```
Python 3.7.0 (default, Jun 28 2018, 07:39:16)
Type "copyright", "credits" or "license" for more information.

IPython 7.2.0 -- An enhanced Interactive Python.

Restarting kernel...
```

```
In [1]: runfile('/Users/yifan/MiSeq/test/MutationFinder.py',
wdir='/Users/yifan/MiSeq/test')
This is the start of comparison
---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
||||||||  ||||||||||||||||
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23

The first mismatch occurs at position 5

What is the name of this mutation? (e.g. AC in, G sub, etc.) AC in
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 0]]
We found a new mutation! Next Query:
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||  |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

The first mismatch occurs at position 4

What is the name of this mutation? (e.g. AC in, G sub, etc.) A in
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 0], ['A in', 4,
'GGGGCTAACGTTATTTATACGTGTTTAGT', 0]]
We found a new mutation! Next Query:
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||||
```

1

```
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23


No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||  |||||||||||||||
GGGGCTA--TTATTTATACGTGTTTAGT
   Score=21


The first mismatch occurs at position 4

What is the name of this mutation? (e.g. AC in, G sub, etc.) CG
del
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 0], ['A in', 4,
'GGGGCTAACGTTATTTATACGTGTTTAGT', 0], ['CG del', 4,
'GGGGCTATTATTTATACGTGTTTAGT', 0]]
We found a new mutation! Next Query:
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23


This mutation has been already identified as "A in" at position 4
-----------------------------
---01234567890123456789
GGGGCTA-CGTTATTTATAC-GTGT-----
||||||| |||||||||||  ||||
GGGGCTAACGTTATTTATA-TGTGTTTAGT
   Score=22


The first mismatch occurs at position 4

What is the name of this mutation? (e.g. AC in, G sub, etc.) A in
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 0], ['A in', 4,
'GGGGCTAACGTTATTTATACGTGTTTAGT', 1], ['CG del', 4,
'GGGGCTATTATTTATACGTGTTTAGT', 0], ['A in', 4,
'GGGGCTAACGTTATTTATATGTGTTTAGT', 0]]
We found a new mutation! Next Query:
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
-----------------------------
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
-----------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
-----------------------------
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||| | ||||||||||||||||
GGGGC-AACGTTATTTATACGTGTTTAGT
   Score=22
```

The first mismatch occurs at position 2

What is the name of this mutation? (e.g. AC in, G sub, etc.) T sub
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 0], ['A in', 4,
'GGGGCTAACGTTATTTATACGTGTTTAGT', 4], ['CG del', 4,
'GGGGCTATTATTTATACGTGTTTAGT', 0], ['A in', 4,
'GGGGCTAACGTTATTTATATGTGTTTAGT', 0], ['T sub', 2,
'GGGGCAACGTTATTTATACGTGTTTAGT', 0]]
We found a new mutation! Next Query:
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||| | ||||||||||||||||
GGGGC-AACGTTATTTATACGTGTTTAGT
  Score=22

This mutation has been already identified as "T sub" at position 2

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||| ||||||||||||||
GGGGCTA--TTATTTATACGTGTTTAGT
  Score=21

This mutation has been already identified as "CG del" at position
4

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23

No mutation found :) Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23

No mutation found :) Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT

```
   Score=23

This mutation has been already identified as "A in" at position 4
-----------------------------
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
  Score=23

This mutation has been already identified as "A in" at position 4
-----------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
||||||||  |||||||||||||||
```

```
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23


This mutation has been already identified as "AC in" at position 5
-----------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23


No mutation found :)  Next query:

---01234567890123456789
GGGGCTAC-GTTATTTATACGTGT-----
||||||||  ||||||||||||||
GGGGCTA-TGTTATTTATACGTGTTTAGT
   Score=22


The first mismatch occurs at position 4

What is the name of this mutation? (e.g. AC in, G sub, etc.) C sub
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 1], ['A in', 4,
'GGGGCTAACGTTATTTATACGTGTTTAGT', 6], ['CG del', 4,
'GGGGCTATTATTTATACGTGTTTAGT', 1], ['A in', 4,
'GGGGCTAACGTTATTTATATGTGTTTAGT', 0], ['T sub', 2,
'GGGGCAACGTTATTTATACGTGTTTAGT', 1], ['C sub', 4,
'GGGGCTATGTTATTTATACGTGTTTAGT', 0]]
We found a new mutation! Next Query:
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23


This mutation has been already identified as "A in" at position 4
-----------------------------
---01234567890123456789
G--GG-
GCTACGTTATTTATACGTGT----------------------------------------
-------------
    || |||||||||||||||||||||||
-ACGGTGCTACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)
   Score=22


The first mismatch occurs at position -3
```

What is the name of this mutation? (e.g. AC in, G sub, etc.)
unknown1
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 1], ['A in', 4,
'GGGGCTAACGTTATTTATACGTGTTTAGT', 7], ['CG del', 4,
'GGGGCTATTATTTATACGTGTTTAGT', 1], ['A in', 4,
'GGGGCTAACGTTATTTATATGTGTTTAGT', 0], ['T sub', 2,
'GGGGCAACGTTATTTATACGTGTTTAGT', 1], ['C sub', 4,
'GGGGCTATGTTATTTATACGTGTTTAGT', 0], ['unknown1', -3,
'ACGGTGCTACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 0]]
We found a new mutation! Next Query:
---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "AC in" at position 5

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :) Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||

```
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4
------------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4
------------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
```

```
|||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23


No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23


No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
  Score=23


This mutation has been already identified as "A in" at position 4
----------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23


No mutation found :)  Next query:

---01234567890123456789
G--GG-
GCTACGTTATTTATACGTGT-----------------------------------------
--------------
    || |||||||||||||||||||
-ACGGTGCTACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)
  Score=22


This mutation has been already identified as "unknown1" at
position -3
----------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||  ||||||||||||||
GGGGCTA--TTATTTATACGTGTTTAGT
  Score=21
```

This mutation has been already identified as "CG del" at position 4

```
_____
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| |||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
_____
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| |||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
_____
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| |||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
_____
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
```

```
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||   |||||||||||||||
GGGGCTA--TTATTTATACGTGTTTAGT
   Score=21
```

This mutation has been already identified as "CG del" at position 4

```
-----------------------------
---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
|||||||   |||||||||||||||
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "AC in" at position 5

```
-----------------------------
---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
|||||||   |||||||||||||||
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "AC in" at position 5

```
-----------------------------
---01234567890123456789
```

```
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4
----------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4
----------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:
```

```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
    Score=23
```

This mutation has been already identified as "A in" at position 4
_____

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
    Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
    Score=23
```

This mutation has been already identified as "A in" at position 4
_____

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
    Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
    Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
    Score=23
```

```
This mutation has been already identified as "A in" at position 4
------------------------------
---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
||||||||  ||||||||||||||||
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23


This mutation has been already identified as "AC in" at position 5
------------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23


No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23


This mutation has been already identified as "A in" at position 4
------------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23


No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23


This mutation has been already identified as "A in" at position 4
------------------------------
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||| |||||||||||||||
GGGGCTA--TTATTTATACGTGTTTAGT
   Score=21

This mutation has been already identified as "CG del" at position 4

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4

---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
|||||||| |||||||||||||||
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "AC in" at position 5

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :) Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||

```
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4
-----------------------------
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4
-----------------------------
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4
-----------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
```
17

```
|||||||||  ||||||||||||||||
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "AC in" at position 5
```
------------------------------
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4
```
------------------------------
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4
```
------------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
```

```
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
G--GG-
GCTACGTTATTTATACGTGT-----------------------------------------
--------------
    || |||||||||||||||||||||
-ACGGCGCTACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)
  Score=22

The first mismatch occurs at position -3

What is the name of this mutation? (e.g. AC in, G sub, etc.)
unknown2
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 7], ['A in', 4,
'GGGGCTAACGTTATTTATACGTGTTTAGT', 33], ['CG del', 4,
'GGGGCTATTATTTATACGTGTTTAGT', 4], ['A in', 4,
'GGGGCTAACGTTATTTATATGTGTTTAGT', 0], ['T sub', 2,
'GGGGCAACGTTATTTATACGTGTTTAGT', 1], ['C sub', 4,
'GGGGCTATGTTATTTATACGTGTTTAGT', 0], ['unknown1', -3,
'ACGGTGCTACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)', 1], ['unknown2', -3,
'ACGGCGCTACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)', 0]]
We found a new mutation! Next Query:
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
  Score=23

This mutation has been already identified as "A in" at position 4
```

```
_____
---01234567890123456789
G--G-
GGCTACGTTATTTATACGTGT------------------------------------------
--------------
    | ||||||||||||||||||||||
-ACGTGGCTACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)
  Score=22
```

The first mismatch occurs at position -3

What is the name of this mutation? (e.g. AC in, G sub, etc.)
unknown3
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 7], ['A in', 4,
'GGGGCTAACGTTATTTATACGTGTTTAGT', 34], ['CG del', 4,
'GGGGCTATTATTTATACGTGTTTAGT', 4], ['A in', 4,
'GGGGCTAACGTTATTTATATGTGTTTAGT', 0], ['T sub', 2,
'GGGGCAACGTTATTTATACGTGTTTAGT', 1], ['C sub', 4,
'GGGGCTATGTTATTTATACGTGTTTAGT', 0], ['unknown1', -3,
'ACGGTGCTACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 1], ['unknown2', -3,
'ACGGCGCTACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 0], ['unknown3', -3,
'ACGTGGCTACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 0]]
We found a new mutation! Next Query:
```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
```

```
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
||||||||  |||||||||||||||
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "AC in" at position 5
-----------------------------
---01234567890123456789
G-GGG-CTA-
CGTTATTTATACGTGT------------------------------------------
----------
   ||| ||| |||||||||||||||||
-CGGGTCTAACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)
   Score=22

The first mismatch occurs at position -3

What is the name of this mutation? (e.g. AC in, G sub, etc.)
unknown4
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 8], ['A in', 4,
'GGGGCTAACGTTATTTATACGTGTTTAGT', 34], ['CG del', 4,
'GGGGCTATTATTTATACGTGTTTAGT', 4], ['A in', 4,
'GGGGCTAACGTTATTTATATGTGTTTAGT', 0], ['T sub', 2,
'GGGGCAACGTTATTTATACGTGTTTAGT', 1], ['C sub', 4,
'GGGGCTATGTTATTTATACGTGTTTAGT', 0], ['unknown1', -3,
'ACGGTGCTACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)', 1], ['unknown2', -3,
'ACGGCGCTACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)', 0], ['unknown3', -3,
'ACGTGGCTACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)', 0], ['unknown4', -3,
'CGGGTCTAACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)', 0]]
We found a new mutation! Next Query:
---01234567890123456789
G--GG-
GCTACGTTATTTATACGTGT------------------------------------------
--------------
   || |||||||||||||||||||||
-ACGGTGCTACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)
                                                              22
```

```
   Score=22

This mutation has been already identified as "unknown1" at
position -3
_____
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4
_____
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATA-CGTGT-----
```

```
||||||  |||||||||||  |||||
GGGGCT-TCGTTATTTAT-TCGTGTTTAGT
  Score=21
```

The first mismatch occurs at position 3

What is the name of this mutation? (e.g. AC in, G sub, etc.) A sub
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 8], ['A in', 4,
'GGGGCTAACGTTATTTATACGTGTTTAGT', 35], ['CG del', 4,
'GGGGCTATTATTTATACGTGTTTAGT', 4], ['A in', 4,
'GGGGCTAACGTTATTTATATGTGTTTAGT', 0], ['T sub', 2,
'GGGGCAACGTTATTTATACGTGTTTAGT', 1], ['C sub', 4,
'GGGGCTATGTTATTTATACGTGTTTAGT', 0], ['unknown1', -3,
'ACGGTGCTACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 2], ['unknown2', -3,
'ACGGCGCTACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 0], ['unknown3', -3,
'ACGTGGCTACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 0], ['unknown4', -3,
'CGGGTCTAACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 0], ['A sub', 3,
'GGGGCTTCGTTATTTATTCGTGTTTAGT', 0]]
We found a new mutation! Next Query:
```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
   ||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
   ||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
  Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
G--GGG-
CTACGTTATTTATACGTGT----------------------------------------------
------------
    ||| ||||||||||||||||||||
-ACGGGTCTACGTTATTTATACGTGTTTAGT  (requires further investigation,
PAM sequence is off)
  Score=22
```

The first mismatch occurs at position -3

What is the name of this mutation? (e.g. AC in, G sub, etc.)
unknown5
[['AC in', 5, 'GGGGCTACACGTTATTTATACGTGTTTAGT', 8], ['A in', 4,
'GGGGCTAACGTTATTTATACGTGTTTAGT', 35], ['CG del', 4,
'GGGGCTATTATTTATACGTGTTTAGT', 4], ['A in', 4,
'GGGGCTAACGTTATTTATATGTGTTTAGT', 0], ['T sub', 2,
'GGGGCAACGTTATTTATACGTGTTTAGT', 1], ['C sub', 4,
'GGGGCTATGTTATTTATACGTGTTTAGT', 0], ['unknown1', -3,
'ACGGTGCTACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 2], ['unknown2', -3,
'ACGGCGCTACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 0], ['unknown3', -3,
'ACGTGGCTACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 0], ['unknown4', -3,
'CGGGTCTAACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 0], ['A sub', 3,
'GGGGCTTCGTTATTTATTCGTGTTTAGT', 0], ['unknown5', -3,
'ACGGGTCTACGTTATTTATACGTGTTTAGT (requires further investigation,
PAM sequence is off)', 0]]
We found a new mutation! Next Query:
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :) Next query:

---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "AC in" at position 5

```
---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "AC in" at position 5

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| |||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4
_____
```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4
_____
```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4
_____
```
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4
_____
```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTAC--GTTATTTATACGTGT-----
||||||||   ||||||||||||||||
GGGGCTACACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "AC in" at position 5
_____
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :) Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :) Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :) Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :) Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4
_____
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||| |||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4

```
------------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||  ||||||||||||||
GGGGCTA--TTATTTATACGTGTTTAGT
   Score=21
```

This mutation has been already identified as "CG del" at position 4

```
------------------------------
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
||||||| ||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23
```

This mutation has been already identified as "A in" at position 4

```
------------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23
```

No mutation found :) Next query:

```
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
```

```
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||  |||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4
-----------------------------
---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
|||||||  |||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
   Score=23

This mutation has been already identified as "A in" at position 4
-----------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
   Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTA-CGTTATTTATACGTGT-----
```

```
||||||| |||||||||||||||||||
GGGGCTAACGTTATTTATACGTGTTTAGT
    Score=23

This mutation has been already identified as "A in" at position 4
------------------------------
---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
    Score=23

No mutation found :)  Next query:

---01234567890123456789
GGGGCTACGTTATTTATACGTGT-----
|||||||||||||||||||||||||
GGGGCTACGTTATTTATACGTGTTTAGT
    Score=23

No mutation found :)  Next query:
```

In [**2**]: