UTS
UNIVERSITY OF TECHNOLOGY SYDNEY

The Learning Analytics API (LA-API)

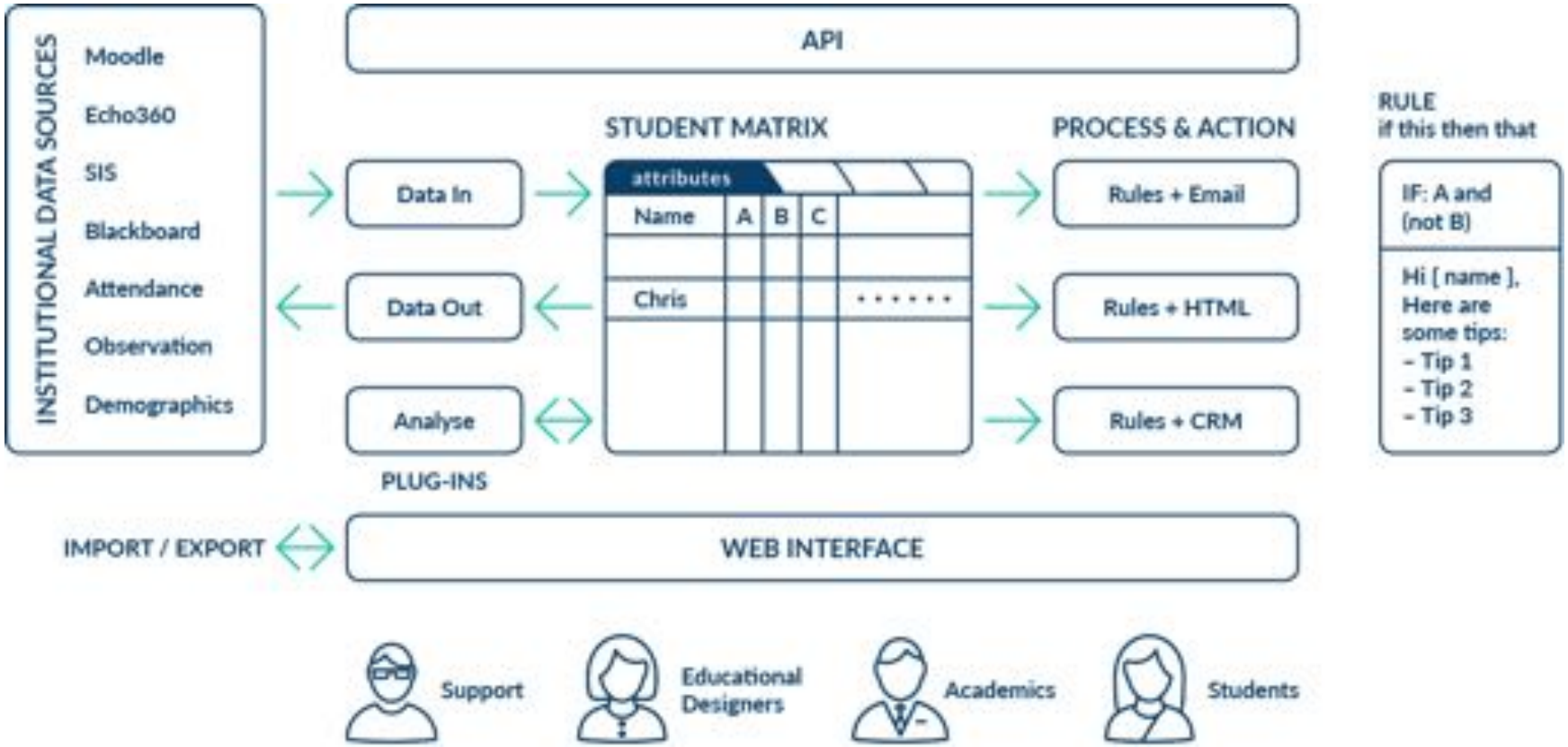
Kirsty Kitto
Connected Intelligence Centre
@KirstyKitto • kirsty.kitto@uts.edu.au

UTS:CIC
CONNECTED INTELLIGENCE CENTRE

utscic.edu.au

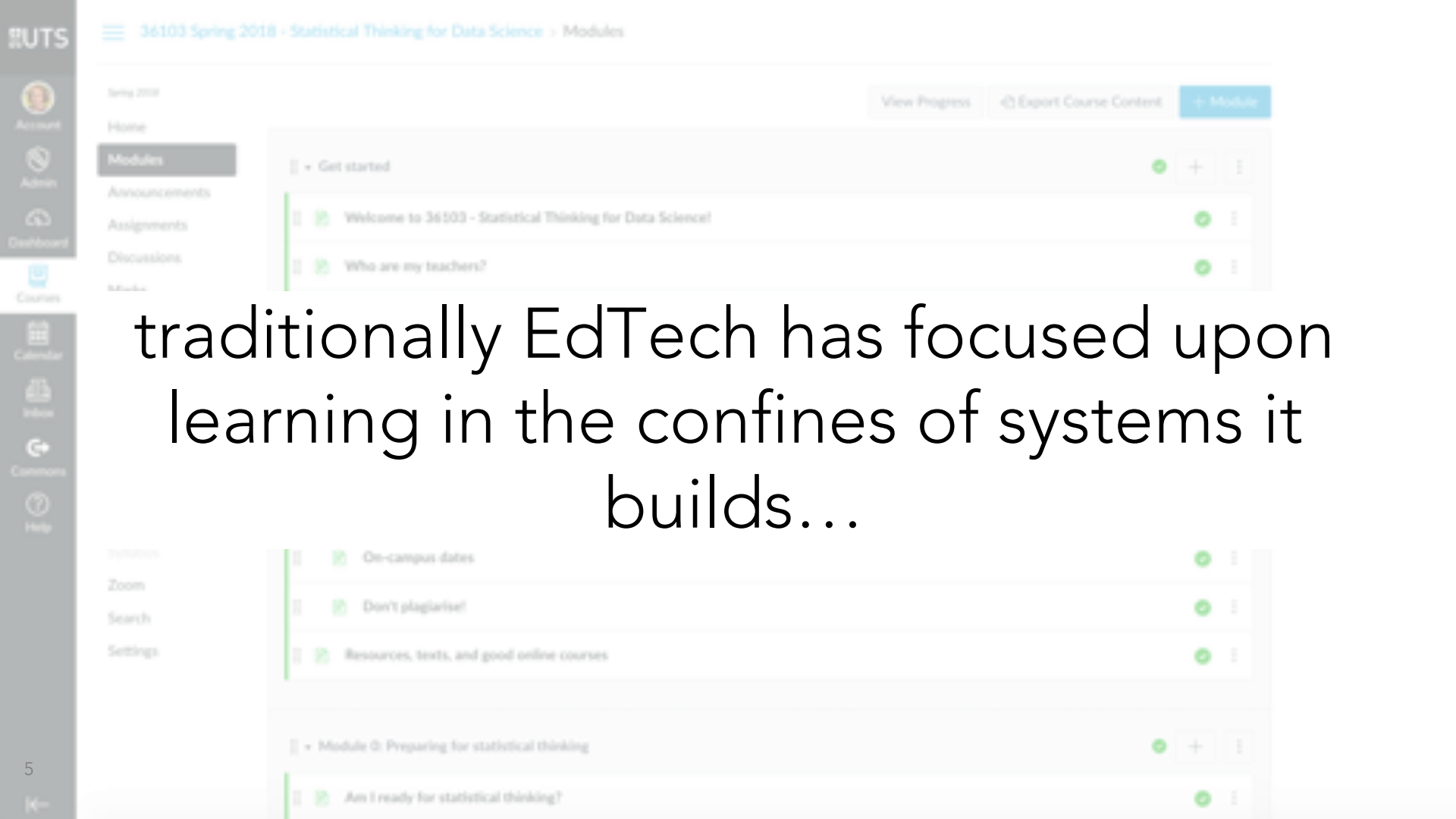

How do I get data
into OnTask?

OnTask can (sometimes) get data from…



but learning happens in
many places and spaces!

https://commons.wikimedia.org/wiki/File:Andrea_Leslie_helps_students_search_(8696541130).jpg



traditionally EdTech has focused upon learning in the confines of systems it builds…

as the sector increasingly seeks to deliver a personal learning experience we will need to get smarter about data collection and learning analytics

a vision of the future… that has existed for a long time

a vision of the future… that has existed for a long time

OUR STRATEGY

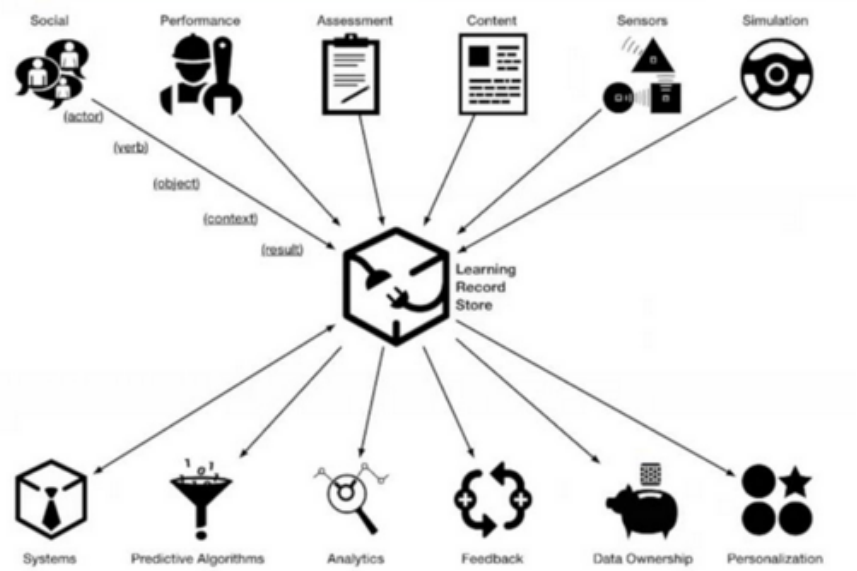
UTS 2027

Current UTS 2027 initiatives

- Lifetime learning
- Personal learning experience
- Digital partners
- New ways of working
- Precinct, community, partnerships
- Connected research
- International profile
- Social change

Problem 1: data interoperability

new data standards have emerged that provide best practice approaches for unifying data from multiple places and spaces

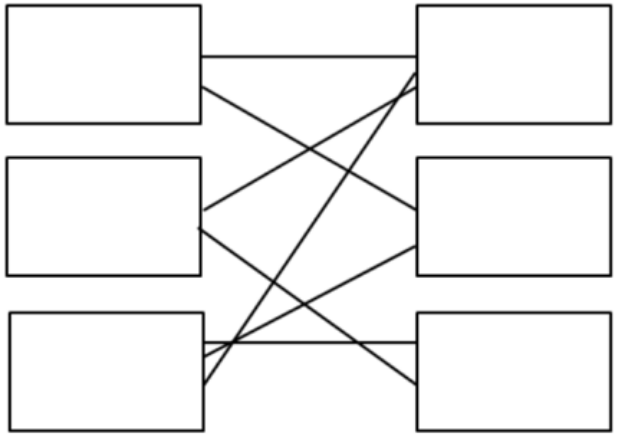


but they are incomplete, and most vendors only partially implement them…

https://www.apereo.org/communities/learning-analytics-initiative/learning-analytics-webinar-state-xapi-and-imsglobal

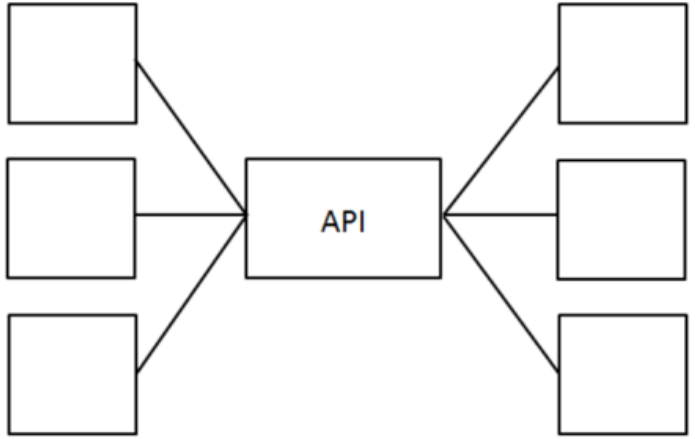
Problem 2: tight couplings between systems

what types of architectures should we be designing for university systems?



Legacy architecture. Point to point integrations mean increased QA efforts whenever any one system is modified or upgraded.

OR



API-based architecture. Systems can be built on top of stable APIs and upgraded/replaced independent of each other with reduced QA effort.

https://edutechnica.com/2015/06/09/flipping-the-model-the-campus-api/

Problem 3: LA is not a well defined field!

- a wide array of data inputs are used across the sector
- non-standard data formats
- new algorithms become available all the time
- new tools emerge which use different data structures
- we often need to send data to a tool that is “just a little bit different”

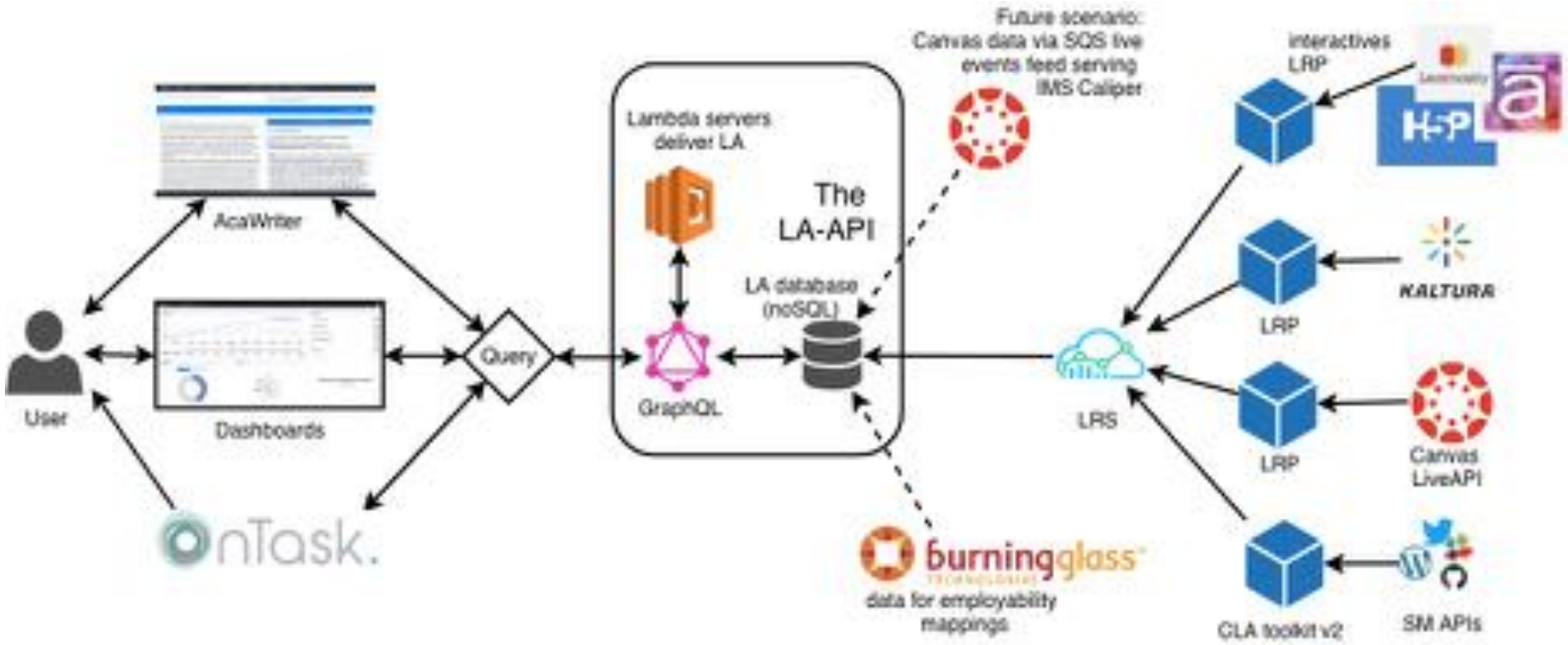
How can we create and maintain flexible but robust data interfaces that enable rapid development and expansion of LA capabilities?
(Is an API flexible enough?)

graphQL offers a solution!

GraphQL is a query language that enables an abstraction of server-side API calls under a single neat wrapper, instead of to multiple endpoints…

- flexible - different applications can access to student data as required
- strongly typed - clearly defines how the client can access the data, so acts as an intermediate layer between back end complex infrastructure and front end user interfaces
- extensible – enables ongoing addition of LA services as necessary
- efficient data retrieval - student facing LA applications and dashboards need to be mobile

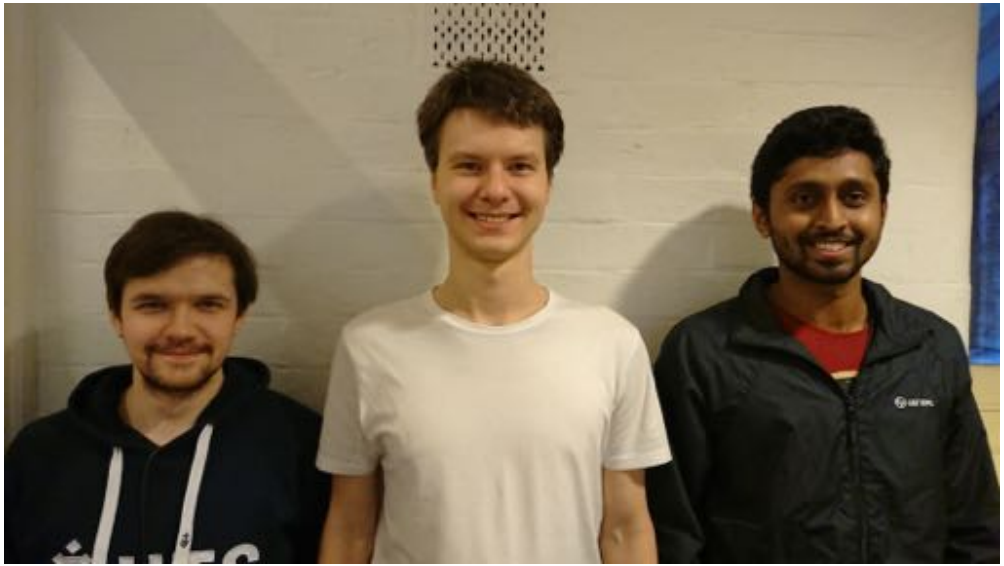
the LA-API – flexible and extensible ETL for learning analytics integrations



built by a very small team!

Radhika Vijay Mogarkar

Aliaksei Kuncevič



Andrei Masslenikov

Sasha Gromov

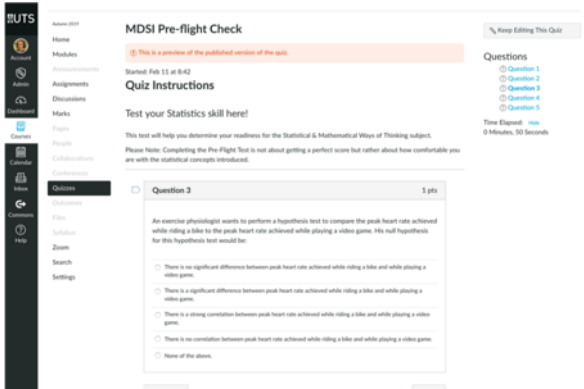
Abishek Arunachalam

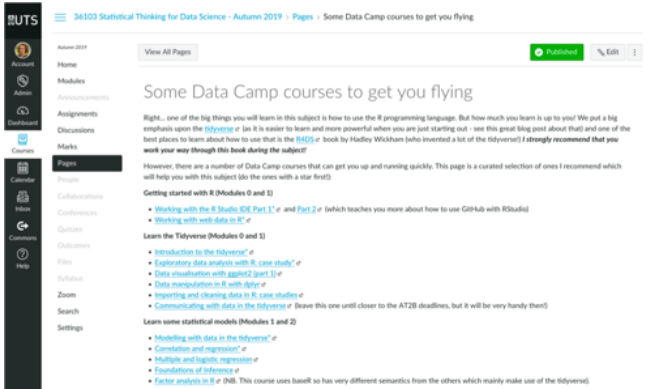
Example: Masters of Data Science and Innovation

(a diverse cohort – could OnTask give course wide personalised advice?)

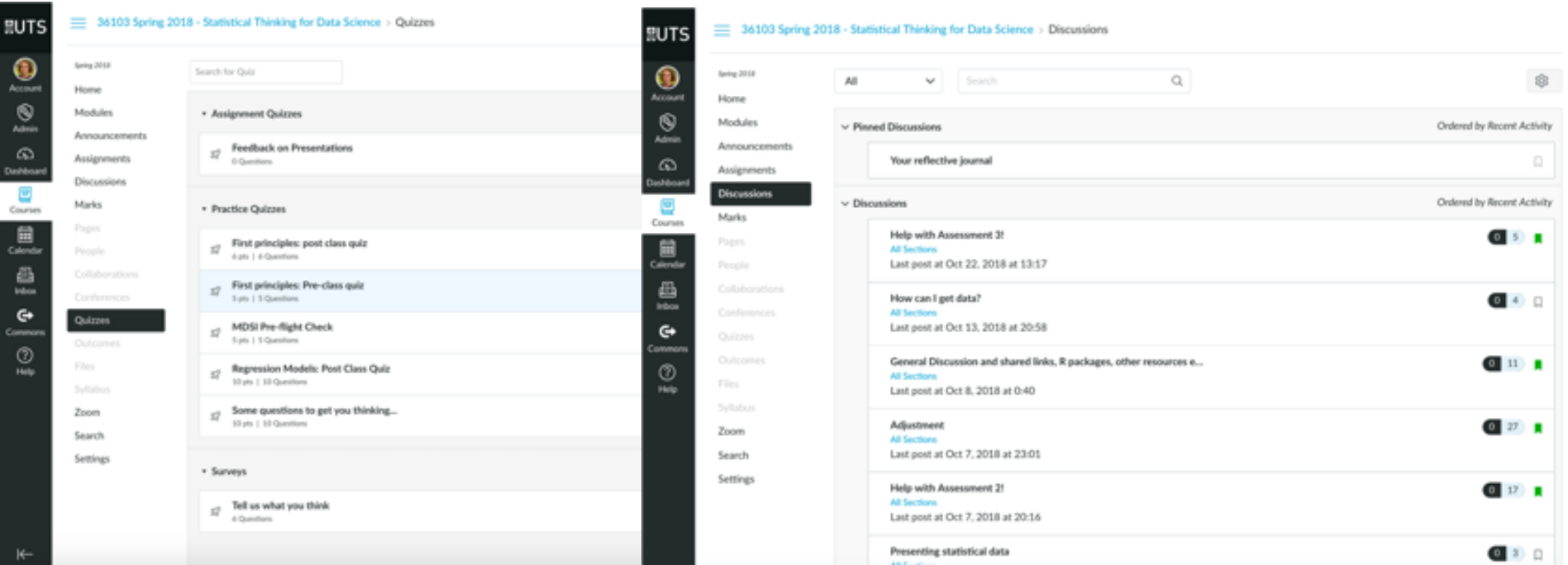
- vibrant slack community across cohorts
- wordpress used for some assessments

- 36103: Statistical Thinking for Data Science
  - Canvas (quizzes, discussions, other activity)
  - trello, GitHub, slack, google…
  - lots of flipped work using DataCamp
  - some assessments submitted using wordpress

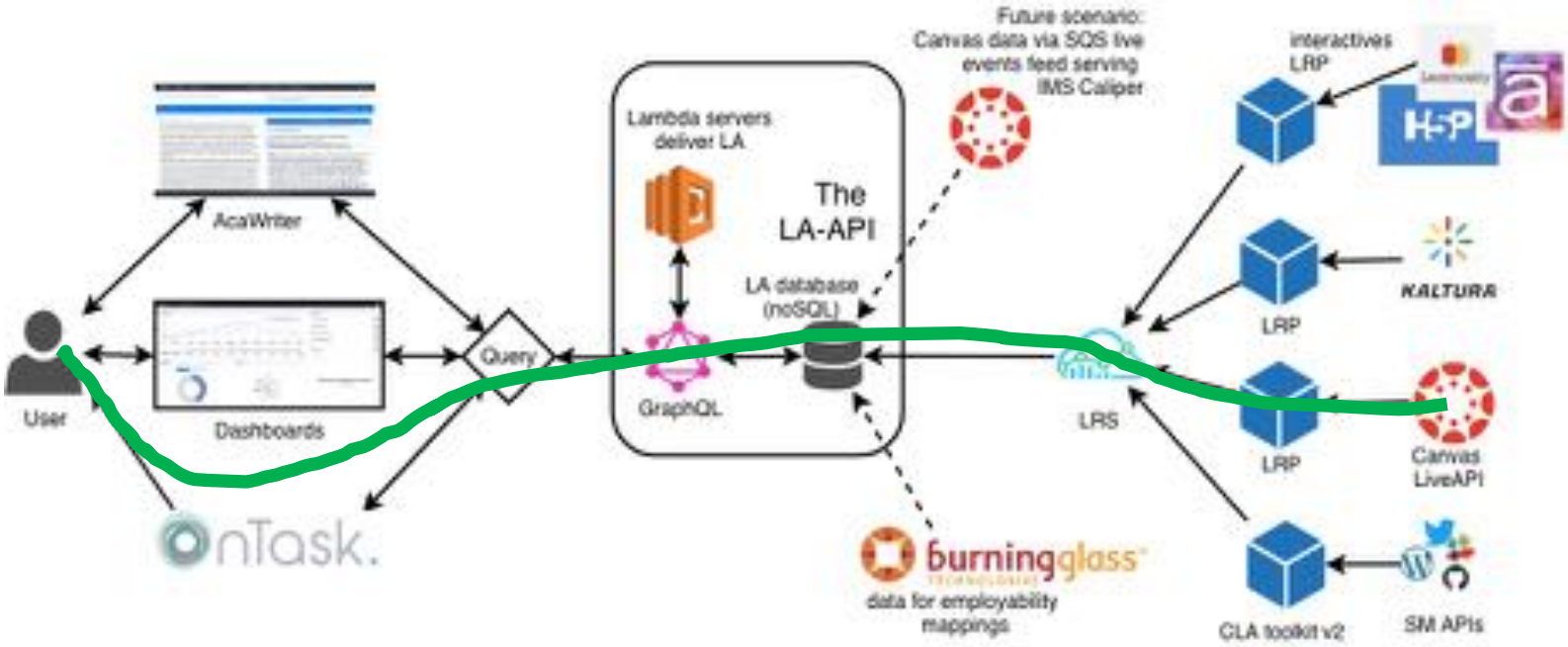




big problems with understanding assessable unassessed participation in subjects using Canvas…



ETL: Canvas data to users
(via OnTask and Dashboards)



how does the LA-API work?

```
let users = await getUsers(courseData);
//get just courses that have associated grps ->discussions
let groupData = await getGroupData(courseData);
//now run through this list and get details based on grp/id/dic_topic/id
let groupDiscussion = await getGroupDiscussions(groupData);

let subData = await getSubData(courseData);

//now run to get all sub discussion data and should match the format like group discussion
let subDiscussions = await getDiscussionSubData(subData);

//get all new users for these groups and consolidate the list with existing users
let allUsers = await getGdUsers(groupDiscussion, users);

//get all new users for these sub discussions and consolidate the list with existing users
let final_users = await getSdUsers(subDiscussions, allUsers);

let statements = await generateStatements(courseData, final_users);

let gStatements = await generateGdStatements(groupDiscussion, final_users);

let sStatements = await generateSdStatements(subDiscussions, final_users);

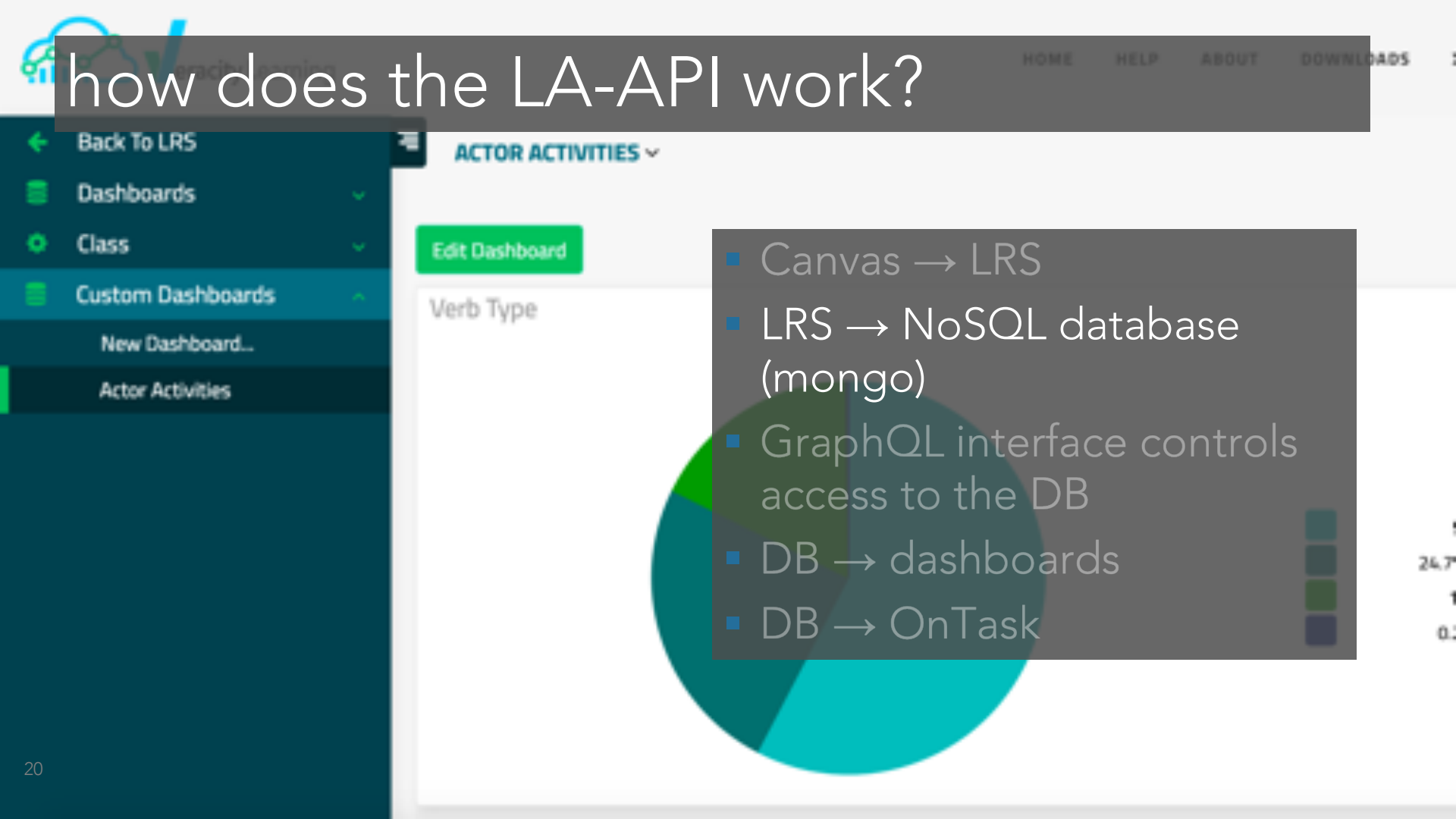
let allStmts = statements.concat(gStatements);

let final_stmts = allStmts.concat(sStatements);
let inserted = await insertIntoLRS(final_stmts);

return inserted;
```

- Canvas → LRS
- LRS → NoSQL database (mongo)
- GraphQL interface controls access to the DB
- DB → dashboards
- DB → OnTask

how does the LA-API work?



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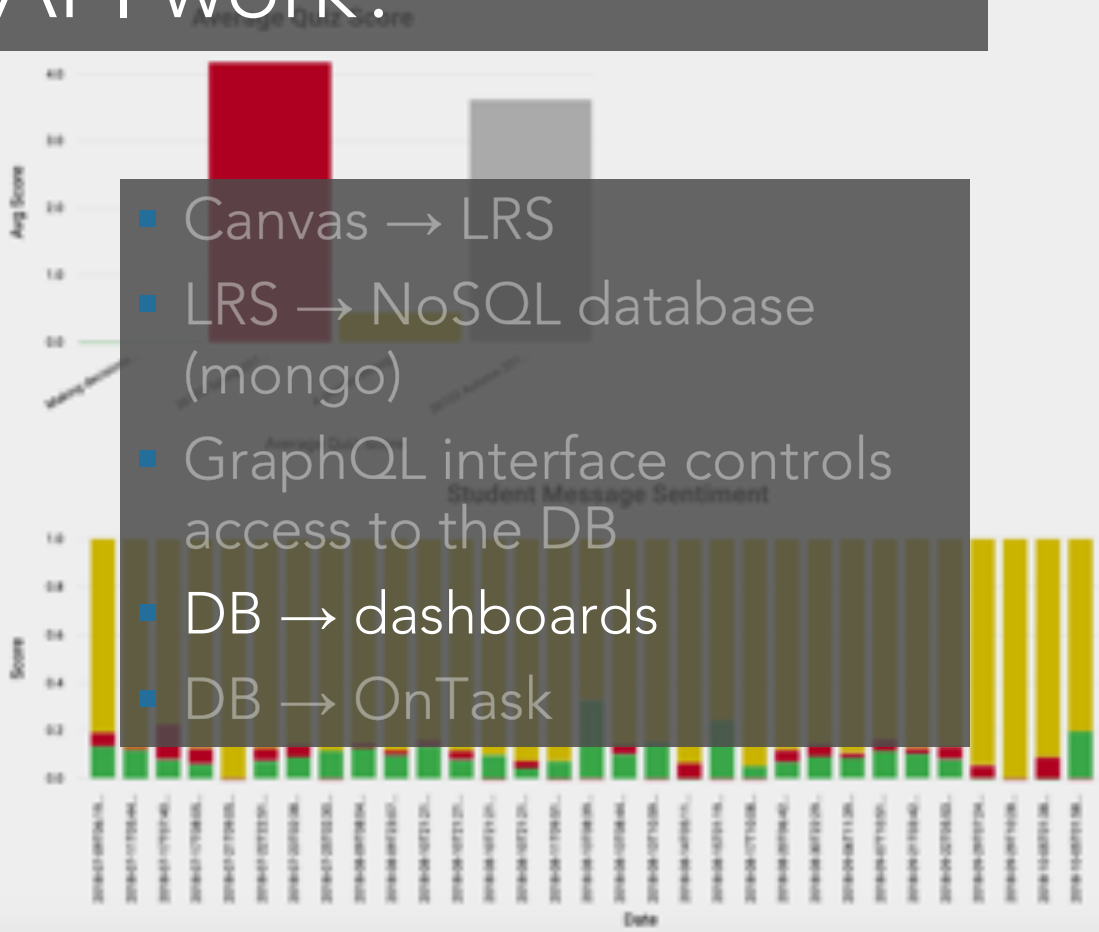

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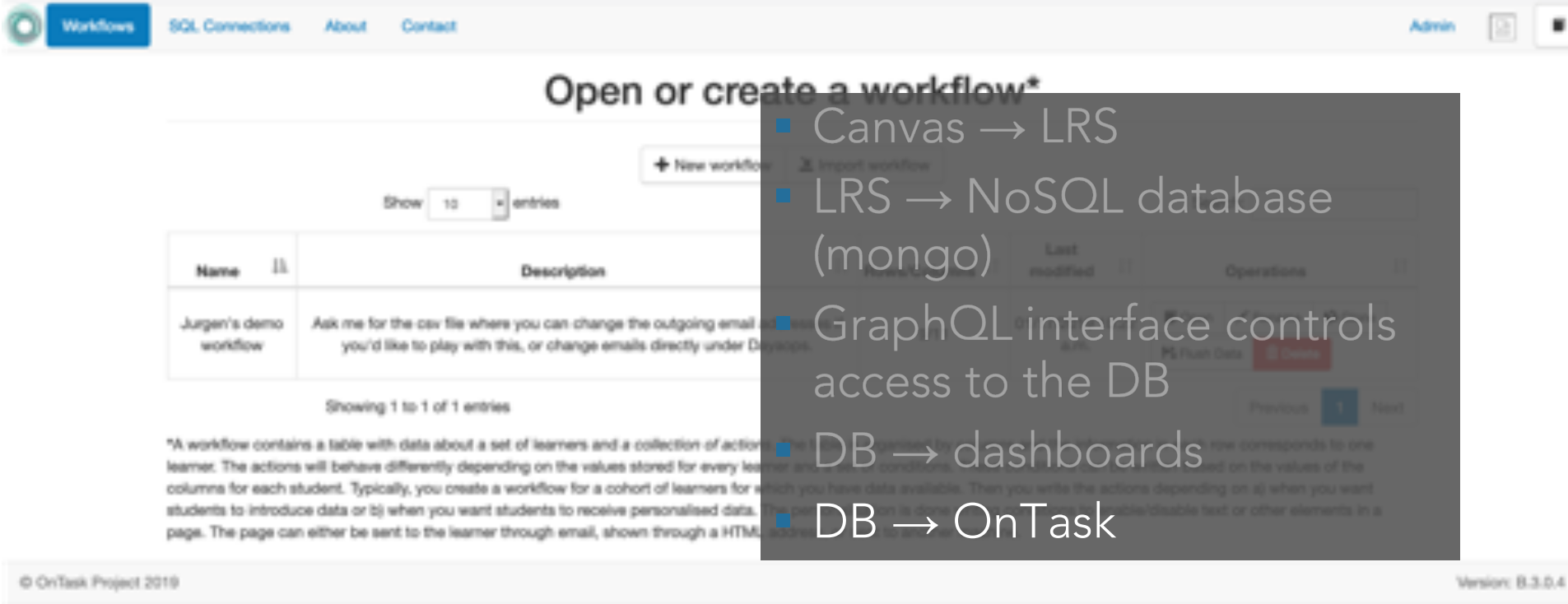

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creating workflows from the LA-API…

Show 10 entries

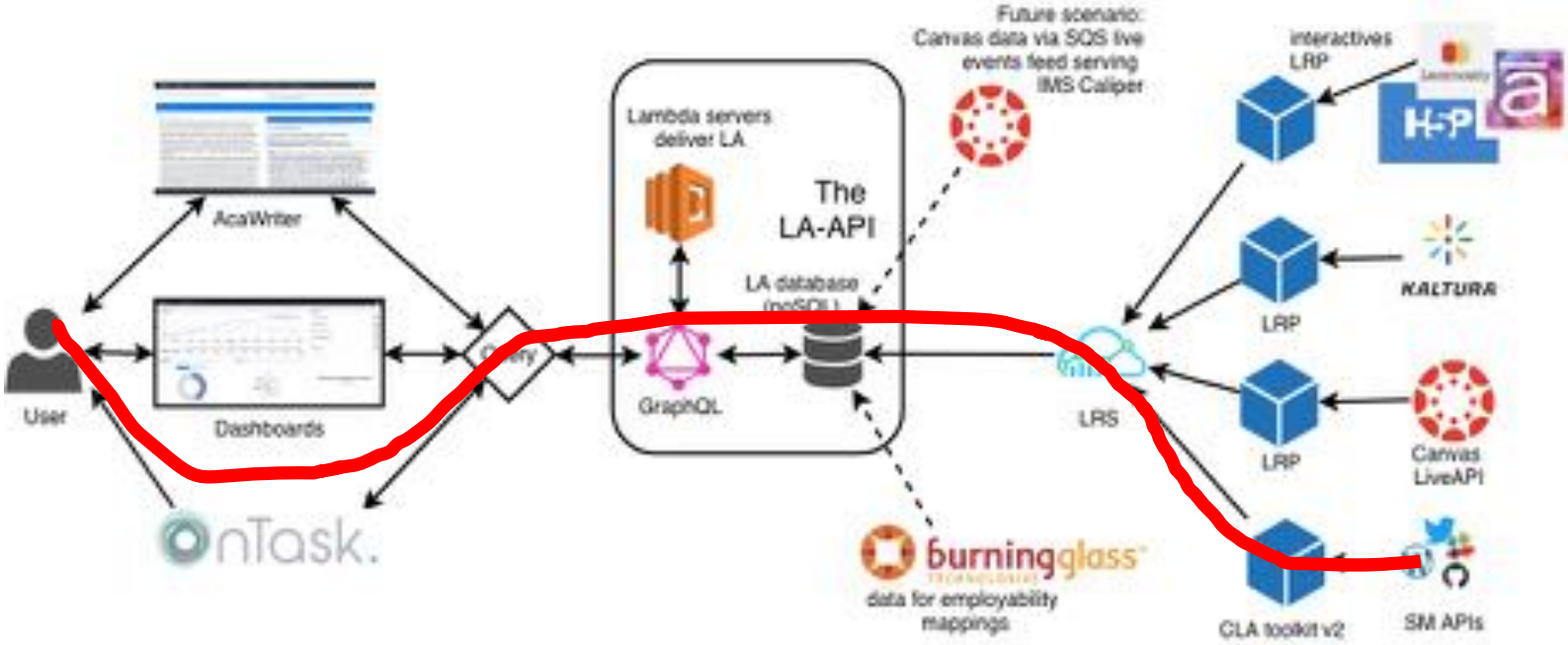
Search:

	First principles: Pre-class quiz	First principles: post class quiz	MDSI Pre-flight Check	Regression Models: Post Class Quiz	Some questions to get you thinking...	email
Operations	0.00		5.00		9.13	linda.j.chelugat@student.uts.edu.au
Operations	0.00	2.00	2.00		6.93	anm.faisal@student.uts.edu.au
Operations	0.00		4.00	1.00	10.00	maryalice.campbell@student.uts.edu.au
Operations	2.00		3.00			yashesvi.munshi@student.uts.edu.au
Operations	2.25	1.00	2.00		5.03	annegorge.pelayre@student.uts.edu.au
Operations	3.00	2.00	1.00		2.53	muhammad.m.rahman-1@student.uts.edu.au
Operations	3.25		1.00	0.00	6.70	ujashkumar.leuva@student.uts.edu.au
Operations	4.00		4.00	3.00	1.83	yuan.zhang-2@student.uts.edu.au
Operations	4.00	4.00	4.00		7.03	svetlana.sapegina@student.uts.edu.au
Operations	4.00	2.00	1.00	0.00	4.60	saminathan.raghavan@student.uts.edu.au

a few things to note about this approach

- we have defined vocabulary via xAPI (so what appears in OnTask is not arbitrary, and has a standard structure)
- data model currently includes:
  - quizzes (MC questions)
  - notes (discussion fora and social media)
- context in xAPI statements can be extended with more info e.g. learning designs
- we can still extend the workflow with other data… so it is flexible as well as defaulting to a standard format

but wait - there's more!



ID14-3821: ENABLING CONNECTED LEARNING VIA OPEN SOURCE ANALYTICS IN THE WILD: LEARNING ANALYTICS BEYOND THE LMS

This project was supported by the Australian Government's office for learning and teaching

QUEENSLAND UNIVERSITY OF TECHNOLOGY:
Kirsty Kitto (Lead Investigator), Mandy Lupton, John Banks, Dann Mallet, Peter Bruza

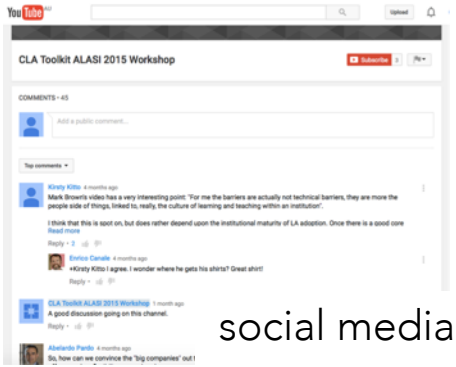
UNIVERSITY OF SOUTH AUSTRALIA
Shane Dawson, Dragan Gašević (Uni of Edinburgh)

UNIVERSITY OF TECHNOLOGY SYDNEY
Simon Buckingham Shum (and now Kirsty Kitto!)

UNIVERSITY OF SYDNEY
Abelardo Pardo

UNIVERSITY OF TEXAS (ARLINGTON)
George Siemens

the connected learning analytics toolkit



social media

Learning Record Store

scraping

xAPI

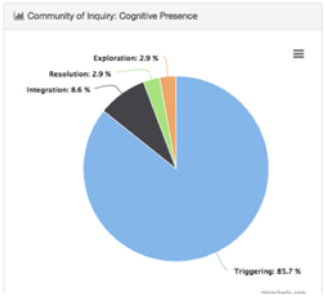
analysis

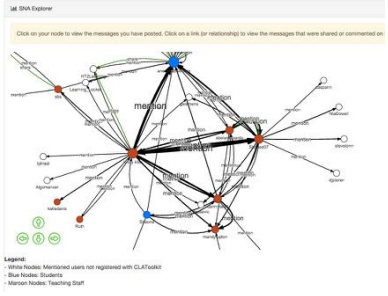
learning analytics

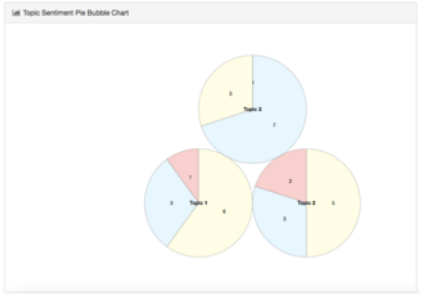
students

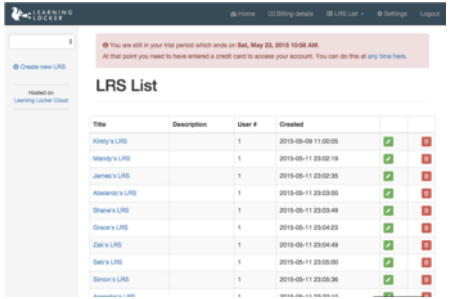
academics

admin & developers

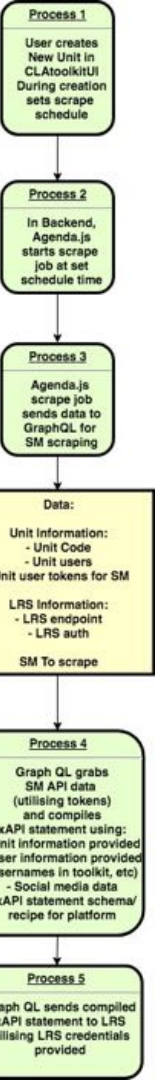








Kitto, K., Cross, S., Waters, Z., Lupton, M. (2015). Learning Analytics beyond the LMS: the Connected Learning Analytics Toolkit. In Proceedings of the Fifth International Conference on Learning Analytics and Knowledge (LAK15). ACM, New York, NY, USA, 11-15.

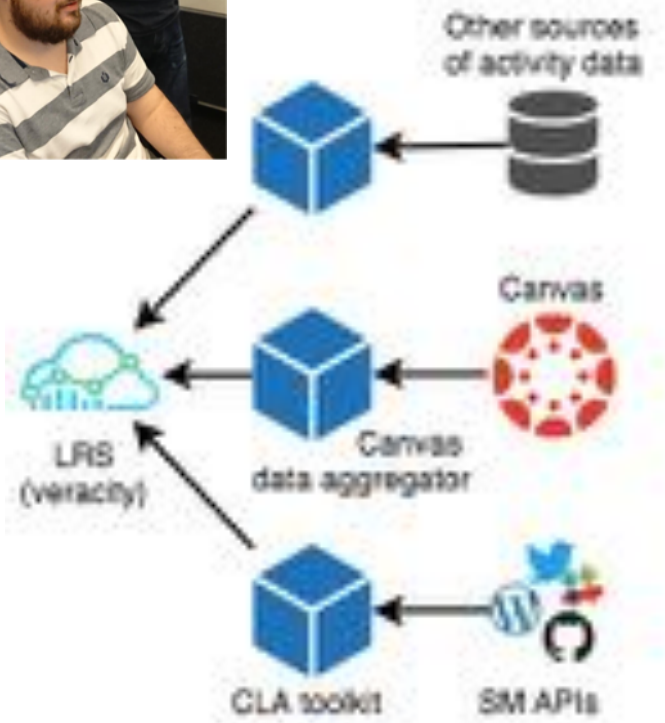


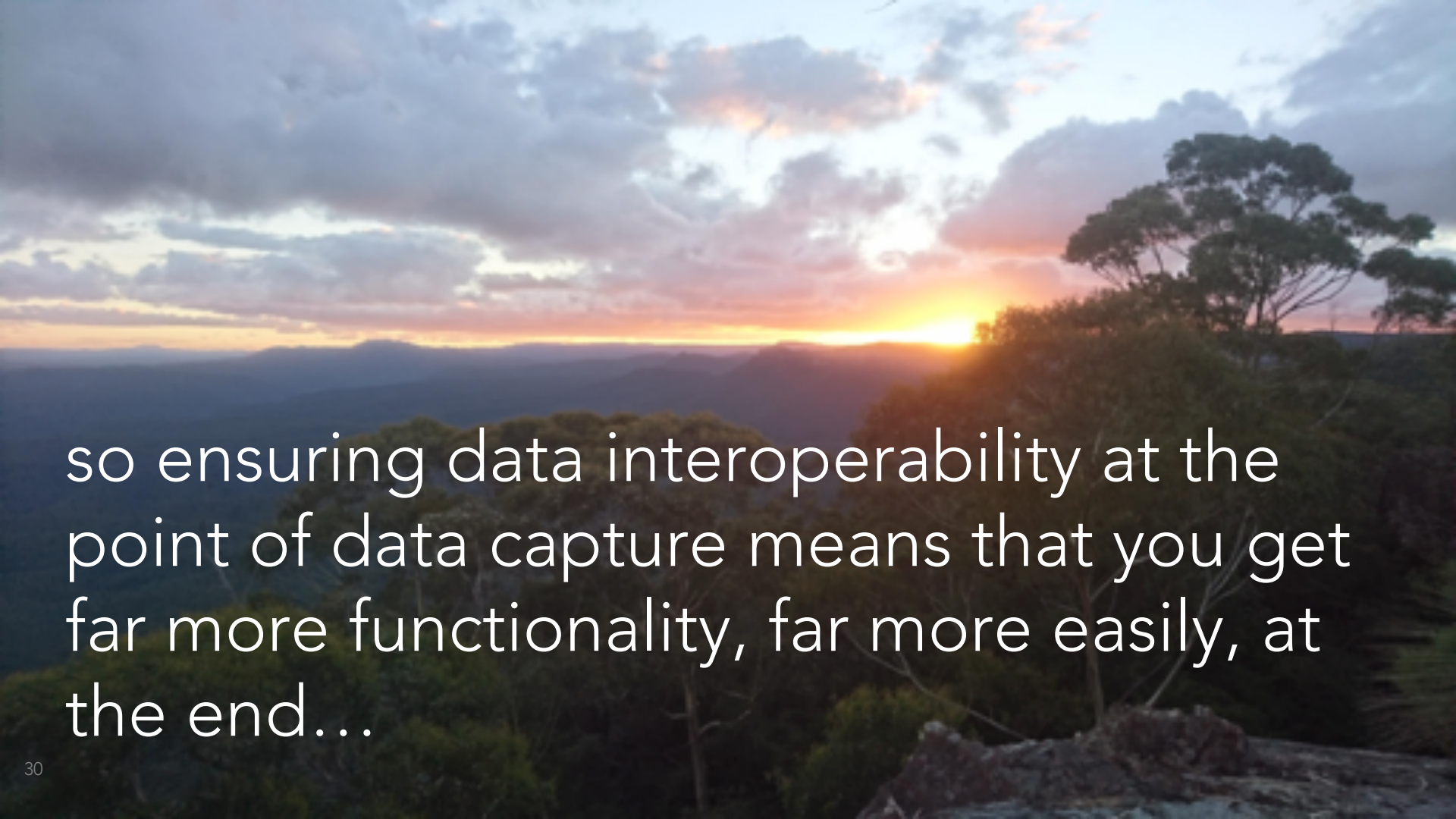
CLA toolkit V2

- no dashboards reports!
- it just collects data and sends it to the LRS
- maintains modularity!
- trello, slack, twitter, GitHub integrations
- a second suite of tools are used to deliver LA, dashboards, and other tools (e.g. piping data to OnTask)

Andrei Masslenikov

Zak Waters




so ensuring data interoperability at the point of data capture means that you get far more functionality, far more easily, at the end…

looking inside at the nuts and bolts

https://www.cmswire.com/cms/customer-experience/the-iot-will-drive-the-future-of-digital-experience-027937.php

xAPI data flow

BUT: just because its xAPI doesn't mean that statements are interoperable!

a simplest possible legal xAPI statement

```
{
    "id": "12345678-1234-5678-1234-567812345678",
    "actor":{
        "mbox":"mailto:xapi@adlnet.gov"
    },
    "verb":{
        "id":"http://adlnet.gov/expapi/verbs/created",
        "display":{
            "en-US":"created"
        }
    },
    "object":{
        "id":"http://example.adlnet.gov/xapi/example/activity"
    }
}
```

statement properties

Property	Type	Description	Required
id	UUID	UUID assigned by LRS if not set by the Learning Record Provider.	Recommended
actor	Object	Whom the Statement is about, as an Agent or Group Object.	Required
verb	Object	Action taken by the Actor.	Required
object	Object	Activity, Agent, or another Statement that is the Object of the Statement.	Required
result	Object	Result Object, further details representing a measured outcome.	Optional
context	Object	Context that gives the Statement more meaning. Examples: a team the Actor is working with, altitude at which a scenario was attempted in a flight simulator.	Optional
timestamp	Timestamp	Timestamp of when the events described within this Statement occurred. Set by the LRS if not provided.	Optional
stored	Timestamp	Timestamp of when this Statement was recorded. Set by LRS.	Set by LRS
authority	Object	Agent or Group who is asserting this Statement is true. Verified by the LRS based on authentication. Set by LRS if not provided or if a strong trust relationship between the Learning Record Provider and LRS has not been established.	Optional
version	Version	The Statement's associated xAPI version, formatted according to Semantic Versioning 1.0.0.	Not Recommended
attachments	Ordered array of Attachment Objects	Headers for Attachments to the Statement	Optional

https://github.com/adlnet/xAPI-Spec/blob/master/xAPI-Data.md#statement-properties

an example xAPI statement

(but its still very simple!)

https://github.com/adlnet/xAPI-Spec/blob/master/xAPI-Data.md#Appendix2A


```
{
 "actor": {
   "mbox": "mailto:kirsty.kitto@uts.edu.au",
   "name": "Kirsty Kitto",
   "objectType": "Agent",
   "id": "mailto:kirsty.kitto@uts.edu.au"
 },
 "verb": {
   "id": "http://activitystrea.ms/create",
   "display": {
     "en-US": "created"
   }
 },
 "object": {
   "id": "https://canvas.uts.edu.au/courses/604/discussion_topics/8095",
   "definition": {
     "name": {
       "en-US": "Note"
     },
     "description": {
       "en-US": "<p>Something that has really helped! I cant <strong>believe</strong> you aren't using it
     }
   },
   "objectType": "Activity"
 },
 "context": {
   "platform": "Canvas",
   "contextActivities": {
     "category": [
       {
         "id": "http://activitystrea.ms/schema/1.0.0"
       }
     ],
     "parent": [
       {
         "id": "https://canvas.uts.edu.au/courses/604"
       }
     ],
     "grouping": [
       {
         "id": "https://canvas.uts.edu.au/courses/604/discussion_topics/8095"
       }
     ]
   }
 },
 "id": "214cf69b-c4ad-416f-8073-cd9d30282f37",
 "timestamp": "2018-09-07T01:58:14.359Z",
 "stored": "2018-09-07T01:58:14.359Z",
 "authority": {
   "objectType": "Agent",
   "account": {
     "homePage": "https://canvas-cic.lrs.io/keys/canvas-cic",
     "name": "canvas-cic"
   }
 }
}
```

a more realistic example xAPI statement

(but its still very simple!)

https://github.com/adlnet/xAPI-Spec/blob/master/xAPI-Data.md#Appendix2A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    "platform": "Canvas",
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        }
      ]
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        "en-US": "Note"
      },
      "description": {
        "en-US": "<p>Something that has really helped! I cant <strong>believe</strong> you aren't using it
      }
    },
    "objectType": "Activity"
  },
  "context": {
    "platform": "Canvas",
    "contextActivities": {
      "category": [
        {
          "id": "http://activitystrea.ms/schema/1.0.0"
        }
      ],
      "parent": [
        {
          "id": "https://canvas.uts.edu.au/courses/604"
        }
      ],
      "grouping": [
        {
          "id": "https://canvas.uts.edu.au/courses/604/discussion_topics/8095"
        }
      ]
    }
  },
  "id": "214cf69b-c4ad-416f-8073-cd9d30282f37",
  "timestamp": "2018-09-07T01:58:14.359Z",
  "stored": "2018-09-07T01:58:14.359Z",
  "authority": {
    "objectType": "Agent",
    "account": {
      "homePage": "https://canvas-cic.lrs.io/keys/canvas-cic",
      "name": "canvas-cic"
    }
  }
}
```

a more realistic example xAPI statement

(but its still very simple!)

https://github.com/adlnet/xAPI-Spec/blob/master/xAPI-Data.md#Appendix2A


```
{
 "actor": {
   "mbox": "mailto:kirsty.kitto@uts.edu.au",
   "name": "Kirsty Kitto",
   "objectType": "Agent",
   "id": "mailto:kirsty.kitto@uts.edu.au"
 },
 "verb": {
   "id": "http://activitystrea.ms/create",
   "display": {
     "en-US": "created"
   }
 },
 "object": {
   "id": "https://canvas.uts.edu.au/courses/604/discussion_topics/8095",
   "definition": {
     "name": {
       "en-US": "Note"
     },
     "description": {
       "en-US": "<p>Something that has really helped! I cant <strong>believe</strong> you aren't using it
     }
   },
   "objectType": "Activity"
 },
 "context": {
   "platform": "Canvas",
   "contextActivities": {
     "category": [
       {
         "id": "http://activitystrea.ms/schema/1.0.0"
       }
     ],
     "parent": [
       {
         "id": "https://canvas.uts.edu.au/courses/604"
       }
     ],
     "grouping": [
       {
         "id": "https://canvas.uts.edu.au/courses/604/discussion_topics/8095"
       }
     ]
   }
 },
 "id": "814cf69b-c4ad-416f-8675-cd9d30282f37",
 "timestamp": "2018-09-07T01:58:14.359Z",
 "stored": "2018-09-07T01:58:14.359Z",
 "authority": {
   "objectType": "Agent",
   "account": {
     "homePage": "https://canvas-cic.lrs.io/keys/canvas-cic",
     "name": "canvas-cic"
   }
 }
}
```

Statement Explorer

Learn more about how statements work

This example statement does not include every possible property of the statement. To get a fuller picture, click on each section and then follow the links through to the relevant deep dive. You should also read about attachments and extensions.


```
{
  "actor": {
      "name": "Example Learner",
      "mbox": "mailto:learner@example.com",
      "objectType": "Agent",
    },

  "verb": {
```

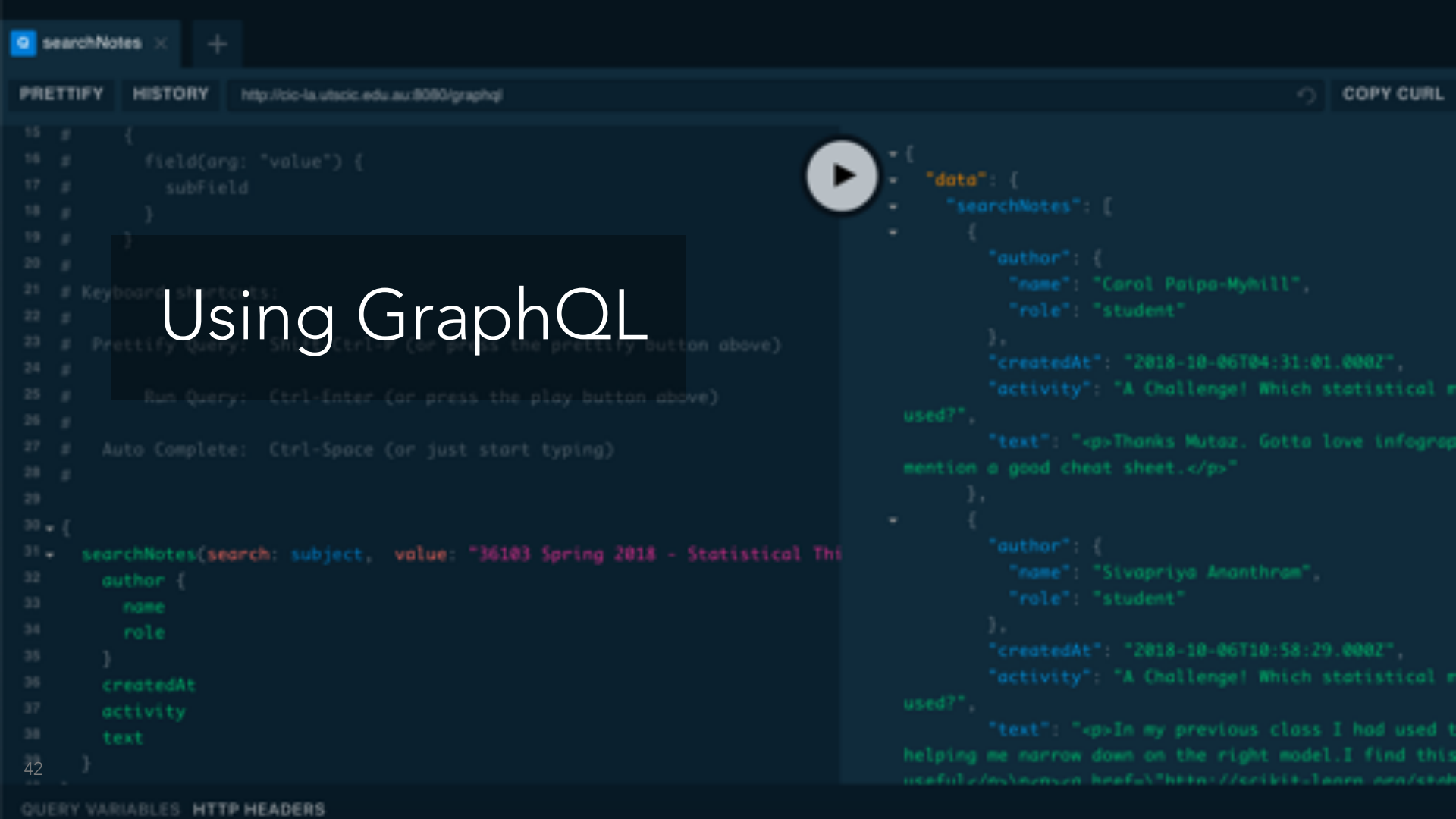

Explanation

Select each element of the statement to read the explanation.

AWS lambda services run many of the services in the LA-API

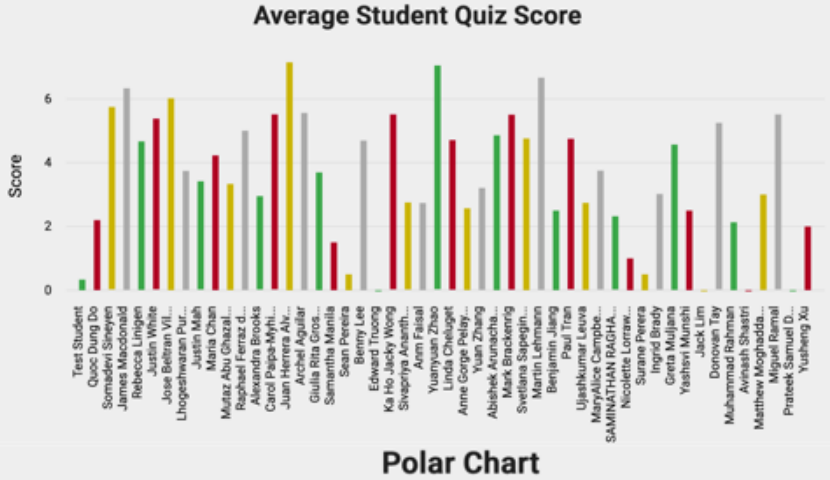
- runs code without provisioning or managing servers
- executes code only when needed and scales automatically
- minimises costs and puts burden of maintenance on AWS

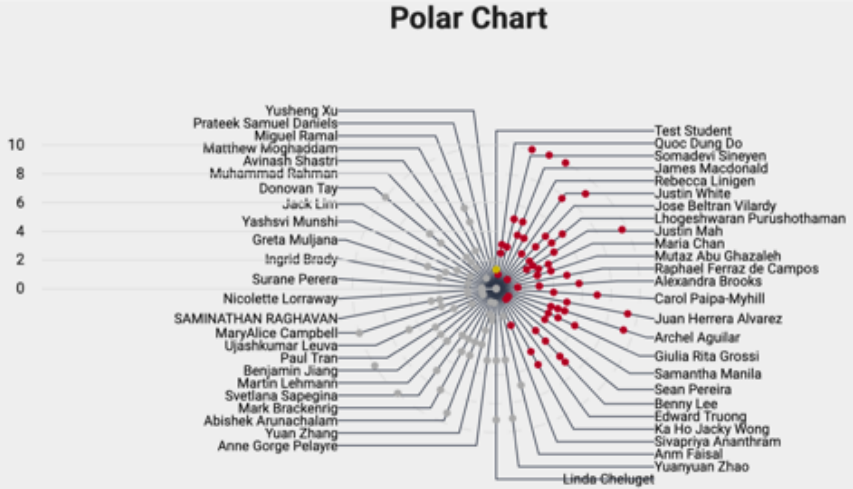
https://docs.aws.amazon.com/lambda/latest/dg/welcome.html


searchNotes
PRETTIFY
HISTORY
http://cic-la.utscic.edu.au:8080/graphql
COPY CURL
Using GraphQL
{
searchNotes(search: subject, value: "36103 Spring 2018 - Statistical Thi
author {
name
role
}
createdAt
activity
text
}
"data": {
"searchNotes": [
"author": {
"name": "Carol Paipa-Myhill",
"role": "student"
"createdAt": "2018-10-06T04:31:01.000Z",
"activity": "A Challenge! Which statistical
used?",
"text": " Thanks Mutaz. Gotta love infogra
mention a good cheat sheet. "
"author": {
"name": "Sivapriya Ananthram",
"role": "student"
"createdAt": "2018-10-06T10:58:29.000Z",
"activity": "A Challenge! Which statistical
used?",
"text": " In my previous class I had used
helping me narrow down on the right model.I find this
QUERY VARIABLES
HTTP HEADERS

the front end

- designed to be robust and extensible
- generated with Angular CLI version 7.0.0-rc.2
- ngx-charts used for widgets (https://github.com/swimlane/ngx-charts)
- once charts are added they can be reused with new calls to the graphQL…





http://la-api-dashboards.s3-website-ap-southeast-2.amazonaws.com/demo

lessons learned so far

- learning analytics *must* be designed from the end use back to the data capture
- early attention to data interoperability makes the reporting *much easier*
- common vocabulary standardises reporting and analytics… even for products that have been designed for flexibility
- extensible and flexible querying makes it easy to reuse data pipelines and so brings large gains quickly (after early pain)

design a learning activity

It can use a mix of:

- Canvas data (discussions and quizzes implemented but other data could be integrated in future – give us priorities!)
- Slack, Trello, Twitter, GitHub
- other social media? (not implemented but *could* be…)

Questions for you to answer

1. what are students doing? is it one activity? a sequence?
2. what analytics do they see? and when?
3. what do they do after that? is it assessed? how?

Kitto, K., Lupton, M., Davis, K., & Waters, Z. (2017). Designing for student-facing learning analytics. Australasian Journal of Educational Technology, 33(5), 152-168.

Part C (Project Review and Contribution to Community)

Weight: 20%
Length: 700-1000 words
Individual Assessment
Due date: 11:59pm Sunday 7th October
Submitted via Canvas in PDF format.

Rationale
As a data science professional, you will often have to undergo performance reviews, or argue the case for a promotion. It is important that you learn how to make use of evidence to justify claims that you make about your contribution to projects, and of your broader influence in the wider data science community. This will be assisted by an ability to reflect upon events that occur during projects, and the identification of strategies for improvement.

In Part C of Assessment 2, you will present evidence of your contribution to the Statistical Thinking community, along with a reflective review of your professional practice in the project.

You should follow the recommendations of this guide in crafting your reflective review: https://intranet.birmingham.ac.uk/as/libraryservices/library/skills/asc/documents/public/Short-Guide-Reflective-Writing.pdf. This review will need to make use of evidence generated during your groupwork project, which should be curated in an appendix. The appendix **must** contain:

1. At least one R script that you generated during the group project (whether or not it was used in the final project deliverables).
2. A printout of your reflective journal (generated on Canvas) which should include at least 5 reflective entries over the life of your group project.
3. A curated collection of other artefacts that help you to support the claims that you are making in your reflective review (e.g. slack posts, emails, forum posts, a data analysis of your contributions etc.)

You should reference the items from your Appendix in your reflection, explaining how they provide evidence of your claims. That is, you **should use this evidence to make your case.**

Be careful: some of the fora you use may have time/space limits! For example, slack does not store messages beyond a limit. You should be storing evidence as you go!

Task
In 700-1000 words you will construct a reflective review that considers:

1. **The group dynamics of your team.** You might want to consider some of the following questions: What went well? What did not work so well? What would you try next time to try and generate a better team dynamics? How did your team dynamics affect the statistical modelling process? Was your group dynamics "healthy"?
2. **Your contribution to the broader Statistical Thinking community.** How have you helped out people beyond your group? What responses have you made to people's questions in the forums and slack? Have you asked any questions that provoked an interesting discussion? How have you contributed to the fora? **(It should be a lot for top marks!)**

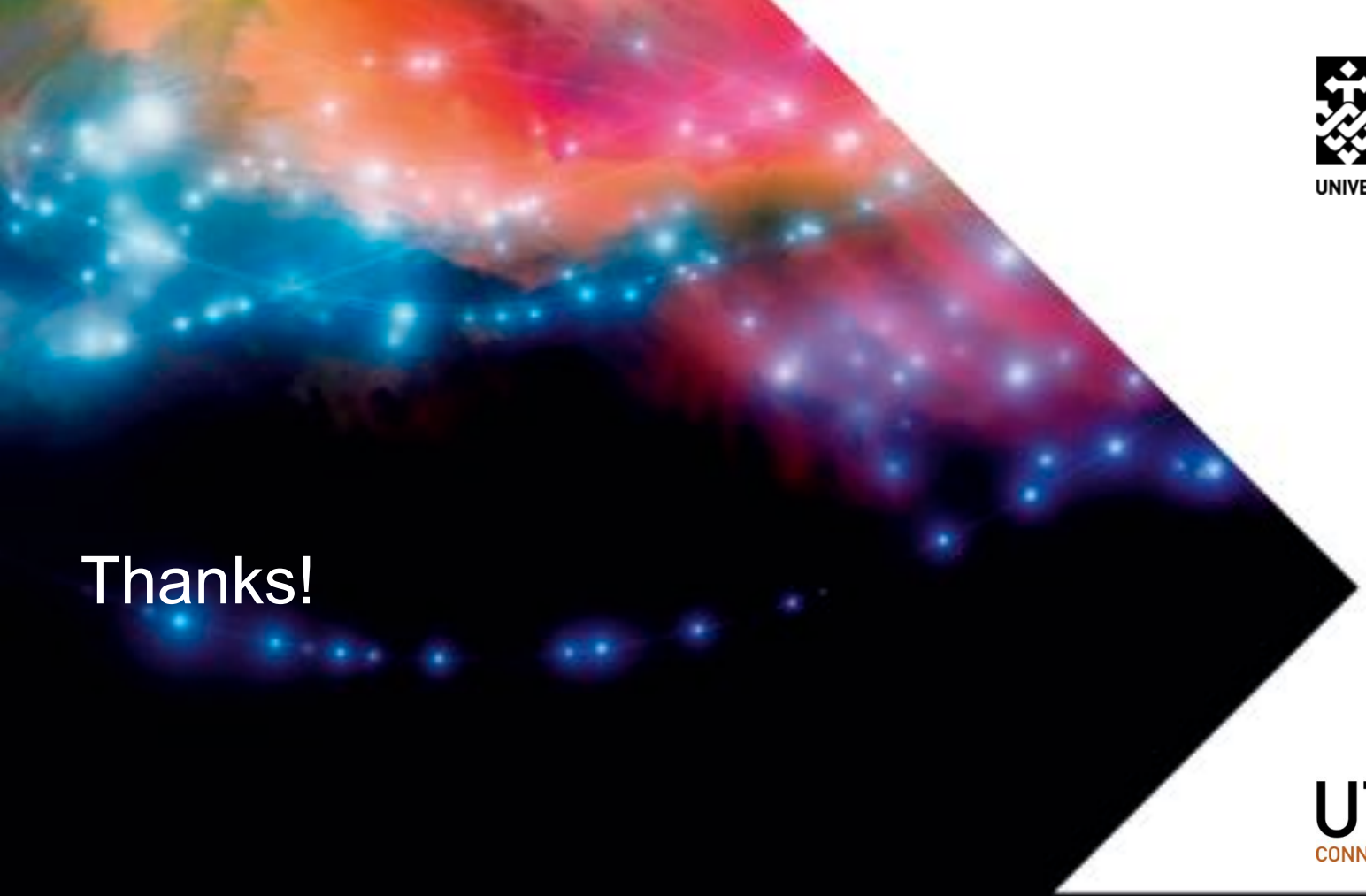
NB. If the reflections of your group suggest to subject coordinator that you have not contributed to the earlier deliverables for Assessment Task 2 then your marks for those items may be adjusted as appropriate. This may include a 0% mark.

Assessment Criteria: Part C

SLO	CILO	Assessment Criteria	Weight
7	3.3	Depth of evidence demonstrating your contribution to your group and to the broader Statistical Thinking community.	50%
1	2.4	Insightfulness and criticality in reviewing your contributions and identifying strategies for improvement in future collaborative work to achieve better outcomes.	50%
Sub Total			**100**
Total (20%)			**/20**

our development priorities for 2019

1. LTI integration of dashboards into Canvas
2. Canvas has now implemented IMS Caliper which will make it easier to pull large amounts of data into the DB and then access through the graph
3. Employability datasets
4. Institutional datasets (SIS etc.) through a second API layer
5. Integration with ACA Writer to support student writing
6. Interactive tools connected via LTI to Canvas - work towards interoperable integrations via standard xAPI Profiles
7. Personal data stores
8. Others? What should we focus on?



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Thanks!

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go play…

- http://la-api-dashboards.s3-website-ap-southeast-2.amazonaws.com/demo
- http://la-api-dashboards.s3-website-ap-southeast-2.amazonaws.com/canvas
- http://canvasdashboard.utscic.edu.au/social (fake data)

What would you like to see there?