

Engin 103
April 15, 2008

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Enengineering 103 –UMass Boston CW 9 (In-Class-Work 9)

Case Structure and the Formula Node

Make a VI following the link "Time of Flight with LabVIEW"

Please insert names and dates within the Front Panels. By alphabetical order of the last names, the first two students in each team will submit LabVIEW LLB file cw9_XX_a.llb, the next two students will submit LabVIEW LLB file cw9_XX_b.llb, to the *files* folder in the server. Each LLB file should contain two VI's corresponding to this CW. These files need to be uploaded to the server today to receive credit.

*Remember that this is an individual work (turn it in, as instructed, with your name and date). Home-works and class-works count 20% toward the course grade. Class-works are done in class.

$y = 2.75\text{m}$
 $v = 0$

$$t = v_0/g$$

$$t = v_0/g$$

$y = h_0$
 $v = v_0$

$$t = -v_0/g + \sqrt{2/g(h_0 + v_0^2/(2g))}$$

$y = 0$

The coin is tossed up at B with an initial speed v_0 , reaching zero speed at C, falling back to B and continuing to A. In summary its trajectory will be BCBA. The coin follows a constant deceleration motion between B and C, and constant acceleration between C and A. The constant acceleration is $g = 9.81\text{m/s}^2$. By conservation of energy, the coin

accelerates from zero speed at C to the initial speed v_0 at B. The time it takes to cover BCB is

$$t_{BCB} = 2 \frac{v_0}{g}$$

and the time it takes to cover BA is

$$t_{BA} = -\frac{v_0}{g} + \sqrt{\frac{2}{g} \left(h_0 + \frac{v_0^2}{2g} \right)}$$

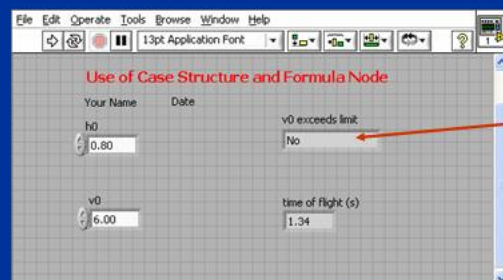
so the total time of flight is

$$t_{BCBA} = \frac{v_0}{g} + \sqrt{\frac{2}{g} \left(h_0 + \frac{v_0^2}{2g} \right)}$$

Today we did CW9: LabVIEW Case Structure and Formula Node. The equations and background information can be found in the link to “Time of Flight with LabVIEW Case Structure” in the e-syllabus. The VI will output the time of flight for a coin-like object when it is tossed from an initial height h_0 and given an initial speed v_0 . The object should not hit the ceiling at 2.75m, this translates into a maximum value for v_0 , or $v_{0,max}$. The VI will use a Case Structure to decide whether to output the time of flight, when $v_0 \leq v_{0,max}$, or just 0, when $v_0 > v_{0,max}$.

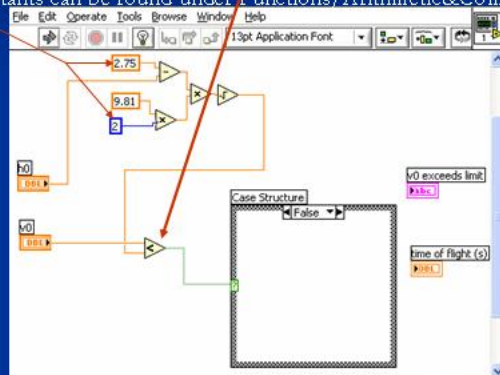
Case Structure: We use it to perform different actions depending on whether a condition is satisfied or not, similar to an IF/THEN in a conventional programming language.

Formula Node: we use it to enter a formula as an expression, as in a conventional Programming language.



1) In the Front Panel, place Two Numeric Controls for h_0 and v_0 ; one String Indicator (Controls/Text Indicators); and one Numeric Indicator for the Time of flight t .

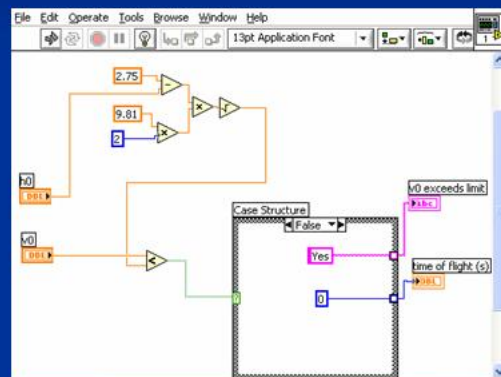
2) In the Block Diagram produce the upper limit for v_0 using the given formula (see E-syllabus) in term of h_0 . Note for the "Less?" operator (Functions/Arithmetic&Comparison/Express Comparison): it is checking whether the upper terminal is less than the lower terminal, giving a result of true or false. Numeric constants can be found under Functions/Arithmetic&Comparison/Express Numeric



The case structure can be found in Functions/Exec Ctrl/Case Structure or All Functions/Structure. Note it has two windows: False and True. The result of the Less? Operator will dictate which window to use.

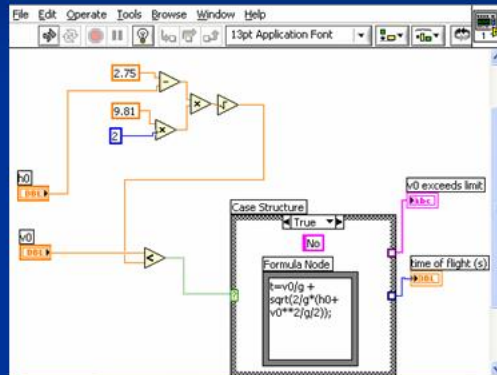
7

3) Enter a String Constant (All Functions/String) to say Yes in the False window (when v_0 Is NOT less than its maximum allowed value, then connect it to the String Indicator ("v0 exceeds limit"). And a Numeric Constant of 0 connected to The time of flight.



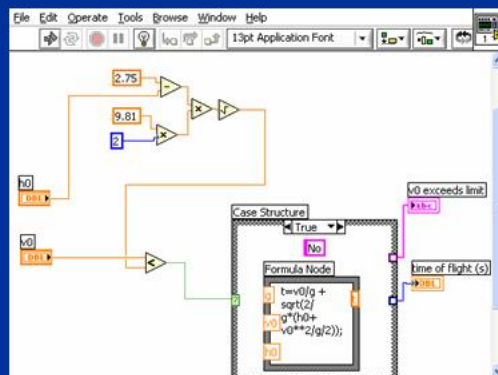
8

4) Switch to the True window, enter a Formula Node (All Functions/Structures), type in The formula as indicated in equation (2) in the link using "g**2" for power (not "g^2" as In Excel). Enter a String Constant for to indicate NO then connect to String Indicator "v0 exceeds limit".



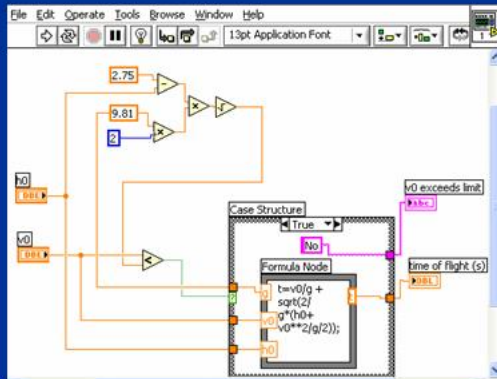
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5) To connect the Formula Node to the rest of the Diagram, right-click on the left border Of the Formula Node, select Add Input, an orange box appears, type in "v0", the same way as you refer to the initial speed in your formula within the Formula Node. Then repeat for "g" and "h0". Also right-click on the right border of the Formula Node, select Add Output, then type "t" in the orange box, remember to use the same variable as You refer to the time of flight in your expression within the Formula Node.



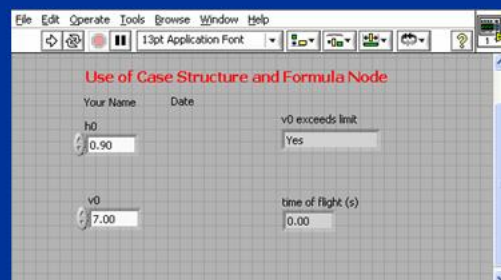
10

6) Wire the "Inputs and Output" variables for the Formula Node as you defined in the Previous step to the corresponding elements in the Diagram as shown below. The "Run" button should become continuous now if you did not get any grammar Error. To check other type of hidden errors (non-grammar errors are not detected by the software) test the VI following step 7).



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7) The testing step is important to detect "hidden" errors or non-grammar errors which Cannot be detected by the software. You should get the same outputs for the inputs Shown below. Also in the link there is a table of different input values for a more Thorough testing. This constitutes CW8 that is due today (note the values you need to Use in the CW and do Operate/Save Current Values as Default before you save.



12

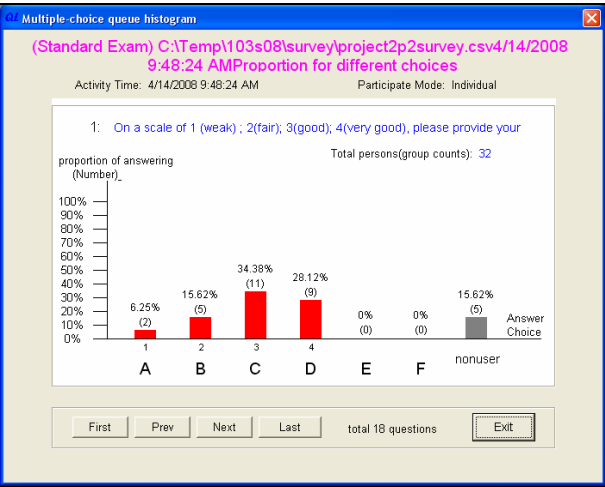
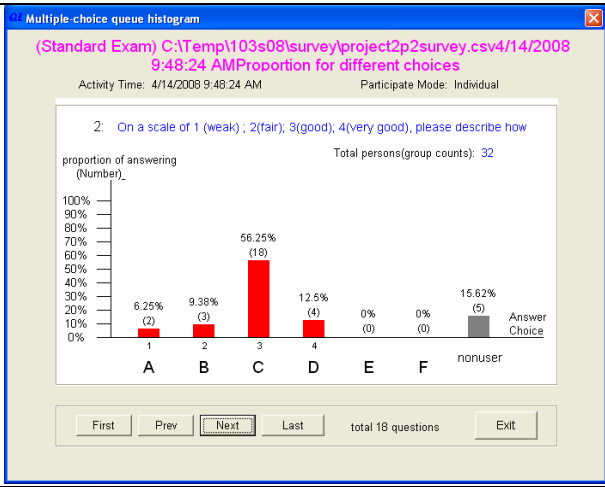
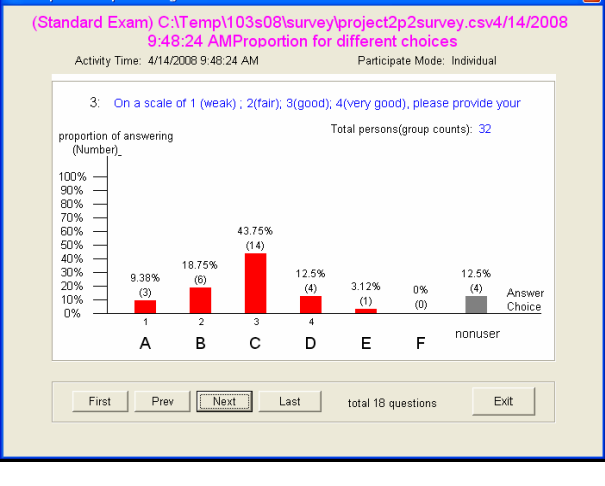
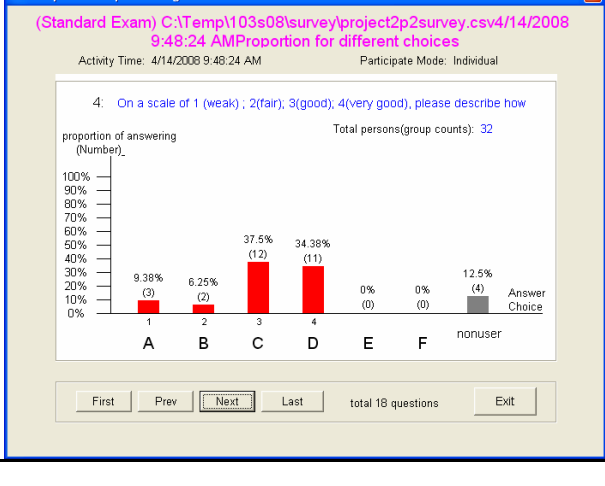
| Common errors (click on the broken RUN arrow to view error list) | Reasons |
|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Formula Node: undefined variable | The variables you defined as inputs (left border of the Formula Node) or outputs (right border of the Formula Node) did not match the variables you typed in the |

| | |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| | equation. |
| Formula Node: missing semicolon | The equation within the Formula Node needs to end with a semicolon. |
| Tunnel: missing assignment to tunnel | Every output element outside the Case Structure needs to be connected to elements in BOTH the True and False windows. |
| Formula Node: integer type required | The power operation in the new LabVIEW editions should read “***” |

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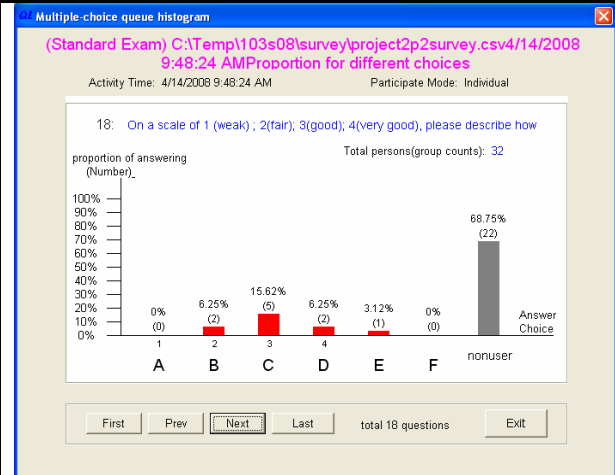
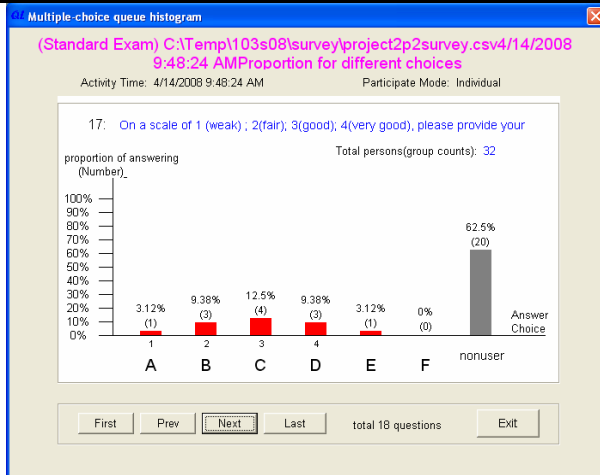
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Project 2 Part II Survey

| | | |
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| Team | On a scale of 1 (weak) ; 2(fair); 3(good); 4(very good), please provide your feedback on this team Virtual Instrument regarding the LabVIEW elements they used and the sub-VI they created | On a scale of 1 (weak) ; 2(fair); 3(good); 4(very good), please describe how interesting is the problem or topic this team used in their Virtual Instrument |
| 1 |  <p>Multiple-choice queue histogram</p> <p>(Standard Exam) C:\Temp\103s08\survey\project2p2survey.csv4/14/2008 9:48:24 AM</p> <p>Activity Time: 4/14/2008 9:48:24 AM Participate Mode: Individual</p> <p>1: On a scale of 1 (weak) ; 2(fair); 3(good); 4(very good), please provide your feedback on this team Virtual Instrument regarding the LabVIEW elements they used and the sub-VI they created</p> <p>proportion of answering (Number)</p> <p>Total persons(group counts): 32</p> <p>100% 90% 80% 70% 60% 50% 40% 30% 20% 10% 0%</p> <p>6.25% (2) 15.62% (5) 34.38% (11) 28.12% (9) 0% (0) 0% (0) 15.62% (5)</p> <p>A B C D E F nonuser</p> <p>First Prev Next Last total 18 questions Exit</p> |  <p>Multiple-choice queue histogram</p> <p>(Standard Exam) C:\Temp\103s08\survey\project2p2survey.csv4/14/2008 9:48:24 AM</p> <p>Activity Time: 4/14/2008 9:48:24 AM Participate Mode: Individual</p> <p>2: On a scale of 1 (weak) ; 2(fair); 3(good); 4(very good), please describe how interesting is the problem or topic this team used in their Virtual Instrument</p> <p>proportion of answering (Number)</p> <p>Total persons(group counts): 32</p> <p>100% 90% 80% 70% 60% 50% 40% 30% 20% 10% 0%</p> <p>6.25% (2) 9.38% (3) 56.25% (18) 12.5% (4) 0% (0) 0% (0) 15.62% (5)</p> <p>A B C D E F nonuser</p> <p>First Prev Next Last total 18 questions Exit</p> |
| 2 |  <p>Multiple-choice queue histogram</p> <p>(Standard Exam) C:\Temp\103s08\survey\project2p2survey.csv4/14/2008 9:48:24 AM</p> <p>Activity Time: 4/14/2008 9:48:24 AM Participate Mode: Individual</p> <p>3: On a scale of 1 (weak) ; 2(fair); 3(good); 4(very good), please provide your feedback on this team Virtual Instrument regarding the LabVIEW elements they used and the sub-VI they created</p> <p>proportion of answering (Number)</p> <p>Total persons(group counts): 32</p> <p>100% 90% 80% 70% 60% 50% 40% 30% 20% 10% 0%</p> <p>9.38% (3) 18.75% (6) 43.75% (14) 12.5% (4) 3.12% (1) 0% (0) 12.5% (4)</p> <p>A B C D E F nonuser</p> <p>First Prev Next Last total 18 questions Exit</p> |  <p>Multiple-choice queue histogram</p> <p>(Standard Exam) C:\Temp\103s08\survey\project2p2survey.csv4/14/2008 9:48:24 AM</p> <p>Activity Time: 4/14/2008 9:48:24 AM Participate Mode: Individual</p> <p>4: On a scale of 1 (weak) ; 2(fair); 3(good); 4(very good), please describe how interesting is the problem or topic this team used in their Virtual Instrument</p> <p>proportion of answering (Number)</p> <p>Total persons(group counts): 32</p> <p>100% 90% 80% 70% 60% 50% 40% 30% 20% 10% 0%</p> <p>9.38% (3) 6.25% (2) 37.5% (12) 34.38% (11) 0% (0) 0% (0) 12.5% (4)</p> <p>A B C D E F nonuser</p> <p>First Prev Next Last total 18 questions Exit</p> |

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|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------|-------|---|--------|-----|---|-------|-----|---|--------|------|---|--------|------|---|-------|-----|---|----|-----|---------|--------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------|-------|---|-------|-----|---|--------|-----|---|--------|------|---|--------|------|---|-------|-----|---|----|-----|---------|--------|-----|
| Choice | Proportion | Count | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 15.62% | (5) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | 3.12% | (1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | 46.88% | (15) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | 18.75% | (6) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | 0% | (0) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | 0% | (0) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| nonuser | 15.62% | (5) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Choice | Proportion | Count | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 3.12% | (1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | 9.38% | (3) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | 53.12% | (17) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | 18.75% | (6) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | 0% | (0) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | 0% | (0) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| nonuser | 15.62% | (5) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Choice | Proportion | Count | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 9.38% | (3) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | 6.25% | (2) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | 46.88% | (15) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | 21.88% | (7) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | 3.12% | (1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | 0% | (0) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| nonuser | 12.5% | (4) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Choice | Proportion | Count | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 3.12% | (1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | 18.75% | (6) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | 34.38% | (11) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | 25% | (8) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | 0% | (0) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | 0% | (0) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| nonuser | 18.75% | (6) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Choice | Proportion | Count | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 3.12% | (1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | 12.5% | (4) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | 40.62% | (13) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | 31.25% | (10) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | 3.12% | (1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | 0% | (0) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| nonuser | 9.38% | (3) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Choice | Proportion | Count | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 3.12% | (1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | 6.25% | (2) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | 43.75% | (14) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | 31.25% | (10) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | 3.12% | (1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | 0% | (0) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| nonuser | 12.5% | (4) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



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LOGBOOK: [example of a logbook page](#)

- Use a quadrille notebook; number all pages; date all entries
- Write your notes for all activities, thoughts, problems and solutions, and learning conclusions related to Engin 103. You should write down progress, outcomes, and conclusions on projects and teamwork; conclusions from class work (including LabVIEW) and homework.
- In addition you should answer in the logbook all questions listed in these notes in blue, as shown below:

39) Explain what does the Case Structure do. Describe another situation in which you can use this LabVIEW element.

40) Where do you find the Formula Node? What is it used for?

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