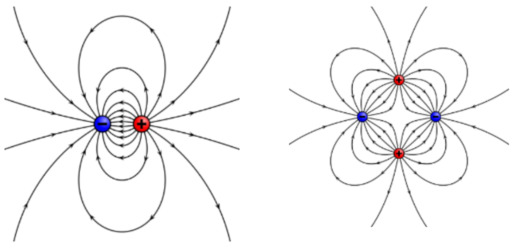
Computer Work for Unit 13 dipole and quadrupole

[Vpython]: In some cases, we need to read the click position of the mouse in the running window. Here is the program. This can be done by the code from #1 to #2, very similar to the interrupt callback used in CW12 last semester. Code other than this part is for the preparation of the homework.

```
from visual import *

k = 8.99*10**9                    # Nm**2/C**2
L, size = 1.0, 0.1                # pole-length, charge size
polecharge, poleposition, polecolor = [1E-5, -1E-5], [vector(L, 0, 0), (-L, 0, 0)], [(1, 0, 0), (0, 0, 1)]
ball_m, ball_q = 1E-6, 1E-12  #kg(mass of ball), C(charge of ball)

scene = display(title='dipole', height=500, width=500, range=3.5, auto_scale=False, background=(0.5,0.5,0))
pole_set = [sphere(pos=p, radius=size, color= cc, q = charge) for (charge, p, cc) in zip(polecharge, poleposition, polecolor)]
ball = []
label(text='Left click to place balls.', pos=(0,0.5,0), opacity=0.2)

def Force_E(r, q):
   return vector(0, 0, 0)

#1
def makeSphere(evt):
   loc = evt.pos
   print "click at ", loc
   ball.append(sphere(pos=loc, radius=0.05, color=(1,0,1), make_trail=True, v=vector(0,0,0), a=vector(0,0,0), q=ball_q))

scene.bind('mousedown', makeSphere, scene)
#2

dt = 0.001
while 1:
   rate(3000)
```



In the figures you see the electric field lines generated by an electric dipole and an electric quadrupole, respectively. But they are displayed in two dimensions, making them difficult to be comprehended in three dimensions. This homework is to make 3 dimensional field lines of any distributions of charges.

Practice:

1. In the given code, an electric dipole made of charges 1×10^{-5} C at (1m,0,0) and -1×10^{-5} C at (-1m, 0,0) are shown and fixed in positions. When you click the mouse left button, a pink ball is placed on the location where you clicked. The ball of mass 1E-6 kg carries charge 1×10^{-12} C is initially at rest. Now complete the function Force_E(r,q) and write codes in makeSphere(evt) that will print the electric force (which is a vector) caused by the dipole. In this program, you can click as many times at different locations.

2. The ball you created in the virtual world will be accelerated by the electric force exerted by the dipole. Now complete the code that the ball will move and leave a trail of the trajectory.

Homework Submission: (practice 2 + below)

Instead of moving the position of the ball by the velocity, which is the time accumulation of the acceleration, move the position of the ball directly by the acceleration (that is, pos += acceleration*dt). Then the trail left behind is the electric field line. Let the starting point to be very close to the positive charge at (1, 0, 0) and eventually the ball will end at the negative charge at (-1, 0, 0). This way, if you have enough balls at suitable distribution around the positive charge, you can complete the electric field lines in 3 dimensions for the electric dipole. You may do the same to get the electric field lines for quadrupoles or any other charge distributions.