

## A Appendices

### A.1 Statistics of TABFACT Dataset

Table 6 provides the statistics of TABFACT (Chen et al., 2020), a recent large-scale table-based fact verification dataset on which we evaluate our method. Each evidence table comes along with 2 to 20 statements, and consists of 14 rows and 5-6 rows in average.

### A.2 Pre-defined Operations in Program Selection

Programs consists of operations, and the definition of operations are listed in Table 7, mainly following (Chen et al., 2020).

### A.3 Pre-defined Templates for Verbalization

In our proposed framework, there are 50 pre-defined operations, details are in Table 7. For each operation, we define templates for operation and its executed result. There are three types of executed results: (1) string or number type; (2) boolean type; (3) view or row type, where it is a sub-table or rows extracted from the evidence table.

We represent templates for different types of operations accordingly. The detailed templates are listed in the following Table 8, Table 9 and Table 10.

Split	Sentence	Table	Row	Col
Train	92,283	13,182	14.1	5.5
Val	12,792	1,696	14.0	5.4
Test	12,779	1,695	14.2	5.4

Table 6: Statistics of TABFACT and the split of Train/Val/Test.

Operations	Arguments	Output	Function
count	View	Number	Return the number of rows in the View
	View, Header String, Cell String/ Number	Bool	Return whether the cell string/number exists under the Header Column of the given View
without	View, Header String, Cell String/ Cell Number	Bool	Return whether the cell string/number does not exist under the Header Column of the given view
none	String	Bool	Whether the string represents None, like “None”, “No”, “-”, “No information provided”
before/after	Row, Row	Row	Returns whether row1 is before/after row2
first/second/ third/fourth	View, Row	Bool	Returns whether the row is in the first/second/ third position of the view
avg/sum/ max/min	View, Header String	Number	Returns the average/summation/max/min value under the Header Column of the given view
argmin/ argmax	View, Header String	Row	Returns the row with the max/min value under the Header Column of the given view
Hop	Row, Header String	Number/ String	Returns the cell value under the Header Column of the given row
diff/add	Number, Number	Number	Perform arithmetic operations on two numbers
greater/less	Number, Number	Bool	Returns whether the first number is greater/less than the second number
Equal/ Unequal	String, String/ Number, Number	Bool	Compare two numbers or strings to see whether they are the same
filter_eq/ filter_greater/ filter_less/ filter_greater_or_equal/ filter_less_or_equal	View, Header String, Number	View	Returns the subview of the given with the cell values under the Header column greater/less/eq/... against the given number
all_eq/all_greater/ all_less/ all_greater_or_equal/ all_less_or_equal	View, Header String, Number	Bool	Returns the whether all of the cell values under the Header column are greater/less/eq/... against the given number
and/or	Bool, Bool	Bool	Returns the Boolean operation results of two inputs

Table 7: Details of pre-defined operations.

Operation operator, [arguments], answer	Templates	
	Operation	Operation Results
count, [verb_arg1], ans	the number of [verb_arg1]	the number of [verb_arg1] is [string(ans)]
avg/sum/max/min, [verb_arg1,verb_arg2], ans	average/sum/maximum/minimum [verb_arg1] where column [verb_arg2]	average/sum/maximum/minimum [verb_arg1] where column [verb_arg2] is [string(ans)]
add/diff, [verb_arg1, verb_arg2], ans	sum/difference of [verb_arg1] and [verb_arg2]	sum/difference of [verb_arg1] and [verb_arg2] is [string(ans)]
uniq_num/uniq_string, [verb_arg1, verb_arg2],ans	the unique value of [verb_arg1] in column [verb_arg2]	the unique value of [verb_arg1] in column [verb_arg2] is [string(ans)]
most_freq, [verb_arg1, verb_arg2],ans	the most frequent value of [verb_arg1] in column [verb_arg2]	the most frequent value of [verb_arg1] in column [verb_arg2] is [string(ans)]
half/one_third, [verb_arg1], ans	half/one third of value in [verb_arg1]	half/one third of value in [verb_arg1] is [string(ans)]
num_hop, [verb_arg1, verb_arg2],ans	the first value of [verb_arg1] where column [verb_arg2]	the first value of [verb_arg1] where column [verb_arg2] is [string(ans)]

Table 8: Templates for operations with string or number type executed results.

Operation operator, [arguments], answer	Templates	
	Operation	Operation Results
only, [verb_arg1], ans:true/false	number of rows in [verb_arg1]	number of rows in [verb_arg1] [true:is/false:is not] one
several, [verb_arg1], ans:true/false	number of rows in [verb_arg1]	number of rows in [verb_arg1] [true:is/false:is not] more than one
zero/none, [verb_arg1], ans:true/false	the [verb_arg1]	the [verb_arg1] [true:is/false:is not] zero/none
first/second/third/fourth, [verb_arg1, verb_arg2], ans:true/false	the first/second/third/fourth row [verb_arg2] in [verb_arg1]	the first/second/third/fourth row in [verb_arg1] [true:is/false:is not] row [verb_arg2]
and/or, [verb_arg1, verb_arg2], ans:true/false	[verb_arg1] and/or [verb_arg2]	[verb_arg1] and/or [verb_arg2] [true:is/false:is not] true
greater/less, [verb_arg1, verb_arg2], ans:true/false	[verb_arg1] greater/less than [verb_arg2]	[verb_arg1] [true:is/false: is not] greater/less than [verb_arg2]
equal, [verb_arg1, verb_arg2], ans:true/false	[verb_arg1] equal to [verb_arg2]	[verb_arg1] [true:is/false: is not] equal to [verb_arg2]
unequal, [verb_arg1, verb_arg2], ans:true/false	[verb_arg1] not equal to [verb_arg2]	[verb_arg1] [true:is/false: is not] not equal to [verb_arg2]
with/without, [verb_arg1, verb_arg2, verb_arg3], ans:true/false	[verb_arg1] where column [verb_arg2] with/without value [verb_arg3]	[verb_arg1] where column [verb_arg2] with/without value [verb_arg3] [true:is/false:is not] true
all_equal, [verb_arg1, verb_arg2, verb_arg3], ans:true/false	[verb_arg1] where column [verb_arg2] all equal to value [verb_arg3]	[verb_arg1] where column [verb_arg2] all equal to value [verb_arg3] [true:is/false:is not] true
all_less/all_greater, [verb_arg1, verb_arg2, verb_arg3], ans:true/false	[verb_arg1] where column [verb_arg2] all less/greater than value [verb_arg3]	[verb_arg1] where column [verb_arg2] all less/greater than value [verb_arg3] [true:is/false:is not] true
all_less_or_equal/ all_greater_or_equal, [verb_arg1, verb_arg2, verb_arg3], ans:true/false	[verb_arg1] where column [verb_arg2] all less/greater than or equal to value [verb_arg3]	[verb_arg1] where column [verb_arg2] all less/greater than or equal to value [verb_arg3] [true:is/false:is not] true

Table 9: Templates for operations with boolean type executed results.

Operation operator, [arguments], answer	Templates	
	Operation	Operation Results
before/after, [verb_arg1, verb_arg2], ans	[verb_arg1] before/after [verb_arg2]	[verb_arg1] before/after [verb_arg2] is row [indices of ans]
argmax/argmin, [verb_arg1, verb_arg2], ans	row where column [verb_arg2] with maximum/minimum value in [verb_arg1]	row where column [verb_arg2] with maximum/minimum value in [verb_arg1] is row [indices of ans]
filter_eq, [verb_arg1, verb_arg2, verb_arg3], ans	[verb_arg1] where column [verb_arg2] equal to value [verb_arg3]	[verb_arg1] where column [verb_arg2] equal to value [verb_arg3] is row [indices of ans]
filter_less/filter_greater, [verb_arg1, verb_arg2, verb_arg3], ans:true/false	[verb_arg1] where column [verb_arg2] less/greater than value [verb_arg3]	[verb_arg1] where column [verb_arg2] less/greater than value [verb_arg3] is row [indices of ans]
less_or_equal/ greater_or_equal, [verb_arg1, verb_arg2, verb_arg3], ans:true/false	[verb_arg1] where column [verb_arg2] less/greater than or equal to value [verb_arg3]	[verb_arg1] where column [verb_arg2] less/greater than or equal to value [verb_arg3] is row [indices of ans]

Table 10: Templates for operations with view or row type executed results.