

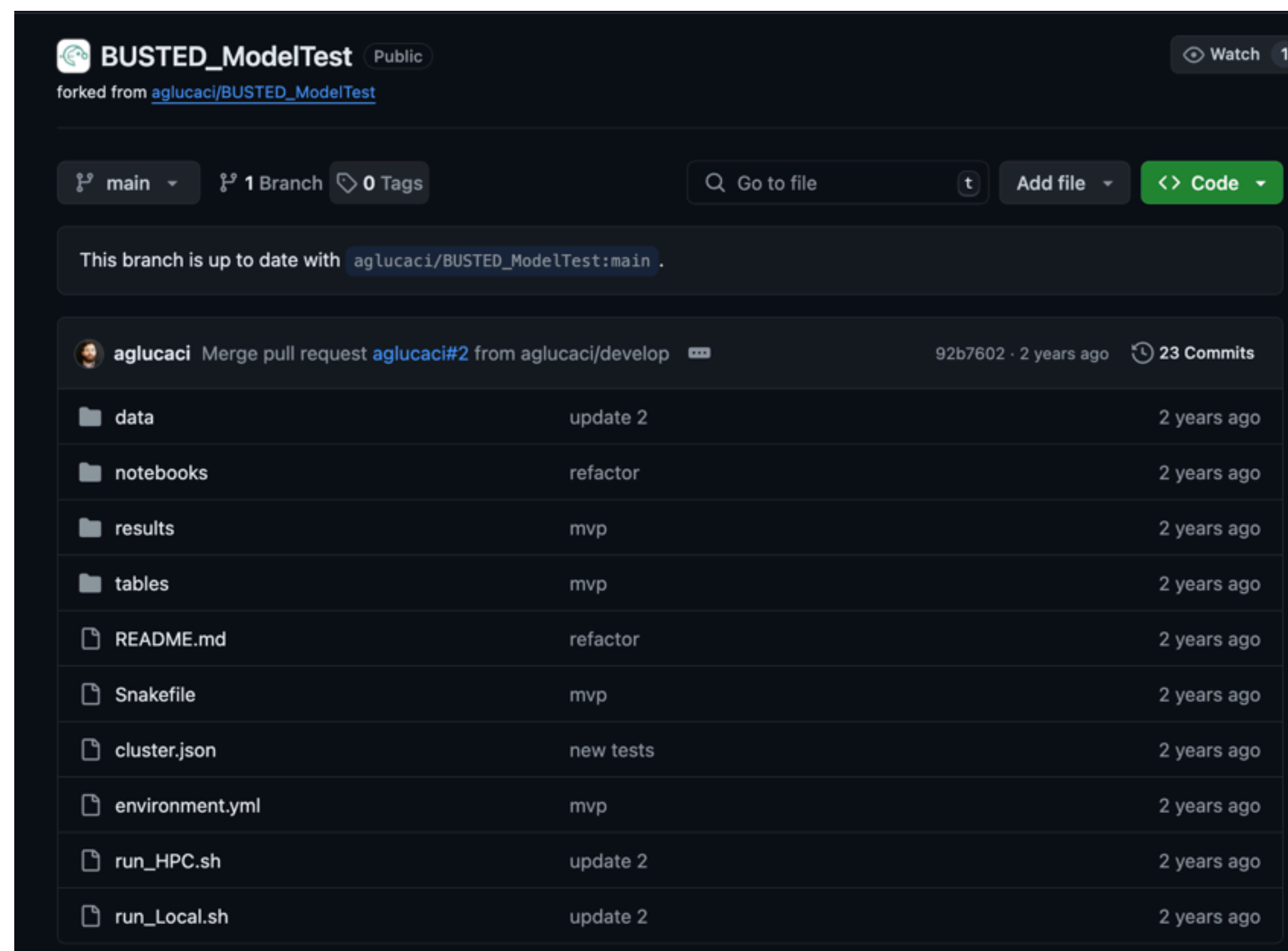
Substitution models in the BUSTED framework

Table 1. Substitution Models Considered in this Paper.

Model	Reference	Nonsynonymous Rates	Synonymous Rates	Multinucleotide Substitutions	Number of Parameters
BUSTED	Murrell et al. (2015)	Random effects branch–site modeled by a $K(=3)$ -bin discrete distribution	None	None	$B + 13 + 2 \times K$
+S	Wisotsky et al. (2020)	Random branch–site effects modeled by a $K(=3)$ -bin general discrete distribution	Random site effects modeled by an $L(=3)$ -bin unit mean general discrete distribution	None	$B + 11 + 2 \times (K + L)$
+MH	Lucaci et al. (2021)	Random branch–site effects modeled by a $K(=3)$ -bin general discrete distribution	None	Alignment-wide double- (δ) and triple- (ψ) nucleotide substitution rates	$B + 15 + 2 \times K$
+S+MH	This paper	Random branch–site effects modeled by a $K(=3)$ -bin general discrete distribution	Random site effects modeled by an $L(=3)$ -bin unit mean general discrete distribution	Alignment-wide double- (δ) and triple- (ψ) nucleotide substitution rates	$B + 13 + 2 \times (K + L)$

NOTE.— B , the number of branches in the phylogenetic tree. K and L are user-tunable parameters, set to 3 each by default.

BUSTED Model-testing application



The screenshot shows the GitHub repository page for **BUSTED_ModelTest**, which is a public repository forked from [aglucaci/BUSTED_ModelTest](#). The repository has 1 branch (main) and 0 tags. A message indicates that the current branch is up to date with `aglucaci/BUSTED_ModelTest:main`. Below this, a pull request is listed: **aglucaci** Merge pull request [aglucaci#2](#) from `aglucaci/develop`, dated 2 years ago, with 23 commits. The file list includes:

File	Commit Message	Time
data	update 2	2 years ago
notebooks	refactor	2 years ago
results	mvp	2 years ago
tables	mvp	2 years ago
README.md	refactor	2 years ago
Snakefile	mvp	2 years ago
cluster.json	new tests	2 years ago
environment.yml	mvp	2 years ago
run_HPC.sh	update 2	2 years ago
run_Local.sh	update 2	2 years ago

Example run

Once setup completes, we have provided a sample dataset `data/adh.nex`. To run this, the program will all ready be set up, it will look in the `data` folder for NEXUS files `.nex` and apply the model testing application to it.

To execute on your local computer type `run_Local.sh`, otherwise use `run_HPC.sh` to submit this job to your server.

This will produce the following JSON and likelihood fit (.fit) files

```
— results/
  |— adh.nex.BUSTEDS.json
  |— adh.nex.BUSTEDS.json.fit
  |— adh.nex.BUSTED.json
  |— adh.nex.BUSTED.json.fit
  |— adh.nex.BUSTEDS-MH.json
  |— adh.nex.BUSTEDS-MH.json.fit
  |— adh.nex.BUSTED-MH.json
  |— adh.nex.BUSTED-MH.json.fit
— tables/
  |— adh.nex.csv
```

Available at https://github.com/veg/BUSTED_ModelTest