Engineering Sketch Pad (ESP)

Training Session 5
CSM Language (2)

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Overview

- Looping
  - PATBEG, PATBREAK, PATEND
- Logic
  - IFTHEN, ELSEIF, ELSE, ENDIF
- Signal Handling
  - THROW, CATBEG, CATEND
- Homework Exercises

Patterns (1)

- Patterns are like “for” or “do” loops
  - the Branches between the `PATBEG` and `PATEND` are executed a known number of times
  - at the beginning of each “instance”, the pattern number is incremented (from 1 to the number of copies)
  - one can break out of the pattern early with a `PATBREAK` statement
    - breaks out if argument evaluates to a positive number
  - patterns can be nested within other patterns

Patterns (2)

- Example pattern (indentation optional):

```
PATBEG     i     3
   SET     j     i-1
   BOX     j     0   0   1   1   1
   ROTATEX j*10  0   0
PATEND
```

- is the same as:

```
BOX      0   0   0   1   1   1
ROTATEX  0   0   0

BOX      1   0   0   1   1   1
ROTATEX  10  0   0

BOX      2   0   0   1   1   1
ROTATEX  20  0   0
```

If/then (1)

- If/then constructs are used to make a choice within a `.csm` script
  - start with `IFTHEN` statement
  - has zero or more `ELSEIF` statements
  - has zero or one `ELSE` statement
  - has exactly one `ENDIF` statement
- The `IFTHEN` and `ELSEIF` statements have arguments, which can be specified in lowercase or UPPERCASE
  - `val1` — an expression
  - `op1` — can be `lt`, `le`, `eq`, `ge`, `gt`, `ne`, `LT`, ...
  - `val2` — an expression
  - `op2` — can be `or`, `xor`, `and`, `OR`, ... (defaults to `and`)
  - `val3` — an expression (defaults to `0`)
  - `op3` — can be `lt`, `le`, `eq`, `ge`, `gt`, `ne`, `LT`, or ... (defaults to `eq`)
  - `val4` — an expression (defaults to `0`)

If/then (2)

- Example (indentation optional):

```
IFTHEN    a   eq  4   or  b   ne  2
   BOX    0   0   0   1   1   1
ELSEIF    c   eq  sqrt(9)
   BOX    2   2   2   2   2   2
ELSE
   BOX    3   3   3   3   3   3
ENDIF
```

- Note that only one of the `BOX` commands will be executed

Throw/catch (1)

- Throw/catch constructs are used to generate and react to signals (errors)
- Signals can be generated by
  - executing a `THROW` command
    - `ESP` uses negative signal numbers, so users should generally use positive signal numbers to avoid collisions
  - a run-time error encountered elsewhere (see "help" for more info)
- When a signal is generated, all Branches are skipped until a matching `CATBEG` statement is encountered
  - the signal is cancelled
  - processing continues at the statement following the `CATBEG`
- If a `CATBEG` statement is encountered when there is no pending signal (or the pending signal does not match the `CATBEG`)
  - all Branches up to, and including the matching `CATEND` statement, are skipped

Throw/catch (2)

```
 1: BOX      0 0 0 1 1 1

 2: THROW    99

 3: SPHERE   0 0 0 1

 4: CATBEG   98
 5:    SPHERE    0 0 0 2
 6: CATEND

 7: SPHERE   0 0 0 3

 8: CATBEG   99
 9:    BOX         1 0 0 1 1 1
10: CATEND

11: CATBEG   99
12:    SPHERE   0 0 0 4
13: CATEND

14: END
```

- BOX in line 1 is generated
- SPHERE in line 3 is skipped (since there is an active signal)
- CATBEG/CATEND in lines 4–6 are skipped (since they do not match 99)
- SPHERE in line 7 is skipped
- BOX in line 9 is generated
- CATBEG/CATEND in lines 11–13 are skipped (since the signal was cancelled when it was caught in line 8)

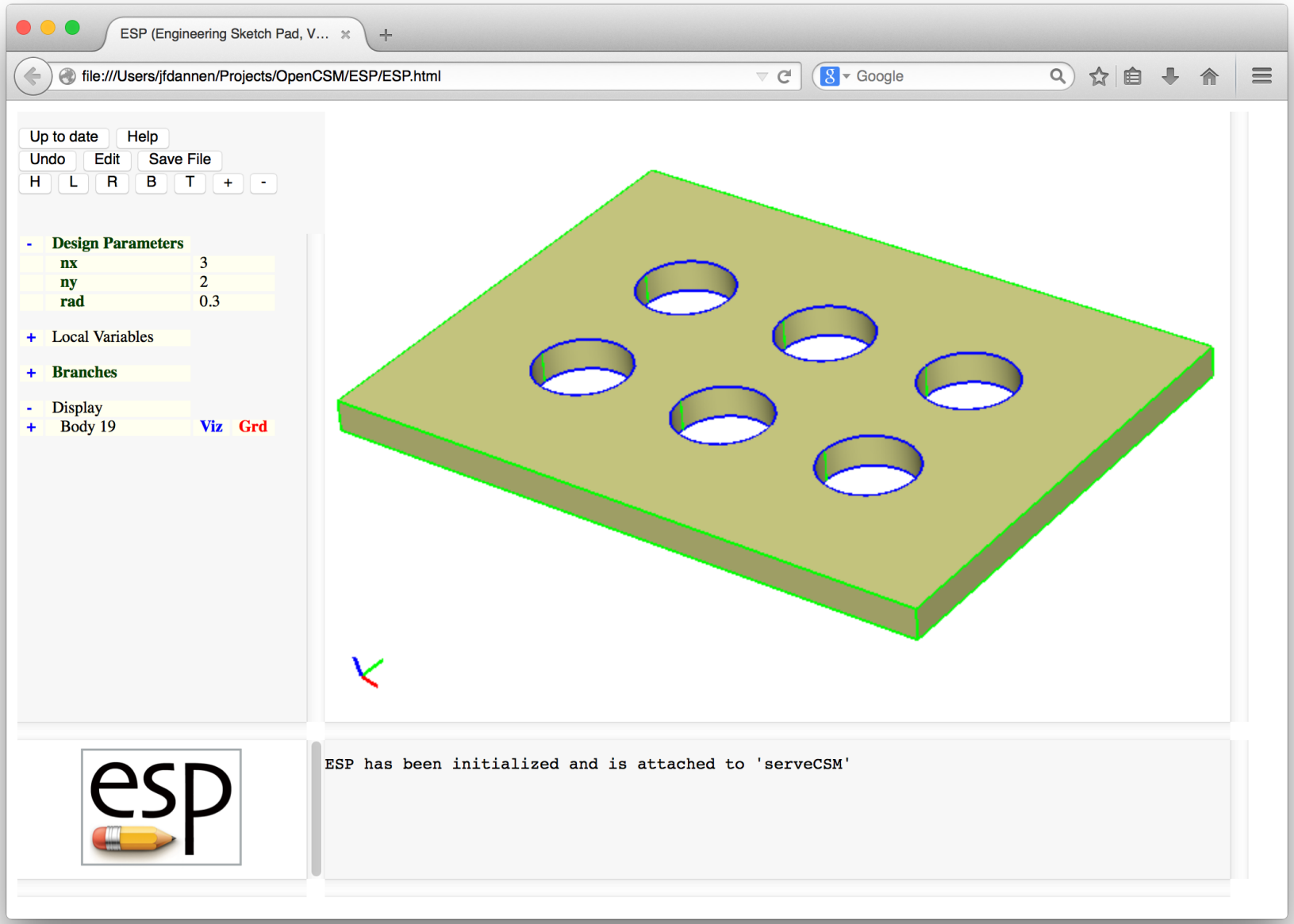
Special Note on Programming Blocks

- Programming Blocks are delineated by
  - `PATBEG` and `PATEND`
  - `IFTHEN`, `ELSEIF`, `ELSE`, and `ENDIF`
  - `SOLBEG` and `SOLEND`
  - `CATBEG` and `CATEND`
- Any programming Block can be nested fully within any other programming Block (up to 20 levels deep)

Homework Exercises

- Rectangular plate with holes
- Round plate with holes
- Determine if two Bodys overlap
- Files in `$ESP_ROOT/training/ESP/data/session05` will get you started

Rectangular Plate with Holes (1)



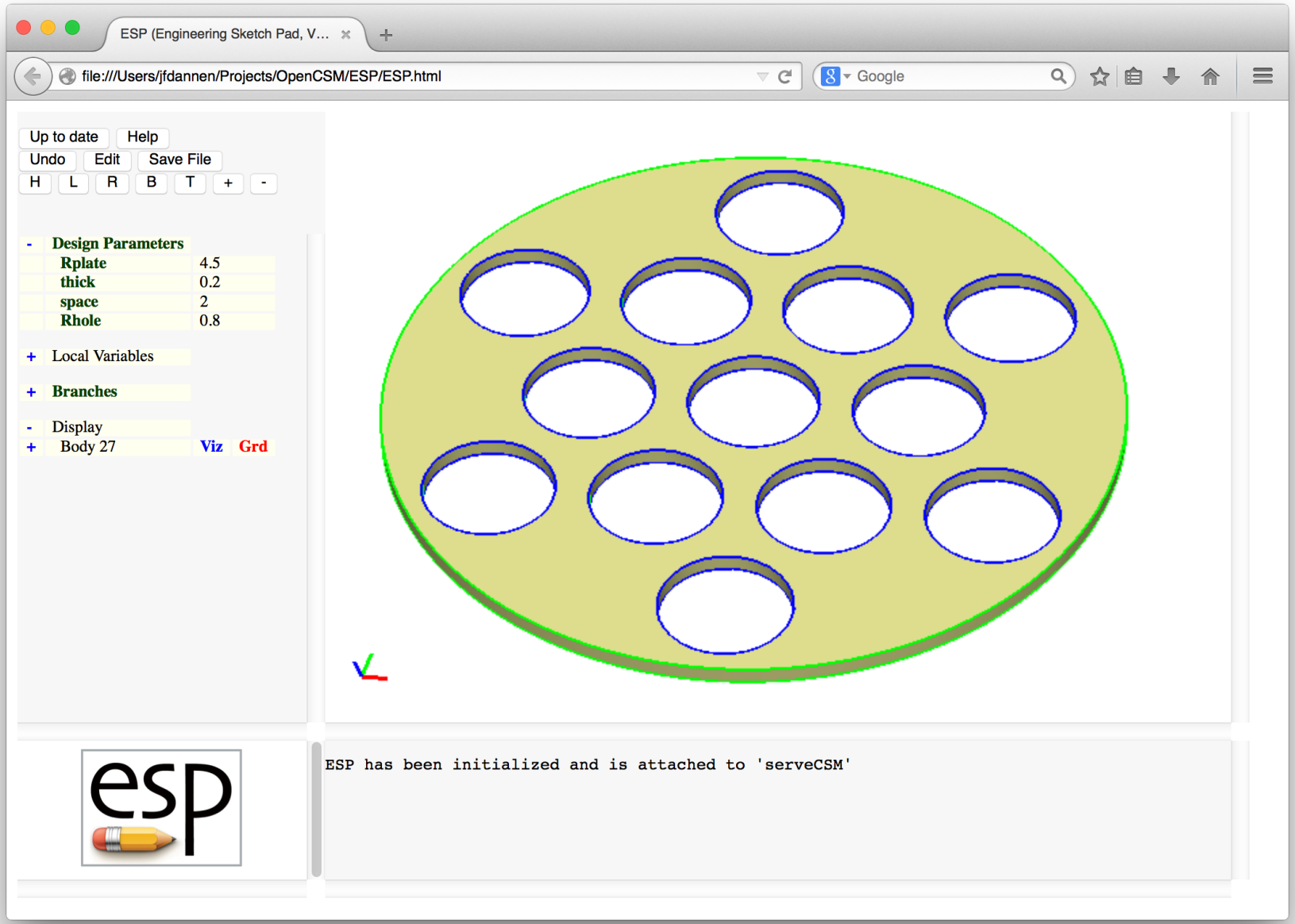
Rectangular Plate with Holes (2)

nx	number of holes in X-direction	3.00
ny	number of holes in Y-direction	2.00
rad	radius of each hole	0.30
	distance between hole centers	1.00

Rectangular Plate with Holes (3)

- Can you make a single hole in the center of the plate?
- Can you change your solution to have the holes spaced so that they fill the plate?
- What if you make the radius of the hole too big?

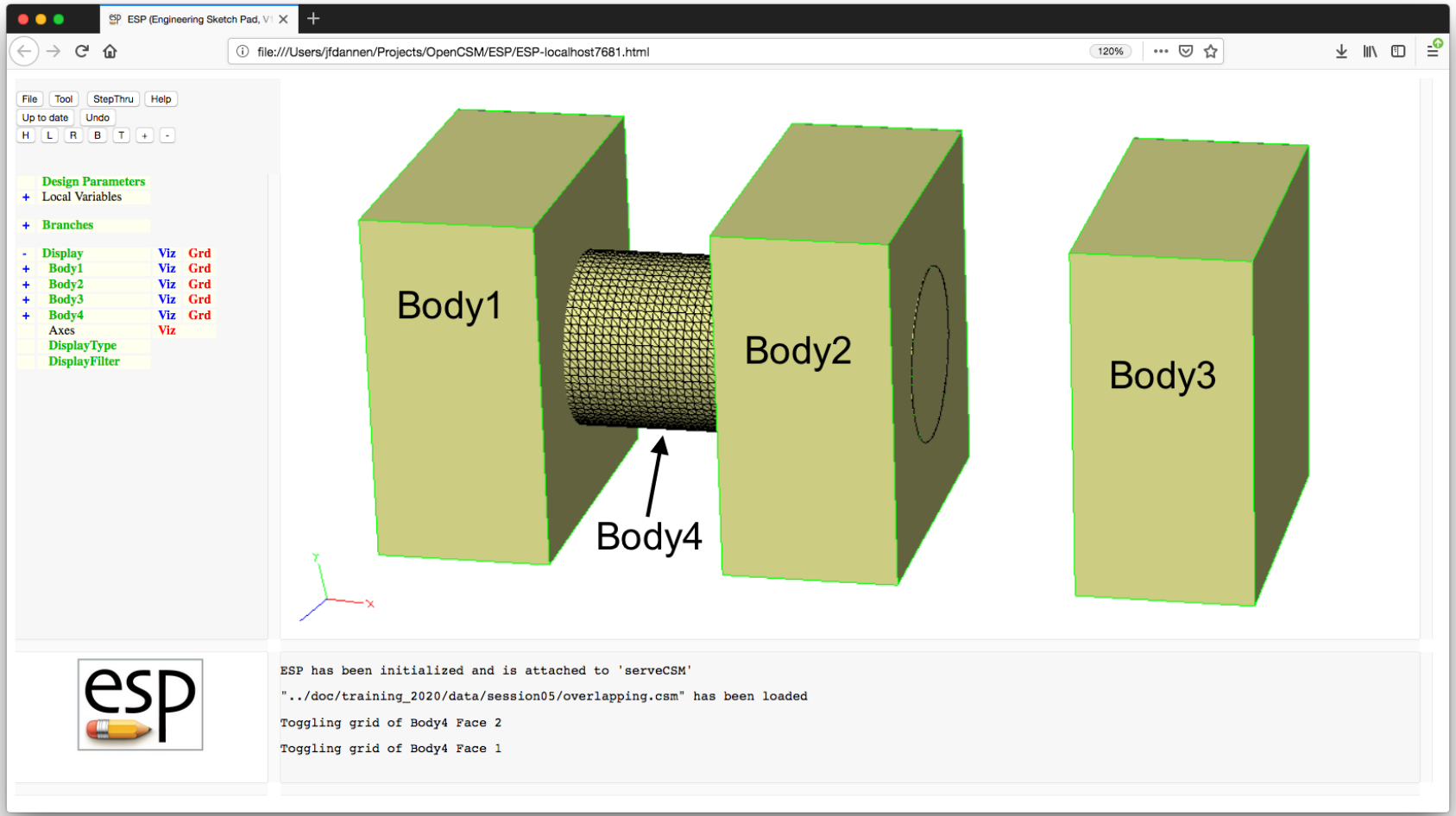
Round Plate with Holes (1)



Round Plate with Holes (2)

Rplate	radius of plate	4.50
thick	thickness of plate	0.20
space	distance between hole centers	2.00
Rhole	radius of holes	0.80
	number of holes selected automatically	

Overlapping Bodys (1)



Overlapping Bodys (2)

- Write `.csm` file to:
  - set `overlap1` to 1 if Bodys 1 and 4 overlap, otherwise set it to 0
  - set `overlap2` to 1 if Bodys 2 and 4 overlap, otherwise set it to 0
  - set `overlap3` to 1 if Bodys 3 and 4 overlap, otherwise set it to 0
- Try to use a pattern to do this compactly