

Environmental metagenomics

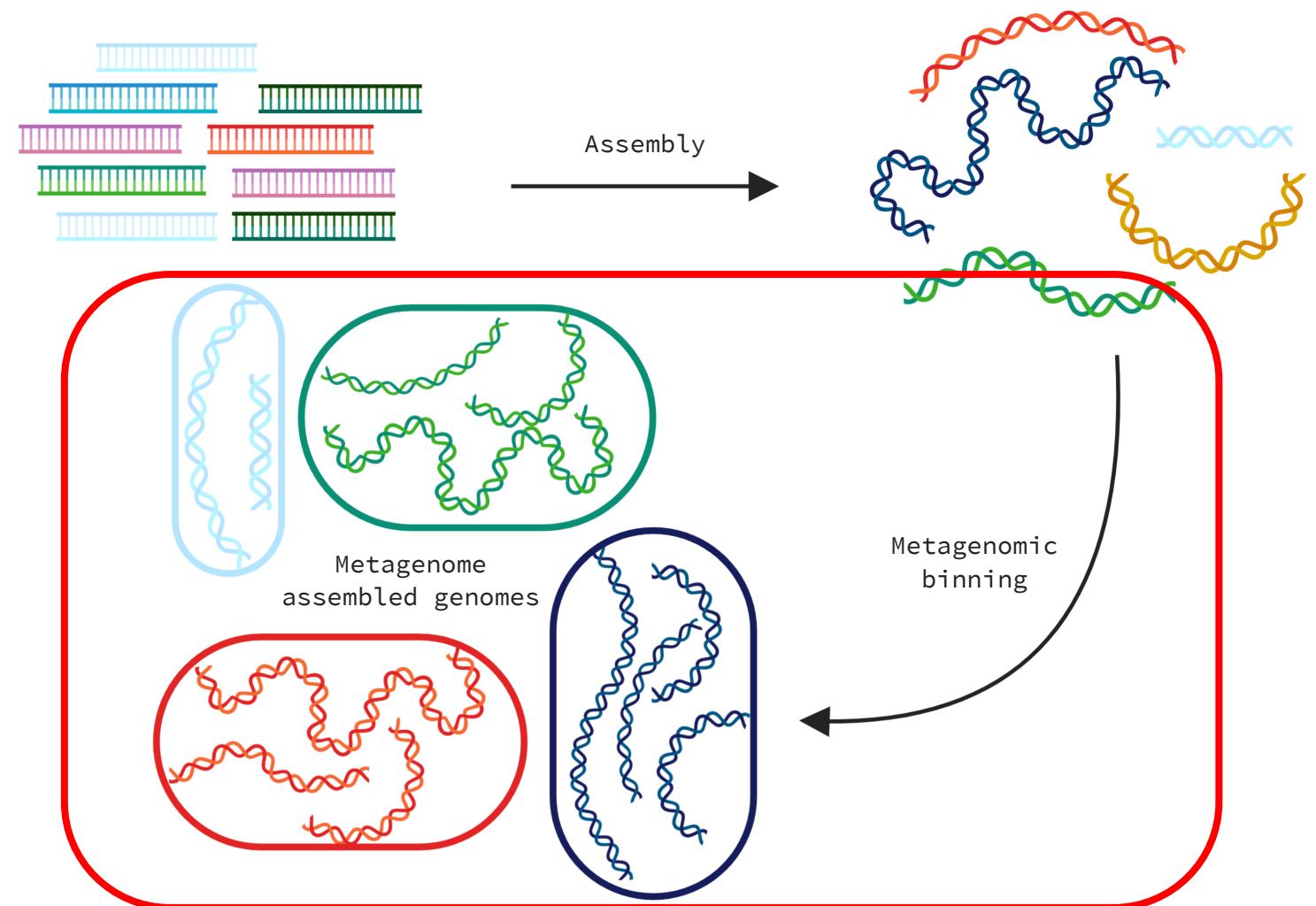
Genome-resolved metagenomics

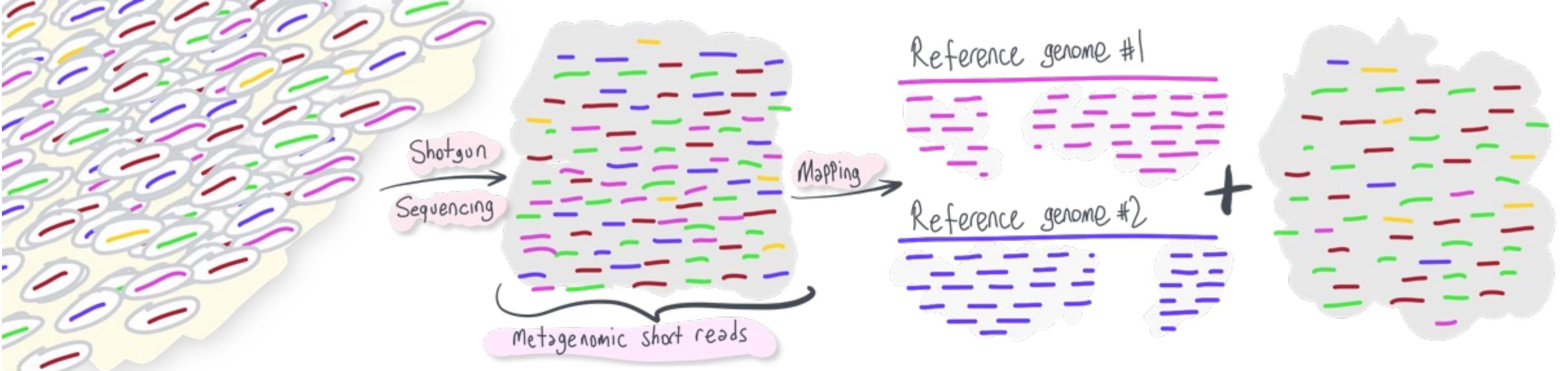


Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

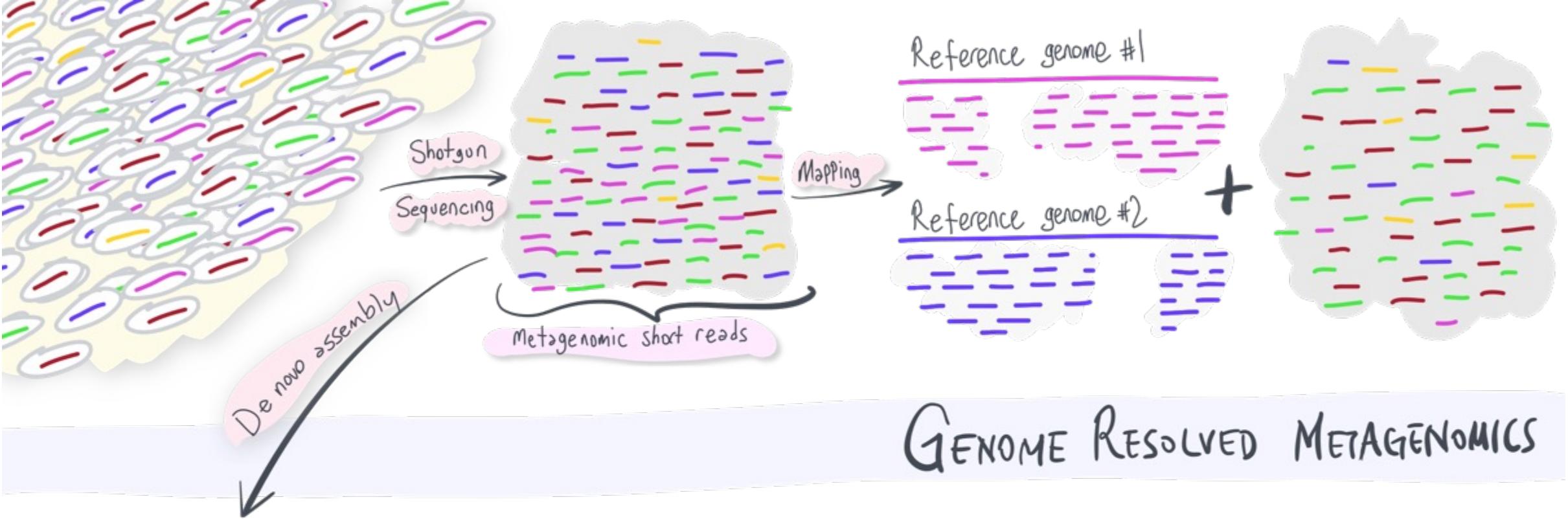
What is genome-resolved metagenomics?



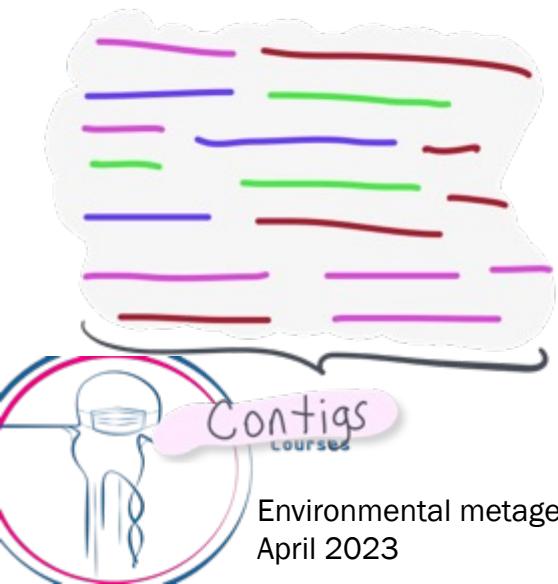


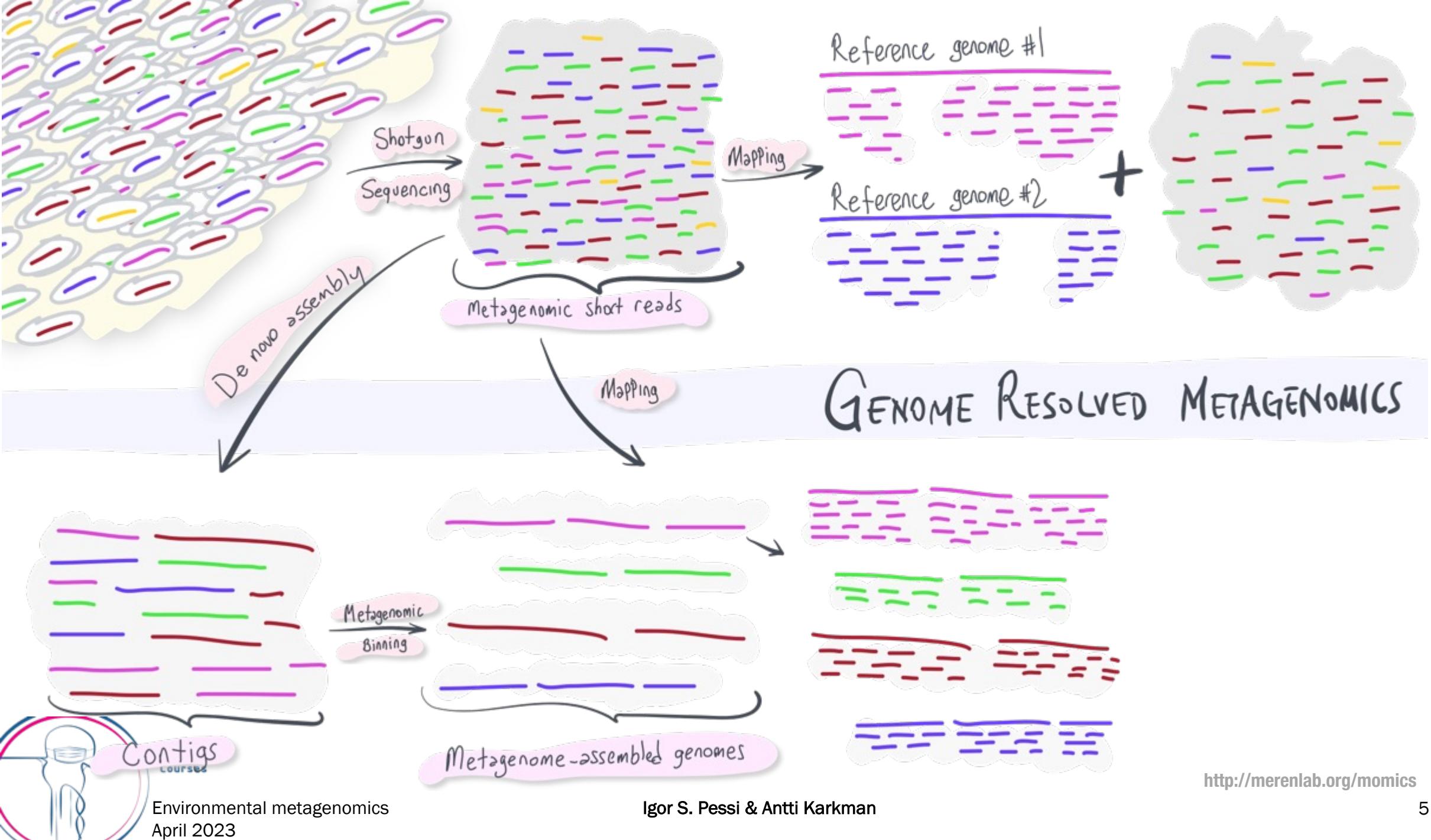
GENOME RESOLVED METAGENOMICS





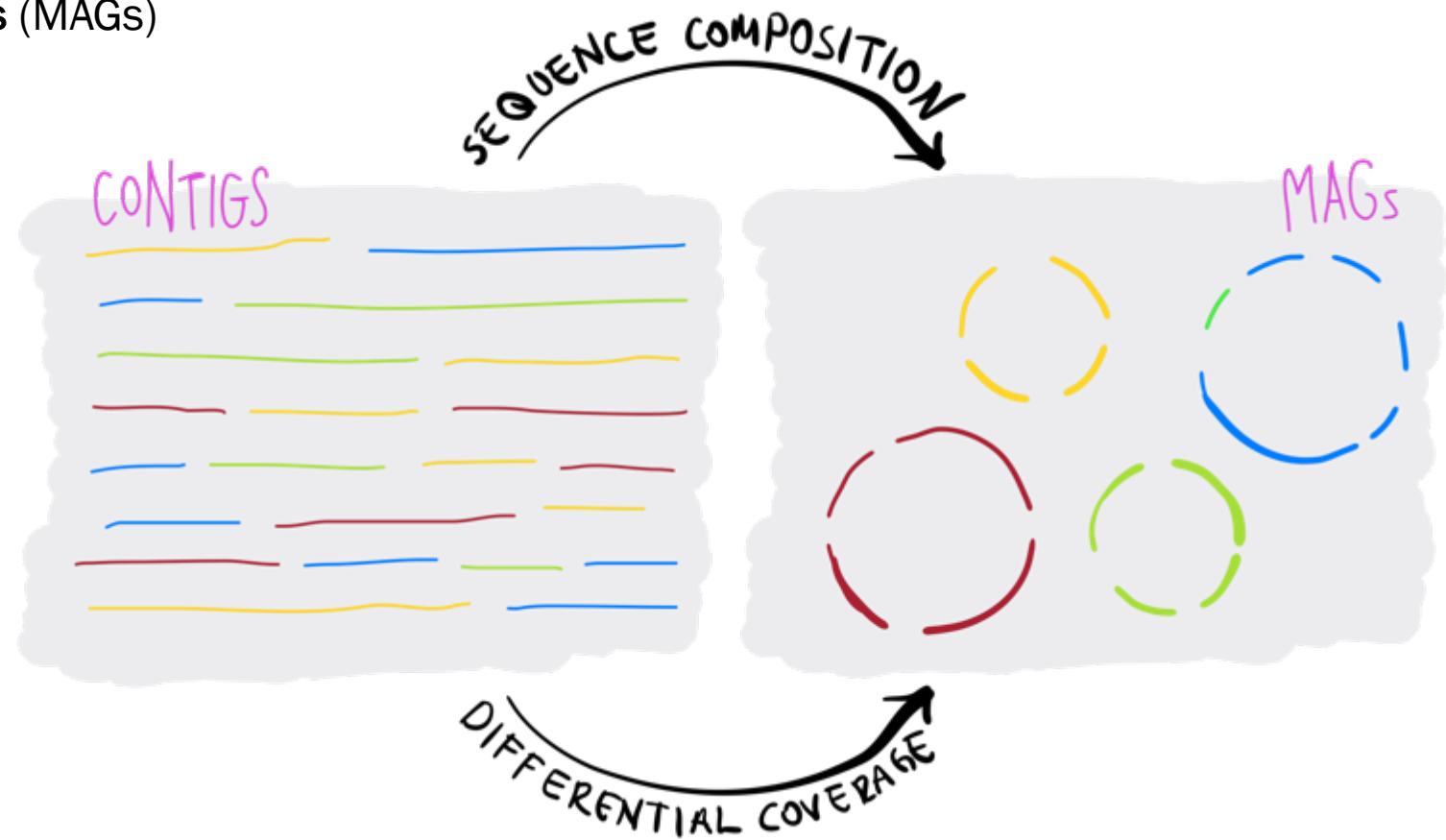
GENOME RESOLVED METAGENOMICS



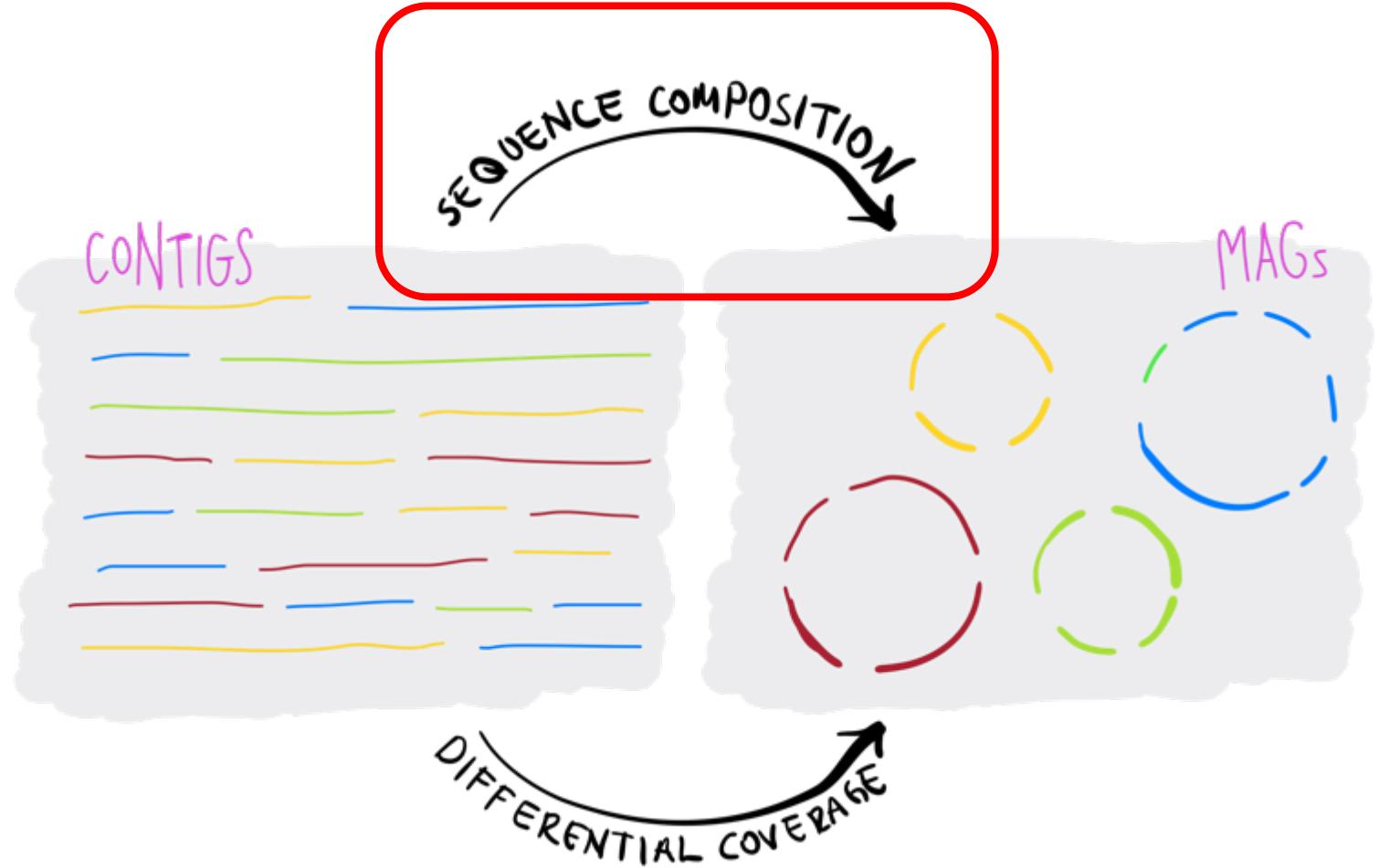


Metagenomic binning

From contigs to
metagenome assembled genomes (MAGs)



Sequence composition – kmers



Physalia
Courses

Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>

GTTTGCGCATGATTAAGGGAGTTCTTGTGCTTC

AA	AC	AG	AT	CA	CC	CG	CT	GA	GC	GG	GT	TA	TC	TG	TT
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

k=2



Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>

GT

TTGGCATGATTAAGGGAGTTCTTGTGCTTC

AA	AC	AG	AT	CA	CC	CG	CT	GA	GC	GG	GT	TA	TC	TG	TT
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

k=2

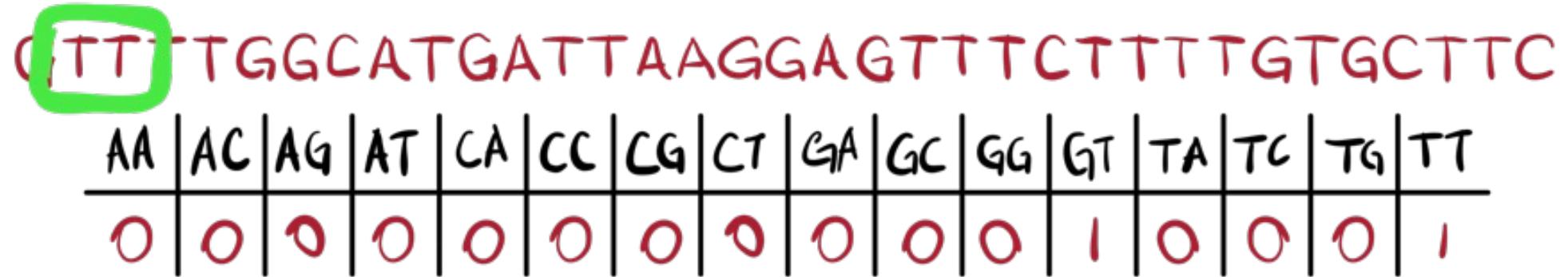


Physalia
Courses

Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>



k=2



Physalia
Courses

Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>



k=2



Physalia
Courses

Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>



k=2



Physalia
Courses

Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>

12

GTTTGCGCATGATTAAGGGAGTTCTTGTGCTTC

AA	AC	AG	AT	CA	CC	CG	CT	GA	GC	GG	GT	TA	TC	TG	TT
1	0	2	2	1	0	0	2	2	2	2	3	1	2	4	10

9

GAAGCACAAAAGAAACTCCTTAATCATGCCAAAAAC

AA	AC	AG	AT	CA	CC	CG	CT	GA	GC	GG	GT	TA	TC	TG	TT
10	3	2	2	4	2	0	2	2	2	5	0	1	2	1	1

k=2



Physalia
Courses

Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>

13

GTTTGCGATGATTAAAGGGAGTTCTTGTGCTTC

AA	AC	AG	AT	CA	CC	CG	CT	GA	GC	GG	GT	TA	TC	TG	TT
1	0	2	2	1	0	0	2	2	2	2	3	1	2	4	10

9

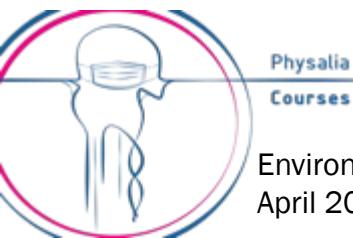
GAAGCACAAAAGAAAACCTCCTTAATCATGCCAAAAAC

AA	AC	AG	AT	CA	CC	CG	CT	GA	GC	GG	GT	TA	TC	TG	TT
10	3	2	2	4	2	0	2	2	2	5	0	1	2	1	1

GTTTGCGATGATTAAAGGGAGTTCTTGTGCTTC
GAAGCACAAAAGAAAACCTCCTTAATCATGCCAAAAAC +

AA	AC	AG	GA	CA	CC	CG	GC	AT	TA
11	3	4	4	5	2	0	2	2	1

k=2



Physalia
Courses

Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>

14

GTTTGCGCATGATTAAGGGAGTTCTTTGTGCTTC

	AA	AC	AG	GA	CA	CC	CG	GC	AT	TA
X	11	3	4	4	5	2	0	2	2	1
Y										
Z										
L										
K										
M										

k=2



Physalia
Courses

Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>

15

ACTTCCGCAGTCGGGCATTACGCGTTGTGGAATGA

	AA	AC	AG	GA	CA	CC	CG	GC	AT	TA
X	11	3	4	4	5	2	0	2	2	1
Y	4	5	2	4	5	4	4	3	2	1
Z										
L										
K										
M										

k=2



AC TTGCGCAGTCGCGCATTACGCGTAGTGGAAATAA

	AA	AC	AG	GA	CA	CC	CG	GC	AT	TA
X	11	3	4	4	5	2	0	2	2	1
Y	4	5	2	4	5	4	4	3	2	1
Z	4	5	3	2	4	1	5	5	2	3
L										
K										
M										

k=2



Physalia
Courses

Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>

17

	AA	AC	AG	GA	CA	CC	CG	GC	AT	TA
X	11	3	4	4	5	2	0	2	2	1
Y	4	5	2	4	5	4	4	3	2	1
Z	4	5	3	2	4	1	5	5	2	3
L	11	6	3	2	2	3	2	1	1	4
K	1	1	2	2	1	8	9	10	0	0
M	0	4	4	3	4	10	4	5	0	0

k=2



Physalia
Courses

Environmental metagenomics
April 2023

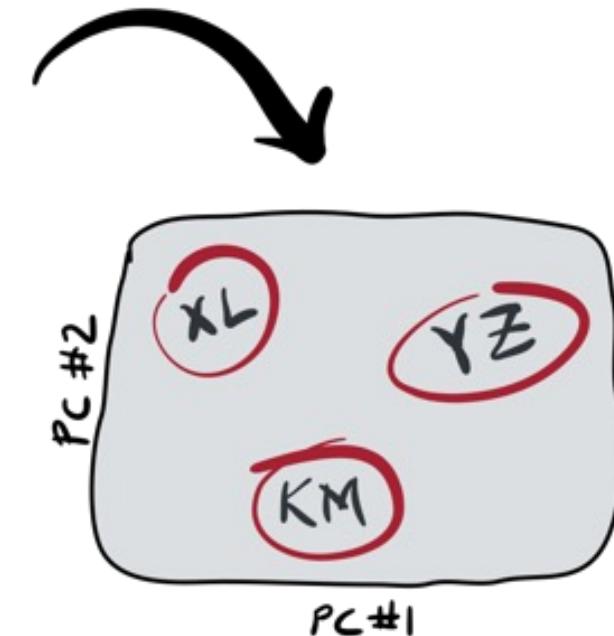
Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>

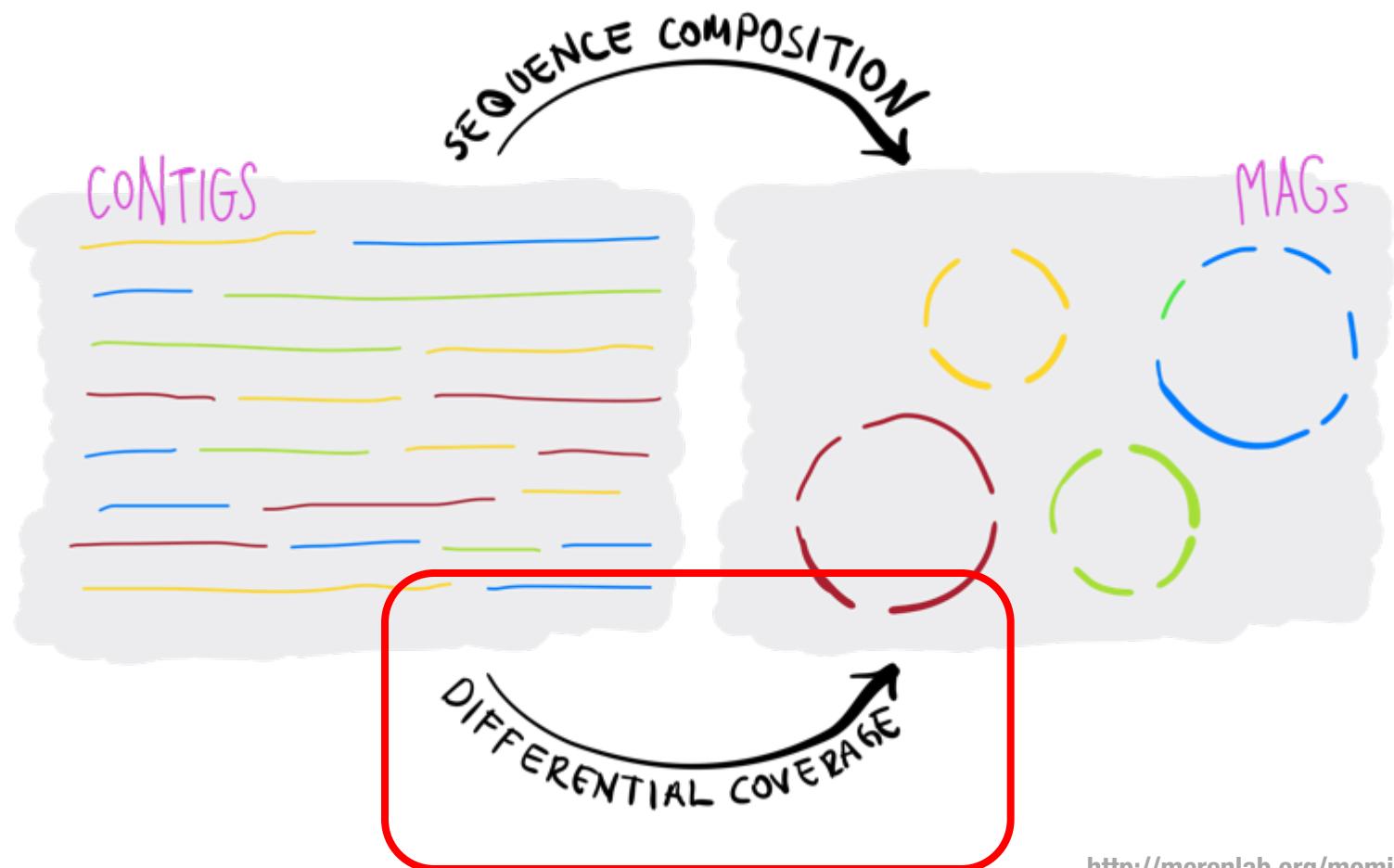
18

	AA	AC	AG	GA	CA	CC	CG	GC	AT	TA
X	11	3	4	4	5	2	0	2	2	1
Y	4	5	2	4	5	4	4	3	2	1
Z	4	5	3	2	4	1	5	5	2	3
L	11	6	3	2	2	3	2	1	1	4
K	1	1	2	2	1	8	9	10	0	0
M	0	4	4	3	4	10	4	5	0	0

k=2



Differential coverage



CONTIG #1

CONTIG #2



Physalia
Courses

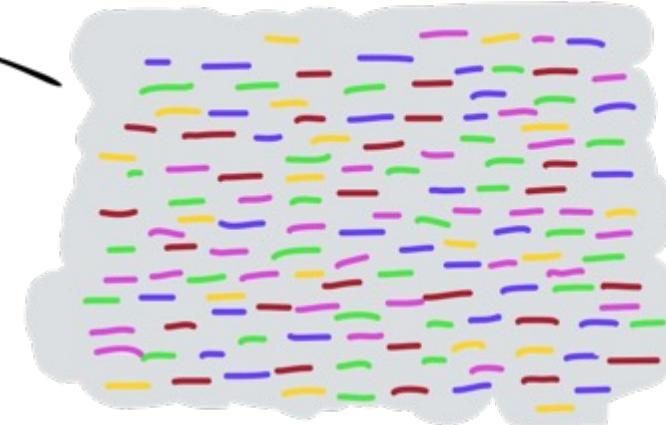
Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>

21

CONTIG #1



CONTIG #2



Physalia
Courses

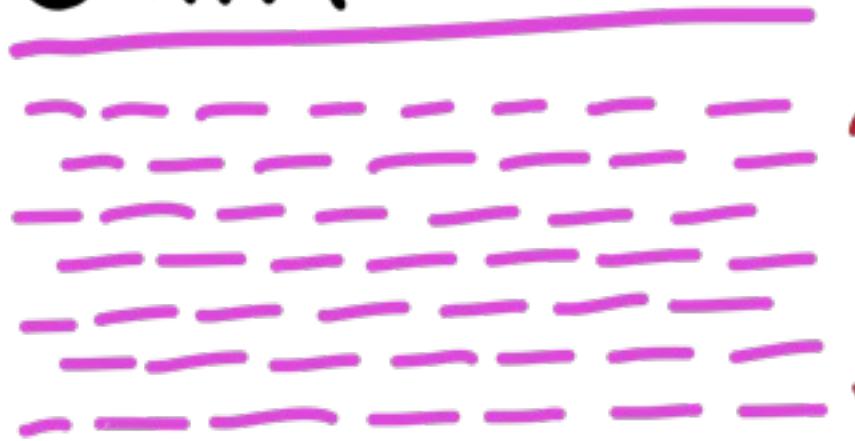
Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

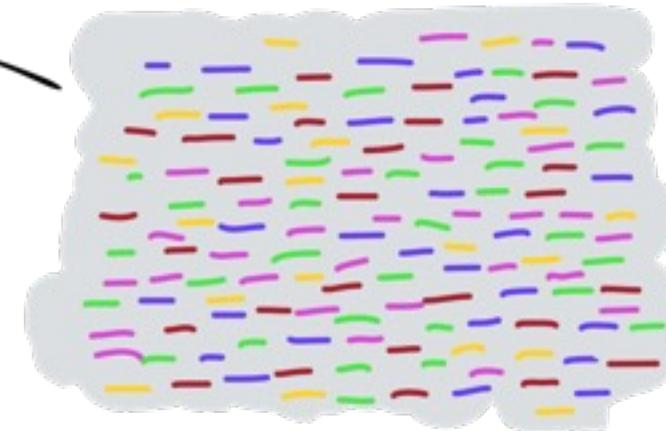
<http://merenlab.org/momics>

22

CONTIG #1



COVERAGE: ~7X



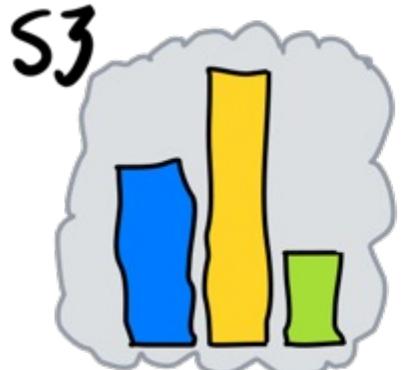
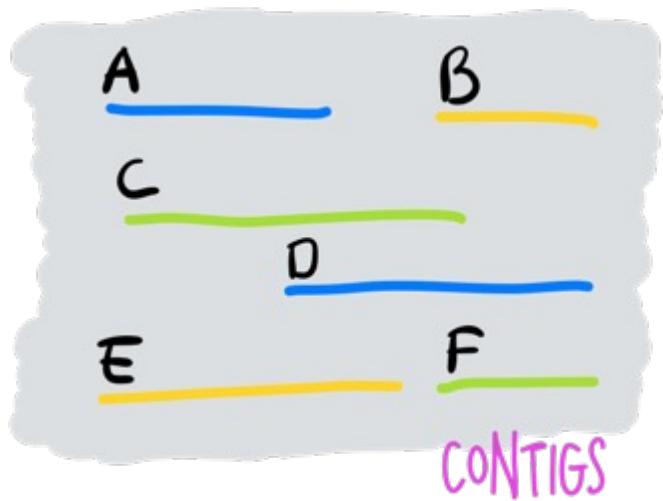
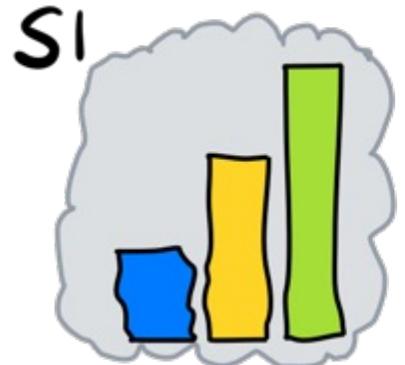
METAGENOMIC READS

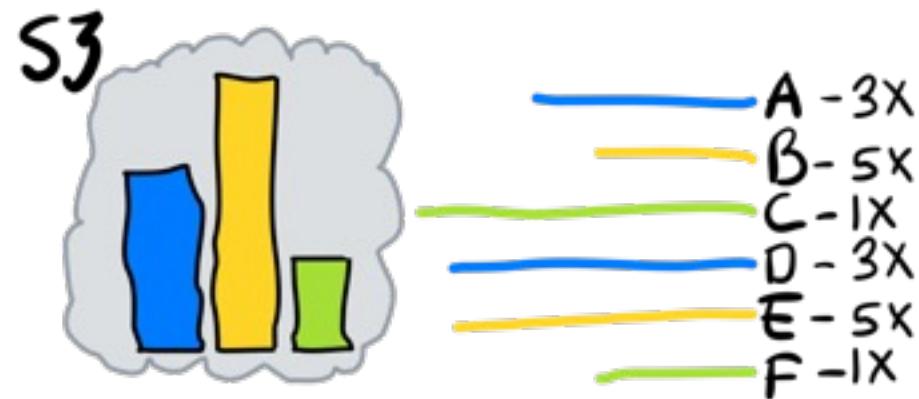
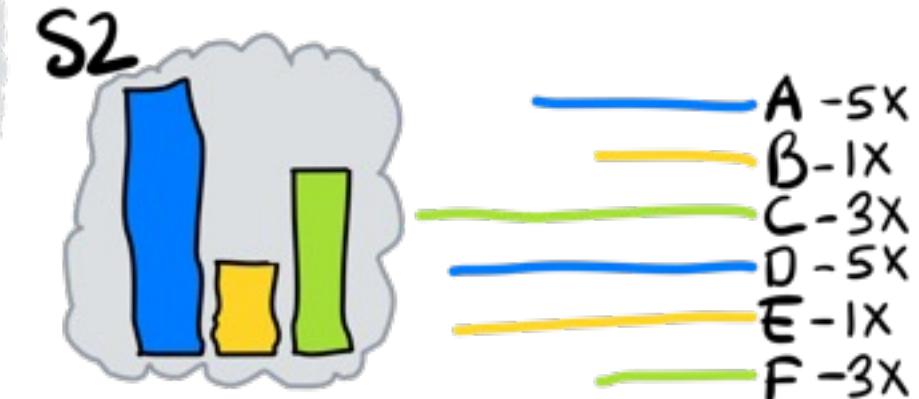
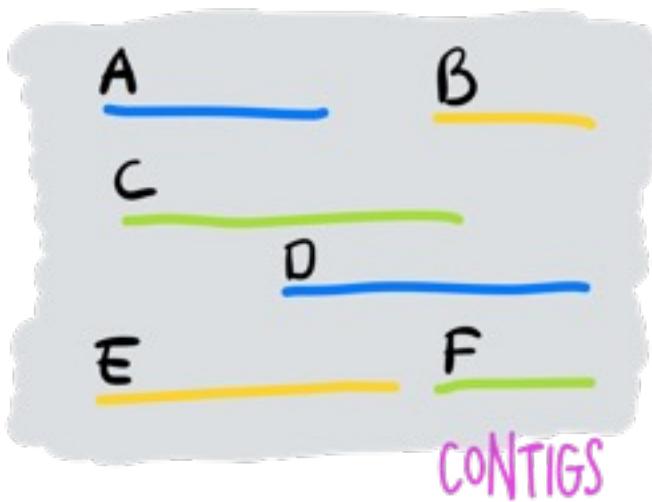
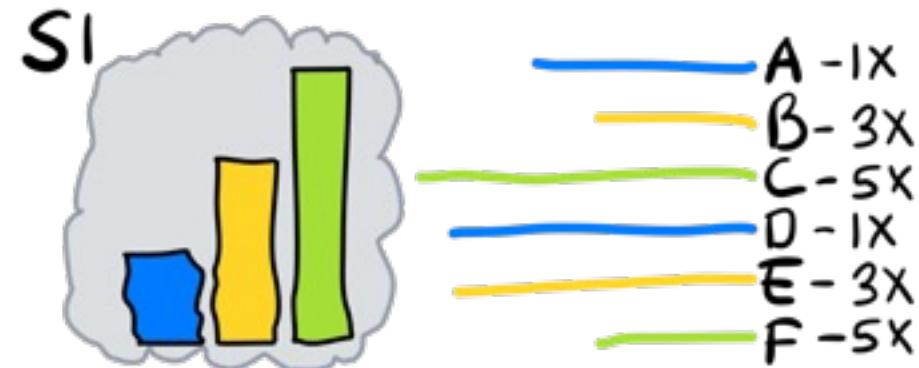
CONTIG #2

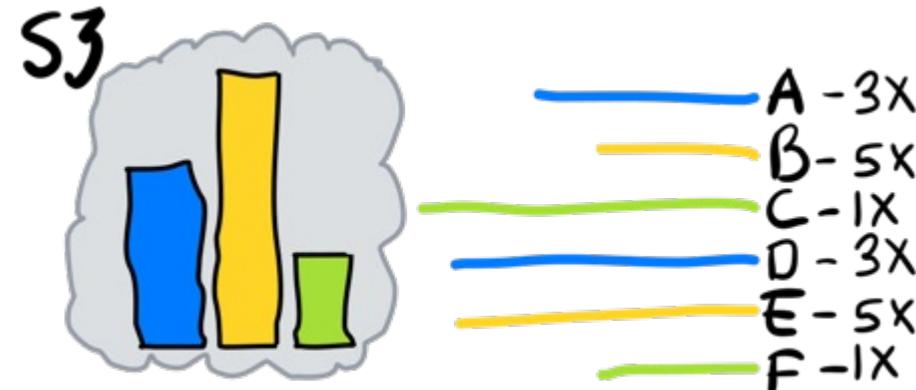
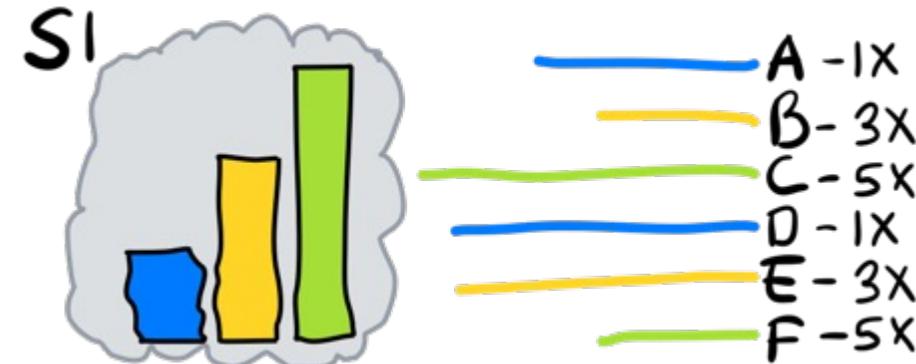
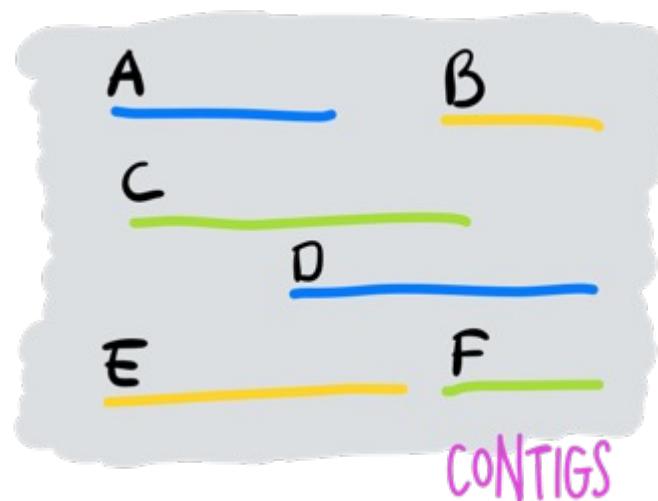


COVERAGE: ~4X

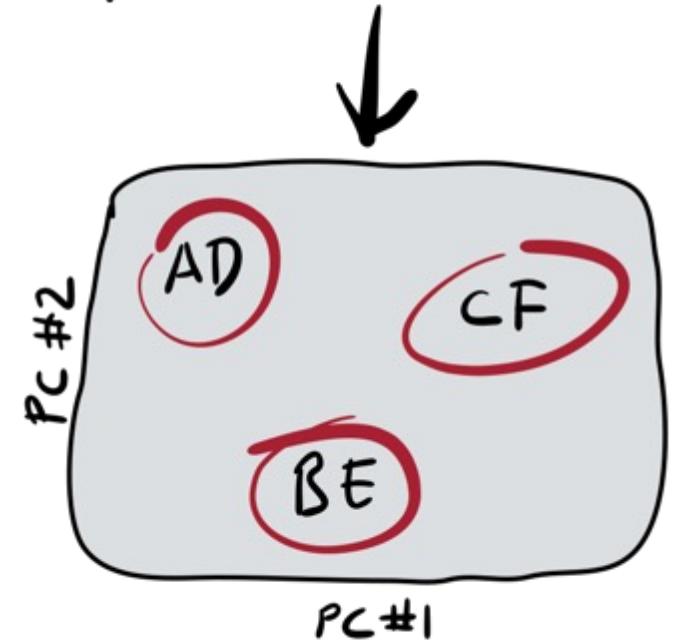








	A	B	C	D	E	F
S1	1	3	5	1	3	5
S2	5	1	3	5	1	3
S3	3	5	1	3	5	1



Genome-resolved metagenomics *in action*



Environmental metagenomics
April 2023

Igor S. Pessi & Antti Karkman

27

Genome-resolved metagenomics *in action*

- Several automatic binning algorithms available
 - CONCOCT, MetaBat, MaxBin, BinSanity, Autometa, DAS Tool, SemiBin2 ...
 - Various algorithms, but most rely on kmers and coverage
- Manual binning in anvi'o
 - Tetranucleotide frequency *and/or* differential coverage
 - Also, automatic binning results can be visualised



Files and workflows in anvi'o

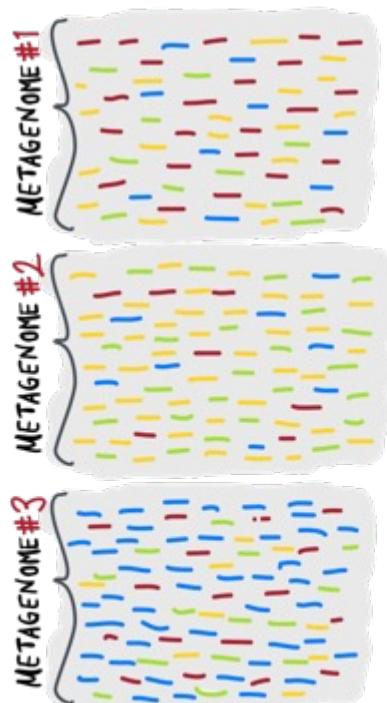


Environmental metagenomics
April 2023

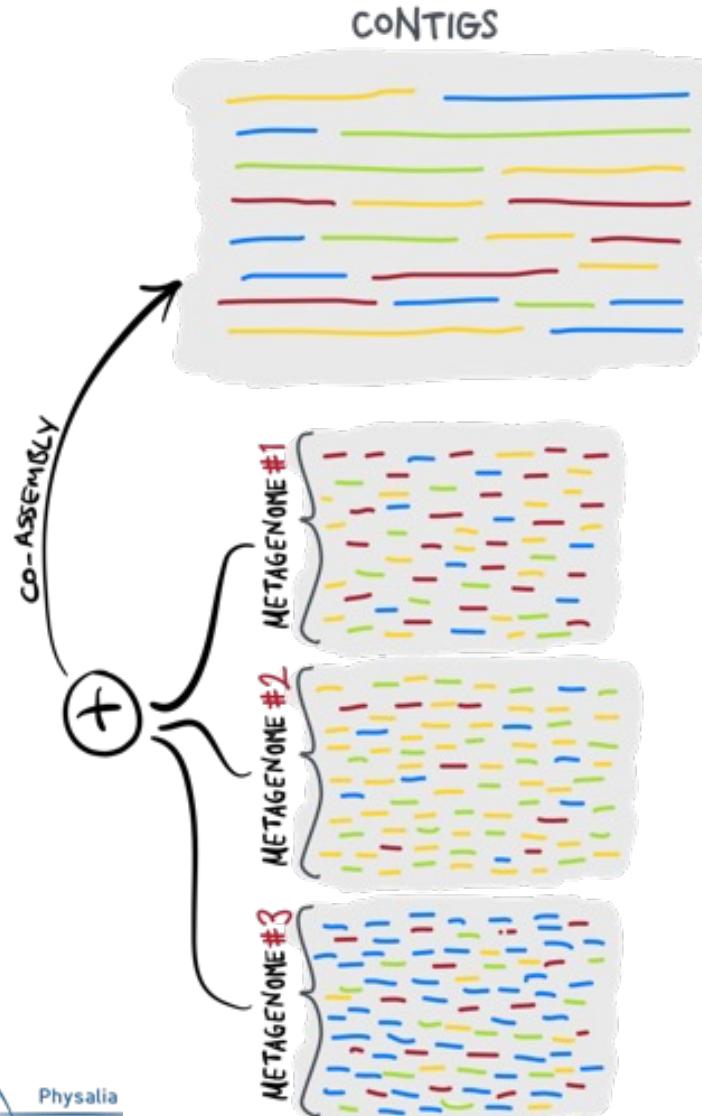
Igor S. Pessi & Antti Karkman

29

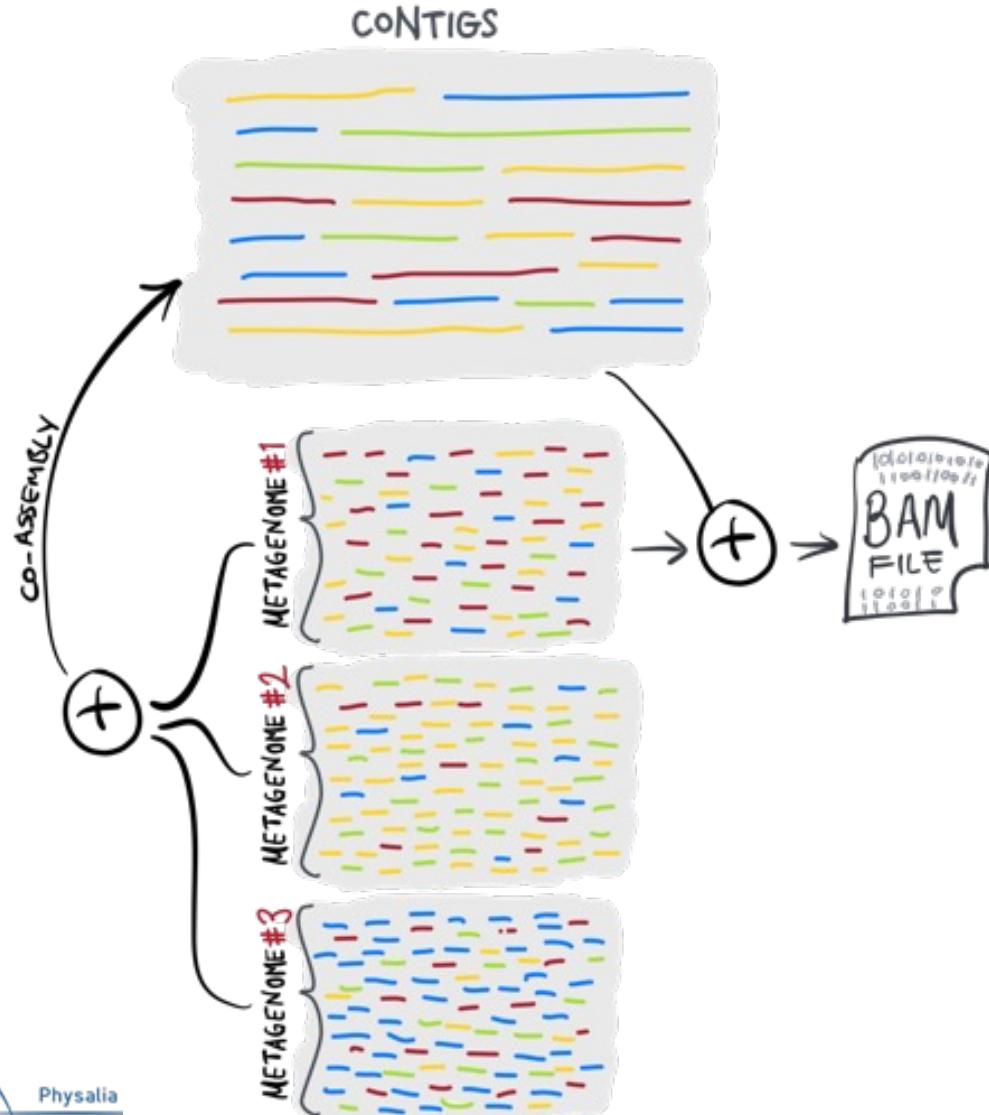
Files and workflows in anvi'o



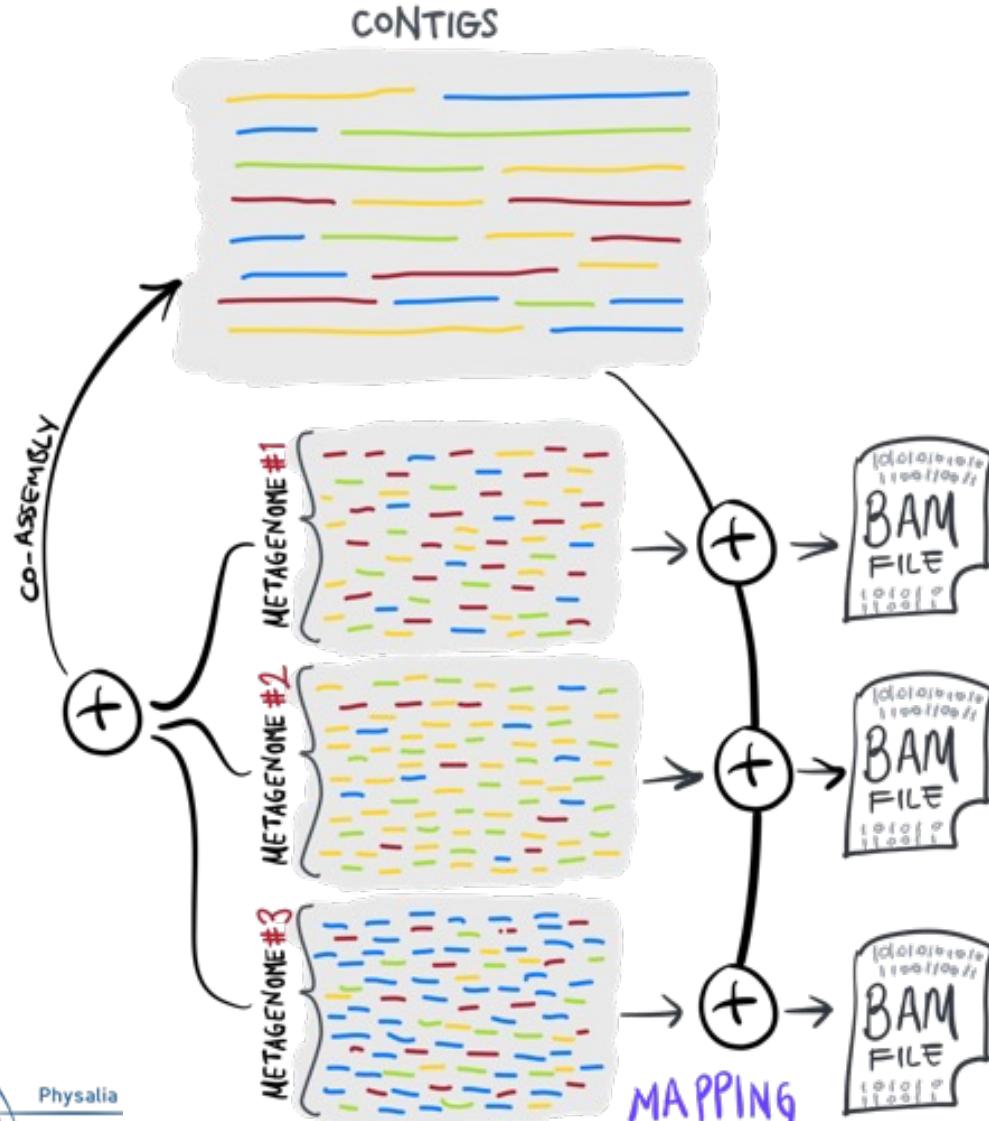
Files and workflows in anvi'o



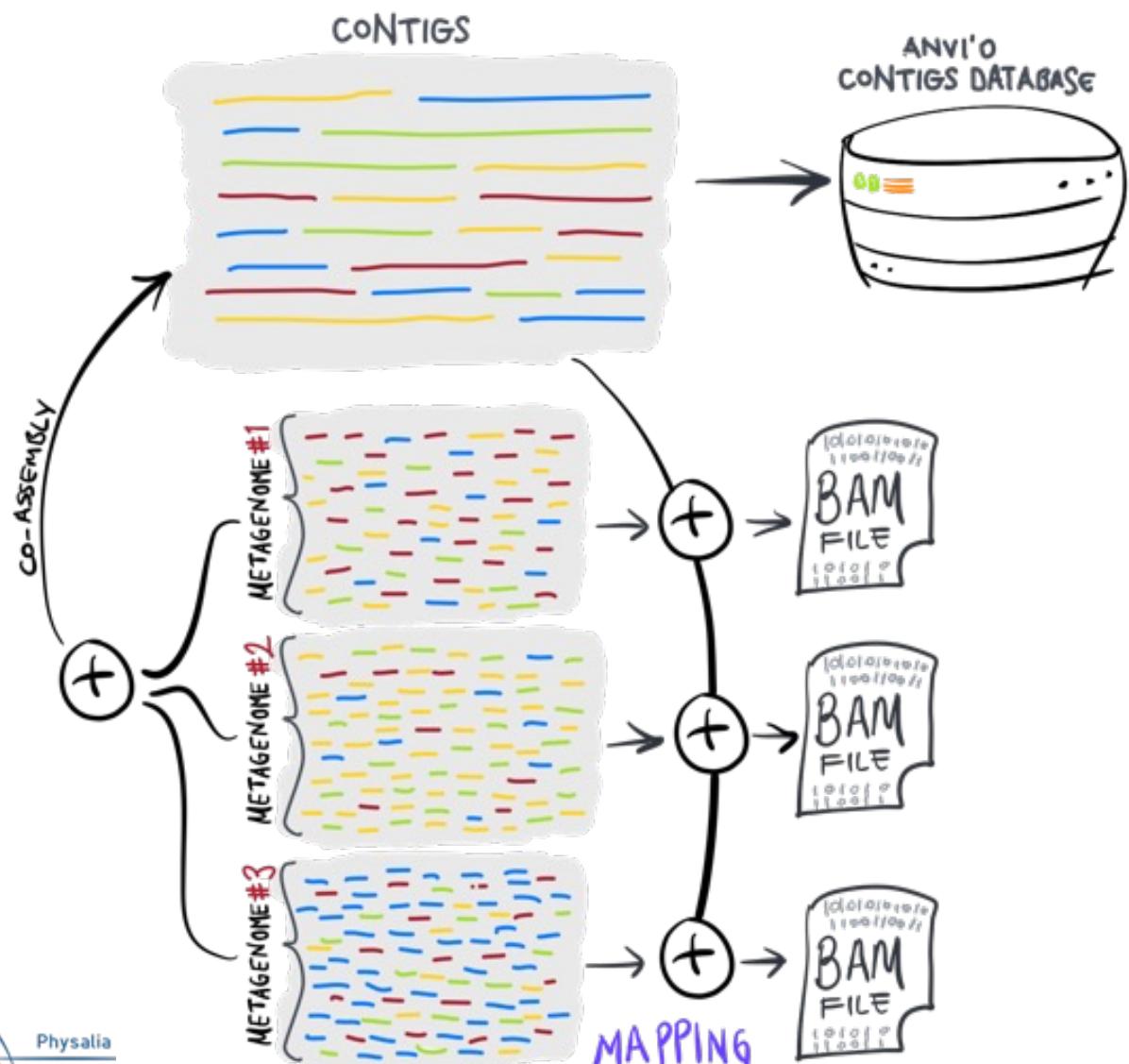
Files and workflows in anvi'o



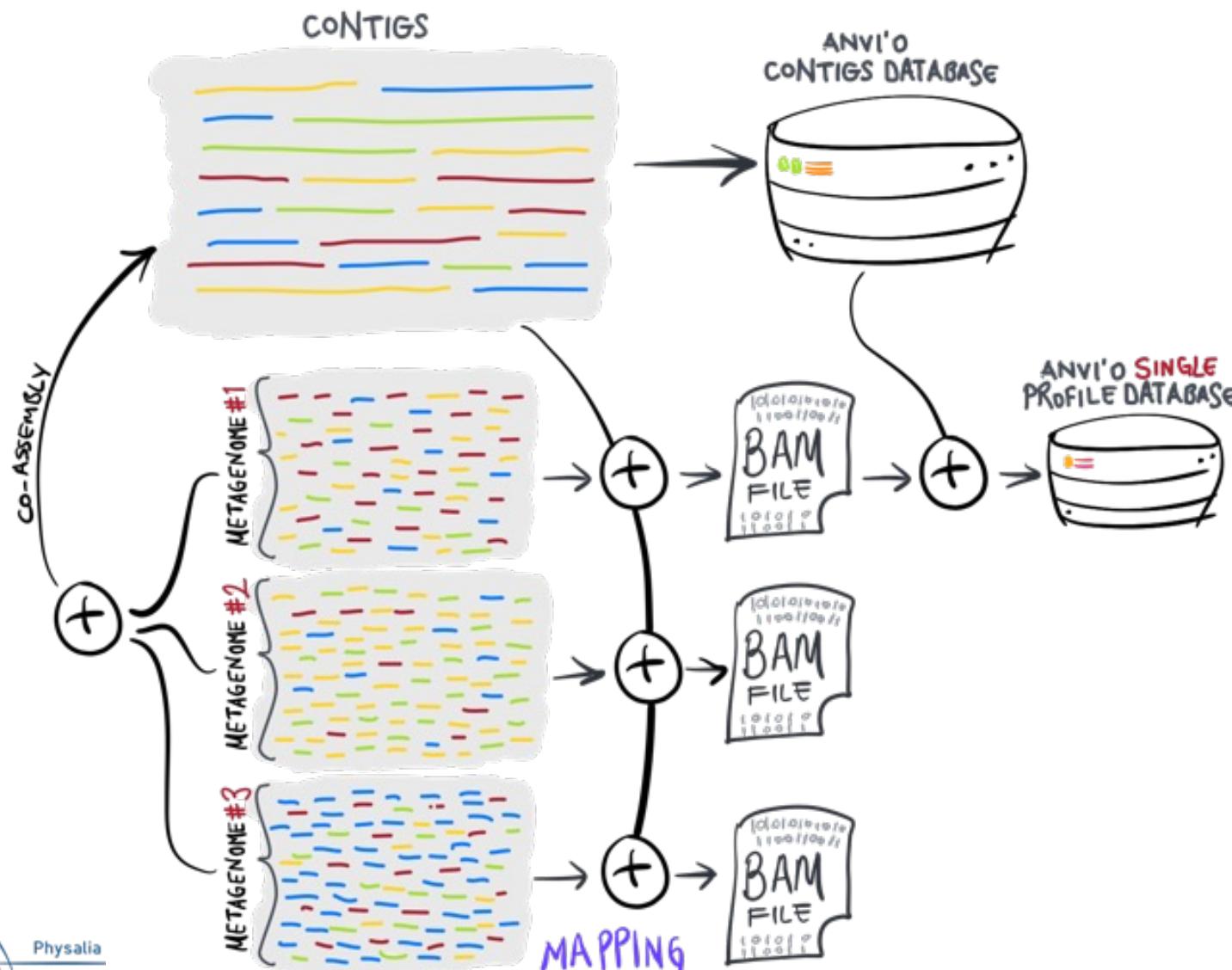
Files and workflows in anvi'o



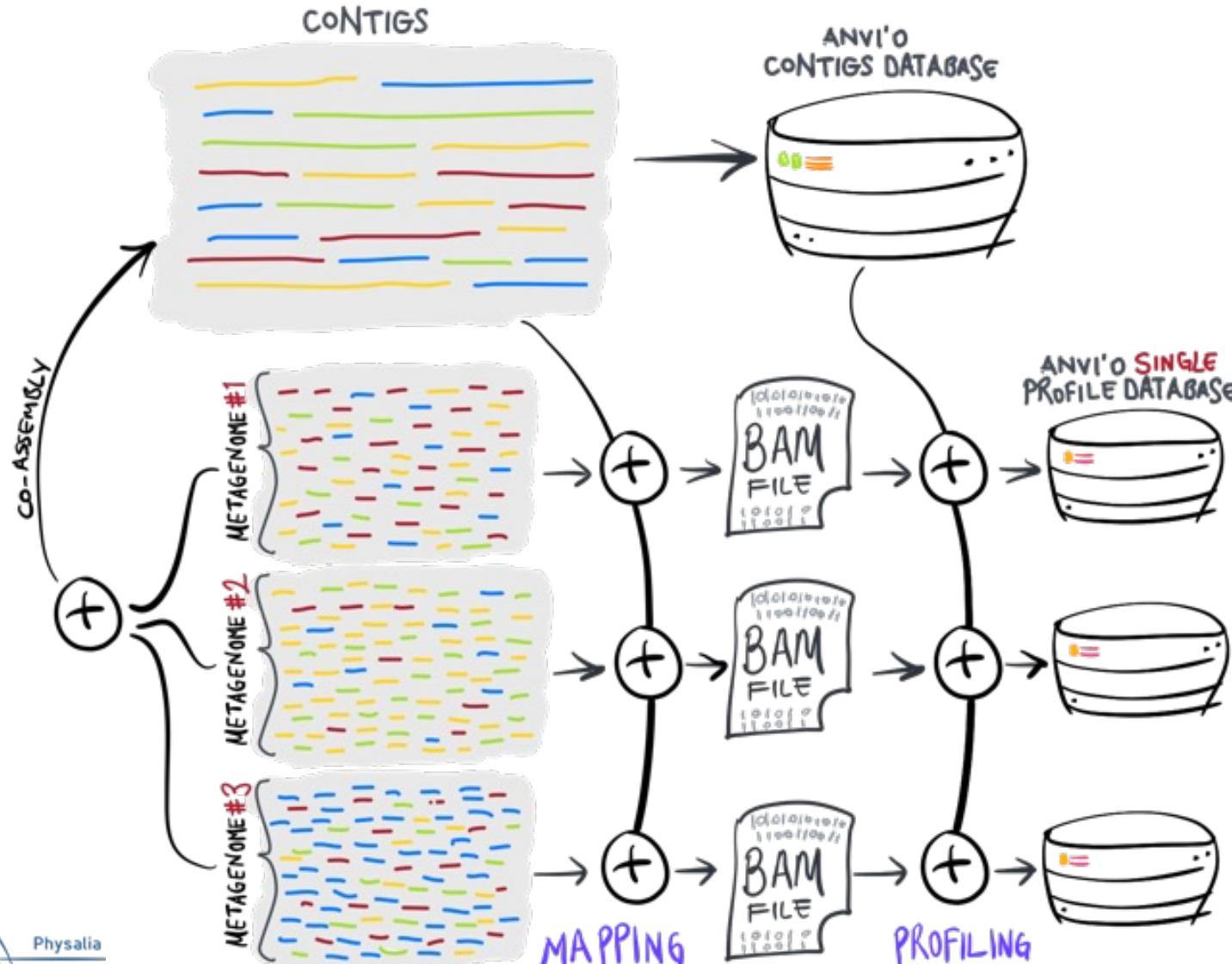
Files and workflows in anvi'o



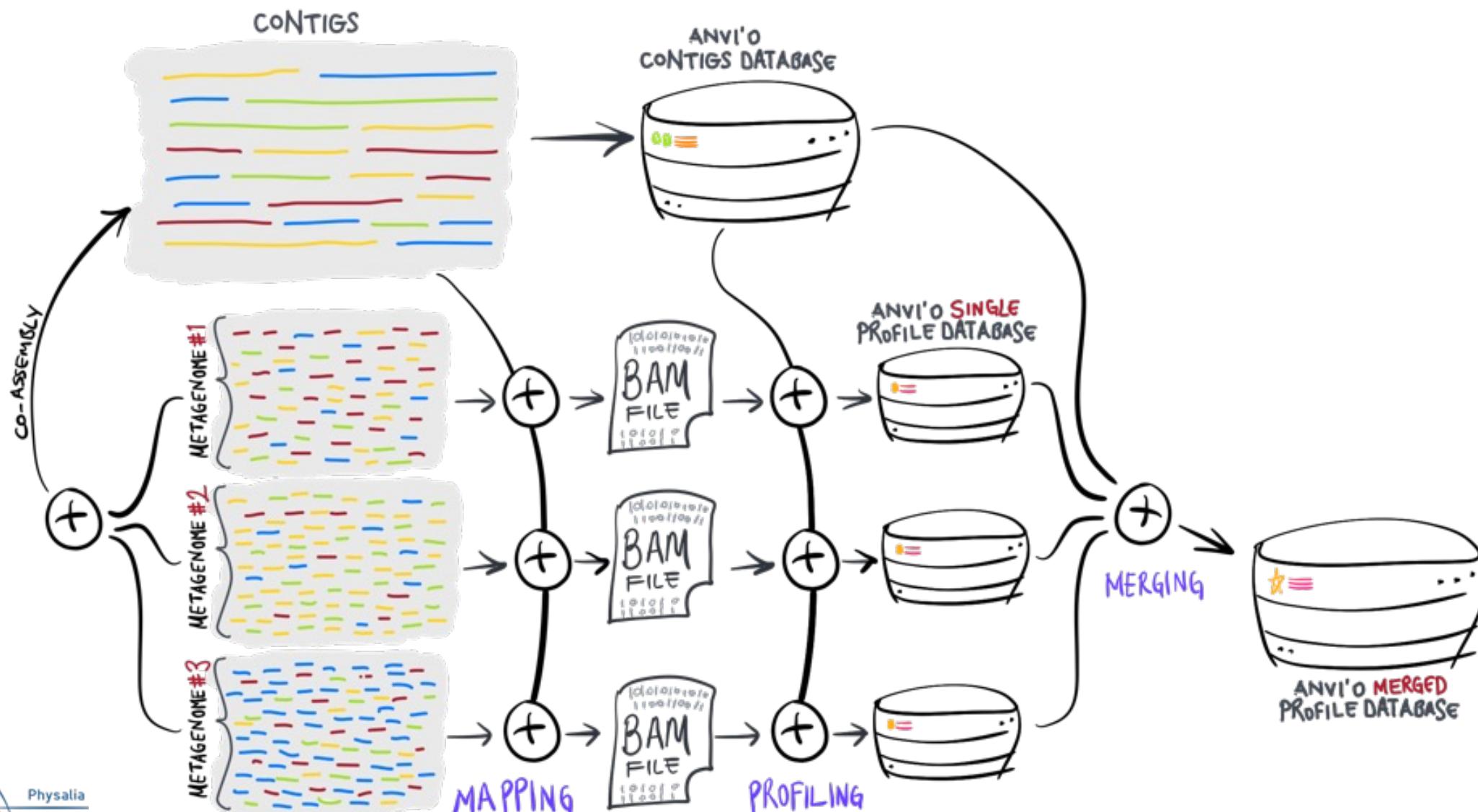
Files and workflows in anvi'o



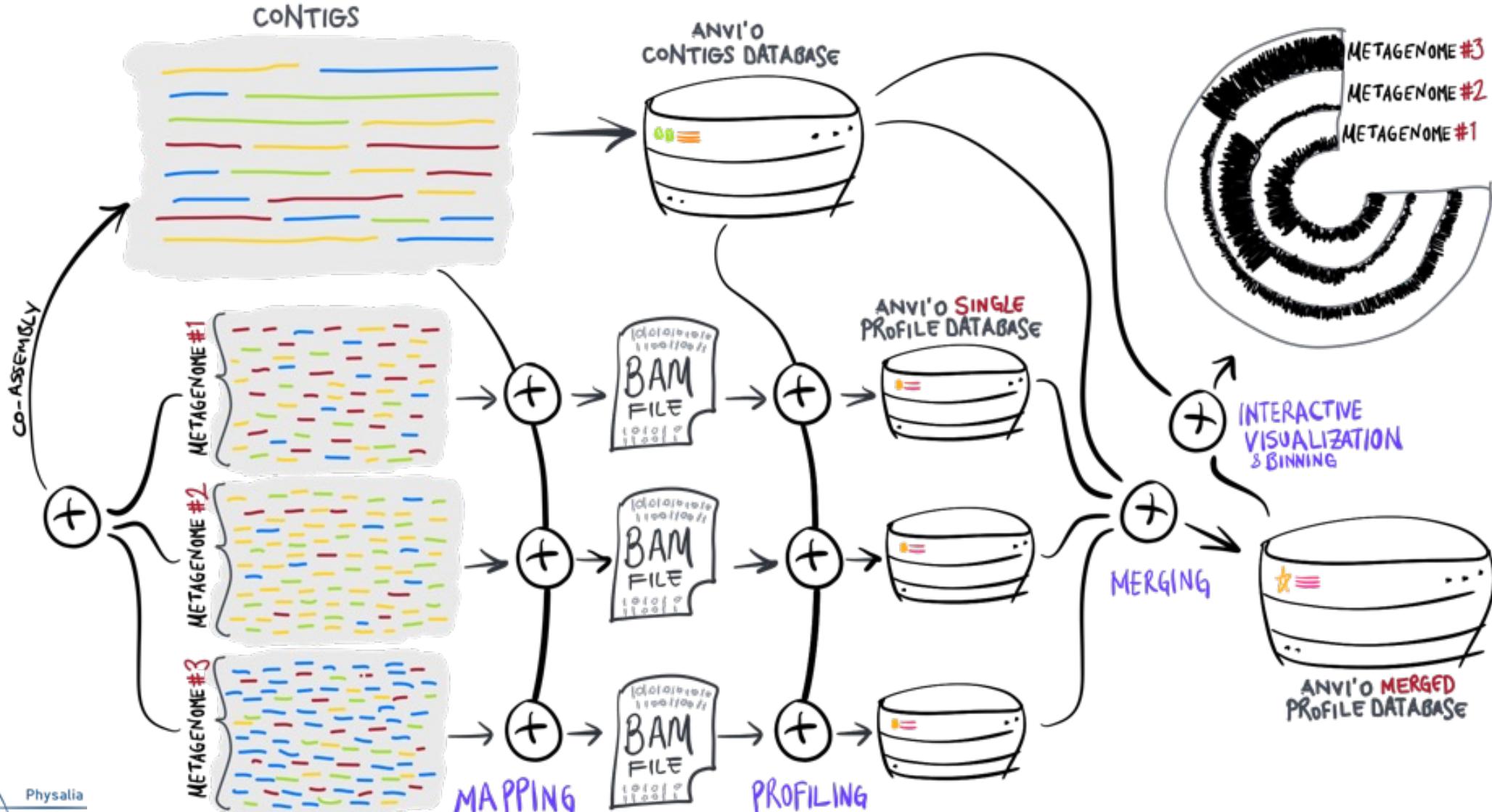
Files and workflows in anvi'o



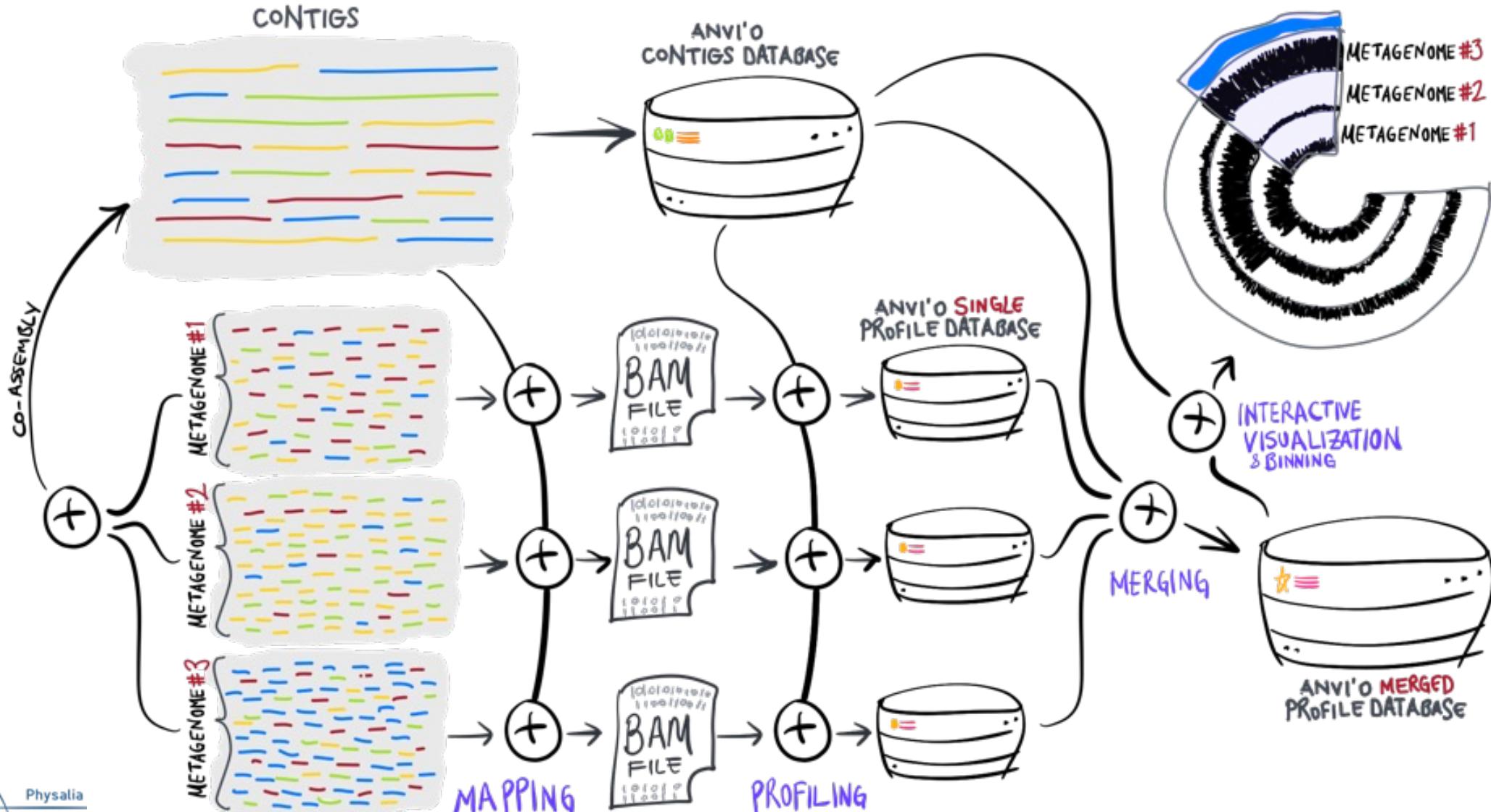
Files and workflows in anvi'o



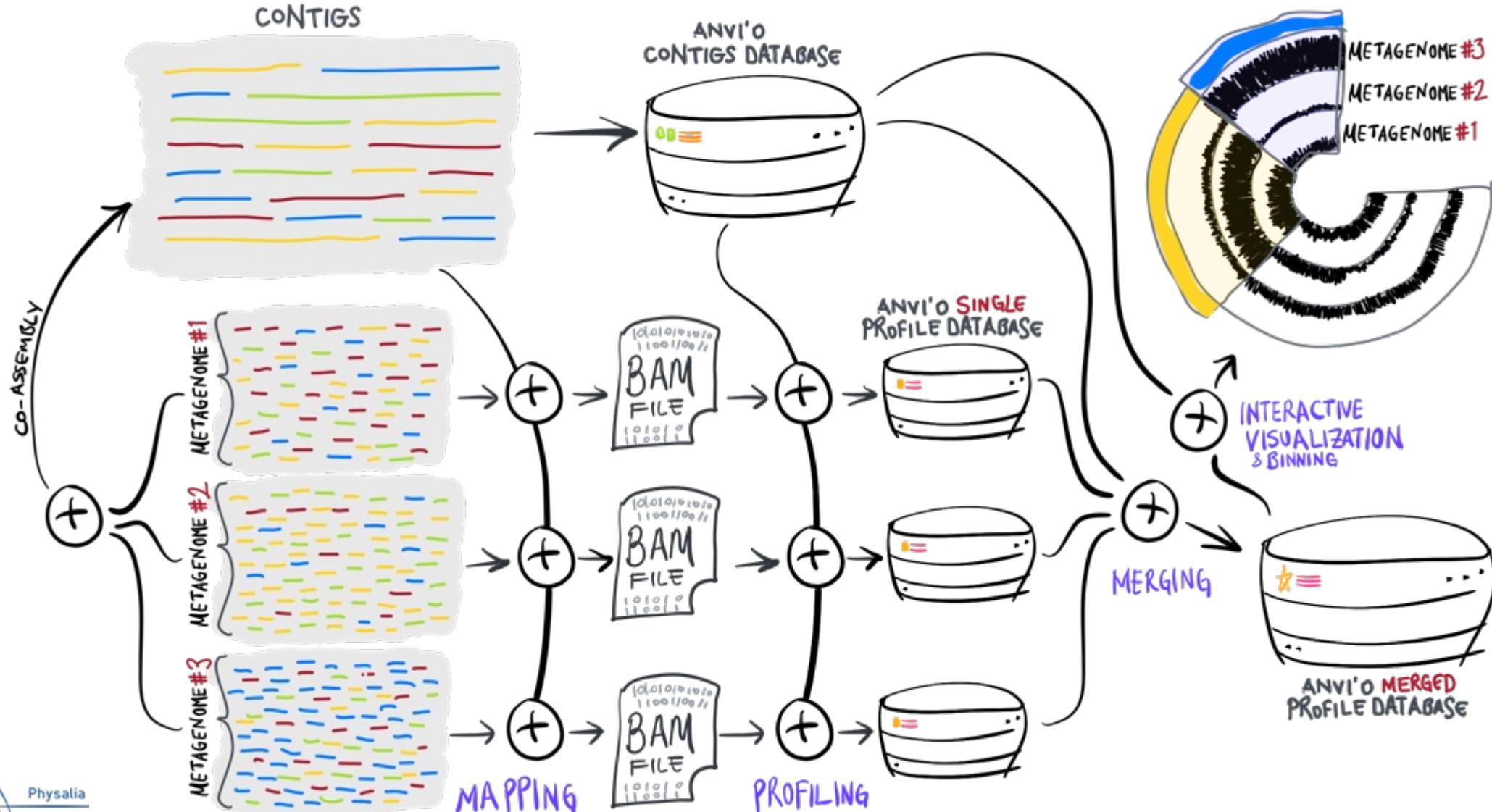
Files and workflows in anvi'o



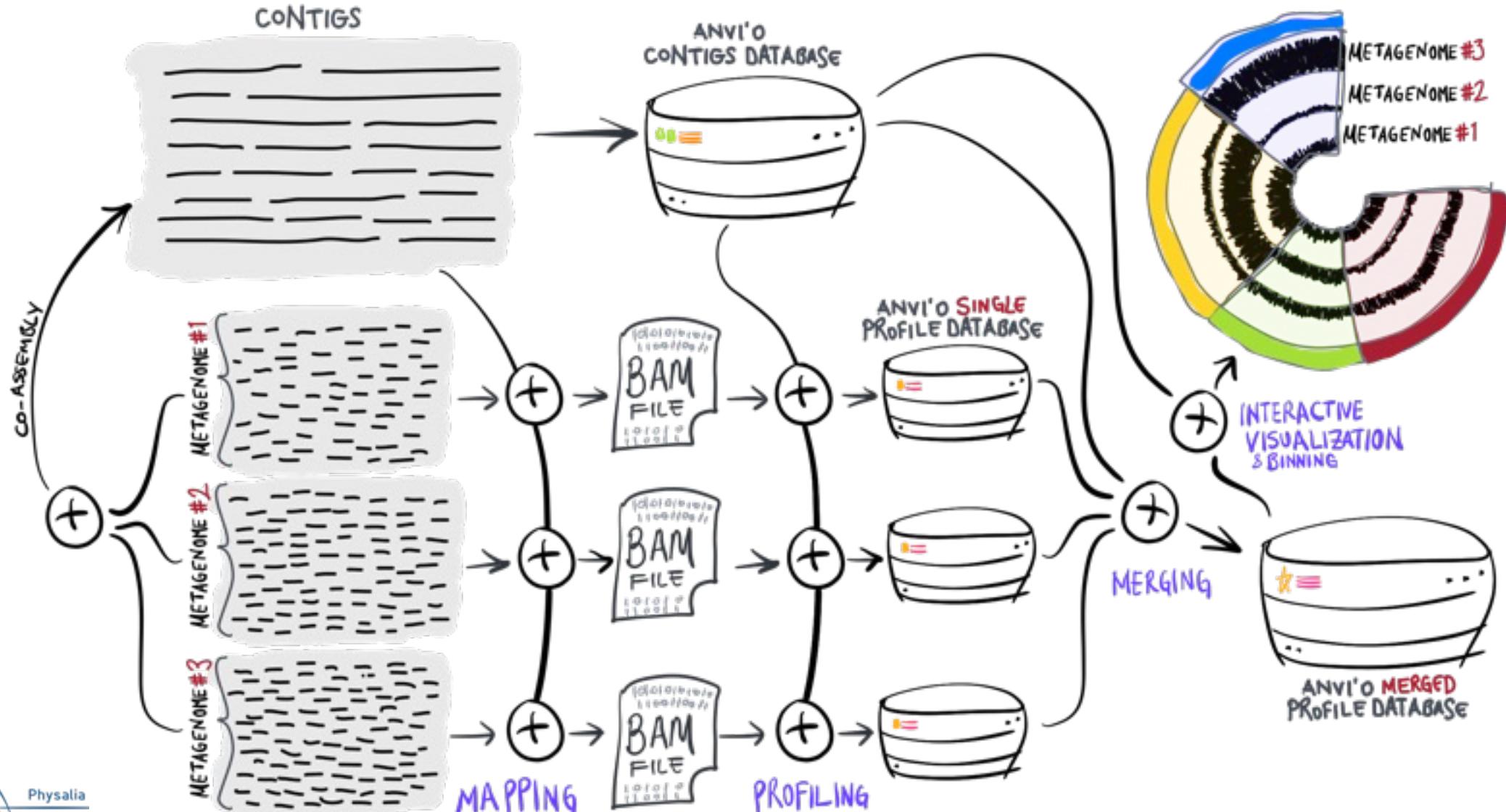
Files and workflows in anvi'o



Files and workflows in anvi'o



Files and workflows in anvi'o



Anvi'o interactive view

