Evolution of LMS and Studio Architecture

May 26, 2017

Nimisha Asthagiri
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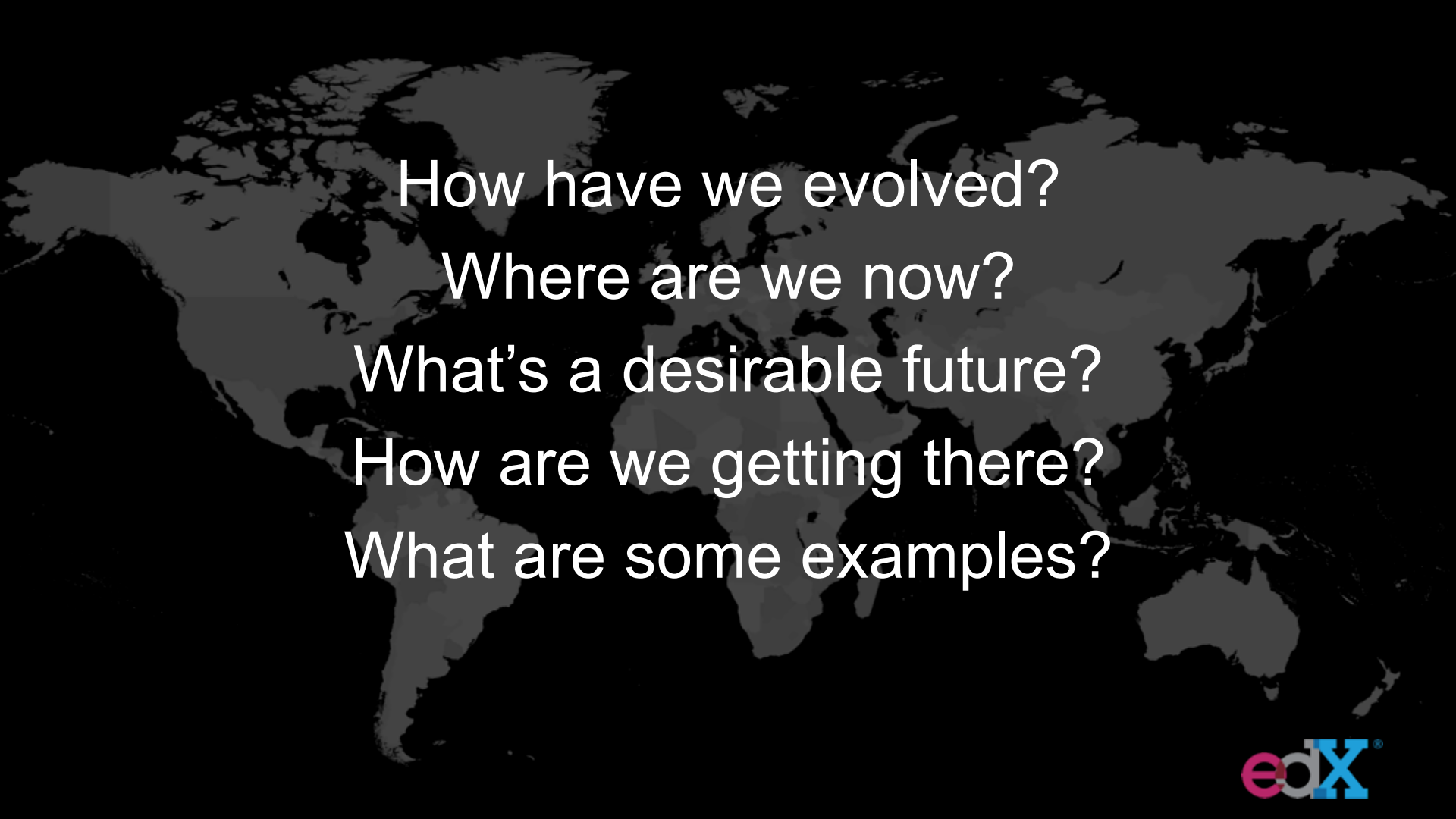
github.com/nasthagiri


How have we evolved?
Where are we now?
What's a desirable future?
How are we getting there?
What are some examples?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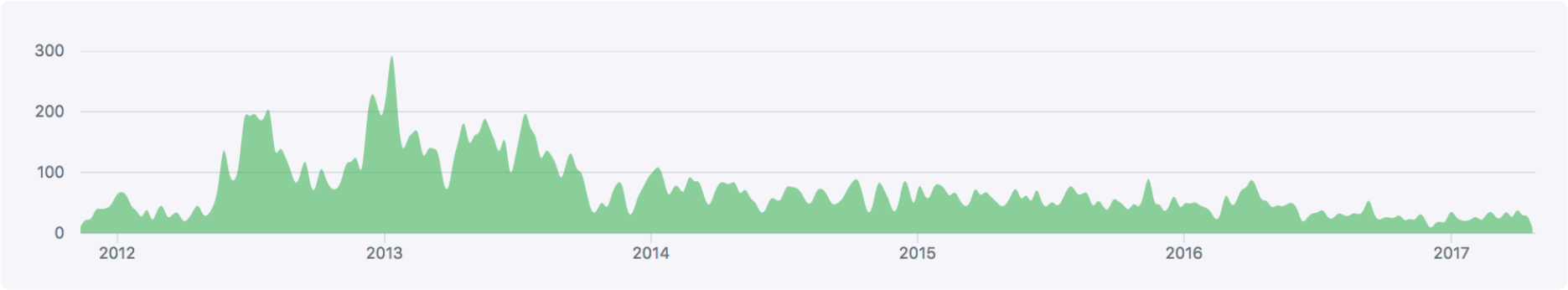
edx-platform Commits

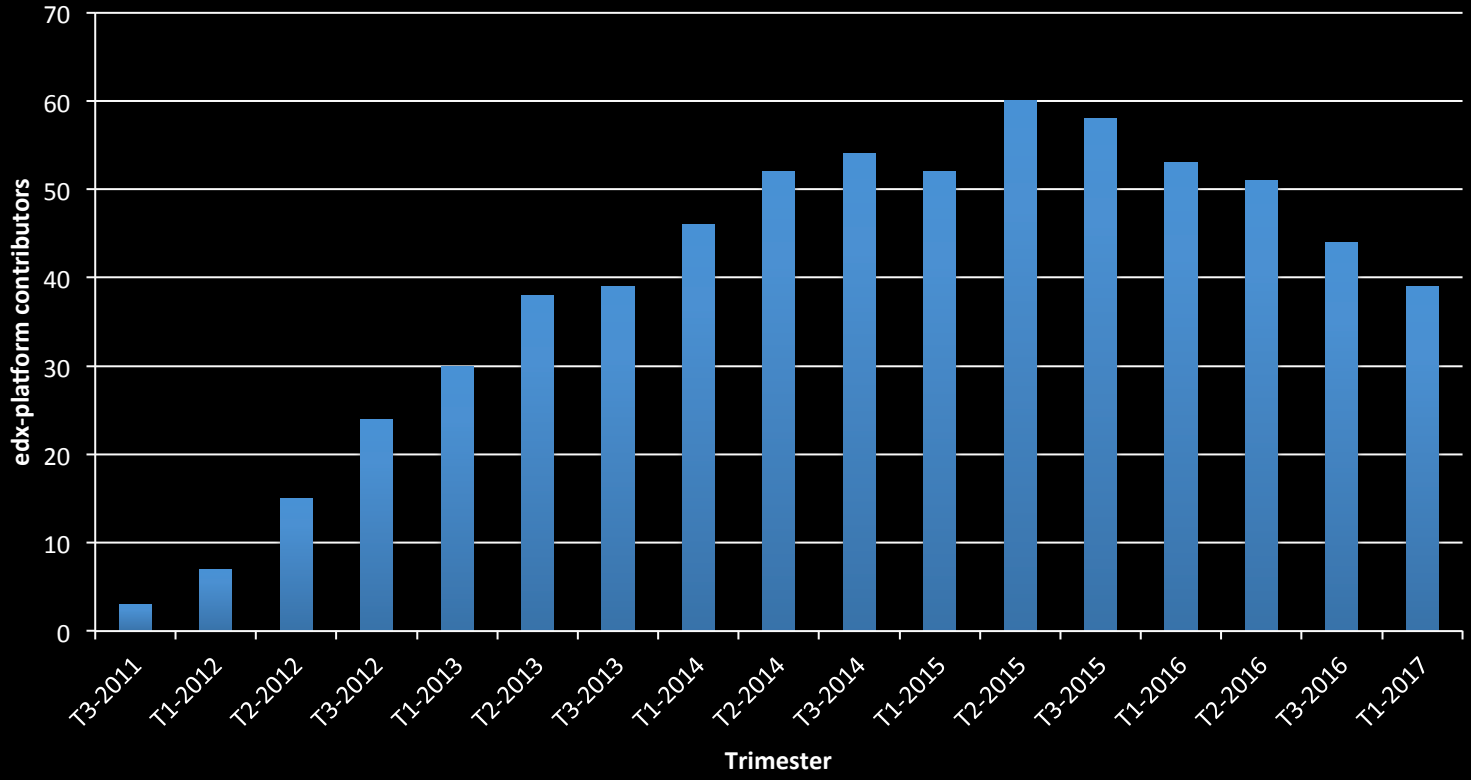
Dec 4, 2011 – May 18, 2017

Contributions to master, excluding merge commits

Contributions: **Commits**

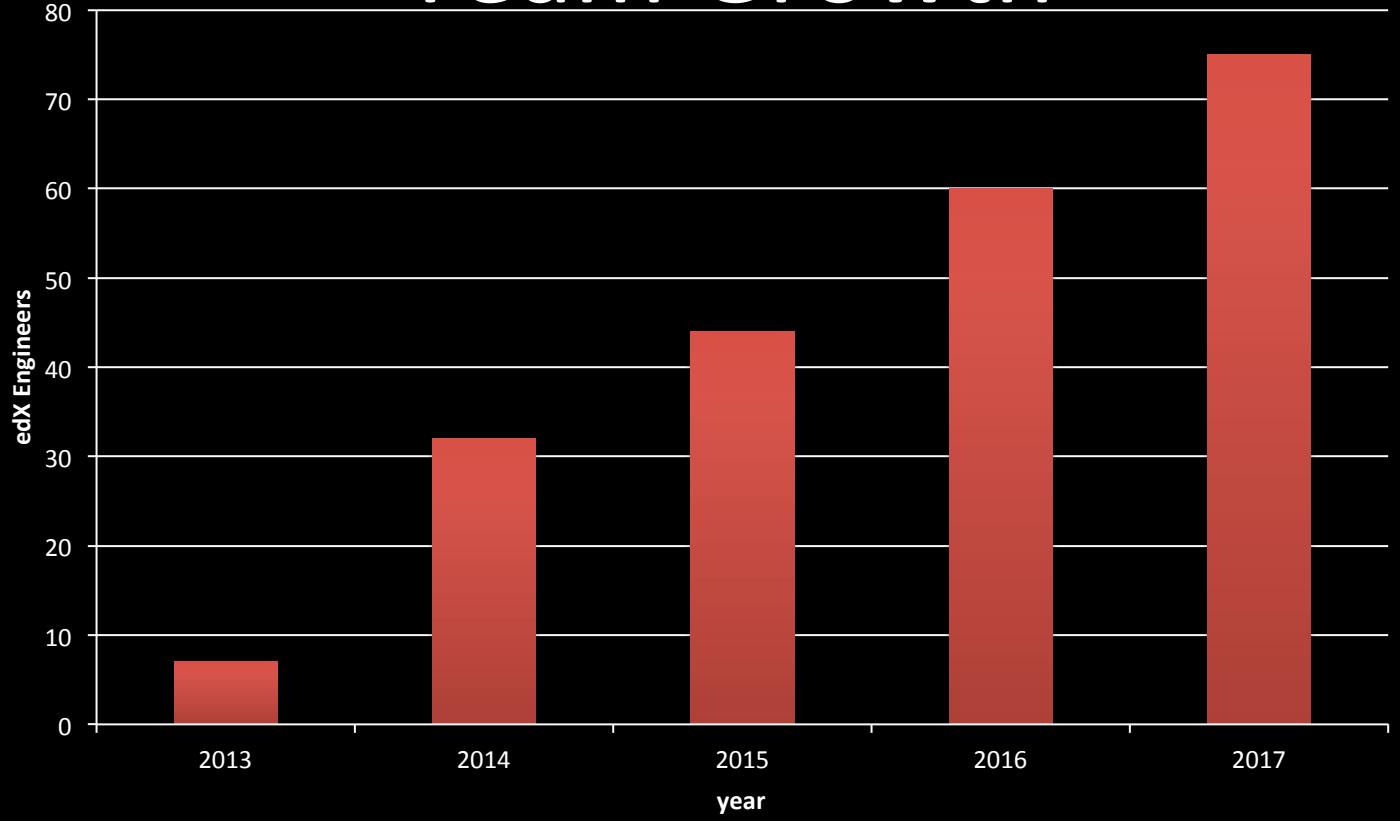


edx-platform Contributors

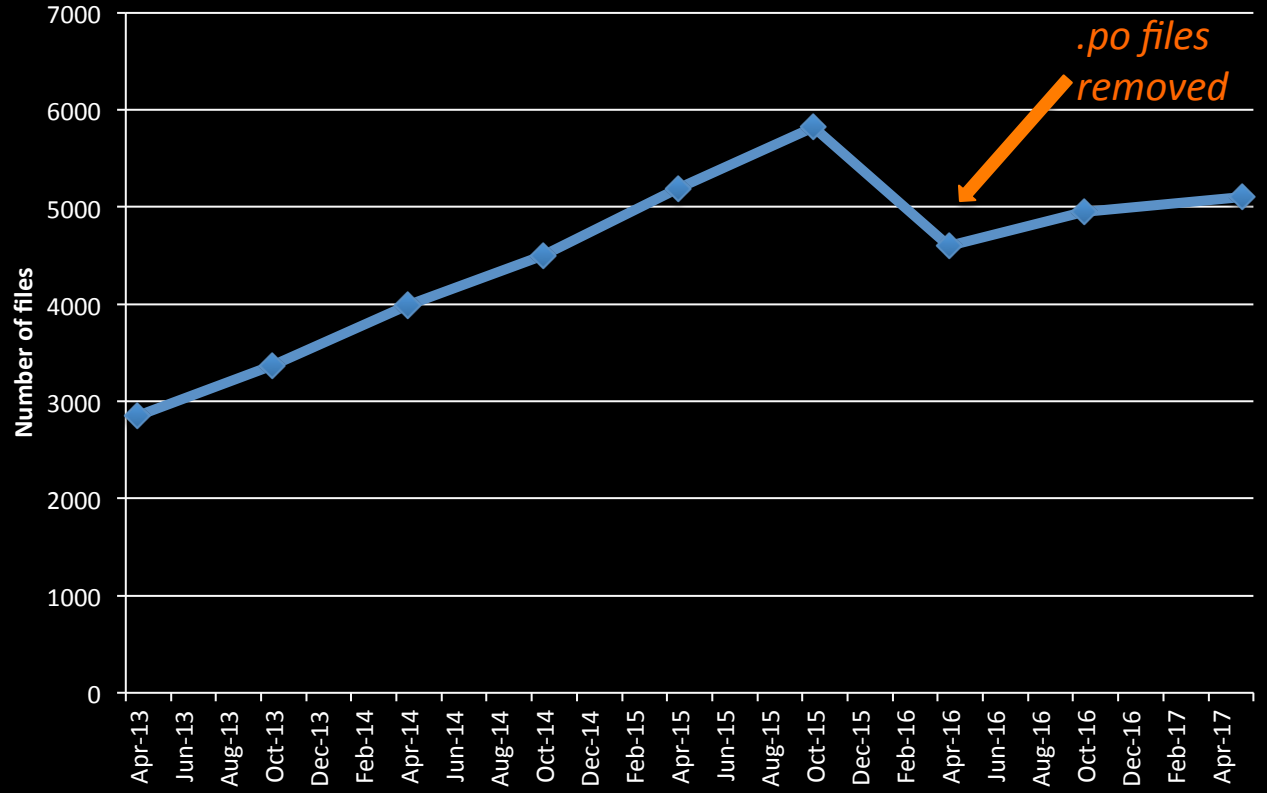


Total: 342

Team Growth


80
70
60
50
40
30
20
10
0
edX Engineers
2013
2014
2015
2016
2017
year

File Growth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Number of files
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5000
4000
3000
2000
1000
0
Apr-13
Jun-13
Aug-13
Oct-13
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Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
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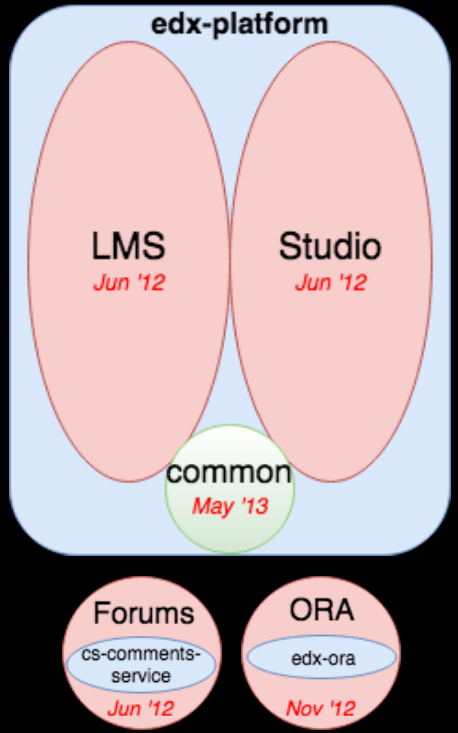
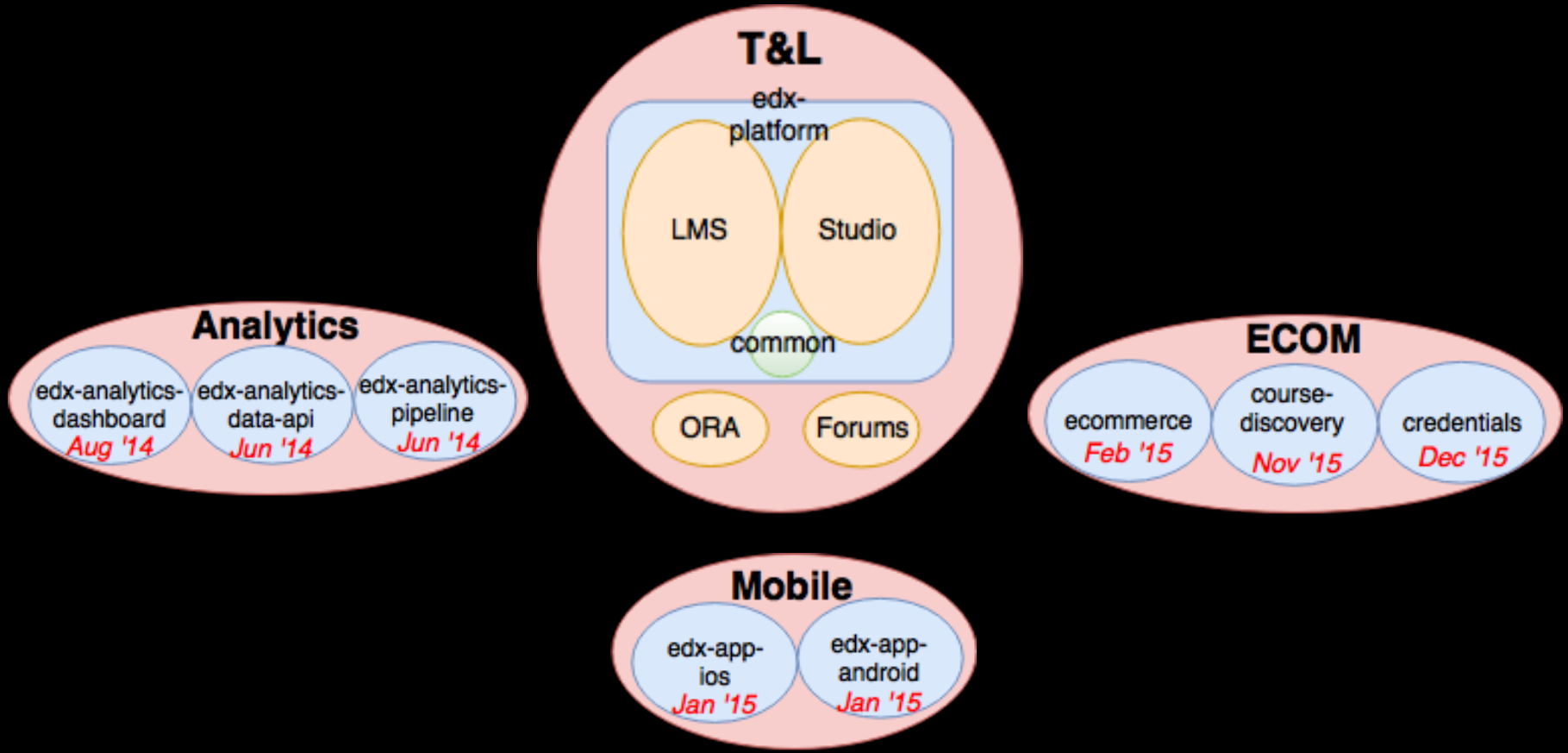
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17

edx-platform

Dec '11


edx-platform
LMS
Jun '12
Studio
Jun '12
common
May '13
Forums
cs-comments-service
Jun '12
ORA
edx-ora
Nov '12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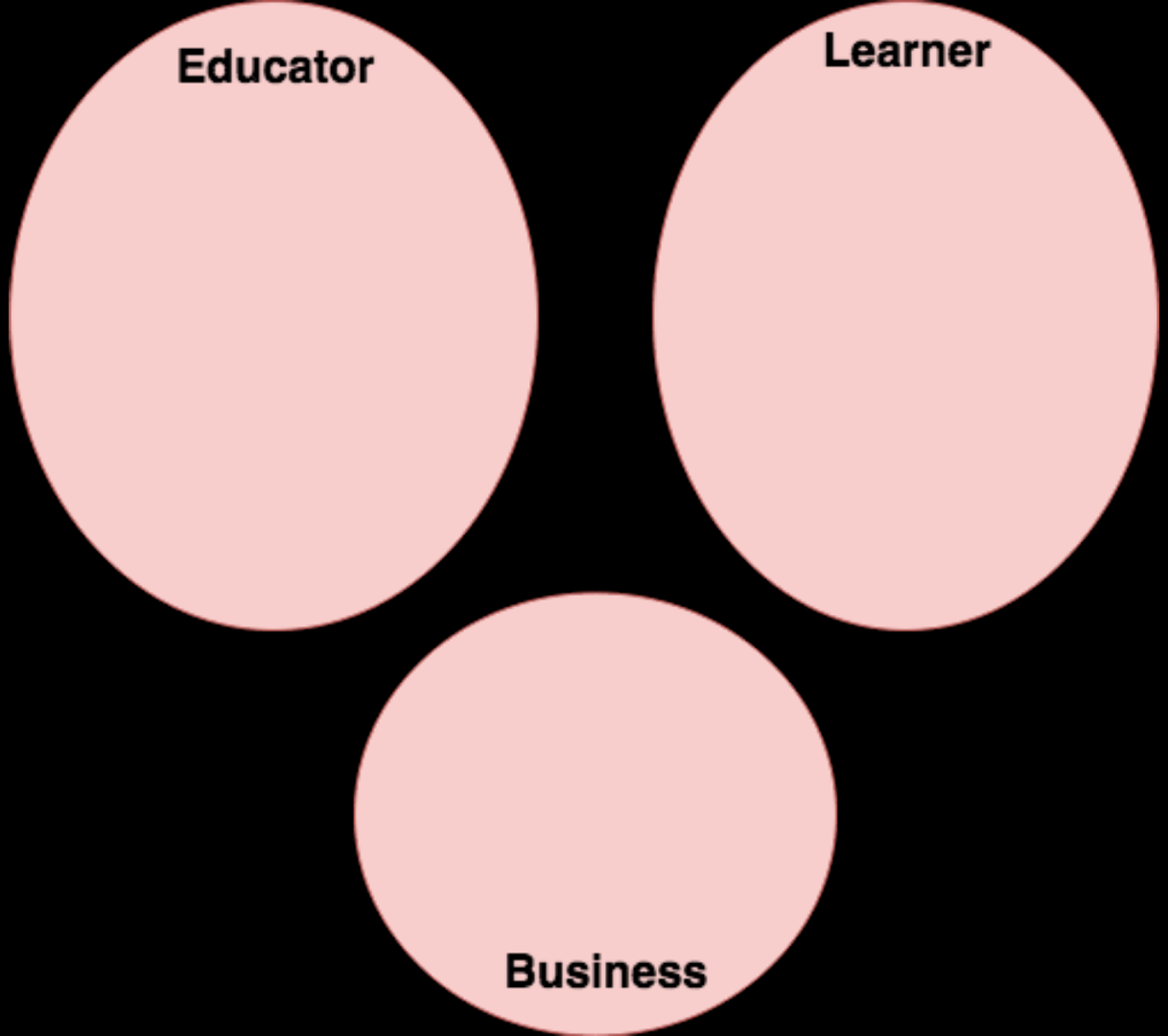
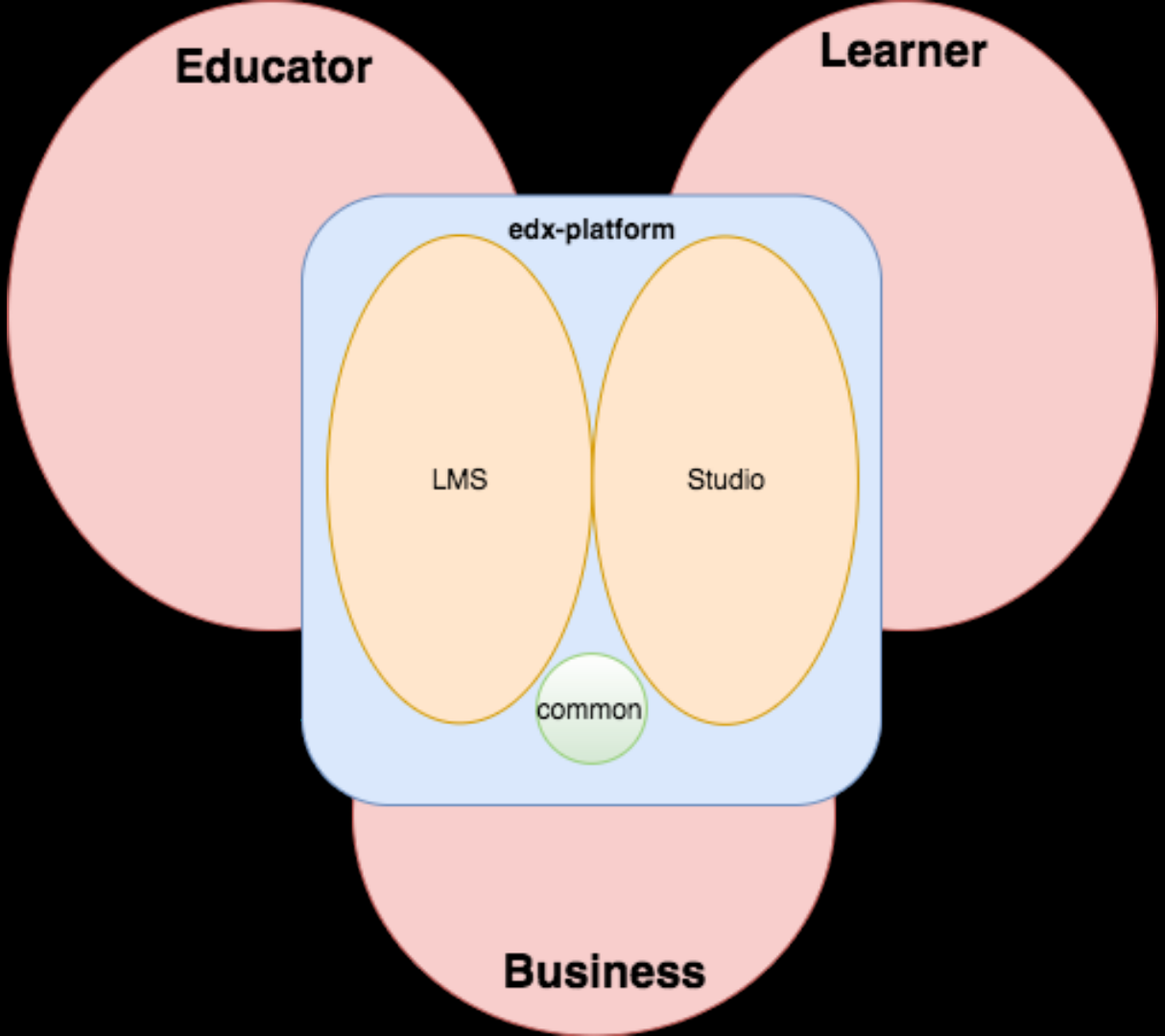
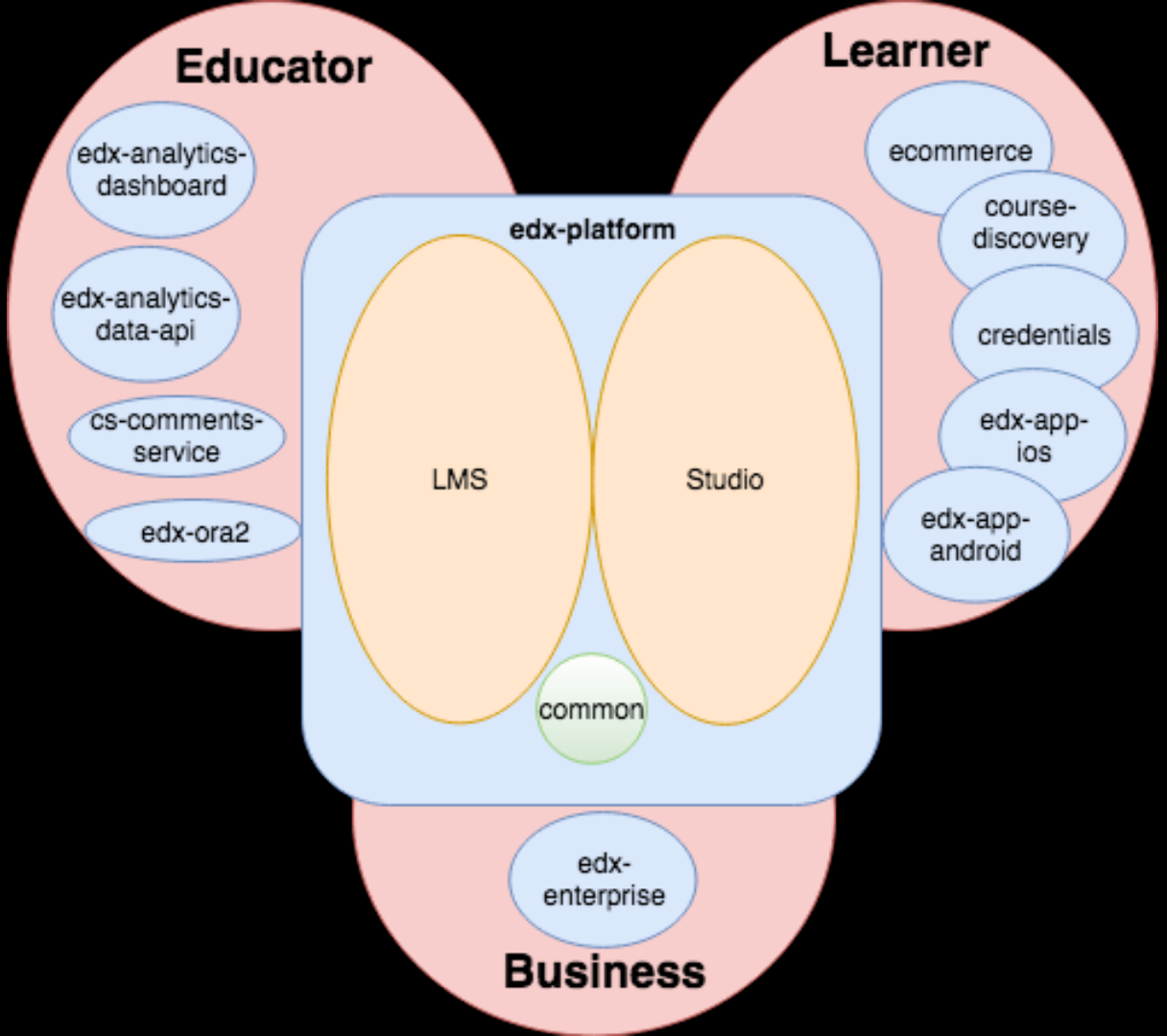
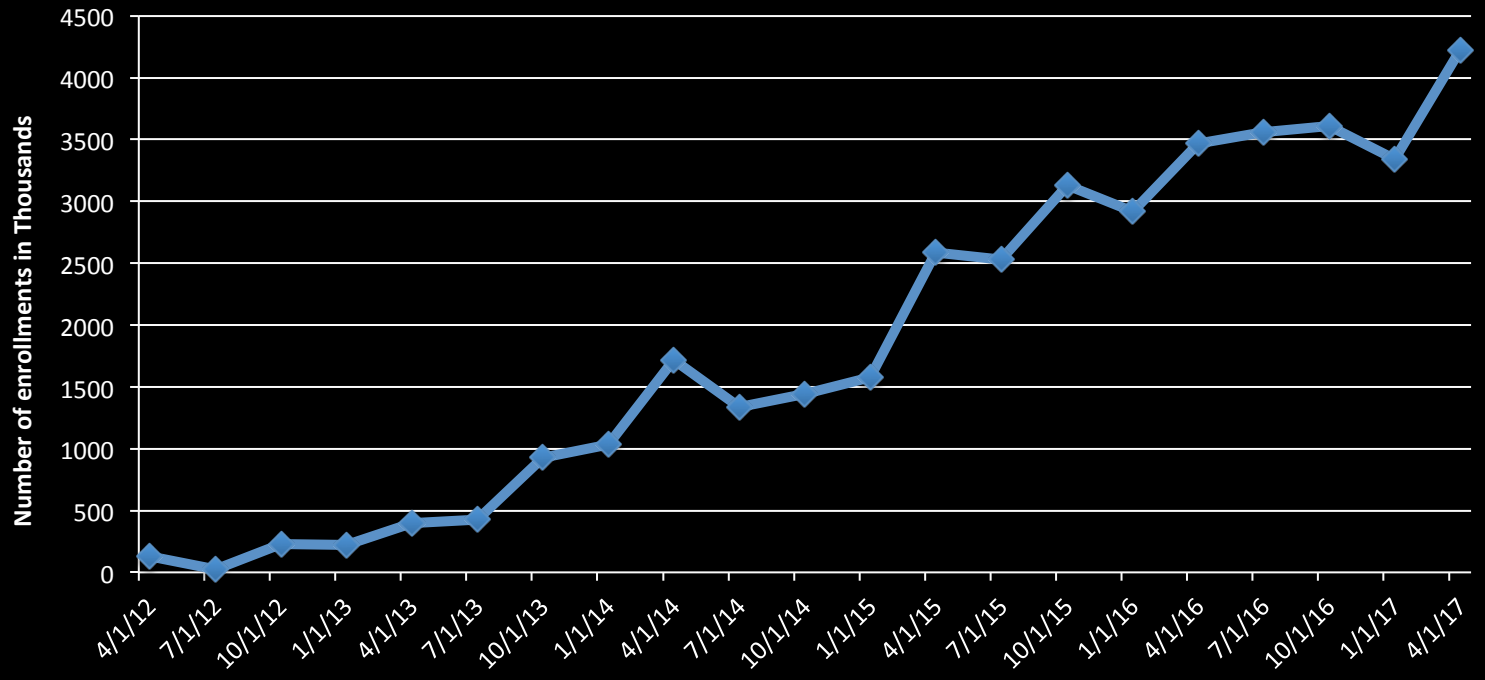
edx-platform
LMS
Studio
common
ORA
Forums
Analytics
edx-analytics-dashboard
Aug '14
edx-analytics-data-api
Jun '14
edx-analytics-pipeline
Jun '14
ECOM
ecommerce
Feb '15
course-discovery
Nov '15
credentials
Dec '15
Mobile
edx-app-ios
Jan '15
edx-app-android
Jan '15


Educator
Learner
Business

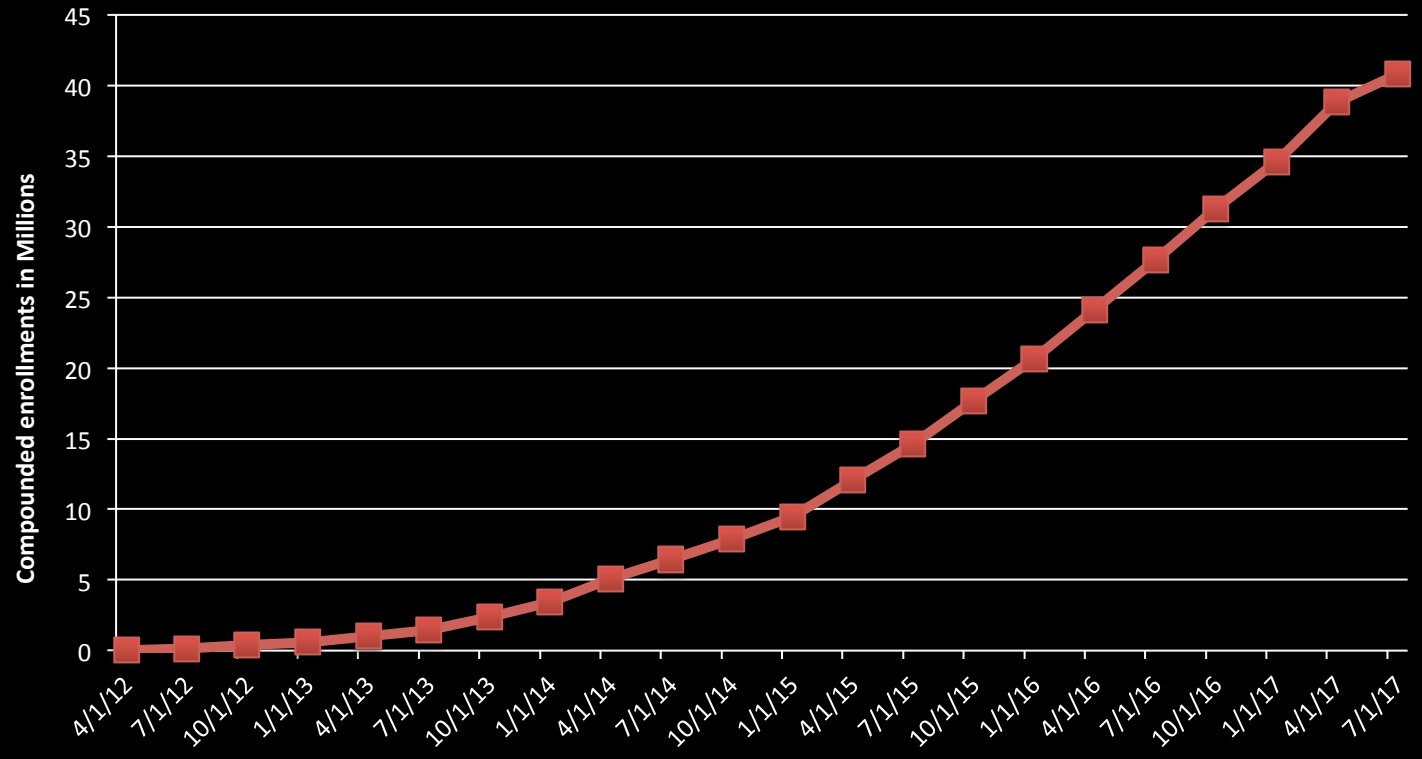

Educator
Learner
edx-platform
LMS
Studio
common
Business


Educator
edx-analytics-dashboard
edx-analytics-data-api
cs-comments-service
edx-ora2
Learner
ecommerce
course-discovery
credentials
edx-app-ios
edx-app-android
edx-platform
LMS
Studio
common
edx-enterprise
Business

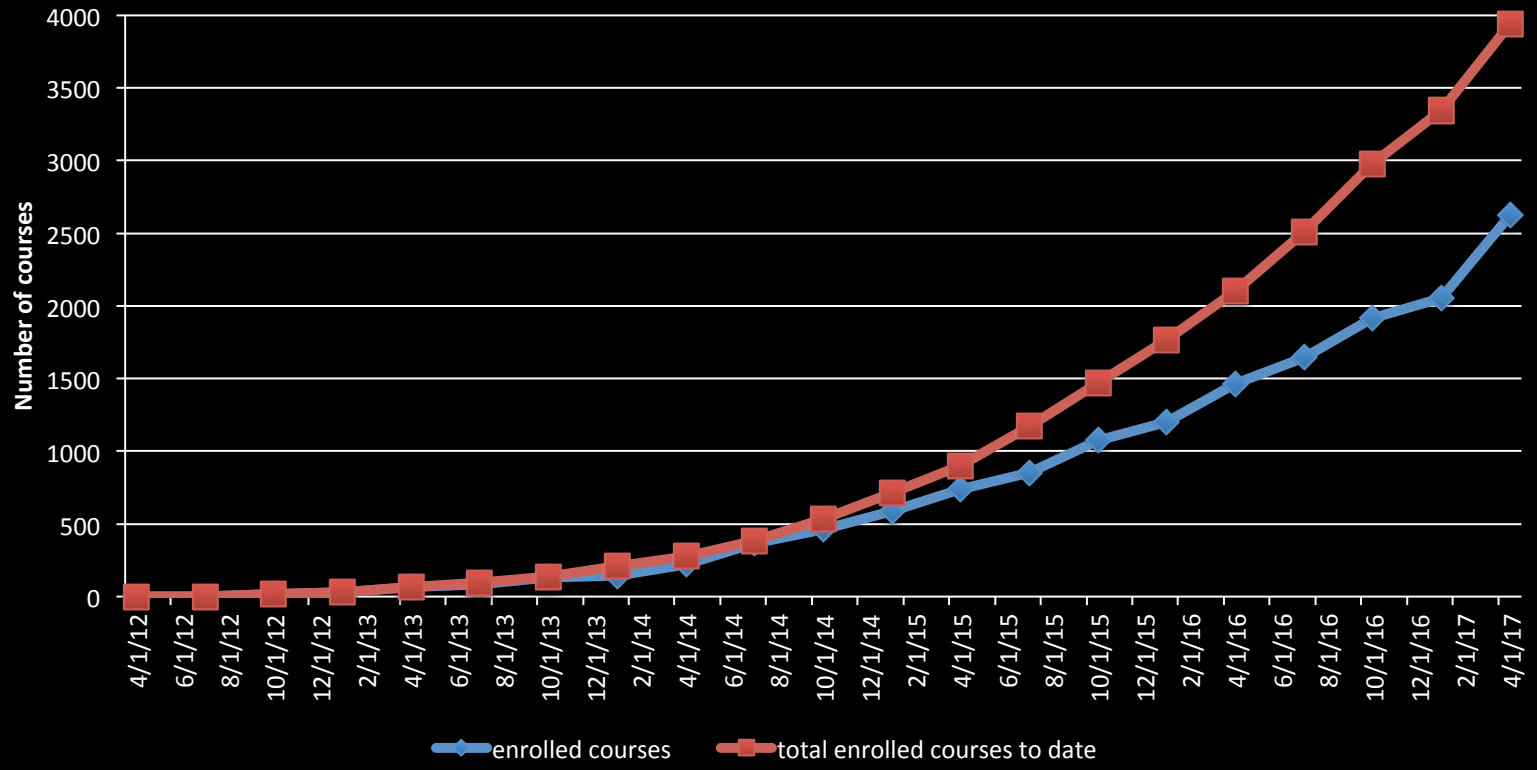
Usage Growth



Usage Growth



Data Growth


Number of courses
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3500
3000
2500
2000
1500
1000
500
0
4/1/12
6/1/12
8/1/12
10/1/12
12/1/12
2/1/13
4/1/13
6/1/13
8/1/13
10/1/13
12/1/13
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12/1/15
2/1/16
4/1/16
6/1/16
8/1/16
10/1/16
12/1/16
2/1/17
4/1/17
enrolled courses
total enrolled courses to date


How have we evolved?
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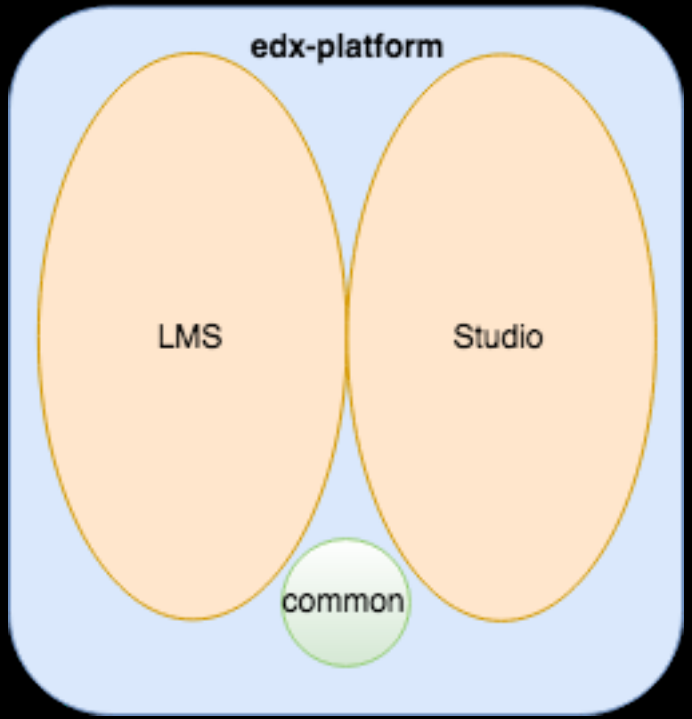
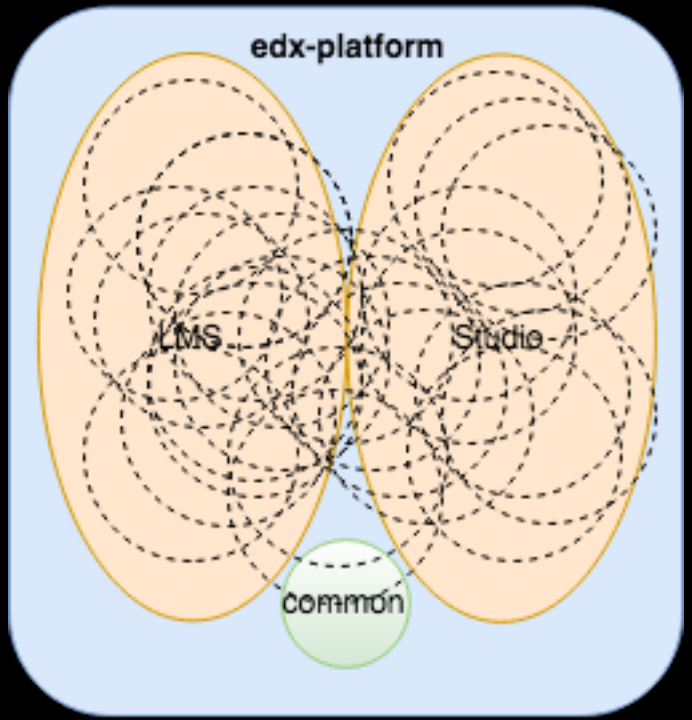
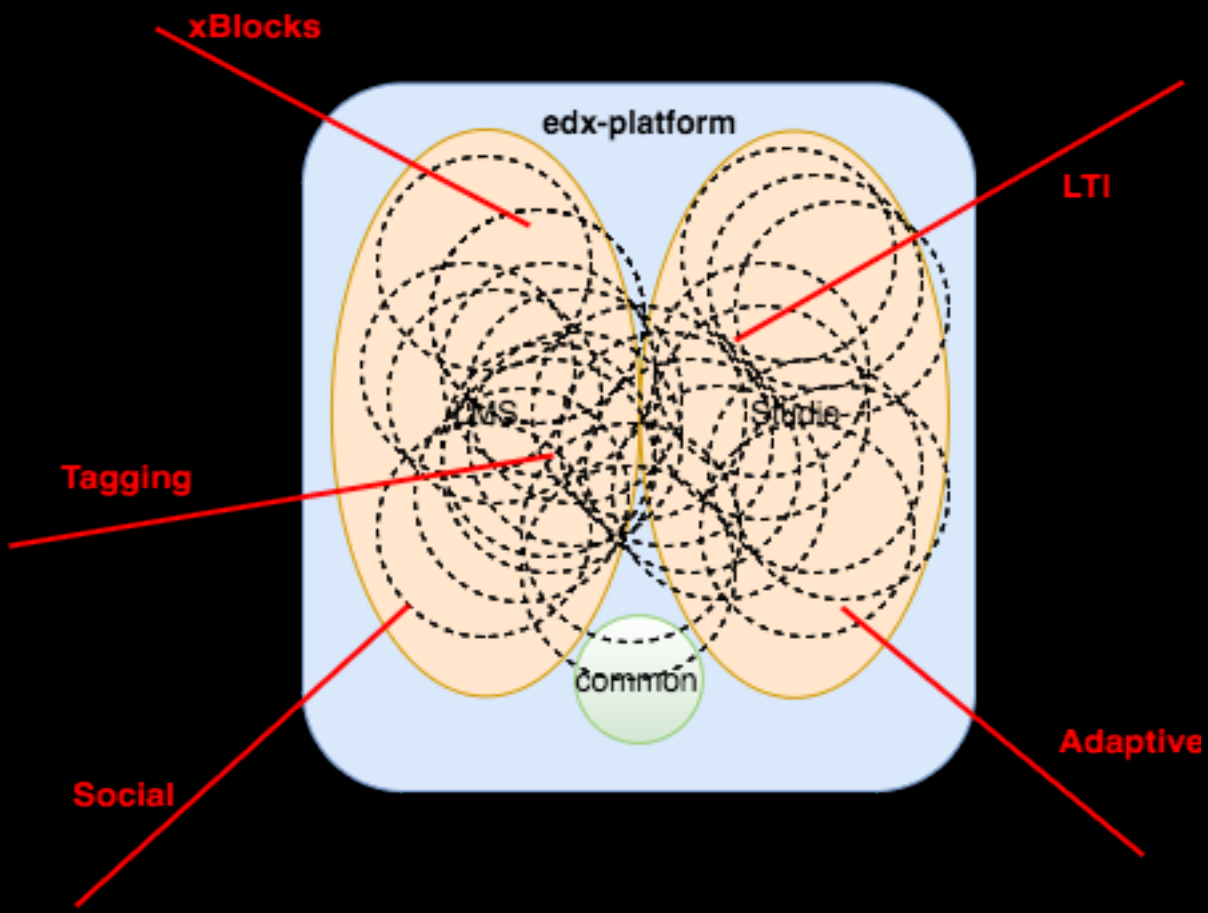
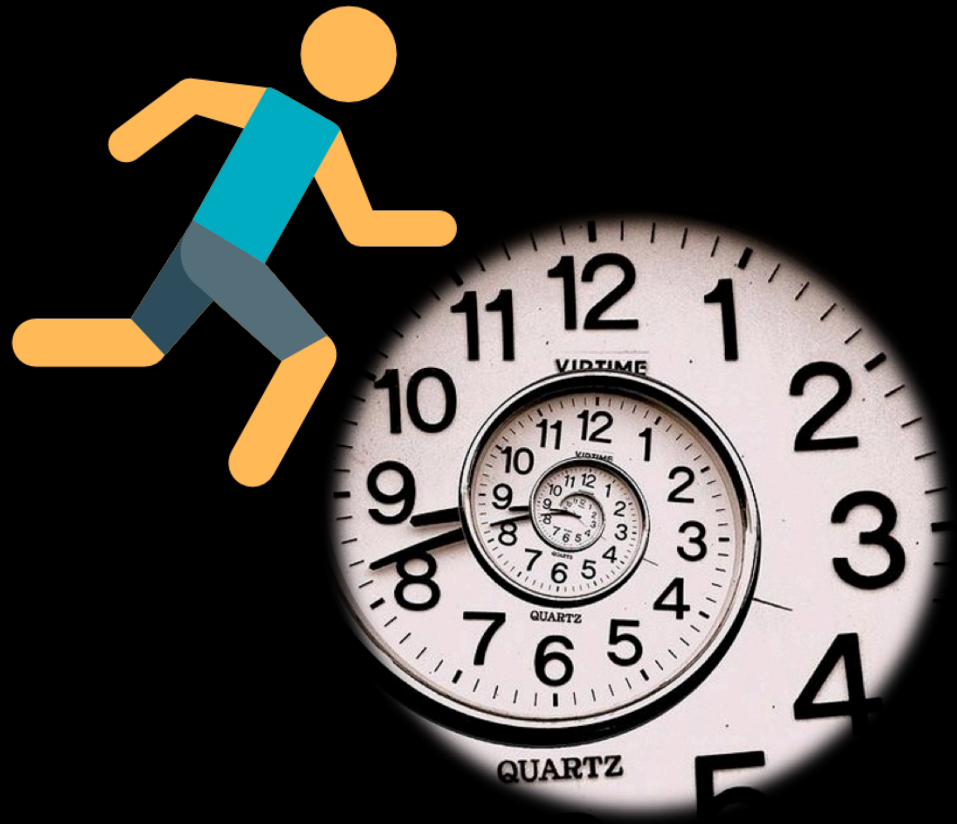
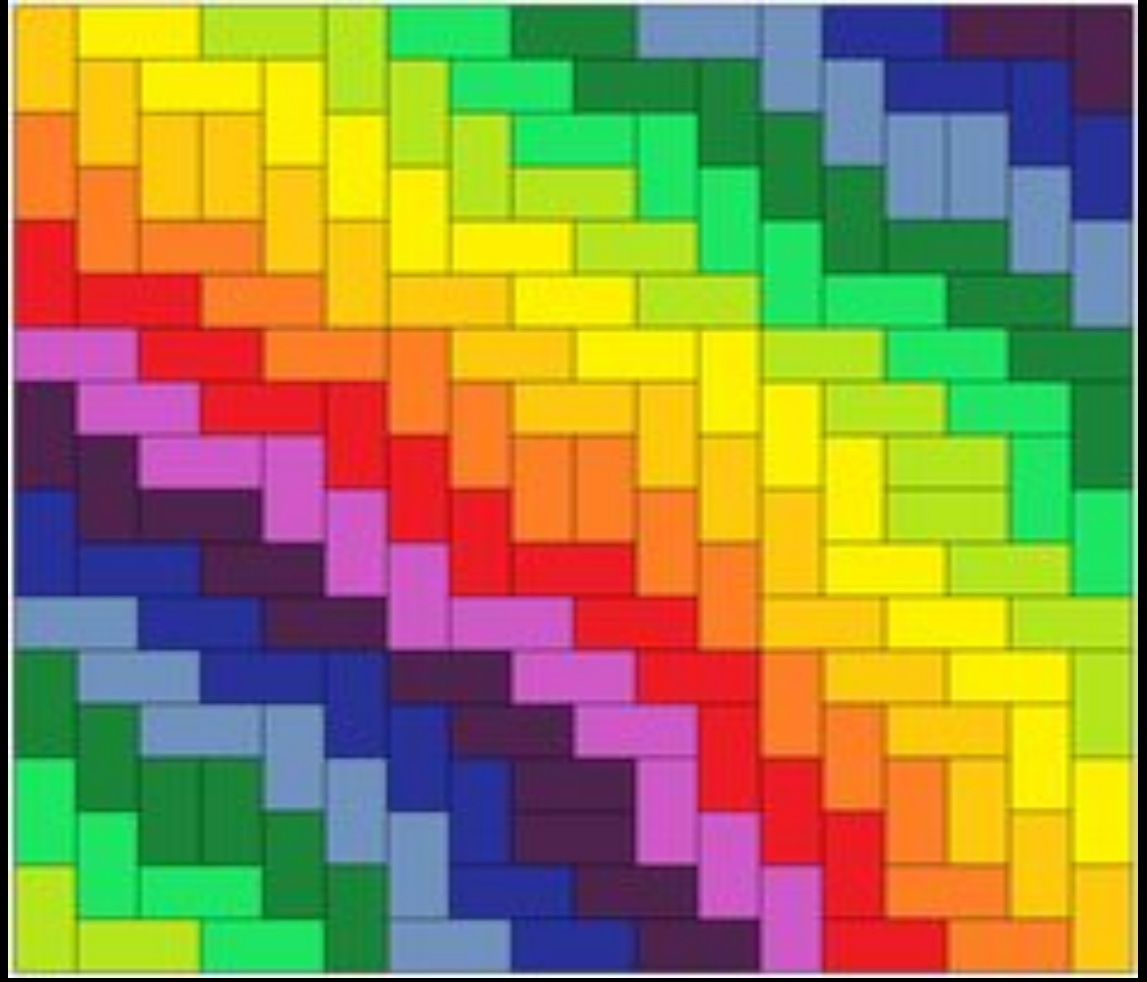
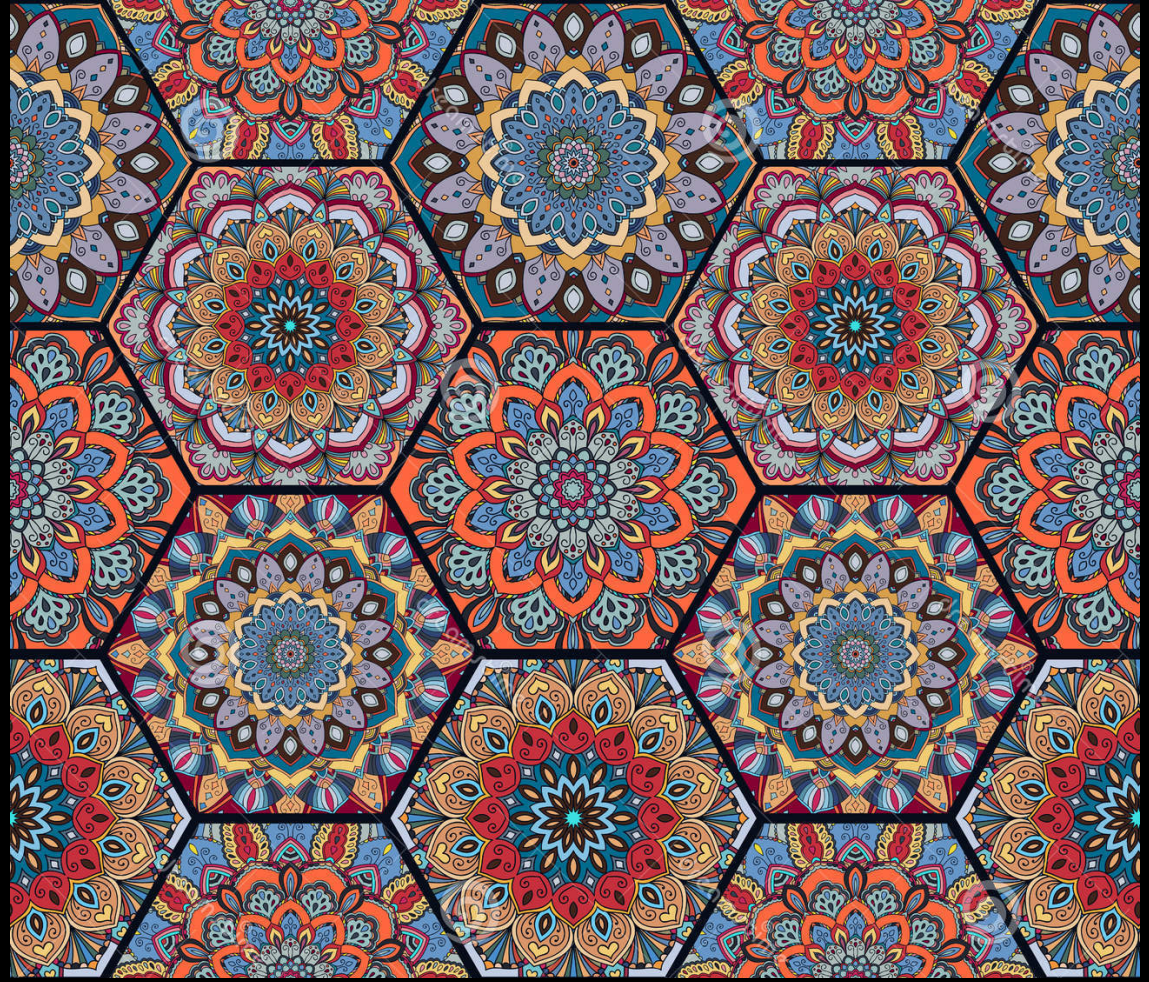

edx-platform
LMS
Studio
common


edx-platform
LMS
Studio
common


xBlocks
edx-platform
LTI
LMS
Studio
Tagging
common
Adaptive
Social


QUARTZ
QUARTZ






How have we evolved?
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Resilient

Responsive

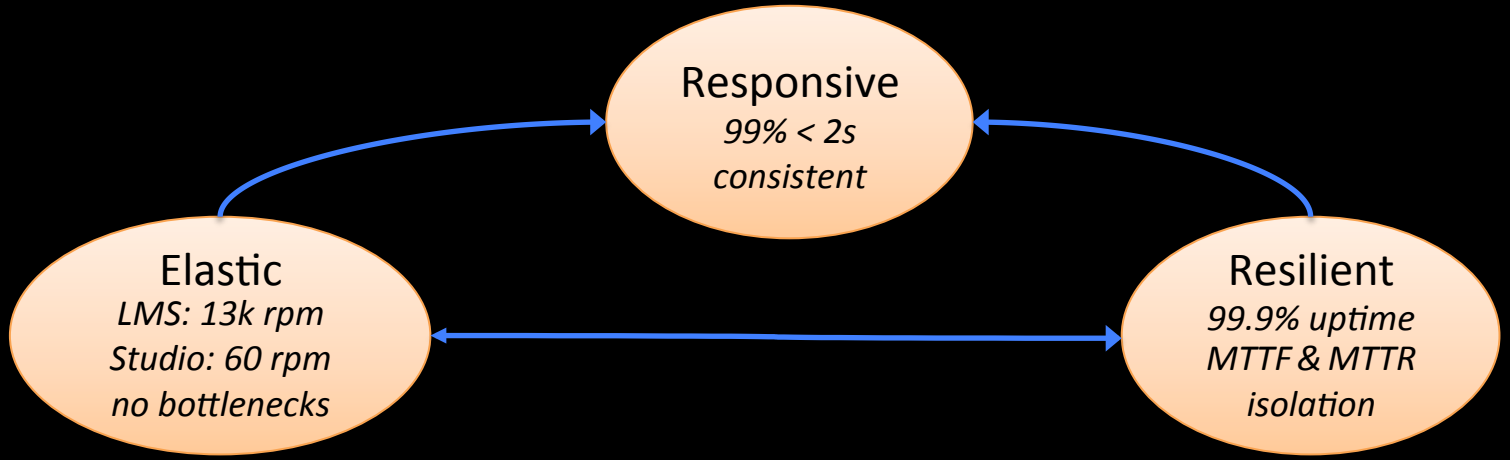
Modularity

Elastic

Extensibility

Discoverability

Reactive Manifesto

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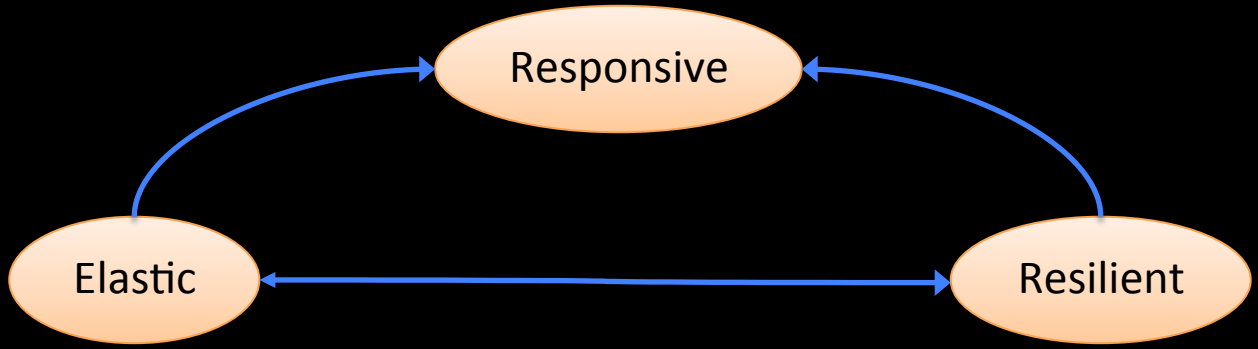
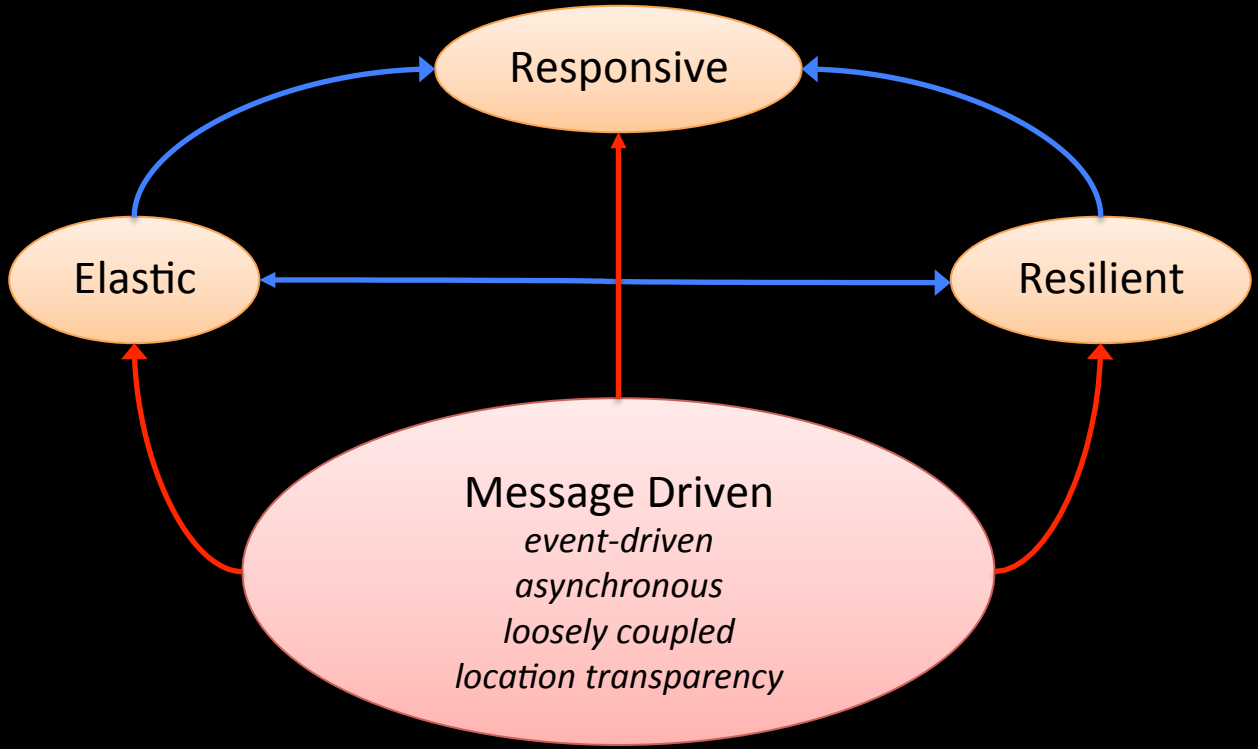
Reactive Manifesto



Reactive Manifesto



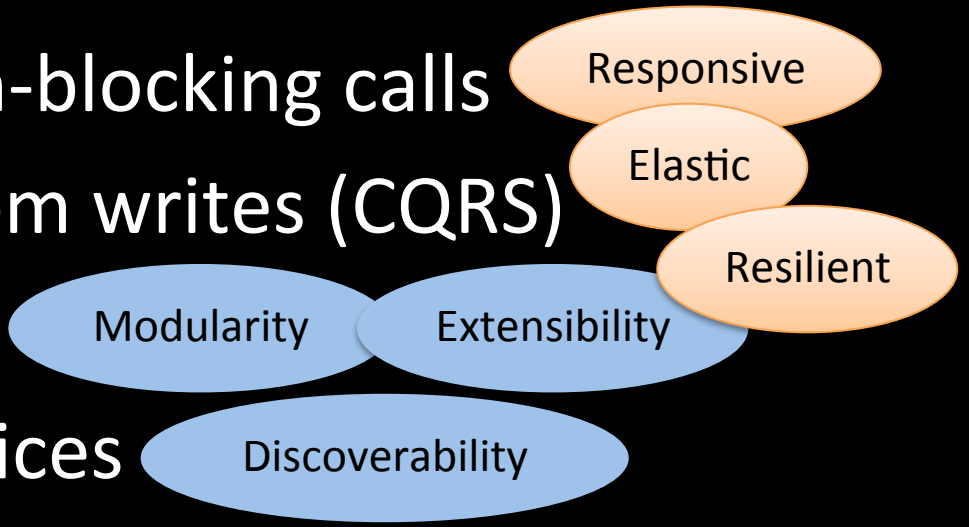
Asynchronous: Orchestration or Choreography?

Resources

- Reactive Manifesto
- Self-contained Systems (SCS)
- Domain Driven Design, Eric Evans
- Building Microservices, Sam Newman
- Modularity, Parnas, 1972
- Architecture Decision Records, Michael Nygard

Main take aways

- Asynchronous non-blocking calls
- Separate reads from writes (CQRS)
- Bounded contexts
- Aligned best practices




JUAN CARLOS I Y SOFIA
·1987·


EL BANCO DE ESPAÑA
CIEN
PESETAS
100

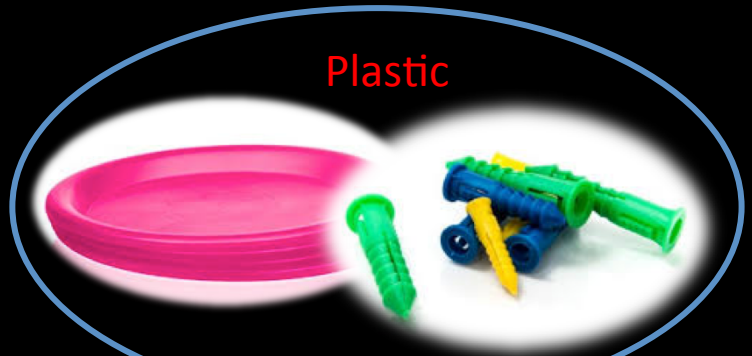

UNITED STATES OF AMERICA
LIBERTY
IN GOD WE TRUST
QUARTER DOLLAR

Technical Concerns

Steel

Silver

Wood



Plastic

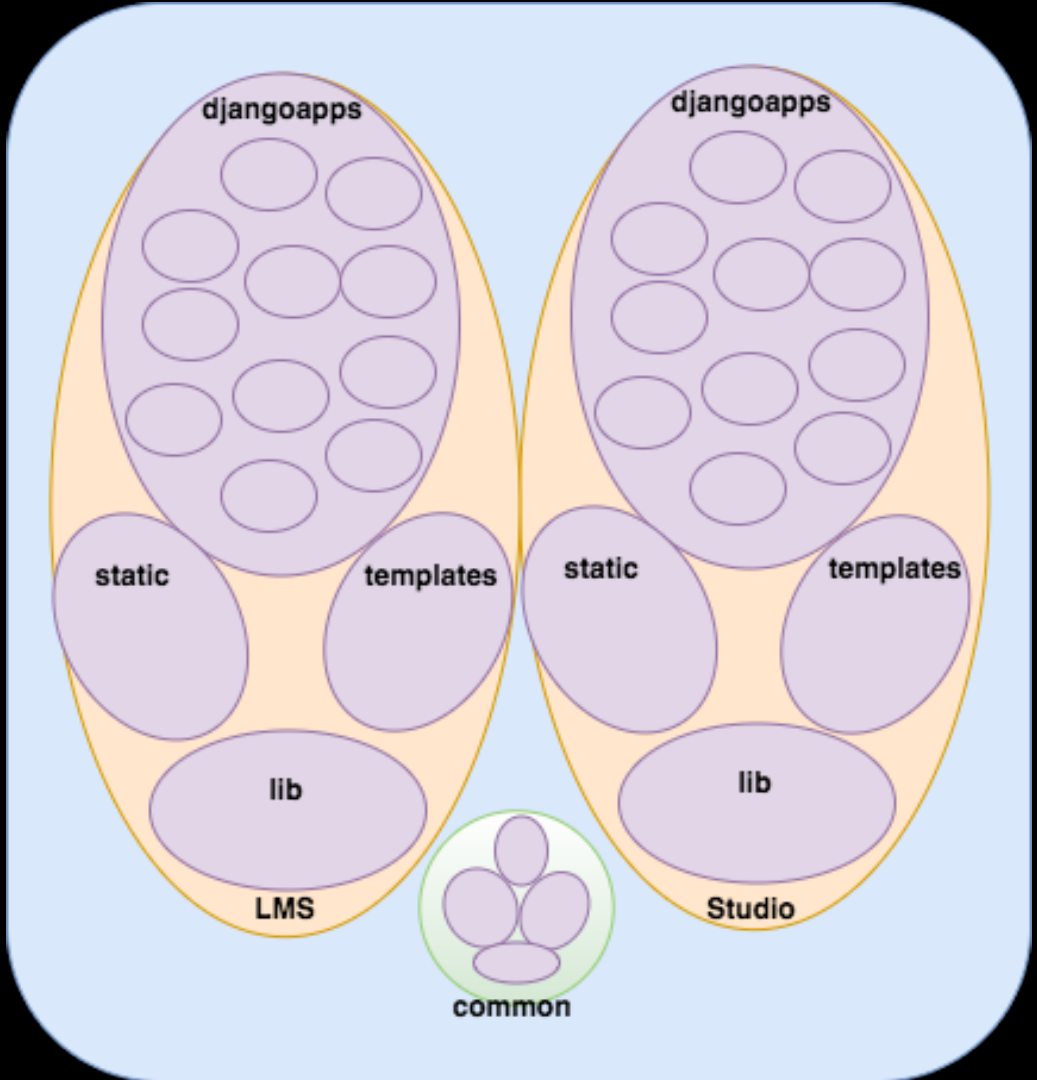
Business Concerns

Currency

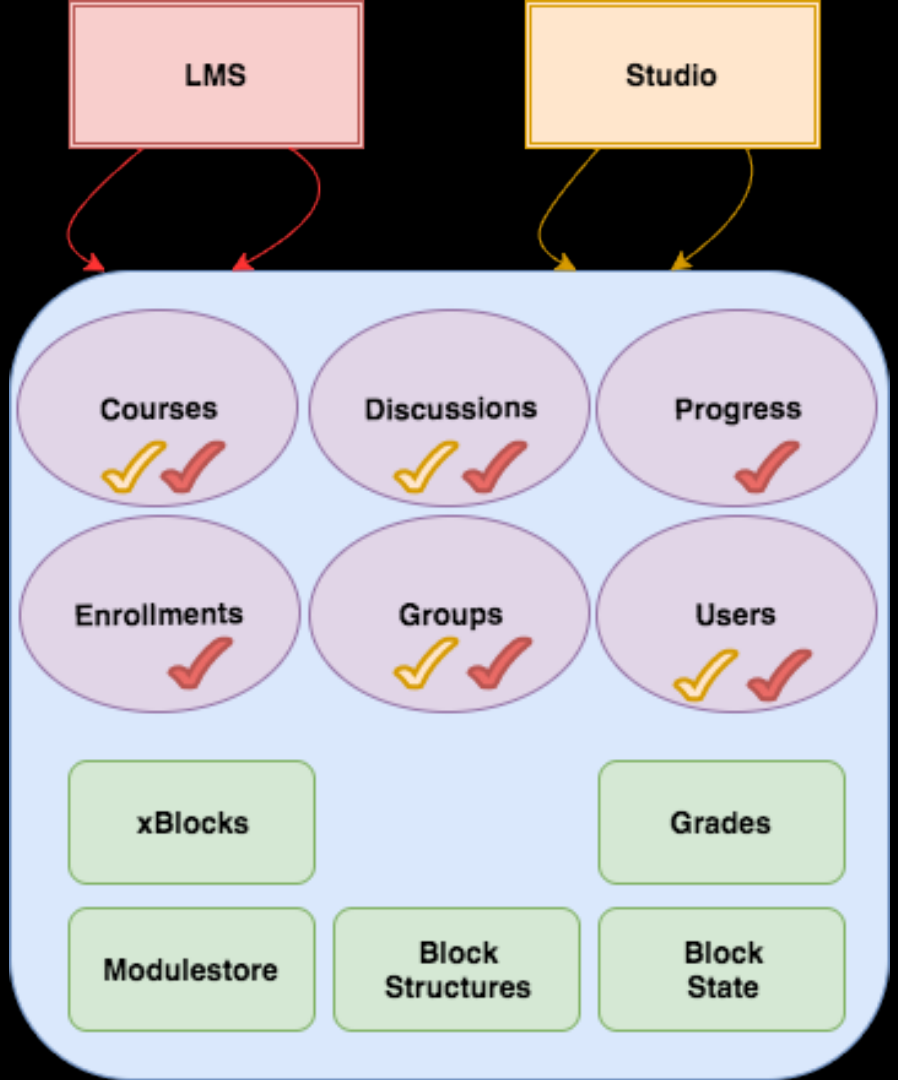
Hardware

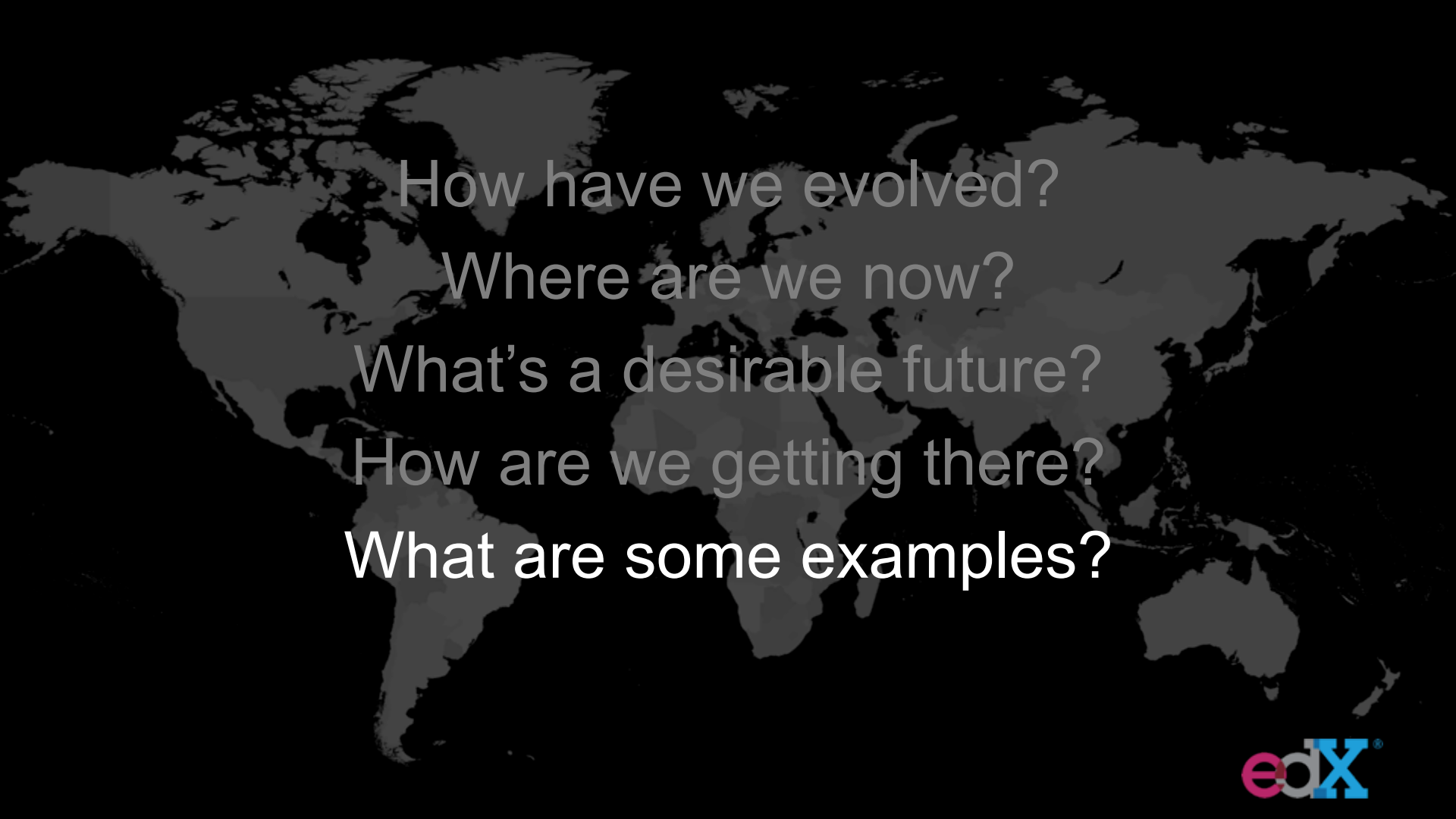
Kitchenware

Technical Concerns



Business Concerns

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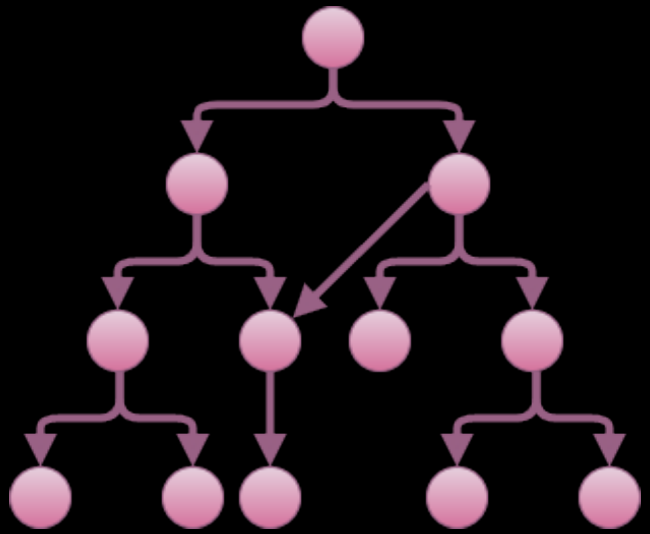
Recent examples

	Asynchronous	Bounded Context	CQRS	Extensibility
Grades	✔	✔	✔	
Course sharing	✔		✔	
Course experiences		✔		✔
Enterprise	✔	✔		
Course import/export	✔			
Block transformers	✔	✔	✔	✔
Course catalog	✔		✔	
Course overviews	✔		✔	
LTI consumer xBlock		✔		✔

Block Transformers

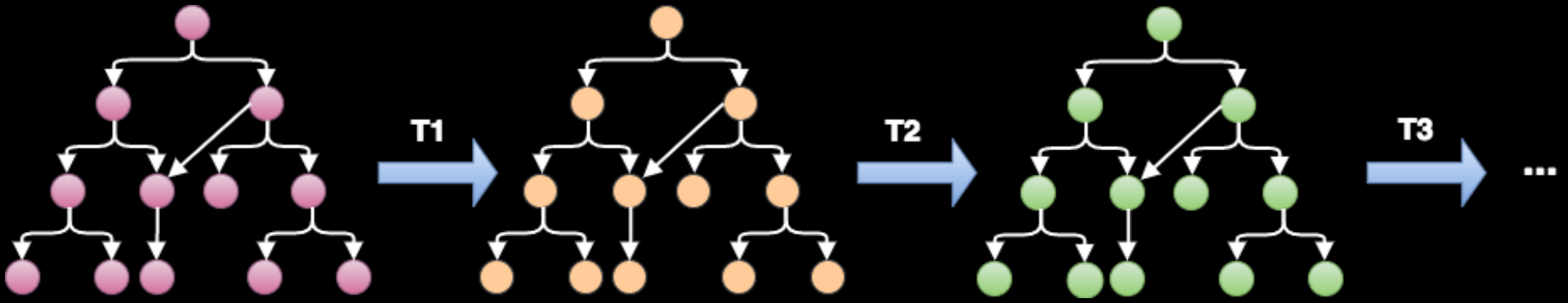


today's max: 4,332 blocks in an MIT course

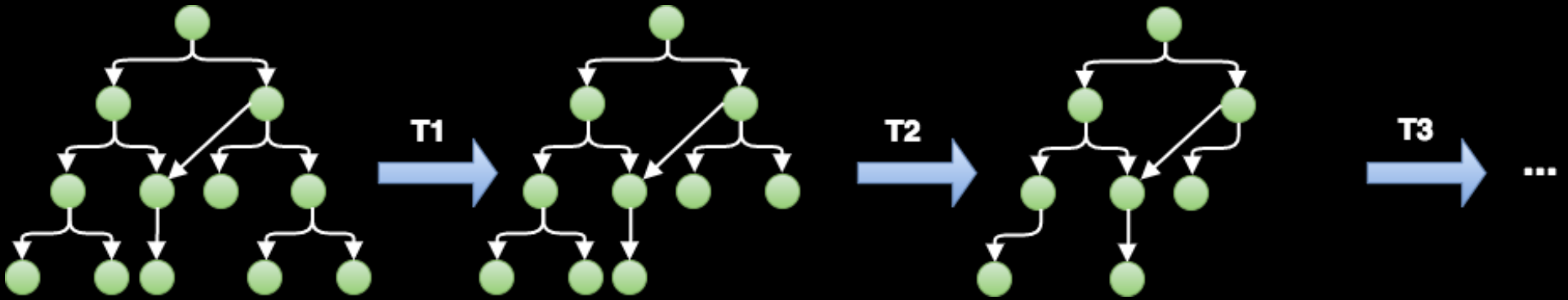
Block Transformers

- *Collect phase* for expensive operations
  - Content tree traversal
  - Denormalize
  - xBlock instantiation via Modulestore
  - Asynchronous, non-blocking
- *Read phase* for fast-access to block data
  - User-specific and API-specific transformations
  - Access read-optimized data structure from AWS S3
  - Synchronous, blocking

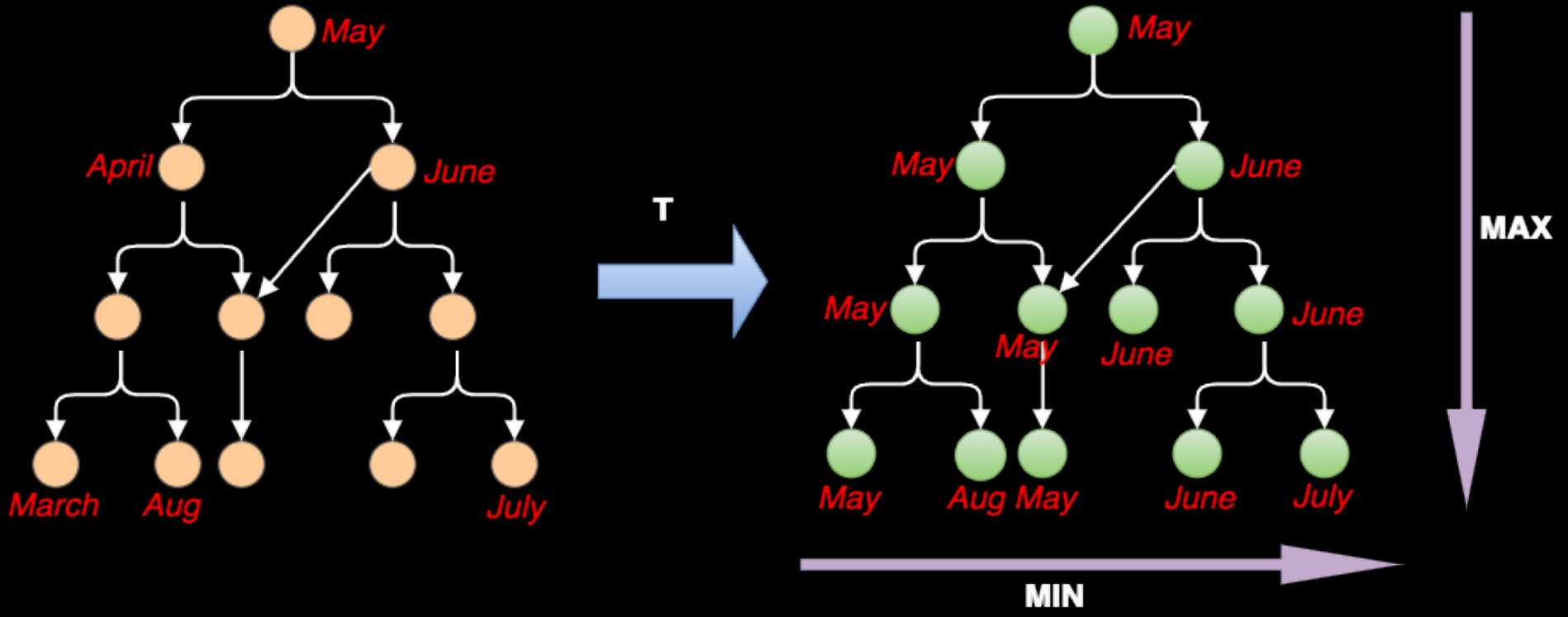
Block Transformer 'Collect' Phase:

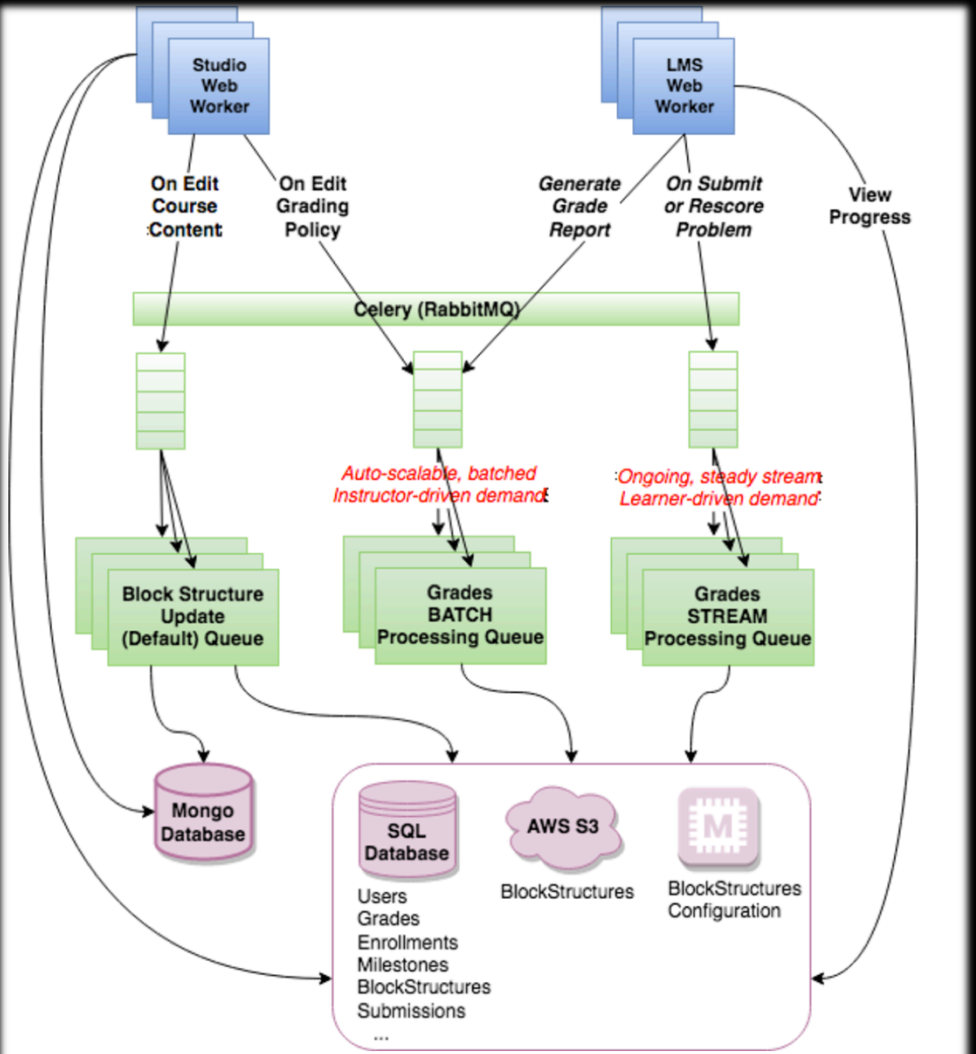


Block Transformer 'Transform' (Read) Phase:



Example: Start Date Transformer 'Collect' Phase:




Studio Web Worker
LMS Web Worker
On Edit Course Content
On Edit Grading Policy
Generate Grade Report
On Submit or Rescore Problem
View Progress
Celery (RabbitMQ)
Auto-scalable, batched
Instructor-driven demand
Ongoing, steady stream
Learner-driven demand
Block Structure Update (Default) Queue
Grades BATCH Processing Queue
Grades STREAM Processing Queue
Mongo Database
SQL Database
AWS S3
BlockStructures
BlockStructures Configuration
Users
Grades
Enrollments
Milestones
BlockStructures
Submissions
...

Best Practices

- Join the discussions (OEPs, doc PRs, slack):
  - Tests
  - Code Structure
  - Extensibility
    - xBlocks + django
    - *Pluggable framework: Stevedore*
    - *LTI + SSO*
    - *Web hooks*

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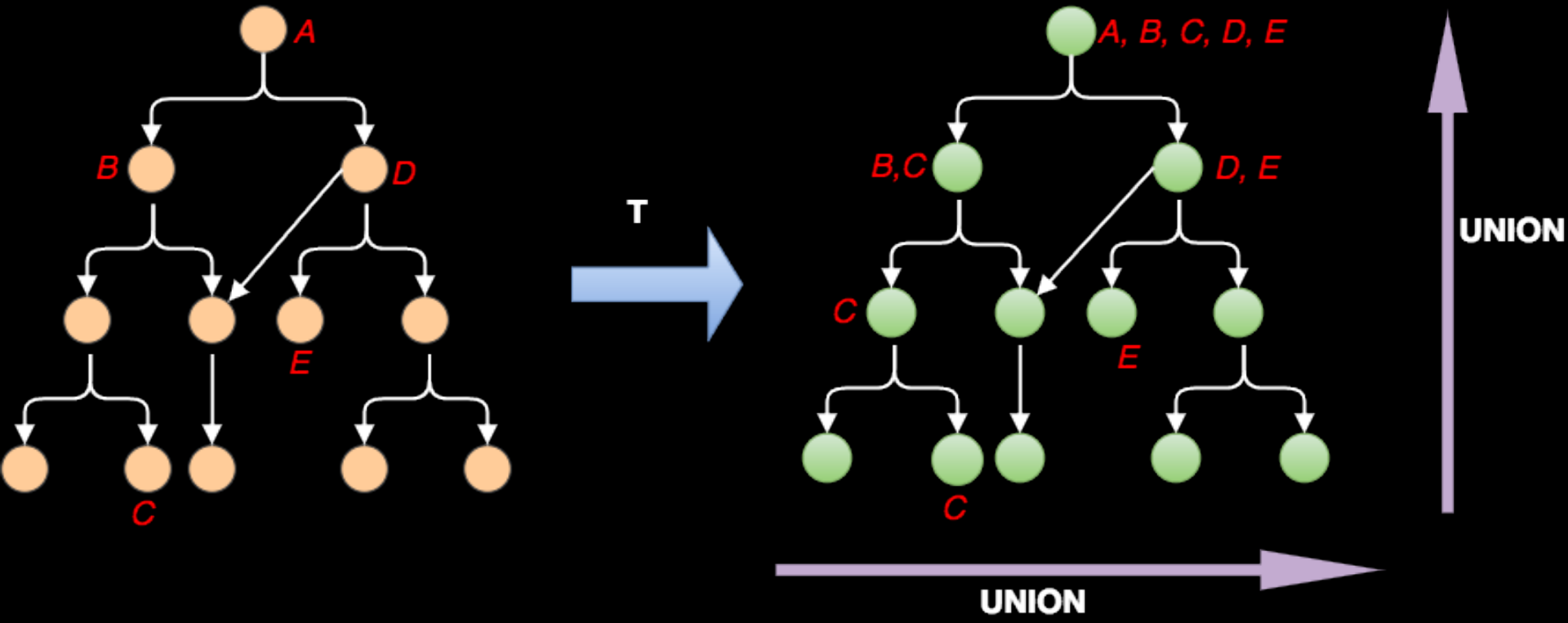
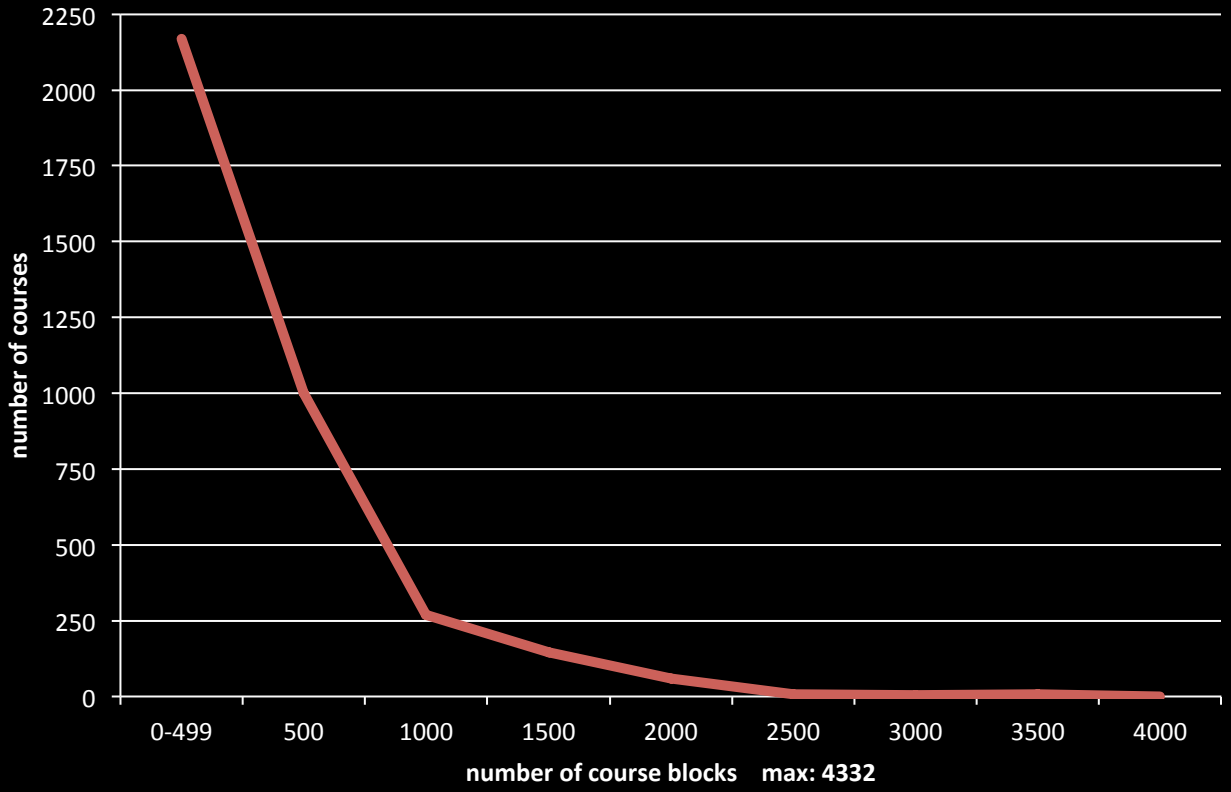
Extra Slides

Example: Content Tags Transformer 'Collect' Phase:



Data Scale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2000
1750
1500
1250
1000
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500
250
0
number of courses
0-499
500
1000
1500
2000
2500
3000
3500
4000
number of course blocks
max: 4332