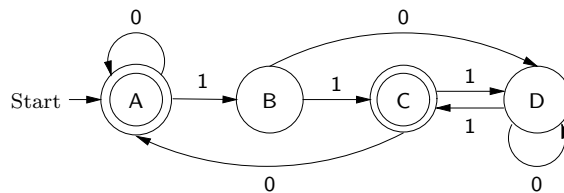


## Exercise Set 5

Due by 4:00 p.m. on Tuesday, November 20

### Exercise 1 (20 points)

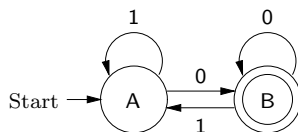
Let  $M$  be the DFA



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 (20 points)

Let  $M$  be the FA



Give a step-by-step explanation of how our FA-to-regular expression conversion algorithm turns  $M$  into a regular expression  $\alpha$ , where the regular expression simplification function  $simp \in \mathbf{Reg} \rightarrow \mathbf{Reg}$  is **simplify(weakSubset)**. Use Forlan to carry out the calls to  $simp$ . Also use Forlan to check that your final answer is correct. (Include a transcript of your Forlan session.)

### Exercise 3 (60 points)

Define  $\mathbf{Sur} \in \{0, 1, 2\}^* \times \{0, 1, 2\}^* \times \{0, 1, 2\}^* \rightarrow \mathbf{Lan}$  by: for all  $x, y, z \in \{0, 1, 2\}^*$ ,  $\mathbf{Sur}(x, y, z) = \{w \in \{0, 1, 2\}^* \mid \text{for all } u, v \in \{0, 1, 2\}^*, \text{ if } w = uyv, \text{ then } x \text{ is a suffix of } u \text{ and } z \text{ is a prefix of } v\}$ . (“sur” is short for “surround”.)

(a) Explain how some of the functions/algorithms that we have studied can be used to define a function/algorithm  $\mathbf{surDFA} \in \{0, 1, 2\}^* \times \{0, 1, 2\}^* \times \{0, 1, 2\}^* \rightarrow \mathbf{DFA}$  such that, for all  $x, y, z \in \{0, 1, 2\}^*$ ,  $\mathbf{surDFA}(x, y, z)$  is a DFA, with as few states as possible, such that  $L(\mathbf{surDFA}(x, y, z)) = \mathbf{Sur}(x, y, z)$ . Prove that your answer is correct. [40 points]

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

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

You should assume that  $\mathbf{surDFA}$  will only be called with elements of  $\{0, 1, 2\}^*$ . Evaluate the declaration

```
val dfa =  
  surDFA(Str.fromString "00",  
         Str.fromString "11",  
         Str.fromString "22");
```

Display  $\mathbf{dfa}$  using  $\mathbf{DFA.output}$ . Also draw  $\mathbf{dfa}$ , doing your best to make its structure clear. (Include a transcript of your Forlan session.) [20 points]