Intelligent systems that learn

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Google™
Predicting friendship

Input: two people
Output: should they be Facebook friends?

Features:

• number of friends in common
  10
  no
  yes

• same school
  5.2

• same home town
  2
  yes

• similar music
  1
  yes

• similar hobbies
  no

Rule
Yes!
Learning prediction rules

Learning is using previous experience to perform better in future situations.

The problem of induction:

Will future futures resemble past futures?

The problem of generalization:

How to make predictions about situations never previously encountered?
Memory

yes

no

?
Memory

yes

- Star
- Square
- Circle
- Green shape

no

- Green shape
- Circle
- Star
- Triangle
- Arrow

No
Averaging

Yes

No

?
Averaging

yes

no

Yes
Generalization

yes

no

→ ?

○ ?
What’s the right hypothesis?
What’s the right hypothesis?
Now, what’s the right hypothesis?
Now, what’s the right hypothesis?
How about now?
How about now? Answer 1
How about now?  Answer 2
Your turn!

Gather into a group with at least 10 people near you

• Note the large word and the box around it
• Just look at the ‘yes’ or ‘no’ in the upper left corner (ignore the other labels for now)
• Invent a rule that predicts yes or no on cards you haven’t seen
Rule 1:
Rule 1: Is it the name of a fruit?

- guava: Yes
Rule 2:
Rule 2: Does it start with a vowel?

Yes or no?
Rule 3:
Rule 3: Does it start with a vowel or have a red box?
Rule 4:

Yes

No

guava

No

Yes
Rule 4: Does it end with a vowel?

Noise in the data

guava

yes

no

no

yes
Robots!

What is a robot?
Robots!

What is a robot?

- Sensors: camera, force, tactile, joints
- Effectors: motors in wheels, arms; speech
- Computers
- Software
  - Sensor processing
  - Control
  - Intelligence
Robots!

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- Software
  - Sensor processing
  - Control
  - Intelligence
Simple job

Drive as fast as you can to a distance of 0.5 meters from the wall

You know:
  • The robot's current distance from the wall

You can set:
  • The robot's forward velocity (speed)

Your job:
  • Figure out a rule for telling the robot how fast to go, depending on how far away from the wall it is
Real robot meets real world

WTF? ¹

¹ Where’s the fork?
Cupboard
Navigation among movable obstacles
LEDs!

https://learn.adafruit.com/all-about-leds
Be in demand!

Google, Facebook Battle For Computer Science Grads. Salaries Soar.

New Grads, Masters & PhDs
Ready to dive in, get to work, and have an immediate impact? We need dynamic people that get excited by big questions and unsolved problems.

Open Positions
Recruiting (1)
- Analyst, Online Operations, Austin (New Grad)

Online Sales Operations (6)
- Analyst, Online Sales Operations - French (Dublin) (New Grad)
- Analyst, Online Sales Operations - German (Dublin) (New Grad)
- Analyst, Online Sales Operations - Italian (Dublin) (New Grad)
- Analyst, Online Sales Operations - Spanish (Dublin) (New Grad)

User Operations (4)
- Analyst, User Operations - French (Dublin) (New Grad)
- Analyst, User Operations - German (Dublin) (New Grad)
- Analyst, User Operations - Spanish (Dublin) (New Grad)
- Analyst, User Operations - Turkish (Dublin) (New Grad)

Engineering (8)
- Software Engineer, Ads Infrastructure and Optimization (New Grad)
- Software Engineer, Advertising Auction (New Grad)
- Software Engineer, Data (New Grad)
- Software Engineer, Facebook Platform (New Grad)

Meet us at:
Select university:

Benefits and Perks
We've got it good!
At our Palo Alto headquarters, we also offer free breakfast, lunch and dinner at our Cafes. Whether you're looking for healthy salads, or hearty world cuisine from Belfitz, India, etc., or just a couple slices of pizza, Chef Jouff and his team of culinary geniuses in Palo Alto make it happen every day.

Life at Facebook
Innovation is paramount
No matter what part of Facebook you join, you’ll be building something big and new. You won’t simply be finding answers; you’ll be framing questions that no one has ever asked before – and identifying unprecedented opportunities. We welcome pioneers. In fact, we insist on them.
Be creative!

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Have fun! Have impact!

At Google, innovation and creativity keeps our projects changing and improving. Our consistency comes from our Googlers – smart, amazing people who foster an environment of collaboration and fun.
Have fun! Have impact!

I like working at Google because of the people, the perks, and the potential to impact. I am surrounded by some of the smartest and nicest (yet most humble) engineers—of course it’s easier to stay nice when you are well-fed, can get massages on campus, and can grab a beer on Friday afternoons. But what inspires me the most is the potential to impact millions of people through what I do.
Why do technology and design?

Fun!
• using your imagination to invent new things
• solving challenging problems
• working with people
• writing and explaining
• making things

Satisfying
• final product
• improving the life of people who use what you make
• broad impact on society, health, nature

Great background for many careers
On programming

If you've never programmed a computer, you should. There's nothing like it in the whole world. When you program a computer, it does *exactly* what you tell it to do. It's like designing a machine – any machine, like a car, like a faucet, like a gas-hinge for a door -- using math and instructions. It's awesome in the truest sense: it can fill you with awe.

A computer is the most complicated machine you'll ever use. It's made of billions of micro-miniaturized transistors that can be configured to run any program you can imagine. But when you sit down at the keyboard and write a line of code, those transistors do what you tell them to.

Most of us will never build a car. Pretty much none of us will ever create an aviation system. Design a building. Lay out a city.

Those are complicated machines, those things, and they're off-limits to the likes of you and me. But a computer is like, ten times more complicated, and it will dance to any tune you play. You can learn to write simple code in an afternoon.

Start with a language like Python, which was written to give non-programmers an easier way to make the machine dance to their tune. Even if you only write code for one day, one afternoon, you have to do it. Computers can control you or they can lighten your work -- if you want to be in charge of your machines, you have to learn to write code.
Talk to me about

- Software engineering
- Data analytics / machine learning
  "big data"
- Robotics
- Mathematical modeling
- Optimization and operations research
Computer science
Artificial intelligence
Robotics
Hypothesis

- blue?
  - yes
  - oval?
    - big?
      - no
      - yes
    - no
  - no
Decision Tree

- blue?
  - yes
  - blue?
    - yes
    - oval?
      - yes
      - big?
        - yes
        - no
      - no
    - no
Decision Tree

- blue? yes
- blue? no
  - oval? yes
  - big? no
  - big? yes
- oval? no