E534 - Big Data Applications
Lecture Notes

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Geoffrey C. Fox Gregor von Laszewski

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1 PREFACE

Fri Sep 6 12:33:31 EDT 2019

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- https://github.com/cyberaide/bookmanager/issues

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2 WEEK 1

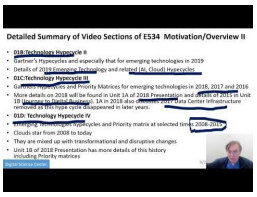
2.1 Part I Motivation I

2.1.1 Motivation

Big Data Applications & Analytics: Motivation/Overview; Machine (actually Deep) Learning, Big Data, and the Cloud; Centerpieces of the Current and Future Economy,

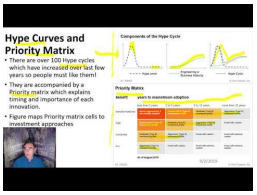
2.1.2 00) Mechanics of Course, Summary, and overall remarks on course

In this section we discuss the summary of the motivation section.



2.1.2.1 01A) Technology Hypecycle I

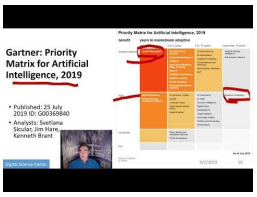
Today clouds and big data have got through the hype cycle (they have emerged) but features like blockchain, serverless and machine learning are on recent hype cycles while areas like deep learning have several entries (as in fact do clouds) Gartner's Hypecycles and especially that for emerging technologies in 2019 The phases of hypecycles Priority Matrix with benefits and adoption time Initial discussion of 2019 Hypecycle for Emerging Technologies



2.1.2.2 01B) Technology Hypecycle II

Today clouds and big data have got through the hype cycle (they have emerged)

but features like blockchain, serverless and machine learning are on recent hype cycles while areas like deep learning have several entries (as in fact do clouds) Gartner’s Hypecycles and especially that for emerging technologies in 2019 Details of 2019 Emerging Technology and related (AI, Cloud) Hypecycles

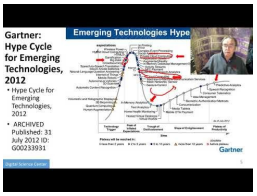


2.1.2.3 01C) Technology Hypecycle III

Today clouds and big data have got through the hype cycle (they have emerged) but features like blockchain, serverless and machine learning are on recent hype cycles while areas like deep learning have several entries (as in fact do clouds) Gartners Hypecycles and Priority Matrices for emerging technologies in 2018, 2017 and 2016 More details on 2018 will be found in Unit 1A of 2018 Presentation and details of 2015 in Unit 1B (Journey to Digital Business). 1A in 2018 also discusses 2017 Data Center Infrastructure removed as this hype cycle disappeared in later years.

2.1.3 01D) Technology Hypecycle IV

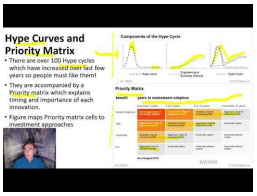
Today clouds and big data have got through the hype cycle (they have emerged) but features like blockchain, serverless and machine learning are on recent hype cycles while areas like deep learning have several entries (as in fact do clouds) Emerging Technologies hypecycles and Priority matrix at selected times 2008-2015 Clouds star from 2008 to today They are mixed up with transformational and disruptive changes Unit 1B of 2018 Presentation has more details of this history including Priority matrices



2.1.4 02)

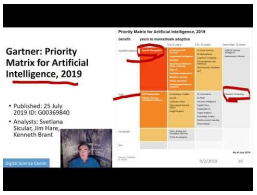
2.1.4.1 02A) Clouds/Big Data Applications I

The Data Deluge Big Data; a lot of the best examples have NOT been updated (as I can't find updates) so some slides old but still make the correct points Big Data Deluge has become the Deep Learning Deluge Big Data is an agreed fact; Deep Learning still evolving fast but has stream of successes!



2.1.4.2 02B) Cloud/Big Data Applications II

Clouds in science where area called cyberinfrastructure; The usage pattern from NIST is removed. See 2018 lectures 2B of the motivation for this discussion

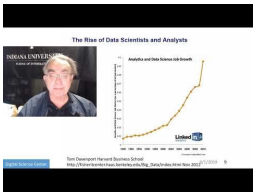


2.1.4.3 02C) Cloud/Big Data

Usage Trends Google and related Trends Artificial Intelligence from Microsoft, Gartner and Meeker

2.1.5 03) Jobs In areas like Data Science, Clouds and Computer Science and Computer

Engineering

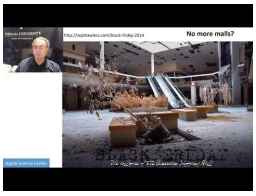


2.1.6 04) Industry, Technology, Consumer Trends Basic trends 2018 Lectures 4A 4B have

more details removed as dated but still valid See 2018 Lesson 4C for 3 Technology trends for 2016: Voice as HCI, Cars, Deep Learning

2.1.7 05) Digital Disruption and Transformation The Past displaced by Digital

Disruption; some more details are in 2018 Presentation Lesson 5



2.1.8 06)

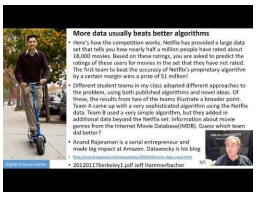
2.1.9 06A) Computing Model I Industry adopted clouds which are attractive for data

analytics. Clouds are a dominant force in Industry. Examples are given

2.1.9.1 06B) Computing Model II with 3 subsections is removed; please see 2018

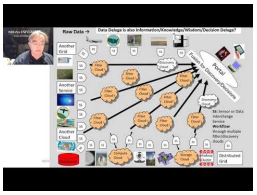
Presentation for this Developments after 2014 mainly from Gartner Cloud Market share Blockchain

2.1.10 07) Research Model 4th Paradigm; From Theory to Data driven science?

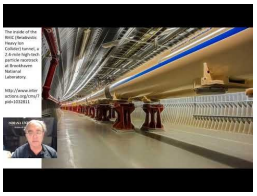


2.1.11 08) Data Science Pipeline DIKW: Data, Information, Knowledge, Wisdom, Decisions.

More details on Data Science Platforms are in 2018 Lesson 8 presentation

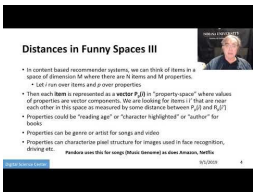


2.1.12 09) Physics: Looking for Higgs Particle with Large Hadron Collider LHC Physics as a big data example

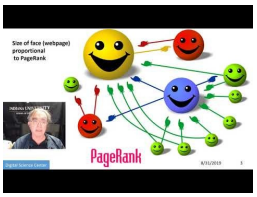


2.1.13 10) Recommender Systems I General remarks and Netflix example

2.1.14 11) Recommender Systems II Exploring Data Bags and Spaces

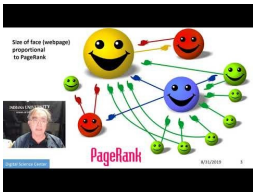


2.1.15 12) Web Search and Information Retrieval Another Big Data Example

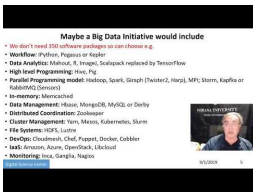


2.1.16 13) Cloud Applications in Research Removed Science Clouds, Internet of Things

Part 12 continuation. See 2018 Presentation (same as 2017 for lesson 13) and Cloud Unit 2019-I) this year

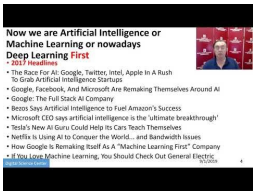


2.1.17 14) Parallel Computing and MapReduce Software Ecosystems



2.1.18 15) Online education and data science education Removed.

You can find it in the 2017 version. In Week 2 you can see more about this.



2.1.19 16) Conclusions

Conclusion contain in the latter part of the part 15.

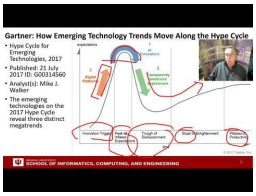
Motivation Archive Big Data Applications & Analytics: Motivation/Overview; Machine (actually Deep) Learning, Big Data, and the Cloud; Centerpieces of the Current and Future Economy. Backup Lectures from previous years referenced in 2019 class

3 WEEK 2

3.1 Part II Motivation II

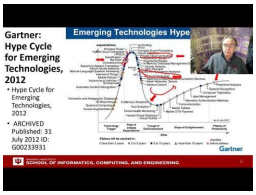
3.1.1 2018 BDAA Motivation-1A) Technology Hypecycle I

In this section we discuss on general remarks including Hype curves.



3.1.2 2018 BDAA Motivation-1B) Technology Hypecycle II

In this section we continue our discussion on general remarks including Hype curves.

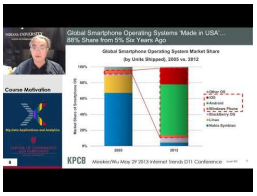


3.1.3 2018 BDAA Motivation-2B) Cloud/Big Data Applications II

In this section we discuss clouds in science where area called cyberinfrastructure; the usage pattern from NIST Artificial Intelligence from Gartner and Meeker.

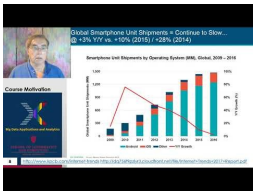
3.1.4 2018 BDAA Motivation-4A) Industry Trends I

In this section we discuss on Lesson 4A many technology trends through end of 2014.



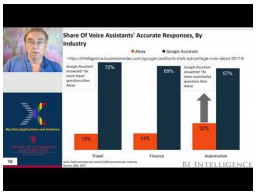
3.1.5 2018 BDAA Motivation-4B) Industry Trends II

In this section we continue our discussion on industry trends. This section includes Lesson 4B 2015 onwards many technology adoption trends.



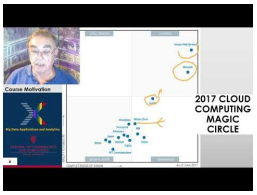
3.1.6 2017 BDAA Motivation-4C)Industry Trends III

In this section we continue our discussion on industry trends. This section contains lesson 4C 2015 onwards 3 technology trends voice as HCI cars deep learning.



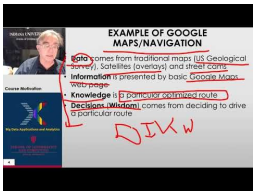
3.1.7 2018 BDAA Motivation-6B) Computing Model II

In this section we discuss computing models. This section contains lesson 6B with 3 subsections developments after 2014 mainly from Gartner cloud market share blockchain



3.1.8 2017 BDAA Motivation-8) Data Science Pipeline DIKW

In this section, we discuss data science pipelines. This section also contains about data, information, knowledge, wisdom forming DIKW term. And also it contains some discussion on data science platforms.

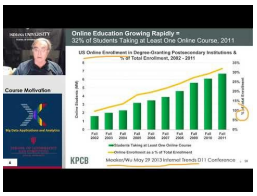


3.1.9 2017 BDAA Motivation-13) Cloud Applications in Research Science Clouds Internet of Things

In this section we discuss about internet of things and related cloud applications.

3.1.10 2017 BDAA Motivation-15) Data Science Education Opportunities at Universities

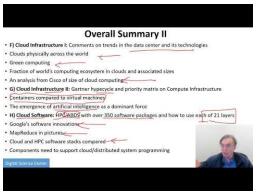
In this section we discuss more on data science education opportunities.



4 WEEK 3

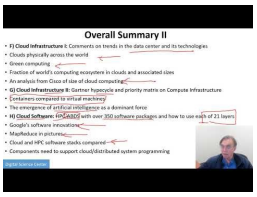
4.1 Part III Cloud

4.1.1 A. Summary of Course



4.1.2 B. Defining Clouds I

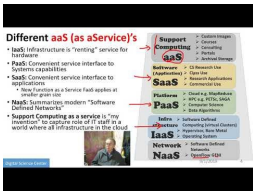
In this lecture we discuss the basic definition of cloud and two very simple examples of why virtualization is important.



In this lecture we discuss how clouds are situated wrt HPC and supercomputers, why multicore chips are important in a typical data center.

4.1.3 C. Defining Clouds II

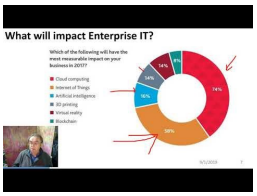
In this lecture we discuss service-oriented architectures, Software services as Message-linked computing capabilities.



In this lecture we discuss different aaS's: Network, Infrastructure, Platform, Software. The amazing services that Amazon AWS and Microsoft Azure have Initial Gartner comments on clouds (they are now the norm) and evolution of servers; serverless and microservices Gartner hypecycle and priority matrix on

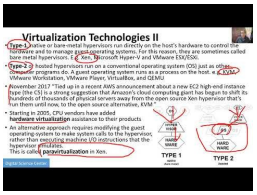
Infrastructure Strategies.

4.1.4 D. Defining Clouds III: Cloud Market Share



In this lecture we discuss on how important the cloud market shares are and how much money do they make.

4.1.5 E. Virtualization: Virtualization Technologies,



In this lecture we discuss hypervisors and the different approaches KVM, Xen, Docker and Openstack.

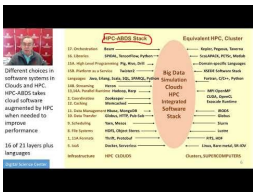
4.1.6 F. Cloud Infrastructure I

In this lecture we comment on trends in the data center and its technologies. Clouds physically spread across the world Green computing Fraction of world's computing ecosystem. In clouds and associated sizes an analysis from Cisco of size of cloud computing is discussed in this lecture.

4.1.7 G. Cloud Infrastructure II

In this lecture, we discuss Gartner hypecycle and priority matrix on Compute Infrastructure Containers compared to virtual machines The emergence of artificial intelligence as a dominant force.

4.1.8 H. Cloud Software:

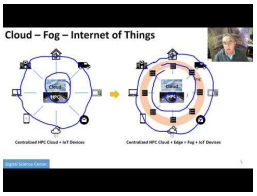


In this lecture we discuss, HPC-ABDS with over 350 software packages and how to use each of 21 layers Google's software innovations MapReduce in pictures Cloud and HPC software stacks compared Components need to support cloud/distributed system programming.

4.1.9 I. Cloud Applications I: Clouds in science where area called

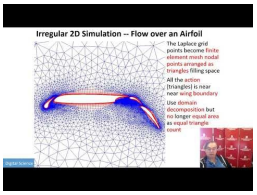
In this lecture we discuss cyberinfrastructure; the science usage pattern from NIST Artificial Intelligence from Gartner.

4.1.10 J. Cloud Applications II: Characterize Applications using NIST



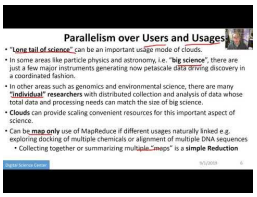
In this lecture we discuss the approach Internet of Things with different types of MapReduce.

4.1.11 K. Parallel Computing



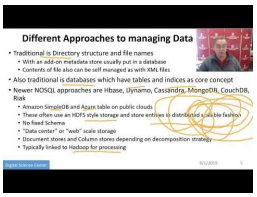
In this lecture we discuss analogies, parallel computing in pictures and some useful analogies and principles.

4.1.12 L. Real Parallel Computing: Single Program/Instruction Multiple Data SIMD SPMD



In this lecture, we discuss Big Data and Simulations compared and we furthermore discusses what is hard to do.

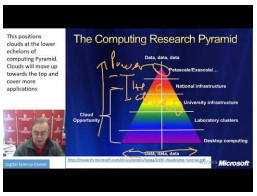
4.1.13 M. Storage: Cloud data



In this lecture we discuss about the approaches, repositories, file systems, data

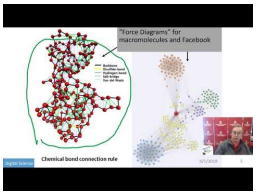
lakes.

4.1.14 N. HPC and Clouds



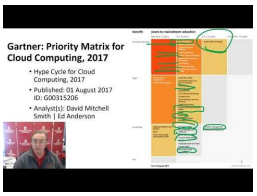
In this lecture we discuss the Branscomb Pyramid Supercomputers versus clouds Science Computing Environments.

4.1.15 O. Comparison of Data Analytics with Simulation:



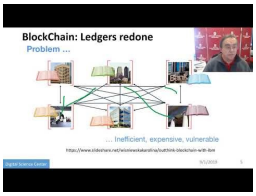
In this lecture we discuss the structure of different applications for simulations and Big Data Software implications Languages.

4.1.16 P. The Future I



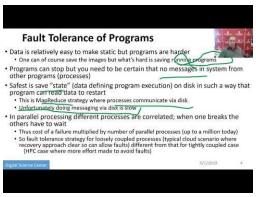
In this lecture we discuss Gartner cloud computing hypecycle and priority matrix 2017 and 2019 Hyperscale computing Serverless and FaaS Cloud Native Microservices Update to 2019 Hypecycle.

4.1.17 Q. other Issues II



In this lecture we discuss on Security Blockchain.

4.1.18 R. The Future and other Issues III



In this lecture we discuss on Fault Tolerance.

5 Assignments

5.1 Assignments

Due dates are on Canvas. Click on the links to checkout the assignment pages.

5.1.1 Assignment 1

5.1.2 Assignment 2

5.1.3 Assignment 3

6 GITHUB

6.1 TRACK PROGRESS WITH GITHUB

We will be adding git issues for all the assignments provided in the class. This way you can also keep a track on the items need to be completed. It is like a todo list. You can check things once you complete it. This way you can easily track what you need to do and you can comment on the issue to report the questions you have. This is an experimental idea we are trying in the class. Hope this helps to manage your work load efficiently.

6.1.1 How to check this?

All you have to do is go to your git repository.

Here are the steps to use this tool effectively.

6.1.1.1 Step 1

Go to the repo. Here we use a sample repo.

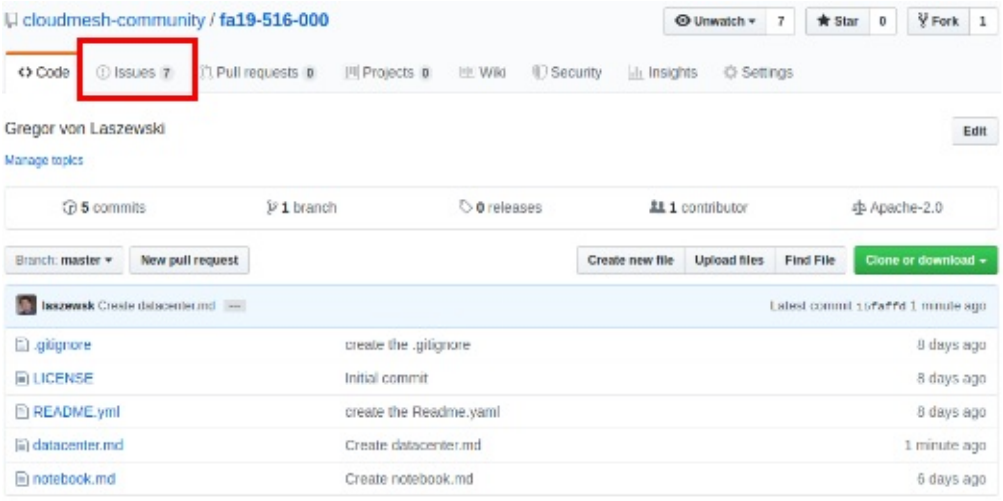
Sample Repo

Link to your repo will be https://github.com/cloudmesh-community/fa19-{class-id}-{hid}

class-id is your class number for instance 534. hid is your homework id assigned.

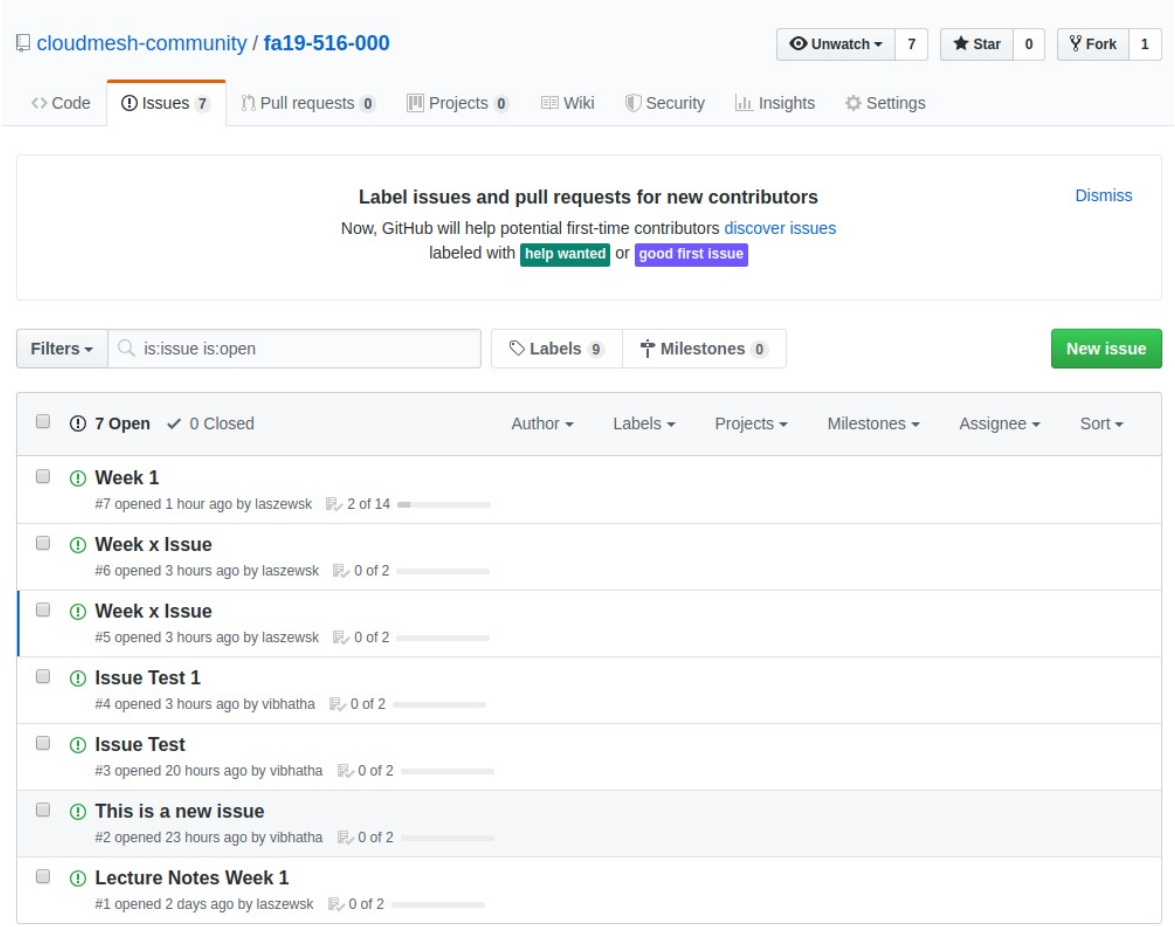
6.1.1.2 Step 2

The red colored box shows where you need to navigate next. Click on issues.



6.1.1.3 Step 3

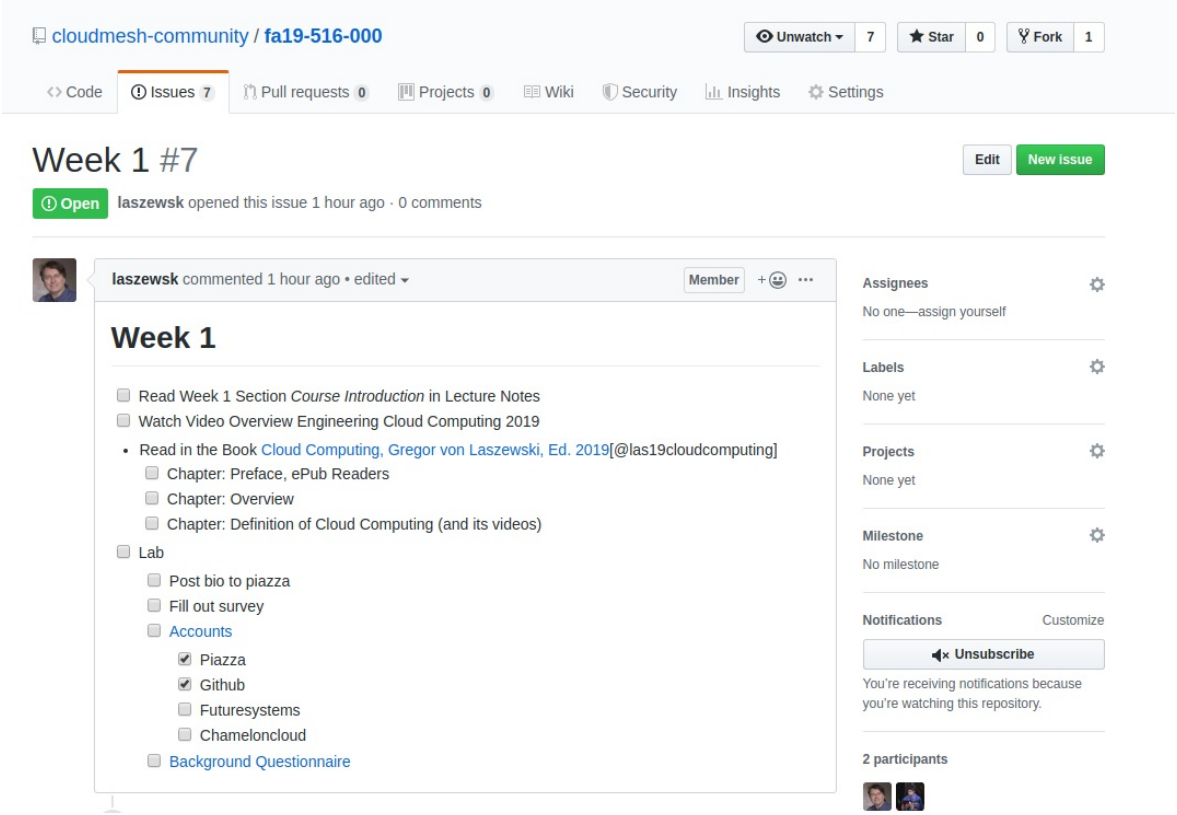
Git issue list looks like this. The inputs in this are dummy values we used to test the module. In your repo, things will be readable and identified based on week. This way you know what you need to do this week.



Git Repo View

6.1.1.4 Step 4

This is how a git issue looks like this.

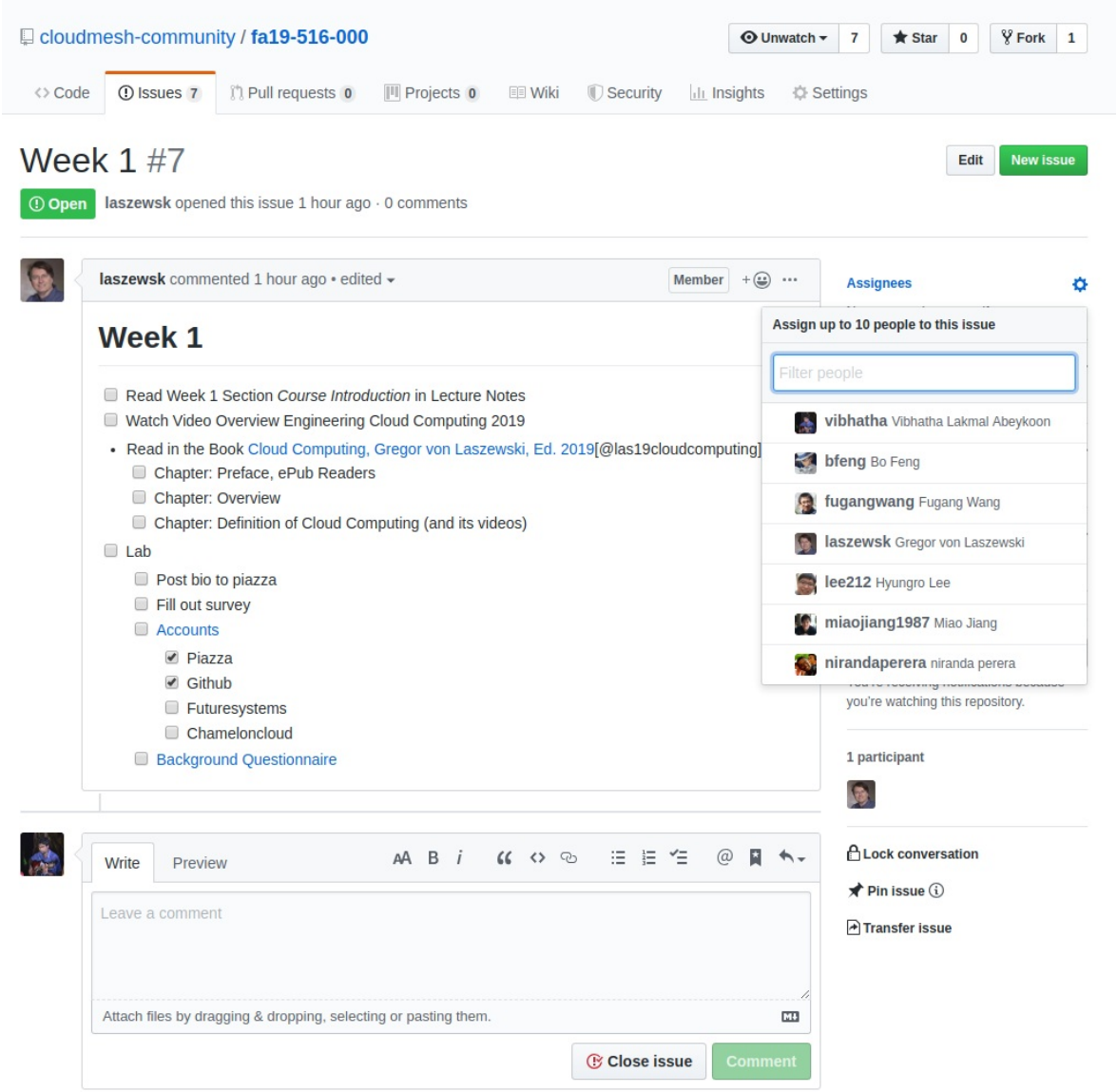


Git Issue View

In here you will see the things that you need to do with main task and subtasks. This looks like a tood list. No pressure you can customize the way you want it. We'll put in the basic skeleton for this one.

6.1.1.5 Step 5 (Optional)

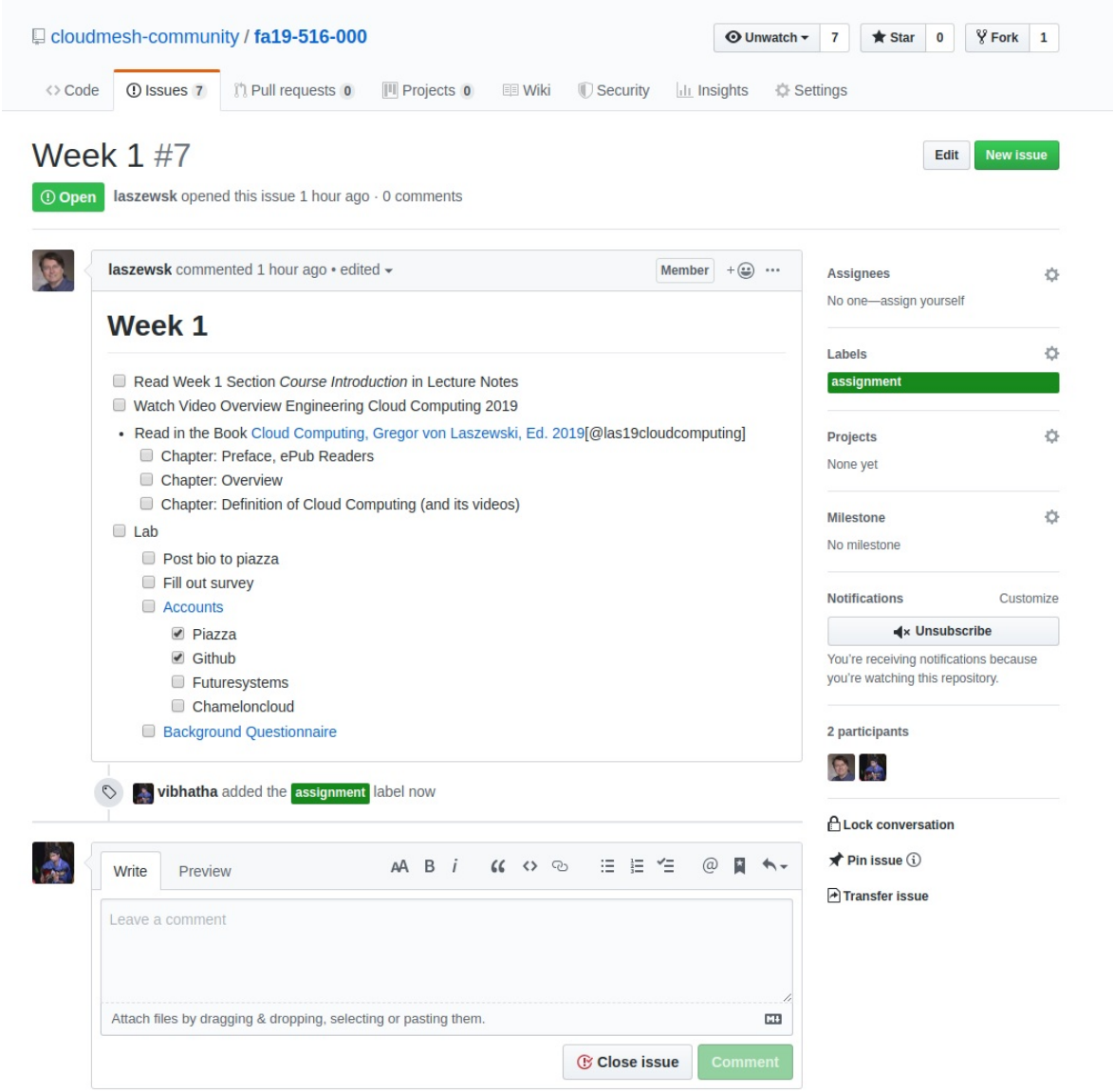
Assign a TA, once you have completed the issues, you can assign a TA to resolve if you have issues. In all issues you can make a comment and you can use @ sign to add the specific TA. For E534 Fall 2019 you can add **???** as an assignee for your issue and we will communicate to solve the issues. This is an optional thing, you can use canvas or meeting hours to mention your concerns.



Git Issue View

6.1.1.6 Step 6 (Optional)

You can add a label to your issue by clicking labels option in the right hand size within a given issue.



Git Issue View

7 REFERENCES