# CSCI 5481 Homework 1

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September 9, 2018

## Homework 1: BURST

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### PRINT PYTHON FILE

```
%cat exercise01.py
```

```
# Output file for CSCI 5481 Fall 2018 Exercise 1
# Christopher White
# September 19, 2018
#
# Usage:
# exercise01.py -h
import sys, os
import argparse
from subprocess import Popen, PIPE

def make_arg_parser():
    parser = argparse.ArgumentParser(prog='exercise01.py',
                          # version="%prog 1.0",
                          formatter_class=argparse.ArgumentDefaultsHelpFormatter)
    parser.add_argument("-q","--query",
                        default=argparse.SUPPRESS,
                        required=True,
                        help="Path to query fasta [required]")
    parser.add_argument("-r","--ref",
                        default=argparse.SUPPRESS,
                        required=True,
                        help="Path to reference fasta [required]")
    parser.add_argument("-t","--taxonomy",
                        default=None,
                        required=True,
```

```
                    help="Path to taxonomy file [required]")
    parser.add_argument("-o","--output",
                    default=None,
                    required=True,
                    help="Path to output file [required]")
    parser.add_argument("-c","--command",
                    default='./burst',
                    help="Path to BURST command")
    parser.add_argument("-V","--verbose",
                    action="store_true",
                    help="Verbose output")
    return parser

# Runs BURST to search query sequences against reference sequences
def run_burst(query, ref, taxonomy, output, burst_cmd='./burst', verbose=False):
    """thread worker function"""

    cmd = burst_cmd + ' -q ' + query + ' -r ' + ref + ' -t ' + taxonomy + ' -o ' + output

    return run_command(cmd, verbose=verbose)

# runs the given command and returns return value and output
def run_command(cmd, verbose=False):
    if verbose:
        print(cmd)

    proc = Popen(cmd,shell=True,universal_newlines=True,stdout=PIPE,stderr=PIPE)

    stdout, stderr = proc.communicate('Running command')
    return_val = proc.returncode
    return str(return_val), stdout, stderr


if __name__ == '__main__':
    parser = make_arg_parser()
    args = parser.parse_args()

    return_value, stdout, stderr = run_burst(args.query, args.ref, args.taxonomy, args.outpu

    print('\nReturn Value: '+return_value)
    print('\nSTDOUT: ...\n'+stdout)
    print('\nSTDERR: '+stderr)
    print('---')
```

## RUN COMMAND LINE

```
!python exercise01.py -q query.fna -r ref.fna -t taxonomy.txt -o output.txt -c ./burst -V
./burst -q query.fna -r ref.fna -t taxonomy.txt -o output.txt

Return Value: 0

STDOUT: ...
 --> Setting threads to 0
Using up to AVX-128 with 0 threads.
Parsed 130727 queries.
Max query len: 101, avg. divergence: 90.764586 (18.509566 w/o dupes)
Parsed 5000 references.
There are 5000 references and hence 312 clumps (+1)
Average R pack length = 1423.881789
Searching best paths through 35294 unique queries...

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Search Progress: [100.00%]
Search complete. Consolidating results...

Alignment time: 7.511785 seconds


STDERR:
---
```

---

## PROCESS OUTPUT FILE

```
import pandas as pd
import numpy as np

df = pd.read_csv('output.txt', header=None, delim_whitespace=True,
                 names=['qseqid','sseqid','pident','length','mismatch','gapopen','qstart','qe

df.head(5)
```

### Question 1: What fraction of the input query sequences had a match in the database at 97% or above?

```
df[df['pident']>=97].count()['qseqid'], df['pident'].count()
```

```
(45550, 46011)
```

There are 45,550 at 97% or above out of 46,011 entries.

### Question 2: What is the most common bacterial species in the query set?

```
df['qseqid'].value_counts()
```

```
k278A.2.418424_651300242          1
h9M.1.418588_808479870            1
```

```
Amz6chldM.418668_793073478        1
TS109.418691_885856118            1
Amz6teen.418569_1029400378        1
TS129.418618_381258008            1
USchp33ChildB.418578_213517173    1
TS7.418860_392489734              1
TS195.418848_408859884            1
h95M.1.418831_743636910           1
TS129.418618_398711882            1
h264M.1.418377_251539154          1
h147M.1.418531_262271267          1
TS111.418684_365510845            1
USchp33ChildB.418578_234887031    1
h9M.1.418588_777264590            1
Amz29adlt.418370_1021060745       1
k278A.2.418424_647844107          1
USchp25Child.418345_206657105     1
TS109.418691_921630454            1
Amz29adlt.418370_1017418414       1
TS111.418684_379500016            1
TS1.418828_346501103              1
USchp18Mom.418783_228226310       1
Amz6chldM.418668_767329927        1
TS1.418828_355543881              1
h273M.1.418507_296460623          1
h68M.1.418773_188195634           1
TS109.418691_947299040            1
h279M.1.418530_648185250          1
                                 ..
USchp4Mom.418666_192812823        1
Amz5chldF1.418757_1012389222      1
Amz30adlt.418837_766998154        1
TS193.418750_406059473            1
TS4.418810_367555296              1
TS25.418407_916630067             1
Amz4adltF.418711_801824048        1
h165M.1.418394_292960889          1
Amz4chldM2.418774_768826770       1
h101M.1.418586_633813835          1
Amz4chldM2.418774_816398505       1
h146M.1.418838_251654143          1
TS195.418848_376963069            1
USchp36Mom.418718_375555754       1
Amz4adltF.418711_819346976        1
h146M.1.418838_270865891          1
TS193.418750_357094037            1
```

```
USchp3Mom.418727_892595014        1
Amz30adlt.418837_743246919        1
TS193.418750_363283526            1
Amz5chldF2.418405_762273143       1
TS193.418750_364868631            1
TS129.418618_375016390            1
TS195.418848_410389318            1
TS195.418848_359383225            1
USchp1Mom.418814_911228524        1
TS111.418684_348606674            1
h146M.1.418838_255619300          1
h257M.1.418454_584706830          1
h235M.1.418489_623997400          1
Name: qseqid, Length: 46011, dtype: int64
```

The answer is that all of the id's are unique.

### Question 3: What is the average percent similarity of the matches?

```
np.average(df['pident'])
```

```
98.46259236202215
```

The average of the percent similarity is 98.4626%.