90 minutes to build an Autodesk Forge application for project management

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Phuc Le Hieu Hong

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About the speaker

Phuc Le Hieu Hong (Ken)

Phuc Le is a Digital Consultant, BIM Advisor, BIM Application Expert & Forge Developer. He currently serves as a Technical Specialist at Autodesk Asean, supporting firms and organizations in the AEC sector to successfully implement Building Information Modelling, Cloud Collaboration, Computational Design, and Generative Design.
About the speaker

**Uy Vo Le**

**Uy Vo Le** has a degree in civil engineering but he has been working as a BIM Developer for more than 4 years at Woh Hup, Singapore, and now at Cofico, Vietnam. In line with his career objective “Bring as many benefits of IT as possible to Construction Management”, his works focus on developing Revit add-ins and Forge application.
Project scheduling is an important factor that needs to be strictly controlled to ensure the success of a project. Therefore, project team needs a simple, useful application that can also be accessed online in order to perform project management tasks with BIM models during the construction process.

In this class, you will learn how to build a Forge application to visually manage project progress by utilizing BIM models. Forge platform is Cloud-based developer tools from Autodesk. We will introduce Forge APIs by walking through a sample code demonstrations to help you gain access to your BIM data. Forge APIs also provide you the way to manipulate and update more information in BIM models on the cloud.

If you are interested in learning Forge, a powerful cloud application, to innovate the way you work and make the best use of your data then this class is for you.
Learning Objectives

1. FORGE OVERVIEW
   Understand how the Autodesk Forge platform can help overcome challenges in project management

2. VIEW MODELS
   Learn how to use the Forge APIs to upload, convert and display your models in a web browser

3. CUSTOMIZE DATA
   Learn how to use the Forge APIs to access and customize your cloud data and create dashboard

4. BUILD YOUR OWN APP
   Learn how to use the Forge tool to build a project schedule management application of your own
Agenda

AUTODESK FORGE OVERVIEW – FORGE APIS
- What is Forge
- Introduce Forge APIs
- What you can do with Forge
- Forge application for Project Management

BUILD YOUR FORGE APPLICATION FOR PROJECT MANAGEMENT
- Application overview
- Setup the environment
- Understand the code
- Run the code

CONCLUSION
- Summary
- Next steps
Autodesk Forge overview

AUTODESK FORGE
What is Forge?

- FORGE is a *set of web service APIs* that power the future of making things.

*Application Program Interface*

- **Technology:**
Forge takes components from Autodesk’s powerful library of software and delivers them as cloud-based building blocks for companies to create their own new solutions.
Valuable information about how things are designed, made and used is generated, but not always connected.

<table>
<thead>
<tr>
<th>Viewing</th>
<th>Planning</th>
<th>Schedules</th>
<th>Cost Estimating</th>
<th>Fabrication</th>
<th>ERP</th>
<th>CRM</th>
<th>Inspections</th>
<th>Maintenance Services</th>
<th>Purchasing</th>
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File Formats:
- STL
- MicroStation
- SketchUp
- DWG
- DXF
- 3D MAX
- IGES
- FBX

60+ File Formats
The Forge platform makes connections and delivers data.
Components of Forge

TECHNOLOGY
Cloud services

RESOURCES
Information & Tools

COMMUNITY
Partner and customer ecosystem
Forge APIs

**Viewer**
Render 3D and 2D model data within a browser. The models can come from a wide range of applications such as AutoCAD, Fusion 360, Revit, and many more.

**Model Derivative**
Derive outputs viewable by the Forge Viewer from more than 60 CAD file formats, and extract metadata about the models as well as the individual objects within the model.

**Webhooks**
Subscribe to and receive notifications of the occurrence of events within the Forge ecosystem.

**BIM 360**
Integrate with the Autodesk BIM 360 platform to extend its capabilities to reach segments of the construction ecosystem that don't have direct access to BIM data.

**Data Management**
Access data across BIM 360 team, Fusion Team, BIM 360 Docs, and the Object Storage Service to build apps to display and extend your data in ways that add value to your users.

**Reality Capture**
Convert digital images into high resolution textured meshes, dense point clouds and orthophotos.

**Design Automation**
Automate repetitive tasks by leveraging on the scale of the Forge Platform and running scripts on your design files in the cloud.

**Token Flex**
Access Autodesk Token Flex Usage Data platform to generate reports on consumption, usage, and contract details.

**Authentication**
Generate tokens based on the OAuth 2.0 standard to authenticate requests made to Forge APIs and SDKs.
Who is Forge for?

CUSTOMERS

APP DEV PARTNERS

SYSTEM INTEGRATORS
What Customers and Partners Build

- Data Visualization & Analysis
- Digital Twin
- Augmented & Virtual Reality
- SaaS Integration
- Catalogs
- Configurators
- Design Automation
- Photo to 3D
Next challenges in project management

• **The need for customization:**
  - *Customers* who want to improve their project management workflows or create new ones that both drive internal digital innovation and improvements.
  - *App DEV Partners* who want to develop new apps to fill in project management workflows.
  - *System Integrators* who are looking for a platform to provide software development and consulting services to help companies accelerate their business productivity.

• **One of the customization needs for project management is scheduling.** To perform project management tasks in sync with BIM models during the construction progress.
How Forge platform can help overcome these challenges

- End-to-end solution
- Allow to customize
- Cloud-based application
- Forge APIs
- Integration
- Mobility
Build your own Forge application
Forge application for project management

Value Drivers:

• Add valuable context to your data by presenting it on a 3D model.
• Streamline the tracking and management of construction project objects from design through handover.
• Give stakeholders access to project data without requiring them to install a desktop application.
• Single source of truth with BIM models on cloud.
Generic workflow

Display BIM models on your Website → Add/Custom your Data

- Tracking Construction Progress
- Color-Coding Model Components
- Displaying associated data
- Visualization with charts

Add/Custom your Data
Forge application for project management

- **Who is this for**
  For those who are interested in Forge

- **What is required**
  - A Forge account
  - A text editor
  - Basic knowledge of:
    - HTML and CSS
    - JavaScript
    - Node.js, Command Line (for Windows users)
    - Terminal (for Mac/Linux/Unix users)
    - Express Basic Routing
    - Module FS
    - jQuery
Web development

- HTML
  - Content
  - Structural
- CSS
  - Style
  - Presentational
- JS
  - Behavioral

Frameworks and libraries:
- Node.js
- Express
- jQuery
- React
- .NET
- AngularJS
Forge APIs used in this application

- **Authentication (Oauth)** is used to generate tokens based on the Oauth 2.0 specification.
- **Data Management API** is used to upload a file or to access a file stored in Autodesk Cloud storage.
- **Model Derivative API** is used to translate the file to prepare it for viewing.
- **Forge Viewer API** is used to:
  - *Display* an interactive 3D view of the translated model on a webpage.
  - *Detect* when a user clicks on a model component. The web application may then query a database for data related to that component.
  - *Query object data* from the model to prepare data for creating charts in dashboard.
Live hands-on
Step-by-step walkthrough

1 – SET UP
- TEST ENVIRONMENT
- CREATE FORGE APP
- GET THE DATASETS

2 – UNDERSTAND THE CODE
- VIEW MODELS
- UPDATE DATA
- CREATE DASHBOARD

3 – RUN THE CODE

DEBUG & TESTING
Set up

• Getting test environment:
  o Node.js
  o NPM
  o Visual Studio Code

• Creating your Forge app and Getting Forge Client ID and Forge Client Secret
  o Registering an app
  o Forge Client ID
  o Forge Client Secret

• Getting the datasets
View your models - Workflow

Client-side

- http://localhost:3000
- index.html

Web server (Express.js)

- /api/forge/oauth
- /api/forge/oss
  - /buckets
- /api/forge
  - /modelderivative
- Viewer

OAuth
Data Management
Model Derivative
FORGE
Bucket key & Policy key

Note that bucket keys must be of the form `[-a-zA-z0-9]{3,128}`

Each bucket also has a retention policy that determines object retention time, it is the policy key:

- **transient**: Cache-like storage that persists for only 24 hours, ideal for ephemeral objects.
- **temporary**: Storage that persists for 30 days.
- **persistent**: Storage that persists until it’s deleted.
Model Derivative API

Source Files → Model Derivative API

Output

- File Translation
- Thumbnails
- Geometry Extraction
- Data Extraction
## Frontend JS vs Backend JS

<table>
<thead>
<tr>
<th>Frontend JavaScript</th>
<th>Backend JavaScript</th>
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</thead>
<tbody>
<tr>
<td>Referenced from within an HTML file.</td>
<td>Not placed inside or accessed from within an HTML file.</td>
</tr>
<tr>
<td>Runs on the end user's web browser and hence is visible to end users and can be</td>
<td>Runs on a Node.js server and is not visible to end user on their browser.</td>
</tr>
<tr>
<td>changed by them.</td>
<td></td>
</tr>
<tr>
<td>Changes to the code only require a page refresh.</td>
<td>Changes to the code require restarting the Node.js server.</td>
</tr>
<tr>
<td>The script must not contain any sensitive data.</td>
<td>Can contain sensitive data such as the API key.</td>
</tr>
<tr>
<td>Example: index.html</td>
<td>Example: start.js</td>
</tr>
</tbody>
</table>
Update model data - Workflow

Client-side

- Viewer Extensions
  - Custom Menu
  - Status Toolbar Button

Web server (Express.js)

- /api/forge
  - /saveFile

- statusfile.json
  - save
  - get

- Local file
- MySQL database
- SQL server
- Mongo DB

Data structure

```
{
ModelId: string,
AddCompleted: string[],
AddActive: string[],
AddPlanned: string[]
}
```

indexOf.html
Create Dashboard - Workflow

Client-side

- Viewer Extensions
  - Custom Menu
  - Status Toolbar Button

Web server (Express.js)

- /api/forge/saveFile
  - Get status data
    - Prepare data (DashboardPanel.js)
      - Add chart
        - Bar chart
        - Pie chart

- index.html

- New Dashboard
  - Dashboard

- Viewer

FORGE
Forge application for project management
Conclusion
In today’s session, we learned how to

• Set up a simple Express web server
• Two-Legged Authentication using the Forge Authentication APIs
• Create a bucket (Data Management API)
• Upload a file and save it as an object in a bucket (Data Management API)
• Read objects from a bucket (Data Management API)
• Translate the object into the SVF format (Model Derivative API)
• Display the SVF data in a web browser (Viewer API)
• Add custom properties to models’ objects. (Viewer Extension)
• Save added data.
• Getting current data of models.
• Retrieve added custom data for displaying on dashboard.
• Add dashboard: bar chart and pie chart (Viewer API)
Benefits

Increased Productivity
Enhance project status visibility, easily customize and view objects statuses

Streamlined Workflow
Connect objects information with BIM models and issues, checklists in a centralized repository

Share Data Across Teams
Instantly collaborate with team members located anywhere in office or construction site
Next steps

• Deployment:
  o Amazon Web Services
  o Microsoft Azure
  o Heroku

• Advanced Forge application
  • Integrate your apps and services with BIM 360

• Support & Online resources
  o Developer Portal is the "source of truth" on Forge!
  o Samples: Autodesk Forge on Github
  o Blog: Forge Blog

• Getting help
  o https://forge.autodesk.com/FAQ
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3. **Customize Data**
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4. **Build Your Own App**
   - Learn how to use the Forge tool to build a project schedule management application of your own
Thank you!

If you have any questions or concerns, please feel free to comment on the class page.

Don’t forget to press the Recommend button and get all materials of my AU classes at the following link.