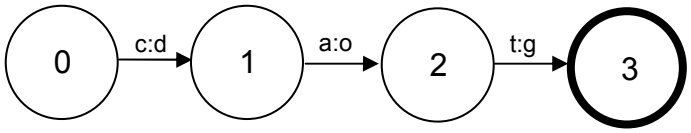
Computational Machines

by Tom Payne

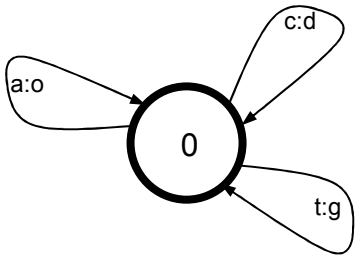
The following is a diagram of a machine that changes the English word "cat" into the English word "dog". All such machines start with a circle numbered "0" and end with a darker circle. The numbers other than "0" don't really matter:

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"

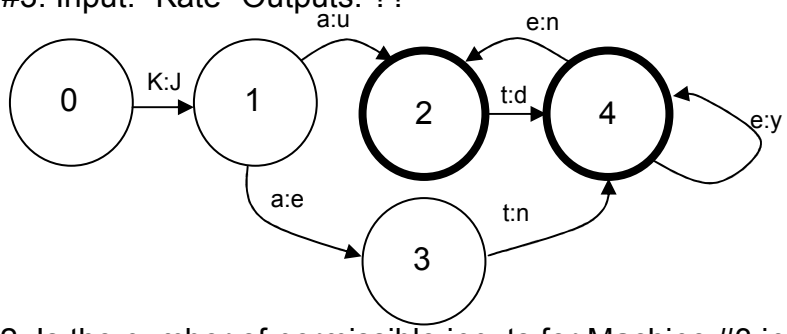


Machine #2 will actually accept an infinite number of inputs, most of which are not words in any language, for example cccc, ccat, caaat, ccccccccccctttttttttttttt, ttttttttt . . . *ad infinitum*.

Problem #1: Explain how this can be.

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?

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

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).

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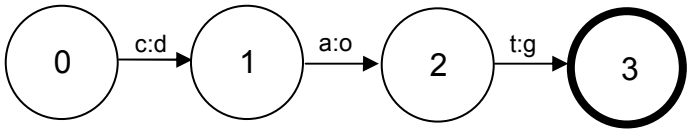

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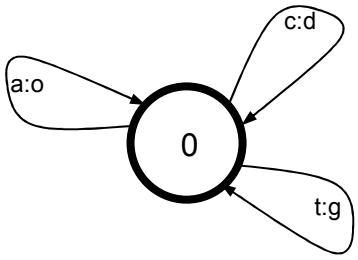


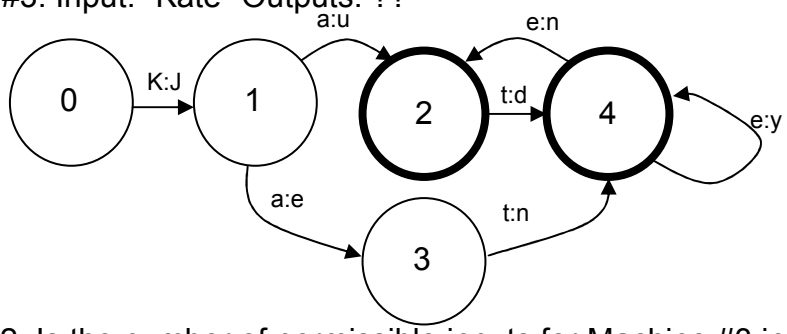
Machine #2 will actually accept an infinite number of inputs, most of which are not words in any language, for example cccc, ccat, caaat, ccccccccccctttttttttttttt, ttttttttt . . . *ad infinitum*.

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?

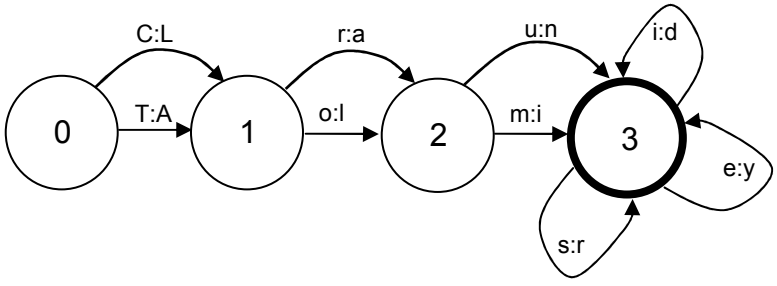
Yes, because "e" can be processed an infinite number of times, therefore any combination that starts out with Kate... and includes any number of "e" letters can be processed (e.g., Katee, Kateeeeeee . . . etc.). Also, there is a potential loop consisting of the sequence "et". So the machine could process "Katet, Katetet, Katetetetetete . . . 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:



Maasai

by Doris L. Payne

Maasai is a language spoken by about 800,000 people in East Africa, mostly in Kenya and Tanzania.

As with many languages in East Africa, "tone" is very important in Maasai. The different tones are written as marks above some letters. For example, the letters á, í and ó are all pronounced with high tone. The letters à, ì and ò are all pronounced with low tone. If there is no mark over a letter, it is pronounced with "mid tone," half way in between high and low.

There are also some letters in the Maasai alphabet that are not used in English. For example, "ɔ" is a sound like the English word "awe." "ɛ" is similar to the vowel sound in "let," "ʊ" is like the vowel sound in "hood" and "ɪ" is like the vowel sound in "lit." You don't need to be able to pronounce these words in order to solve the problem, however, you should pay very close attention to the letters and the tone marks.

The following are some sentences in Maasai, and the English translations in random order. Indicate which translation goes with each Maasai sentence by placing the letter of the correct translation in the space provided:

1. éósh ɔlmʊraní ɔlásʊráì ____
2. áadɔ́l ɔlásʊráí ____
3. áaósh ɔlmʊraní ____
4. ídɔ́l ɔlmʊránì ____
5. íóshokí ɔlmʊránì ɔlásʊráì ____
6. ádúŋokí ɔlmʊránì ɔlcɛtá ____
7. ádúŋ ɔlcɛtá ____
8. áaduŋokí ɔlmʊraní ɔlcɛtá ____
9. áadúŋ ɔlmʊraní ____
10. édúŋ ɔlmʊraní ____

English translations in *random order*

A. 'The warrior cuts me.'
B. 'The warrior cuts the tree for me.'
C. 'The warrior cuts it.'
D. 'I cut the tree for the warrior.'
E. 'The warrior hits me.'
F. 'You see the warrior.'
G. 'The warrior hits the snake.'
H. 'The snake sees me.'
I. You hit the snake for the warrior.'
J. 'I cut the tree.'

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1. éósh ɔlmʊraní ɔlásʊráì _G___
2. áadɔ́l ɔlásʊráí _H___
3. áaósh ɔlmʊraní _E___
4. ídɔ́l ɔlmʊránì _F___
5. íóshokí ɔlmʊránì ɔlásʊráì _I___
6. ádúŋokí ɔlmʊránì ɔlcɛtá _D___
7. ádúŋ ɔlcɛtá _J___
8. áaduŋokí ɔlmʊraní ɔlcɛtá _B___
9. áadúŋ ɔlmʊraní _A___
10. édúŋ ɔlmʊraní _C___

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J. 'I cut the tree.'

YOUR NAME: REGISTRATION #:

(10 points)

(M) No smoke without fire (1/3)

Think about the meaning of the following sentence:

(1) The 2010 Winter Olympics were in Canada.

Assuming that we only know sentence 1 to be true, is sentence 2 necessarily true?

(2) The 2010 Winter Olympics were in Vancouver.

The answer is no. Assuming we only know sentence 1 to be true, the 2010 Winter Olympics could have taken place in any Canadian city, but not necessarily in Vancouver.

Now examine the relationship between sentences 3 and 4. Assuming sentence 3 is true, is sentence 4 now necessarily true?

(3) The 2010 Winter Olympics were in Vancouver.
(4) The 2010 Winter Olympics were in Canada.

Now the answer is yes. Since Vancouver is a Canadian city, any event which occurs in Vancouver necessarily occurs in Canada.

The logical relationship which holds between sentences 3 and 4 is called an *entailment*. In formal terms, sentence A entails sentence B if whenever A is true, B is necessarily true. The entailment relationship is typically represented graphically this way: A **||-** B.

Here are some more examples of the entailment relationship between sentences:

(5) Shaun White is a Winter Olympian **||-** Shaun White is an Olympian
(6) Shaun White is an Olympian **||-** Shaun White is an athlete
(7) Shaun White won a gold medal **||-** Someone won a gold medal

Notice that the entailment relationship must hold in the specified direction but will not necessarily hold in both directions. So, sentence 3 entails sentence 4 even though sentence 4 does not entail sentence 3.

YOUR NAME: REGISTRATION #:

(M) No smoke without fire (2/3)

Now examine the relationship between sentences 8 and 9.

(8) I did not see Shaun White win the gold medal in the 2010 Winter Olympics.
(9) Shaun White won the gold medal in the 2010 Winter Olympics.

Sentences 8 and 9 illustrate a relationship called *presupposition*. In this pair of sentences, the information presented in sentence 9 is what the speaker assumes (or presupposes) to be the case when uttering sentence 8. That is, to say *"I did not see Shaun White win the gold medal"* assumes the belief that Shaun White won a gold medal. In formal terms, sentence A presupposes sentence B if A not only implies B but also implies that the truth of B is somehow taken for granted. A presupposition of a sentence is thus part of the background against which its truth or falsity is judged. The presupposition relationship is typically represented graphically this way: A >> B

Here are some more examples of presuppositions (where the first sentence in each pair presupposes the second):

(10) I regret not seeing Shaun White's gold medal run >> Shaun White had a gold medal run
(11) Shaun White continues to rule the halfpipe >> Shaun White had been ruling the halfpipe
(12) Snowboarding is now an Olympic sport >> Snowboarding was once not an Olympic sport

YOUR NAME: REGISTRATION #:

(M) No smoke without fire (3/3)

M1. For any given pair of sentences, the entailment and presupposition relationships may or may not hold, together or separately.

For each of the following possible combinations, your task is to provide one example of a pair of sentences with an explanation of your reasoning for proposing your pair of sentences as a valid and convincing example in each case.

a. A pair of sentences in which sentence A **neither entails nor presupposes** sentence B.

b. A pair of sentences in which sentence A **entails and presupposes** sentence B.

c. A pair of sentences in which sentence A **presupposes but does not entail** sentence B.

d. A pair of sentences in which sentence A **entails but does not presuppose** sentence B.

2010 Solutions

(M) No smoke without fire (1/2)

M1. For any given pair of sentences, the entailment and presupposition relationships may or may not hold, together or separately.

a. A pair of sentences in which sentence A **neither entails nor presupposes** sentence B.

A. Shaun White is a Winter Olympian.
B. The 2010 Winter Olympics were in Vancouver.

Explanation: Sentences A and B are unrelated.

Entailment: Given that sentence A is true, there is no way to know whether sentence B is true or false. If Shaun White is a Winter Olympian, the 2010 Winter Olympics may or may not have taken place in Vancouver. Thus, there is no entailment relationship between these two sentences.

Presupposition: When uttering sentence A, a speaker would not take sentence B for granted (or assume that sentence B is background information against which the truth or falsity of sentence A would be judged). A speaker would not utter "Shaun White is a Winter Olympian" and assume the belief/take for granted that the 2010 Winter Olympics were in Vancouver.

b. A pair of sentences in which sentence A **entails and presupposes** sentence B.

A. Shaun White continues to rule the halfpipe
B. Shaun White had been ruling the halfpipe.

Entailment: If sentence A is true, sentence B is necessarily true. The entailment relationship between these sentences relies on the meaning of the verb *continue* – to *continue to rule* the halfpipe, Shaun White had to be ruling the halfpipe already. Thus, sentence A entails sentence B.

Presupposition: When uttering sentence A, a speaker would take sentence B for granted (or assume that sentence B is background information against which the truth or falsity of sentence A would be judged). A speaker who utters "Shaun White continues to rule the halfpipe" assumes the belief/takes for granted that Shaun White had been ruling the halfpipe. Thus, sentence A presupposes sentence B.

(M) No smoke without fire (2/2)

M1. For any given pair of sentences, the entailment and presupposition relationships may or may not hold, together or separately.

c. A pair of sentences in which sentence A **presupposes but does not entail** sentence B.

A. I did not see Shaun White win the gold medal in the 2010 Winter Olympics.
B. Shaun White won the gold medal in the 2010 Winter Olympics.

Entailment: If sentence A is true, sentence B *may or may not* be true. The absence of an entailment relationship between these sentences relies on the words "did not see" – if it is true that I *did not see* Shaun White win the gold medal, then Shaun White may or may not have won the gold medal. Thus, sentence A does not entail sentence B.

Presupposition: When uttering sentence A, a speaker would take sentence B for granted (or assume that sentence B is background information against which the truth or falsity of sentence A would be judged). Specifically, a speaker who utters "I did not see Shaun White win the gold medal in the 2010 Winter Olympics" assumes the belief that Shaun White did actually win the gold medal in the 2010 Winter Olympics. Thus, sentence A presupposes sentence B.

d. A pair of sentences in which sentence A **entails but does not presuppose** sentence B.

A. Shaun White did not win the gold medal in the 2010 Winter Olympics.
B. Shaun White did not both win the gold medal in the 2010 Winter Olympics and injure his ankle.

Entailment: If Shaun White did not win the gold medal in the 2010 Winter Olympics, then he necessarily did not *both* win that gold medal *and* injure his ankle, since he definitely did not win the gold medal. If one fact is not the case (the fact presented in sentence A), then both facts cannot be the case, either (the fact presented in sentence A + the new fact added to it in sentence B). Thus if sentence A is true, sentence B is *necessarily* true. Thus, sentence A entails sentence B.

Presupposition: When uttering sentence A, a speaker would not take sentence B for granted (or assume that sentence B is a background against which the truth or falsity of sentence A would be judged). Specifically, by uttering "Shaun White did not win the gold medal in the 2010 Winter Olympics" a speaker could not assume the belief that Shaun White did not both win the gold and injure his ankle, or that Shaun White either won a gold medal or injured his ankle. Whether Shaun White injured his ankle would not be information taken for granted when uttering "Shaun White did not win the gold medal in the 2010 Winter Olympics." Thus, sentence A does not presuppose sentence B.