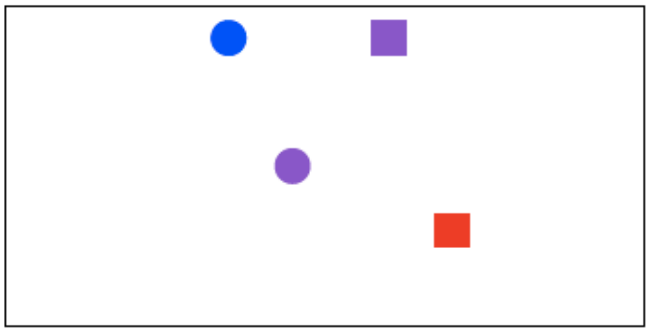
Amsterdam University College

Logic, Information flow and Argumentation

Homework exercises, Week 7, part b (due Tuesday 27 March).

1. Consider the model given by the diagram below. For each formula, decide whether it is true or not.

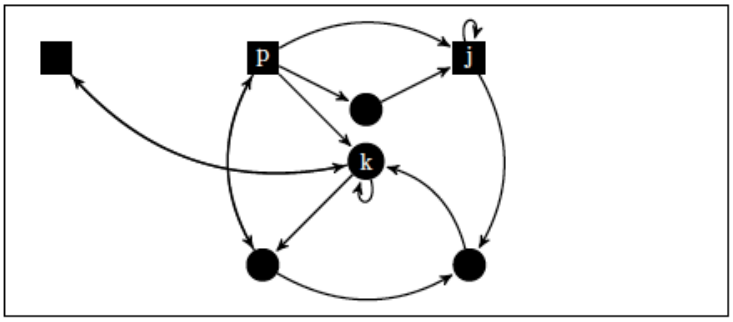
   Colors (*R*ed, *G*reen, *B*lue, *P*urple) and shapes (*S*quare, *C*ircle).



   - $\exists x(Rx \wedge Cx)$
   - $\forall x(Cx \vee Sx)$
   - $\exists xGx \vee \exists xCx$
   - $\exists xRx \wedge \exists xCx$
   - $\forall xCx \vee \forall xSx$
   - $\exists x(Gx \vee Cx)$

2. Do the same for the following model and set of formulas:

■: boy •: girl • → ■: • loves ■



- $Ljk \rightarrow Lkj$
- $\neg(Ljk \wedge Lkj)$
- $\forall x(Bx \rightarrow Lxk)$
- $\forall x((Bx \vee Gx) \rightarrow \neg Lxp)$
- $Ljk \wedge Lkj$
- $(Ljk \wedge Lpk) \rightarrow (\neg Lpj \wedge \neg Lkj)$
- $\neg\forall x(Gx \rightarrow Lxx)$
- $\exists x(Gx \wedge Lpx \wedge Lxj)$

3. Consider the following two models M and N, with the arrow representing an abstract relation R:

For both models decide whether the following sentences are true:

(a) $\exists x(x = x)$
(b) $\exists x\exists y\neg(x = y)$
(c) $\exists x\exists y\exists z(\neg(x = y) \wedge \neg(y = z) \wedge \neg(x = z))$
(d) $\exists x\exists y(Rxy \wedge Ryx)$
(e) $\exists x\exists y(Rxy \wedge \neg Ryx)$
(f) $\forall x\exists y Rxy$
(g) $\forall x\exists y\neg Rxy$
(h) $\forall x\exists y(\neg(x = y) \wedge \neg Rxy)$
(i) $\forall x\forall y(Rxy \rightarrow Ryx)$
(j) $\exists x\forall y\neg Rxy$
(k) $\exists x\forall y(\neg(x = y) \rightarrow \neg Rxy)$