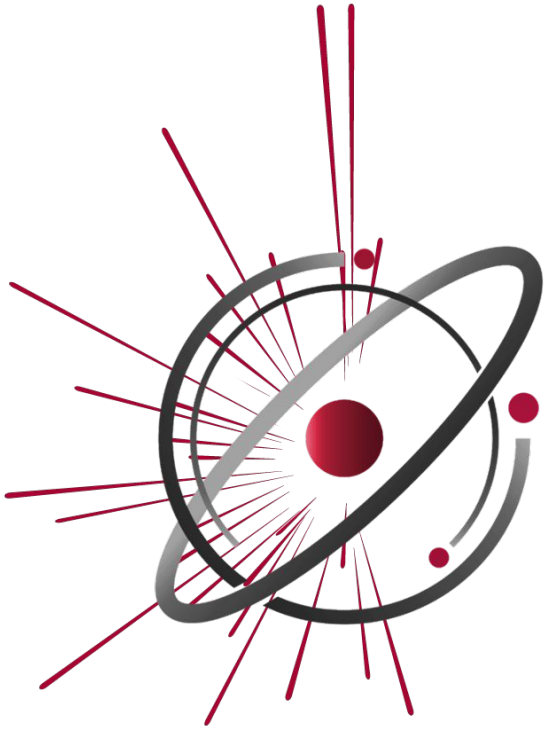


LSST DESC & COIN

RESSPECT

Recommendation System for Spectroscopic Follow-up

LSST France, 17 May 2022

Emille Ishida, on behalf of the RESSPECT team

The goal of RESSPECT:

To build a **recommendation system** for the construction of an **optimal training sample** given available spectroscopic resources.

*It is **NOT** the goal of RESSPECT:*

- Build a better classifier
- Maximize the number of spectroscopically confirmed SN Ia
- Test a complete cosmology pipeline
- …

The SN Ia *photometric* cosmology pipeline

Cosmology results from photometrically classified SN IA

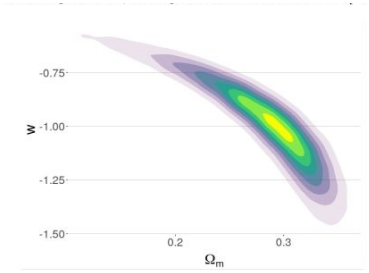
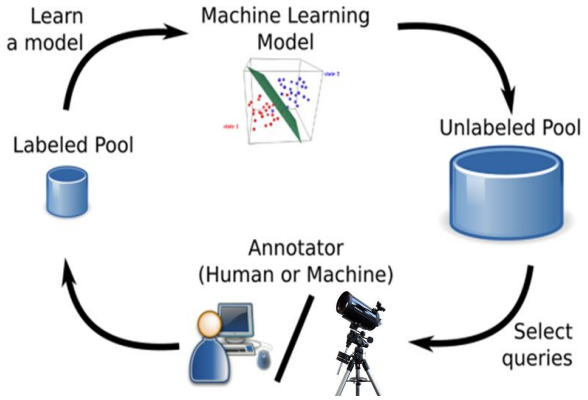


Photo-classified SN Ia

SN candidates

Trained machine learning classifier



Requires full light curves!

learning algorithm

+

Training sample

Optimize this!

Using this!

Feature extraction

Requirement: *Uniform matrix for both, partial as well as full light curves*

Using Bazin,

$$f(t) = A\frac{e^{-(t-t_0)/\tau_f}}{1+e^{(t-t_0)/\tau_r}} + B,$$

Data includes forced photometry

Comparing Different Parameterisations

Name	# Params	Comparative Score (/ 100)	Time Taken	Authors
Bazin	5	56 ± 2	30 ms	Bazin et. al. (2009)
ALERCE v1	6	50 ± 2	37 ms	Sanchez-Saez et. al. (2020)
ALERCE v2	6	47 ± 2	78 ms	Sanchez-Saez et. al. (2020)
FRED	5	47 ± 2	45 ms	Peng et. al. (2010)

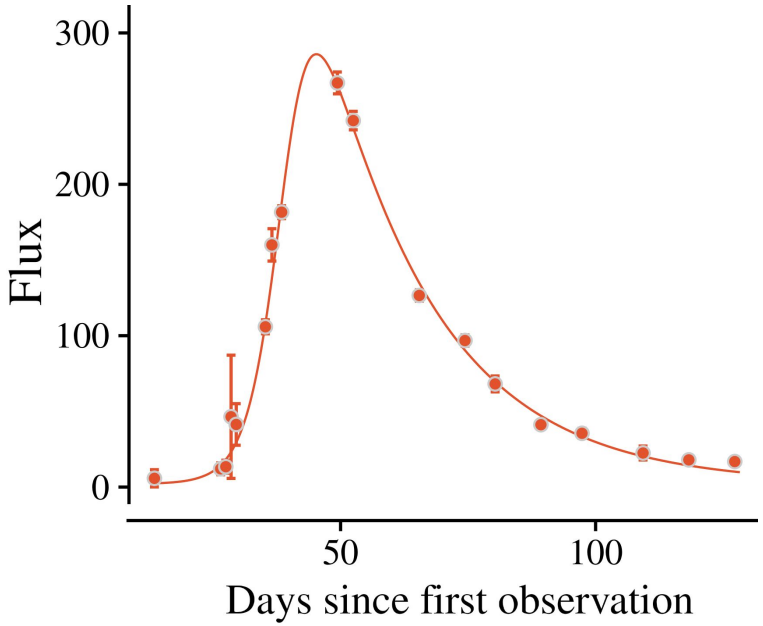
Optimized feature extraction routine by Siddharth Chaini and Johann Cohen-Tanugi
Re-factorization and pipeline optimization by Rupesh Durgesh

If only it was that simple

Take into account observational caveats

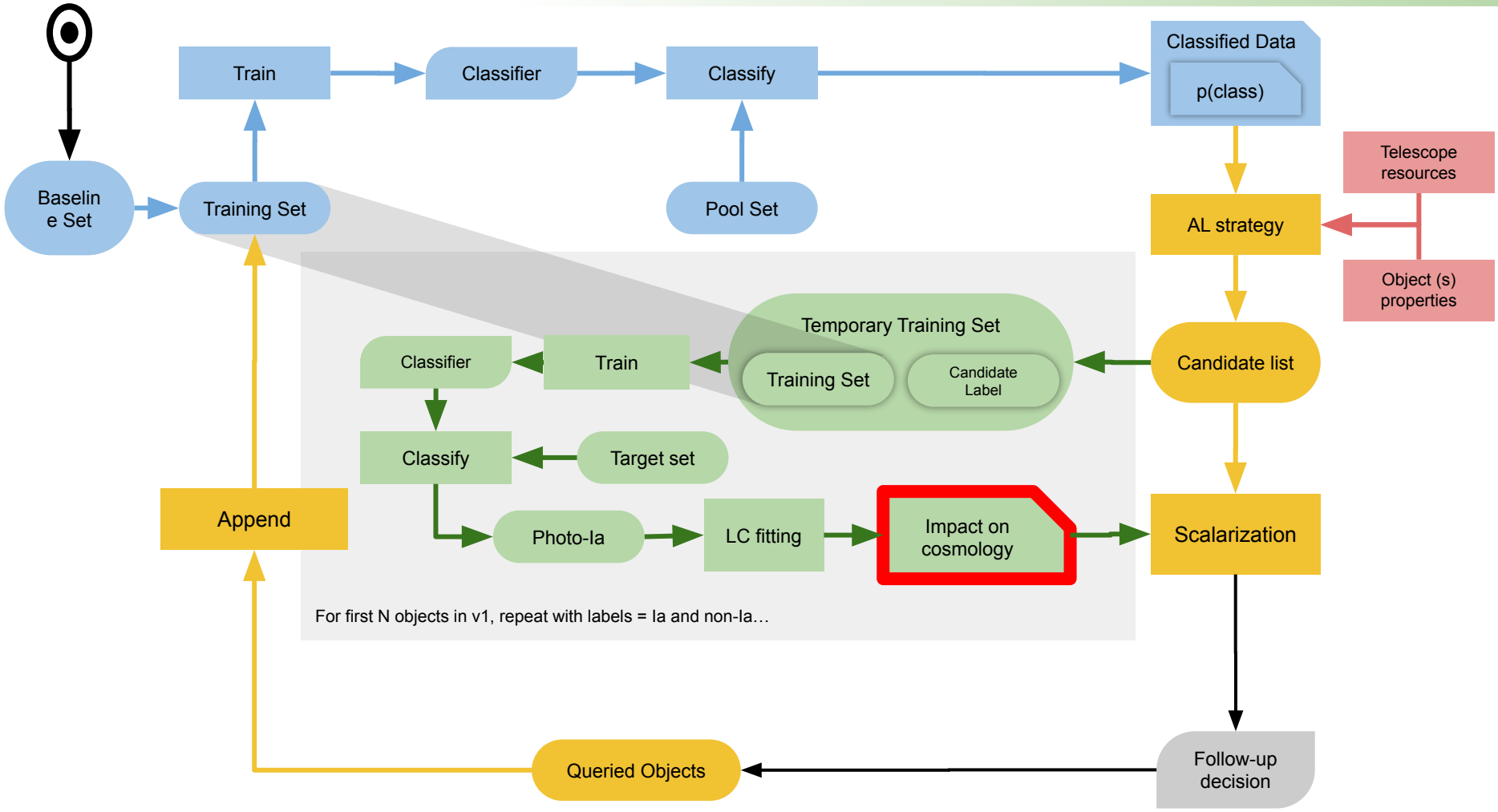
- Window of Opportunity for Labelling
- Evolving Samples
  - We must make query decisions before we can observe the full LC
  - New observations are added for points already in the training sample
- Multiple Instruments
- Evolving Costs
  - Observing costs for a given object changes as it evolves.

Example light curve



Kennamer et al., 2020 - arXiv:astro-ph/2010.05941

+ Cosmological Feedback



Legend

Machine Learning

Active Learning

External factor

Cosmological Feedback

Datasets

Process

Models

Products

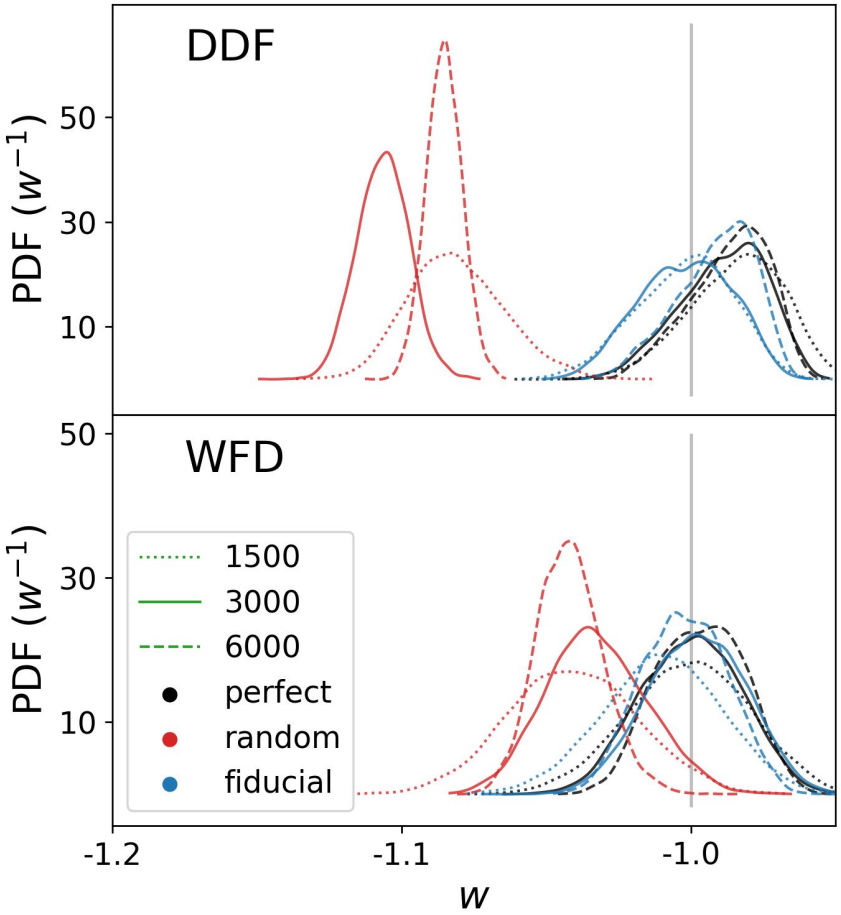
Are classification metrics good proxies for SN Ia cosmological constraining power?

By Alex Malz, Mi Dai and the RESSPECT team

- Goals:
  - Evaluate how the impact on cosmology varies with contaminant class
  - Find a suitable metric to evaluate impact on cosmology (**NOT** cosmology result)

Are classification metrics good proxies for SN Ia cosmological constraining power?

By Alex Malz, Mi Dai and the RESSPECT team



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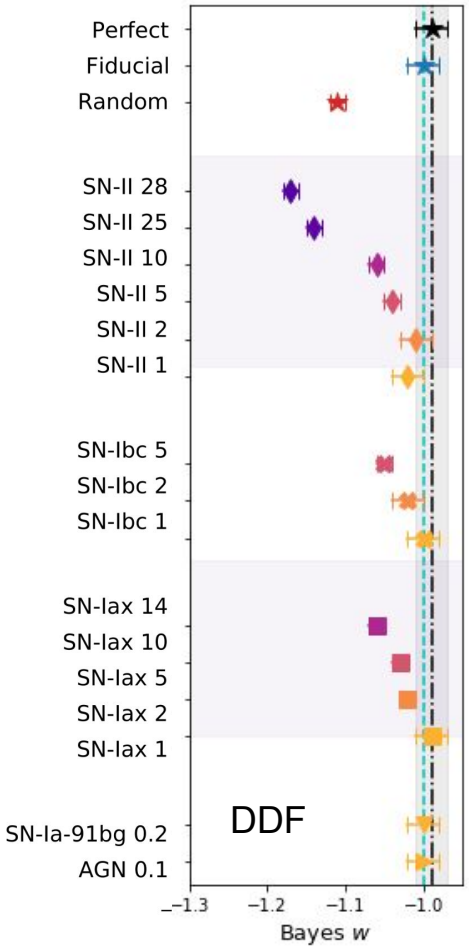
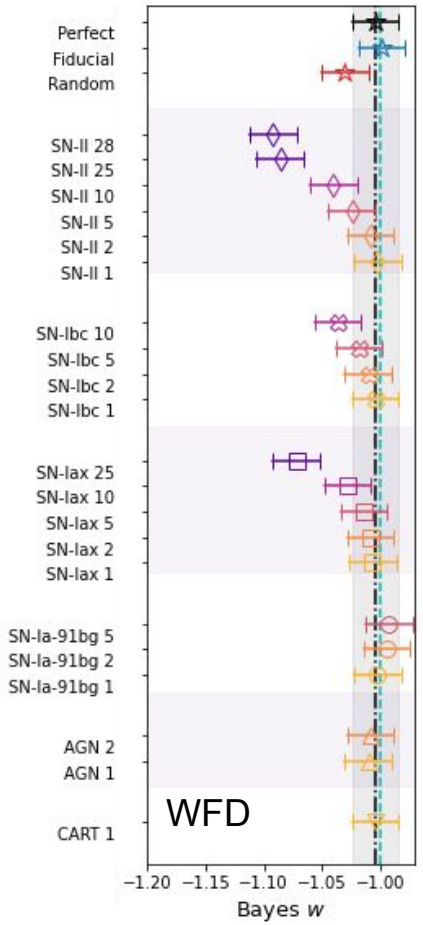


Fiducial corresponds to Avocado classification results

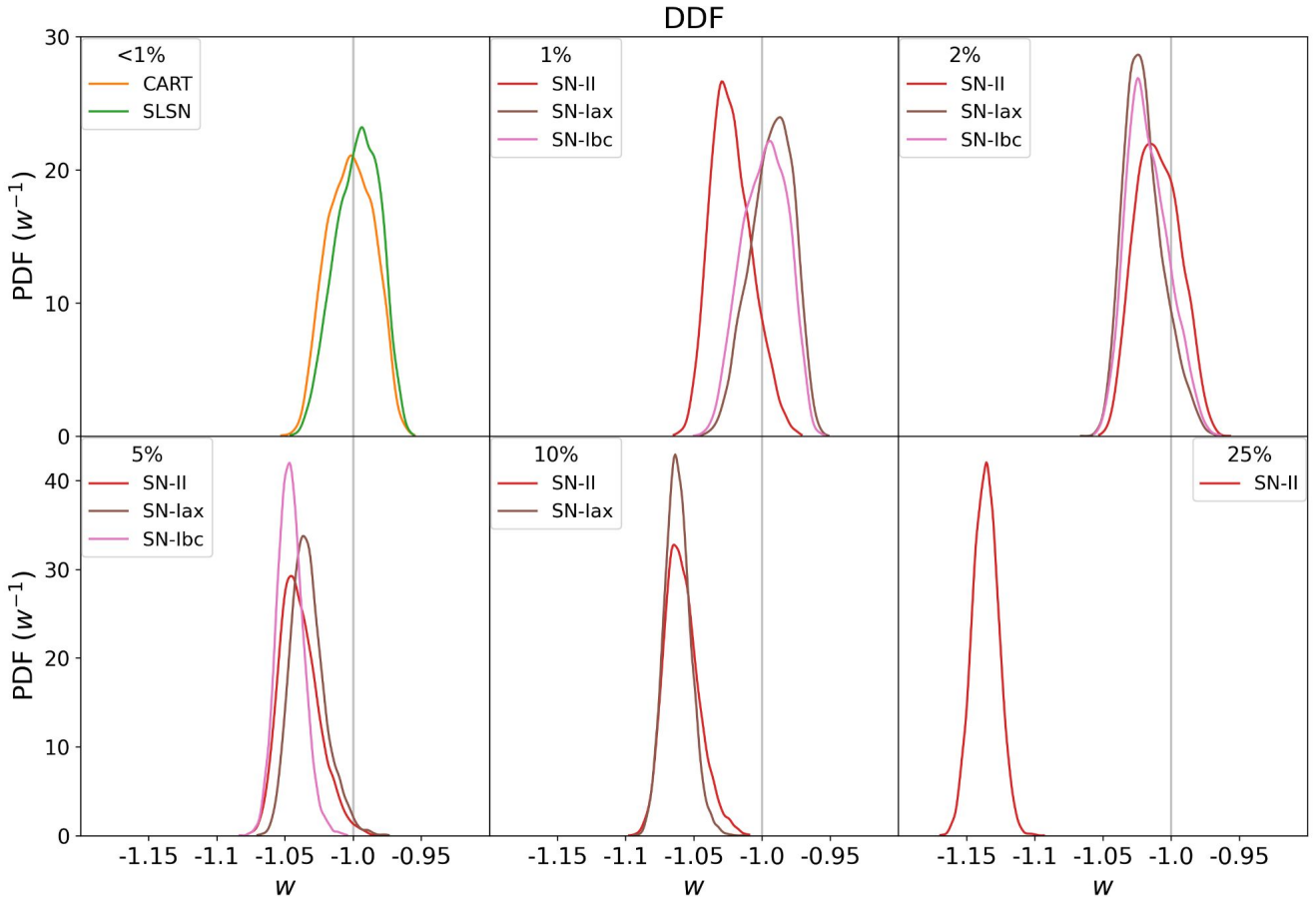


Currently under internal review in DESC and COIN

Spin-off project

Are classification metrics good proxies for SN Ia cosmological constraining power?

By Alex Malz, Mi Dai and the RESSPECT team



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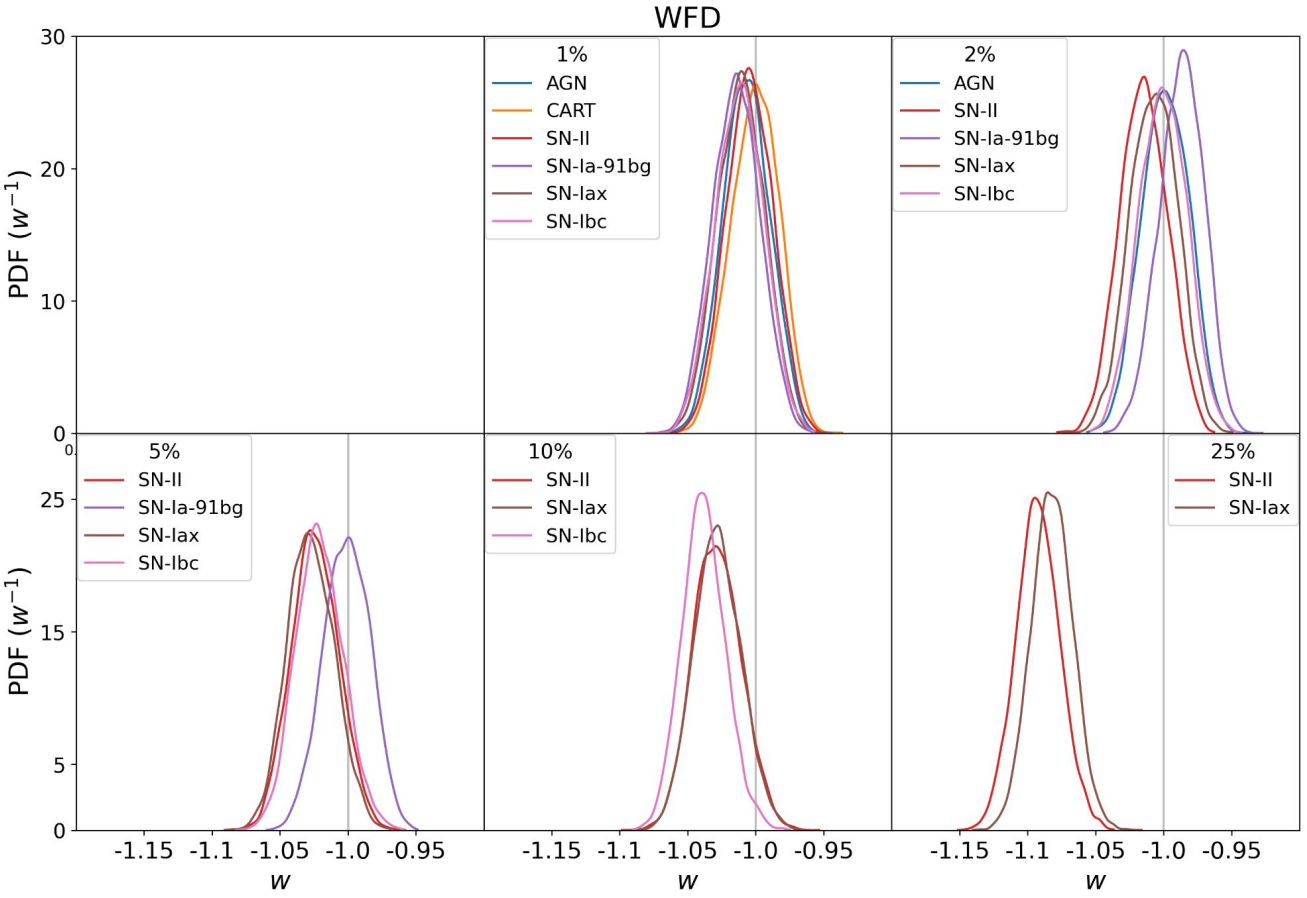

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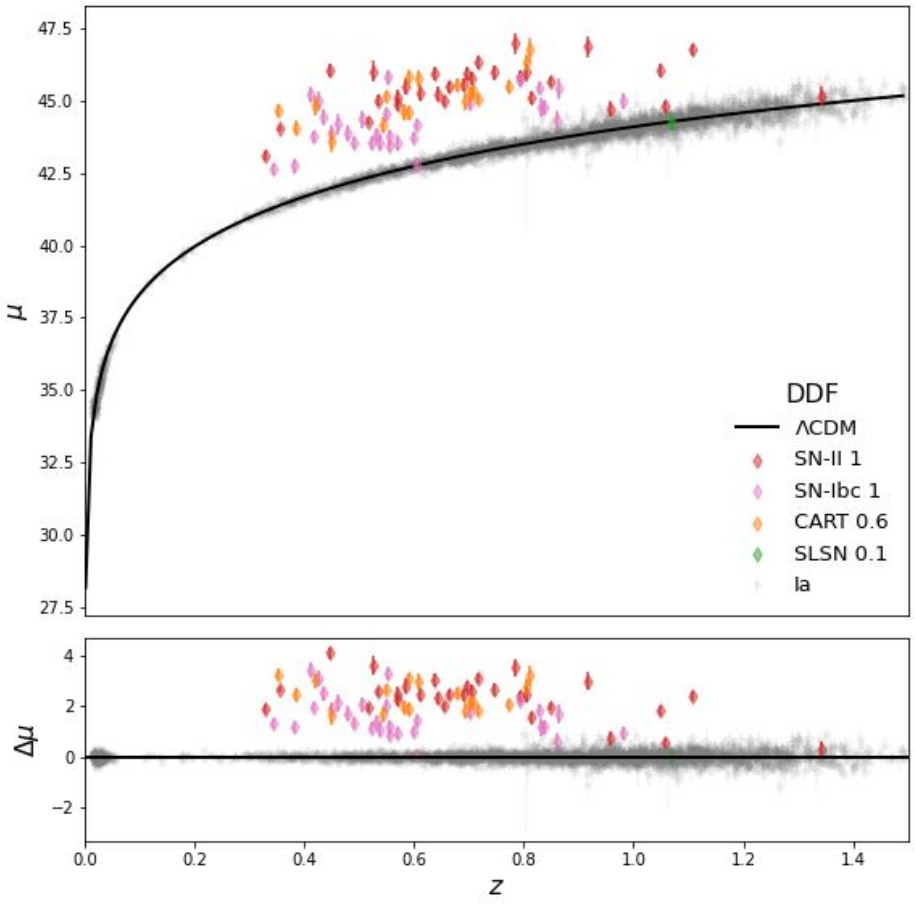

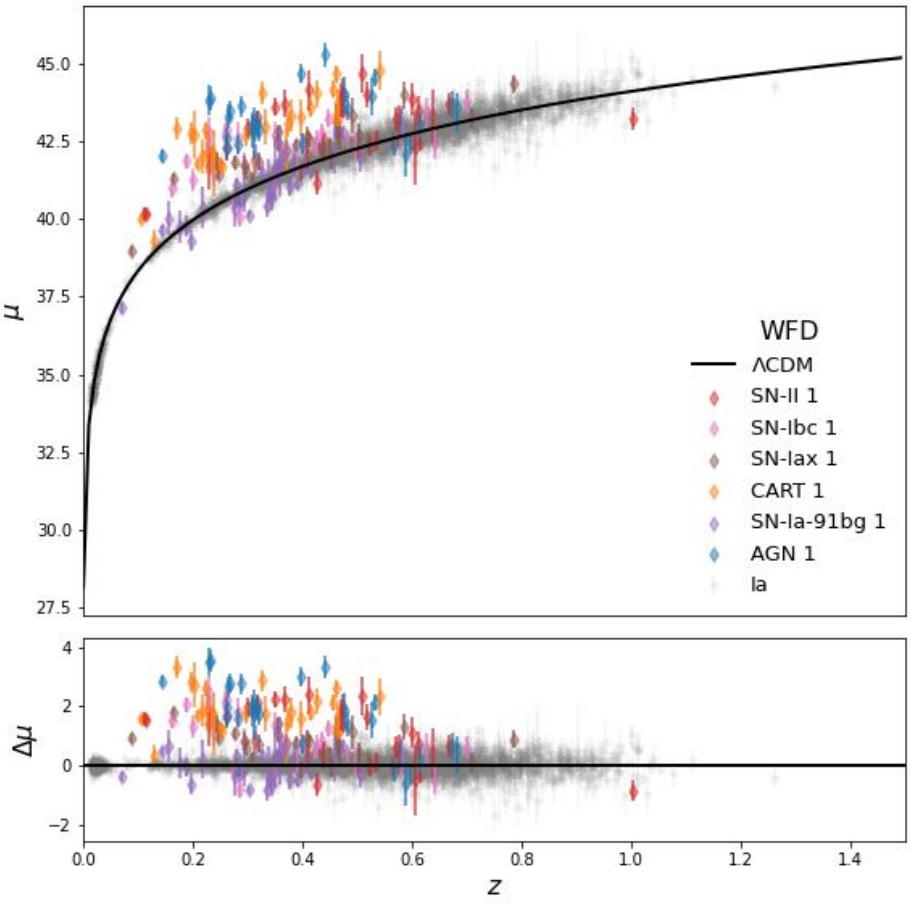

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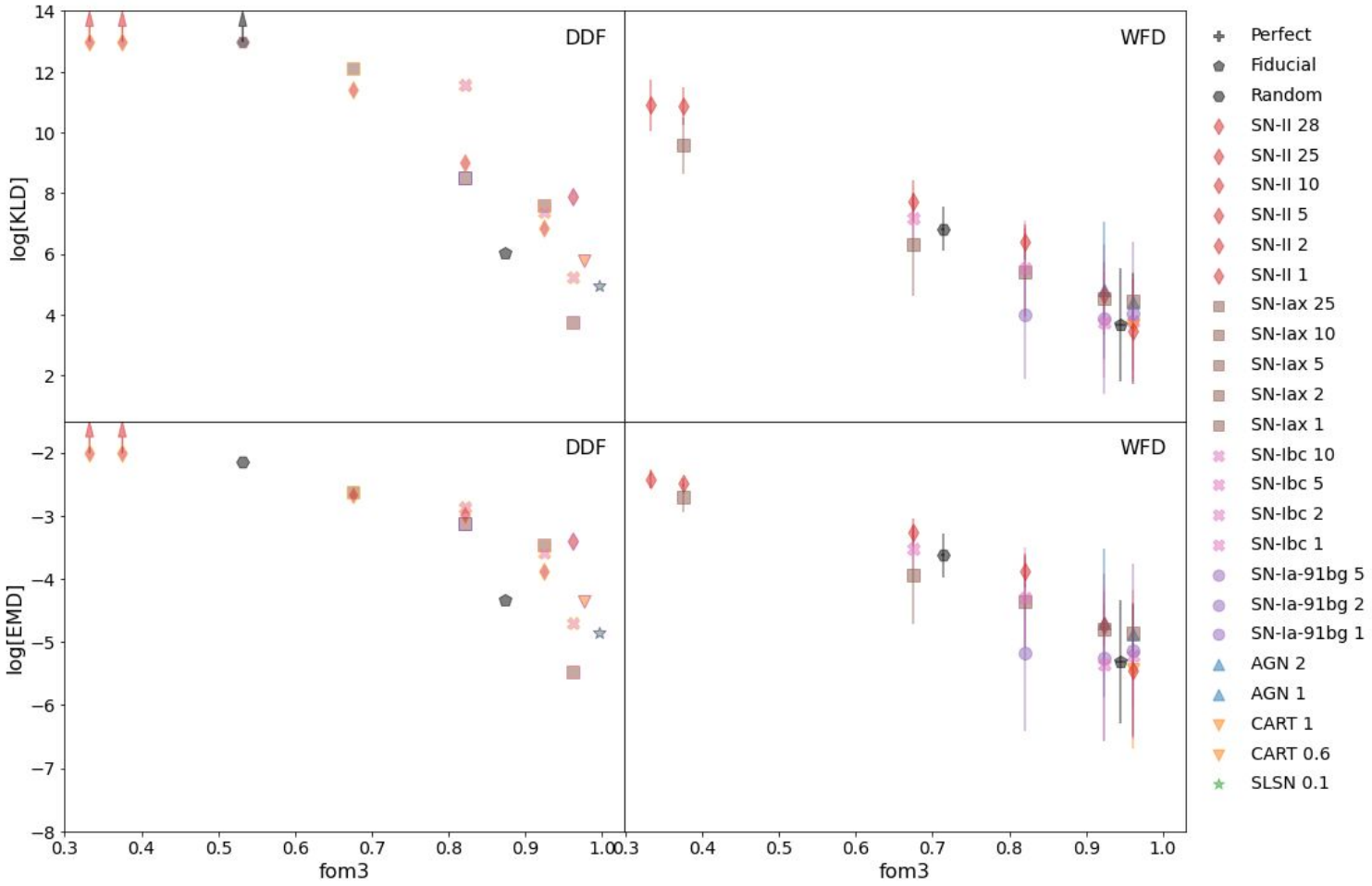
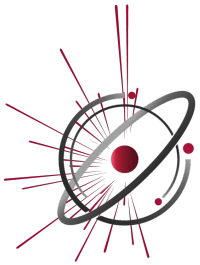


Next steps

- Posterior based metrics for RESSPECT loop
- Cosmology metric and the AL pipeline are now being integrated
- Track the evolution of metrics within active learning loops
- Implement a more flexible telescope time availability
- Metrics paper almost ready for resubmission
- Write the paper and documentation for the pipeline

Alex Malz aimalz@astro.ruhr-uni-bochum.de
Mi Dai: mi.dai@jhu.edu
Emille Ishida: emille.ishida@clermont.in2p3.fr



LSST DESC & COIN
RESSPECT
Recommendation System for Spectroscopic Follow-up

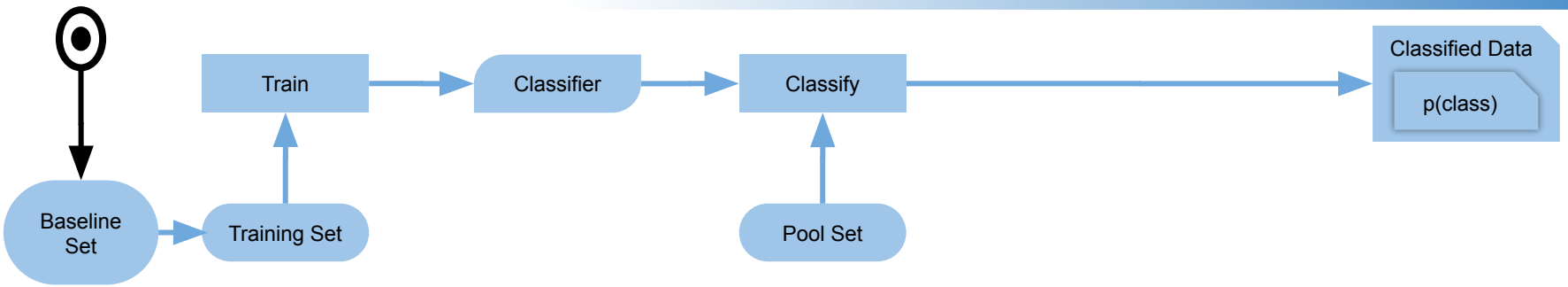
SALT2 fit

class	DDF	DDF %	WFD	WFD %
Ia	9621	85.6	999 789	91.3
II	1028	9.1	72319	6.6
Iax	362	3.2	8993	0.8
Ibc	196	1.7	11603	1.1
CART	19	0.2	1136	0.1
AGN	1	< 0.1	146	< 0.1
91bg	4	< 0.1	308	< 0.1
SLSN	4	< 0.1	503	< 0.01
TDE	1	< 0.1	–	–
PISN	–	–	9	< 0.1
ILOT	–	–	22	< 0.1
KN	–	–	1	< 0.1
Total	11 236	100	1 094 829	100

Table 1. The populations of light curves in each field that survive a SALT2 fit.

Malz et al. (the RESSPECT team), *Are classification metrics good proxies for SN Ia cosmological constraining power?*, under internal review

Machine Learning



Legend

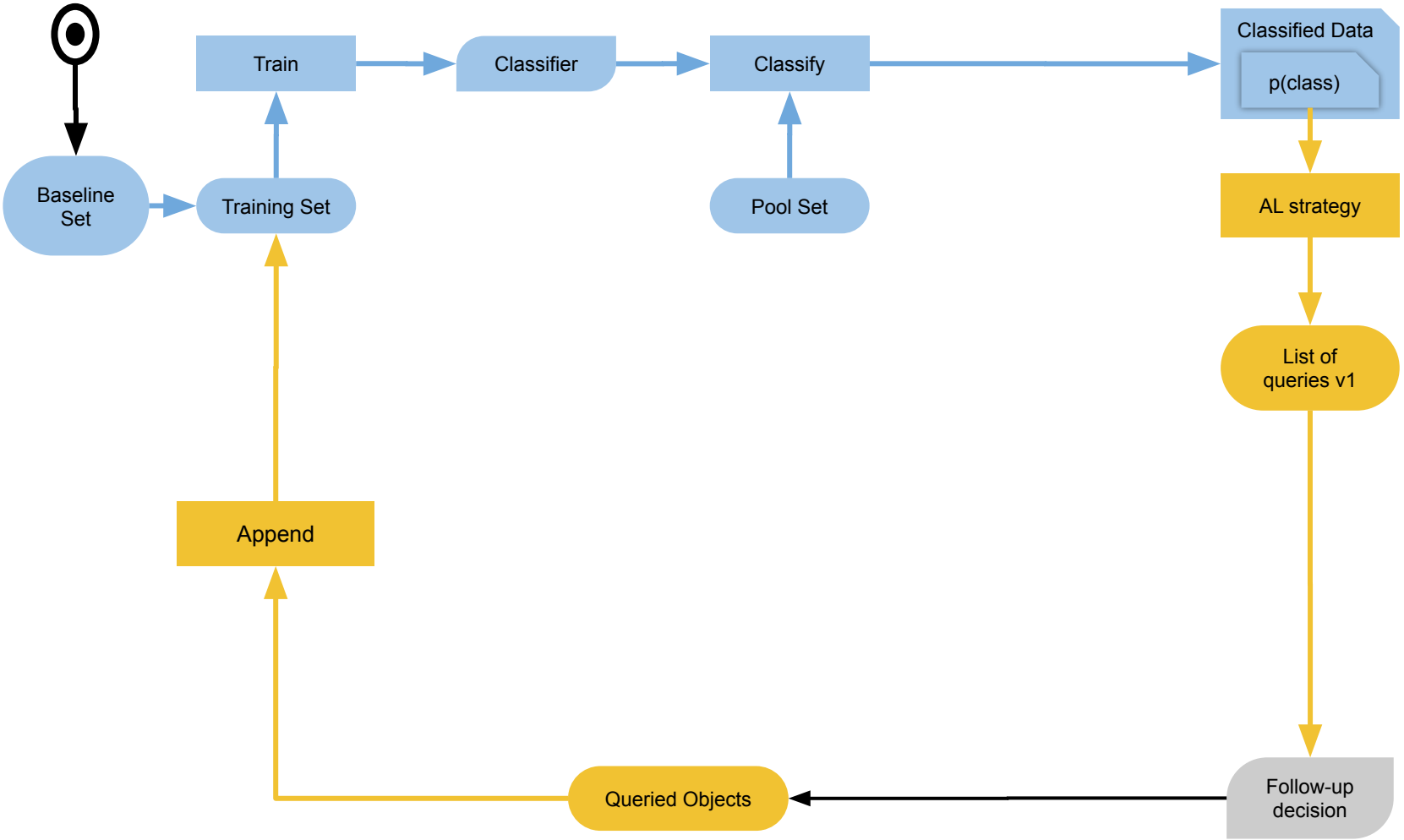
Machine Learning

Active Learning

External factor

Cosmological Feedback

Active Learning



Legend

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Cosmological Feedback

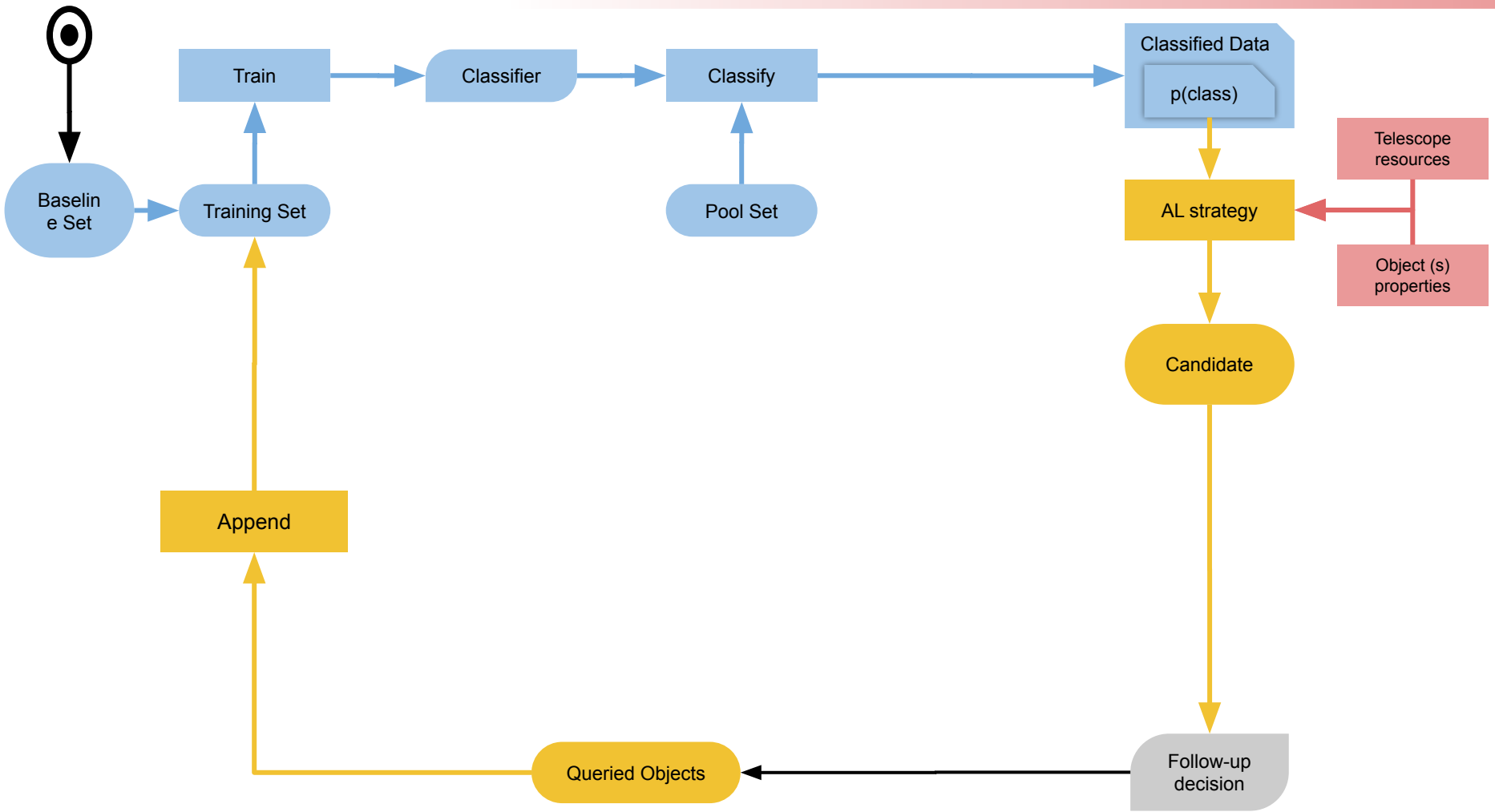
Datasets

Process

Models

Products

External Factors



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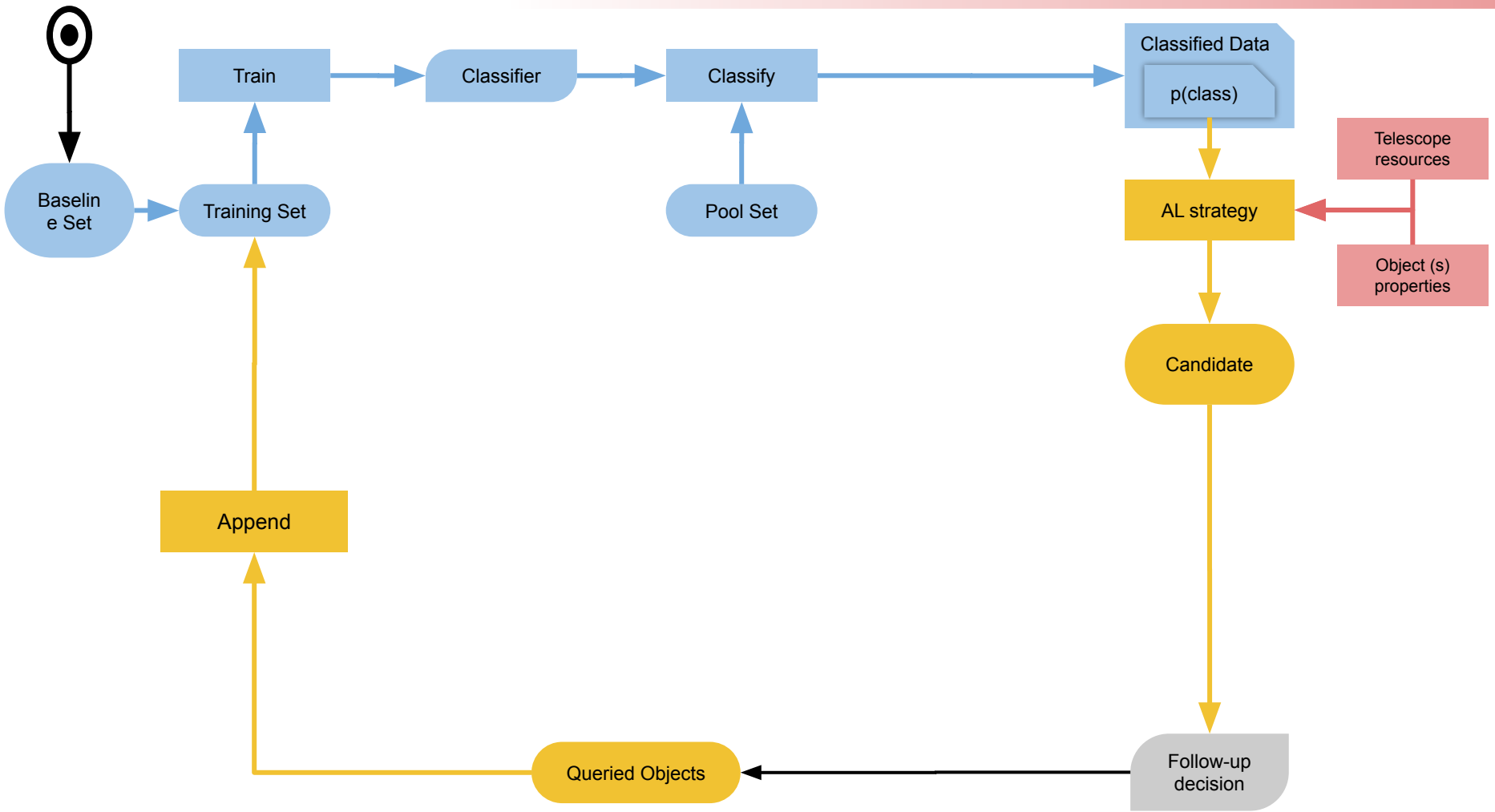

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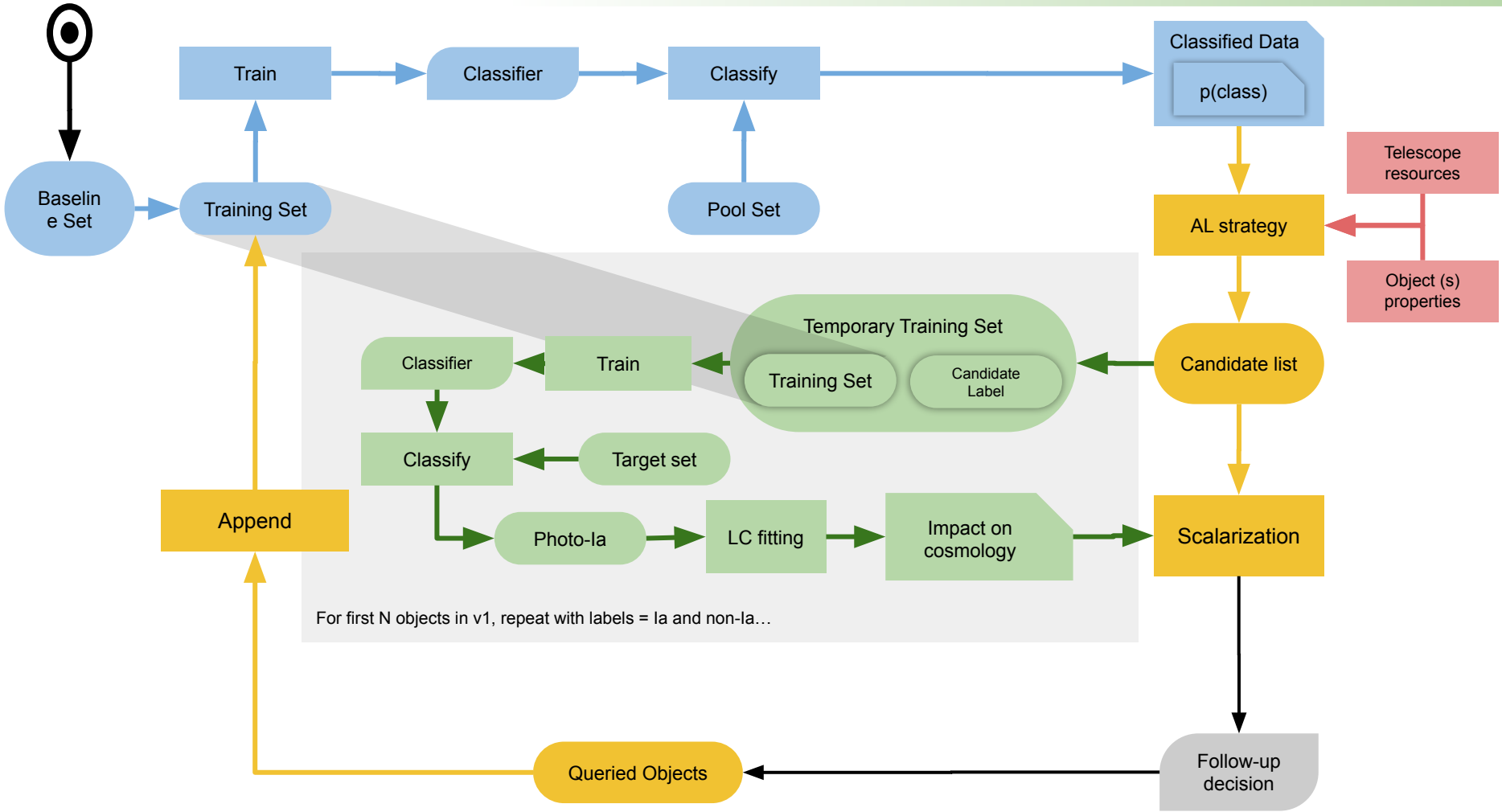

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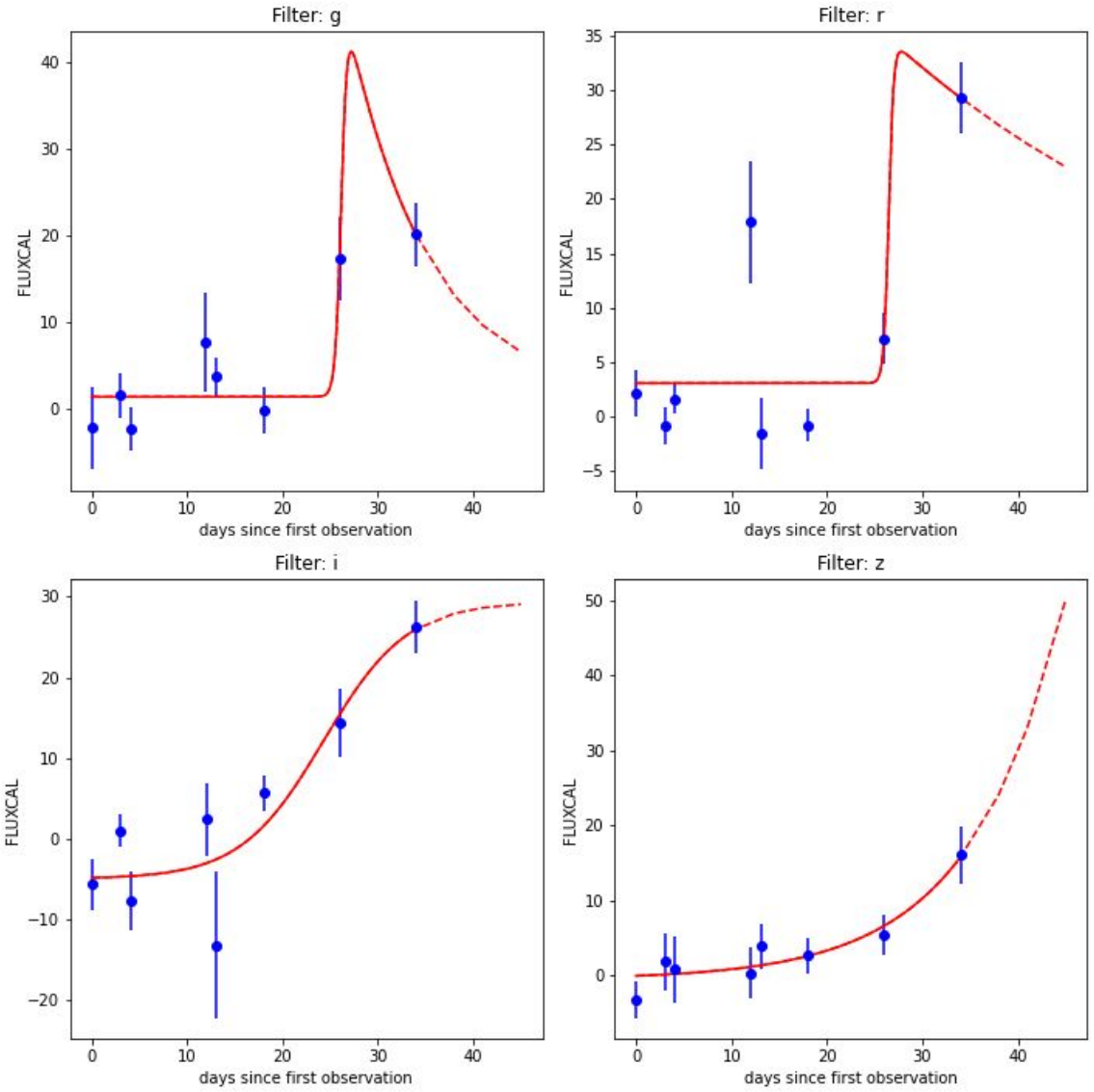
Magnitude today needed for cost calculation

Included extrapolation Given Bazin Fit.

This is flux, We need mag

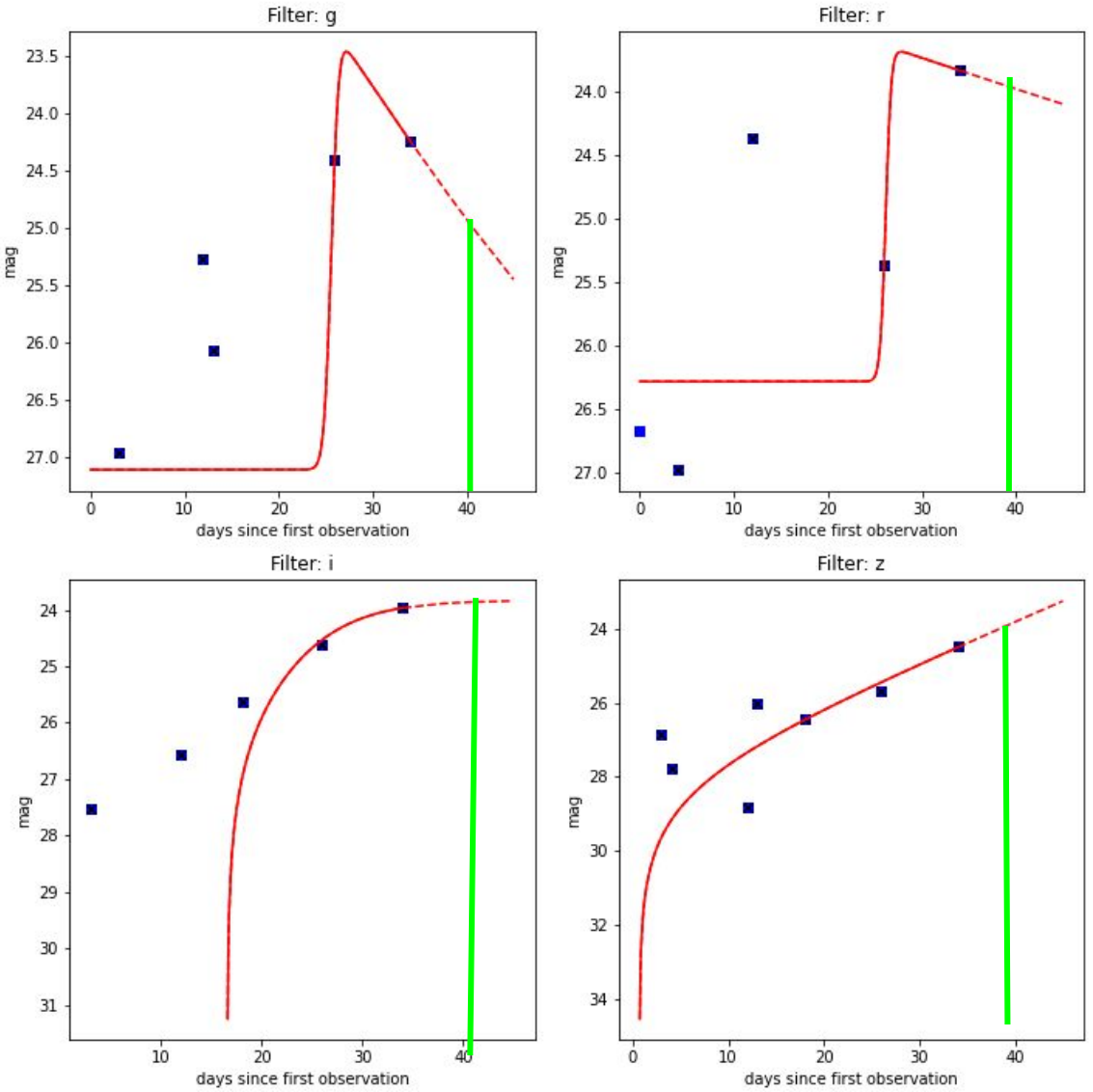
$$f(t) = A\frac{e^{-(t-t_0)/\tau_f}}{1+e^{(t-t_0)/\tau_r}} + B,$$



Magnitude today needed for cost calculation

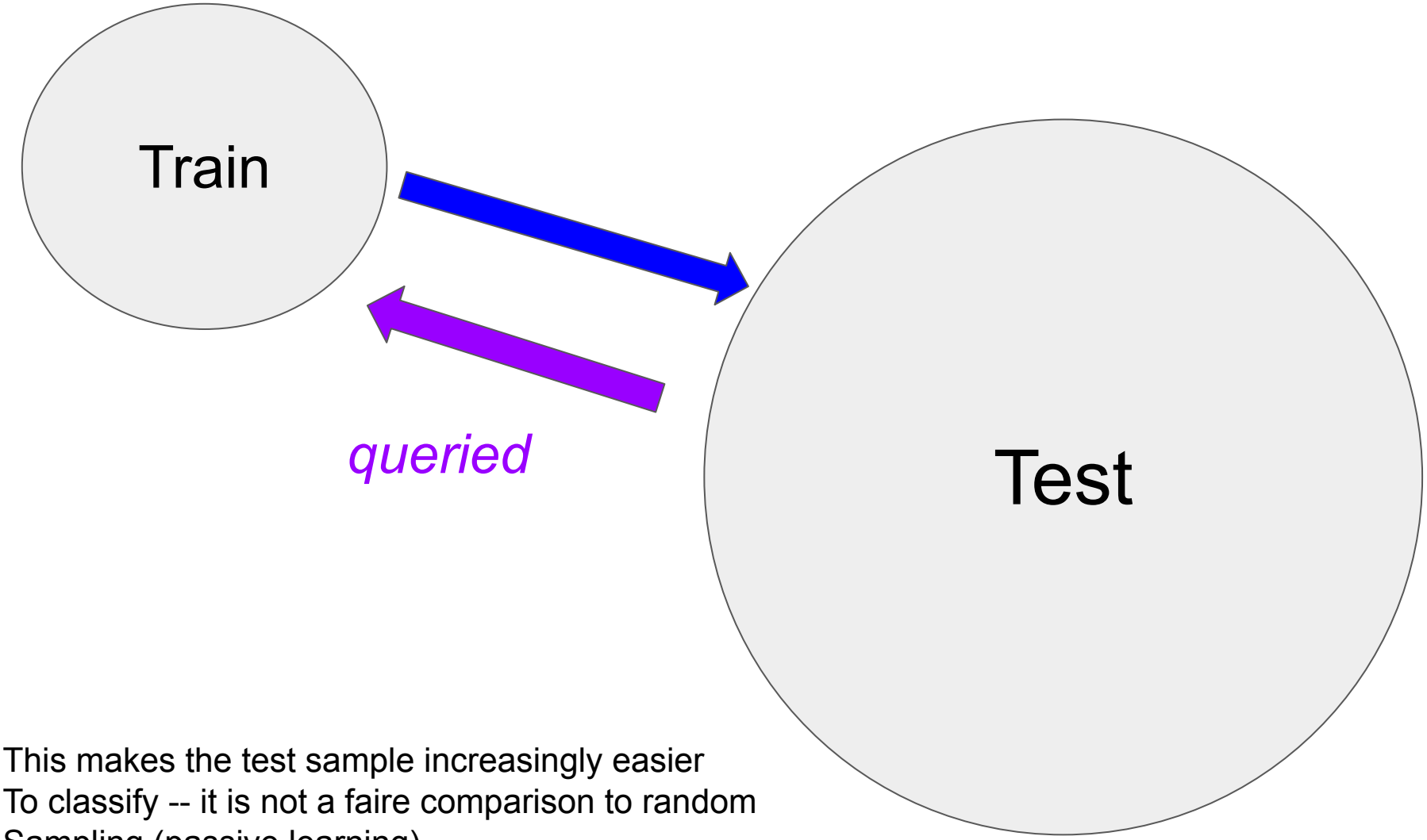
Extrapolation
In mag is now included
In the pipeline

So we get the estimated
Mag today
Given the Bazin fit ...



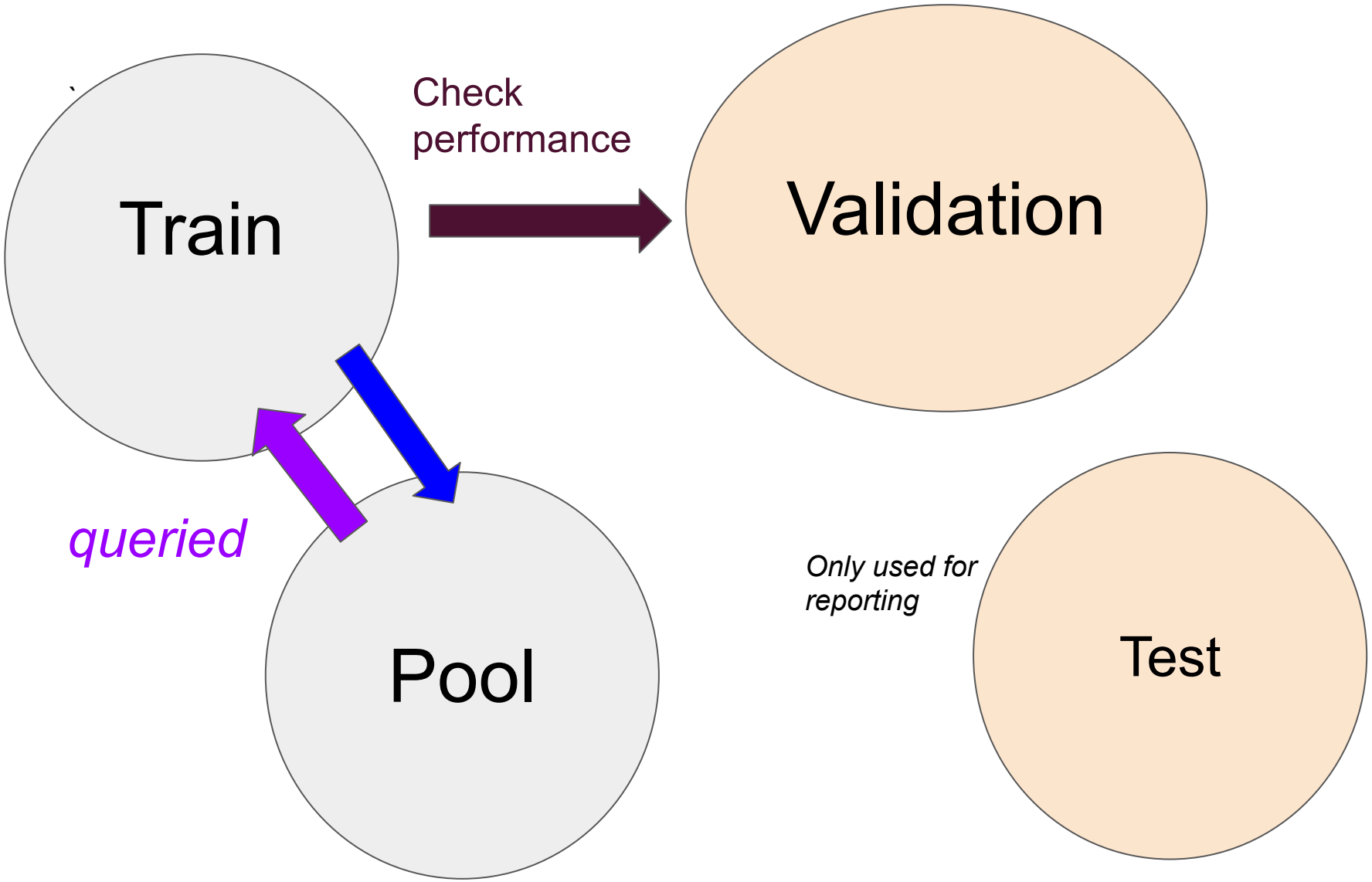
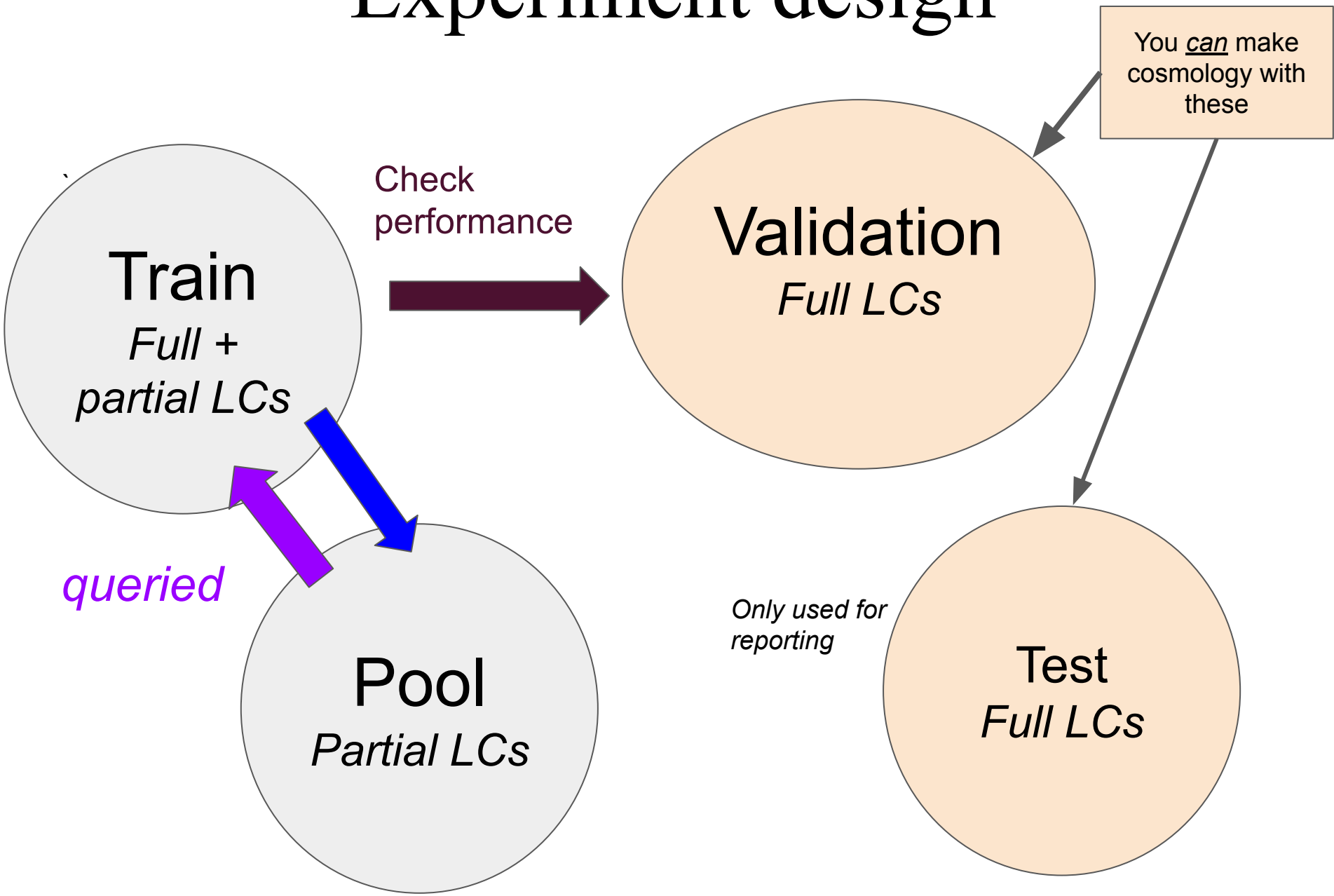
Traditionally …

Experiment design



This makes the test sample increasingly easier
To classify -- it is not a faire comparison to random
Sampling (passive learning)

Experiment design



Experiment design