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# Assignment 1
# CSI2120 Programming Paradigms
**Winter 2016**
**Due on February 2nd, 2016 before 11:00 pm in Virtual Campus**
# [5 marks in total]

*Question 1.*   **[1 mark]**

Consider the following Prolog program:

```
p1(X,Y):-p3(X),p2(Y,X).
p2(X,Y):-p3(X),p4(Y),X\=Y.
p3(a).
p3(b).
p3(c).
p3(d).
p4(c).
p4(a).
p4(b).
```

a)  Draw the complete search tree for the following query:

```
?-  p1(X,Y).
```

and mark the found solutions clearly.

b)  Use a single cut in the program such that only one solution for each `X` is found. For example, if `X = a, Y = b` is found, the solution `X = a, Y = c` should be excluded.

*Question 2.*   **[2 marks]**

Develop rules for finding numbers which cubic is below a certain number.

a)  Create the rule `cubeLess(X,B,R)` which calculates the power of 3 and the remainder such that $b = x^3 + r$. Therefore, for a query cubeLess( 2, 10, R), the result should be R=2. Note, that you will not be able to call the rule without X and B instantiated.

b) Use the rule cubeLess from a) to find all numbers with a cube smaller than a given limit by creating a new rule smallerCube(X,B). Print your results to the console with `write/1` and `writeln/1` . Example:

```
?- smallerCube(X,130).
1 rest 129
2 rest 122
3 rest 103
4 rest 66
5 rest 5
```

Because $1^3 = 1 + 129 = 130$, $2^3 = 8 + 122 = 130$ and so on.

c) Create another (and separate) rule `restSum(B,S)` to add up all the remainders from finding all cubes up to an upper limit.

```
?- restSum(130,S).
S = 425.
```

d) Write another rule to print all the rest sums that are multiples of 3 within a range. For example, in the range from 1 to 20:

```
?- showAllRestSum(1,20).
1 rest 0
4 rest 3
7 rest 6
9 rest 9
12 rest 15
15 rest 21
18 rest 27
true.
```

_____

### Question 3.    [2 marks]

You will find the inventory of an outfitter on the following page.

a) Create a Prolog database representing the items that the outfitter sells.

b) Paul is going camping for the first time and needs to buy a tent, sleeping bag and pad as well as back pack. Write a query for Paul who likes a sleeping bag good down to at least 0 deg. Celcius, and a sleeping pad of 5cm or more. Make sure to also calculate the total price of the package.

c) The travel company Cheap Thrills is offering a trip for 4.  Mary, Sean, Paula and Thomas are signed up. Create a predicate for Cheap Thrills to find equipment for their four customers. Mary does not want to share a tent with Sean. Paula and Thomas would like to share a sleeping bag but still need a sleeping pad. They want it all to fit in two back packs and the customers are allowed to bring personal belongings of 7 kg each.

```
?- tripFor4(7,mary(MB,MP),sean(SB,SP),
            paula(PTB,PP),thomas(PTB,TP), tents( T1, T2),
            backpacks(B1,B2)).
```

d) The  outfitter also sells two package deal: *Basic for 2* at $ 600 and *Extra* for one person at $650. *Basic for 2* consists of the *Dreamer* tent, the *Cabin* sleeping bag, two sleeping pads *Pfft* and one *Trapper* back pack. Extra consists of  a *Hermite* tent, a *Mountain* sleeping bag, a *Rock* sleeping pad and  a *Air* backpack.

Jill and Kyle are buying equipment for their camping trip.  They will each bring 5 kg of personal belongings. They like the *Dreamer* tent for sure, want to use only one back pack and they can spent up to $750 in total. Write the rule `equipment2`, that will produce all solutions for them:

```
?- equipment2(5,jill(JB,JP),kyle(KB,KP),tents(dreamer),
            backpacks(BP),750).
```

e) Cheap Thrills wants to offer a comfort trip for which their guide carries the tents and a *Heaven* sleeping pad for all customers. The predicate needs to return true if  the number of people N can be served with one guide (i.e., the guide must carry in her/his backpack all tents and sleeping pads). Take into account that the guide also has to carry his/her personal belongings of 5 kg, a sleeping bag and a pad.

```
?- comfort(5,guide(GB,GP),backpacks(GBP),N).
```

_____

Tents
Dreamer, sleeps 2, 4.5 kg, $ 199.
Hermite, sleeps 1, 2 kg $ 159.
Family, sleeps 5, 5 kg, $349.
Expedition, sleeps 8, 8.5 kg, $ 699.

Sleeping bags
Mountain, -15C,  mummy,  1.5 kg, $ 350.
Cabin, 5C, double-bag (2 person), 5kg, $250.
Square, -3C, rectangular, 2.5kg, $150.

Sleeping pads
Rock, 2cm, 0.2kg, $100.
Pfft, 3cm, 0.8kg, $10.
Heaven, 10cm, 0.4kg, $ 80.
Moon, 5cm, 0.4kg, $50.

Backpacks
Trapper, 20 kg, $ 250.
Prospector, 25kg, $ 220.
Air, 10kg, $ 150.
Comfort, 15kg, $ 200.