The Chinese University of Hong Kong
Department of Computer Science and Engineering
CENG2030 Fundamentals of Embedded System Design

Lab 1: Engineering Drawing

Submission Instructions:

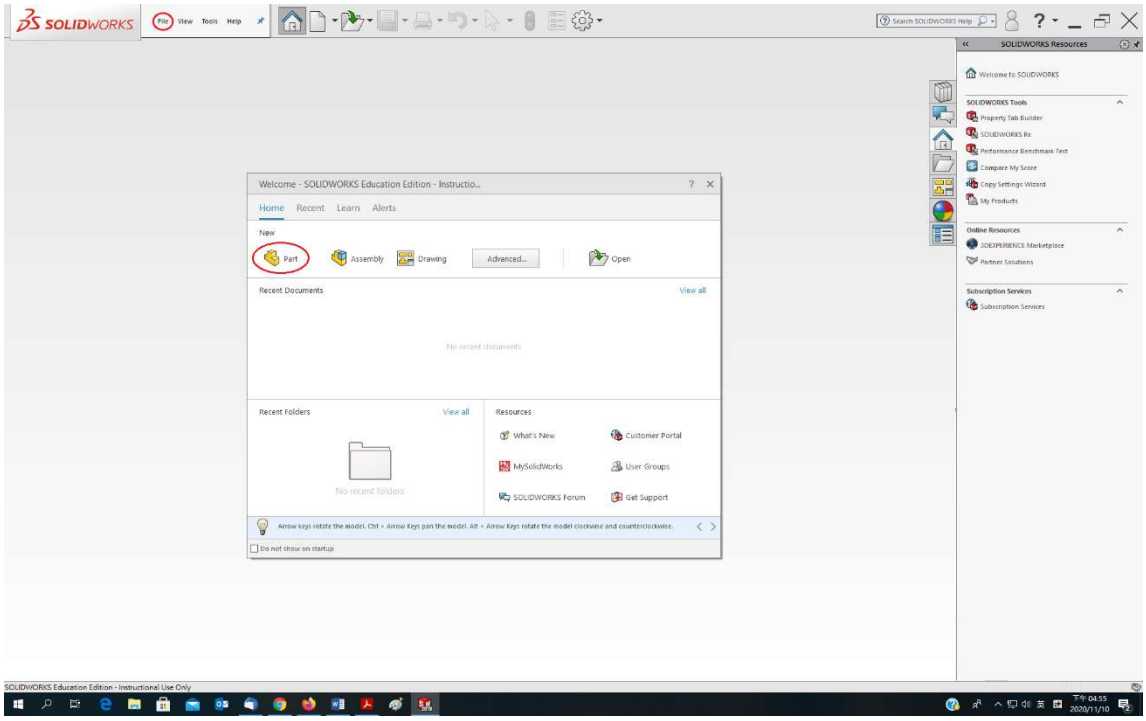
- Compress all the files you created for this lab to one single zip/rar file, with your SID in the filename such as **lab1_1155xxxxxx.zip**
- 5 marks will be deducted for wrong format of filename

- Upload the zip/rar file **on or before 23:59** on the lab day
- 10 marks per day will be deducted for late submission

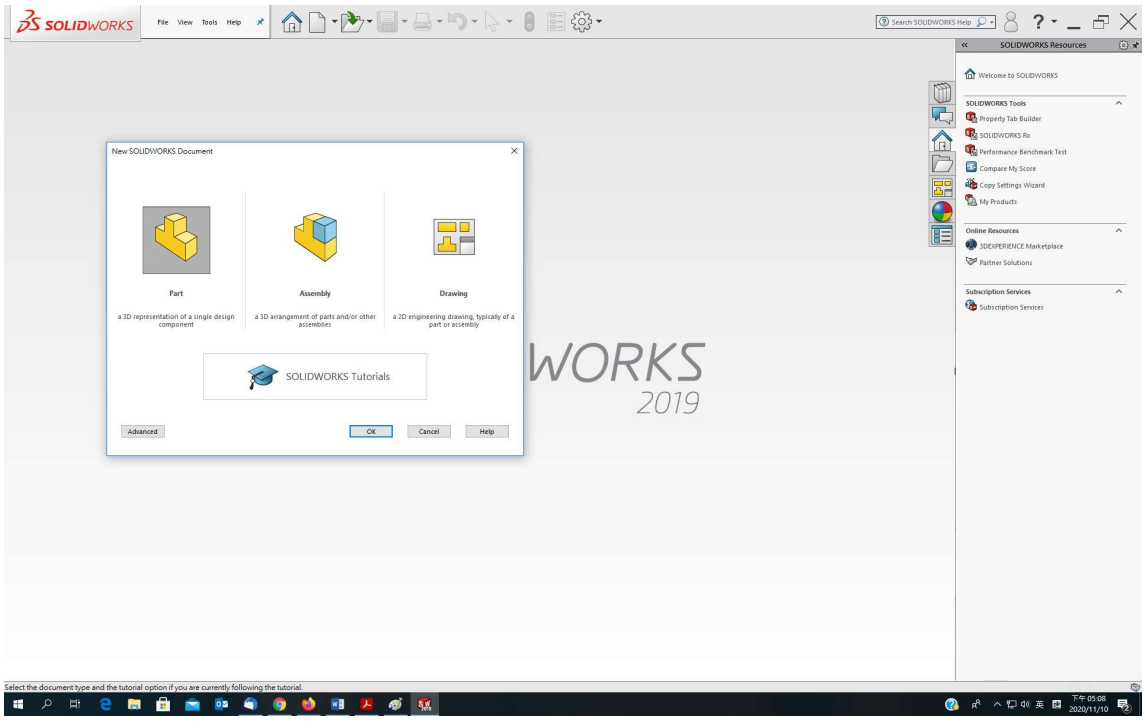
1. Getting Started with SolidWorks

1.1. Double click the SolidWorks icon at the Desktop of your computer (it takes about 10 minutes to start)

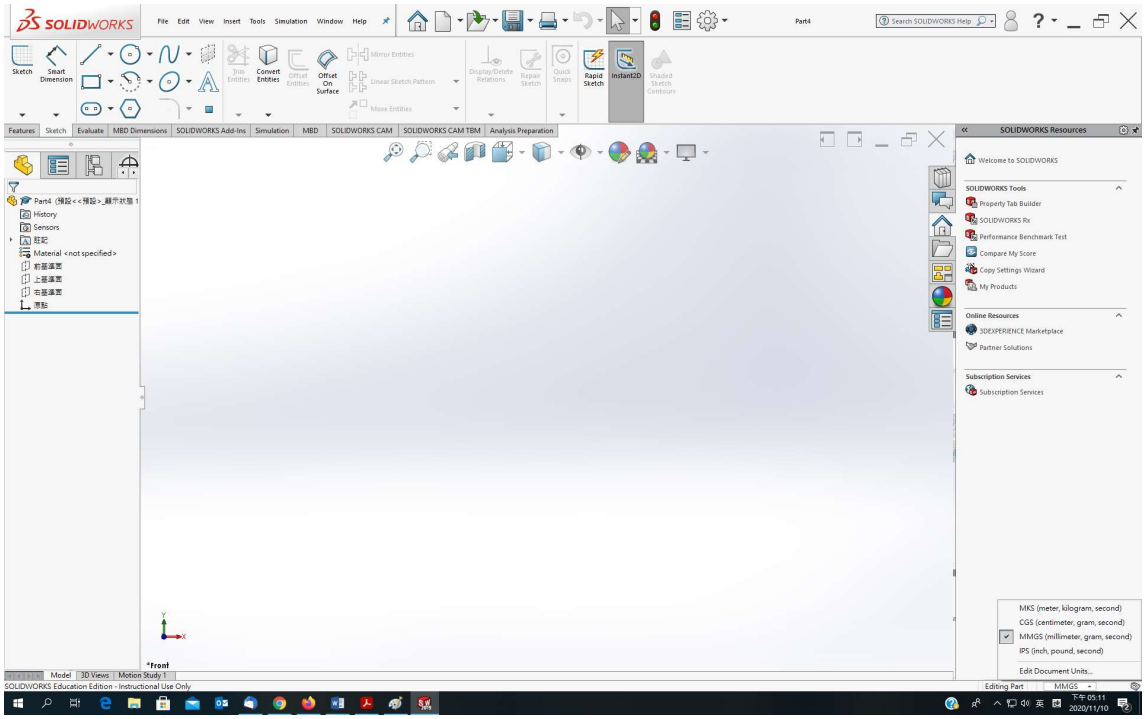
1.2. SolidWorks will start up as shown below.



1.3. To create a new drawing, click **File > New** at the menu bar, and

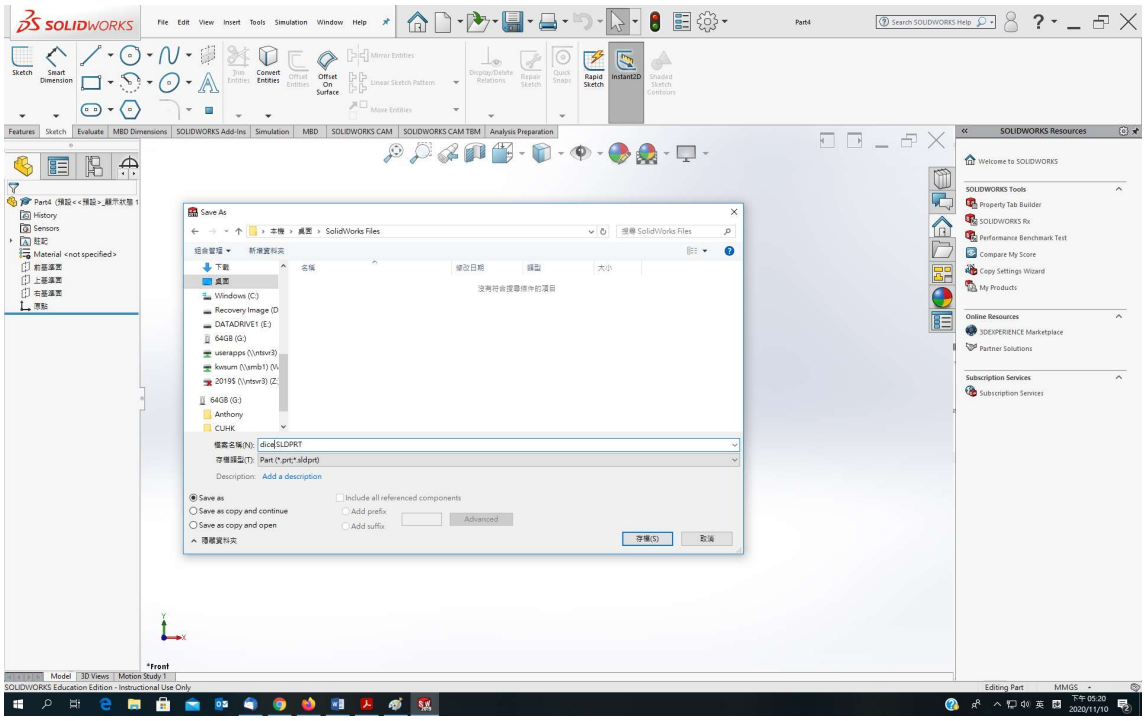


1.4. Click the **Part** icon, and **OK**



1.5. To change the units, select **MMGS** for (millimeter, gram, second) near to the right bottom corner. It can also be set at **Tools > Options > Document Properties > Units** later.

1.6. To save this part file, click **File > Save**

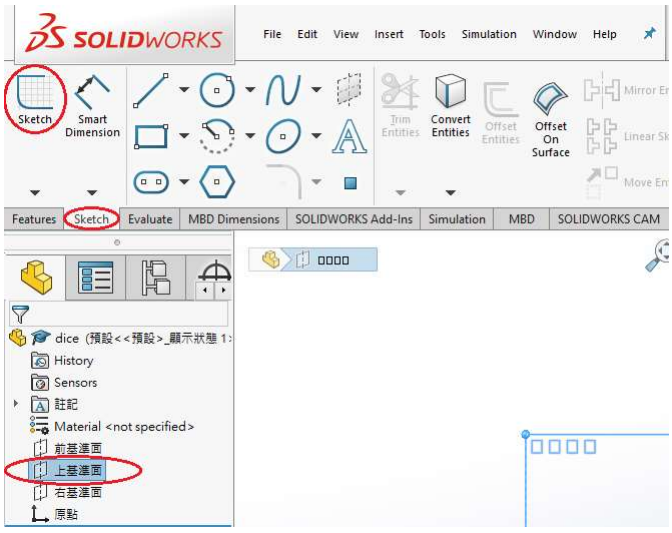


1.7. Name this part file as **dice.SLDPRT**, select your own data directory, and click **Save**

2. Sketch in 2-D Plane

2.1. To start drawing, you need to select a planer surface to draw. Initially there are 3 virtual planes you can draw on. They are Front Plane, Top Plane, and Right Plane.

2.2. Select **Top Plane** for instance, then in the **Sketch** tab, click **Sketch** icon to create/edit a sketch.



2.3. As you are doing 2D drawing, keep the **Sketch** tab on in the tool bar.

2.4. [Optional] You can select **Line**  tool to draw straight lines. You can draw polygonal lines by successive mouse clicks. It will stop when you click on the start point to produce a closed-loop contour. After you complete the shape, exit this tool by pressing **Esc** button on the keyboard.

2.5. [Optional] To change the shape of the polygon that you have drawn, you can pull any line by clicking the straight line, or by clicking on any vertices, and move it. (Note: You need to first exit the **Line** tool, or other shape sketch tools, to edit a shape.)

To delete line(s), you can click any line and then press **Delete** button on keyboard. Multiple selections can be made via holding down **Ctrl** button on keyboard and clicking the lines successively.

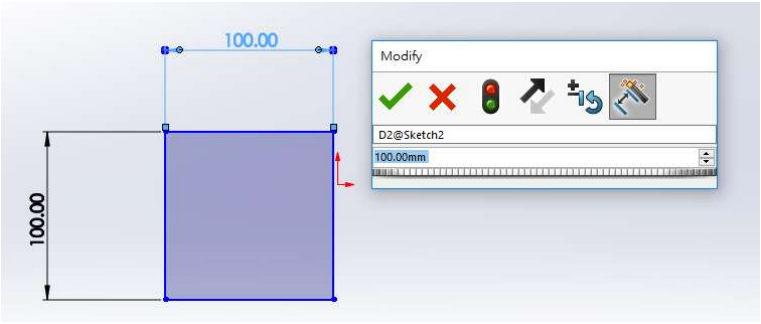
2.6. To draw a dice, we can first click the **Corner Rectangle**  tool. Click one of the corners of the desired rectangle first and then click the opposite diagonal corner.

2.7. Now you can adjust the length of the rectangle by a **Smart Dimension** 

tool.

2.8. To define the length of the rectangle, after you have selected the **Smart Dimension** tool, click the top edge of the rectangle. A dimension is displayed. Place it a bit above the top edge. Then a small editing window is shown. You can type **100** or **100mm** inside the window and hit **Enter** on keyboard. You should see the rectangle changes and moves a bit.

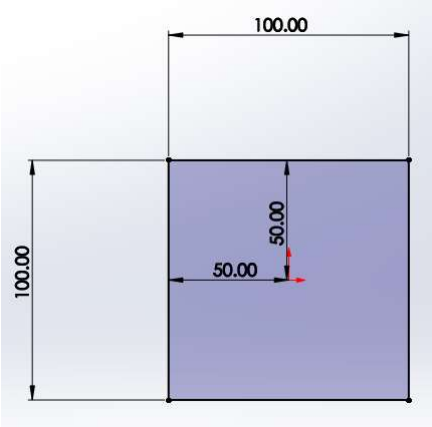
2.9. [Optional] After the rectangle has changed shape, it may be difficult to view to select other edges. You can **spin the mouse wheel** to zoom, or **press down the mouse wheel** (it has a button inside) and **move the mouse to rotate** the viewing angle. To move in linear direction, hold down **Ctrl** button on the keyboard, **press the mouse wheel and then move the mouse** to move.



2.10. Repeat the above dimensioning for the right edge and also set it to 100mm to make it a square.

2.11. You will notice that the lines of the rectangle are all in blue color. It means that all the blue edges are not yet fully-defined (i.e. fixed with respect to the environment). You may verify it by moving any lines or corners of the rectangle. The positions of the rectangle is not yet fixed with respect to the origin  .

2.12. Now we will fix the position of the rectangle by defining the distance between the edges and the origin. Select the **Smart Dimension** tool. First click on the top edge, but DO NOT place anywhere. Then do the 2nd click on the origin. You will see the dimension direction has changed. Place the dimension near the right-edge-length for consistence and set it to **50mm**.

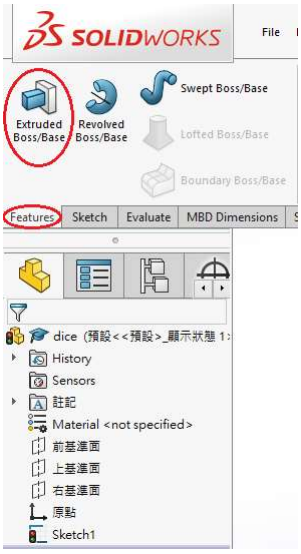


2.13. Repeat it for the distance between the right edge and the origin, and also keep it at **50mm**.

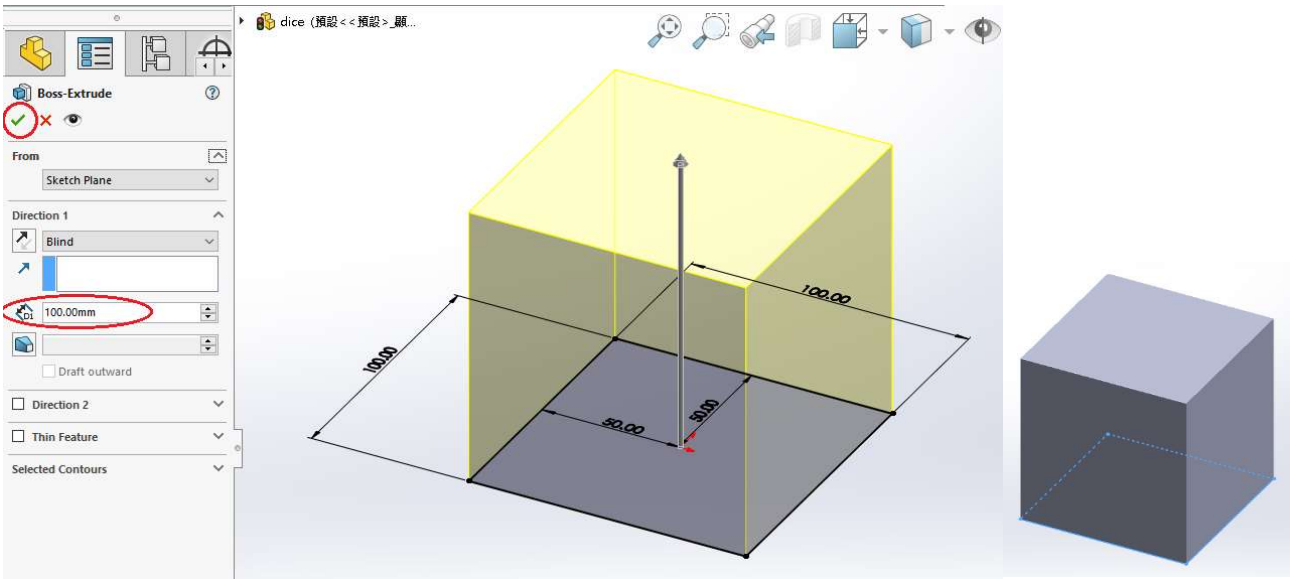
2.14. To finish/confirm the sketch, you can click the transparent icon  at top-right hand corner. (Note: DO NOT click the nearby red cross  , which is the exit-and-discard button.) However, you can skip this step to directly proceed to building-3D-feature. If you don't select the confirm button, the software assumes you are building additional features for the current sketch. Please note that one sketch may contain drawings of several shapes. But they should be ON THE SAME SURFACE.

3. Creating a 3D Feature

3.1. Continuing from the last sketch of a square without confirming a sketch, go to the **Features** tab, and select **Extruded Boss/Base**. This is the function to create a prism from a 2D closed-loop contours.



3.2. Type **100mm** in the field, keep the option as **Blind**, then click the top **Green Tick** icon to confirm.

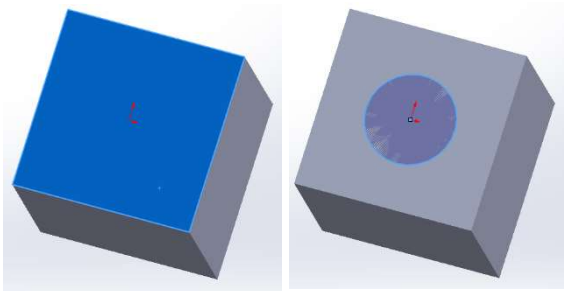


4. Draw More Features on the 6 Sides

4.1. Draw an ONE

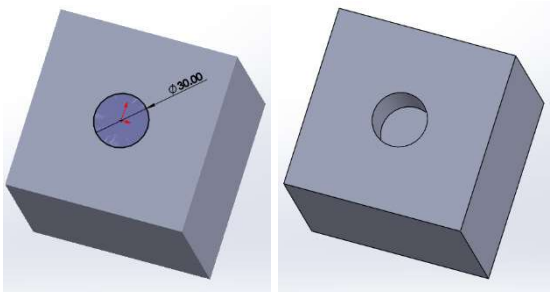
4.1.1. You can further sketch on one planer surface by first **clicking on the surface** and then selecting the **Sketch** button in the **Sketch** tab.

4.1.2. Let's select the surface with the origin to sketch. After entering the sketch, make sure the origin is at the middle of the square. If the origin exists on one of the edges (meaning the origin is actually on the other surface that shares that edge with the current surface), exit that sketch by pressing the transparent "Red cross" button at the top-right corner and then select another surface



4.1.3. Now in the **Sketch** tab, click the **Circle**  tool to draw a circle. The first click should be at the center of the circle and the 2nd click should be on the circumference. Draw the circle centered at the origin (middle of the square) and then place the 2nd point anywhere you like. Again, press **Esc** when you finish drawing a shape.

4.1.4. Dimension the radius/diameter using **Smart Dimension**. Single-click on the circumference and place the diameter label anywhere you like, change the diameter to **30mm**. The special sign before the value 30.00 indicates that it is the diameter.



4.1.5. Go to **Features** tab and select **Extruded Cut** 

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4.1.6. In the option panel, make sure it is **Blind** (cut it blindly, to a certain depth), and type **10mm**. You could toggle the extrude direction by pressing the small arrow beside the Blind option.

4.1.7. Press the **Green Tick** to confirm.

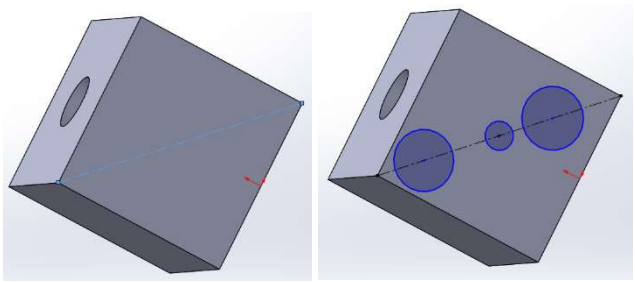
4.2. Draw a THREE

4.2.1. In this part you will try to use a Construction Line to help you sketch and save the tedious dimensioning work.

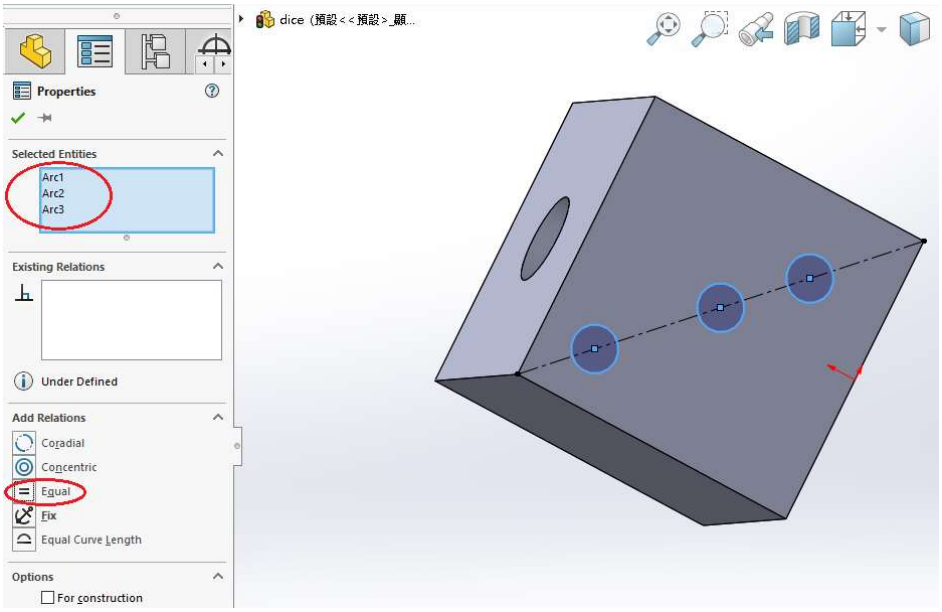
4.2.2. **Click** on any one of the remaining planes.

4.2.3. In the **Line**  tool , there is a small triangle nearby. Click it to open a short menu about additional options for this tool. For example, the additional line option is the "centerline". It is NOT a solid line and therefore it cannot be used to build any geometry directly. Select **Centerline**, then click one corner and its diagonal corner. After that, press **Esc** or double click at other place to complete the centerline drawing. Since the 3D cube is fully defined (i.e. fixed), drawing from the 2 corners also fixes the centerline (it becomes black).

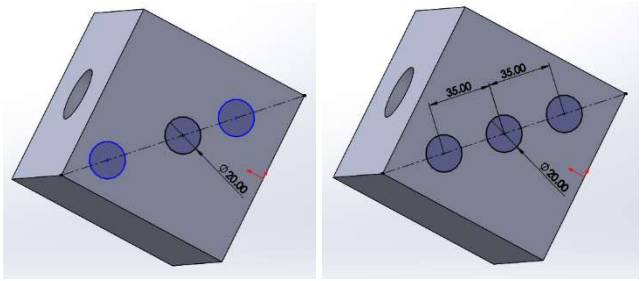
4.2.4. Draw one circle at the middle of the centerline, and then draw 2 more circles near the center circle.



4.2.5. Now, to save the number of times of dimensioning, you can set the 3 circles to be of the same diameter. Hold down the **Ctrl** button, and then select all 3 circles. A property window is shown. Select **Equal** and then press the **Green Tick**. You should see that the circles are changed to equal size.

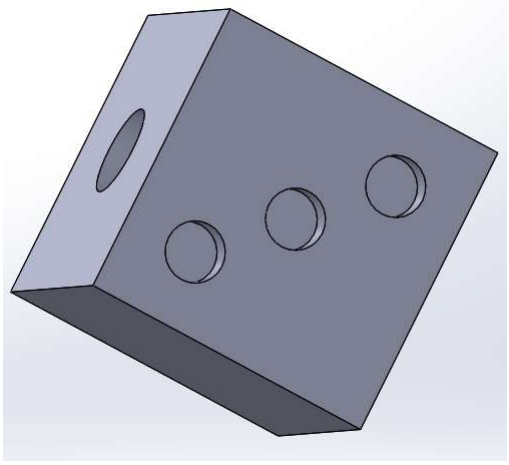


4.2.6. Now dimension either one of the circle to **20mm**. All 3 circles will change correspondingly. Notice that only the middle circle is fully-defined, the other two are not.



4.2.7. Dimension the distances between the circles by using the **Smart Dimension** tool. Clicking any two circles will give you the distance between their centers. Set the distances to **35mm**.

4.2.8. Go to **Features** tab, select **Extruded Cut** and cut it **10mm** deep (same as before for the "ONE-side").



4.3. Draw a TWO

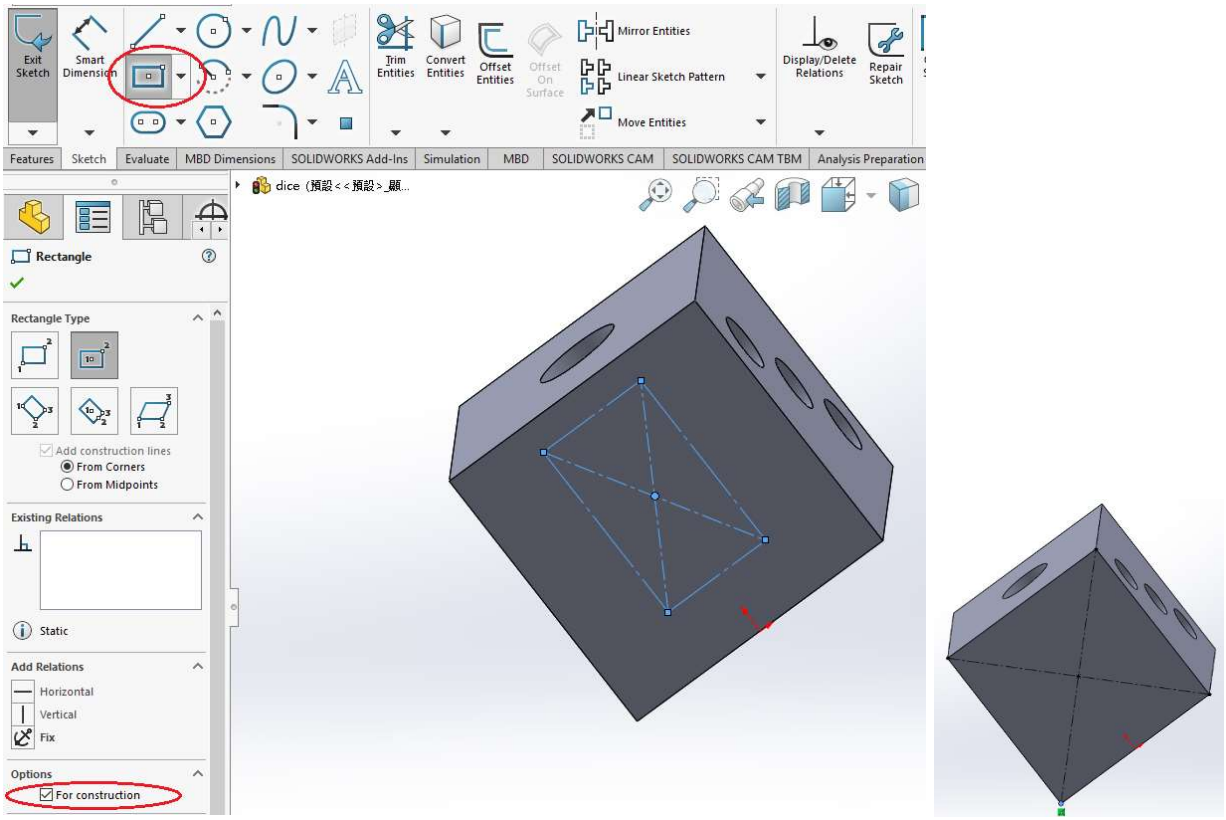
4.3.1. This session is left for your own exercise. You can use the techniques in the previous section to complete the task.

4.4. Draw a FOUR

4.4.1. In this part you will practice how to use more complex constructional geometries to help you sketch.

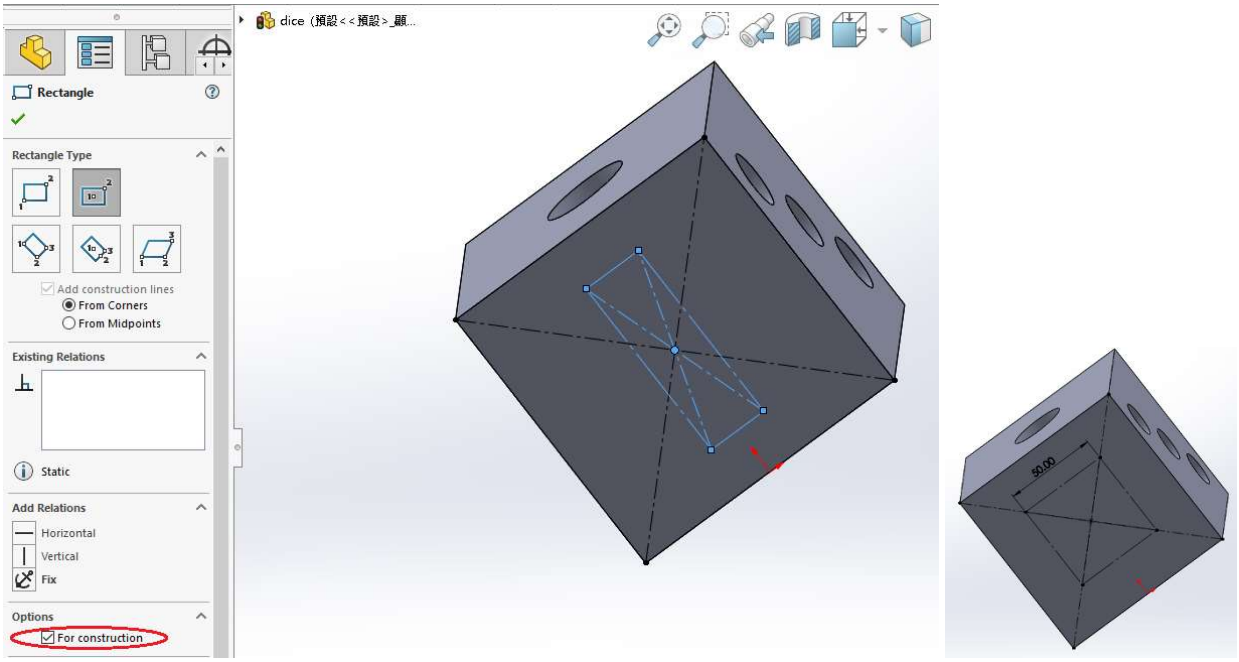
4.4.2. **Click** on any one of the remaining sides which DOES NOT HAVE AN ORIGIN AT THE MIDDLE.

4.4.3. Go the **Sketch** tab. Click the small triangle near the **Rectangle**  and select the 2nd option **Center Rectangle**. This tool can be used like the circle tool by first clicking the center of the rectangle, then clicking one of the corner of the rectangle. DO NOT CONFIRM yet. In the options panel of the rectangle, check the **For construction** option. Press the **Green Tick** to confirm, and you should see a centerline-constructed rectangle.

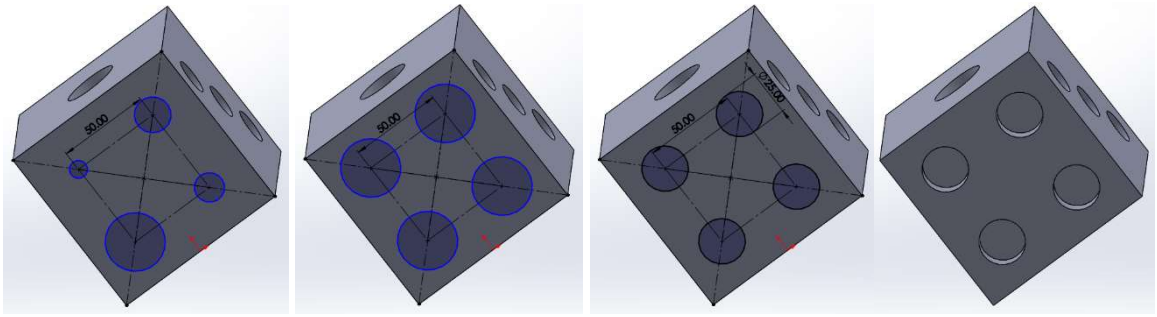


4.4.4. Now, drag one of the corner to the corner of the square. Then drag another corner to the diagonal corner. Now you have the center at the middle.

4.4.5. Draw another center rectangle starting from your newly created center, and place another corner along one of the diagonal centerline that you just created. Again, DO NOT CONFIRM yet. Under the options of the rectangle, check the **For construction** option. Due to geometry constrains, you now have a squared construction rectangle. You can drag the blue edge to change the size of the square. Now dimension the top blue edge to **50mm** and confirm it.



4.4.6. Draw 4 circles centered at the corners of the **50mm** construction rectangle. Set them to **Equal** (in diameter) and set diameters to **25mm**.



4.4.7. **Extruded Cut** for **10mm**.

4.5. Draw a FIVE

4.5.1. This part is left for your own exercise.

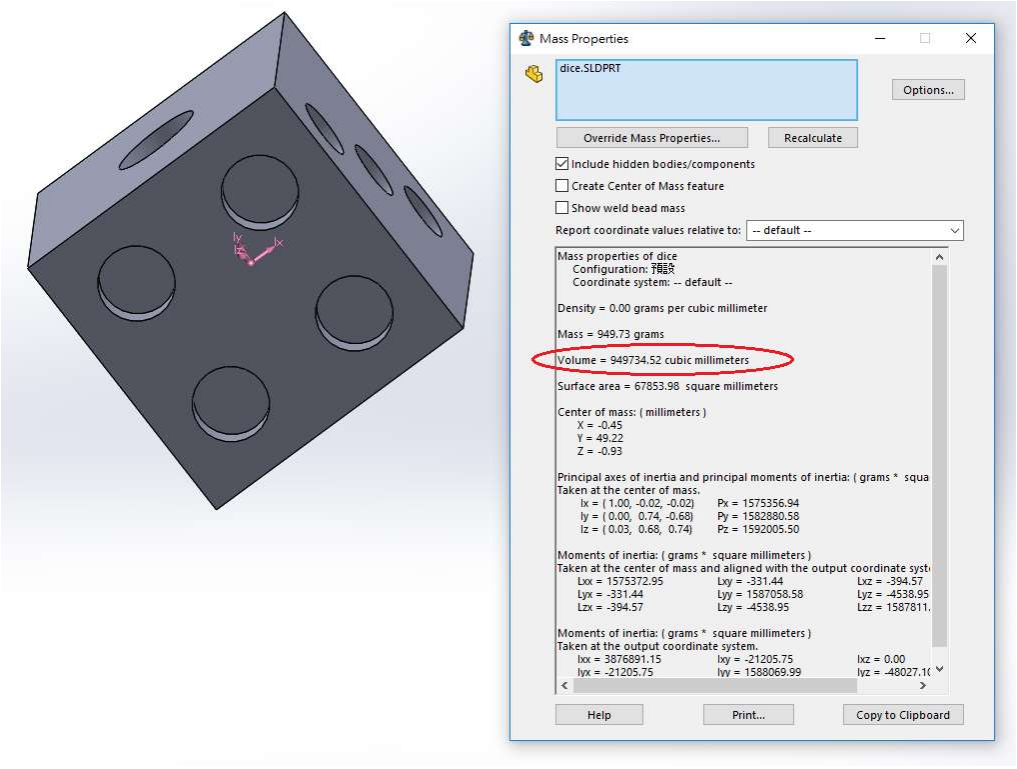
4.6. Draw a SIX

4.6.1. This part is left for your own exercise.

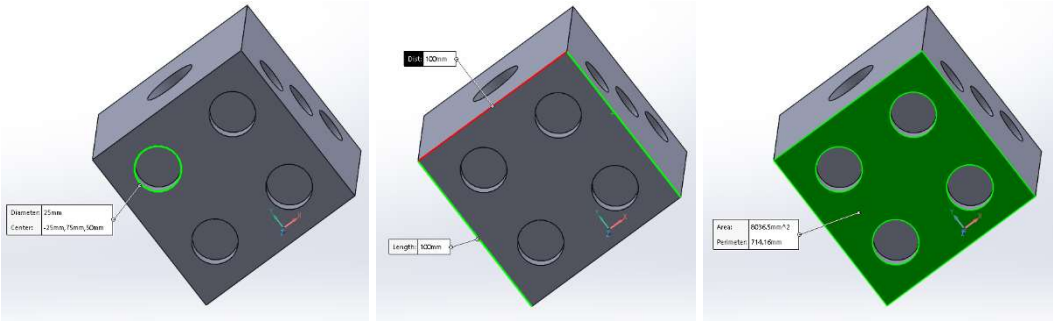
5. Measure and Volume Checking

5.1. There exists functions for you to measure distance between features, and to measure the volume of your created parts.

5.2. To **measure the volume** of a part, go to the **Evaluate** tab and select **Mass Properties**. An information window is shown, and you could find the item of **Volume = ?????? cubic millimeter**. Your submitted parts may be subjected to a maximum volume limitation, so try your best to design your parts efficiently.



5.3. To **measure the distance** between different points/planes, in the **Evaluate** tab select **Measure**. Then you can click on any planes/points to measure the quantity. For example, you can measure the parameter(s) of the clicked part(s) in green.

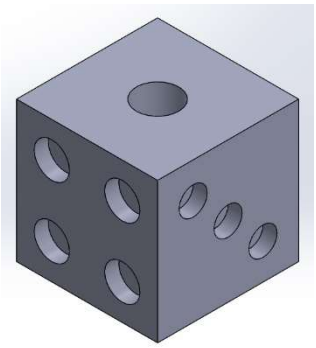


6. Saving the File

6.1. It is always suggested to save the files many times to keep a roll-back option. You could rollback to your previous saved design when you encounter a software clash.

6.2. To save files, you can press **Ctrl+S** on keyboard, or move your mouse cursor to the top-left corner of the software and select **File** > **Save**.

6.3. If you have to submit file for 3D-printing, select **File** > **Save As** to save a file with the extension **.STL**, for example, **dice.stl**.



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