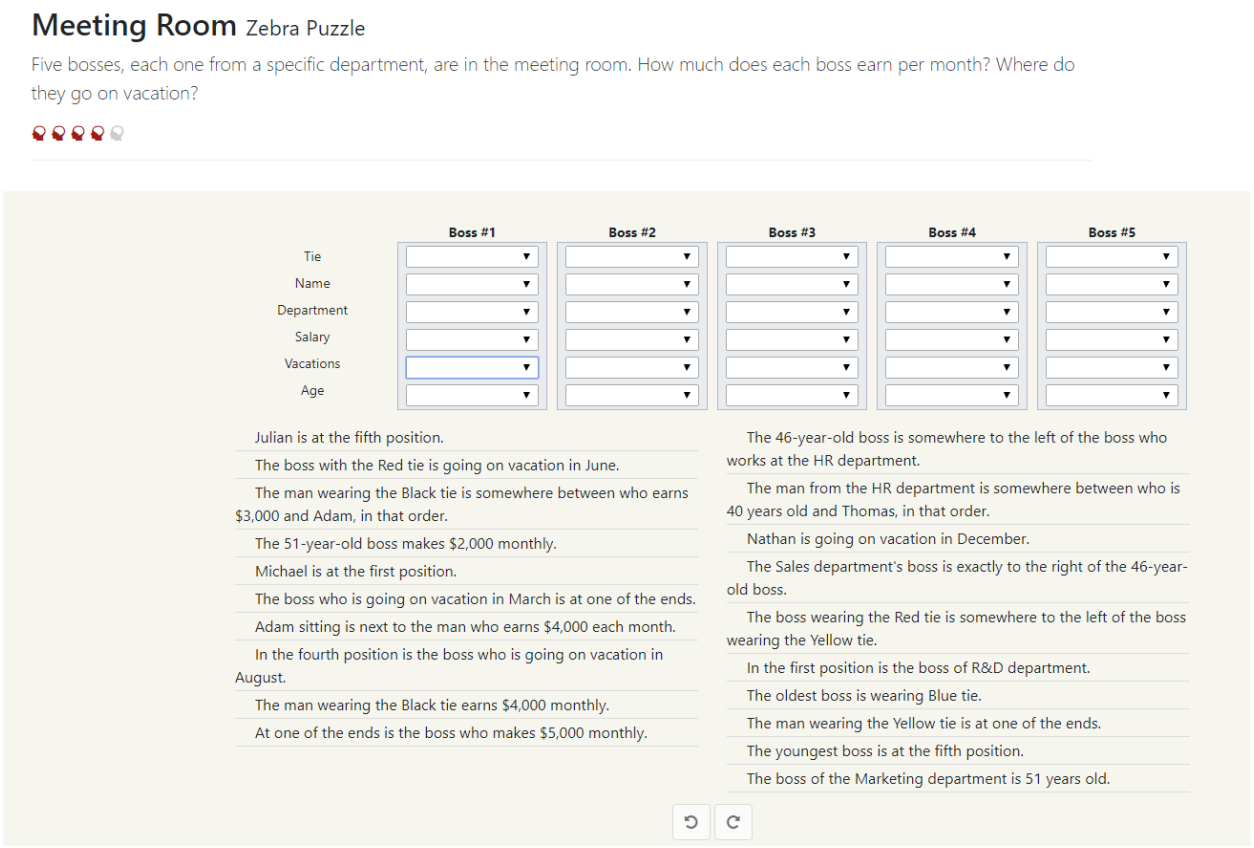
Week 3

Author: Florin Deleanu

Assignment 1

From https://www.brainzilla.com/logic/zebra/meeting-room/ at the hard section



This puzzle was straightforward to solve. Fist we declare each of the bosses ‘traits’ as an integer. Then we make sure the traits are distinct if they are the same category but also between 1 and 5

After that we put each sentence from the puzzle in code form in z3 to get the result.

```
#boss names: adam,julian,nathan,michael,thomas
a,j,n,m,t = Ints('a j n m t')
#tie colors
tieBlack,tieBlue,tieGreen,tieRed,tieYell=Ints('tieBlack tieBlue tieGreen tieRed tieYell')
#department
dpHr,dpIt,dpMarket,dpRD,dpSales=Ints('dpHr dpIt dpMarket dpRD dpSales')
#salaries (each number means thousand)
s2,s3,s4,s5,s6=Ints('s2 s3 s4 s5 s6')
#vacations
vAug,vDec,vJan,vJun,vMar=Ints('vAug vDec vJan vJun vMar')
#ages
ag34,ag40,ag46,ag51,ag55=Ints('ag34 ag40 ag46 ag51 ag55')

s=Solver()

def makeDistinctandRange(v1,v2,v3,v4,v5):
    s.add(Distinct(v1,v2,v3,v4,v5))
    s.add(v1>0,v2>0,v3>0,v4>0,v5>0, v1<6,v2<6,v3<6,v4<6,v5<6)

makeDistinctandRange(a,j,n,m,t)
makeDistinctandRange(tieBlack,tieBlue,tieGreen,tieRed,tieYell)
makeDistinctandRange(s2,s3,s4,s5,s6)
makeDistinctandRange(vAug,vDec,vJan,vJun,vMar)
makeDistinctandRange(ag34,ag40,ag46,ag51,ag55)
makeDistinctandRange(dpHr,dpIt,dpMarket,dpRD,dpSales)

s.add(j==5)
s.add(tieRed==vJun)
s.add(tieBlack>s3,tieBlack<a)
s.add(ag51==s2)
s.add(m==1)
s.add(Or(vMar==1,vMar==5))
s.add(Or(a==s4+1,a==s4-1))
s.add(vAug==4)
s.add(tieBlack==s4)
s.add(Or(s5==1,s5==5))
s.add(ag46<dpHr)
s.add(dpHr>ag40,dpHr<t)
s.add(n==vDec)
s.add(dpSales==ag46+1)
s.add(tieRed<tieYell)
s.add(dpRD==1)
s.add(ag55==tieBlue)
s.add(Or(tieYell==1,tieYell==5))
s.add(ag34==5)
s.add(dpMarket==ag51)



print(s.check())
print(s.model())
```

```
sat
[t = 4,
 s6 = 3,
 vMar = 5,
 tieYell = 5,
 dpIt = 5,
 tieGreen = 4,
 s2 = 4,
 a = 3,
 vJan = 3,
 s3 = 1,
 vDec = 2,
 vJun = 1,
 tieBlue = 3,
 s5 = 5,
 ag40 = 2,
 s4 = 2,
 ag46 = 1,
 dpHr = 3,
 dpMarket = 4,
 ag34 = 5,
 ag55 = 3,
 dpRD = 1,
 dpSales = 2,
 n = 2,
 tieBlack = 2,
 vAug = 4,
 m = 1,
 ag51 = 4,
 tieRed = 1,
 j = 5]
```

This result is equivalent to the picture below

	Boss #1	Boss #2	Boss #3	Boss #4	Boss #5
Tie	red	black	blue	green	yellow
Name	Michael	Nathan	Adam	Thomas	Julian
Department	R&D	sales	HR	marketing	IT
Salary	$3,000	$4,000	$6,000	$2,000	$5,000
Vacations	June	December	January	August	March
Age	46 years	40 years	55 years	51 years	34 years

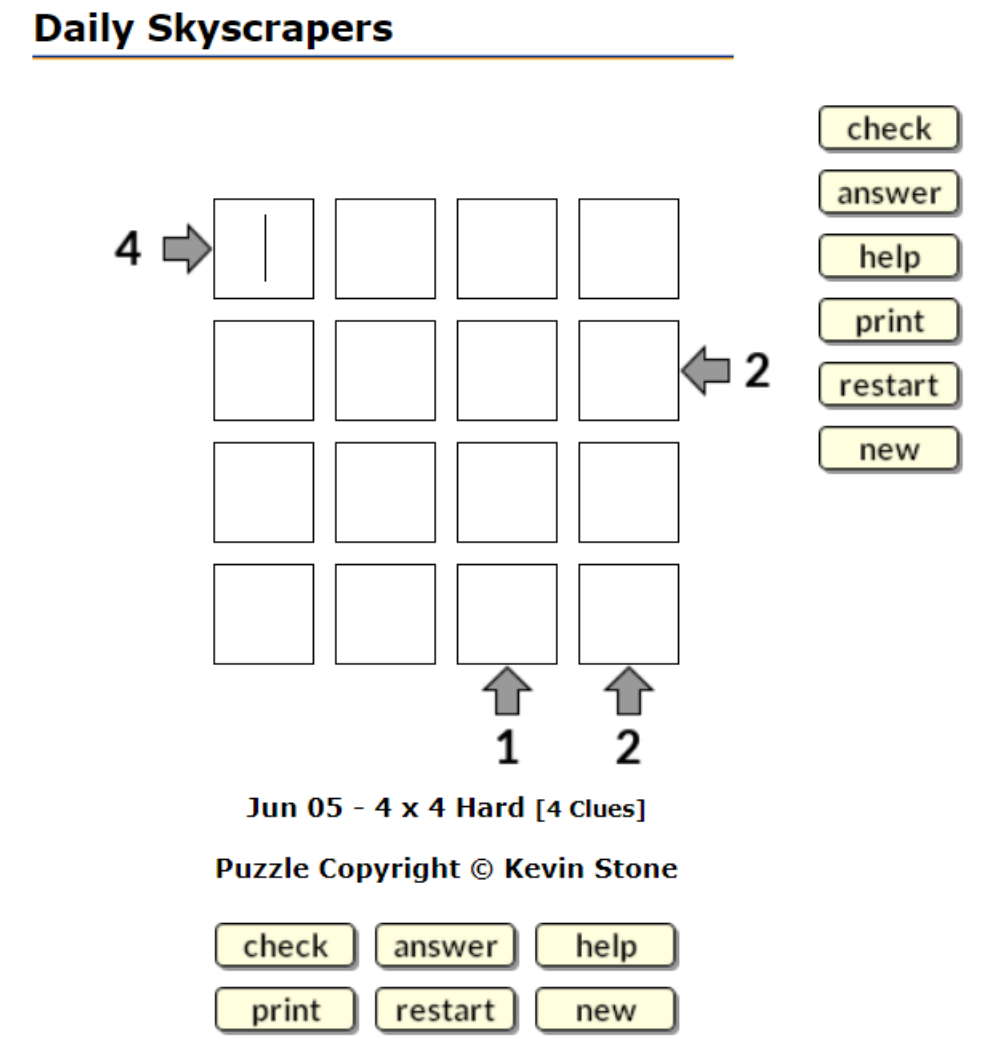
- ✔ ~~Julian is at the fifth position.~~
- ✔ ~~The boss with the Red tie is going on vacation in June.~~
- ✔ ~~The man wearing the Black tie is somewhere between who earns $3,000 and Adam, in that order.~~
- ✔ ~~The 51-year-old boss makes $2,000 monthly.~~
- ✔ ~~Michael is at the first position.~~
- ✔ ~~The boss who is going on vacation in March is at one of the~~
- ✔ ~~Adam sitting is next to the man who earns $4,000 each month.~~
- ✔ ~~In the fourth position is the boss who is going on vacation in August.~~
- ✔ ~~The man wearing the Black tie earns $4,000 monthly.~~
- ✔ ~~At one of the ends is the boss who makes $5,000 monthly.~~

brainzilla

- ✔ ~~The 46-year-old boss is somewhere to the left of the boss who works at the HR department.~~
- ✔ ~~The man from the HR department is somewhere between who is years old and Thomas, in that order.~~
- ✔ ~~man is going on vacation in December.~~
- ✔ ~~Sales department's boss is exactly to the right of the 46-year-boss.~~
- ✔ ~~boss wearing the Red tie is somewhere to the left of the boss wearing the Yellow tie.~~
- ✔ ~~In the first position is the boss of R&D department.~~
- ✔ ~~The oldest boss is wearing Blue tie.~~
- ✔ ~~The man wearing the Yellow tie is at one of the ends.~~
- ✔ ~~The youngest boss is at the fifth position.~~
- ✔ ~~The boss of the Marketing department is 51 years old.~~

Assignment 2

From https://brainbashers.com/showskyscraper.asp?date=0605&size=4&diff=3



For this skyscraper I chose the hard 4x4 one

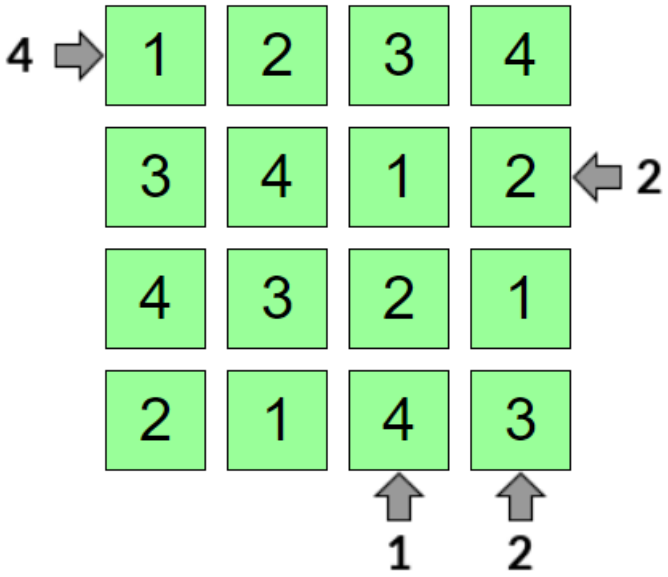
For this assignment I had to think of the possible combinations that satisfy a column/row's constraint. For example if we see a 2 that doesn't necessarily mean the second variable is the biggest, it could also mean the third variable is the biggest but the first one must be bigger than the second one. The code below explains shows the combinations I found more in depth.

At the last page the solved puzzle can be seen based on the output in the screenshot from z3

```
#4x4 skyscraper matrix
a11,a12,a13,a14 = Ints('a11 a12 a13 a14')
a21,a22,a23,a24 = Ints('a21 a22 a23 a24')
a31,a32,a33,a34 = Ints('a31 a32 a33 a34')
a41,a42,a43,a44 = Ints('a41 a42 a43 a44')

#f(1) means first variable is the biggest
def see1(v1,v2,v3,v4):
    s.add(v1==4)

#f(2) means first variable is smaller than the second and the second the biggest OR
#     first>second and first<third and third>forth OR
#     first>second, first>third, first<forth
def see2(v1,v2,v3,v4):
    s.add(Or( And(v1<v2,v2>v3,v2>v4),And(v1>v2,v1<v3,v3>v4),And(v1>v2,v1>v3,v1<v4 ) ))

#f(3) means first variable is smaller than second, second smaller then third and third the biggest OR
#     first<second, second>third, second<forth
#    first<third, second<first, third<forth
def see3(v1,v2,v3,v4):
    s.add(Or(And(v1<v2,v2<v3,v3>v4), And(v1<v2,v2>v3,v2<v4), And(v1<v3,v2<v1,v3<v4) ))

#f(4) means the variables in line/col are in ascending order
def see4(v1,v2,v3,v4):
    s.add(v1<v2,v2<v3,v3<v4)

def makeDistinctandRange(v1,v2,v3,v4):
    s.add(Distinct(v1,v2,v3,v4))
    s.add(v1>0,v2>0,v3>0,v4>0, v1<5,v2<5,v3<5,v4<5)

s=Solver()
makeDistinctandRange(a11,a12,a13,a14)
makeDistinctandRange(a21,a22,a23,a24)
makeDistinctandRange(a31,a32,a33,a34)
makeDistinctandRange(a41,a42,a43,a44)

makeDistinctandRange(a11,a21,a31,a41)
makeDistinctandRange(a12,a22,a32,a42)
makeDistinctandRange(a13,a23,a33,a43)
makeDistinctandRange(a14,a24,a34,a44)

see4(a11,a12,a13,a14)
see1(a43,a33,a23,a13)
see2(a44,a34,a24,a14)
see2(a24,a23,a22,a21)


print(s.check())
print(s.model())
```

```
sat
[a13 = 3,
 a44 = 3,
 a14 = 4,
 a24 = 2,
 a34 = 1,
 a31 = 4,
 a12 = 2,
 a32 = 3,
 a21 = 3,
 a22 = 4,
 a33 = 2,
 a11 = 1,
 a41 = 2,
 a42 = 1,
 a23 = 1,
 a43 = 4]
```

Daily Skyscrapers



check
answer
help
print
restart
new

Jun 05 - 4 x 4 Hard [4 Clues]

check answer help
print restart new