**Carnegie Mellon University**

# 1 Automate Robot Assembly

The Week 5 problem set assignment focuses on design automation. The goal of the assignment is to write some simple rules to retrieve parameters from an Excel spreadsheet and drive the various properties and components of the assembly accordingly. Once the rules have been written the robot assembly should update by running one main rule which runs all the other rules.
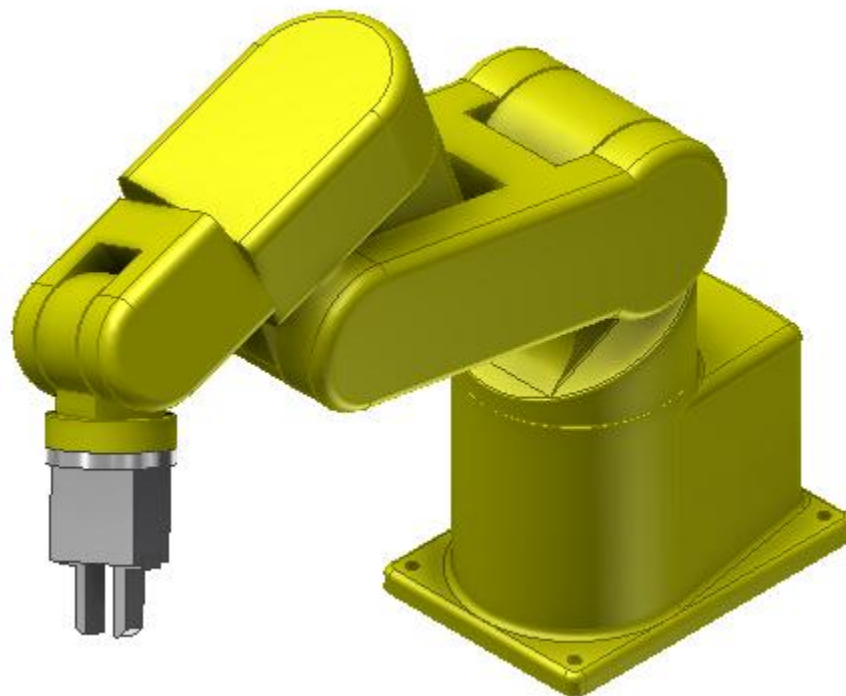


## 1.1 Provided Items

To start the assignment you are provided 14 files consisting of Autodesk Inventor part and assembly files in a ZIP file. **Week 5 Problem Set Instructions.mp4** is a video showing the requirements for this problem set. Using the provided files, write the rules to drive the robot assembly.

- Week 5 - Problem Set Files.zip containing:
  - *Robot-Assembly-A.iam*
  - *Robot-Base-Specifications.xls*
  - 12 Autodesk Inventor part and assembly files

## 1.2  Final Deliverable

Please submit a zip file with the final assembly and all the parts and sub-assemblies to ensure everything in the assembly is collected.   Use Inventor's Pack and Go.   Prior to running the Pack and Go make sure you have set the **Intro to CAD & CAE.ipj** project file active. (See the Appendix at the end of this document for the steps to use Pack and Go)

- Save the *Robot-Assembly-A.iam* using  the following naming convention:

    **ps5_your_andrew_id**

## 1.3  Grading

Grading for this problem set will be based on the following elements:
- 100% - Fulfillment of all (4) four of the Automation Requirements

## Automation Requirement 1

Add parameters to the robot assembly. The **Bold** word is the parameter name, units. The text in the parenthesis will be added as the tool tip for the parameter.

- populate multi-value lists for:
    - **Robot_Color, Text,** (Color of robot components)
        - Yellow
        - Blue
        - Orange
    - **Robot_Capacity, kg,** (Weight (in kg) of load handling capacity)
        - 50
        - 100
        - 250
        - 500

        NOTE: This multi-value list should be pulled from the *Robot-Base-Specifications.xls*
    - **End_Effector, Text**
        - Gripper
        - Welder

- set default values
    - **Base_Hole_Offset, mm,** (Distance from edge of base to center of mount hole)
        - **15**
    - **Base_Max_End_Hole_Spacing, mm,** (Maximum distance between holes in end of base)
        - **200**
    - **Base_Max_Side_Hole_Spacing, mm,** (Maximum distance between holes in side of base)
        - **250**

## Automation Requirement 2

Create a **Robot Assembly Parameters** form.

- *User Interface* – a tab group which contains the parameters a user will normally want to manipulate
  - o Group all of the "axis angle" parameters in an *Axis Angle* group
- *Standards* – a tab group which contains "standard" parameters a user will normally NOT need to manipulate
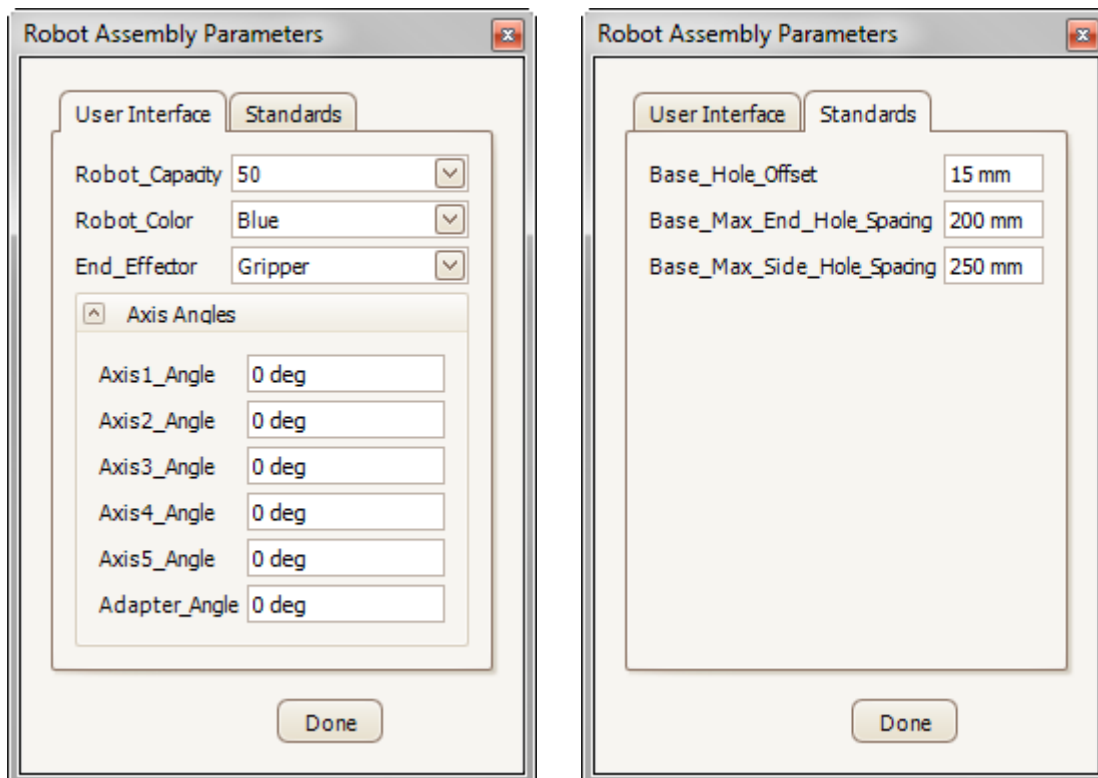
# ME 24-688 – Week 5
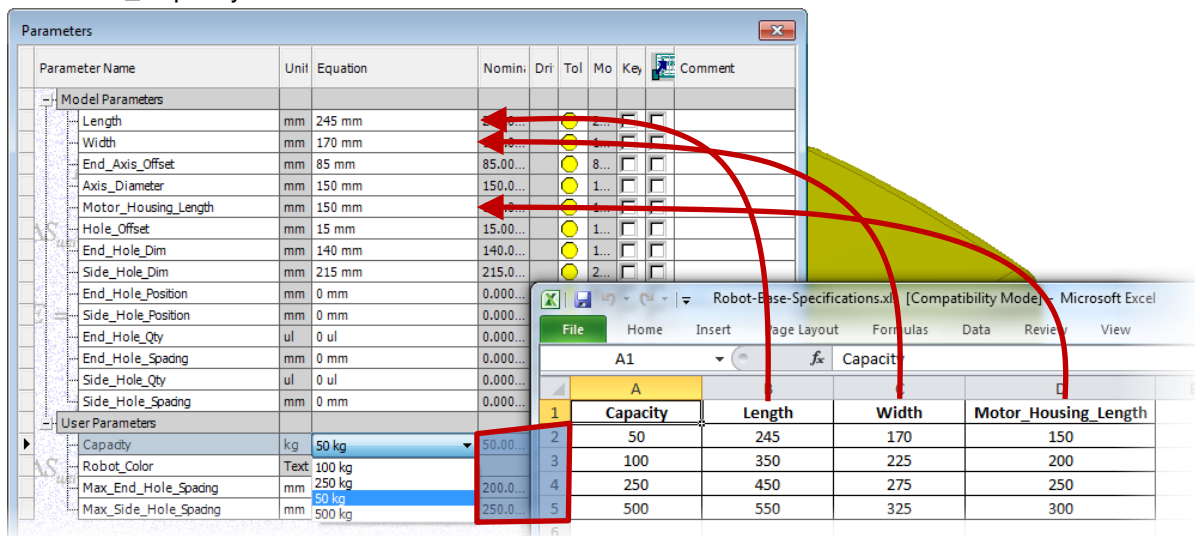
# Problem Set Assignment

## Automation Requirement 3

Write the following rules to drive the robot assembly. The **Bold** word is the rule name:

- **Parameter Rule** – Validate the parameters from the **Robot Assembly Parameters** form based on the tool tips outlined below. (Tip: Use the *Parameter Limits* wizard to generate the iLogic code.)
    - **Axis1_Angle, deg,** (Angle between base and axis1 (-180 degrees to 180 degrees))
    - **Axis2_Angle, deg,** (Angle between axis1 and axis2 (25 degrees to 205 degrees))
    - **Axis3_Angle, deg,** (Angle between axis2 and axis3 (180 degrees to 360 degrees))
    - **Axis4_Angle, deg,** (Angle between axis3 and axis4 (-180 degrees to 180 degrees))
    - **Axis5_Angle, deg, (**Angle between axis4 and axis5 (-90 degrees to 90 degrees))
    - **Adapter_Angle, deg, (**Angle between axis5 and the adapter (-180 degrees to 180 degrees))
- **Color Rule** – Passes the color parameter to each robot component and add a rule in the component to control the color of the part (not end effectors)
- **End Effector Rule** – Sets the end effector
- **Robot Base Rule** – Passes parameters required to drive the *Robot-Base-Model-A* component
- **iProperties Rule** – Sets Author, Designer, and Description for the assembly (generate an appropriate description based on capacity, color and end effector)
    - Below is how the Description iProperty should appear:
        - Capacity: 50 kg - Color: Yellow - Application: Gripper Robot

## Automation Requirement 4

Write the following rules to drive the **Robot-Base-Model-A.ipt** component. The **Bold** word is the rule name:

- **Parameter Rule** – Sets parameter values from *Robot-Base-Specifications.xls* based on selected Robot_Capacity



- **End Axis Offset Rule** – Calculates **End_Axis_Offset** so axis & motor housing feature is centered on base
- **Mount Hole Rule**

- o Sets parameters for all mount hole positions and patterns so the quantity of holes and the spacing between the holes never exceed the corresponding maximum spacing parameter, while maintaining the standard **Hole_Offse**t around the perimeter.
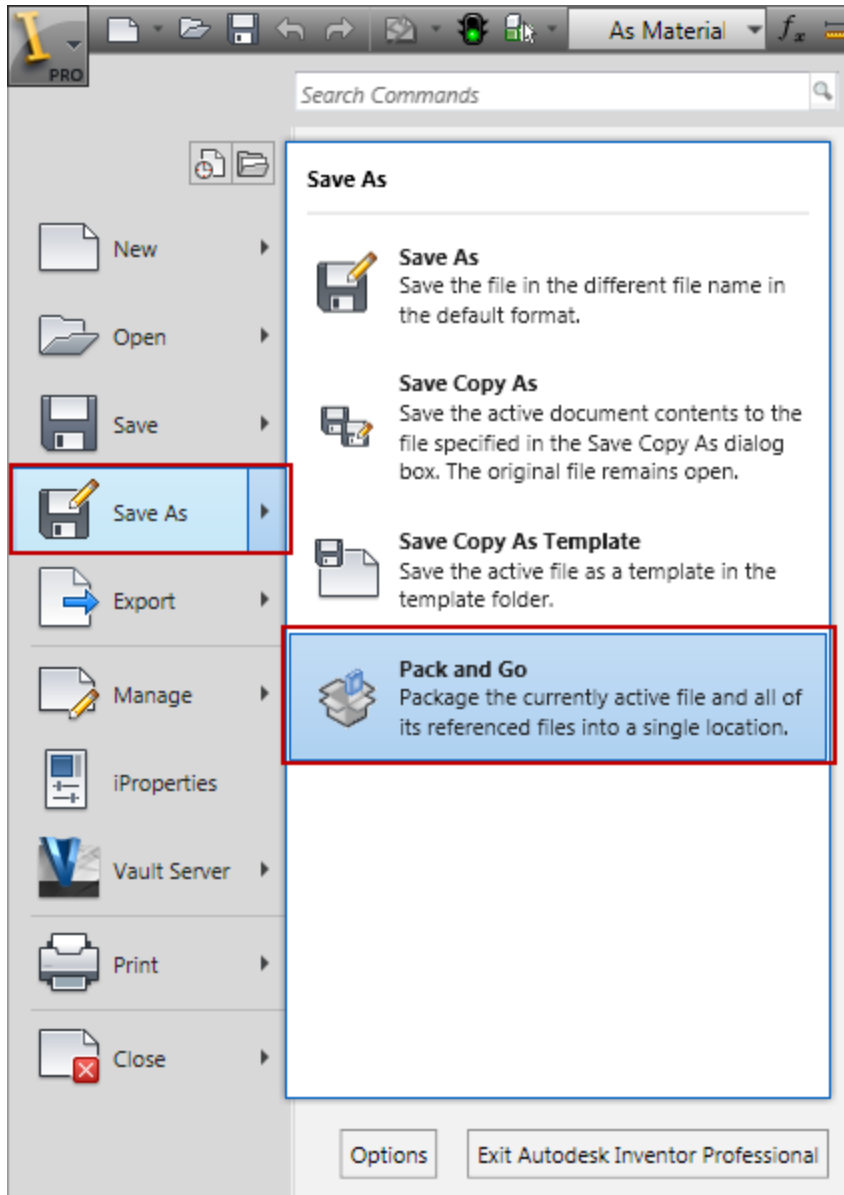- o Suppresses end holes and side holes if capacity is equal to 50 kg
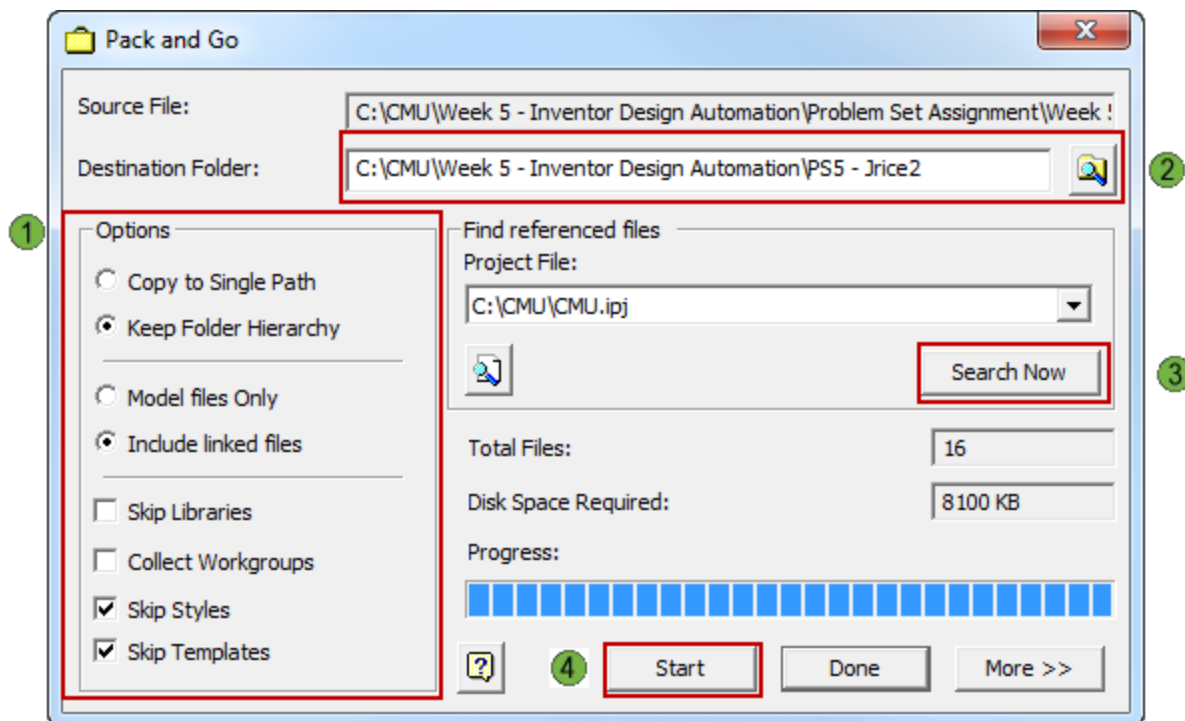
## 1.4  Pack and Go

The following images show the steps to use Pack and Go

NOTE: Make sure the Intro To CAD & CAE project is set active and all files are in a sub folder of the workspace.

① Set the **Options** as shown above.

② Set the **Destination Folder**.

③ Click **Search Now.**

④ Click **Start**.