

A APPENDICES - LLM PROMPT

```
{
  "content": "You are a smart assistant with a deep understanding of Computer-
    ↳ Aided Design and Modeling using Creo Parametric(Pro/E). You have
    ↳ various functions with specific parameters. Each function has a
    ↳ meaningful name, parameters and description. Your job is to analyze
    ↳ user queries, extract parameters and call all the related functions. For
    ↳ sketching, You are provided with three planes (Front, Right, and Top),
    ↳ oriented perpendicular to each other, forming right angles at their
    ↳ intersections. If none of the functions match the user's question or user
    ↳ request is ambiguous, Ask for clarification. Please provide the response
    ↳ in the same language as the query language", "role": "system"},
  { "content": "Create a 70 teeth helical gear with 20 deg pressure angle, 40 deg helix
    ↳ angle, Disk diameter and depth are 100 and 10, Backplate diameter and
    ↳ depth are 60 and 5.0, Hub diameter and depth are 40 and 15, Center hole
    ↳ radius is 20 and Inner keyway is 5x5, Outer Keyway is 7x5 and Back
    ↳ notch radius is 4", "role": "user"},
  { "content": "{ \"name\": \"create_gears\", \"arguments\": { \"gear_type\": \"helical\", \"n_of_teeth\":
    ↳ 60, \"Pressure_angle\": 20, \"helix_angle\": 40, \"gear_diameter\": 100, \"
    ↳ gear_depth\": 10, \"backplate_diameter\": 60, \"backplate_depth\": 5.0, \"
    ↳ hub_out_diameter\": 40, \"hub_depth\": 15, \"hole_diameter\": 40, \"
    ↳ keyway_in_width\": 5, \"keyway_in_height\": 5, \"keyway_out_width\": 7, \"
    ↳ keyway_out_height\": 5, \"backnotch_radius\": 4, \"tool_purpose\": \"Create a
    ↳ 60-teeth helical gear with 14.5 deg pressure and 40.0 deg helix angles
    ↳ and and specified features.\"}}, \"role\": \"assistant\"},
  { \"content\": \"Create a chair with 32x40x2 seat having four circular legs with radius 3
    ↳ and height 38 and a 32x2x50 backrest\", \"role\": \"user\"},
  { \"content\": \"{ \"name\": \"draw_sketches\", \"arguments\": { \"sketch_name\": \"Seat\", \"
    ↳ shape_type\": \"rectangle\", \"center_x\": 0.0, \"center_y\": 0.0, \"width\": 32.0, \"
    ↳ height\": 40.0, \"datum_offset\": 0.0, \"extrusion_depth\": -2.0, \"
    ↳ extrusion_type\": \"solid\", \"sketching_plane\": \"top\", \"sketch_only\": false, \"
    ↳ tool_purpose\": \"Create a 32x40x2 (WxHxD) seat for the chair on top
    ↳ datum plane.\"}}, \"role\": \"assistant\"},
  { \"content\": \"{ \"name\": \"draw_sketches\", \"arguments\": { \"sketch_name\": \"Leg1\", \"
    ↳ shape_type\": \"circle\", \"center_x\": 13.0, \"center_y\": 17.0, \"radius\": 3.0, \"
    ↳ datum_offset\": 0.0, \"extrusion_depth\": -38.0, \"extrusion_type\": \"solid\", \"
    ↳ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Create a
    ↳ circular leg with a radius of 3 and height of 38, positioned at 12x, 16y on
    ↳ the top plane under the seat.\"}}, \"role\": \"assistant\"},
  { \"content\": \"{ \"name\": \"draw_sketches\", \"arguments\": { \"sketch_name\": \"Leg2\", \"
    ↳ shape_type\": \"circle\", \"center_x\": -13.0, \"center_y\": 17.0, \"radius\": 3.0, \"
    ↳ datum_offset\": 0.0, \"extrusion_depth\": -38.0, \"extrusion_type\": \"solid\", \"
    ↳ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Create a
    ↳ circular leg with a radius of 3 and a height of 38, positioned at -12x, 16y
    ↳ on the top plane under the seat.\"}}, \"role\": \"assistant\"},
  { \"content\": \"{ \"name\": \"draw_sketches\", \"arguments\": { \"sketch_name\": \"Leg3\", \"
    ↳ shape_type\": \"circle\", \"center_x\": -13.0, \"center_y\": -17.0, \"radius\": 3.0, \"
    ↳ datum_offset\": 0.0, \"extrusion_depth\": -38.0, \"extrusion_type\": \"solid\", \"
    ↳ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Create
    ↳ another chair leg with 3 radius and 38 height, located at -12x, -16y on
    ↳ the top plane under the seat.\"}}, \"role\": \"assistant\"},
  { \"content\": \"{ \"name\": \"draw_sketches\", \"arguments\": { \"sketch_name\": \"Leg4\", \"
    ↳ shape_type\": \"circle\", \"center_x\": 13.0, \"center_y\": -17.0, \"radius\": 3.0, \"
    ↳ datum_offset\": 0.0, \"extrusion_depth\": -38.0, \"extrusion_type\": \"solid\", \"
    ↳ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Fabricate
    ↳ the third leg of the chair with a 3 radius and 38 height, precisely placed
    ↳ at 12x, -16y on the top plane under the seat.\"}}, \"role\": \"assistant\"},
  { \"content\": \"{ \"name\": \"draw_sketches\", \"arguments\": { \"sketch_name\": \"Backrest\", \"
    ↳ shape_type\": \"rectangle\", \"center_x\": 0.0, \"center_y\": 19.0, \"width\": 32.0, \"
    ↳ height\": 2.0, \"datum_offset\": 0.0, \"extrusion_depth\": 50.0, \"extrusion_type
    ↳ \": \"solid\", \"sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"
    ↳ Construct a 32x2x50 (WxHxD) backrest for the chair, mounted on the
    ↳ backside of the seat.\"}}, \"role\": \"assistant\"},
  { \"content\": \"Create a table with circular top of radius 10 units and thickness 0.5 and
    ↳ 4 Octagonal legs of radius 1 and height 20\", \"role\": \"user\"},
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{ \"content\": \"{ \"arguments\": { \"sketch_name\": \"TableTop\", \"shape_type\": \"circle\", \"
    ↳ center_x\": 0.0, \"center_y\": 0.0, \"radius\": 10.0, \"datum_offset\": 0.0, \"
    ↳ extrusion_depth\": 0.5, \"extrusion_type\": \"solid\", \"sketching_plane\": \"top\",
    ↳ \"sketch_only\": false, \"tool_purpose\": \"Create a circular table top with a
    ↳ radius of 10 units and a thickness of 0.5, positioned centrally on the top
    ↳ sketching plane.\"}, \"name\": \"draw_sketches\"}}, \"role\": \"assistant\"},
  { \"content\": \"{ \"arguments\": { \"sketch_name\": \"Leg1\", \"shape_type\": \"polygon\", \"
    ↳ center_x\": 5.0, \"center_y\": 5.0, \"radius\": 1.0, \"num_sides\": 8, \"datum_offset
    ↳ \": 0.0, \"extrusion_depth\": -20.0, \"extrusion_type\": \"solid\", \"
    ↳ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Generate
    ↳ the first octagonal leg of the table with a radius of 1 and height of 20,
    ↳ positioned at 5,5 on the top sketching plane.\"}, \"name\": \"draw_sketches\"}},
    ↳ \"role\": \"assistant\"},
  { \"content\": \"{ \"arguments\": { \"sketch_name\": \"Leg2\", \"shape_type\": \"polygon\", \"
    ↳ center_x\": -5.0, \"center_y\": 5.0, \"radius\": 1.0, \"num_sides\": 8, \"
    ↳ datum_offset\": 0.0, \"extrusion_depth\": -20.0, \"extrusion_type\": \"solid\", \"
    ↳ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Create the
    ↳ second octagonal leg of the table with a radius of 1 and height of 20,
    ↳ positioned at -5,5 on the top sketching plane.\"}, \"name\": \"draw_sketches
    ↳ \": \"role\": \"assistant\"},
  { \"content\": \"{ \"arguments\": { \"sketch_name\": \"Leg3\", \"shape_type\": \"polygon\", \"
    ↳ center_x\": -5.0, \"center_y\": -5.0, \"radius\": 1.0, \"num_sides\": 8, \"
    ↳ datum_offset\": 0.0, \"extrusion_depth\": -20.0, \"extrusion_type\": \"solid\", \"
    ↳ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Form the
    ↳ third octagonal leg of the table with a radius of 1 and height of 20,
    ↳ located at -5,-5 on the top sketching plane.\"}, \"name\": \"draw_sketches\"}},
    ↳ \"role\": \"assistant\"},
  { \"content\": \"{ \"arguments\": { \"sketch_name\": \"Leg4\", \"shape_type\": \"polygon\", \"
    ↳ center_x\": 5.0, \"center_y\": -5.0, \"radius\": 1.0, \"num_sides\": 8, \"
    ↳ datum_offset\": 0.0, \"extrusion_depth\": -20.0, \"extrusion_type\": \"solid\", \"
    ↳ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Construct
    ↳ the fourth octagonal leg of the table with a radius of 1 and height of 20,
    ↳ positioned at 5,-5 on the top sketching plane.\"}, \"name\": \"draw_sketches
    ↳ \": \"role\": \"assistant\"},
  { \"content\": \"Please create a Mug with radius 1, height 4, Thickness 0.05 and a
    ↳ handle of 0.3 Thickness\", \"role\": \"user\"},
  { \"content\": \"{ \"name\": \"draw_sketches\", \"arguments\": { \"sketch_name\": \"MugBody\", \"
    ↳ shape_type\": \"circle\", \"center_x\": 0.0, \"center_y\": 0.0, \"radius\": 1, \"
    ↳ datum_offset\": 0, \"extrusion_depth\": 0.05, \"extrusion_type\": \"solid\", \"
    ↳ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Design the
    ↳ body of the mug with a radius of 1 and a height of 4, on the top
    ↳ sketching plane.\"}}, \"role\": \"assistant\"},
  { \"content\": \"{ \"name\": \"draw_sketches\", \"arguments\": { \"sketch_name\": \"MugHollow\",
    ↳ \"shape_type\": \"circle\", \"center_x\": 0.0, \"center_y\": 0.0, \"radius\": 1, \"
    ↳ datum_offset\": 0.05, \"extrusion_depth\": 4.0, \"extrusion_type\": \"shell\", \"
    ↳ shell_thickness\": 0.05, \"sketching_plane\": \"top\", \"sketch_only\": false, \"
    ↳ tool_purpose\": \"Create the hollow mug shell with a radius of 1, depth of
    ↳ 4 and thickness 0.05, on the top sketching plane.\"}}, \"role\": \"assistant\"},
  { \"content\": \"{ \"name\": \"draw_sketches\", \"arguments\": { \"sketch_name\": \"Handle\", \"
    ↳ shape_type\": \"spline\", \"tangentType\": \"both\", \"startTangAngle\": 0.0, \"
    ↳ endTangAngle\": 0.0, \"points\": [{ \"x\": 1.0, \"y\": 3.5}, { \"x\": 1.5, \"y\": 3.5}, { \"x\":
    ↳ 1.0, \"y\": 1.0}], \"datum_offset\": 0.0, \"extrusion_depth\": 0.3, \"extrusion_type\":
    ↳ \"shell\", \"shell_thickness\": 0.3, \"sketching_plane\": \"front\", \"sketch_only\":
    ↳ false, \"tool_purpose\": \"Design the mug's handle using a spline shape,
    ↳ attaching it to the body.\"}}, \"role\": \"assistant\"},
  { \"content\": \"Draw a cupboard with a width of 22, a height of 30, and a depth of 10.
    ↳ Include a back panel, right, left, bottom and top panels and two doors
    ↳ with slight gap between them at the front. Incorporate three shelves
    ↳ inside resulting in equal partitions. Each panel and shelf thickness is 0.5.
    ↳ Please add 0.5x1.5x0.75 handles on both doors and add a lock with 0.5
    ↳ radius on right door\", \"role\": \"user\"},
  { \"content\": \"{ \"arguments\": { \"sketch_name\": \"BackPanel\", \"shape_type\": \"rectangle\", \"
    ↳ center_x\": 0.0, \"center_y\": 0.0, \"width\": 22.0, \"height\": 30.0, \"datum_offset
    ↳ \": -5.0, \"extrusion_depth\": 0.5, \"extrusion_type\": \"solid\", \"sketching_plane
    ↳ \": \"front\", \"sketch_only\": false, \"tool_purpose\": \"Create the 22x30x0.5 (
    ↳ WxHxD) back panel of the cupboard, Sketching on front datum plane
    ↳ with -5.0 offset.\"}, \"name\": \"draw_sketches\"}}, \"role\": \"assistant\"},
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1973 { "content": "{ \"arguments\": { \"sketch_name\": \"RightPanel\", \"shape_type\": \"rectangle\", \"
1974   ↪ center_x\": 0.0, \"center_y\": 0.0, \"width\": 10.0, \"height\": 30.0, \"datum_offset
1975   ↪ \": 11.0, \"extrusion_depth\": -0.5, \"extrusion_type\": \"solid\", \"
1976   ↪ sketching_plane\": \"right\", \"sketch_only\": false, \"tool_purpose\": \"Create 10
1977   ↪ x30x0.5 (WxHxD) right side panel of the cupboard, Sketching on right
1978   ↪ datum plane with 11.0 offset.\"}; \"name\": \"draw_sketches\"}; \"role\": \"
1979   ↪ assistant\"},
1980 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"LeftPanel\", \"shape_type\": \"rectangle\", \"
1981   ↪ center_x\": 0.0, \"center_y\": 0.0, \"width\": 10.0, \"height\": 30.0, \"datum_offset
1982   ↪ \": -11.0, \"extrusion_depth\": 0.5, \"extrusion_type\": \"solid\", \"
1983   ↪ sketching_plane\": \"right\", \"sketch_only\": false, \"tool_purpose\": \"Create 10
1984   ↪ x30x0.5 (WxHxD) left side panel of the cupboard, Sketching on right
1985   ↪ datum plane with -11.0 offset.\"}; \"name\": \"draw_sketches\"}; \"role\": \"
1986   ↪ assistant\"},
1987 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"BottomPanel\", \"shape_type\": \"rectangle
1988   ↪ \", \"center_x\": 0.0, \"center_y\": 0.0, \"width\": 21.0, \"height\": 10.0, \"
1989   ↪ datum_offset\": -14.5, \"extrusion_depth\": -0.5, \"extrusion_type\": \"solid\", \"
1990   ↪ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Create 21
1991   ↪ x10x0.5 (WxHxD) bottom panel of the cupboard, Sketching on top datum
1992   ↪ plane with -14.5 offset.\"}; \"name\": \"draw_sketches\"}; \"role\": \"assistant\"},
1993 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"TopPanel\", \"shape_type\": \"rectangle\", \"
1994   ↪ center_x\": 0.0, \"center_y\": 0.0, \"width\": 21.0, \"height\": 10.0, \"datum_offset
1995   ↪ \": 15.0, \"extrusion_depth\": -0.5, \"extrusion_type\": \"solid\", \"
1996   ↪ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Create 21
1997   ↪ x10x0.5 (WxHxD) top panel of the cupboard, Sketching on top datum
1998   ↪ plane with 14.5 offset.\"}; \"name\": \"draw_sketches\"}; \"role\": \"assistant\"},
1999 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"BottomShelf\", \"shape_type\": \"rectangle\",
2000   ↪ \", \"center_x\": 0.0, \"center_y\": 0.0, \"width\": 21.0, \"height\": 10.0, \"
2001   ↪ datum_offset\": -7.5, \"extrusion_depth\": -0.5, \"extrusion_type\": \"solid\", \"
2002   ↪ sketching_plane\": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Create the
2003   ↪ 21x10x0.5 (WxHxD) Bottom shelf inside the cupboard, Sketching on top
2004   ↪ datum plane with -7.5 offset.\"}; \"name\": \"draw_sketches\"}; \"role\": \"
2005   ↪ assistant\"},
2006 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"MidShelf\", \"shape_type\": \"rectangle\", \"
2007   ↪ center_x\": 0.0, \"center_y\": 0.0, \"width\": 21.0, \"height\": 10.0, \"datum_offset
2008   ↪ \": 0.0, \"extrusion_depth\": -0.5, \"extrusion_type\": \"solid\", \"sketching_plane
2009   ↪ \": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Create the 21x10x0.5 (
2010   ↪ WxHxD) mid shelf inside the cupboard, Sketching on top datum plane
2011   ↪ with 0.0 offset.\"}; \"name\": \"draw_sketches\"}; \"role\": \"assistant\"},
2012 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"UpperShelf\", \"shape_type\": \"rectangle\",
2013   ↪ \", \"center_x\": 0.0, \"center_y\": 0.0, \"width\": 21.0, \"height\": 10.0, \"datum_offset
2014   ↪ \": 7.5, \"extrusion_depth\": -0.5, \"extrusion_type\": \"solid\", \"sketching_plane
2015   ↪ \": \"top\", \"sketch_only\": false, \"tool_purpose\": \"Create the 21x10x0.5 (
2016   ↪ WxHxD) upper shelf inside the cupboard, Sketching on top datum plane
2017   ↪ with 7.5 offset.\"}; \"name\": \"draw_sketches\"}; \"role\": \"assistant\"},
2018 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"RightDoor\", \"shape_type\": \"rectangle\", \"
2019   ↪ center_x\": 5.55, \"center_y\": 0.0, \"width\": 10.95, \"height\": 30.0, \"
2020   ↪ datum_offset\": 5.0, \"extrusion_depth\": 0.5, \"extrusion_type\": \"solid\", \"
2021   ↪ sketching_plane\": \"front\", \"sketch_only\": false, \"tool_purpose\": \"Create
2022   ↪ the right door for the cupboard\"}; \"name\": \"draw_sketches\"}; \"role\": \"
2023   ↪ assistant\"},
2024 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"LeftDoor\", \"shape_type\": \"rectangle\", \"
2025   ↪ center_x\": -5.55, \"center_y\": 0.0, \"width\": 10.95, \"height\": 30.0, \"
2026   ↪ datum_offset\": 5.0, \"extrusion_depth\": 0.5, \"extrusion_type\": \"solid\", \"
2027   ↪ sketching_plane\": \"front\", \"sketch_only\": false, \"tool_purpose\": \"Create
2028   ↪ the left door for the cupboard\"}; \"name\": \"draw_sketches\"}; \"role\": \"
2029   ↪ assistant\"},
2030 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"RightDoorHandle\", \"shape_type\": \"

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2031 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"DoorLock\", \"shape_type\": \"circle\", \"
2032   ↪ center_x\": 1.0, \"center_y\": -2.5, \"radius\": 0.5, \"datum_offset\": 5.5, \"
2033   ↪ extrusion_depth\": 0.25, \"extrusion_type\": \"solid\", \"sketching_plane\": \"
2034   ↪ front\", \"sketch_only\": false, \"tool_purpose\": \"Create a circular lock, with
2035   ↪ a 0.5-unit radius on the right door of the cupboard\"}; \"name\": \"
2036   ↪ draw_sketches\"}; \"role\": \"assistant\"},
2037 { \"content\": \"Please create a metallic plate that has a diameter of 6 cm and a
2038   ↪ thickness of 0.2 cm, including a center hole measuring 4 cm\", \"role\": \"
2039   ↪ user\"},
2040 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"MetallicPlate\", \"shape_type\": \"circle\", \"
2041   ↪ center_x\": 0.0, \"center_y\": 0.0, \"radius\": 3.0, \"datum_offset\": 0.0, \"
2042   ↪ extrusion_depth\": 0.2, \"extrusion_type\": \"solid\", \"sketching_plane\": \"top\", \"
2043   ↪ sketch_only\": false, \"tool_purpose\": \"Create the outer shape of the
2044   ↪ metallic plate with a diameter of 6 cm and a thickness of 0.2 cm.\"}; \"name
2045   ↪ \": \"draw_sketches\"}; \"role\": \"assistant\"},
2046 { \"content\": \"{ \"arguments\": { \"sketch_name\": \"PlateCenterHole\", \"shape_type\": \"circle\",
2047   ↪ \"center_x\": 0.0, \"center_y\": 0.0, \"radius\": 2.0, \"datum_offset\": 0.0, \"
2048   ↪ extrusion_depth\": 0.2, \"extrusion_type\": \"hole\", \"sketching_plane\": \"top\", \"
2049   ↪ sketch_only\": false, \"tool_purpose\": \"Create the center hole of the metallic
2050   ↪ plate with a diameter of 4 cm.\"}; \"name\": \"draw_sketches\"}; \"role\": \"
2051   ↪ assistant\"},
2052 { \"content\": \"Select similar edges from the entire model and apply roundness with
2053   ↪ radius 0.5\", \"role\": \"user\"},
2054 { \"content\": \"{ \"name\": \"select_similar_edges\", \"arguments\": { \"from_entire_model\": true
2055   ↪ \", \"tool_purpose\": \"Select similar edges throughout the model.\"}; \"role\": \"
2056   ↪ assistant\"},
2057 { \"content\": \"{ \"name\": \"apply_round_feature\", \"arguments\": { \"radius\": 0.5, \"
2058   ↪ tool_purpose\": \"Round selected edges using a 0.5 radius.\"}; \"role\": \"
2059   ↪ assistant\"},
2060 ]

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Listing 1: LLM prompt

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2061 [
2062 {
2063   \"type\": \"function\",
2064   \"function\": {
2065     \"name\": \"draw_sketches\",
2066     \"description\": \"Use this function for creating 2D sketches and 3D shapes on the
2067       ↪ specified datum plane. This function is capable of drawing various
2068       ↪ shapes, including points, lines, polylines, arcs, circles, rectangles, ellipses,
2069       ↪ splines, text, regular polygons, and stars, along with their
2070       ↪ corresponding 3D counterparts.\",
2071     \"parameters\": {
2072       \"type\": \"object\",
2073       \"properties\": {
2074         \"shape_type\": {
2075           \"type\": \"string\",
2076           \"description\": \"The type of primitive shape to draw\",
2077           \"enum\": [\"point\", \"line\", \"polyline\", \"circle\", \"rectangle\", \"spline\", \"arc\", \"
2078             ↪ ellipse\", \"polygon\", \"star\", \"text\"]
2079         },
2080         \"sketching_plane\": {
2081           \"type\": \"string\", \"enum\": [\"front\", \"right\", \"top\"], \"default\": \"front\",
2082           \"description\": \"Sketching plane (XY is 'front' datum Plane i.e.
2083             ↪ Perpendicular to Z-axis, YZ is 'right' datum Plane i.e. Perpendicular to X
2084             ↪ -axis and ZX is 'top' datum Plane i.e. Perpendicular to Y-axis)\"
2085         },
2086         \"sketch_only\": {
2087           \"type\": \"boolean\", \"default\": true,
2088           \"description\": \"Whether only sketch or also apply the extrusion with

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2089     },
2090     "datum_offset": {
2091         "type": "number", "default": 0.0,
2092         "description": "Most important argument: This variable represents Z-
2093         ↪ axis offset from the origin. A positive value indicates movement forward,
2094         ↪ while a negative value indicates movement backward. It also acts x and
2095         ↪ y-axis offset from other planes. E.g., For front plane it is Z-axis offset
2096         ↪ from centered front plane, while also serving as a X-axis offset from
2097         ↪ Right Planes (Positive value means left side of right planes) and Y-axis
2098         ↪ offset from Top planes (Positive value means bottom side of top planes),
2099         ↪ Whereas for right plane it is Z-axis offset from centered right plane and
2100         ↪ x-axis offset from other front and top planes (Positive value means right
2101         ↪ sides of both front and top planes), Whereas, for top plane it is z-axis
2102         ↪ offset from centered top plane and y-axis offset from both centered front
2103         ↪ and right datum planes (Positive value means up side of both front and
2104         ↪ right datums)"
2105     },
2106     "extrusion_depth": {
2107         "type": "number", "default": 10.0,
2108         "description": "Depth of the sketch for extrusion, it makes 2D Sketch
2109         ↪ into 3D Solid, Cut or Shell, positive for up and negative for down"
2110     },
2111     "sketch_name": {
2112         "type": "string", "description": "Meaningful and unique name of the
2113         ↪ sketch without white spaces"
2114     },
2115     "tool_purpose": {
2116         "type": "string", "description": "A brief and meaningful purpose of tool
2117         ↪ for user-friendly presentation on GUI."
2118     },
2119     "center_x": {
2120         "type": "number", "default": 0.0,
2121         "description": "X-coordinate of the center (applicable to circle, ellipse,
2122         ↪ rectangle and arc). The x-axis of the front planes shares the same
2123         ↪ positive direction as the x-axis on the top planes. Whereas, The x-axis
2124         ↪ of the right planes aligns with the y-axis of the top planes, with
2125         ↪ corresponding negative directions."
2126     },
2127     "center_y": {
2128         "type": "number", "default": 0.0,
2129         "description": "Y-coordinate of the center (applicable to circle, ellipse,
2130         ↪ rectangle and arc). The y-axis of the front planes shares the same
2131         ↪ positive direction as the y-axis on the right planes. Whereas, The y-axis
2132         ↪ of the top planes aligns with the x-axis of the right planes, with
2133         ↪ corresponding negative directions."
2134     },
2135     "width": {
2136         "type": "number", "default": 10.0, "exclusiveMinimum": 0.0,
2137         "description": "Width of the rectangle, (applicable to rectangle only),
2138         ↪ Note: Rectangle center at center_x, center_y"
2139     },
2140     "height": {
2141         "type": "number", "default": 10.0, "exclusiveMinimum": 0.0,
2142         "description": "Height of the rectangle (applicable to rectangle only),
2143         ↪ Note: Rectangle center at center_x, center_y"
2144     },
2145     "xRadius": {
2146         "type": "number", "default": 10.0, "exclusiveMinimum": 0.0,
2147         "description": "X radius of the ellipse (applicable to ellipse only)"
2148     },
2149     "yRadius": {
2150         "type": "number", "default": 10.0, "exclusiveMinimum": 0.0,
2151         "description": "Y radius of the ellipse (applicable to ellipse only)"
2152     },
2153     "radius": {
2154         "type": "number", "default": 10.0, "exclusiveMinimum": 0.0,
2155         "description": "Radius of the shape (applicable to circle, arc, rectangle (
2156         ↪ For Rounded Corners) and inscribed circles of regular polygon and star)"
2157     },

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2147     "startAngle": {
2148         "type": "number", "default": 0.0, "minimum": 0.0, "maximum": 360.0,
2149         "description": "Start angle of the shape (applicable to arc and spline)"
2150     },
2151     "endAngle": {
2152         "type": "number", "default": 0.0, "minimum": 0.0, "maximum": 360.0,
2153         "description": "End angle of the shape (applicable to arc and spline)"
2154     },
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2161         "description": "Start tangent angle of the spline (applicable to spline
2162         ↪ only)"
2163     },
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2165         "type": "number", "default": 0.0, "minimum": 0.0, "maximum": 360.0,
2166         "description": "End tangent angle of the spline (applicable to spline only
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2172         ↪ input. If the user mentions a specific side length, use that; otherwise, if
2173         ↪ the user mentions the radius, use it. If the user hasn't mentioned any,
2174         ↪ select the default value for the radius)"
2175     },
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2178         "description": "Number of sides (applicable to regular polygon only)"
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2182         "description": "Number of tips (applicable to star only)"
2183     },
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2185         "type": "number", "description": "X-coordinate of the first_corner (
2186         ↪ applicable to text and arc only)"
2187     },
2188     "first_corner_y": {
2189         "type": "number", "description": "Y-coordinate of the first_corner (
2190         ↪ applicable to text and arc only)"
2191     },
2192     "second_corner_x": {
2193         "type": "number", "description": "X-coordinate of the second_corner (
2194         ↪ applicable to text and arc only)"
2195     },
2196     "second_corner_y": {
2197         "type": "number", "description": "Y-coordinate of the second_corner (
2198         ↪ applicable to text and arc only)"
2199     },
2200     "comment_text": {
2201         "type": "string", "description": "comment string for text sketch (
2202         ↪ applicable to text only)"
2203     },
2204     "points": {
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2206         "description": "Array of points (applicable to point, line, polyline and
2207         ↪ spline only)",
2208         "items": {
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2210             "properties": {
2211                 "x": {"type": "number"}, "y": {"type": "number"}
2212             }
2213         }
2214     },

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2205 "additionalProperties": false,
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2207 ↪ datum_offset", "extrusion_direction", "sketch_name", "center_x", "
2208 ↪ center_y"]
2209 }
2210 },
2211 {
2212 "type": "function",
2213 "function": {
2214 "name": "create_gears",
2215 "description": "Use this function to draw various types of mechanical gears",
2216 "parameters": {
2217 "type": "object",
2218 "properties": {
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2220 "type": "string", "enum": ["gear"],
2221 "description": "The type of primitive shape to draw"
2222 },
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2224 "type": "string", "default": "spur",
2225 "description": "Type of gear",
2226 "enum": ["spur", "ring", "helical"]
2227 },
2228 "datum_x_offset": {
2229 "type": "number", "default": 0.0,
2230 "description": "X offset for gear datum"
2231 },
2232 "datum_y_offset": {
2233 "type": "number", "default": 0.0,
2234 "description": "Y offset for gear datum"
2235 },
2236 "datum_z_offset": {
2237 "type": "number", "default": 0.0,
2238 "description": "Z offset for gear datum"
2239 },
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2242 "description": "Diameter of the gear"
2243 },
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2245 "type": "number", "default": 10.0, "exclusiveMinimum": 0.0,
2246 "description": "Depth of the gear"
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2249 "type": "number", "default": 10.0, "exclusiveMinimum": 0.0,
2250 "description": "Diameter of the backplate for gears"
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2253 "type": "number", "default": 5.0, "exclusiveMinimum": 0.0,
2254 "description": "Depth of the backplate for gears"
2255 },
2256 "hub_out_diameter": {
2257 "type": "number", "default": 60.0, "exclusiveMinimum": 0.0,
2258 "description": "Outer diameter of the hub for gears"
2259 },
2260 "hub_depth": {
2261 "type": "number", "default": 10.0, "exclusiveMinimum": 0.0,
2262 "description": "Depth of the hub for gears"
2263 },
2264 "n_of_teeth": {
2265 "type": "integer", "default": 60.0, "minimum": 16, "maximum": 360,
2266 "description": "Number of teeth for gears"
2267 },
2268 "hole_diameter": {
2269 "type": "number", "default": 5.0, "exclusiveMinimum": 0.0,
2270 "description": "Diameter of the hole in the gear"
2271 },
2272 "keyway_in_width": {

```

```

2263 "type": "number", "default": 10.0, "exclusiveMinimum": 0.0,
2264 "description": "Width of the keyway inside the gear"
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2266 "keyway_in_height": {
2267 "type": "number", "default": 10.0, "exclusiveMinimum": 0.0,
2268 "description": "Height of the keyway inside the gear"
2269 },
2270 "keyway_out_width": {
2271 "type": "number", "default": 7.0, "exclusiveMinimum": 0.0,
2272 "description": "Width of the keyway outside the gear"
2273 },
2274 "keyway_out_height": {
2275 "type": "number", "default": 5.0, "exclusiveMinimum": 0.0,
2276 "description": "Height of the keyway outside the gear"
2277 },
2278 "backnotch_radius": {
2279 "type": "number", "default": 4.0, "exclusiveMinimum": 0.0,
2280 "description": "Radius of the backnotch for gears"
2281 },
2282 "Pressure_angle": {
2283 "type": "number", "default": 20.0, "minimum": 12, "maximum": 25,
2284 "description": "Pressure angle for gears"
2285 },
2286 "helix_angle": {
2287 "type": "number", "default": 30.0, "minimum": 0, "maximum": 60,
2288 "description": "Helix angle for helical gears"
2289 },
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2291 },
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2295 },
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2298 "function": {
2299 "name": "select_similar_edges",
2300 "description": "Use this function to choose similar edges",
2301 "parameters": {
2302 "type": "object",
2303 "properties": {
2304 "from_entire_model": {
2305 "type": "boolean",
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2307 ↪ or within a specific selection.",
2308 "default": true
2309 },
2310 "tool_purpose": {...}
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2313 "required": [ "from_entire_model", "tool_purpose" ]
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2315 },
2316 {
2317 "type": "function",
2318 "function": {
2319 "name": "apply_round_feature",
2320 "description": "Use this function to Apply round feature to the selected edges with
2321 ↪ specified radius",
2322 "parameters": {
2323 "type": "object",
2324 "properties": {
2325 "radius": {
2326 "type": "number", "default": 0.25, "exclusiveMinimum": 0.0, "maximum": 100.0,
2327 "description": "The radius of the round feature"
2328 },
2329 "tool_purpose": {...}

```



```

2321 },
2322 "additionalProperties": false,
2323 "required": [ "radius", "tool_purpose" ]
2324 }
2325 }
2326 ...
2327 ...
2328 ]

```

Listing 2: APIs Description Included in Prompt

CAD-Copilot ensures that only contextually relevant examples are used.

B API DESCRIPTIONS

In this section, we provide detailed descriptions of the APIs used in CAD-Copilot. These APIs facilitate various CAD operations through natural language queries.

• draw_sketches

- *Description*: This function is used for creating 2D sketches and 3D shapes on the specified datum plane. It supports various shapes, including points, lines, polylines, arcs, circles, rectangles, ellipses, splines, text, regular polygons, and stars, along with their corresponding 3D counterparts.
- *Parameters*:
 - * **shape_type (string)**: The type of primitive shape to draw. Options include point, line, polyline, circle, rectangle, spline, arc, ellipse, polygon, star, and text.
 - * **sketching_plane (string)**: The plane on which the sketch is drawn. Options include front, right, and top. Default is front.
 - * **datum_offset (number)**: The offset from the origin along the Z-axis for the front plane, X-axis for the right plane, and Y-axis for the top plane. Default is 0.0.
 - * **sketch_only (boolean)**: Specifies whether to only sketch or also apply the extrusion with the given depth. Default is true.
 - * **extrusion_type (string)**: The type of extrusion. Options include solid, hole, and shell. Default is solid.
 - * **shell_thickness (number)**: The thickness of the shell if the extrusion type is shell. Default is 0.5.
 - * **extrusion_depth (number)**: The depth of the sketch for extrusion, making the 2D sketch into a 3D solid, cut, or shell. Positive values extrude up, and negative values extrude down. Default is 10.0.
 - * **sketch_name (string)**: A meaningful and unique name of the sketch without white spaces.
 - * **tool_purpose (string)**: A brief and meaningful purpose of the tool for user-friendly presentation on the GUI.
 - * **center_x (number)**: The X-coordinate of the center. Default is 0.0.
 - * **center_y (number)**: The Y-coordinate of the center. Default is 0.0.
 - * **width (number)**: The width of the rectangle. Default is 10.0.
 - * **height (number)**: The height of the rectangle. Default is 10.0.

- * **xRadius (number)**: The X radius of the ellipse. Default is 10.0.
 - * **yRadius (number)**: The Y radius of the ellipse. Default is 10.0.
 - * **radius (number)**: The radius of the shape. Default is 10.0.
 - * **startAngle (number)**: The start angle of the shape. Default is 0.0.
 - * **endAngle (number)**: The end angle of the shape. Default is 0.0.
 - * **tangentType (string)**: The type of spline tangent. Options include none, start, end, both, and periodic.
 - * **startTangAngle (number)**: The start tangent angle of the spline. Default is 0.0.
 - * **endTangAngle (number)**: The end tangent angle of the spline. Default is 0.0.
 - * **sideLength (number)**: The side length of regular polygons and stars. Default is 10.0.
 - * **num_sides (integer)**: The number of sides for regular polygons. Default is 5.
 - * **num_tips (integer)**: The number of tips for stars. Default is 5.
 - * **first_corner_x (number)**: The X-coordinate of the first corner for text and arc.
 - * **first_corner_y (number)**: The Y-coordinate of the first corner for text and arc.
 - * **second_corner_x (number)**: The X-coordinate of the second corner for text and arc.
 - * **second_corner_y (number)**: The Y-coordinate of the second corner for text and arc.
 - * **comment_text (string)**: The comment text for text sketches.
 - * **points (array)**: An array of points for point, line, polyline, and spline sketches. Each point has X and Y coordinates.
- ### • create_gears
- *Description*: This function is used to draw various types of mechanical gears.
 - *Parameters*:
 - * **shape_type (string)**: The type of primitive shape to draw. Default is gear.
 - * **gear_type (string)**: The type of gear. Options include spur, ring, and helical. Default is spur.
 - * **datum_x_offset (number)**: The X offset for the gear datum. Default is 0.0.
 - * **datum_y_offset (number)**: The Y offset for the gear datum. Default is 0.0.
 - * **datum_z_offset (number)**: The Z offset for the gear datum. Default is 0.0.
 - * **gear_diameter (number)**: The diameter of the gear. Default is 100.0.
 - * **gear_depth (number)**: The depth of the gear. Default is 10.0.
 - * **backplate_diameter (number)**: The diameter of the backplate for gears. Default is 10.0.
 - * **backplate_depth (number)**: The depth of the backplate for gears. Default is 5.0.
 - * **hub_out_diameter (number)**: The outer diameter of the hub for gears. Default is 60.0.

- * **hub_depth (number)**: The depth of the hub for gears. Default is 10.0.
- * **n_of_teeth (integer)**: The number of teeth for gears. Default is 60.
- * **hole_diameter (number)**: The diameter of the hole in the gear. Default is 5.0.
- * **keyway_in_width (number)**: The width of the keyway inside the gear. Default is 10.0.
- * **keyway_in_height (number)**: The height of the keyway inside the gear. Default is 10.0.
- * **keyway_out_width (number)**: The width of the keyway outside the gear. Default is 7.0.
- * **keyway_out_height (number)**: The height of the keyway outside the gear. Default is 5.0.
- * **backnotch_radius (number)**: The radius of the backnotch for gears. Default is 4.0.
- * **Pressure_angle (number)**: The pressure angle for gears. Default is 20.0.
- * **helix_angle (number)**: The helix angle for helical gears. Default is 30.0.
- * **tool_purpose (string)**: A brief and meaningful purpose of the tool for user-friendly presentation on the GUI.
- **select_similar_edges**
 - *Description*: This function selects similar edges within the model. If reference edges are already selected, it will find similar edges; otherwise, it prompts the user to select reference edges.
 - *Parameters*:
 - * **from_entire_model (boolean)**: Specifies whether to select similar edges across the entire model or within a specific selection. Default is true.
 - * **tool_purpose (string)**: A brief and meaningful purpose of the tool for user-friendly presentation on the GUI.
- **apply_round_feature**
 - *Description*: This function applies a round feature to the selected edges with a specified radius.
 - *Parameters*:
 - * **radius (number)**: The radius of the round feature. Default is 0.25, with an exclusive minimum of 0.0 and a maximum of 100.0.
 - * **tool_purpose (string)**: A brief and meaningful purpose of the tool for user-friendly presentation on the GUI.
- **apply_chamfer_feature**
 - *Description*: This function applies a chamfer feature to the selected edges with a specified distance.
 - *Parameters*:
 - * **distance (number)**: The distance of the chamfer feature. Default is 0.25, with an exclusive minimum of 0.0 and a maximum of 100.0.
 - * **tool_purpose (string)**: A brief and meaningful purpose of the tool for user-friendly presentation on the GUI.

C TASK DEFINITIONS

The following tasks were presented to participants in our user study to evaluate the capabilities of CAD-Copilot. The study was divided into two focused areas:

C.1 Design Creation Tasks

C.1.1 Furniture Design Tasks.

- **Chair**:
 - Task 1: Create a chair with a 32x40x2 seat and a 32x2x50 backrest, having four circular legs with radius 3 and height 38.
 - Task 2: Create a chair with a 36x44x2 seat and a 36x2x54 backrest, having four circular legs with radius 3.5 and height 40.
- **Table**:
 - Task 1: Draw a table with a circular top of radius 10 units and thickness 0.5. Add four octagonal legs with radius 1 and height 20.
 - Task 2: Draw a table with a decagonal top of radius 12 units and thickness 0.6. Add four hexagonal legs with radius 1.2 and height 22.
- **Cupboard**:
 - Task 1: Draw a cupboard with a width of 22, a height of 30, and a depth of 10. Include a back panel, right, left, bottom, and top panels, and two doors with a 0.5 gap between them at the front. Inside the cupboard, incorporate three shelves resulting in equal partitions. Each panel and shelf has a thickness of 0.5. Add 0.5x1.5x0.75 handles on both doors and a lock with 0.5 radius on the right door.
 - Task 2: Draw a cupboard with a width of 24, a height of 32, and a depth of 12. Include a back panel, right, left, bottom, and top panels, and two doors with a 0.6 gap between them at the front. Inside the cupboard, incorporate four shelves resulting in equal partitions. Each panel and shelf has a thickness of 0.6. Add 0.6x1.6x0.8 handles on both doors and a lock with 0.6 radius on the right door.
- **Bookshelf**:
 - Task 1: Draw a bookshelf with a width of 20, a height of 28, and a depth of 9. Include a back panel, right, left, bottom, and top panels. Inside the bookshelf, incorporate five shelves resulting in equal partitions. Each panel and shelf has a thickness of 0.5.
 - Task 2: Draw a bookshelf with a width of 22, a height of 30, and a depth of 10. Include a back panel, right, left, bottom, and top panels. Inside the bookshelf, incorporate six shelves resulting in equal partitions. Each panel and shelf has a thickness of 0.6.
- **Bed**:
 - Task 1: Create a bed with a frame of length 80 units, width 60 units, and height 10 units. Add a headboard with a width of 60 units, height of 25 units, and thickness of 2 units. Include four legs with a radius of 1.5 units and height of 12 units.
 - Task 2: Create a bed with a frame of length 85 units, width 65 units, and height 12 units. Add a headboard with a width of 65 units, height of 30 units, and thickness of 2.5 units. Include four decagonal legs with a radius of 1.75 units and height of 14 units.

C.1.2 Electronic Device Design Tasks.

- **Mobile Phone**:
 - Task 1: Create a 10x25x1 mobile phone casing with a 0.6x2x0.1 button on the right surface, a circular button with radius 1.25 on the front surface, a 0.9x0.4x0.2 power button on the top

surface, and 0.5x1x0.1 volume up and down buttons on the left surface.

- Task 2: Create a 12x27x1.2 mobile phone casing with a 0.7x2.5x0.15 button on the right surface, a circular button with radius 1.5 on the front surface, a 1x0.5x0.25 power button on the top surface, and 0.6x1.2x0.15 volume up and down buttons on the left surface.

- **Laptop Casing:**

- Task 1: Create a laptop casing with the following dimensions: 36x24x2 Base, 36x24x1 screen, 30x10x0.2 for keyboard Area on base, 10x5x0.1 touchpad on Base.
- Task 2: Create a laptop casing with the following dimensions: 38x26x2.2 Base, 38x26x1.2 screen, 32x12x0.25 for keyboard Area on base, 12x6x0.15 touchpad on Base.

- **LCD:**

- Task 1: Create a 20x16x2 LCD with a 4x2x1 stand on a circular base with a radius of 2 cm.
- Task 2: Create a 22x18x2.5 LCD with a 5x2.5x1.2 stand on a circular base with a radius of 2.5 cm.

C.1.3 Mechanical Component Design Tasks.

- **Gears:**

- Task 1: Create a 70-teeth spur gear with a 14.5-degree pressure angle, disk diameter of 100, disk depth of 10, backplate diameter of 60, backplate depth of 5.0, hub diameter of 40, hub depth of 15, center hole radius of 20, inner keyway of 5x5, outer keyway of 7x5, and back notch radius of 4.
- Task 2: Create a 70-teeth spur gear with a 20.0-degree pressure angle, disk diameter of 120, disk depth of 12, backplate diameter of 70, backplate depth of 6.0, hub diameter of 50, hub depth of 20, center hole radius of 25, inner keyway of 6x6, outer keyway of 8x6, and back notch radius of 5.
- Task 3: Create a 60-teeth helical gear with a 20-degree pressure angle, a 40-degree helix angle, disk diameter of 100, disk depth of 10, backplate diameter of 60, backplate depth of 5.0, hub diameter of 40, hub depth of 15, center hole radius of 20, inner keyway of 5x5, outer keyway of 7x5, and back notch radius of 4.
- Task 4: Create a 65-teeth helical gear with a 14.5-degree pressure angle, a 45-degree helix angle, disk diameter of 120, disk depth of 12, backplate diameter of 70, backplate depth of 6.0, hub diameter of 50, hub depth of 20, center hole radius of 25, inner keyway of 6x6, outer keyway of 8x6, and back notch radius of 5.
- Task 5: Create a 65-teeth ring gear with a 20-degree pressure angle and disk diameter of 100.
- Task 6: Create a 70-teeth ring gear with a 14.5-degree pressure angle and disk diameter of 120.

- **Gaskets:**

- Task 1: Create an engine head gasket with the following dimensions: 40 cm in length, 20 cm in width, and 0.2 cm in thickness. Include four cylinder bore holes with a diameter of 8 cm each, four bolt holes with a diameter of 1 cm each, oil passage holes with a diameter of 2 cm each, and water passage holes with a diameter of 3 cm each.
- Task 2: Create an engine head gasket with the following dimensions: 42 cm in length, 22 cm in width, and 0.3 cm in

thickness. Include six cylinder bore holes with a diameter of 6 cm each, four bolt holes with a diameter of 1.5 cm each, oil passage holes with a diameter of 2.5 cm each, and water passage holes with a diameter of 3.5 cm each.

- **Pipes:**

- Task 1: Create a T-shaped pipe with a 100 cm long vertical section, a 4 cm radius, 0.1 cm thickness, and a 50 cm long horizontal section in the middle.
- Task 2: Create a T-shaped pipe with a 120 cm long vertical section, a 5 cm radius, 0.15 cm thickness, and a 60 cm long horizontal section in the middle.

C.2 Detailing Tasks

Participants were provided with generated models and models from the formative study and guided with reference edges. They were then instructed to select similar edges and apply the specified features with referred dimensions. The tasks in this phase included:

C.2.1 Edge Selection and Rounding.

- Select similar edges from the entire model and apply roundness with a radius of 0.2/0.5.

C.2.2 Edge Selection and Chamfering.

- Select similar edges from the entire model and apply chamfer with a distance of 0.2/0.5.