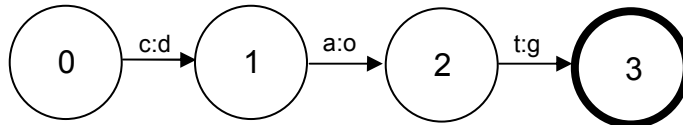# Computational Machines

by Tom Payne

The following is a diagram of a machine that changes the English word "cat" into the English word "dog". All such machines start with a circle numbered "0" and end with a darker circle. The numbers other than "0" don't really matter:

Machine #1. Input: "cat" Output: "dog"

Here is another machine that does the same thing, but will also change the nonsense word "tac" into "god" (If you try to process "tac" with machine #1 it will choke and die):

Machine #2. Input: "cat" Output: "dog",
   Input: "tac" Output "god"
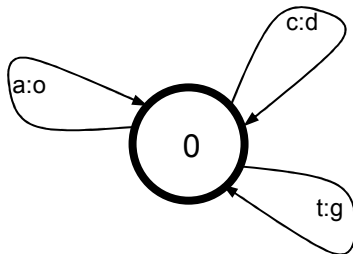
Machine #2 will actually accept an infinite number of inputs, most of which are not words in any language, for example cccc, ccat, caaat, ccccccccccccttttttttttttttttt, ttttttttt . . . *ad infinitum*.

Problem #1: Explain how this can be.

The fact that the arrows loop back to the same circle they start with means that once a letter is processed, it can be processed again. Therefore any number of "c" "a" and "t" letters, in any order, can be processed by this machine. "cat" is just one of the infinite number of possibilities.

Now, here is a machine that will process the name "Kate" and produce several distinct outputs:

Machine #3. Input: "Kate" Outputs: ??
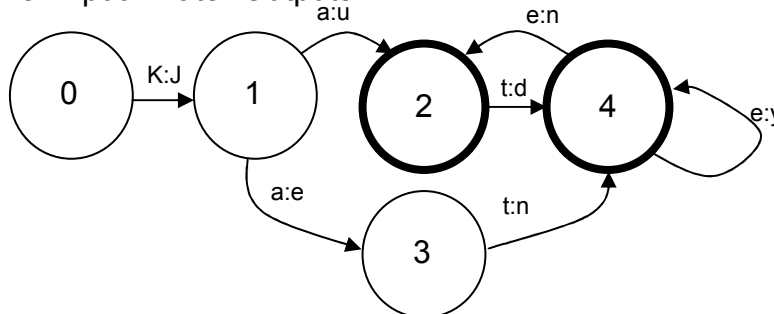
Problem 2: Is the number of permissible inputs for Machine #3 infinite? Why or why not?

Yes, because "e" can be processed an infinite number of times, therefore any combination that starts out with Kate... and includes any number of "e" letters can be processed (e.g., Katee, Kateeeeeee . . . etc.). Also, there is a potential loop consisting of the sequence "et". So the machine could process "Katet, Katetet, Katetetetete . . . on and on). There may be other "loops" as well that contribute to the infinite possibilities of this machine.

Problem 3: What are two common 4-letter girl's names that are permissible outputs of Machine #3?

Jenn, and Judy.

Problem 4: Now draw your own machine that will change "Tom Cruise" into "Ali Landry" using four or fewer circles (your machine must start over when it encounters a space).

There is a large number (maybe infinite?) of machines that will do this. Here is one: