

All Routes with No Repeated Roads

allroutes: \mathbf{F} Road \rightarrow (Road \rightarrow \mathbf{P} Place)
 \rightarrow (Place \times Place) \rightarrow \mathbf{F} (seq Road)

$\forall U: \mathbf{F}$ Road; $f: \text{Road} \rightarrow \mathbf{P}$ Place; $x, y: \text{Place}$; $\sigma: \text{seq Road} \bullet$
 $\sigma \in \mathbf{allroutes} \cup f(x, y) \Leftrightarrow$
 $(\text{ran } \sigma \subseteq U \wedge$
 $(\forall i: \text{dom } \sigma \mid i \neq \#\sigma \bullet (\sigma;f)(i) \cap (\sigma;f)(i+1) \neq \emptyset) \wedge$
 $((x \in (\sigma;f)(1) \wedge y \in (\sigma;f)(\#\sigma)) \vee (y \in (\sigma;f)(1) \wedge x \in (\sigma;f)(\#\sigma))) \wedge$
 $(\forall i, j: \text{dom } \sigma \bullet i \neq j \Rightarrow \sigma(i) \neq \sigma(j)))$

All Routes with No Repeated Places (i.e., no cycles)

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 \rightarrow (Place \times Place) \rightarrow \mathbf{F} (seq Road)

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 $\sigma \in \mathbf{allroutes} \cup f(x, y) \Leftrightarrow$
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 $((x \in (\sigma;f)(1) \wedge y \in (\sigma;f)(\#\sigma)) \vee (y \in (\sigma;f)(1) \wedge x \in (\sigma;f)(\#\sigma))) \wedge$
 $\{p: \text{Place} \mid \#\{i: \text{dom } \sigma \mid p \in \sigma(i)\} > 2\} = \emptyset$