

Tree Structure Analysis

Combinations Tested

- Constant tree:
 - Single input output
 - Multi input single output
 - Single input multi output
 - X inputs Y outputs ($1 < X < Y$)
 - X inputs Y outputs ($1 < Y < X$)
- Linear tree:
 - Single input output
 - Multi input single output
 - Single input multi output
 - X inputs Y outputs ($1 < X < Y$)
 - X inputs Y outputs ($1 < Y < X$)
 - Single categorical input
 - Mixed numerical & categorical input
 - Multi categorical input

General Tree Structure

▼ 8:			
tree_index:	8	name:	"tree"
num_leaves:	21	version:	"v4"
num_cat:	0	num_class:	1
shrinkage:	0.05	num_tree_per_iteration:	1
▼ tree_structure:		label_index:	0
split_index:	0	max_feature_idx:	0
split_feature:	0	objective:	"regression"
split_gain:	0.10196000337600708	average_output:	false
threshold:	0.32277838849773915	▼ feature_names:	
decision_type:	"<="	0:	"Column_0"
default_left:	true	monotone_constraints:	[]
missing_type:	"None"	▼ feature_infos:	
internal_value:	0	▶ Column_0:	{...}
internal_weight:	0		
internal_count:	632		
▶ left_child:	{...}		
▶ right_child:	{...}		

1 input 1 output numerical (constant)

General Tree Structure

```
▼ 8:
  tree_index:      8
  num_leaves:     21
  num_cat:         0
  shrinkage:       0.05
  ▼ tree_structure:
    split_index:   0
    split_feature: 0
    split_gain:    0.10196000337600708
    threshold:     0.32277838849773915
    decision_type: "<="
    default_left:  true
    missing_type:  "None"
    internal_value: 0
    internal_weight: 0
    internal_count: 632
    ▶ left_child:  {...}
    ▶ right_child: {...}
```

```
name:      "tree"
version:   "v4"
num_class: 1
num_tree_per_iteration: 1
label_index: 0
max_feature_idx: 0
objective:  "regression"
average_output: false
▼ feature_names:
  0:      "Column_0"
monotone_constraints: []
▼ feature_infos:
  ▼ Column_0:
    min_value: 0.00463202300460286
    max_value: 0.9997176732861306
    values:    []
```

1 input 1 output numerical (linear)

General Tree Structure

▼ tree_info:

▼ 0:

tree_index:	0
num_leaves:	24
num_cat:	0
shrinkage:	1
tree_structure:	
split_index:	0
split_feature:	2
split_gain:	0.9434239864349365
threshold:	0.6665317632867276
decision_type:	"<="
default_left:	true
missing_type:	"None"
internal_value:	0.484057
internal_weight:	0
internal_count:	647
▶ left_child:	{...}
▶ right_child:	{...}

name:	"tree"
version:	"v4"
num_class:	1
num_tree_per_iteration:	1
label_index:	0
max_feature_idx:	4
objective:	"regression"
average_output:	false
feature_names:	
0:	"Column_0"
1:	"Column_1"
2:	"Column_2"
3:	"Column_3"
4:	"Column_4"
monotone_constraints:	[]

5 inputs 5 outputs numerical (linear)

General Tree Structure

```
▼ tree_info:
  ▼ 0:
    tree_index:      0
    num_leaves:      26
    num_cat:          5
    shrinkage:        1
    ▼ tree_structure:
      split_index:    0
      split_feature:   0
      split_gain:      0.2277749925851822
      threshold:       0.9611304406466848
      decision_type:   "<="
      default_left:    true
      missing_type:    "None"
      internal_value:  0.498222
      internal_weight: 0
      internal_count:  647
      ▶ left_child:    {...}
      ▶ right_child:   {...}
```

```
name:      "tree"
version:    "v4"
num_class:  1
num_tree_per_iteration: 1
label_index: 0
max_feature_idx: 2
objective:  "regression"
average_output: false
▼ feature_names:
  0:      "Column_0"
  1:      "Column_1"
  2:      "Column_2"
monotone_constraints: []
▼ feature_infos:
  ▶ Column_0:  {...}
  ▶ Column_1:  {...}
  ▶ Column_2:  {...}
```

1 numerical 2 categorical inputs 5 outputs (linear)

General Tree Structure

▼ feature_infos:		name:	"tree"	▼ 3:	
▼ Column_0:		version:	"v4"	tree_index:	3
min_value:	0.00013469300448532007	num_class:	1	num_leaves:	26
max_value:	0.9997176732861306	num_tree_per_iteration:	1	num_cat:	3
values:	[]	label_index:	0	shrinkage:	0.05
▼ Column_1:		max_feature_idx:	4	▼ tree_structure:	
min_value:	0.000011634755366141114	objective:	"regression"	split_index:	0
max_value:	0.9983475113929496	average_output:	false	split_feature:	1
values:	[]	▼ feature_names:		split_gain:	0.7711219787597656
▼ Column_2:		0:	"Column_0"	threshold:	0.6388387594920623
min_value:	0.001353625715468154	1:	"Column_1"	decision_type:	"<="
max_value:	0.9966968538529769	2:	"Column_2"	default_left:	true
values:	[]	3:	"Column_3"	missing_type:	"None"
▼ Column_3:		4:	"Column_4"	internal_value:	0
min_value:	-1	monotone_constraints:	[]	internal_weight:	0
max_value:	2			internal_count:	647
▶ values:	[...]			▶ left_child:	{...}
▼ Column_4:				▶ right_child:	{...}
min_value:	-1				
max_value:	2				
▶ values:	[...]				

3 continuous 2 categorical inputs 5 outputs (linear)

Summary

Cached Data:

- Name
- Version
- Num_Class
- Num_Tree_Per_Iteration
- Objective
- Max feature idx
- Monotone constraints
- Parent tree info:
 - Index
 - Num leaves
 - Num cat
 - Shrinkage
 - Decision type
- Weights and Values

Computed Data:

- min/max col value
- Leaf/child values
- Split indices
- Split gains
- Threshold
- Bounds