

# Writing User Subroutines with Abaqus

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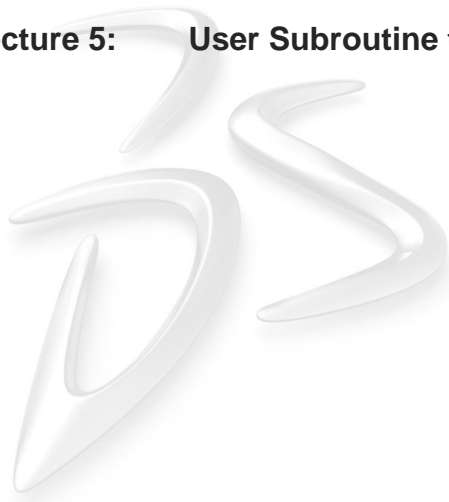


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## Day 1

- **Lecture 1:** Introduction
- **Lecture 2:** User Subroutines (V)DLOAD and UTRACLOAD
- **Lecture 3:** User Subroutine FILM
- **Workshop 1:** User Subroutine FILM
- **Lecture 4:** User Subroutine (V)USDFLD
- **Lecture 5:** User Subroutine URDFIL

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## Day 2

- Lecture 6: User Subroutine `UVARM`
- Lecture 7: Writing a `UMAT` or `VUMAT`
- Workshop 2: User Subroutine `UMAT`: Tangent Stiffness
- Lecture 8: Creating a Nonlinear User Element (`UEL` and `VUEL`)



## Appendices

- Appendix 1: Logical Modeling in Abaqus
- Workshop 3: Controlling an Inverted Pendulum with `VUAMP`



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## Revision Status

Lecture 1	5/11	Updated for 6.11
Lecture 2	5/11	Updated for 6.11
Lecture 3	5/11	Updated for 6.11
Lecture 4	5/11	Updated for 6.11
Lecture 5	5/11	Updated for 6.11
Lecture 6	5/11	Updated for 6.11
Lecture 7	5/11	Updated for 6.11
Lecture 8	5/11	Updated for 6.11
Appendix 1	5/11	Updated for 6.11
Workshop 1	5/11	Updated for 6.11
Workshop 2	5/11	Updated for 6.11
Workshop 3	5/11	Updated for 6.11
Workshop Answers 1	5/11	Updated for 6.11
Workshop Answers 2	5/11	Updated for 6.11



# Introduction

## Lecture 1

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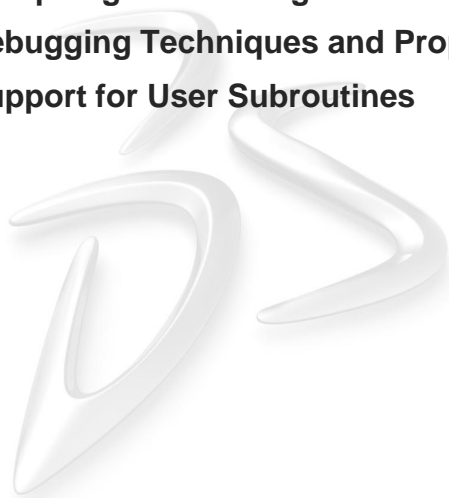
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L1.2

### Overview

- Overview of Some User Subroutines
- Where User Subroutines Fit into Abaqus/Standard
- Including User Subroutines in a Model
- Writing Output from User Subroutines
- Compiling and Linking User Subroutines
- Debugging Techniques and Proper Programming Habits
- Support for User Subroutines

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# User Subroutines (V)DLOAD and UTRACLOAD

Lecture 2

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## Overview

- Introduction
- Abaqus Usage
- DLOAD Subroutine Interface
- Example: Viscoelastic Cylinder
- Example: Asymmetric Pressure Loads
- VDLOAD Subroutine Interface
- Example: Viscoelastic Cylinder Revisited
- UTRACLOAD Subroutine Interface
- Example: Flexure of a Cantilever Beam

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# User Subroutine FILM

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## Overview

- Introduction
- Abaqus Usage
- FILM Subroutine Interface
- Example: Radiation in Finned Surface
- Workshop: User Subroutine FILM

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# User Subroutine (V)USDFLD

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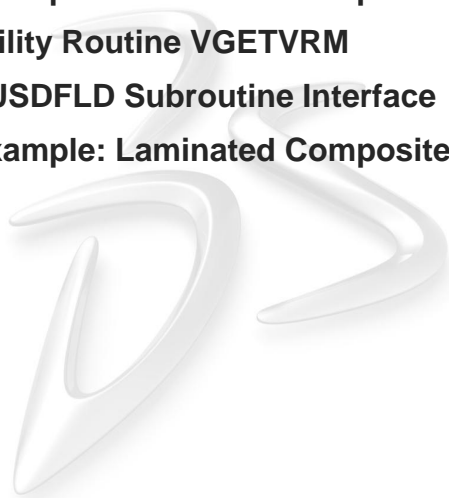
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## Overview

- Introduction
- Abaqus Usage
- Utility Routine GETVRM
- USDFLD Subroutine Interface
- Example: Laminated Composite Plate Failure
- Utility Routine VGETVRM
- VUSDFLD Subroutine Interface
- Example: Laminated Composite Plate Failure Revisited

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# User Subroutine URDFIL

Lecture 5

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## Overview

- Introduction
- Abaqus Usage
- URDFIL Subroutine Interface
- Example: Using URDFIL to Terminate an Analysis

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# User Subroutine UVARM

Lecture 6

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## Overview

- Introduction
- Abaqus Usage
- UVARM Subroutine Interface
- Example: Calculation of Stress Relative to Shift Tensor
- Creating Contour Plots for UELs

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# Writing a UMAT or VUMAT

Lecture 7

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## Agenda

- Overview
- Motivation
- Steps Required in Writing a UMAT or VUMAT
- UMAT Interface
- Example 1: UMAT for Isotropic Isothermal Elasticity
- Example 2: UMAT for Non-Isothermal Elasticity
- Example 3: UMAT for Neo-Hookean Hyperelasticity
- Example 4: UMAT for Kinematic Hardening Plasticity
- Example 5: UMAT for Isotropic Hardening Plasticity
- VUMAT Interface
- Example 6: VUMAT for Isotropic Isothermal Elasticity
- Example 7: VUMAT for Neo-Hookean Hyperelasticity
- Example 8: VUMAT for Kinematic Hardening Plasticity
- Example 9: VUMAT for Isotropic Hardening Plasticity

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# Creating a Nonlinear User Element

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## Overview

- Motivation
- Defining a User Element in Abaqus/Standard
- UEL Interface
- Example 1: Planar Beam Element with Nonlinear Section Behavior
- Example 2: Force Control Element
- Example 3: Plane Strain Element
- UELMAT Interface
- Using Nonlinear User Elements in Various Analysis Procedures
- Defining a User Element in Abaqus/Explicit
- VUEL Interface
- Example 4: Three-Dimensional Truss Element

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# Logical Modeling in Abaqus

Appendix 1

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## Overview

- Introduction
- Defining Logical Modeling
- Example: Force Control
- Workshop

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