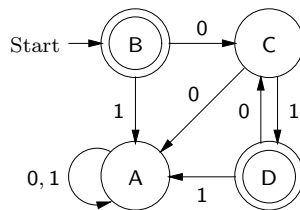


## Exercise Set 5

Due by 4:00 p.m. on Tuesday, November 25

### Exercise 1 (20 points)

Let  $M$  be the DFA



Give a step-by-step explanation of how our DFA minimization algorithm turns  $M$  into a DFA  $N$  with as few states as possible. Draw  $N$  and use Forlan to check that your final answer is correct. (Include a transcript of your Forlan session.)

### Exercise 2 (15 points)

Find DFAs  $M_1$  and  $M_2$  such that the DFAs

$$N_1 = \mathbf{minus}(M_1, M_2),$$

$$N_2 = \mathbf{inter}(M_1, \mathbf{complement}(M_2, \emptyset))$$

are *not* equivalent. Use Forlan to check that your answer is correct, and to show how the languages accepted by  $N_1$  and  $N_2$  are related. (Include a transcript of your Forlan session.)

### Exercise 3 (65 points)

Define  $\mathbf{IFF} \in \{0, 1\}^* \times \{0, 1\}^* \rightarrow \mathbf{Lan}$  by: for all  $x, y \in \{0, 1\}^*$ ,

$$\mathbf{IFF}(x, y) = \{ w \in \{0, 1\}^* \mid x \text{ is a substring of } w \text{ iff } y \text{ is a substring of } w \}.$$

(a) Explain how some of the functions/algorithms that we have studied can be used to define a function/algorithm  $\mathbf{iffDFA} \in \{0, 1\}^* \times \{0, 1\}^* \rightarrow \mathbf{DFA}$  such that, for all  $x, y \in \{0, 1\}^*$ ,  $\mathbf{iffDFA}(x, y)$  is a DFA, with as few states as possible, such that  $L(\mathbf{iffDFA}(x, y)) = \mathbf{IFF}(x, y)$ . Prove that your answer is correct. [40 points]

(b) Turn the definition of  $\mathbf{iffDFA}$  into an SML/Forlan function

```
val iffDFA : str * str -> dfa
```

You should assume that `iffDFA` will only be called with elements of  $\{0, 1\}^*$ . Evaluate the declaration

```
val dfa = iffDFA(Str.fromString "0011", Str.fromString "1100");
```

Display `dfa` using `DFA.output`. Also draw `dfa`, doing your best to make its structure clear. (Include a transcript of your Forlan session.) [25 points]