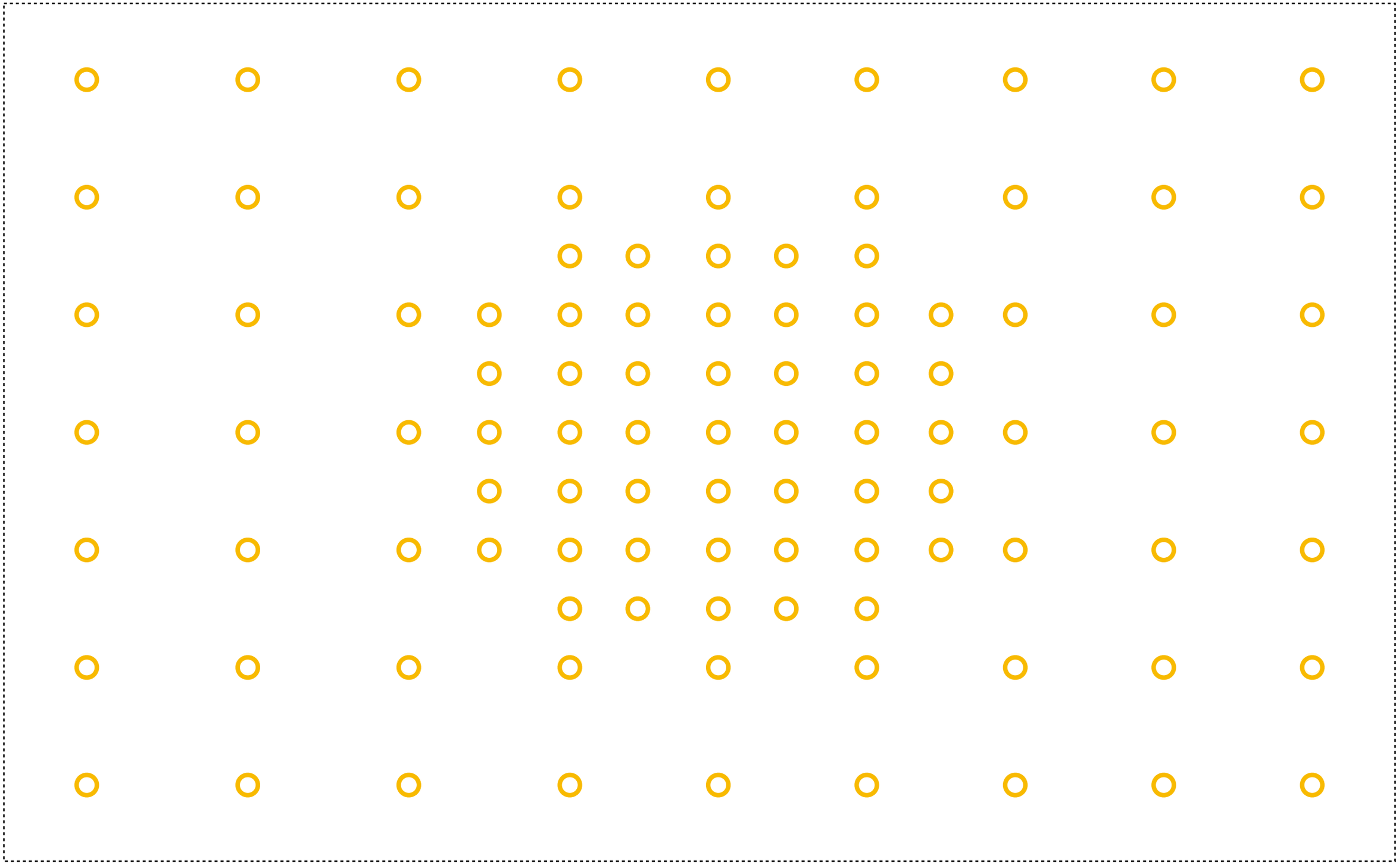
Sensor Location Optimisation using Gaussian Processes

A Graphical Overview



V : All Points

V : All Points

A : Sensors

V : All Points

A : Sensors

y : Sensor candidate

V : All Points

A : Sensors

y : Sensor candidate

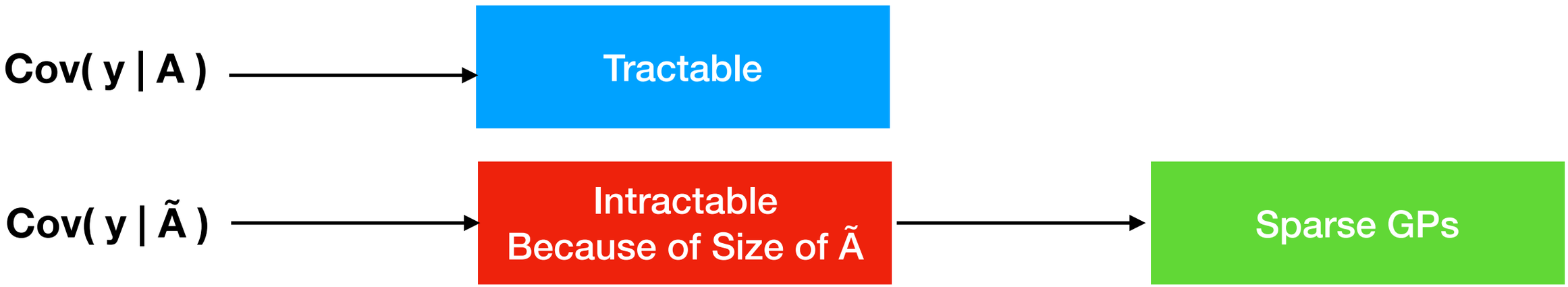
Ã : Rest of the locations

Gain in Mutual Information :

MI(A + y) - MI(A) = H(y | A) - H(y |Ã)

=> Cov(y | A) / Cov(y | Ã)

Cov(y | A) and Cov(y | Ã) are obtained via GPs



Sparse GPs

U : Pseudo-Points for Training of the GP

What is the set In which they should be selected ?

Ã

Problem : depends of A and y.

Re-optimize the Sparse GP for each prediction

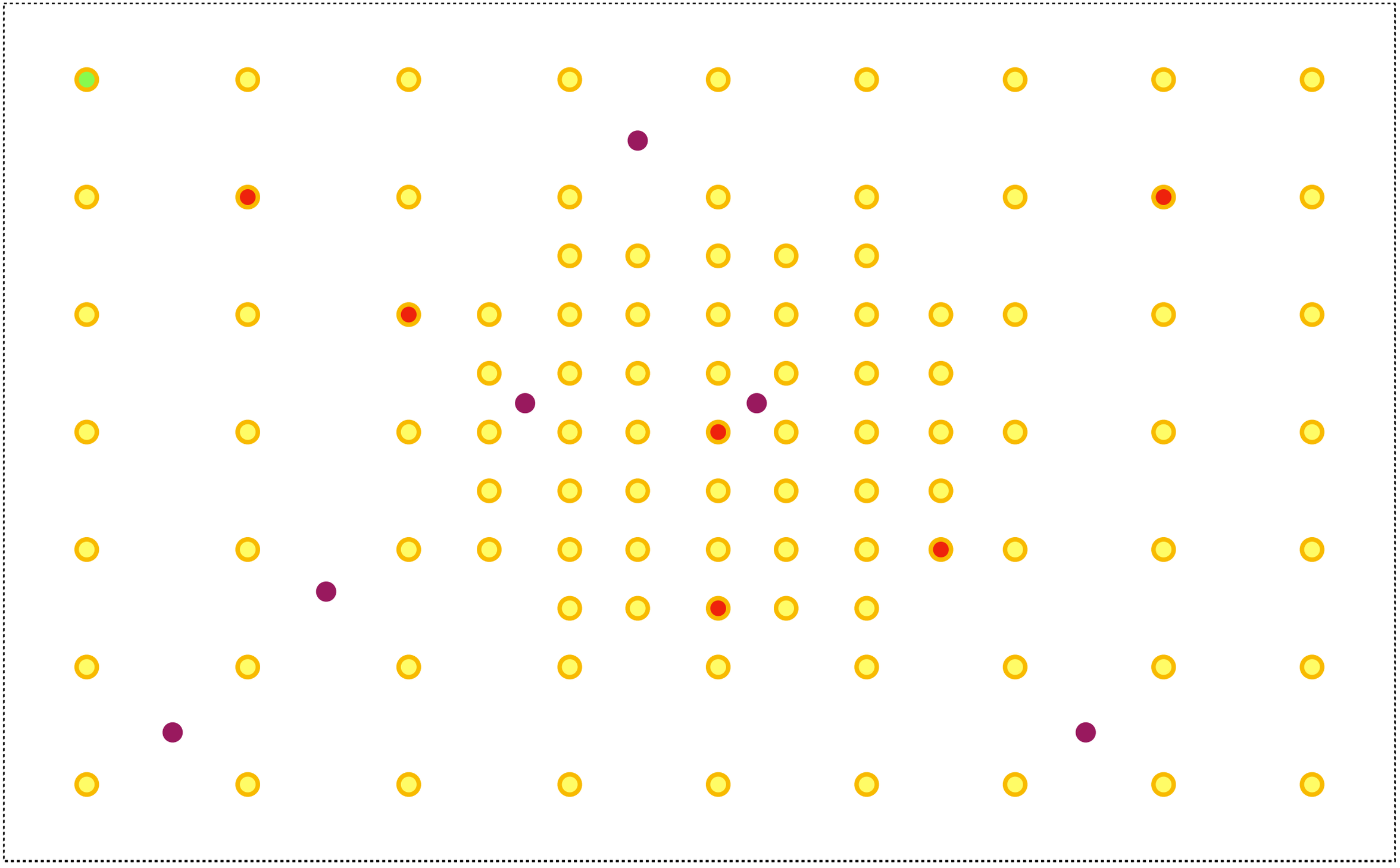
Too Expensive

Remove the points U from the set of potential sensors S

Those points might be the optimal sensor positions

Create new points outside of U

It’s fine ! Because the Algorithm naturally does that initially



V : All Points

A : Sensors

y : Sensor candidate

Ã : Rest of the locations

U : Pseudo Inputs for Sparse P representation of Ã

Small Scale	Medium Scale	Full Scale
• Numpy and GPy give consistent results	• Using Isotropic/ Stationary Kernels. (numpy and GPy)	• Using Isotropic/ Stationary Kernels. (numpy and GPy)

Roadmap Sensors GP Project

Initialisation

- Import VTK
- Create Subsets
- Preprocessing
- Saving Temp

Modeling

Full GPs
- Using numpy
- Using GPy

Sparse GPs
- Using GPy. VFE approach of Titsias (2009)

Covariance
- Using Isotropic/ Stationary Kernels. (numpy and GPy)

Non-Stationary Covariance
- Using Isotropic/ Stationary Kernels. (numpy and GPy)

Training
- Using Isotropic/ Stationary Kernels. (numpy and GPy)

Evaluation
- Using Isotropic/ Stationary Kernels. (numpy and GPy)

Optimisation

Naive Algorithm
- Using numpy
- Using GPy

Lazy Algorithm
- Using numpy
- Using GPy

Small Scale
- Numpy and GPy give consistent results

Medium Scale
- Using Isotropic/ Stationary Kernels. (numpy and GPy)

Full Scale
- Using Isotropic/ Stationary Kernels. (numpy and GPy)

Display & Exportation

- Export in VTK
- Create Subsets
- Preprocessing
- Saving Temp

Focus on Covariance Estimation ?

Or Scalable GPs with simpler covariance