Tentamen 28 Maart 2019, antwoorden

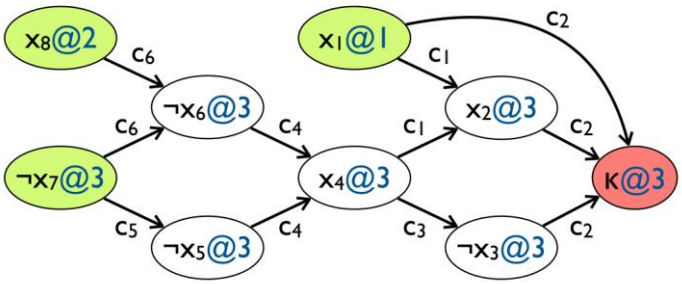
Knowledge Representation (Vrije Universiteit Amsterdam)

Examination for Knowledge Representation, 28 March 2009

1. Propositional logic Logic (10pt)

a. 0
b. Somewhere between 1 and 2^k (or (2^k)-1 if F is satisfiable but not valid)
c. 0 (inconsistent = unsatisfiable)
d. 2^k

2. SAT solving: clause Learning (10pt)



(some students applied pure-literal simplification, and then there is no conflict. For those students the question is excluded from the exam)

3. SAT solving: GSAT (15pt)

```
procedure GSAT(Sigma)
  for i := 1 to MAX-TRIES ; These are the restarts
    T := random(Sigma) ; random assignment
    for j := 1 to MAX-FLIPS ; To ensure termination
      if T satisfies Sigma then return T
      else T := T with variable flipped to maximize
                number of satisfied clauses
      ; It doesn't matter if the number does
      ; not increase.  This are the sideways flips
    end
  end
```

a.
b. True (each variable always has a value),
   alternatively:
   False, because not each variable gets *changed* at each iteration
c. False
d. False (it is sound, but not complete
e. True
f. To avoid exploring forever parts of the search space that do not contain a solution
g. To make sure you explore the whole local search space before jumping elsewhere (and miss a nearby solution)
h. To void wandering for too long in parts of the search space that do not contain a solution

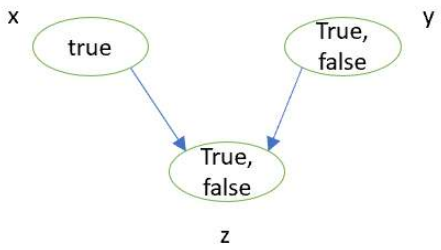
4. Description Logic (10pt)

a. If you know at least one actor then all your friends are envious
b. Happy parens are precisely those parens all of whose children are either doctors or have a child who is a doctor

5. Description Logic (10pt)

a. {Alice,Bob}
b. {Bob}
c. {Clair}
d. {Clair}
e. {}

6. CSP (10pt)



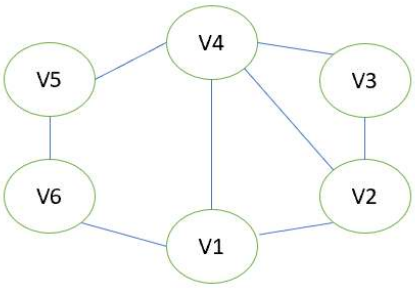
a.
For every value of x (true) there is some value of z that is consist with z= x∧y (in fact, both values of z might be consistent with x=true)
Y=true is consistent with both z=true and z=false
Y=false isconsistent with z=false
So the problem is directionally arc-consistent

Vice versa: z=true is consistent with x=true and with y=true,
Z=false is obviously consistent with y=false, as well as with x=true
So the problem is also bi-directionally arc-consistent

The pair {x=true,y=true} is consistent with z=true
The pair {x=true,y=false} is consistent with z=false
The pair {x=true,z=true} is consistent with y=true
The pair {x=true,z=false} is consistent with y=false
So, any pair of consistent values can be extended to a consistent third value in the constraint, hence the problem is also hyper-arc consistent

b. Yes. Simply give each variable the domain {true,false}, the constraint says that from each clause, at least one literal has to be true.
c. No, CSPs can also be over very different domains (e.g. real numbers) and can have very different constraints (eg inequalities).

7. CSP (10pt)



a.
All variables initially have domain {1,2,3,4}
The least constraining values will be for V3,V5,V6, so because of the tie-breaking constraint we choose V3=1. This causes the reductions V4={2,3,4} and V2={2,3,4}.

The next least constraining values is now V5, and the tie-breaker causes us to choose V5=1, causing V6={2,3,4}. We can now choose V1=1 without causing any further value constraints. At this point, only the v2≠v4 constraint is unsatified. The tie-breaker chooses V2=2.
This gives the solution
V1=1,
V2={2},
V3=1,
V4={3,4}
V5=1,
V6={2,3,4}

b. V4 is the most constraining variable, so pick V4={1}. This causes V1={2,3,4}, V2={2,3,4}, V3={2,3,4} and V5={2,3,4}. Now V1 and V2 are most constaining, so pick V1=2. This causes V2={3,4} and V6={1,3,4}. Now V2 is most constraining, so pick V2={3}. This causes V3={2,4}. Now V3,V5 and V6 are most constraining, so pick V3={2} and then V5={2} leading to the solution:
V1=2
V2=3
V3=2
V4=1
V5=2
V6=1,3,4

8. QR (10pt)

Influence: The magnitude of the causing quantity determines the derivative of the affected quantity.

Proportionality: Directed propagation of derivative information from the causing quantity to the affected quantity.

9. QR (15pt)

a. Sim2 (5 states)

b.

State	Q1:M	Q1:∂	Q2:M	Q2:∂
1	V1	-	P2	-
2	V1	-	V2	-
3	0	0	0	0
4	V1	-	0	0
5	0	0	V2	-

First a point-value that changes (from S1 to S2), from S2 there are 3 options (Q1 goes to 0 (S5) or Q2 goes to 0 (S4), or both (S3)), after that from S4 and S5 the other quantity also goes to 0.