Machine Learning A
Fall 2022

Course Team

- Lecturers
  - Sadegh Talebi (course organizer)
  - Christian Igel
  - Yevgeny Seldin

- TAs
  - Ola Rønning
  - Andreas Manoukian (x3), Lennard Hilgendorf (x2), Adrien Vakili (x2), Ankit Kariryaa, Arthur Mellinger, Mikolay Mazurczyk, Ziheng Liu, Peter Hansen, Frederik Johansen

Weekly Plan

	Mon	Tue	Wed	Thu	Fri
9:15 – 10:00	TA (x3) + OTA		Lecture 1		TA (x2)
10:15 – 11:00	TA (x3) + OTA		Lecture 1		TA (x2)
11:15 – 12:00	TA (x3) + OTA		Lecture 1 Q&A		TA (x2)
12:00 – 13:15					
13:15 – 14:00	TA (x5)	TA	Lecture 2		TA (x2)
14:15 – 15:00	TA (x5)	TA	Lecture 2		TA (x2)
15:15 – 16:00	TA (x5)	TA	Lecture 2 Q&A		TA (x2)
16:15 – 17:00					
18:00		**HA DEADLINE**			

- The first lecture is on Monday, Sep 5, 13:15-15:00.
- All the remaining lectures are on Wednesdays, starting Sep 7.
- The TA classes start on Friday, Sep 9.
- ‘TA’ are physical TA classes (3-hour slots). You can attend any and as many you like.
- ‘OTA’ is online TA class / online reception hours by TAs

Tentative Lecture Plan

	Morning	Afternoon
Mon, Sep 5		Course Introduction
Wed, Sep 7	Introduction to Supervised Learning; K-Nearest Neighbors; Validation; Cross-validation	Linear Regression
Wed, Sep 14	Validation (cont'd); Markov's and Chebyshev's Inequalities	Linear Classification; Perceptron; Logistic Regression
Wed, Sep 21	Hoeffding's Inequality; Generalization in Finite Hypothesis Classes	Feature Transformations and Classification/Regression in Transformed Feature Spaces; Regularization
Wed, Sep 28	Occam's Razor, decision trees	Random Forests
Wed, Oct 5	Neural Networks I	PCA
Wed, Oct 12	Neural Networks II	Clustering
Wed, Oct 19	Autumn Break	
Wed, Oct 26	Course summary and evaluation	

Yevgeny **Christian** **Sadegh** **All**

Home Assignments

- Weekly home assignments
- Every student must submit their own report
  - It is allowed to discuss the questions in small groups
  - NOT allowed to copy from each other, neither reports nor code

- You must score at least 50% to be admitted to the final exam
  - You can score 50% on all assignments or 100% on half of the assignments or anything in between, the average counts
  - We determine eligibility by taking a lower confidence bound on your score (keep working, you still have a chance!)
  - Your submissions demonstrate your work throughout the course; if you end up close to the borderline 50%, we will take the number of submissions into account

Exam Eligibility & Late Submissions

- You have to score at least 50% in the home assignments to be admitted to the final exam
  - Exam eligibility is determined the week before the exam (the exact date is decided by the exam office). Only assignments graded by that date count
  - For re-exam eligibility all the assignments count ; you may need to resubmit
    - Primary exam eligibility is “inherited”, if it was already obtained
- Late submissions will not be graded
  - Irrespective of the reason
  - But we will count it positively if you submit all assignments
- Do NOT notify us about late submissions
  - Irrespective of the reason
  - I.e., even if you were sick, do NOT notify us
- No resubmissions (except for re-exam qualification, if necessary)
- No grade complaints under 25 points mistake
  - We are happy to help you with the material, but we do not want to waste time on point counting: you only have to score above 50%

Final Exam

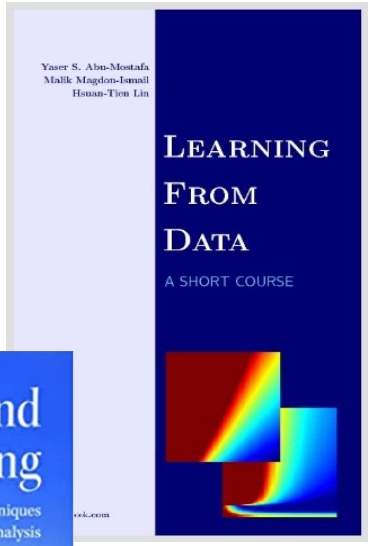
- Final exam: 5-day take-home exam in the 8th week of the block (deadline on Friday, Nov 4)
- **Final exam must be solved individually**
  - You are NOT allowed to work in groups on the final exam
  - We will be very strict about cheating; if proven guilty you may be expelled from the university
- Final grade = final exam grade

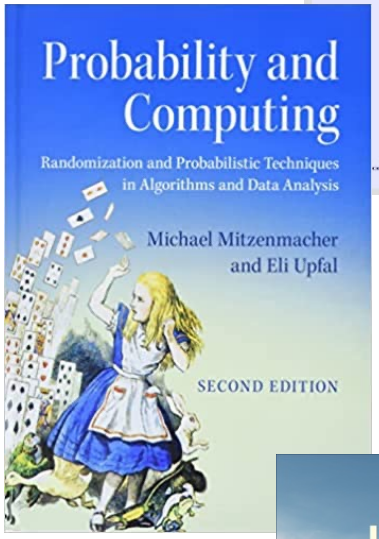
Feedback on Home Assignments

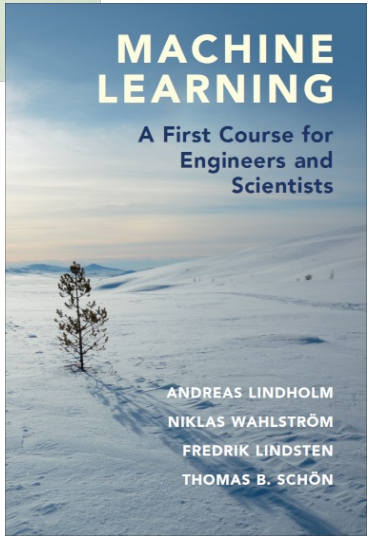
- We have Q&A hour at the end of each lecture, where you are welcome to ask questions about submitted home assignments and any other questions about the material and where we will present some reference solutions
- You are also welcome to ask on Absalon
- The TAs are expected to make a short comment regarding what was wrong when they take points
- The TAs are *not* expected to provide written feedback on how to fix your mistakes, but you can ask them or us to explain orally at a TA session or Q&A hour
- We do *not* hand out written reference solutions (but we do go over questions on blackboard at Q&A)

Course Material

- **Primary material:** our lecture notes, slides, and blackboard
- **Supplementary material [OPTIONAL]:** "Learning from Data" textbook
  - Additional chapters online at http://amlbook.com
- **Supplementary material [OPTIONAL]:** "Probability and Computing"
  - Free online copy available
- **Supplementary material [OPTIONAL]:** "Machine Learning: A First Course for Engineers and Scientists"
  - Free online copy available







What is Machine Learning?

Examples of Learning Systems

- Biological
  - Animals
  - Humans
  - Plants (?)
- Machine learning

What is Learning?

- Ability to use past experience to take better actions in new situations

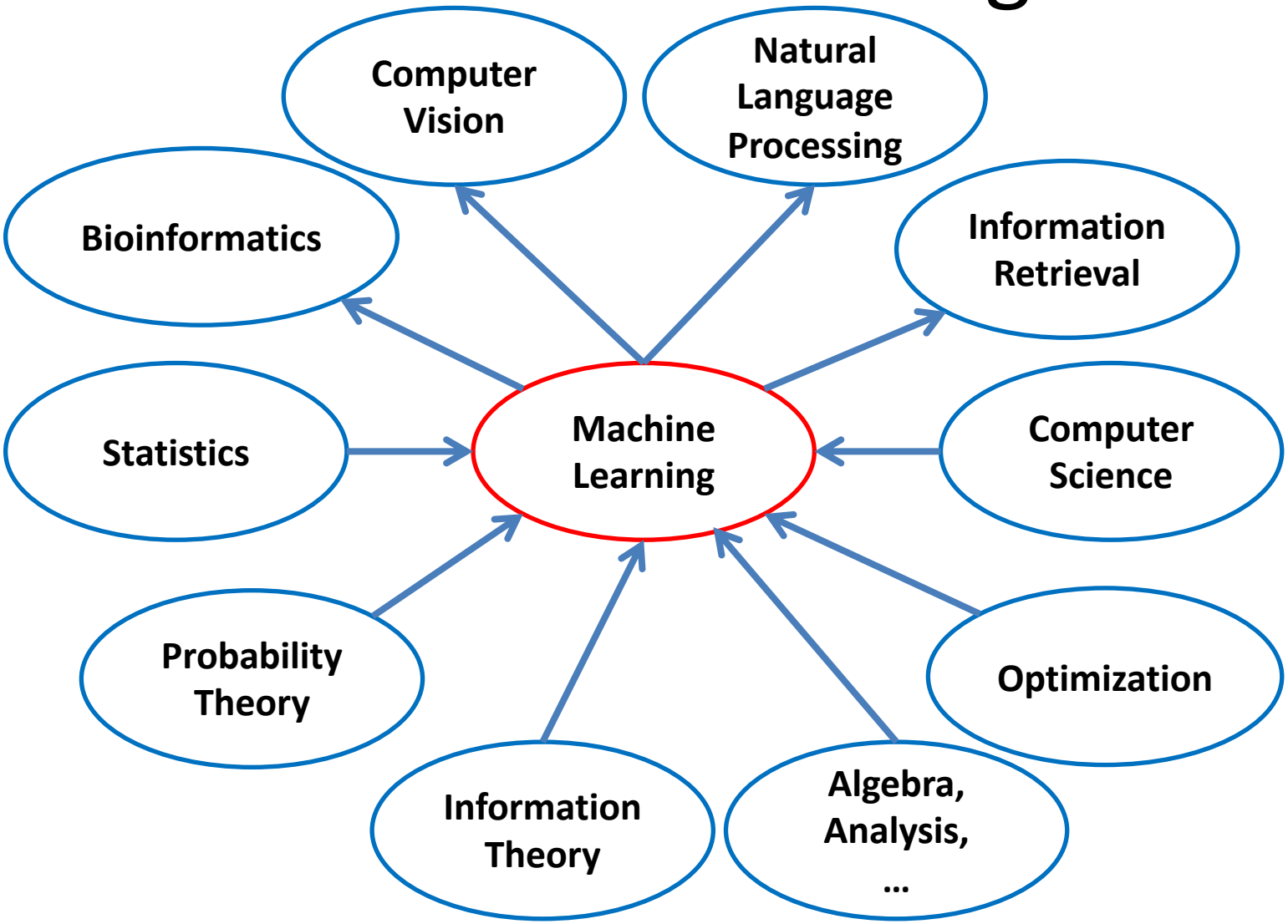
Success stories of Machine Learning

- Speech recognition
- Handwriting recognition
- Machine translation (e.g., Google translate)
- Autonomous driving
- Human genome analysis

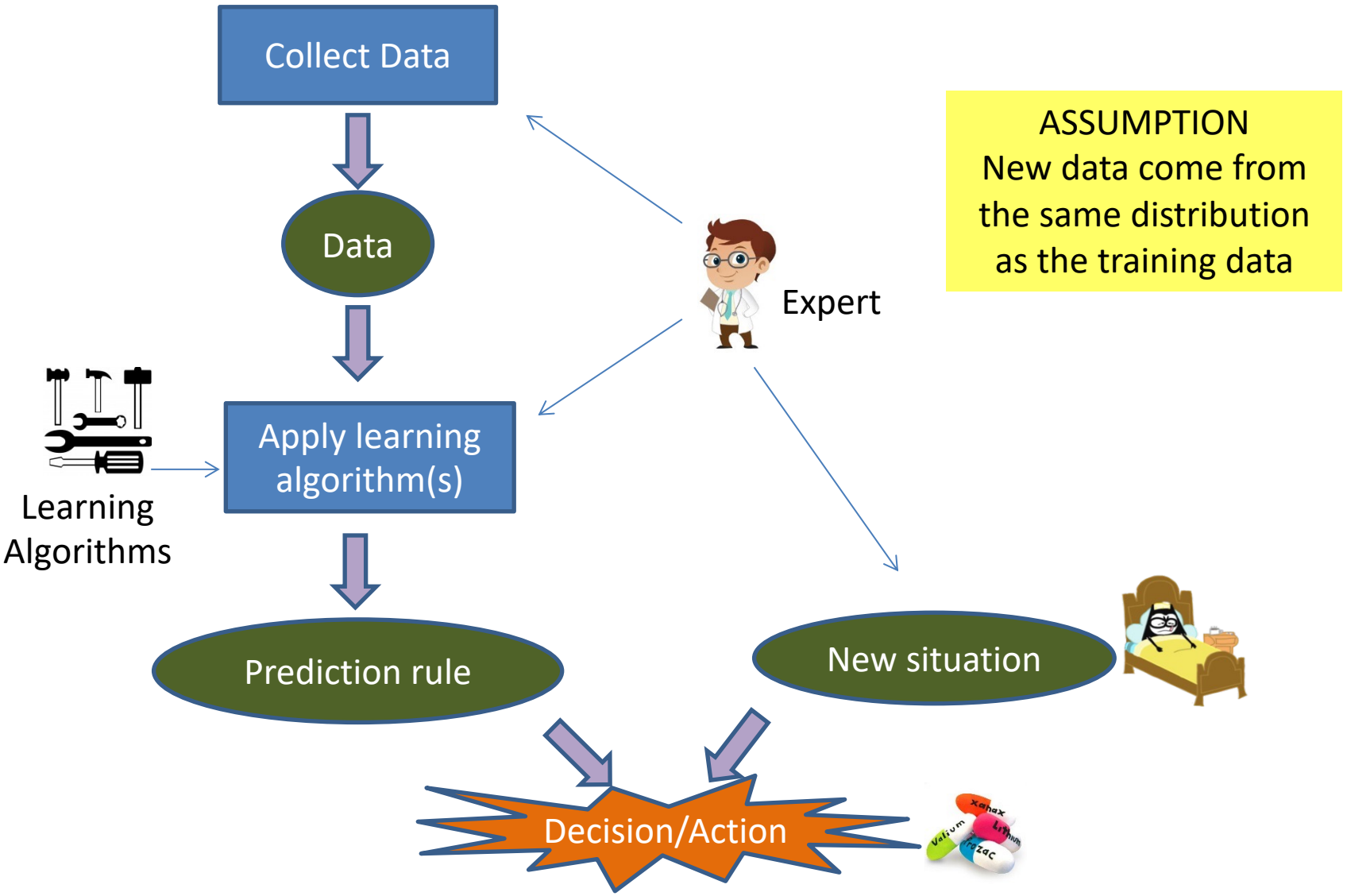
When do we need Machine Learning?

- Tasks that are too complex to program
  - Tasks performed by humans
    - Speech recognition, image understanding, etc.
  - Tasks beyond human capabilities
    - Analysis of large datasets: genetic data, medical data, Internet data, etc.
- Adaptivity
  - Adaptation in handwriting recognition; spam filtering; advertising; etc.

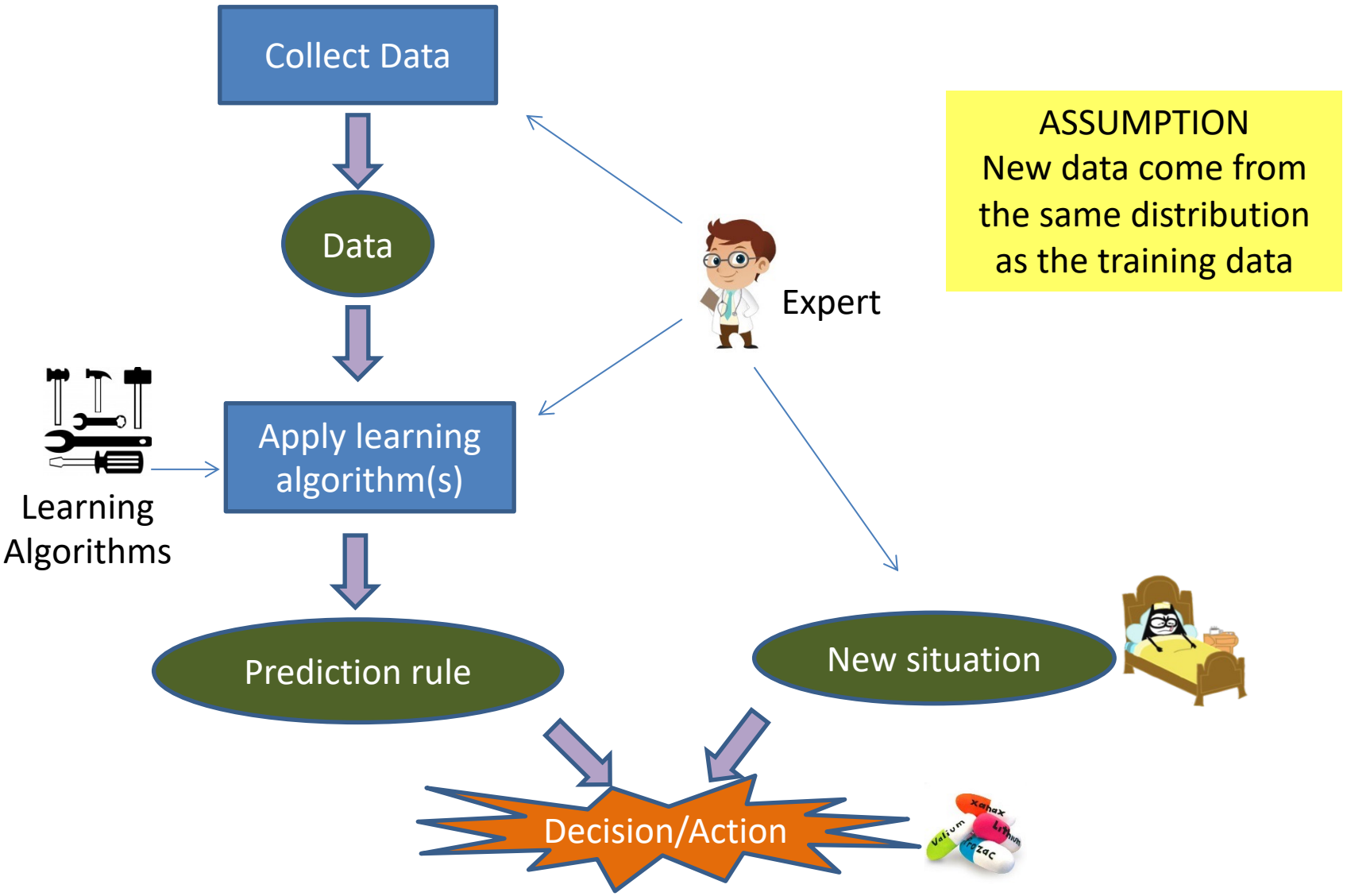
Machine Learning



“Classical” Learning Process



Where are you in this picture?



Peculiarities of Machine Learning

- When you flip a coin *n* times, there is always a probability that the average outcome will not be representative of the true bias

- When you take a data sample and apply a learning algorithm, there is always a probability that the prediction accuracy on the sample is not representative of the true accuracy

- And it may well be that the training data is not sampled from the same distribution as new data

Course goals

- Teach how to work with uncertainty
- Teach some machine learning algorithms
- Teach the assumptions behind learning algorithms
- Teach tools for analyzing the algorithms