Research in Computational Learning Laboratory

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Computational Learning Laboratory

Composition

a 3.5-year-old lab with 1 faculty, 7 MS students, 1 undergraduate student, 14 MS/BS alumni

Our Research

Our Vision: **expand the horizon of machine learning**

- How broadly can machines learn? (application)
- How efficiently can machines learn? (algorithm)
- How precisely can machines learn? (theory)

What is Machine Learning?

*A study that allows **computational systems** to adaptively **improve** their performance with experience accumulated from the **data observed**.*

- remove **computational systems**:
  General (Human/Biological/Machine) Learning
- remove **improve**:
  Data Processing
- remove **data observed**:
  Computer Science

Apple, Orange, or Strawberry?

?

apple

orange

strawberry

ML: *A study that allows **computational systems** to adaptively **improve** their performance with experience accumulated from the **data observed**.*

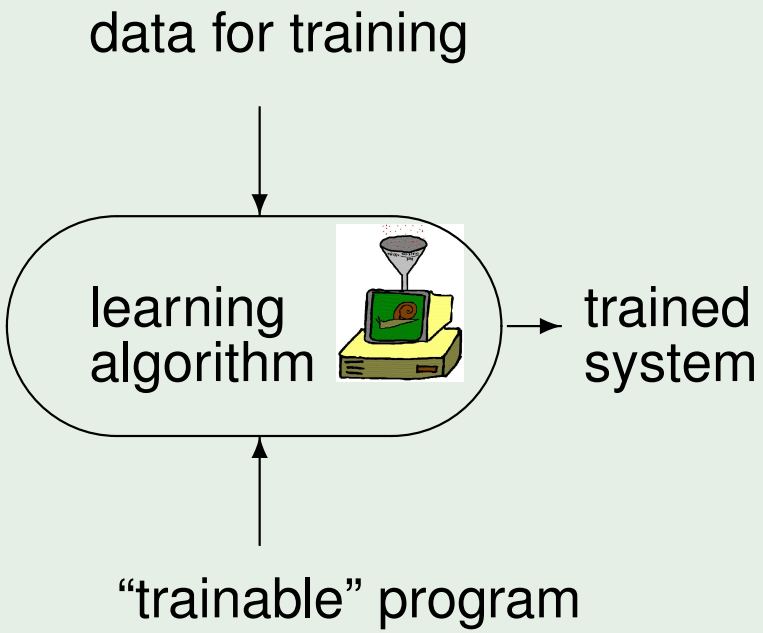
- **computational systems**: an automatic classification procedure
- **improve**: better classification accuracy
- **data observed**: labeled pictures of apples, oranges and strawberries

Programming versus Machine Learning

Programming Approach

```
if (color ≈ RED){
  if (shape ≈ CIRC)
    return APPLE;
  else
    return STRAWBERRY;
}
else
  ...
  ...
  ...
  ...
```

Machine Learning Approach



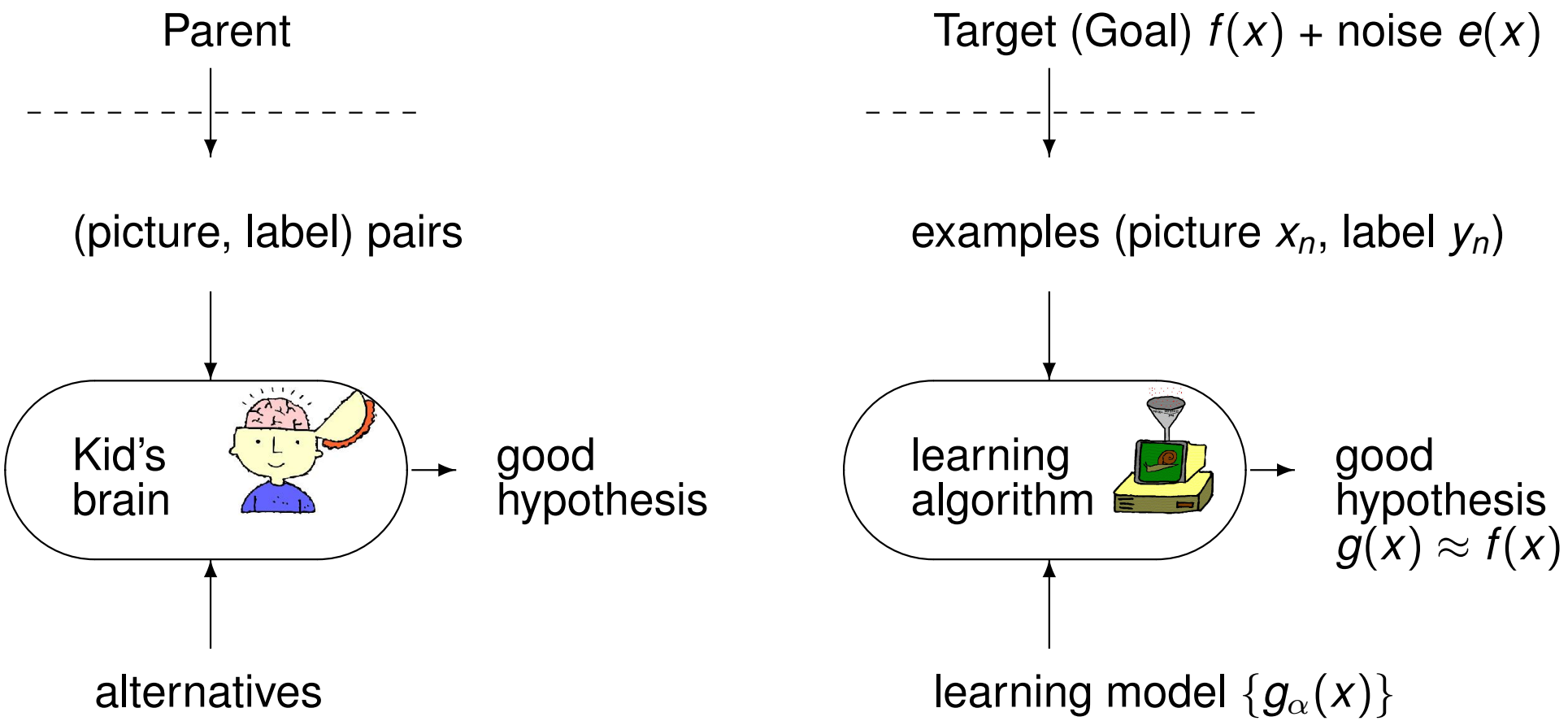
ML: an alternative route to construct complicated systems
–train (teach) the computers as your students

The Machine Learning Route

ML: an alternative route to construct complicated systems

- when human cannot construct it manually (navigating on Mars)
- when human cannot embed the expertise easily (speech/visual recognition)
- when there is a need for rapid decisions (routing, high-frequency trading)
- when there is a need to be user-oriented (consumer-targeted marketing)

Human Learning versus Machine Learning



challenge:

see only $\{(x_n, y_n)\}$ without knowing $f(x)$ or $e(x)$

$\stackrel{?}{\Longrightarrow}$ **generalize** to unseen (x, y) w.r.t. $f(x)$

Snapshots of Our Undergraduate Research

How to teach the computers to ...

- ask key questions to help (machine) learning? (Joseph Wen, B95; Yu-Cheng Chou, B96; Chun-Liang Li, B97)
  - traditional machine learning: like duck-feeding
  - active learning: encourage computers to ask questions
    —好問則裕

Snapshots of Our Research

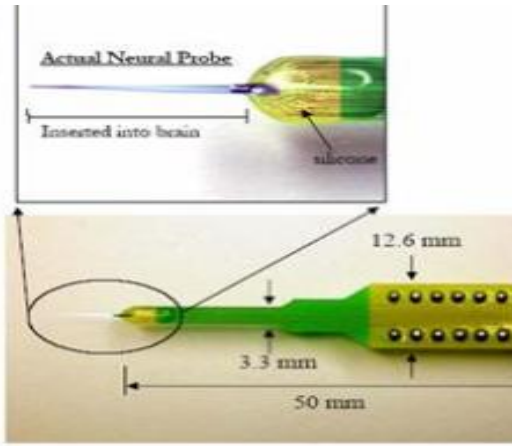
How to teach the computers to ...

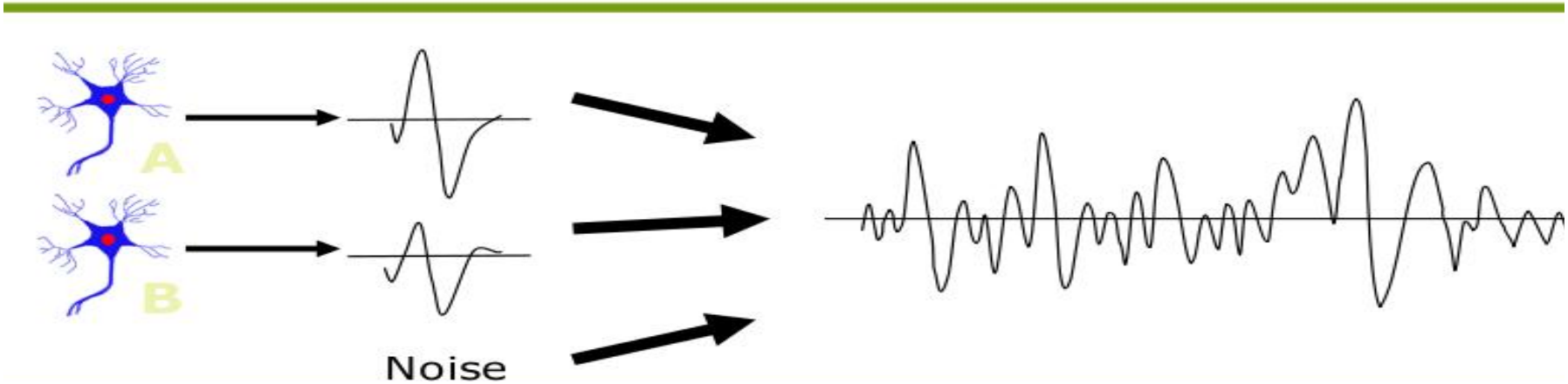
- adaptively collaborate with other learners/computers for better performance? (Shang-Tse Chen, B95)
  - many “so-so” learners, few “very very very good” ones
  - boosting: combine some “so-so” learners to get “very very very good” ones
    —團結力量大？！

Snapshots of Our Research

How to teach the computers to ...

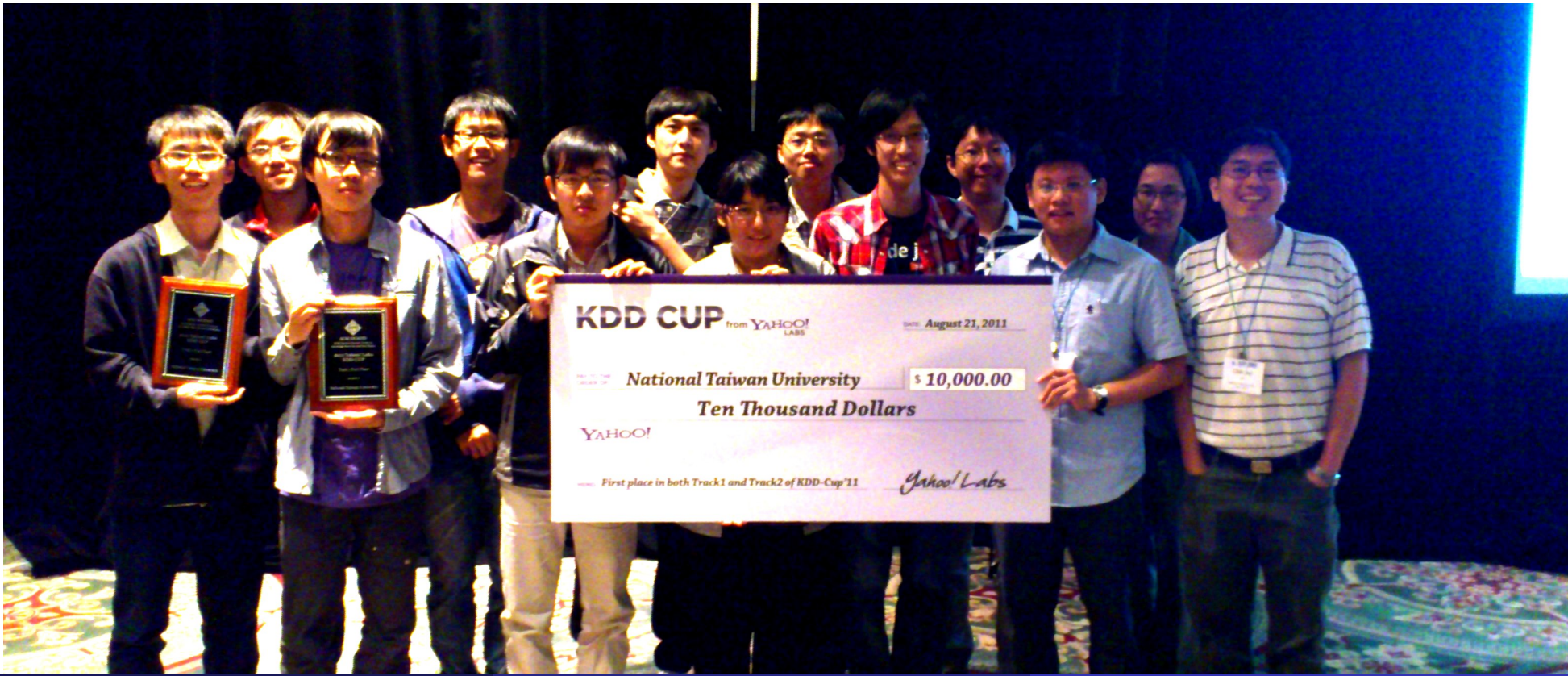
- decode our neural intentions? (Chia-Hsuan Wang, B95)





Furthermore

- three years ago: *KDDCup 2009 Third Place of Slow Track ...*
- two years ago: *KDDCup 2010 First Place ...*
- one year ago: *KDDCup 2011 Double Champions ...*
- this year: *KDDCup 2012 First Place of Track 2 ...*
- next year: **we are shooting for a higher goal!**



Disadvantages of Computational Learning Lab.

- high risk:
  less structured equipments/rules/advisor :-)
- serious research:
  aim for top-notch research results
- free style:
  research driven at students' own responsibility

Advantages of Computational Learning Lab.

- free style:
  research driven at students' own creativity
- research-oriented:
  start doing research early and throughout
- diverse topics:
  anything (weakly) related to computational learning
- useful knowledge:
  learning tools can be a lifetime asset
- warm environment:
  family-type lab

Words from Witnesses (1/2)

- Cxxxxxi: advisor good at both algorithm and theory; “learning” is full of FUN in our lab!
- Lxxxxxxxxxxn:
  - can find support from other lab members easily
  - can have more viewpoints in mathematics especially Linear Algebra
- Kxxxxn:
  - lots of empty seats in our lab
  - advisor really open minded—encouraged to have wild ideas
  - advisor just like a friend—go to the gym and play games together
  - advisor is really cute (?!)
  - advisor will Google every last detail about you

Words from Witnesses (2/2)

- sxxxxxxo: 可以來開開眼界，看看上帝
- Mxxxxa:
  - very free and can do anything you want
  - advisor is funny, friendly and a little shiny
  - colorful lab life —don't be cheated by words like 爲了生活快樂起見，不要來修ML 也許比較好XD
  - lmxxx96@ptt2 said: 有些人一直都不會被釘在白板上都是電人 But in our lab, everyone gets 釘在白板上 some time. Come challenge yourself!
- pxxxxxxxa:
  - 增進英文能力,學會報paper並累積做研究的經驗, CLlab能讓你三個願望,一次滿足!
  - Join CLlab, and learn with peers that have ACM level programming skill and president award learning skill—and professor that have both.
  - Join CLlab, you'll be as smart/strong as CharlieL. (?!)

students encouraged to pursuit their dreams: study abroad, continue in NTU, go to industry, do intern, etc.

加入計算學習實驗室
不要讓你的電腦輸在起跑點上

—Hsuan-Tien Lin, 2008