

t52\_cat\_4 (TMG-  
soSrW6qjRWHXkwZWuNz4mYEAtMB7LXHJ)

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Let  $m1\_subset\_1 : \iota \Rightarrow \iota \Rightarrow o$  be given. Let  $u1\_struct\_0 : \iota \Rightarrow \iota$  be given. Let  $k23\_cat\_4 : \iota \Rightarrow \iota \Rightarrow \iota$  be given. Let  $u4\_struct\_0 : \iota \Rightarrow \iota$  be given. Let  $r4\_cat\_3 : \iota \Rightarrow \iota \Rightarrow \iota \Rightarrow \iota \Rightarrow o$  be given. Let  $v2\_struct\_0 : \iota \Rightarrow o$  be given. Let  $v11\_struct\_0 : \iota \Rightarrow o$  be given. Let  $v2\_cat\_1 : \iota \Rightarrow o$  be given. Let  $v3\_cat\_1 : \iota \Rightarrow o$  be given. Let  $v4\_cat\_1 : \iota \Rightarrow o$  be given. Let  $v5\_cat\_1 : \iota \Rightarrow o$  be given. Let  $v6\_cat\_1 : \iota \Rightarrow o$  be given. Let  $v5\_cat\_4 : \iota \Rightarrow o$  be given. Let  $l2\_cat\_4 : \iota \Rightarrow o$  be given. Let  $l1\_cat\_1 : \iota \Rightarrow o$  be given. Let  $l1\_graph\_1 : \iota \Rightarrow o$  be given. Let  $k4\_graph\_1 : \iota \Rightarrow \iota \Rightarrow \iota$  be given. Let  $k3\_graph\_1 : \iota \Rightarrow \iota \Rightarrow \iota$  be given. Let  $k1\_cat\_1 : \iota \Rightarrow \iota \Rightarrow \iota \Rightarrow \iota$  be given. Let  $k2\_cat\_1 : \iota \Rightarrow \iota \Rightarrow \iota \Rightarrow \iota$  be given. Assume the following.

$$\begin{aligned} & \forall X0. \forall X1. \forall X2. (m1\_subset\_1 X2 (u4\_struct\_0 \\ & (k23\_cat\_4 X0 X1))) \Rightarrow (\forall X3. (m1\_subset\_1 X3 (u4\_struct\_0 \\ & (k23\_cat\_4 X0 X1))) \Rightarrow (X2 = X3)) \end{aligned} \quad (1)$$

Assume the following.

$$\begin{aligned} & \forall X0. \forall X1. \forall X2. (m1\_subset\_1 X2 (u1\_struct\_0 \\ & (k23\_cat\_4 X0 X1))) \Rightarrow (\forall X3. (m1\_subset\_1 X3 (u1\_struct\_0 \\ & (k23\_cat\_4 X0 X1))) \Rightarrow (X2 = X3)) \end{aligned} \quad (2)$$

Assume the following.

$$\begin{aligned} & \forall X0. \forall X1. (\neg v2\_struct\_0 (k23\_cat\_4 X0 X1)) \wedge ((\neg v11\_struct\_0 \\ & (k23\_cat\_4 X0 X1)) \wedge ((v2\_cat\_1 (k23\_cat\_4 X0 X1)) \wedge ((v3\_cat\_1 ( \\ & k23\_cat\_4 X0 X1)) \wedge ((v4\_cat\_1 (k23\_cat\_4 X0 X1)) \wedge ((v5\_cat\_1 (k23\_cat\_4 \\ & X0 X1)) \wedge ((v6\_cat\_1 (k23\_cat\_4 X0 X1)) \wedge (v5\_cat\_4 (k23\_cat\_4 X0 \\ & X1)))))))))) \end{aligned} \quad (3)$$

Assume the following.

$$\forall X0. \exists X1. m1\_subset\_1 X1 X0 \quad (4)$$

Assume the following.

$$\forall X0. (l2\_cat\_4 X0) \Rightarrow (l1\_cat\_1 X0) \quad (5)$$

Assume the following.

$$\forall X0.(l1\_cat\_1 X0) \Rightarrow (l1\_graph\_1 X0) \quad (6)$$

Assume the following.

$$\begin{aligned} \forall X0.\forall X1.(((\neg v2\_struct\_0 X0) \wedge ((\neg v11\_struct\_0 X0) \wedge \\ (l1\_graph\_1 X0))) \wedge (m1\_subset\_1 X1 (u4\_struct\_0 X0))) \Rightarrow (m1\_subset\_1 \\ (k4\_graph\_1 X0 X1) (u1\_struct\_0 X0)) \end{aligned} \quad (7)$$

Assume the following.

$$\begin{aligned} \forall X0.\forall X1.(((\neg v2\_struct\_0 X0) \wedge ((\neg v11\_struct\_0 X0) \wedge \\ (l1\_graph\_1 X0))) \wedge (m1\_subset\_1 X1 (u4\_struct\_0 X0))) \Rightarrow (m1\_subset\_1 \\ (k3\_graph\_1 X0 X1) (u1\_struct\_0 X0)) \end{aligned} \quad (8)$$

Assume the following.

$$\forall X0.\forall X1.(v5\_cat\_4 (k23\_cat\_4 X0 X1)) \wedge (l2\_cat\_4 \\ (k23\_cat\_4 X0 X1)) \quad (9)$$

Assume the following.

$$\begin{aligned} \forall X0.\forall X1.\forall X2.((l1\_cat\_1 X0) \wedge ((m1\_subset\_1 \\ X1 (u4\_struct\_0 X0)) \wedge (m1\_subset\_1 X2 (u4\_struct\_0 X0)))) \Rightarrow (m1\_subset\_1 \\ (k1\_cat\_1 X0 X1 X2) (u4\_struct\_0 X0)) \end{aligned} \quad (10)$$

Assume the following.

$$\begin{aligned} \forall X0.((\neg v2\_struct\_0 X0) \wedge ((\neg v11\_struct\_0 X0) \wedge (l1\_cat\_1 \\ X0))) \Rightarrow (\forall X1.(m1\_subset\_1 X1 (u1\_struct\_0 X0)) \Rightarrow (\forall X2. \\ (m1\_subset\_1 X2 (u1\_struct\_0 X0)) \Rightarrow (k2\_cat\_1 X0 X1 X2 = ReplSep ( \\ toset (\lambda X3 : \iota.m1\_subset\_1 X3 (u4\_struct\_0 X0)) (\lambda X3 : \\ \iota.(k3\_graph\_1 X0 X3 = X1) \wedge (k4\_graph\_1 X0 X3 = X2)) (\lambda X3 : \iota. \\ X3)))) \end{aligned} \quad (11)$$

Assume the following.

$$\begin{aligned}
& \forall X0.((\neg v2\_struct\_0 X0) \wedge ((\neg v11\_struct\_0 X0) \wedge ((v2\_cat\_1 \\
& X0) \wedge ((v3\_cat\_1 X0) \wedge ((v4\_cat\_1 X0) \wedge ((v5\_cat\_1 X0) \wedge ((v6\_cat\_1 \\
& X0) \wedge (l1\_cat\_1 X0)))))))) \Rightarrow (\forall X1.(m1\_subset\_1 X1 (u1\_struct\_0 \\
& X0)) \Rightarrow (\forall X2.(m1\_subset\_1 X2 (u4\_struct\_0 X0)) \Rightarrow (\forall X3. \\
& (m1\_subset\_1 X3 (u4\_struct\_0 X0)) \Rightarrow ((r4\_cat\_3 X0 X1 X2 X3) \Leftrightarrow ((k4\_graph\_1 \\
& X0 X2 = X1) \wedge ((k4\_graph\_1 X0 X3 = X1) \wedge (\forall X4.(m1\_subset\_1 X4 \\
& (u1\_struct\_0 X0)) \Rightarrow (\forall X5.(m1\_subset\_1 X5 (u4\_struct\_0 X0)) \Rightarrow \\
& (\forall X6.(m1\_subset\_1 X6 (u4\_struct\_0 X0)) \Rightarrow (\neg(X5 \in k2\_cat\_1 \\
& X0 (k3\_graph\_1 X0 X2) X4) \wedge ((X6 \in k2\_cat\_1 X0 (k3\_graph\_1 X0 X3) X4) \wedge \\
& (\forall X7.(m1\_subset\_1 X7 (u4\_struct\_0 X0)) \Rightarrow (\neg(X7 \in k2\_cat\_1 \\
& X0 X1 X4) \wedge (\forall X8.(m1\_subset\_1 X8 (u4\_struct\_0 X0)) \Rightarrow ((X8 \in \\
& k2\_cat\_1 X0 X1 X4) \Rightarrow (((k1\_cat\_1 X0 X2 X8 = X5) \wedge (k1\_cat\_1 X0 X3 X8 = X6)) \Leftrightarrow \\
& (X7 = X8))))))))))))))
\end{aligned} \tag{12}$$

**Theorem 1**

$$\begin{aligned}
& \forall X0. \forall X1. \forall X2. (m1\_subset\_1 X2 (u1\_struct\_0 \\
& (k23\_cat\_4 X0 X1))) \Rightarrow (\forall X3. (m1\_subset\_1 X3 (u4\_struct\_0 \\
& (k23\_cat\_4 X0 X1))) \Rightarrow (\forall X4. (m1\_subset\_1 X4 (u4\_struct\_0 \\
& (k23\_cat\_4 X0 X1))) \Rightarrow (r4\_cat\_3 (k23\_cat\_4 X0 X1) X2 X3 X4))
\end{aligned}$$