

**Start Time:**

**Your name:**

**Stop Time:**

**Integrity signature:**

Suggested time limit 15 minutes, not counting download and upload. Please add explanation if over 20 minutes.

**Definition:** Recall that for  $v$  and  $w$  strings,  $v \circ w = vw$  is the concatenation of  $v$  and  $w$ . Let the concatenation  $R \circ S$  of two sets  $R$  and  $S$  of strings in  $\Sigma^*$  be the set of strings

$$R \circ S = \{v \circ w : v \in R \text{ and } w \in S\}.$$

1. Let  $\Sigma^* = \{0, 1\}$ . Suppose  $R$  and  $S$  are subsets of  $\Sigma^*$  (i.e., they are unary relations.) Further suppose  $R$  and  $S$  are decidable. Prove that  $R \circ S$  is decidable (by giving an algorithm that decides  $R \circ S$  in terms of algorithms that decide  $R$  and decide  $S$ ).