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Lab 3

Exercise One

1) $f(x_1, x_2, x_3, x_4) = x_1^2 + x_2^2 + x_3^2 + x_4^2$ $g(x_1, x_2, x_3, x_4) = x_1 + x_2 + x_3 + x_4 = 20$
 $\nabla f(x_1, x_2, x_3, x_4) = \langle 2x_1, 2x_2, 2x_3, 2x_4 \rangle$ $\nabla g(x_1, x_2, x_3, x_4) = \langle 1, 1, 1, 1 \rangle$
 $2x_1 = \lambda$
 $2x_2 = \lambda$ $x_1 = x_2 = x_3 = x_4$ $x_1 + x_1 + x_1 + x_1 = 20$ $4x_1 = 20$ $x_1 = 5$
 $2x_3 = \lambda$ $x_1 = x_2 = x_3 = x_4 = 5$
 $2x_4 = \lambda$
 $f(5, 5, 5, 5) = 5^2 + 5^2 + 5^2 + 5^2 = 100$

Exercise Two

```
Command Window
New to MATLAB? See resources for Getting Started.

>> syms g(x,y)
>> syms f(x,y,z)
>> g = 2-x^2 - 0.5*y^2;
>> f = x^2 + y^2 + z^2;
>> gF = gradient(f);
>> gG = gradient(g);
>> sol = vpasolve([gF(1) == gG(1)*l, gF(2) == gG(2)*l, gF(3) == gG(3)*l, z==2-x^2-0.5*y^2], [x, y, z, l])
Undefined function or variable 'l'.

>> syms l
>> sol = vpasolve([gF(1) == gG(1)*l, gF(2) == gG(2)*l, gF(3) == gG(3)*l, z==2-x^2-0.5*y^2], [x, y, z, l])
Index exceeds matrix dimensions.

Error in sym/subsref (line 881)
    R_tilde = builtin('subsref',L_tilde,Idx);

>> sol = vpasolve([gF(0,1) == gG(0,1)*l, gF(0,2) == gG(0,2)*l, gF(0,3) == gG(0,3)*l, z==2-x^2-0.5*y^2], [x, y, z, l])
Subscript indices must either be real positive integers or logicals.

Error in sym/subsref (line 881)
    R_tilde = builtin('subsref',L_tilde,Idx);

>> sol = vpasolve([gF(1) == gG(1)*l, gF(2) == gG(2)*l, gF(3) == gG(3)*l, z==2-x^2-0.5*y^2], [x, y, z, l])
Index exceeds matrix dimensions.

Error in sym/subsref (line 881)
    R_tilde = builtin('subsref',L_tilde,Idx);

>> gF

gF =

    2*x
    2*y
    2*z

>> sol = vpasolve([gF(1,0) == gG(1,0)*l, gF(2,0) == gG(2,0)*l, gF(3,0) == gG(3,0)*l, z==2-x^2-0.5*y^2], [x, y, z, l])
Subscript indices must either be real positive integers or logicals.

Error in sym/subsref (line 881)
    R_tilde = builtin('subsref',L_tilde,Idx);

>> sol = vpasolve([gF(1) == gG(1)*l, gF(2) == gG(2)*l, gF(3) == 0*l, z==2-x^2-0.5*y^2], [x, y, z, l])

sol =

    struct with fields:
        x: [4x1 sym]
```

```
Command Window
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y: [4x1 sym]
z: [4x1 sym]
l: [4x1 sym]

>> x
x =
x

>> sol.x
ans =
0
0
-1.4142135623730950488016887242097
1.4142135623730950488016887242097

>> sol
sol =
struct with fields:
    x: [4x1 sym]
    y: [4x1 sym]
    z: [4x1 sym]
    l: [4x1 sym]

>> sol.y
ans =
-2.0
2.0
0
0

>> sol.z
ans =
0
0
0
0

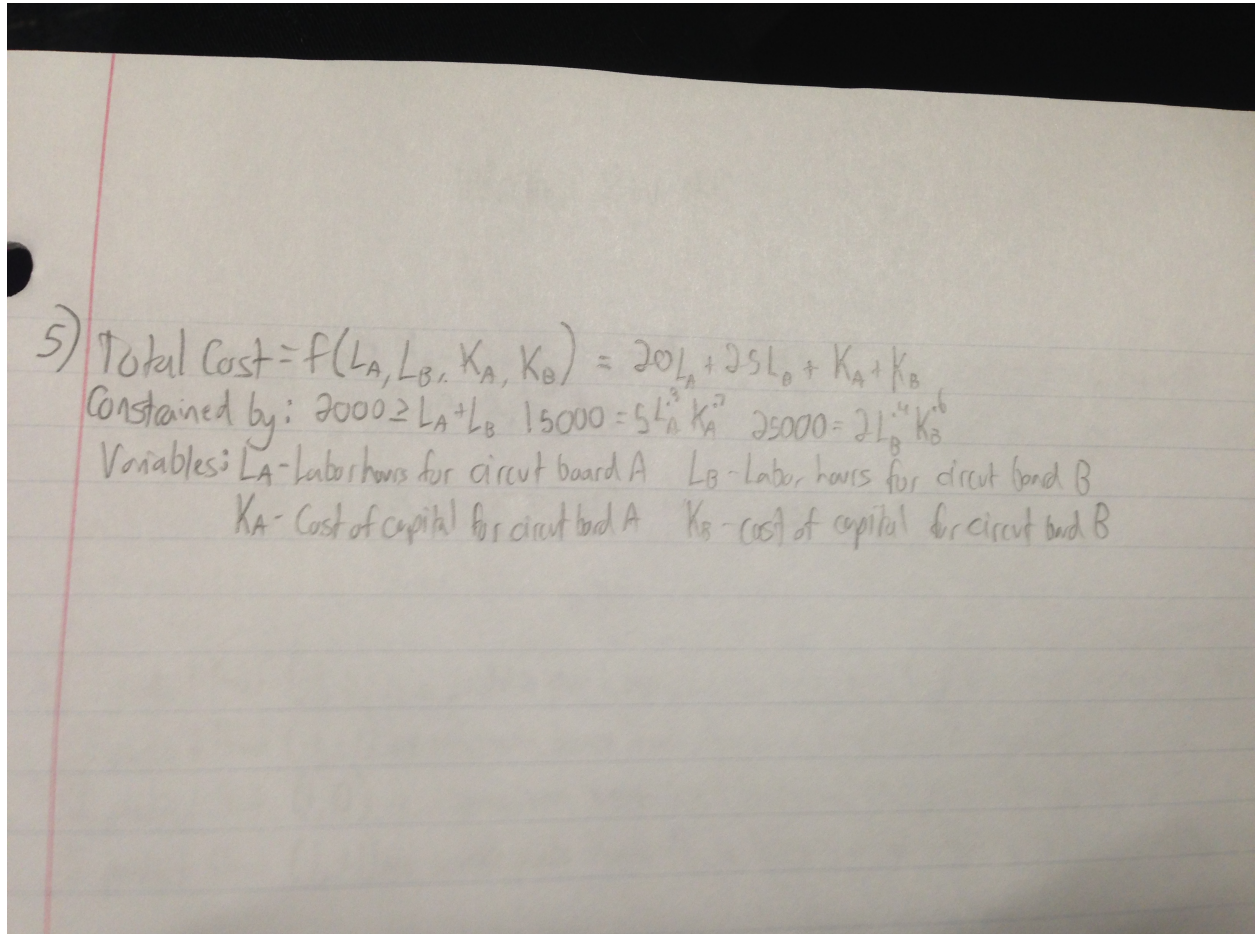
fx >>
```

Figure 1: The solutions that work are: $(0, -2, 0)$, $(0, 0, 0)$, $(-1.4142, -2, 0)$, $(-1.4142, 0, 0)$, $(1.4142, -2, 0)$.

Exercise Three

Exercise Four

Exercise Five



Handwritten notes on lined paper:

5) Total Cost = $f(L_A, L_B, K_A, K_B) = 20L_A + 25L_B + K_A + K_B$
Constrained by: $2000 \geq L_A + L_B$ $15000 = 5L_A^3 K_A^2$ $25000 = 2L_B^4 K_B^6$
Variables: L_A - Labor hours for circuit board A L_B - Labor hours for circuit board B
 K_A - Cost of capital for circuit board A K_B - Cost of capital for circuit board B

Exercise Six

Exercise Seven