

Big Education in the Era of Big Data

Irwin King

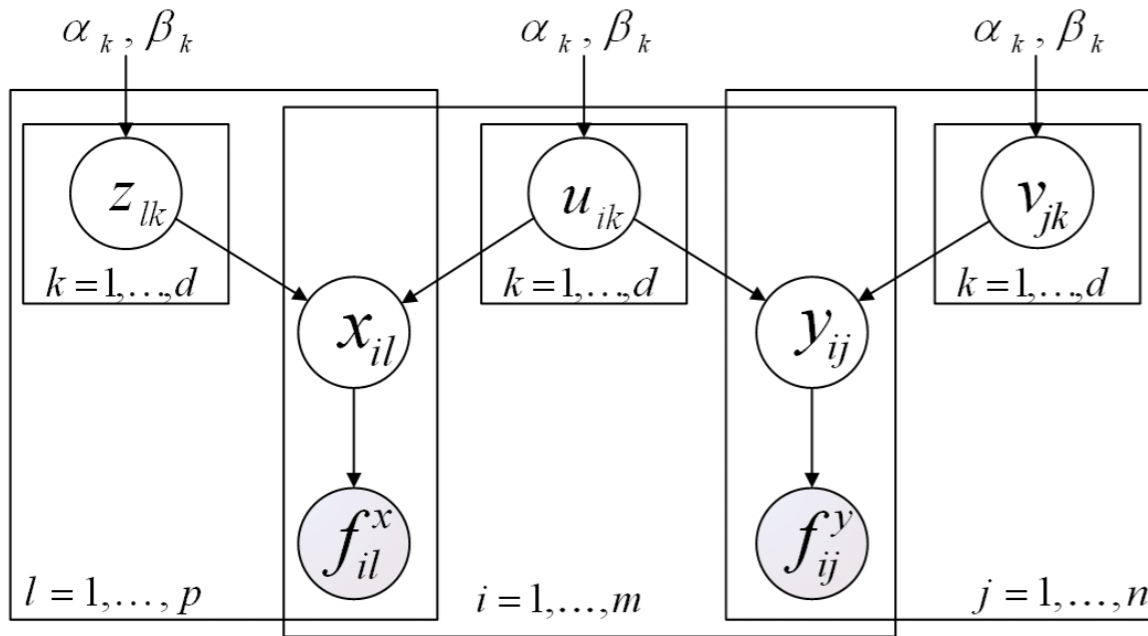
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Collective Probabilistic Factor Model



$$\mathcal{L}(U, V, Z; F^x, F^y)$$

$$\begin{aligned}
 &= \sum_{i=1}^m \sum_{l=1}^p (f_{il}^x \ln x_{il} - x_{il}) + \sum_{i=1}^m \sum_{j=1}^n (f_{ij}^y \ln y_{ij} - y_{ij}) \\
 &+ \sum_{i=1}^m \sum_{k=1}^d ((\alpha_k - 1) \ln(u_{ik}/\beta_k) - u_{ik}/\beta_k) \\
 &+ \sum_{j=1}^n \sum_{k=1}^d ((\alpha_k - 1) \ln(v_{jk}/\beta_k) - v_{jk}/\beta_k) \\
 &+ \sum_{l=1}^p \sum_{k=1}^d ((\alpha_k - 1) \ln(z_{lk}/\beta_k) - z_{lk}/\beta_k) + \text{const.}
 \end{aligned}$$

$$u_{ik} \leftarrow u_{ik} \frac{\sum_{j=1}^n (f_{ij}^y v_{jk} / y_{ij}) + \sum_{l=1}^p (f_{il}^x z_{lk} / x_{il}) + (\alpha_k - 1) / u_{ik}}{\sum_{j=1}^n v_{jk} + \sum_{l=1}^p z_{lk} + 1 / \beta_k}$$

$$v_{jk} \leftarrow v_{jk} \frac{\sum_{i=1}^m (f_{ij}^y u_{ik} / y_{ij}) + (\alpha_k - 1) / v_{jk}}{\sum_{i=1}^m u_{ik} + 1 / \beta_k},$$

$$z_{lk} \leftarrow z_{lk} \frac{\sum_{i=1}^m (f_{il}^x u_{ik} / x_{il}) + (\alpha_k - 1) / z_{lk}}{\sum_{i=1}^m u_{ik} + 1 / \beta_k}.$$

$$u_{ik} \leftarrow u_{ik} \frac{\theta \sum_{j=1}^n (f_{ij}^y v_{jk} / y_{ij}) + (1 - \theta) \sum_{l=1}^p (f_{il}^x z_{lk} / x_{il}) + (\alpha_k - 1) / u_{ik}}{\theta \sum_{j=1}^n v_{jk} + (1 - \theta) \sum_{l=1}^p z_{lk} + 1 / \beta_k}$$





Our Education System

Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid.

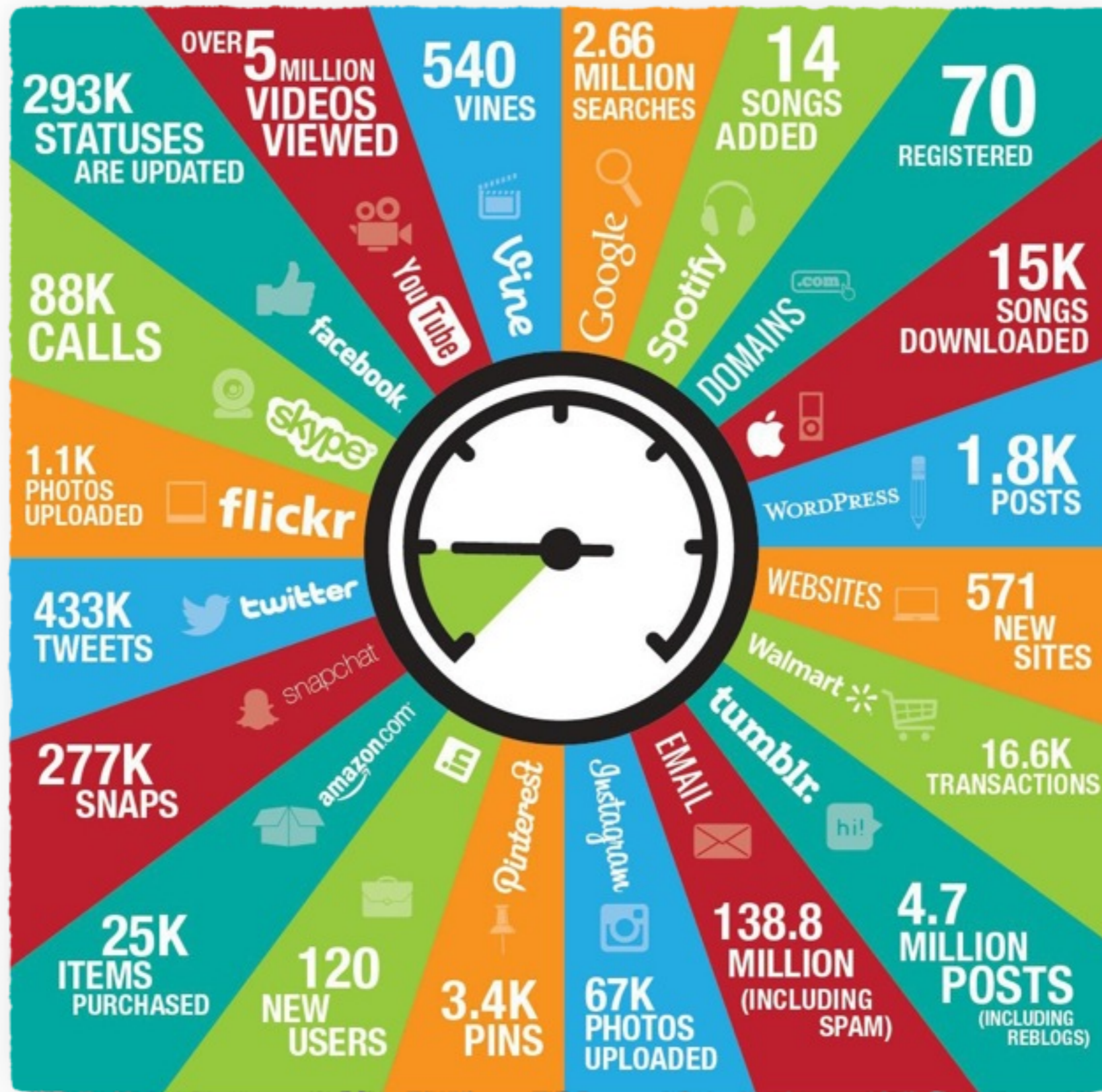
Words of Wisdom

The **BEST** universities focus on **EDUCATION!**

The **BETTER** universities focus on
citation numbers and impact factors...

The **GOOD** universities focus on
counting the number of publications...





Velocity

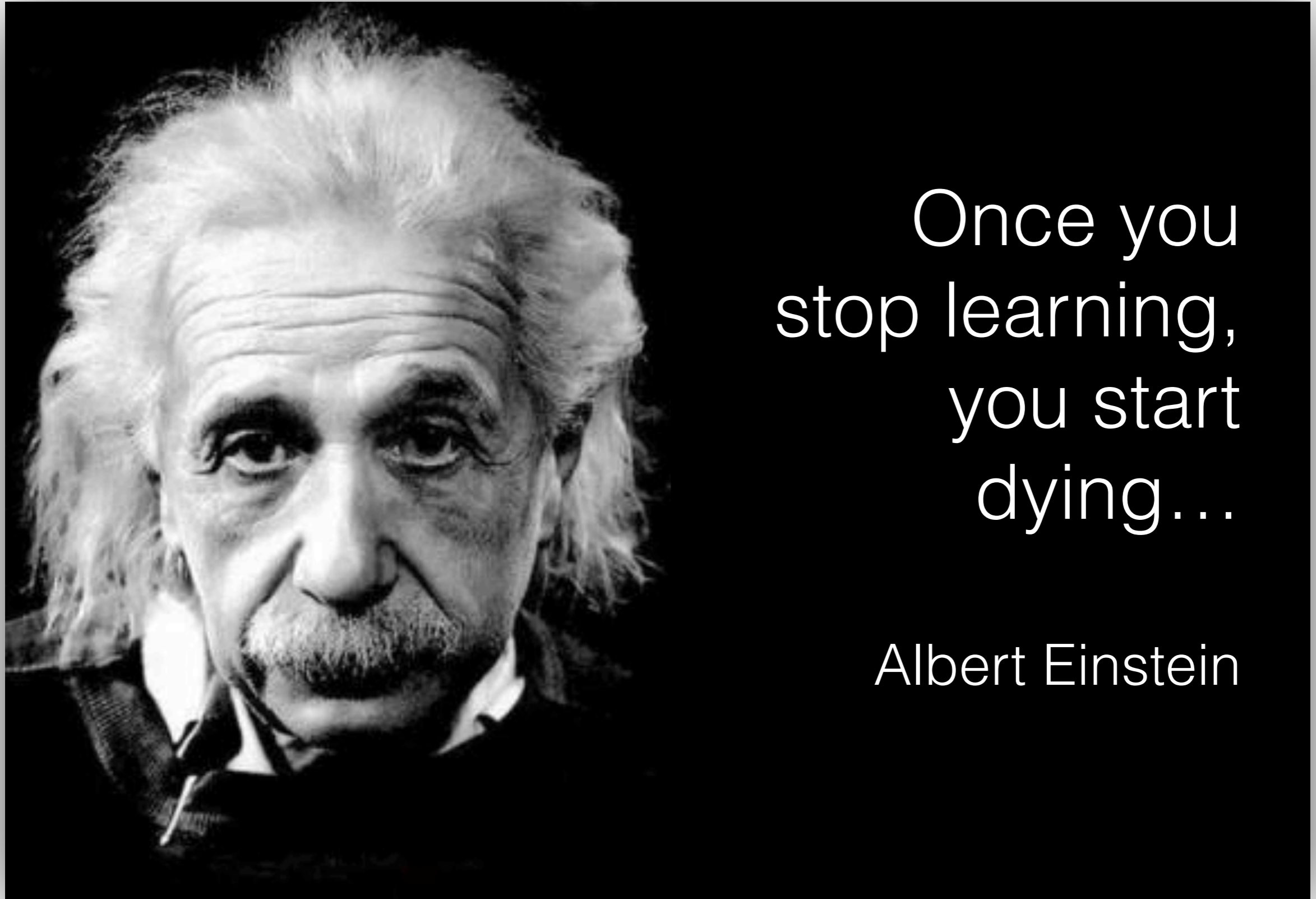
VALUE!

Veracity



Big Education on Lifelong Learning





Once you
stop learning,
you start
dying...

Albert Einstein



MILESTONES IN E-LEARNING

1971

The Open University opens in England with an open admissions policy, and begins broadcasting lectures on television. **25,000 students enroll.**



1989

University of Phoenix launches its private, for-profit online school. **12 students enroll.**



1993

Criteria is created by pioneer William Graziadei III, Ph.D: e-learning systems must be easy to use, portable, replicable, scalable, and affordable.



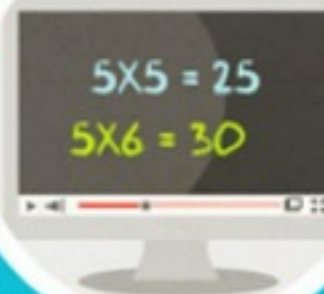
1999

The term 'e-Learning' is coined at an educational seminar.



2004

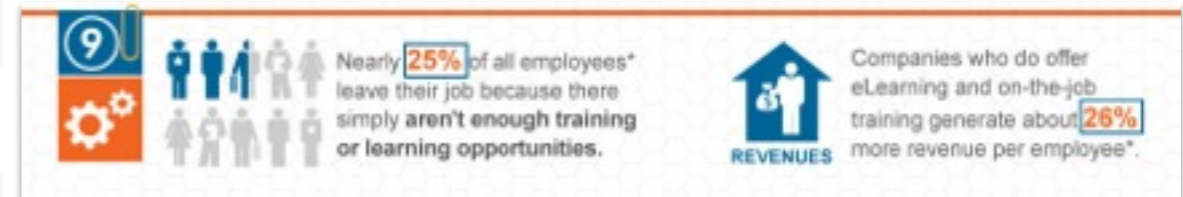
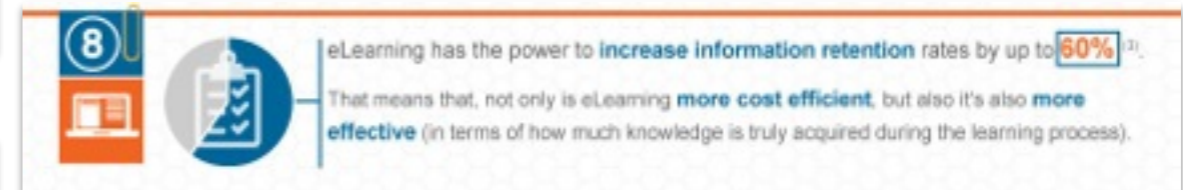
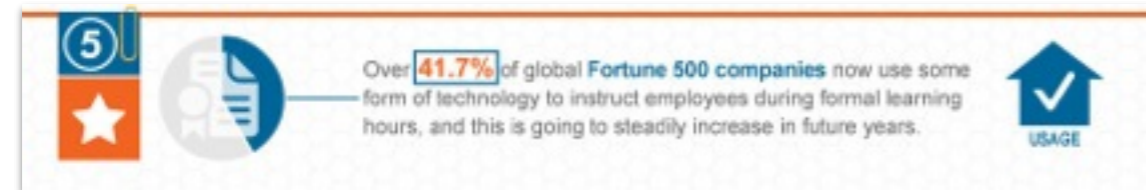
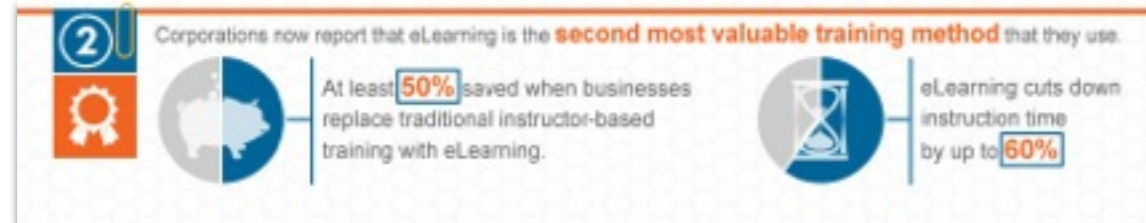
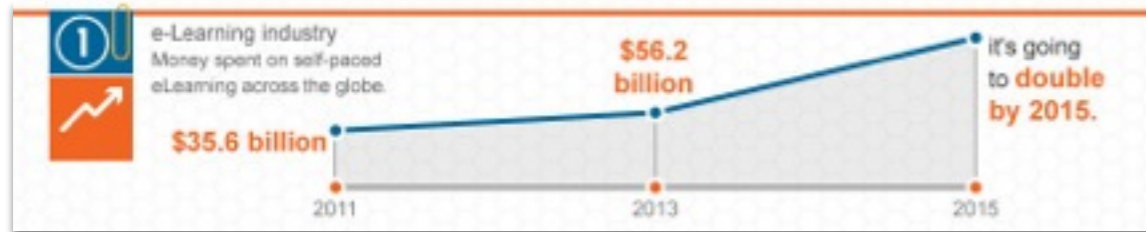
Salman Khan records instructional YouTube videos to help his cousins with math. **The rising popularity of these videos leads him to found the Khan Academy, a not-for-profit, free, online educational organization.**



traditional course Time saved
 participants web knowledge online
 cost-efficient technology education
 method management software Eco-Friendly
TOP 10 eLearning self-paced
 Effective create **STATISTICS** information **FOR 2014**
 Keep-Up-To-Date content support internet
 computer system Productivity social Opportunities
 work

The rise in eLearning's popularity isn't showing any signs of slowing. In fact, judging by the following Top 10 eLearning statistics for 2014, the future of the eLearning Industry is brighter than ever:







e-Learning industry
Money spent on self-paced
eLearning across the globe

\$35.6 billion

2011

BIG MONEY

\$56.2
billion

2013

2015

it's going
to **double**
by 2015.



2013: About **4.6** out of 10 college students
are taking at least one course online.

BIG USERS

roughly **half** of all college
classes* will be eLearning-based.

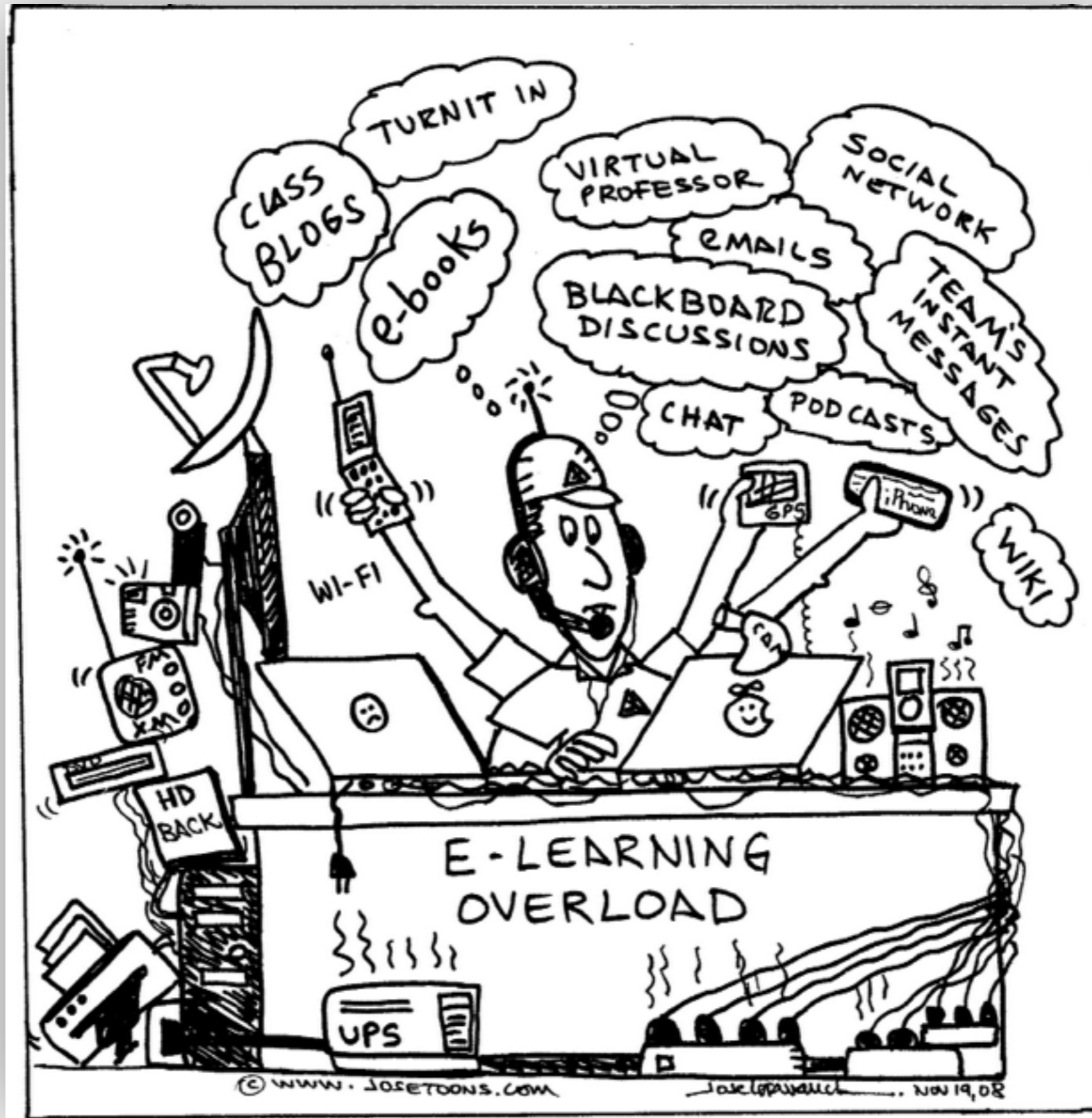


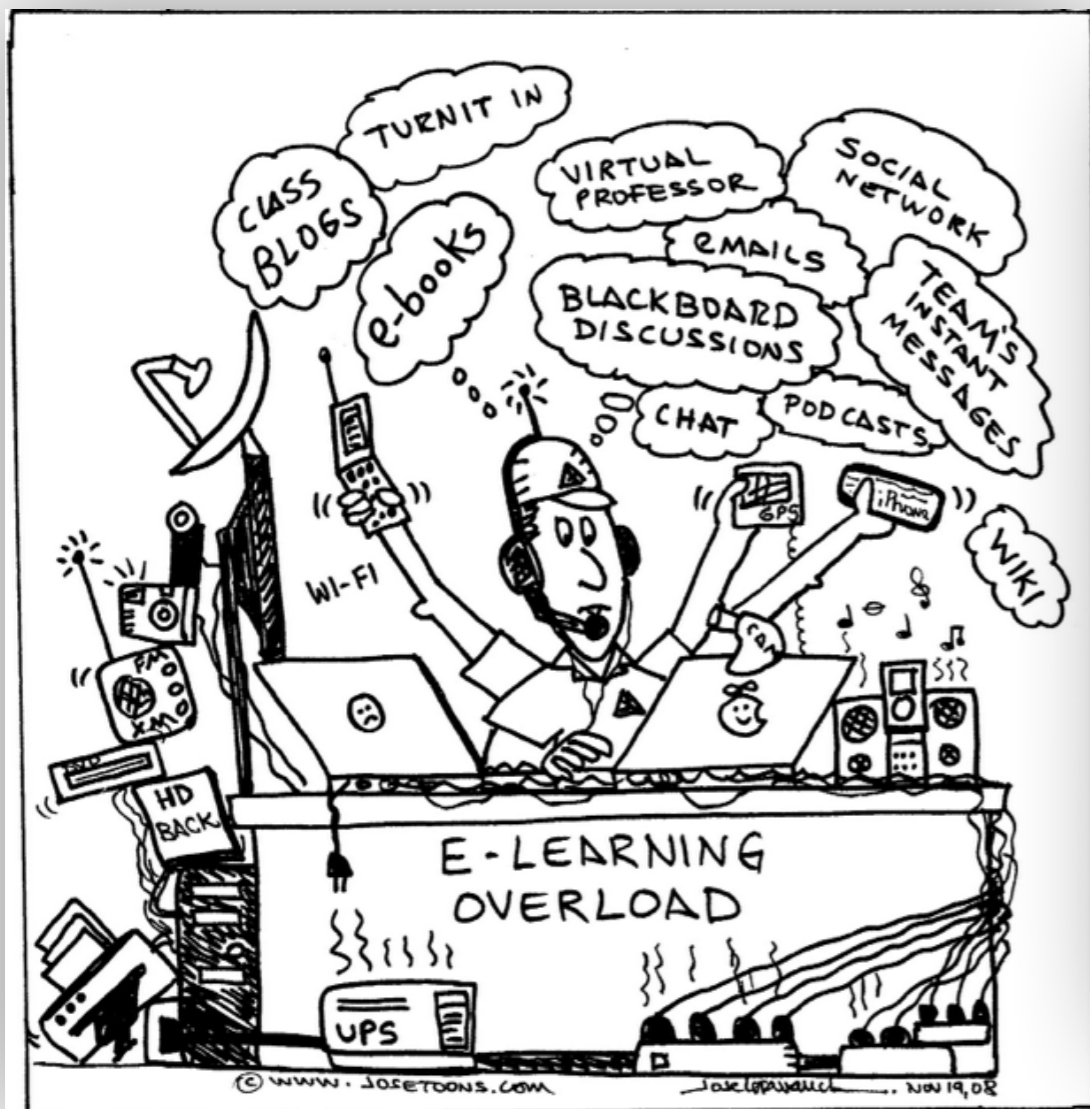
eLearning has the power to **increase information retention** rates by up to **60%** ⁽³⁾.

BIG IMPROVEMENT

it's also **more**
effective (in the
learning process).







The task of the modern educator is not to cut down jungles, but to irrigate deserts.

C.S. Lewis



Trends in Big Education





Collaboration



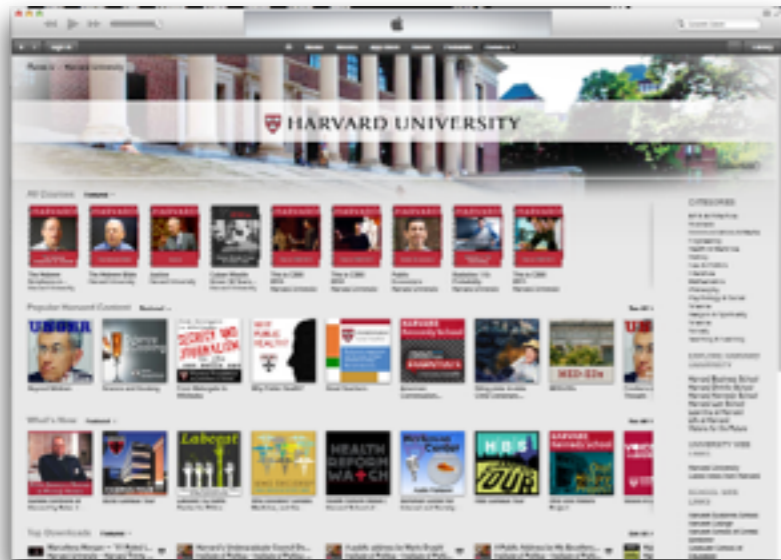
**Cost
effectiveness**



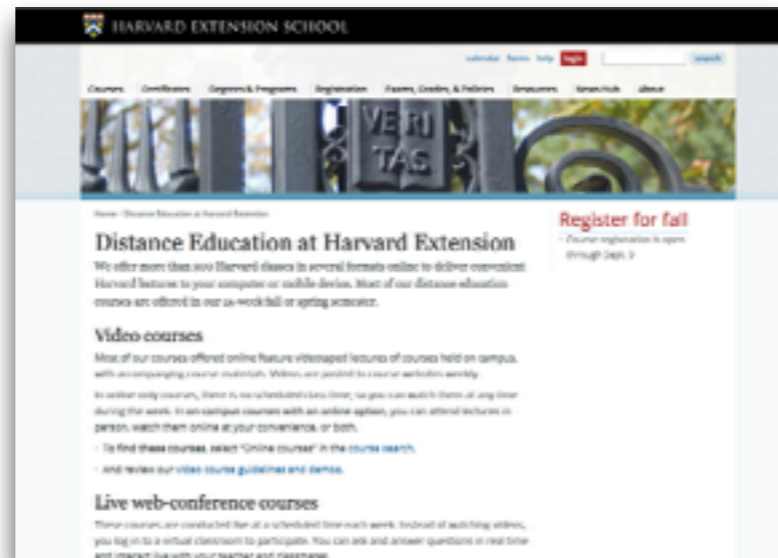
Customization



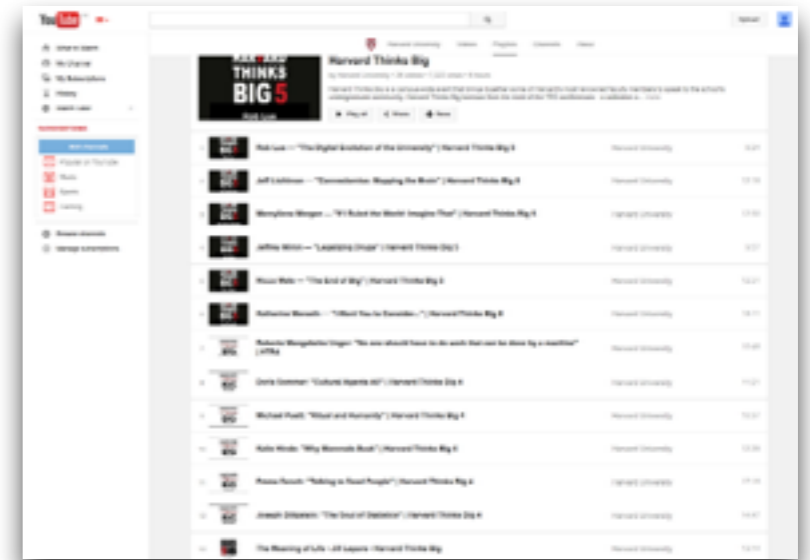
Multimodal Learning



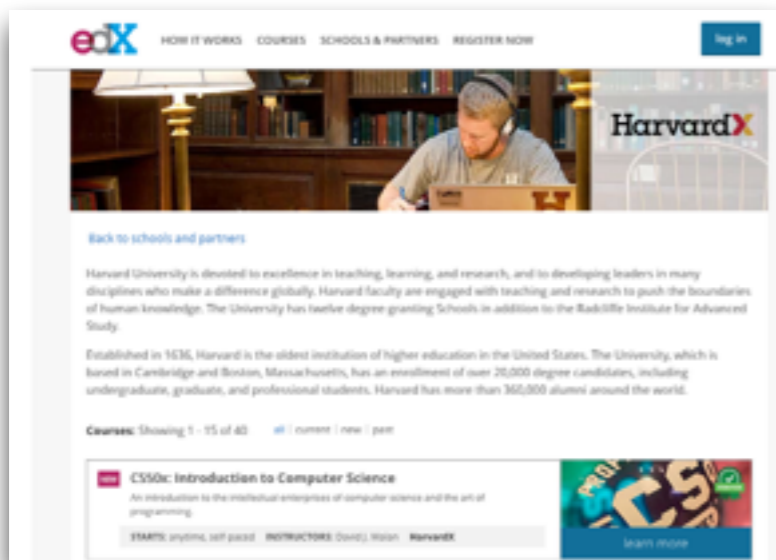
Harvard @ iTunes U



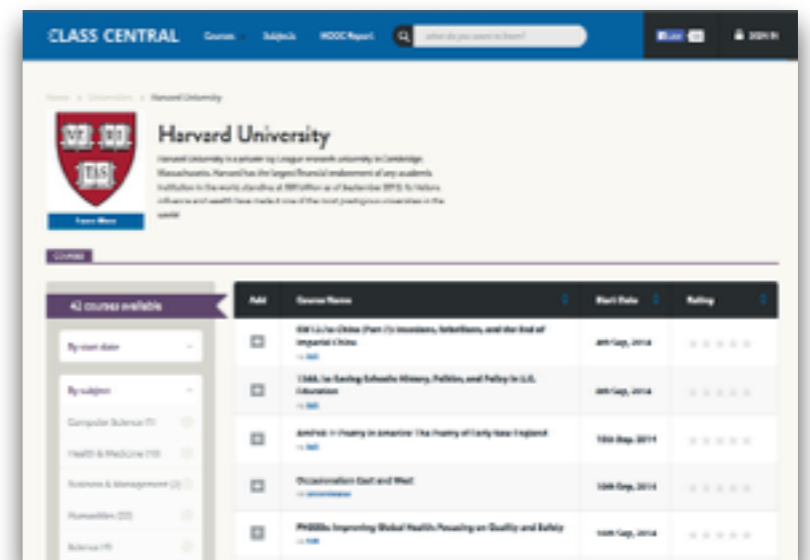
harvard.edu



Harvard @ YouTube



Harvard @ edX



Harvard @ Class Central



MOOC

Massive Open Online Course

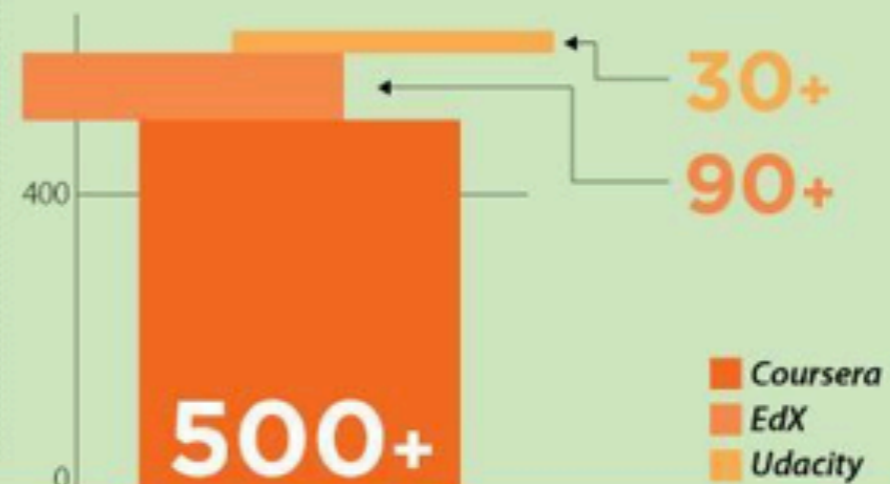


MASSIVE

Students enrolled in MOOCs



Courses offered by major platforms



OPEN

These courses are provided by many different universities and open to anyone who wishes to enroll.

87

The number of academic partners that offer courses on Coursera's platform



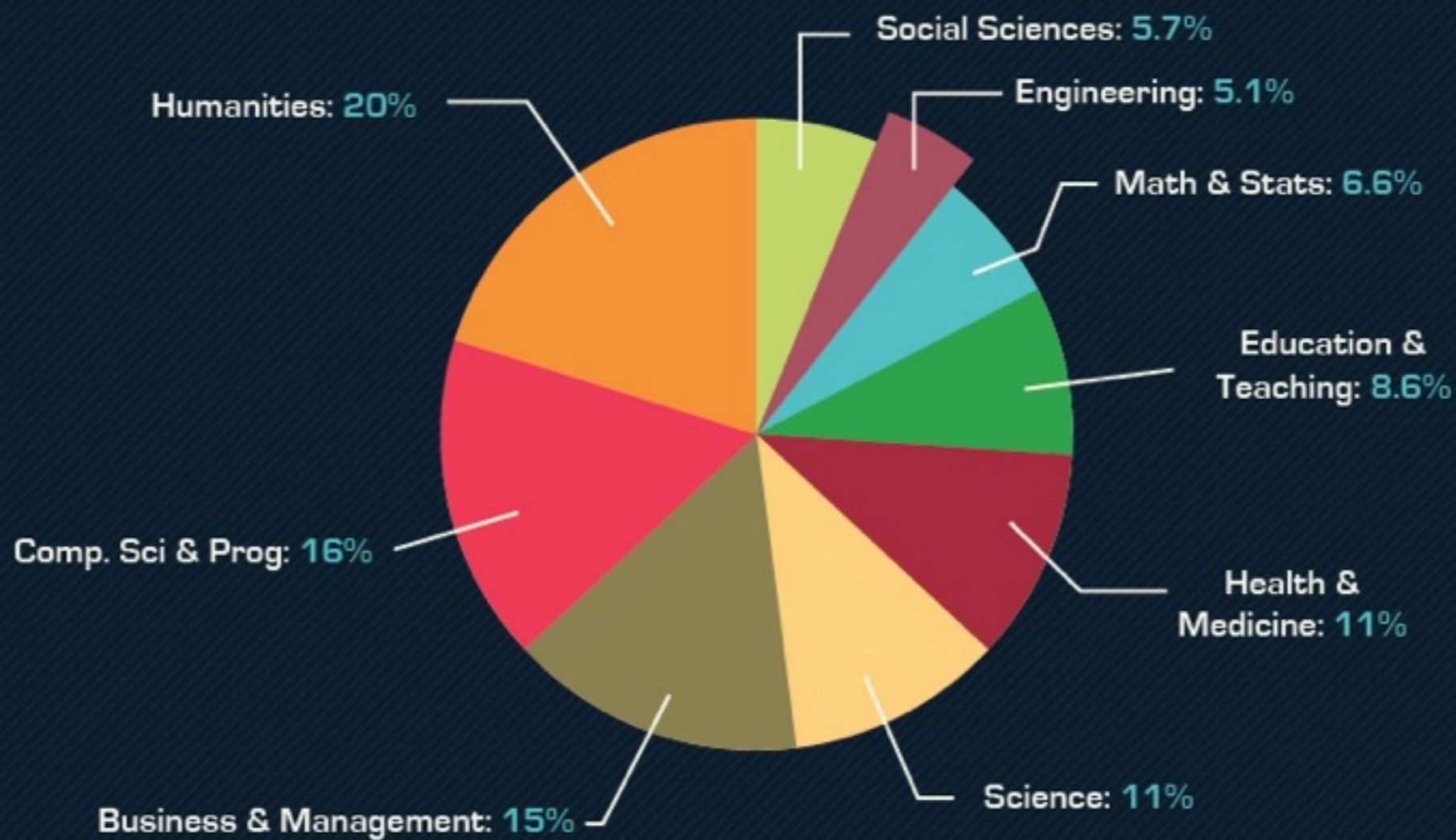
ONLINE

Courses are even reaching as far as developing countries like Mongolia, where high school students are taking courses from:



Courses Offered

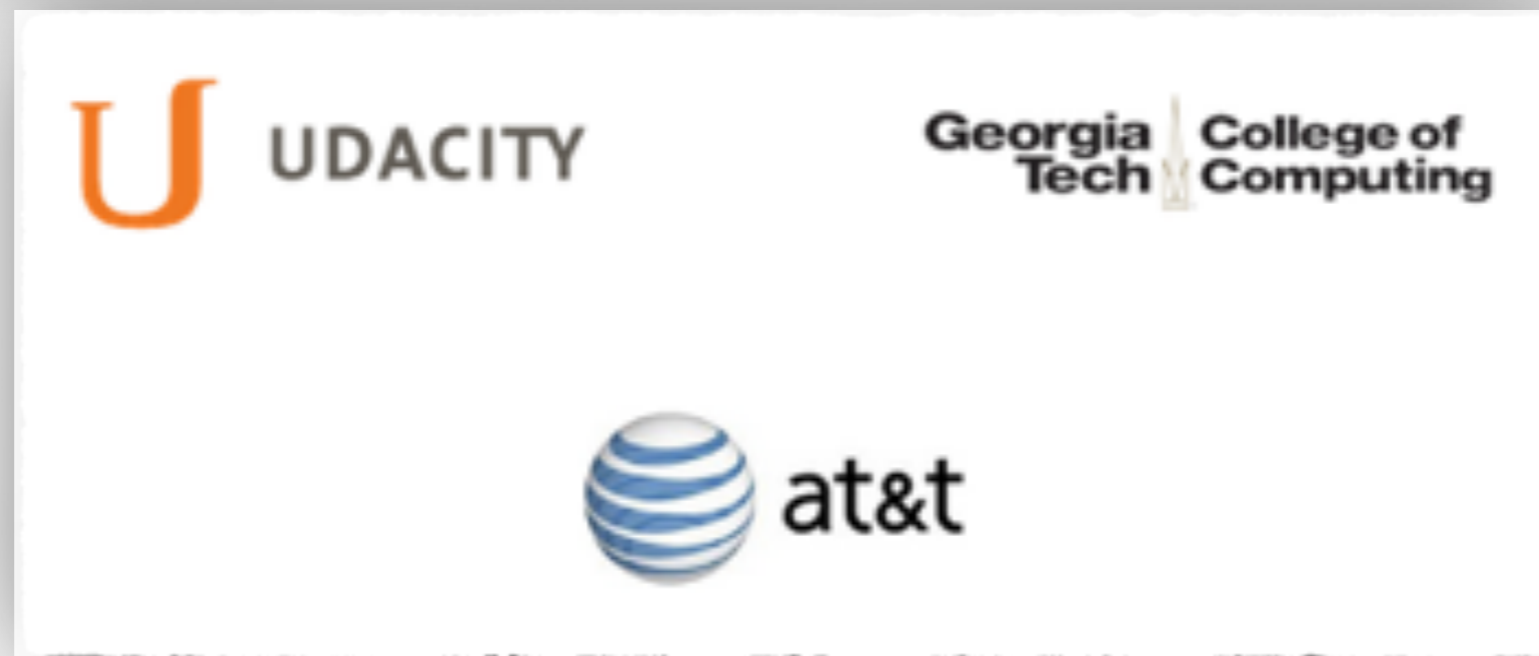
1200+ courses available



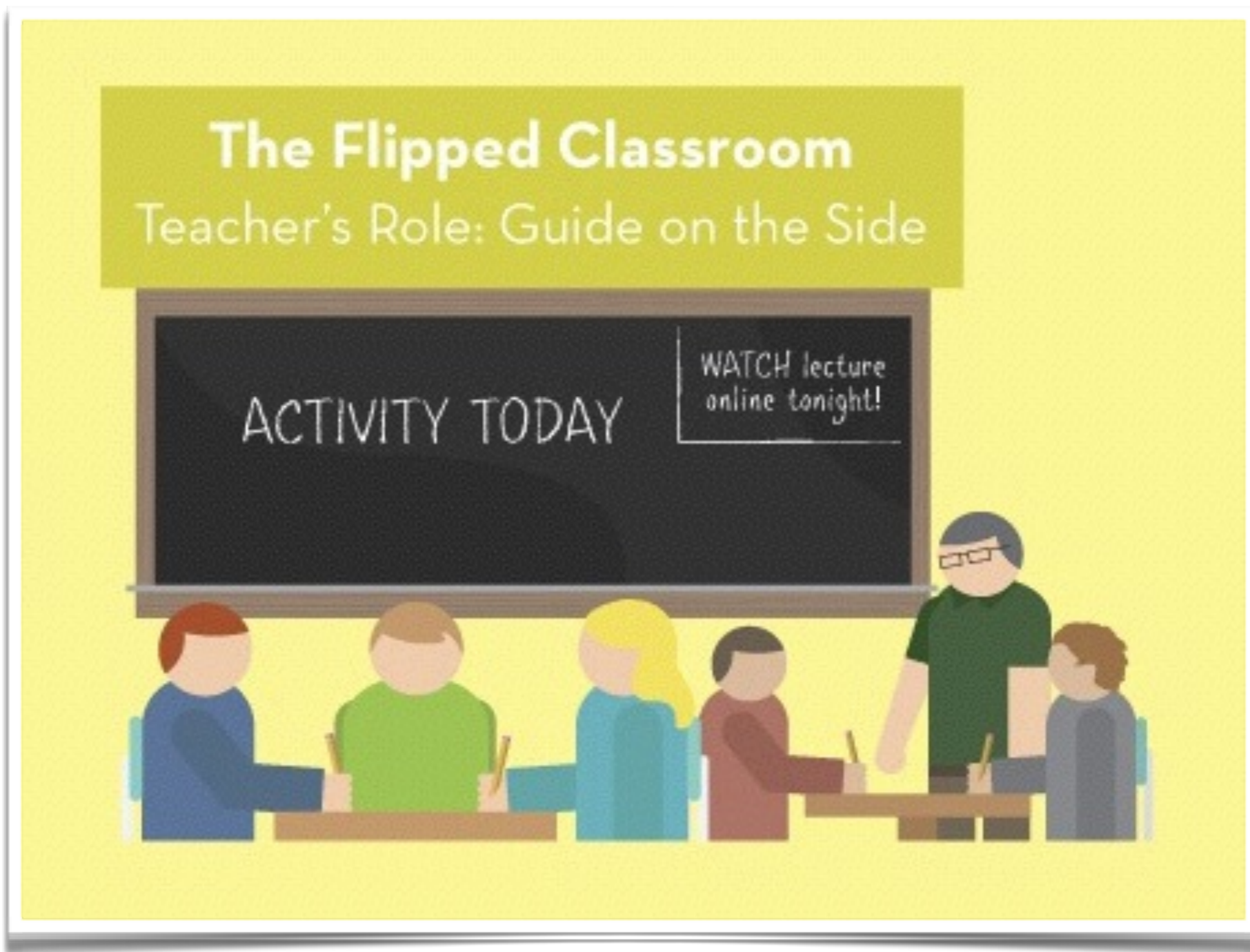
SOURCE: Edsurge



Small Private Online Course (SPOC) with Degree



Flipped Classroom



Microlearning

KHANACADEMY Subject: Computer pro... Coach About Donate Search for subjects, skills, and videos Log in Sign up

COMPUTER PROGRAMMING

Intro to JS: Drawing & Animation

In these tutorials, you'll learn how to use the JavaScript language and the ProcessingJS library to create fun drawings and animations. If you've never programmed before, start here to learn how!

- + Create Program
- Documentation
- ? Help Requests
- Project Evaluations
- Community Questions

ALL CONTENT IN "INTRO TO JS: DRAWING & ANIMATION"

Intro to programming

If you've never been here before, check out this introductory video first. Then get coding!

- ▶ What is Programming?
- ▶ A Tour of Programming on Khan Academy

Drawing basics

We'll show you the basics of programming and how to draw shapes.

- ▶ Intro to Drawing
- ★ Challenge: H for Hopper
- ▶ More Drawing!
- ★ Challenge: Simple Shapes!
- ★ Challenge: CRAZY Face

Coloring

We'll show you how to color and outline your shapes!

- ▶ Intro to Coloring
- ★ Challenge: Ice Cream Code
- ★ Challenge: It's a Beautiful Day
- ▶ The Power of the Docs
- ✔ Project: What's for Dinner?

Variables

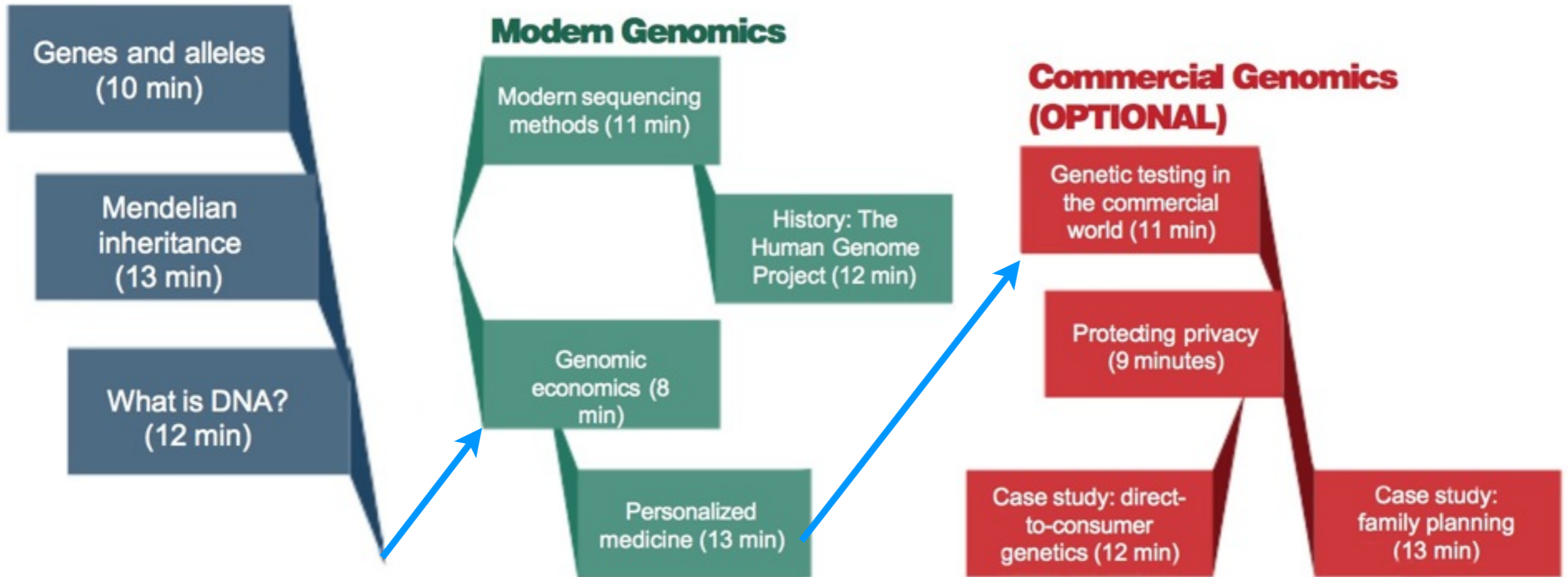
We'll cover how to use variables to hold

- ▶ Intro to Variables



Personalized Learning

Basic Genetics Refresher (OPTIONAL)



Active Learning

The screenshot shows a courseware interface with a navigation menu on the left and a video player on the right. The navigation menu includes links for Courseware, Course Info, Discussion, Wiki, Progress, and Syllabus & Course Information. The video player is titled "FOR LOOP COMBINATIONS" and displays a video titled "Nested loop trace example". The video content shows a code snippet for a nested loop and its output.

```
for i = 1:3
    fprintf('*')
    for j = 1:5
        fprintf('%d', j)
    end
    fprintf('\n')
end
```

Output:
*12345
*12345
*12345



Peer Learning

Coursera MOOC Participation

MOOC participation
by IP address, aggregated to
23,000 sq. km hexagons

- High
- Medium
- Low
- None

3+ million of 5+ million locatable IP addresses represented on the map

CARTOGRAPHY LAB
University of Wisconsin-Madison



KEEP

Knowledge and Education
Exchange Platform



KEEP Education Cloud

- Educational resources to **anyone, anytime, anywhere**, on **any device**
- An **education cloud platform** to provide aggregated eLearning resources for teachers and students
- Big Data **analytics for education**
- **Knowledge aggregation** and **technology integration!**
- Multi-year, multi-discipline, and cross-institutional project with **strong partners and alliances**



KEEP's Mission

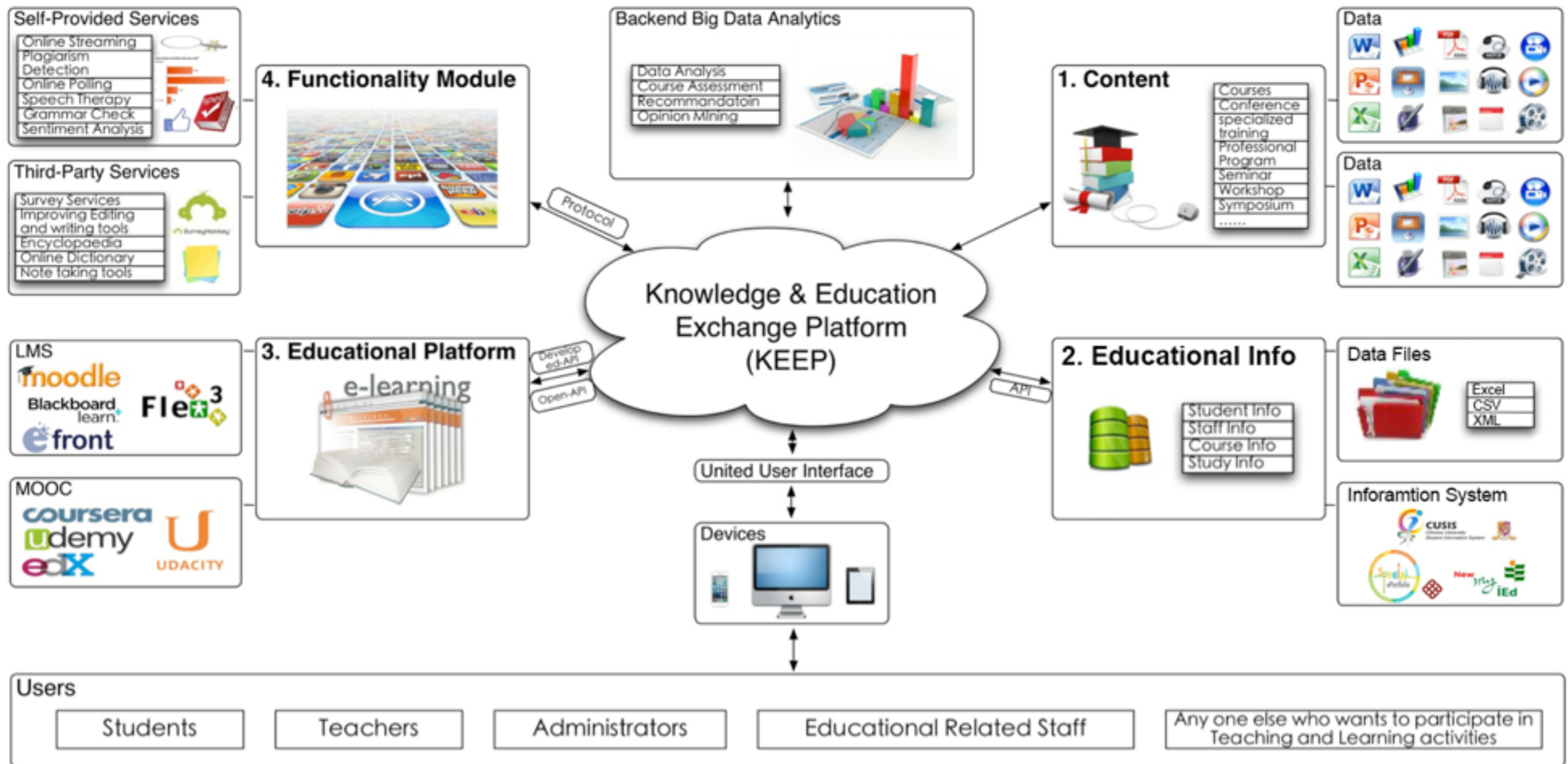
- Promote eLearning and educational **resources** from **content providers**
- Support **students** and **educators** in teaching and learning through advanced **analytics**
- Provide **administrators** important information to assess, evaluate, make decision, and predict **performances** based on analytics
- Interface with **developers** to design and implement educational **technologies**



Some Partners and Alliances



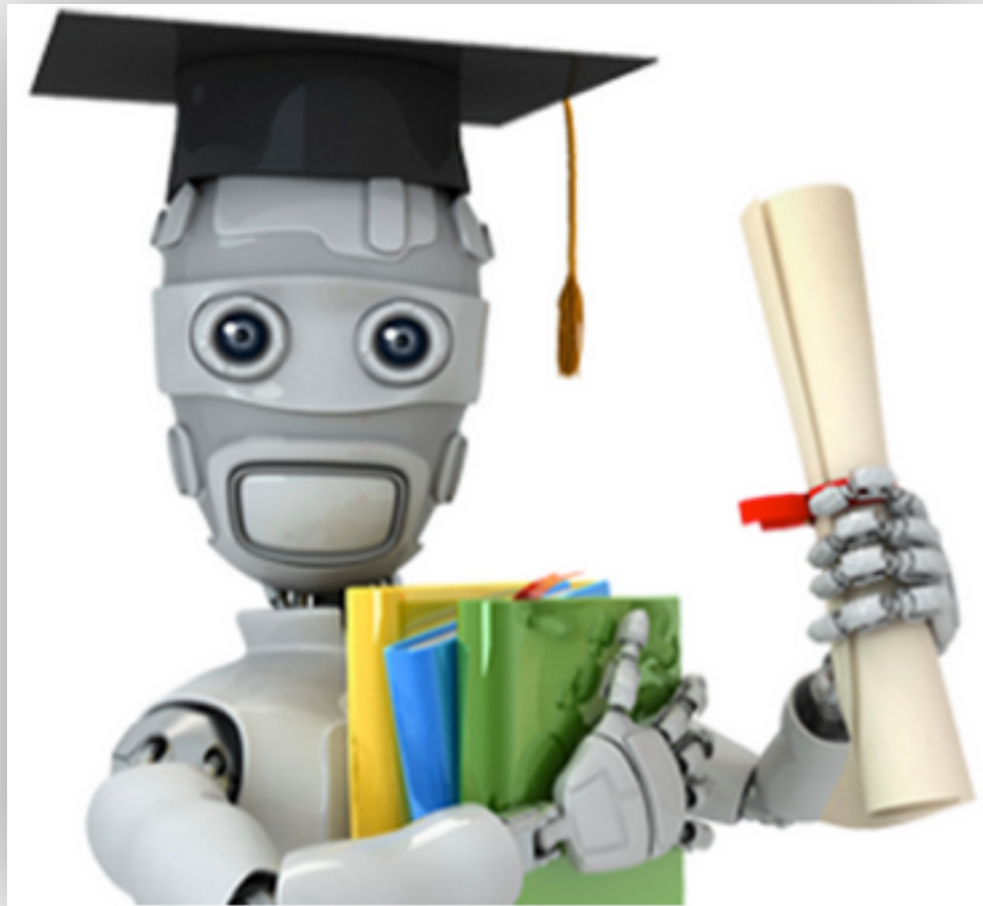
The KEEP Education Cloud



Work in Progress & Future Works



Natural Language Processing



- Text and semantic analysis
- Summarization
- Sentiment analysis
- Automated grading
- Q&A systems for classes



Recommendations



- Personalized learning
- Courses, tutors, peering learning partners, etc.
- Learning resources, time allocation, etc.
- Career planning



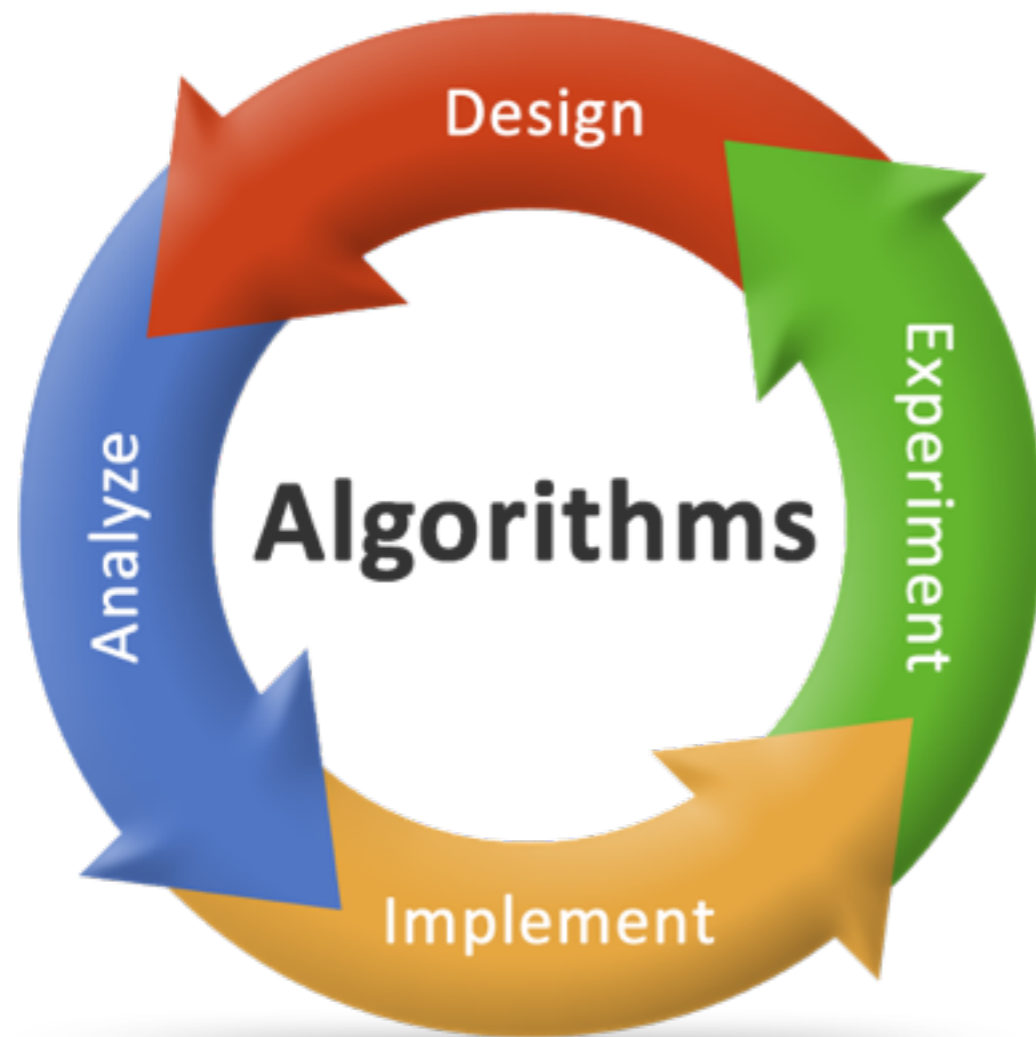
Knowledge Map



- Explore topics and concepts
- Track topic changes
- Make topic comparisons and inferences
- Better search on concepts



Algorithms & Techniques



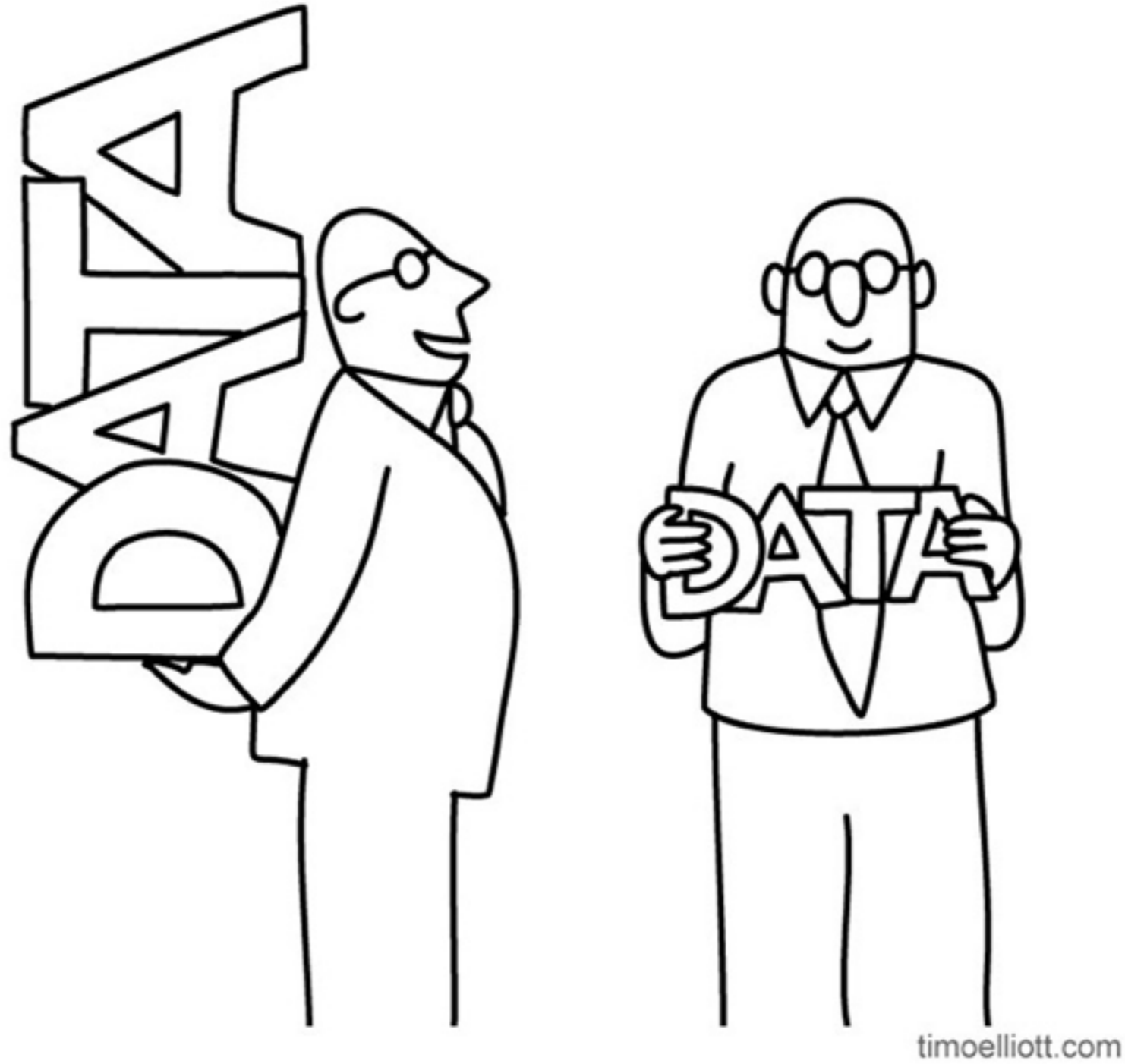
- Machine learning
- Data analytics
- Social computing
- Web intelligence
- Multimedia information processing



Get Involved

Partners and alliances are welcomed.





“I think you’ll find that mine is bigger...”



Concluding Remarks

- *Be Inspired*
 - Big Education is the focus!
- *Be Informed*
 - Big Data in Education is the **VALUE** proposition!
- *Be Challenged*
 - Use technologies to transform education in the Big Data Era!





The Chinese University of Hong Kong



Q&A

