## Where is Machine Learning Going?

#### Francis Bach

INRIA - Ecole Normale Supérieure, Paris, France





NeurIPS Workshop on Experiment Pre-Registration

November 2020

# Where is Machine Learning Going? A personal and biased view

# Where is Machine Learning Going? A personal and biased view

- NeurIPS: from 2000 to 2020
- Shift in values
- A scientific approach to machine learning
- BONUS: Should my daughter do a PhD in machine learning?

NIPS 2000	NeurIPS 2020

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants	10 000 participants

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants (very) little diversity	10 000 participants little diversity

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants (very) little diversity	10 000 participants little diversity
kernels	neural networks

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants (very) little diversity	10 000 participants little diversity
kernels	neural networks
short 7-page paper	20-page supplementary material

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants (very) little diversity	10 000 participants little diversity
kernels	neural networks
short 7-page paper toy simulations	20-page supplementary material large-scale experiments

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants (very) little diversity	10 000 participants little diversity
kernels	neural networks
short 7-page paper toy simulations small computing power	20-page supplementary material large-scale experiments lots of computing power

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants (very) little diversity	10 000 participants little diversity
kernels	neural networks
short 7-page paper toy simulations small computing power Matlab	20-page supplementary material large-scale experiments lots of computing power Python

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants (very) little diversity	10 000 participants little diversity
kernels	neural networks
short 7-page paper toy simulations small computing power Matlab few preprints	20-page supplementary material large-scale experiments lots of computing power Python  ArXiv

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants (very) little diversity	10 000 participants little diversity
kernels	neural networks
short 7-page paper toy simulations small computing power Matlab	20-page supplementary material large-scale experiments lots of computing power Python
few preprints	ArXiv
tiny industry presence	massive industry presence

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants (very) little diversity	10 000 participants little diversity
kernels	neural networks
short 7-page paper toy simulations small computing power Matlab	20-page supplementary material large-scale experiments lots of computing power Python
few preprints	ArXiv
tiny industry presence	massive industry presence
no money	lots of money

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants (very) little diversity	10 000 participants little diversity
kernels	neural networks
short 7-page paper toy simulations small computing power Matlab few preprints	20-page supplementary material large-scale experiments lots of computing power Python  ArXiv
tiny industry presence no money nobody cared	massive industry presence lots of money lot of (external) attention

NIPS 2000	NeurIPS 2020
contested US election results	contested US election results
300 participants (very) little diversity	10 000 participants little diversity
kernels	neural networks
short 7-page paper toy simulations small computing power Matlab	20-page supplementary material large-scale experiments lots of computing power Python
few preprints	ArXiv
tiny industry presence no money	massive industry presence lots of money
nobody cared no social media	lot of (external) attention Twitter

• More professionalism

- More professionalism
- Strong industry presence

- More professionalism
- Strong industry presence
- Hype, social networks and marketing

- More professionalism
- Strong industry presence
- Hype, social networks and marketing
  - Some wisdom from physics:

Physical Review adheres to the following policy with respect to use of terms such as "new" or "novel:" All material accepted for publication in the Physical Review is expected to contain new results in physics. Phrases such as "new," "for the first time," etc., therefore should normally be unnecessary; they are not in keeping with the journal's scientific style. Furthermore, such phrases could be construed as claims of priority, which the editors cannot assess and hence must rule out.

- More professionalism
- Strong industry presence
- Hype, social networks and marketing
- Increased competition

- More professionalism
- Strong industry presence
- Hype, social networks and marketing
- Increased competition
- From science to engineering

### • Empirical research

- Minimizing "test error" on a benchmark is not the only goal

#### • Empirical research

- Minimizing "test error" on a benchmark is not the only goal
- Level 0: rigorous reporting of results (error bars, true testing set)

#### Empirical research

- Minimizing "test error" on a benchmark is not the only goal
- Level 0: rigorous reporting of results (error bars, true testing set)
- Level 1: ablation studies (what is important and generalizable?)

### Empirical research

- Minimizing "test error" on a benchmark is not the only goal
- Level 0: rigorous reporting of results (error bars, true testing set)
- Level 1: ablation studies (what is important and generalizable?)
- Level 2: pre-registration of experiments

### Empirical research

- Minimizing "test error" on a benchmark is not the only goal
- Level 0: rigorous reporting of results (error bars, true testing set)
- Level 1: ablation studies (what is important and generalizable?)
- Level 2: pre-registration of experiments

#### Theoretical research

Learning theory can lack rigor as well

### Empirical research

- Minimizing "test error" on a benchmark is not the only goal
- Level 0: rigorous reporting of results (error bars, true testing set)
- Level 1: ablation studies (what is important and generalizable?)
- Level 2: pre-registration of experiments

- Learning theory can lack rigor as well
- Level 0: correct proofs

### Empirical research

- Minimizing "test error" on a benchmark is not the only goal
- Level 0: rigorous reporting of results (error bars, true testing set)
- Level 1: ablation studies (what is important and generalizable?)
- Level 2: pre-registration of experiments

- Learning theory can lack rigor as well
- Level 0: correct proofs
- Level 1: consistent / relevant set of assumptions

### Empirical research

- Minimizing "test error" on a benchmark is not the only goal
- Level 0: rigorous reporting of results (error bars, true testing set)
- Level 1: ablation studies (what is important and generalizable?)
- Level 2: pre-registration of experiments

- Learning theory can lack rigor as well
- Level 0: correct proofs
- Level 1: consistent / relevant set of assumptions
- Level 2: matching theory and practice

### Empirical research

- Minimizing "test error" on a benchmark is not the only goal
- Level 0: rigorous reporting of results (error bars, true testing set)
- Level 1: ablation studies (what is important and generalizable?)
- Level 2: pre-registration of experiments

- Learning theory can lack rigor as well
- Level 0: correct proofs
- Level 1: consistent / relevant set of assumptions
- Level 2: matching theory and practice
- Many interesting research questions beyond benchmarks

• Disclaimer: whatever I say, she does the opposite...

- Disclaimer: whatever I say, she does the opposite...
- Stress and competition
  - ArXiv and deadlines

- Disclaimer: whatever I say, she does the opposite...
- Stress and competition
  - ArXiv and deadlines
- Why do we do scientific research for?
  - To save the world
  - As a game
  - To make money?
  - etc...

- Disclaimer: whatever I say, she does the opposite...
- Stress and competition
  - ArXiv and deadlines
- Why do we do scientific research for?
  - To save the world
  - As a game
  - To make money?
  - etc..
- Where is machine learning going?