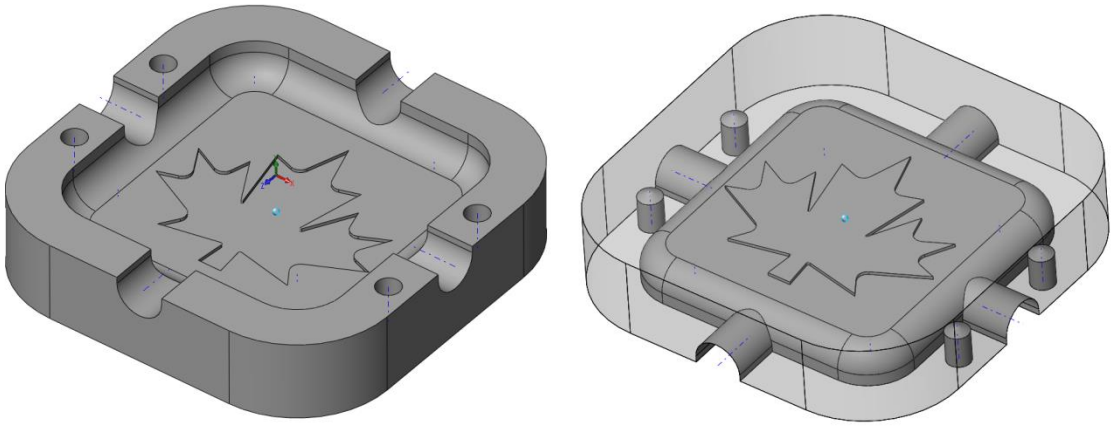
PROJECT 2
CAM SOFTWARE-ASSISTED PART PROGRAMMING

Objective

The primary objective of the project is to fabricate the component shown in Figure 1 below. All dimensions of the part have to be according to the 3D digital (*e.g.* CAD/SolidWorks) master model of the part called *Project 2.SLDPRT* file and provided in OWL (and in the shared course drive, see further) along with the current project description.

The NC code required to machine the part can be generated only by means of the provided CAM software called Edgecam. Once the baseline machining strategy has been devised and tested on a machined component termed "baseline workpiece", identify means to improve it (shorter cycle time, better part quality, etc.) and modify the machining strategy in Edgecam accordingly. Please note that – unless there is time and interest – there is no need to fabricate the "enhanced workpiece" based on the proposed improved strategy.



Side A

Side B
(transparency on, engraving missing)

Figure 1

Additional directions

- Use the central area of B side to engrave the following from top to bottom on three different lines: i) Western Engineering (WE) logo, ii) the current year (2024), and iii) your group number. The WE logo and your group number could be identical with those used for Project 1 (but they do not have to be, you have the freedom to use a different/better font as well).
- The depth of these engravings should not exceed 0.016" because otherwise part cracking might occur since the part was already thinned out significantly in the central region (from both A and B sides). The orientation of the engraving on B side should be consistent with that of the leaf on the A side (and not upside down). Finally, please ensure that the width of all your B-side engravings (letters and digits) is slightly larger than 1/16" (mathematically, this is equivalent with *width > 1/16"* but **not** with *width ≥ 1/16"*) because otherwise the CAM software will simply refuse to generate the path.

- Given your lack of prior exposure to Edgecam, teaching assistants will guide/help you in defining the machining strategy to be used for the side A of the "baseline workpiece". Based on this experience, you are to define the machining strategy for the side B of the "baseline workpiece". After that, you are to define the improved strategy (or strategies, if you are modifying the machining sequences for both side A and side B) for the "enhanced workpiece".
- You must use the edge finder (fixture offset = G54 to G59) and offline tool length measurement (tool length offset = G43 Hn) to set part zero location. No other methods (such as manual jogging that was used for Project 1) to determine part zero will be permitted for this project. Workpiece has to be appropriately clamped in the vise during the entire machining procedure.

Tasks

Submit by **4:00 p.m. on Monday, March 18, 2024** the following (only **one** submission per group in each of the four categories below):

1. ***Machined component(s)***
   The fabricated workpiece(s) will be handed in to the supervising TA.
2. ***Lab report***
   The report will be submitted electronically via OWL (one submission per group). The report should be at least three single-spaced typewritten pages in 12-pt. font long and it should include details and/or comments on:
   - Machining sequence/technology chosen
   - Tooling selected and its setup procedure
   - Dimensional accuracy and surface quality of the machined part
   - The improvements brought to the baseline strategy in order to fabricate the enhanced workpiece
   - "Lessons learned" and ways to improve the overall setup used for this project
3. ***Edgecam part files (*.epf)***
   The following files should be submitted electronically through OWL:
   - One file outlining the strategy used to machine the side A of the "baseline workpiece"
   - One file outlining the strategy used to machine the side B of the "baseline workpiece" (no instructions provided, you will have to use the knowledge accumulated while working on side A under teaching assistant and/or course instructor guidance)
   - One or two files outlining improvements brought to the baseline machining strategy as indicated in the report (that were or could be used to machine the "enhanced workpiece"). Depending where machining strategy improvements were identified in the last part of the report, you can submit one or two files improved strategy files (*i.e.*, one file per workpiece orientation in the fixture). Same as above, no instructions are provided since you are to generate the improved strategies based on the experience you have accumulated with Edgecam.

4. ***NC program files (*.nc or *.txt)***
   A total of three or four files text submitted electronically through OWL. Depending on whether your improved strategy affects only side A, only side B, or both, you will have to submit three or four NC programs (*i.e.*, one per *.epf file submitted, see point 3 above)

Available hardware

- *Three-axis CNC machine tool:* Tormach PCNC Series II milling machine
- *Workholding device:* Vise
- *Blanks*: Plexiglas raw stock cut at 2.3" x 2.3" x ½" (approximate dimensions)
- *Cutting tools:* 1/2", 3/8", 1/4", 1/8", 1/16" flat-end mills; 1/8" and 1/16" ball-end mills and 1/8" drill bit

Available software and data

- *CNC simulator and backplotting software: PathPilot* (virtual/browser-based via PathPilot Hub or locally installed on the computer attached to the Tormach machine tool) or *Tormach PCNC* (locally installed on the lab computer)
- *CAM software:* Edgecam 2022 R1 2247.B9227
  - The Edgecam installation kit is available in the course shared drive that can be mapped/accessed by manually pointing in Windows Explorer to \\ebithp-c1v9.eng.uwo.ca\mme4459 followed by login with your UWO domain credentials. This shared network resource is accessible only to those enrolled in this course and it can only be accessed when your laptop is connected to the Western wireless network. Alternatively, you can just copy the kit on an USB stick connected to the lab computer because the aforementioned shared network location was already mapped as *Z:*\ drive for each of the local *cncgroupX* profiles that you are using to log into the lab computer.
  - Edgecam software can be installed on personal computers, but it needs to be configured to be able to check out our educational Edgecam license and this is only possible when the computer is connected to the Western wireless network. If used with a different Internet provider (outside of Western network), the software is fully functional in demo (also called "Student" or "Homework" mode) with the exception of postprocessing (*i.e.*, NC program generation) that can only be performed a computer capable to check out the Edgecam license.
  - Please contact the course instructor for Edgecam installation and configuration details on personal computers.
  - Please note that numerous Edgecam video tutorials were posted in Week 6 of the Course Content tab of the OWL-based course website .
  - The **.epf* file (*epf* stands for educational part file, commercial Edgecam licenses generate *ppf* = production part files; the software developer clearly wanted to be able to differentiate between the two types of files) generated on the demo/student version can be reopened on a licensed installation of Edgecam and post-processing (*i.e.*, G-code generation based on the chosen tool path strategies) can be performed with one

click of a button (once your laptop is in the Western wireless network). Alternatively, you can just transfer the **.epf* file to the lab computer that is inherently able to perform the post-processing task since it is connected to the Edgecam server.

  - Please note that enhanced graphic capabilities are required in order for Edgecam to display the geometry properly, and this is not the case with most/many laptops equipped with integrated graphics. Past experience shows that the issue becomes more prominent particularly when attempting to display numerous 3D objects in the graphic window. Because of this, laptops with discrete graphic cards are recommended for any graphics-intensive applications (such is, for instance, the case of CAD, CAM and FEA).

- *Project-related files:* All are available in *Z:*\ drive. As mentioned above, this drive was already mapped on both lab computers and for all lab group profiles.

Project Mark

The following elements will be considered while marking your project:

- *Dimensional accuracy of the part*
  All final dimensions of the machined part should be as close as possible to its CAD model. Differences in blank/stock thickness are to be ignored.

- *Part quality/aesthetics/appearance*
  Avoid scratches, burrs, tool marks, dents, scallops and ridges on all machined surfaces. If they do occur, then please ensure to comment on their possible source as well as ways to eliminate them.

- *Correctness and professionalism of the report*
  Please remember that the report should be prepared in a professional manner both with respect to formatting and technical terminology – or machining jargon, if you wish – used in a sense that layman and colloquial terms should be avoided at all costs. The report should also make a good use of explanatory figures, whenever they seem to be appropriate to clarify the concept explained within text. The most important questions to be answered by the report are "what", "how" and "why", but this should be accomplished without their obstinate and/or *ad litteram* repetition throughout the text of the report.

  The report should also include specific comments/table on the noticed discrepancies between the nominal dimensions (*i.e.* those specified by digital master/CAD data) and the effective ones (*i.e.* the ones measured on the part). In terms of improvement means (*e.g.* "lessons learned"), the report can address means to correct "potential" or "real" issues noticed during machining which might have affected (*e.g.* decreased) the overall productivity of the process (which actually translates into fabrication costs) as well as the accuracy/quality of the machined part.

- *Feasibility of the proposed improvements of the baseline machining strategy*
  As you might expect, the most important part of your report pertains to the proposed improvement directions of the baseline machining strategy, such that it is extremely important to underscore all differences between your baseline and improved machining strategies, *i.e.* what is the change you have made and why do you think it should be be effective. While you have the freedom to define your own improvement criterion/criteria,

they will have to be clearly identified/spelled out in your report. Also, the improvements have to be somehow quantifiable (*i.e.* time to machine the part, surface quality, number of operations, etc.) or else they cannot be verified and hence they might as well not exist (!). One last mention: the improved machining strategy should not push the Tormach CNC machine to its limits, *i.e.* you are not allowed to just "artificially" increase the feeds and speeds of the machine and then claim that the part was just produced in a shorter time and thus this a possible and valid machining strategy improvement. A good/valid improved machining strategy might entail a "redesign" of the entire manufacturing sequence (e.g. succession, type and/or parameters of various machining operations). It all comes down to your overall understanding of machining sequence as well as of the associated parameters as inputted within the Edgecam software interface.

Please note that

- *Late penalties are **20% off per day***
  This applies to both report and part submissions.
- *Each group member of the same group will essentially receive the same credit*
  However, those who are absent and/or late for more than 10 minutes during any of the three lab sessions allocated for this project will be *proportionally penalized*. By contrast, if the entire group decides to not show up to a particular lab session, no group penalty will be applied, but the project will still have to be submitted by the assigned deadline. Once again, no makeup classes can be provided, such that make sure you finish your project during the allotted lab sessions. In engineering terms, this means that **lab time ≈ machine run time**. Please remember: like in production, when the machine is down, the resources are wasted, which in turn simply means that you did not plan properly your actions.
- For a more complete description of laboratory/project policies, please refer to the "Course Policies" section of the course outline.