In [1]:

```
'''
Patrick Ballou
ID: 801130521
ECGR 4105
Homework 0
Problem 2
'''
```

Out[1]:

```
'\nPatrick Ballou\nID: 801130521\nECGR 4105\nHomework 0\nProblem 2\n'
```

In [2]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

In [3]:

```
#create pandas dataframe and split into inputs(x) and output(y)
df = pd.read_csv("D3.csv")
x = df.values[:,0:3]
y = df.values[:,3]
m = len(x)
```

In [4]:

```
#create x_0 2d array of ones with length m
x_0 = np.ones((m,1))
#prepare x so it can be concatenated with x_0
x = x.reshape(m,3)
#concatenate x_0 with x
X = np.hstack((x_0, x))
```

In [5]:

```
#loss function
def compute_cost(X, y, theta):
    predictions = X.dot(theta)
    errors = np.subtract(predictions, y)
    sqrErrors = np.square(errors)
    J = (1/(2*m))*np.sum(sqrErrors)

    return J
```

In [6]:

```
#gradient descent function
def gradient_descent(X, y, theta, alpha, iterations):
    cost_history = np.zeros(iterations)

    for i in range(iterations):
        predictions = X.dot(theta)
        errors = np.subtract(predictions, y)
        sum_delta = (alpha/m) * X.transpose().dot(errors)
        theta -= sum_delta
        cost_history[i] = compute_cost(X, y, theta)

    return theta, cost_history
```

In [7]:

```
#initialize theta, # of iterations, and learning rate
theta = np.zeros(4)
iterations = 50000
alpha = .01
```

In [8]:

```
#calculate cost for and output last value which should be the lowest
```

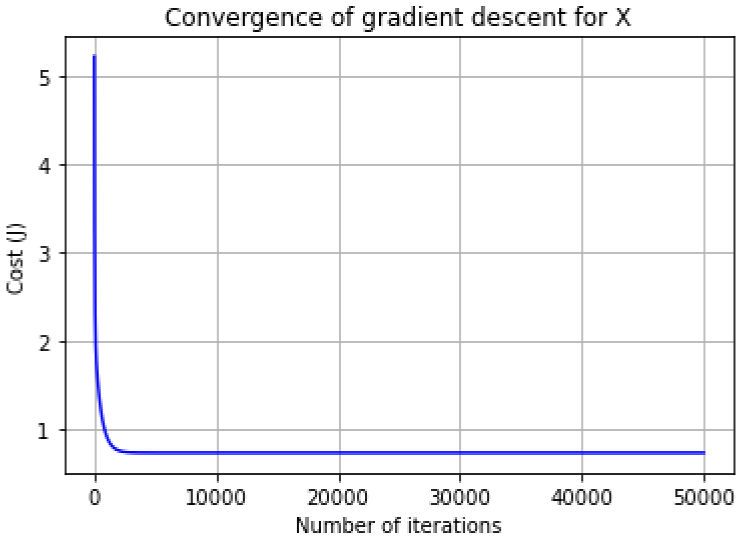
```
theta, cost_history = gradient_descent(X, y, theta, alpha, iterations)
print("Final theta values:", theta)
```

```
Final theta values: [ 5.31416717 -2.00371927  0.53256334 -0.26560187]
```

In [9]:

```
#plot loss vs iterations
plt.plot(range(1, iterations + 1), cost_history, color='blue')
plt.rcParams["figure.figsize"] = (10,6)
plt.grid()
plt.xlabel('Number of iterations')
plt.ylabel('Cost (J)')
plt.title('Convergence of gradient descent for X')
print("Cost:", cost_history[-1])
```

```
Cost: 0.738464241568294
```



In [10]:

```
#predict new values
new_x = np.array([[1,1,1,1],[1,2,0,4],[1,3,2,1]])
unseen_y = new_x.dot(theta)
print(unseen_y)
```

```
[3.57740937 0.24432117 0.10253417]
```