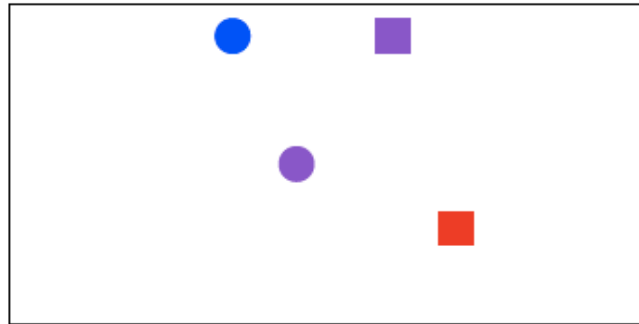


**Homework exercises, Week 7, part b (due Tuesday 27 March).**

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

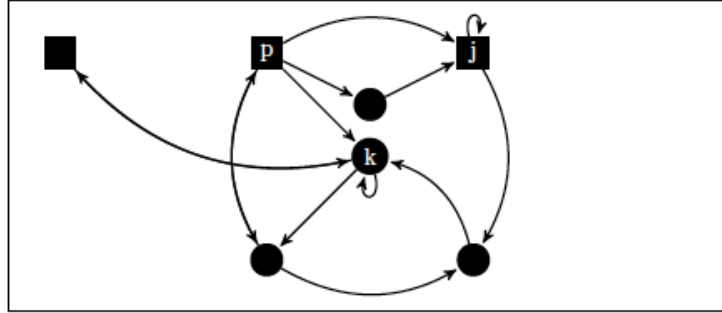
Colors (*Red, Green, Blue, Purple*) and shapes (*Square, Circle*).



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

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

■: boy      ●: girl      ● → ■: ● loves ■



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

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:

- $\exists x(x = x)$
- $\exists x \exists y \neg(x = y)$
- $\exists x \exists y \exists z (\neg(x = y) \wedge \neg(y = z) \wedge \neg(x = z))$
- $\exists x \exists y (Rxy \wedge Ryx)$
- $\exists x \exists y (Rxy \wedge \neg Ryx)$
- $\forall x \exists y Rxy$
- $\forall x \exists y \neg Rxy$
- $\forall x \exists y (\neg(x = y) \wedge \neg Rxy)$
- $\forall x \forall y (Rxy \rightarrow Ryx)$
- $\exists x \forall y \neg Rxy$
- $\exists x \forall y (\neg(x = y) \rightarrow \neg Rxy)$