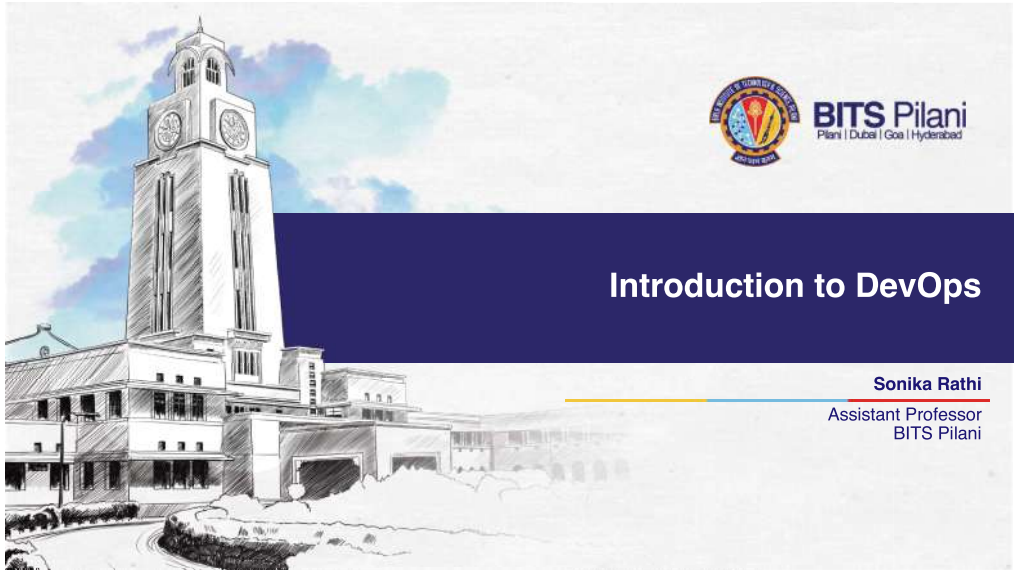
Extracted Titles

No.	Title	Page
1	Introduction to DevOps	1
2	Text Books	2
3	Reference Books	3
4	Introduction	4
5	Software Development Life Cycle	5
6	Software Development Life Cycle	6
7	Software Development Life Cycle	7
8	Software Development Life Cycle	8
9	Software Development Life Cycle	9
10	Software Development Life Cycle	10
11	Software Development Life Cycle	11
12	Software Development Life Cycle	12
13	Case Study	13
14	Waterfall Model	14
15	Waterfall Model Contd..	15
16	Waterfall Model Contd..	16
17	Waterfall Model Contd..	17
18	Need of Agile	18
19	Principles of Agile Methodology	19
20	Pillars of Agile Methodology	20
21	Agile Brings What??	21
22	Agile Methodologies	22
23	Roles in Agile	23
24	Agile Methodology	24
25	Operational Methodology	25
26	IT Service Management (ITSM)	26
27	ITIL	27
28	ITIL	28
29	ITIL	29
30	Thank You!	30
31	Introduction to DevOps	31
32	Introduction	32
33	DevOps	33
34	DevOps	34
35	Problems of Delivering Software	35
36	Common Release Antipatterns	36
37	Common Release Antipatterns	37
38	Common Release Antipatterns	38
39	Principles of Software Delivery	39



BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

Text Books

T1 & T2

- DevOps: A Software Architect's Perspective (SEI Series in Software Engineering) by Len Bass, Ingo Weber, Liming Zhu , Publisher: Addison Wesley (18 May 2015)
- Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation by Jez Humble, David Farley. Publisher: Addison Wesley, 2011

Reference Books

R1 & R2

- Effective DevOps: Building A Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis , Ryn Daniels. Publisher: O'Reilly Media, June 2016
- The DevOPS Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations by Gene Kim, Patrick Debois, John Willis, Jez Humble, John Allspaw. Publisher: IT Revolution Press (October 6, 2016)

Agenda

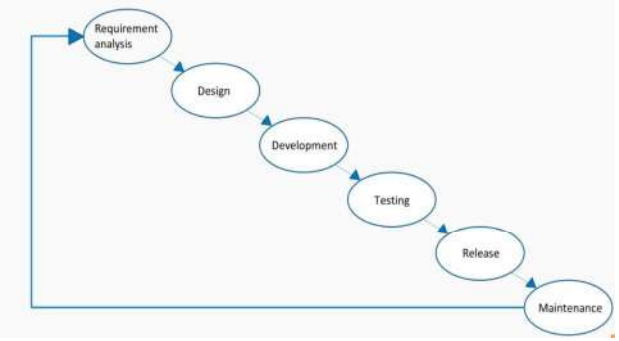
Introduction

- Software development lifecycle
- The Waterfall approach : Advantages & Disadvantages
- Agile Methodology
- Operational Methodologies: ITIL

Software Development Life Cycle

SDLC Phases

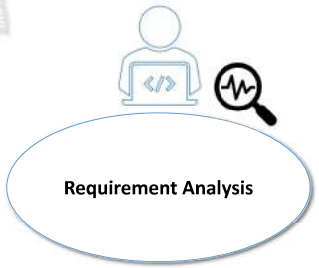
Diagram of our day-to-day activity as software engineers



Software Development Life Cycle

Requirement Analysis

- Encounter majority of problems
- Find common language between people outside of IT and people in IT
- Leads to different problems around terminology
- Business flow being capture incorrectly
- Iterative approach



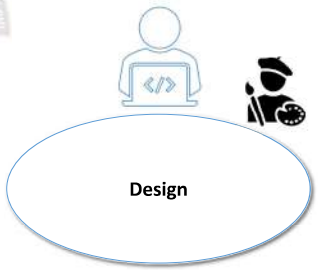
Software Development Life Cycle

Requirement Analysis Contd..

Software Development Life Cycle

Design

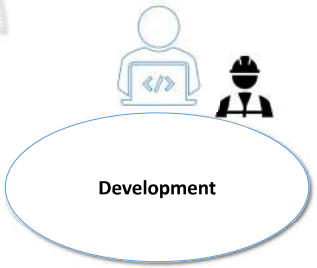
- Design our flows in language that IT crowd can understand straight away
- Overlaps with requirement analysis
- Desirable as diagrams are perfect middle language that we are looking for
- Minimal Viable Product



Software Development Life Cycle

Development

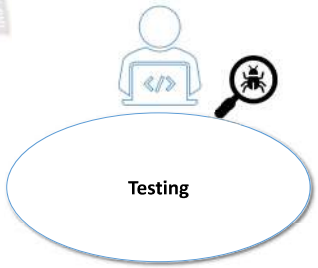
- Software is built
- Builds technical artifacts that work and according to potentially flawed specification
- Our software is going to be imperfect
- Deliver early and deliver often is mantra followed to minimize impact of wrong specification
- Stakeholders can test product before problem is too big to be tackled
- Involving stakeholders early enough is good strategy
- No matter what we do, our software has to be modular so we can plug and play modules in order to accommodate new requirements



Software Development Life Cycle

Testing

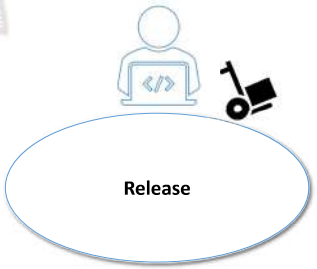
- Continuous Integration server will run testing and inform us about potential problems in application
- Depending on complexity of software, testing can be very extensive
- Continuous integration server focuses on running integration and acceptance



Software Development Life Cycle

Release

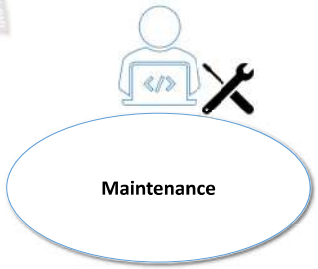
- Deliver software to what we call production
- There will be bugs and reason why we planned our software to be able to fix problems quickly
- Create something called as Continuous delivery pipelines
- Enables developers to execute build-test-deploy cycle very quickly
- Deploy = Release



Software Development Life Cycle

Maintenance

- There are two types of maintenance evolutive and corrective
- Evolutive maintenance – evolve software by adding new functionalities or improving business flows to suit business needs
- Corrective maintenance – One where we fix bugs and misconceptions
- Minimize latter but we can not totally avoid



Case Study

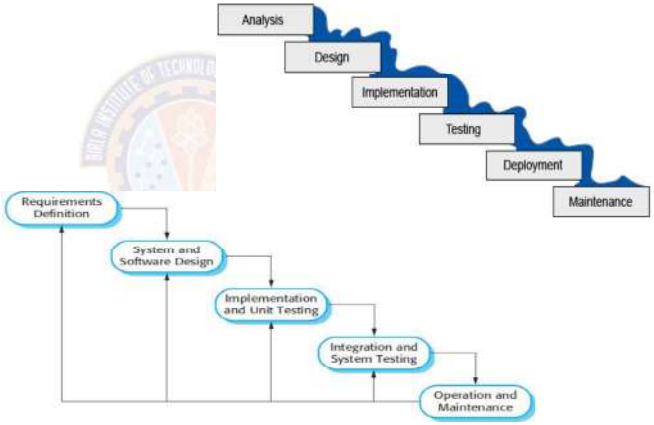
The Power of Automated Deployment form Continuous Delivery Book

- Large team dedicated to release
- High level of intervention
- Automated build, deploy, test and release system
- Only seven seconds to deploy the application into production
- Successful deployment of the system
- Roll back the change in the same amount of time

Waterfall Model

Waterfall Model and Feedback Amendment in Waterfall Model

- Classical Life cycle /Black Box Model
- Sequential in Nature
- Systematic, sequential approach to software development that begins with customer specification of requirements and progresses through planning, modeling, construction, and deployment, culminating in ongoing support of the completed software



Waterfall Model Contd..

Advantages

- Easy to use and follow
- Cost effective
- Each phase completely developed
- Development processed in sequential manner, so very less chance of rework
- Easy to manage the project
- Easy documentation

Waterfall Model Contd..

Waterfall Model Problems

- The main drawback of the waterfall model is the difficulty of accommodating change after the process is underway
- In principle, a phase has to be complete before moving onto the next phase
- Inflexible partitioning of the project into distinct stages makes it difficult to respond to changing customer requirements
  - Therefore, this model is only appropriate when the requirements are well-understood and changes will be fairly limited during the design process
  - Few business systems have stable requirements
- Does Waterfall ends????
- The waterfall model is mostly used for large systems engineering projects where a system is developed at several sites
  - In those circumstances, the plan-driven nature of the waterfall model helps coordinate the work

Waterfall Model Contd..

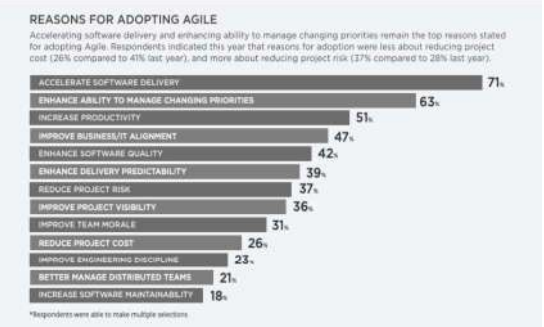
When to apply Waterfall?

Need of Agile

Why Agile?

- The project will produce the wrong product
- The project will produce a product of inferior quality
- The project will be late
- We'll have to work 80 hour weeks
- We'll have to break commitments
- We won't be having fun

- Storm called Agile
- According to VersionOne's State of Agile Report in 2017 says 94% of organizations practice Agile, and in 2018 it reported 97% organizations practice agile development methods



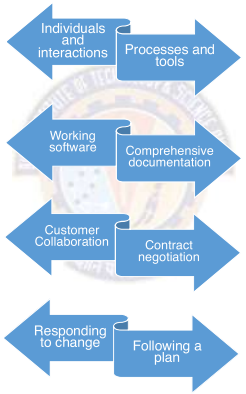
Principles of Agile Methodology

Twelve Principles

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale
4. Business people and developers must work together daily throughout the project
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation
7. Working software is the primary measure of progress
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely
9. Continuous attention to technical excellence and good design enhances agility
10. Simplicity--the art of maximizing the amount of work not done--is essential
11. The best architectures, requirements, and designs emerge from self-organizing teams
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly

Pillars of Agile Methodology

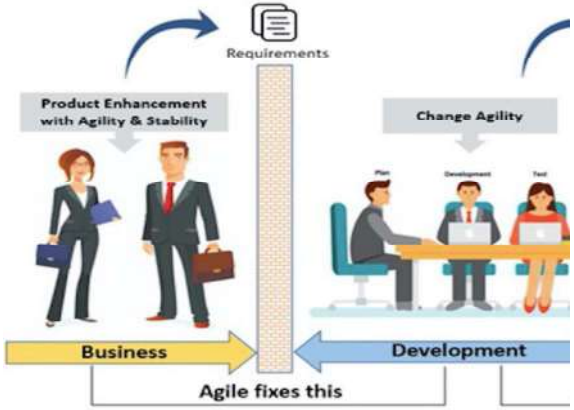
Agile focuses on



Agile Brings What??

Being Agile

- Effective (rapid and adaptive) response to change
- Effective communication among all stakeholders
- Drawing the customer onto the team
- Organizing a team so that it is in control of the work performed



Agile Methodologies

Few of Agile Methodologies

- Scrum
- Extreme Programming [XP]
- Test driven Development [TDD]
- Feature Driven Development [FDD]
- Behavior-driven development [BDD]

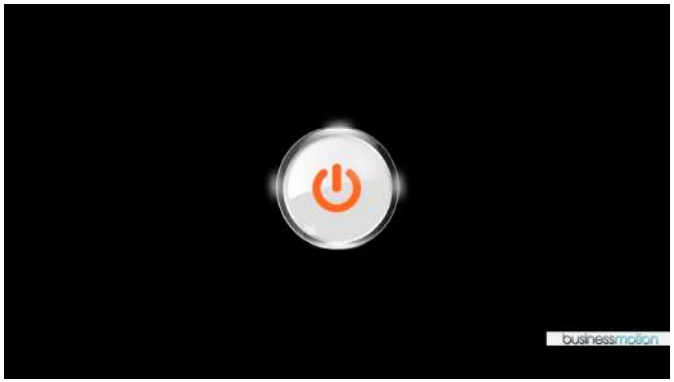
Roles in Agile

Basic roles involved

- User
- Product Owner
- Software Development Team

Agile Methodology

Summary



https://www.youtube.com/watch?v=1iccpf2eN1Q

Operational Methodology

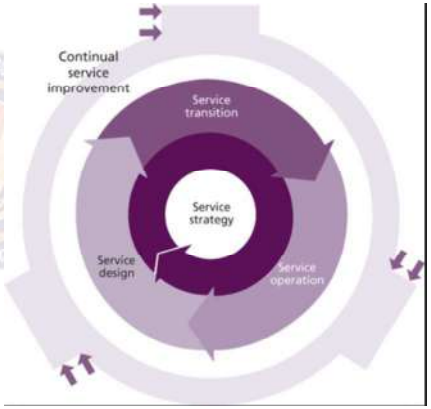
ITIL

- ITIL is a framework of best practices for delivering IT services
- The ITIL processes within IT Service Management (ITSM) ensure that IT Services are provided in a focused, client-friendly and cost-optimized manner
- ITIL's systematic approach to IT service management can help businesses
  - Manage risk
  - Strengthen customer relations
  - Establish cost-effective practices
  - And build a stable IT environment
- that allows for
  - Growth
  - Scale and
  - Change

IT Service Management (ITSM)

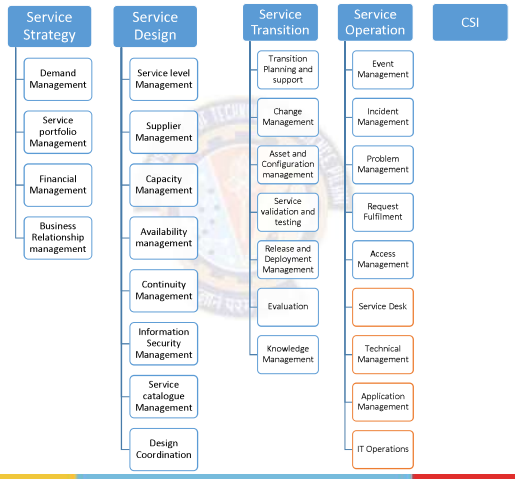
Lifecycle

- ITIL views ITSM as a lifecycle
- Five Phases:
  - Service Strategy
  - Service Design
  - Service Transition
  - Service Operation
  - Service Improvement [create and maintain value]



ITIL

Framework



ITIL

Is a Project???

- ITIL is not a "Project"
- ITIL is ongoing journey
- Benefits of ITIL:
  - Pink Elephant reports that Procter and Gamble saved about $500 million over four years by reducing help desk calls and improving operating procedures
  - Nationwide Insurance achieved a 40 percent reduction in system outages and estimates a $4.3 million ROI over three years
  - Capital One reduced its "business critical" incidents by 92 percent over two years

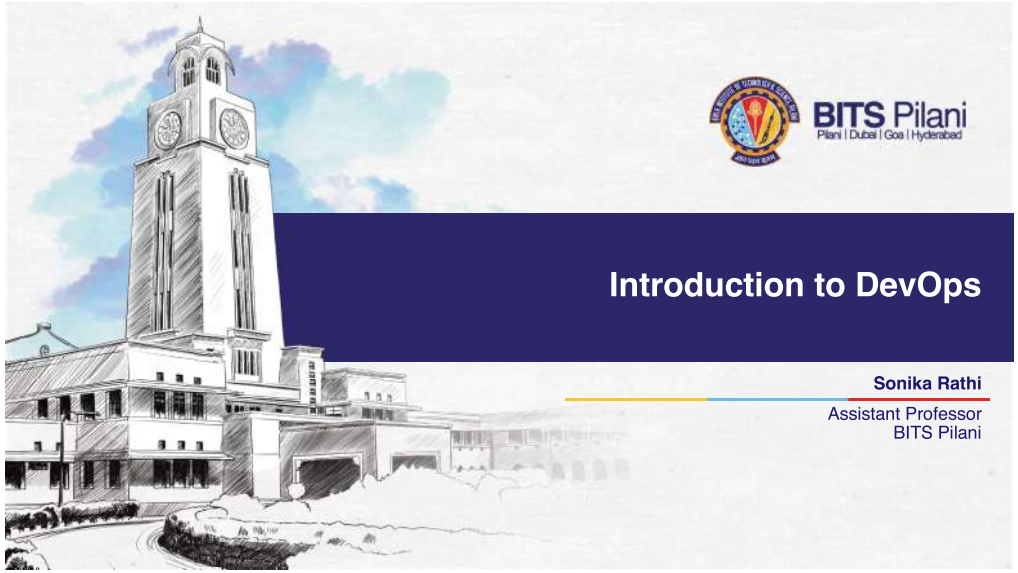
ITIL

Lets Review

https://www.youtube.com/watch?v=FSfgovmPHO8

Thank You!

In our next session:



BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

Agenda

Introduction

- About DevOps
- Problems of Delivering Software
- Principles of Software Delivery
- Need for DevOps
- DevOps Practices in Organization
- The Continuous DevOps Life Cycle Process
- Evolution of DevOps
- Case studies

DevOps

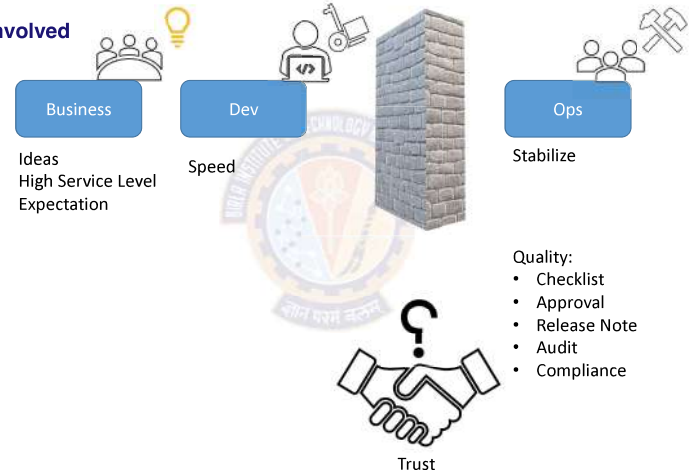
Definition

- "DevOps is a set of practices intended to reduce the time between committing a change to a system and the change being placed into normal production, while ensuring high quality"

Implications of this definition
- Practices and tools
- Do not restricted scope of DevOps to testing and development

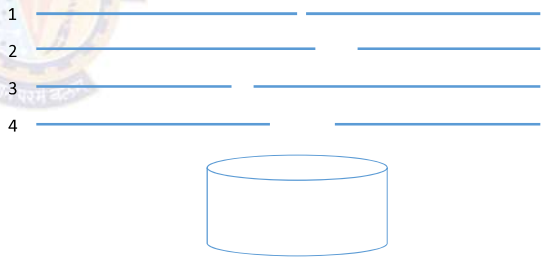
DevOps

Perspective involved



Problems of Delivering Software

- Converting Idea to Product / Service?
- Reliable, rapid, low-risk software releases
- Ideal Environment
- Generic Methodologies for Software Methodologies
- More focus on Requirement Gathering
- Understanding the Value Stream Map



Common Release Antipatterns

Deploying Software Manually

- Extensive and detailed documentation
- Reliance on manual testing
- Frequent calls to the development team to explain
- Frequent corrections to the release process
- Sitting bleary-eyed in front of a monitor at 2 A.M

Common Release Antipatterns

Deploying to a Production-like Environment Only after Development Is Complete

- Tester tested the system on development machines
- Releasing into staging is the first time that operations people interact with the new release
- Who Assembles? The Development Team
- Collaboration between development and Operations?

Common Release Antipatterns

Manual Configuration Management of Production Environments

- Difference in Deployment to Stage and Production
- Different host behave differently
- Long time to prepare an environment
- Cannot step back to an earlier configuration of your system
- Modification to Configuration Directly

Principles of Software Delivery

- Create a Repeatable, Reliable Process for Releasing Software
- Automate Almost Everything
- Keep Everything in Version Control
- If It Hurts, Do It More Frequently, and Bring the Pain Forward
- Build Quality In
  - "The Earlier you catch the defects, the cheaper they are to fix"
- Done, Means Released
- Everybody Is Responsible for the Delivery Process
- Continuous Improvement

DevOps Practices

Five different categories of DevOps practices

- Treat Ops as first-class citizens from the point of view of requirements
- Make Dev more responsible for relevant incident handling
- Enforce the deployment process used by all, including Dev and Ops personnel
- Use continuous deployment
- Develop infrastructure code, such as deployment scripts

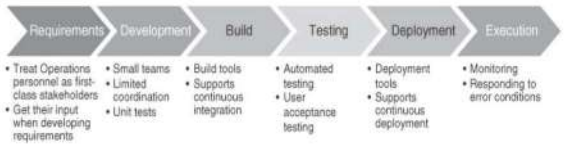
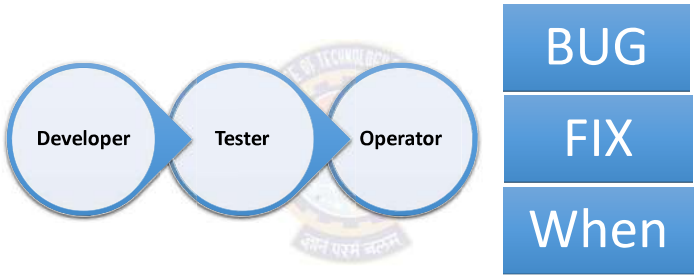


FIGURE 1.1 DevOps life cycle processes [Notation: Porter's Value Chain]

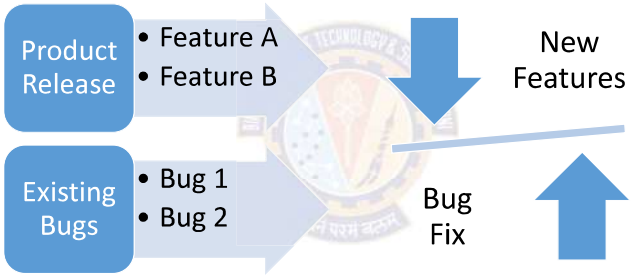
Need for DevOps

Timelines



Need for DevOps

Imbalance



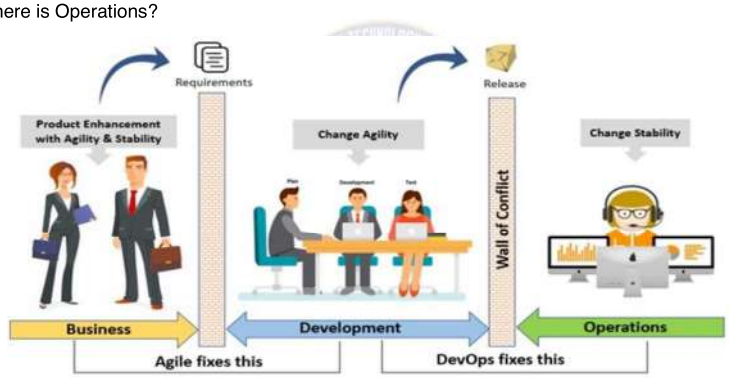
Need for DevOps

Blame Game

Need for DevOps

Where is Operations?

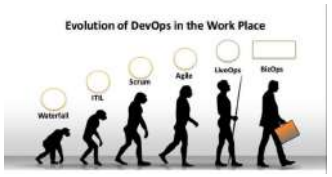
- Development is All Well (Waterfall, Agile)
- Where is Operations?



The evolution of DevOps

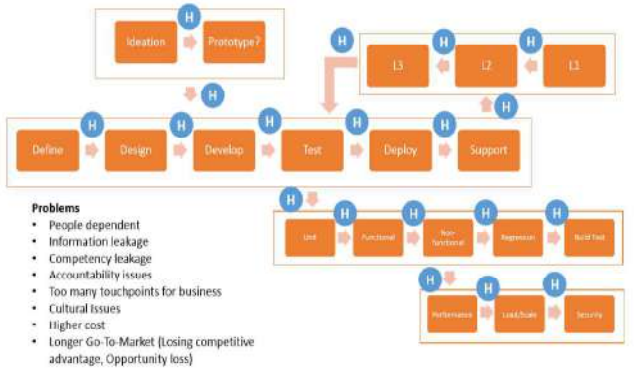
History

- Back in 2007
- Patrick Debois [Belgian Engineer]
- Initially it was Agile Infrastructure but later coined the phrase DevOps
- Velocity conference in 2008
- And if you see you may come across more tangential DevOps Initiative
  - WinOps
  - DevSecOps
  - BizDevOps



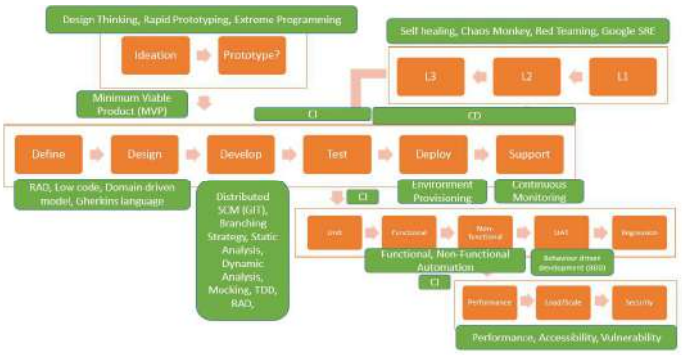
The old world before DevOps

More Handshakes



Evolution of DevOps :: New world

No More Handshakes



Case Study

Flickr / Yahoo

- Flickr was able to reach
  - 10+ Deploy per day after adopting DevOps
- In 2009
- You May Also Refer:
- YouTube Link: https://www.youtube.com/watch?v=LdOe18KhtT4

flickr

Case Study

Netflix

- Netflix's streaming service is a large distributed system hosted on Amazon Web Services (AWS)
- So many components that have to work together to provide reliable video streams to customers across a wide range of devices
- Netflix engineers needed to focus heavily on the quality attributes of reliability and robustness for both server- and client-side components
- Achieved this with DevOps by introducing a tool called Chaos Monkey
- Chaos Monkey is basically a script that runs continually in all Netflix environments, causing chaos by randomly shutting down server instances
- Thus, while writing code, Netflix developers are constantly operating in an environment of unreliable services and unexpected outages
- Unique opportunity to test their software in unexpected failure conditions

NETFLIX

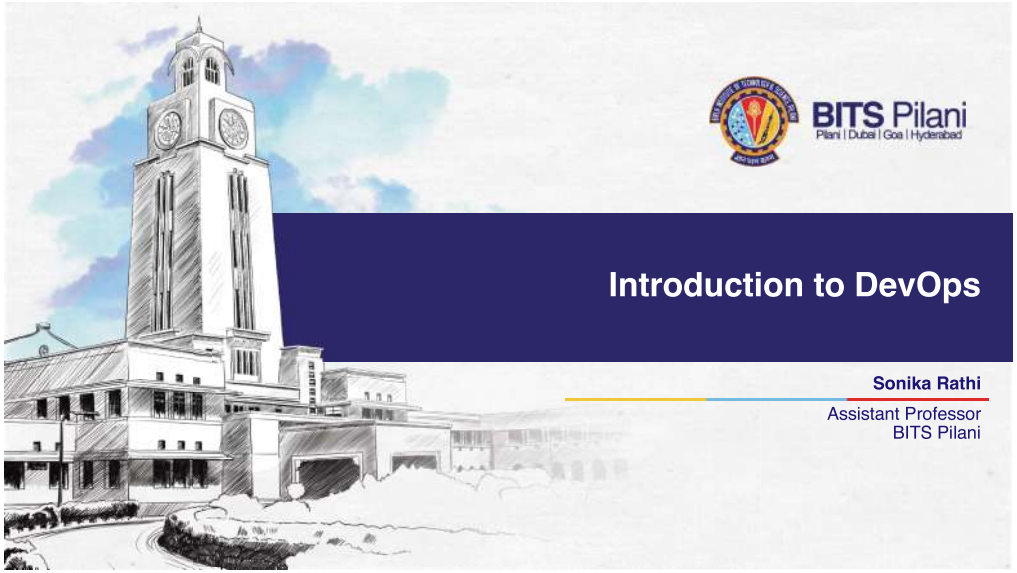
References

CS 1 & 2

- 4th chapter from Effective DevOps Building a Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis and Katherine Daniels
- 1st chapter Continuous Delivery by Jez Humble and David Farley and 5th Chapter from Effective DevOps Building a Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis and Katherine Daniels
- For ITIL: https://www.simplilearn.com/itil-key-concepts-and-summary-article,

Thank You!

In our next session:



Agenda

Understanding DevOps

- DevOps Misconception
- DevOps Anti-Patterns
- Three Dimensions of DevOps
  - Process
  - People
  - Tools

DevOps Misconception

DevOps Myths & Misconception

- DevOps is a Team
- CI/CD is all about DevOps
- Non-Compliant to Industry Standards

An additional team is likely to cause more communication issues

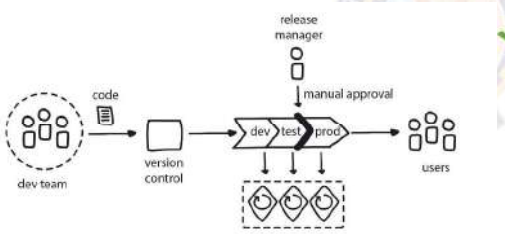
Scalability
Consistency
Reliability

Regulations implement control in order to be compliant
Controls reduce the risk that may affect the confidentiality, integrity, and availability of information

DevOps Misconception

DevOps Myths & Misconception

- Automation eliminates ALL bottlenecks
- "Universal" Continuous Delivery pipeline
- All about Tools
- Release as fast as Amazon / Facebook



Improve the partnership b/w dev test & Ops

It increases feedback loops
However Hand off processes can often add to process wait states

Empowered smaller self-sufficient teams and Continuous Delivery Engineer

Processes to fit organizational and busin needs — not vice-versa

Mandating tools developers can use.
Prioritizing tools over people

DevOps Anti-Patterns

Anti-Patterns

- Blame Culture
  - A blame culture is one that tends toward blaming and punishing people when mistakes are made, either at an individual or an organizational level
- Silos
  - A departmental or organizational silo describes the mentality of teams that do not share their knowledge with other teams in the same company
- Root Cause Analysis
  - Root cause analysis (RCA) is a method to identify contributing and "root" causes of events or near-misses/close calls and the appropriate actions to prevent recurrence
- Human Errors
  - Human error, the idea that a human being made a mistake that directly caused a failure, is often cited as the root cause in a root cause analysis

Lessons of History

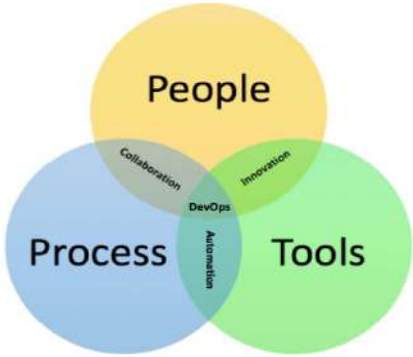
Example for Silos

- TVS India
  - T. V. Sundaram Iyengar
  - Founded in 1978

DevOps Dimensions

Three dimensions of DevOps

- People
- Process
- Tools / Technology



DevOps - Process

DevOps and Agile

- We need processes and policies for doing things in a proper way and standardized across the projects so the sequence of operations, constraints, rules and so on are well defined to measure success
- One of the characterizations of DevOps emphasizes the relationship of DevOps practices to agile practices
- We will focus on what is added by DevOps
- We interpret transition as deployment

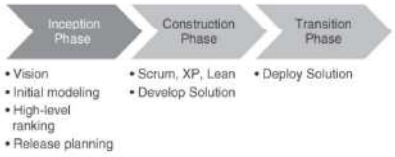


FIGURE 1.2 Disciplined Agile Delivery phases for each release. (Adapted from *Disciplined Agile Delivery: A Practitioner's Guide* by Ambler and Lines) [Notation: Porter's Value Chain]

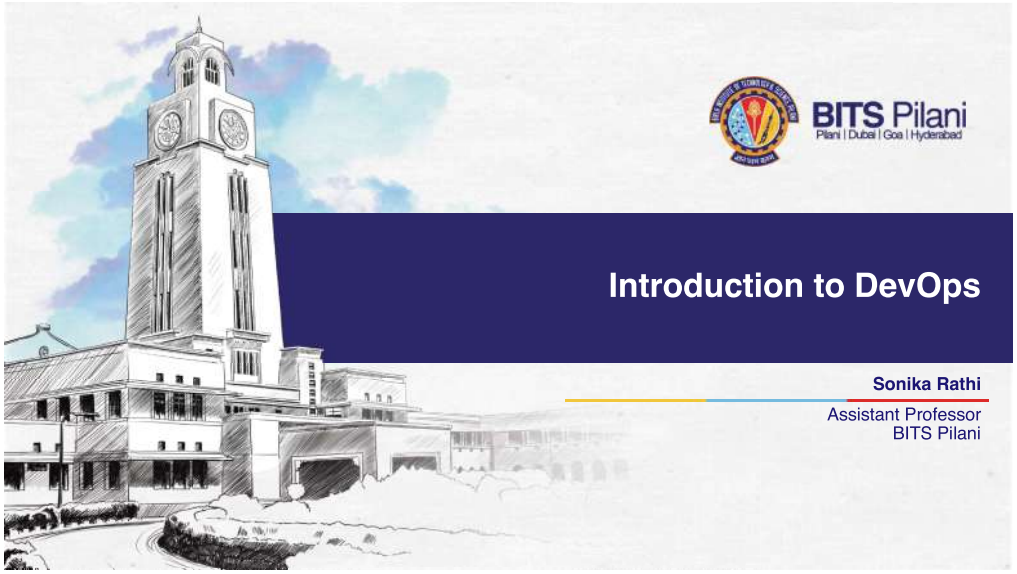
DevOps and Agile

DevOps practices impact all three phases

- Inception phase : During the inception phase, release planning and initial requirements specification are done
  - Considerations of Ops will add some requirements for the developers
  - Release planning includes feature prioritization but it also includes coordination with operations personnel
- Construction phase: During the construction phase, key elements of the DevOps practices are the management of the code branches,
  - the use of continuous integration
  - continuous deployment
  - incorporation of test cases for automated testing
- Transition phase: In the transition phase, the solution is deployed and the development team is responsible for the deployment, monitoring the process of the deployment, deciding whether to roll back and when, and monitoring the execution after deployment

Thank You!

In our next session:



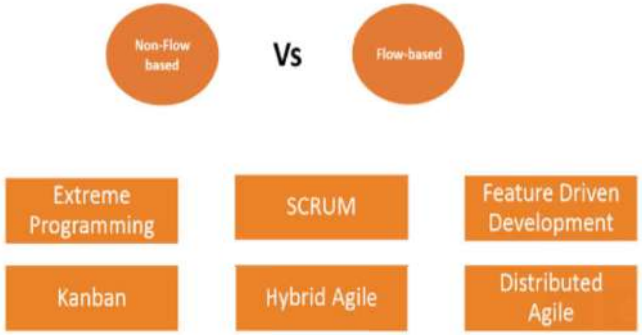
Agenda

DevOps : Process Dimension

- DevOps and Agile
- Team Structure
- Agile Methodology
  - TDD
  - BDD
  - FDD

DevOps – Process

Process



DevOps – Process

Team Structure

- Choosing appropriate team structure (Resource planning)

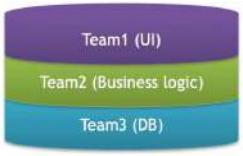
Component Team Structure

Featured Team Structure

DevOps – Process

Component teams

- Made up of experts that specialize in a specific domain
- Architecture diagram can be represented as layer of the system
- Advantages:
  - work is always done by people specifically qualified to do the work
  - work is done efficiently with a low defect density
- Disadvantages
  - Working as Component Teams increases the amount of time it takes to deliver
  - working in Component Teams will have a negative effect on productivity that cannot be over emphasized

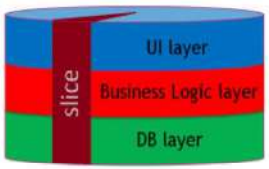


Architecture diagram

DevOps – Process

Feature teams

- Feature Teams contain multi-disciplined individuals that have the ability and freedom to work in any area of the system
- Feature Team usually has at least one member with specialist knowledge for each layer of the system
- This allows Feature Teams to work on what are known as 'vertical slices' of the architecture



DevOps – Process

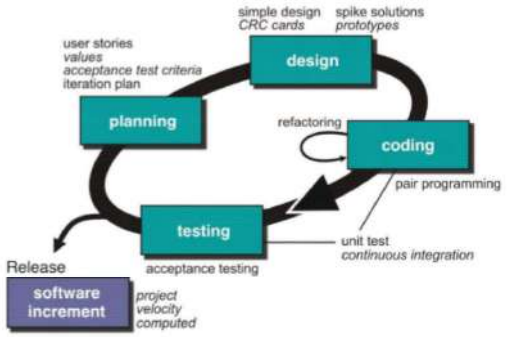
Feature teams

- The characteristics of a feature team are listed below:
  - long-lived—the team stays together so that they can 'jell' for higher performance; they take on new features over time
  - co-located
  - work on a complete customer-centric feature, across all components and disciplines (analysis, programming, testing, …)
  - composed of generalizing specialists
  - in Scrum, typically 7 ± 2 people
- Disadvantages
  - untrained or inexperienced employee to deliver a poorly designed piece of work into a live environment
  - Where do you get the personnel ('generalizing specialists')?

DevOps: Process

TDD

- Prerequisite :: XP



TDD

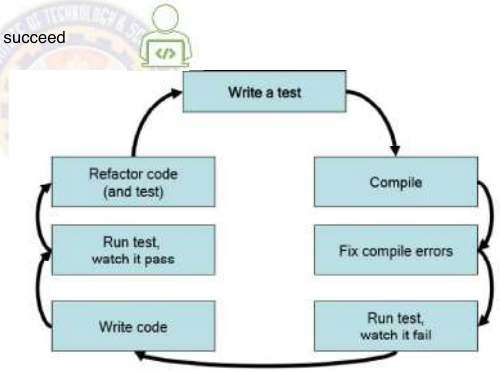
Understanding

- Many Names
  - Test driven development
  - Test drive design
  - Emergent design
  - Test first development
- TDD Quotes
  - Kent Beck said “Test-first code tends to be more cohesive and less coupled than code in which testing isn’t a part of the intimate coding cycle”
  - “If you can’t write a test for what you are about to code, then you shouldn’t even be thinking about coding”

TDD

TDD Three steps

- RED
  - Write a new TEST which fails
- GREEN
  - Write simplest possible code to make it succeed
- REFACTOR
  - Refactor the code (including test code)



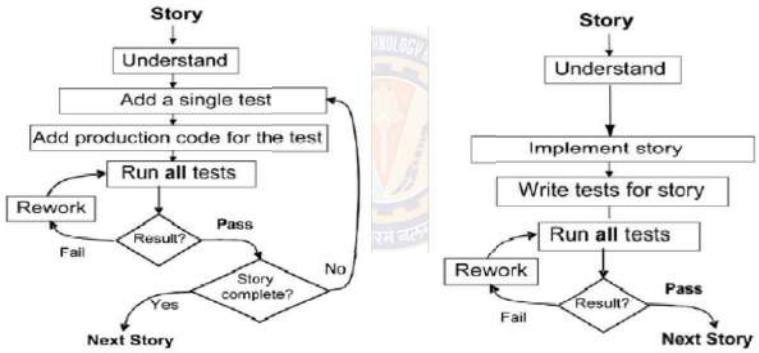
TDD

Why TDD

- TDD can lead to more modularized, flexible, and extensible code
- Clean code
- Better code documentation
- More productive
- Good design

TDD

Test First vs. Test Last



TDD Cycle

Red, Green and Refactor

- Example (payment gateway task)

1. Choose a small task
2. Write a failing test (RED Test)
3. Write simplest code to make the test pass (GREEN Test)
4. REFACTOR
5. Repeat

Implementation Code

```
payment_gateway = function () {
    credit_card ();
    netbanking ();
    upi_payment ();  ⟶  all_upi_payment ();
}
```

Run all test

Tests

```
.....
.....
.....
```

```
new_test= function () {
    payment_gateway_includes_upi_option ();
}
```

TDD

Lets Have TDD Overview

https://www.youtube.com/watch?v=uGaNkTahrIw&t=132s

DevOps: Process

FDD

- What is a Feature?
  - Definition: small function expressed in client-valued terms
  - FDD's form of a customer requirement

FDD

FDD Primary Roles

- Project Manager
- Chief Architect
- Development Manager
- Domain Experts
- Class Owners
  - This concept differs FDD over XP
  - Benefits
    - Someone responsible for integrity of each class
    - Each class will have an expert available
    - Class owners can make changes much quicker, if needed anytime
    - Easily lends to notion of code ownership
    - Assists in FDD scaling to larger teams, as we have one person available for complete ownership of feature.
- Chief Programmers

FDD

FDD Primary Roles

- Release Manager
- Language Guru
- Build Engineer
- Toolsmith
- System Administrator
- Tester
- Deployers
- Technical Writer

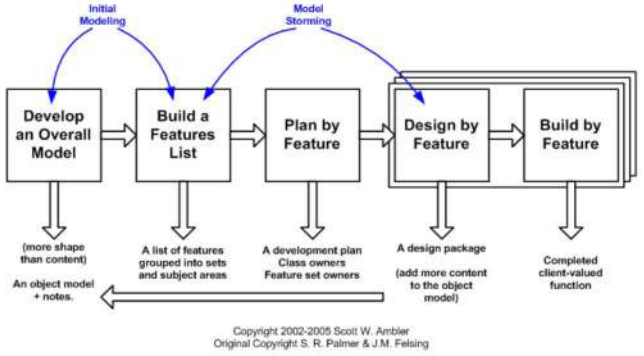
FDD

Feature Driven Development Process

- Process #1: Develop an Overall Model
- Process #2: Build a Features List
- Process #3: Plan By Feature
  - Constructing the initial schedule, Forming level of individual features, Prioritizing by business value , As we work on above factors we do consider dependencies, difficulty, and risks.
  - These factors will help us on Assigning responsibilities to team members, Determining Class Owners , Assigning feature sets to chief programmers
- Process #4: Design By Feature
  - Goal: not to design the system in its entirety but instead is to do just enough initial design that you are able to build on
  - This is more about Form Feature Teams: Where team members collaborate on the full low level analysis and design.
- Process #5: Build By Feature
  - Goal: Deliver real, completed, client-valued function as often as possible

FDD

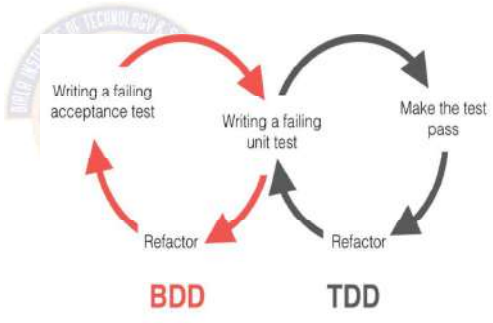
Feature Driven Development Process



DevOps: Process

BDD

- What is BDD?:
  - General Technique of TDD
  - Follows same principle as TDD
  - Shared tools
  - Shared Process



https://www.youtube.com/watch?v=4QFYTQy47yA

BDD

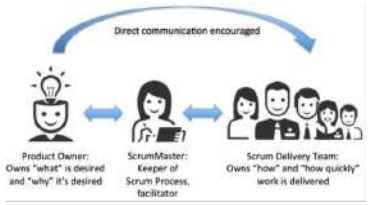
BDD Basic structure : Example

- User story:
  - As someone interested in using the Mobile app, I want to sign up in from the app so that I can enjoy my membership.

- Mobile App Signup:
- Scenario 1:
  - Given that I am on the app's "Create new account" screen
  - Then I should see a "Sign up using Facebook" button
  - And I should see a "Sign up using Twitter" button
  - And I should see a "Sign up with email" form field
  - Then I should see a new screen that asks permission to use my Facebook account data to create my new Mobile app account

DevOps: Process

SCRUM



SCRUM

SCRUM Overview

- You can refer below YouTube video for understanding the structure of organization to be agile.
- This Video is of First Bank in world to adopt Agile Scrum
- https://www.youtube.com/watch?v=uXg6hG6FrG0

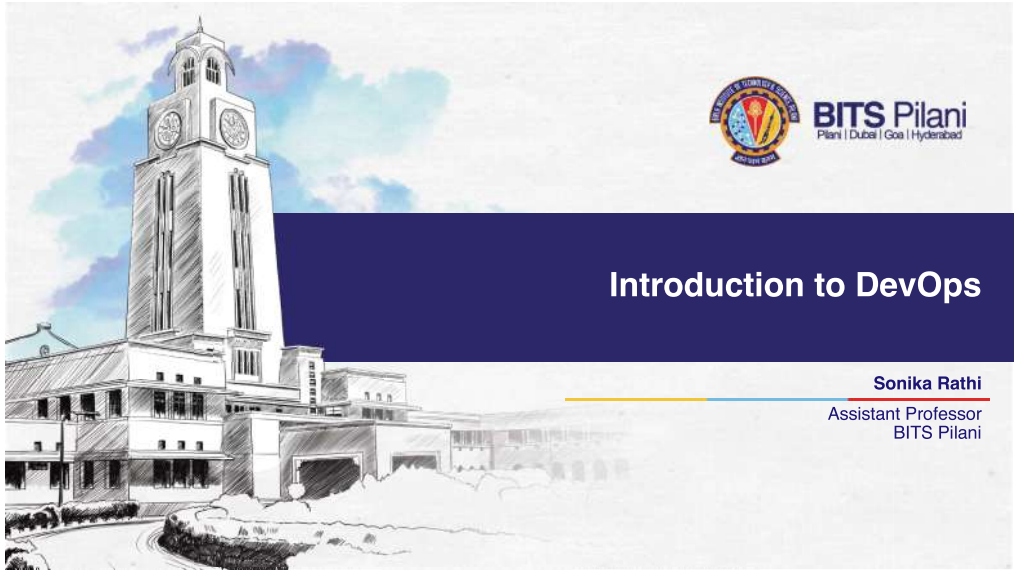
References

CS 2 & 3

- Chapter 5 from Effective DevOps Building a Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis and Katherine Daniels
-
- For BDD and FDD: https://www.agilealliance.org

Thank You!

In our next session:



BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

Agenda

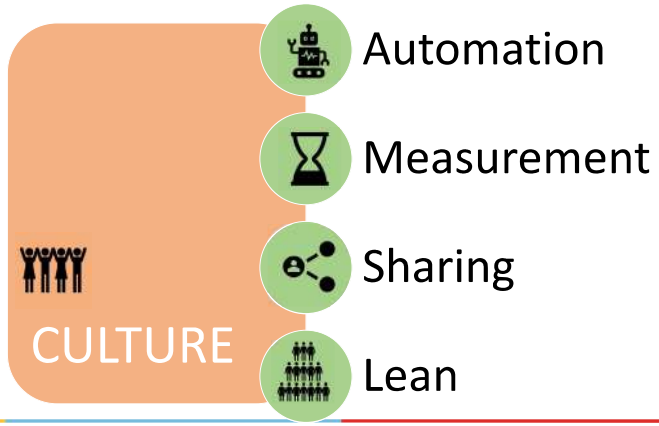
DevOps : People & Tools Dimension

- Transformation to Enterprise DevOps culture
- DevOps - People
- DevOps – Tools

Transformation to Enterprise DevOps culture

DevOps Values

More than anything else, DevOps is a culture movement based on human and technical interaction to improve relationships and results



Transformation to Enterprise DevOps culture

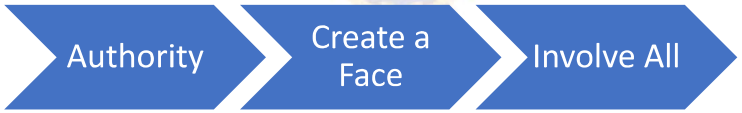
Initial Planning for Enterprise Readiness

- Participants should absolutely include all the towers that make up the solution delivery
- Design Thinking : It is a great method; it leverages the expertise of all stakeholders, enables them to come to a common understanding
- High Level Output

Transformation to Enterprise DevOps culture

Establish a DevOps Centre of Excellence

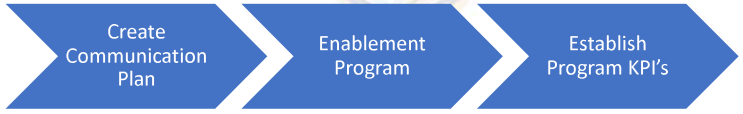
- At the right organizational level and enterprise authority
- Create a Face: It has to be led by an enterprise leader who has the support and buy-in from all the towers
- Active Participant from All Towers of Delivery & Participants must be chosen wisely
- These phases help concrete the vision and strategies of organization and help in setup the best practices to support cultural movement



Transformation to Enterprise DevOps culture

Establish Program Governance

- Agile and DevOps, practitioners' roles and responsibilities will change
- Need awareness, enablement and empowerment to succeed
- KPIs must shift from individual metrics to holistic customer business outcomes



Transformation to Enterprise DevOps culture

Establish Project In-take Process

- DevOps SME's conduct in-take workshops for Scrum Teams
- Automation scripts, Infrastructure assets
- Test Automation, Branching and Merging & Lessons Learned
- Fit for purpose tool selection and Application Criticality

Transformation to Enterprise DevOps culture

Identify and Initiate Pilots

- Value stream-mapping exercise
- Level of detail necessary:
- To identify end to end as-is process, tooling, manual and automated processes
- And skills and people

Transformation to Enterprise DevOps culture

Scale Out DevOps Program

- Onboard Parallel Release Trains
- Apply Intake Process
- Support, Monitor and Manage

DevOps - People

People

- DevOps is a cultural movement; it's all about people
- Building a DevOps culture, therefore, is at the core of DevOps adoption

An organization may adopt the most efficient processes or automated tools possible, but they're useless without the people who eventually must execute those processes and use those tools

- DevOps culture is characterized by a high degree of collaboration across roles, focus on business instead of departmental objectives, trust, and high value placed on learning through experimentation
- Building a culture isn't like adopting a process or a tool
- It requires social engineering of teams of people, each with unique predispositions, experiences, and biases
- This diversity can make culture-building challenging and difficult

DevOps – People

Managing People, Not Resources

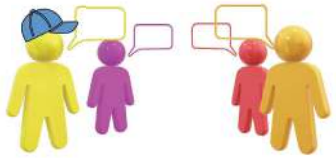
"Managing teams would be easy if it wasn't for the people you have to deal with"

- Calling people as resources
- A resource is something you can manage without much tailoring
- With people, that is never true
- For an Example: We have probably all been planning for projects and creating a plan that includes a certain amount of "anonymous full-time equivalents (FTEs)." Then a bit later, we start putting names to it and realize that we need more or less effort based on the actual people we have available for the project
- One Java developer is just not the same as another; and honestly, we would never consider ourselves to be just a resource whose job someone else could do with the same efficiency and effectiveness

DevOps – People

Don't change Organization; Change your self

- You will not be able to get the organization to change
- But what you can do is change your part of the organization
- Manage your teams the way that you would like to be treated
- As you climb higher in the hierarchy, your area of influence will increase and, with that, a larger and larger part of the organization will work the way you would like it to
- Ex. "Jack Welch" he was the CEO of General Electric till 2001, his cabin was of all transparent glass; And this cabin did not have any door. So, it was an open-door cabin. And the label on the door was "PLEASE DISTRUB ME".



DevOps – People

Identifying Business Objective

- Getting everyone headed in the same direction
- And working toward the same goal

"Identify Common Business Objective for the Team and Organization"

- Incent the entire team based on business outcomes versus conflicting team incentives
- Easy to measure progress of goal for team and organization

DevOps isn't the goal. It helps you reach your goals

Effective Management of People

One-On-Ones

- Regular one-on-one meetings with the people who report directly to you
- Don't be Anonymous
- Having an open-door policy is NOT the same as setting up one-on-ones
- Let feel people are important to you
- You are making time for them

- Best Practices : have weekly or bi weekly 30 minutes one-on –one, learn more about person, let them raise first and provide your updates
- Benefit to Manager?
- Benefit to Employee?

Effective Management of People

Feedback

- Everyone would like to get more feedback from his or her boss
- Dan Pink's mastery, autonomy, and purpose : "When you do x, y happens, which is not optimal. Can you find a way to do it differently next time to lead to a better outcome? "

What You hear in your Feedback?

- Focus on feedback?

Effective Management of People

Delegation

- Feel on delegation of JOB to others?

Managerial Economics 101

Effective Management of People

Creating a Blameless Culture

- Who is being blamed?
- You will have to cover it without delegating the blame to the person in your team who is responsible
- The team will appreciate this
- The more you share with the rest of the organization the positive impact a member of your team has made, the better you will look too
- These two practices empower the people on your team to do the best job they can for you
- Whenever you have failures or problems, your root-cause analysis should not focus on who did what but on how we need to change the system so that the next person is able to avoid making the mistake again

Effective Management of People

Measuring Your Organizational Culture

- There are a few different ways to measure culture
- The Westrum survey measures
  - On my team, information is actively sought
  - On my team, failures are learning opportunities, and messengers of them are not punished
  - On my team, responsibilities are shared
  - On my team, cross-functional collaboration is encouraged and rewarded
  - On my team, failure causes inquiry
  - On my team, new ideas are welcomed
- There are few more suggestions:
  - I would recommend the team to my friends as a good place to work
  - I have the tools and resources to do my role well
  - I rarely think about leaving this team or my company
  - My role makes good use of my skills and abilities

Remember that advice stated before: you can only control your part of the organization

DevOps – Tools

What is DevOps Tools:

- Tools can be used to improve and maintain various aspects of culture
- Software development tools help with the process of programming, documenting, testing, and fixing bugs in applications and services
- Not restricted to specific roles, these tools are important to anyone who works on software in some capacity
  - Local development environment,
  - Version control,
  - Artifact Management,
  - Automation and Monitoring

DevOps Tools

Local Development Environment

- A consistent local development environment is critical to quickly get employees started contributing to your product
- Don't Consider this as limitation:
  - This is not to say that individuals should be locked into a single standard editor with no flexibility or customization, but rather it means ensuring that they have the tools needed to get their jobs done effectively
- Minimal requirements may vary in your environment depending on individual preferences:
  - Multiple Displays
  - High-Resolution Displays
  - Specific Keyboards, Mice, and other Input Devices

DevOps Tools

Version Control

- Having the ability to commit, compare, merge, and restore past revisions of objects to the repository allows for richer cooperation and collaboration within and between teams
- Version control enables teams to deal with conflicts that result from having multiple people working on the same file or project at the same time, and provides a safe way to make changes and roll them back if necessary
- When choosing the appropriate version control system (VCS) for your environment, look for one that encourages the sort of collaboration in your organization that you want to see
  - Opening and forking repositories;
  - Contributing back to repositories;
  - Contributions to your own repositories;
  - Defining processes for contributing; and
  - Sharing commit rights

DevOps Tools

Artifact Management

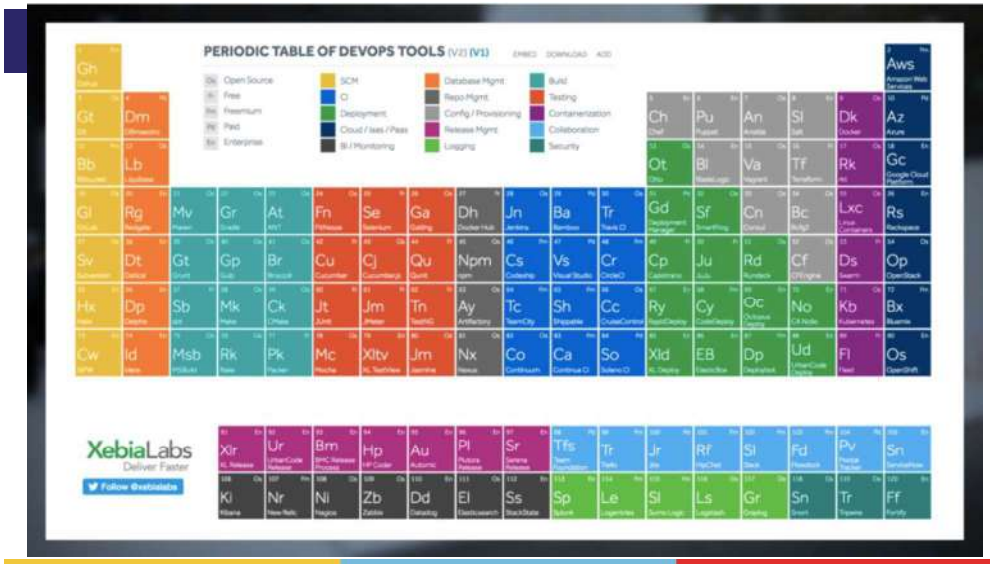
- An artifact is the output of any step in the software development process
- When choosing between a simple repository and more complex feature-full repository, understand the cost of supporting additional services as well as inherent security concerns
- An artifact repository should be:
  - Secure;
  - Trusted;
  - Stable;
  - Accessible; and
  - Versioned
- You can store a versioned common library as an artifact separate from your software version control, allowing all teams to use the exact same shared library

DevOps Tools

Other Automation Tools

- Automation tools reduce labor, energy, and/or materials used with a goal of improving quality, precision, and accuracy of outcomes
- Server Installation
  - Server installation is the automation of configuring and setting up individual servers
- Infrastructure Automation
  - Configuration Management
  - Capacity Management
- System Provisioning
- Test and Build Automation
  - On-demand automation
  - Scheduled automation
  - Triggered automation
  - Smoke testing
  - Regression testing
  - Usability testing

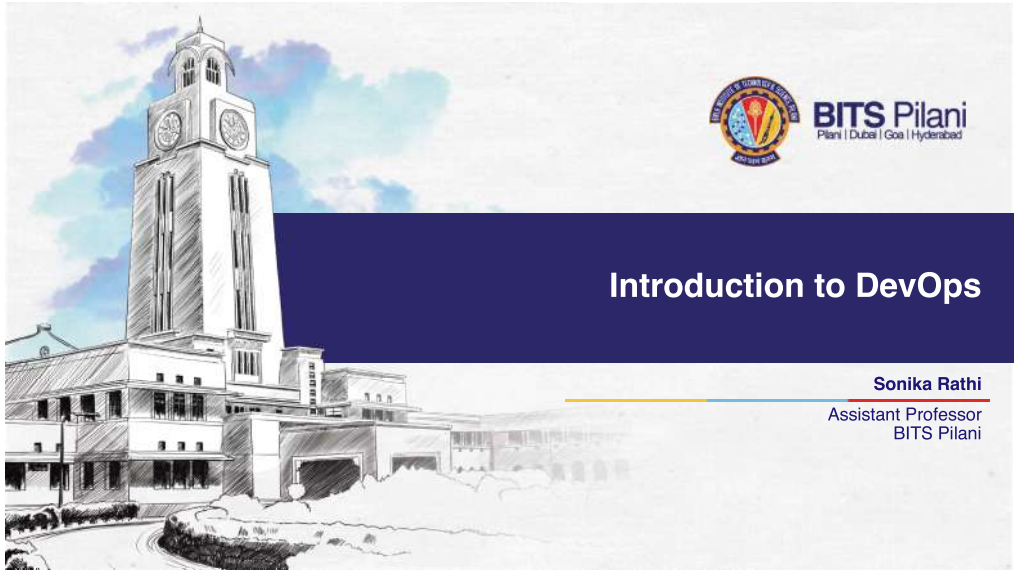
DevOps Tools Ecosystem



Q&A

Thank You!

In our next session:



BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

Agenda

Could for DevOps & Version Control System

- Cloud as a catalyst for DevOps
- Evolution of Version Control
- Version Control System Types
  - Centralized Version Control Systems
  - Distributed Version Control Systems
- Introduction to GIT
- GIT Basics commands
- Creating Repositories, Clone, Push, Commit, Review
- Git Branching
- Git Managing Conflicts
- Git Tagging
- Git workflow
  - Centralized Workflow
  - Feature Branch Workflow
- Best Practices- clean code

DevOps Tools

Cloud as a Catalyst for DevOps

- Characterization of the cloud by National Institute of Standards and Technology (NIST)
  - On-demand self-service
  - Broad network access
  - Resource pooling
  - Rapid elasticity
    - It is the Capabilities can be elastically provisioned and released
- Measured service
- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)

Cloud as a Catalyst for DevOps

Software as a Service (SaaS)

- In this the consumer is provided the capability to use the provider's applications running on a cloud infrastructure
- The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based e-mail) or an application interface
- The consumer does not manage or control the underlying cloud infrastructure including networks, servers, operating systems, storage.
- For an example, you can relate google apps, Cisco WebEx, as a Service, Office 365 service, where Provider deals with the licensing of software's

Cloud as a Catalyst for DevOps

Platform as a Service (PaaS)

- The consumer is provided the capability to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider
- The consumer does not manage or control the underlying cloud infrastructure including networks, servers, operating systems, or storage, but consumer has control over the deployed applications and possibly configuration settings for the application-hosting environment
- For an Example: .NET Development platform is considered as a platform

Cloud as a Catalyst for DevOps

Infrastructure as a Service (IaaS)

- The consumer is provided the capability to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications
- The consumer does not manage or control the underlying cloud infrastructure but consumer has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls). For this you can consider any Server Provisioning is IaaS,

Cloud as a Catalyst for DevOps

Three of the unique aspects of the cloud that impact DevOps

- Three of the unique aspects of the cloud that impact DevOps:
- The ability to create and switch environments simply
  - Simply create and migrate environments is—as is the ease of cloning new instances
- The ability to create VMs easily
  - Administering the running VMs are important to find out for which VM we are paying but not using it
  - Tool such as, Janitor Monkey to scan an account
- The management of databases

Evolution of Version Control

Generations of VCS

- What is “version control”, and why should you care?
- Definition: Version control is a system that records changes to a file or set of files over time so that you can recall specific versions later
- The history of version control tools can be divided into three generations

Generation	Networking	Operations	Concurrency	Example Tool
First Generation	None	One file at a time	Locks	RCS, SCCS
Second Generation	Centralized	Multi-file	Merge before commit	CVS, Subversion
Third Generation	Distributed	Changesets	Commit before merge	Bazaar, Git

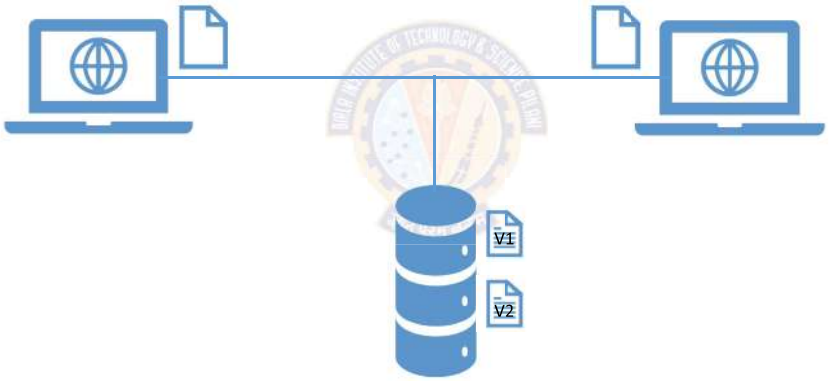
Version Control System

Benefits

- Change history
- Concurrent working (Collaboration)
- Traceability
- Backup & Restoration

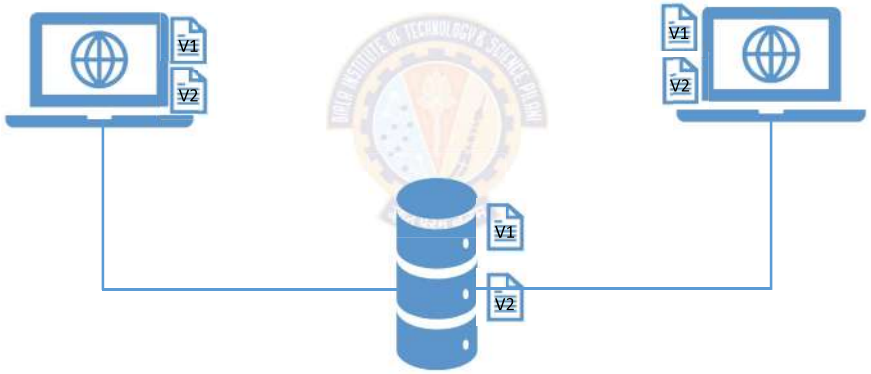
Version Control System Types

Centralized source code management System



Version Control System Types

Distributed source code management System



CVCS Vs. DVCS

Lets discuss con's

CVCS

- Sigle point of failure
- Remote commits are slow
- Continuous connection

DVCS

- Need more space
- Bandwidth for large project

Available Tools

CVCS

- Open source:
  - Subversion (SVN)
  - Concurrent Versions System (CVS)
  - Vesta
  - OpenCVS
- Commercial:
  - AccuRev
  - Helix Core
  - IBM Rational ClearCase
  - Team Foundation Server (TFS)

DVCS

- Open source:
  - Git
  - Bazaar
  - Mercurial
- Commercial:
  - Visual Studio: Team Services
  - Sun WorkShop: TeamWare
  - Plastic SCM – by Codice Software, Inc
  - Code Co-op

Git & GitHub

What we will learn in this session

- Git & GitHub relationship
- Prerequisite
- Foundation of Git

Concept of Git

Understanding GitHub

Beyond the basics

Git

What is Git

Popular Source Control system

Distributed system

Free (Open Source tool)

Git

Why use Git

GitHub

What is GitHub?

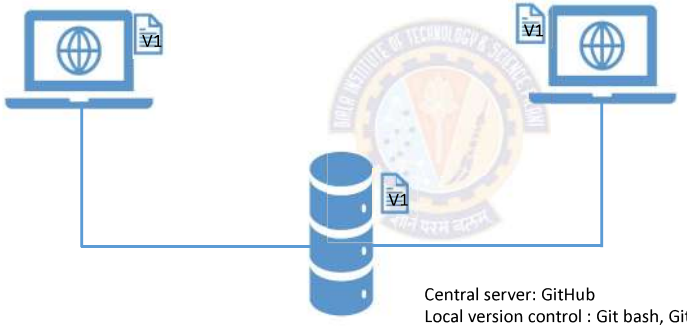
Hosting service on Git

More than just source control for your code
- Issue management, Working with Teams, etc.,

Free & Paid options

Git & GitHub

Relationship



Central server: GitHub
Local version control : Git bash, Git Desktop

Git

Working with Git

Console
We will use this

GUI
GitHub Desktop
Source tree

Git & GitHub

Getting your system ready

- Install appropriate Git bash form official site
- Command line (Git bash)
- Server account (GitHub account)

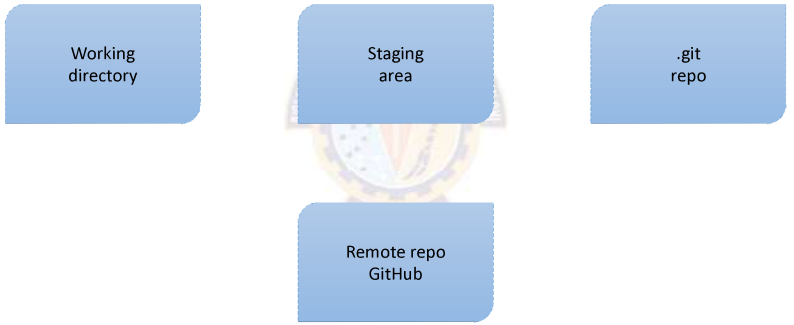
Support for all platform

Git Foundation

The 3 State of Git

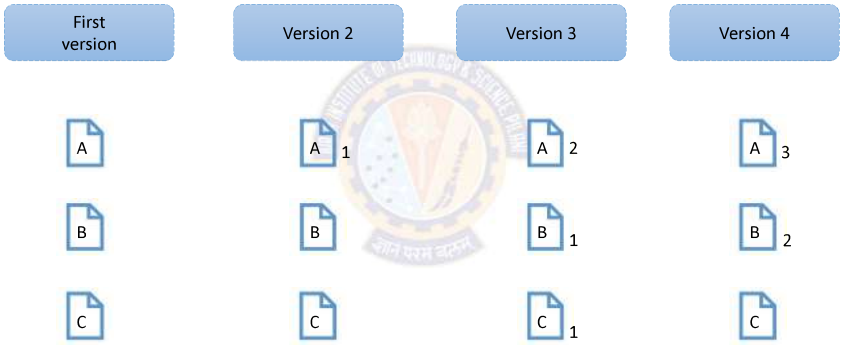
Git Foundation

The 3 areas of Git



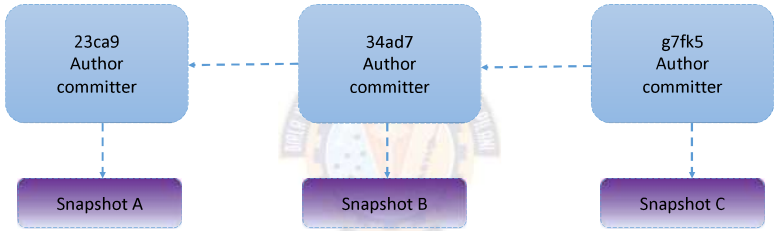
Git Foundation

Concepts of Snapshots in Git & GitHub



Git Foundation

Commits in Git



Git

Basic Commands

```
$ git
$ git config
$ git init
$ git clone
$ git status
$ git add
$ git commit
$ git branch
$ git checkout
$ git push
$ git fetch
$ git merge
$ git pull
$ git log
$ git reset
$ git revert
```

GitHub

GitHub's main Features

Code management

Pull requests

Issues

CICD

Global search

GitHub

Connecting with local machine

HTTPS
Requires user name & password

SSH
Easier to work with

GitHub

Working with repository

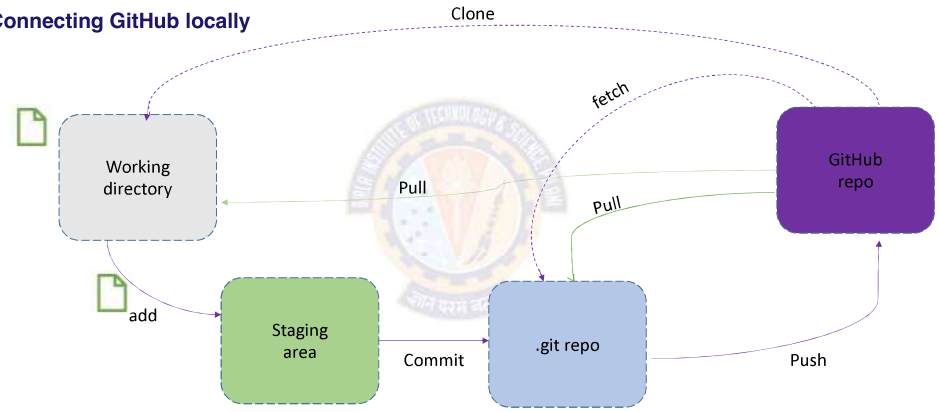
Repositories are building block of GitHub

"Folder" for your project

Public or Private

GitHub

Connecting GitHub locally



GitHub

Working with special files

README is special file known by GitHub

Rendered automatically on landing page

Typically written in markdown(.md)

Other files:

LICENSE | CHANGELOG | CODE_OF_CONDUCT

CONTRIBUTORS | SUPPORT | CODEOWNERS

GitHub

Repository Feature

TOPICS | ISSUES | Insight

PROJECTS | Pull Requests | Settings

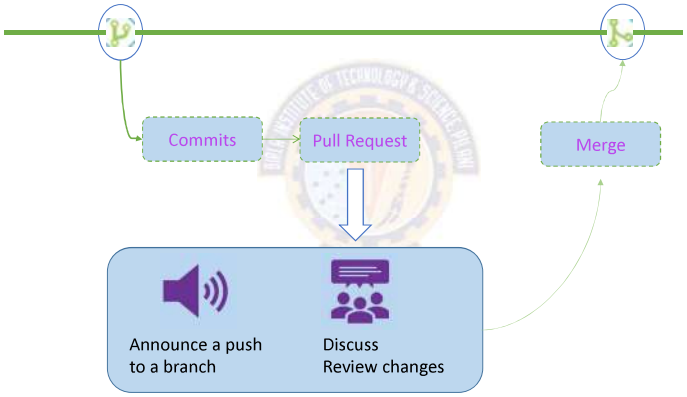
Git

Workflow

Centralized | Feature workflow

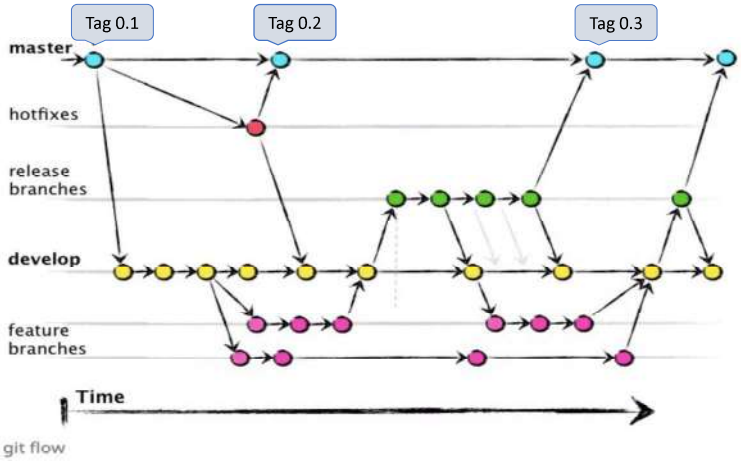
GitHub

Branching



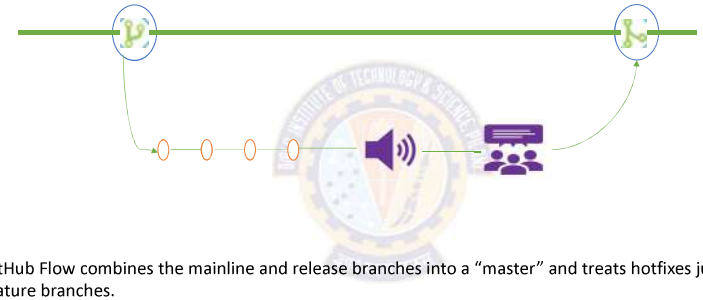
GitHub

Git Flow



GitHub

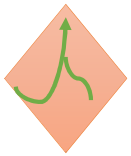
GitHub Flow



GitHub Flow combines the mainline and release branches into a “master” and treats hotfixes just like feature branches.

Git & GitHub

Merging with conflicts



Typical conflicts:

- Editing on the same line
- Editing on already deleted file

Merge conflicts needs to be solved before merge happen (Manual intervention)

Git Command

Revert

- Git revert will create a new commit
- Git revert undoes a single commit
- It is a safe way if undo

Reset

- Git reset command is a complex
- Dangerous
- Git reset has three primary form of invocation
  - git reset --hard HEAD
  - git reset --mixed HEAD
  - git reset --soft HEAD

Git command

Git Tag

- Tags are ref's that point to specific points in Git history
- Marked version release (i.e. v1.1.1)
- A tag is like a branch that doesn't change
- Unlike branches, tags, after being created, have no further history of commits
- Common Tag operations:
  - Create tag
  - List tags
  - Delete tag
  - Sharing tag

Git

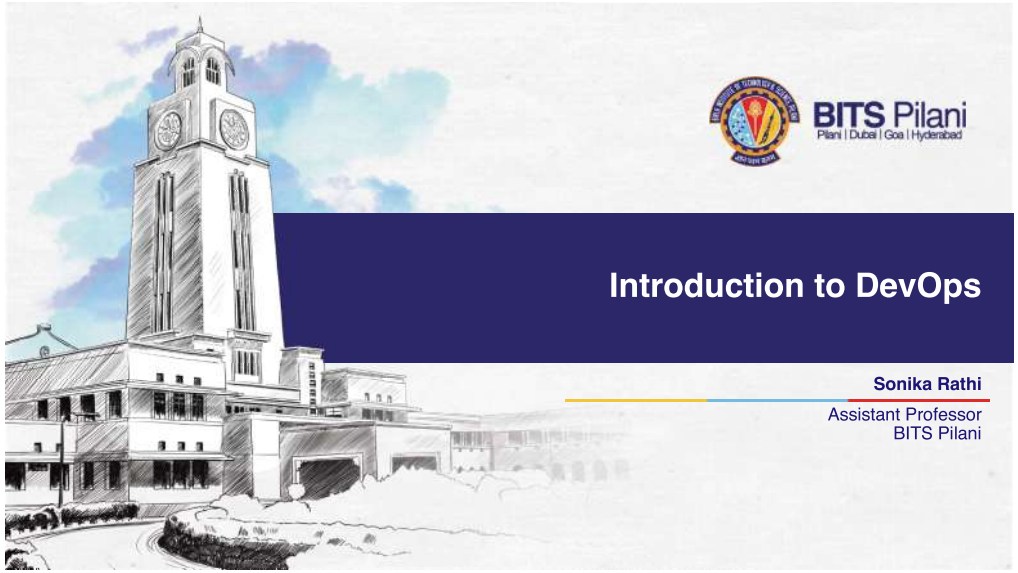
Clean Code

- Follow standard conventions
- Keep it simple, Simpler is always better, Reduce complexity as much as possible
- Be consistent i.e. If you do something a certain way, do all similar things in the same way
- Use self explanatory variables
- Choose descriptive and unambiguous names
- Keep functions small
- Each Function should do one thing
- Use function names descriptive
- Prefer to have less arguments
- Always try to explain yourself in code; put proper comments
- Declare variables close to their usage
- Keep lines short
- Code should be readable
- Code should be fast
- Code should be generic
- Code should be reusable

Q&A

Thank You!

In our next session:



Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

Agenda

Version Control System

- Manage Dependencies
- Automate the process of assembling software components with build tools
- Use of Build Tools
  - Maven
  - Gradle

Component

Why Component based design

- large-scale code structure within an application
- also refer as “modules”
- In Windows, a component is normally packaged as a DLL
- In UNIX, it may be packaged as an SO (Shared object) file
- In the Java world, it is probably a JAR file

Benefits

- encouraging reuse and good architectural (loose coupling)
- efficient ways for large teams of developers to collaborate

Component

Challenges of component based design

- Components form a series of dependencies, which in turn depend on external libraries
- Each component may have several release branches

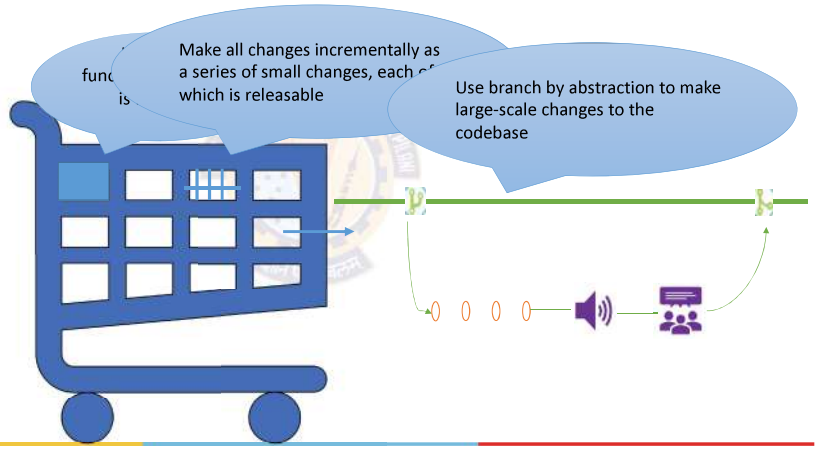
To overcome this we need to follow the best practices

Delay in release

- finding good versions of each of these components
- Then assembled them into a system which even compiles is an extremely difficult process

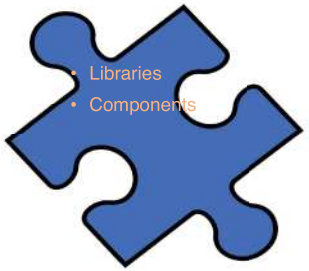
Best Practices for component based design

Keeping Your Application Releasable



Best Practices for component based design

Mange your applications dependencies



Dependencies

What is dependencies

- Dependency occurs when one piece of software depends upon another in order to build or run
- Software applications → host operating environment
- Like:
- Java applications → JVM
- .NET applications → CLR,
- Rails applications → Ruby and the Rails framework,
- C applications → C standard library etc.

Dependencies

Dependencies can be

- Build time dependencies and Run time dependencies
- Libraries and components

Libraries	Components
• Software packages that your team does not control, other than choosing which to use • Libraries are Usually updated rarely	• Pieces of software that your application depends upon, but which are also developed by your team, or other teams in your organization • Components are usually updated frequently

This distinction is important because when designing a build process, there are more things to consider when dealing with components than libraries

Dependencies

Build time dependencies and Run time dependencies

- Ex. In C and C++, your build-time dependencies are simply header files, while at run time you require a binary to be present in the form of a dynamic-link library (DLL) or shared library (SO)
- Managing dependency can be difficult

Build-time dependencies must be present when your application is compiled and linked (if necessary)

Runtime dependencies must be present when the application runs, performing its usual function

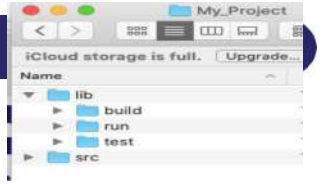
Most common dependency problem

With libraries at run time

- Dependency Hell also refer as DLL Hell
- Occurs when an application depends upon one particular version of something, but is deployed with a different version, or with nothing at all

Managing Libraries

Implementing Version Control



- Simplest solution, and will work fine for small projects
- Create lib directory
- Use a naming convention for libraries that includes their version number; you know exactly which versions you're using

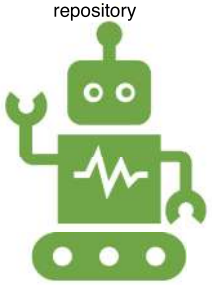
Benefit:
- Everything you need to build your application is in version control
- Once you have a local check-out of the project repository, you know you can repeatably build the same packages that everybody else has

Problems:
- your checked-in library repository may become large and it may become hard to know which of these libraries are still being used by your application
- Another problem crops up if your project must run with other projects on the same platform
- Manually managing transitive dependencies across projects rapidly becomes painful

Managing Libraries

Automated

- Declare libraries and use a tool like Maven or Ivy or gradle
- To download libraries from Internet repositories or (preferably) your organization's own artifact repository



Managing Component

Components to be separated from Codebase

- Part of your codebase needs to be deployed independently (for example, a server or a rich client)
- It takes too long to compile and link the code

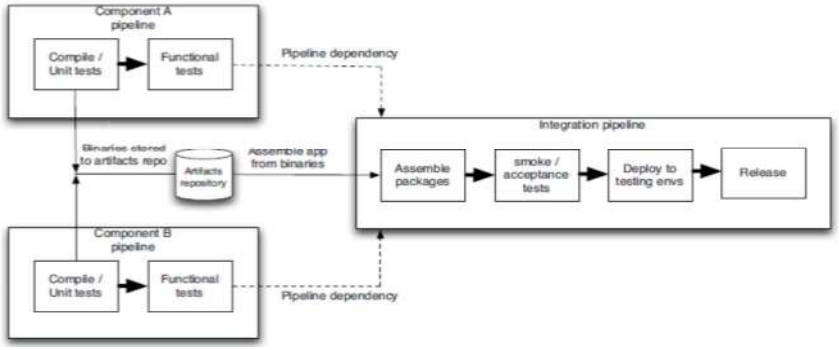
Managing Component

Pipelining Components

- Split your system into several different pipelines
- The build for each component or set of components should have its own pipeline to prove that it is fit for release
- This pipeline will perform the following steps
  - Compile the code, if necessary
  - Assemble one or more binaries that are capable of deployment to any environment
  - Run unit tests
  - Run acceptance tests
  - Support manual testing, where appropriate

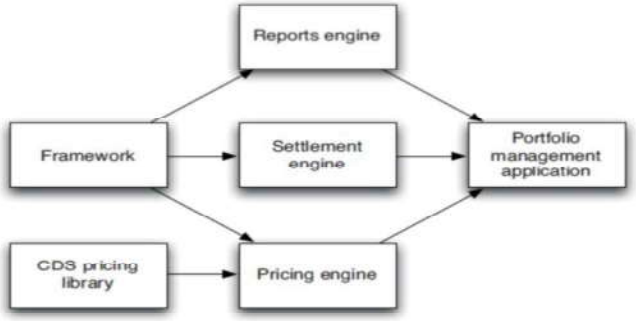
Managing Component

Integration Pipeline



Managing Component

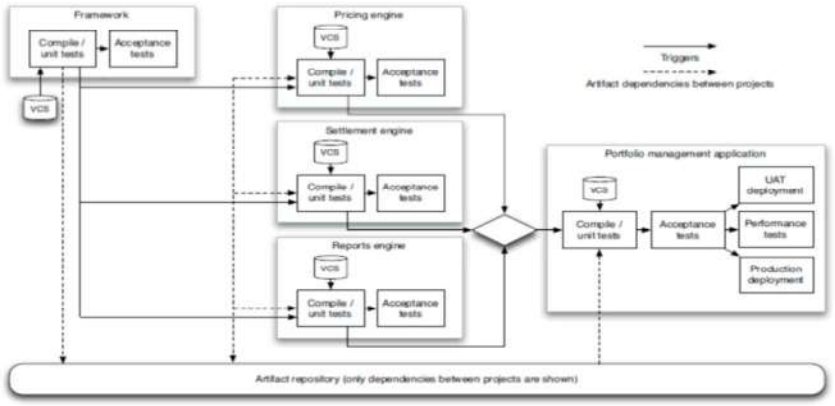
Managing Dependency Graphs



credit default swap (CDS) library that is provided by third party

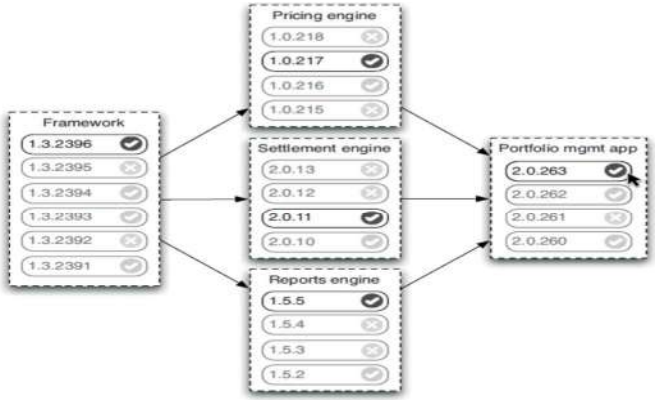
Managing Component

Pipelining Dependency Graphs



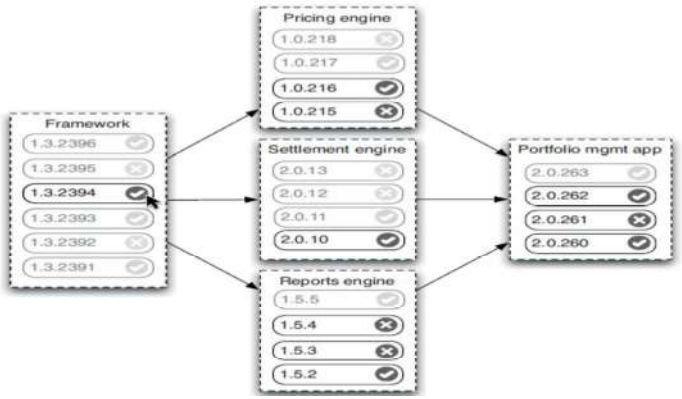
Managing Component

Visualizing upstream dependencies



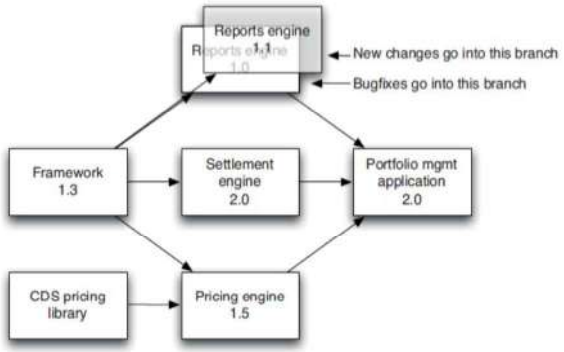
Managing Component

Visualizing downstream dependencies



Managing Component

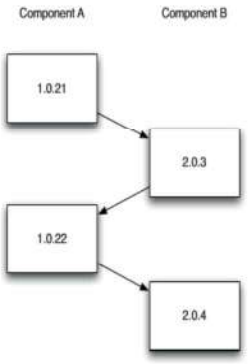
Branching Components



Managing Component

Circular Dependencies

- This occurs when the dependency graph contains cycles
- No build system supports such a configuration out of the box, so you have to hack your toolchain to support it



Circular dependency build ladder

Build automation

Build tools

- Steps of a build process

Compile the source code

Running & evaluating the unit test

Processing existing resource files (configurations)

Generating artifacts (WAR, JAR,..)

Build automation

Build tools

- Additional steps that are often executed in the a build process:

Administering dependencies

Analyzing code quality (static code analysis)

Running additional tests

Archiving generated artifacts and packages in a central repository

Automating Build Process

Build Tools

- Maven
- Gradle

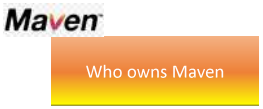
Technology	Tool
Rails	Rake
.Net	MsBuild
Java	Ant, Maven, Buildr, Gradle
C,C++	SCons

Maven

What is Maven

Build Tool
- One artifact (Component, JAR, even a ZIP)
- Manage Dependencies

Management Tool
- Handles Versioning / Releases
- Describe Project
- Produce Javadocs / Site information



Apache Software Foundation
Maven official site is built with Maven
Open Source

Maven

Maven Structure

- src/main/java : by default maven looks for a src/main/java directory underneath of project)
- target folder : compiles all our source code to target directory
- pom.xml : maven compile source code in way provided by pom.xml

- Different language : src/main/groovy or src/main/resources
- Unit testing: src/test/java

- Target directory : Everything get compile

  Even your test gets run and validated

  Packaged Conents (like JAR, WAR or ZIP depending on what we have provided in pom.xml

Maven

Pom.xml

- Maven uniquely identifies a project using
- groupID :
  - The groupid is often the same as our package
  - Ex: com.bits or com.maven.training
  - gorupId is like, business name or application name as you would reference it as a web address
- artifactId :
  - Same as name of your application
  - Ex. HelloWorld, OnDemandService etc.
- version :
  - Version of project
  - Format {Major}.{Minor}.{Maintenance} if it is RELEASE
  - '-SNAPSHOT ' to identify in development
  - Ex: 1.0-SNAPSHOT

Maven

Pom.xml

- packaging :
  - Packaging is how we want to distribute our application
  - Ex. JAR file, a WAR file, RAR file or an EAR file
  - The default packing is JAR
- dependencies :
  - Just add it to our dependency section of POM file
  - Need to know our three things for dependency i.e. groupId, artifactId, and version
- plugins
  - Just add it to plugins section of POM file

Maven

Pom.xml example

```xml
<project >
  <groupId>com.bits</groupId>
  <artifactId>HelloWorld</artifactId>
  <version>1.0-SNAPSHOT</version>
  <modelVersion>4.0.0</modelVersion>
  <packaging>jar</packaging>

  <dependencies>
      <dependency>
          <groupId>org.apache.commons</groupId>
          <artifactId>commons-lang3</artifactId>
          <version>3.8.1</version>
      </dependency>
  </dependencies>

  <build>
    <plugins>
        <plugin>
            <groupId>org.apache.maven.plugins</groupId>
            <artifactId>maven-compiler-plugin</artifactId>
            <version>3.7.0</version>
            <configuration>
                <target>10</target>
                <source>10</source>
                <release>10</release>
            </configuration>

        </plugin>
    </plugins>
</build>

</project>
```

Maven

Maven Goals


clean


compile


package

- First run compile goal
- Then runs unit test
- Generate artifact/package as per provided in pom.xml
- Ex. JAR, WAR


install

- First run package goal
- Then install the package in local repository
- Default it is .m2 folder


deploy

- Runs install goal first
- then deploy it to a corporate or remote repository
- Like file sharing

Maven

Project Inheritance

- Pom files can inherit configuration
  - groupId, version
  - Project Config
  - Dependencies
  - Plugin configuration
  - Etc.

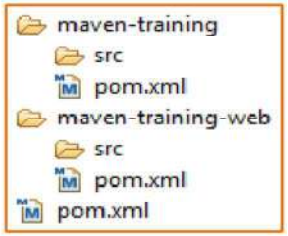
```xml
<?xml version="1.0" encoding="UTF-8"?>
<project>
    <parent>
        <artifactId>maven-training-parent</artifactId>
        <groupId>org.lds.training</groupId>
        <version>1.0</version>
    </parent>
    <modelVersion>4.0.0</modelVersion>
    <artifactId>maven-training</artifactId>
    <packaging>jar</packaging>
</project>
```

Maven

Multi Module Projects

- Maven has 1st class multi-module support
- Each maven project creates 1 primary artifact
- A parent pom is used to group modules

```xml
<project>
    ...
    <packaging>pom</packaging>
    <modules>
        <module>maven-training</module>
        <module>maven-training-web</module>
    </modules>
</project>
```



Gradle

What is Gradle

What is Gradle

Open source build automation tool
Gradle build scripts are written in Domain Specific Language [DSL]

Why Gradle

High performance
- runs only required task; which have been changed
- Build cache helps to reuse tasks outputs from previous run
- ability to have shared build cache within different machine

JVM foundation
- Java Development Kit is prerequisite
- It is not limited to Java

Gradle

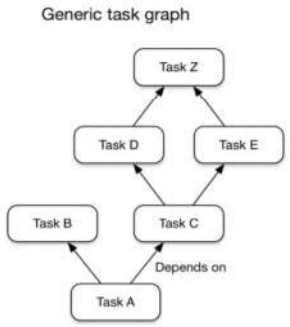
Core concepts

- Tasks and the dependencies between them
- Gradle calculates a directed, acyclic graph to determine which tasks have to be executed in which order
- Graph can change through custom tasks, additional plug-ins, or the modification of existing dependencies
- Plug-ins allows to work with other programming languages like Groovy, kotlin C++ etc.,

Gradle

Core model

- The core model is based on tasks
  - Directed Acyclic Graphs (DAGs) of tasks
- Example of a Graph
- Tasks Consists of:
  - Action : To perform something
  - Input : values to action
  - Output : generated by



Build Tool

Summary

Gradle	Maven
Flexibility: • Flexibility on Conventions • User Friendly & Customized	**Flexibility:** • No flexibility on Conventions • It is rigid
Performance: • It process only the files has been changed • Reusability by working with Build Cache • Shipping is faster	**Performance:** • It process the complete build • No Build Cache concept • Shipping is slow as compared to Gradle
User Experience: • IDE Support : Is in evolving Stage • CLI : Modern CLI	**User Experience:** • IDE Support : Is mature • CLI solution is classic in comparison with Gradle

References

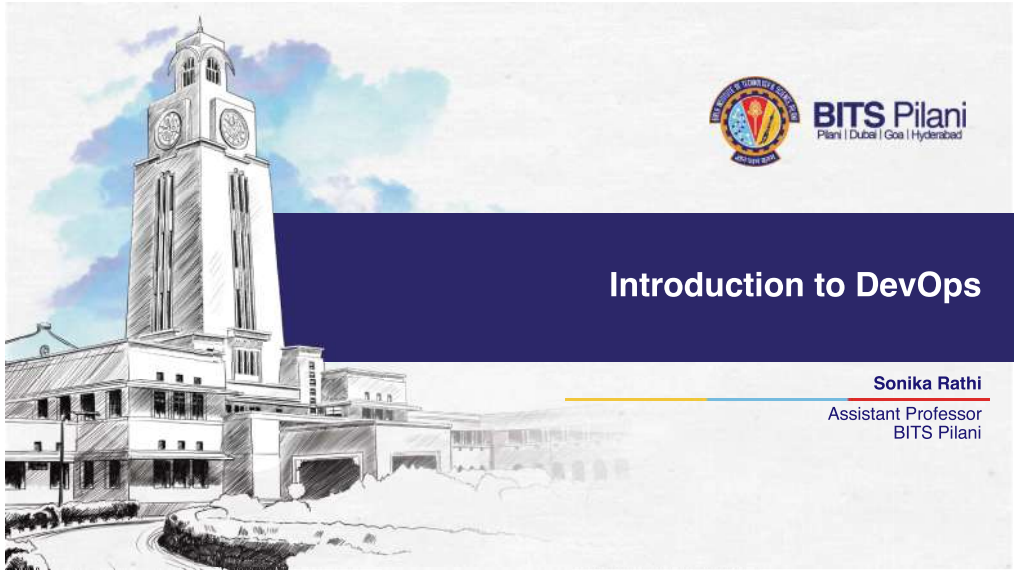
CS 4,5,6 & 7

- Chapter 5 from Effective DevOps Building a Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis and Katherine Daniels
- Transformation to Enterprise DevOps culture: https://devops.com/six-step-approach-enterprise-devops-transformation/
- **Cloud as a Catalyst:**
- TextBook 2: Contineous Delivery : Chapter 11 Managing Infrastructure and Environments
- TextBook 1: DevOps A S/W Architect Pres: Chapter 2 the Cloud as a Platform
- Chapter 3, from DevOps: A Software Architect's Perspective (SEI Series in Software Engineering) by Len Bass, Ingo Weber, Liming Zhu ,
- Chapter 5, Effective DevOps: Building A Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis
- https://git-scm.com/

Q&A

Thank You!

In our next session:



BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

Agenda

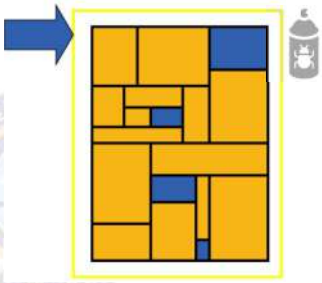
Automating Build Process

- Unit testing
- Automates Test Suite - Selenium
- Continuous Code Inspection
- Code Inspection Tools
  - Sonarqube

Unit Testing

Traditional Testing

- Test the system as a whole
- Errors go undetected
- Isolation of errors difficult to track down



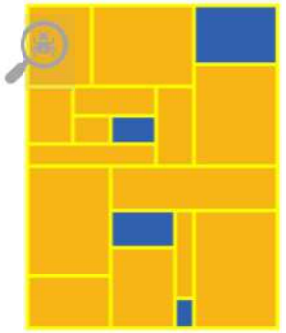
Traditional Testing Strategies

- Print Statements
- Use of Debugger
- Debugger Expressions
- Test Scripts

Unit Testing

What is Unit Testing

- Is a level of the software testing process where individual units/components of a software/system are tested
- Each part tested individually
- All components tested at least once
- Errors picked up earlier
- Scope is smaller, easier to fix errors
- Typically written and run by software developers
- Its goal is to isolate each part of the program and show that the individual parts are correct



Unit Testing

Why Unit Testing

Concerned with

- Functional correctness and completeness
- Error handling
- Checking input values (parameter)
- Correctness of output data (return values)
- Optimizing algorithm and performance

- Faster Debugging
- Faster Development
- Better Design
- Excellent Regression Tool
- Reduce Future Cost

Unit Testing

Benefits

- Unit testing allows the programmer to refactor code earlier and make sure the module works correctly
- By testing the parts of a program first and then testing the sum of its parts, i.e. integration testing becomes much easier
- Unit testing provides a sort of living documentation of the system

Unit Testing

Guidelines

- Keep unit tests small and fast
- Unit tests should be fully automated and non-interactive
- Make unit tests simple to run
- Measure the tests
- Fix failing tests immediately
- Keep testing at unit level
- Keep tests independent
- Name tests properly
- Prioritize testing

Test Automation

Selenium

- Preform an sort of interaction
- Selenium helps to automate web browser interaction
- Scripts perform the interactions

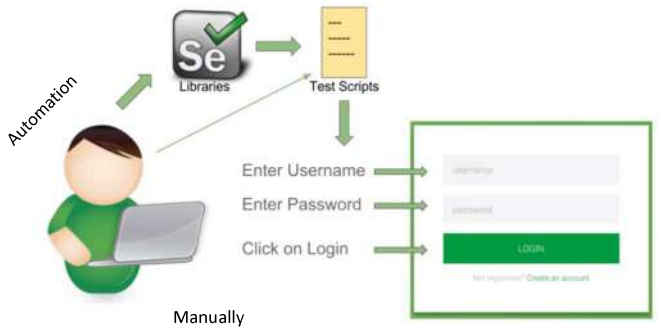
Selenium

Benefits

- Frequent regression testing
- Rapid feedback to developers
- Virtually unlimited iterations of test case execution
- Support for Agile and extreme development methodologies
- Disciplined documentation of test cases
- Customized defect reporting
- Finding defects missed by manual testing
- Reduced Business Expenses
- Reusability of Automated Tests
- Faster Time-to-Market

Selenium

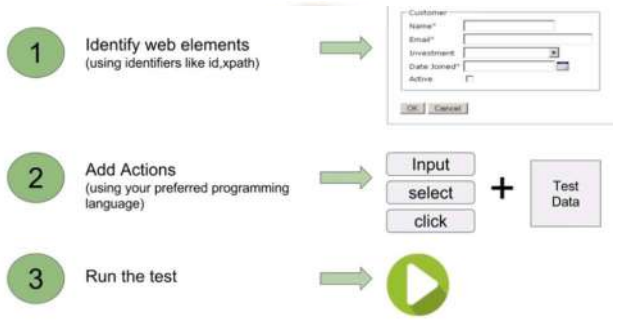
Lets say you want to test one login page



Selenium

Example

- At a high level you will be doing three things with Selenium



Selenium

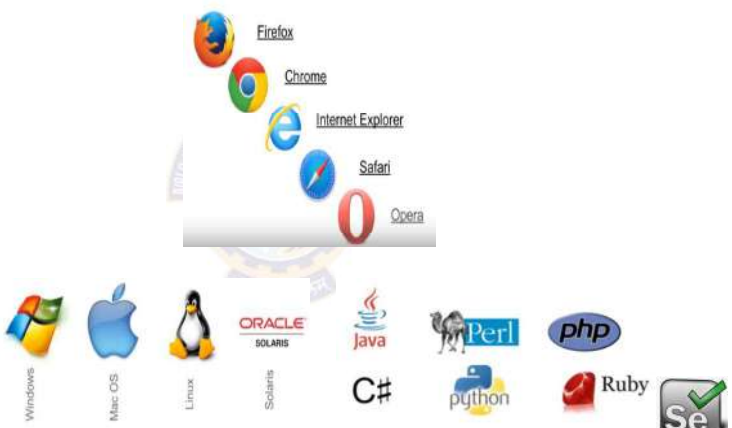
Components

- Selenium IDE
  - A Record and playback plugin for Firefox add-on
  - Prototype testing
- Selenium RC (Remote Control)
  - Also known as selenium 1
  - Used to execute scripts (written in any language) using Javascript
  - Now Selenium 1 is deprecated and is not actively supported
- WebDriver
  - Most actively used component today
  - An API used to interact directly with the web browser
  - Is a successor to Selenium 1 / Selenium RC
  - Selenium RC and WebDriver are merged to form Selenium 2
- Selenium Grid
  - A tool to run tests in parallel across different machines and different browser simultaneously
  - Used to minimize the execution time

Selenium

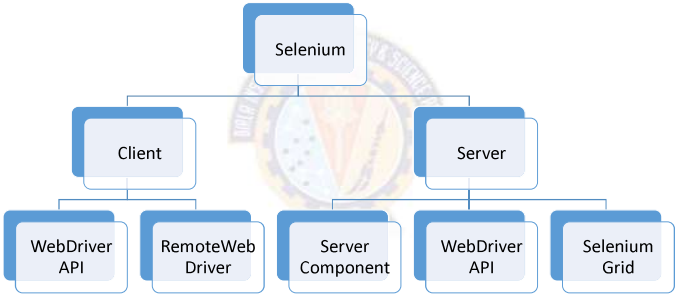
Supports

- Browsers
- OS
- Language



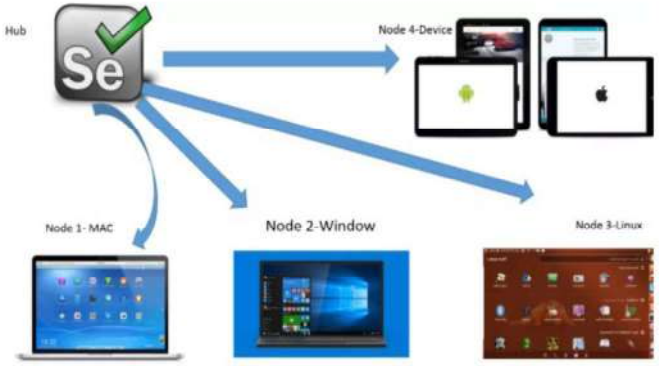
Selenium

Architecture



Selenium

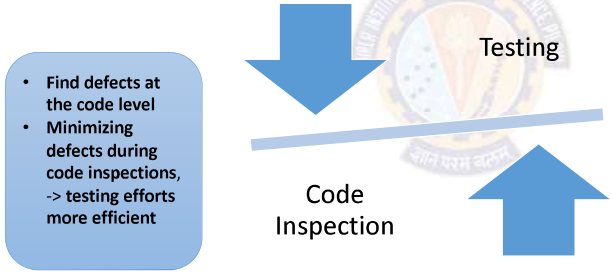
Selenium Grid



Continuous Code Inspection

Continuous code inspection = Constantly scanning code

- Identify if any defects
- It is a process of code review
- Its been proved 90% of defects can be addressed using code inspections tools



- **Find defects at the code level**
- **Minimizing defects during code inspections, -> testing efforts more efficient**

- **Verifies functionality** and **improves software quality**
- **Expensive** if you have to go through it over and over again

Note: Even with automated testing, it takes time to verify functionality; by resolving defects at the code level, you'll be able to test functionality faster

Continuous Code Inspection

Code Inspection Measures

- Code inspections must be well-defined as per requirements:
  - Functional requirements : User Needs : Cosmetic
  - Structural requirements : System Needs : Re-engineering
- Run Time Defects:
  - Identify run time errors before program run
  - Examples: Initialization (using the value of unset data), Arithmetic Operations (operations on signed data resulting in overflow) & Array and pointers (array out of bounds, dereferencing NULL pointers), etc.,
- Preventative Practices:
  - This help you avoid error-prone or confusing code
  - Example: Declarations (function default arguments, access protection), Code Structure (analysis of switch statements) & Safe Typing (warnings on type casting, assignments, operations), etc.,
- Style:
  - In-house coding standards are often just style, layout, or naming rules and guidelines
  - Instead using a proven coding standard is better for improving quality

Continuous Code Inspection

Improve Your Code Inspection Process:

- Involve Stakeholders
  - Developer, Management & Customer
- Collaborate
  - Collaboration — both in coding and in code inspections
- Recognize Exceptions
  - Sometimes there are exceptions to the rule
  - In an ideal world, code is 100% compliant to every rule in a coding standard
  - The reality is different
- Document Traceability
  - Traceability is important for audits
  - Capture the history of software quality

- **What to Look For in Code Inspection Tools**
  - Automated inspection
  - Collaboration system

Continuous Code Inspection Tool

SonarQube

capability to show health of an application

Highlight issues newly introduced

Quality Gate, you can fix the leak and therefore improve code quality systematically

sonarqube

SonarQube

Overall health

- Bug:
  - An issue that represents something wrong in the code
  - If this has not broken yet, it will, and probably at the worst possible moment
- Code Smell:
  - A maintainability-related issue in the code
  - Examples: Dead Code, Duplicate code, Comments, Long method, Long parameter list, Long class etc.,
- Vulnerability:
  - A security-related issue which represents a backdoor for attackers

sonarqube

SonarQube

Enforce Quality Gate

- To fully enforce a code quality practice across all teams, need a Quality Gate
- A set of requirements that tells whether or not a new version of a project can go into production
- SonarQube's default Quality Gate checks what happened on the Leak period and fails if your new code got worse in this period

A quality gate is the best way to enforce a quality policy in your organization

Define a set of Boolean conditions based on measure thresholds against which projects are measured

It supports multiple quality gate definitions

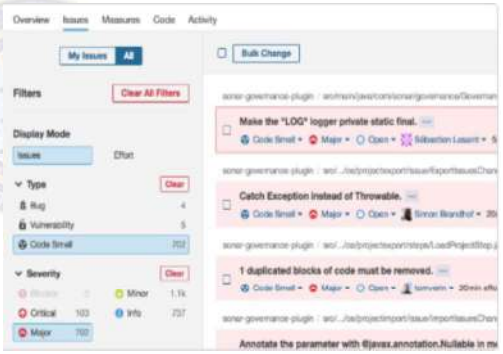
Example: Failed Project

sonarqube

SonarQube

Dig into issues

- The "Issues" page of your project gives you full power to analyze in detail
- What the main issues are?
- Where they are located?
- When they were added to your code base?
- And who originally introduced them?

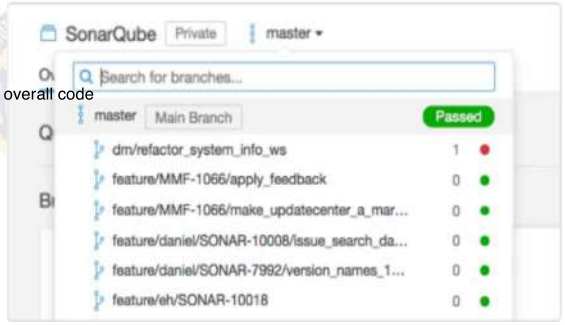


sonarqube

SonarQube

Analyzing Source Code

- Analyze pull requests
  - Focuses on new code – The Pull Request quality gate only uses your project's quality gate conditions that apply to "on New Code" metrics.
- Branch Analysis
  - Each branch has a quality gate that:
  - Applies on conditions on New Code and overall code
  - Assigns a status (Passed or Failed)



sonarqube

SonarQube

Integration for DevOps

maven Gradle

Makefile MSBuild

Bamboo Travis CI

Jenkins AppVeyor

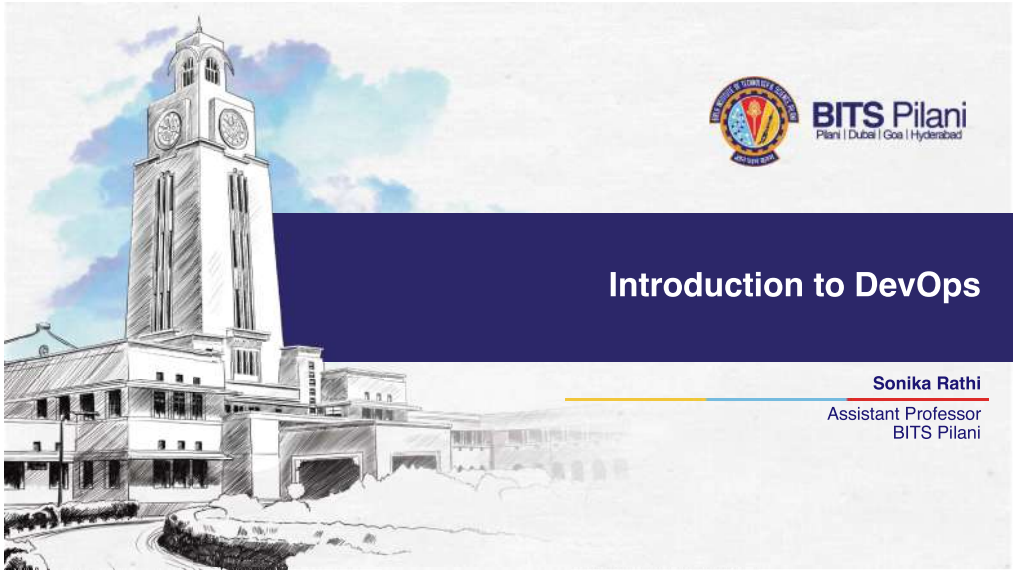
Azure DevOps TeamCity

sonarqube

Q&A

Thank You!

In our next session:



BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

Agenda

Continuous Integration

- Continuous Integration
- Prerequisites for Continuous Integration Version Control
- Continuous Integration Practices

Continuous Integration

Continuous integration (CI)

- Process of integrating new code written by developers with a mainline or "master" branch frequently throughout the day

"Nobody is interested in trying to run the whole application until it is finished"

- Application wont be in a working state
- Team during development spends significant proportion time in an unusable state
- Lengthy integration phases at the end of development

Continuous Integration

Continuous integration requires

- Every time somebody commits any change, the entire application is built and a comprehensive set of automated tests is run against it
- If the build or test process fails, the development team stops whatever they are doing and fixes the problem immediately
- The goal of continuous integration is that the software is in a working state all the time

In simple words we can say "Finish First Before Start"

Implementing Continuous Integration

Pre-requisites

1. Version Control
2. An Automated Build
3. Agreement of the Team

Continuous Integration Pre-requisite

Agreement of the Team

- This is more about People & Culture
- Continuous integration is a practice, not a tool
- It requires a degree of commitment and discipline from your development team or people involved
- As said “Fix first before Proceed”: Need everyone to check in small incremental changes frequently to mainline and agree that the highest priority task on the project is to fix any change that breaks the application
- If people don’t adopt the discipline necessary for it to work, attempts at continuous integration will not lead to the improvement in quality that you hope for

Continuous Integration

CI Tools

- Open Source :
  - Jenkins
  - Cruise Control
  - GitLab CI
  - GitHub Actions
- Commercial:
  - ThoughtWorks Studios
  - TeamCity by JetBrains
  - Bamboo by Atlassians
  - BuildForge by IBM

How it was before Continuous Integration

Just a glance !!!

- Nightly Build ☹

Note: this strategy will not be a good Idea when you have a geographically dispersed team working on a common codebase from different time zones

Continuous Integration

Pre-requisite & Best Practices

Prerequisite

Check In Regularly -> frequent check-ins

Create a Comprehensive Automated Test Suite
- Unit Test
- Component Test
- Acceptance Test

Will provide extremely high level of confidence that any introduced change has not broken existing functionality

Keep the Build and Test Process Short
- Standard Recommendation:
- *10 min is Good*
- *5 min is Better*
- *90 Sec is IDEAL*

Managing Your Development Workspace
- local Development Workspace must be replica of Production

Continuous Integration

Pre-requisite & Best Practices

Best Practices

Don't Check In on a Broken Build

What if we do Check In on Broken Build:

If any new check-in or build trigger during broken state will take much longer time to fix

Frequent broken build will encourage team not to care much about working condition

Commit locally than direct to Production

Wait for Commit Tests to Pass before Moving On

At time of Check-in, you should monitor the build progress

Never go home with broken build

Always Be Prepared to Revert to the Previous Revision

The previous revision was good because; you don't check in on a broken build

Continuous Integration

Scenario 1

Friday at5.30 PM; your build is fail.

- You will be leaving late, and try to fix it
- You can revert changes
- You can leave the build broken

What Option you will opt here?

✗ Stay late to fix the build after working hours

Check in early enough so you have helping hands around
If it is late to Check In then Save your Check in for Next Day
Make rule of not checking in less than an hour before the end of work

Best Solution if you are alone then:
Revert it from your Source Control

Leaving Broken Build:

- On Monday your memory will no longer be fresh
- It will take you significantly longer to understand the problem and fix it
- Everyone at work will yell at you
- If you are late on Monday; be ready to answer n number of calls
- Not the least your name will be mud

Continuous Integration

Scenario 2

If you try to revert every time then; how can you make progress?

Time Boxing

- Establish a team rule
- When the build breaks on check-in, try to fix it for ten minutes or any approximate time your environment can bare
- However it should not be so long
- If, after ten minutes, you aren't finished with the solution, revert to the previous version from your version control system

CS 8 and 9

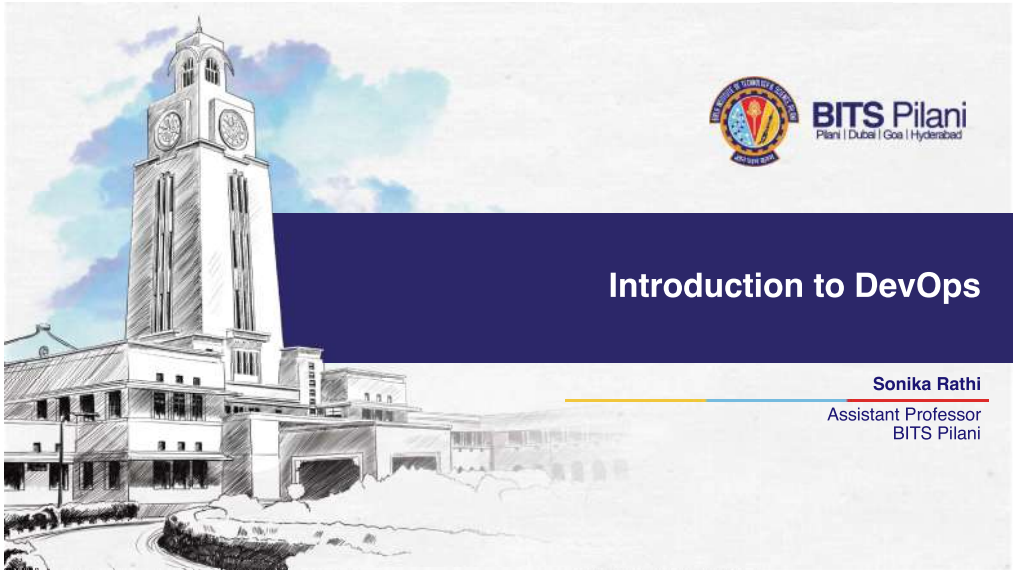
- Chapter 4, from DevOps: A Software Architect's Perspective (SEI Series in Software Engineering) by Len Bass, Ingo Weber, Liming Zhu ,
- https://www.seleniumhq.org/docs/index.jsp
- https://www.sonarsource.com
- https://docs.sonarqube.org

- Chapter 5, from DevOps: A Software Architect's Perspective (SEI Series in Software Engineering) by Len Bass, Ingo Weber, Liming Zhu ,
- Chapter 11,12, from Effective DevOps: Building A Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis

Q&A

Thank You!

In our next session:



Agenda

Continuous Integration

- Using Continuous Integration Software:: Jenkins
- Artifact Management

Continuous Integration System

Jenkins

- The Jenkins project was started in 2004 (originally called Hudson) by Kohsuke Kawaguch
- Open Source
- Offers more than 1400 plugins

Jenkins

Prepare your environment

- Need Version control system
- Java
- Install Jenkins
- Jenkins default port 8080

Jenkins

Post installation

- Unlocking Jenkins
  - When you first access a new Jenkins instance, you are asked to unlock it using an automatically generated password
- Linux -> Jenkins console log output
- Windows -> $JENKINS_HOME/secrets/initialAdminPassword

Jenkins

Customization

- Plugins
- Integration with Git (Manage Jenkins -> Mange Plugins)
- Integrating Maven (Manage Jenkins -> Configure System)
- https://plugins.jenkins.io/
- Removing plugin
  - Uninstall option form Jenkins UI
  - Removing the corresponding .hpi file from the JENKINS_HOME/plugins directory on the master

Jenkins

Pipeline

- "Jenkins Pipeline is a suite of plugins which supports implementing and integrating continuous delivery pipelines into Jenkins"
- The definition of a Jenkins Pipeline is written into a text file (called a Jenkinsfile)

```
pipeline {
    agent any

    stages {
        stage('Build') {
        steps {
                    sh 'make'
                    archiveArtifacts artifacts: '**/target/*.jar'
                }
            }
        }
        stage('Test') {
        steps {
                    /* `make check` returns non-zero on test failures, * using `true` to    allow the
Pipeline to continue nonetheless */
                    sh 'make check || true'
                    junit '**/target/*.xml' }
                }
            }
        stage('Deploy') {
        when {
                    expression {
                                currentBuild.result == null || currentBuild.result == 'SUCCESS'
                            }
                }
        steps {
                    sh 'make publish'
                }
            }
}
```

In Figure:
1. Agent: It indicates that Jenkins should allocate an executor and workspace for this part of the Pipeline
2. Stage: It describes a stage of this Pipeline
3. Steps: It describes the steps to be run in this stage
4. SH: sh executes the given shell command (linux)
5. junit: It is a Pipeline step provided by the plugin

Jenkins

Why Jenkins Pipeline

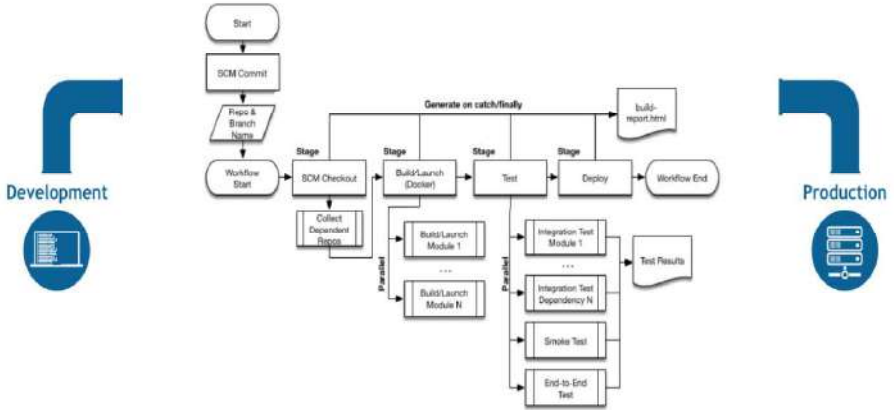
Code:
Pipelines are implemented in code and typically checked into source control, giving teams the ability to edit, review

Durable:
Pipelines can survive both planned and unplanned restarts of the Jenkins master

Pausable:
Pipelines can optionally stop and wait for human input or approval before continuing the Pipeline run

Versatile:
perform work in parallel

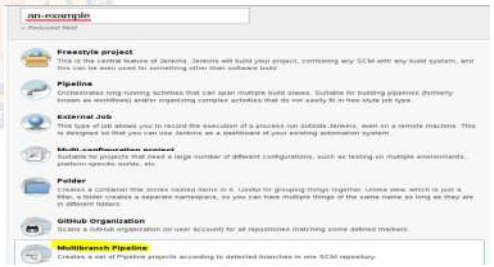
Jenkins Pipeline



Jenkins

Multibranch

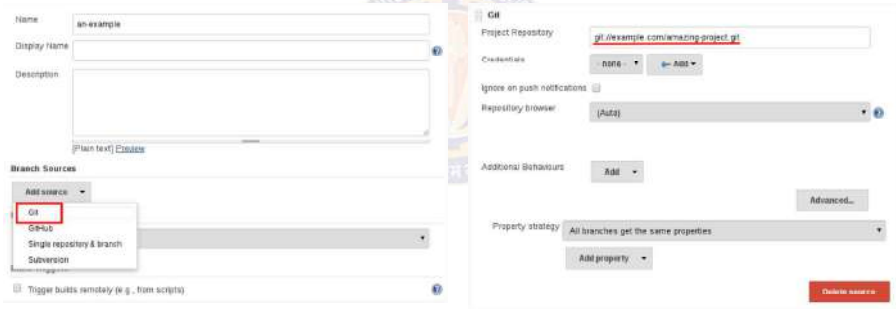
- The Multibranch Pipeline project type enables you to implement different Jenkinsfiles for different branches of the same project
- In a Multibranch Pipeline project, Jenkins automatically discovers, manages and executes Pipelines for branches which contain a Jenkinsfile in source control
- This eliminates the need for manual Pipeline creation and management
- Steps to To create a Multibranch Pipeline:
  - Step1: Click New Item on Jenkins home page
  - Step2 : Enter a name for your Pipeline, select Multibranch Pipeline and click OK



Jenkins

Multibranch

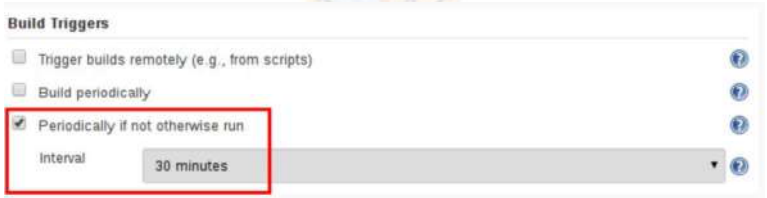
- Step3 : Add a Branch Source (for example, Git) and enter the location of the repository
- Step4: Save the Multibranch Pipeline project



Jenkins

Multibranch

- Step5: Build Trigger Interval can be set
- Additional Environment Variables
  - BRANCH_NAME : Name of the branch for which this Pipeline is executing, for example master
  - CHANGE_ID : An identifier corresponding to some kind of change request, such as a pull request number



Artifact Management

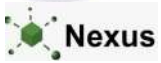
What is Artifact

- An artifact is the output of any step in the software development process
- Artifacts can be a number of things like JARs , WARs, Libraries, Assets and application
- Generally, an artifact repository can serve as:
  - A central point for management of binaries and dependencies;
  - A configurable proxy between organization and public repositories; and
  - An integrated depot for build promotions of internally developed software

Artifact Management

Artifact Management Tools

- An artifact repository should be:
  - secure;
  - trusted;
  - stable;
  - accessible; and
  - Versioned
- Artifact Management Tools:
  - JFrog
  - Nexus
  - Maven
  - HelixCore



Artifact Management

Why

- Having an artifact repository allows you to treat your dependencies statically
- Artifact repositories allow you to store artifacts the way you use them
- Some repository systems only store a single version of a package at a time
- Ideally, your local development environment has the same access to your internal artifact repository as the other build and deploy mechanisms in your environment
- This helps minimize the “it works on my laptop” syndrome because the same packages and dependencies used in production are now used in the local development environment
- If you don’t have access to the internet within your environment; artifact management helps to have your own universe
- Relying on the internet for your dependencies means that somebody else ultimately owns the availability and consistency of your builds, something that many organizations hope to avoid
- An artifact repository organizes and manages binary files and their metadata in a central place

Artifact Management

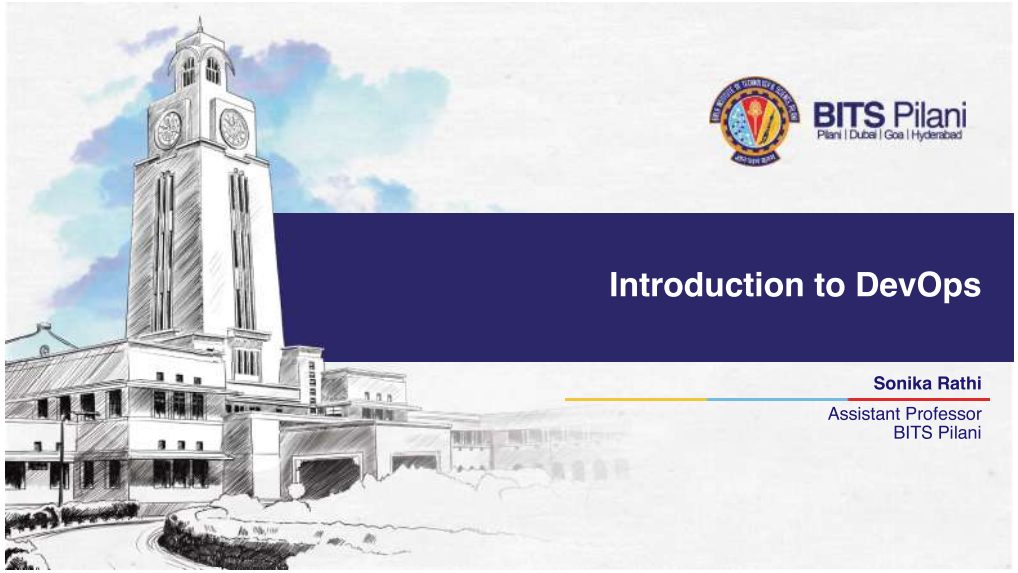
Benefits

- The Binary Repository Manager: Artifact repositories allow teams to easily find the correct version of a given artifact
- This means developers can push to, and pull from, the artifact repository as part of the DevOps workflow
- Single Source of Truth: Artifact repositories improve the way teams work together by ensuring everyone is using the correct files
- It helps CI / CD to be more reliable

Q&A

Thank You!

In our next session:



BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

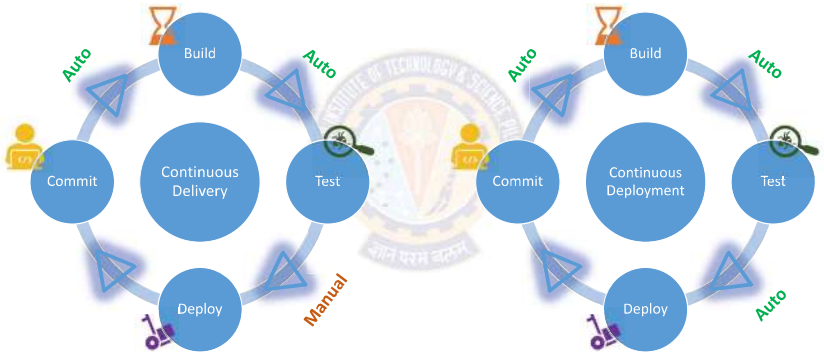
Agenda

Continuous Deployment

- Introduction to Deployment
- Deployment Consideration
- Challenges of Deployment
- Deployment pipeline
- Structure of Deployment Pipeline
- Basic Deployment Pipeline
- Stages of Deployment Pipeline

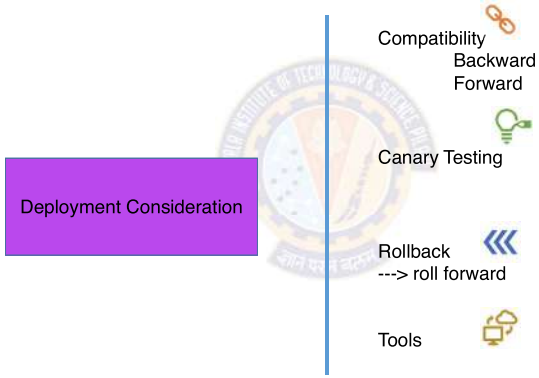
Continuous Deployment

Introduction to CD



Deployment

Considerations



Deployment

Challenges in Deployment

- Deployment Process Waste

  Build and operations teams waiting for documentation or fixes

  Testers waiting for “good” builds of the software

  Development teams receiving bug reports weeks after the team has moved on to new functionality

  Discovering, towards the end of the development process, that the application’s architecture will not support the system’s nonfunctional requirements

This leads to software that is undeployable because it has taken so long to get it into a production-like environment, and buggy because the feedback cycle between the development team and the testing and operations team is so long

Deployment

New Approach

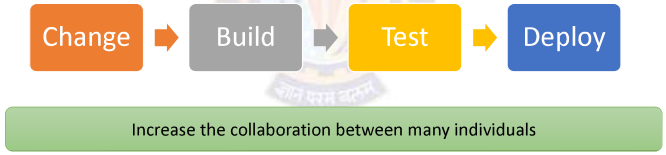
- End-to-End approach to delivering software
- Deployment of Application should be easy & one click to go
- A powerful feedback loop; rapid feedback on both the code and the deployment process
- Lowering the risk of a release and transferring knowledge of the deployment process to the development team
- Testing teams deploy builds into testing environments themselves, at the push of a button
- Operations can deploy builds into staging and production environments at the push of a button
- Developers can see which builds have been through which stages in the release process, and what problems were found
- Automate Build, Deploy, Test and Release System

Note: As a result, everybody in the delivery process gets two things: access to the things they need when they need them, and visibility into the release process to improve feedback so that bottlenecks can be identified, optimized, and removed.
This leads to a delivery process which is not only faster but also safer

Deployment Pipeline

What is Deployment Pipeline

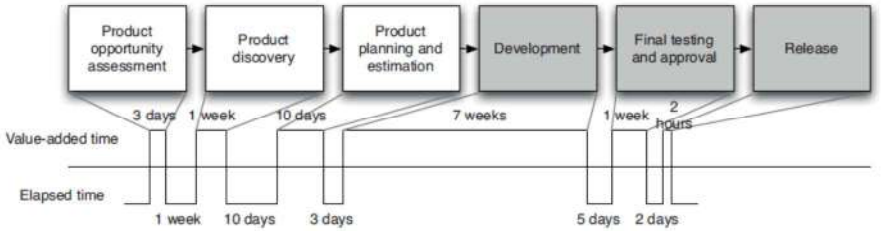
- An automated manifestation of your process for getting software from version control into the production



Increase the collaboration between many individuals

Deployment Pipeline

Value Stream Map of a Product Creation



A high-level value stream map for the creation of a new product

Cycle Time : 11 Weeks,3 Days & 2 hours
Waste Time : 5 Weeks
Lead Time : 16 Weeks,3 Days & 2 hours

Structure of Deployment Pipeline

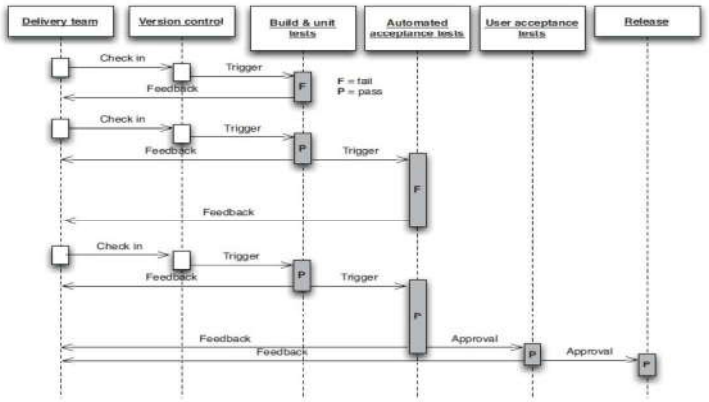
Expected steps to be followed

1. The input to the pipeline is a particular revision in version control
2. Every change creates a build
3. It pass through a sequence of tests and challenges to, its viability as a production release

- As the build passes each test of its fitness, confidence in it increases
- The objective is to eliminate unfit release candidates as early in the process as we can and get feedback on the root cause of failure to the team as rapidly as possible
- Any build that fails a stage in the process will not generally be promoted to the next

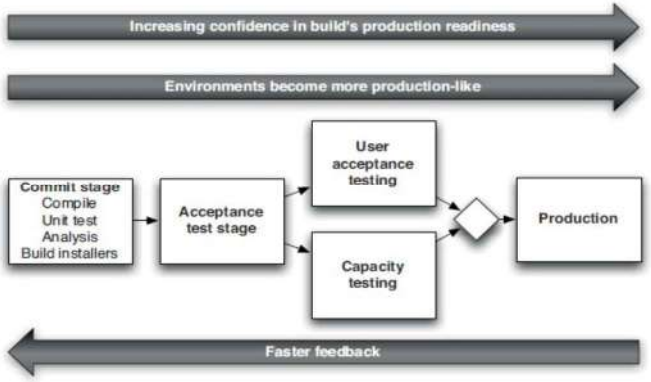
Structure of Deployment Pipeline

Example



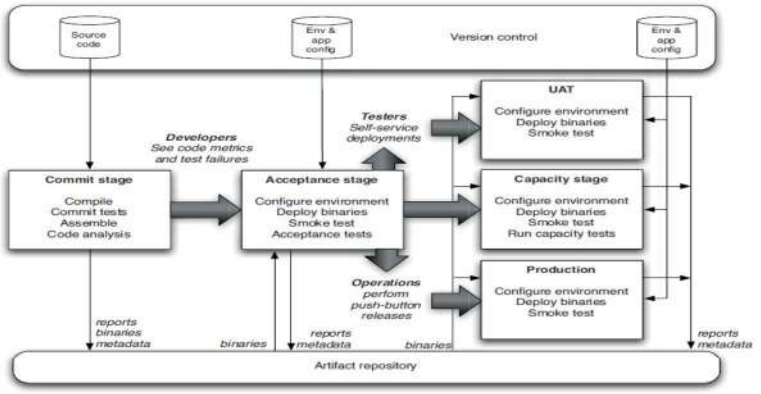
Structure of Deployment Pipeline

Broad Overview



Deployment Pipeline

Basic Deployment Pipeline



Basic Deployment Pipeline

Outcome

- The ultimate purpose of all this is to get feedback as fast as possible
- To make the feedback cycle fast
- To be able to see which build is deployed into which environment and
- Which stages in your pipeline each build has passed

Note: It means that if you see a problem in the acceptance tests (for example), you can immediately find out which changes were checked into version control that resulted in the acceptance tests failing

Deployment Pipeline

Antipatterns of dealing with Binaries

- The source code will be compiled repeatedly in different contexts: during the commit process, again at acceptance test time, again for capacity testing, and often once for each separate deployment target

- Every time you compile the code, you run the risk of introducing some difference
- The version of the compiler installed in the later stages may be different from the version that you used for your commit tests
- You may pick up a different version of some third-party library that you didn't intend
- Even the configuration of the compiler may change the behavior of the application

Antipatterns of dealing with Binaries

Violates two Principles

Efficiency of Deployment pipeline
- Recompiling violates this principle because it takes time, especially in large systems
- Delayed feedback

Always build upon foundations
- The binaries that get deployed into production should be exactly the same as those that went through the acceptance test process
- Recreation of binaries violates this principle

Deployment Pipeline

Deployment Pipeline Practices

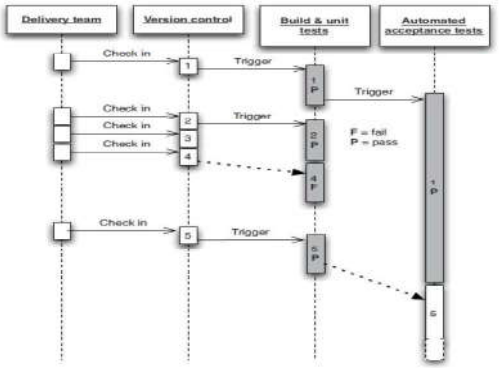
1. Only Build Your Binaries Once
2. Deploy the Same Way to Every Environment

   Note: Using the same script to deploy to production that you use to deploy to development environments is a fantastic way to prevent the "it works on my machine" syndrome
3. Smoke-Test Your Deployments
4. Deploy into a Copy of Production
5. Each Change Should Propagate through the Pipeline Instantly
6. Intelligent pipeline scheduling
7. If Any Part of the Pipeline Fails, Stop the Line

Deployment Pipeline Practices

Intelligent scheduling

- Intelligent scheduling is crucial to implementing a deployment pipeline



Deployment Pipeline

Stages in Deployment Pipeline

- The Commit Stage
- The Automated Acceptance Gate
- Subsequent Test Stages
- Preparing to Release

Preparing to Release

Release Plan

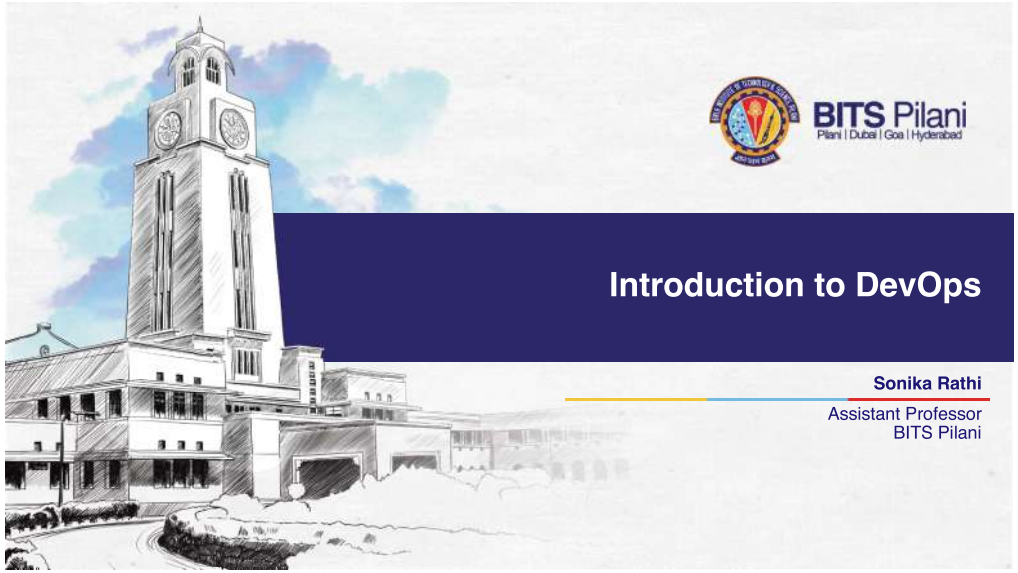
- Have a release plan that is created and maintained by everybody involved in delivering the software, including developers and testers, as well as operations, infrastructure, and support personnel
- Minimize the effect of people making mistakes by automating as much of the process as possible
- Practice the procedure often in production-like environments, so you can debug the process and the technology supporting it
- Have the ability to back out a release if things don't go according to plan
- Have a strategy for migrating configuration and production data as part of the upgrade and rollback processes

Note: Goal is a completely automated release process, Releasing should be as simple as choosing a version of the application to release and pressing a button and Backing out should be just as simple

Q&A

Thank You!

In our next session:



BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

Agenda

Continuous Deployment

- Human Free Deployment
- Implementing a Deployment Pipeline
- Rolling back deployment
- Zero-downtime Release
- Deployment Strategies

Human Free Deployments

Automating Deployment and Release

- Reduces issues due manual mistakes
- Audit logs

Human Free Deployments

Benefits

- With automated deployment and release, the process of delivery becomes available to everyone
- Developers, testers, and operations teams no longer need to rely on ticketing systems and email threads to get builds deployed so they can gather feedback on the production readiness of the system
- Testers can decide which version of the system they want in their test environment without needing to be technical experts themselves, nor relying on the availability of such expertise to make the deployment
- Sales people can access the latest version of the application with the killer feature that will swing the deal with a client
- An important reason for the reduction in risk is the degree to which the process of release itself is rehearsed, tested, and perfected
- Since you use the same process to deploy your system to each of your environments and to release it, the deployment process is tested very frequently—perhaps many times a day

Implementing a Deployment Pipeline

The steps to implement a deployment pipeline

- Model your value stream and create a walking skeleton
- Automate the build and deployment process
- Automate unit tests and code analysis
- Automate acceptance tests
- Automate releases

Deployment Consideration

Rolling Back Deployments

- It is essential to roll back a deployment in case it goes wrong
- As, debugging problems in a running production environment is almost certain to result in late nights
- a way to restore service to your users when things go wrong, so you can debug the failure in the comfort of normal working hours
- There are several methods of performing a rollback
  - blue-green deployments and canary releasing can also be used to perform zero-downtime releases and rollbacks

Rolling Back Deployments

Rolling Back Deployments Constraints

- Data : If your release process makes changes to your data, it can be hard to roll back

- There are two general principles you should follow when creating a plan for rolling back a release
- Ensure that the state of your production system, including databases and state held on the filesystem, is backed up before doing a release
- The second is to practice your rollback plan, including restoring from the backup or migrating the database back before every release to make sure it works

Deployments

Zero-Downtime Releases

- Hot deployment, in which the process of switching users from one release to another happens nearly instantaneously
- It must also be possible to back users out to the previous version nearly instantaneously too, if something goes wrong
- The key to zero-downtime releases is decoupling the various parts of the release process so they can happen independently as far as possible

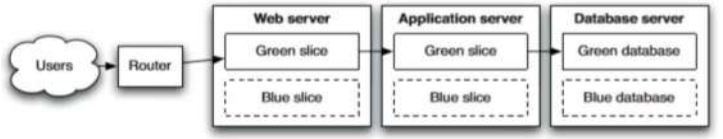
Deployment

Deployment Strategies

Blue-Green Deployments

Introduction

- This is one of the most powerful techniques we know for managing releases
- The idea is to have two identical versions of your production environment, which we'll call blue and green



Blue-Green Deployments

Challenges

- It is usually not possible to switch over directly from the green database to the blue database because it takes time to migrate the data from one release to the next if there are schema changes

Solutions:
1) Put the application into read-only mode shortly before switchover
2) Another approach is to design your application so that you can migrate the database independently of the upgrade process

Blue-Green Deployments

Setup

blue and green environments can be completely separate replicas of each other

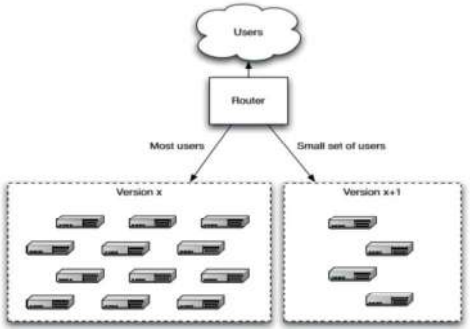
you can only afford a single production environment
have two copies of your application running side by side on the same environment (with its own resources like port, filesystem etc.,)

Use virtualization

Canary Releasing

Introduction

- Involves rolling out a new version of an application to a subset of the production servers to get fast feedback
- Like a canary in a coal mine, this quickly uncovers any problems with the new version without impacting the majority of users



Canary Releasing

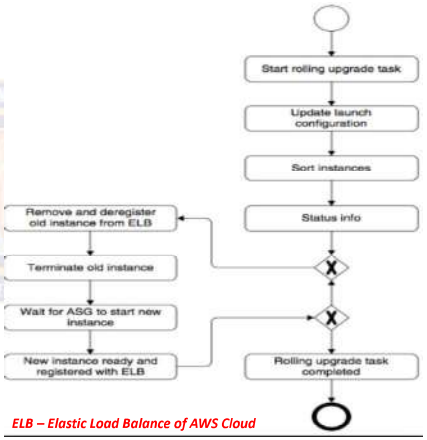
Benefits

- It makes rolling back easy: Just stop routing users to the bad version, and you can investigate the logs at your freedom
- You can use it for A/B testing by routing some users to the new version and some to the old version
  - Some companies measure the usage of new features, and kill them if not enough people use them
  - Others measure the actual revenue generated by the new version, and roll back if the revenue for the new version is lower
- You can check if the application meets capacity requirements by gradually ramping up the load, slowly routing more and more users to the application and measuring the application's response time and metrics like CPU usage, I/O, and memory usage, and watching for exceptions in logs

Rolling upgrade

Introduction

- A rolling upgrade consists of deploying a small number of new version systems at a time directly to the production environment
- In this deployment simultaneously you turn off the old version system
- Before you remove the original system; make sure the new version system is serving the purpose



ELB – Elastic Load Balance of AWS Cloud

Rolling upgrade

Benefits

- Cost Effective
- Risk Effective

Emergency Fixes

Best Practice for Emergency Fixes

- Run every emergency fix through your standard deployment pipeline
- You should always consider how many people the defect affects, how often it occurs, and how severe the defect is in terms of its impact on users
- Some considerations to take into account when dealing with a defect in production:
  - Never do them late at night, and always pair with somebody else
  - Make sure you have tested your emergency fix process
  - Only under extreme circumstances bypass the usual process for making changes to your application
  - Make sure you have tested making an emergency fix using your staging environment
  - Sometimes it's better to roll back to the previous version than to deploy a fix, do some analysis to work out what the best solution is

Deployment

Tips and Tricks

- The People Who Do the Deployment Should Be Involved in Creating the Deployment Process
  - Things Go Better When Development and Operations Are Friends
- Log Deployment Activities
  - If your deployment process isn't completely automated, including the provisioning of environments, it is important to log all the files that your automated deployment process copies or creates
- Don't Delete the Old Files, Move Them
- Deployment Is the Whole Team's Responsibility
  - A "build and deployment expert" is an antipattern. Every member of the team should know how to deploy, and every member of the team should know how to maintain the deployment scripts

References

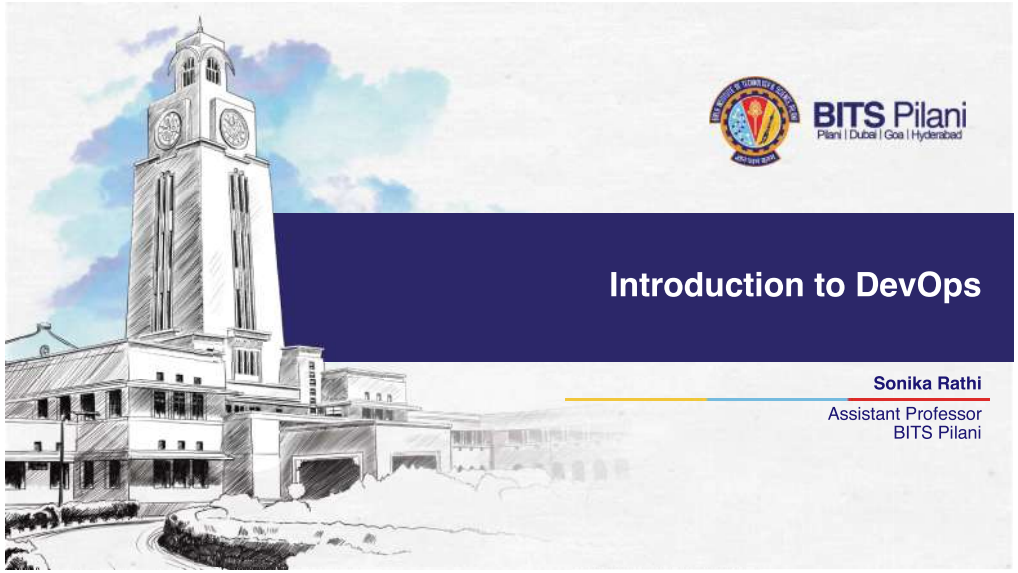
CS 11 and 12

- Text Book 1: DevOps: A Software Architect's Perspective (SEI Series in Software Engineering) by Len Bass, Ingo Weber, Liming Zhu , Publisher: Addison Wesley (18 May 2015) : Chapter 6 : Deployment
- Text Book 2: Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation by Jez Humble, David Farley. Publisher: Addison Wesley, 2011 : Chapter 5 : Anatomy of the Deployment Pipeline

Q&A

Thank You!

In our next session:



BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

Review CS#7

Continuous Deployment

- Introduction to Deployment
- Deployment Consideration
- Challenges of Deployment
- Deployment pipeline
- Structure of Deployment Pipeline
- Basic Deployment Pipeline
- Stages of Deployment Pipeline
- Human Free Deployment
- Implementing a Deployment Pipeline
- Rolling back deployment
- Zero-downtime Release
- Deployment Strategies

Agenda

Continuous Monitoring

- Introduction to Monitoring
- What to Monitor
- Goals of Monitoring
  - Failure detection
  - Performance degradation
  - Capacity planning
  - User Interaction
  - Intrusion detection
- How to Monitor
- Challenges in Monitoring
- Monitoring Tools
- ELK
- ELK Architecture
- ELK Features and Benefits

Continuous Monitoring

Introduction to Monitoring

- The process of observing and recording system state changes and data flows

State changes can be expressed by direct measurement of the state or by logs recording updates that impact part of the state

Data flows can be captured by logging requests and responses between both internal components and external systems

Continuous Monitoring

Monitoring fall into five different categories

1) Identifying failures and the associated faults both at runtime and during postmortems held after a failure has occurred

2) Identifying performance problems of both individual systems and collections of interacting systems

3) Characterizing workload for both short- and long-term capacity planning and billing purposes

4) Measuring user reactions to various types of interfaces or business offerings

5) Detecting intruders who are attempting to break into the system

Continuous Monitoring

What to Monitor

- The data to be monitored for the most part comes from the various levels of the stack

Goal of Monitoring	Source of Data
Failure Detection	Application and Infrastructure
Performance Degradation Detection	Application and Infrastructure
Capacity Planning	Application and Infrastructure
User reaction to business offerings	Application
Intruder detection	Application and Infrastructure

Above Table lists the insights you might gain from the monitoring data and the portions of the stack where such data can be collected

Continuous Monitoring

Fundamental items to be monitored

Inputs

Resources
hard resources such as CPU, memory, disk, and network—even if virtualized
soft resources such as queues, thread pools, or configuration specifications

Outcomes
include items such as transactions and business-oriented activities

Goals Monitoring

Failure Detection

Failures of any element in physical infrastructure is possible

The total failures are relatively easy to detect
No data is flowing where data used to flow

Partial failures that are difficult to detect
Partial failures also manifest as performance problems

Goals Monitoring

Failure Detection

Detecting software failures :
1) The monitoring software performs health checks on the system from an external point
2) A special agent inside the system performs the monitoring
3) The system itself detects problems and reports them

Hardware Failure:
datacenter provider's responsibility

Software Failure:
Dependency Software failure
Software Misconfiguration

Goals of Monitoring

Performance Degradation

- Degraded performance can be observed by comparing current performance to historical data—or by complaints from clients or end users
- Ideally your monitoring system catches performance degradation before users are impacted at a notable strength

Goals of Monitoring

Performance Degradation

Performance measures

Latency
The time from the initiation of an activity to its completion
It is the period from a user request to the satisfaction of that request

Throughput
The number of operations of a particular type in a unit time

Utilization
The relative amount of use of a resource
Hard resources : CPU (80%), Memory, disk
Soft resources: queues or thread pools

Goals of Monitoring

Capacity Planning

Long-term Capacity Planning
Involves humans and has a time frame on the order of days, weeks, months, or even years
This capacity planning is intended to match hardware needs, whether real or virtualized, with workload requirements
Example:
In a physical datacenter, it involves ordering hardware
In a virtualized public datacenter, it involves deciding on the number and characteristics of the virtual resources

Note: In capacity planning characterization of the current workload gathered from monitoring data and a projection of the future workload based on business considerations and the current workload

Goals of Monitoring

Capacity Planning

Short-term Capacity Planning
Planning is performed automatically and has a time frame on the order of minutes
In this capacity planning the context of a virtualized environment such as the cloud, creating a new virtual machine (VM) for an application or deleting an existing VM
Example:
Monitoring the usage of the current VM instances was an important portion of each option

Note: Charging for use is an essential characteristic of the cloud as defined by the U.S. National Institute of Science and Technology

Goals of Monitoring

User Interaction

User satisfaction depends

The latency of a user request

The reliability of the system with which the user is interacting

User interface modification

Types of User Interaction Monitoring:
Real user monitoring (RUM)
Synthetic monitoring

Goals of Monitoring

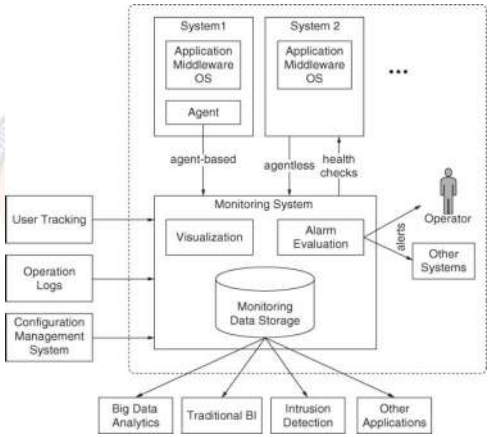
Intrusion Detection

- Intruders can break into a system by disrupting an application
  - Example: Through incorrect authorization
- Applications can monitor users and their activities to determine whether the activities are consistent with the users' role in the organization
- An intrusion detector is a software application that monitors network traffic by looking for abnormalities
- Intrusion detectors use a variety of different techniques to identify attacks:
  - They use historical data from an organization's network to understand what is normal
  - They use libraries that contain the network traffic patterns observed during various attacks
  - Example: Current traffic on network vs Expected traffic in historical data
    - The organization may have a policy disallowing external traffic on particular ports

Continuous Monitoring

How to Monitor?

- Agentless
- Agent-based
- Health Check: External systems can also monitor system or application-level states through health checks, performance-related requests, or transaction monitoring



Continuous Monitoring

Why Monitoring

- A monitoring system allows operators to drill down into detailed monitoring data and logs; which helps in:
- Error diagnosis
- Root Cause Analysis
- Deciding on the best reaction to a problem

Monitoring Operation Activities

Monitoring Operations

- Operations tools monitor resources such as configuration settings to determine whether they conform to pre-specified settings and monitor resource specification files to identify any changes
- Both of these types of monitoring are best done by agents that periodically sample the actual values and the files that specify those values
- There are different Operation Tools like Chef, Puppet, Saltstack and Ansible etc.,
- The offerings of different configuration management tools now available with both Agent Based and Agentless

Monitoring Operation Activities

Collection and Storage

- The core of monitoring is recoding and analyzing time series data, namely, a sequence of time-stamped data points
- Three key challenges in collection and storage:
  - Collating related items by time:
    - Time stamps in a distributed system are not going to be consistent
  - Collating related items by context:
    - If there is any parallel process for the same operation, then it is very difficult to reconstruct a sequence of events to diagnose a problem
  - Handling the volume of monitoring data
    - Big Data, Hadoop etc.
- Change in Monitoring Configuration

Monitoring Operation Activities

Log

sources of the logs

Applications
Web servers
Database systems
DevOps pipeline
Another Logs by
- Operations tools
- An upgrade tool
- Migration tool
- Configuration management tool

Use of Logs

During operations to detect and diagnose problems
During debugging to detect errors
During post-problem forensics to understand the sequence that led to a particular problem

Monitoring Operation Activities

Log

- General rules about writing logs

Logs should have a consistent format
Logs should include an explanation for why this particular log message was produced
Log entries should include context information (Process ID, Request ID, VM ID etc.,)
Logs should provide screening information (Severity level, Alert level)

Monitoring Operation Activities

Graphing and Display

- It is useful to visualize all relevant data collected by monitoring system

Monitoring Operation Activities

Alarms and Alerts

Alerts:

Alerts are raised for purposes of informing

Alerts are raised in advance of an alarm

Example: The datacenter temperature is rising

Alarms:

Alarms require action by the operator

Or

Alarms require action by another system

Example: The datacenter is on fire

Alarms and alerts can be triggered by

Events

A particular physical machine is not responding

By values crossing a threshold

The response time for a particular disk is greater than an acceptable value

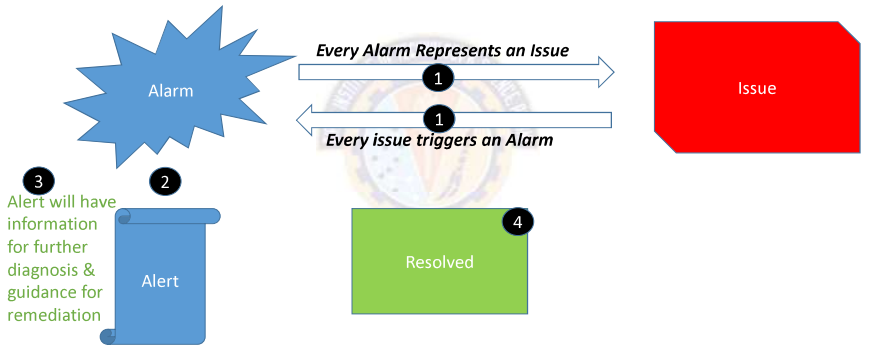
By sophisticated combinations of values and trends

Percentage monitoring of a file system

CPU Utilization on peak in a Day

Monitoring Operation Activities

Alarms and Alerts



Monitoring

Challenges in Monitoring by DevOps

- Challenge 1: Monitoring Under Continuous Changes
- Challenge 2: Bottom-Up vs. Top-Down and Monitoring in the Cloud
- Challenge 3: Monitoring a Microservice Architecture
- Challenge 4: Dealing with Large Volumes of Distributed (Log) Data

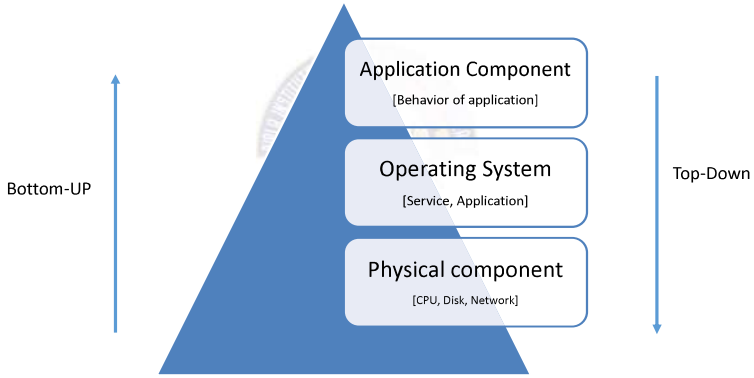
Challenges in Monitoring

Challenge 1: Monitoring Under Continuous Changes

- Here the solution is to automate the configuration of alarms, alerts, and thresholds as much as possible; the monitoring configuration process is just another DevOps process that can and should be automated
- Example:
  - When you provision a new server, a part of the job is to register this server in the monitoring system automatically
  - When a server is terminated, a de-registration process should happen automatically
  - For example, the monitoring results during canary testing for a small set of servers can be the new baseline for the full system and populated automatically

Challenges in Monitoring

Challenge 2: Bottom-Up vs. Top-Down and Monitoring in the Cloud



Challenges in Monitoring

Challenge 2: Bottom-Up vs. Top-Down and Monitoring in the Cloud

- Adopting a more top-down approach for monitoring cloud-based and highly complex systems is an attempt to solve these problems
  - You monitor the top level or aggregated data and only dive into the lower-level data in a smart way if you notice issues at the top level
  - The lower-level data must still be collected but not systematically monitored for errors
- Risk : By above solution you are sacrificing the opportunity to notice issues earlier; and it might already be too late to prevent a bigger impact once you notice that something is wrong at the top level

Note: There is no easy solution, bottom-up and top-down monitoring are both important and should be combined in practice

Challenges in Monitoring

Challenge 3: Monitoring a Microservice Architecture

- Adoption of a microservice architecture enables having an independent team for each microservice
- Every external request may potentially travel through a large number of internal services before an answer is returned
- In a large-scale system, one part or another may experience some slowdown at any given time, which may consequently lead to a negative impact on an unacceptable portion of the overall requests

Note: Need of intelligent monitor systems; one can monitor at microservice level

Challenges in Monitoring

Challenge 4: Dealing with Large Volumes of Distributed (Log) Data

- Operators should use varied and changeable intervals rather than fixed ones, depending on the current situation of the system
  - If there are initial signs of an anomaly or when a periodic operation is starting, set finer-grained monitoring
  - Return to bigger time intervals when the situation is resolved or the operation completed
- Use a modern distributed logging or messaging system for data collection
  - A distributed logging system such as Logstash can collect all kinds of logs and conduct a lot of local processing before shipping the data off
  - This type of system allows you to reduce performance overhead, remove noise, and even identify errors locally

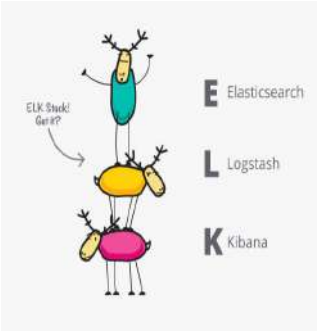
Continuous Monitoring

Monitoring Tools

Continuous Monitoring

ELK

- ELK is the acronym for three open source projects
- Elasticsearch, Logstash, and Kibana
- Elasticsearch is a search and analytics engine
- Logstash is a server-side data processing pipeline that ingests data from multiple sources simultaneously, transforms it, and then sends it to a "stash" like Elasticsearch
- Kibana lets users visualize data with charts and graphs in Elasticsearch



ELK

Elasticsearch

- ELK is started with Elasticsearch
- The open source, distributed, RESTful, JSON-based [Key Pair value] search engine
- Easy to use, scalable and flexible, it earned hyper-popularity among users and a company formed around it
- Elasticsearch lets you perform and combine many types of searches — structured, unstructured, geo, metric
- Elasticsearch aggregations let you zoom out to explore trends and patterns in your data
- Elasticsearch is a NoSQL database that is based on the Lucene search engine

ELK

Logstash

- Logstash is an open source
- It is a server-side data processing
- It is a distributed log management systems, tailored for processing large amounts of text-based logs
- Logstash consumes data from a mass of sources simultaneously, transforms it, and then sends it to your favorite “stash”
- Logstash works in three stages collection, processing, and dispatching

ELK

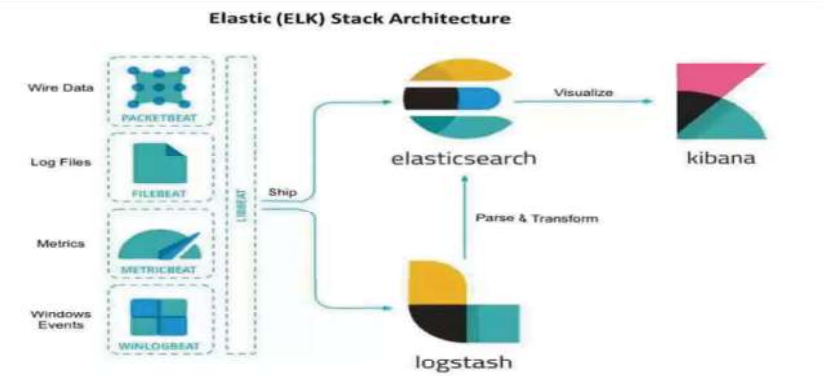
Kibana

- Kibana lets you visualize your Elasticsearch data and navigate the Elastic Stack
- Kibana gives you the freedom to select the way you give shape to your data
- Kibana core ships with the classics: histograms, line graphs, pie charts, sunbursts, and more

kibana

ELK

Architecture



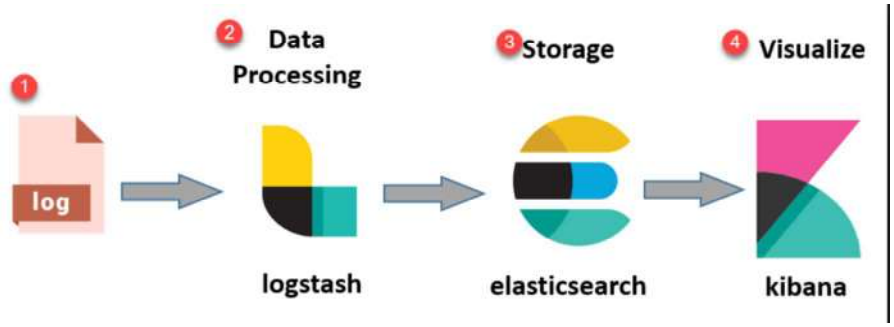
ELK

Features & Benefits

- Security:
  - Protect your Elasticsearch data in a robust and granular way
- Alerting:
  - Get notifications about changes in your data
- Monitoring:
  - Maintain a pulse on your Elastic Stack to keep it firing on all cylinders
- Reporting:
  - Create and share reports of your Kibana charts and dashboards
- Graph:
  - Explore meaningful relationships in your data
- Machine Learning:
  - Automate anomaly detection on your Elasticsearch data

ELK

Quick Review



References

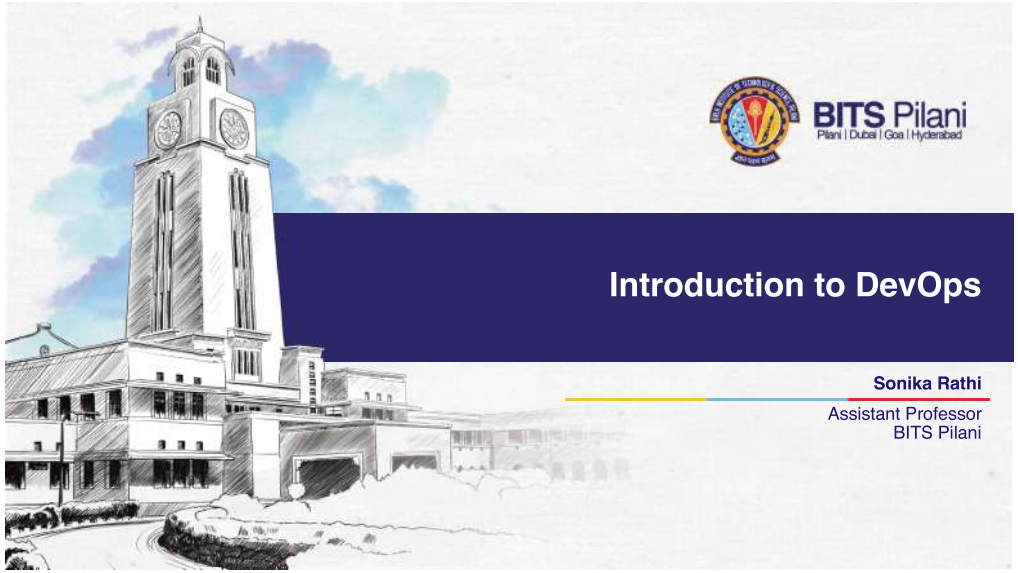
Text Book Mapping

- Text Book 1: DevOps: A Software Architect's Perspective (SEI Series in Software Engineering) by Len Bass, Ingo Weber, Liming Zhu , Publisher: Addison Wesley (18 May 2015) : Chapter 7 : Monitoring

Q&A

Thank You!

In our next session:



BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

Agenda

Configuration Management

- Introduction to Configuration [Infrastructure Concept]
- Managing Application Configuration
- Managing Environments
- Infrastructure as code
- Server Provisioning
- Automating and Managing Server Provisioning
- Configuration management tools- Chef, Puppet
- Managing on-demand infrastructure
- Auto Scaling

Configuration Management

Introduction to Configuration

- Started in the 1950s by the United States Department of Defense as a technical management discipline

  Process of establishing and maintaining the consistency of something's functional and physical attributes as well as performance throughout its lifecycle

- ***Configuration management refers to the process by which all artifacts relevant to your project, and the relationships between them, are stored, retrieved, uniquely identified, and modified***

  This includes the policies, processes, documentation, and tools required to implement this system of consistent performance, functionality, and attributes

Introduction to Configuration Management

Identify your CM strategy

Can I ***exactly reproduce any of my environments***, including the version of the operating system, its patch level, the network configuration, the software stack, the applications deployed into it, and their configuration?

Can I ***easily make an incremental change*** to any of these individual items and ***deploy the change to any, and all, of my environments?***

Can I easily see each change that occurred to a particular environment and trace it back to see exactly what the change was, who made it, and when they made it?

Is it easy for every member of the team to get the information they need, and to make the changes they need to make?

Introduction to Configuration Management

Managing Software Configuration

Configuration information

Used to change the behavior of software at build time, deploy time, and run time

Delivery teams need to consider carefully:

- What configuration options should be available
- How to manage them throughout the application's life,
- How to ensure that configuration is managed consistently across components, applications, and technologies

Treat configuration of your system in the same way you treat your code

Introduction to Configuration Management

Facts and Myth

Flexibility & Configuration

Everyone wants flexible software

Flexibility usually comes at a cost

The desire to achieve flexibility may lead to the common antipattern of "ultimate configurability" which is, all too frequently, stated as a requirement for software projects

Myth

Configuration information is somehow less risky to change than source code

Introduction to Configuration Management

Configuration Vs Source Code

One can stop system easily by changing the configuration compare to by changing the source code

Source Code	Configuration information
Change the source code The compiler will rule out nonsense And automated tests should catch most other errors	Change the Configuration configuration information is free-form and untested Ex: Change in the URL

Introduction to Configuration Management

Injecting Configuration information

Configuration information can be injected into application at several points

Build Deploy Test Release

Generally, we consider it bad practice to inject configuration information at build or packaging time

It is usually important to be able to configure your application at deployment time so that you can tell it where the services it depends upon such as database, messaging servers, or external systems belong

Manging Configuration

Level of Configurations

- Application Configuration
- Environment Configuration

Manging Application Configuration

How does it works?

Consideration

How do you represent your configuration information?

How do your deployment scripts access it?

How does it vary between environments, applications, and versions of applications?

Considerable Solution

Configuration information is often modeled as a set of name-value strings
A database
A version control system
Or A directory or registry

Note: Version control is the easiest, just check in configuration file, and get the history of your configuration over time for free also It is worth keeping a list of the available configuration options for application in the same repository as its source code

Manging Application Configuration

How does it Works? Cont..

Manging Application Configuration

Modeling Configuration

- Each configuration setting can be modeled as a tuple, so the configuration for an application consists of a set of tuples
- Tuple value typically depends upon:
  - The application
  - The version of the application
  - The environment it runs in (for example, development, UAT, performance, staging, or production)

Use cases when modeling configuration information

Adding a new environment

Creating a new version of the application

Promoting a new version of your application from one environment to another

Relocating a database server

Manging Application Configuration

Principles of Managing Application Configuration

- Keep the available configuration options for your application in the same repository as its source code, but keep the values somewhere else
- Configuration settings have a lifecycle completely different from that of code, while passwords and other sensitive information should not be checked in to version control at all
- Configuration should always be performed by automated processes using values taken from configuration repository, so that one can always identify the configuration of every application in every environment
- Test your configuration scripts
- Use clear naming conventions for configuration options
- Ensure that configuration information is modular and encapsulated
  - So that changes in one place don't have knock-on effects for other, apparently unrelated, pieces of configuration

Manging Application Configuration

Testing Configuration

- **There are two parts to testing configuration:**

The first stage is to ensure that references to external services in configuration settings are good

Example: As part of deployment script, ensure that the messaging bus are configured to use is actually up and running at the address configured

Deployment or installation script should fail if anything application depends on is not available; this acts as a great smoke test for configuration settings

The second stage is to actually run some smoke tests once application is installed to make sure it is operating as expected

Example: This should involve just a few tests exercising functionality that depends on the configuration settings being correct

Managing Environments

Environments ?

No application is Island

Every application depends on hardware, software, infrastructure, and external systems in order to work

Any application depends on:
- Application Configuration like port, messaging bus etc.
- Operating System Configuration

Managing Environments

Problems in Managing Configuration

If the **collection of configuration** information is **very large**
One **small change can break the whole application** or severely degrade its performance
Once it is broken, finding the problem and **fixing it takes an unknown amount of time** and requires senior personnel
It is **extremely difficult to precisely reproduce manually configured environments** for testing purposes
It is **difficult** to maintain such environments without the configuration, and hence behavior, of different nodes drifting apart

Managing Environments

How to Manage Environments

Best Way

fully automated Process

It should always be cheaper to create a new environment than to repair an old one

Managing Environments

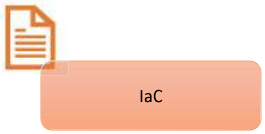
The kinds of environment configuration information should be concerned

- The various operating systems in environment, including their versions, patch levels, and configuration settings
- The additional software packages that need to be installed on each environment to support application, including their versions and configuration
- The networking topology required for your application to work
- Any external services that your application depends upon, including their versions and configuration
- Any data or other state that is present in them (for example, production databases)

Note: There are two principles of an effective configuration management strategy: Keep binary files independent from configuration information, and keep all configuration information in one place

Infrastructure as Code [IaC]

Introduction



Method of writing and deploying machine-readable definition files that generate service components

IaC helps IT operations teams manage and provision IT infrastructure automatically through code without relying on manual processes

IaC is often described as “programmable infrastructure”

Infrastructure as Code [IaC]

IaC for DevOps

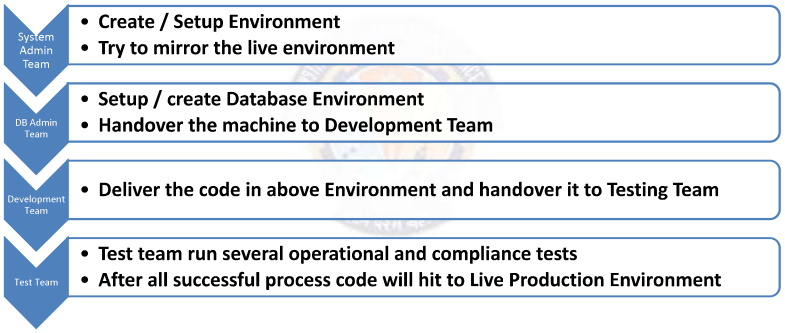
In generic software development, a fundamental constraint is the need for the environment

- i.e. Testing or Staging environment = Live Environment

Note:
This is the only way of assuring that the new code will not crash with existing code definitions – generating errors or conflicts that may compromise the entire system

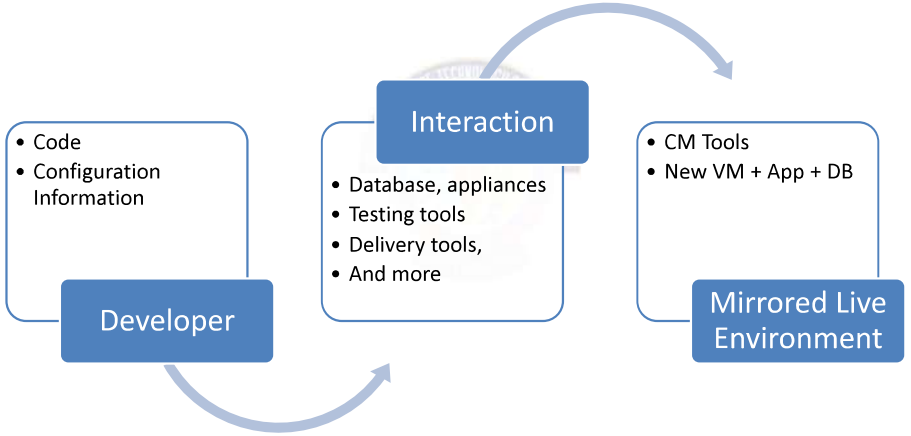
Infrastructure as Code [IaC]

Before IaC and DevOps?



Infrastructure as Code [IaC]

What is achieved with the help of DevOps and IaC?



Infrastructure as Code [IaC]

Benefits of IaC Summary

- Reducing Shadow IT
- Improving Customer Satisfaction
- Operating Expenses [OPEX]
- Capital Expenditure [CAPEX]
- Standardization
- Safer Change Management

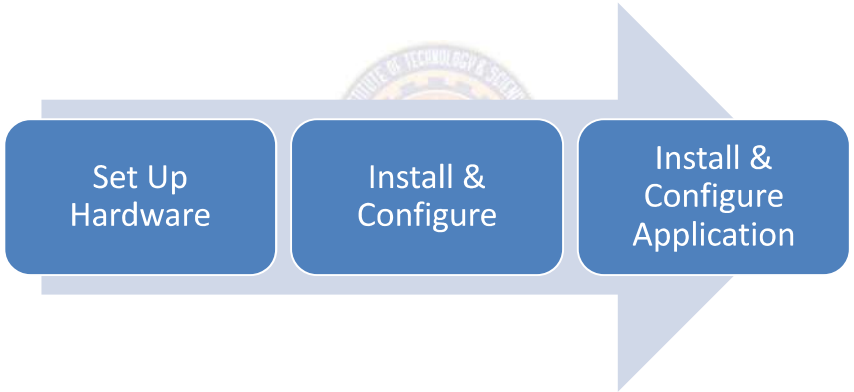
Infrastructure as Code [IaC]

Risks involved with IaC

- Missing proper planning
- IaC requires new skills
- Error replication
- Configuration Drift
- Accidental Destruction

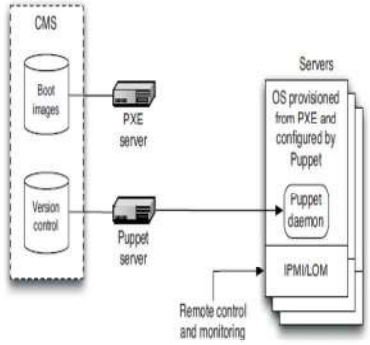
Provisioning Servers

What is Provisioning Servers



Provisioning Servers

An Automate Approach to Provisioning



DHCP

Dynamic Host Configuration Protocol

- Client request for IP
- Respond to the Request

PXE

Preboot Execution Environment

- Request for Boot Image Info
- Boot Image File Name

TFTP

Trivial File Transfer Protocol

- Request file of Boot Image
- Boot Image File to the client

An Automate Approach to Provisioning

Benefits

- Reduction to Man Hours for installation and configuration
- Reduce Operational Cost
- Reduces Errors
- Better Quality Assurance

Configuration management in DevOps

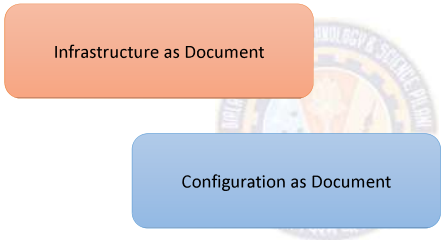
Clear thought

Configuration management deals with the state of any given infrastructure or software system at any given time

Change Management deals with how changes are made to those configurations

Configuration management in DevOps

Traditional Approach



Configuration management in DevOps

New Approach

Infrastructure as code : "It is defining the entire environment definition as a code or a script instead of recording in a formal document"

Configuration as code : "It is nothing but defining all the configurations of the servers or any other resources as a code or script and checking them into version control"

Configuration management in DevOps

Tools

- Puppet
- Chef
- Ansible
- Terraform
- Cloud formation etc.

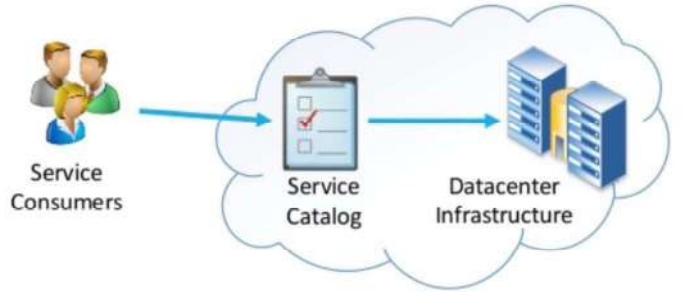
Managing on-demand infrastructure

Why

- We live in a society where you can get anything on demand, right from your smartphone
- You can have groceries delivered to your house
- You can hire someone to clean your home or run your errands
- And ride-sharing services like Uber
- So why should infrastructure be any different?

Managing on-demand infrastructure

Cloud Provider

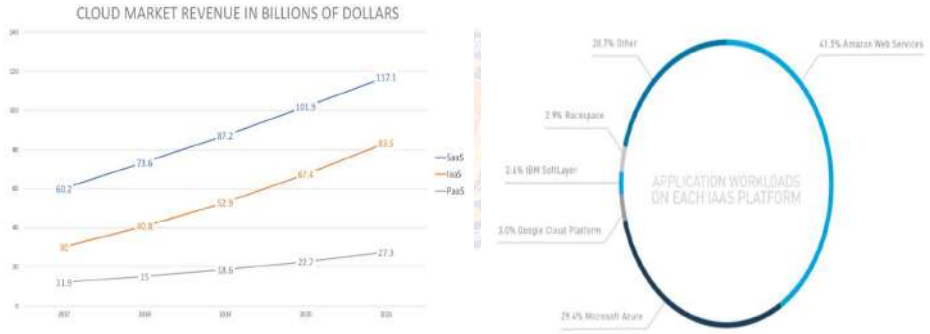


Managing on-demand infrastructure

Cloud Companies

Managing on-demand infrastructure

Stats



Managing on-demand infrastructure

Benefits of On-Demand Infrastructure

- Cost savings
- Scalability and flexibility
- Faster time to market
- Support for DR and high availability
- Focus on business growth

Auto Scaling

Auto Scaling Offers

- Auto Scaling typically means allowing some servers to go to sleep during times of low load
- Saving on Power and Energy
- For companies using infrastructure hosted in the cloud, Auto Scaling can mean lower bills, because most cloud providers charge based on total usage rather than maximum capacity
- Auto Scaling can help by allowing the company to run less time-sensitive workloads on machines that get freed up by Auto Scaling during times of low traffic
- Auto Scaling can offer greater uptime and more availability in cases where production workloads are variable and unpredictable

Auto Scaling

Approaches

Scheduled Auto Scaling Approach

This is an approach to Auto Scaling where changes are made to the minimum size, maximum size, or desired capacity of the Auto Scaling group at specific times of day

E.g. E-commerce sites: Flipkart Big Billion Day, Amazon's Great India Sale

Predictive Auto Scaling

The idea is to combine recent usage trends with historical usage data as well as other kinds of data to predict usage in the future, and Auto Scale based on these predictions

E.g. Online Social and Media Hosting

Auto Scaling

Who Offers Auto Scaling?

- Amazon Web Services (AWS) : In 2009, Amazon launched its own Auto Scaling feature along with Elastic Load Balancing
- Netflix is the well know consumer of Auto Scaling at AWS
- Microsoft's Windows Azure : Around 2013, Microsoft announced that Auto Scaling support to its Windows Azure cloud computing platform
- Oracle Cloud Platform: It allows server instances to automatically scale a cluster in or out by defining an Auto Scaling rule
- Google Cloud Platform : In 2015 Google Compute Engine announced a public beta of its Auto Scaling feature for use

References

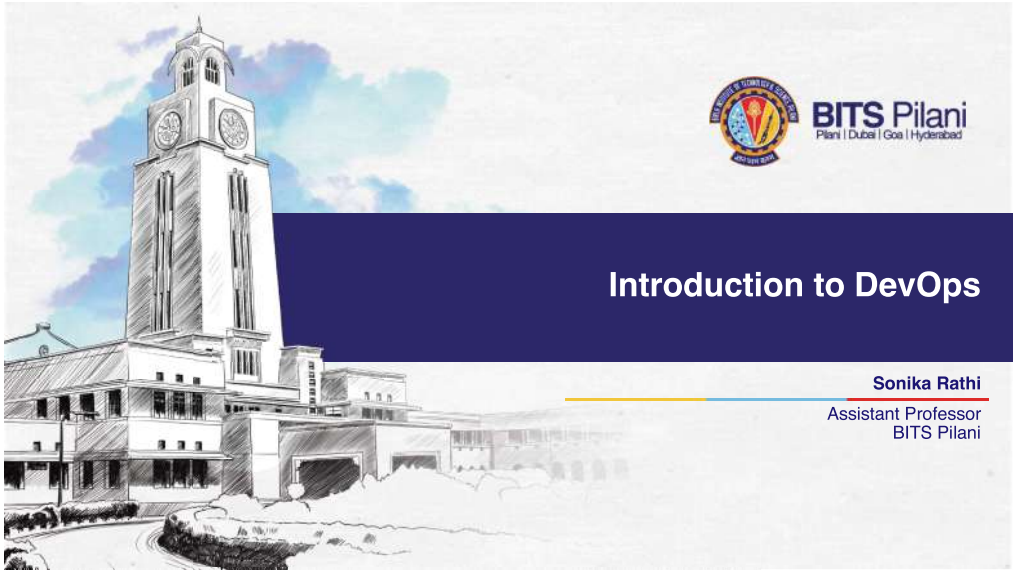
Text Book Mapping

- Text Book 2: Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation by Jez Humble, David Farley. Publisher: Addison Wesley, 2011: Chapter 2 : Configuration Management
- Reference Book1:Effective DevOps: Building A Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis , Ryn Daniels. Publisher: O'Reilly Media, June 2016: Chapter 4 Foundation Terminology and concepts
- https://www.bmc.com/blogs/infrastructure-as-code/

Q&A

Thank You!

In our next session:



Agenda

Configuration Management Tools and Virtualization & Containerization

- CM – Tools
  - Chef Configuration Management Tool
  - Puppet & Puppet Enterprise
  - Ansible
- Pre Virtualization World
- Virtualization
- Hypervisors Vs Containerization
- Docker

Configuration Management Tools

Configuration Management Tool Provides

What they Offer in common

- Quick Provisioning of New Servers
- Quick Recovery from Critical Events
- No More Snowflake Servers [Complex or Unique Servers]
- Version Control for the Server Environment
- Easy Replication of Environments

Offer in common for Servers

- Automation Framework
- Idempotent Behavior
- Templating System
- Extensibility

Configuration Management Tool

Chef

Why

- Automate the infrastructure provisioning
- Infrastructure as Code
- Configuration as Code
- Ruby DSL language
- Solution is compatible with Physical, Virtual, and Cloud Machines
- Capability to get integrated with any of the cloud technology
- Open Source

Who

- Facebook
- Etsy
- Cheezburger
- Indiegogo

Chef

Chef Components

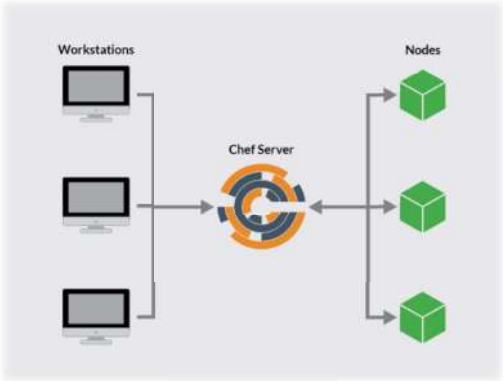
Chef Server
A hub for configuration data
Chef server stores cookbooks, the policies that are applied to nodes
And metadata that describes each registered node that is managed by Chef

Actual Server (Node)
These are the machines that are managed by Chef
The Chef client is installed on each node
It is used to configure the node to its desired state

Chef Workstation
It is the location where users interact with Chef
At Chef Workstation, Users can author and test cookbooks

Chef

Chef Components the Workflow



Chef Terms

Cookbooks

Fundamental unit of configuration and policy distribution

Defines a scenario and contains everything that is required to support that scenario

The chef-client uses Ruby as its reference language for creating cookbooks and defining recipes, with an extended DSL for specific resources

```
~/chef-repo/cookbooks/lamp_stack/apache.rb
1  package "apache2" do
2    action :install
3  end
```

```
~/chef-repo/cookbooks/lamp_stack/apache.rb
1  service "apache2" do
2    action [:enable, :start]
3  end
```

Chef Terms

Chef Supermarket

It is the location in which community cookbooks are shared and managed

Cookbooks that are part of the Chef Supermarket may be used by any Chef user

How community cookbooks are used varies from organization to organization

The chef-repo

It is the repository structure in which cookbooks are authored, tested, and maintained and from which policy is uploaded to the Chef server

The chef-repo should be synchronized with a version control system such as Git and then managed

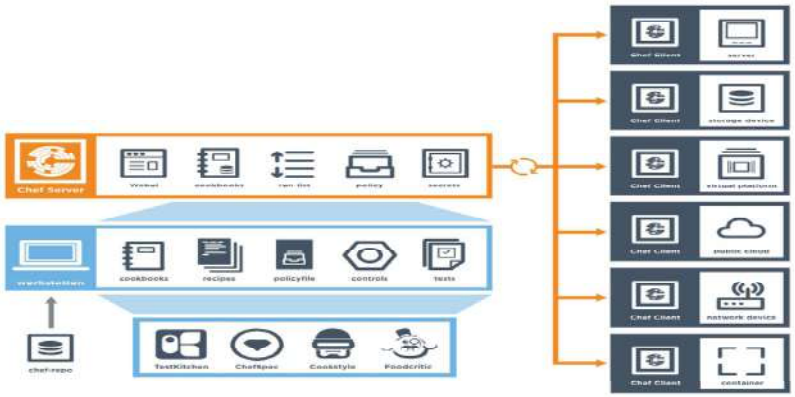
Chef

Workstation Components and Tools

- **The Chef Development Kit**
  - It is a package that contains everything that is needed to start using Chef
    Chef-client, chef and knife command line tools
- **Chef**
  - Chef is the command-line tool
  - Chef is used to work with items in a chef-repo
- **Knife**
  - knife is also the command-line tool
  - It interact with nodes or work with objects on the Chef server
- **Test Kitchen**
  - It is a testing harness for rapid validation of Chef code
- **InSpec**
  - It is a Chef's open source security & compliance automation framework
- **chef-run**
  - It is a tool for running ad-hoc tasks

Chef

Lets Summarize



Configuration Management Tool

Puppet

Why

- Automate the infrastructure provisioning
- Infrastructure as Code
- Configuration as Code
- Puppet gives you an automatic way to inspect, deliver, operate and future-proof all of your infrastructure and deliver all of your applications faster
- Open Source

Puppet

Puppet Components

Puppet Master

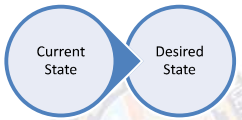
- Puppet master is a Ruby application
- It compiles configurations for any number of Puppet agent nodes
- Puppet Server is an application that runs on the Java Virtual Machine (JVM)
- Supported platforms:
  - Red Hat Enterprise Linux
  - Fedora
  - Debian
  - and Ubuntu

Puppet Agent

- Managed nodes run the Puppet agent application, as a background service
- Periodically, the agent sends facts to a master and requests a catalog
- The master compiles the catalog using several sources of information, and returns the catalog to the agent

Puppet Terms

Catalog



- The catalog describes the desired state for each resource that should be managed
- It also specify dependency information for resources that should be managed in a certain order
- The agent uses a document called a catalog to configure; which it downloads from master
- For each resource under management, the catalog describes its desired state
- The ”puppet apply command” compiles its own catalog

Puppet Terms

Facter

- Facter is the cross-platform system profiling library in Puppet
- It discovers and reports per-node facts, which are available in your Puppet manifests as variables
- Before requesting a catalog, the agent uses Facter to collect system information

```
$ facter -p os
{
  architecture => "x86_64",
  family => "RedHat",
  hardware => "x86_64",
  name => "CentOS",
  release => {
    full => "6.8",
    major => "6",
    minor => "8"
  },
  selinux => {
    enabled => false
  }
}
```

Puppet Terms

Resources

- Puppet code is composed primarily of resource declarations
- A resource describes something about the state of the system
- Such as a certain user or file should exist
- Here is an example of a user resource declaration

Resource Example:

```
user { sonika':
 ensure    => present,
 uid       => '1000',
 gid       => '1000',
 shell     => '/bin/bash',
 home      => '/home/sonika'
}
```

Puppet Terms

Manifests

- Manifests are Puppet programs
- Manifests are composed of puppet code
- And their filenames use the .pp extension
- The default main manifest in Puppet installed via apt is /etc/puppet/manifests/site.pp

Manifest: Example

```
file { "/var/bits/devops":
      ensure => "present",
      owner => "sonika",
      group => "bits",
      mode => "664",
      content => "This is a test file created using puppet.
                  Puppet is really cool",
}
```

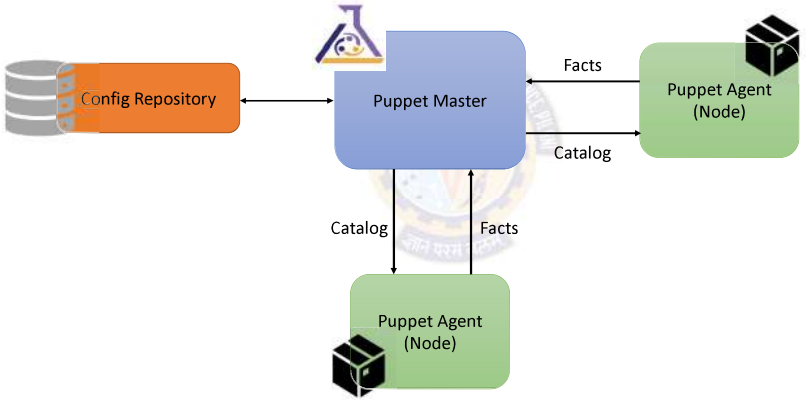
Puppet Terms

The Puppet Forge

- Puppet Forge was launched in 2012
- The Puppet Forge is one of the most utilized resources in the Puppet world
- It is a repository of modules written both by Puppet and by the Puppet user community
- These modules solve a wide variety of problems, and using them can save you time and effort
- Puppet Forge has over 5,500 modules published
- The puppet module tool provides a command line interface for managing modules from the Forge

Puppet Architecture

Client-Server Architecture & Working



Configuration Management Tool

Ansible

Why

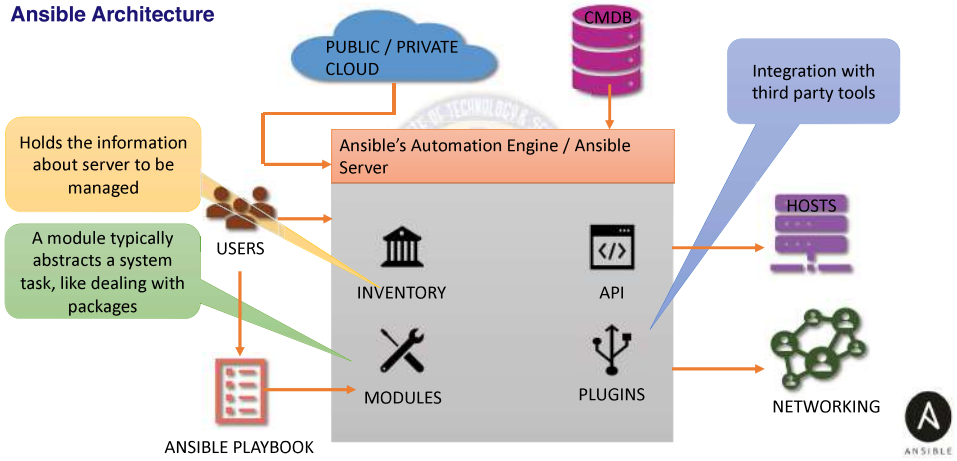
Agentless
- It uses no agents and no additional custom security infrastructure, so it's easy to deploy

High level interaction
- It uses a very simple language (YAML, in the form of Ansible Playbooks)

Multi-tier deployment
- Ansible models your IT infrastructure by describing how all of your systems inter-relate, rather than just managing one system at a time

Ansible

Ansible Architecture



Ansible

Playbook, Facts, Handlers

- The entry point for Ansible provisioning, where the automation is defined through tasks using YAML format
  - Play: A provisioning executed from start to finish is called a play. In simple words, execution of a playbook is called a play
  - Task: A block that defines a single procedure to be executed, e.g. Install a package
- Facts: Global variables containing information about the system, like network interfaces or operating system
- Handlers: Used to trigger service status changes, like restarting or stopping a service

Ansible

Examples

```
---
[webservers]
www1.example.com
www2.example.com

[dbservers]
db0.example.com
db1.example.com
```

Example of Inventory

```
---
- hosts: webservers
serial: 5 # update 5 machines at a time
roles:
- common
- webapp

- hosts: content_servers
roles:
- common
- content
```

Example of Playbook

```
---
- hosts: webservers
  vars:
    http_port: 80
    max_clients: 200
  remote_user: root
  tasks:
  - name: ensure apache is at the latest version
    yum:
      name: httpd
      state: latest
  - name: write the apache config file
    template:
      src: /srv/httpd.j2
      dest: /etc/httpd.conf
    notify:
    - restart apache
  - name: ensure apache is running
    service:
      name: httpd
      state: started
  handlers:
    - name: restart apache
      service:
        name: httpd
        state: restarted
```

Example: Playbook of webapp

Puppet Vs Ansible

Lets Compare

Puppet

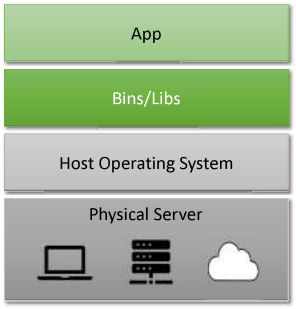
- Puppet is introduced in 2005
- Agent based Solution
- Puppet is model-driven and was built with systems administrators in mind; Moderate complex to setup and use
- Pull Base Methodology; end nodes contact back to Master
- Matured knowledge base
- Puppet Forge: Almost 6000 Modules available

Ansible

- Ansible is introduced in 2012
- Agent less Solution
- Ansible is easy to setup and understand than Puppet; More end user friendly
- Push Base Methodology; Master push tasks to end nodes
- Growing knowledge base
- Ansible Galaxy is still growing

Pre virtualization World

How it was



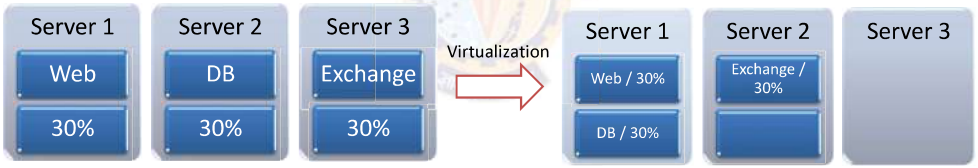
Problem

- Huge cost
- Slow Deployment
- Hard to migrate

Virtualization!!!

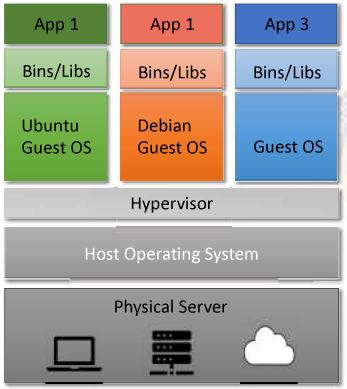
How it is

- Virtualization is technology that lets you create useful IT services using resources that are traditionally bound to hardware
- It allows you to use a physical machine's full capacity by distributing its capabilities among many users or environments



Virtualization!!!

H/w level virtualization



Benefits:

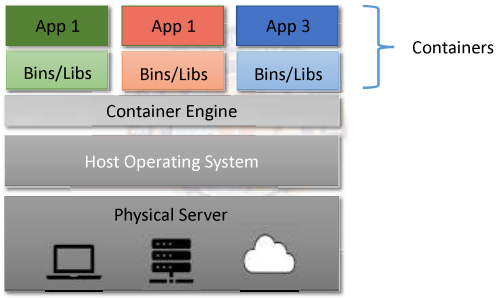
- More cost effective
- Easy to scale

Limitations:

- Kernel Resource Duplication
- Application portability issue

Virtualization!!!

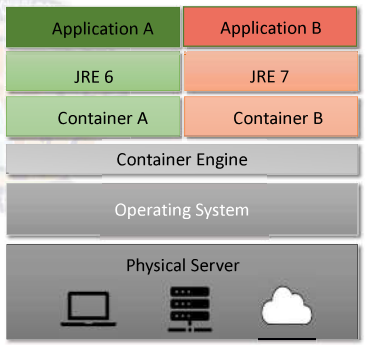
OS level virtualization



Container based Virtualization

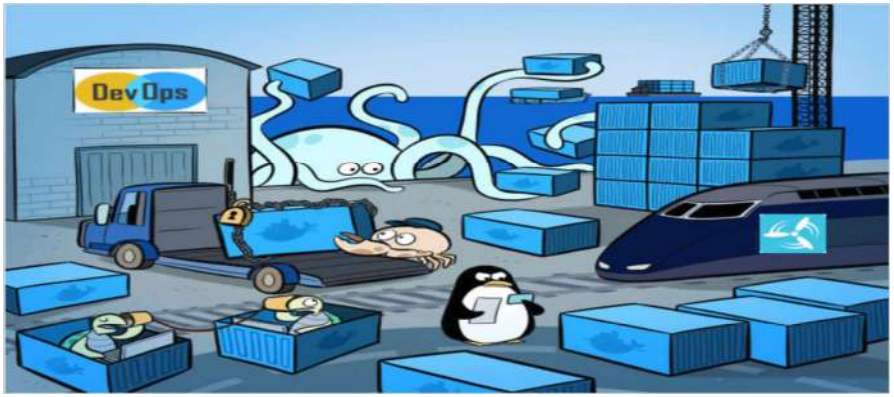
Benefits

- More cost effective
- Faster deployment speed
- Great portability



Container based Virtualization

Docker



Docker

Why

Open platform for developing, shipping, and running applications

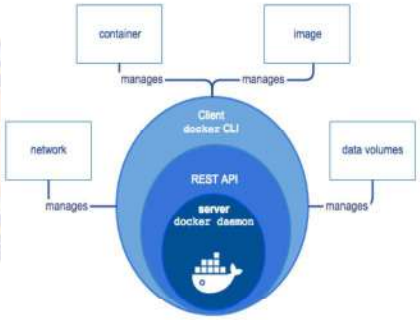
Enables you to separate your applications from your infrastructure so you can deliver software quickly

By taking advantage of Docker's methodologies for shipping, testing, and deploying code quickly, you can significantly reduce the delay between writing code and running it in production

Docker

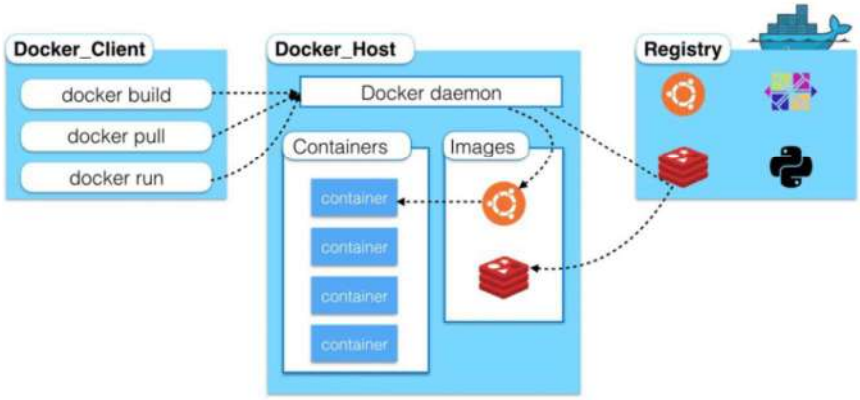
Docker Engine

- Client-server application
- A server which is a type of long-running program called a daemon process (the dockerd command)
- A REST API which specifies interfaces that programs can use to talk to the daemon and instruct it what to do
- A command line interface (CLI) client (the docker command)



Docker architecture

How it Works!!!



Docker Concepts

Images and Containers

Image

- An image is an executable package
- An image is a read-only template with instructions
- To build your own image, you create a Dockerfile

Containers

- A container is launched by running an image
- A container is a runtime instance of an image
- One can create, start, stop, move, or delete a container using the Docker API or CLI

Docker Concepts

Service

- Services are really just containers in production
- A service only runs one image, but it codifies
  - Way the Image Runs
  - What Ports it should use
  - How many replicas and etc.
- Scaling a service
  - No of container instances
  - Assign more compute resources

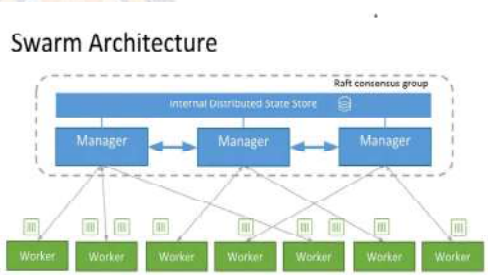
```yaml
version: "3"
services:
  web:
    # replace username/repo:tag with your name and image details
    image: username/repo:tag
    deploy:
      replicas: 5
      resources:
        limits:
          cpus: "0.1"
          memory: 50M
      restart_policy:
        condition: on-failure
    ports:
      - "4000:80"
    networks:
      - webnet
networks:
  webnet:
```

Docker-compose.yml

Docker Concepts

Swarms

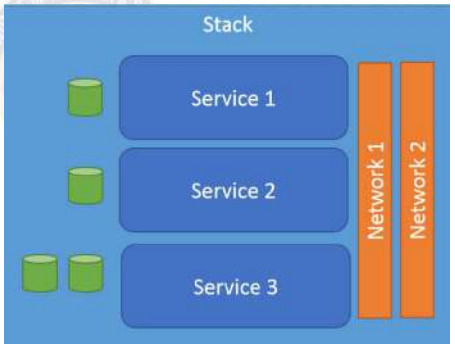
- A swarm is a group of machines that are running Docker and joined into a cluster
- Docker Command gets executed on a cluster by a swarm manager
- The machines in a swarm can be physical or virtual
- After joining a swarm, machines are referred to as nodes
- Swarm Strategies:
  - emptiest node
  - global



Docker Concepts

Stacks

- A stack is a group of interrelated services that share dependencies, and can be orchestrated and scaled together
- A single stack is capable of defining and coordinating the functionality of an entire application



Docker Concepts

Docker file

- Dockerfile defines what goes on in the environment inside a container
- This file has information about all resources, that is network interface and disk drives used for the container

```
# Use an official Python runtime as a parent image
FROM python:2.7-slim

# Set the working directory to /app
WORKDIR /app

# Copy the current directory contents into the container at /app
COPY . /app

# Install any needed packages specified in requirements.txt
RUN pip install --trusted-host pypi.python.org -r requirements.txt

# Make port 80 available to the world outside this container
EXPOSE 80

# Define environment variable
ENV NAME World

# Run app.py when the container launches
CMD ["python", "app.py"]
```

Docker Concepts

Docker Cloud

- Docker Cloud provides a hosted registry service with build and testing facilities for Dockerized application images
- Access to Docker Cloud is managed by Docker ID
- Manage Builds and Images
- Manage Swarms
- Manage Infrastructure
- Manage Nodes and Apps
- Integration with AWS and Microsoft Azure Services

Docker Concepts

Docker Store

- For developers and operators, Docker Store is the best way to discover high-quality Docker content
- Independent Software Vendors (ISVs) can utilize Docker Store to distribute and sell their Dockerized content
- Store Experience:
  - Access to Docker's large and growing customer-base
  - Customers can try or buy your software
  - Use of Docker licensing support
  - Docker handle checkout
  - Seamless updates and upgrades for your customers
  - Become Docker Certified

Docker Concepts

Docker Hub

- Docker Hub is a cloud-based registry service
- Allows link to code repositories
- Build images and test them
- Stores Images
- Links to Docker Cloud to deploy images to hosts
- It is a Centralize Solution for:
  - container image discovery
  - distribution and change management
  - user and team collaboration
  - workflow automation throughout the development pipeline

Docker Concepts

How is Docker Store different from Docker Hub

Docker Hub	Docker Store
Contents by Docker community	Contents submitted for approved by qualified Store Vendor Partners
Anyone can push new images to the community	Contents are published and maintained by Entity
No guarantees around the quality or compatibility	Docker Certified quality assurance
Common Thing: The Docker official Images are Available in both	

References

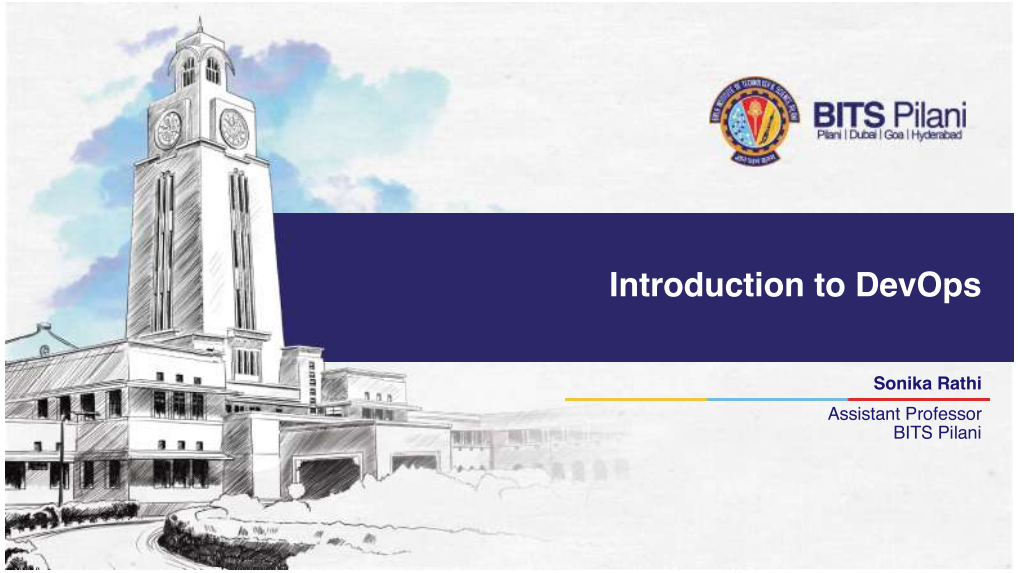
External

- https://docs.chef.io/
- https://docs.puppet.com/
- https://forge.puppet.com/
- https://docs.ansible.com/
- https://www.redhat.com/en/topics/virtualization/what-is-virtualization
- https://docs.docker.com/engine/docker-overview/#docker-engine
- https://docs.docker.com/

Q&A

Thank You!

In our next session:



BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

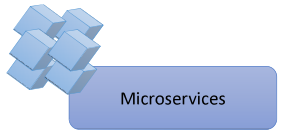
Agenda

Microservices and Current Trends

- Introduction to Microservices
  - Need of Microservices for DevOps
  - Benefits of Microservice and DevOps
- Introduction to Kubernetes
  - Kubernetes Architecture
  - Kubernetes Benefits
- AWS Lambda
  - Function as a Service [FaaS]
  - Serverless Computing
  - AWS Lambda - Success Story
  - AWS Lambda Benefits

Microservices

Introduction



Software development technique

A type of the service-oriented architecture (SOA); that structures an application as a collection of loosely coupled services

It improves modularity

Enables small autonomous teams to develop, deploy and scale their respective services independently

Allows the architecture of an individual service to emerge through continuous refactoring

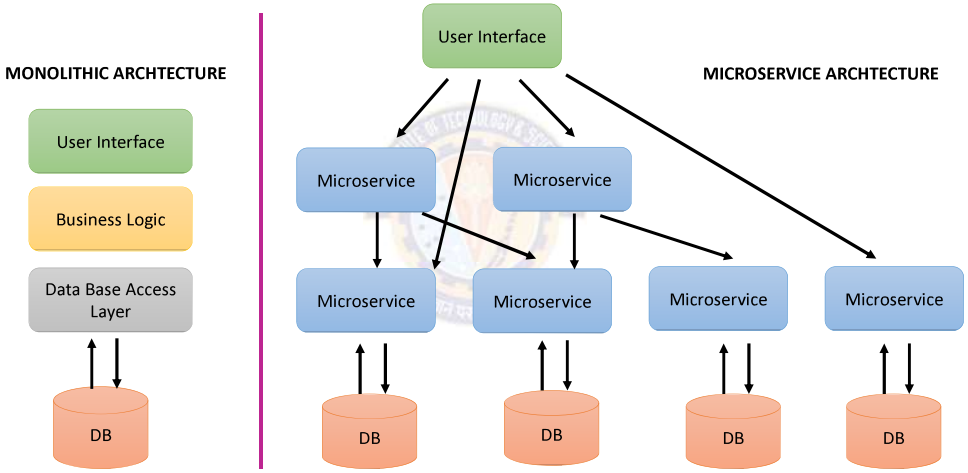
Microservices

Introduction

Who

- Uber
- Netflix
- Amazon
- Ebay
- Gilt
- Tesla

Microservice Architecture



Microservices

Lets compare

Monolithic – Software Development	Microservices – Software Development
Traditional Software Development [Waterfall]	New Approach to Software Development [Agility]
Large Team Working on single complex Application	Services are encouraged to be small by handful Developers
No Single Developer understand entire Application	Developers understand the Services
Limited Reuse is realized	Use of REST API – reused by other services
Scaling is Challenge	Services can be scaled as they exists Independent
Challenge for Operational Agility	Services and Teams become Agile
Single Development Stack	Autonomous Service Development Stacks

Microservices

How does it works

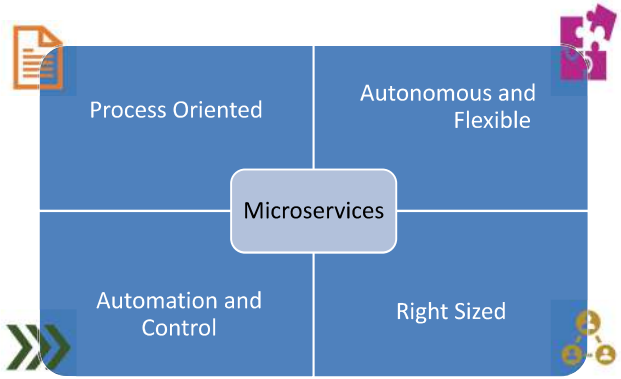
The Idea is to break down applications into smaller, independent services

That will not dependent upon a specific coding language

Using Microservices Ideology divide large & complex applications in to smaller building blocks

Microservices

Characteristics of Microservices



Microservices and DevOps

Need of Microservices for DevOps

- DevOps promotes small, more empowered and autonomous teams, along with automation and measurements
- It has great potential to be a fantastic improvement in the way IT and business work together
- Challenging Area:
  - Setup Pipeline for new automation tooling
  - The mindset of Architects

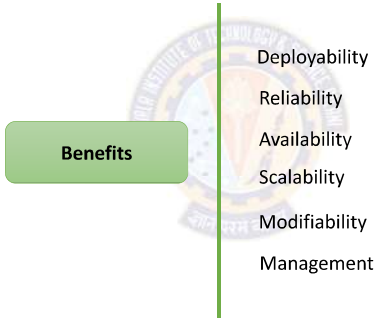
Microservices and DevOps

Microservices enabling DevOps

- With small autonomous DevOps teams, the world will start producing small autonomous components, called microservices
- It makes sense to produce deployable components for a business function
- This will help in speed improve five to ten times by moving to the cloud and using a high productivity platform
- DevOps and microservices are more or less inseparable, they can hardly exist in separation

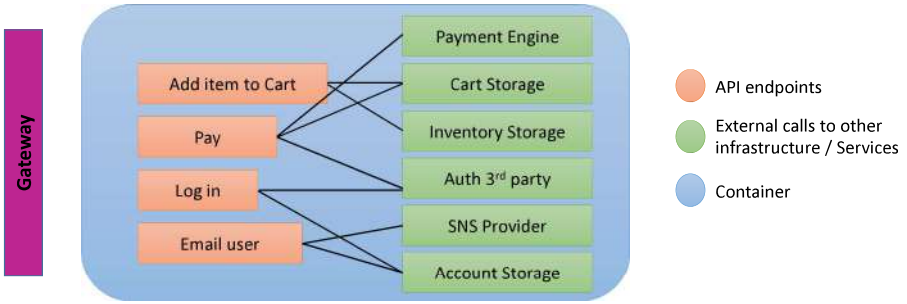
Microservices and DevOps

Benefits



Microservices Example

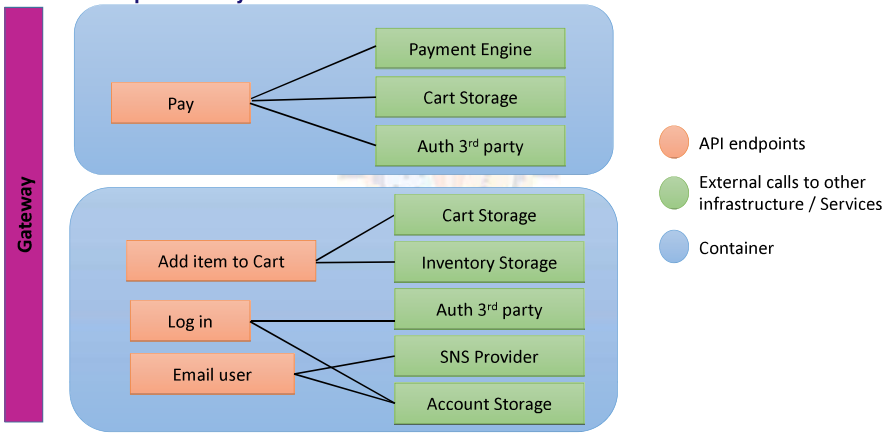
Lets understand with example



Monolith application example

Microservices Example

Our Goal is to split out Payments service from the monolith



Kubernetes

Introduction

Kubernetes is an open source system for managing containerized applications across multiple hosts, providing basic mechanisms for deployment, maintenance, and scaling of applications

Hosted by the Cloud Native Computing Foundation (CNCF)

Symbol K8 - is an abbreviation derived by replacing the 8 letters “ubernete” with “8”

Kubernetes

What?

A system for running and coordinating containerized applications across a cluster of machines

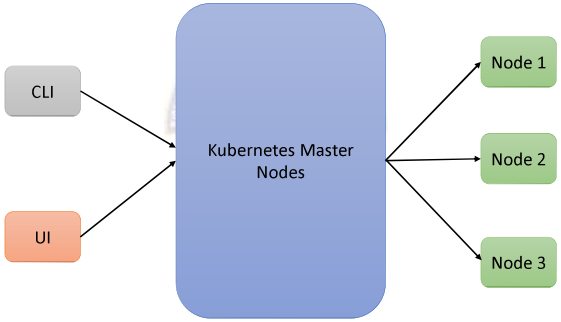
Platform designed to completely manage the life cycle of containerized applications and services

Kubernetes helps with methods that provide

- Predictability
- Scalability
- High availability

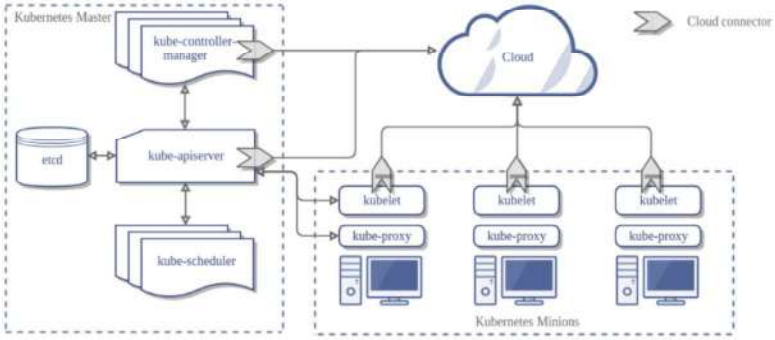
Kubernetes

Components



Kubernetes

Architecture



Kubernetes Components

Kubernetes Master Server Components

- Kubernetes master server acts as the primary control plane for Kubernetes clusters
- Overall the components on the master server work together to accept user requests, determine the best ways to schedule workload containers, authenticate clients and nodes, adjust cluster-wide networking, and manage scaling and health checking responsibilities
- These components can be installed on a single machine or distributed across multiple servers

Globally available configuration store

Distributed key value store

Configured to span across multiple nodes

etcd can be configured on a single master server or, in production scenarios, distributed among a number of machines

Kubernetes Components

Kubernetes Master Server Components

kube-apiserver

Main Management Point

It allows a user to configure Kubernetes' workloads and organizational units

It is also responsible for making sure that the etcd store and the service details of deployed containers are in agreement

The API server implements a RESTful interface

kube-controller-manager

It manages different controllers that regulate the state of the cluster, manage workload life cycles, and perform routine tasks

A replication controller ensures that the number of replicas defines for a pod machine

When a change is seen, the controller reads the new information and implements the procedure that fulfills the desired state

Kubernetes Components

Kubernetes Master Server Components

kube-scheduler

The process that actually assigns workloads to specific nodes in the cluster is the scheduler

The scheduler is responsible for tracking available capacity on each host to make sure that workloads are not scheduled in excess of the available resources

Kubernetes Components

Kubernetes Node Server Components

- In Kubernetes, servers that perform work by running containers are known as nodes
- Node servers have a few requirements that are necessary for :
  - Communicating with master components
  - Configuring the container networking
  - Running the actual workloads assigned

A Container Runtime

The first component that each node must have

This requirement is satisfied by installing and running Docker

Responsible for starting and managing containers

Runs the containers defined in the workloads submitted to the cluster

Kubernetes Components

Kubernetes Node Server Components

kubelet

The main contact point for each node with the cluster group

Responsible for relaying information to and from the control plane services

Interact with the etcd store to read configuration details or write new values

The kubelet service communicates with the master components to authenticate to the cluster and receive commands and work

kube-proxy

To manage individual host subnetting and make services available to other components

This process forwards requests to the correct containers

It can do primitive load balancing

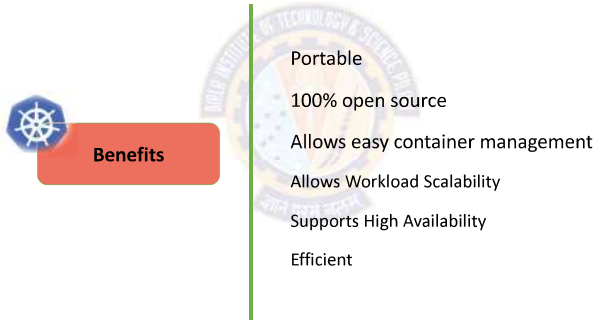
Kubernetes Objects

Kubernetes Pods

- One or more tightly coupled containers are encapsulated in an object called a pod
- Generally represents one or more containers that should be controlled as a single application
- Consist of containers that operate closely together, share a life cycle, and should always be scheduled on the same node
- Share their environment, volumes, and IP space
- Consist of a main container that satisfies the general purpose of the workload and optionally some helper containers that facilitate closely related tasks

Kubernetes

Benefits



Kubernetes II Docker Swarm

Lets compare

Features	Kubernetes	Docker Swarm
Installation	Complex installation but a strong resultant cluster once set up	Simple installation but the resultant cluster is not comparatively strong
GUI	Comes with an inbuilt Dashboard	There is no Dashboard which makes management complex
Scalability	Highly scalable service that can scale with the requirements. 5000 node clusters with 150,000 pods	Very high scalability. Up to 5 times more scalable than Kubernetes. 1000 node clusters with 30,000 containers
Load Balancing	Manual load balancing is often needed to balance traffic between different containers in different pods	Capability to execute auto load balancing of traffic between containers in the same cluster
Rollbacks	Automatic rollbacks with the ability to deploy rolling updates	Automatic rollback facility available only in Docker 17.04 and higher if a service update fails to deploy
Logging and Monitoring	Inbuilt tools available for logging and monitoring	Lack of inbuilt tools. Needs 3rd party tools for the purpose
Node Support	Supports up to 5000 nodes	Supports 2000+ nodes
Optimization Target	Optimized for one single large cluster	Optimized for multiple smaller clusters
Updates	The in-place cluster updates have been constantly maturing	Cluster can be upgraded in place
Networking	An overlay network is used which lets pods communicate across multiple nodes	The Docker Daemons is connected by overlay networks and the overlay network driver is used
Availability	High availability. Health checks are performed directly on the pods	High availability. Containers are restarted on a new host if a host failure is encountered

AWS Lambda

Function as a Service [FaaS]

- AWS Lambda is a compute service that lets you run code without provisioning or managing servers
- “serverless” computing
- You pay only for the compute time you consume - there is no charge when your code is not running
- Lambda functions can write state to external data stores via web requests
- External Data store can be of AWS or Any
  - AWS Solutions: S3, Dynamo, and Redshift
  - Other Solutions: PostgreSQL, Cassandra and Kafka

AWS Lambda : Success Story The Seattle Times

Challenges

After maintaining on-premises hardware and custom publishing software for nearly two decades, The Seattle Times sought to migrate its website publishing to a contemporary content management platform

To avoid the costs of acquiring and configuring new hardware infrastructure and the required staff to maintain it, the company initially chose a fully managed hosting vendor

But after several months, The Times' software engineering team found it had sacrificed flexibility and agility in exchange for less maintenance responsibility

As the hosted platform struggled with managing traffic under a vastly fluctuating load, The Seattle Times team was constrained in its ability to scale up to meet customer demand

AWS Lambda : Success Story The Seattle Times

Why Amazon Web Services?

To address these core scalability concerns, The Seattle Times engineering team considered several alternative hosting options, including self-hosting on premises, more flexible managed hosting options, and various cloud providers

The team concluded that the available cloud options provided the needed flexibility, appropriate architecture, and desired cost savings. The company ultimately chose Amazon Web Services (AWS), in part because of the maturity of the product offering and, most significantly, the auto-scaling capabilities built into the service

The Seattle Times deployed its new system in just six hours. The website moved to the AWS platform between 11 p.m. and 3 a.m. and final testing was completed by 5 a.m. — in time for the next news day

AWS Lambda : Success Story The Seattle Times

End Result

With AWS, The Seattle Times can now automatically scale up very rapidly to accommodate spikes in website traffic when big stories break, and scale down during slower traffic periods to reduce costs

“Auto-scaling is really the clincher to this,” Seattle Times says. “With AWS, we can now serve our online readers with speed and efficiency, scaling to meet demand and delivering a better reader experience.”

"AWS Lambda provides us with extremely fast image resizing,” Seattle times says.

“Before, if we needed an image resized in 10 different sizes, it would happen serially. With AWS Lambda, all 10 images get created at the same time, so it’s quite a bit faster and it involves no server maintenance.”

AWS Lambda : Success Story The Seattle Times

How it worked

References

External

- **Docker :** https://docs.docker.com/
- **Microservices :**
- https://www.mendix.com/blog/the-microservices-you-need-for-devops/
- https://www.mulesoft.com/resources/api/what-are-microservices
- **Kubernetes :** https://kubernetes.io/docs/concepts/
- **Kubernetes in 5 mins by VMware:** https://www.youtube.com/watch?v=PH-2FfFD2PU
- **AWS Lambda:** https://www.youtube.com/watch?time_continue=1&v=eOBq__h4OJ4

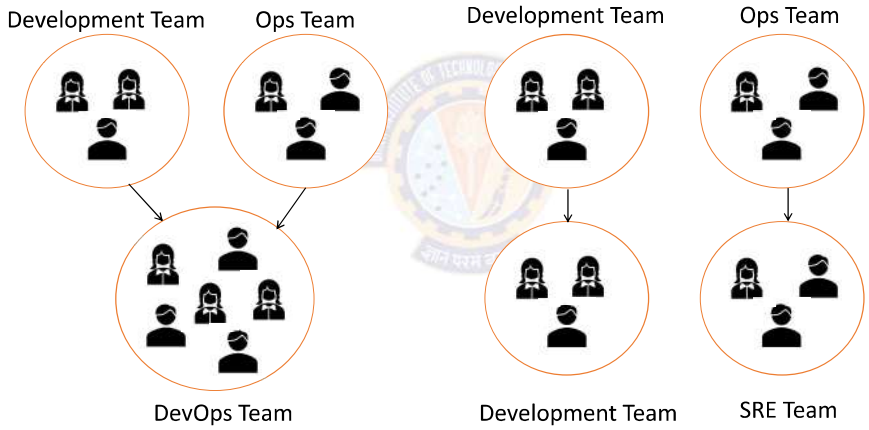
SRE & DevOps

Two sides of same coins

	SRE	DevOps
Essence	Set of practices & metrics	Mindset and culture of collaboration
Coined	2003, by Ben Treynor, @ Google	2009, by Patrick Debois
Goal	Bridge the gap between Dev & Operation	Bridge the gap between Dev & Operation
Focus	Site availability & Reliability	Continuity & Speed, Early time to market, stability
Team Structure	Site reliability engineers with ops and development skills	Wide range of role Product owners, developers, QA engineers, SREs etc.,

DevOps & SRE

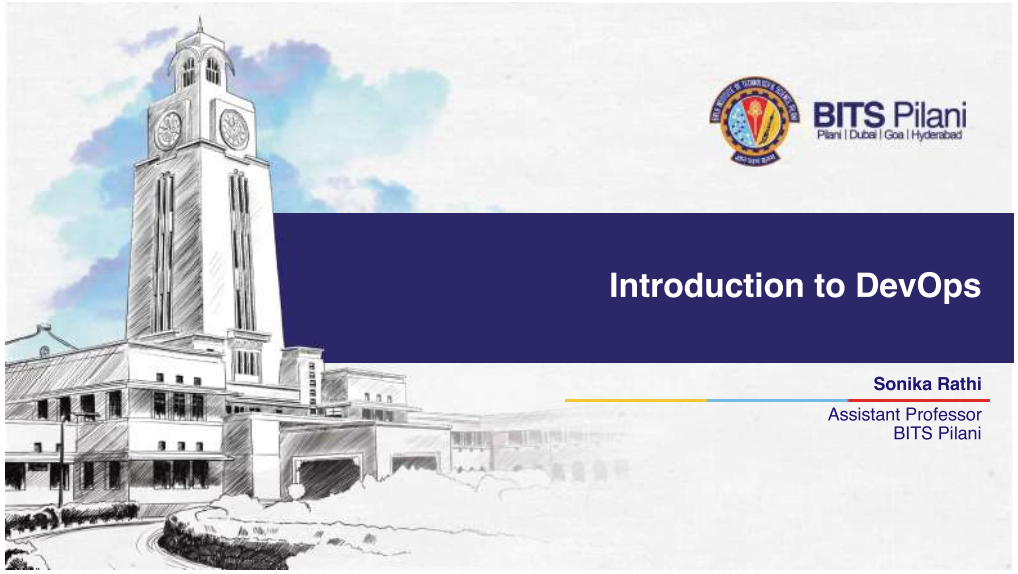
Big Picture



Q&A

Thank You!

In our next session:



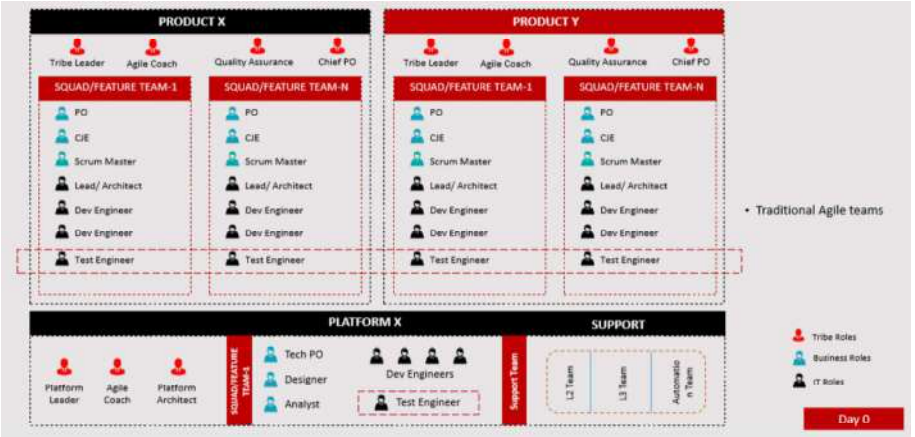
BITS Pilani
Pilani | Dubai | Goa | Hyderabad

Introduction to DevOps

Sonika Rathi
Assistant Professor
BITS Pilani

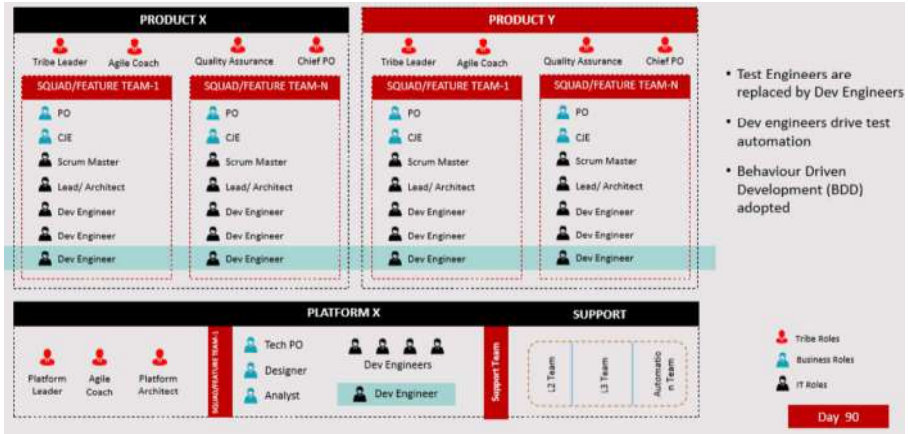
Transition in IT:

State 1 Traditional Agile teams



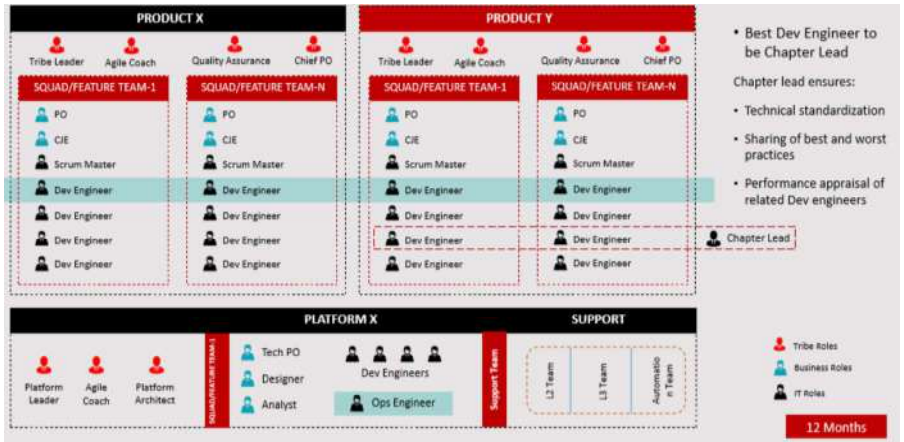
Transition in IT:

State 2 Embedding full-stack engineers and driving Test automation



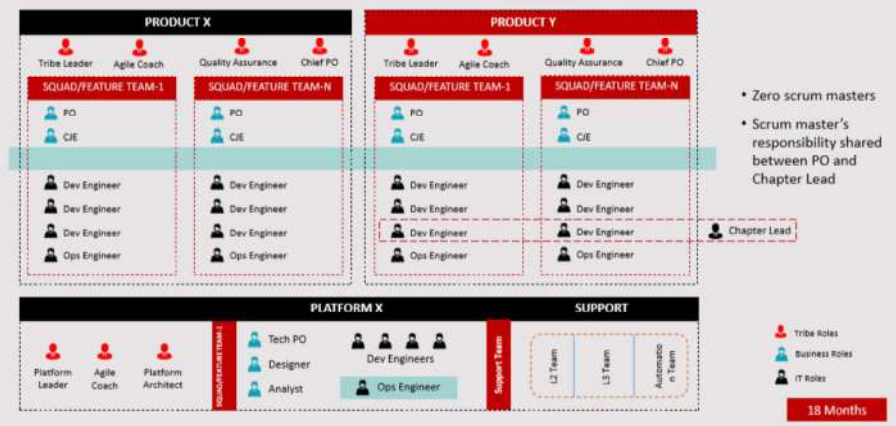
Transition in IT:

State 3 Introduce Chapter Leads



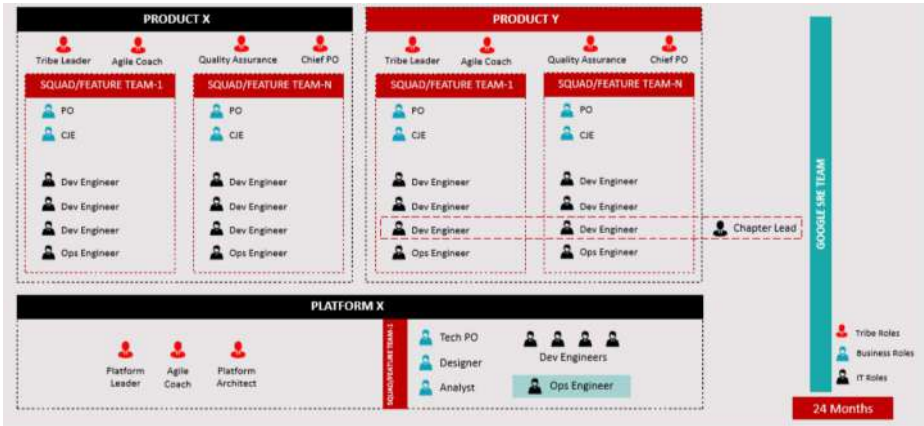
Transition in IT:

State 4 Zero scrum master



Transition in IT:

ITIL to Google SRE based support



Q&A

Thank You!

In our next session:

Module 0

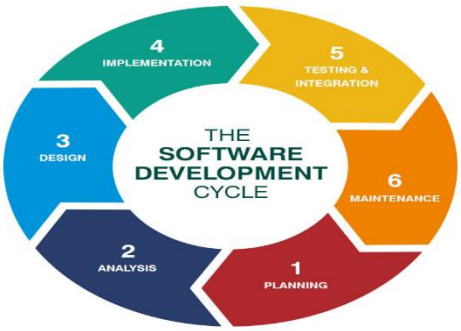
Foundational Terminology and Concepts

Software development lifecycle

SDLC stands for **Software Development Lifecycle**.

Definition: The process of planning, creating, testing, deploying, and maintaining software applications.

(Or)



It is defined as a sequence of steps followed for developing a software system.

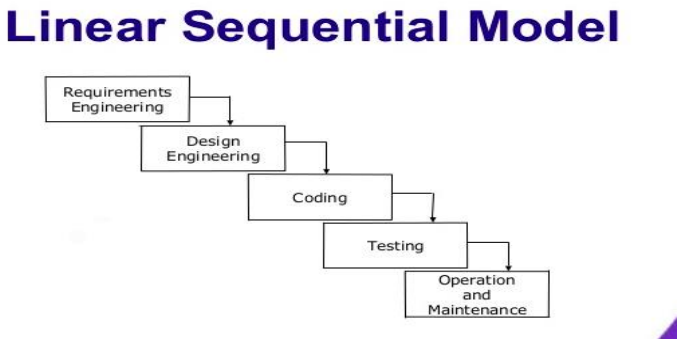
- The main steps include –
    a. planning,
    b. analysing,
    c. designing,
    d. implementation, and
    e. maintenance.
- Testing is also performed on the software product generated like alpha, beta testing. There are various SDLC models the more common being the Waterfall Model. The main benefit of following the SDLC Lifecycle is the good quality end product.

The Waterfall approach

- The Waterfall model is a **linear** and **sequential** approach to software development.
- It progresses through stages such as requirements, design, implementation, testing, deployment, and maintenance, with each stage building upon the previous one.

Pros: Simple, easy to understand and use for small projects with well-defined requirements.

Cons: Less flexibility, potential for project delays due to the rigid structure.



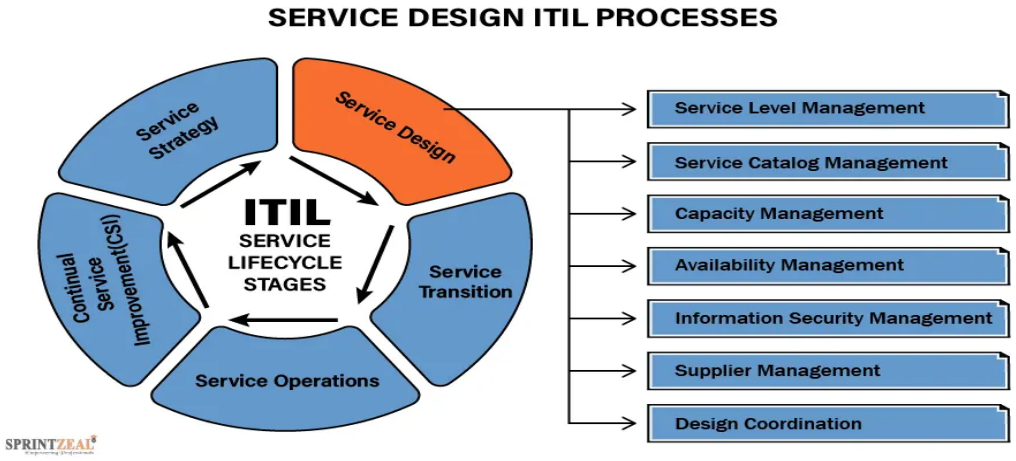
Agile Methodology

- Agile is an iterative and incremental approach to software development.
- It emphasizes collaboration, flexibility, and customer feedback throughout the development process.
- Agile methodologies include Scrum, Kanban, and Extreme Programming (XP), among others

The Agile methodology is a project management approach that involves breaking the project into phases and emphasizes continuous collaboration and improvement. Teams follow a cycle of planning, executing, and evaluating.

Operational Methodologies: ITIL

- ITIL (Information Technology Infrastructure Library):
- ITIL is a framework for effectively managing IT services throughout the entire service lifecycle.
- ITIL is a set of practices for IT service management (ITSM) that focuses on aligning IT services with the needs of the business.
- It provides a framework for organizations to plan, deliver, and support IT services.



Development, Testing, Release, and Deployment Concepts

- Development: Writing code and building software.
- Testing: Ensuring the software meets specified requirements.
- Release: Making the software available to users.
- Deployment: Installing and configuring the software for use.

Provisioning, Version Control

- Provisioning: The process of preparing and equipping a network to allow it to provide (new) services to its users.
- Provisioning involves setting up and managing infrastructure and resources needed for software deployment.

(Or)

- provisioning simply means providing or making something available to something or someone. In enterprise IT settings, the someone represents authorized users who need to access one or more hardware or software resources, such as servers, applications, storage devices, edge devices and so forth.

- Version Control: The version control workflow reduces the risk of multiple versions of an application spreading across multiple development machines or servers. Bugs and updates that break are reverted until the code works as expected.

- Version control (or source control) is the practice of tracking and managing changes to source code over time. It helps in collaboration and managing different versions of the code.

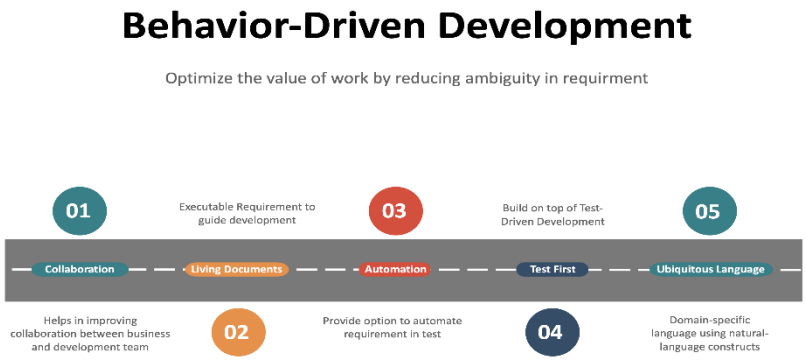
Test Driven Development, Feature Driven Development

- TDD is a development approach where tests are written before the actual code. Developers iteratively write code to pass tests.
  Tdd aims to minimize bugs and maintain code quality through comprehensive unit testing
  TDD's emphasis on unit testing helps identify and address bugs early in the development process, ensuring a smoother user experience

- FDD is an iterative and incremental software development methodology that is model-driven and feature-centric.
- FDD, which stands for Feature-Driven Development, is a framework in the Agile methodology. As the name suggests, it focuses on developing working software with features that satisfy client needs. FDD aims to ensure regular and on-time delivery to customers, in line with the values and principles of the Agile Manifesto.

Behavior-driven development

- BDD is an extension of TDD that involves collaboration between developers, testers, and non-technical stakeholders.
- It focuses on defining the behaviour of a system using natural language specifications that can be understood by all involved parties.



Module 1: Why and What is DevOps?

Why DevOps?

1. Collaboration and Communication:

- Challenge: Traditional silos between development and operations can lead to miscommunication and delays.
- DevOps Solution: Promotes collaboration and communication between development and operations teams, breaking down silos.

2. Continuous Integration and Deployment:

- Challenge: Manual integration and deployment processes can be time-consuming and error-prone.
- DevOps Solution: Implements continuous integration and continuous deployment (CI/CD) pipelines for automated and frequent releases.

3. Faster Time to Market:

- Challenge: Lengthy development and deployment cycles can hinder a company's ability to respond quickly to market demands.
- DevOps Solution: Shortens development cycles, enabling faster and more frequent releases, ensuring quicker response to market changes.

4. Improved Efficiency:

- Challenge: Inefficient processes can lead to wasted time and resources.
- DevOps Solution: Streamlines workflows, reduces manual interventions, and automates repetitive tasks, resulting in increased efficiency.

5. Enhanced Reliability and Stability:

- Challenge: Traditional approaches might result in instability during deployment.
- DevOps Solution: Focuses on automated testing, infrastructure as code (IaC), and monitoring to ensure reliability and stability throughout the software lifecycle.

What is DevOps?

1. Team Culture:

Definition: DevOps is a way of working that brings together development and operations teams.

(or)

DevOps is a cultural and collaborative approach that bridges the gap between development (Dev) and operations (Ops) teams.

2. Key Principles:

- Automation: Automate routine tasks to make work easier.
- Collaboration: Work closely and share responsibilities across teams.
- Continuous Integration (CI): Regularly merge code changes into a shared repository.
- Continuous Deployment (CD): Automate the process of moving code changes into production.

3. Core Practices:

- Infrastructure as Code (IaC): Manage infrastructure using code for consistency.
- Continuous Testing: Automate testing to catch issues early.
- Monitoring and Logging: Keep an eye on performance and catch problems with monitoring tools.
- Microservices and Containers: Break down big applications into smaller parts for flexibility.

4. Benefits:

- Speedy Delivery: Get software out faster.
- Better Teamwork: Improve collaboration and understanding between teams.
- High Quality: Catch and fix issues early for top-notch software.
- Efficiency Boost: Save time and effort through automation.

5. DevOps Tools:

- Examples: Jenkins, Docker, Kubernetes, Ansible - tools that help with automation and collaboration.
- In a nutshell, DevOps is about teams working together, using automation to make things faster and more reliable. It's a friendly alliance between development and operations for creating and delivering great software.

Problems of Delivering Software

- Communication Gaps
  - Issue: Lack of effective communication between development and operations teams.
  - Impact: Delays, misunderstandings, and increased chances of errors during deployment.

- **Slow Delivery Cycles**
  - Issue: Traditional development cycles are often slow and rigid.
  - Impact: Difficulty in adapting to market changes quickly, leading to potential loss of opportunities.

- **Manual Errors**
  - Issue: Manual processes in software development can result in errors during deployment.
  - Impact: Unstable systems, downtime, and increased maintenance efforts.

- **Inconsistent Environments**
  - Issue: Differences between development and production environments.
  - Impact: Issues arise when moving code from one environment to another**.**

Principles of Software Delivery

- **Collaboration**
  - Principle: Foster collaboration between development, operations, and other stakeholders.
  - Outcome: Improved communication, shared goals, and a smoother delivery process.

- **Automation**
  a. Principle: Automate repetitive tasks in the software development lifecycle.
  b. Outcome: Faster and more reliable software delivery with fewer manual errors**.**
- **Continuous Feedback**
  a. Principle: Collect and act on feedback throughout the development process.
  b. Outcome: Early detection of issues, leading to quicker resolution and continuous improvement.

- **Continuous Testing**
  - Principle: Integrate testing throughout the development cycle.
  - Outcome: Higher software quality, with issues identified and addressed early on.

Need for DevOps

- **Business Agility**
  - Need: Respond quickly to changing market demands.
  - DevOps Solution: Enables faster development cycles and quicker response to market changes.
- **Efficiency and Reliability**
  - Need: Improve efficiency and ensure system reliability.
  - DevOps Solution: Automation, continuous testing, and monitoring contribute to increased efficiency and stability.

Evolution of DevOps

Historical Perspective

- Phases: Traditional IT → Agile Development → DevOps.
- Transition: From siloed roles to collaborative and automated practices.

Key Influences

- Agile Manifesto: Emphasized collaboration and adaptability.
- Lean Principles: Focused on efficiency and reducing waste.

DevOps Practices

Continuous Integration (CI)

- Definition: Frequently integrating code changes into a shared repository.
- Purpose: Early detection of integration issues.

Continuous Inspection

- Definition: Regularly checking code quality and adherence to coding standards.

- Purpose: Maintain code consistency and identify potential issues.

Continuous Deployment/Delivery

- Deployment: Automated release of code to production.
- Delivery: Ensuring the code is always in a deployable state.

Continuous Monitoring

- Definition: Ongoing monitoring of applications and infrastructure in real-time.
- Purpose: Quickly identify and address performance issues and failures.

6. DevOps Culture

- Collaboration and Shared Responsibility
  - Culture Shift: Breaking down silos and fostering a collaborative mindset.
  - Shared Responsibility: Everyone involved in the delivery process takes responsibility for success.
- Innovation and Continuous Learning
  - Encouragement: Encourages innovation and a commitment to continuous improvement.
  - Learning Culture: Embraces new technologies and methodologies.

The Waterfall approach advantages and disadvantages

- Clear Project Scope:
  - Advantage: The Waterfall approach provides a clear and well-defined project scope from the outset.
  - DevOps Impact: Helps DevOps teams understand the project requirements thoroughly, aiding in planning and collaboration.

- Structured Development Process:
  - Advantage: Waterfall emphasizes a structured and sequential development process.
  - DevOps Impact: Provides a foundation for creating a structured and automated DevOps pipeline with clear stages.

- Detailed Documentation:
  - Advantage: Comprehensive documentation is created at each stage.
  - DevOps Impact: Valuable for understanding the software architecture and requirements, supporting continuous integration and deployment efforts.

- Predictable Milestones:
  - Advantage: Milestones are well-defined, leading to predictability.
  - DevOps Impact: Allows DevOps teams to plan and automate deployment pipelines based on these milestones.

Disadvantages of Applying Waterfall in DevOps:

- Rigidity and Lack of Flexibility:

    - Disadvantage: Waterfall is inflexible, making it challenging to accommodate changes.
    - DevOps Impact: In a DevOps environment where agility is crucial, inflexibility can hinder quick adaptations and continuous integration.
- Late Detection of Issues:
    - Disadvantage: Testing occurs late in the Waterfall process.
    - DevOps Impact: In contrast to DevOps principles that emphasize continuous testing, late testing can result in delayed issue detection and resolution.
- Extended Development Cycles:
    - Disadvantage: Each phase must be completed before moving to the next, extending development cycles.
    - DevOps Impact: Contrary to the DevOps goal of rapid and frequent releases, Waterfall's extended timelines may hinder the continuous delivery pipeline.
- Limited User Involvement:
    - Disadvantage: Limited user involvement until the testing phase.
    - DevOps Impact: DevOps emphasizes collaboration with stakeholders, and limited user involvement can lead to misalignment with user expectations.
- Risk of Delivering Misaligned Solutions:
    - Disadvantage: The success of Waterfall heavily depends on accurately defining requirements upfront.
    - DevOps Impact: In a DevOps environment where changes are expected, rigid adherence to initial requirements may result in delivering solutions that no longer align with evolving needs.
- Not Optimized for Continuous Integration:
    - Disadvantage: Waterfall's sequential nature is not optimized for continuous integration.
    - DevOps Impact: DevOps thrives on continuous integration, and Waterfall's lack of emphasis on this can hinder automated testing and deployment.

Define the stages of a DevOps evolution

Certainly, here are the stages of DevOps evolution with accompanying definitions:

- Silos (Pre-DevOps):

Definition: The traditional organizational structure where different teams, such as development, testing, and operations, operate in isolation with minimal communication and collaboration.

Challenges: Lack of synergy, slow release cycles, and difficulty in sharing knowledge among teams.

- Infancy:

Definition: The initial recognition of the need for change towards a collaborative approach. Teams start to acknowledge the benefits of working together more closely.

Initiatives: Basic adoption of DevOps principles, emphasizing better communication and the importance of collaboration.

- Adoption:

Definition: The introduction of fundamental DevOps practices and tools aimed at improving collaboration and automation.

Initiatives: Implementation of continuous integration (CI) and continuous delivery (CD), increased automation of repetitive tasks, and closer collaboration between development and operations teams.

- Scaling and Expansion:

Definition: Widening the scope of DevOps practices across the organization and integrating them into various business units.

Initiatives: Scaling CI/CD processes, further automation of testing and deployment, adoption of infrastructure as code (IaC), and increased collaboration with other departments.

- Enterprise Standardization:

Definition: Establishing DevOps as a standard approach across the entire enterprise with a focus on optimization and standardization.

Initiatives: Setting enterprise-wide standards for DevOps practices, integrating security into the DevOps process (DevSecOps), comprehensive monitoring, and further optimization of workflows.

- Continuous Improvement:

Definition: Fostering a culture of continuous improvement and learning from experiences, with a focus on identifying and resolving bottlenecks and inefficiencies.

Initiatives: Proactive monitoring, feedback loops, blameless post-mortems, and a commitment to ongoing enhancement of processes.

- Innovation and Transformation:

Definition: DevOps ingrained in the organizational culture, promoting a proactive and innovative mindset.

Initiatives: Embracing advanced technologies (e.g., cloud-native, AI/ML), fostering a culture of experimentation, and actively seeking ways to improve and innovate in all aspects of the software delivery lifecycle.

These stages provide a framework for organizations to assess their DevOps maturity and guide their journey towards more efficient and collaborative software development and delivery practices.

DevOps practices in organizations

DevOps practices in organizations encompass a range of principles, processes, and tools that aim to improve collaboration and efficiency between development and operations teams. Here are some key DevOps practices commonly adopted by organizations:

1. **Continuous Integration (CI):**
    - **Definition:** Developers integrate code changes frequently into a shared repository, and automated builds and tests are triggered upon each integration.
    - **Benefits:** Early detection of integration issues, faster feedback, and a more reliable codebase.
2. **Continuous Delivery (CD):**
    - **Definition:** Extending CI by automatically deploying code changes to testing or staging environments, and potentially to production, after passing automated tests.
    - **Benefits:** Accelerated release cycles, reduced manual intervention, and increased reliability in the deployment process.
3. **Infrastructure as Code (IaC):**
    - **Definition:** Managing and provisioning infrastructure using code, allowing for automated and repeatable infrastructure deployments.
    - **Benefits:** Consistency in infrastructure setups, easier scalability, and improved version control for infrastructure configurations.
4. **Automated Testing:**
    - **Definition:** Implementing automated testing at various levels (unit, integration, system) to ensure code quality and identify issues early in the development process.
    - **Benefits:** Faster feedback on code changes, improved code reliability, and reduced manual testing efforts.
5. **Collaboration and Communication:**
    - **Definition:** Encouraging open communication and collaboration between development, operations, and other relevant teams.
    - **Benefits:** Faster issue resolution, shared understanding of goals, and a more cohesive work environment.
6. **Monitoring and Logging:**
    - **Definition:** Implementing tools and practices for monitoring application performance and collecting logs to quickly identify and respond to issues.
    - **Benefits:** Faster detection of anomalies, proactive issue resolution, and improved system reliability.
7. **Security as Code (DevSecOps):**

- **Definition:** Integrating security practices into the DevOps pipeline, ensuring security is addressed throughout the software development lifecycle.
- **Benefits:** Early identification and mitigation of security vulnerabilities, improved compliance, and reduced security risks.

8. **Version Control:**
    - **Definition:** Managing and tracking changes to code and infrastructure configurations using version control systems (e.g., Git).
    - **Benefits:** History tracking, collaboration, and the ability to revert to previous states, enhancing code and configuration management.
9. **Microservices Architecture:**
    - **Definition:** Designing applications as a collection of small, independent services that communicate through APIs.
    - **Benefits:** Improved scalability, flexibility, and faster development cycles.
10. **Containerization and Orchestration:**
    - **Definition:** Using containerization technologies (e.g., Docker) for packaging applications and container orchestration tools (e.g., Kubernetes) for managing and scaling containerized applications.
    - **Benefits:** Consistent deployment environments, scalability, and resource efficiency.

These practices collectively contribute to achieving the goals of DevOps, which include faster and more reliable software delivery, enhanced collaboration between teams, and the ability to respond quickly to changing business requirements. Organizations often tailor these practices based on their specific needs, technology stack, and development methodologies.

The Continuous DevOps Life Cycle Process

The Continuous DevOps Lifecycle is a software development and delivery approach that emphasizes collaboration and communication between development (Dev) and operations (Ops) teams. The goal is to streamline the software development and delivery process, ensuring continuous improvement and faster, more reliable releases. The lifecycle typically consists of several continuous practices, including Continuous Integration (CI), Continuous Inspection, Continuous Deployment, Continuous Delivery, and Continuous Monitoring. Let's delve into each of these:

1. **Continuous Integration (CI):**
    - **Objective:** To merge code changes from multiple developers into a shared repository continuously.
    - **Process:**
        - Developers work on their local branches and regularly commit code changes.

- An automated CI server monitors the repository for changes.
- The CI server pulls the latest code, builds the application, and runs automated tests.
- If the build and tests pass, the code is integrated into the main branch.

2. **Continuous Inspection:**
    - **Objective:** To ensure code quality and adherence to coding standards.
    - **Process:**
        - Automated tools are used to analyze code for potential issues, such as coding standards violations, security vulnerabilities, and other quality metrics.
        - Reports are generated to provide developers with feedback on areas that need improvement.
        - Continuous Inspection helps maintain a high level of code quality throughout the development process.
3. **Continuous Deployment:**
    - **Objective:** To automatically deploy code changes to production environments.
    - **Process:**
        - Once code changes pass CI and inspection, they are automatically deployed to production environments without manual intervention.
        - This process aims to reduce lead time and increase the frequency of releases, making it possible to deliver new features and fixes more rapidly.
4. **Continuous Delivery:**
    - **Objective:** To ensure that code changes are always in a deployable state and can be released to production at any time.
    - **Process:**
        - Similar to Continuous Deployment but with a manual step for approval before releasing to production.
        - Automated processes take code changes through various environments (e.g., development, testing, staging) until they are ready for production.
        - Deployment to production requires a manual approval, allowing for human intervention and decision-making.
5. **Continuous Monitoring:**
    - **Objective:** To monitor application performance, detect issues, and gather data for continuous improvement.
    - **Process:**

- Real-time monitoring tools track application behavior and performance in production.
- Alerts are configured to notify teams of potential issues or performance degradation.
- Monitoring data is analyzed to identify areas for improvement, and feedback is looped back into the development process.

By implementing these continuous practices, organizations can achieve faster, more reliable software delivery, reduce errors, and respond more quickly to changing business requirements. The DevOps lifecycle promotes a culture of collaboration, automation, and continuous improvement, enhancing the overall efficiency of the software development process.

Case Studies:

IBM:

IBM has embraced the Continuous DevOps Lifecycle Process to enhance its software development practices. With solutions like IBM UrbanCode and Jenkins integration, IBM aims to automate and streamline the entire lifecycle. They emphasize collaboration, code quality, and rapid deployment.

Facebook:

Facebook, now Meta, is known for its advanced DevOps practices. They heavily use tools like Jenkins and Phabricator for continuous integration, automated testing, and code review. The rapid deployment of features and bug fixes is crucial for Facebook's dynamic platform, and their DevOps practices play a vital role in achieving this.

Netflix:

Netflix has been a pioneer in adopting DevOps methodologies. Their success is attributed to a robust Continuous Delivery pipeline. With tools like Spinnaker, Netflix can deploy changes rapidly and with minimal risk. Continuous Monitoring ensures that their streaming services remain highly available and performant.

Common Trends:

- **Automation:** All three companies heavily invest in automation to minimize manual intervention and speed up processes.
- **Collaboration:** Emphasis on collaboration is evident, breaking down silos between development and operations teams.
- **Rapid Deployment:** The ability to release features and updates quickly and reliably is a common theme across IBM, Facebook, and Netflix.
- **Monitoring for Performance:** Continuous Monitoring is crucial for ensuring system performance, user satisfaction, and identifying issues promptly.

These case studies highlight how these tech giants leverage the Continuous DevOps Lifecycle Process to stay competitive in the ever-evolving tech landscape.

Module 2

Module 2: DevOps Dimensions

- Three dimensions of DevOps – People, Process, Technology/Tools
- DevOps- Process
  - DevOps and Agile
  - Agile methodology for DevOps Effectiveness
  - Flow Vs Non-Flow based Agile processes
  - Choosing the appropriate team structure: Feature Vs Component teams
  - Enterprise Agile frameworks and their relevance to DevOps
  - Behavior driven development, Feature driven Development
  - Cloud as a catalyst for DevOps
- DevOps – People
  - Team structure in a DevOps
  - Transformation to Enterprise DevOps culture
  - Building competencies, Full Stack Developers
  - Self-organized teams, Intrinsic Motivation
- Technology in DevOps(Infrastructure as code, Delivery Pipeline, Release Management)
- Tools/technology as enablers for DevOps

Pillars of DevOps

- Three dimensions of DevOps – People, Process, Technology/Tools

1. People

DevOps is a culture at its core. DevOps intention is better collaboration between development and operations. The goal is to break down traditional organizational siloes between these two teams for a more harmonious, effective deployment. The only way DevOps methodology can be truly effective is with the entire team moving together with the same process and goal in mind.

- **Collaboration and Culture:** DevOps emphasizes a cultural shift towards collaboration and shared responsibility. It involves breaking down silos between development and operations teams to foster a culture of communication and collaboration.
- **Skills and Training:** Teams need to acquire the necessary skills to work in a DevOps environment. Cross-functional training ensures that team members are familiar with both development and operations aspects, enabling them to contribute effectively.

2. **Process:**

Continuous processes are the tactical support for effective DevOps Methodology. CI/CD is a set of DevOps best practices designed to help teams ship software more quickly and efficiently.

- **Continuous Integration (CI):** CI involves regularly integrating code changes into a shared repository. This practice helps identify and address integration issues early in the development process, reducing the risk of defects.
- **Continuous Deployment (CD):** CD extends CI by automatically deploying code changes to production environments after passing automated tests. This streamlines the release process and enables faster and more reliable releases.
- **Agile Practices:** DevOps often aligns with Agile methodologies, promoting iterative and incremental development. Agile practices, such as Scrum or Kanban, contribute to faster and more flexible development cycles.

3. **Technology/Tools:**
    - **Automation:** DevOps relies heavily on automation to streamline repetitive tasks, such as code builds, testing, and deployment. Automation tools improve efficiency, reduce errors, and enable faster delivery.
    - **Infrastructure as Code (IaC):** IaC involves managing and provisioning infrastructure through machine-readable scripts. This ensures consistency across environments and simplifies the management of infrastructure.
    - **Monitoring and Logging:** Continuous monitoring and logging provide visibility into the performance and health of applications and infrastructure. This enables quick detection and resolution of issues, contributing to a more reliable system.

Success in DevOps often requires a balance and integration of these three dimensions. While tools and technology automate processes, a collaborative culture and effective communication among team members are equally critical for achieving the goals of DevOps—faster delivery, improved quality, and enhanced collaboration.

DevOps Misconception

DevOps, a term combining "development" and "operations," is a set of practices and cultural philosophies aimed at improving collaboration and productivity between software development and IT operations teams. However, there are some common misconceptions about DevOps that are important to address:

1. **DevOps is a specific tool or technology:** One common misconception is that DevOps is a tool or a set of tools. DevOps is more about culture, collaboration, and practices than any specific tool. While there are tools that support DevOps practices, it's essential to understand that adopting a tool alone doesn't mean you're practicing DevOps.
2. **DevOps is only for large organizations:** Some believe that DevOps is only relevant for large enterprises with extensive IT infrastructure and complex systems. In reality, DevOps principles can be applied to organizations of all sizes. The key is to adapt the practices to the specific needs and scale of the organization.
3. **DevOps eliminates the need for specialized roles:** Another misconception is that DevOps promotes a one-size-fits-all approach, where everyone does everything. While DevOps

encourages cross-functional collaboration, it doesn't eliminate the need for specialized roles. It promotes shared responsibilities and improved communication but doesn't erase the importance of expertise in specific areas.

4. **DevOps is all about automation:** While automation is a crucial aspect of DevOps, it's not the sole focus. DevOps emphasizes automation to streamline repetitive tasks, but it also highlights the importance of culture, collaboration, and continuous improvement. Manual processes and human interactions remain valuable in certain contexts.
5. **DevOps is a one-time implementation:** DevOps is an ongoing journey rather than a one-time project. It involves continuous improvement and adaptation to changing requirements and technologies. It's not just about implementing DevOps practices once but rather about fostering a culture of continuous integration, delivery, and feedback.
6. **DevOps is only for development and operations teams:** Although DevOps originated from the collaboration between development and operations teams, its principles can be extended to other parts of an organization, such as quality assurance, security, and business stakeholders. DevOps encourages breaking down silos and fostering collaboration across all relevant departments.
7. **DevOps solves all IT problems:** Adopting DevOps practices does not magically solve all IT-related challenges. While it can significantly improve efficiency, collaboration, and delivery speed, it's not a panacea. Organizations still need to address issues such as cultural resistance, legacy systems, and other business-related challenges.

Understanding these misconceptions is crucial for organizations looking to implement DevOps successfully. It's essential to view DevOps as a holistic approach that encompasses culture, practices, and tools rather than a narrow focus on specific technologies or teams.

Agile Methodology – Scrum

Agile means “incremental, allowing teams to develop projects in small increments. Scrum is one of the many types of agile methodology, known for breaking projects down into sizable chunks called “sprints.” Agile scrum methodology is good for businesses that need to finish specific projects quickly.

Agile methodology is an iterative and incremental approach to software development that prioritizes flexibility, collaboration, and customer satisfaction. Scrum is one of the most widely used frameworks within the Agile methodology. Here are the key components of Scrum:

1. **Roles:**
    - **Product Owner:** Represents the customer and defines the features of the product.
    - **Scrum Master:** Facilitates the Scrum process and ensures the team adheres to its practices.
    - **Development Team:** Cross-functional team responsible for delivering the product.
2. **Artifacts:**

- **Product Backlog:** A prioritized list of features, enhancements, and bug fixes, maintained by the Product Owner.
- **Sprint Backlog:** A subset of the Product Backlog chosen for a specific sprint.
- **Increment:** The sum of all the completed tasks during a sprint, which should be a potentially shippable product.

3. **Events (or Ceremonies):**
    - **Sprint Planning:** At the beginning of each sprint, the team plans the work to be done.
    - **Daily Scrum (Daily Standup):** A short daily meeting where team members discuss progress and plan the day's work.
    - **Sprint Review:** Held at the end of each sprint to demonstrate the completed work to stakeholders.
    - **Sprint Retrospective:** A meeting after the Sprint Review where the team reflects on the past sprint and discusses improvements.
4. **Sprints:**
    - Time-boxed iterations, usually 2-4 weeks long, where a potentially shippable product increment is produced.
    - At the end of each sprint, a product increment is delivered.
5. **Scrum Values:**
    - **Commitment:** Team members commit to completing their allocated tasks.
    - **Courage:** The team is not afraid to raise issues and challenges.
    - **Focus:** The team concentrates on completing the planned work during the sprint.
    - **Openness:** Transparency and open communication within the team.
    - **Respect:** Team members respect each other's expertise and contributions.
6. **Flexibility:**
    - Agile and Scrum emphasize adaptability to changes in requirements or priorities.

The iterative nature of Scrum allows teams to quickly respond to changes, deliver valuable features frequently, and receive continuous feedback from stakeholders. It's widely used in various industries beyond software development due to its flexibility and efficiency in delivering high-quality products.

Agile scrum methodology is a project management system that relies on incremental development. Each iteration consists of two- to four-week sprints, where the goal of each sprint is to build the most important features first and come out with a potentially deliverable product. More features are built into the product in subsequent sprints and are adjusted based on stakeholder and customer feedback between sprints.

Whereas other project management methods emphasize building an entire product in one operation from start to finish, agile scrum methodology focuses on delivering several iterations of a product to provide stakeholders with the highest business value in the least amount of time.

Agile scrum methodology has several benefits. First, it encourages products to be built faster, since each set of goals must be completed within each sprint's time frame. It also requires frequent planning and goal setting, which helps the scrum team focus on the current sprint's objectives and increase productivity.

DevOps- Process

DevOps Process:

DevOps is a set of practices that aims to automate and integrate the processes between software development (Dev) and IT operations (Ops). The goal is to shorten the systems development life cycle and provide continuous delivery with high software quality. The typical DevOps process includes:

1. **Planning:**
    - Define and plan the development and deployment process.
    - Establish requirements and set goals for the development and operational teams.
2. **Coding:**
    - Developers write code and collaborate on version control systems.
    - Continuous Integration (CI) ensures that code changes are automatically built, tested, and integrated into a shared repository.
3. **Building:**
    - Automated build processes compile the code, ensuring consistency and reducing manual errors.
    - Artifacts generated during the build are stored in a repository.
4. **Testing:**
    - Automated testing is a key component to ensure the reliability and quality of the software.
    - Testing is performed continuously throughout the development process.
5. **Deployment:**
    - Automated deployment processes facilitate the release of software to production environments.
    - Continuous Deployment (CD) automates the deployment of code changes to production.

6. **Monitoring:**
    - Continuous monitoring of applications and infrastructure helps identify issues promptly.
    - Feedback loops are established to improve future development and operations.
7. **Collaboration and Communication:**
    - Encourages collaboration between development and operations teams.
    - Tools and practices are implemented to facilitate communication and information sharing.

DevOps and Agile:

DevOps and Agile methodologies share common goals of improving collaboration, accelerating delivery, and responding quickly to change. Agile focuses on the development aspect, ensuring that small, incremental changes are made quickly, while DevOps extends this to the entire software delivery process, including deployment and operations.

The combination of DevOps and Agile methodologies leads to a more holistic approach to software development, where cross-functional teams work collaboratively and iteratively to deliver value to end-users.

Agile Methodology for DevOps Effectiveness:

Agile methodologies provide a foundation for DevOps effectiveness by emphasizing:

1. **Iterative and Incremental Development:** Agile's iterative approach aligns with the continuous delivery aspect of DevOps, enabling faster and more frequent releases.
2. **Cross-Functional Teams:** Agile promotes the formation of cross-functional teams, breaking down silos between development and operations, which is a core principle in DevOps.
3. **Customer Collaboration:** Agile methodologies prioritize customer feedback, aligning with DevOps' focus on delivering value to end-users.
4. **Adaptability:** Both Agile and DevOps encourage adaptability to changing requirements, allowing teams to respond quickly to customer needs and market dynamics.
5. **Continuous Improvement:** Agile's retrospective meetings and DevOps' feedback loops promote continuous improvement in both development and operational processes.

Behavior Driven Development (BDD), Feature Driven Development (FDD), and Test Driven Development (TDD):

1. **Behavior Driven Development (BDD):**
    - BDD is a collaborative approach that involves stakeholders (developers, QA, business analysts) in the entire software development process.
    - It focuses on the behavior of the system from the user's perspective.
    - Specifications are written in natural language and can be understood by non-technical stakeholders.

- Tools like Cucumber, SpecFlow, and Behave are commonly used for BDD.

2. **Feature Driven Development (FDD):**
    - FDD is an iterative and incremental software development methodology.
    - It is feature-centric, with an emphasis on designing and building features based on client-valued functionality.
    - Development is organized around feature teams, each responsible for a specific feature or set of features.
    - Regular, short iterations are a key component of FDD.
3. **Test Driven Development (TDD):**
    - TDD is a software development approach where tests are written before the code is implemented.
    - The process involves writing a failing automated test, writing the minimum code necessary to make the test pass, and then refactoring the code.
    - TDD helps ensure code correctness, encourages modular and maintainable code, and provides a safety net for future changes.
    - Unit testing frameworks like JUnit, NUnit, and pytest are often used in TDD.

These development methodologies and practices can complement each other, and teams may choose to adopt a combination based on their specific needs and project requirements.

DevOps – People

- RL2.3.1 Team structure in a DevOps
- RL2.3.2 Transformation to Enterprise DevOps culture
- RL2.3.3 DevOps Culture

In a DevOps environment**, team structure** is crucial for fostering collaboration and breaking down traditional silos between development and operations. Here are key aspects of team structure in a DevOps setting:

1. **Cross-Functional Teams:**
    - DevOps promotes the concept of cross-functional teams where members have a diverse skill set, including development, operations, testing, and sometimes security.
    - This ensures that the team can handle end-to-end responsibilities for delivering and maintaining a product or service.
2. **Roles and Responsibilities:**
    - Team members often share responsibilities that traditionally belonged to distinct roles (e.g., developers and operations).
    - Automation is used to streamline routine tasks, allowing team members to focus on more strategic and value-added activities.
3. **Collaboration and Communication:**

- DevOps encourages a culture of open communication and collaboration.
- Tools and practices, such as chat platforms, shared repositories, and regular meetings, facilitate seamless collaboration among team members.

4. **Site Reliability Engineering (SRE):**
    - Some organizations adopt SRE principles, introducing roles focused on reliability and performance, aiming to ensure that services are highly available and performant.
5. **Continuous Learning:**
    - DevOps teams emphasize a culture of continuous learning and improvement. This includes staying updated on new technologies, tools, and industry best practices.
6. **Empowerment and Autonomy:**
    - Team members are empowered to make decisions related to their areas of expertise.
    - Autonomy allows for faster decision-making and response to changes.

RL2.3.2 Transformation to Enterprise DevOps:

Transforming to Enterprise DevOps involves scaling DevOps practices across the entire organization, aligning business goals with IT initiatives, and fostering a culture of collaboration. Here are key considerations for this transformation:

1. **Leadership Support:**
    - Successful DevOps transformations require strong support from leadership. Executives should understand and champion the cultural shift and changes in processes.
2. **Cultural Transformation:**
    - Encourage a cultural shift towards collaboration, shared responsibility, and a focus on delivering value to customers.
    - Foster a blame-free culture where learning from failures is encouraged.
3. **Automation and Tooling:**
    - Invest in automation tools to streamline development, testing, deployment, and monitoring processes.
    - Tools should support end-to-end automation and integration across the software delivery pipeline.
4. **Metrics and Measurement:**
    - Define and measure key performance indicators (KPIs) to assess the success of DevOps practices.
    - Metrics may include lead time, deployment frequency, change failure rate, and mean time to recovery.
5. **Training and Skill Development:**

- Provide training programs to enhance the skills of team members.
- Upskilling ensures that the workforce is equipped to handle the changes introduced by DevOps practices.

6. **Feedback Loops:**
    - Establish feedback loops at various stages of the software delivery lifecycle to continuously improve processes.
    - Feedback mechanisms should include both automated and human-driven assessments.
7. **Security Integration:**
    - Include security practices in the DevOps pipeline, adopting DevSecOps principles to integrate security into every phase of development and operations.
8. **Scaling Agile:**
    - Align DevOps with Agile methodologies to achieve a seamless flow of work from ideation to deployment.
    - Leverage Agile principles to enhance collaboration and responsiveness.

Enterprise DevOps is a holistic approach that extends the benefits of DevOps beyond individual teams to the entire organization, fostering a culture of continuous improvement and innovation.

RL2.3.3 DevOps Culture:

DevOps culture is characterized by collaboration, shared ownership, and a focus on delivering value to customers. Key elements of a DevOps culture include:

1. **Collaboration:**
    - DevOps emphasizes breaking down silos between development, operations, and other functional areas.
    - Collaborative teams work together seamlessly to achieve common goals.
2. **Automation:**
    - Automation is a cornerstone of DevOps culture, enabling efficient and repeatable processes.
    - Automated testing, continuous integration, and continuous deployment contribute to a streamlined development pipeline.
3. **Continuous Improvement:**
    - A DevOps culture fosters a mindset of continuous improvement.
    - Teams regularly reflect on their processes, identify areas for enhancement, and implement changes to optimize efficiency.
4. **Customer-Centricity:**

- DevOps places a strong emphasis on delivering value to customers quickly and consistently.
- Teams prioritize features and improvements based on customer needs and feedback.

5. **Transparency:**
    - Transparency and open communication are essential in a DevOps culture.
    - Teams share information about their work, challenges, and progress, promoting trust and collaboration.
6. **Resilience:**
    - DevOps encourages building resilient systems that can quickly recover from failures.
    - Practices like chaos engineering and failure testing contribute to the development of robust and reliable systems.
7. **Adaptability:**
    - A DevOps culture embraces change and adapts to evolving requirements and technologies.
    - Teams are encouraged to experiment, learn from failures, and iterate on their processes.
8. **Inclusivity:**
    - DevOps promotes inclusivity, where all team members are valued for their contributions regardless of their specific roles.
    - Diversity in skills and perspectives is considered an asset.

DevOps culture is not just about implementing tools or processes but is deeply rooted in the mindset and behavior of individuals and teams. It seeks to create an environment where collaboration, innovation, and continuous improvement thrive.

DevOps-Tools

RL2.4.1 Tools and Technology in DevOps:

The successful implementation of DevOps relies heavily on the use of various tools and technologies that automate and streamline different aspects of the software development lifecycle. Here are key considerations regarding tools and technology in DevOps:

1. **Version Control:**
    - Tools like Git, SVN, and Mercurial are used for version control to manage and track changes in source code efficiently.
2. **Continuous Integration (CI):**
    - CI tools such as Jenkins, Travis CI, and CircleCI automate the process of integrating code changes into a shared repository, allowing early detection of integration issues.

3. **Continuous Deployment/Delivery (CD):**
    - CD tools like Ansible, Puppet, and Chef automate the deployment and delivery of applications, ensuring consistency and reliability.
4. **Containerization:**
    - Containerization tools like Docker and container orchestration platforms like Kubernetes enable the packaging, distribution, and management of applications and their dependencies.
5. **Collaboration and Communication:**
    - Collaboration tools like Slack, Microsoft Teams, and communication platforms facilitate efficient communication and collaboration among team members.
6. **Monitoring and Logging:**
    - Monitoring tools such as Nagios, Prometheus, and logging tools like ELK Stack (Elasticsearch, Logstash, Kibana) help in tracking application performance and identifying issues.
7. **Infrastructure as Code (IaC):**
    - IaC tools like Terraform and AWS CloudFormation enable the automated provisioning and management of infrastructure resources.
8. **Testing Automation:**
    - Testing automation tools, including Selenium for web applications and JUnit for Java, help in automating testing processes, ensuring faster and more reliable releases.
9. **Configuration Management:**
    - Configuration management tools like Ansible and Puppet automate the configuration and management of infrastructure and application settings.
10. **Artifact Repository:**
    - Artifact repositories like Nexus and Artifactory store and manage binary artifacts, ensuring version control and traceability.
11. **Security Tools:**
    - Security-focused tools like SonarQube for code analysis and OWASP Dependency-Check for checking dependencies help in identifying and mitigating security vulnerabilities.
12. **Performance Testing:**
    - Performance testing tools such as Apache JMeter and Gatling assist in evaluating the performance of applications under various conditions.

RL2.4.2 Cloud as a Catalyst for DevOps:

The adoption of cloud computing has significantly catalyzed the evolution and success of DevOps practices. Here's how the cloud serves as a catalyst for DevOps:

1. **Scalability and Flexibility:**
    - Cloud platforms, such as AWS, Azure, and Google Cloud, offer scalable infrastructure, allowing teams to dynamically scale resources up or down based on demand.
2. **Resource Provisioning:**
    - Cloud services provide easy and rapid provisioning of virtual machines, containers, and other resources through Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) offerings.
3. **Automation Capabilities:**
    - Cloud environments support automation, enabling the use of Infrastructure as Code (IaC) tools to automate the deployment and management of infrastructure resources.
4. **DevOps Collaboration:**
    - Cloud platforms facilitate collaboration among development and operations teams by providing shared and accessible environments for development, testing, and deployment.
5. **Continuous Integration/Continuous Deployment (CI/CD):**
    - Cloud services seamlessly integrate with CI/CD pipelines, allowing for automated testing, deployment, and delivery of applications.
6. **Cost Efficiency:**
    - Cloud services offer a pay-as-you-go model, reducing capital expenditures and allowing organizations to optimize costs based on actual resource usage.
7. **Global Reach:**
    - Cloud providers have data centers distributed globally, enabling organizations to deploy applications closer to their users, reducing latency and improving performance.
8. **Managed Services:**
    - Cloud platforms provide a wide range of managed services, such as databases, machine learning, and analytics, freeing up DevOps teams from managing underlying infrastructure.
9. **Security and Compliance:**
    - Cloud providers invest heavily in security measures and compliance certifications, enhancing the overall security posture of applications deployed in the cloud.
10. **Elasticity:**
    - Cloud environments offer elasticity, allowing applications to automatically scale based on demand, ensuring optimal performance during peak times.

The cloud's flexibility, automation capabilities, and collaboration features align well with DevOps principles, making it a natural choice for organizations looking to accelerate their software delivery and improve operational efficiency.

- **DevOps- Process**
  Agile methodology for DevOps Effectiveness
  Flow Vs Non-Flow based Agile processes
  Choosing the appropriate team structure: Feature Vs Component teams
  Enterprise Agile frameworks and their relevance to DevOps

  Discuss (with examples and practical insights) Test Driven Development, Feature Driven Development, Behavior-driven development

Cloud as a catalyst for DevOps

Key components of the DevOps process include:

1. **Continuous Integration (CI):** Developers integrate code into a shared repository multiple times a day. Each integration triggers an automated build and test process to detect errors early.
2. **Continuous Deployment (CD):** Automated testing and deployment processes ensure that code changes are automatically deployed to production once they pass the tests.
3. **Continuous Monitoring and Feedback:** Monitoring tools provide feedback on the performance and health of applications in real-time. This feedback loop helps in identifying and resolving issues quickly.
4. **Infrastructure as Code (IaC):** Automating infrastructure setup and configuration through code, allowing for consistency and reproducibility.
5. **Collaboration and Communication:** DevOps emphasizes strong collaboration between development, operations, and other stakeholders to ensure a shared understanding of goals and challenges.

Agile Methodology for DevOps Effectiveness: Agile methodologies, such as Scrum or Kanban, align well with DevOps principles. Both Agile and DevOps focus on iterative development, customer feedback, and continuous improvement.

Agile practices that enhance DevOps effectiveness include:

1. **Sprints:** Short development cycles (sprints) align with the continuous delivery aspect of DevOps.
2. **User Stories:** Breaking down features into user stories helps in creating small, manageable tasks that can be continuously integrated and deployed.

3. **Retrospectives:** Regular retrospectives encourage continuous improvement, a key DevOps principle.

Flow vs. Non-Flow Based Agile Processes:

- **Flow-Based Agile:** Focuses on smooth, continuous delivery of features. Kanban is an example where work items move through stages without predefined iterations.
- **Non-Flow-Based Agile:** Follows iterative development cycles with fixed timeframes, as seen in Scrum.

The choice depends on the project's nature. Flow-based may suit continuous delivery, while non-flow-based may be better for projects with well-defined iterations.

Choosing Team Structure: Feature vs. Component Teams:

- **Feature Teams:** Cross-functional teams responsible for end-to-end delivery of a feature.
- **Component Teams:** Specialized teams focusing on specific components or layers.

Choosing depends on project requirements. Feature teams often enhance agility, but component teams can provide expertise in specialized areas.

Enterprise Agile Frameworks and Their Relevance to DevOps: Frameworks like SAFe (Scaled Agile Framework) or LeSS (Large Scale Scrum) aim to scale Agile practices. They promote collaboration, alignment, and faster delivery across large organizations. The key is to adapt these frameworks to integrate seamlessly with DevOps practices.

Test-Driven Development (TDD), Feature-Driven Development (FDD), Behavior-Driven Development (BDD):

Test Driven Development (TDD), Feature Driven Development (FDD), and Behavior-Driven Development (BDD) are three distinct software development methodologies, each emphasizing different aspects of the development process. Let's delve into each one with examples and practical insights:

- **TDD:** Developers write tests before writing the corresponding code, ensuring that the code meets the specified requirements.
- **FDD:** Focuses on building features iteratively, emphasizing domain object modeling and feature lists.
- **BDD:** Involves collaboration between developers, QA, and non-technical stakeholders to define behavior through scenarios written in natural language.

Each approach addresses different aspects of software development and can be chosen based on the project's requirements and team preferences.

1. **Test Driven Development (TDD):**
    - **Overview:** TDD is a development approach where tests are written before the actual code. The cycle involves writing a test, then writing the minimum amount of code

necessary to pass that test, and finally refactoring the code while ensuring the tests still pass.

- **Example:**
    - Suppose you are developing a function to calculate the square of a number. In TDD, you would start by writing a test case for the square function, specifying the expected output for a given input.
    - Once the test is in place, you write the minimal code required to make the test pass. For instance, writing a function that simply returns the input squared.
    - After that, you may refactor the code for readability or efficiency while making sure the test continues to pass.
- **Practical Insight:**
    - TDD can lead to more reliable and maintainable code since changes are less likely to introduce unexpected issues.
    - It can be challenging to adopt TDD in large projects initially, but the long-term benefits often outweigh the initial learning curve.

2. **Feature Driven Development (FDD):**
    - **Overview:** FDD is an iterative and incremental software development methodology that is primarily driven by designing and building features. It focuses on client-valued functionality and is often used in larger projects.
    - **Example:**
        - In FDD, the development process typically starts with building a feature list based on client requirements. Each feature is then broken down into smaller, manageable tasks.
        - Developers work on implementing and completing each feature independently. This process continues iteratively until all features are implemented.
    - **Practical Insight:**
        - FDD provides a structured approach to development, making it suitable for larger projects with a diverse set of features.
        - It requires good project management skills to organize and track the progress of feature development.
3. **Behavior-Driven Development (BDD):**
    - **Overview:** BDD is an extension of TDD that involves collaboration between developers, QA, and non-technical stakeholders. It emphasizes writing tests in a natural language format that can be understood by both technical and non-technical team members.
    - **Example:**

        - Consider a scenario where a user tries to log in with an incorrect password. In BDD, this scenario would be written in a format like "Given the user enters the wrong password, When they try to log in, Then an error message should be displayed."
        - The natural language descriptions are then converted into executable tests, ensuring that the software behaves as described.
    - **Practical Insight:**
        - BDD encourages collaboration and communication between different roles within a development team.
        - The use of natural language in writing tests promotes a shared understanding of the software's behavior among team members.

In practice, the choice between these methodologies often depends on project size, team structure, and the nature of the application being developed. Some teams may even adopt a combination of these methodologies to leverage their strengths in different aspects of the development lifecycle.

Cloud as a Catalyst for DevOps:

- **Infrastructure Scalability:** Cloud allows dynamic scaling of infrastructure resources to handle varying workloads efficiently.
- **Automation and Orchestration:** Cloud services provide tools for automating deployment, scaling, and management of applications.
- **Collaboration and Accessibility:** Cloud facilitates collaboration among geographically dispersed teams and provides accessibility to resources from anywhere.
- **Cost Efficiency:** Pay-as-you-go models in the cloud optimize costs and provide flexibility.

Examples of cloud services like AWS, Azure, or Google Cloud Platform demonstrate how cloud computing accelerates DevOps practices by providing a scalable and flexible infrastructure.

- **DevOps – People**
  Building competencies, Full Stack Developers
  Self-organized teams, Intrinsic Motivation

The adoption of DevOps principles often involves a focus on people, collaboration, and fostering a culture that encourages continuous learning and improvement. Let's explore the mentioned aspects related to DevOps people practices:

1. **Building Competencies:**

- **Overview:** In a DevOps environment, it's crucial to build and enhance the skills and competencies of team members. This includes both technical and non-technical skills that are relevant to the DevOps lifecycle.
- **Example:**
    - DevOps team members may need to acquire skills in automation tools, cloud technologies, containerization, and continuous integration/continuous deployment (CI/CD) pipelines.
    - Cross-training team members to understand both development and operations aspects helps create a more versatile and collaborative workforce.

2. **Full Stack Developers:**
    - **Overview:** Full Stack Developers are individuals who possess a broad skill set and can work on both the front-end and back-end aspects of software development. In DevOps, having team members with a full-stack mindset helps bridge the gap between development and operations.
    - **Example:**
        - A Full Stack Developer in a DevOps team might be capable of not only writing application code but also configuring and managing infrastructure as code, monitoring application performance, and troubleshooting production issues.
        - This reduces handovers between development and operations teams, leading to faster delivery and more efficient problem resolution.
3. **Self-Organized Teams:**
    - **Overview:** DevOps encourages the formation of self-organized teams that have the autonomy to make decisions and manage their own work. This promotes a culture of ownership and responsibility.
    - **Example:**
        - Instead of rigidly following a predefined set of tasks, a self-organized DevOps team may collectively decide how to implement a feature, which tools to use, and how to improve their development and deployment processes.
        - Self-organization fosters a sense of accountability and allows teams to respond quickly to changing requirements and challenges.
4. **Intrinsic Motivation:**
    - **Overview:** DevOps emphasizes intrinsic motivation, where team members are driven by a genuine interest in their work, a sense of purpose, and the desire to continuously improve.
    - **Example:**

- Team members might be motivated by the opportunity to contribute to the success of the organization, improve collaboration, or enhance the overall efficiency of the development lifecycle.
- Intrinsic motivation is often linked to the autonomy provided to teams, as they have the freedom to innovate and find better ways to achieve their goals.

In summary, DevOps places a strong emphasis on empowering and enabling its people. Building competencies, encouraging a full-stack mindset, fostering self-organized teams, and promoting intrinsic motivation are key aspects of creating a culture that aligns with DevOps principles. This people-centric approach is essential for achieving the collaboration, efficiency, and continuous improvement goals that DevOps aims to deliver.

- Technology in DevOps(Infrastructure as code, Delivery Pipeline, Release Management)

In DevOps, technology plays a critical role in automating and streamlining processes across the software development lifecycle. Here are key technological aspects in DevOps, including Infrastructure as Code (IaC), Delivery Pipeline, and Release Management:

1. **Infrastructure as Code (IaC):**
    - **Overview:** IaC is a key DevOps practice that involves managing and provisioning infrastructure through machine-readable script files. This allows for consistent and repeatable infrastructure deployment and configuration.
    - **Example:**
        - Tools like Terraform, Ansible, or AWS CloudFormation enable teams to define infrastructure components, such as virtual machines, networks, and databases, in code.
        - Developers can version control these infrastructure scripts, ensuring that changes to the infrastructure are traceable, reversible, and can be reviewed collaboratively.
2. **Delivery Pipeline:**
    - **Overview:** The delivery pipeline in DevOps refers to the automated sequence of steps that code goes through, from development to testing, and ultimately to production deployment. It facilitates continuous integration and continuous delivery (CI/CD).
    - **Example:**
        - Jenkins, GitLab CI/CD, and Travis CI are examples of tools that help create delivery pipelines. When a developer commits code, the pipeline automatically triggers actions such as compiling code, running tests, and deploying to staging or production environments.

- Automated pipelines reduce manual interventions, decrease the time taken for software delivery, and increase the reliability of the release process.

3. **Release Management:**

   - **Overview:** Release management in DevOps involves planning, scheduling, and controlling the movement of code changes through different stages, ultimately releasing them into production. It ensures that new features and bug fixes are delivered in a controlled and reliable manner.

   - **Example:**

     - Release management tools like Octopus Deploy or AWS CodeDeploy help automate the deployment of applications to various environments.

     - Features such as canary releases, blue-green deployments, and feature toggles are incorporated to minimize downtime and mitigate risks during the release process.

4. **Containerization and Orchestration:**

   - **Overview:** Containers encapsulate applications and their dependencies, ensuring consistency across various environments. Orchestration tools manage the deployment, scaling, and maintenance of containerized applications.

   - **Example:**

     - Docker is a popular containerization platform, while Kubernetes is a widely used orchestration tool. Together, they allow teams to package applications and deploy them consistently across development, testing, and production environments.

     - Container orchestration simplifies the management of containerized applications at scale, enabling efficient resource utilization and dynamic scaling.

5. **Monitoring and Logging:**

   - **Overview:** Continuous monitoring and logging are essential for identifying and addressing issues in real-time. DevOps teams rely on monitoring tools to track application performance, system health, and user behavior.

   - **Example:**

     - Tools like Prometheus, Grafana, and ELK Stack (Elasticsearch, Logstash, Kibana) are used for monitoring and logging. They provide insights into application behavior, help troubleshoot issues, and contribute to continuous improvement.

- Automated alerts can be configured to notify teams of potential problems, allowing for proactive intervention.

In conclusion, technology is a fundamental enabler of DevOps practices, allowing teams to automate, standardize, and optimize their workflows. Infrastructure as Code, Delivery Pipelines, Release Management, Containerization, and Monitoring collectively contribute to achieving the goals of speed, collaboration, and reliability in the DevOps paradigm.

- Tools/technology as enablers for DevOps

DevOps relies heavily on a variety of tools and technologies to automate and streamline different aspects of the software development lifecycle. Here's an overview of key categories of tools used as enablers for DevOps:

1. **Version Control:**
    - **Tools:** Git, SVN (Subversion), Mercurial
    - **Role:** Version control systems help manage and track changes to the source code. Git, in particular, is widely used in DevOps for its distributed and branching capabilities.
2. **Continuous Integration/Continuous Deployment (CI/CD):**
    - **Tools:** Jenkins, GitLab CI/CD, Travis CI, CircleCI
    - **Role:** CI/CD tools automate the building, testing, and deployment of code changes. They enable frequent integration, faster feedback loops, and consistent delivery of software.
3. **Configuration Management:**
    - **Tools:** Ansible, Chef, Puppet, SaltStack
    - **Role:** Configuration management tools automate the setup and configuration of infrastructure and applications. They ensure consistency across environments and facilitate Infrastructure as Code (IaC) practices.
4. **Containerization:**
    - **Tools:** Docker, Podman
    - **Role:** Containers encapsulate applications and their dependencies, ensuring consistency and portability. Docker, in particular, is widely used for creating, distributing, and running containerized applications.
5. **Container Orchestration:**
    - **Tools:** Kubernetes, Docker Swarm, OpenShift

- **Role:** Orchestration tools manage the deployment, scaling, and operation of containerized applications. Kubernetes is a leading orchestration platform widely used in DevOps for automating containerized workloads.

6. **Infrastructure as Code (IaC):**
    - **Tools:** Terraform, AWS CloudFormation, Azure Resource Manager
    - **Role:** IaC tools enable the definition and provisioning of infrastructure using code. They help automate the creation and management of infrastructure components, promoting consistency and repeatability.
7. **Monitoring and Logging:**
    - **Tools:** Prometheus, Grafana, ELK Stack (Elasticsearch, Logstash, Kibana)
    - **Role:** Monitoring tools track the performance and health of applications and infrastructure, while logging tools help collect, analyze, and visualize logs for troubleshooting and analysis.
8. **Collaboration and Communication:**
    - **Tools:** Slack, Microsoft Teams, Mattermost
    - **Role:** Collaboration tools facilitate communication and information sharing among team members. Integrating these tools into the DevOps workflow helps enhance collaboration and transparency.
9. **Versioning and Artifact Repositories:**
    - **Tools:** Nexus Repository, JFrog Artifactory
    - **Role:** These tools store and manage artifacts, dependencies, and binary files. They play a crucial role in versioning and ensuring a reliable source for the artifacts required in the software development process.
10. **Security and Compliance:**
    - **Tools:** SonarQube, Checkmarx, OWASP Dependency-Check
    - **Role:** Security tools help identify and address security vulnerabilities in the code and dependencies. They ensure that security is integrated into the DevOps pipeline.
11. **Test Automation:**
    - **Tools:** Selenium, JUnit, NUnit
    - **Role:** Test automation tools automate the execution of test cases, helping ensure the quality of the software. They integrate with CI/CD pipelines for continuous

testing.

The specific toolset used in a DevOps environment may vary based on the technology stack, organizational preferences, and project requirements. Adopting a combination of these tools helps organizations achieve automation, collaboration, and efficiency in their software development and delivery processes.

Discuss on Cloud as a catalyst for DevOps

Cloud computing is a significant catalyst for the adoption and success of DevOps practices. It provides a dynamic and scalable infrastructure that aligns well with the principles and goals of DevOps. Here's a discussion on how the cloud acts as a catalyst for DevOps:

1. **Infrastructure Provisioning and Automation:**
    - **Advantage:** Cloud platforms offer Infrastructure as a Service (IaaS) and Platform as a Service (PaaS), allowing teams to provision and manage infrastructure resources programmatically. This is a fundamental aspect of DevOps, promoting Infrastructure as Code (IaC) principles.
    - **Example:** With services like AWS CloudFormation or Azure Resource Manager, teams can define and deploy infrastructure using code, enabling automated and consistent infrastructure provisioning.
2. **Scalability and Elasticity:**
    - **Advantage:** Cloud environments provide on-demand scalability, allowing applications to scale up or down based on demand. This aligns with the DevOps goal of continuous delivery and the ability to respond to changing workloads.
    - **Example:** Auto-scaling features in cloud platforms automatically adjust the number of resources (e.g., virtual machines or containers) based on predefined rules and metrics.
3. **Resource Management and Optimization:**
    - **Advantage:** Cloud services offer tools to monitor and optimize resource utilization, helping organizations achieve cost-effectiveness and efficiency.
    - **Example:** Cloud providers offer dashboards and analytics tools (e.g., AWS Cost Explorer) that enable teams to analyze resource usage, identify inefficiencies, and optimize costs.
4. **Collaboration and Flexibility:**
    - **Advantage:** Cloud platforms provide a collaborative environment where development, operations, and other stakeholders can work together seamlessly. The flexibility of cloud services allows teams to experiment, innovate, and iterate quickly.

- **Example:** Tools like AWS Organizations or Azure DevOps provide collaborative spaces for different teams to work on projects, manage access controls, and share resources.

5. **DevOps Toolchain Integration:**
    - **Advantage:** Cloud providers offer integrations with a wide array of DevOps tools, facilitating seamless integration into the development lifecycle.
    - **Example:** CI/CD tools like Jenkins, GitLab CI/CD, or Azure DevOps can easily connect to cloud platforms to automate the deployment of applications and services.
6. **Continuous Integration and Deployment:**
    - **Advantage:** Cloud services support continuous integration and continuous deployment (CI/CD) practices, allowing teams to automate the building, testing, and deployment of applications.
    - **Example:** Cloud-native CI/CD services such as AWS CodePipeline, Azure DevOps Pipelines, or Google Cloud Build streamline the process of building, testing, and deploying code changes.
7. **Managed Services and Abstraction:**
    - **Advantage:** Cloud platforms offer a variety of managed services, abstracting away the complexities of infrastructure management. This allows teams to focus on building and deploying applications.
    - **Example:** Cloud-based databases, serverless computing, and container orchestration services (e.g., AWS Lambda, Azure Kubernetes Service) are examples of managed services that simplify deployment and operations.
8. **Global Reach and High Availability:**
    - **Advantage:** Cloud providers have a global infrastructure footprint, enabling applications to be deployed across multiple regions for high availability and disaster recovery.
    - **Example:** Multi-region deployment strategies in the cloud, coupled with load balancing and redundancy, enhance the reliability and availability of applications.

In summary, cloud computing acts as a catalyst for DevOps by providing a flexible, scalable, and collaborative environment. It empowers organizations to embrace DevOps principles such as automation, continuous integration, and continuous delivery, leading to faster development cycles, improved collaboration, and enhanced agility in responding to business needs.

Module 3 Source Code Management (Using GIT as an example tool)

- **Centralized Version Control Systems**
- **Distributed Version Control Systems**
- RL3.1.1 Evolution of Version Control
- RL3.1.2 Version control system and its types

Evolution of Version Control (RL3.1.1):

Overview:

- The evolution of version control reflects the growing complexity of software development and the need for more efficient collaboration.
- Initially, developers manually managed versions, which became impractical as projects grew.
- Centralized systems addressed some issues but introduced limitations, leading to the development of Distributed Version Control Systems.

Stages of Evolution:

- **Manual Methods:** Developers kept copies and manually tracked changes.
- **Centralized Systems:** Introduced a central repository for better collaboration.
- **Distributed Systems:** Provided greater flexibility and improved collaboration.

Version Control System and its Types (RL3.1.2):

Overview:

- A Version Control System (VCS) is a tool that manages the history of changes to source code files.
- Two main types are Centralized Version Control Systems (CVCS) and Distributed Version Control Systems (DVCS).

Roles and Types:

- **Repository:** The database storing the version history.
- **Working Copy:** The local copy of the code that developers work on.

Centralized vs. Distributed:

- **CVCS:** Relies on a central server for version control.
- **DVCS:** Provides each developer with a complete local copy of the repository.

Examples:

- **CVCS Examples:** CVS, SVN.
- **DVCS Examples:** Git, Mercurial.

In conclusion, version control systems play a crucial role in software development by managing changes, enabling collaboration, and preserving project history. The evolution from manual methods to centralized and then distributed systems reflects the need for more efficient and scalable solutions in the development process. Developers can choose between CVCS and DVCS based on project requirements and collaboration preferences.

1. Centralized Version Control Systems (CVCS):

Overview:

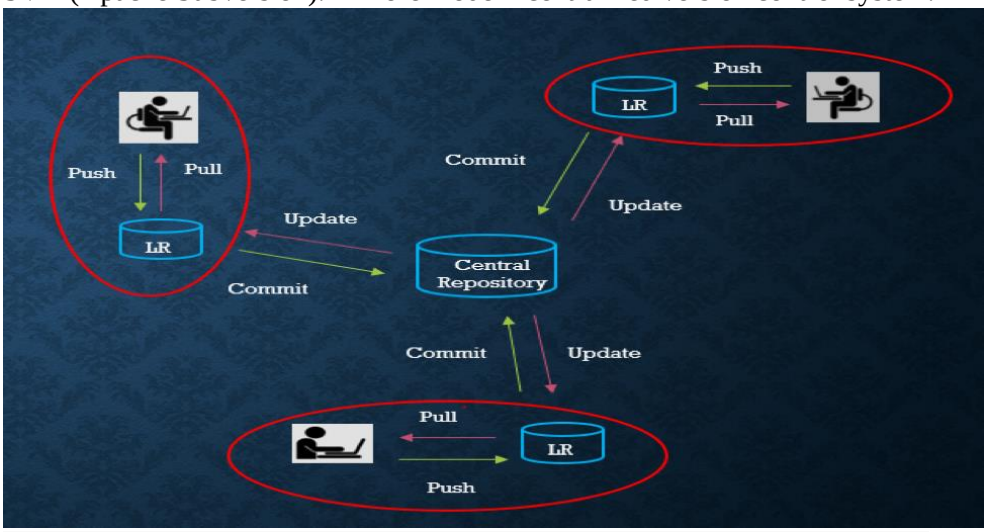
- In a CVCS, there is a central repository that holds all versions of the project's files.
- Developers check out a copy of the code from this central repository to work on it locally.
- Changes made by developers are committed back to the central server, and other team members can update their local copies to get the latest changes.

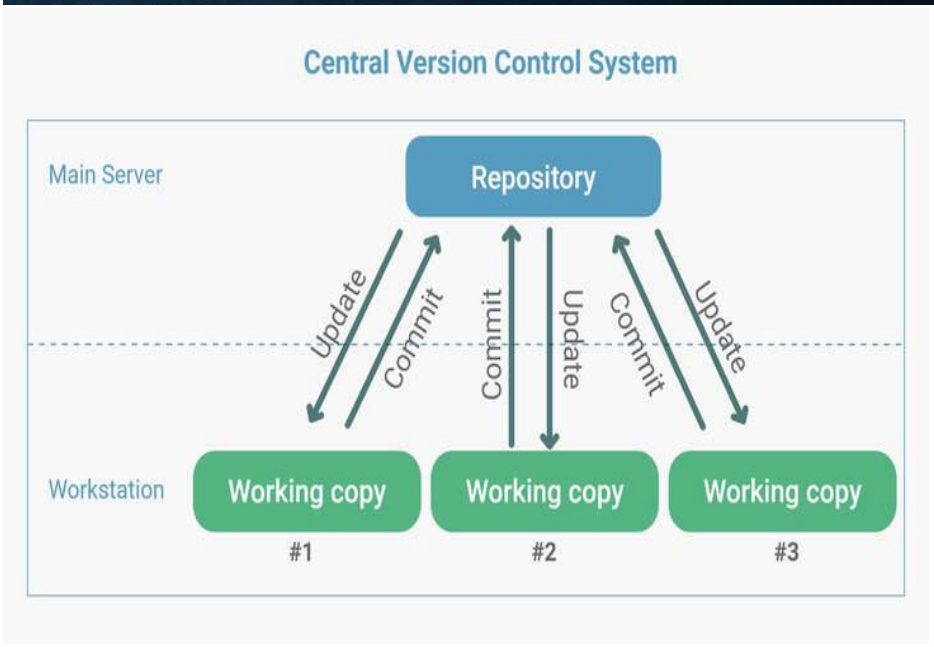
Characteristics:

- **Single Point of Truth:** The central server acts as a single point of truth for the entire project.
- **Network Dependency:** Developers need a constant network connection to access and commit changes to the central repository.
- **History and Changes:** The version history is centralized, making it easier to track changes.

Examples:

- CVS (Concurrent Versions System): One of the earliest CVCS.
- SVN (Apache Subversion): A more modern centralized version control system.





2. Distributed Version Control Systems (DVCS):

Overview:

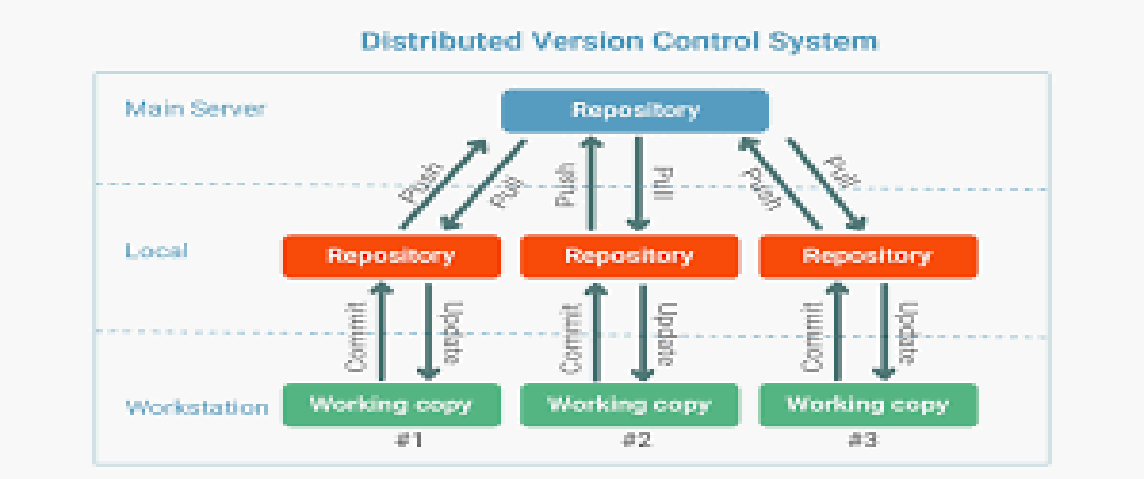
- In a DVCS, each developer has a local repository containing the entire version history of the project.
- Developers can work independently, committing changes to their local repository.
- Changes can be shared by pushing and pulling between repositories, enabling decentralized collaboration.

Characteristics:

- **Decentralized:** Each developer has a complete copy of the project's history, making the system more resilient and flexible.
- **Offline Work:** Developers can work offline, committing changes to their local repository, and later sync with others.
- **Branching and Merging:** Easier branching and merging capabilities, allowing parallel development.

Examples:

- Git: Widely used for its speed, flexibility, and robust branching and merging features.
- Mercurial: Another DVCS with a focus on simplicity and ease of use.



- **Overview of GIT**
- **Git Feature branching**
- **Managing Conflicts using GIT**
- **Tagging and Merging operations in GIT**
- **Benefits of Clean code**

RL 3.2 Introduction to GIT

- RL3.2.1 About GIT
- RL3.2.1 GIT Basics commands

RL3.3 GIT workflows

- RL3.3.1 Feature workflow
- RL3.3.2 Centralized workflow

RL3.4 Clean Code Management

RL3.4.1 Best Practices of Clean Code

About git:

Git is a mature, actively maintained open source project originally developed in 2005 by Linus Torvalds, the famous creator of the Linux operating system kernel. A staggering number of software projects rely on Git for version control, including commercial projects as well as open source.

Overview of GIT:

GIT is a distributed version control system widely used for source code management. It allows multiple developers to work on a project simultaneously, tracking changes and versions. Here are some key concepts:

- **Repository**: A collection of files and version history.
- **Commit**: A snapshot of changes made to files in the repository.
- **Branch**: A parallel version of the code that diverges from the main line of development.
- **Merge**: Combining changes from different branches.
- **Pull Request**: A proposed set of changes to be merged into a target branch.
- **Clone**: Copying a repository from one location to another.

For details expalnaton

Link: https://www.atlassian.com/git/tutorials/comparing-workflows/gitflow-workflow

RL3.2.1 GIT Basics commands

- Git commit
- Git branch
- Git init
- Git status
- Git push
- Git add
- Git checkout
- Cloning
- Git merge
- Git pull
- Git config
- Git log
- Git diff
- Git remote
- Git r m
- Git tag
- Git rebase
- Git stash
- Git reset
- Git task
- Repository
- Status

Git Feature Branching:

The core idea behind the Feature Branch Workflow is that all feature development should take place in a dedicated branch instead of the main branch. This encapsulation makes it easy for multiple developers to work on a particular feature without disturbing the main codebase.

Feature branching in Git involves creating a new branch for each new feature or bug fix. This keeps development isolated and allows for parallel work without affecting the main codebase. Steps:

1. **Create a Branch**: **git checkout -b feature-branch-name**
2. **Make Changes**: Develop and commit changes on the feature branch.
3. **Merge Changes**: Once the feature is ready, merge it back into the main branch.
4. **Delete Feature Branch**: After merging, clean up by deleting the feature branch.

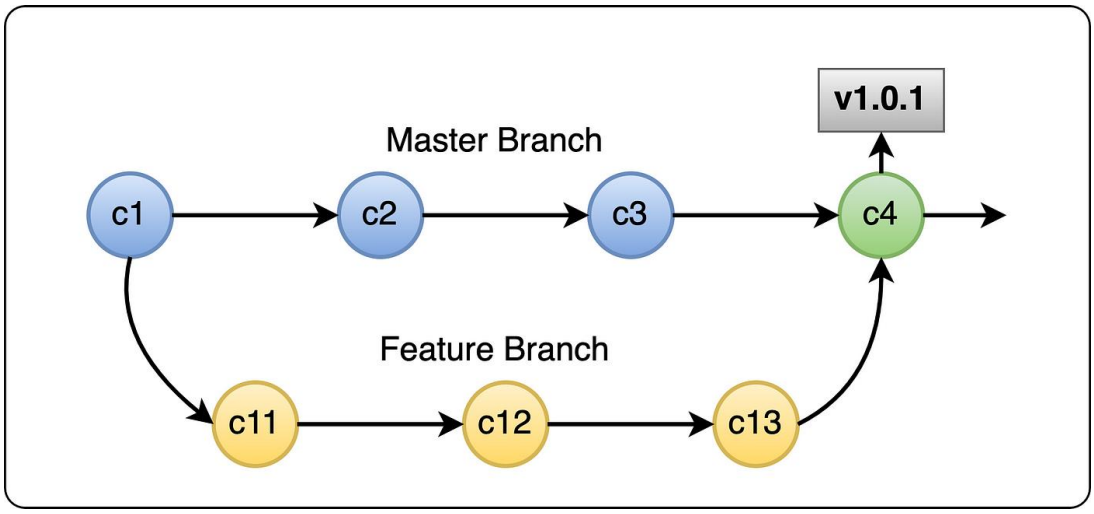
Managing Conflicts using GIT:

Conflicts occur when Git cannot automatically merge changes. Resolve conflicts by:

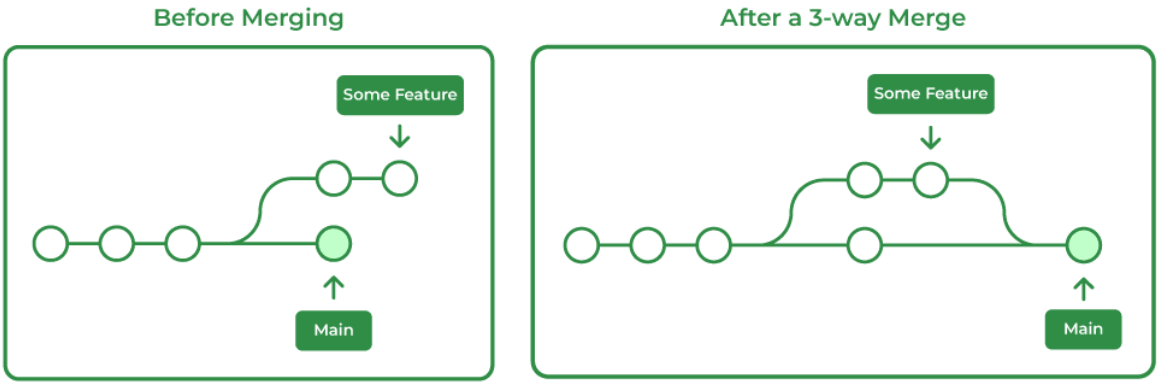
1. **Identify Conflicts**: Git marks conflicting sections in the files.
2. **Manually Resolve**: Edit conflicted files to resolve differences.
3. **Add Changes**: After resolving conflicts, stage the changes.
4. **Complete Merge or Rebase**: Continue with the merge or rebase process.

Tagging and Merging Operations in GIT:

- **Tagging**: Assigning a meaningful name to a specific commit for easy reference.
    - Creating a tag: **git tag -a v1.0 -m "Version 1.0"**
    - Tagging is traditionally used to create semantic version number identifier tags that correspond to software release cycles. The git tag command is the primary driver of tag: creation, modification and deletion. There are two types of tags; annotated and lightweight.



- **Merging**: Combining changes from different branches.
    - Merging is Git's way of putting a forked history back together again. The git merge command lets you take the independent lines of development created by git branch and integrate them into a single branch.
    - Merge branches: **git merge branch-name**
    - Fast-Forward Merge: When changes in the target branch are linear.
    - Three-Way Merge: Combining changes when divergent branches exist.



Centralized workflow

A centralized workflow involves every contributor committing to the main branch without using any other branch. This strategy works well for small teams, because team members can communicate so that multiple developers aren't contributing to the same piece of code simultaneously.

After developers apply a stash and solve any merge conflicts, they can just commit as usual without dealing with automatic merge commits, unless someone pushed their changes at the same time. Because this strategy is simple, it is well-suited for small teams, Git beginners, and projects that don’t get a lot of updates.

Benefits of Clean Code:

Writing clean code is crucial for several reasons:

Why soo important??

1. **Readability**: Clean code is easy to read and understand, aiding collaboration.
2. **Maintainability**: It simplifies maintenance and reduces the likelihood of introducing bugs during updates.
3. **Debugging**: Identifying and fixing issues is more straightforward in clean code.
4. **Efficiency**: Clean code improves development speed and reduces the chances of errors.
5. **Collaboration**: Easier collaboration among team members as everyone can comprehend the codebase.

6. **Scalability**: Clean code is more adaptable to changes and future enhancements.
7. **Code Reviews**: Facilitates effective and constructive code reviews.

How to maintain in simple way.....

- Easier to maintain

Clean code is more organized and modular, which makes it easier to make changes and less likely to introduce bugs.

- Easier to spot bugs

Clean code leads to fewer bugs and errors, making the quality assurance testing process easier.

- Easier to understand

Clean code is easier to read and understand, which makes it easier to maintain over time.

- Easier for search engines to understand

Clean code is easier for search engines to understand.

- Improved software quality

Clean code enhances code comprehension, leading to faster onboarding for new team members and better collaboration among developers.

- Reduced costs

Clean code reduces the cost of maintenance, debugging, and refactoring, enabling more efficient development processes.

- Continuous learning and improvement

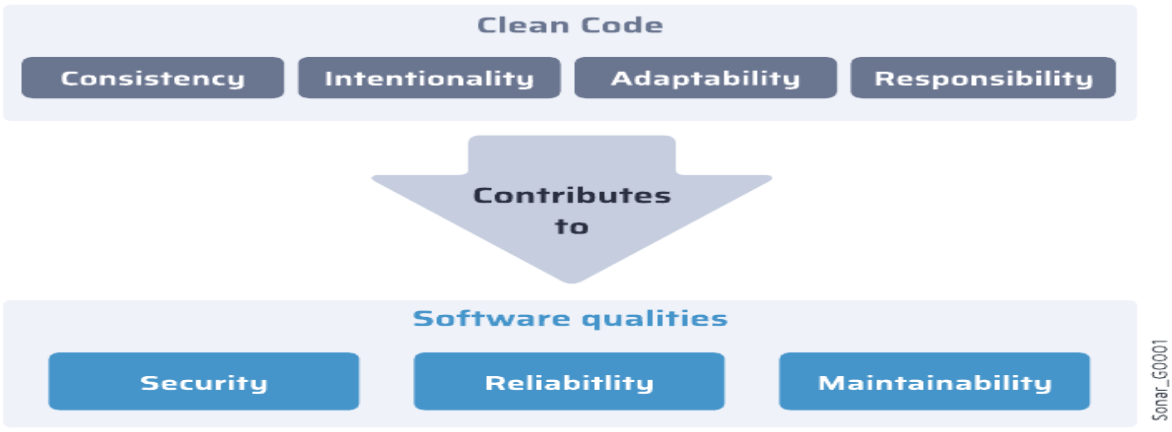
Coding requires continuous learning and improvement, with code reviews and refactoring serving as opportunities for both.

- Personal responsibility

You aren't responsible for anyone else's code, and you own the quality and security of the new code you are working on today

Principles of Clean Code

1. Avoid Hard-Coded Numbers
2. Use Meaningful and Descriptive Names
3. Use Comments Sparingly, and When You Do, Make Them Meaningful
4. Write Short Functions That Only Do One Thing
5. Follow the DRY (Don't Repeat Yourself) Principle and Avoid Duplicating Code or Logic
6. Follow Established Code-Writing Standards
7. Encapsulate Nested Conditionals into Functions
8. Refactor Continuously
9. Use Version Control



Best Practices of Clean Code

- Writing
- Formatting
- Choose descriptive and unambiguous names
- Comments
- Functions should do one thing
- Keeping your code dry
- Meaningful names
- Use exception handling
- Commenting and documentation
- Naming convention
- Refactoring
- Use clear and meaningful variable names
- Version control
- Code cohesion
- Code comments
- Code documentation
- Conclusion
- Error handling
- Follow the single responsibility principle
- Indent your code
- Avoid comments
- Avoid long methods
- Number
- Calling the function should be readable

Module 4: Continuous build and code quality

- Manage Dependencies
  Automate the process of assembling software components with build tools
- Use of Build Tools- Maven, Gradle
- Unit testing
- Enable Fast Reliable Automated Testing
- Setting up Automated Test Suite – Selenium
- Continuous code inspection - Code quality
- Code quality analysis tools- sonarqube

RL 4.1 Manage Dependencies • RL 4.1.1 What is Dependency? • RL 4.1.2 Common Dependency Problems RL 4.2 Build Management • RL 4.2.1 Introduction to build • RL 4.2.2 Build Tools – Maven and Gradle RL 4.3 DevOps approach for Testing • RL 4.3.1 Traditional Vs. Unit Testing • RL 4.3.2 Automated Test Suite – Selenium RL 4.4 Need for Code Inspection & Analysis • RL 4.4.1 Continuous code inspection - Code quality • RL 4.4.2 Code quality analysis tools- sonarqube
• Automate the process of assembling software components with build tools • Use of Build Tools- Maven, Gradle • Outline Unit testing in DevOps • Enable Fast Reliable Automated Testing • Setting up Automated Test Suite – Selenium • Effectiveness of Code quality in Continuous Code Inspection • Code quality analysis using sonarqube

Manage Dependencies

- RL 4.1.1 What is Dependency?
- RL 4.1.2 Common Dependency Problems

RL 4.1.1 What is Dependency?

Dependency refers to the relationship between different elements or components in a system. It signifies that the behaviour or state of one element relies on the behavior or state of another. In various domains like software development, understanding dependencies is crucial for managing interactions between different parts of a system.

RL 4.1.2 Common Dependency Problems

1. **Circular Dependencies:**
    - Occur when components rely on each other in a circular manner, making it difficult to determine a clear execution order.
2. **Version Dependency Issues:**
    - Arise when components have version requirements, and compatibility problems occur due to updates or changes.
3. **Inconsistent Dependency Management:**
    - Lack of a proper system for managing dependencies can lead to issues, especially when different versions are used across a team.
4. **Implicit Dependencies:**
    - Problems arise when dependencies are not explicitly declared or documented, making it hard to understand the relationships between components.
5. **Hard-Coded Dependencies:**
    - Referring to specific components or values directly in the code can reduce flexibility and make updates challenging.
6. **Overly Tight Coupling:**
    - Tight connections between components make it challenging to modify or replace one without affecting others.
7. **Dependency Hell:**
    - Describes situations where managing and resolving dependencies becomes extremely complex, often with conflicting requirements across different components.
      Effectively managing dependencies involves addressing these issues to ensure a stable and maintainable system, whether in software development or other areas where dependencies are crucial.

Automate the process of assembling software components with build tools

Automating the process of assembling software components is a common practice in software development, and build tools play a key role in this automation. Here's an overview of how build tools help automate the software assembly process:

Choose a Build Tool:

1. **Select a Build Tool:**
    - Choose a build tool that suits the programming language and technology stack of your project. Popular build tools include Maven, Gradle, npm, Apache Ant, or others depending on your project requirements.

Project Configuration:

2. **Create a Build Configuration File:**
    - Set up a configuration file (e.g., **pom.xml** for Maven, **build.gradle** for Gradle) where you define project settings, dependencies, and build tasks.
3. **Define Dependencies:**
    - Specify the dependencies your project relies on. Build tools will automatically fetch and manage these dependencies during the build process.

Automate Compilation:

4. **Compile Source Code:**
    - Configure the build tool to compile your source code. This involves converting your high-level code into executable binaries or libraries.
5. **Handle Compilation Options:**
    - Specify any compilation options, such as optimization levels, target platforms, or other settings relevant to your project.

Dependency Management:

6. **Fetch Dependencies:**
    - Build tools automate the process of fetching external dependencies. Ensure that your build configuration accurately lists the required libraries and their versions.
7. **Resolve Transitive Dependencies:**
    - Modern build tools handle transitive dependencies, ensuring that all required dependencies, including those needed by your dependencies, are resolved correctly.

Automated Testing:

8. **Integrate Testing Frameworks:**
    - Configure your build tool to integrate with testing frameworks. This enables automated execution of unit tests and other testing procedures.
9. **Execute Tests:**
    - As part of the build process, run tests to verify that your software functions as expected. Build tools can report test results and identify issues.

Code Quality and Analysis:

10. **Incorporate Code Quality Tools:**
    - Integrate tools for code quality checks, linting, and static analysis. This ensures that your code adheres to coding standards and best practices.

Packaging and Distribution:

11. **Package the Software:**
    - Specify how your software should be packaged for distribution. This might involve creating executable files, JAR files, or other distribution formats.
12. **Automate Deployment (Optional):**
    - If applicable, configure the build tool to automate the deployment process, allowing for seamless integration with Continuous Integration/Continuous Deployment (CI/CD) pipelines.

Continuous Integration:

13. **Integrate with CI/CD:**
    - Connect your build tool with a CI/CD system (e.g., Jenkins, GitLab CI, GitHub Actions) to automate the entire build and deployment workflow.

Documentation:

14. **Generate Documentation (Optional):**
    - Some build tools offer features to generate documentation automatically. This ensures that documentation stays up-to-date with code changes.

Execute the Build:

15. **Run the Build Command:**
    - Execute the build command provided by your chosen build tool. This might be something like **mvn clean install** for Maven or **./gradlew build** for Gradle.

Use of Build Tools- Maven, Gradle

Both Maven and Gradle are popular build tools in the software development ecosystem, and they are used to automate various aspects of the build process. Below, I'll provide a brief overview of each and highlight their common use cases.

Maven:

1. Project Management:

- Maven is widely used for project management and dependency management in Java-based projects. It simplifies the process of building and managing Java projects.

2. Convention over Configuration:

- Maven follows the principle of "convention over configuration," which means that it provides default configurations and project structures. Developers need to adhere to these conventions, making it easier to understand and work on projects.

3. Dependency Management:

- Maven excels in managing project dependencies. It uses a centralized repository for storing and retrieving project dependencies, ensuring that the correct versions are used consistently across the development team.

4. Build Lifecycle:

- Maven defines a standard build lifecycle consisting of phases such as clean, compile, test, package, install, and deploy. Developers can execute these phases to perform specific tasks, making the build process structured and predictable.

5. XML Configuration:

- Maven uses XML for configuration, where the project configuration details, dependencies, and build settings are defined in a **pom.xml** file.

6. Extensibility:

- Maven is extensible through plugins. Developers can create custom plugins or use existing ones to enhance the build process with additional functionalities.

Gradle:

1. Flexibility and Customization:

- Gradle is known for its flexibility and allows developers to define build scripts using a Groovy-based DSL (Domain-Specific Language) or Kotlin. This provides more expressive and concise build scripts compared to XML-based configurations.

2. Incremental Builds:

- Gradle supports incremental builds, meaning it only rebuilds parts of the project that have changed. This can significantly speed up the build process, especially for large projects.

3. Multi-language Support:

- Gradle is not limited to Java projects and supports various programming languages. It is commonly used for Android development and is applicable to projects involving languages like Groovy, Scala, and more.

4. Dependency Management:

- Similar to Maven, Gradle manages project dependencies efficiently. It supports multiple repositories and allows developers to specify dependencies using various notation styles.

5. Plugin Ecosystem:

- Gradle has a rich plugin ecosystem, offering a wide range of plugins for different purposes. These plugins can be easily integrated into the build scripts to extend functionality.

6. Gradle Wrapper:

- Gradle includes a feature called the "Gradle Wrapper," allowing projects to specify a Gradle version in a self-contained manner. This helps in ensuring that the build uses a consistent Gradle version across different environments.

Common Use Cases for Both Maven and Gradle:

1. **Dependency Resolution:**
    - Both Maven and Gradle are used to manage project dependencies, ensuring that the correct versions of libraries are used.
2. **Build Automation:**
    - They automate the build process, including compilation, testing, and packaging, making it easier to produce consistent and reliable builds.
3. **Project Structuring:**
    - Maven and Gradle help in organizing project structures, providing a standardized layout for source code, resources, and configuration.
4. **Continuous Integration:**

- Both build tools are seamlessly integrated into CI/CD pipelines, allowing for automated and continuous builds and deployments.

5. **Plugin Support:**
    - Developers can extend functionality by incorporating various plugins for tasks like code quality checks, documentation generation, and more.

Ultimately, the choice between Maven and Gradle often depends on the specific requirements and preferences of the development team, as both tools are capable and widely adopted in the industry.

Outline Unit testing in DevOps

Unit testing is a critical component of the DevOps lifecycle, contributing to the overall goal of delivering high-quality software rapidly and reliably. Unit testing involves testing individual units or components of a software application in isolation to ensure they function as intended. Here's an outline of how unit testing fits into the DevOps process:

1. Integration into the Development Cycle:

- Unit testing is integrated into the development cycle, allowing developers to validate the correctness of their code as they write it. This ensures that defects are caught early in the development process.

2. Automated Testing:

- Unit tests are typically automated to allow for quick and repeatable validation of code changes. Automation is crucial in DevOps to enable continuous integration and continuous delivery (CI/CD) processes.

3. Version Control Integration:

- Unit tests are often tied to version control systems. Whenever a developer makes changes to the codebase, unit tests are triggered automatically to check if the modifications introduce any issues.

4. Continuous Integration (CI):

- In a DevOps environment, unit tests are a fundamental part of CI pipelines. CI tools automatically build and test the application whenever changes are pushed to the version control system, providing rapid feedback to the development team.

5. Code Quality and Standards:

- Unit testing helps maintain code quality by enforcing coding standards and identifying potential issues early in the development process. It ensures that each unit of code behaves as expected.

6. Isolation of Components:

- Unit testing focuses on testing individual components in isolation. This allows for the identification and resolution of issues within specific functions or modules without the need for a complete application environment.

7. Mocking and Stubbing:

- Unit tests often involve the use of mocking and stubbing to isolate units of code from external dependencies. This ensures that the tests focus solely on the behavior of the specific unit being tested.

8. Test Coverage:

- DevOps processes often emphasize achieving high test coverage. Unit testing contributes to this goal by covering a significant portion of the codebase, helping ensure that critical paths and edge cases are tested.

9. Feedback Loop:

- Unit tests provide a rapid feedback loop to developers. As soon as they make changes, they receive immediate feedback on whether those changes pass or break existing functionality.

10. Regression Testing:

- Unit tests play a crucial role in regression testing. When new features are added or bugs are fixed, unit tests help ensure that existing functionality remains intact.

11. Parallel Execution:

- Unit tests can be designed for parallel execution, allowing for faster test runs. This is particularly important in a DevOps environment where speed and efficiency are key.

12. Integration with Build Tools:

- Unit testing is often integrated with build tools (e.g., Maven, Gradle) to automate the execution of tests as part of the build process. This ensures that only successfully tested code is promoted through the development pipeline.

13. Continuous Delivery (CD):

- In continuous delivery, unit tests contribute to the reliability of the pipeline, ensuring that each build is thoroughly tested before being deployed to production or other environments.

By incorporating unit testing into the DevOps process, organizations can significantly improve the quality of their software, reduce the likelihood of defects, and accelerate the delivery of reliable software to end-users.

Enable Fast Reliable Automated Testing

Enabling fast, reliable, and automated testing is crucial for achieving efficient and reliable software development processes, especially in a DevOps environment. Here are key practices and strategies to achieve this goal:

1. Automate Testing Processes:

- Automate as many testing processes as possible, including unit tests, integration tests, and end-to-end tests. Automation ensures consistency, repeatability, and faster feedback.

2. Use a Testing Framework:

- Choose a robust testing framework that suits your programming language and application type. Common frameworks include JUnit for Java, pytest for Python, and Jasmine for JavaScript.

3. Implement Unit Testing:

- Prioritize unit testing to ensure that individual components or functions of your code behave as expected. Use mocking and stubbing to isolate units and speed up test execution.

4. Integration Testing:

- Conduct integration tests to verify that different components work together seamlessly. Automated integration tests catch issues that might not be apparent in unit tests.

5. End-to-End Testing:

- Implement end-to-end tests to validate the entire application's workflow. Use tools like Selenium for web applications or Appium for mobile applications to automate end-to-end testing.

6. Parallelize Test Execution:

- Parallelize test execution to save time. Running tests concurrently or in parallel allows you to complete the testing process faster, especially when dealing with large test suites.

7. Continuous Integration (CI):

- Integrate automated testing into your CI/CD pipeline. This ensures that tests are automatically triggered whenever code changes are pushed to the version control system, providing quick feedback.

8. Frequent Test Runs:

- Run automated tests frequently, preferably after every code commit. This practice helps identify issues early in the development process, reducing the chances of defects accumulating.

9. Cloud-Based Testing Services:

- Utilize cloud-based testing services for scalable and parallelized testing. Platforms like AWS Device Farm or Sauce Labs provide access to a variety of devices and browsers for testing.

10. Use Containerization:

- Containerize your application using tools like Docker. This allows you to create consistent testing environments, ensuring that tests run in the same environment as the production system.

11. Continuous Monitoring:

- Implement continuous monitoring of test results and performance metrics. Identify patterns, trends, or issues in test runs to continuously improve the reliability and efficiency of your tests.

12. Randomized Testing:

- Consider incorporating randomized testing to discover unexpected issues. Randomized testing involves injecting random inputs into the system to identify potential edge cases and vulnerabilities.

13. Automated Test Data Generation:

- Automate the generation of test data to ensure consistency and repeatability in test scenarios. Tools like Faker or custom scripts can be used for this purpose.

14. Maintainable Test Code:

- Write maintainable and modular test code. Well-organized tests are easier to update, extend, and troubleshoot, contributing to the reliability of the testing process.

15. Collaboration Between Dev and QA:

- Foster collaboration between developers and quality assurance (QA) teams. Encourage communication and shared responsibility for testing to catch issues early in the development cycle.

By implementing these strategies, you can create a robust testing infrastructure that not only provides fast and reliable feedback but also supports the principles of continuous integration and continuous delivery in a DevOps environment.

Setting up Automated Test Suite – Selenium

Setting up an automated test suite with Selenium involves several steps. Selenium is a popular framework for automating web browsers, and it supports multiple programming languages such as Java, Python, C#, etc. Below is a general guide on setting up an automated test suite using Selenium WebDriver and TestNG (a testing framework for Java)

1. Prerequisites:

- Install Java Development Kit (JDK) on your machine.
- Set up an Integrated Development Environment (IDE) such as Eclipse or IntelliJ.
- Create a new Java project.

2. **Add Selenium WebDriver Dependencies:**

3. Download Browser Drivers:

- Download the appropriate browser drivers (e.g., ChromeDriver, GeckoDriver for Firefox) and configure their paths in your project. WebDriver needs these drivers to interact with browsers.

4. Create Test Classes:

Write test classes using Selenium WebDriver commands. Use TestNG annotations for test configuration and execution. Example:

5. Configure TestNG:

- Create a TestNG XML file to configure your test suite. Define test classes, suites, and other configurations. Example:

6. Run Tests:

- Execute your test suite using the TestNG XML file or directly from your IDE. The browser will open, perform actions defined in your test classes, and generate test reports.

7. Reporting:

- Integrate reporting tools for better visibility into test results. TestNG generates HTML reports by default, but you can explore additional reporting tools like ExtentReports or Allure for more detailed and interactive reports.

8. Version Control:

- Consider using version control systems like Git to manage your test code. This ensures collaboration and versioning of your automated tests.

9. CI/CD Integration:

- Integrate your automated test suite into your Continuous Integration (CI) pipeline. Jenkins, GitLab CI, or other CI tools can be configured to trigger test runs upon code changes.

10. Parallel Execution:

- Optimize your test suite for parallel execution to save time. TestNG supports parallel execution, and you can configure it based on your requirements.

Remember to adapt these steps based on your specific project requirements and development environment. Additionally, keep your test suite modular, maintainable, and regularly update it as your application evolves.

Continuous code inspection plays a crucial role in maintaining and improving code quality throughout the software development lifecycle. Code quality refers to the overall health, readability, maintainability, and adherence to coding standards of the source code. Integrating code quality practices into continuous inspection processes brings several benefits:

1. Early Detection of Issues:

- Continuous code inspection allows for the early detection of code issues and violations of coding standards. This proactive approach ensures that problems are identified as soon as code changes are made.

2. Reduced Technical Debt:

- Identifying and fixing code issues promptly helps in reducing technical debt. Technical debt refers to the accumulation of suboptimal code that may become harder to address over time if not resolved promptly.

3. Improved Code Readability:

- Regular code inspection encourages developers to follow best practices and write clean, readable code. This, in turn, enhances collaboration among team members and makes it easier for new developers to understand and contribute to the codebase.

4. Consistency Across the Codebase:

- Continuous code inspection enforces coding standards consistently across the codebase. This ensures a uniform coding style, making the codebase more maintainable and reducing the likelihood of errors.

5. Enhanced Code Review Process:

- Automated code quality checks provide additional information during code reviews. Developers can focus on higher-level design aspects and business logic, while automated tools help catch common coding mistakes and compliance issues.

6. Prevention of Security Vulnerabilities:

- Continuous inspection tools can identify potential security vulnerabilities and insecure coding practices. Addressing these issues early in the development process helps in building more secure software.

7. Facilitation of Continuous Integration:

- Code quality checks are often integrated into continuous integration (CI) pipelines. This ensures that every code change is subjected to automated testing and code inspection, maintaining a high level of quality throughout the development process.

8. Enhanced Software Maintainability:

- High code quality results in more maintainable software. Well-organized, readable, and properly documented code is easier to modify, extend, and troubleshoot, reducing the time and effort required for ongoing maintenance.

9. Automation for Efficiency:

- Continuous code inspection automates the process of checking for code quality issues. This automation speeds up the feedback loop and allows developers to focus on delivering features rather than spending excessive time on manual code reviews.

10. Metrics for Improvement:

11. Support for Refactoring:

12. Adherence to Coding Standards:

In summary, the effectiveness of code quality in continuous code inspection lies in its ability to identify and address issues early, maintain a consistent coding standard, and contribute to the overall health and longevity of the software. Integrating code quality practices into continuous integration and delivery pipelines is a proactive approach that aligns with the principles of DevOps and contributes to the overall success of software development projects.

Code quality analysis using sonarqube

SonarQube is an open-source platform for continuous inspection of code quality. It performs static code analysis to identify code smells, bugs, and security vulnerabilities, helping development teams maintain and improve the quality of their codebase. Here's an overview of how to perform code quality analysis using SonarQube:

1. Install and Configure SonarQube:

- Install SonarQube on a server or use the hosted SonarCloud service.
- Set up the necessary configurations, including database connections and authentication.

2. Integrate SonarQube with Your Build System:

- SonarQube can be integrated into various build tools such as Maven, Gradle, MSBuild, and others.
- Configure your build script to include tasks for running SonarQube analysis.

3. Analyze Code:

- Run the SonarQube analysis on your codebase using the configured build tool.
- For example, using Maven, you can run the following command
- `mvn sonar:sonar`

4. View SonarQube Dashboard:

- Access the SonarQube dashboard through the web interface.
- The dashboard provides an overview of code quality metrics, including issues, coverage, duplications, and more.

5. Review Code Smells, Bugs, and Vulnerabilities:

- SonarQube categorizes issues into different types, such as code smells, bugs, and security vulnerabilities.
- Use the dashboard to identify areas of improvement and prioritize the resolution of critical issues.

6. Understand Metrics:

- SonarQube provides various metrics to evaluate code quality, including:
    - **Coverage:** Percentage of code covered by automated tests.
    - **Duplication:** Percentage of duplicated code in the codebase.
    - **Code Smells:** Indications of potential problems in the code structure.
    - **Security Vulnerabilities:** Identified security issues in the code.

- **Technical Debt:** Estimate of the effort required to fix all code issues.

7. Configure Quality Gates:

- Quality Gates define the conditions for a successful analysis.
- Configure quality gate thresholds for metrics to ensure that only high-quality code is considered acceptable.

8. Custom Rules and Profiles:

- Customize coding rules and quality profiles based on your project's specific requirements.
- SonarQube allows you to create custom rules or modify existing ones to align with your coding standards.

9. Integration with CI/CD:

- Integrate SonarQube analysis into your CI/CD pipeline to ensure that code quality checks are performed automatically with each code commit.
- This integration helps in maintaining a consistent level of code quality throughout the development process.

10. Address Issues:

11. Review and Track Progress:

12. Notifications and Alerts:

SonarQube is a powerful tool for maintaining and improving code quality. Its integration into the development workflow ensures that code quality is not just a one-time effort but an ongoing practice throughout the software development lifecycle. Regular analysis and continuous improvement based on SonarQube reports contribute to the creation of robust, maintainable, and secure software.