Methodological topics
Data-science specifics (part 1)

datalys

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30th October 2019

PeWe@FIIT
personalized web group

Warming-up

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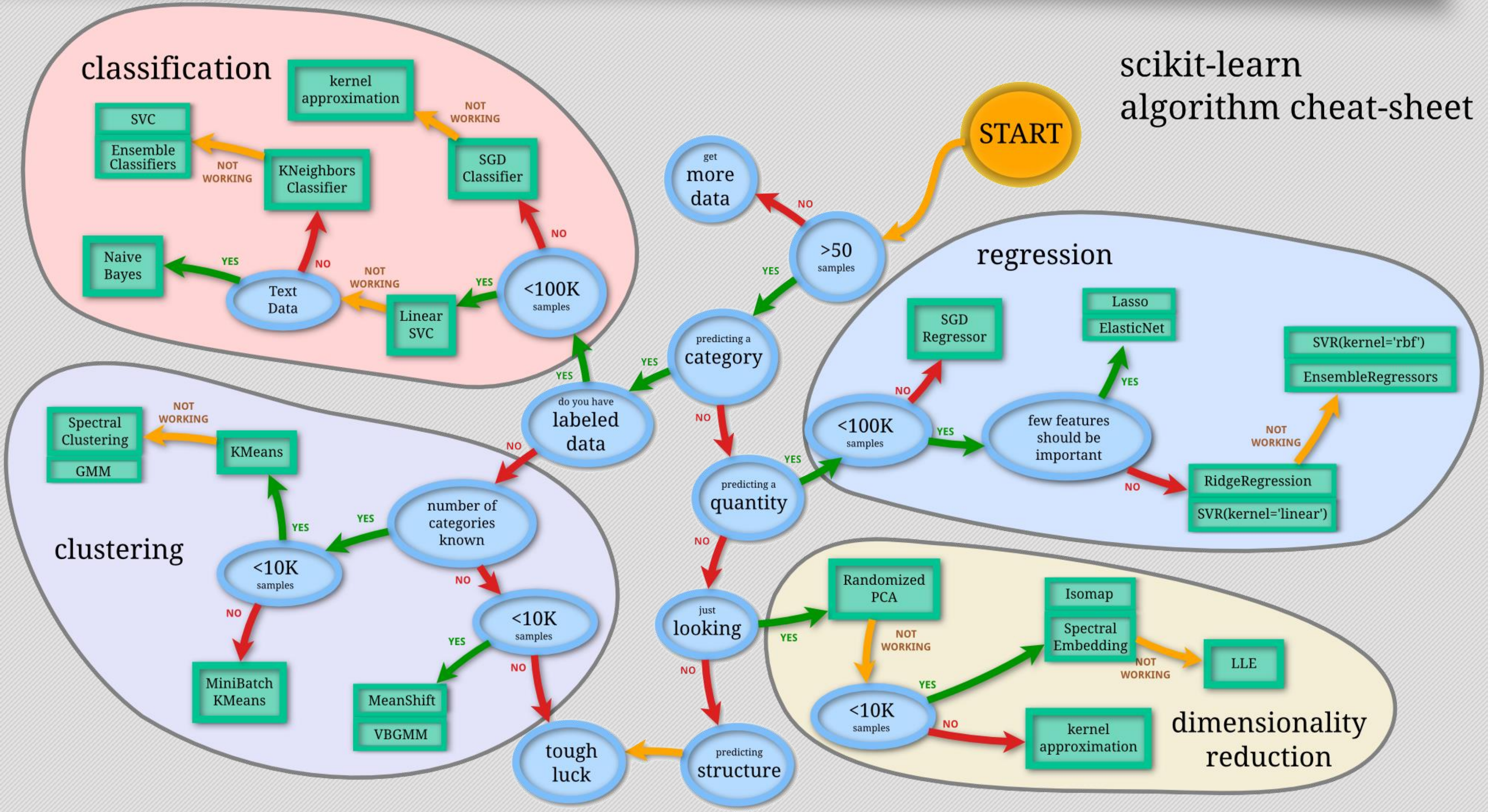
  - Analyze the existing solutions, write notes, compare them
  - Select few most related articles, describe them in very details
  - Pay a strong attention to summary/discussion at the end of analyses’ section

Scikit-learn algorithm cheat-sheet



scikit-learn
algorithm cheat-sheet

START

>50 samples

NO

get more data

YES

predicting a category

YES

do you have labeled data

YES

classification

<100K samples

YES

Linear SVC

NOT WORKING

Text Data

YES

Naive Bayes

NO

KNeighbors Classifier

NOT WORKING

SVC

Ensemble Classifiers

NO

SGD Classifier

NOT WORKING

kernel approximation

NO

clustering

number of categories known

YES

<10K samples

YES

KMeans

NOT WORKING

Spectral Clustering

GMM

NO

MiniBatch KMeans

NO

<10K samples

YES

MeanShift

VBGMM

NO

tough luck

NO

predicting a quantity

YES

regression

<100K samples

NO

SGD Regressor

YES

few features should be important

YES

Lasso

ElasticNet

NO

RidgeRegression

SVR(kernel='linear')

NOT WORKING

SVR(kernel='rbf')

EnsembleRegressors

NO

just looking

YES

dimensionality reduction

Randomized PCA

NOT WORKING

<10K samples

YES

Isomap

Spectral Embedding

NOT WORKING

LLE

NO

kernel approximation

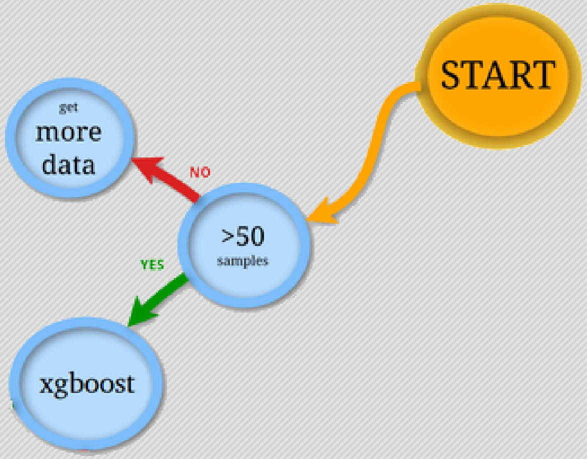
NO

predicting structure

tough luck

http://scikit-learn.org/stable/tutorial/machine_learning_map/

Scikit-learn algorithm cheat-sheet - simplified



scikit-learn
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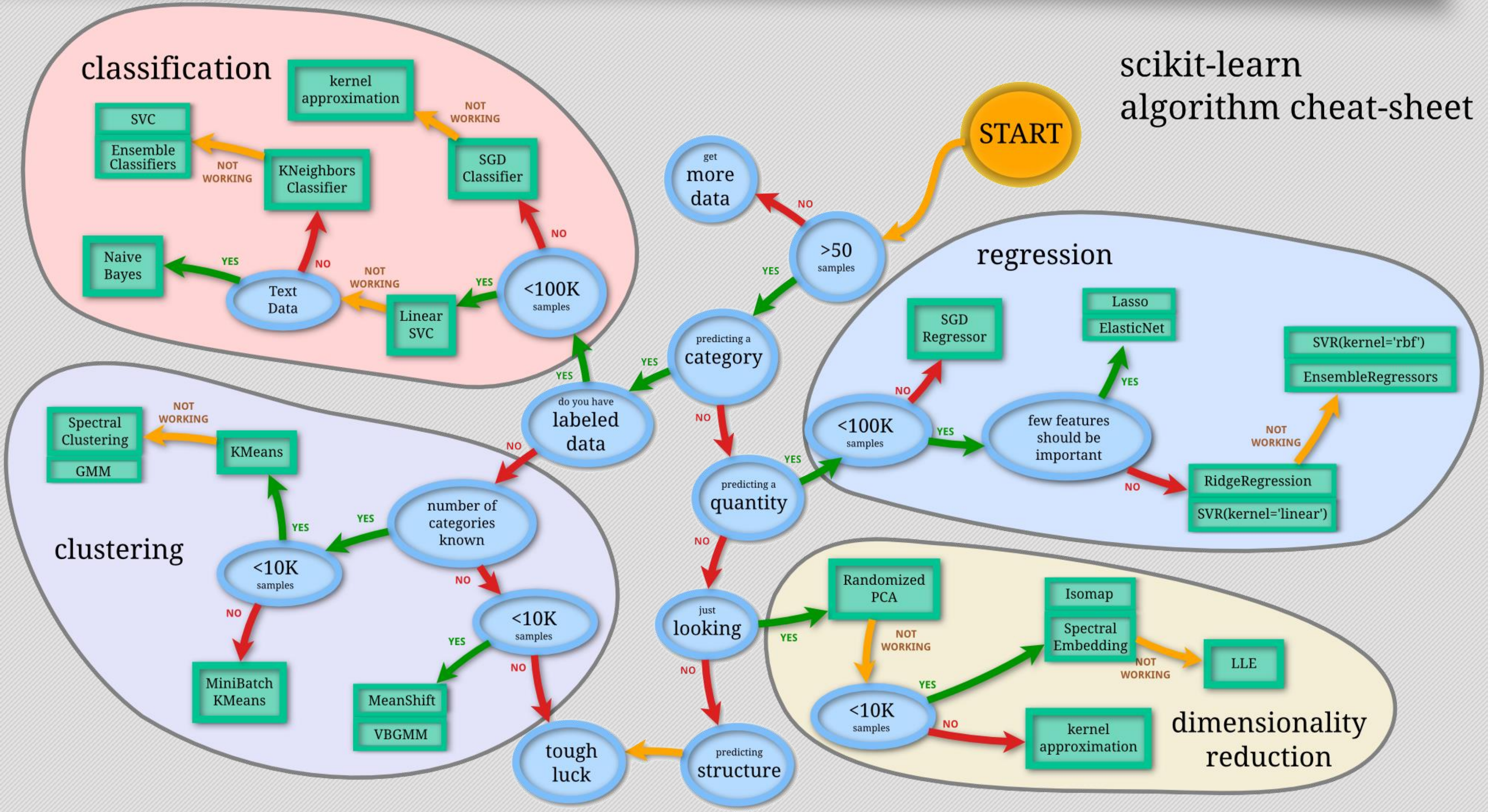
https://twitter.com/bmurr26/status/707103333408833536

Scikit-learn algorithm cheat-sheet



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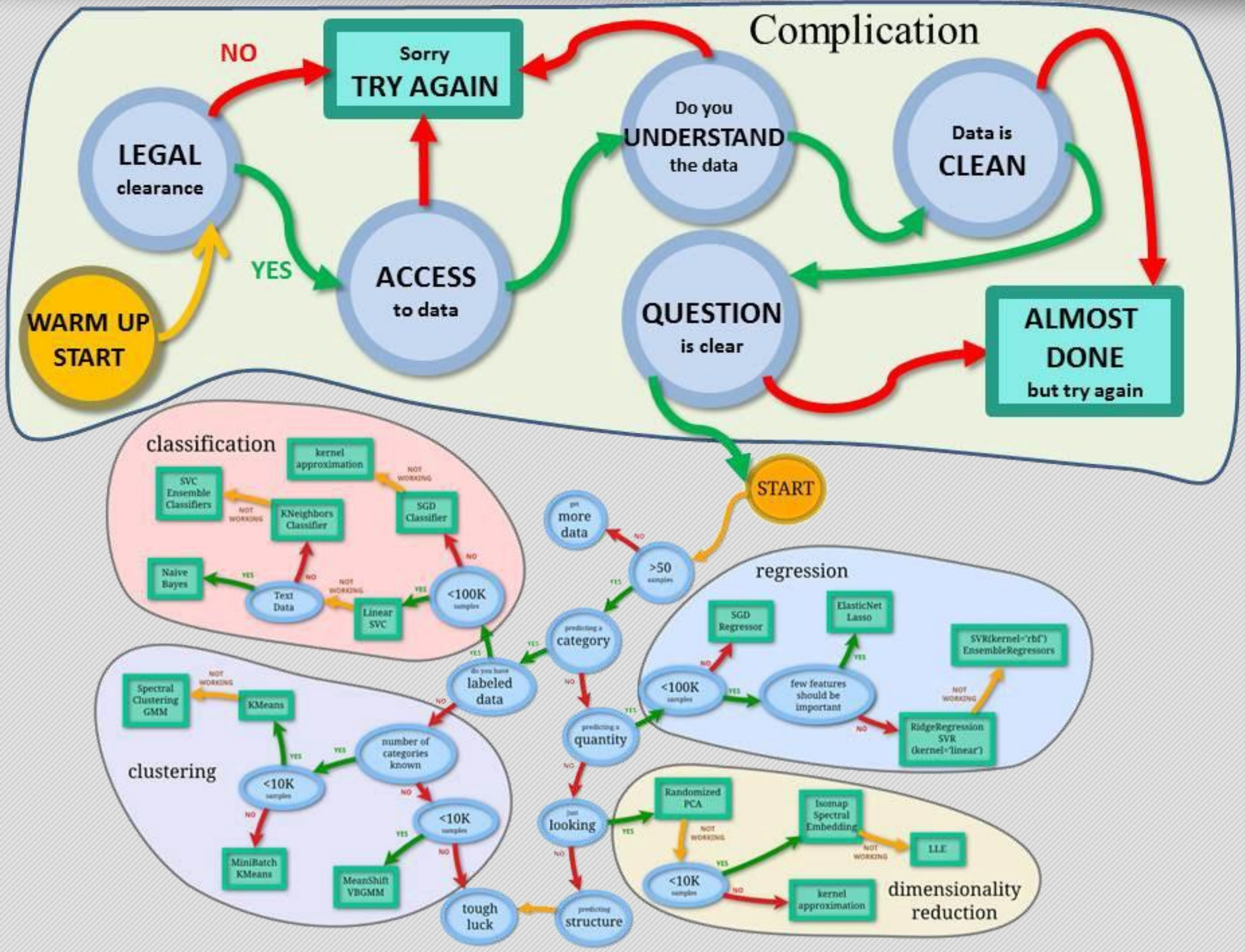
Scikit-learn algorithm cheat-sheet - extended

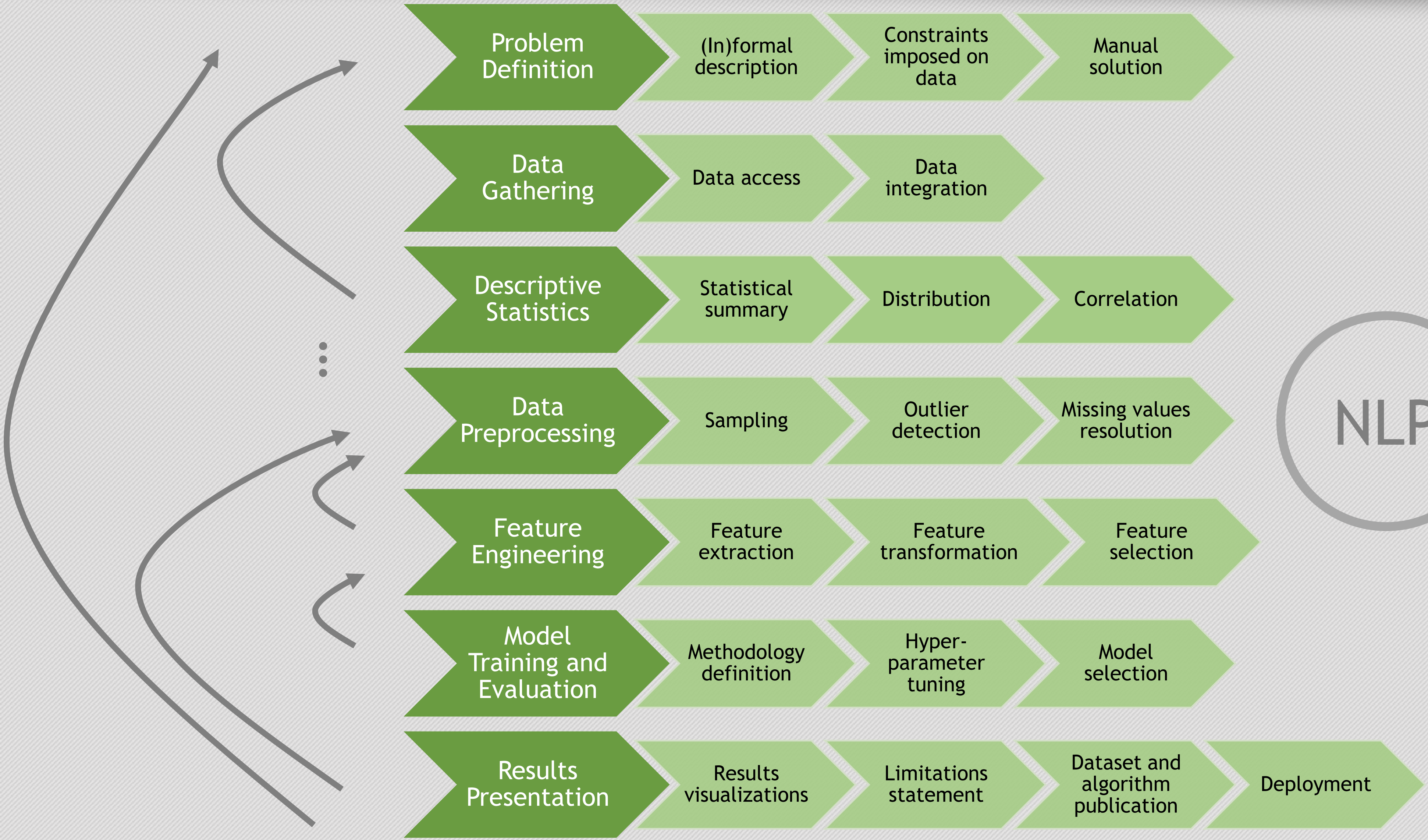


https://medium.com/@chris_bour/an-extended-version-of-the-scikit-learn-cheat-sheet-5f46efc6cbb

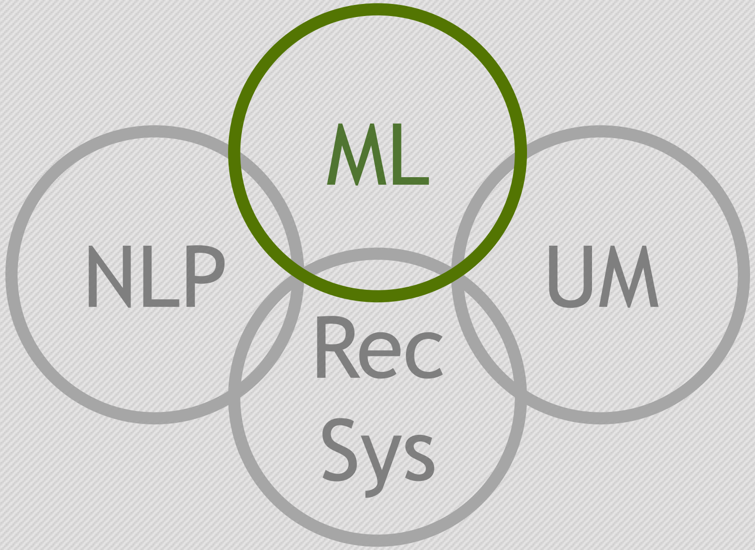
Data-science specific questions…

- … you need to answer before starting work on solution proposal and implementation:
  - How to define data-science (machine learning, …) task?
  - How to select/create appropriate dataset?
  - How to describe your dataset?
  - How to preprocess your dataset?
  - …

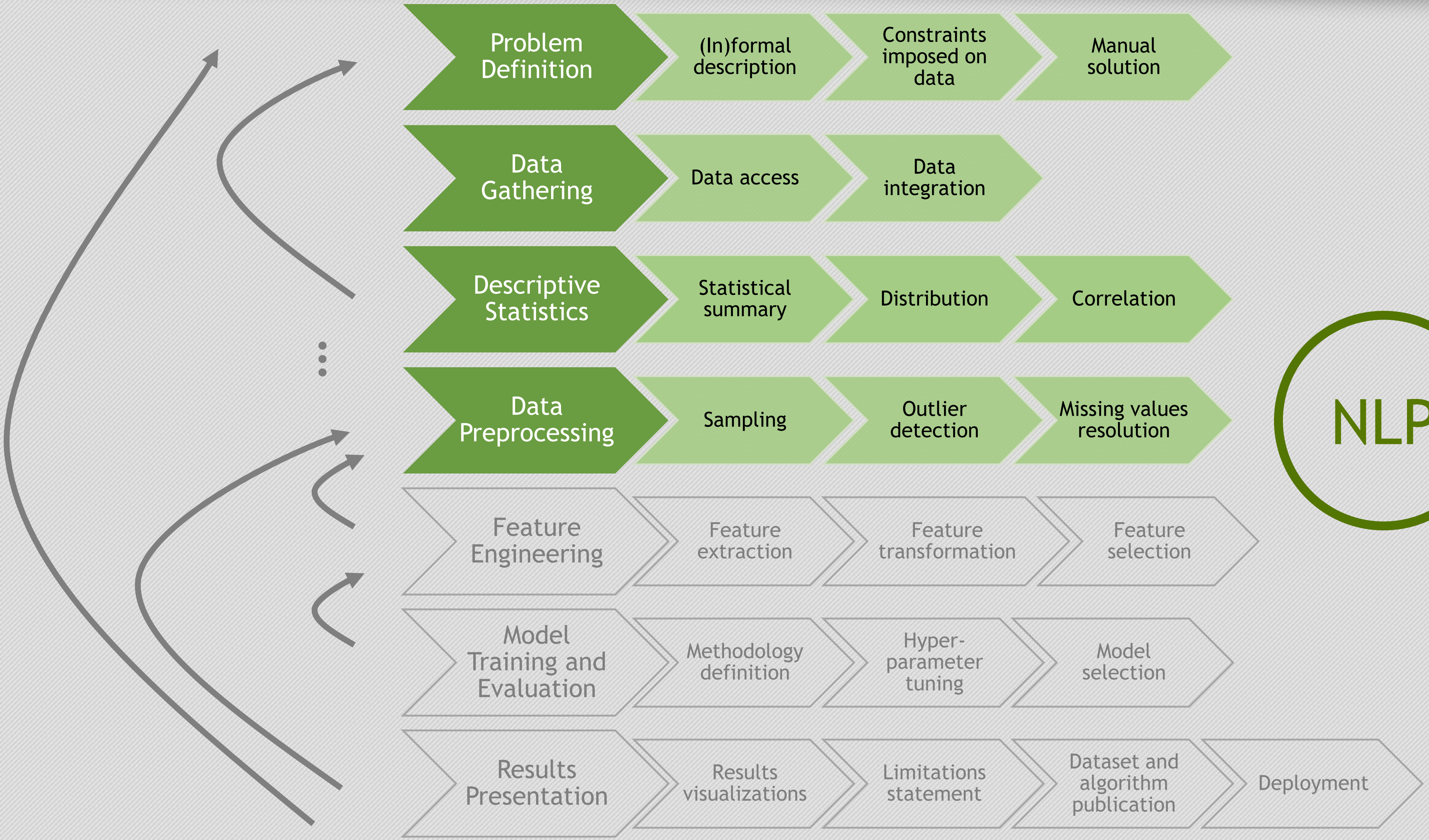
ML Workflow: Overview



- Problem Definition
  - (In)formal description
  - Constraints imposed on data
  - Manual solution
- Data Gathering
  - Data access
  - Data integration
- Descriptive Statistics
  - Statistical summary
  - Distribution
  - Correlation
- Data Preprocessing
  - Sampling
  - Outlier detection
  - Missing values resolution
- Feature Engineering
  - Feature extraction
  - Feature transformation
  - Feature selection
- Model Training and Evaluation
  - Methodology definition
  - Hyper-parameter tuning
  - Model selection
- Results Presentation
  - Results visualizations
  - Limitations statement
  - Dataset and algorithm publication
  - Deployment



ML Workflow: Generic part



- **Problem Definition**: (In)formal description → Constraints imposed on data → Manual solution
- **Data Gathering**: Data access → Data integration
- **Descriptive Statistics**: Statistical summary → Distribution → Correlation
- ⋮
- **Data Preprocessing**: Sampling → Outlier detection → Missing values resolution
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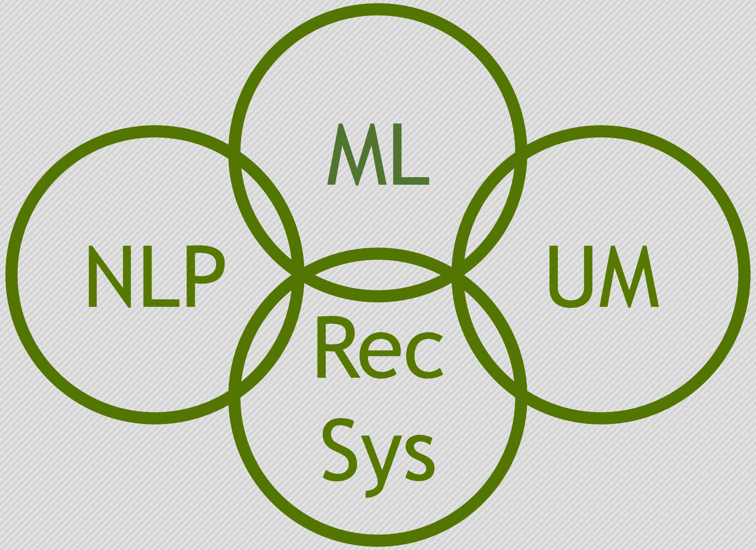
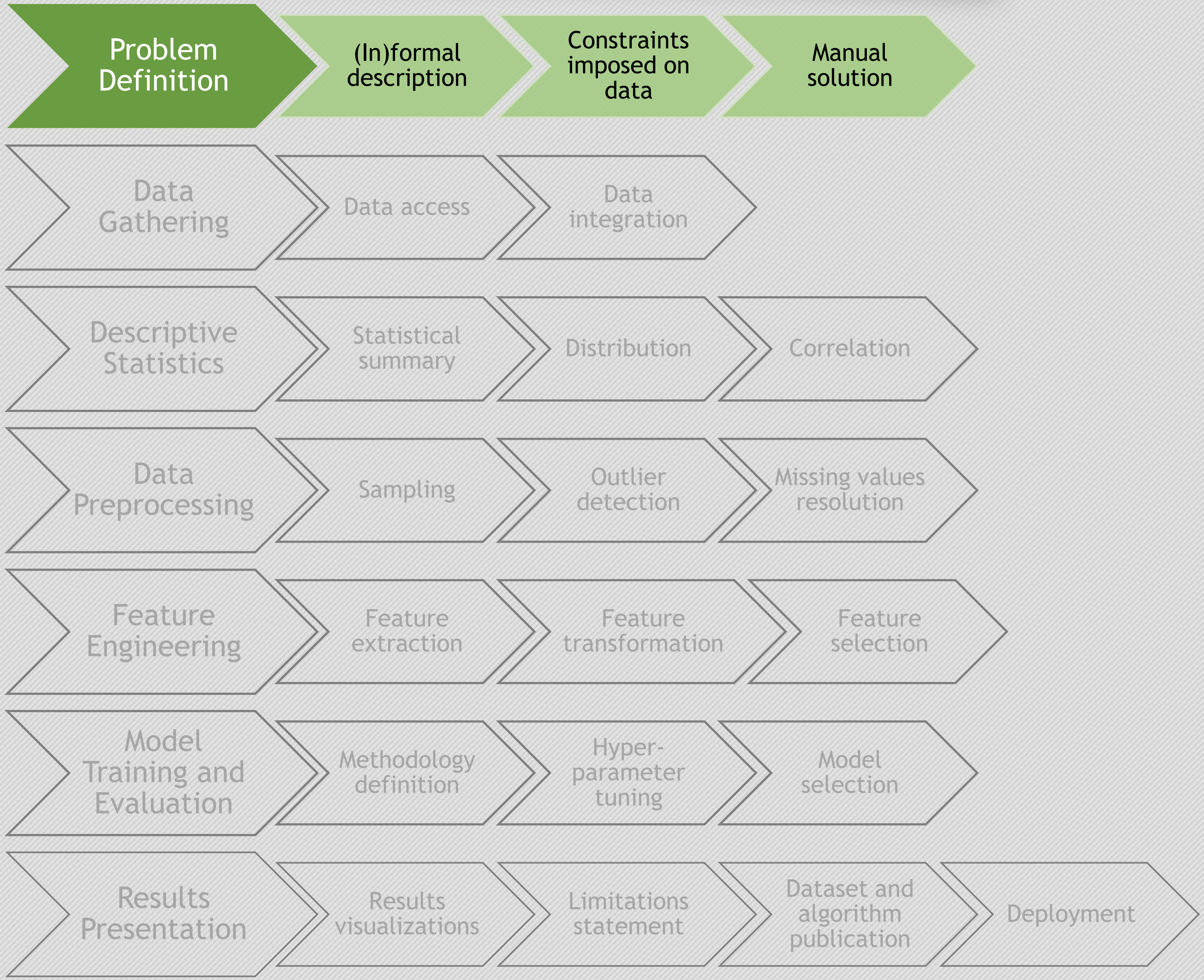


Step 1: Problem Definition

- Clearly identify your problem you are trying to solve
  - Informal description
    - As you would explain it to your friends
    - Refer back to motivation stated in analyses' summary/discussion
  - Formal description
    - As a research question
    - As a hypothesis
    - As a machine learning task



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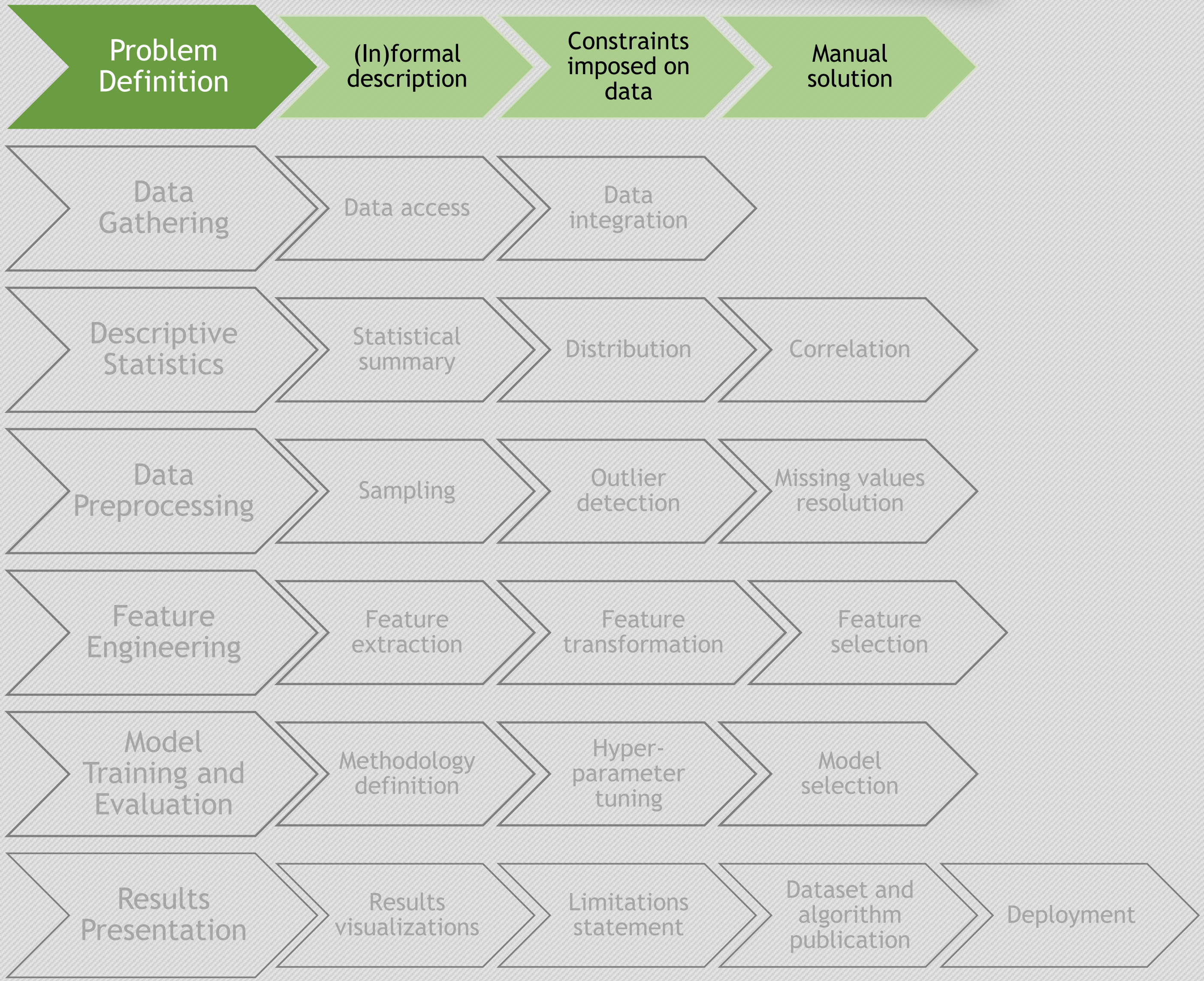
- Identify constraints imposed on required dataset



Problem Definition	(In)formal description	Constraints imposed on data	Manual solution	
Data Gathering	Data access	Data integration		
Descriptive Statistics	Statistical summary	Distribution	Correlation	
Data Preprocessing	Sampling	Outlier detection	Missing values resolution	
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  - Formal description
    - As a research question
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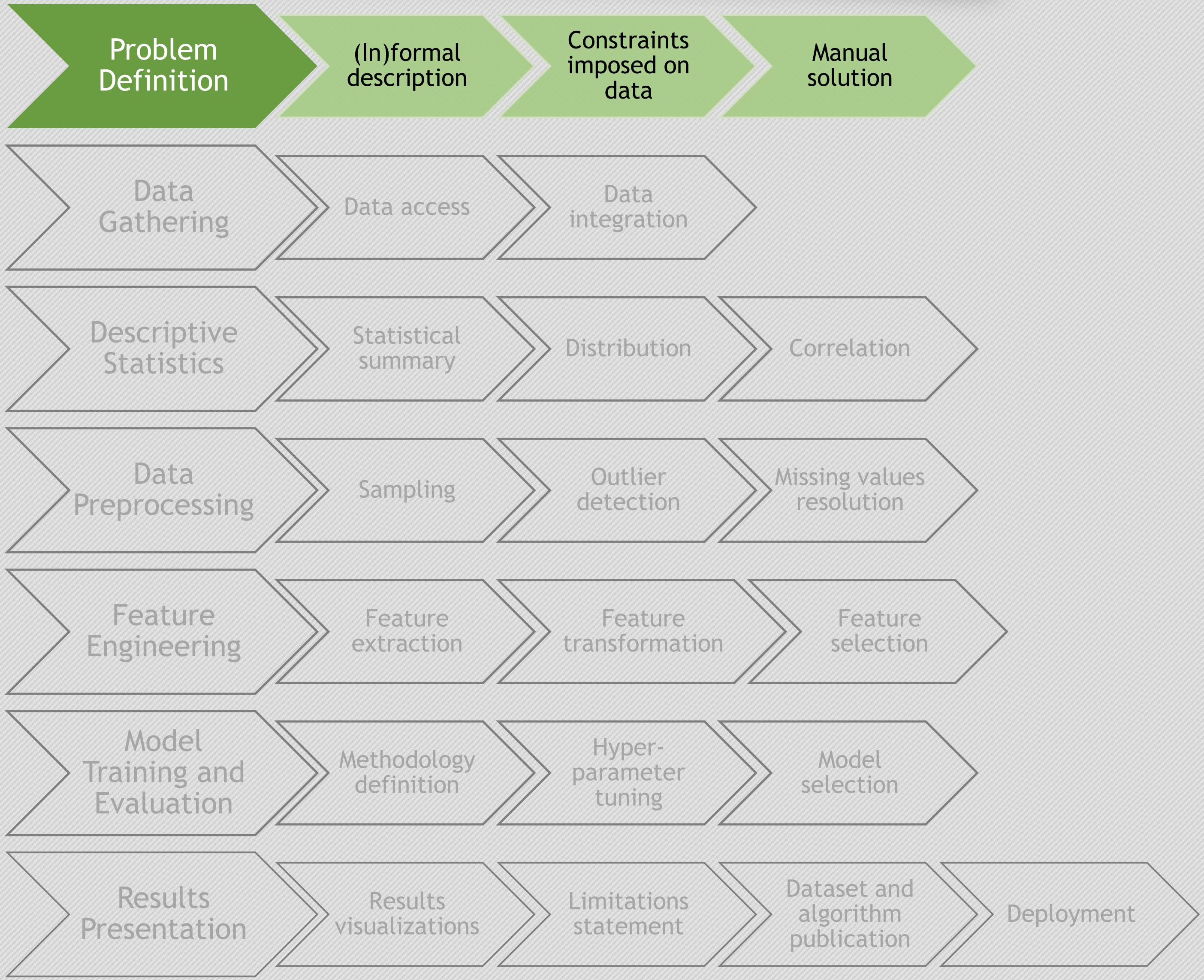
    - As a machine learning task
- Identify constraints imposed on required dataset
- Explore possible manual solutions
  - If they do not exist, it is not a problem any more (in many cases)



Problem Definition → (In)formal description → Constraints imposed on data → Manual solution

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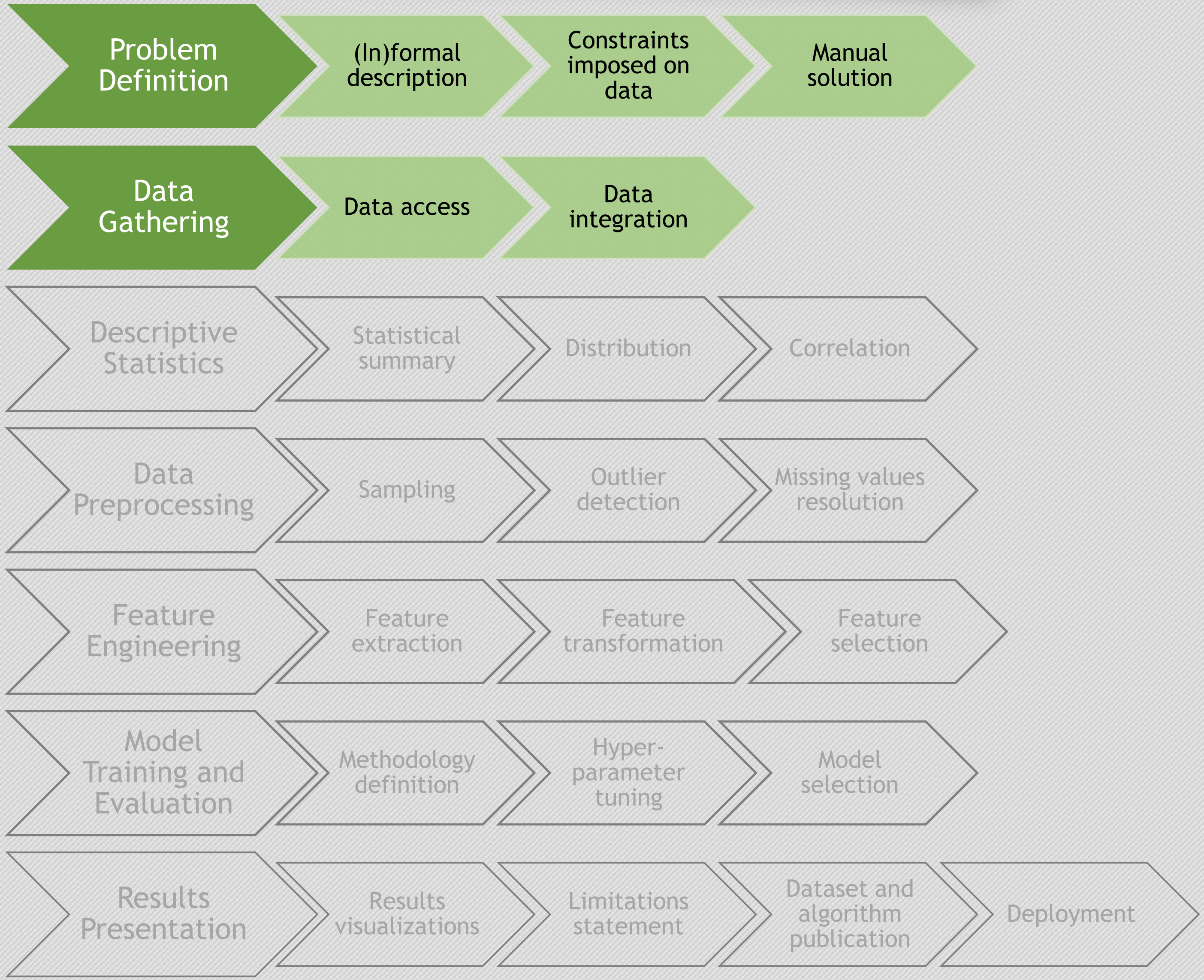
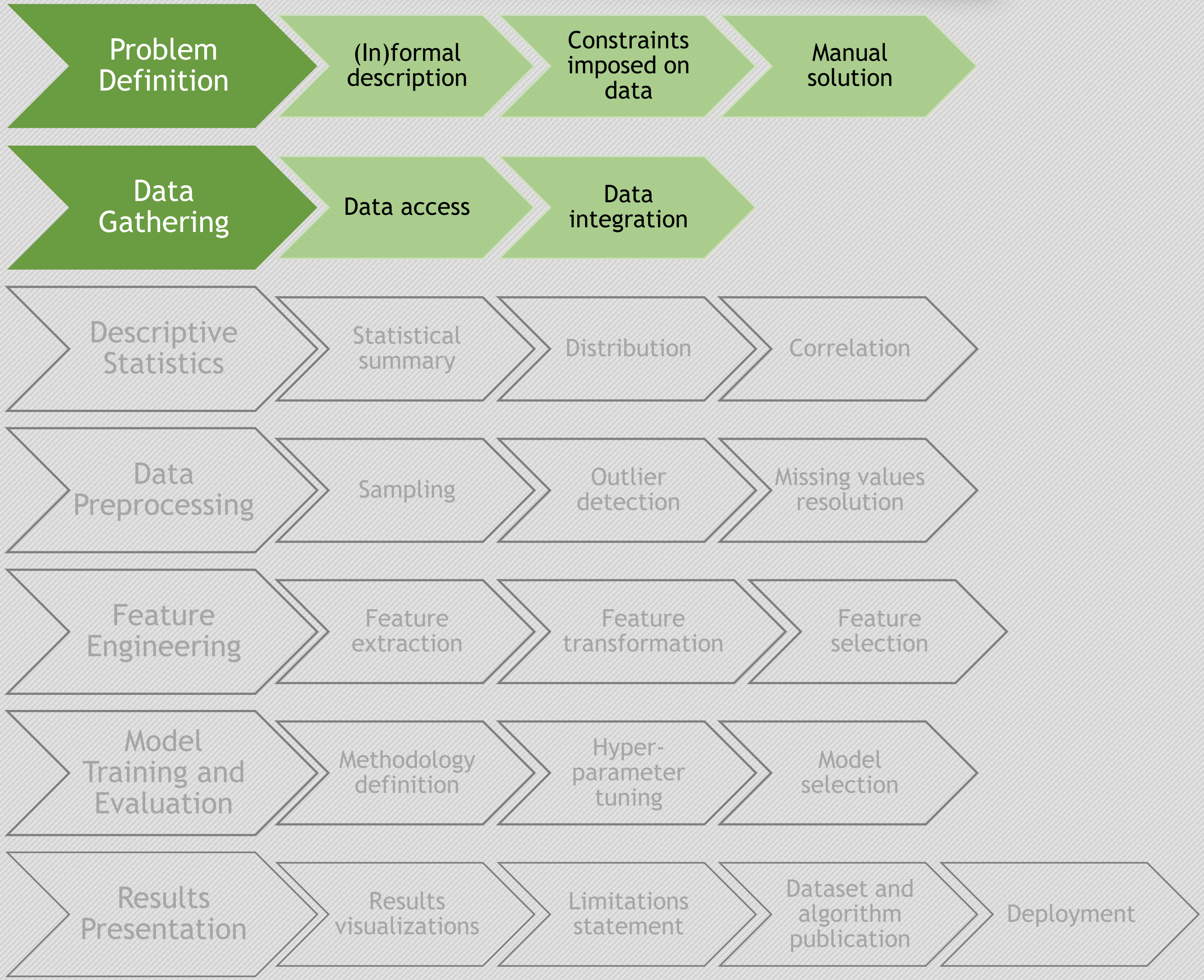
Step 2: Data Gathering

- Data access
  - Prepared datasets, crawling, API
  - Legal issues



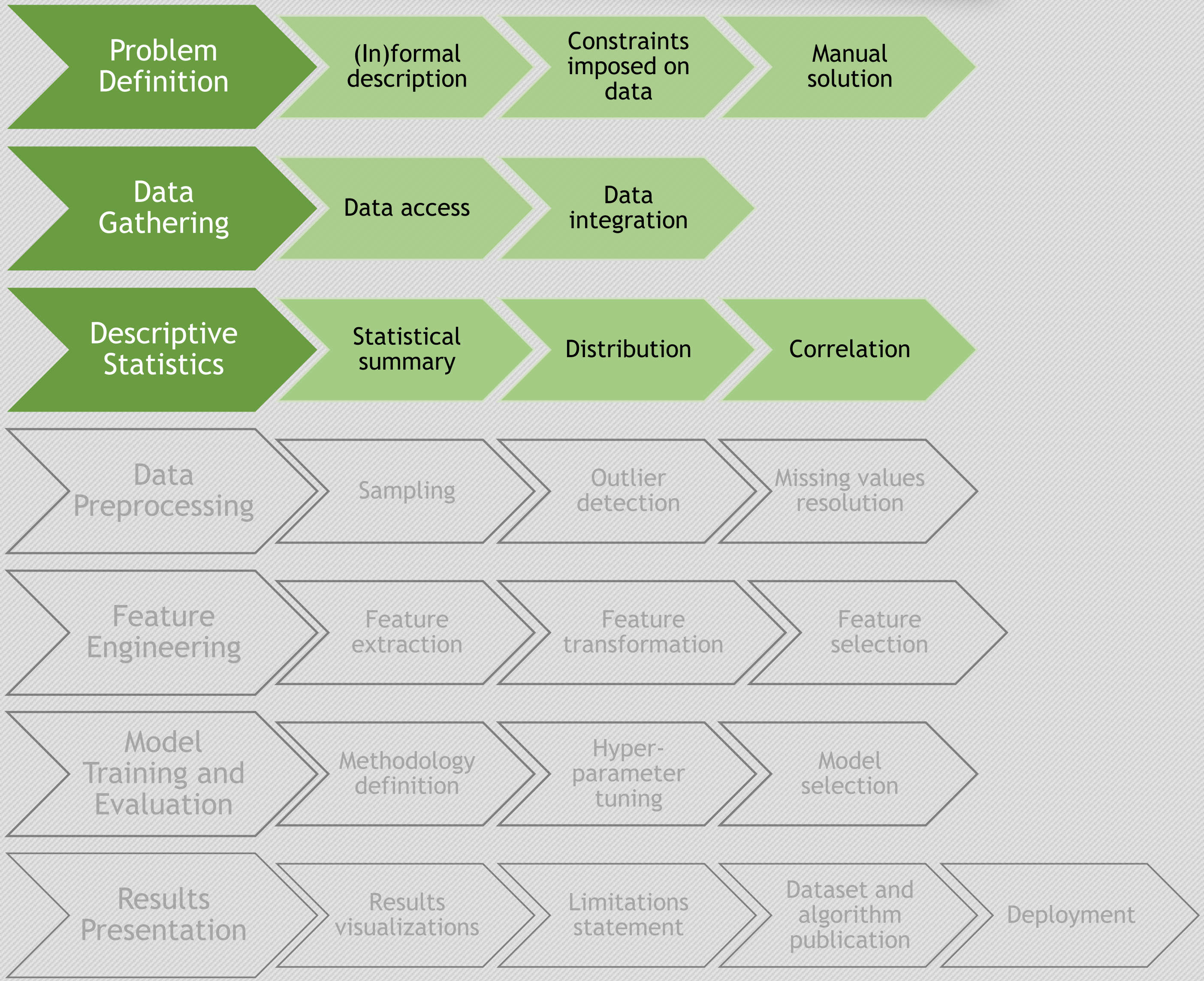
Step 2: Data Integration

- Data access
  - Prepared datasets, crawling, API
  - Legal issues
- Data integration
  - Some ML task can be solved only when you integrate data from several sources
    - Different sources = different structure and format
  - Data consolidation
    - Entity mapping
    - User IDs (email, DB ID, cookie, username, …)
    - Item IDs (code, name, …)



Step 3: Descriptive Statistics

- Known your data!
  - Otherwise, you are just guessing…



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- Known your data!
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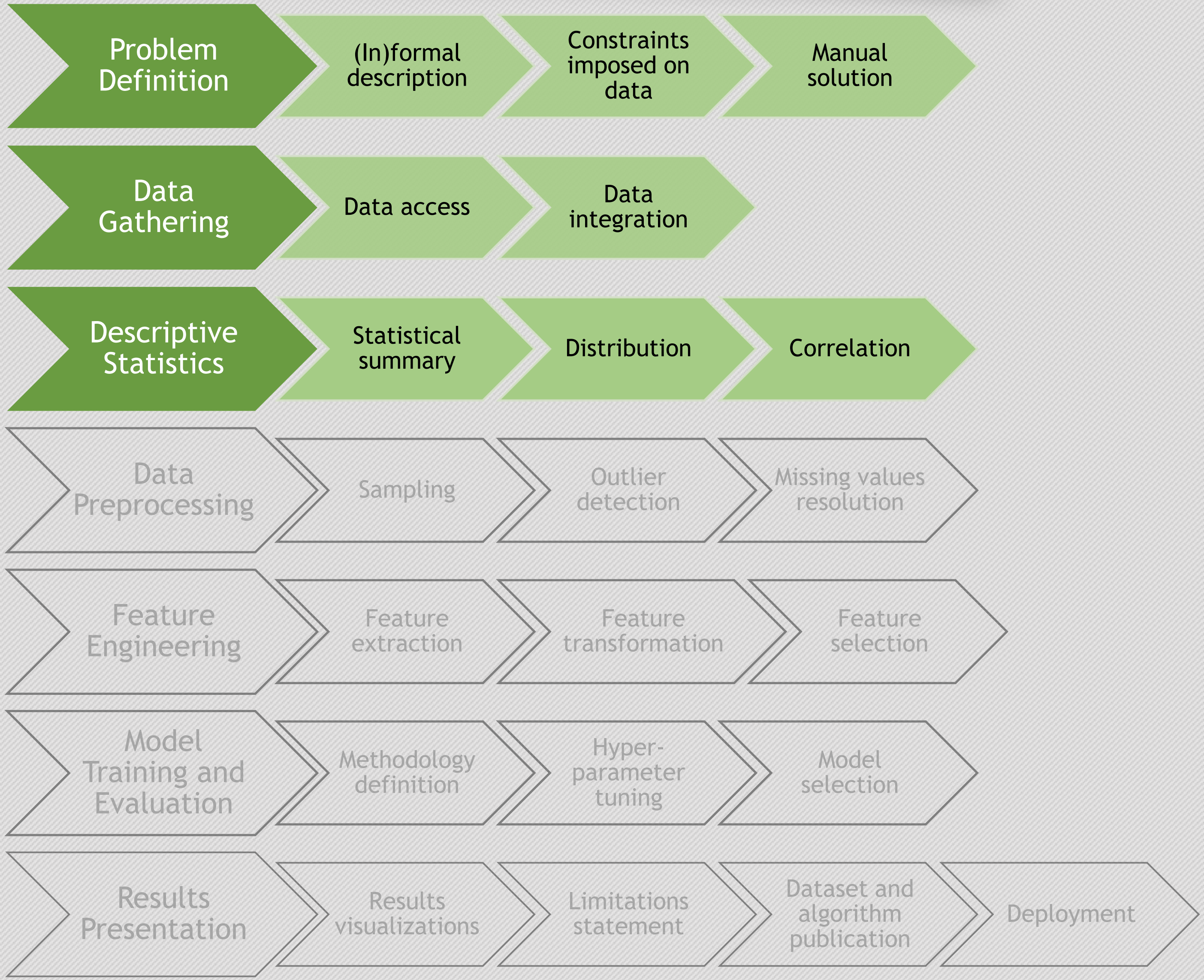
- Summarize data
  - Volume of data (attributes, instances)
  - Data types
  - Distribution of data
  - Relations in data
- Visualize data
  - Histograms, boxplots, scatterplots



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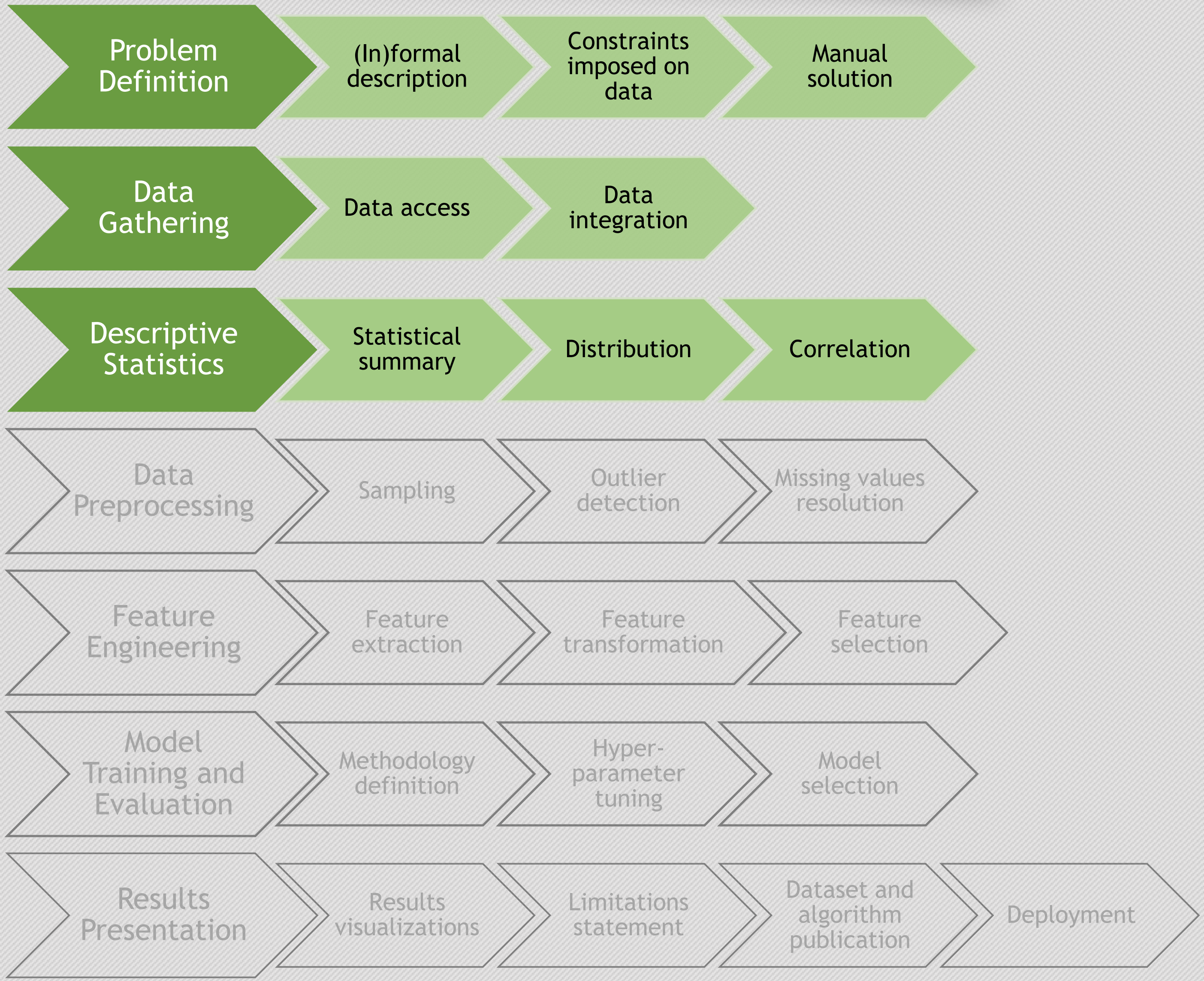
- Result of descriptive statistics is an **important** input to all consequent steps



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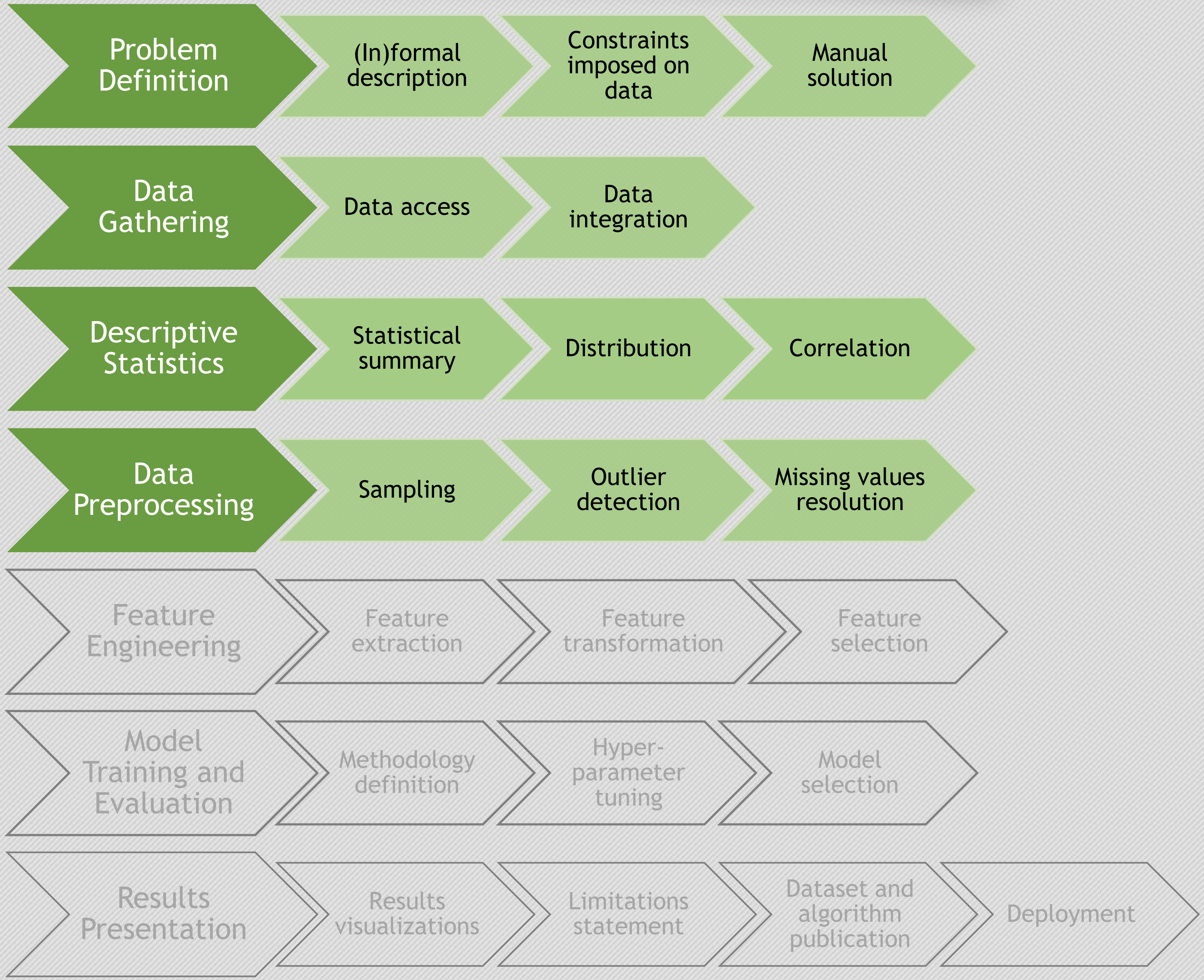
- Have large data? Do sampling!
  - Less data result in shorter training times
  - You can still finally run the model on larger portion of data



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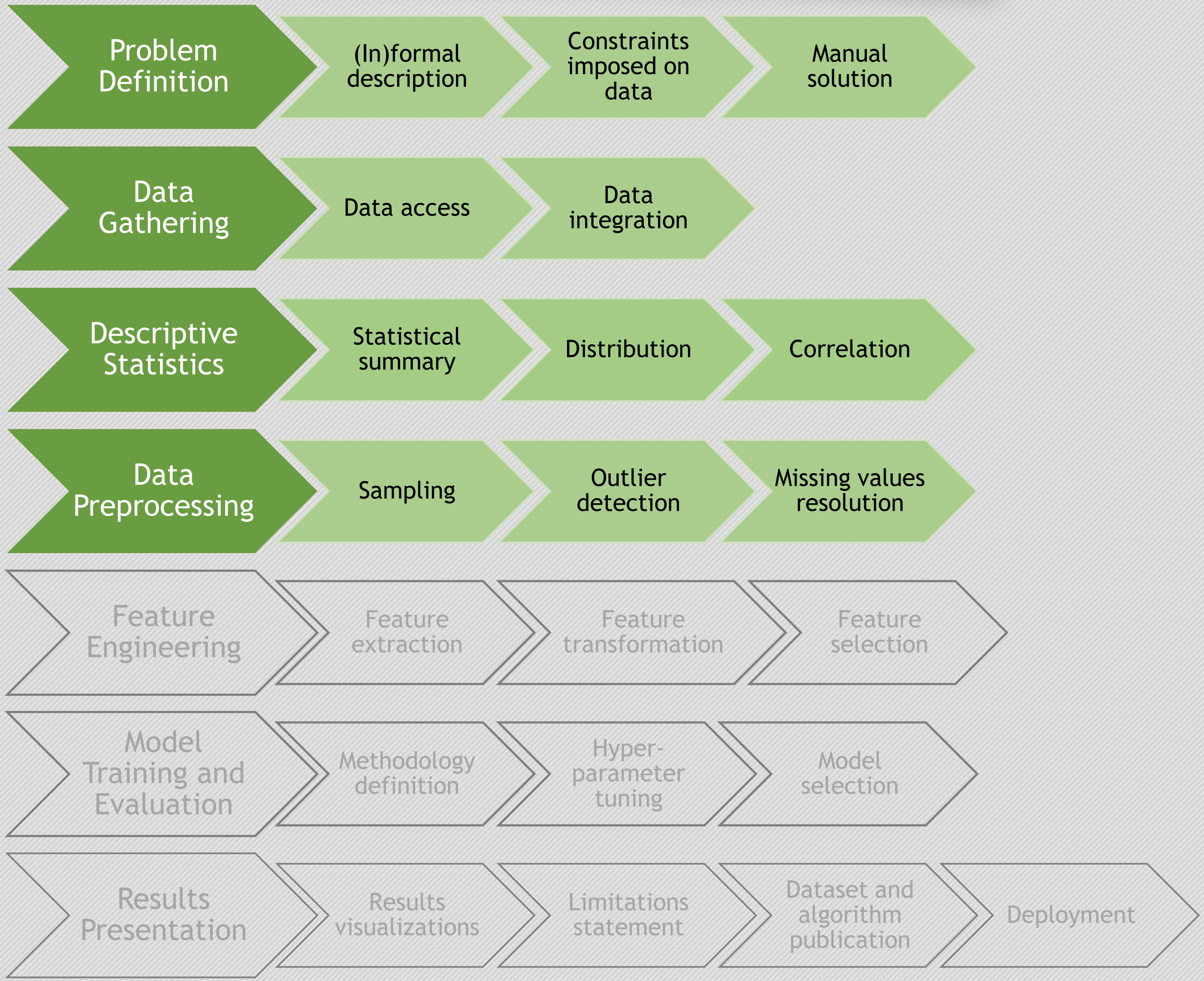
- Machine learning requires well-prepared data
  - Detect outliers
  - Replace missing values



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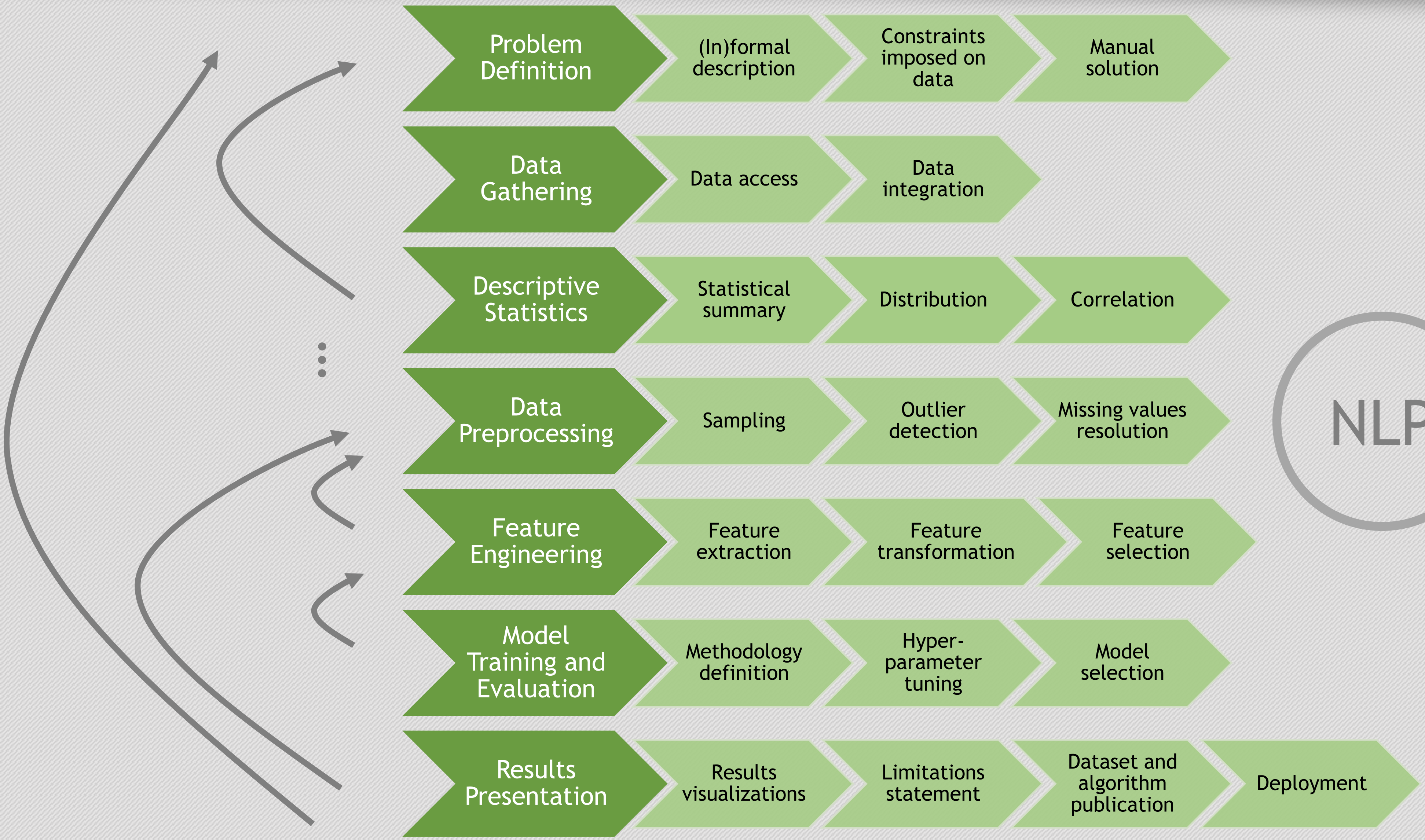

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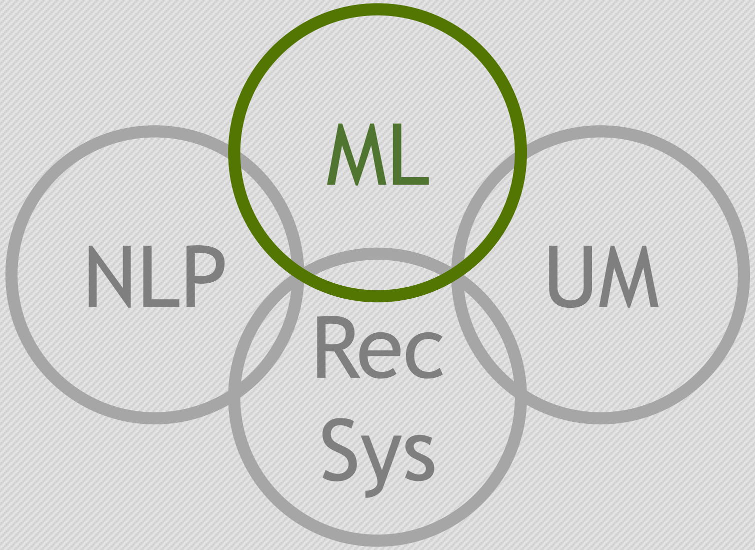

Sources

- https://machinelearningmastery.com/4-steps-to-get-started-in-machine-learning/