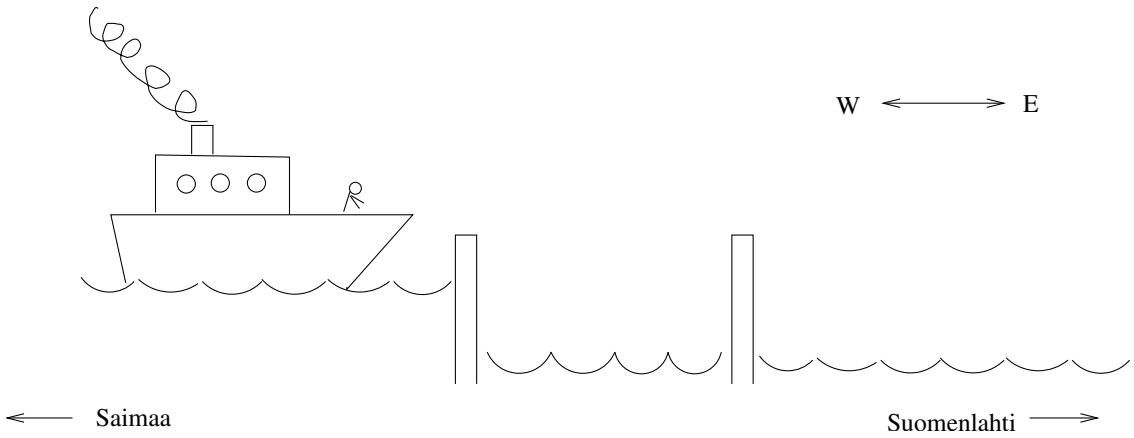
Exercise session 3

1. Let's have alphabet $\Sigma = \{a, b\}$. Construct a finite automaton, which recognizes the following language:

   a) $L(M) = L(\emptyset)$
   b) $L(M) = L(\emptyset^*)$
   c) $L(M) = L(\epsilon)$
   d) $L(M) = L(\epsilon^*)$
   e) $L(M) = L(\Sigma^*)$



2. Construct a lock automaton for a channel, which opens and closes the locks and increases and decreases the water level automatically. The Western lock gate can be opened only when the water is up and the Eastern gate only when the water is down. You can control the water level only when both gates are closed. The automaton gets the following input data from the control system:

   WD = water down
   WU = water up
   SW = a ship from West
   SE = a ship from East
   GC = gates closed
   SL = a ship in lock

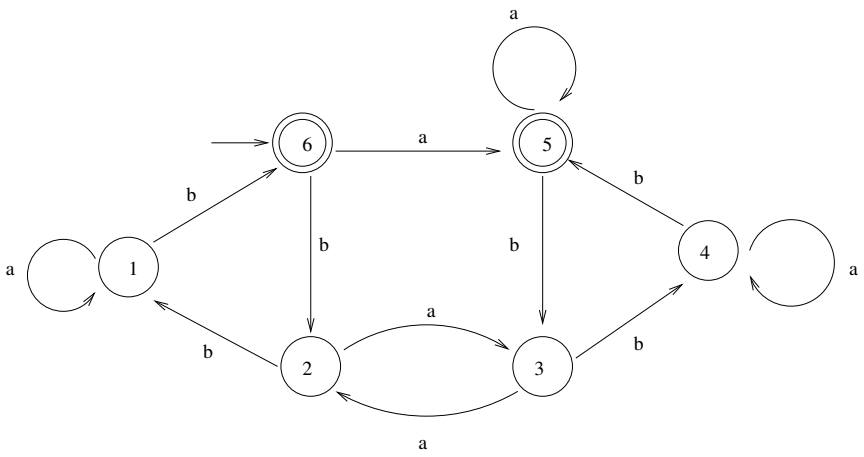
You may suppose that between the ships the lock automaton waits one gate open, until the next ship arrives.

(Notice! The automaton doesn't have any special initial or final states.)

3. Let $\Sigma = \{0, 1\}$. Construct a deterministic finite automaton M, which recognizes the following language

   a) $L(M) = \{w|$the length of w is odd$\}$
   b) $L(M) = \{w|$number of 1s in w is multiple of three$\}$
   c) $L(M) = \{w|w$ has even number of 1s and 0s$\}$

4. Create a minimum automaton that is equivalent to the following deterministic finite automaton.



5. Let's consider the comic in the lecture material about a nondeterministic automaton consulting the doctor. Which middle phases does the operation consist of? Does everything go as it should?

6. Invent at least one phenomenon in your everyday life, which can be described as a nondeterministic automaton. Draw the transition diagram of your automaton. Can you transform it to a deterministic one?

7. Generating a regular language: "The Poem Automat" **2 points**

   Implement a program that creates rows according to the regular expression (the)(ATTR)* SUBJ PRED the (ATTR)* OBJ(ATTRIB$\cup\epsilon$) Languages ATTR, SUBJ, OBJ, PRED and ATTRIB consist of the following words, for example:

   ATTR = {fat, black}
   SUBJ = {cat, moon, fish}
   OBJ = {cat, moon, fish}
   PRED = {shines, watches, swims}
   ATTRIB = {in the sky, in the lake}

   Your program can now produce 'verses' like the following:

   The black cat watches the fat fish in the lake
   The moon swims in the sky

   NB! Specify that not all predicates may be followed by an object (e.g. swims).

   Expand the example as you wish with words that fit into the poem! Add the exclamations

   "What a (ATTR) (SUBJ)!"

   and the questions

   "Are you a (ATTR) (SUBJ)?"

   Hand in the code of your program and examples of your outputs (poems) to the instructor! Be ready to represent your program/poems in the art exhibition!