non-trivial component: cylinders could be displayed. This is done using similar methods done in part A. First the intersection with the lid and bottom are considered, and then consider the sides of the cylinder.
2. Anti-aliasing: Anti-aliasing was done by computing average color for nearby pixels rather than focus on the color at the center point. The specific algorithm come from the textbook and can be reviewed here:

```
For each pixel (i, j) do
    c= 0;
    for(p = 0->n-1)
        for(q = 0->n-1)
            Do c = c+ray-color(i+(p+0.5)/n, j+(q+0.5)/n)

    Cij = c/n^2;
```

3. Refraction: Refraction was done using the algorithm provided in the textbook in pg305. I also did some other researches online which includes Introduction to Shading.
4. Soft shadow using extended light sources. Using random parallel light sources instead of a single point light source(which does not exist) is one of the main component of creating soft shadows. The algorithm used can also be found in the textbook.

```
For each pixel(i, j) do
    C = 0;
    Generate N = n^2 jittered 2D points and store in array r[];
    Generate N = n^2 jittered 2D points and store in array s[];
    Shuffle points in array[s];
    For p = 0 ->N-1 do
        C= c+ ray_color(i+r[p]x().j + r[p].y,s[p])
    Cij = c/N
```

There are 4 degrees of freedom:

1) Whether show the shadow;
2) How deep does the refraction need reflection need to go
3) For the glossy reflection how blurr the result needs to be
4) How far or whether to anti-aliasing

There are 7 sets of bmp pictures, each set consists of 2 pictures from different viewing angles showing the exact same objects (the two objects from part A and another cylinder) with different effects. They are in folder graphs.

External resources::

1) Fundamentals of Computer Graphics 3rd edition P.Shirley.

2) Introduction to Shading, https://www.scratchapixel.com/lessons/3d-basic-rendering/introduction-to-shading/reflection-refraction-fresnel