Turtle Search for COVID-19

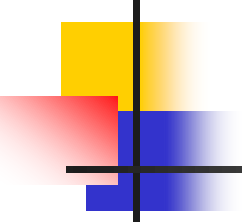**Silicon Valley Forth Interest Group**

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COVID-19 (CV)

- **Wuhan Coronovirus was named SARS-CoV-2, then COVID-19, and then China Virus, according to Mr. Trump.**

- **The pandemic now claimed 233K deaths in US, and 1.14M deaths in the world, as of 10/22/2020.**

COVID-19 Downloads

- 3/9/2020 51 sequences
- 3/25/2020 120 sequences
- 3/30/2020 320 sequences
- 4/16/2020 785 sequences
- 6/25/2020 4,058 sequences
- 7/15/2020   7,021 sequences
- 9/20/2020 16,516 sequences
- 10/14/2020 18,869 sequences

Search Virus Sequences

- **My Exhaustive Pattern Search algorithm was used to identify similarities and differences between sequences.**

- **It works, but is fundamentally flawed.**

Exhaustive Search

- **It assumes that all 20-nucleotide patterns in a virus are unique.**

- **Repeated 20-nucleotide patterns cause errors in assembling matched sequences.**

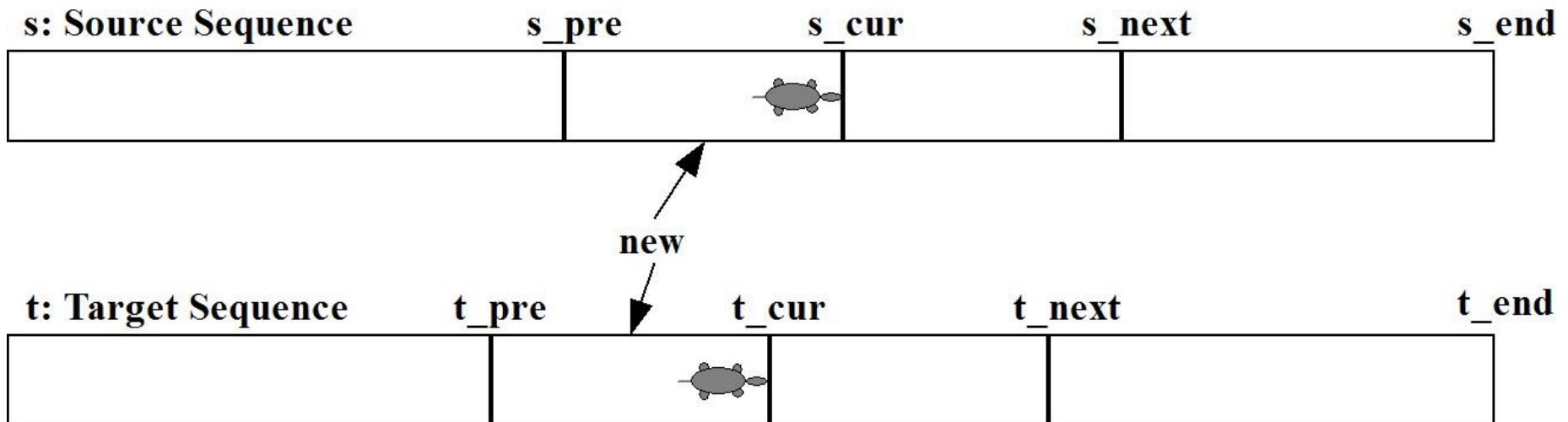- **It is difficult to find and fix the errors.**

Turtle Search

- **Instead of the brute-force matching of 20-nucleotide patterns in the Exhaustive Search, a gentle sequential search algorithm is developed.**

- **It is called Turtle Search.**

Turtle Search

s: Source Sequence   s_pre   s_cur   s_next   s_end

new

t: Target Sequence   t_pre   t_cur   t_next   t_end

Turtle Search

- **s_cur and t_cur are two turtles crawling through the strings s and t to compare them letter by letter.**

- **When the turtles find mismatched substrings, they spit out the mismatched substrings to an output file.**

- **The output file contains all mutants.**

Turtle Search

- **s and t are two strings to be compared.**

- **s_cur and t_cur point to the current letters to be matched.**

- **Because s and t are very similar, letters pointed to by s_cur and t_cur are mostly equal, and s_cur and t_cur are incremented to match the next letters.**

Turtle Search

- **If new=1, s_pre and t-pre point to the beginnings of two mismatched strings.**

- **If new=0, letters before s_cur and t_cur are equal, belonging to two matched strings.**

Turtle Search

- **If the letters pointed to by *s_cur* and *t_cur* are equal:**

- **If new=1, *s_pre* and t-pre point to the beginnings of two mismatched substrings, write these substrings to the output file, and clear new to 0;**

- **Else, increment s_cur and t_cur.**

Turtle Search

- **If *s_cur* and *t_cur* point to two mismatched letters:**

- **If new=1, increment *s_cur* and t-cur to extend the two mismatched strings;**

- **Else, let s_pre=s_cur and t_pre=t_cur, and search the next matching 20-letter strings at s_next and t_next.**

Turtle Search

- **Now, s_next and t_next point to two matched 20-letter substrings.**

- **Write the two mismatched strings, from s_cur to s_next and from t_cur to t_next, to the output file;**

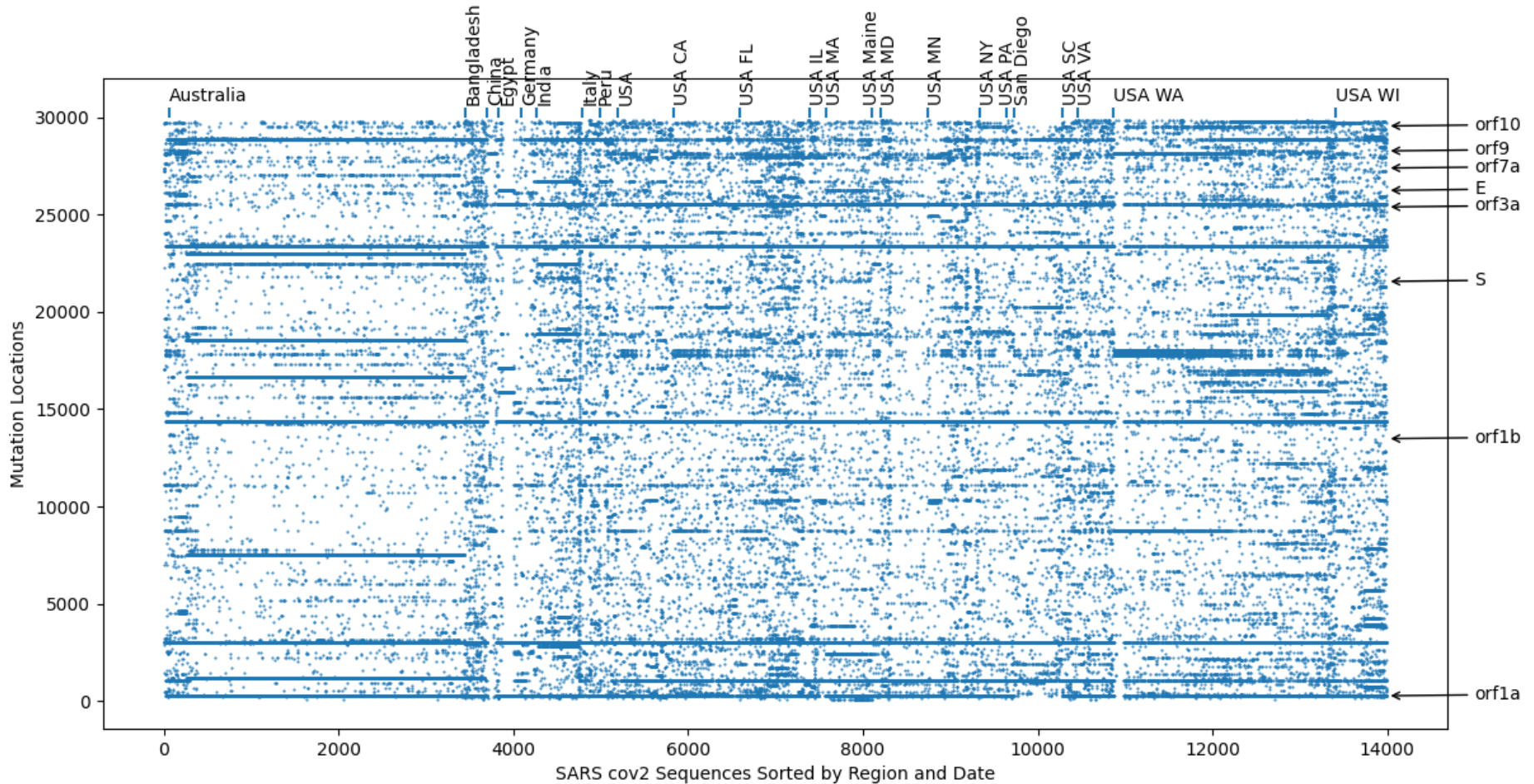- **Set s_pre and s_cur to s_next+20, and set t_pre and t_cur to t_next+20. Clear new to 0.**

Turtle Search

- **It is like two turtles crawling through the s and t strings letter by letter, and spitting out mismatched substrings along the way.**

- **Actually, the turtles search much faster than the Exhaustive Search, by not doing lots of redundant forward searches.**

COVID-19 Mutants

Point Mutations

- **Up to 9/20/2020, three mutants CV1, CV2 and CV3 were identified:**
  - **CV1: C8782T, T28144C**
  - **CV2: C241T, C3037T, C14408T, A23403G,**
  - **CV3: G11083T, G26144T**

Point Mutations

- **Up to 10/15/2020, three mutants CV1, and CV3 had disappeared.**
- **CV2 developed these mutants:**
  - **Australia mutant**
  - **India mutant**
  - **Egypt mutant**
  - **San Diego mutant**
  - **Washington mutant**

Point Mutations

- **The most prevalent point mutations are :**
  - **C241T**
  - **C3037T**
  - **C14408T**
  - **A23403G**
  - **GGG28881AAC**

Australia Mutant

- A1163T
- T7540C
- G16647T
- C18555T
- C22480T
- G22992A

India Mutant

- **C2836T**
- **T7540C**
- **C18877T**
- **C22987T**
- **G25563T**
- **C26735T**
- **C28854T**

Egypt Mutant

- **G15907A**
- **T17091C**
- **G25563T**
- **G26257T**

California Mutant

- **C1059T**
- **G25563T**

Florida Mutant

- **C1059T**
- **C10319T**
- **G25563T**

San Diego Mutant

- **No C241T**
- **C1059T**
- **C10319T**
- **A20268G**

Washington Mutant

- **C1059T**
- **C14937T**
- **C18998T**
- **C21017T**
- **G25445T**
- **G25563T**

Wisconsin Mutant

- **C1059T**
- **C4898A**
- **G6032A**
- **C7777T**
- **T12805C**
- **G19455A**
- **G25563T**
- **G29402T**

Conclusion

- **COVID-19 virus developed in to many geological mutants.**

- **The Turtle Search algorithm works well and much faster.**

- **I will present a still faster and simpler Rabbit Search algorithm next month.**
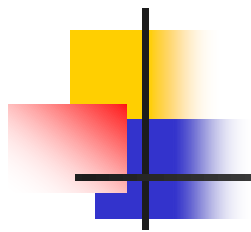
To Cure COVID-19

- **Infected people can be cured with intravenous infusion of vitamin C.**

- **Intravenous infusion protocol:**

  20 grams of sodium at the beginning of symptoms.

Take Vitamin C and Go Back to Work!

- **Take 10 grams of vitamin C everyday to protect yourself from infection.**

- **If infected, take 10 grams of vitamin C every 4 hours until diarrhea to suppress the CV virus.**

Thank You!