# ME 24-688 – Week 5 Problem Set Assignment



#### 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
  - o Robot-Base-Specifications.xls
  - o 12 Autodesk Inventor part and assembly files

### **Problem Set Assignment**

#### **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





### **Problem Set Assignment**

#### **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:

0

- Robot\_Color, Text, (Color of robot components)
  - Yellow
  - Blue
  - Orange
- **Robot\_Capacity, kg,** (Weight (in kg) of load handling capacity)
  - **5**0
  - 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
  - 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

Robot Assembly Pa	rameters 🗾									
User Interface	Standards									
Robot_Capacity	50 🗸									
Robot_Color	Blue 🕑									
End_Effector	Gripper 🕑									
Axis Angles	Axis Angles									
Axis1_Angle	0 deg									
Axis2_Angle	0 deg									
Axis3_Angle	0 deg									
Axis4_Angle	0 deg									
Axis5_Angle	0 deg									
Adapter_Angle	e 0 deg									
	Done									

Robot Assembly Parameters						
User Interface Standards						
Base_Hole_Offset 15 mm						
Base_Max_End_Hole_Spacing 200 mm						
Base_Max_Side_Hole_Spacing 250 mm						
Done						

### **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

ara	meter Name	Unit	Equation	Nomini	Dri	Tol	Мо	Key	2	Comment					
IN	Model Parameters														
57	Length	mm	245 mm	<b></b>		0	2	E.							
1	Width	mm	170 mm	<b>-</b>		0	1								
	End_Axis_Offset	mm	85 mm	85.00		Ō	8								
18	Axis_Diameter	mm	150 mm	150.0		Ō	1								
i.	Motor_Housing_Length	mm	150 mm	<b></b>		0	<b>1</b>					$\mathbf{\Sigma}$			
7	Hole_Offset	mm	15 mm	15.00		0	1								
щ	End_Hole_Dim	mm	140 mm	140.0		0	1					- N			
6	Side_Hole_Dim	mm	215 mm	215.0		0	2								
	End_Hole_Position	mm	0 mm	0.000			10	- 0	- I	- Robot-B	ase-Specif	fications.xl	[Compat	ibility Model - Mic	rosoft Exce
	Side_Hole_Position	mm	0 mm	0.000			-1								
	End_Hole_Qty	ul	0 ul	0.000		File		Hor	me	Insert	age Layo	ut For	ulas	Data Review	View
	End_Hole_Spacing	mm	0 mm	0.000				A1		<b>-</b> (0	$f_x$	Capacit			
	Side_Hole_Qty	ul	0 ul	0.000		6		٨							
	Side_Hole_Spacing	mm	0 mm	0.000	1	i-	0	-			ath	14/	l d+b	Motor Housin	a Longth
ΗL	Jser Parameters				1		Сара		лу		igui	vv		Motor_Housing_Length	
	Capacity	kg	50 kg	▼ 50.00	2	H		50		24	45	1	./U	150	
- C - C - C - C - C - C - C - C - C - C	Robot_Color	Text	100 kg		3	L		100		35	50	2	25	200	
5	197														
w	Max_End_Hole_Spacing	mm	250 kg	200.0	4	L		250		45	50	2	75	250	

- End Axis Offset Rule Calculates End\_Axis\_Offset so axis & motor housing feature is centered on base
- Mount Hole Rule



### **Problem Set Assignment**

- 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\_Offset around the perimeter.
- $\circ$  Suppresses end holes and side holes if capacity is equal to 50 kg



### **Problem Set Assignment**

#### 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.





## **Problem Set Assignment**

Í	Pack and Go		×						
	Source File: C:\CMU	\Week 5 - Inventor Design Automation\Problem S	et Assignment\Week !						
	Destination Folder: C:\CMU	\Week 5 - Inventor Design Automation\PS5 - Jrice	2 2						
1	Options Copy to Single Path	Find referenced files Project File: C:\CMU\CMU.ipj							
	C Model files Only	<u>a</u>	Search Now 3						
	• Include linked files	Total Files:	16						
	Skip Libraries	Disk Space Required:	8100 KB						
	Collect Workgroups	Progress:							
	Skip Styles								
	Skip Templates	C 4 Start Done	More >>						
1	Set the <b>Options</b> as shown abov	e.							
2	Set the <b>Destination Folder</b> .								
3	Click Search Now.								

#### 4 Click Start.