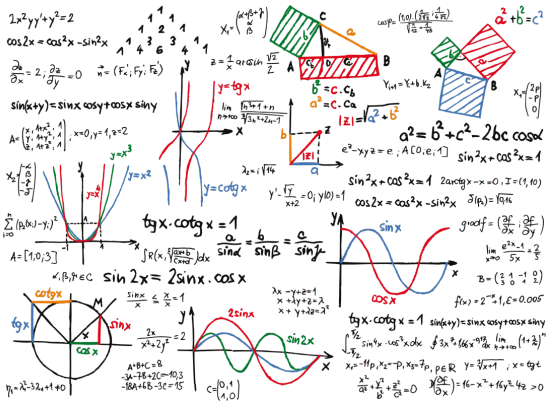
B1 - Mathematics

B-MAT-100

104intersection

Third dimension and quadratic equations



2.0

104intersection

binary name:	104intersection
repository name:	104intersection_*$ACADEMIC_YEAR*
repository rights:	ramassage-tek
language:	C, C++, pyhton3, perl, ruby, php or bash
compilation:	when necessary, via Makefile, including re, clean and fclean rules

- Your repository must contain the totality of your source files, but no useless files (binary, temp files, obj files,...).
- All the bonus files (including a potential specific Makefile) should be in a directory named *bonus*.
- Error messages have to be written on the error output, and the program should then exit with the 84 error code (0 if there is no error).

To create synthesis images (when doing ray tracing, for example), potential intersection points between light rays and scene objects (here cylinders, spheres and cones) must be computed. This is exactly what you have to do in this project.

To do so, you need to write a 3 dimensional equation of the considered surface, and inject into it the equation of the straight line representing the light ray. You'll get a quadratic equation, with 0, 1, 2 or an infinite number of solutions that will give you the intersection points coordinates.

The straight line is defined by the coordinates of a point by which it passes through and the coordinates of a parallel vector.

O being the origin of the coordinate system, and X, Y and Z the axis, the surfaces that must be handled in this project are:

- O-centered spheres,
- Cylinders of revolution around Z axis,
- Cones of revolution around Z axis which apex is O.

USAGE

Terminal

```
~/B-MAT-100> ./104intersection -h
USAGE
    ./104intersection opt xp yp zp xv yv zv p

DESCRIPTION
    opt             surface option: 1 for a sphere, 2 for a cylinder, 3 for a cone
    (xp, yp, zp)    coordinates of a point by which the light ray passes through
    (xv, yv, zv)    coordinates of a vector parallel to the light ray
    p               parameter: radius of the sphere, radius of the cylinder, or
                    angle formed by the cone and the Z-axis
```

SUGGESTED BONUSES

- Adding other surfaces,
- Managing several simultaneous surfaces.

EXAMPLES

Terminal

```
~/B-MAT-100> ./104intersection 1 0 0 2 1 1 0 1
Sphere of radius 1
Line passing through the point (0, 0, 2) and parallel to the vector (1, 1, 0)
No intersection point.
```

Terminal

```
~/B-MAT-100> ./104intersection 1 4 0 3 0 0 -2 4
Sphere of radius 4
Line passing through the point (4, 0, 3) and parallel to the vector (0, 0, -2)
1 intersection point:
(4.000, 0.000, 0.000)
```

Terminal

```
~/B-MAT-100> ./104intersection 2 0 0 2 1 1 0 1
Cylinder of radius 1
Line passing through the point (0, 0, 2) and parallel to the vector (1, 1, 0)
2 intersection points:
(0.707, 0.707, 2.000)
(-0.707, -0.707, 2.000)
```

Terminal

```
~/B-MAT-100> ./104intersection 3 -1 -1 -1 1 1 5 30
Cone with a 30 degree angle
Line passing through the point (-1, -1, -1) and parallel to the vector (1, 1, 5)
2 intersection points:
(-1.568, -1.568, -3.842)
(-0.537, -0.537, 1.315)
```

Terminal

```
~/B-MAT-100> ./104intersection 2 1 0 0 0 0 1 1
Cylinder of radius 1
Line passing through the point (1, 0, 0) and parallel to the vector (0, 0, 1)
There is an infinite number of intersection points.
```