Genome Assembly

Lecture 18
Oct 14, 2016

Announcements

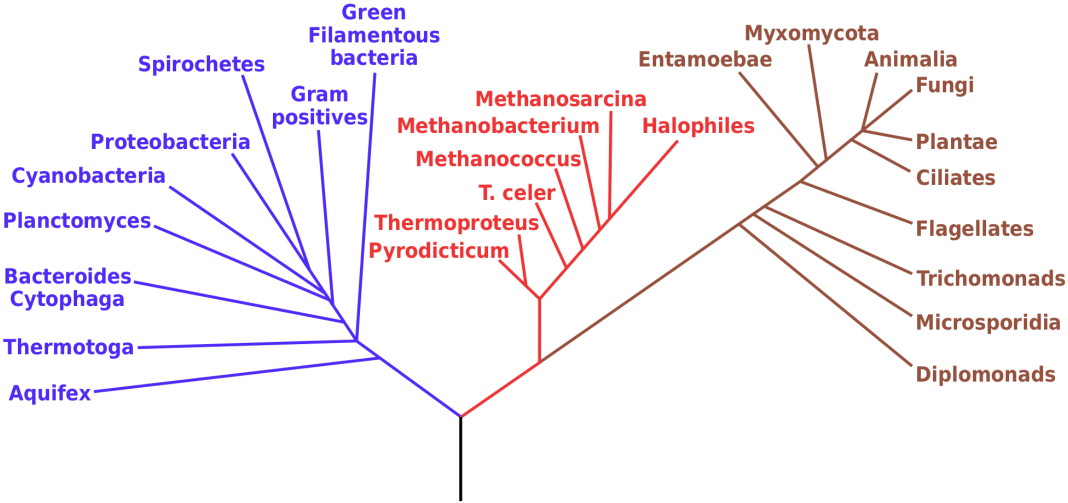
Why do you want to Assemble a genome?

What do you need to Assemble a genome?

Assemble a genome? General Strategies

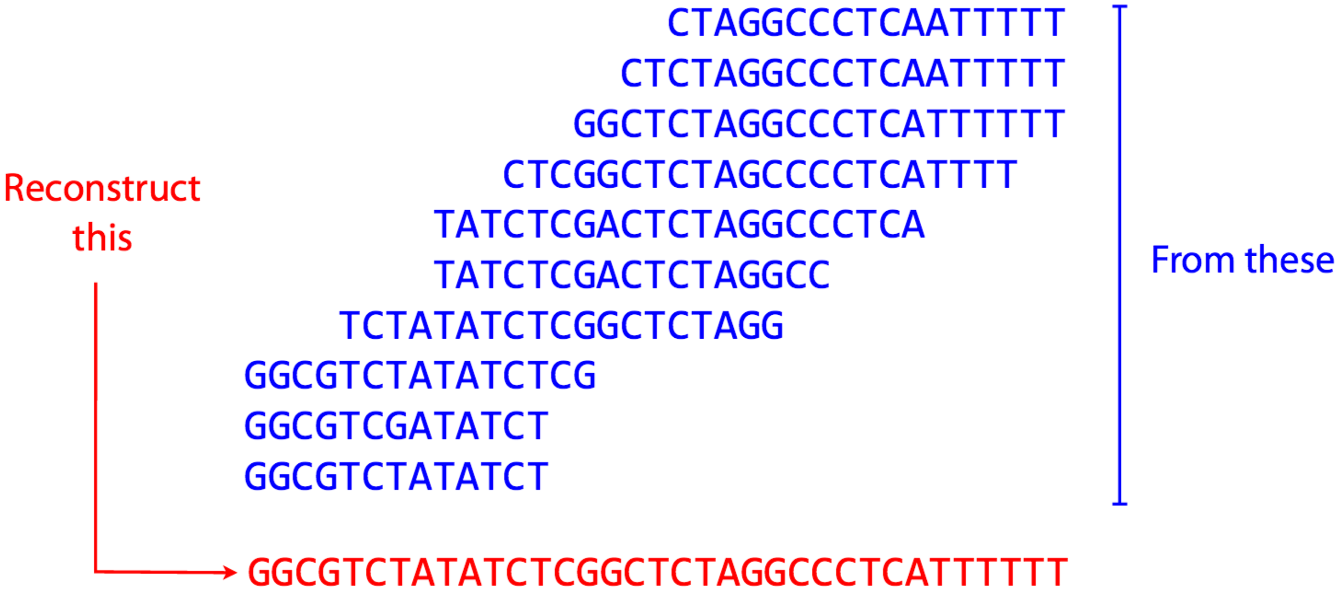
Genome size	Unlimited $$	Typical
>10Mb		
10Mb - 100Mb		
> 100 Mb		

Genome Sizes



ASSEMBLY

Assume sequencing produces such a large # fragments that almost all genome positions are *covered* by many fragments...



CTAGGCCCTCAATTTTT

CTCTAGGCCCTCAATTTTT

GGCTCTAGGCCCTCATTTTTT

CTCGGCTCTAGCCCCTCATTTT

TATCTCGACTCTAGGCCCTCA

TATCTCGACTCTAGGCC

TCTATATCTCGGCTCTAGG

GGCGTCTATATCTCG

GGCGTCGATATCT

GGCGTCTATATCT

From these

Reconstruct this

GGCGTCTATATCTCGGCTCTAGGCCCTCATTTTTT

Assembly

...but we don’t know what came from where

CTAGGCCCTCAATTTTT
GGCGTCTATATCT
CTCTAGGCCCTCAATTTTT
TCTATATCTCGGCTCTAGG
GGCTCTAGGCCCTCATTTTTT
CTCGGCTCTAGCCCCTCATTTT
TATCTCGACTCTAGGCCCTCA
GGCGTCGATATCT
TATCTCGACTCTAGGCC
GGCGTCTATATCTCG

From these

Reconstruct this

GGCGTCTATATCTCGGCTCTAGGCCCTCATTTTTT

Assembly

Key term: *coverage*. Usually it's short for *average coverage*: the average number of reads covering a position in the genome.

```
                  CTAGGCCCTCAATTTTT
                CTCTAGGCCCTCAATTTTT
              GGCTCTAGGCCCTCATTTTTT
           CTCGGCTCTAGCCCCTCATTTT
        TATCTCGACTCTAGGCCCTCA                177 nucleotides
        TATCTCGACTCTAGGCC
    TCTATATCTCGGCTCTAGG
GGCGTCTATATCTCG
GGCGTCGATATCT
GGCGTCTATATCT
GGCGTCTATATCTCGGCTCTAGGCCCTCATTTTTT          35 nucleotides
```

Average coverage = 177 / 35 ≈ 7x

OTHER ASSEMBLY TERMS

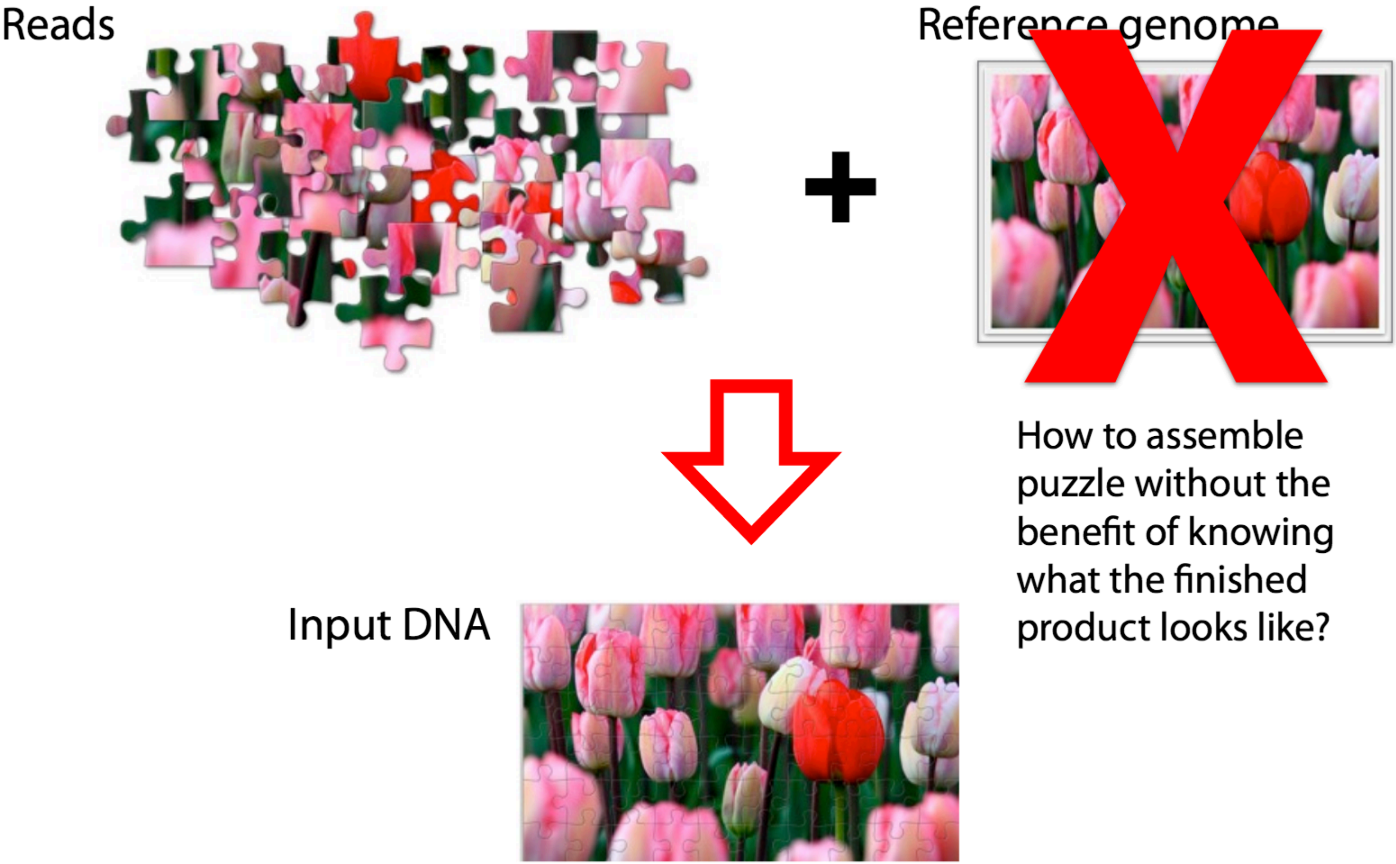
Unitig

Contig

scaffold

Assembly

- Complicated by:



Reads

+

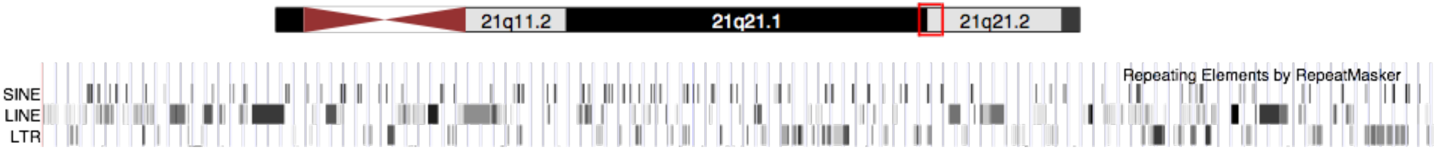
Reference genome

Input DNA

How to assemble puzzle without the benefit of knowing what the finished product looks like?

Assembly

- Complicated by:



Assembly

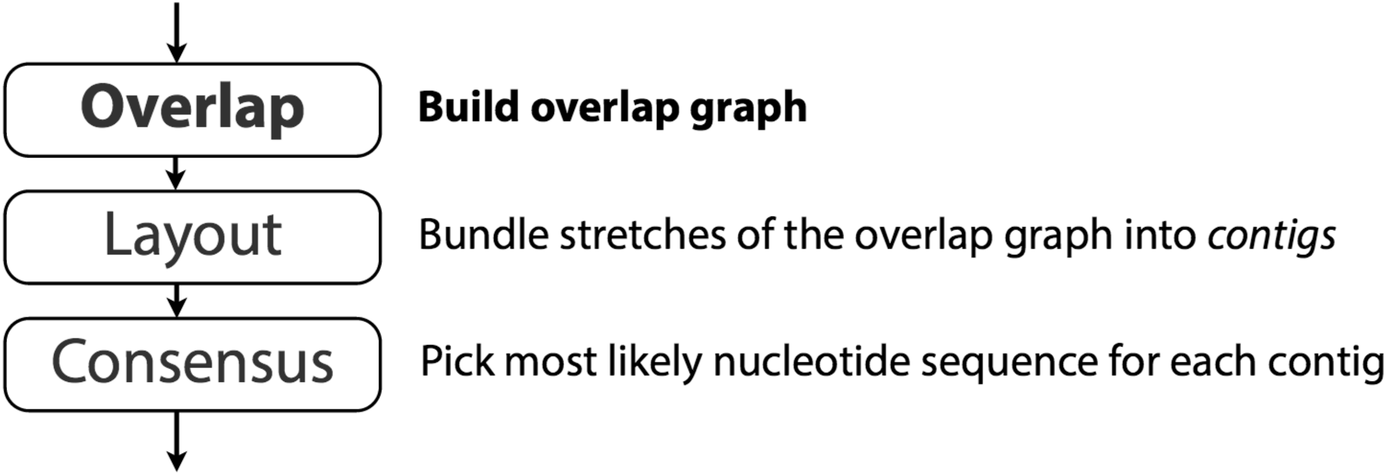
- Work flow:

ASSEMBLY

- 3 assembly strategies:

ASSEMBLY

- OLC Assembly



Overlap **Build overlap graph**

Layout Bundle stretches of the overlap graph into *contigs*

Consensus Pick most likely nucleotide sequence for each contig

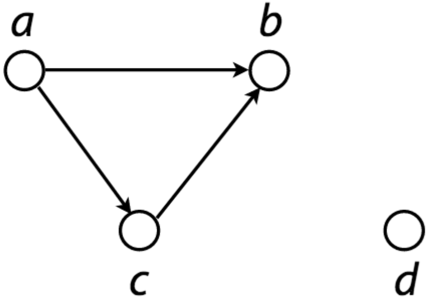
ASSEMBLY

- OLC Assembly: Characteristics

Assembly

Directed graph *G*(*V*, *E*) consists of set of *vertices, V* and set of *directed edges, E*

Directed edge is an *ordered pair* of vertices. First is the *source*, second is the *sink*.



Vertex is drawn as a circle

Edge is drawn as a line with an arrow connecting two circles

Vertex also called *node* or *point*

Edge also called *arc* or *line*

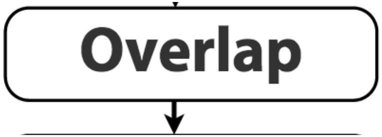
Directed graph also called *digraph*

$V = \{ a, b, c, d \}$

$E = \{ (a, b), (a, c), (c, b) \}$

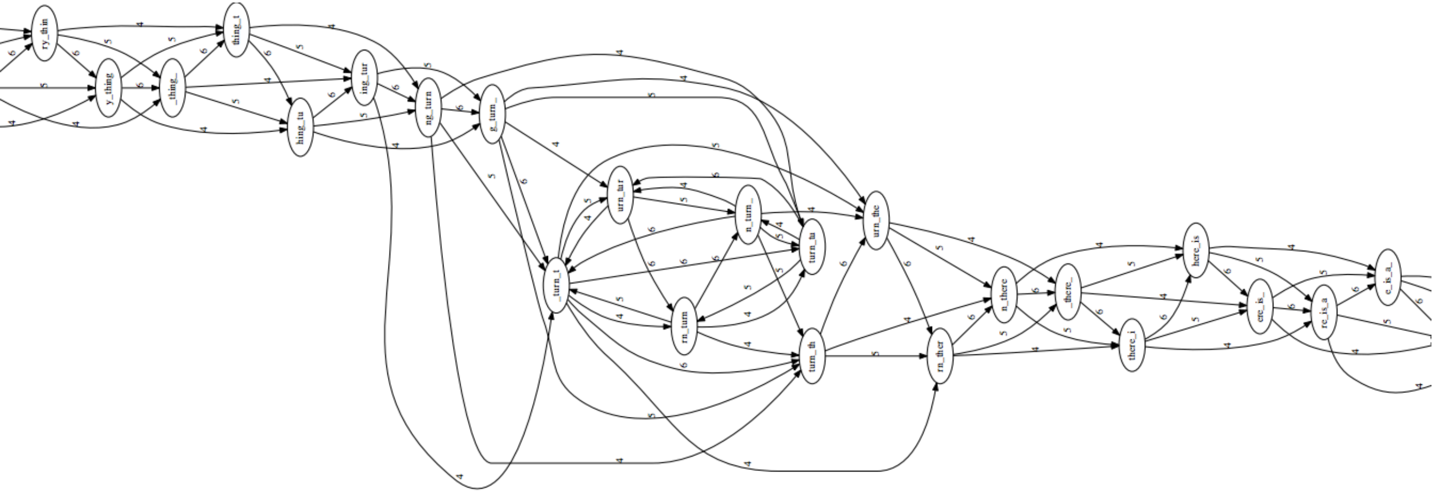
Source Sink

Assembly

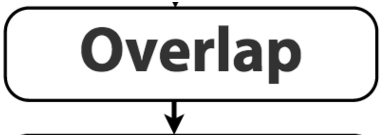


Build overlap graph

to_every_thing_turn_turn_turn_there_is_a_season
L=4, k=7



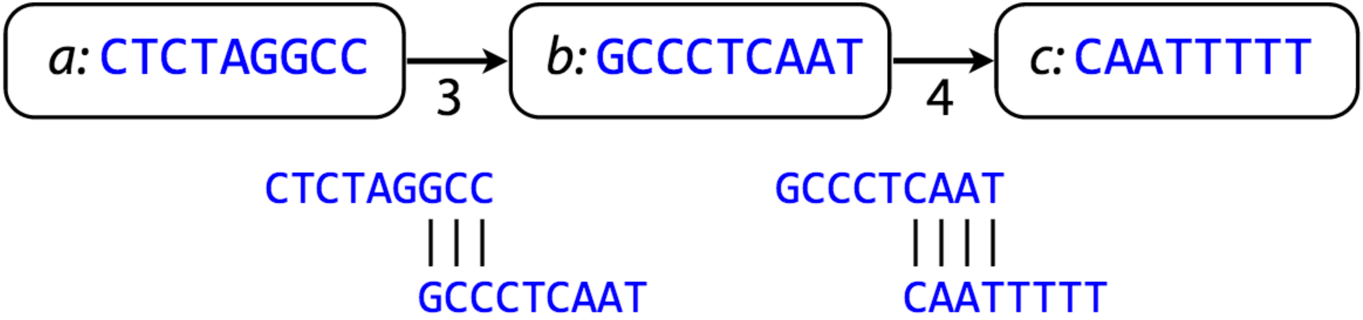
ASSEMBLY



Build overlap graph

Vertices (reads): { *a:* CTCTAGGCC, *b:* GCCCTCAAT, *c:* CAATTTTT }

Edges (overlaps): { (*a*, *b*), (*b*, *c*) }


a: CTCTAGGCC
3
b: GCCCTCAAT
4
c: CAATTTTT
CTCTAGGCC
GCCCTCAAT
GCCCTCAAT
CAATTTTT