

ECS124

Theory and Practice of Bioinformatics



**Learn the computer science behind
human genomics and personalized medicine.**

Algorithm labs inspired by real discoveries.



01 SEARCH



Personalized gene editing

Search KJ's CPS1 sequence
for a unique editing target;
map reads on both strands.

Naive search • Z • Boyer-Moore • KMP

02 ALIGN

```
A C G T T A A G C C T
| | | | |
A C G T T - - C C T
```

Cystic fibrosis & immunity

Align CFTR to study F508del;
match mouse and human FOXP3
to explore autoimmune disease.

Edit distance • Global/local • Affine gaps

03 INDEX

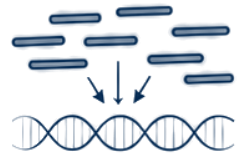


Rare-disease genetics

Index genomes and map reads
to find KAT6B mutations
linked to Ohdo syndrome.

Suffix trees • Hash-table k-mer indexes

04 ASSEMBLE

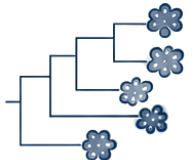


First SARS-CoV-2 genome

Rebuild SARS-CoV-2 from reads.
Explore how read length
helps bridge genome repeats.

Overlap graphs • de Bruijn graphs

05 BUILD TREES

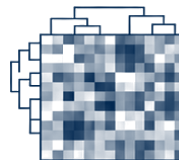


Cancer & human ancestry

Trace clones in kidney cancer.
Compare evolutionary trees
with Neandertal DNA.

Perfect phylogeny • UPGMA • Neighbor joining

06 MACHINE LEARNING



Breast cancer & ancient DNA

Cluster yeast expression data.
Use hidden Markov models
to trace Neandertal ancestry.

k-means • Hierarchical clustering • HMMs

SEQUENCE DATA

```
ACGTTGCAACGT
GTCAGTTAGCGA
TTACGCAATGCT
CAGTTGACCTGA
...
```



YOUR CODE



BIOLOGICAL INSIGHT



Winter Quarter 2027

UCDAVIS