Name: ________________

Student number: ________________

Exercise 1 (Regular Languages). (13 points)

(i) Give a regular expression that describes the language $\boxed{2}$

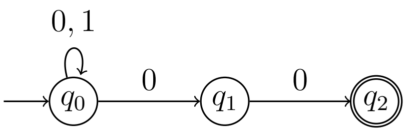
$$L := \{w \in \{0,1\}^* \mid w = 0 \text{ or } w \text{ ends with } 00\}$$

(ii) Give a nondeterministic finite automaton, possibly with ϵ-transitions (ϵ-NFA), that recognises the language which is given by the regular expression $\boxed{3}$

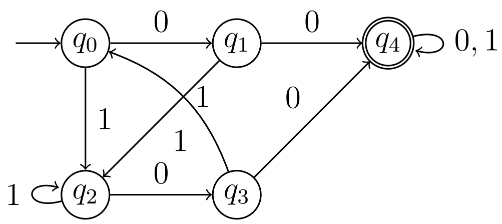
$$\alpha := (11 + 0)^*(00 + 1)^*$$

(iii) Show that the automaton constructed in (ii) accepts the word $w := 1101$. $\boxed{1}$

(iv) Apply the powerset construction to turn the following nondeterministic finite automaton (NFA) $\mathfrak{A}$ into a deterministic finite automaton (DFA) $\mathfrak{A}'$. $\boxed{3}$



(v) Minimise the following deterministic finite automaton (DFA) $\mathfrak{A}$. $\boxed{5}$
(**Reminder:** the minimal DFA is obtained by merging equivalent states. Here, two states are considered equivalent if they accept the same outgoing words.)



Exercise 2 (Context-Free Languages). (12 points)

(i) Give a context-free grammar G which generates the language $\boxed{5}$

$$L := \{a^i b^j c^k \mid i, j, k \geq 1 \text{ and } (i \neq j \text{ or } j \neq k)\}.$$

(ii) Give a derivation of the word $aabcc \in L$ from the start symbol of G. $\boxed{1}$

(iii) Let G' be the following context-free grammar: $\boxed{5}$

$$\begin{array}{lcl} S & \rightarrow & SA \mid a \\ A & \rightarrow & BS \\ B & \rightarrow & BB \mid BS \mid b \mid c \end{array}$$

and let $w := acbaa$. Employ the CYK-Algorithm to show that $w \in L(G')$. Use the following table to compute the sets

$$N_{i,j} := \{A \in N \mid A \Rightarrow^* w[i,j]\} \qquad (1 \leq i \leq j \leq 5)$$

where $w[i,j] := a_i \dots a_j$ for $w = a_1 a_2 a_3 a_4 a_5$.

$i \backslash j$	1	2	3	4	5
1					
2	X				
3	X	X			
4	X	X	X		
5	X	X	X	X	