Course objectives
Upon completion of this course you will be able to:

- Define general contact and contact pairs
- Define appropriate surfaces (rigid or deformable)
- Model frictional contact
- Model large sliding between deformable bodies
- Resolve overclosures in interference fit problems

Targeted audience
Simulation Analysts

Prerequisites
This course is recommended for engineers with experience using Abaqus/Standard

About this Course
2 days
Day 1

- Lecture 1: Introduction
- Lecture 2: Contact Workflow
  - Workshop 1: Compression of a Rubber Seal
- Lecture 3: Surface-based Contact
  - Workshop 2: Lap Joint Analysis
- Lecture 4: Contact Logic and Diagnostics Tools
  - Workshop 3: Bolted Flange Analysis
Day 2

Lecture 5: Contact Properties
  Workshop 4 Disk Forging Analysis

Lecture 6: Interference Fits
  Workshop 5 Interference Fit Analysis
  Workshop 6 Syringe Analysis (optional)

Lecture 7: Additional Features
  Workshop 7 Pipe Reel Analysis

Lecture 8: Modeling Tips
  Workshop 8 Snap Fit Analysis
  Workshop 9 Analysis of a Radial Shaft Seal
Additional Material

- Appendix 1: Node-to-Surface Formulation
- Appendix 2: Contact Elements
- Appendix 3: Dynamic Contact using Implicit Integration
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  - Abaqus, Isight, Tosca, fe-safe
  - All using a common extended licensing pool
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Abaqus
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Fluid, Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization

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

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

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

Realistic Human Simulation
High Speed Crash & Impact
Noise & Vibration

Material Calibration
Workflow Automation
Design Exploration

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

Safety Factors
Creep-Fatigue Interaction
Weld Fatigue
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Lesson 1: Introduction

Lesson content:

- General Considerations
- Surface-based Contact
- Contact Examples
- Ingredients of a Contact Model

30 minutes
Lesson 2: Contact Workflow

Lesson content:

- Defining Contact Pairs
- Defining Surfaces for Contact Pairs
- Defining General Contact
- Workshop Preliminaries
- Workshop 1: Compression of a Rubber Seal (IA)
- Workshop 1: Compression of a Rubber Seal (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.
Lesson 3: Surface-based Contact

Lesson content:

- Contact Formulations
- Contact Discretization
- Contact Enforcement Methods
- Relative Sliding Between Bodies
- Output of Contact Results
- Summary
- Workshop 2: Lap Joint Analysis (IA)
- Workshop 2: Lap Joint Analysis (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.
Lesson 4: Contact Logic and Diagnostics Tools

Lesson content:

- Newton Method
- The Contact Algorithm
- Contact Diagnostics: Visual
- Contact Diagnostics: Text
- Workshop 3: Bolted Flange Analysis (IA)
- Workshop 3: Bolted Flange Analysis (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.
Lesson 5: Contact Properties

Lesson content:

- Pressure-Overclosure Models
- Friction Models
- Friction Enforcement
- Workshop 4: Disk Forging Analysis (IA)
- Workshop 4: Disk Forging Analysis (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.
Lesson 6: Interference Fits

Lesson content:

- Initial Overclosure
- Strain-free Adjustments
- Interference Fit Problems
- Interference Fit Techniques for General Contact
- Interference Fit Techniques for Contact Pairs
- Interference Fit Example
- Precise Specification of Clearances
- Geometric Smoothing for Curved Surfaces
- Workshop 5: Interference Fit Analysis (IA)
- Workshop 5: Interference Fit Analysis (KW)
- Workshop 6: Syringe Analysis (IA)
- Workshop 6: Syringe Analysis (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.
Lesson 7: Additional Features

Lesson content:

- Beam Contact
- Tie Constraints
- Rigid Bodies and Contact
- Analytical Rigid Surfaces
- Pre-Tensioning of Cross-Sections
- Pressure Penetration
- Workshop 7: Pipe Reel Analysis (IA)
- Workshop 7: Pipe Reel Analysis (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.
Lesson 8: Modeling Tips

Lesson content:

- Initial Rigid Body Motion
- Overconstraint
- Contact with Quadratic Elements
- Unsymmetric Matrices in Finite-Sliding Problems
- Dynamic Instabilities
- Modeling Corners and Edges
- Workshop 8: Snap Fit Analysis (IA)
- Workshop 8: Snap Fit Analysis (KW)
- Workshop 9: Analysis of a Radial Shaft Seal (IA)
- Workshop 9: Analysis of a Radial Shaft Seal (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.
Appendix 1: Node-to-Surface Formulation

Appendix content:

- Discretization
- Finite Sliding: Surface Considerations
- Small Sliding Characteristics
- Small Sliding: Local Contact Plane
- Small Sliding: Surface Considerations
Appendix 2: Contact Elements

**Appendix content:**

- Surface-Based vs. Contact Element Approach
- Contact Elements
- Contact Element Output
- Contact Element Visualization
Appendix 3: Dynamic Contact using Implicit Integration

Appendix content:

- Time Integration Issues
- Implicit Dynamics
- Damping
- Impact Problems
- Contact in Linear Perturbation Procedures