



上海交通大学  
SHANGHAI JIAO TONG UNIVERSITY



# Chapter 10

# Pan-genomics

Spring 2019



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# Reading materials

1. Tettelin, Hervé, et al. “Genome analysis of multiple pathogenic isolates of *Streptococcus agalactiae*: implications for the microbial “pan-genome”. ***PNAS***, **2005**, 102(39): 13950-13955.
2. Computational Pan-Genomics Consortium, “Computational pan-genomics: status, promises and challenges”, ***Brief Bioinform***, 2016, Oct 21.
3. Hu, Z., Sun, C., Zhao, Y., Wei, C.\*, “EUPAN enables pan-genome studies of a large number of eukaryotic genomes”, ***Bioinformatics***, 2017, 23(15):2408-2409
4. Sun, C., Hu, Z., Lu, K., Zhao, Y., Lu, J., Zheng, T., Wang, W., Shi, J., Zhang, D., Li, Z., Wei, C., “RPAN: Rice Pan-genome Browser for ~3,000 rice genomes”, ***Nucleic Acids Research***, 2017, 45(2): 597-605.
5. Wang, W., et al., “Genomic variation in 3,010 diverse accessions of Asian cultivated rice”, ***Nature***, 2018



# What is pan-genome?

Individual genome

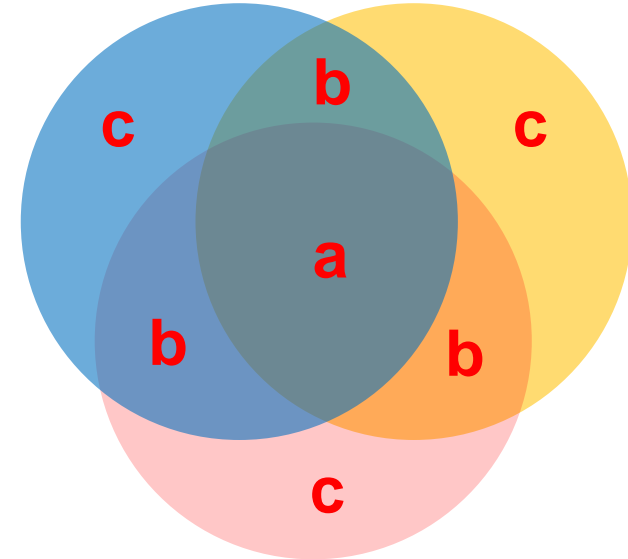
Pan-genome\*

- pan, from Greek παν, means all, everything

- Core genes [a]

- Dispensable genes [b]

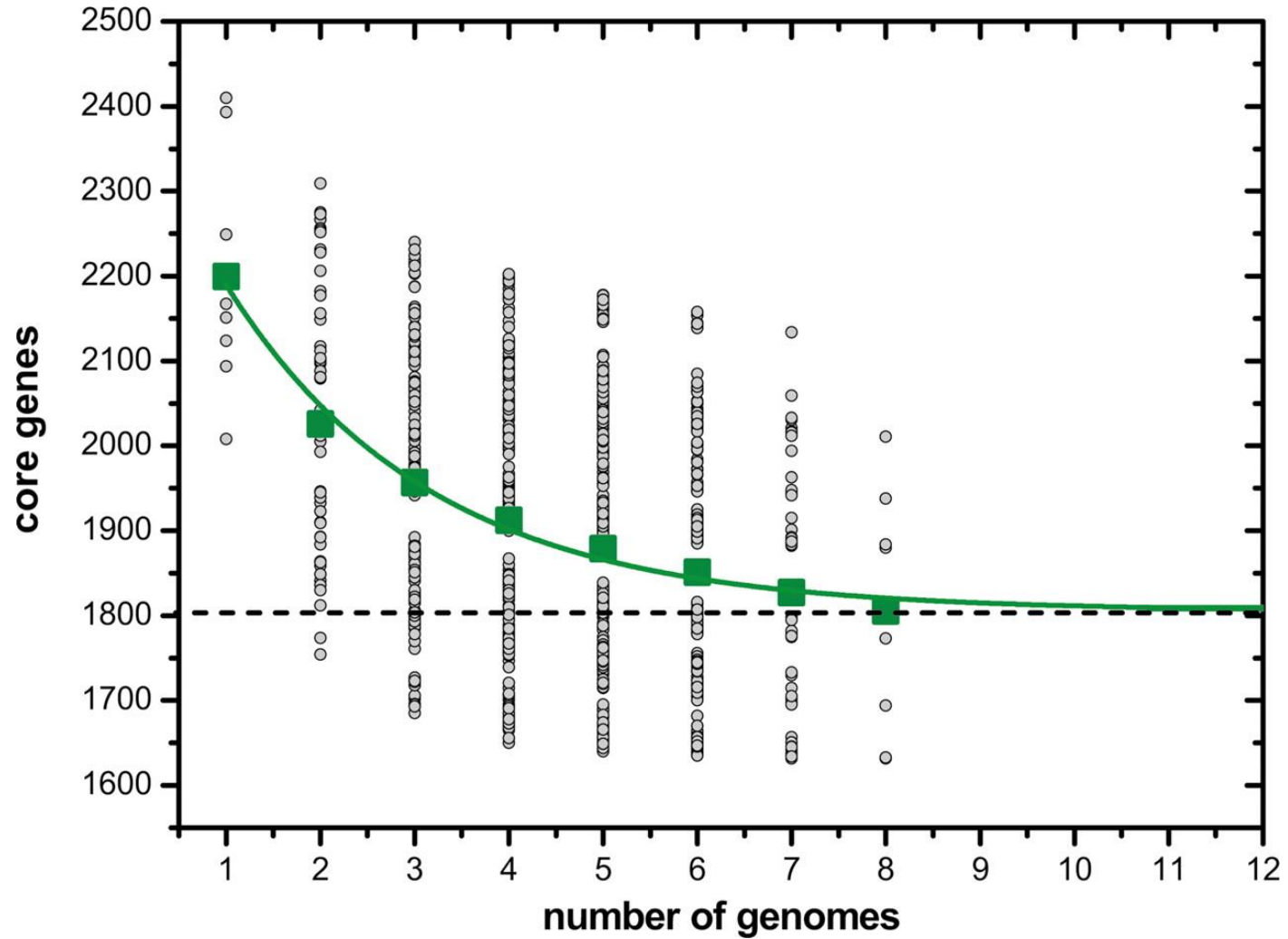
- Unique genes [c]



\* Tettelin, Hervé, et al. "Genome analysis of multiple pathogenic isolates of *Streptococcus agalactiae*: implications for the microbial "pan-genome". *PNAS* 102.39 (2005): 13950-13955.



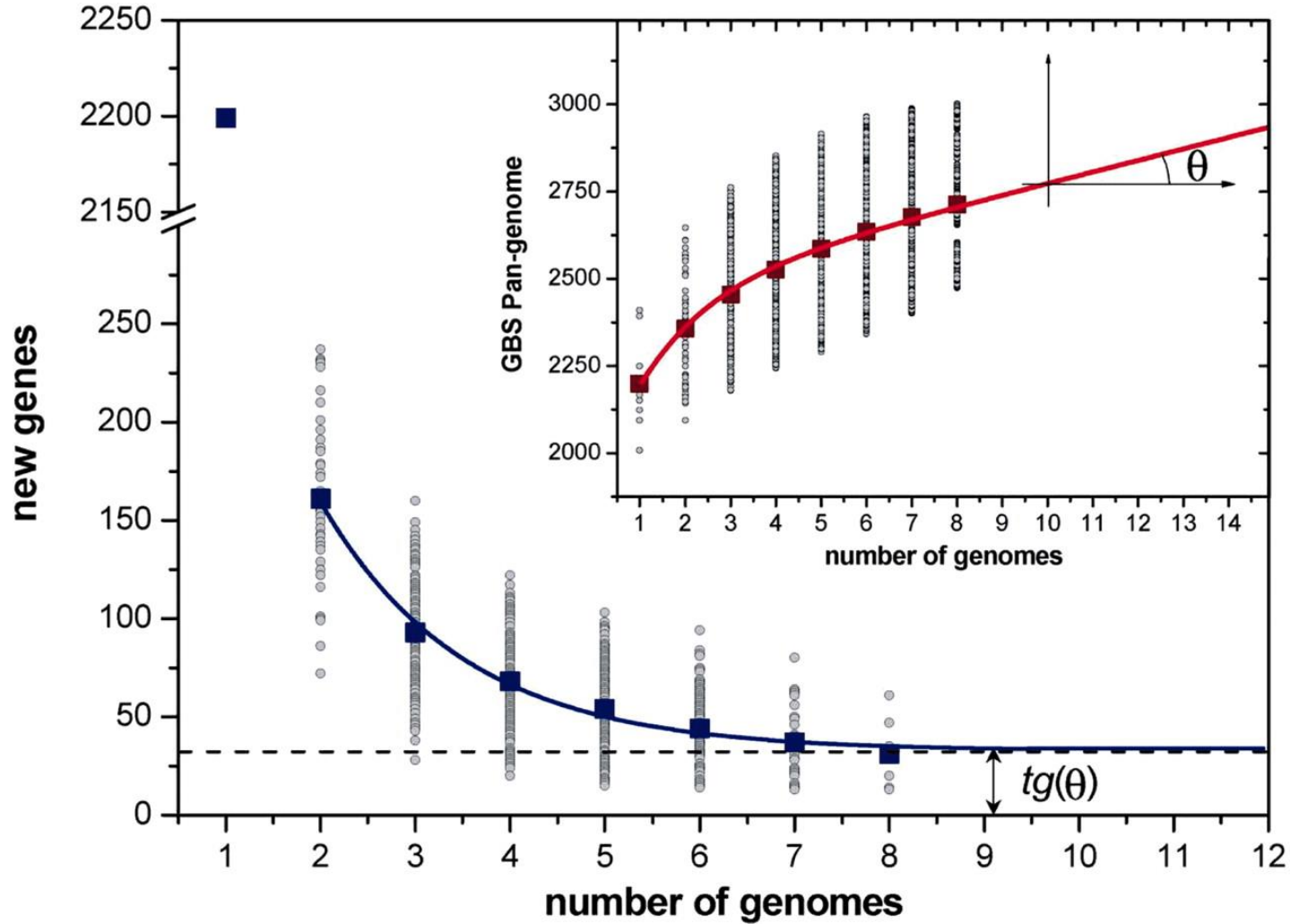
# GBS core genome.



Hervé Tettelin et al. PNAS 2005;102:13950-13955



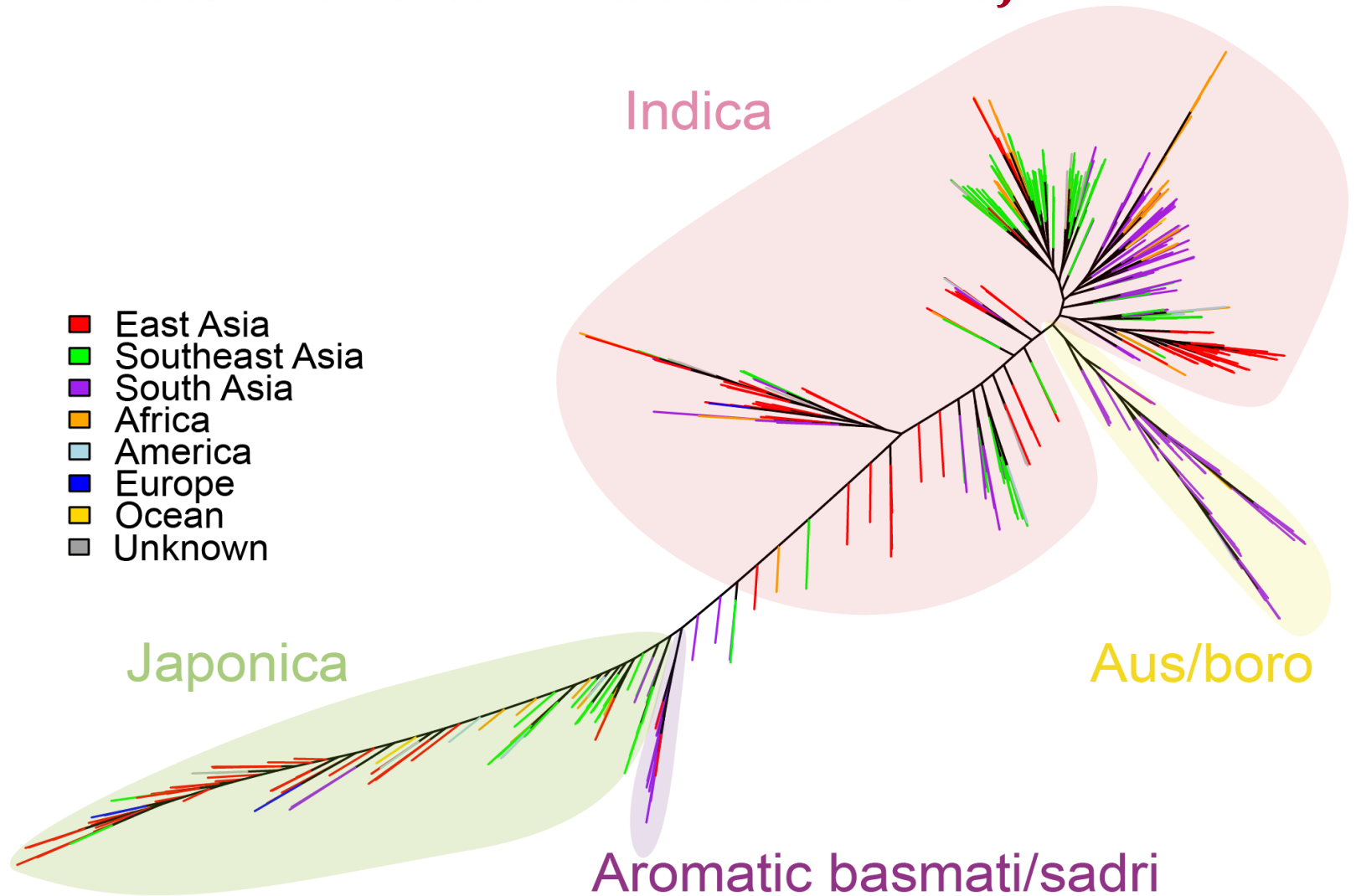
# GBS pan-genome (An open pan-genome!)



Hervé Tettelin et al. PNAS 2005;102:13950-13955



# The 3000 Rice Genome Project



Sun, C. et al., "RPAN: Rice Pan-genome Browser for ~3,000 rice genomes", *Nucleic Acids Research*, 2017, 45(2): 597-605.



# EUPAN: Eukaryote Pan-genome ANalysis

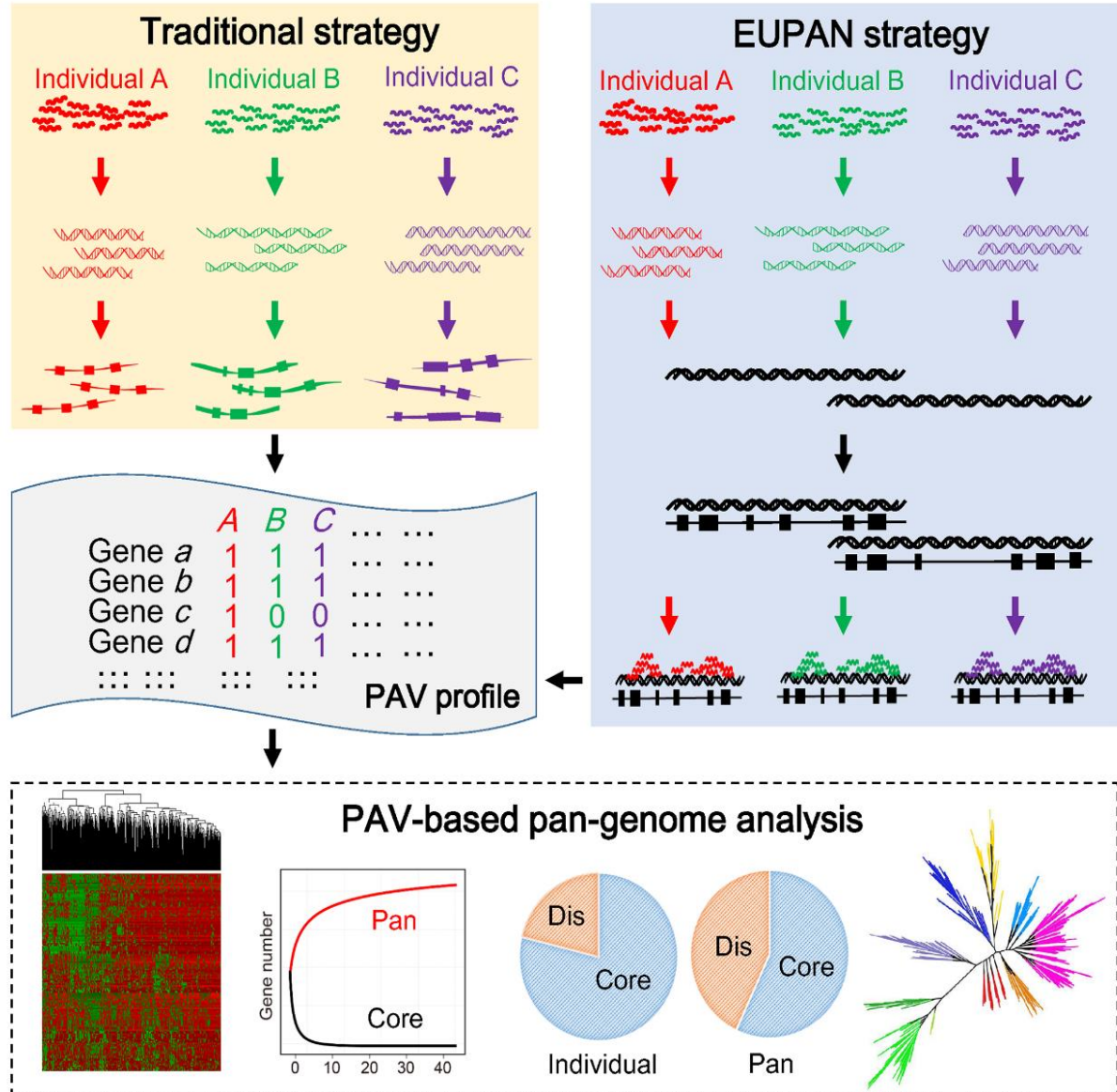
Sequencing data



PAV profile



Pan-genome analysis







# The rice pan-genome (3k rice genomes)

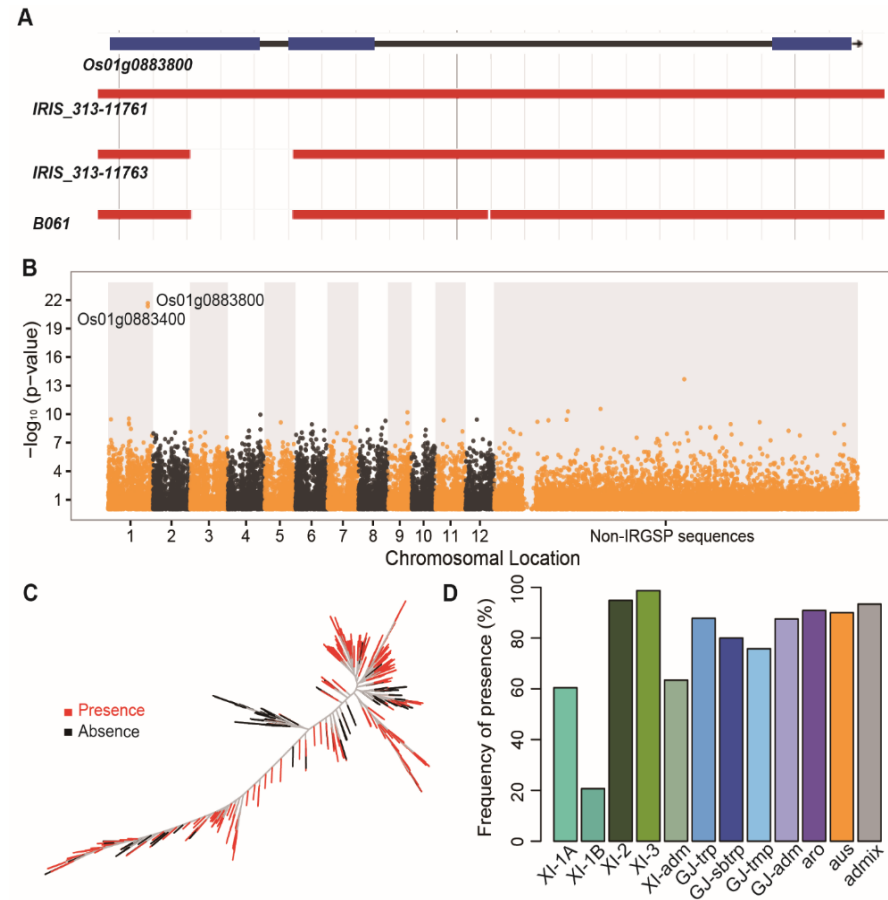
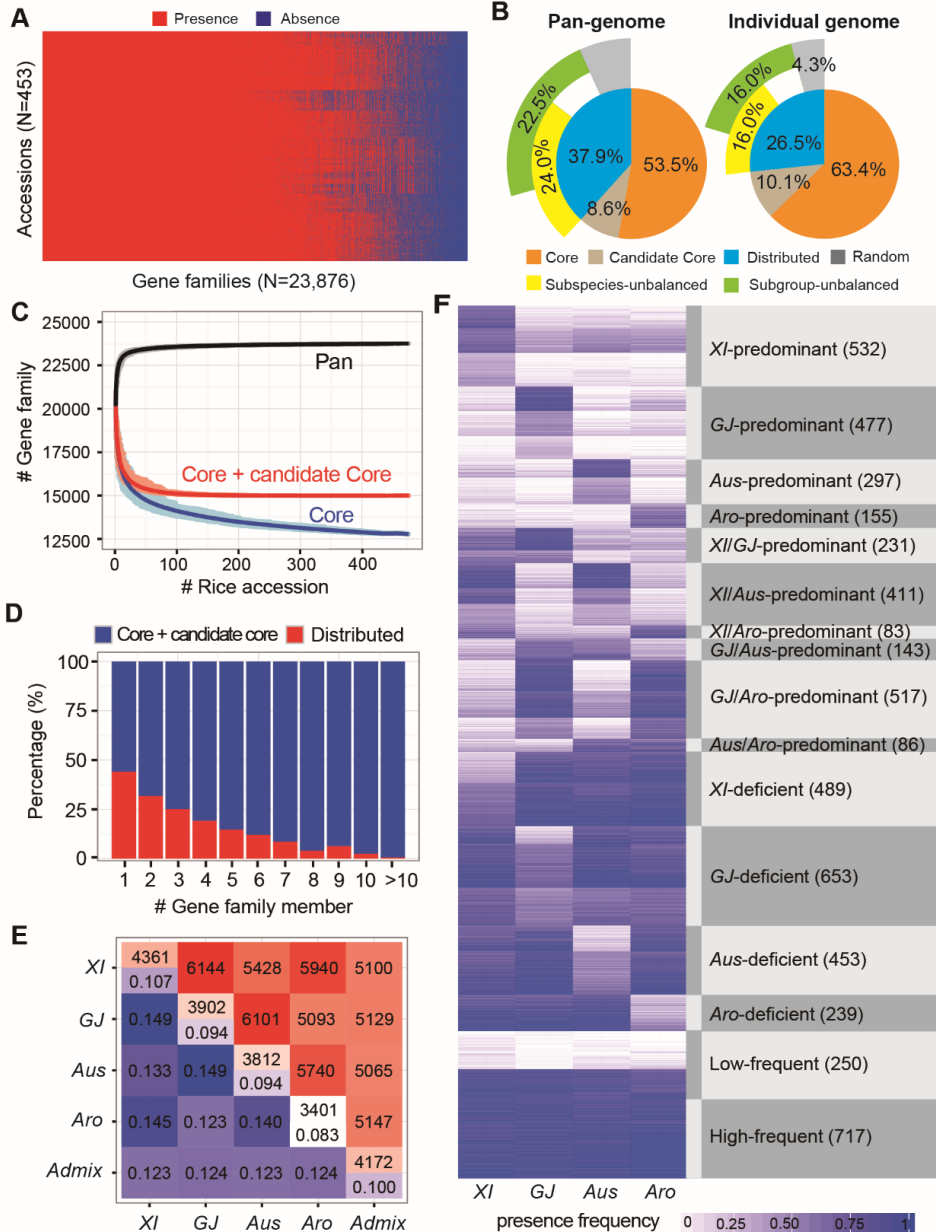


Fig S8. PAV of plant height related gene *Sd-1*.

Fig. 4. A. landscape of rice pan-genome.



# RPAN:

## Rice PAN-genome browser for >3000 genomes

Home

Search

Visualization

Rice table

Gene table

Expression

Download

About & Manual

### 3K Rice Pan-genome Browser

Lab of Computational Genomics and Metagenomics

Shanghai Jiao Tong University

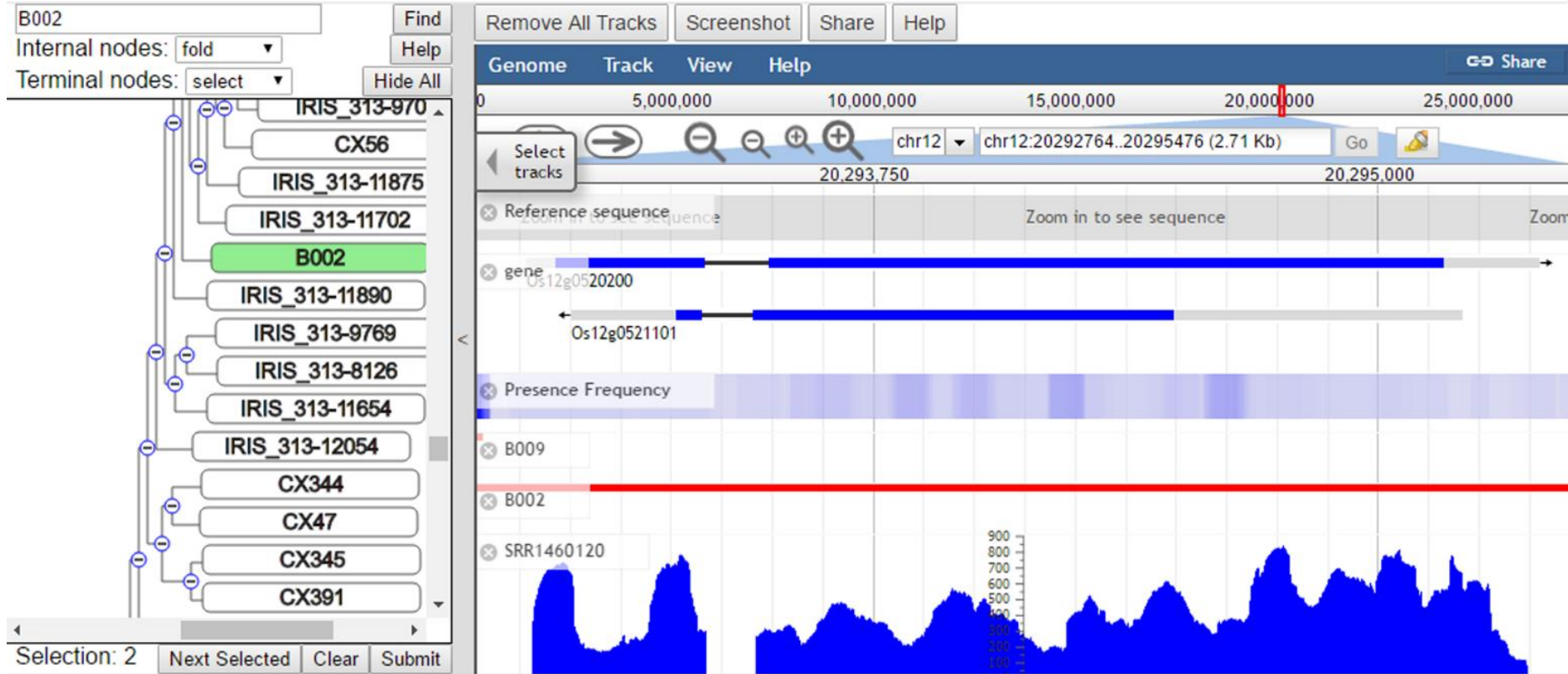


<http://cgm.sjtu.edu.cn/3kricedb/>

Sun, C. et al., “RPAN: Rice Pan-genome Browser for ~3,000 rice genomes”,  
*Nucleic Acids Research*, 2017, 45(2): 597-605



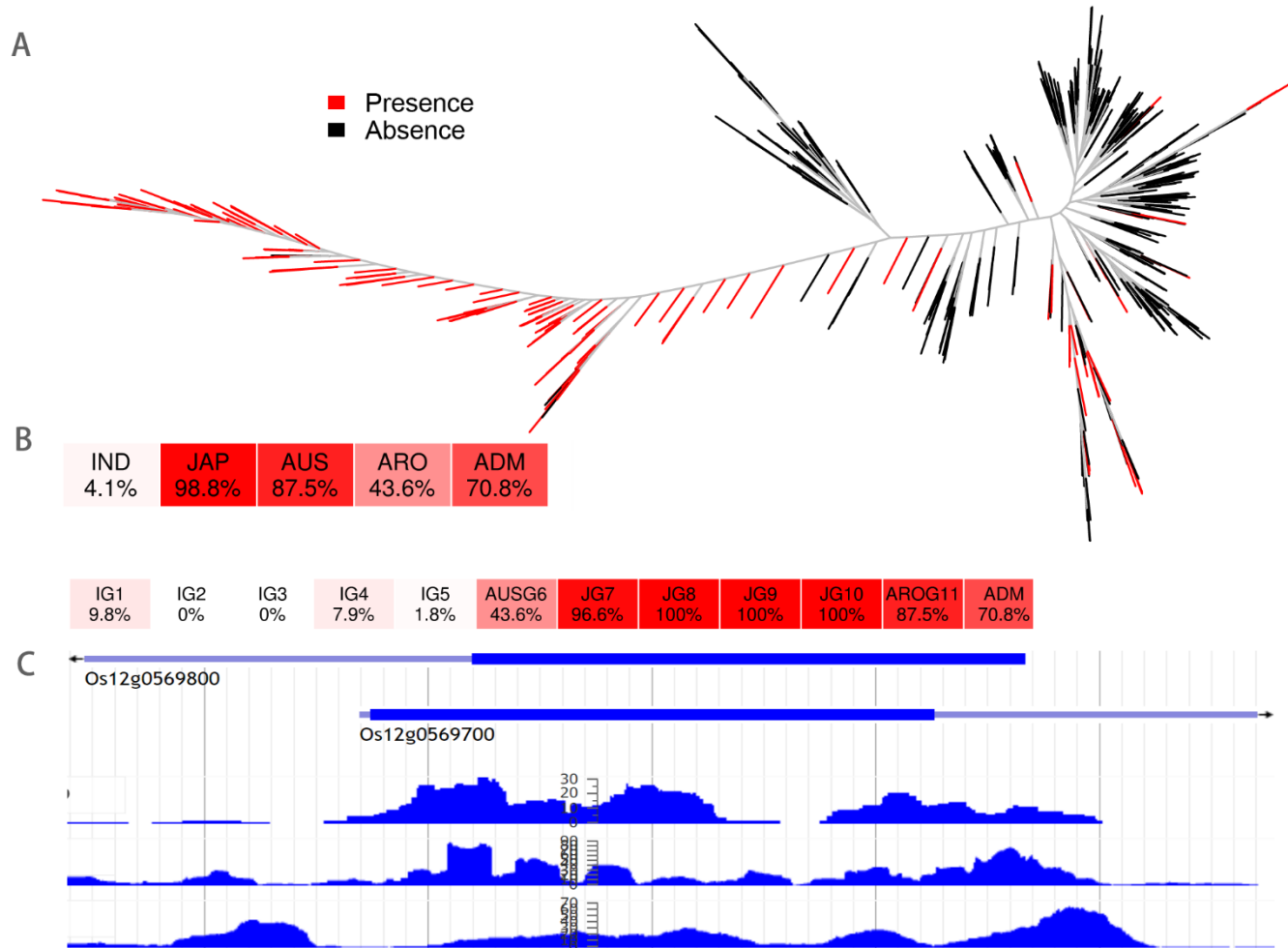
# RPAN: Rice PAN-genome Browser



Sun, C. et al., “RPAN: Rice Pan-genome Browser for ~3,000 rice genomes”, *Nucleic Acids Research*, 2017, 45(2): 597-605



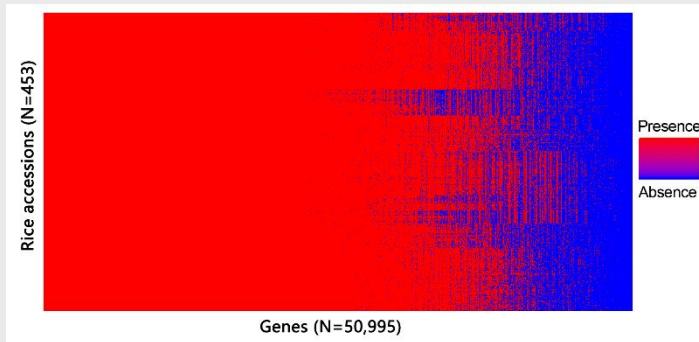
# RPAN



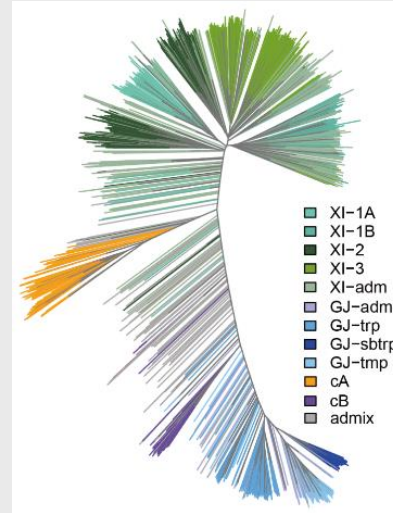
Sun, C. et al., “RPAN: Rice Pan-genome Browser for ~3,000 rice genomes”, *Nucleic Acids Research*, 2017, 45(2): 597-605.



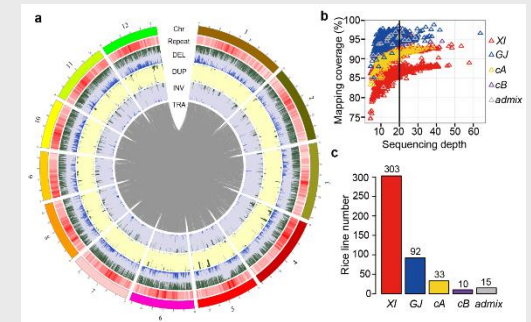
# Pan-genomics based genomics analysis



**Pan-genome  
analysis  
PAV**



**SNP**



**SV**



**Biomarker identification**

**Phenotype**



# Computational pan-genomics: status, promises and challenges

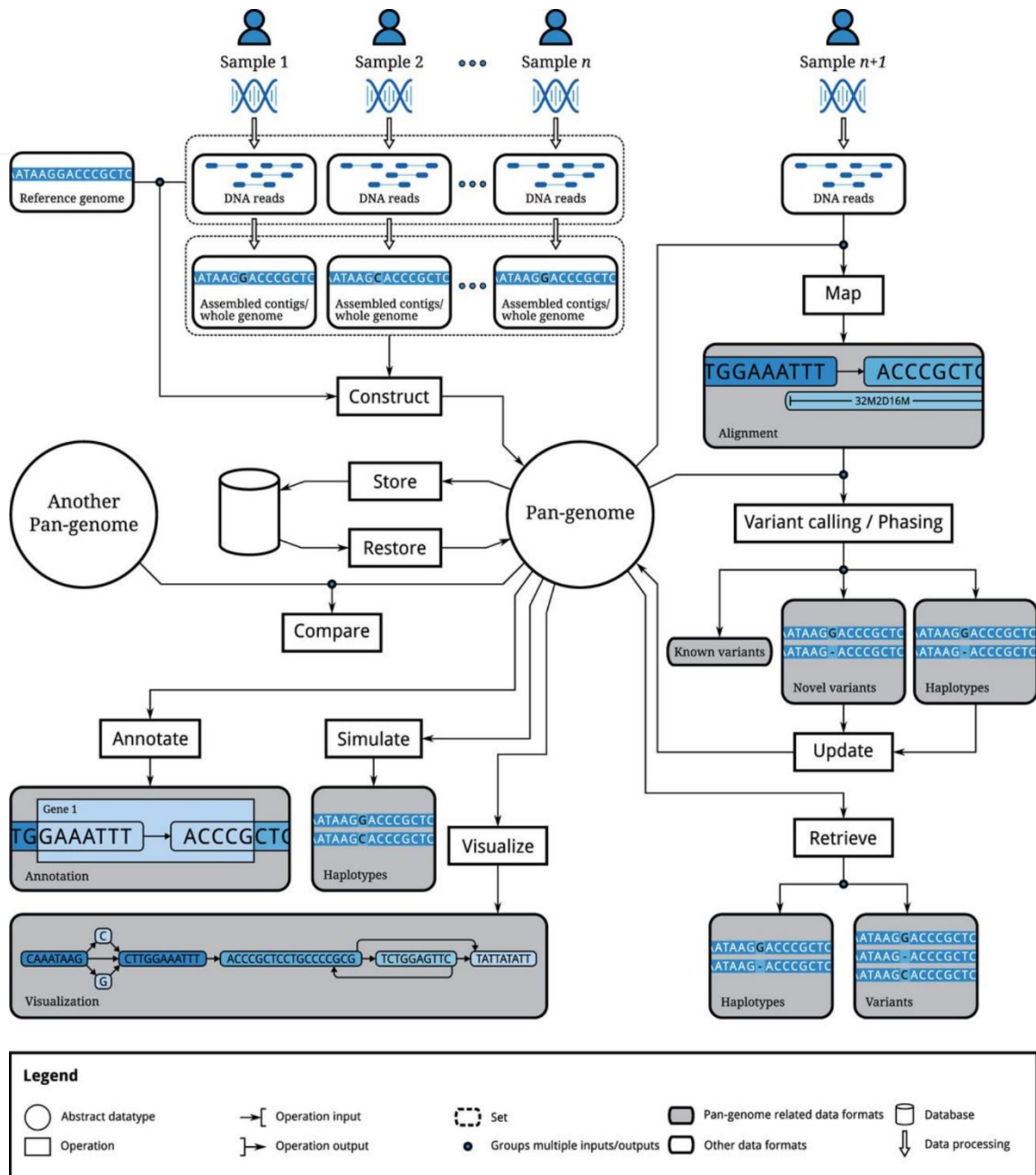


Illustration of operations to be supported by a pan-genome data structure.



# Summary

**It's pan-genome era now!**

**Crop pan-genomes**

**wheat pan-genomes**

**Human pan-genomes**

**Cancer genomes**

**Human body single cell genomes**