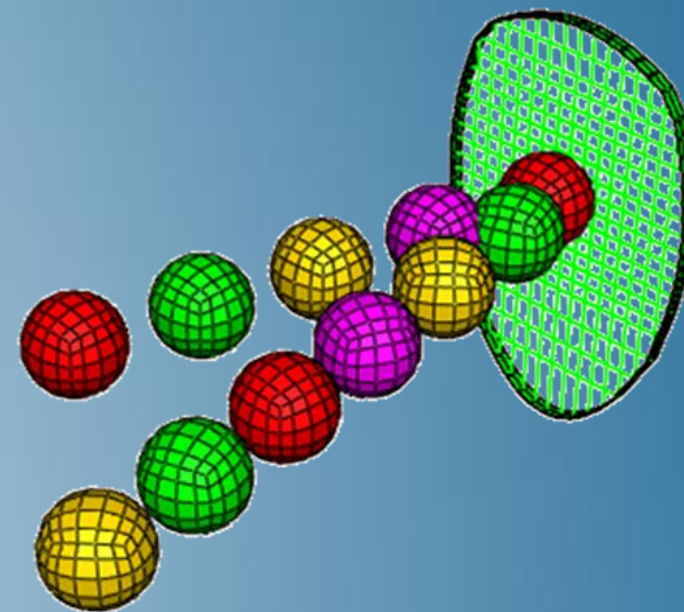


# Introduction to Abaqus Scripting

Abaqus 2018



**3DEXPERIENCE®**



# About this Course

## Course objectives

- ▶ Help students to develop a high level understanding of the Abaqus scripting capabilities.
- ▶ Organize and present the technical details of Python and the Abaqus Scripting Interface.
- ▶ Expose the strengths and weaknesses of Abaqus scripting.
- ▶ Encourage the student to use scripting in new ways.

## Targeted audience

Simulation Analysts

## Prerequisites

None



2 days

# Day 1

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- ▶ Lecture 1                      Overview of Scripting in Abaqus
  - Workshop 1      Creating a Basic Abaqus Script
  
- ▶ Lecture 2                      Why Python?
  - Workshop 2      Running Python
  
- ▶ Lecture 3                      Python Core Language Part 1
  - Workshop 3      Python Types, Operators, and Expressions
  - Workshop 4      Investigating Python Objects
  
- ▶ Lecture 4                      Python Core Language Part 2
  - Workshop 5a     Defining functions
  - Workshop 5b     Defining a Function for a Series Calculation (optional)
  - Workshop 6      Modules

## Day 2

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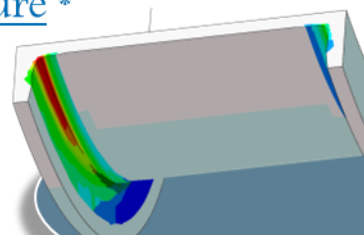
- ▶ Lecture 5                    Abaqus Scripting Interface Basics
  - Workshop 7    Creating a Macro and Getting Input interactively
- ▶ Lecture 6                    Abaqus Object Model
  - Workshop 8    Working with the Session Object
- ▶ Lecture 7                    Postprocessing with Abaqus Scripting
  - Workshop 9    Working with the ODB Object
  - Workshop 10   Linear Superposition of Results
- ▶ Lecture 8                    Miscellaneous Topics
  - Workshop 11   Creating Kernel and GUI Scripts
  - Workshop 12   Setting Abaqus Defaults

# SIMULIA

- ▶ SIMULIA is the Dassault Systèmes brand for Realistic Simulation solutions
- ▶ Portfolio of established, best-in-class products
  - Abaqus, Isight, Tosca, fe-safe, Simpack

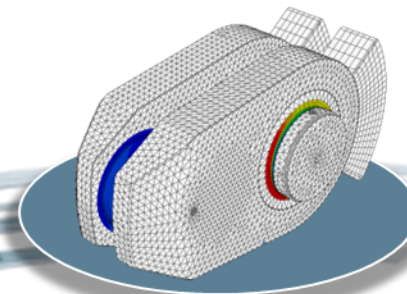
## Design Optimization: Tosca Structure \*

Simulation-driven design refinement to improve performance



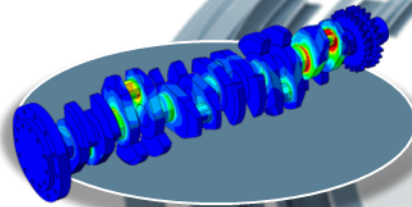
## Durability Assessment: fe-safe \*

Accurate life estimation to achieve certification



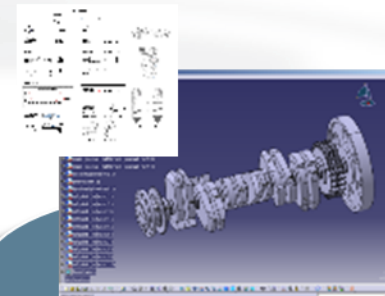
## FEA Stress Analysis: Abaqus \*

Detailed stress analysis using extracted load history from MBS



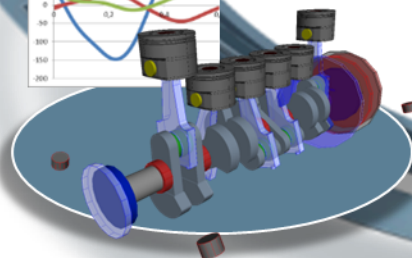
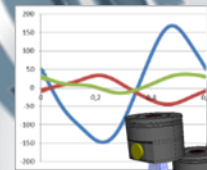
## CAD Geometry: CATIA

Fully parameterized 3D geometry; FEA model generation via associative interface



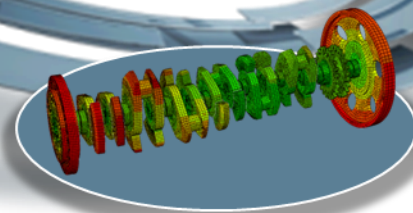
## Multibody Simulation: Simpack

System analysis to extract virtual load history of complete working cycle



## Mesh Calibration: Isight \*

Automated mesh calibration; sufficient mesh quality for accurate results

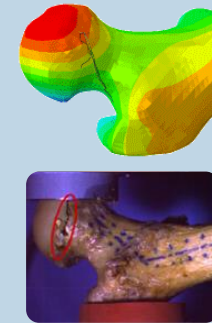


\* Included in extended licensing pool

# SIMULIA's Power of the Portfolio

## Abaqus

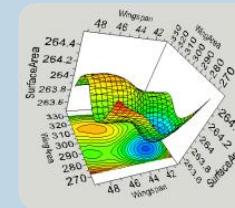
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



**Realistic Human Simulation  
High Speed Crash & Impact  
Noise & Vibration**

## Isight

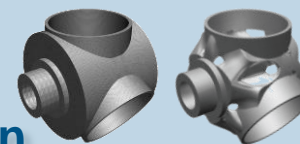
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



**Material Calibration  
Workflow Automation  
Design Exploration**

## Tosca

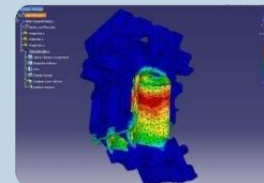
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



**Conceptual/Detailed Design  
Weight, Stiffness, Stress  
Pressure Loss Reduction**

## fe-safe

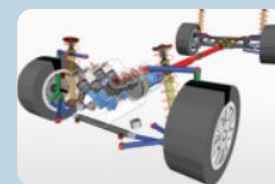
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



**Safety Factors  
Creep-Fatigue Interaction  
Weld Fatigue**

## Simpack

- 3D Multibody Dynamics Simulation
- Mechanical or Mechatronic Systems
- Detailed Transient Simulation (Offline and Realtime)



**Complete System Analyses  
(Quasi-)Static, Dynamics, NVH  
Flex Bodies, Advanced  
Contact**



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## Revision Status

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Lecture 1	11/17	Updated for Abaqus 2018
Lecture 2	11/17	Updated for Abaqus 2018
Lecture 3	11/17	Updated for Abaqus 2018
Lecture 4	11/17	Updated for Abaqus 2018
Lecture 5	11/17	Updated for Abaqus 2018
Lecture 6	11/17	Updated for Abaqus 2018
Lecture 7	11/17	Updated for Abaqus 2018
Lecture 8	11/17	Updated for Abaqus 2018
Appendix 1	11/17	Updated for Abaqus 2018
Workshop 1	11/17	Updated for Abaqus 2018
Workshop 2	11/17	Updated for Abaqus 2018
Workshop 3	11/17	Updated for Abaqus 2018
Workshop 4	11/17	Updated for Abaqus 2018
Workshop 5a	11/17	Updated for Abaqus 2018
Workshop 5b	11/17	Updated for Abaqus 2018
Workshop 6	11/17	Updated for Abaqus 2018
Workshop 7	11/17	Updated for Abaqus 2018
Workshop 8	11/17	Updated for Abaqus 2018
Workshop 9	11/17	Updated for Abaqus 2018
Workshop 10	11/17	Updated for Abaqus 2018
Workshop 11	11/17	Updated for Abaqus 2018
Workshop 12	11/17	Updated for Abaqus 2018

# Lesson 1: Overview of Scripting in Abaqus

## *Lesson content:*

- ▶ Overview
- ▶ Terminology
- ▶ Types and Languages for Customizing Abaqus
- ▶ Abaqus Python Resources
- ▶ Examples
- ▶ Abaqus Scripting Interface Basics
- ▶ Workshop Preliminaries
- ▶ Workshop 1: Creating a Basic Abaqus Script



75 minutes

# Lesson 2: Why Python?

## *Lesson content:*

- ▶ High Level Description of the Language
- ▶ Why Python?
- ▶ Growing Python Universe
- ▶ Running Python
- ▶ Lexical Convention and Syntax
- ▶ Workshop 2: Running Python



2 hours



# Lesson 3: Python Core Language Part 1

## *Lesson content:*

- ▶ Types Overview
- ▶ Principal built-in types
- ▶ Operators and Expressions
- ▶ Workshop 3: Python Types, Operators, and Expressions
- ▶ Objects
- ▶ Workshop 4: Investigating Python Objects



3 hours

# Lesson 4: Python Core Language Part 2

## *Lesson content:*

- ▶ Control Flow
- ▶ Functions
- ▶ Workshop 5a: Defining functions
- ▶ Workshop 5b: Defining a Function for a Series Calculation (optional)
- ▶ Modules
- ▶ Namespaces
- ▶ Exceptions
- ▶ Common Issues for New Users
- ▶ Workshop 6: Modules



3 hours

# Lesson 5: Abaqus Scripting Interface Basics

## *Lesson content:*

- ▶ Abaqus PDE
- ▶ Abaqus Namespaces
- ▶ Abaqus Macro Scripts
- ▶ Abaqus Python Style Guide
- ▶ Getting Input
- ▶ Workshop 7: Creating a Macro and Getting Input interactively



1.5 hours

# Lesson 6: Abaqus Object Model

## *Lesson content:*

- ▶ Introduction to Object Oriented Programming
- ▶ Abaqus Object Model Basics
- ▶ The Session Object
- ▶ The Mdb Object
- ▶ Exploring Your Data
- ▶ Abaqus Data Types
- ▶ Abaqus Modules
- ▶ Workshop 8: Working with the Session Object



2.5 hours



# Lesson 7: Postprocessing with Abaqus Scripting

## *Lesson content:*

- ▶ The Odb Object
- ▶ Writing to the Odb
- ▶ Examples
- ▶ Workshop 9: Working with the ODB Object
- ▶ Workshop 10: Linear Superposition of Results



2.5 hours

# Lesson 8: Miscellaneous Topics

## *Lesson content:*

- ▶ Plug-ins
- ▶ Really Simple GUI (RSG)
- ▶ Job Monitoring
- ▶ Custom Data
- ▶ Setting Abaqus Defaults
- ▶ Workshop 11: Creating Kernel and GUI Scripts
- ▶ Workshop 12: Setting Abaqus Defaults



3 hours

# Appendix 1

## *Appendix content:*

- ▶ Data Types
- ▶ Objects
- ▶ Common Issues for New Users
- ▶ Setting Abaqus Defaults
- ▶ Copy of Objects
- ▶ Custom Data
- ▶ Abaqus PDE Extras
- ▶ Object Oriented Programming: Inheritance



30 minutes