

Finding Magnetic Cataclysmic Variable Stars with Fink

Clément Mur

With Emille Ishida and the Fink Cataclysmic Variable team from Brasil

Fink Collaboration Meeting — July 17, 2025

Outline

Introduction

Magnetic Cataclysmic Variable Stars

Method

Performances

Results

ZTF Implementation

Expectations for LSST

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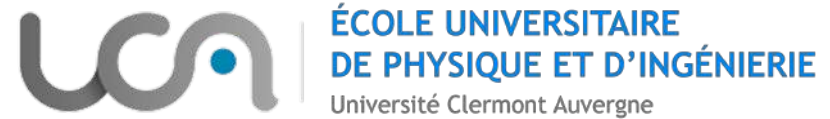
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Introduction

- M2 internship
- Supervized by Emille Ishida
- In collaboration with the Fink CV team from Brazil
- Goal: Implement a Fink module for mCVs



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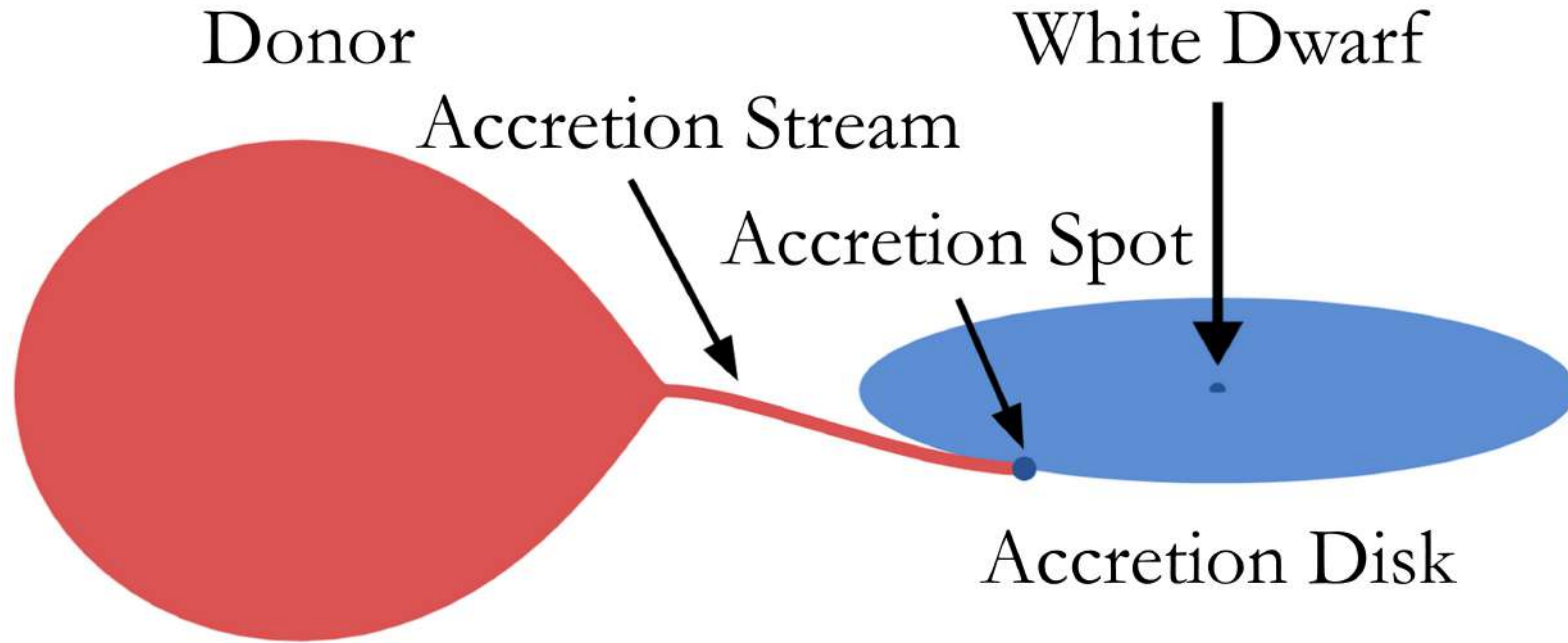
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Non-Magnetic Cataclysmic Variable Stars



Philip D. Hall, Wikimedia

Why “Cataclysmic Variables”?

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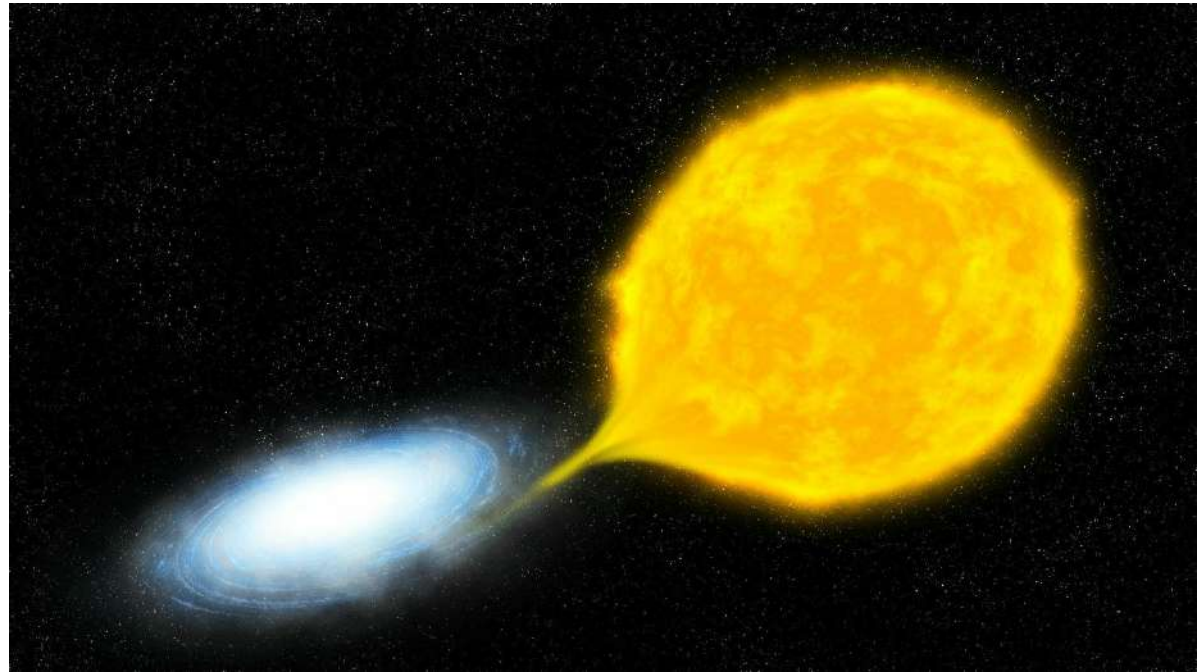
- Eclipses

Why “Cataclysmic Variables”?

- Eclipses
- Change of regime

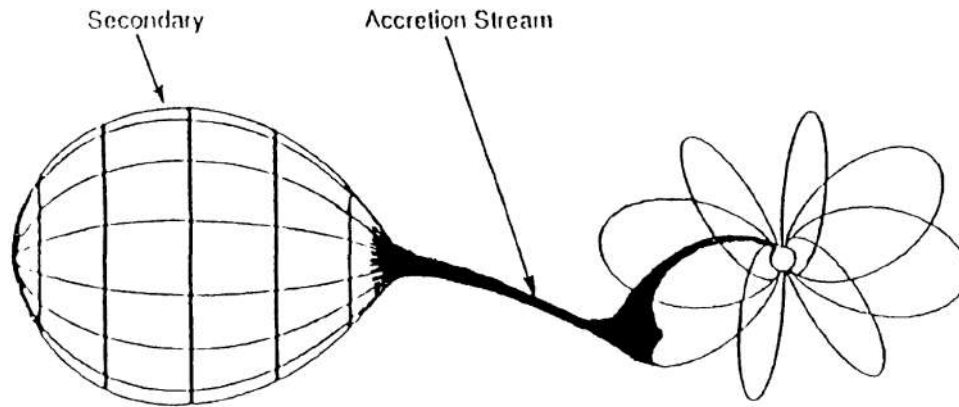
Why “Cataclysmic Variables”?

- Eclipses
- Change of regime
- Outbursts / novae

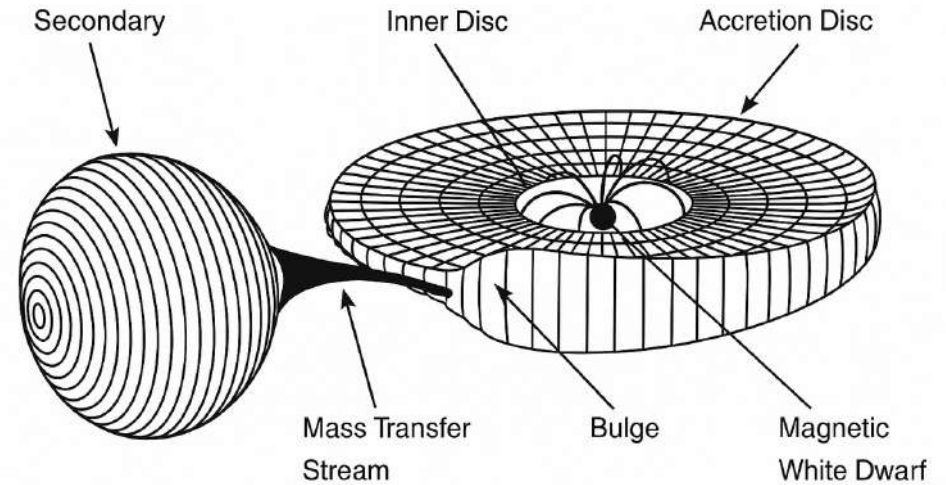


Artist view of a Cataclysmic Variable outburst, NASA/SOFIA/L. Proudfit

Polars & Intermediate Polars



Polar diagram, Cropper, The Polars, 1990



Intermediate Polar diagram, NASA, <https://heasarc.gsfc.nasa.gov/docs/objects/cvs/cvstext.html>

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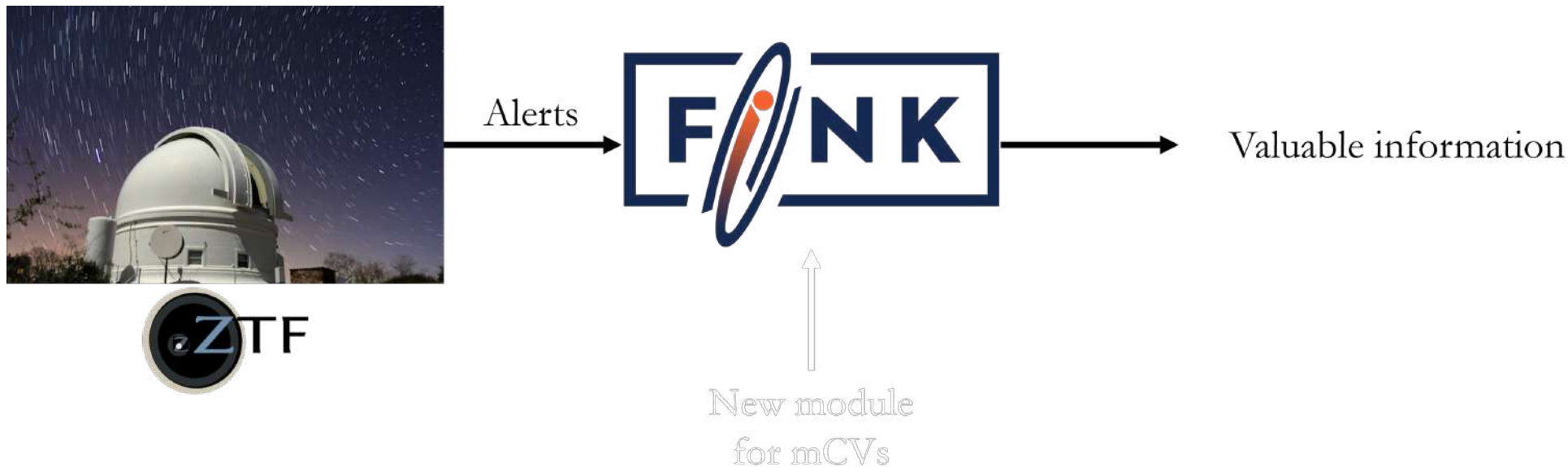
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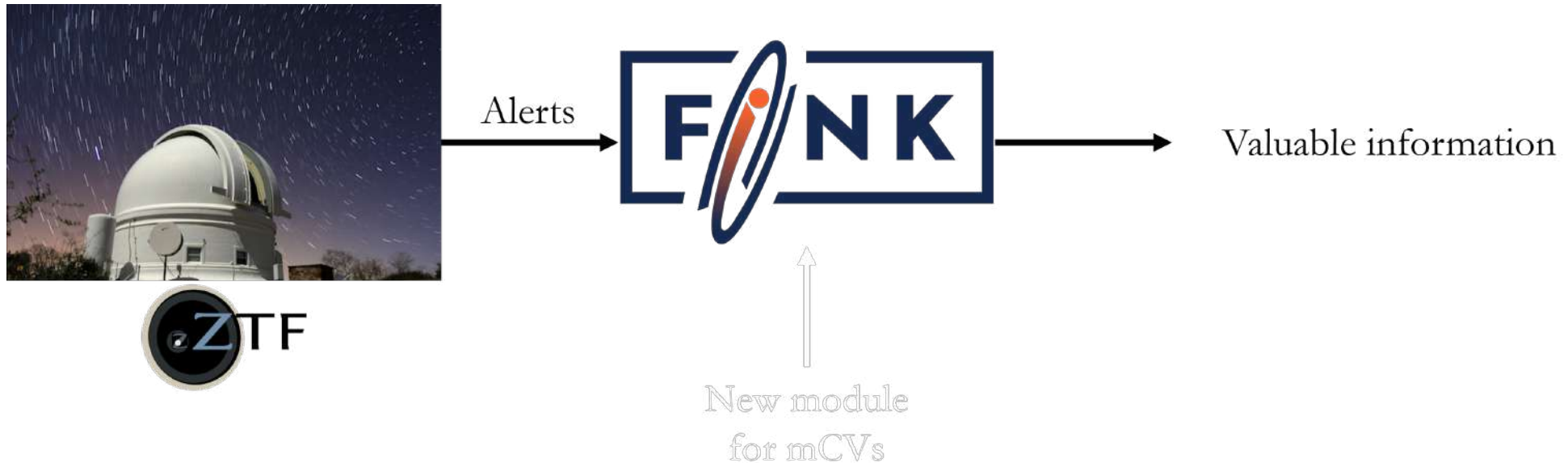
ZTF Implementation

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Full Pipeline Overview



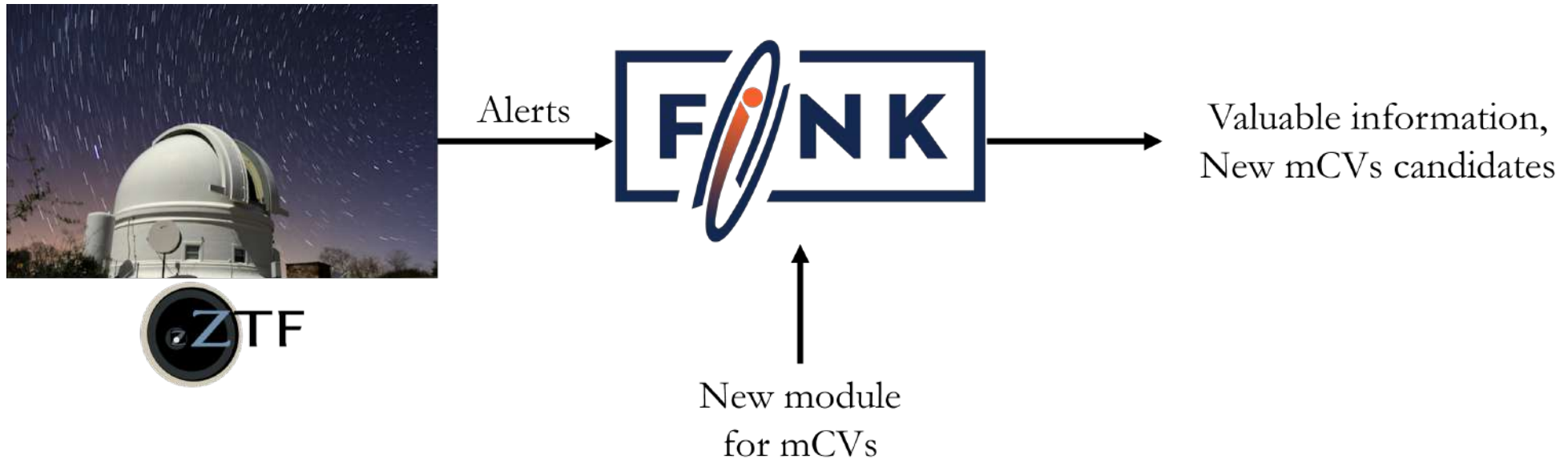
Full Pipeline Overview



Alert:

Package containing lightcurve data of an object over the 30 days previous to the last detection.

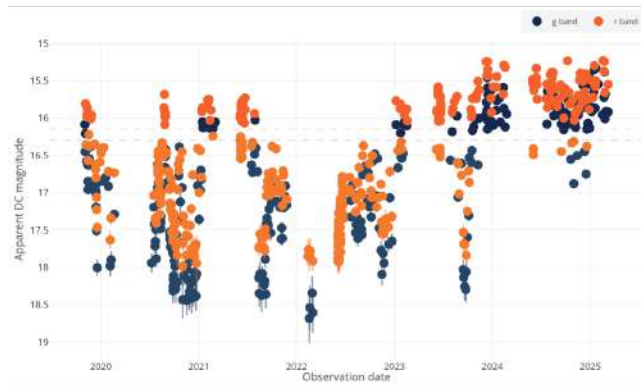
Full Pipeline Overview



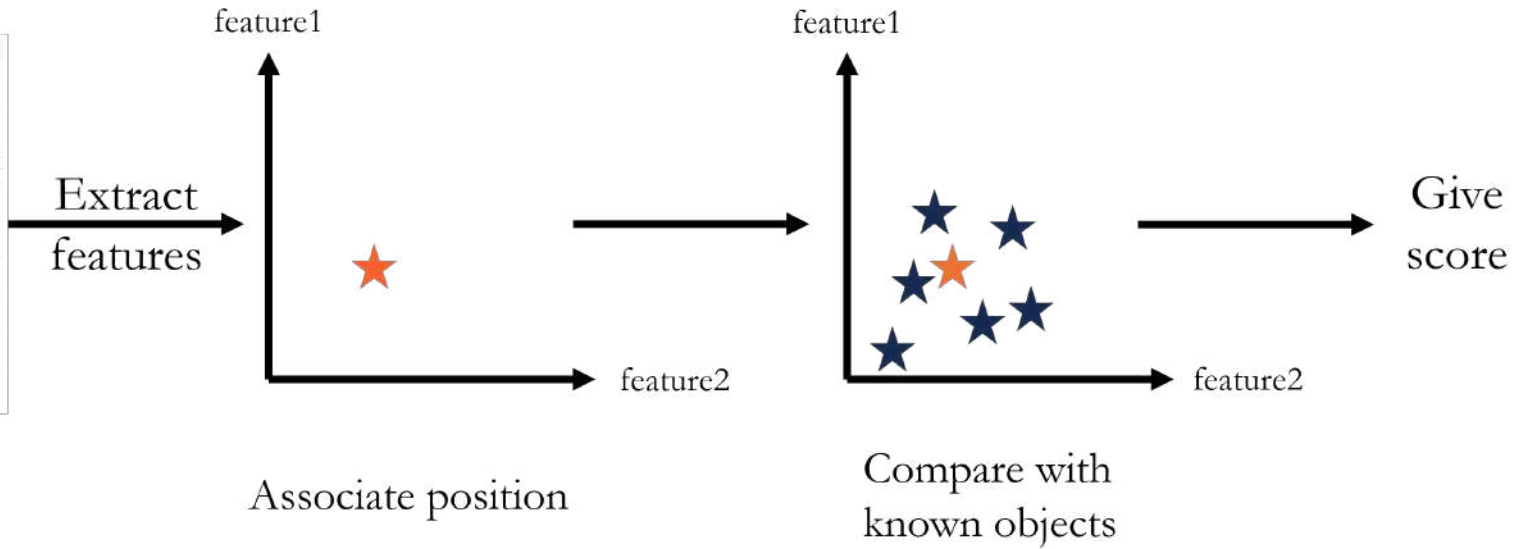
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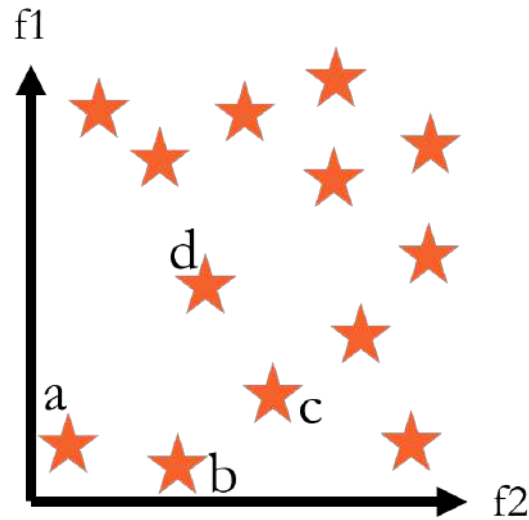
Algorithm Working Principle



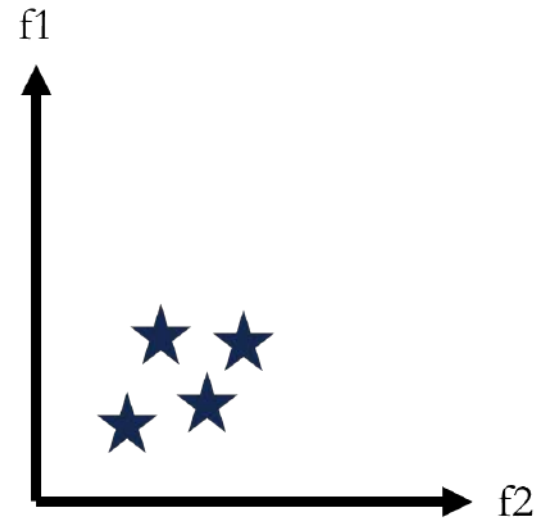
Unknown lightcurve



Scoring



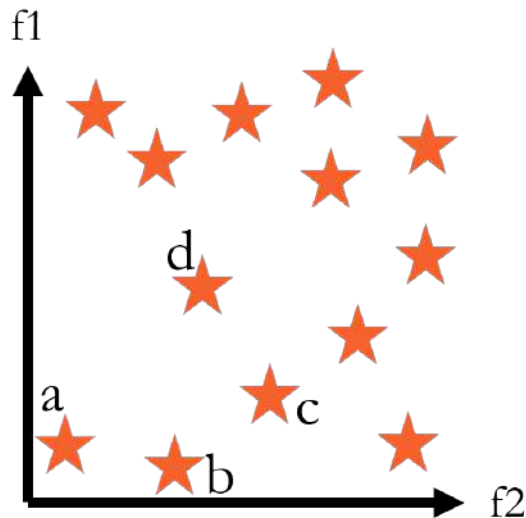
Unknown objects from
a night of observation



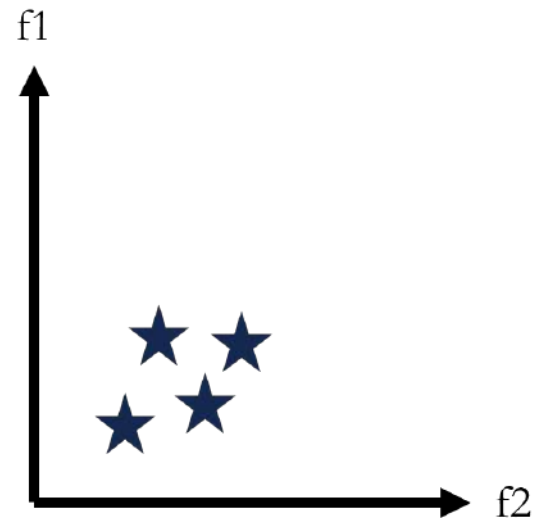
All known mCVs

Scoring

Nearest neighbors list:



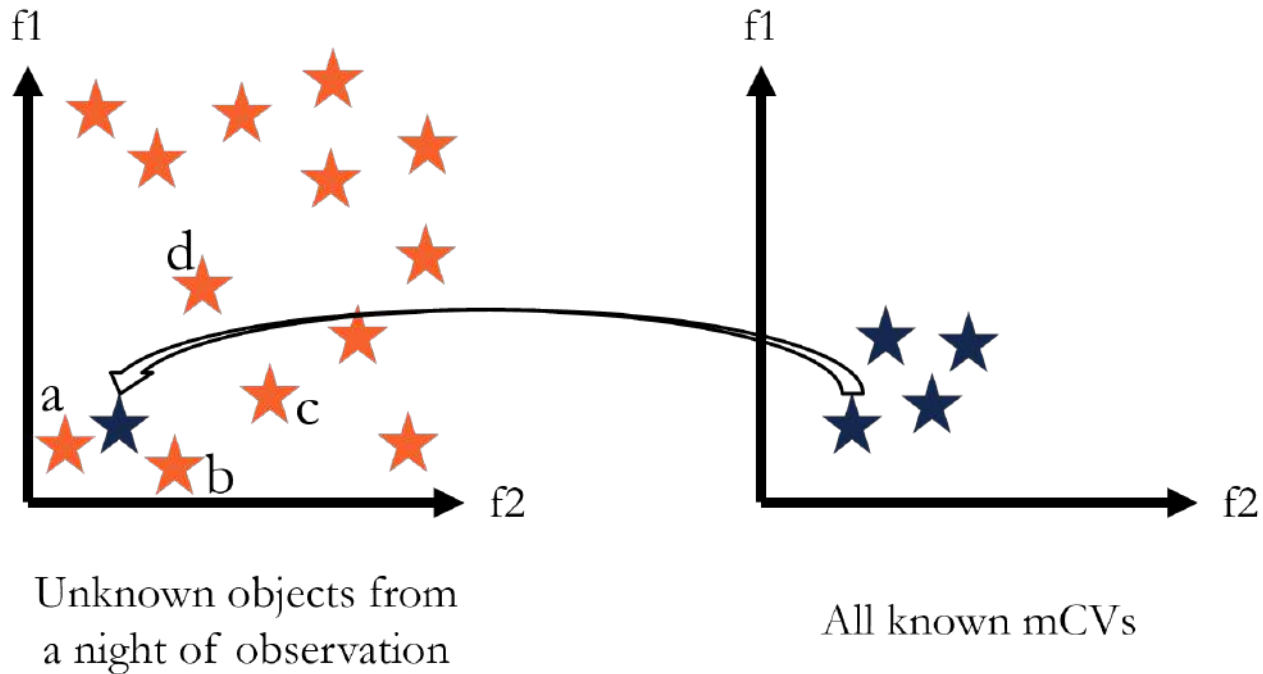
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All known mCVs

Scoring

Nearest neighbors list:
a, b

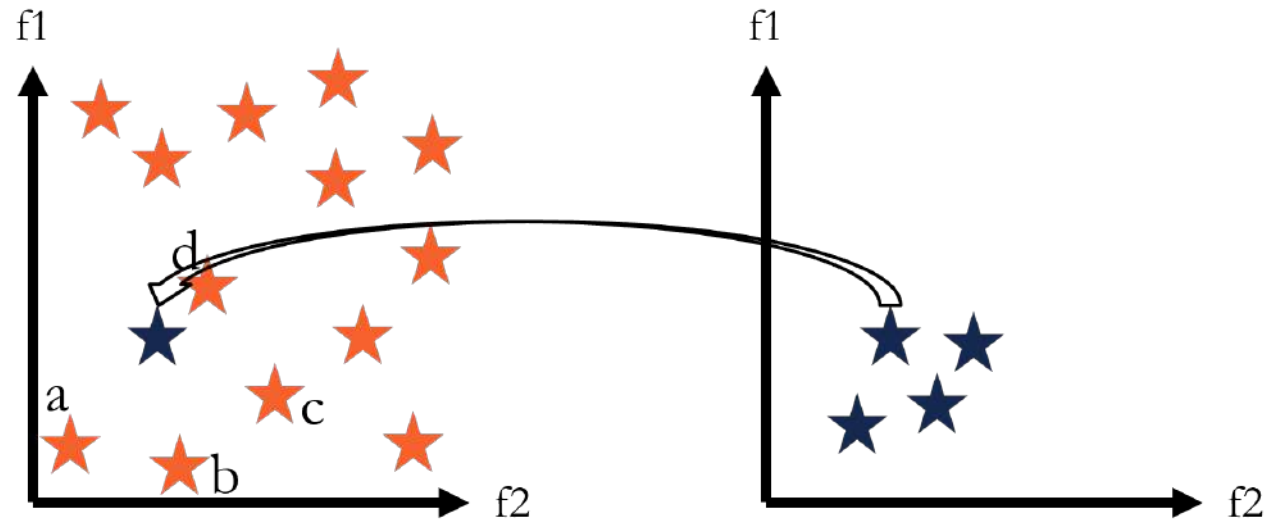


Scoring

Nearest neighbors list:

a, b,

d, c



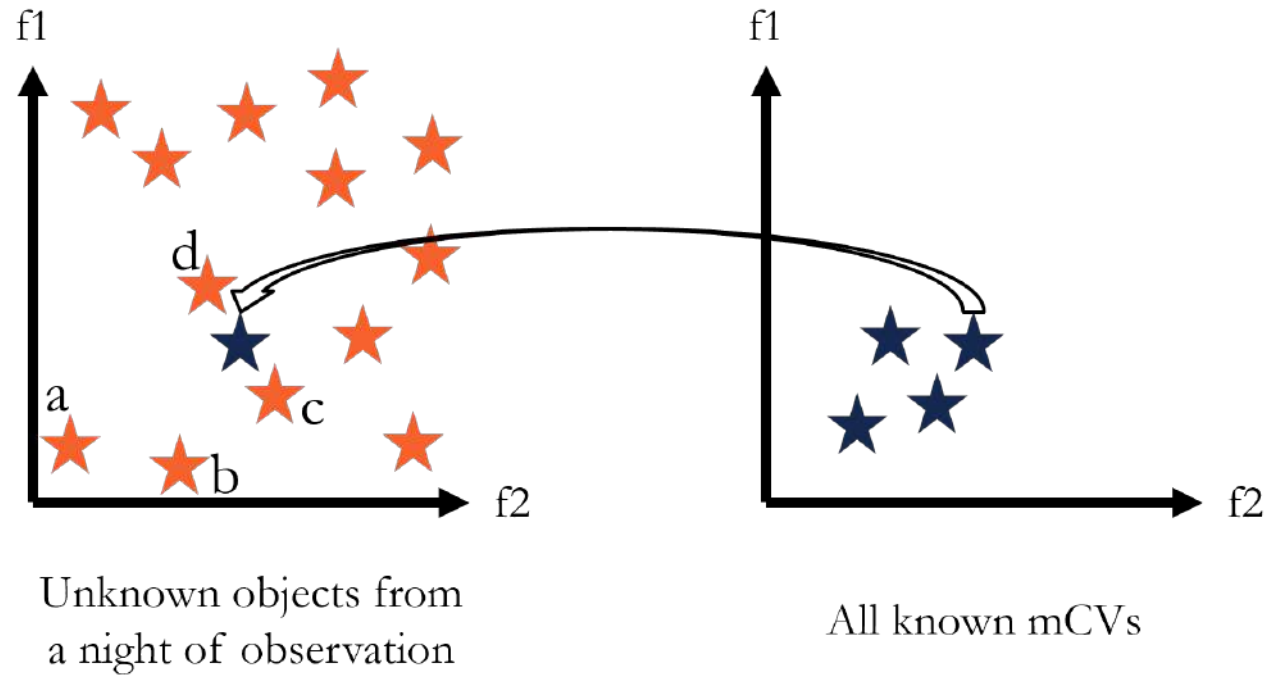
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All known mCVs

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Nearest neighbors list:

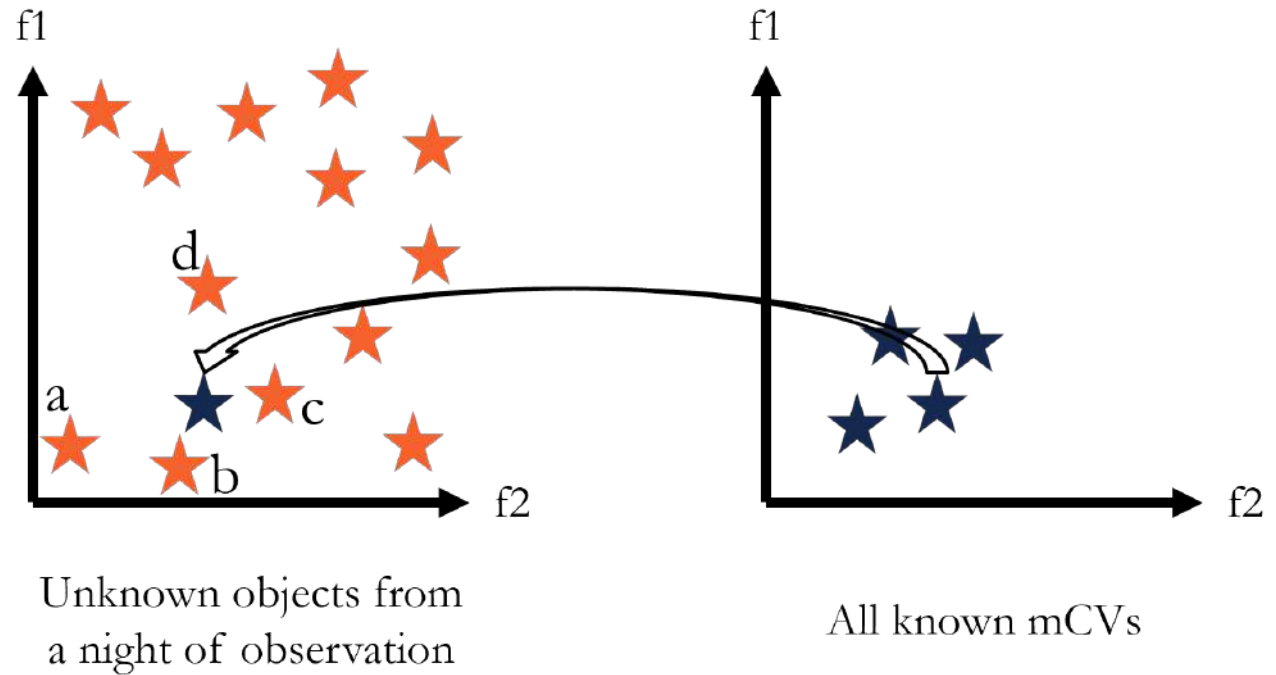
a, b,
d, c,
d, c



Scoring

Nearest neighbors list:

a, b,
d, c,
d, c,
b, c



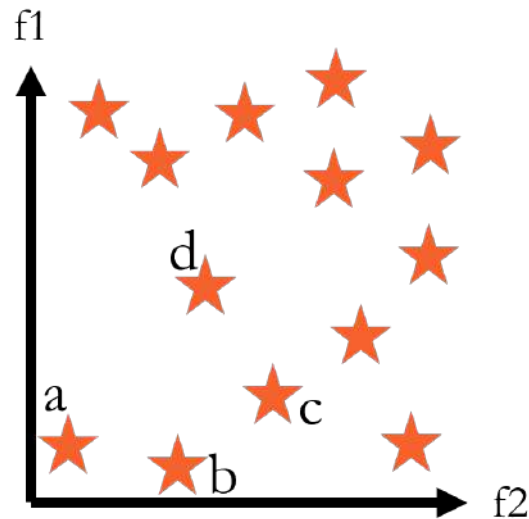
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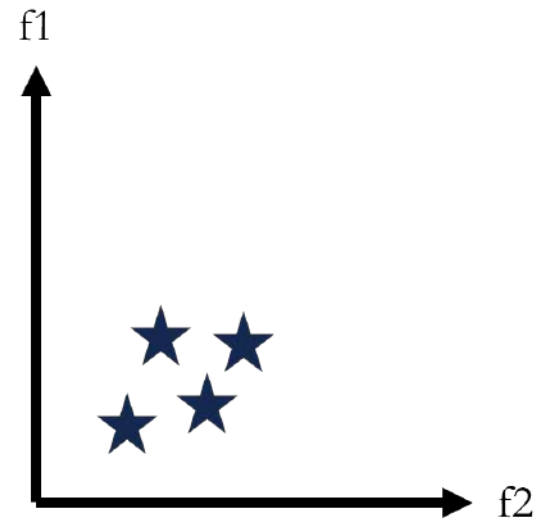
a, b,
d, c,
d, c,
b, c

Scores:

a: 1,
b: 2,
c: 3,
d: 2



Unknown objects from
a night of observation



All known mCVs

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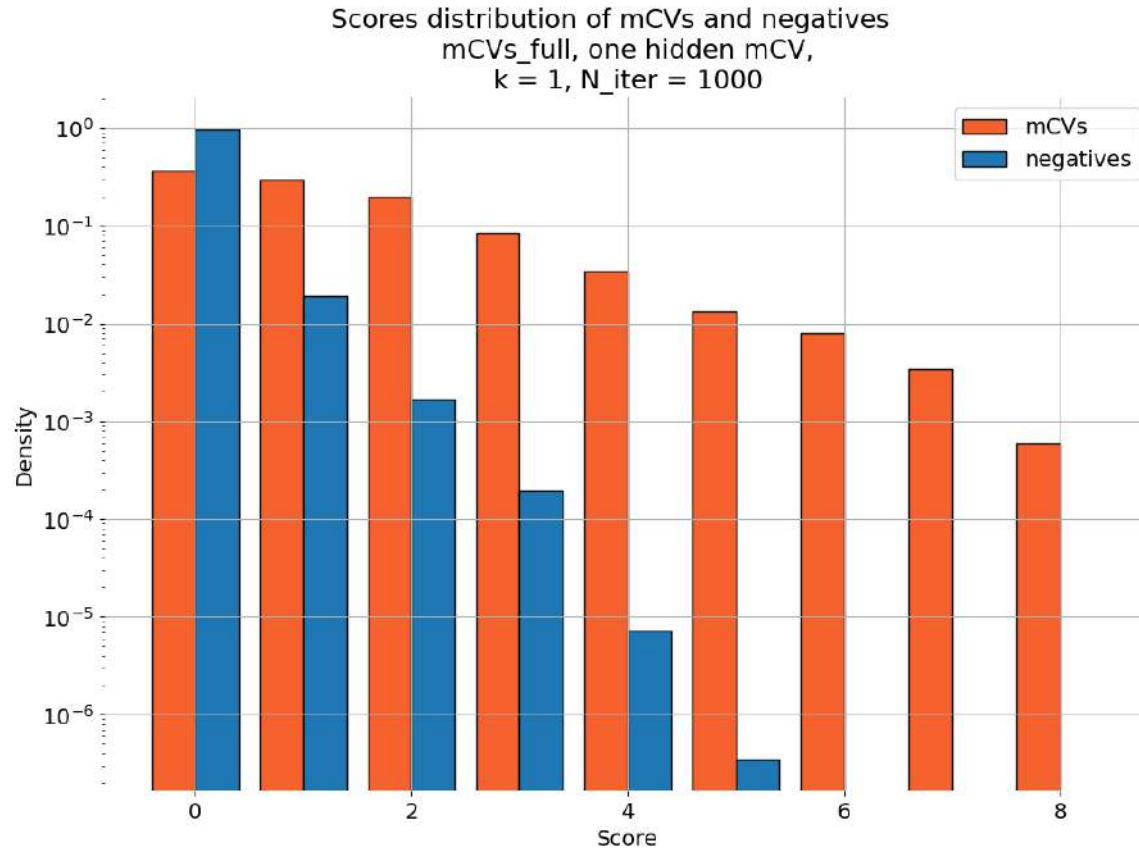
Performances

Results

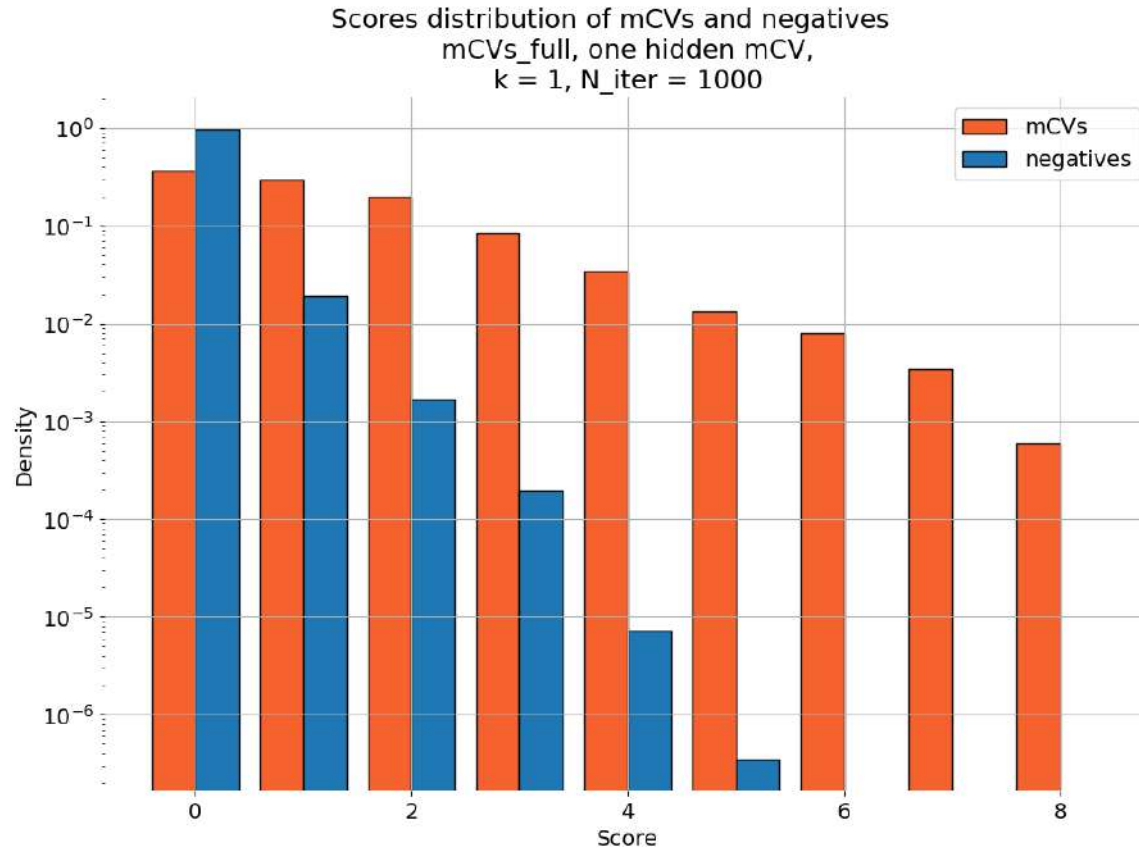
ZTF Implementation

Expectations for LSST

Performances

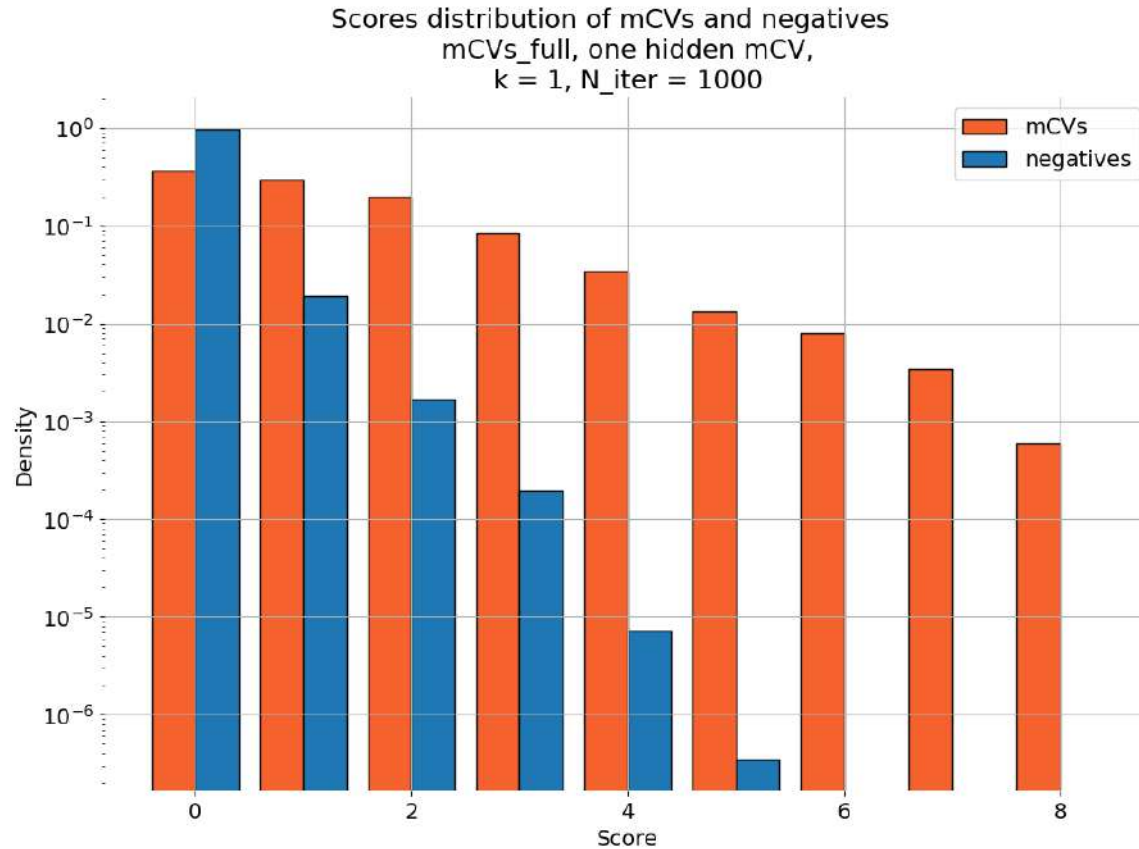


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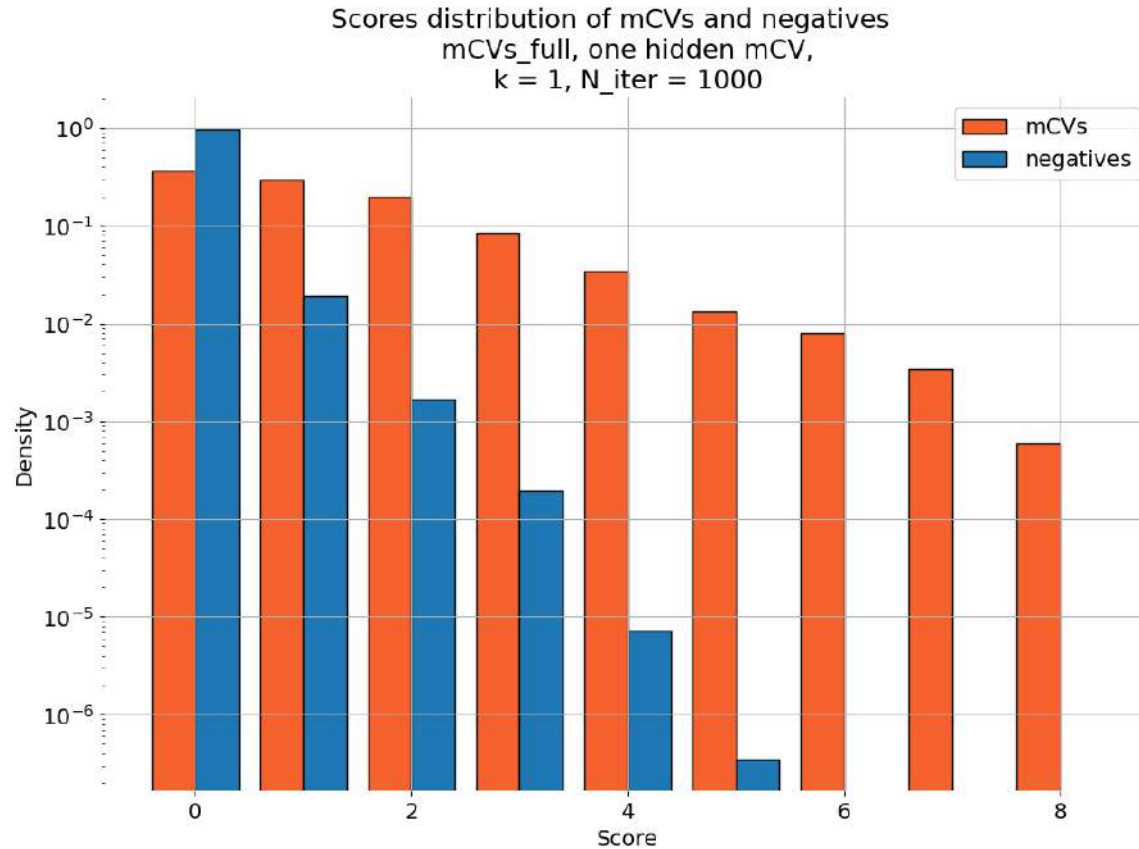
- Sample 2 000 negatives and 1 mCV

Performances



- Sample 2 000 negatives and 1 mCV
- Evaluate scores

Performances



- Sample 2 000 negatives and 1 mCV
- Evaluate scores
- Repeat 1 000 times

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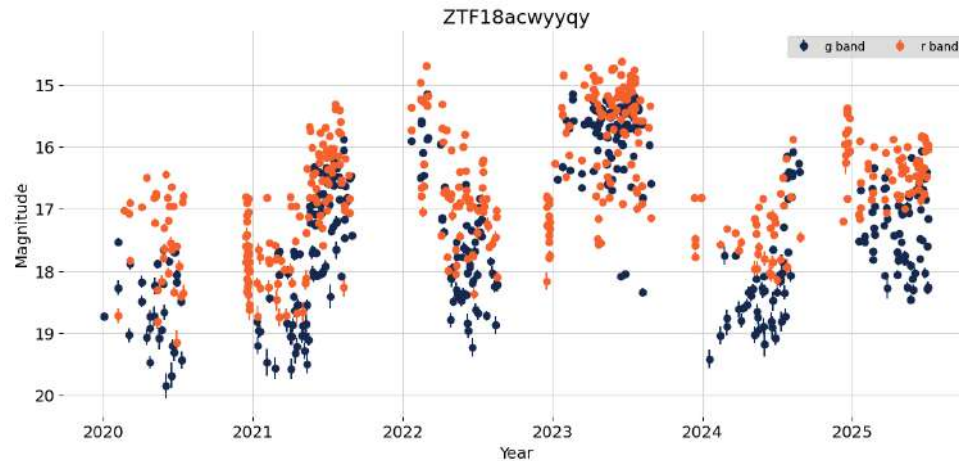
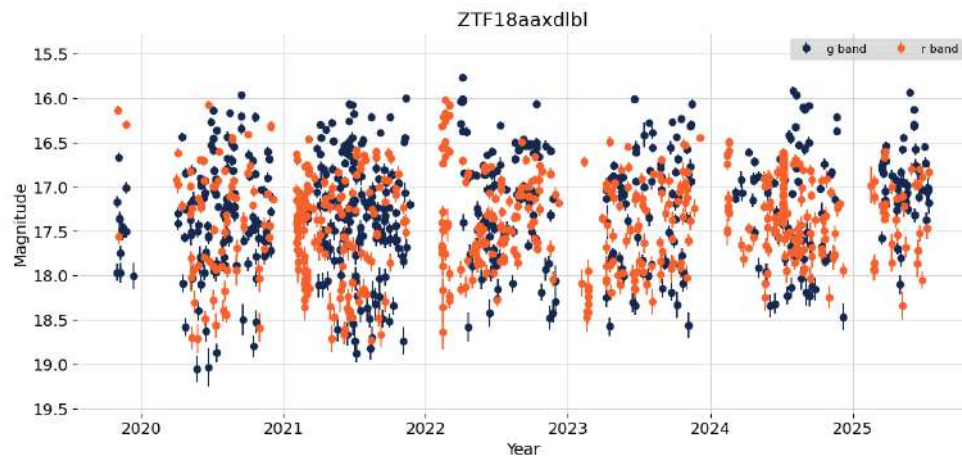
Expectations for LSST

Results

Applied the algorithm on new data from 4 different nights

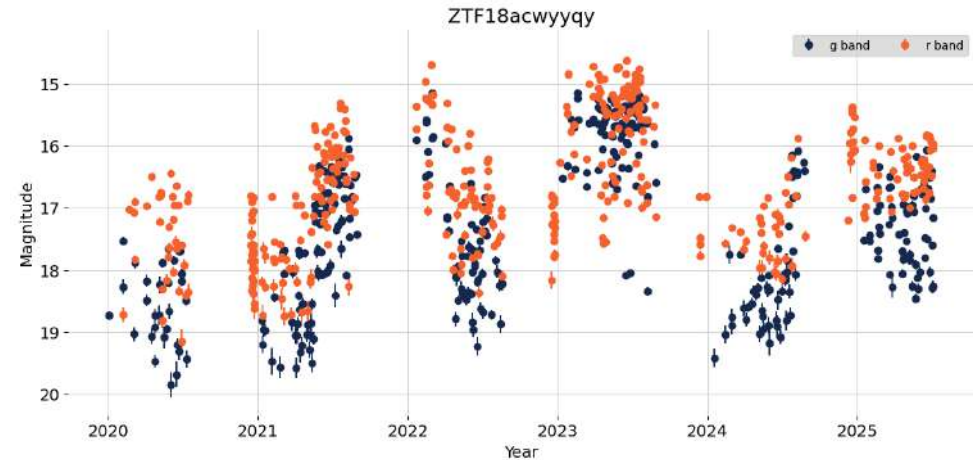
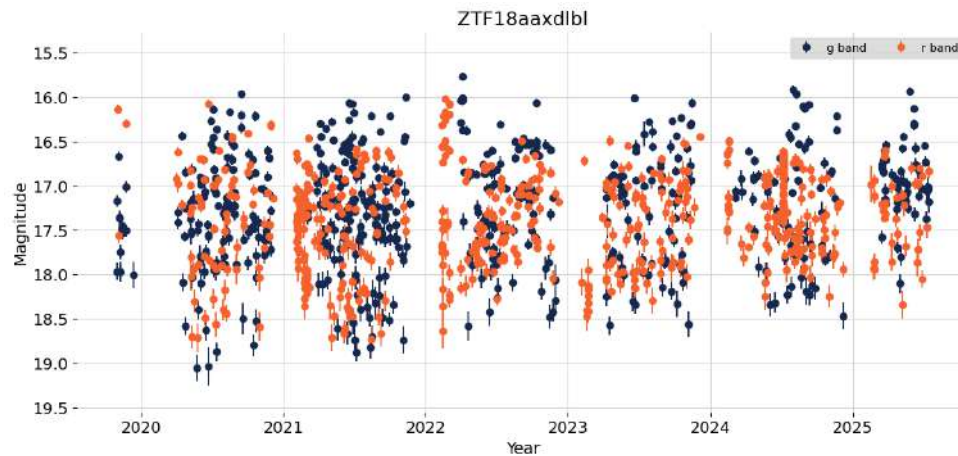
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Applied the algorithm on new data from 4 different nights



Results

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These two are Polars, already classified in VSX

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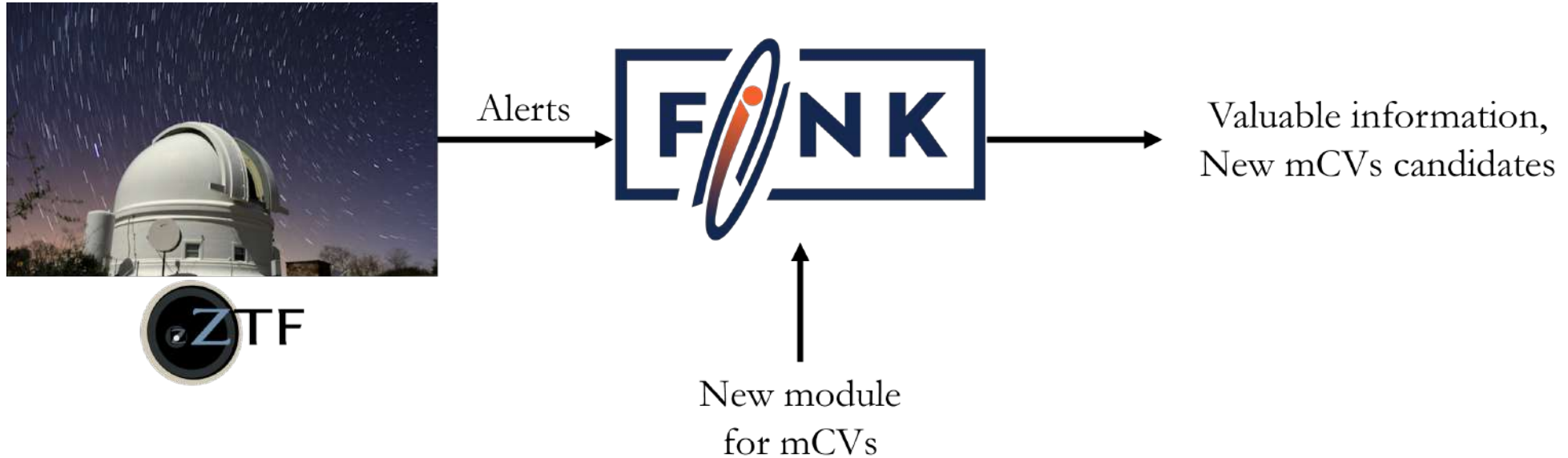
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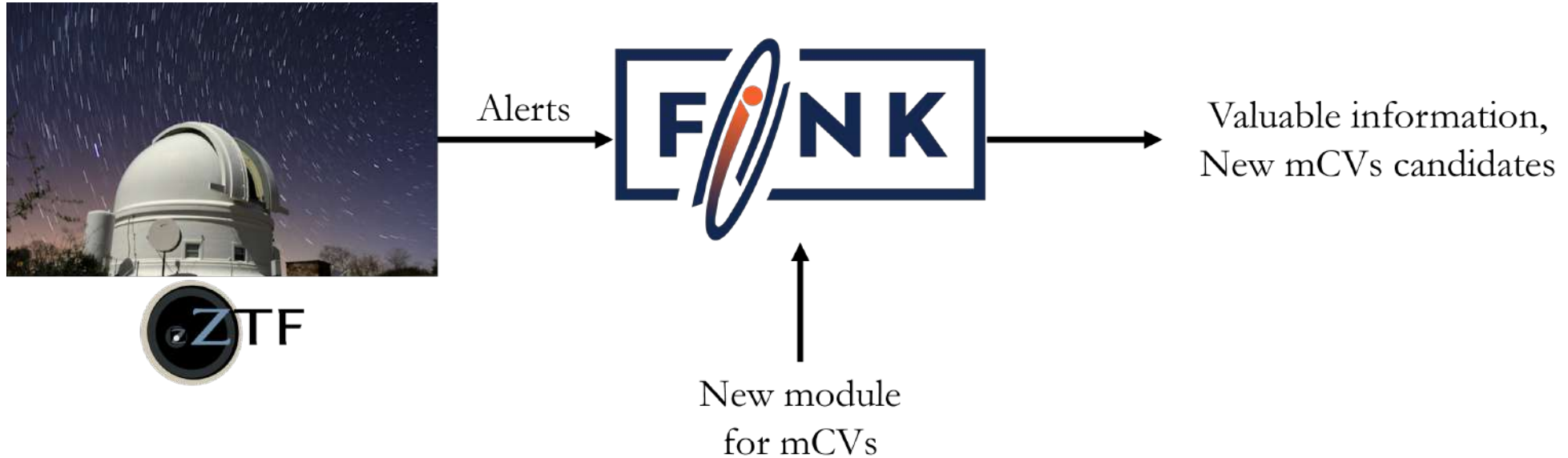
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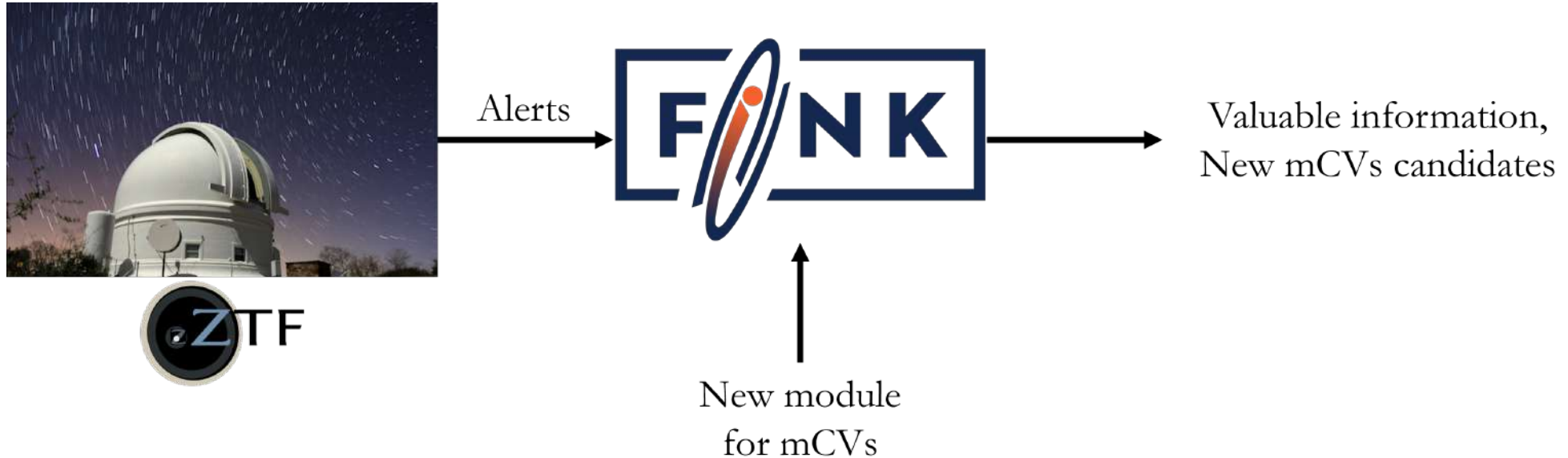


ZTF Implementation



Run automatically every night

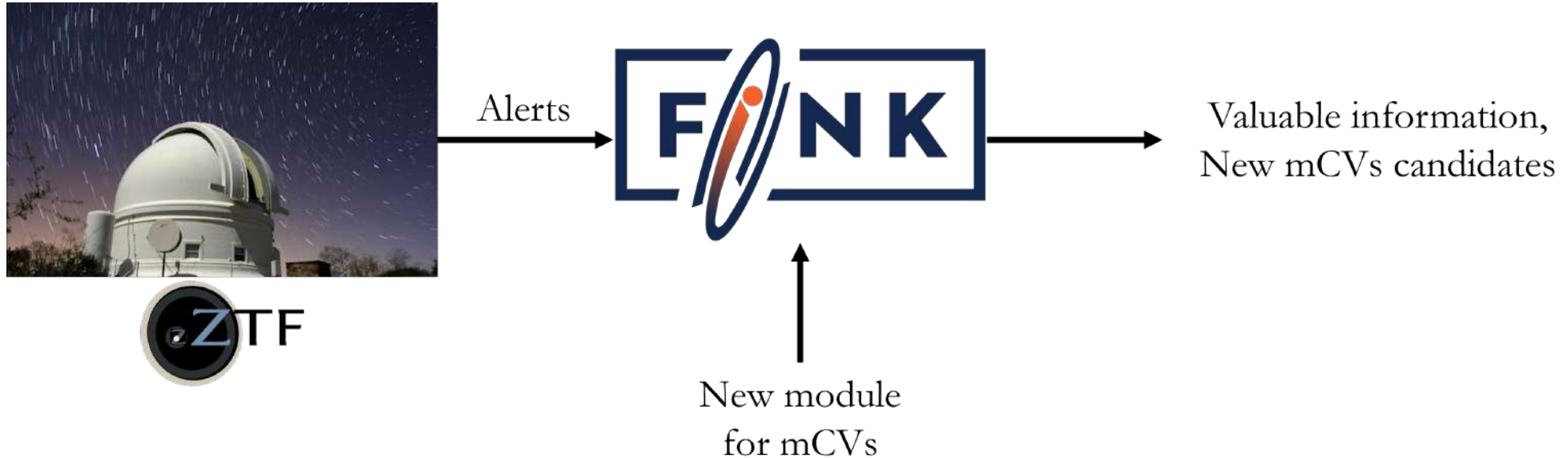
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Run automatically every night

But,

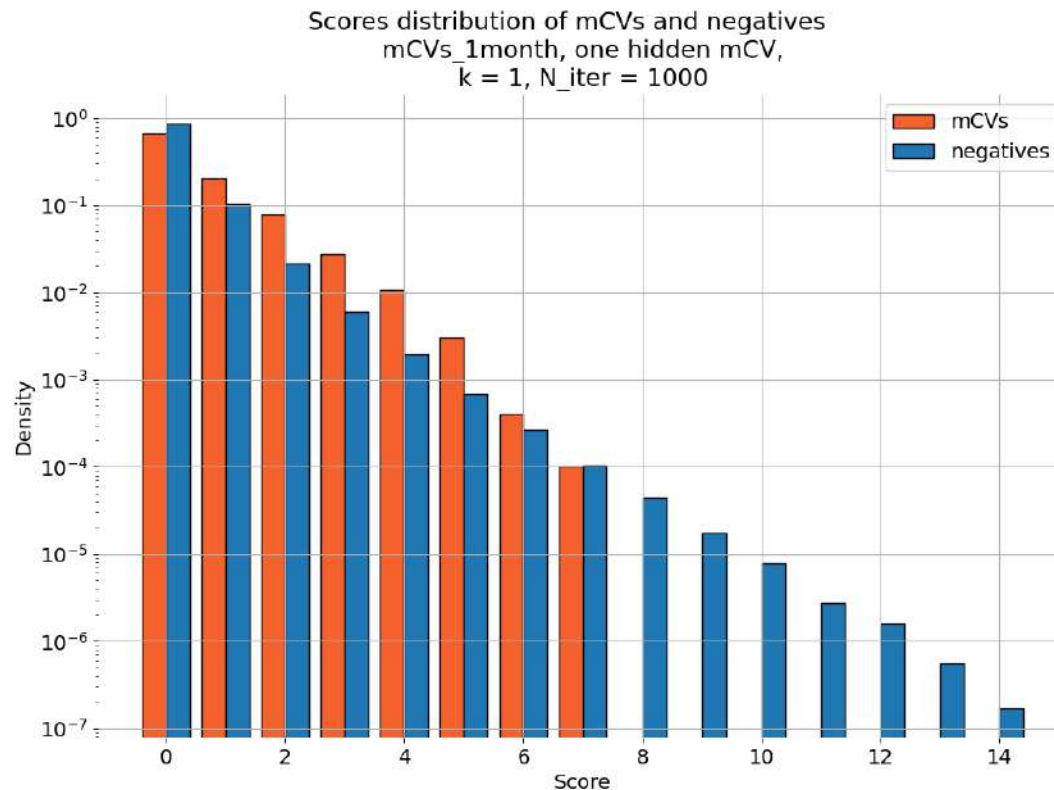
ZTF Implementation



Run automatically every night

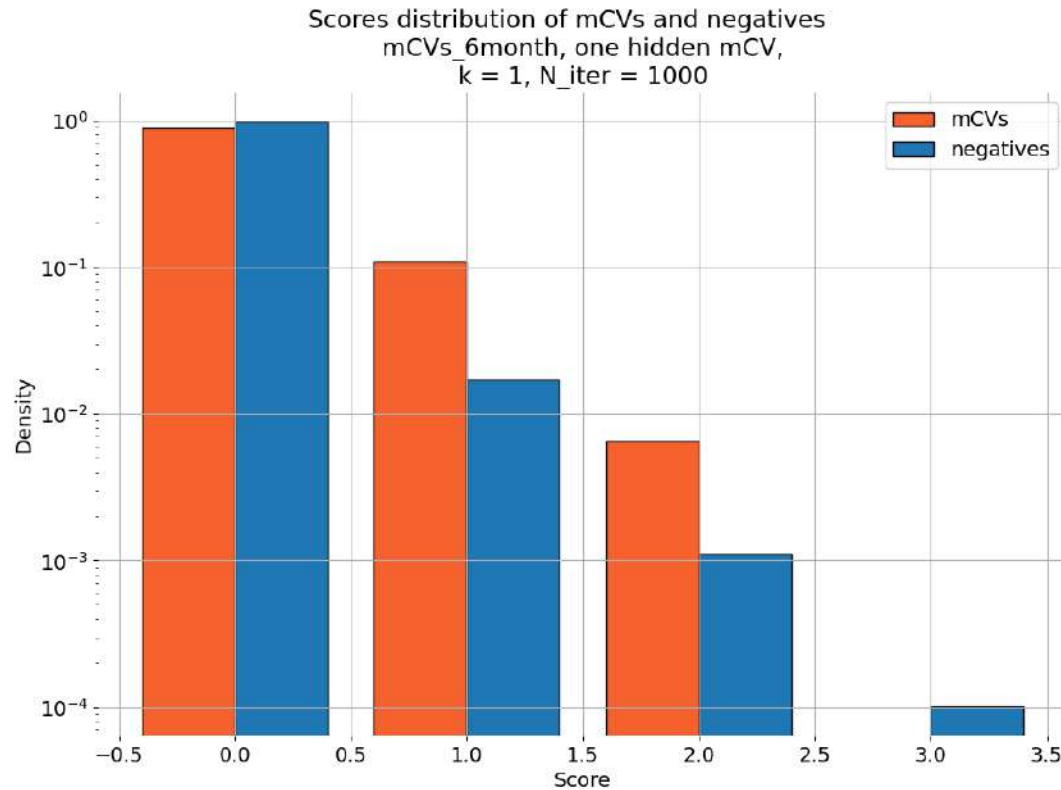
But, concatenating tens of thousands of lightcurves is computationally heavy!

Performance Evolution With Time Range



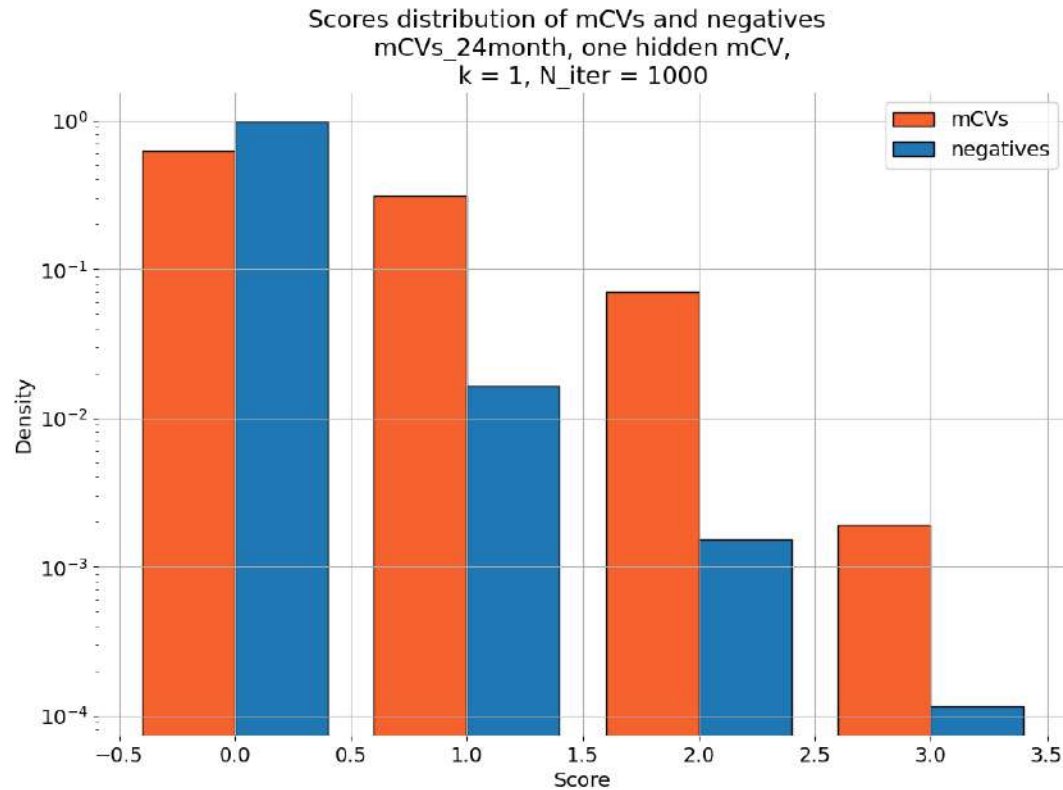
1-month lightcurves

Performance Evolution With Time Range



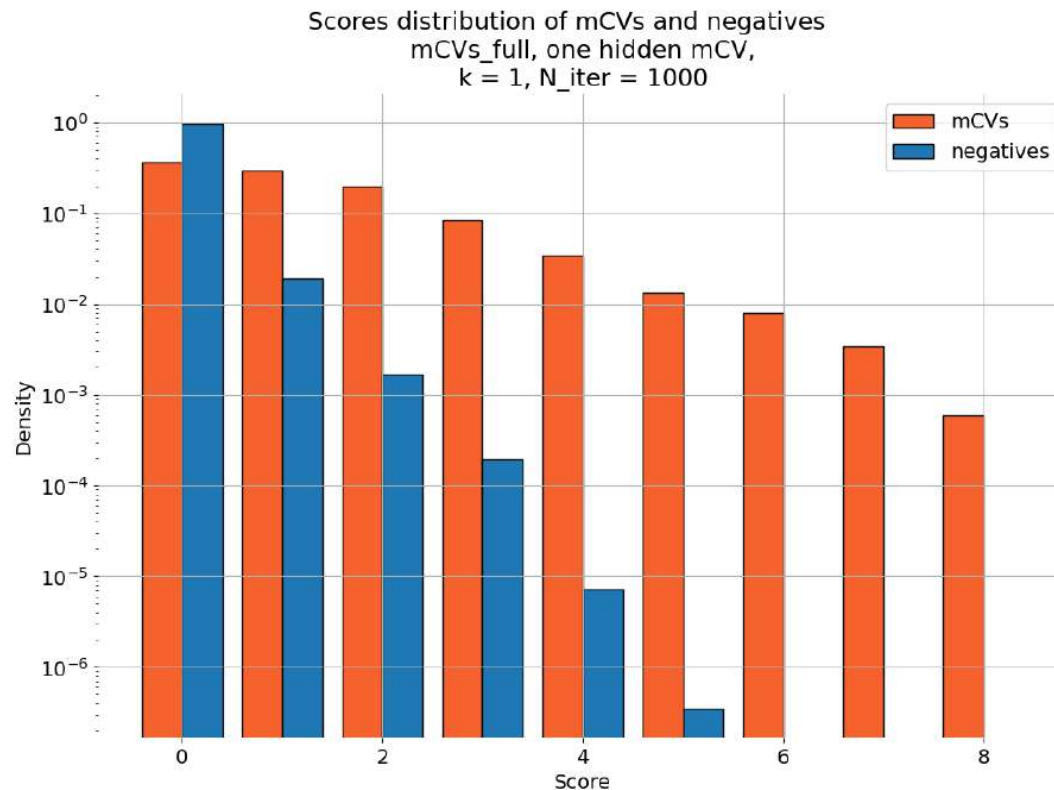
6-month lightcurves

Performance Evolution With Time Range



2-years lightcurves

Performance Evolution With Time Range



full lightcurves (~5 years)

Solutions For Improvement

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Patience is key!

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- Slower cadence

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- Deeper field → saturated objects

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Expect worse performances for now

Expectations for LSST

- Slower cadence
- Deeper field → saturated objects



Expect worse performances for now

LSST will operate for 10 years

Tank you for your attention!

Any question?