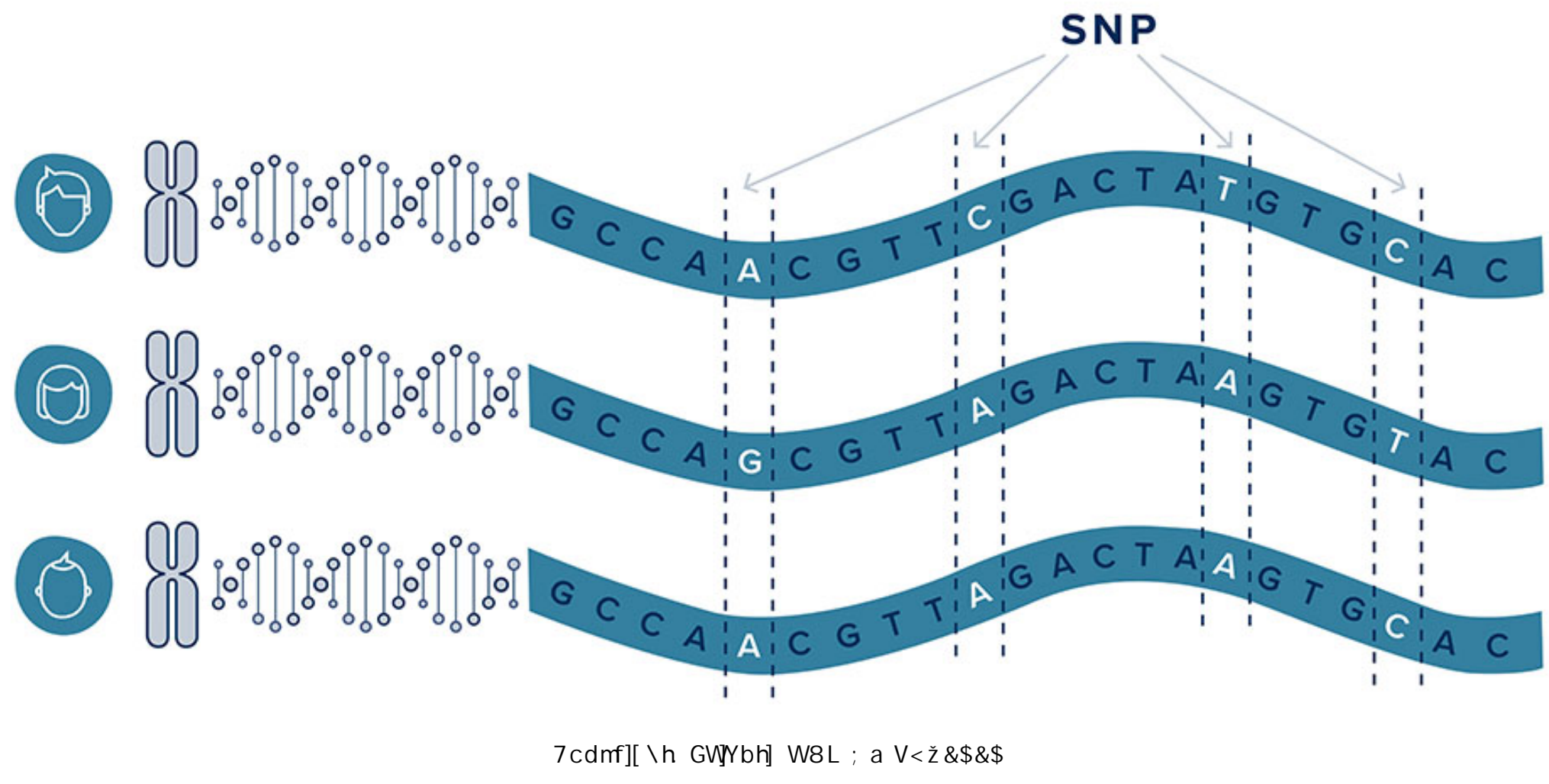


# YbchmdY a di hUjcb k jh A i `h)!`UVY` F UbXca : cfYghg

9\_UhYf]bU 5bhcbyb\_c UbX YggY FYUX

@UVcfUhc]fY X ]bZcfa Uh]ei Yz VwY Dc`ntYwX b]ei Yz D DUfjg

## A ]gg]b[ j U'i Yg ]b G]b[ `Y Bi WYch]XY Dc`ma cfd\ ]ga fGB DŁ XUHU



7cdfj]h GwYbh WBL : a V<2&S&S

- G]b[ `Y Bi WYch]XY Dc`ma cfd\ ]ga ]g U [ Ybca ]Wj Uf]UbhUhU g]b[ `Y VUgY dcg]hcb ]b hY 8B5"
- GBD XUHU ]g i gYX hc ghi Xm\ck hY [ Ybca Y ]b i YbWg X]gYUgYg UbX hfU]hg"
- 7UhY[ cf]WU YbWc]b[ . \$ fKca ]bUbHxca ]bUbHt% fKca ]bUbHa i HUbHt& fa i HUbHa i HUbHt"
- Hrd]WU`m XUHU ]g \[ \X]a Ybg]cbU`d %\$` - %\$` UbX`ck !gUa d`YX B %\$& - %\$` "
- CfYf]b[ ]g ]a dcf]UbhXi Y hc ]b\_U[ Y X]gYei ]]Vf]i a "

### K \mXUHU ]g a ]gg]b[ 3

- 9ffc]g ]b gYbgc]fg"
- 9ffc]g ]b XUHU dfcWgg]b[ "
- 7ca V]b]b[ X] Yfybhghi X]Yg ]bhc cbY"

### K \mhc ]a di hY a ]gg]b[ XUHU3

- A cghc !hY!g\Y ZghUhg]WU` UbX a UVX ]bY `YUfb]b[ a Yh\cXg WUb]bch\UbX`Y a ]gg]b[ j U'i Yg"
- 7cbg]Xf]b[ cb`m]bg]hUbWg`k jh Wca d`YHY ]bZcfa Uh]cb WUb `YUX hc U`cgg cZbYWggUfm ]bZcfa Uh]cb UbX WUb mY`X U j Yfmdccf cf Yj Yb Ya d]mXUHUgYH"
- A ]gg]b[ XUHU ]hgY`Za ][\hYV cZ]bhYfYgh"

### a di hUjcb a Yh\cXg.

- FYZfYbW!VUgYX. i gY FYZfYbW dUbY`g cZ \[ \ ei U`]mUbX gYei YbW]b[ Wc] Yf]b[ fghU]cZ hY!Ufh Zcf \ i a Ub XUHU"
- FYZfYbW!ZYY. i gY cb`mXUHU ]hgY`Zfk \Yb FYZfYbW dUbY`g UfY bchUj U]UV`Yz cZ hY h ]g hY WgY` Zcf bcb!\ i a Ub XUHU"

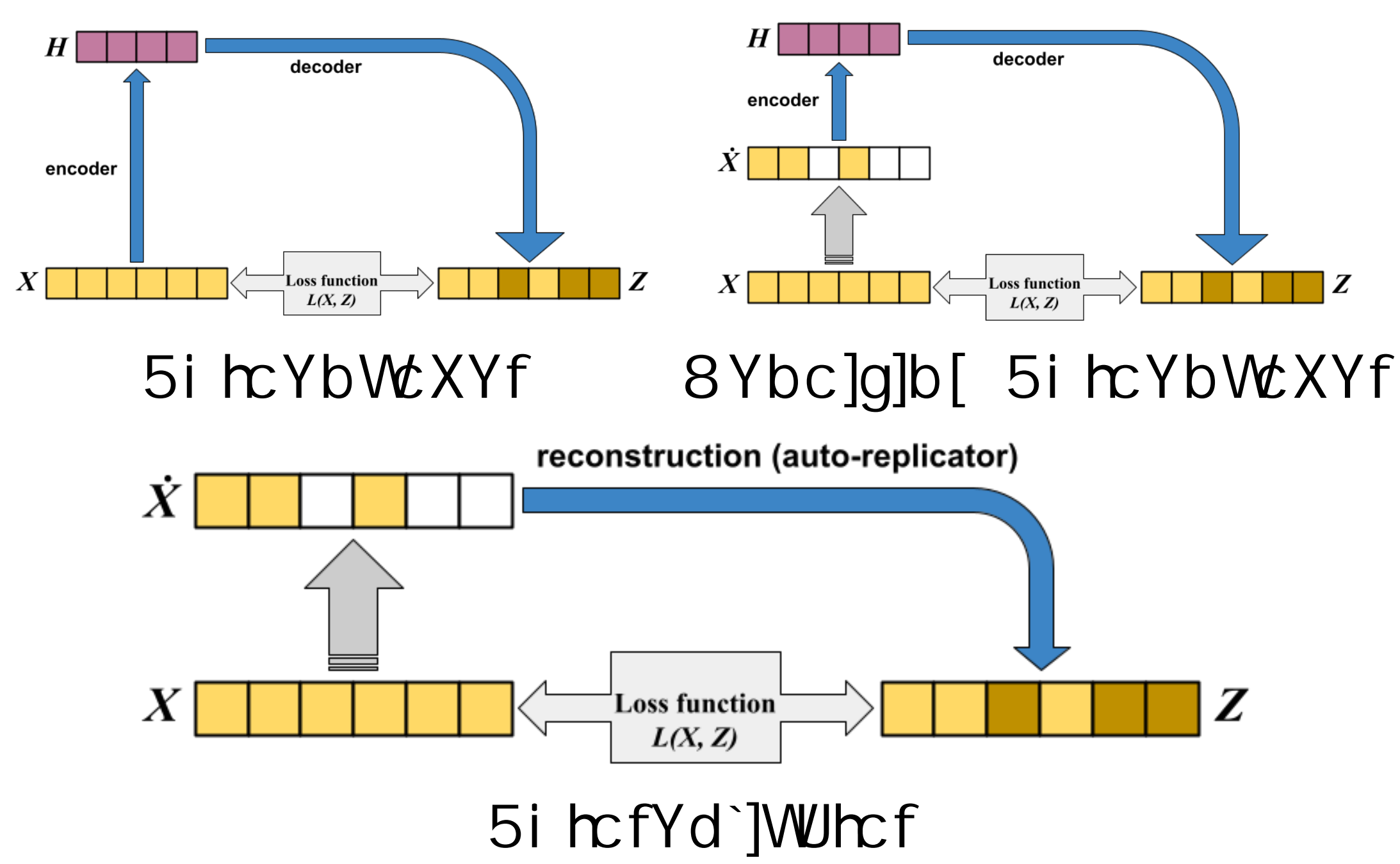
### FYZfYbW!ZYY a Yh\cXg

- A cXY #a YUb #a YX]Ub
- \_ BYUfYghBY][ \Vc]g f]BBŁ
- G]b[ i `Uf JU`i Y 8YVca dcg]hcb fGJ 8Ł
- A ]gg: cfYgh
- 8Ybc]g]b[ 5i hcYbWcXYfg fG785Ł

### @]a ]hU]cbg

- Dccf dYfZcfa UbWZ`Xcb hi gY ch`Yf ZYUH`fyg"
- hkc cf\_gz`Vi hWUb k Y Xc VYHf3
- hkc cf\_gz`Vi hWUb k Y Xc VYHf3
- Hcc g`ck Zcf \[ \X]a Ybg]cbU` XUHU"
- FYei ]fY Wca d`YHY XUHU Zcf hfU]b]b[ "

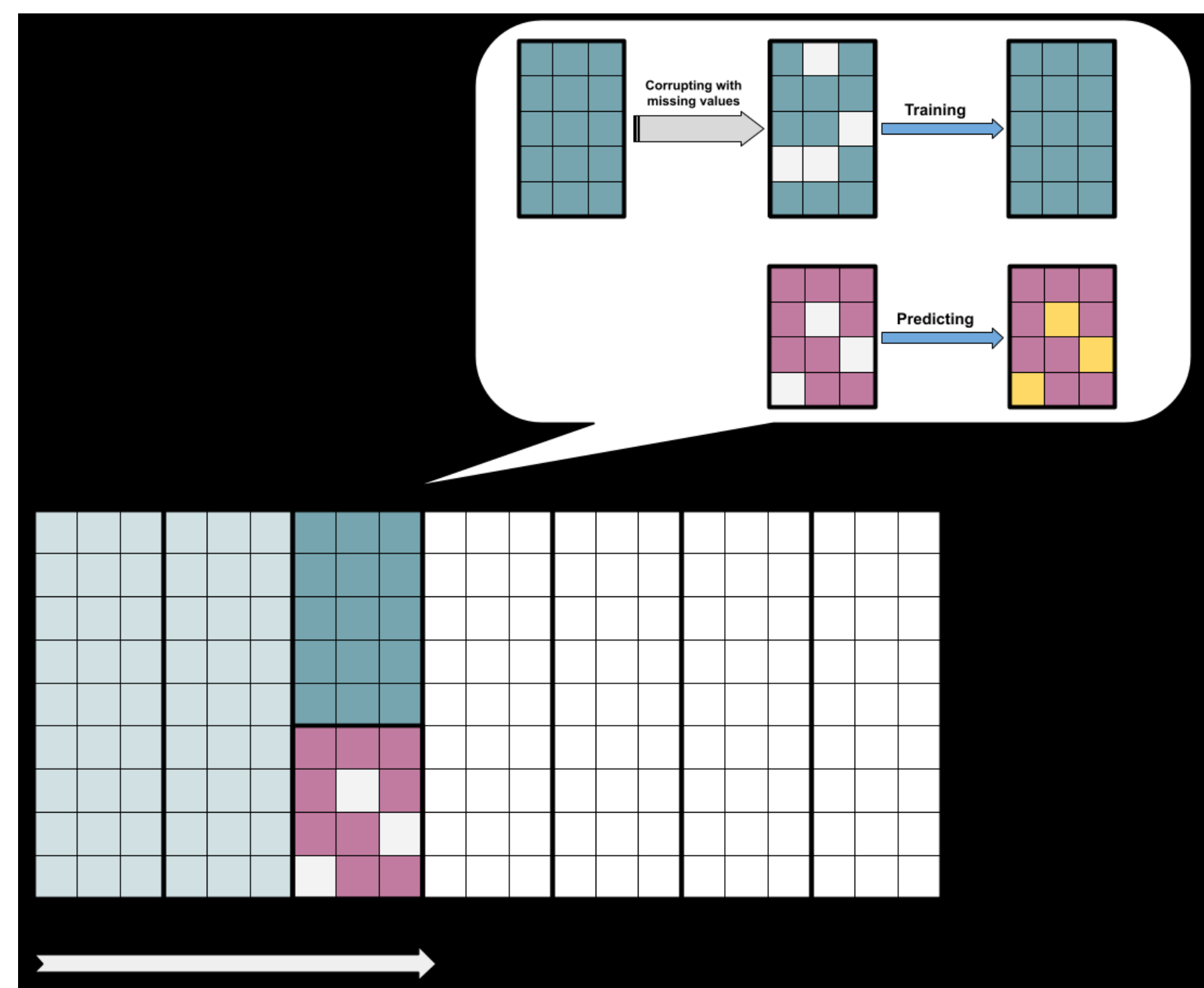
## Ci f UddfcUW. 7\U]bg cZ 5i hcYd`]W]hj Y F UbXca : cfYghg f7\5F: Ł



5i hcYbWcXYf 8Ybc]g]b[ 5i hcYbWcXYf  
reconstruction (auto-replicator)  
5i hcYd`]W]hcf

### K \mhc i gY a i `h)!`UVY` a Yh\cXg3

- Yk Yf dUfUa YHfg hUb bYi fU` bYrk cf\_g f]ccX Zcf`ck !gUa d`YX XUHU"
- Bc bYXX Zcf \]XXYb `UmYfg"
- 6i H"" G]h" bYXX Wca d`YHY XUHU Zcf hfU]b]b[ " =



### 7\U]bg cZ Ui hcYd`]W]hcf

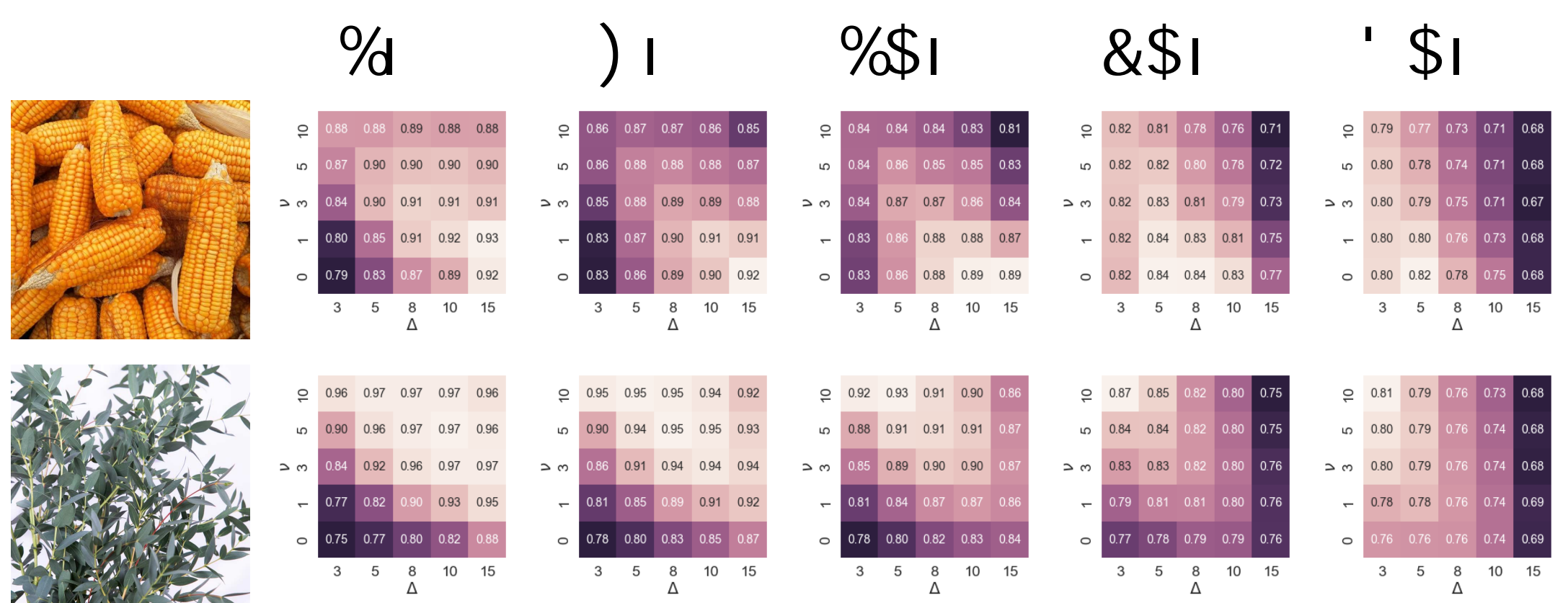
- CbY k ]bXck cZghY 1 hfU]b]b[ dUfhk ]h Wca d`YHY XUHU Z`hYgh]b[ dUfhk ]h a ]gg]b[ j U'i Yg"
- 7\U]b cZk ]bXck g. cb YUW ghYdZghU]b[ k ]bXck g k ]h U`fYUXm]a di hYX j U'i Yg U] UXX]h]cbU` ZYUH`fyg"
- 9bgYa V`Y cZWU]bg. cbY Zcfk UfX WU]bZ`cbY VUW]k UfX WU]bZ`gyj YfU` fUbXca WU]b]b[ "

## F Ygi `hg

### 8UHgYhg i gYX ]b Yi dYf]a YbhgZ dZYUhi fYgZ B gUa d`Yg.

BUa Y	d	B
A U]nY	(( Z+&- &( +	
9i WU`ndh g	' ' Z - , - + \$	
7c`cfUXc 6YHhY	' ( Z% * % ,	
5fUV]WU 7c YY	( Z* * * ) - *	
K \YUh fNi W]k Yfghi Xnt	- Z+ * * ' , ,	
7c YU 7UbYd\cfU	( ) Z+( , %&-	

### ; f]XgYUfWZ Zcf \mdYfdUfUa YHfg UbX .



@[\hYf Wc`cf #\ [\Yf UWWV fUVh

. Ug Yi dYVWYXZV][ [ Yf ZfUW]cb cZa ]gg]b[ j U'i Yg ga U`Yf g]nY cZk ]bXck = WUb VY Ygh]a UhYX hYcYf]hWU`mZbc bYXX Zcf gYUfWZ`  
. a UmVY X] YfYbH'

### 7ca dUf]gcb k ]h ch`Yf a Yh\cXg.

	0.01	0.05	0.1	0.2	0.3	0.01	0.05	0.1	0.2	0.3	0.01	0.05	0.1	0.2	0.3
	Maize					Eucalyptus					Coffea Canephora				
ChARP	0.952	0.935	0.916	0.882	0.845	0.970	0.950	0.926	0.866	0.810	0.799	0.781	0.761	0.731	0.717
kNN (5/10/10)	0.803	0.802	0.801	0.798	0.794	0.851	0.849	0.847	0.843	0.839	0.737	0.739	0.737	0.734	0.731
mode	0.727	0.727	0.726	0.727	0.726	0.725	0.732	0.731	0.730	0.729	0.691	0.693	0.692	0.692	0.691
SVD (50/500/50)	0.647	0.648	0.645	0.643	0.636	0.788	0.788	0.788	0.785	0.780	0.456	0.453	0.450	0.449	0.450
missForest	0.662	0.650	0.622	0.593	0.580	0.684	0.673	0.626	0.564	0.521	0.377	0.449	0.442	0.395	0.383
	Colorado Beetle					Arabica Coffee					Wheat				
ChARP	0.835	0.824	0.818	0.805	0.792	0.897	0.886	0.878	0.866	0.854	0.821	0.808	0.795	0.777	0.762
kNN (50/10/10)	0.765	0.763	0.765	0.765	0.764	0.867	0.866	0.866	0.865	0.864	0.823	0.819	0.818	0.815	0.811
mode	0.761	0.760	0.762	0.761	0.761	0.807	0.804	0.805	0.805	0.804	0.729	0.727	0.729	0.729	0.727
SVD (50/100/200)	0.740	0.737	0.737	0.735	0.734	0.693	0.694	0.696	0.692	0.690	0.622	0.618	0.609	0.600	0.594
missForest	0.352	0.349	0.361	0.326	0.335	0.497	0.480	0.533	0.541	0.586	0.614	0.736	0.746	0.756	0.755

### 7cbWi g]cb

### 7\5F: ]g Ub Y YW]j Y a Yh\cX Zcf a ]gg]b[ j U'i Y ]a ! di hUjcb ]b GBD XUHU

- @ck h]a Y Wca d`YI ]hm O(d . ) = k cf\_g Zcf \[ \X]a Ybg]cbU` XUHUgYhg"
- Bc bYXX Zcf Wca d`YHY XUHU"