Dear colleagues,

In our bridge (discrete mathematics and intro to proofs course), I am introducing "flowcharts" as a form of organizing the rules of inference, as opposed to using the so-called syllogism form. The idea is that the flow of logic for a proof could be thought of as a big puzzle, putting together the right puzzle pieces. Not only can this help the student organize the narrative form of a proof, I believe this can be extremely helpful in helping the student who is new to proofs see if their argument really works.

I just gave students the handout titled "Some of the main flowchart forms". I am proposing a follow-up handout when we get to set membership, tentatively titled "Flowchart forms for using/proving $x \in S$".

I think we often think of there being two fundamentally different forms of sets (a comma-separated roster, or set builder notation). I would contend that there are *three* forms:

1. A "roster method", such as $\mathbb{Z}_{>0} = \{1, 2, 3, 4, \dots\}$

2. A set-builder form, where the conditions both before *and* after the colon must be satisfied. Generically, I wrote this as $S = \{z \in T : P(z)\}$. For a specific example, consider $Z(G) = \{g \in G : \forall h \in G, gh = hg\}$. I am using $P(z)$ to generically represent the condition $\forall h \in G, gh = hg$.

3. A "gather using a running set" form of set definition, where the roles of the text before and after the colon are *very different*. Now, for each instance of the condition after the colon being satisfied, the expression before the colon is an element in the set. As an example, consider for a function $f : A \to B$, the set $\text{range}(f) = \{f(x) : x \in A\}$.

Note that when we compare the last two sets

$$Z(G) = \{g \in G : \forall h \in G, gh = hg\}$$

and

$$\text{range}(f) = \{f(x) : x \in A\},$$

the $g \in G$ and $f(x)$ are both in front of the colon, but play *very* different roles. Similarly, the texts $\forall h \in G, gh = hg$ and $x \in A$ which both appear *after* the colons play *very* different functional roles in defining the set. I call the third type of set a "gather using a running set" method because I think of it being "as I run through each $x \in A$, where A is my 'running set', I pick up an element called $f(x)$ and throw it into my set."