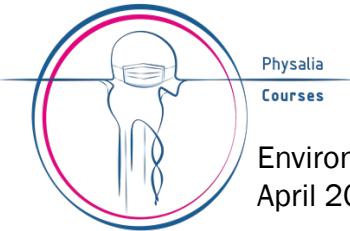


Environmental metagenomics

Genome-resolved metagenomics

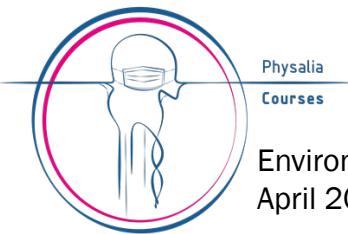
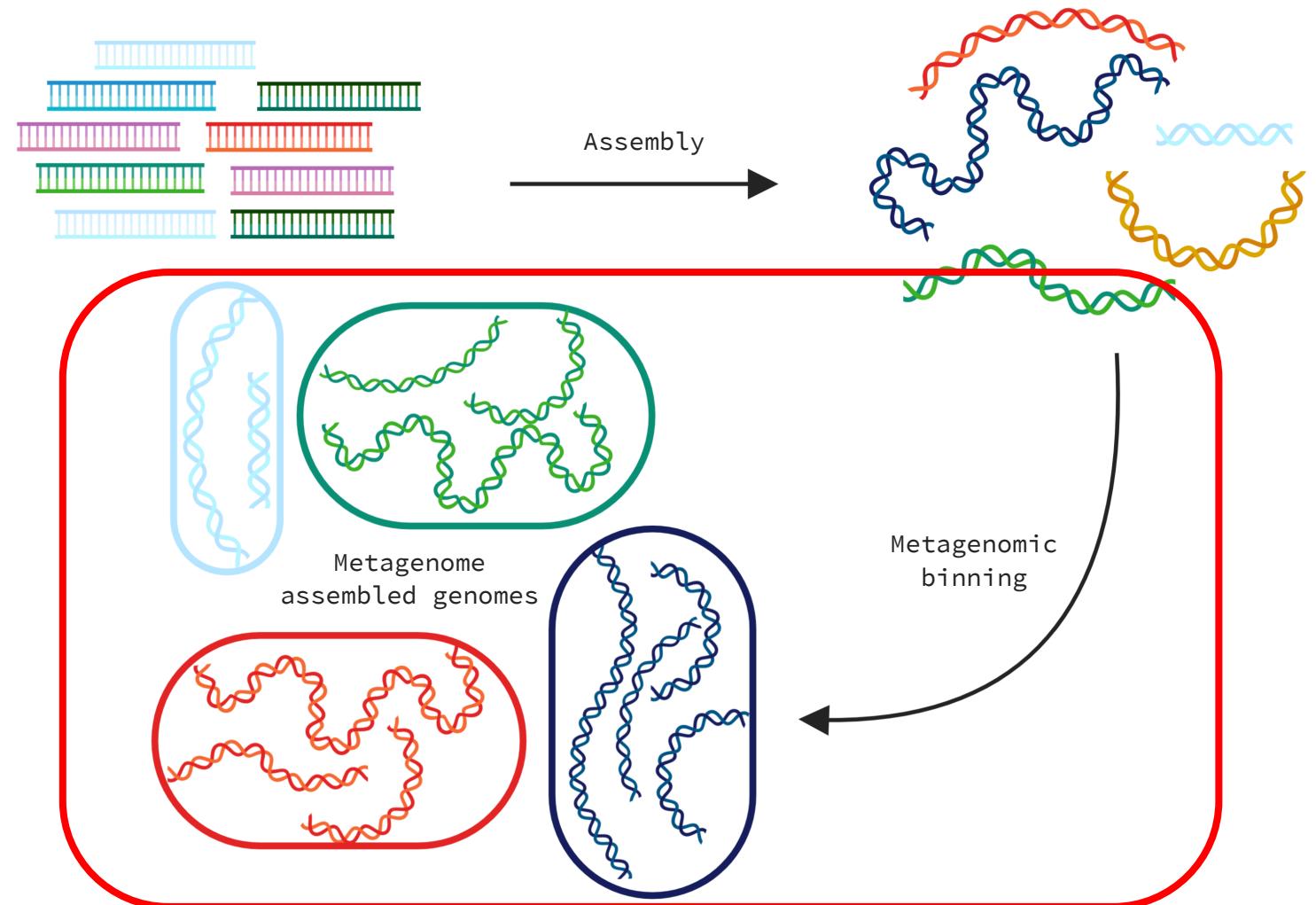


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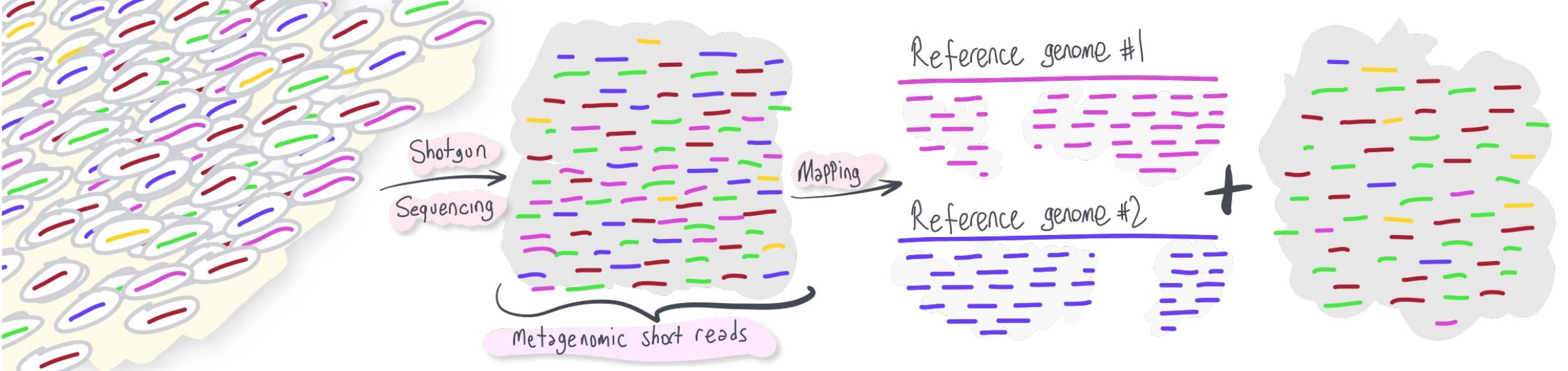
What is genome-resolved metagenomics?



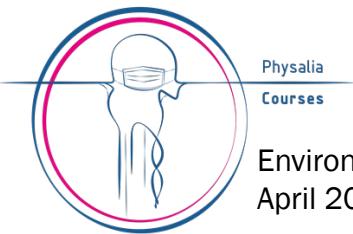
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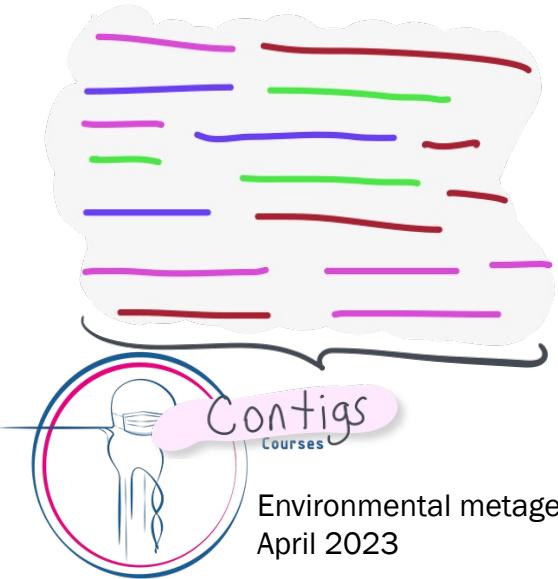
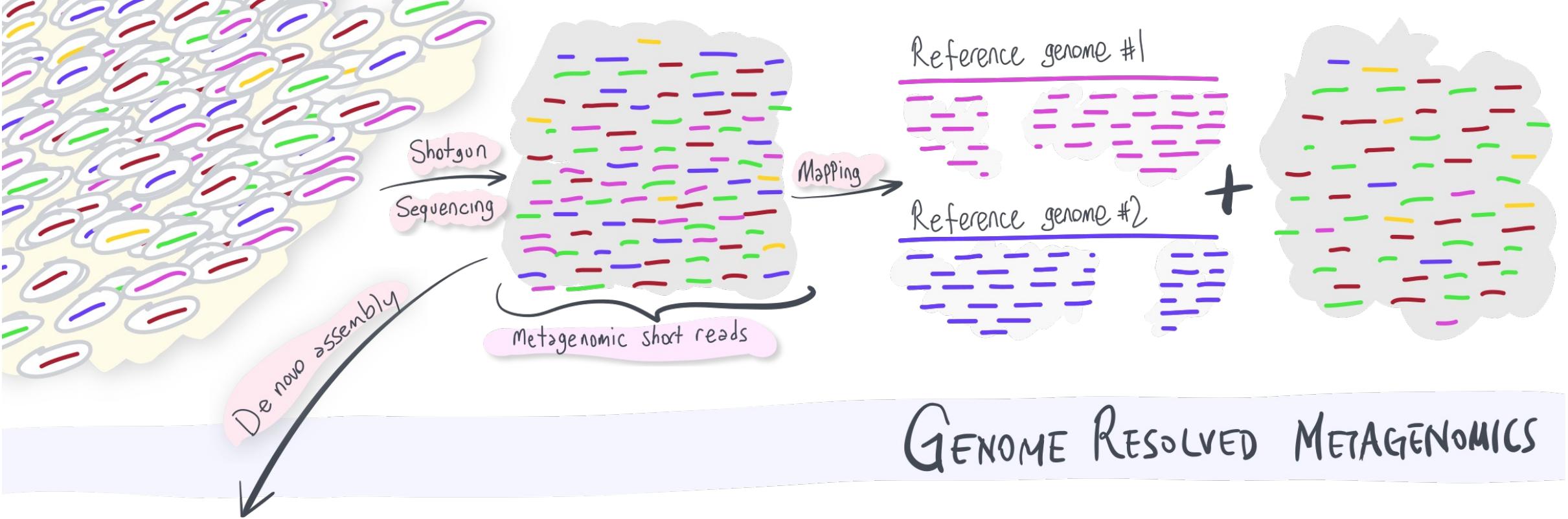
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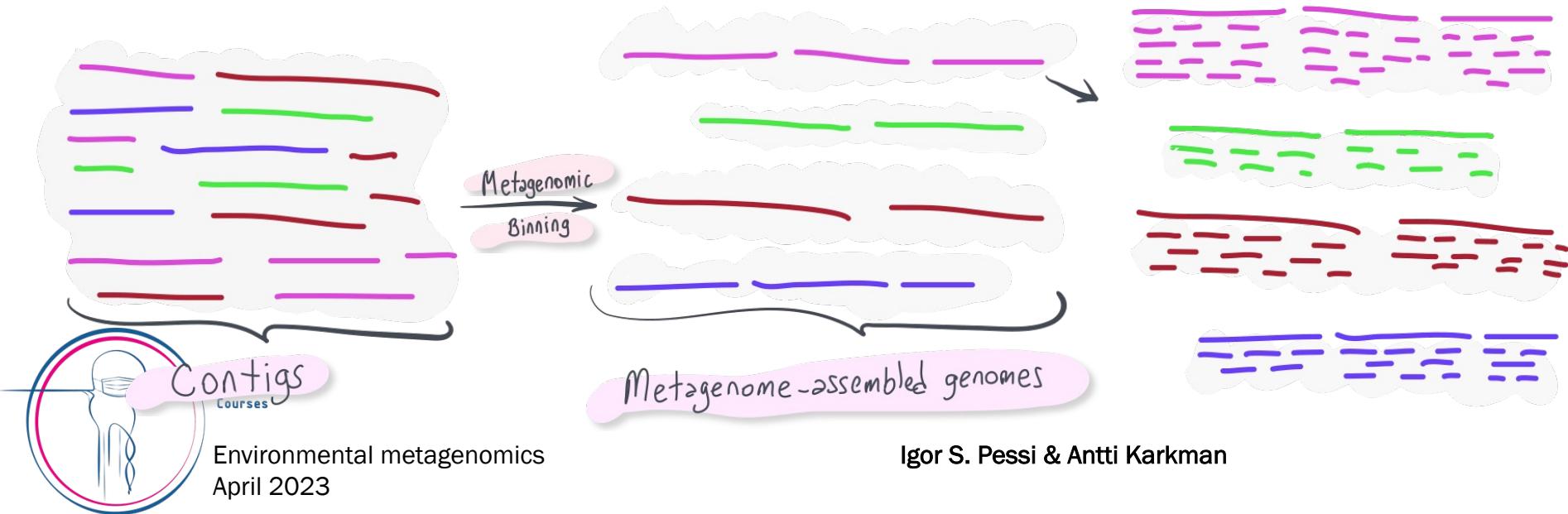
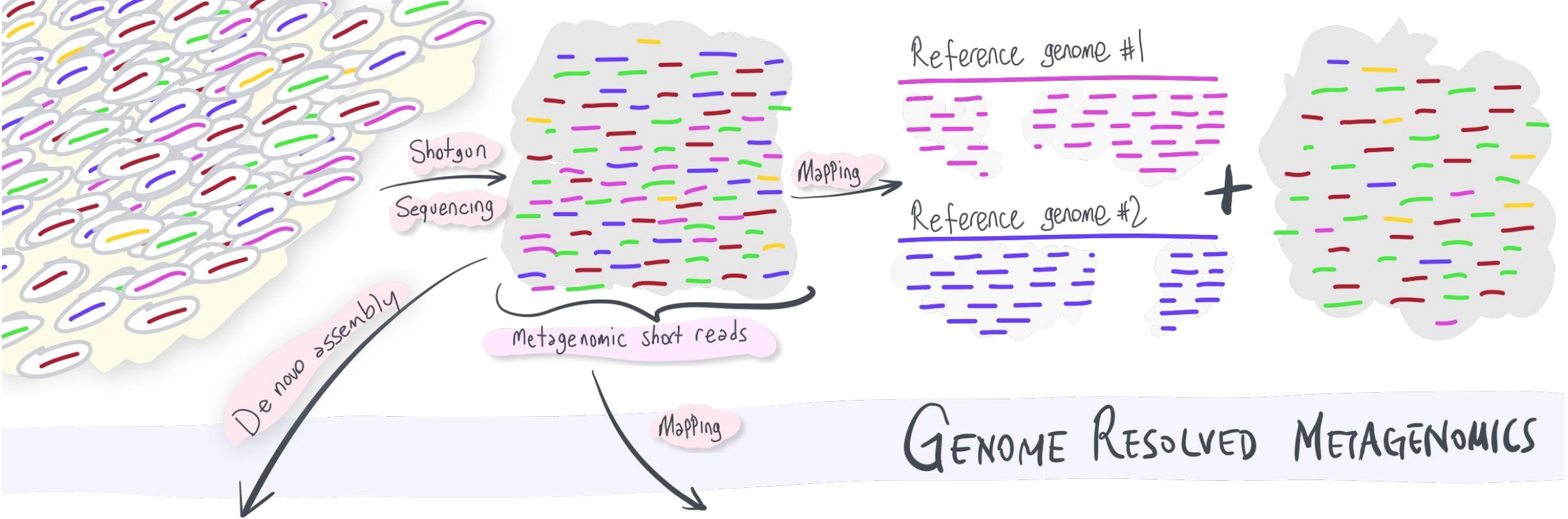
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GENOME RESOLVED METAGENOMICS

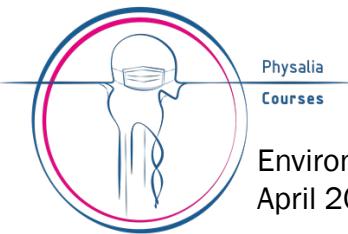
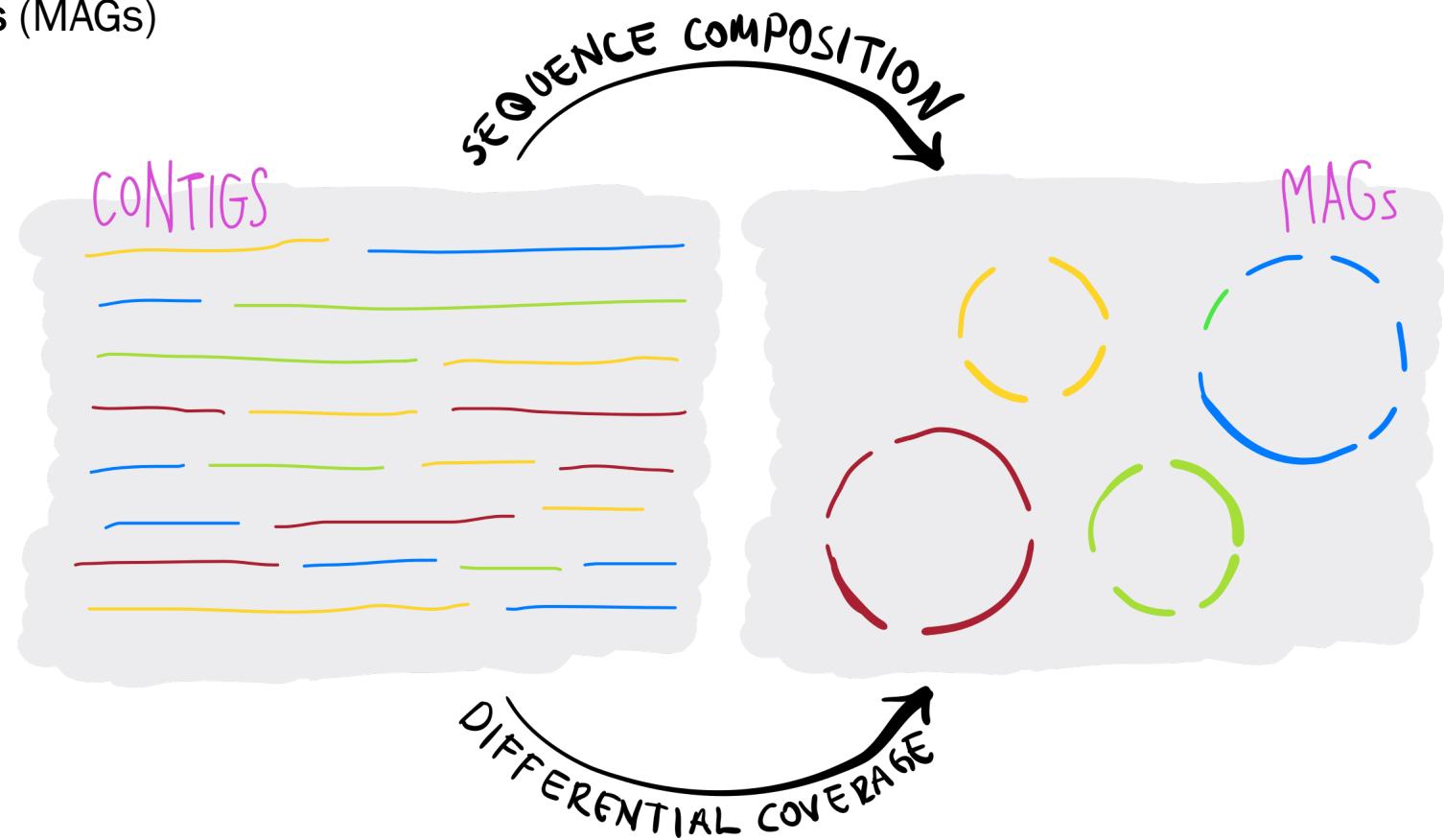




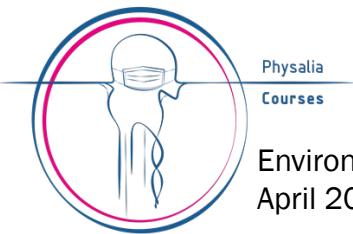
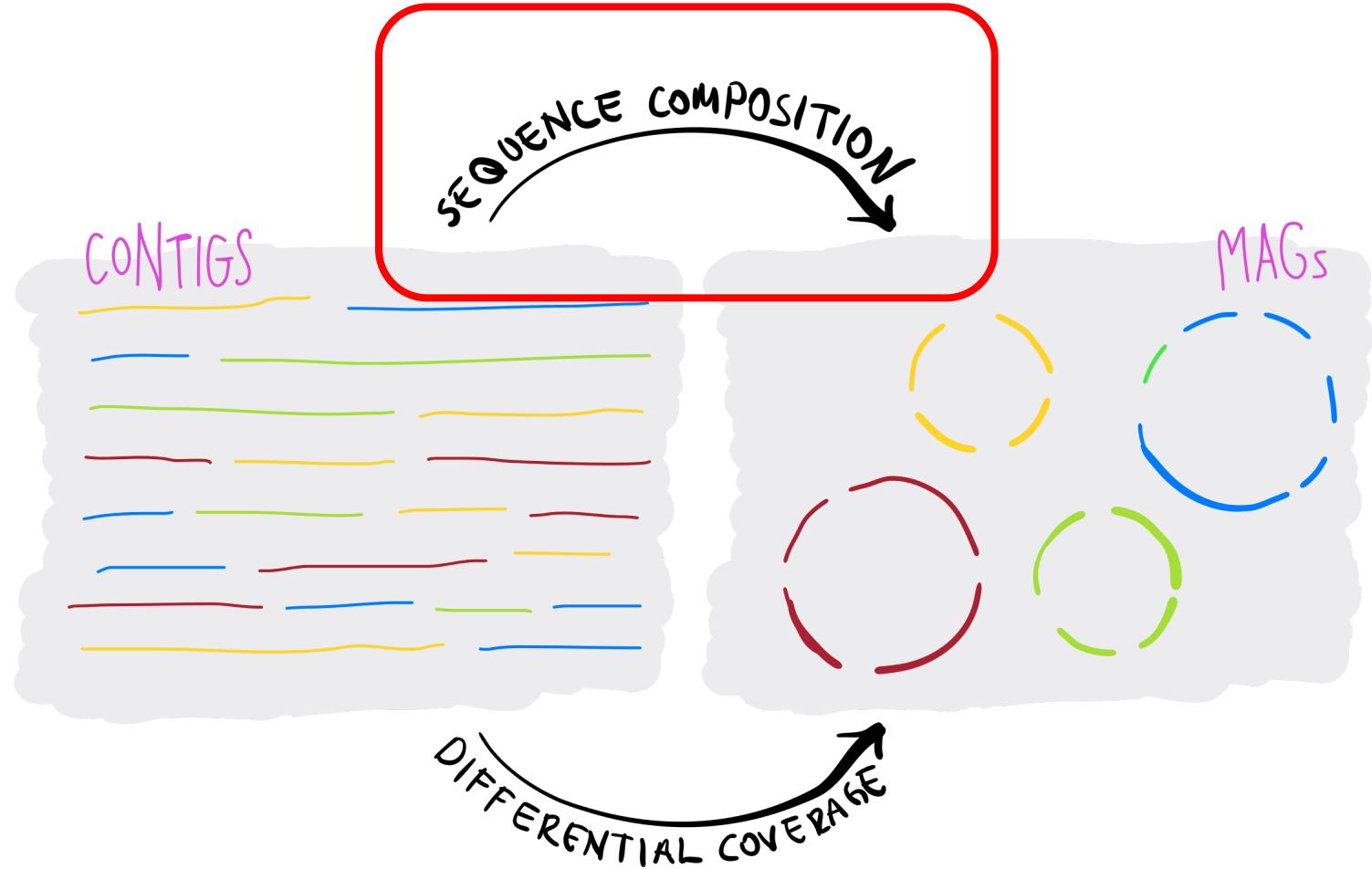


Metagenomic binning

From contigs to
metagenome assembled genomes (MAGs)



Sequence composition – kmers



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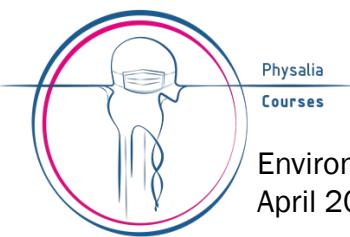
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<http://merenlab.org/momics>

GTTTGCGCATGATTAAGGGAGTTCTTTGTGCTTC

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



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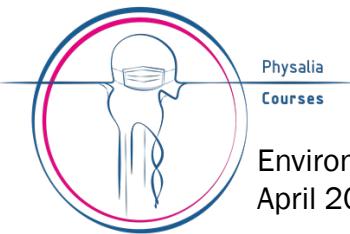
<http://merenlab.org/momics>

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



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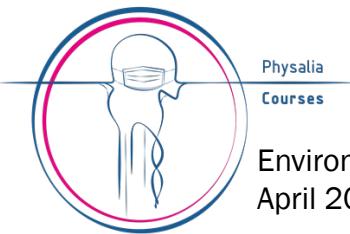
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k=2



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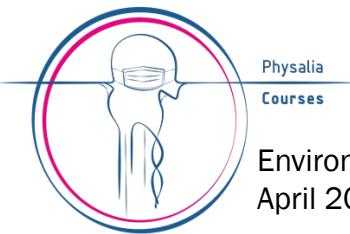
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k=2



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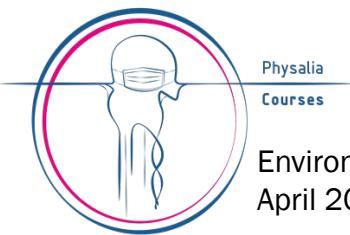
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<http://merenlab.org/momics>

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

k=2



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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



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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



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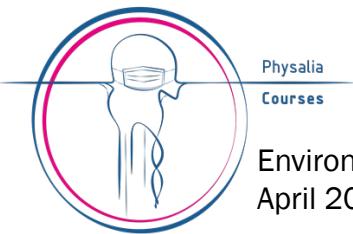
<http://merenlab.org/momics>

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



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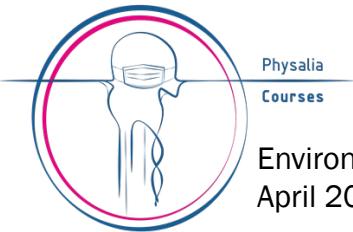
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ACTTCCGCAGTCGGGCATTACGCGTTGTGGAATGA

	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



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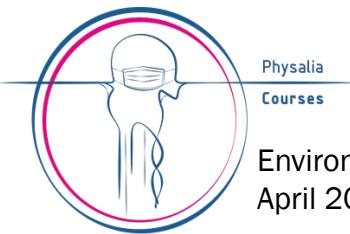
<http://merenlab.org/momics>

16

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



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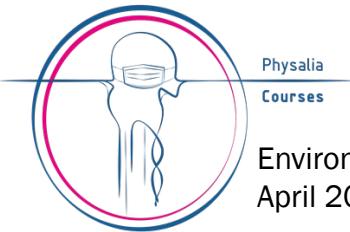
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<http://merenlab.org/momics>

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



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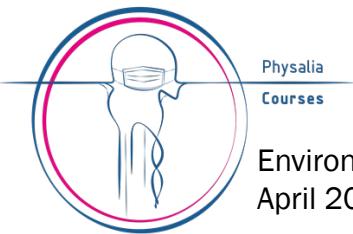
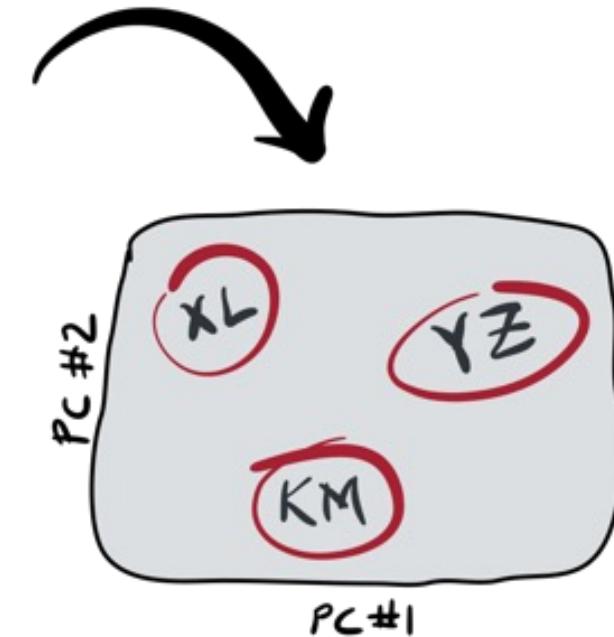
Igor S. Pessi & Antti Karkman

<http://merenlab.org/momics>

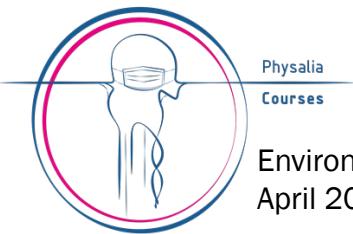
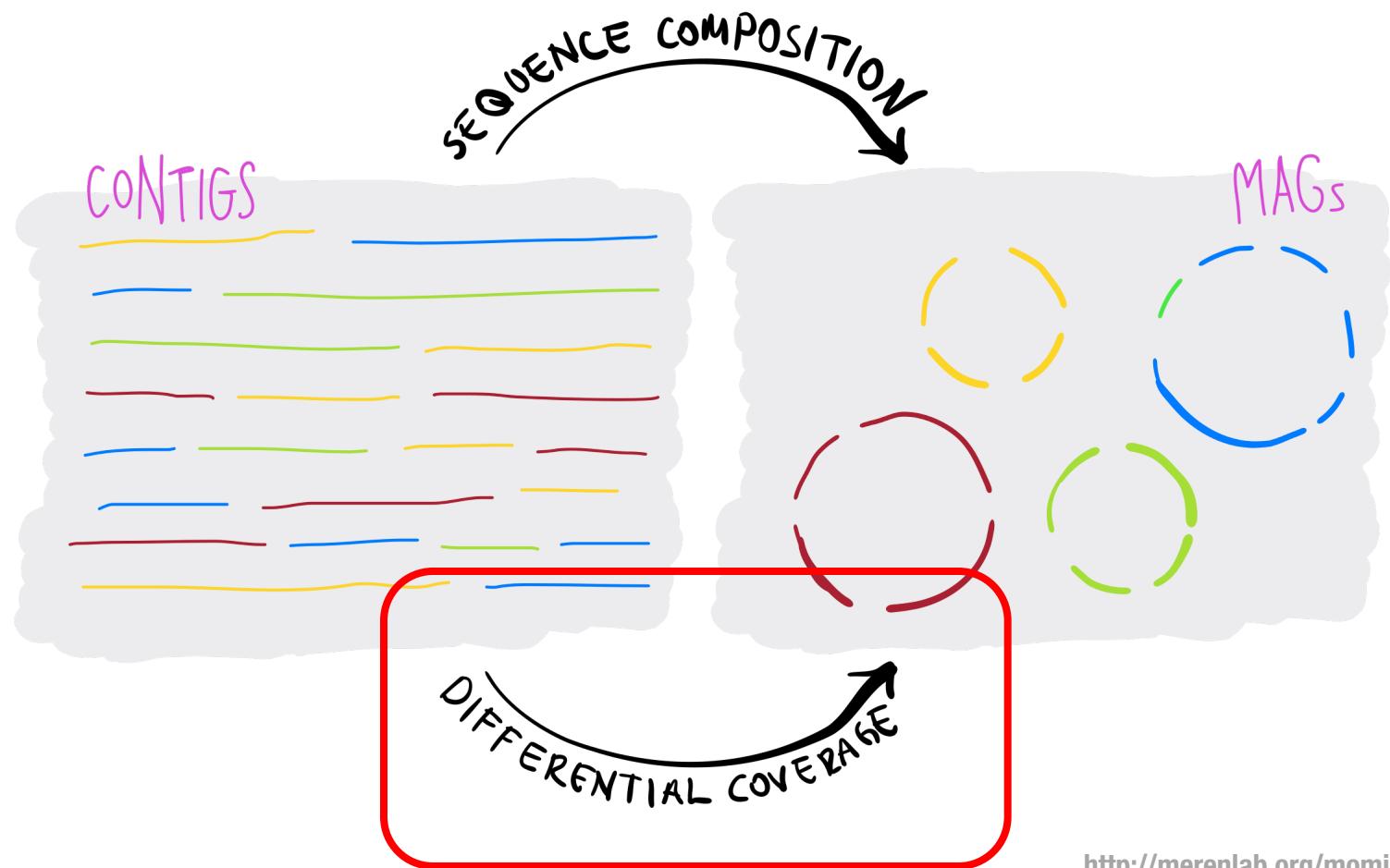
18

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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



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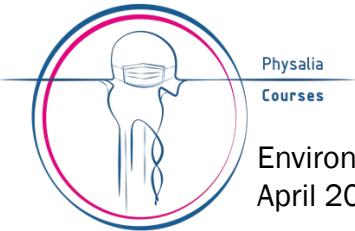
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<http://merenlab.org/momics>

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CONTIG #1

CONTIG #2



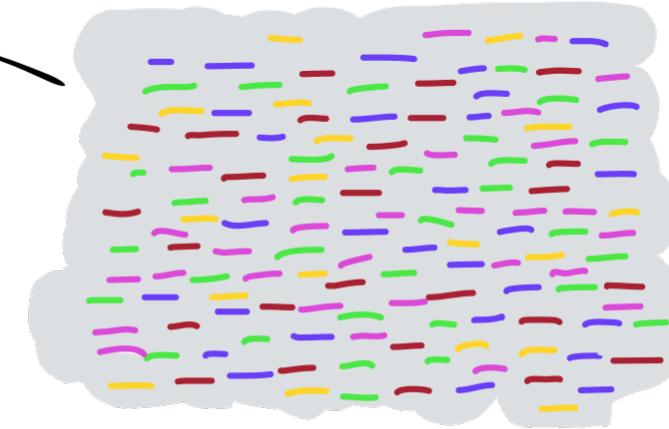
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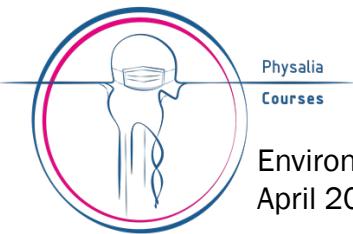
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CONTIG #1



METAGENOMIC READS

CONTIG #2



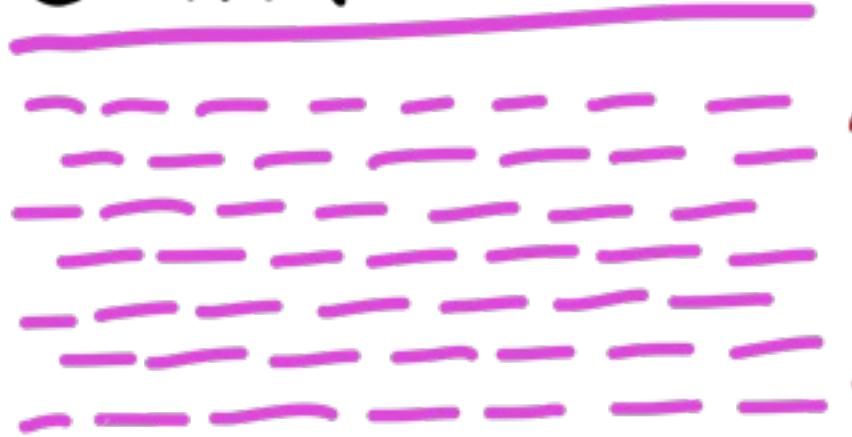
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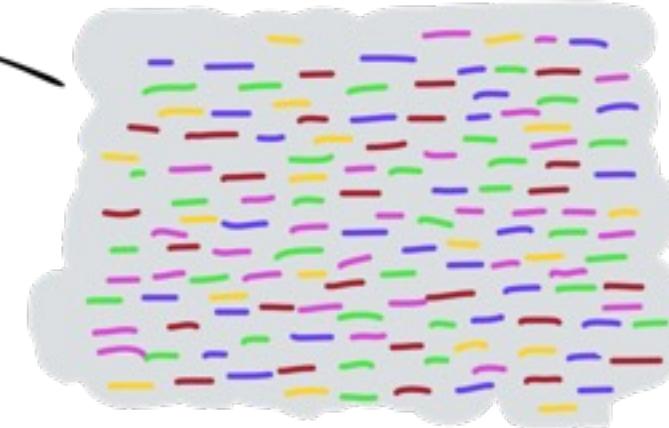
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<http://merenlab.org/momics>

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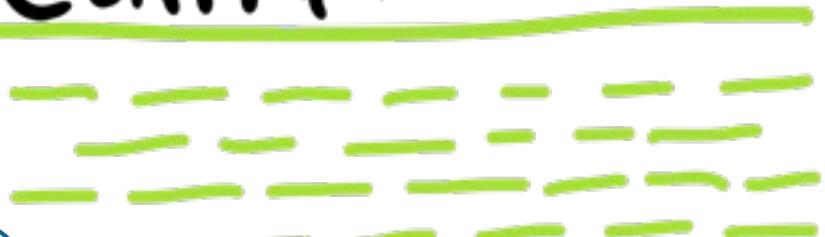
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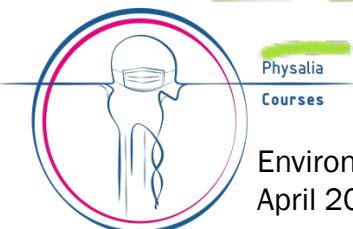
METAGENOMIC READS

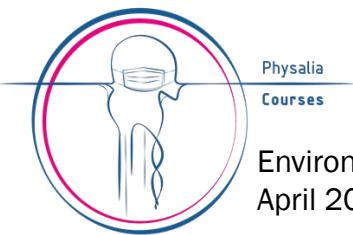
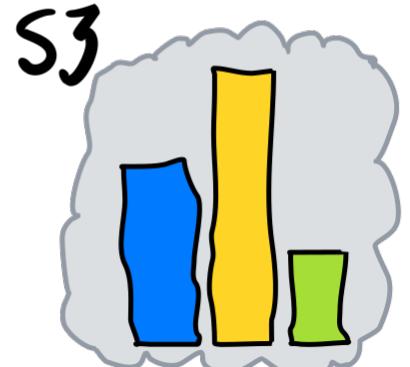
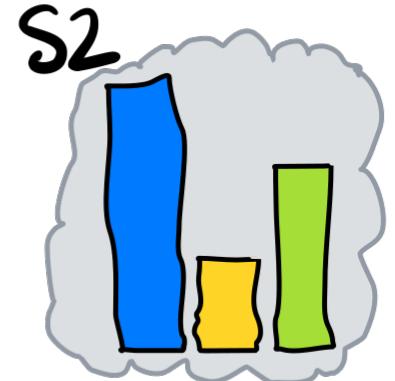
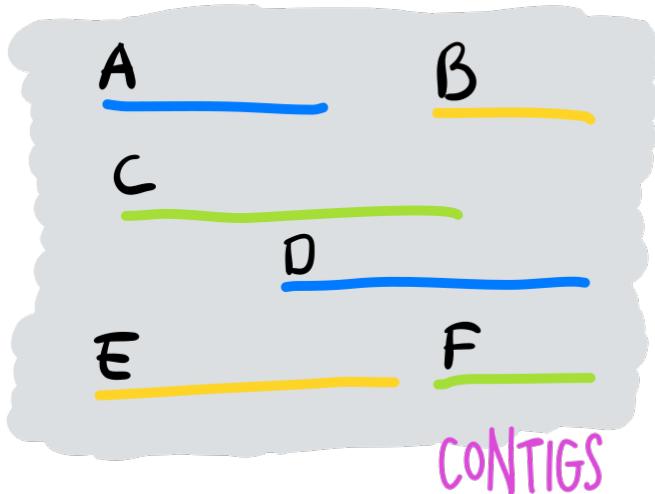
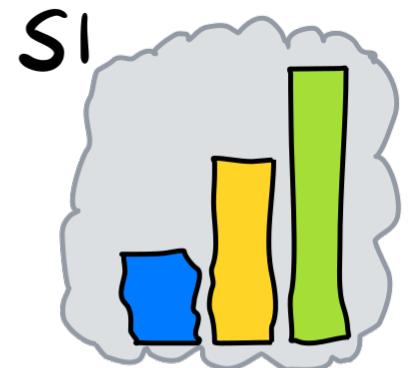
COVERAGE: ~7X

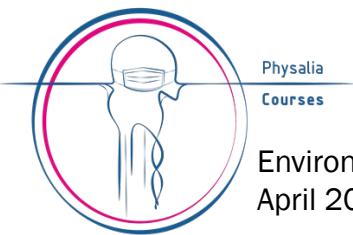
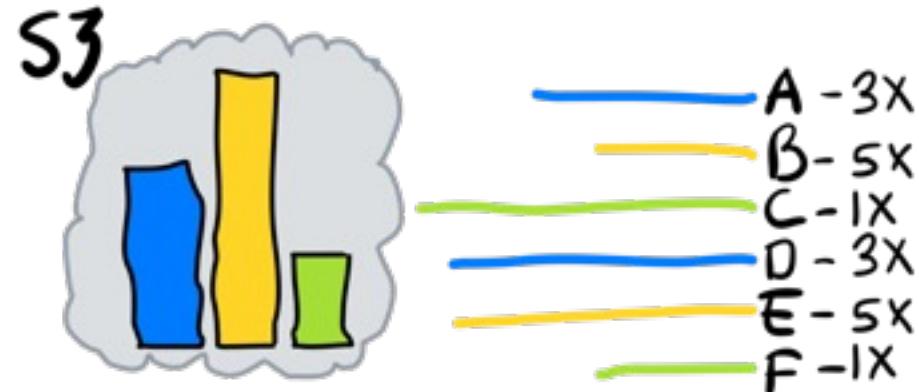
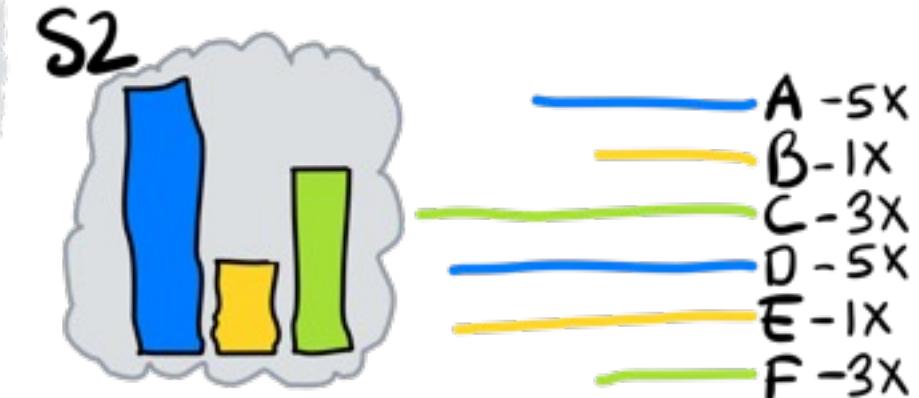
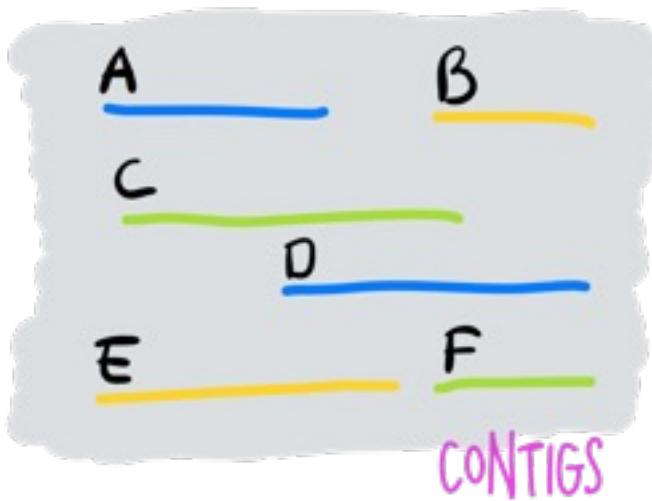
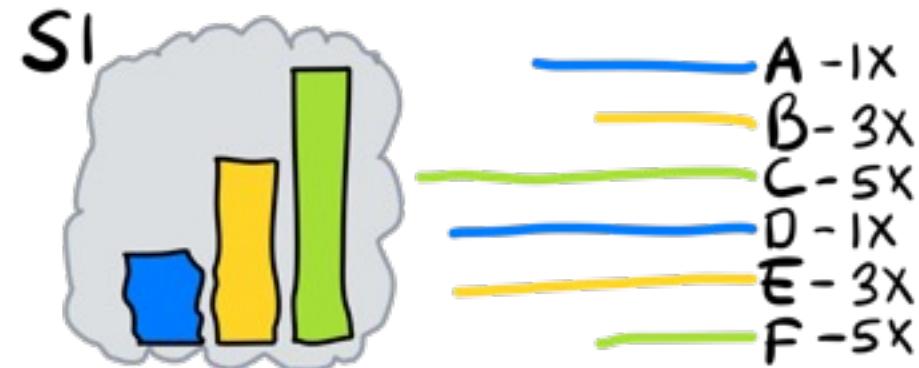
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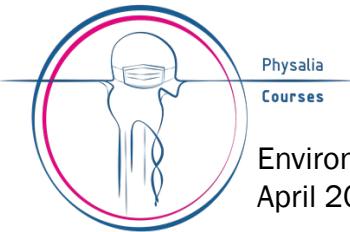


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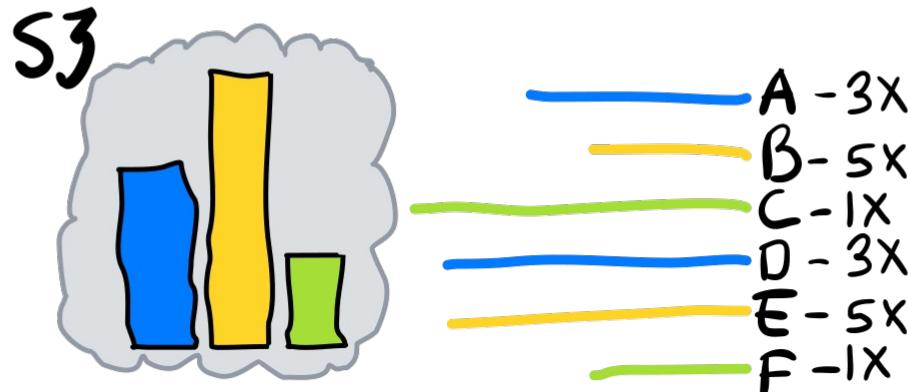
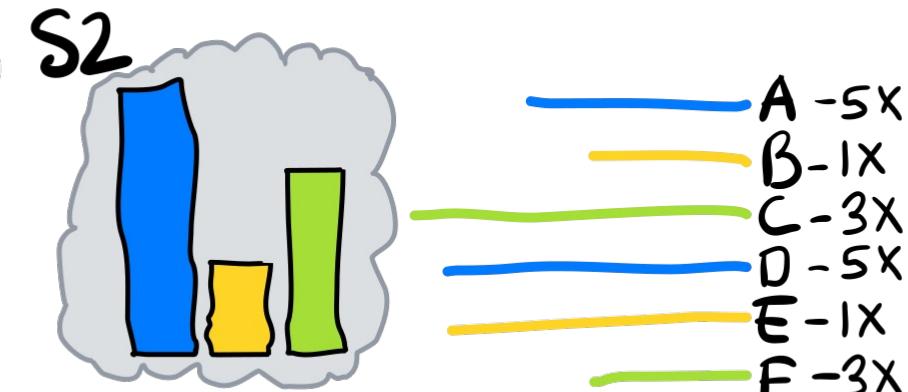
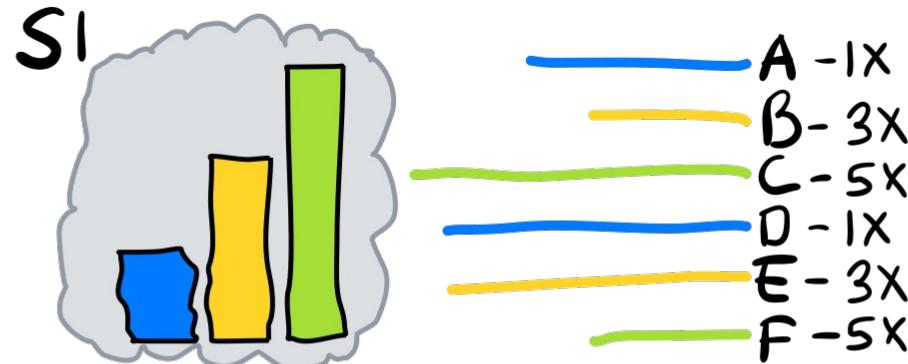
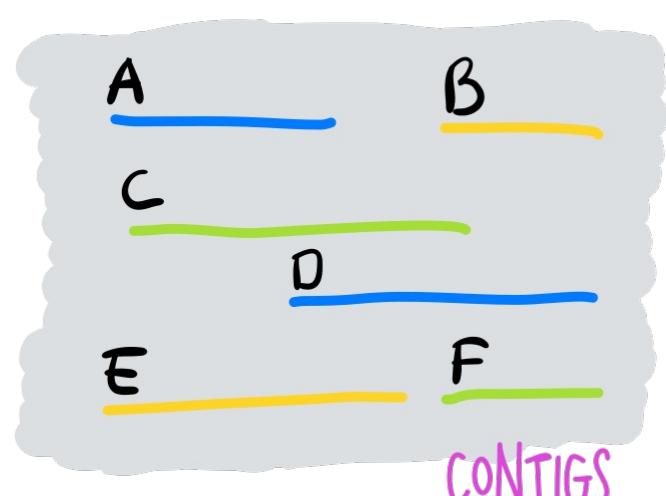




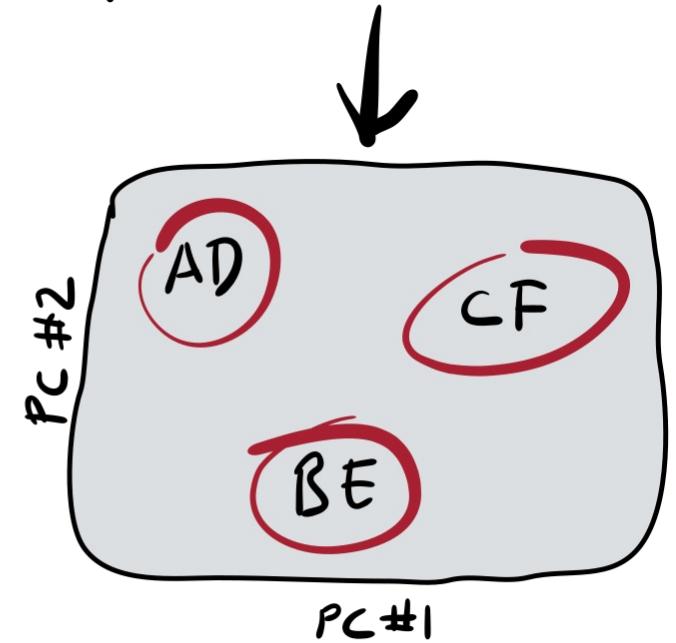




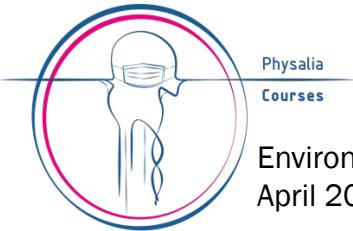
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	A	B	C	D	E	F
S1	1	3	5	1	3	5
S2	5	1	3	5	1	3
S3	3	5	1	3	5	1



Genome-resolved metagenomics *in action*



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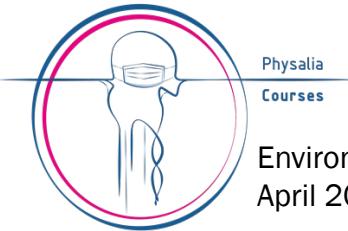
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Genome-resolved metagenomics *in action*

- 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



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Files and workflows in anvi'o



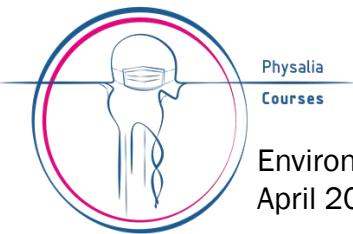
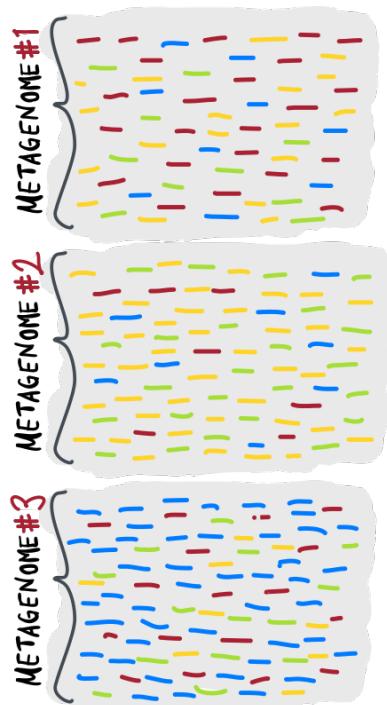
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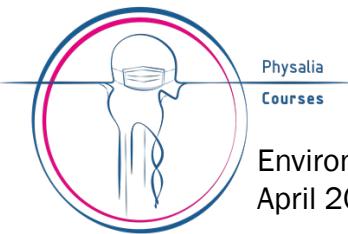
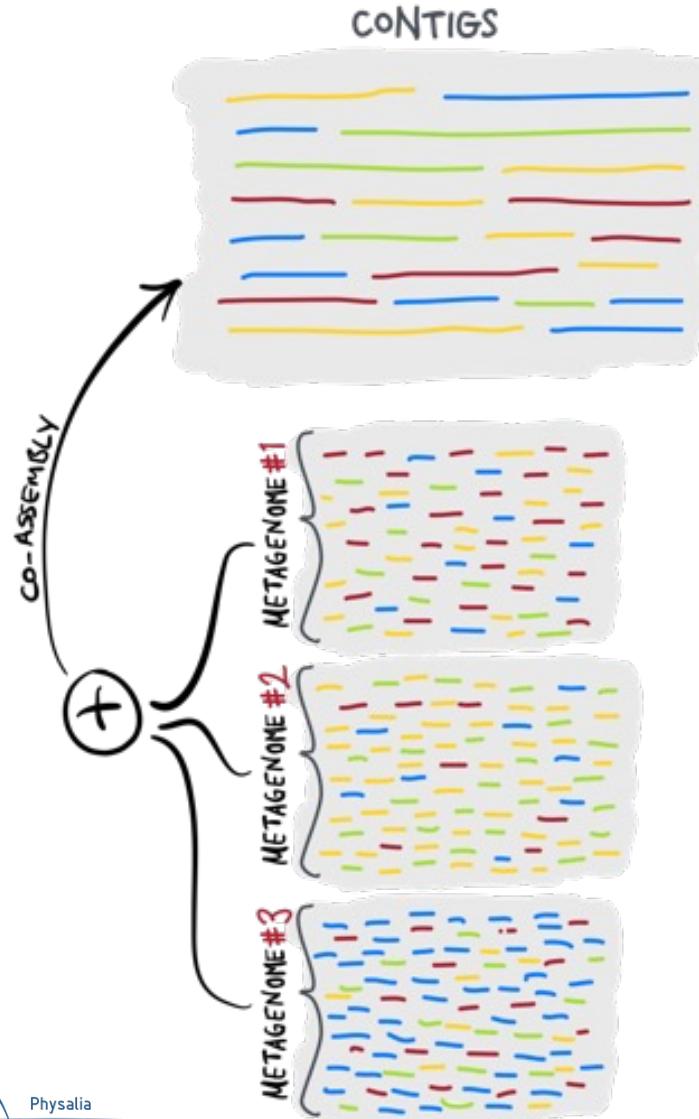
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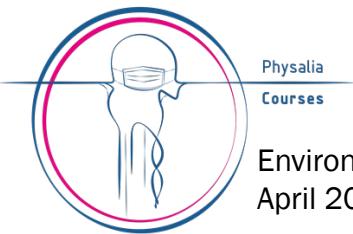
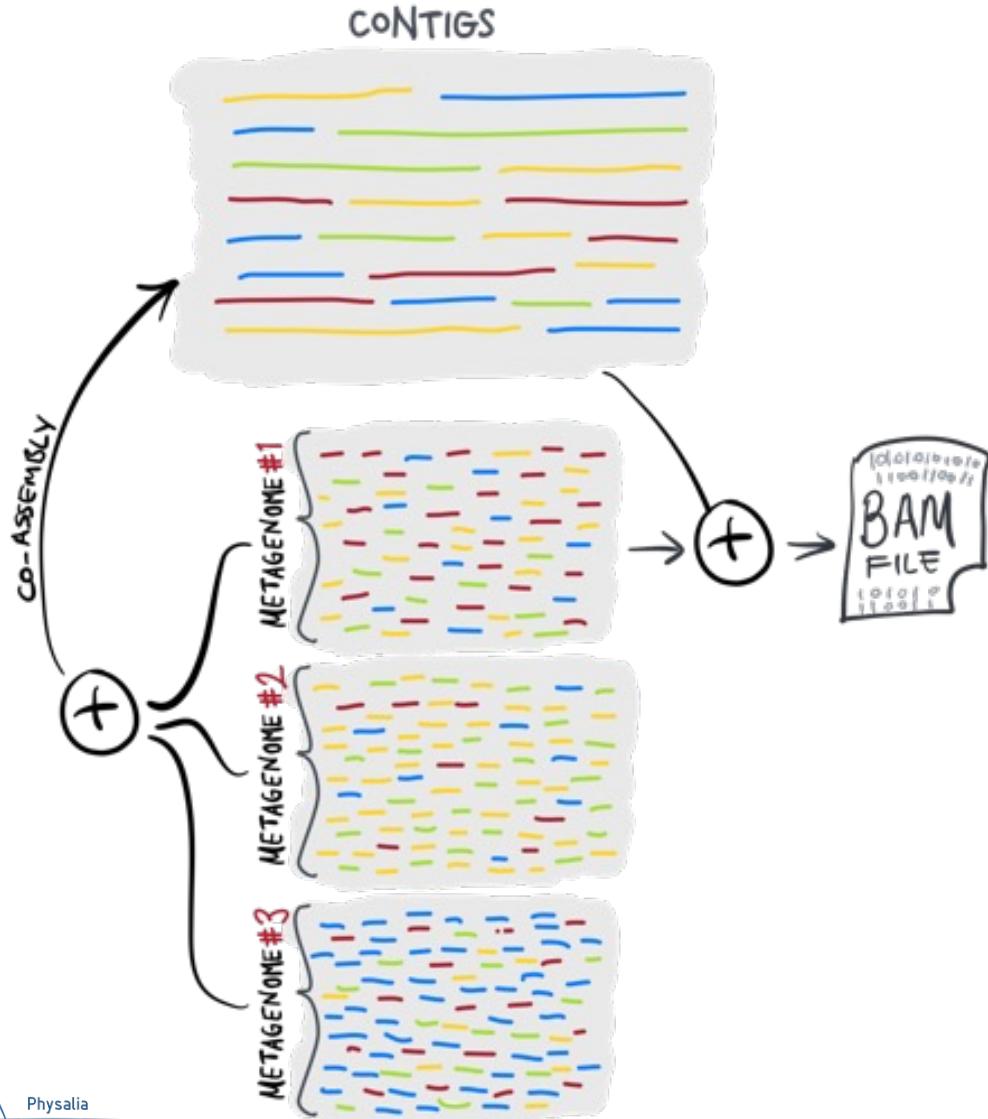
Files and workflows in anvi'o



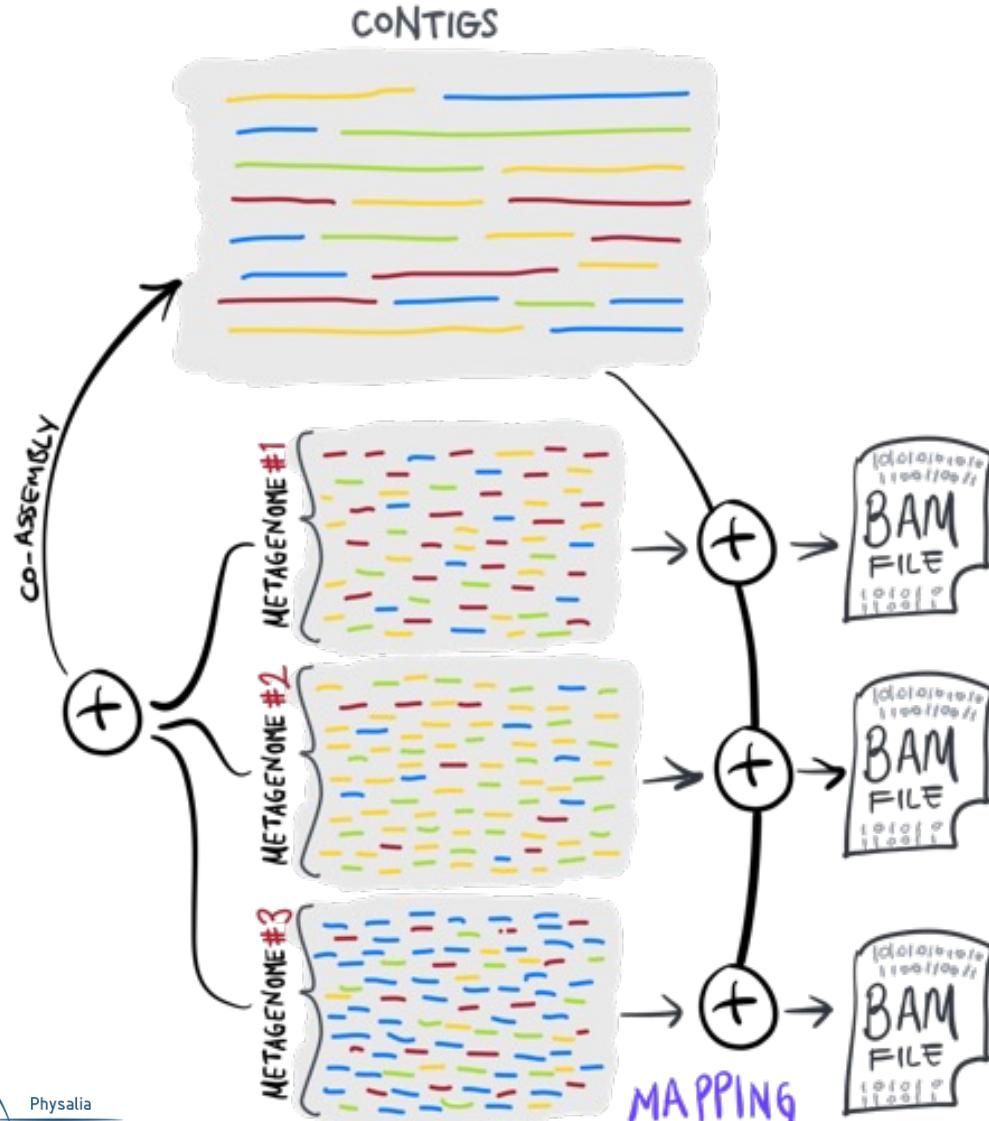
Files and workflows in anvi'o



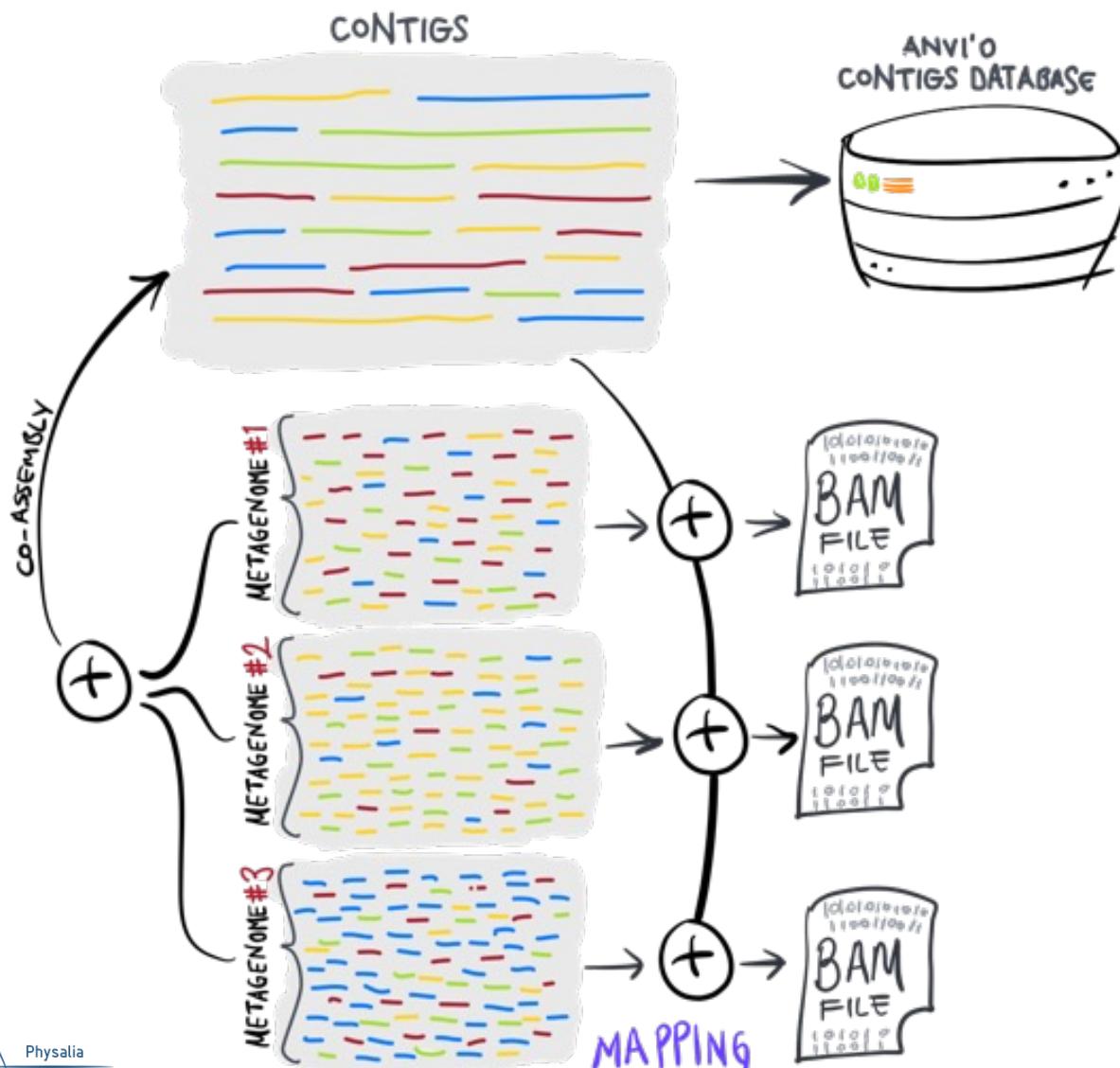
Files and workflows in anvi'o



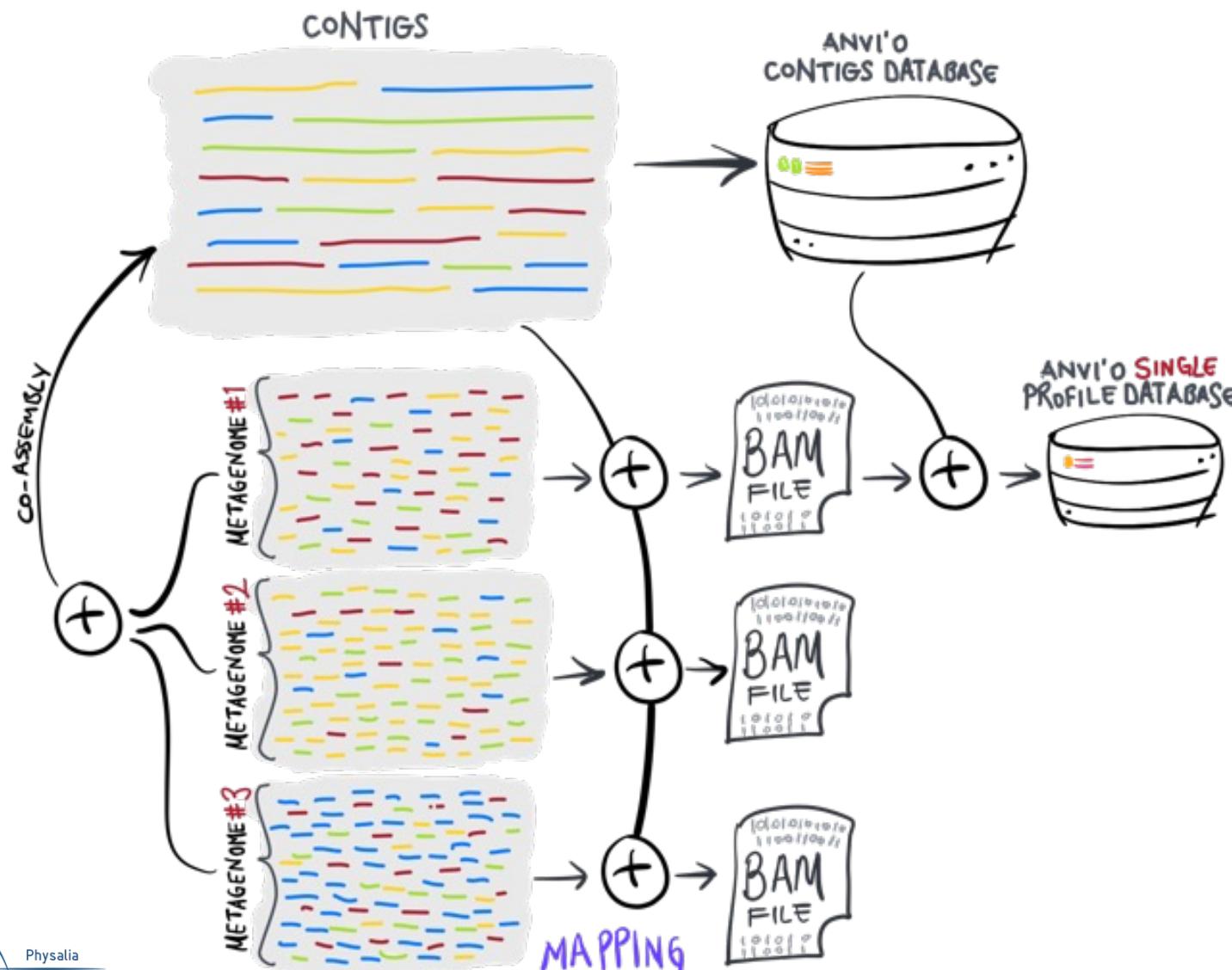
Files and workflows in anvi'o



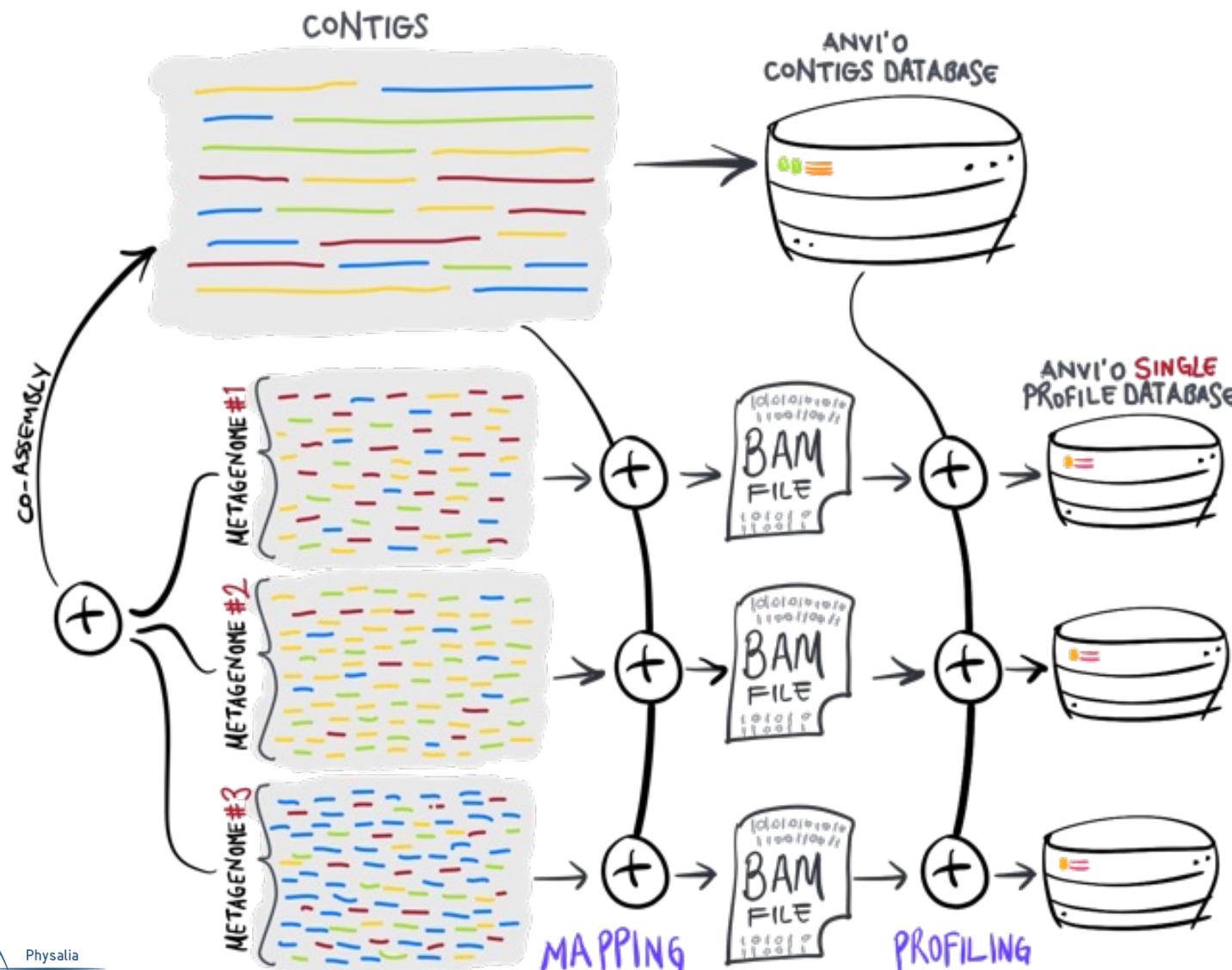
Files and workflows in anvi'o



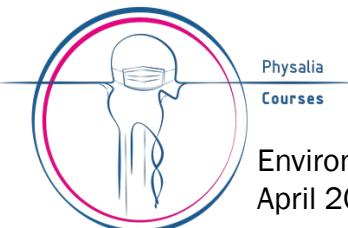
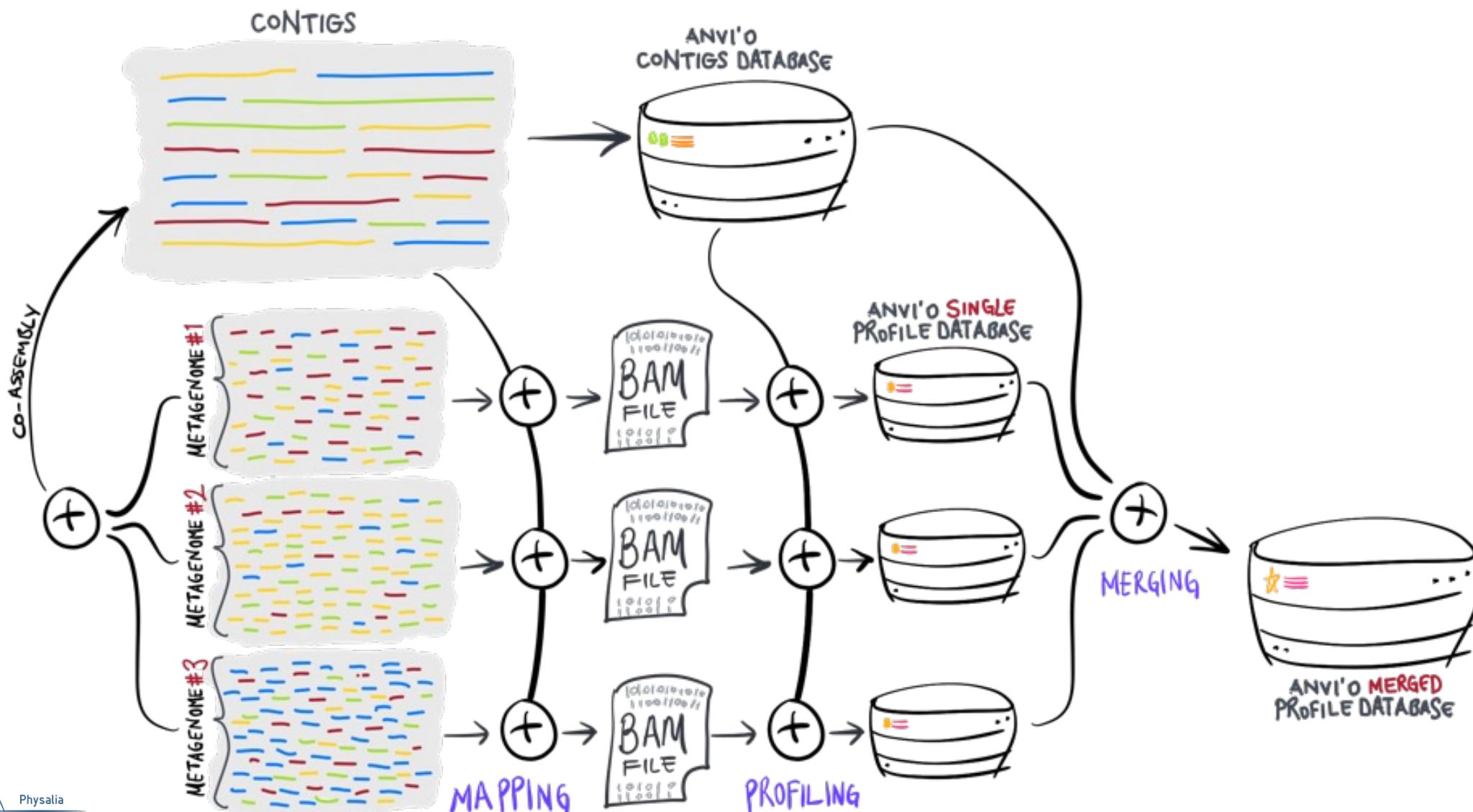
Files and workflows in anvi'o



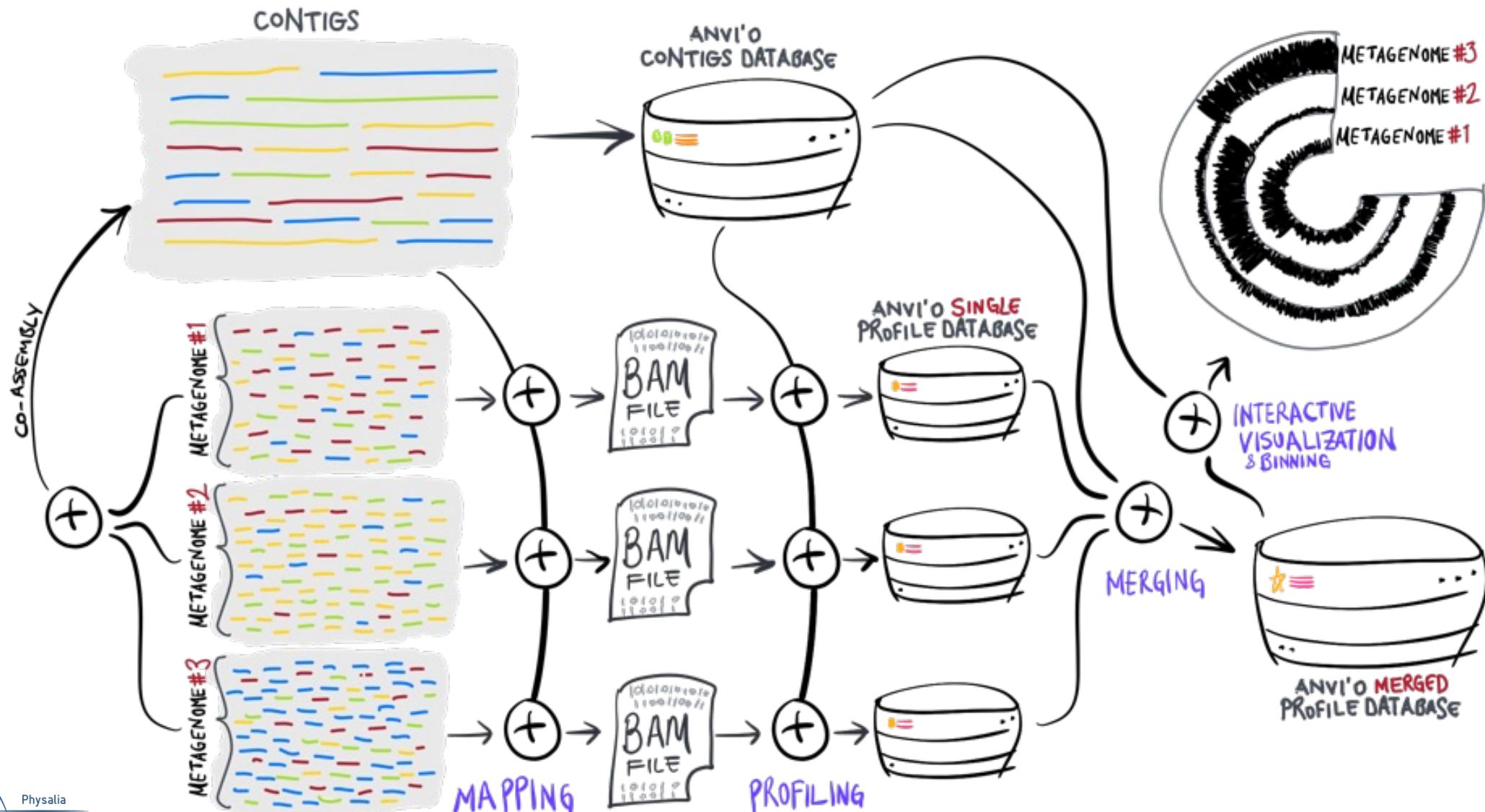
Files and workflows in anvi'o



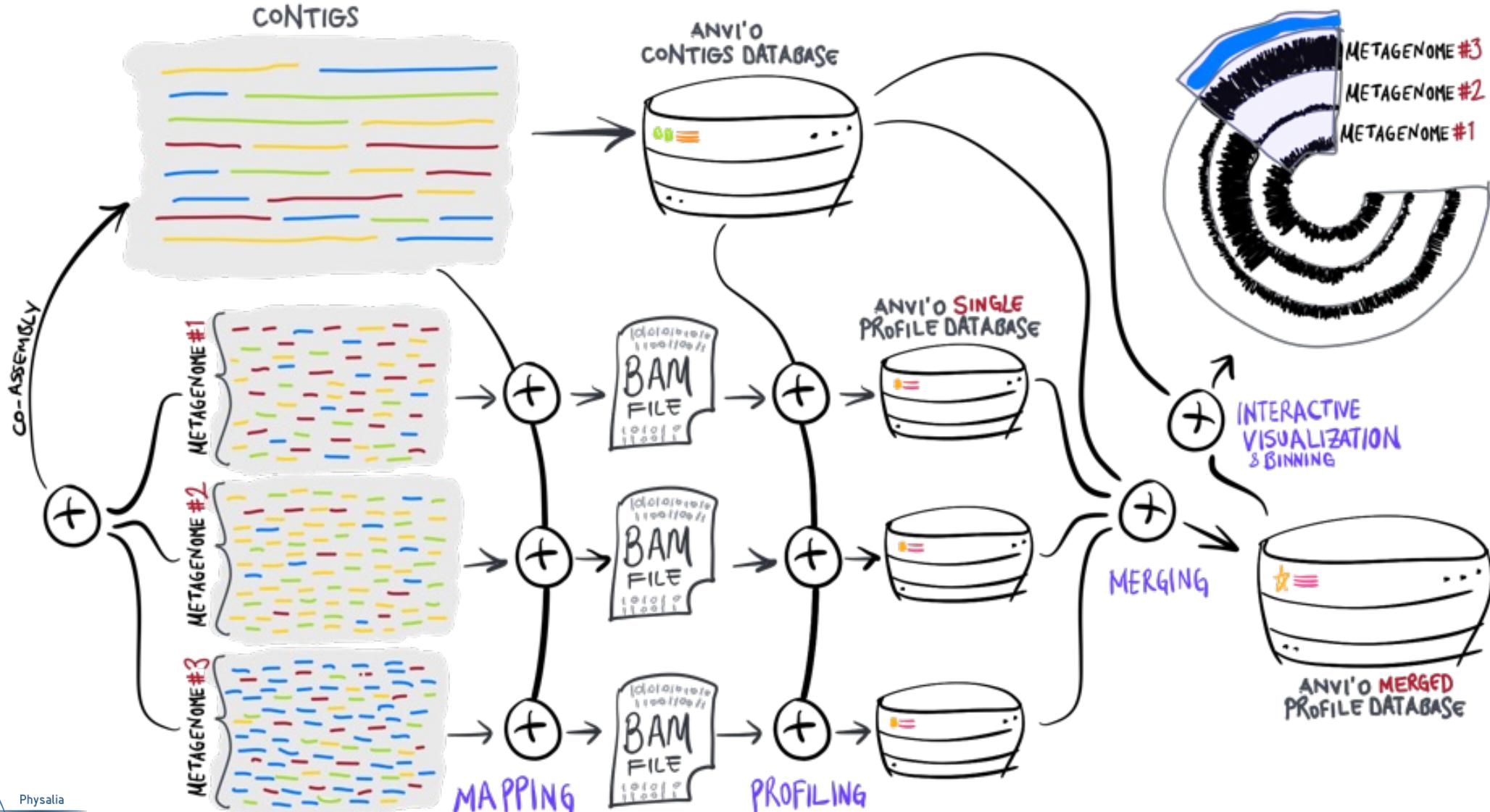
Files and workflows in anvi'o



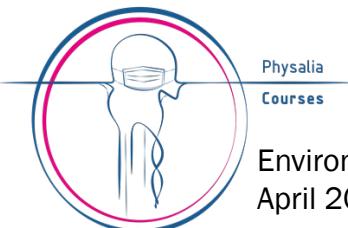
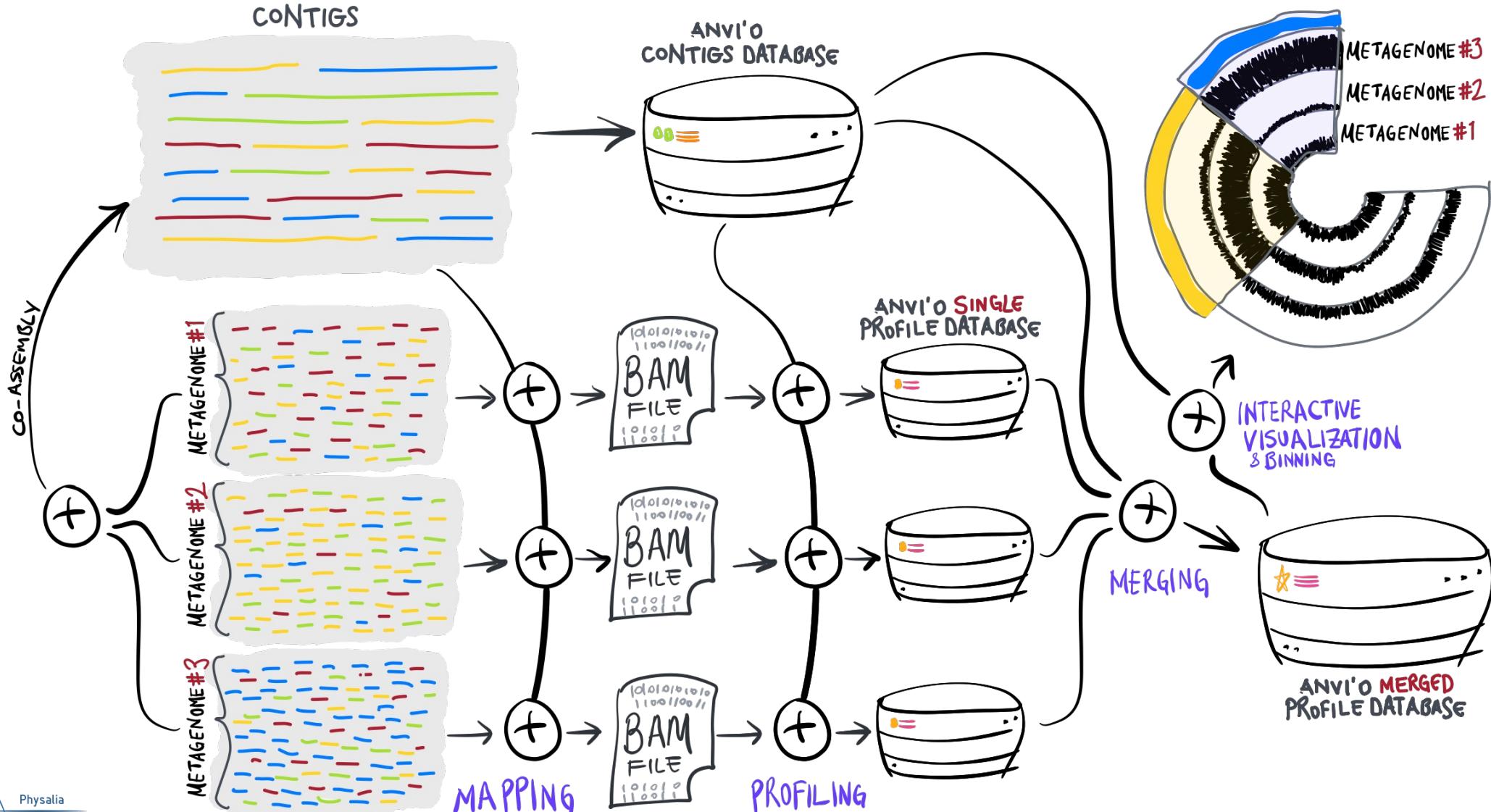
Files and workflows in anvi'o



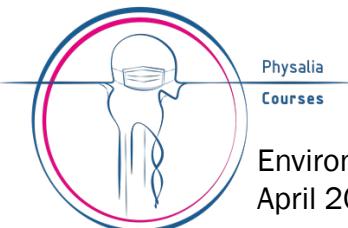
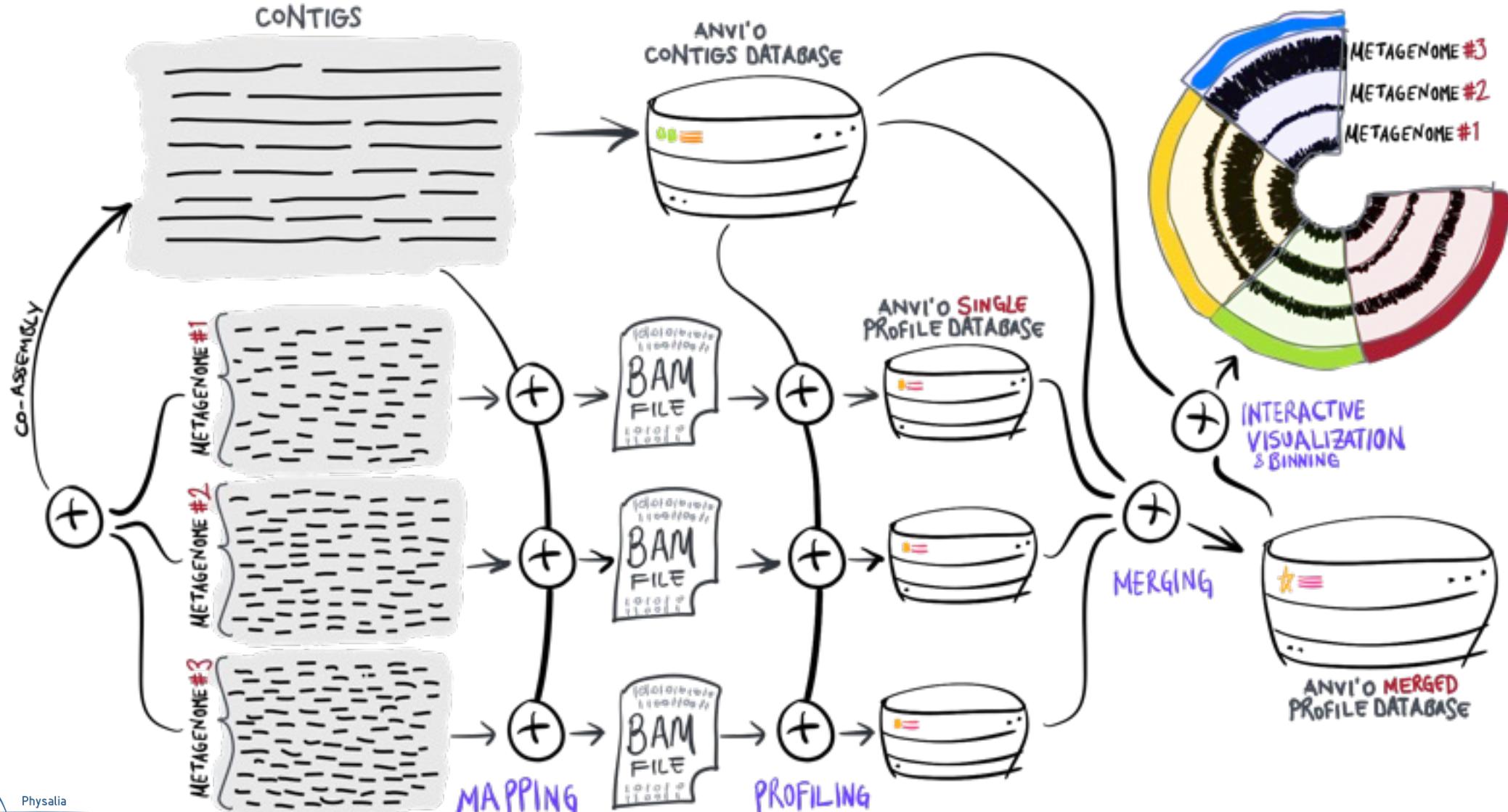
Files and workflows in anvi'o



Files and workflows in anvi'o



Files and workflows in anvi'o



Anvi'o interactive view

