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Puzzle Box Project

JEM – 171, CAD

Fall 2015, revision 1.6

Problem Statement:

You are to design and fabricate a “Puzzle Box” that meets a variety of constraints. You will:

1. Create a 3d model for each part in the assembly.
2. Create a fully constrained virtual assembly.
3. Produce a fully dimensioned and toleranced 2d drawing for each part, with notes and filled-in title block.
4. Produce an exploded assembly drawing with bill of materials (BOM) and callouts.
5. Output your parts on the 3d printer, confirm that they fit together properly.

Constraints:

1. The puzzle box must comprise 3 or more pieces.
2. The assembled and closed box must fit within a 2” cube.
3. The assembly must have interlocks such that it requires some study and care to open. Multiple movements are a must, thus the name “puzzle”.
4. The assembly must be readily assembled and disassembled, requiring little force. Ideally, when fully assembled and turned upside down/sideways etc. no parts fall off.
5. There must be a fully contained internal “treasure” space, large enough to house 10 US pennies. When the box is assembled these coins must not fall out, no matter the orientation of the box.
6. Construction details and suggestions:
   1. Wall thickness should nominally be 1/8” (.125”). You are allowed to have occasional instances of thicker wall to support special details.
   2. Thin details tend to warp and break, particularly long ones. Avoid making long slender parts.
   3. Nominal clearances should be a minimum of .010” between mating/fitted parts. This helps compensate for shrinkage and warpage of parts.
   4. Round details tend to go out-of-round. This could be a problem if you are mating round pieces. Rectangular parts should provide a more reliable fit.
   5. 45 degree rule: overhangs that are greater than 45 degrees will need support material or you need to use clever modeling tricks to get the model to print.
   6. See: <http://makezine.com/2013/12/11/top-ten-tips-designing-models-for-3d-printing/>
7. Extra credit -- engrave or emboss your name or initials on one or more faces of the box.
8. Extra credit also given for innovative puzzles:
   1. Interesting assembly design, goes beyond simple fits
   2. Challenging to open/close (but not flawed!).
   3. Artful or aesthetically appealing design.

**Grading:**

This project addresses multiple course learning objectives:

* Creation of 3D models and assemblies using Solidworks.
* Creation of Engineering part and assembly drawings using Solidworks.
* Fabrication using 3D printing. You get ONE try, so proceed with caution!

Each of these aspects contributes to your overall project grade:

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| **Objective/Criteria** | | **% of Project Grade** |
| 3D part models & assembly | | 35% |
|  | Complete models for all parts |  |
|  | Complete assembly with appropriate mates |  |
| 2D part & assembly drawings | | 40% |
|  | Dimensionally complete |  |
|  | Appropriate tolerances |  |
|  | Well laid out |  |
| 3D printed and assembled puzzle box | | 25% |
|  | Functional and well crafted |  |

Detailed rubrics will be provided on Moodle.

**Deliverables and Due Dates**

You will present your puzzle box during our final exam period. Your presentation should include the following:

1. Assembled puzzle box.
2. Assembly model and drawing saved in pdf format as described [here](http://www.cs.unca.edu/~bruce/Fall15/171/PrintingYourDrawings.pdf).
3. Part drawings (in pdf format) with a discussion of clearances and tolerances for interlocking pieces.

Your presentation will be judged on completeness and your discussion of clearances and tolerances.

The schedule for all deliverables is below.

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| **Deliverable** | **Due Date** |
| In-Class review of preliminary models | Week of 10/26 |
| All models (in .stl format) submitted for printing | No later than Friday, Nov 6, by mid-night. |
| In-Class review of preliminary part drawings | Weeks of 11/16 & 11/23 (for Mon & Tues sections) |
| Final part and assembly drawings | Monday, Nov 30, by mid-night |
| Project presentation | Dec 1 - Dec 7 (final exam period) See the class webpage for the exact date and time. |