A0

October 25, 2020

1 Elec 405 Assignment 0 - Julia Code

[1]:
```
using LinearAlgebra
```

1.1 Question 1

Trials using C matrix.

[11]:
```
C = [0 1 0 1 0; 0 0 1 0 1; 1 0 0 0 0; 0 0 1 0 0; 1 0 0 1 1]
C^3
```

[11]:
```
5×5 Array{Int64,2}:
 3  0  0  1  1
 1  2  1  3  1
 0  0  2  0  1
 0  1  0  1  0
 2  1  3  2  2
```

[12]:
```
C^5
```

[12]:
```
5×5 Array{Int64,2}:
 2  1  7  2  4
 8  2  3  5  4
 1  3  1  4  1
 3  0  0  1  1
 6  5  6  8  5
```

1.2 Question 3

[2]:
```
using Plots
```

[3]:
```
function draw_hyperplane_2D(a, b)
    pyplot()
    x=range(-3, stop=3, length=100)
    g(x) = (dot(a, b) - a[1]*x)/a[2]
    p= plot(x, g,
        title="2d hyperplane",
```

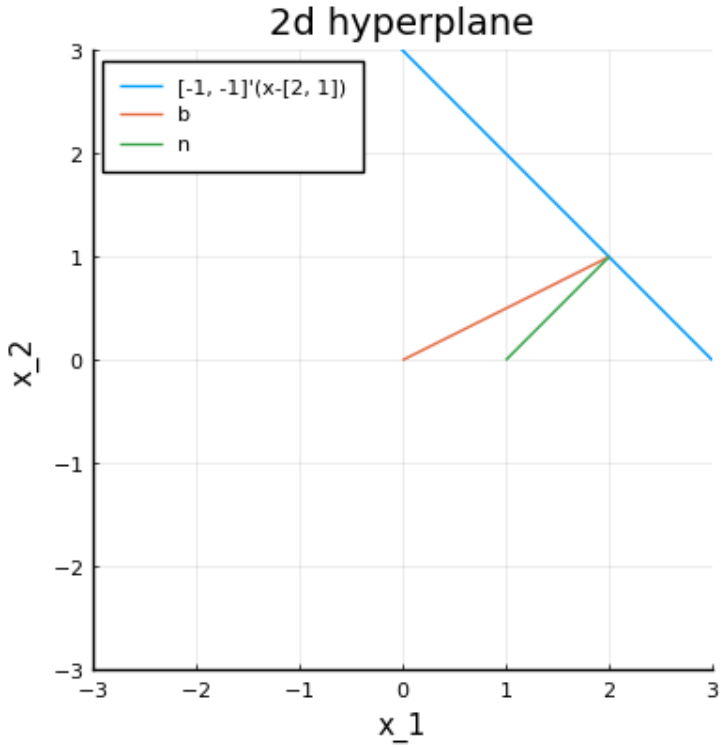
```
        label="$(a)'(x-$(b))",
        xlabel="x_1", ylabel="x_2",
        xlims=(-3, 3), ylims=(-3, 3),
        aspect_ratio=1)
    b_x1 = range(0, stop=b[1], length=100)
    b_x2 = range(0, stop=b[2], length=100)
    plot!(b_x1, b_x2, label="b")
    a_x1 = range(b[1], stop=a[1]+b[1], length=100)
    a_x2 = range(b[2], stop=a[2]+b[2], length=100)
    plot!(a_x1, a_x2, label="n")
    ylabel!(p, "x_2", label_position="left")
end
```

[3]: draw_hyperplane_2D (generic function with 1 method)

1.2.1 Homework example

[4]:
```
a = [-1; -1]
b = [2; 1]
draw_hyperplane_2D(a, b)
```

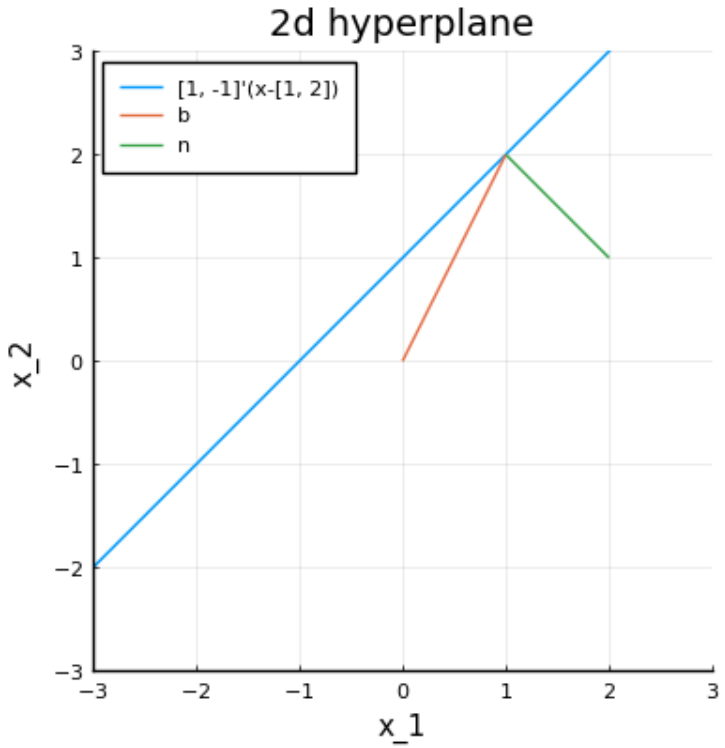
[4]:



1.2.2 Homework asked

[5]:
```
a = [1; -1]
b = [1; 2]
draw_hyperplane_2D(a, b)
```

[5]:



1.3 Question 4 *Hyperplane in 3D World*

[6]:
```
function draw_hyperplane_3D(a, b, camera=(60, 45))
    pyplot()
    x=range(-2, stop=2, length=100)
    y=range(-2, stop=2, length=100)
    g(x, y) = (dot(a, b) - dot(a[1: 2], [x; y]))/a[3]
    p= plot(x, y, g,
        title="Hyperplane in 3D",
        label="$(a)'(x-$(b))=0",
        xlabel="x_1", ylabel="x_2", zlabel="x_3",
        xlims= (-2, 2), ylims=(-2, 2), zlims=(-2, 2),
        st=:surface, camera=camera)

    # plot the normal vector, since b is on the plane plot the vector b to b+a
    a_x1 = range(b[1], stop=(b[1]+a[1]), length=100)
    a_x2 = range(b[2], stop=(b[2]+a[2]), length=100)
```

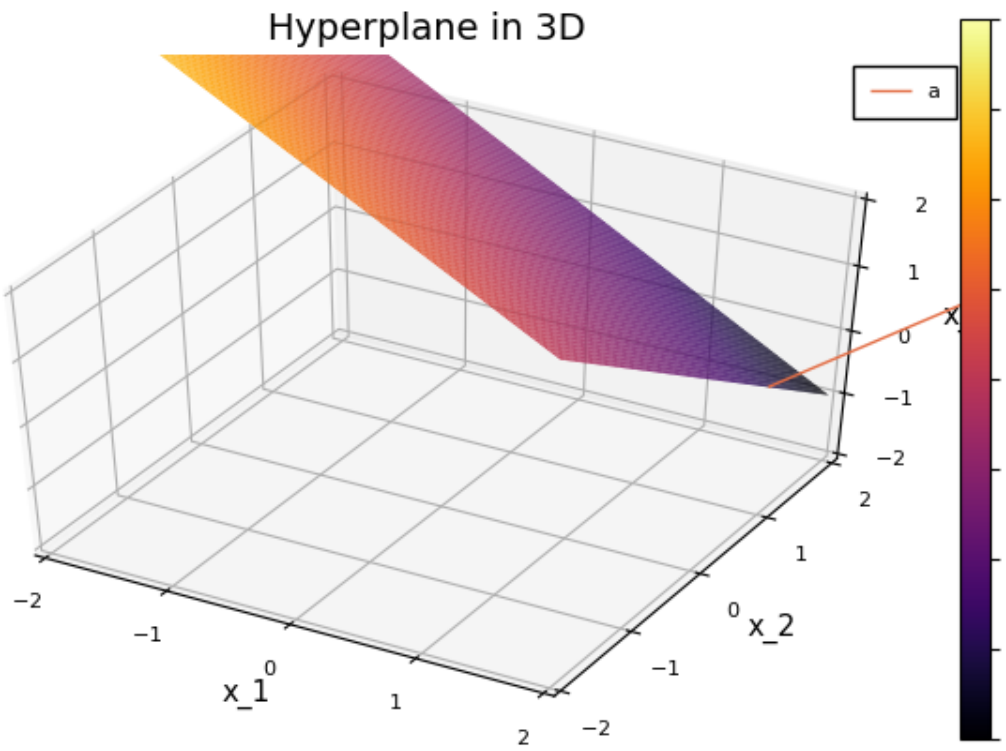
```
    a_x3 = range(b[3], stop=(b[3]+a[3]), length=100)
    plot!(a_x1, a_x2, a_x3, label="a")
end
```

[6]: draw_hyperplane_3D (generic function with 2 methods)

1.3.1 Homework example

[7]:
```
a = [1; 1; 1]
b = [2; 1; 0]
draw_hyperplane_3D(a, b, (30, 45))
```

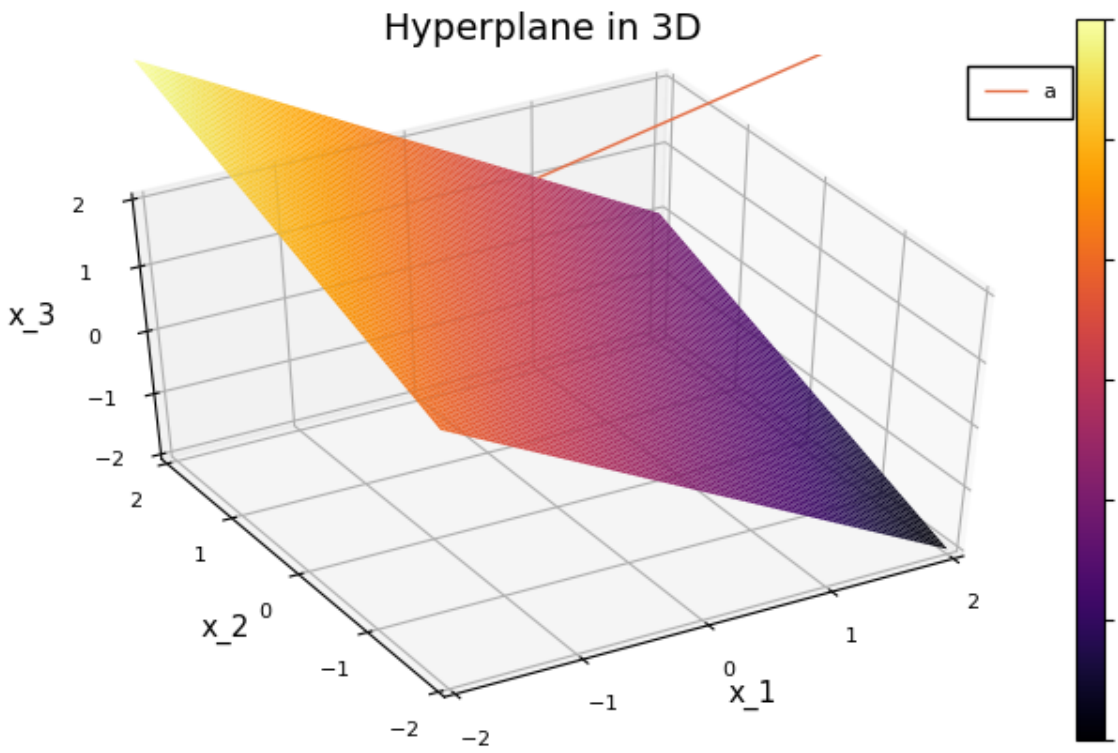
[7]:



1.3.2 Homework asked

[8]:
```
a = [2; -1; 2]
b = [1; 2; 1]
draw_hyperplane_3D(a, b, (-30, 45))
```

[8]:



1.4 Question 5

[9]:
```
A = [2 13 5 6; 0.5 3.25 5.25 2.5; 1 10.5 -.5 9]
b = [16; 7; 3]
x1 = A\b
x1
```

[9]:
```
4-element Array{Float64,1}:
  0.4251968503937001
  1.3092340730135996
  1.045812455261274
 -1.183249821045095
```

x_3 is a free variable, so that x can be written in terms of x_3 as below, $t(x)$ defines this function

[14]:
```
t(x) = [(72.75-68.75*x)/2; 6.75*x-5.75; x; 3-4*x]
```

[14]:
```
t (generic function with 1 method)
```

Below are some examples confirming for different x_3, $Ax = b$

[15]:
```
A*t(1)
```

[15]:
```
3-element Array{Float64,1}:
 16.0
  7.0
  3.0
```

[16]:
```
A*t(2)
```

[16]:
```
3-element Array{Float64,1}:
 16.0
  7.0
  3.0
```

[17]:
```
A*t(4)
```

[17]:
```
3-element Array{Float64,1}:
 16.0
  7.0
  3.0
```

[10]:
```
A2 = [2 13 5 6; 0.5 3.25 1.25 1.5; 1 10.5 -.5 9]
b = [16; 7; 3]
x2 = A2\b
x2
```

[10]:
```
4-element Array{Float64,1}:
  0.3152204649327587
  0.9434583895044879
  1.6171571367507307
 -0.7125505540393904
```

[13]:
```
A2*x2
```

[13]:
```
3-element Array{Float64,1}:
 16.705882352941174
  4.1764705882352935
  3.0000000000000036
```