Exercise 12.1.

Let $B$ be the following Büchi automaton:

(a) Execute the emptiness algorithm $\text{NestedDFS}$ on $B$.
(b) Recall that $\text{NestedDFS}$ is a non-deterministic algorithm and different choices of runs may return different lassos. Which lassos of $B$ can be found by $\text{NestedDFS}$?
(c) Show that $\text{NestedDFS}$ is non-optimal by exhibiting some search sequence on $B$.
(d) Execute the emptiness algorithm $\text{SCCsearch}$ on $B$.
(e) Which lassos of $B$ can be found by $\text{SCCsearch}$?

Exercise 12.2.

Let $B$ be the following Büchi automaton.

(a) For every state of $B$, give the discovery time and finishing time assigned by a DFS on $B$ starting in $s_0$ (i.e. the moment they first become grey and the moment they become black). Visit successors $s_i$ of a given state in the ascending order of their indices $i$. For example, when visiting the successors of $s_2$, first visit $s_3$ and later $s_4$.
(b) The language of $B$ is not empty. Give the witness lasso found by applying $\text{NestedDFS}$ to $B$ following the same convention for the order of successors as above.
Given a non-empty NBA, we use the following definition of optimal execution of NestedDFS: the algorithm reports NONEMPTY at the earliest time such that all the states of a witness lasso have been explored. Is the execution in (b) optimal? Does there exist an optimal execution of NestedDFS on $B$ with a different order for visiting successors?

**Exercise 12.3.**

A Büchi automaton is weak if none of its strongly connected components contains both accepting and non-accepting states. Give an emptiness algorithm for weak Büchi automata. What is the complexity of the algorithm?